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# ANALYSIS OF UNCERTAINTIES CAUSED BY THE ATMOSPHERIC DISPERSION MODEL IN ACCIDENT CONSEQUENCE ASSESSMENTS WITH UFOMOD

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## ABSTRACT

Various techniques available for uncertainty analysis of large computer models are applied, described and selected as most appropriate for analyzing the uncertainty in the predictions of accident consequence assessments. The investigation refers to the atmospheric dispersion and deposition submodel (straight-line Gaussian plume model) of UFOMOD, whose most important input variables and parameters are linked with probability distributions derived from expert judgement.

Uncertainty bands show how much variability exists, sensitivity measures determine what causes this variability in consequences.

Results are presented as confidence bounds of complementary cumulative frequency distributions (CCFDs) of activity concentrations, organ doses and health effects, partially as a function of distance from the site. In addition the ranked influence of the uncertain parameters on the different consequence types is shown. For the *estimation of confidence bounds* it was sufficient to choose a model parameter sample size of n (n=59) equal to 1.5 times the number of uncertain model parameters. Different samples or an increase of sample size did not change the 5%-95% - confidence bands. To get statistically stable results of the *sensitivity analysis*, larger sample sizes are needed (n=100,200). Random or Latin-hypercube sampling schemes as tools for uncertainty and sensitivity analyses led to comparable results.

# UNSICHERHEITSANALYSEN FÜR DAS ATMOSPHÄRISCHE AUSBREITUNGSMODELL IN UNFALLFOLGENABSCHÄTZUNGEN MIT UFOMOD

## ZUSAMMENFASSUNG

Aus einer Reihe anwendbarer Methoden zur Unsicherheits- und Sensitivitätsanalyse großer Computer-Codes werden diejenigen Methoden angewandt, beschrieben und ausgewählt, die am besten geeignet sind, die Unsicherheiten des atmosphärischen Ausbreitungsmodells von UFOMOD zu quantifizieren und zu charakterisieren.

*Unsicherheitsanalysen* liefern quantitative Aussagen über den Einfluß von Parametervariationen auf den Schwankungsbereich der Ergebnisse aus solchen Computer-Codes, während *Sensitivitätsanalysen* die für die Ergebnisschwankungen verantwortlichen Parameter ermitteln.

Resultate werden präsentiert als Konfidenzbänder für komplementäre kumulative Häufigkeitsverteilungen (CCFDs) von Aktivitätskonzentrationen, Organdosen, gesundheitlichen Schäden, sowie der Schutz- und Gegenmaßnahmen (z.T. als Funktion der Entfernung von der kerntechnischen Anlage). Anschließend wird der nach Rangfolge geordnete Einfluß der unsicheren Modellparameter auf die jeweiligen Konsequenzen erörtert. Für *Unsicherheitsanalysen* war es ausreichend einen Stichprobenumfang (n=59) zu wählen, der das 1.5-fache der Anzahl der unsicheren Modellparameter beträgt. Verschiedene Stichproben oder eine Zunahme des Stichprobenumfangs ergab keine Änderung der 5%-95%-Konfidenzbänder. Um statistisch stabile Ergebnisse für *Sensitivitätsanalysen* zu erhalten, wurden größerer Stichprobenumfänge (n=100,200) gewählt. Random Sampling oder Latin Hypercube-Stichprobenverfahren als notwendige Werkzeuge für Unsicherheits- und Sensitivitätsanalysen führten zu vergleichbaren Ergebnissen.

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# CHAPTER 1. INTRODUCTION

Risk studies for installations of the nuclear fuel cycle have been carried out in the USA (e.g. WASH-1400, ZION, LIMERICK, INDIAN POINT), in the United Kingdom (e.g. SIZEWELL) and in West Germany (e.g. GERMAN RISK STUDY, Phase A, RISK ORIENTED ANALYSIS OF THE SNR 300) to quantify and compare accident consequences and their frequencies. But the usefulness of accident concequence assessments in providing guidelines for planning is limited by the uncertainties of the results. A clear understanding of the nature and magnitude of various sources of uncertainty is needed to facilitate the identification of modeling weakpoints and thus areas for further improvements and supporting research and development activities. Formerly it was considered sufficient to treat uncertainties by using combinations of pessimistic assumptions and expert judgement. But this approximation does not necessarily lead to pessimistic results as it was intended by the modelers. Therefore, in the last few years it has become increasingly important to have more realistic rather than pessimistic accident consequence predictions in combination with quantified uncertainties. Improved statistical techniques in calculating uncertainties help to reach this goal and to come to more definitive and quantifiable uncertainty assessment implications. For some general remarks see [10].

To get an insight into the sources of uncertainties and the different methods for their quantification, uncertainty analyses on submodel basis are started with the atmospheric dispersion and deposition submodel (straight-line Gaussian plume model) of UFOMOD/B3 ([37]). As an appropriate scenario the release category FK2 of the German Risk Study (DRS-A) is chosen [7], [8], and [9]. The release of radioactive material to the atmosphere starts one hour after the accident and lasts for three hours. The release of thermal energy favours plume rise during the whole time. To study the effect of model parameter variation on nuclides of different characteristics , iodine-131 and caesium-137 are chosen as representatives of isotopes with short and long radioactive half-lifes. They are also important contributors to early and late fatalities. The following intermediate and final results of accident consequence assessments are investigated:

- **Centerline concentrations**
  The concentration fields in the plume, in the air near ground (1 m height) and on ground surface considering the variability of the averaged[1] concentration values at four distance intervals D1 - D4 in the microscale (D1 = 0.2 km - 0.5 km), and the near (D2 = 0.8 km - 1.2 km), mean (D3 = 8 km - 12 km) and far (D4 = 80 km - 120 km) distance.
- **Doses**
  Short term bone marrow and 50-a whole body doses at these four different distance intervals;
- **Health effects and countermeasures**
  The mean number of early and late fatalities and the average areas affected by the countermeasure 'relocation'.

The uncertainty of these consequences is quantified, propagating the variation of model parameters[2] through the accident consequence code.

In this study the notion of uncertainty analyses is used in the general sense of investigation of model predictions under conditions of parameter variability and focusses on

- the estimation of confidence bounds for consequences, which show how much variability exists, and
- sensitivity measures, which examine relationships between changes in consequences due to changes in model parameter values and provide a ranking of importance.

In [3] and in [17] some estimates are made of the uncertainties in the assessed consequences. Recently two studies have been published for uncertainty analysis of the atmospheric dispersion and deposition submodel of UFOMOD/B3 ( see [14] and [18] ). In the preliminary uncertainty analysis [14] and [34], consequences are calculated with a so-called one-at-a-time

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1 (averaged over 115 weather sequences which represent the weather of one year)

2 In this study, *'model parameters'* comprise *'parameters'* and some *'input variables'* of the atmospheric dispersion and deposition submodel of UFOMOD/B3.

design. Each uncertain parameter is varied separately within its range, all other parameters are fixed at their 'nominal values' (point values), thus quantifying the relative effect on the model output. The uncertainty results depend on the chosen nominal values. Possible interactions between uncertain parameters may lead to a doubtful interpretation of the results. In [18] a multivariate random sample design is used to study uncertainty analysis for the atmospheric dispersion and deposition submodel of UFOMOD/B3.

In this report the results ( see also [12]) of a detailed uncertainty analysis for the atmospheric dispersion and deposition submodel of UFOMOD/B3 are given. The uncertainty analysis investigations were performed within Project 4 of the CEC - MARIA[3] programme (see [39]), aiming at an enhancement of applicability, efficiency and reliability of several techniques available for uncertainty analysis of large computer models. The principal objective of this analysis is to demonstrate the applicability of uncertainty and sensitivity techniques to the UFOMOD/B3 accident consequence code.

Mainly the uncertainty analysis codes from Sandia National Laboratories, Albuquerque NM (USA), are used ( see [27], [28] and [25] ).

**Remark:**

As far as it is allowed to give an opinion about uncertainty analyses, the SANDIA-codes up to now are the best documented, published and available codes. They are easy to use (Do not mix up 'easy to use' with 'usable without thinking').
□

Following [1] or [2] , an uncertainty analysis is performed in the following steps:

1. Identification of model parameters thought to contribute to uncertainty in model predictions.

---

[3] CEC : Commission of the European Communities
MARIA: Methods for Assessing the Radiological Impact of Accidents within the CEC Radiation Protection Research Programme

2. Estimation of upper and lower bounds for each 'uncertainty relevant' parameter over its assumed range, definition of distributions and estimation of correlations between model parameters.
3. Stratified sampling from the estimated distributions of the input parameters.
4. Accident consequence assessments with the sampled parameter values.
5. Estimation of consequence distribution functions to determine the variation in consequences that result from the collective variation in input parameter values.
6. Examination of relationships between parameters and consequences to determine the change in the response of the computer model to changes of individual parameters values.
7. Presentation and interpretation of the results of the analysis.

The first two steps, combined with a short description of the atmospheric dispersion and deposition submodel of UFOMOD/B3, are described in Chap. 2.

Chapter 3 comprises the next procedural actions for uncertainty analyses.

Having defined ranges and distributions for model parameters it is necessary to select specific values for each of the uncertain model parameters to be used in each run of UFOMOD, i.e. to have a suitable sampling scheme. For a sampling scheme to be effective the generated model parameter values should adequately span the model parameter space. The Latin hypercube sampling (LHS) procedure in contrast to the well-known random sampling design (RSD) forces the entire range of each model parameter to be sampled. In Section 3.1 the LHS - sampling scheme and the IMAN/CONOVER - procedure (see [21]) for inducing rank correlations is indicated.

Each UFOMOD run produces *one* complementary cumulative frequency distribution (CCFD). Section 3.2 briefly describes the estimation of confidence bands for CCFDs. The width of the band is an indicator of the sensitivity of model predictions with respect to variations in parameters, which are imprecisely known.

To quantify the relative importance of the uncertain model parameters to the output of the accident consequence model some sensitivity measures are needed to 'rank' the parameters with respect to their influence on the consequences. This will be explicated in Section 3.3.

The partial (rank) correlation coefficient PCC or PRCC, respectively, are measures that explain the relation between a consequence variable and one or more model parameters. When a nonlinear relationship is involved it is often more revealing to calculate PCCs between variable *ranks* than between the *actual* values for the variables. The numerical value of the PRCCs can be used for hypothesis testing to quantify the confidence in the correlation itself, i.e. by statistical reasons one can determine which PRCC values indicate really an importance (significance) of a parameter or which PRCC values are simply due to 'white noise'. Moreover, it is possible to calculate the percentage contribution of each uncertain model parameter to uncertainty in consequences by use of so-called *coefficients of determination* ($R^2$).

The last step in performing uncertainty analyses is to present and interprete the results of the analyses. Chapter 4 condenses the bulk of information obtained from the uncertainty analysis for UFOMOD/B3 and gives a guideline to understand the detailed figures and tables in the Appendix.

The effect of propagation of uncertainties in the model parameters of the atmospheric dispersion and deposition submodel of UFOMOD/B3 is investigated for various consequences (concentrations, doses, health effects). The effect on consequences using different sampling schemes (e.g. LHS, RSD) and various samples sizes is quantified. Both aspects are necessary to consider because of their impacts on computer time/cost, and last not least of the confidence in the results.

# CHAPTER 2. THE ATMOSPHERIC DISPERSION AND DEPOSITION SUBMODEL

As a consequence of an accident in an installation of the nuclear fuel cycle, there is a certain probability that radioactive material is released into the atmosphere from the containment or the exhaust air stack. The radioactive plume travels away from the source of emission according to the actual wind direction and speed. In general the radionuclide concentrations in the air decrease continuously in the course of this movement, mainly due to turbulence in the atmosphere, dry deposition and washout by precipitation, if any.

The atmospheric dispersion and deposition submodel of UFOMOD/B3 is based on the 'Gaussian diffusion model', which has been modified and extended to avoid completely unrealistic results under real release conditions. A detailed description of the model is given in [8], the most important characteristics are summarized in the following:

A general view of the phenomena considered in the model and a schematic view of its structure are given in Figure 1 and Figure 2 .
The basic formula for the calculations of ground level concentrations $C_A$ at a point P(x,y,0) under the assumption of total reflection at the earth's surface is given by:

$$C_A(x,y,0,h_{eff}) =$$

$$= A * \exp\{-[(y^2/2\sigma_y^2) + (h_{eff}^2/2\sigma_z^2)]\} / [\pi\sigma_y(x)\sigma_z(x)u] \qquad (1)$$

where:

| | |
|---|---|
| A | is the activity release rate |
| $\sigma_y(x)$ | is the horizontal dispersion parameter |
| $\sigma_z(x)$ | is the vertical dispersion parameter |
| u | is the mean wind speed averaged over the plume height |
| $h_{eff}$ | is the effective height of emission. |

The dispersion parameters $\sigma_y(x)$ and $\sigma_z(x)$ are expressed by the following power functions:

$$\sigma_y(x) = \sigma_{yo}\, x^{py} \qquad (2)$$

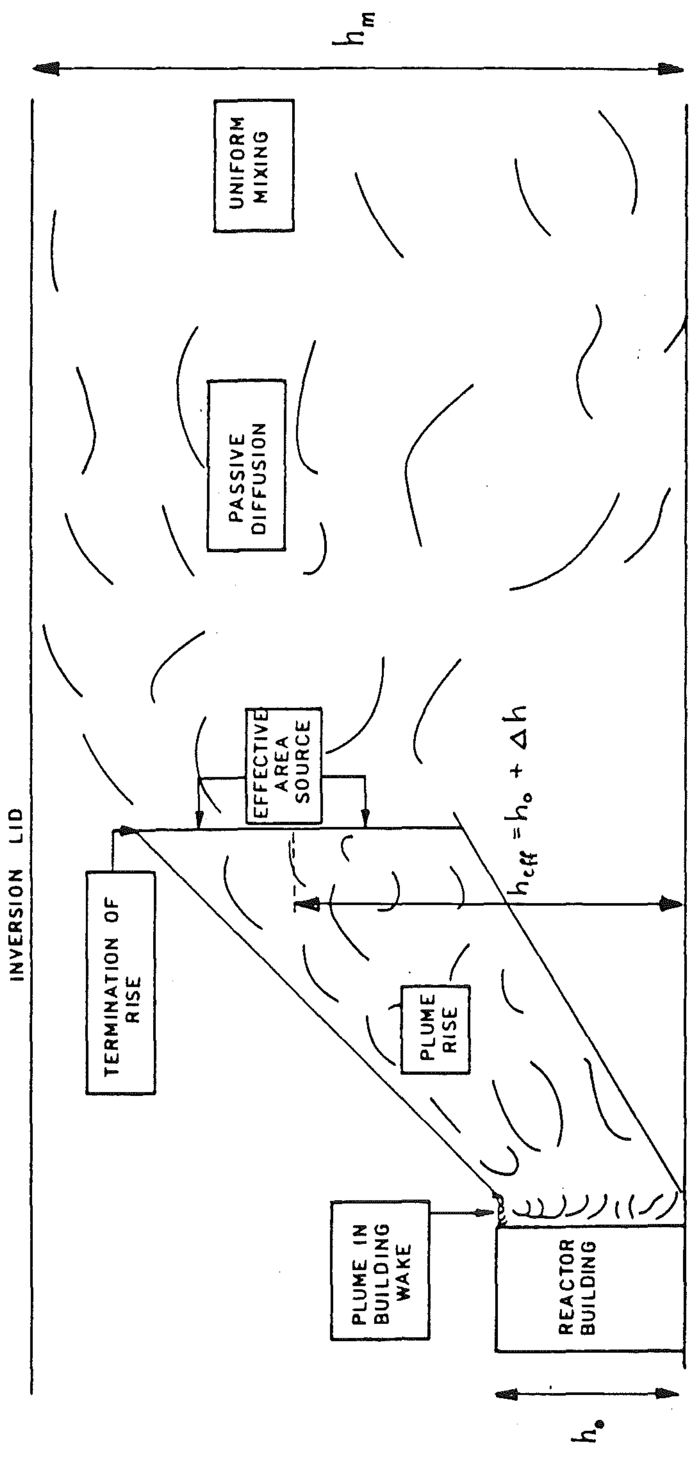


Figure 1. Typical history of plume behaviour: (according to [42],p.1-43)

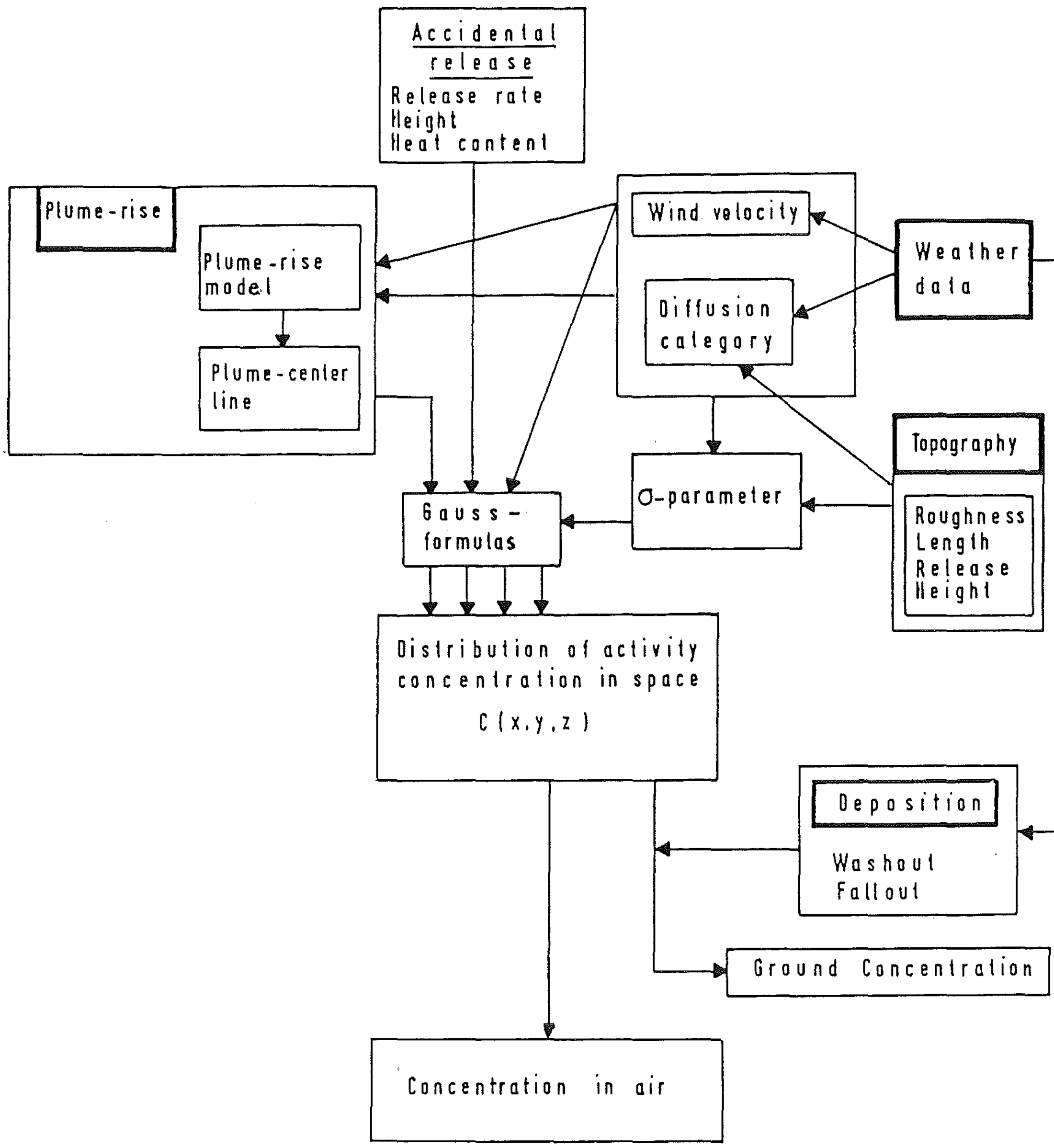


Figure 2. Basic structure of the atmospheric dispersion and deposition submodel of UFOMOD/B3

$$\sigma_z(x) = \sigma_{zo}\, x^{pz} \qquad (3)$$

The coefficients $\sigma_{yo}$, py, and $\sigma_{zo}$, pz, are determined by approximation of eq. 1 to concentration values resulting from tracer experiments carried out at KfK ( see [8] ). They are dependent on roughness length, which has found in the neighboorhood of KfK to be $z_0$ = 1.5 m (roughness grade III).

Corresponding to the mixing height concept, in which an inversion layer stops turbulent exchange at greater heights, the vertical dispersion parameter is kept constant on reaching the value, $\sigma_{zmax}$. This value is linked with the mixing height, $h_m$, by the expression

$$\sigma_{zmax} = (\sqrt{2}/\sqrt{\pi})*h_m = 0.8*h_m \qquad (4)$$

The radioactive material may leave a nuclear facility in one of several ways, e.g. from a stack or leaking from the surface of the building. In the case of a stack release, the source is effectively an isolated point and has negligible influence on the dispersion process. Radioactivity emerging from the building however, may be swept down into a turbulent building wake where it will be diluted before it travels further downwind. This increased dilution is taken into account as follows:

$$C_A * u/A =$$

$$= \exp\{-[(y^2/2\sigma_y^2) + (h_{eff}^2/2\sigma_z^2)]\} * [\pi\sigma_y(x)\sigma_z(x) + C*F]^{-1} \qquad (5)$$

with F representative area flowed to

$$C = \begin{cases} C_1 & \text{when } h_{eff} < 20 \text{ m} \\ 0 & \text{when } h_{eff} > 20 \text{ m} \end{cases}$$

The effective emission height $h_{eff}$ in the eq. 1 and eq. 5 consists of the geometric release height $h_0$ and the increase in height, $\Delta h$, caused by a buoyant, rising plume:

$$h_{eff} = h_0 + \Delta h \qquad (6)$$

As the only reason for plume rise, a release of thermal energy is considered; the possibility of a high upward momentum is neglected. To calculate $\Delta h$, the following modified BRIGG's formulas are used:

For dispersion categories A to D:

$$\Delta h = \{ D_A{}^3 + f_{PR}{}^3 * (F^c x^2/u^3) \}^{1/3} - D_A \qquad (7)$$

For dispersion categories E and F:

$$\Delta h = \{ D_A{}^3 + f_{PR}{}^3 * (F^c/u*s)\}^{1/3} - D_A \qquad (8)$$

where

| | |
|---|---|
| $D_A$ | is the quantity to correct plume rise (area source instead of point source) |
| $f_{PR}$ = | 1.6 for A to D |
| $f_{PR}$ = | 2.9 for E,F |
| $F^c$ = | 8.84 [{($m^4/sec^3$)}/MW] * Q emission coefficient |
| Q | heat content released with the activity plume [MW] |
| u | mean wind speed |
| s | stability parameter |
| x | distance from point of release |

For further details see [8].

To determine the mean wind speed u, the wind profile

$$u(z) = u_0(z/h_0)^p \qquad (9)$$

is averaged over the effective height of emission $h_{eff}$.

$$u = h_{eff} * {}_0\int^{h_{eff}} u(z)dz = u(h_{eff})/(1+p) \qquad (10)$$

where

| | |
|---|---|
| $u(h_{eff})$ | is the wind speed at the effective emission height $h_{eff}$ |
| $u_0$ | is the wind speed at anemometer height $h_0$ |
| p | is the wind profile exponent. |

If u is calculated less than 1 m/sec, then the value 1 m/sec is used.

During the dispersion process, aerosols and iodine are removed from the atmosphere by dry deposition ("fallout") or in the case of precipitation by wet deposition ("washout"). To calculate dry deposition , the so-called "source depletion " model is applied, which assumes proportionality between deposition rate and instantaneous air concentration near ground surface. This ratio is called the deposition velocity $v_d$. The activity inventory of the plume is reduced by the amount deposited.

Wet deposition is modeled by the washout coefficient, $\lambda$, and treated similar to dry deposition. The component of activity remaining in the plume is

$$f_w = \exp\{-\lambda \Delta t\}, \qquad (11)$$

where $\Delta t$ gives the duration of rain. Noble gases are neither wet nor dry deposited.

The meteorological data used to calculate the radioactivity concentrations of the air and the contamination of the soil, namely wind speed, diffusion category and information about precipitation, are adapted at hourly intervals to the measured real weather patterns. The meteorological parameters are assumed to have the same values over all distances at the same time. This is done for 115 weather sequences with starting times each three days plus five hours, distributed over the time span of one year.

A straight line transport of the plume is assumed. This model of straight line diffusion is applied up to a distance of 540 km. The area enclosed by this circle is roughly correspondent to the area of Central Europe.

## 2.1 PARAMETER VALUES AND THEIR DISTRIBUTIONS

The above mentioned eq. 1 to eq. 11 represent the mathematical formulation of the atmospheric dispersion and deposition submodel of UFOMOD/B3. They contain various input quantities, whose actual values are uncertain (i.e. not known exactly) due to

- insufficient knowledge of physical processes
- model simplifications
- lack of data base etc.

In Figure 3 to Figure 8 the parameters, their ranges and distributions are listed and some correlations are mentioned. The distributions express our judgement of the lack of precision in the parameters as input to UFOMOD/B3. They do not represent actual variability in the data. Furthermore, for this report, the choice of source term parameters is based on the assumption of release category FK 2 of the German Risk Study (DRS-A) [8].

To quantify the uncertainties of activity concentrations, the two nuclides

1. Iodine - 131 ( $T_{1/2}$ = 8 days )
2. Caesium - 137 ( $T_{1/2} = 1.2 \times 10^4$ days ~ 30 years )

have been chosen as representatives for isotopes with short and long radioactive half-lifes. They are also important contributors to early and late fatalities.[4] Additionally the influence of different deposition velocities for iodine and aerosols can be investigated.

The resulting concentration fields in the plume, in the air and on ground surface up to 540 km from the site have been analyzed with respect to the variability of the mean concentration values at the four distance intervals:

- 0.2 km ÷ 0.5 km
- 0.8 km ÷ 1.2 km
- 8 km ÷ 12 km
- 80 km ÷ 120 km

representative for the microscale and near, mean and far distances.

The following explanatory remarks refer to the choice of parameter values and their variations:

---

[4] Early fatalities result from non-stochastic health effects, late fatalities from lethal stochastic somatic health effects (e.g. cancer).

## Explanatory remarks to Figure 3 - Figure 8 :

1. The thermal energy Q is released in three subsequent puffs each of one hour duration due to the UFOMOD/B3 modeling of release category FK 2.

2. The wind speed data $u_0$ ( see eq. 9 ) are measured values, taken from hourly recorded weather data on magnetic tape. Their uncertainty is taken into account by:

$$u = (1 + 0.1 * r) u_0 + 0.5 * r$$

The quantity $r$ is an uncertain parameter uniformly distributed between -1 and +1.

3. The effective plume height $h_{eff} = h_0 + \Delta h$ is given by the geometric height of the source, $h_0$, and the plume rise, $\Delta h$. The geometrical height of the source, $h_0$, is uncertain due to the unknown location of the failure of the containment.

4. The quantities $f_{PR}$ and $D_A$ to describe plume rise have been chosen according to expert judgement, as well as the atmospheric dilution parameter $C_1$ in eq. 5.

5. The mixing height $h_m$ for the diffusion categories A to F are valid for roughness length 1.5 m (roughness grade III).

6. The uncertainty of the horizontal and vertical dispersion parameters was assigned to the parameters $\sigma_{yo}$ and $\sigma_{zo}$, respectively ( see eq. 2 and eq. 3 ).

7. Dry and wet deposition parameters are specified for iodine and aerosols. The 50 % - quantiles of the washout coefficients stem from [43].

8. There are some assumed rank correlations (=0.5) within each of the following groups (the numbers correspond to the numbered model parameters from Figure 3, and Figure 4):

   - $G_1 = \{8, \ldots, 13\}$
   - $G_2 = \{14, \ldots, 19\}$

- $G_3$ = {20,...,25}
- $G_4$ = {32,34,36,38}
- $G_5$ = {33,35,37,39}

9. All lognormal distributions are truncated, such that the following statements are satisfied:

   $$\text{Prob}(X < A) = .001 \quad \text{and} \quad \text{Prob}(X > B) = .001,$$

   where A, B are to be specified by the user.

   A variable X has a lognormal distribution if Y = ln (X) has a $N(\mu,\sigma)$-distribution ( $\mu \equiv \mu(y), \sigma \equiv \sigma(y)$ ). The probability density function of X is given by

   $$f(x) = [x*\sigma*\sqrt{(2\pi)}]^{-1} * \exp\{ -1/2*[((\ln(x) - \mu)/\sigma)^2] \} \qquad (12)$$

   Standardization of Y gives the new variable $U := (\ln(x) - \mu)/\sigma$. The log-normally distributed variable can be expressed as:

   $$x \equiv x(u) = m * \exp\{u*\sigma\} \qquad \text{with } m = \exp\{\mu\} \qquad (13)$$

   *Properties:*

   - $x_{median} \equiv x_{.50} = m$ (14)
   - $x_\alpha * x_{1-\alpha} = m^2$ (15)
   - $\mu(x) = \exp\{\mu + (\sigma^2/2)\}$ (16)
   - $\sigma^2(x) = \mu^2(x) * (\exp\{\sigma^2\} - 1)$ (17)

   The user only needs to know the numbers A and B, which will be interpreted as the 0.1%- and 99.9%-quantiles of the lognormal distribution, respectively.

   - $\mu \equiv \mu(y) = [\ln(A) + \ln(B)]/2$ (18)
   - $\sigma^2 \equiv \sigma^2(y) = [(\ln(B) - \ln(A))/(2*u_{.999})]^2$ (19)

| PARAMETER NAME | VARIABLE | |
|---|---|---|
| 1. Q | Thermal energy | |
| 2. R | Quantity to describe error in wind speed | |
| 3. HQ | Height of source | |
| 4. FPR(A-D) | Plume rise factor | DC=A,B,C,D |
| 5. FPR(E,F) | Plume rise factor | DC=E,F |
| 6. DA | Quantity to correct plume rise | |
| 7. C1 | Atmospheric dilution parameter | |
| 8. HM(A) | Mixing height | DC=A |
| 9. HM(B) | Mixing height | DC=B |
| 10. HM(C) | Mixing height | DC=C |
| 11. HM(D) | Mixing height | DC=D |
| 12. HM(E) | Mixing height | DC=E |
| 13. HM(F) | Mixing height | DC=F |
| 14. SIGY(A) | Horizontal dispersion | DC=A |
| 15. SIGY(B) | Horizontal dispersion | DC=B |
| 16. SIGY(C) | Horizontal dispersion | DC=C |
| 17. SIGY(D) | Horizontal dispersion | DC=D |
| 18. SIGY(E) | Horizontal dispersion | DC=E |
| 19. SIGY(F) | Horizontal dispersion | DC=F |

DC := Diffusion category

Figure 3. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3

| PARAMETER NAME | VARIABLE | |
|---|---|---|
| 20. SIGZ(A) | Vertical dispersion | DC=A |
| 21. SIGZ(B) | Vertical dispersion | DC=B |
| 22. SIGZ(C) | Vertical dispersion | DC=C |
| 23. SIGZ(D) | Vertical dispersion | DC=D |
| 24. SIGZ(E) | Vertical dispersion | DC=E |
| 25. SIGZ(F) | Vertical dispersion | DC=F |
| 26. P(A) | Wind profile exponent | DC=A |
| 27. P(B) | Wind profile exponent | DC=B |
| 28. P(C) | Wind profile exponent | DC=C |
| 29. P(D) | Wind profile exponent | DC=D |
| 30. P(E) | Wind profile exponent | DC=E |
| 31. P(F) | Wind profile exponent | DC=F |
| 32. VD(IO) | Dry deposition velocity (m/s) | Iodine |
| 32. VD(AE) | Dry deposition velocity (m/s) | Aerosols |
| 34. LAMB(IO,0-1) | Washout coefficient | (Iodine 0-1mm/s) |
| 35. LAMB(AE,0-1) | Washout coefficient | (Aerosols 0-1mm/s) |
| 36. LAMB(IO,1-3) | Washout coefficient | (Iodine 1-3mm/s) |
| 37. LAMB(AE,1-3) | Washout coefficient | (Aerosols 1-3mm/s) |
| 38. LAMB(IO,>3) | Washout coefficient | (Iodine >3mm/s) |
| 39. LAMB(AE,>3) | Washout coefficient | (Aerosols >3mm/s) |

DC := Diffusion category

Figure 4. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3 (cont'd)

| VARIABLE | ASSUMED RANGE | | | ASSUMED DISTRIBUTION | |
|---|---|---|---|---|---|
| 1. Q | 1.05 | to | 16.8 | lognormal | 1 |
| 2. R | -1.00 | to | 1.00 | uniform | 2 |
| 3. HQ | 3.33 | to | 30.0 | lognormal | 9 |
| 4. FPR(A-D) | 1.10 | to | 2.10 | uniform | 3 4 |
| 5. FPR(E,F) | 1.65 | to | 4.15 | uniform | 3 4 |
| 6. DA | 7.50 | to | 32.5 | uniform | 4 |
| 7. C1 | 0.25 | to | 2.75 | uniform | 4 |
| 8. HM(A) | 1.00E+03 | to | 3.00E+03 | uniform | 5 8 |
| 9. HM(B) | 750. | to | 2.25E+03 | uniform | 5 8 |
| 10. HM(C) | 500. | to | 1.50E+03 | uniform | 5 8 |
| 11. HM(D) | 350. | to | 1.05E+03 | uniform | 5 8 |
| 12. HM(E) | 200. | to | 600. | uniform | 5 8 |
| 13. HM(F) | 125. | to | 375. | uniform | 5 8 |
| 14. SIGY(A) | 0.325 | to | 1.30 | lognormal | 6 8 9 |
| 15. SIGY(B) | 0.325 | to | 1.30 | lognormal | 6 8 9 |
| 16. SIGY(C) | 0.215 | to | 0.86 | lognormal | 6 8 9 |
| 17. SIGY(D) | 0.170 | to | 0.68 | lognormal | 6 8 9 |
| 18. SIGY(E) | 0.170 | to | 0.68 | lognormal | 6 8 9 |
| 19. SIGY(F) | 0.170 | to | 0.68 | lognormal | 6 8 9 |

The small numbers refer to the explanatory remarks for these figures.

Figure 5. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3 (ranges and distributions)

| VARIABLE | ASSUMED RANGE | | | ASSUMED DISTRIBUTION | |
|---|---|---|---|---|---|
| 20. SIGZ(A) | 1.95E-2 | to | 7.80E-2 | lognormal | 6 8 9 |
| 21. SIGZ(B) | 1.00E-2 | to | 4.00E-2 | lognormal | 6 8 9 |
| 22. SIGZ(C) | 2.60E-2 | to | 0.104 | lognormal | 6 8 9 |
| 23. SIGZ(D) | 5.00E-2 | to | 0.200 | lognormal | 6 8 9 |
| 24. SIGZ(E) | 0.33 | to | 1.32 | lognormal | 6 8 9 |
| 25. SIGZ(F) | 0.65 | to | 2.60 | lognormal | 6 8 9 |
| 26. P(A) | 3.50E-2 | to | 0.105 | uniform | |
| 27. P(B) | 6.50E-2 | to | 0.195 | uniform | |
| 28. P(C) | 0.105 | to | 0.315 | uniform | |
| 29. P(D) | 0.17 | to | 0.51 | uniform | |
| 30. P(E) | 0.22 | to | 0.66 | uniform | |
| 31. P(F) | 0.22 | to | 0.66 | uniform | |
| 32. VD(IO) | 2.00E-4 | to | 5.18E-2 | loguniform | 7 8 |
| 33. VD(AE) | 4.00E-5 | to | 1.04E-2 | loguniform | 7 8 |
| 34. LAMB(IO,0-1) | 8.40E-7 | to | 2.17E-4 | loguniform | 7 8 |
| 35. LAMB(AE,0-1) | 6.80E-7 | to | 1.76E-4 | loguniform | 7 8 |
| 36. LAMB(IO,1-3) | 2.10E-6 | to | 5.49E-4 | loguniform | 7 8 |
| 37. LAMB(AE,1-3) | 2.30E-6 | to | 6.06E-4 | loguniform | 7 8 |
| 38. LAMB(IO,>3) | 4.60E-6 | to | 1.20E-3 | loguniform | 7 8 |
| 39. LAMB(AE,>3) | 6.60E-6 | to | 1.71E-3 | loguniform | 7 8 |

The small numbers refer to the explanatory remarks for these figures.

Figure 6. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3 (ranges and distributions) (cont'd)

| VARIABLE | 50% - QUANTILES | OTHER PARAMETERS [9] |
|---|---|---|
| 1. Q | 4.2 | $\mu$ = 1.44, $\sigma^2$ = .2 |
| 2. R | 0. | |
| 3. HQ | 10. | $\mu$ = 2.3 , $\sigma^2$ = .13 |
| 4. FPR(A-D) | 1.6 | |
| 5. FPR(E,F) | 2.9 | |
| 6. DA | 20. | |
| 7. C1 | 1.5 | |
| 8. HM(A) | 2.0E+3 | |
| 9. HM(B) | 1.5E+3 | |
| 10. HM(C) | 1.0E+3 | |
| 11. HM(D) | 7.0E+2 | |
| 12. HM(E) | 4.0E+2 | |
| 13. HM(F) | 2.5E+2 | |
| 14. SIGY(A) | 0.65 | $\mu$ = -.43, $\sigma^2$ = 5.03E-2 |
| 15. SIGY(B) | 0.65 | $\mu$ = -.43, $\sigma^2$ = 5.03E-2 |
| 16. SIGY(C) | 0.43 | $\mu$ = -.84, $\sigma^2$ = 5.03E-2 |
| 17. SIGY(D) | 0.34 | $\mu$ = -1.08, $\sigma^2$ = 5.03E-2 |
| 18. SIGY(E) | 0.34 | $\mu$ = -1.08, $\sigma^2$ = 5.03E-2 |
| 19. SIGY(F) | 0.34 | $\mu$ = -1.08, $\sigma^2$ = 5.03E-2 |

The small number [9] refers to the explanatory remarks.

Figure 7. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3 (50%-quantiles and other parameters)

| VARIABLE | 50% - QUANTILES | OTHER PARAMETERS [9] |
|---|---|---|
| 20. SIGZ(A) | 0.039 | $\mu$ = -3.24, $\sigma^2$ = 5.03E-2 |
| 21. SIGZ(B) | 0.020 | $\mu$ = -3.91, $\sigma^2$ = 5.03E-2 |
| 22. SIGZ(C) | 0.052 | $\mu$ = -2.96, $\sigma^2$ = 5.03E-2 |
| 23. SIGZ(D) | 0.152 | $\mu$ = -2.3 , $\sigma^2$ = 5.03E-2 |
| 24. SIGZ(E) | 0.662 | $\mu$ = -.416, $\sigma^2$ = 5.03E-2 |
| 25. SIGZ(F) | 1.362 | $\mu$ = 0.262, $\sigma^2$ = 5.03E-2 |
| 26. P(A) | 0.07 | |
| 27. P(B) | 0.13 | |
| 28. P(C) | 0.21 | |
| 29. P(D) | 0.34 | |
| 30. P(E) | 0.44 | |
| 31. P(F) | 0.44 | |
| 32. VD(IO) | 0.01 | |
| 33. VD(AE) | 0.002 | |
| 34. LAMB(IO,0-1) | 4.20E-5 | |
| 35. LAMB(AE,0-1) | 3.40E-5 | |
| 36. LAMB(IO,1-3) | 1.06E-4 | |
| 37. LAMB(AE,1-3) | 1.17E-4 | |
| 38. LAMB(IO,>3) | 2.31E-4 | |
| 39. LAMB(AE,>3) | 3.29E-4 | |

The small number [9] refers to the explanatory remarks.

Figure 8. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3 (50%-quantiles and other parameters) (cont'd)

# CHAPTER 3. UNCERTAINTY ANALYSIS - GENERAL STATEMENTS

*Our objective* here is to compare available methods for quantification of uncertainties and identification of those parameters which are most responsible for the variation in consequences. Therefore for the investigations the atmospheric dispersion and deposition submodel of UFOMOD/B3 is chosen, because this physical model and the result it calculates are well understood.

The intent of this study is *not* to go into sophisticated discussions about various types of uncertainty, different models of probability, and mathematical theories. To get a nevertheless necessary insight in this topic see e.g. [19].

To get serious estimates of the *confidence bounds* of consequences informations about the model parameter distributions and parameter correlations must be collected. The expert's opinion and knowledge plays an important role, here (for more details see [40]). According to [1], to determine the parameters that contribute significantly to *sensitivity*, the probabilistic form of the parameter distributions is not as important as the representation over its entire physically possible range.

Following [19], in the case of minimum knowledge, the distribution will be uniform over the maximum conceivable range. Additional knowledge will suggest distributions that are either unimodal and symmetric or a skewed to the lower or higher end of the range. For large ranges, it is usually preferred to choose logarithms of parameter values and to fit a uniform, triangular, or normal distribution for the logarithms (i.e. loguniform, logtriangular, lognormal distributions for the parameter values).

Prior to the actual analysis performed with the UFOMOD/B3 - code, it is necessary to define specific values for each of the uncertain model input parameters to be used in each run of UFOMOD/B3. The selection of sets of specific parameter values is done by a suitable *sampling scheme*. Each run produces *one* complementary cumulative distribution function (CCFD). Confidence bands visualize the variability of the CCFDs of consequences, while sensitivity measures determine what causes this variability in consequences. Uncertainty analysis methods may need much computer runs and time if there are a lot of model parameters and the accident consequence code is long-running. Thus the aim is to get stable and thrustworthy results with the lowest possible number of UFOMOD/B3-runs.

## 3.1 THE SAMPLING SCHEME

There are various possible sampling strategies.

The *one-at-a-time-method* provides an estimate of the effect of a single parameter on consequences at selected fixed conditions of the other parameters. It is simple and can be thought as a sort of visual appreciation of the form of parameter-consequence dependence.

A *factorial design* utilizes two or more fixed values to represent each parameter under consideration. Unlike the one-at-a-time design the factorial design can detect and estimate interactions between uncertain model input parameters.

For a sampling selection procedure to be effective the generated model parameter values should adequately span the model parameter space. The analysis techniques used in this report are based on the well known random sampling (RSD) and Latin hypercube sampling (LHS), which is a modified random sampling with stratified samples.

A Latin hypercube sample of size n stratifies the range of each model parameter into "n" nonoverlapping intervals on the basis of equal probability. Randomly a value is selected from each of these intervals. Let $X_i$ (i=1,...,k) be the model parameters. The n values obtained for $X_1$ are paired at random with the n values obtained for $X_2$. These n pairs are combined in a random manner with the n values for $X_3$ to form n triples. The process is continued until a set of n k-tuples is formed.

This set of k-tuples is called a **Latin hypercube sample of size n**. As an example for (n=2,k=4) see the LHS - sample in Figure 9 and Figure 10 .

LHS in contrast to RSD forces the entire range of each model parameter to be sampled. Following [16], there may exist "spurious" correlations between

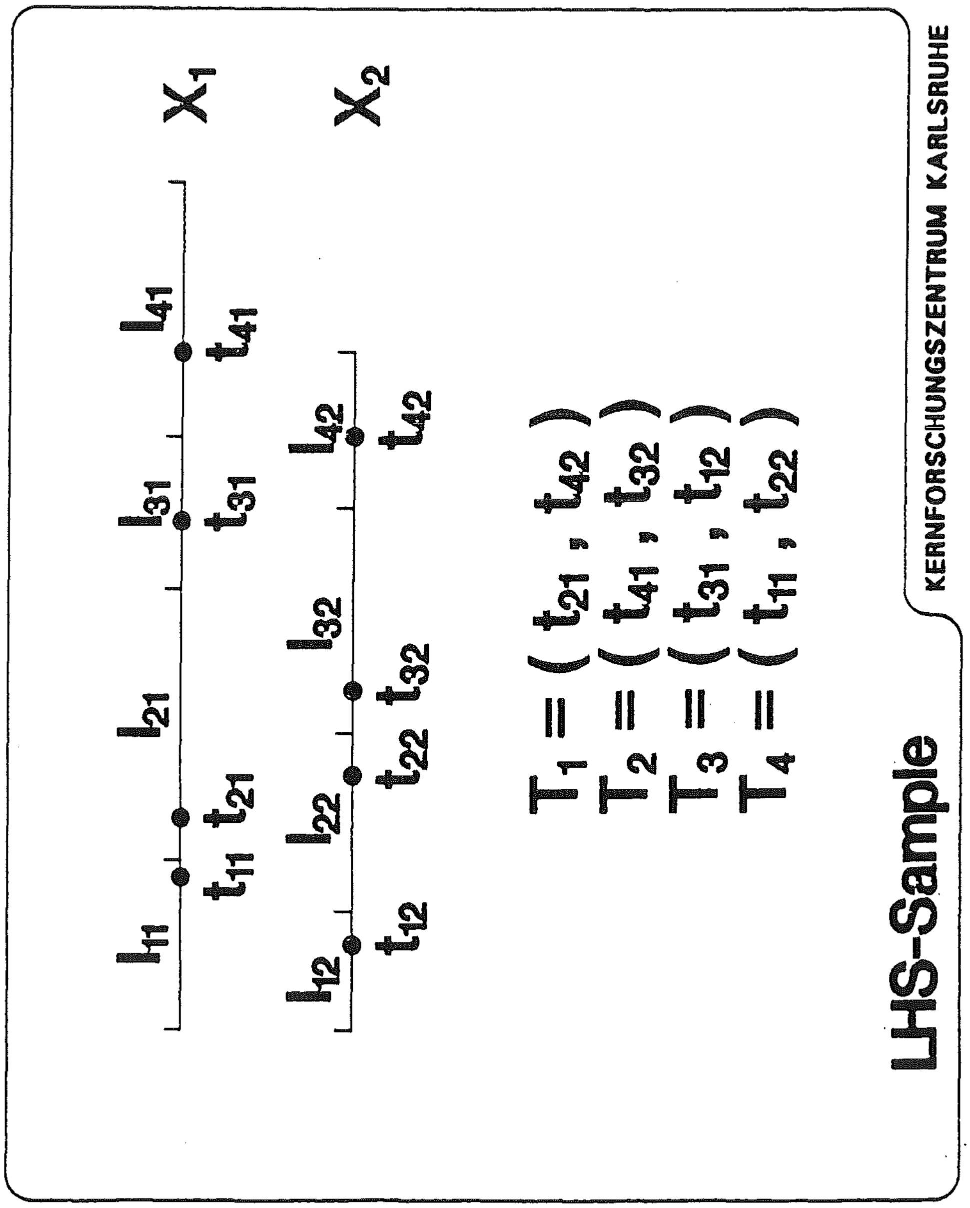


Figure 9. LHS - sample construction for n=2, k=4

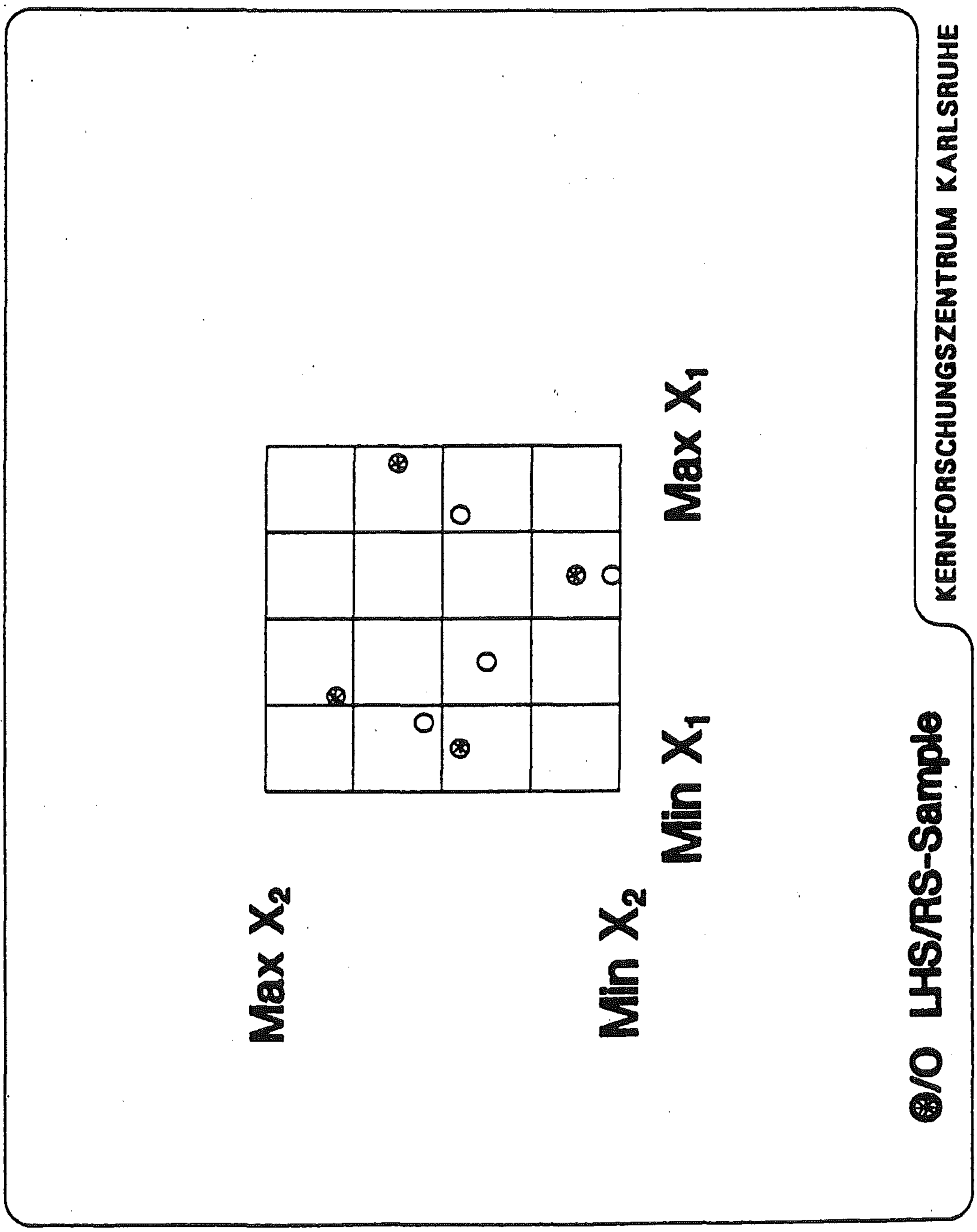


Figure 10. . Comparison LHS - and RSD - sample

model parameter values within a Latin hypercube sample, due to the random pairing of the model parameter values in the generation of the sample. This is most likely when n is small in relation to k. Such correlations can be avoided by modifying the generation of the sample through use of a technique introduced by R.I. Iman and W.J. Conover [16]. This technique preserves the fundamental nature of LHS, but replaces the random pairing of model parameter values with a pairing that keeps all of the pairwise rank correlations among the k model parameters close to zero.

The Iman/Conover-technique can also be used to induce a desired rank correlation structure among the model parameters. The procedure is distribution free and allows exact marginal distributions to remain intact. This is used for the UFOMOD/B3 - LHS - design. For some mathematical details see Appendix A.1.

In producing correlated model parameters one may ask which type of correlation is to be used (e.g. correlation measured on raw or ranked data).

Following [24], a correlation coefficient computed on raw data may lose meaning and interpretation with data from non-normal populations or in the presence of outliers. **Rank correlations** can be quite meaningful in modeling situations where the model parameters are monotonically related and not necessarily normally distributed. Additionally, it may make more sense to talk about monotone relationships, and hence rank correlations, because of the unusual behaviour of the Pearson correlation coefficient in certain joint probability distributions (In some cases there is an unusual lower bound on the correlation value which is greater than -1.).

Following [15], another aspect is: When actual measurements are impossible or feasible to obtain but relative positions can be determined, rank order statistics make full use of all the available information. The question is however, how much information is lost by using the data only to determine relative magnitudes. An approach to a judgement concerning the potential loss of efficiency is to determine the correlation between the variate values and their assigned ranks. If the correlation is high, we would feel intuively more justified in the replacement of actual values by ranks for the purpose of analysis. The hope is that inference procedures based on ranks alone will lead to conclusions which seldom differ from a corresponding inference based on actual variate values. Indeed, from [41] and [30], correlations between raw values and corresponding ranks are very high for some commonly used distributions. We proved analytically raw value - rank value relations for more distribution types. This will be explicated in another report.

## 3.2 ESTIMATION OF CONFIDENCE BOUNDS

According to the sequence of steps in performing uncertainty analyses indicated in Chap. 1, the next task is to run the accident consequence code with the sampled input parameter values from the RS- or LHS-design.

The following distinctions are necessary:

- There are stochastic variations e.g. in weather conditions or wind directions. Each run of UFOMOD/B3 therefore produces one frequency distribution (CCFD) of consequences.
- Due to lack of knowledge about the actual model parameter values there is an uncertainty in these results. This can quantitatively expressed by confidence intervals of the frequency distribution of consequences.

An important question is, how many UFOMOD/B3-runs are necessary to get reliable uncertainty and sensitivity results? Since the computing time is an important factor when analysing long-running computer codes, the designer of a sampling scheme should aim at a low number of runs.

The result of the various comparative investigations performed within this study (see Chap. 4) can be summarized in advance as follows:

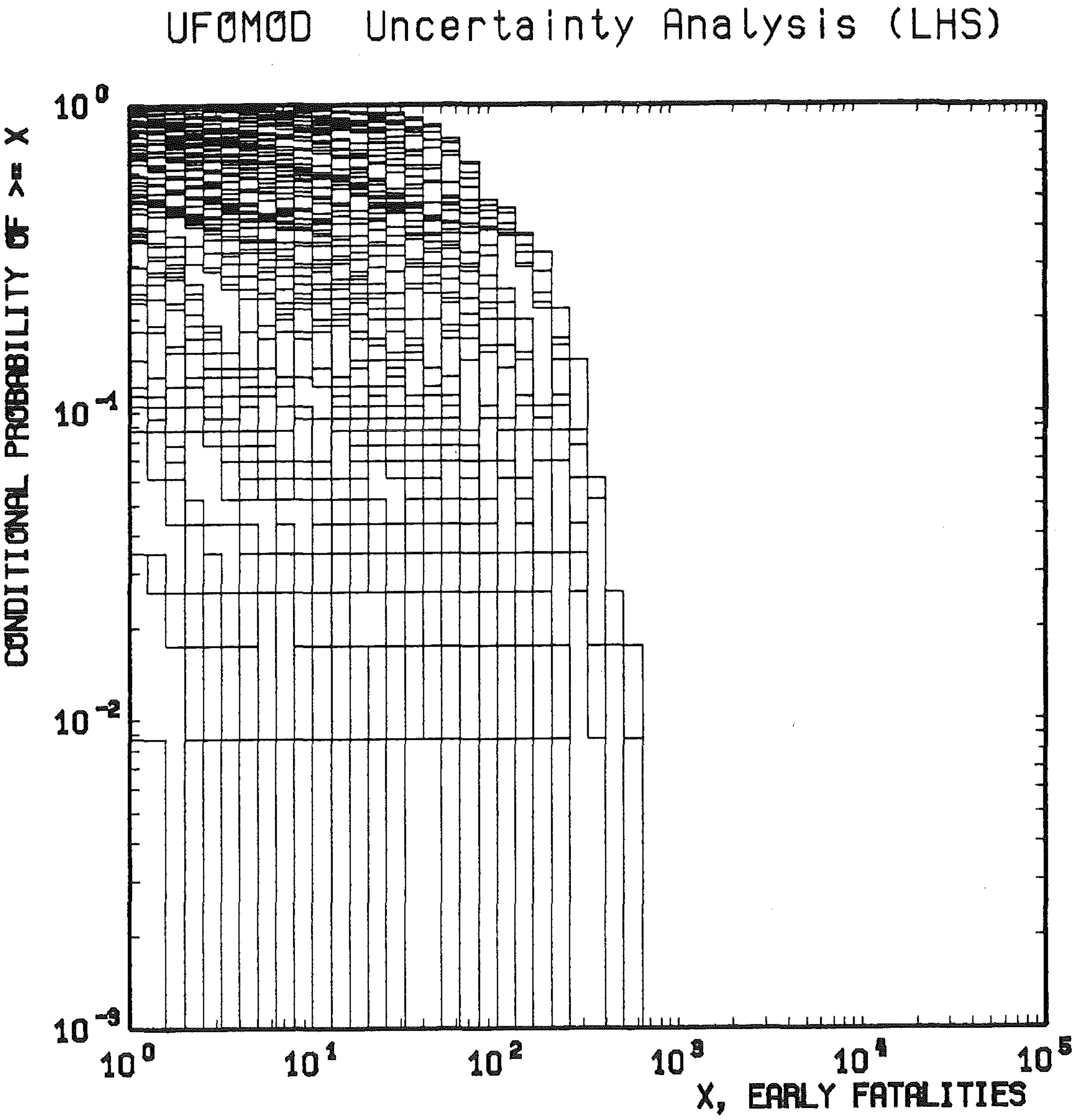


Figure 11. Complementary cumulative frequency distributions (CCFDs) of early fatalities: Each CCFD (assuming FK 2 release has occurred) corresponds to one of the 100 runs in a Latin hypercube sample of size 100.

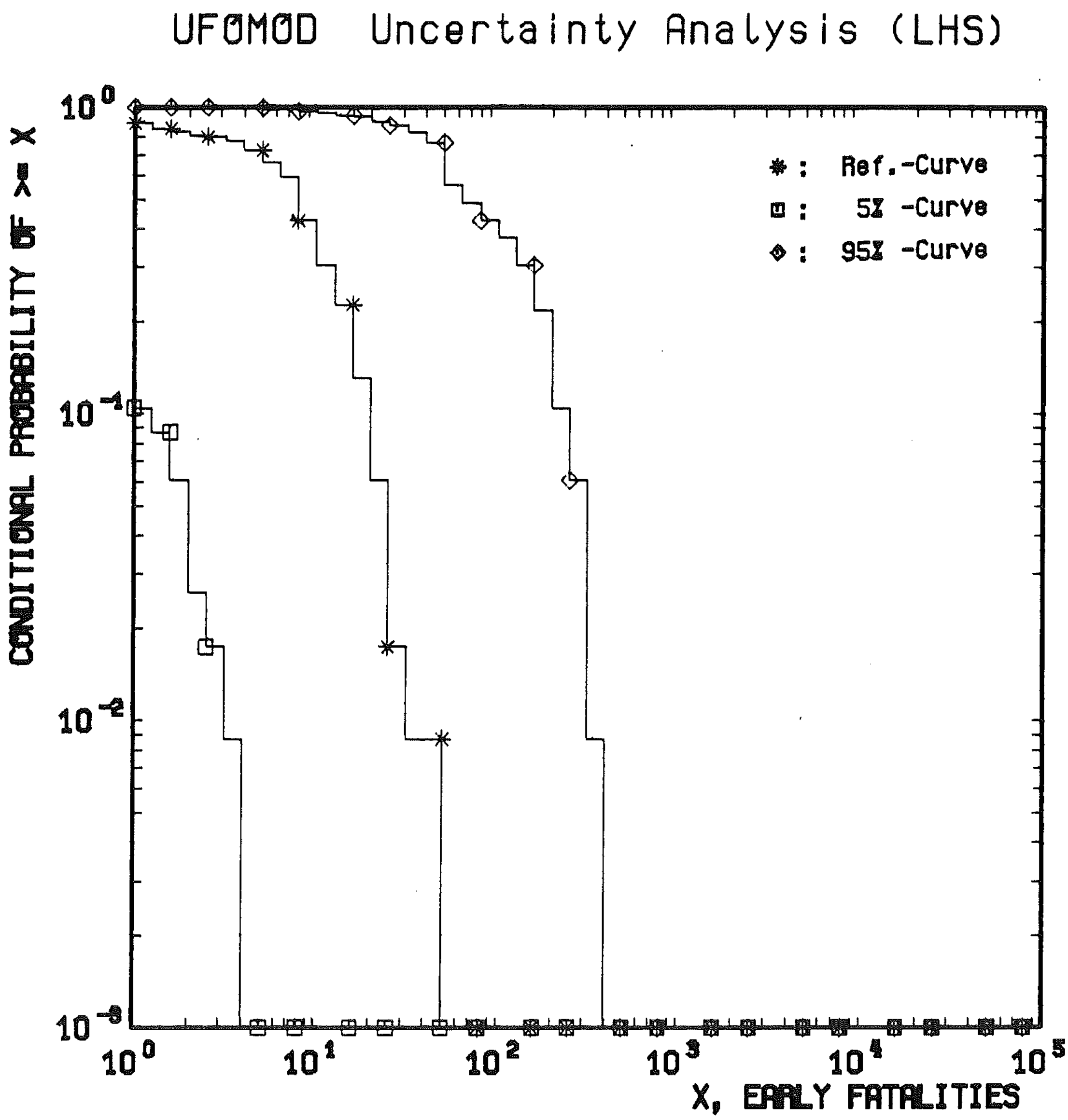


Figure 12. Reference CCFD of early fatalities: The empirical 5%-,95%-quantiles are given as estimated confidence bounds at discrete points of the x-axis.

For **estimating the confidence bounds** of the UFOMOD atmospheric dispersion and deposition submodel it is sufficient to choose a sample of size n (= 1.5 times the number of uncertain model parameters,k (in our case k=59)), such that different samples or an increase of sample size do not change the 5%-95%-confidence bands. This seems to be in correspondence with the experience of SANDIA. (In [26] is stated, that good results can be obtained with n=4/3 times the number of uncertain model parameters.)[5] The statement will be proved in Chap. 4. As a typical example Figure 11 shows 100 estimated complementary cumulative frequency distributions for the mean number of early fatalities.

Figure 12 shows the estimated so-called *reference CCFD* (all uncertain input model parameters are at their point value (50%-quantile)) and the empirical 5%-95%-quantiles at each consequence level. The 5%-95%-'confidence curves' were generated by considering the probability of equaling or exceeding each consequence level appearing on the x-axis. For each consequence level the 5% and 95%-quantiles (or other values: mean, median etc.) were calculated from the 100 associated probability values. These probability estimates for individual consequence levels were then connected to obtain the empirical 5%-95%-confidence curves (see [1]).

So, the confidence bounds have to be interpreted as follows:

There is 90%-confidence that the conditional probability for the mean number of early fatalities, x, is

- below the ordinate value at x of the 95%-curve,and
- above the ordinate value at x of the 5%-curve.

The width of the CCFD-confidence band is an indicator of the sensitivity of model predictions with respect to variations in parameters, which are imprecisely known.

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5 For n<k it seems appropriate to use the LHS - technique in a piecewise fashion on subsets of the k model parameters. For details see [21].

## 3.3 SENSITIVITY ANALYSIS

Now, according to step 6 described in Chap. 1 those uncertain input model parameters have to be identified which are important contributors to variations in consequences. Following [26], there are several methods for quantifying the relative importance of the uncertain model parameters to the output of the accident consequence model. Usually, each of the uncertain model parameters is ranked on the basis of its influence on the consequences. Some methods provide such an overall ranking while others (e.g. stepwise regression) are designed to select subsets consisting of only the most influential parameters.

- Rankings beyond the first few most important uncertain parameters usually have little or no meaning in an absolute ordering, since only a small number of the total number of uncertain parameters actually turns out to be significant. This will be explained later in more detail.
- Sensitivity analysis in conjunction with any form of sampling or design is easiest to carry out *if a regression model is fitted* between the model consequences and the model parameter values. Such a regression model is inherent in the calculation of correlation coefficients. But, regression techniques are influenced by extreme observations and nonlinearities. Therefore it seems to be appropriate to transform the data.

A method which

- is regression based,
- ranks either all uncertain model parameters or only those within a subset, and additionally
- avoids sophisticated transformations

is the ranking on the basis of *partial rank correlation coefficients*.

Now, *regression analyses* define the mathematical relationship between two (or more) variables, while *correlations* measure the strength of the relationship between two variables.

But do all correlation numbers indicate a significant relationship between variables, i.e. is there an actual relationship or only one by chance ('white noise')? Up to which level ('white noise'-level, critical value) the correlation numbers are treated as garbage?

The numerical values of correlation coefficients or partial (rank) correlations coefficients can be used for significance testing of the correlation, or with other words, for hypothesis testing to quantify the confidence in the correlation itself. For details see Appendix A.2.

But to summarize the main results in advance:

To get **statistically stable results for sensitivity analyses** larger samples sizes than for confidence bounds calculations are chosen. The number of uncertain model parameters, which have a sensitivity measure value above the so-called 'white noise level', increase with sample size. For details see Appendix A.2 and the sensitivity tables in Appendix C, which compare the results for n=59, 100 and 200 computer runs.

The **partial correlation coefficient (PCC)** is a measure that explains the linear relation between for instance a consequence variable and one or more uncertain model parameters with the possible linear effects of the remaining parameters removed. Following [16], when nonlinear relationships are involved, it is often more revealing to calculate PCCs between variable *ranks* than between the *actual values* for the variables. Such coefficients are known as **partial rank correlation coefficients (PRCCs)**. Specifically, the smallest value of each variable is assigned the rank 1, the largest value is assigned the rank n (n denotes the number of observations). The partial correlations are then calculated on these ranks.

**Remark:**

One may ask:

- Why rank correlation for explaining sensitivity ?
- Why Pearson's product moment correlation and not Kendall's coefficient ?
- What's about standardized and stepwise regression coefficients ?
- What has to be done if there are different rankings with respect to different sensitivity measures ?

Rank correlations are more comprehensive if there are nonlinearities in the computational models. Some other arguments for using these measures have been given at the beginning of this section.

The 'concordance'-based sensitivity measure, Kendall's $\tau$, can also be choosen for partial (rank) correlation. But, on the other hand, an advantage of using the extension of Spearman's product-moment based $\rho$ is, that existing computer programs for finding Pearson's partial correlation coefficients may be used on the ranks instead of the data, and the partial rank correlation coefficients are obtained easily (for more details concerning similarities and discriminations of the two measures see [6], [15] and [5]).

Standardized (rank) regression coefficients (SRC, SRRC) have been calculated, too. There was nearly the identical importance ranking as in the PCC, PRCC - calculations.

Stepwise regression calculations have not been carried out. But in [26] there is a summary of comparisons of some results achieved with different regression-based sensitivity measures.

In [23] and [26] a way is shown to measure agreement on the selection of the most important model parameters by computing the ordinary correlation coefficient on scores based on the sum of the reciprocals of the assigned ranks (so-called Savage scores).

The next step is to pick out the relevant sensitivity information out of the bulk of hidden messages within the CCFDs.

There are various possible ways to condense the extensive data:

- Estimate fractiles, the estimated mean values etc. of the n CCFDs *at certain consequence levels*. There will be possibly divergent 'importance rankings' for different consequence values.
- Estimate *one* fractile, *one* estimated mean value etc. for each of the n consequence curves.

The second procedure is used for the UFOMOD - uncertainty and sensitivity analyses. To find the most important contributors to uncertainty in the consequences partial rank correlation coefficients (PRCCs) are used.

**Importance ranking** is done by taking *absolute* values of the PRCC values. The model parameter associated with the largest absolute PRCC value is called the **most important** one responsible for uncertainty in consequences and gets **importance rank 1.**

This differs from the definition of *ranks of sample values*, where the smallest values has rank 1, the next smallest has rank 2 and so on.

**Example:**

On the basis of 200 UFOMOD/B3-runs with LHS, the most important uncertain parameters including their PRCC and *importance rank* for each consequence (e.g.: early and late fatalities; areas affected by the countermeasure 'relocation') are identified. By statistical reasons (as explained before), a parameter is significant with confidence 95%, if the absolute value of the corresponding PRCC is greater than .16 (for n=200). The absolute value describes the strength of the input-output dependency, while the (+,-)-sign indicates increasing (decreasing) model consequences for increasing uncertain parameter values. Dry deposition velocity of iodine, VD(IOD), and thermal energy, Q, are the most important sources of variation for the mean number of early fatalities with PRCC-values of .78 and -.58, respectively. Increasing VD(IOD) leads to a strong increase of early fatalities, while increase of Q gives less early fatalities (see Appendices B.8 and C.3).
□

In addition to evaluating the influence of each uncertain model parameter on the model consequences, the calculation of PCCs or PRCCs provide a good indicator of the 'fit of the analysis' to the model behaviour: the **coefficient of determination, $R^2$**, which is a measure of how well the linear regression model based on PCCs (or the corresponding standardized regression coefficients) can reproduce the actual consequence values. Or, in other words, it reflects the fraction of the variance in model consequences which can be explained by regression, i.e. it is possible to calculate the *percentage contribution* of each uncertain model parameter to variations in consequences. $R^2$ varies between 0 and 1 and is the square of the corresponding PCC. The closer $R^2$ is to unit, the better is the model performance.

To clarify this, let us observe a hypothetical system of about twenty uncertain model parameters. Take each parameter separately, omitting all other 19 parameters, and calculate the $R^2$ - value. Assume model parameter X has importance rank 1 and parameter Y has importance rank 20 with respect to the consequence. It is expected (at least when all parameters are uncorrelated) that the greatest amount of the observed variation is accounted for by the most important model parameter (in the linear regression model). The second most important model parameter has a smaller $R^2$ - value, and so on. Thus, the $R^2$ - values should describe a monotonous nonincreasing function of importance ranks.

However, assume now, only X and Y are correlated and have rank 1 or 20, respectively. The corresponding $R^2$ - value for the unimportant Y may be significantly greater than even e.g. the parameter with rank 2! But an unimportant parameter cannot be responsible for more variation than the most important ones.

Therefore, in the case of correlated model parameters, some of the calculated $R^2$ - values (from separately taken parameters) give misleading effects. So, one has to be very careful in interpreting these coefficients of determination when there are correlations present within the group of model parameters.

For more details or problems using $R^2$ - values see Appendix A.3 or [38].

# CHAPTER 4. UNCERTAINTY ANALYSIS APPLICATIONS TO UFOMOD

To have a structure for the bulk of information for the UFOMOD uncertainty and sensitivity analyses, this chapter summarizes the highlights of results. Everyone who is interested in looking at details of UFOMOD uncertainty and sensitivity investigations is refered to the Appendices A, B and C.

At first, the general way of understanding and interpreting uncertainty figures and sensitivity tables is outlined for some illustrative examples.

The presentation of the main results of UFOMOD/B3 - (atmospheric dispersion submodel) uncertainty/sensitivity analysis is divided into three parts, because the following intermediate and final results of accident consequence assessments are investigated:

- **Centerline concentrations**
  The concentration fields in the plume, in the air near ground (1 m height) and on ground surface considering the variability of the averaged[6] concentration values at four distance intervals D1 - D4 in the microscale (D1 = 0.2 km - 0.5 km), and the near (D2 = 0.8 km - 1.2 km), mean (D3 = 8 km - 12 km) and far (D4 = 80 km - 120 km) distance.
- **Doses**
  Short term bone marrow and 50-a whole body doses at these four different distance intervals.
- **Health effects and countermeasures**
  The mean number of early and late fatalities and the average areas affected by the countermeasure 'relocation'.

As it was explained in the previous chapter, due to weather conditions each UFOMOD run produces a frequency distribution for each consequence type (concentrations, doses, health effects) by weighting the results for each weather condition by the probability of its occurrence. For n UFOMOD runs n frequency distributions of consequences are obtained.

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[6] (averaged over 115 weather sequences which represent the weather of one year)

To prove the statement given in Chap. 3.2, concerning the minimum number of code runs to estimate confidence bounds of consequences, Figure 13 shows two frequency distribution functions of bone marrow doses at a distance of 0.8 - 1.2 km.

In Figure 13 each curve corresponds to *one* of two different Latin hypercube samples of size 59. There is only a very small amount of variablity of the results due to sampling, i.e. the two samples of size 59 each led to very similar results. This statement was tested for various different samples of size 59 and 100.
In a similar manner one can compare CCFDs on the basis of different designs:

- Random design (RSD) at KfK
- Tolerance limit design (TLD)[7] at GRS
- Latin hypercube design (LHS) at KfK and GRS

See e.g. in Figure 14 and Figure 15 the confidence curves for the iodine concentration on ground surface in about 10 km distance from the source. There are only slight differences in the width of confidence bands on the basis of different number of runs or designs, respectively.

For the accident consequence model under consideration, uncertainty *and* sensitivity analyses did not lead to significant varying results with respect to different designs and sample sizes larger than 59.

- **Centerline concentrations**
  Summarizing, in the vicinity of the site, at ground or near ground surface, model output uncertainty is quite large (width of uncertainty band between 2.5 and one decade). The reason is, that especially in this region the choice of the thermal energy, the parameter of vertical dispersion, the dry and wet deposition and plume rise are very important. Far away from the source the plume is uniformly mixed in the vertical layer. Dry deposition, the horizontal dispersion parameter and the height of the mixing layer are important in this case. Variations in

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7 Random design to obtain distribution-free tolerance-confidence limits for CCFDs. The TLD-design was constructed at Gesellschaft für Reaktorsicherheit (GRS), Munich (Germany). For more details see [18].

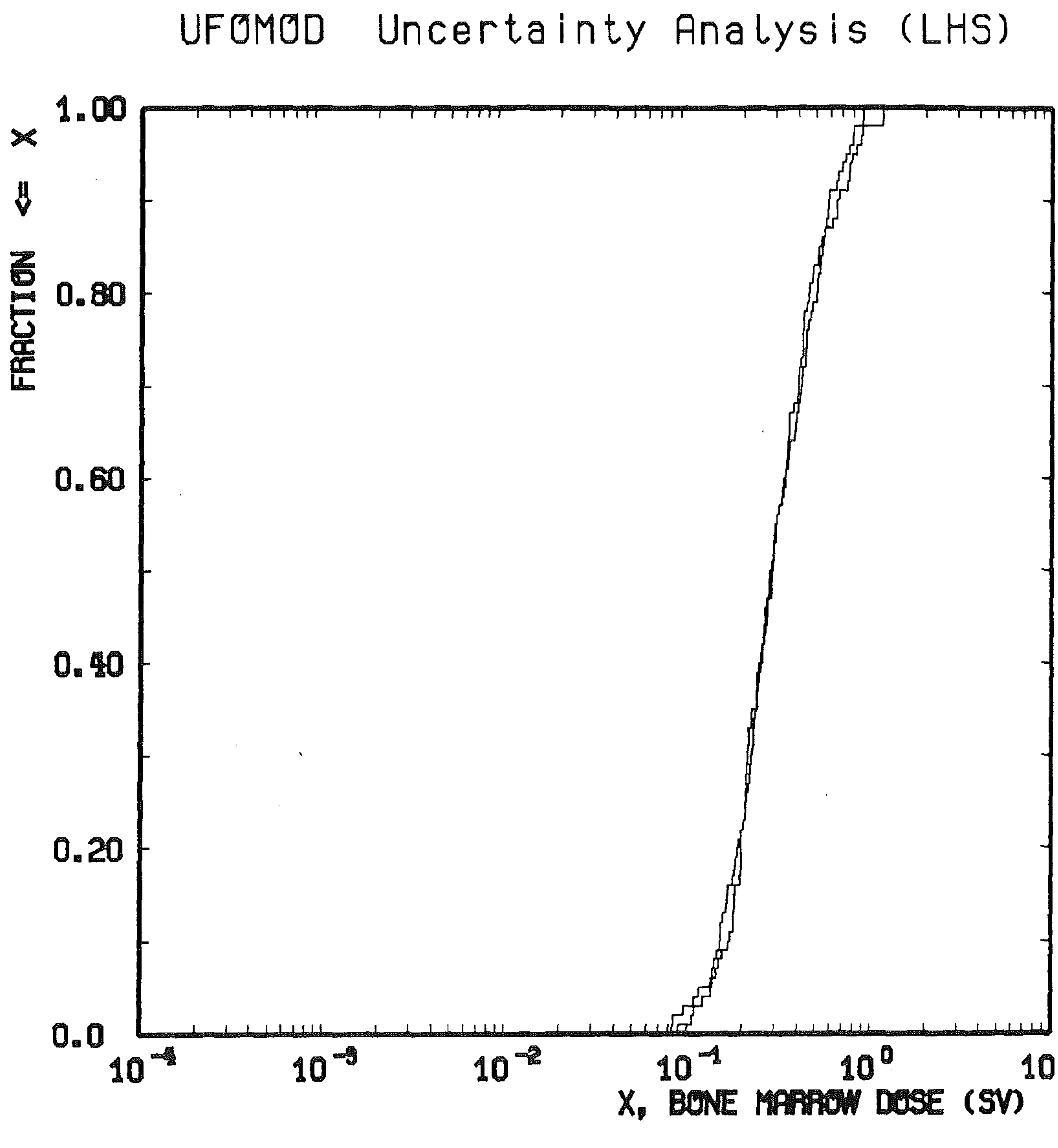


Figure 13. Mean CDFs of mean bone marrow doses at distance 0.8-1.2 km: Each curve corresponds to one Latin hypercube sample of size 59.

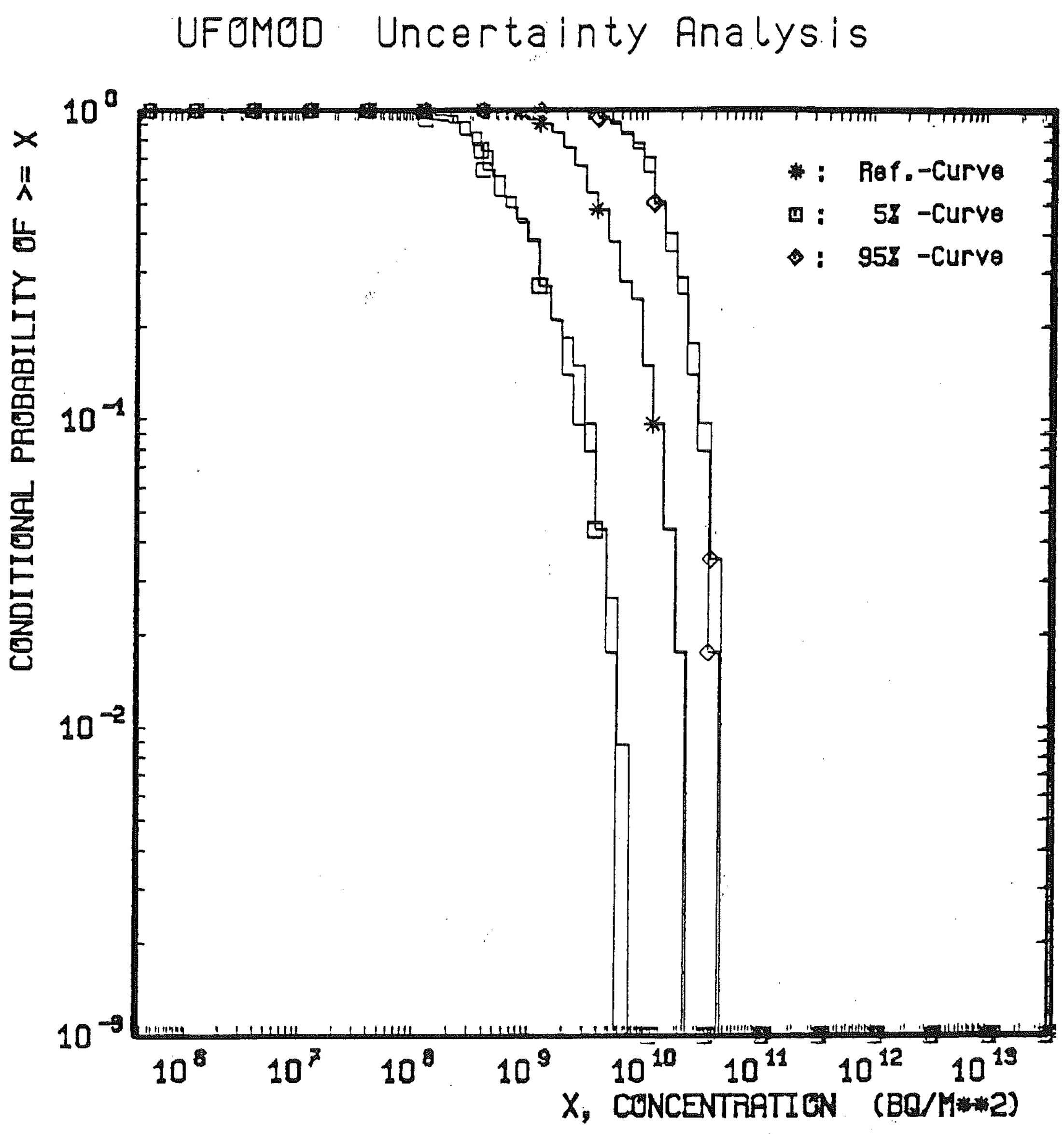


Figure 14. Comparison of confidence curves (RSD and LHS;n=59): Concentration on ground surface for I-131 in a distance of 8 - 12 km

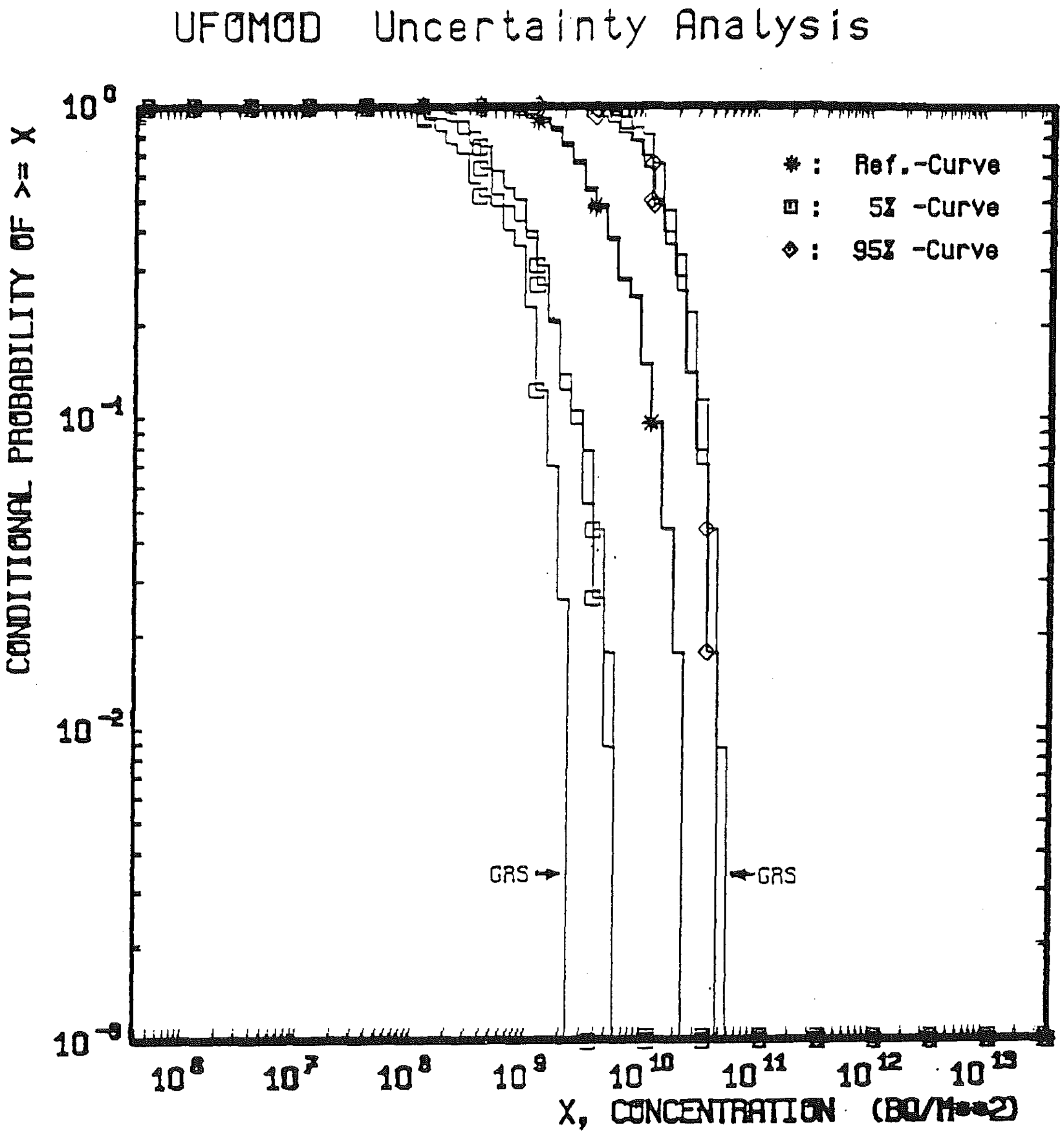


Figure 15. Comparison of confidence curves (LHS;n=59 and 100) at KfK and GRS (n=59): Concentration on ground surface for I-131 in a distance of 8 - 12 km

the plume concentrations are mainly caused by thermal energy and plume rise in the near-site region and horizontal dispersion, height of mixing layer, dry deposition (iodine) at far distances (width of uncertainty bands 3 to .5 decades from near to far distances).

The $R^2$-values e.g. for mean concentrations of caesium-137 on ground surface in about 0.8 - 1.2 km distance (on the basis of 200 runs) indicate that 97% (93%)[8] of the observed variation is accounted for by the model parameters.

Dry deposition of aerosols, VD(AER), accounts for 80% (71%), VD(AER) and thermal energy, Q, together account for 87% (82%) of the total variability. Model parameters with importance ranks greater than 15[9] account for 3% (1%) of the variation.

There is a similar situation in the distance 80 - 120 km. Dry deposition of aerosols, VD(AER), accounts for 83% (78%), VD(AER) and washout coefficient, LDAERO-1, together account for 88% (87%) of the total variability. Model parameters with importance ranks greater than 15 account for 43%[10] (2%) of the variation.

- **Doses**

  Consistent with the results mentioned above, variations in bone marrow doses stem mainly from thermal energy, plume rise (decreasing influence from near-site to far regions), high importance of dry deposition (iodine), and increasing influence of dry and wet deposition (aerosols) from near to far regions (see Figure 16). The width of the uncertainty bands is one to .5 decades from near to far distances. PRCCs for whole body doses are similar to bone marrow doses in near-site regions. At far

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8 The percent values in brackets show the situation where no correlation between the model parameters is assumed.

9 By statistical reasons (see significance test in Appendix A.2.2) only 15 parameters have a PRCC which is greater than the so-called *critical level*. Similar reasons lead to corresponding numbers for dose runs and fatality runs.

10 This percent value is due to the influence of correlations mentioned at the end of Chap. 3.3. For more details see the examples in the Appendix A.3.

distances the most important model parameters are dry deposition (iodine and aerosols), error in wind speed and height of mixing layer.

| DOSES | | PRCC and (rank) of parameters (200 runs) |
|---|---|---|
| bone marrow | D1 | thermal energy -.86 (1), plume rise factor -.86 (2), dry deposition (iodine) .78 (3) |
| | D2 | thermal energy -.92 (1), dry deposition (iodine) .85 (2), plume rise factor -.66 (3) |
| | D3 | error to describe wind speed -.56 (1), dry deposition (iodine) .45 (2), horizontal dispersion parameter .44 (3), |
| | D4 | dry deposition (aerosols) .91 (1), dry deposition (iodine) .69 (2), error to describe wind speed -.55 (3) |

Figure 16. Main sensitivity results for bone marrow dose runs

The $R^2$-values e.g. for bone marrow doses in about 0.8 - 1.2 km distance (on the basis of 200 or 59 runs) indicate that 93% (97%) of the observed variation is accounted for by the model parameters in the regression model.
Thermal energy, Q, accounts for 40% (40%). Dry deposition of iodine, VD(IOD) and thermal energy, Q, together account for 76% (74%) of the total variability. Model parameters with importance ranks greater than 9 account for 25% (7%) of the variation.
There is a similar situation in the distance 80 - 120 km. Dry deposition of aerosols, VD(AER), accounts for 70% (63%), VD(AER) and VD(IOD), together account for 81% (76%) of the total variability. Model parameters with importance ranks greater than 7 account for 50% (11%) of the variation.

- **Health effects and countermeasures**

  Dry deposition (iodine) and thermal energy are dominant for the variation in the number of early fatalities. Due to the non-linear dose-risk relationships for early fatalities, the uncertainty caused by the variability of atmospheric dispersion parameters is rather high (see Figure 11). The same parameters are responsible as in the case of acute bone marrow dose calculations. In contrast to this, 5%- and 95%-confidence bounds of the CCFDs of late fatalities are very close to the reference curve (some ten percent). This insensitivity to parameter variations is caused by the compensating effect of the countermeasures (e.g. relocation or food-bans). Therefore, the uncertainty in the areas affected by relocation is much larger (width of uncertainty band is greater than one decade). Both, the variation of late fatalities and those of countermeasure areas, are mainly caused by uncertainties in dry and wet deposition parameters.

  The $R^2$-values e.g. for the mean number of early fatalities (on the basis of 200 or 59 runs) indicate that 85% (85%) of the observed variation is accounted for by the model parameters in the regression model.

  Dry deposition of iodine, VD(IOD), accounts for 56% (59%). VD(IOD) and thermal energy, Q, together account for 65% (71%) of the total variability. Model parameters with importance ranks greater than 10 (6)[11] account for 42% (16%) of the variation.

In order not to get confused by the tremendous bulk of uncertainty information only the main results have been mentioned up to now. More detailed information will be given in the Appendices B and C concerning **uncertainty** and **sensitivity** with special emphasis on LHS:

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[11] By statistical reasons (see significance test in Appendix A.2.2) the number of parameters which have a PRCC greater than the so-called *critical level* increase with the number of code runs. So, importance rank 10 refers to 200 computer runs and rank 6 to 59 runs, respectively.

- **UNCERTAINTY** (CCFDs and confidence curves)
  - **Activity concentrations** (Iodine, Aerosols) on ground surface, in the air near ground, in the plume at four distance intervals
    - **LHS** (100 runs)
  - **Activity concentrations** (Iodine, Aerosols) on ground surface at four distance intervals
    - **LHS** ( 59 runs)
      - KfK - design
      - GRS - design
    - **RSD** ( 59 runs)
      - KfK - design
      - GRS - design
    - **RSD** (100 runs)
  - **Doses** (bone marrow, whole body) at four distance intervals
    - LHS - design (100 runs)
  - **Health effects** (early and late fatalities, areas affected by the countermeasure 'relocation')
    - LHS - design (100 runs)

- **SENSITIVITY** (Tables of PRCC values)
  - Comparison of concentration runs (LHS) for n=59,100,200
  - Comparison of dose runs (LHS) for n=59,100,200
  - Comparison of fatality runs (LHS) for n=59,100,200
  - Comparison of concentration runs (RSD/LHS) for n=59,100,200
  - Comparison of concentration runs (LHS) for (1x200,2x100)
  - Comparison of concentration runs (LHS) at KfK/GRS n=59
  - Comparison of concentration runs (RSD) at KfK/GRS n=59

# CHAPTER 5. SUMMARY

The aim of report was, on the basis of applying various techniques available for uncertainty and sensitivity analysis of large computer models, to review and select the techniques which are most appropriate for analyzing the uncertainty in the predictions of accident consequence assessments of the atmospheric dispersion and deposition submodel of UFOMOD. The techniques have been used to identify and characterize major contributors to uncertainty in such assessments.

With the UFOMOD-code activity concentrations of the released material, organ doses, early/late fatalities and countermeasures were calculated. The uncertainty of these consequences has been quantified, propagating the variation of the parameters of the atmospheric dispersion submodel through the accident consequence code. The effects of varying sample sizes and different design types on the confidence bands of the predictions were studied. The SANDIA-LHS (Latin Hypercube Sample) and PRCSRC (Partial Rank Correlation)-codes have been used effectively.

- RSD-,TLD- and LHS design gave comparable UFOMOD uncertainty and sensitivity results. The width of the GRS-confidence bands was greater than those coming from SANDIA-RSD and LHS-designs. This may be motivated by the fact, that GRS used a different kind of correlation estimation and LHS-construction.

- Relative small sample sizes (1.5 times the number of model parameters) were sufficient to get statistically stable confidence estimates.

- Increased sample sizes (n=100,200) led to more precision in sensitivity calculations.

- The coefficient od determination, $R^2$, was used to calculate the percentage contribution of each uncertain model parameter to variations in consequences.

# MORE DETAILS, FIGURES AND TABLES

Appendix A.1 gives some details concerning the LHS-procedure and the IMAN/CONOVER-method for inducing rank correlations.

Appendix A.2 describes the partial (rank) correlation coefficient and some significance testing problems.

Appendix A.3 illustrates some experiences concerning the coefficient of determination, $R^2$.

Appendices B and C comprise a detailed set of figures for uncertainty and sensitivity analyses, respectively. If necessary some legends to understand abbreviations are added. The figures and tables are given in the following sequence:

- **UNCERTAINTY** (CCFDs and confidence curves)
  - **Activity concentrations** (Iodine, Aerosols) on ground surface, in the air near ground, in the plume at four distance intervals
    - **LHS** (100 runs)
  - **Activity concentrations** (Iodine, Aerosols) on ground surface at four distance intervals
    - **LHS** ( 59 runs)
      - KfK - design
      - GRS - design
    - **RSD** ( 59 runs)
      - KfK - design
      - GRS - design
    - **RSD** (100 runs)
  - **Doses** (bone marrow, whole body) at four distance intervals
    - LHS - design (100 runs)
  - **Health effects** (early and late fatalities, areas affected by the countermeasure 'relocation')
    - LHS - design (100 runs)

- **SENSITIVITY** (Tables of PRCC values)
  - Comparison of concentration runs (LHS) for n=59,100,200
  - Comparison of dose runs (LHS) for n=59,100,200
  - Comparison of fatality runs (LHS) for n=59,100,200
  - Comparison of concentration runs (RSD/LHS) for n=59,100,200
  - Comparison of concentration runs (LHS) for (1x200,2x100)
  - Comparison of concentration runs (LHS) at KfK/GRS n=59
  - Comparison of concentration runs (RSD) at KfK/GRS n=59

# APPENDIX A. SOME MATHEMATICAL DETAILS

## A.1 THE IMAN/CONOVER - PROCEDURE

This paragraph follows some results presented in [21].

Let C be a (k,k)-rank correlation matrix supplied by the user. Use the Cholesky-factorization to find a lower triangular matrix P, such that PP'=C. For a sample of size n form a (n,k)-matrix R, whose k columns are unique random mixes of van der Waerden scores (see [15]):

$$\{ \Phi^{-1}(i/(n+1)),\ i=1,\dots n \} ,$$

where $\Phi^{-1}$ is the inverse of the standardized normal distribution.
Let T represent the correlation matrix of R. Use the Cholesky-factorization on T to find a lower triangular matrix Q, such that QQ'=T. Next, one wishes to find a matrix S, such that STS'=C or SQQ'S'=C, respectively, for which one solution is $S=PQ^{-1}$. The matrix $R^{*}=RS'$ has a correlation matrix exactly equal to the original correlation matrix C. This comes out by the following

**Theorem** (see [44])

Let $X = (X_1,\dots,X_k)$ be a k-dimensional random vector with expectation $(\mu_1,\dots,\mu_k)$ and correlation matrix K. For a linear transformation Y=XP' we have: The correlation matrix of vector Y is D=PKP'.
□

If $X_i:=R_i$ are the columns of the matrix R of van-der-Waerden scores, T:=QQ' is the correlation matrix of R and $P:=(Q^{-1})'$, then

$$D=Q^{-1}T(Q^{-1})'=I$$

That is, the column vectors $R_i(Q^{-1})'$ have the correlation matrix I. By Wilks' theorem, the column vectors of $R^{*}=R(Q^{-1})'P'$ have the correlation matrix C=PP'.

Finally, it only remains to generate the (n,k)-matrix of model parameters values, according to any desired method or distribution, as if the k random model parameters were independent of each other. Then the values of the parameter in each column are arranged so, that they have the same (rank) order as the corresponding column in the matrix $R^*$. Therefore $M \sim C$, i.e. the sample rank correlation matrix of the model parameter vectors, C, will be the same as the sample rank correlation matrix, say M, of $R^*$. This is formally explained in [29] or [33].

## A.2 PARTIAL CORRELATION COEFFICIENTS

### A.2.1 Definition

This paragraph follows some results presented in [16].

Sensitivity analysis in conjunction with Latin hypercube sampling is based on the construction of regression models. The observations

$(X_{1i}, X_{2i}, \dots, X_{ki}, Y_i)$ i=1,...,n

are used to construct models of the form

$$Y_{est} = b_0 + \Sigma_q b_q Z_q$$

subject to the constraint that

$$\Sigma_i (Y_i - Y_{est})^2$$

be minimized. $b_0$, $B_q$ are constants and each $Z_q$ is a function of $X_1, X_2, \dots, X_k$.

An important property of least squares regression is that

$$\Sigma(Y - Y_m)^2 = \Sigma(Y - Y_{est})^2 + \Sigma(Y_{est} - Y_m)^2$$

where $Y_m$ is the mean of the $Y_i$-values.

The $R^2$ - value (**coefficient of determination**) for a regression falls between 0 and 1 and is defined by

$$R^2 = \Sigma(Y_{est} - Y_m)^2/\Sigma(Y - Y_m)^2$$

The closeness of an $R^2$ - value to 1 provides an indication of how successful the regression model is in accounting for the variation in Y.

For a regression model of the form

$$Y_{est} = b_0 + b_1 Z$$

with an $R^2$ - value of $r^2$, the number $\text{sign}(b_1)|r|$ is called the correlation coefficient between Y and Z, where $\text{sign}(b_1) = 1$ if $b_1 \geq 1$ and $\text{sign}(b_1) = -1$ if $b_1 < 1$. This number provides a measure of linear relationship between these two variables. When more than one independent variable is under consideration, *partial correlation coefficients* are used to provide a measure of the linear relationships between Y and the individual independent variables. The *partial correlation coefficient* between Y and an individual variable $Z_p$ is obtained from the use of a sequence of regression models. The following two regression models are constructed:

$$Y'_{est} = a_0 + \Sigma_{q \neq p}\, a_q Z_q \text{ and}$$

$$Z'_{est} = c_0 + \Sigma_{q \neq p}\, c_q Z_q \text{ and}$$

Then, the results of the two preceding regressions are used to define the new variables $Y - Y'_{est}$ and $Z_p - Z'_p$. By definition, the **partial correlation coefficient between** Y and $Z_p$ is the simple correlation coefficient between $Y - Y'_{est}$ and $Z_p - Z'_p$. Therefore, the partial correlation coefficient provides a measure of the linear relationship between Y and $Z_p$ with the linear effects of the other variables removed.

**Example:**

Sometimes the apparent correlation between two variables may be due in part to the direct influence on both of the other variables: Y and $X_1$ are correlated, but are both influenced by a variable $X_2$. The influence of $X_2$ on Y and $X_1$ must be removed. *Simple linear regression* of Y resp. $X_1$ on $X_2$ gives:

$$Y' = \beta_0 + \beta_1 X_2 , \quad X_1' = \gamma_0 + \gamma_1 X_2$$

Define new variables (Y - Y') and ($X_1$ - $X_1$'). The simple correlation (based on the Pearson product moment correlation) between the 'residuals' (Y - Y') and ($X_1$ - $X_1$') is called the **partial correlation coefficient between Y and $X_1$, given $X_2$** (i.e., the linear influence of $X_2$ on both Y and $X_1$ removed), and is denoted by $r_{1Y.2}$:

$$r_{1Y.2} = [\, r_{1Y} - r_{12} r_{Y2} \,] \,/\, [\, (1 - r_{12}^2)(1 - r_{Y2}^2) \,]^{1/2} \qquad (20)$$

$r_{1Y}$, $r_{12}$, $r_{Y2}$ are simple Pearson product moment correlations of the corresponding variables. For more details see [26], [16], [20], [28] and [36].
□

### A.2.2 Significance Tests

Following [6], the well-known Pearson product-moment correlation formula can be used to estimate Pearson's partial correlation coefficient. Spearman's rank correlation ρ has also been extended to measure partial rank correlation.

Partial correlation coefficients (PRCs) are correlation coefficients on conditional distributions. The distribution of the partial correlation coefficients depends on the multivariate distribution function of the underlying variables. Therefore PRCs may not be directly used as test statistics in nonparametric tests.

Starting from some well-known theorems, we may nevertheless do some approximative tests and analyses.

**Step 1:**

*Find the distribution of the sampling correlation coefficient for random variables (X,Y) with bivariate normal distribution.*

**Theorem (Pitman's test):** (see [30])

Let $u_i = (x_i, y_i)$ (i=1,...n) be a random sample from a bivariate normal distribution with correlation r. Let $r_s$ be the sample correlation coefficient (Pearson's product moment coefficient):

$$r_s = \Sigma(y_i - y_m)(x_i - x_m)/ [\Sigma(y_i - y_m)^2 \Sigma(x_i - x_m)^2]^{1/2} \tag{21}$$

Let r = 0 then

$$T_s = r_s [(n - 2)/(1 - r_s^2)]^{1/2} \tag{22}$$

is distributed as Student' t with (n-2) degrees of freedom.
□

**Theorem:** (see [31] or [35])

Let $(z_1, \ldots, z_k)$ be a random sample from a k-dimensional normal distribution and $r_{ij,u_1,\ldots,u_p} = 0$ where $r_{ij,u_1,\ldots,u_p}$ is the partial correlation coefficient) of order p (p=k-2). $u_1$ and $u_p$ are p=k-2 numbers from {1,...k} which are different from i and j. That means the *partial* correlation between $Z_i$ and $Z_j$ is tested, say, while the indirect correlation due to $Z_{u_1}, \ldots, Z_{u_p}$ is eliminated. Let $r_{s;ij,u_1,\ldots,u_p}$ be the sample partial correlation coefficient) of order p (p=k-2). Take n samples from the vector z, then

$$T_s = r_{s;ij,u_1,\ldots,u_p} [(n - 2 - p)/(1 - r_{s;ij,u_1,\ldots,u_p}^2)]^{1/2} \tag{23}$$

is distributed as Student' t with (n-2-p) degrees of freedom.
□

**Step 2:**

*Try to find adequate approximate formulas for non-normal situations.*

Let $w_i = (u_i, v_i)$ (i=1,...n) be a random sample from a bivariate distribution with correlation r. Let $r_s$ be the sample correlation coefficient. Transform the sample values $(u_1,...,u_n)$ and $(v_1,...,v_n)$ into their order statistics $(u_{(1)},...,u_{(n)})$ and $(v_{(1)},...,v_{(n)})$. Then do an *expected normal scores transformation:* Replace the order statistics of the (u,v)-variables by the expected value of the corresponding order statistics of standard normal variates (X,Y). Then $r_s$ transforms approximately to $\psi_s$ :

$$r_s \sim \psi_s = \Sigma E(x_{(i)})E(y_{(i)}) / \left[\Sigma E^2(x_{(i)}) \Sigma E^2(y_{(i)})\right]^{1/2} \qquad (24)$$

(This is clear from the hint that for a N(0,1)-distributed variable X one has $\Sigma E(X_{(i)}) = 0$ because of $E(X_{(i)}) = - E(X_{(n-i+1)})$.

$\psi_s$ can be used for an expected normal scores test of the hypothesis that U and V are uncorrelated.

[6] explains the role of the expected normal scores as well defined numbers which replace the unpleasant behaviour connected with using the order statistics from normal variables themselves. The procedure is based only on the ranks of the observations and is therefore a *rank test.*

Fisher and Yates (see [4]) suggested the analogue to Pitman's test using the exact normal scores instead of the the original data and applied the usual parametric procedures to these expected normal scores as a nonparametric procedure.

**Step 3:**

*Give the significance test procedure.*

The procedure is as follows:

The 'null' hypothesis reads: "No *partial* correlation exists between Y (the consequence variable) and $X_i$ (one of the uncertain model parameters)", while the indirect influence due to to the other model parameters is eliminated.

Then, for a sample of size n, the partial sample rank correlation, $\rho_{s;Yi,u_1,...,u_p}$, between Y and $X_i$ has to be calculated. $\rho_s$ is then compared with the quantiles of the distribution of the test statistic. The comparison is made at a certain prescribed level of significance, $\alpha$.

The 'null' hypothesis of *no* correlation is rejected, if the correlation value $\rho_s$ leads to $|\rho_s| \geq T_{\alpha/2,n}$, the **critical value**, where $T_{\alpha/2,n}$ is a quantile of the test statistic's distribution.

$$T_{\alpha/2,n} \sim t_{\alpha/2,n-k} / \left[ n - k + t^2_{\alpha/2,n-k} \right]^{1/2} \qquad (25)$$

$t_{\alpha/2,n-k}$ is the $(1 - \alpha/2)$-quantile of the t-distribution with n-k degrees of freedom (compare [22] or [32]). eq. 25 is easily derived from eq. 23.

**Example:**

For k=39 uncertain input model parameters and $\alpha = 0.05$ significance level, the partial rank correlation value (PRCC), $\rho$, is significant, if its absolute value is greater than 0.44 (59 runs), 0.25 (100 runs) or 0.16 (200 runs) , respectively.

## A.3 REMARKS TO $R^2$ - VALUES

Here some additional hints for motivation of the *coefficient of determination,* $R^2$ are given.

The *total variation* of the consequence variable, Y, is defined as $\Sigma(Y - Y_m)^2$, i.e. the sum of squares of the deviation of values of Y from the mean $Y_m$.

$$\Sigma(Y - Y_m)^2 = \Sigma(Y - Y_{est})^2 + \Sigma(Y_{est} - Y_m)^2$$

The first term on the right is called the *unexplained variation* while the second term is called the *explained variation* (by a regression model), so called because the deviations $(Y_{est} - Y_m)$ have a defined pattern while the deviations $(Y - Y_{est})$ behave in a random or unpredictable manner.

The ratio of explained variation to the total variation is called the *coefficient of determination,* $R^2$

$$R^2 = \Sigma(Y_{est} - Y_m)^2/\Sigma(Y - Y_m)^2$$

**Remark** In this report all $R^2$ - values ($Rs^2$) are normalized by $Rt^2$

$R^2 = (Rs^2/Rt^2)*100$,

where $Rs^2$, $Rt^2$ are calculated by the SANDIA - PRCSRC-code (see [28]) and the $Rt^2$ - values are calculated with *all* (i.e. the complete set of) model parameters.

□

In the following lines some examples are presented which show problems in interpretation of $R^2$ - values.

**Examples**

- Consider concentration runs for caesium-137 on ground surface at the the distance of 80 - 120 km.
  Assume there are no correlations (see Figure 19). Decreasing importance ranks for the model parameters give decreasing $R^2$ - values (see e.g. the first 14 important parameters). Groups of separately taken model parameters and their corresponding ('group') $R^2$ - value follow.
  In the case of assumed correlations (see Figure 20) there is no monotone behaviour of $R^2$ - values. The parameter with rank 12 has a $R^2$ - value which is much greater than e.g. the parameter with rank 3. One of the wet deposition parameters does *not* belong to the set of statistically significant parameters. But on the other hand, *all* deposition parameters are correlated. Taking the group of non-significant parameters (including parameters which are correlated to significant variables) will give this 'remarkable' $R^2$ - value of 43%.
  Investigating and interpreting $R^2$ - values led to the detection of somewhat strange expert's assumptions about correlations between dry and wet deposition parameters. These correlations heve been removed at a late stage of UFOMOD/B3 - uncertainty/sensitivity analyses. Nevertheless, these strange correlations did not affect seriously the sequence of statistically significant model parameters.

- Consider now bone marrow dose values in the distance of 80 - 120 km.
  Assume there are no correlations. Decreasing importance ranks for the model parameters give decreasing $R^2$ - values (see e.g. the first seven most important parameters in Figure 21). Then follow groups of sepa-

rately taken model parameters and their corresponding ('group') $R^2$ -values.

In the case of assumed correlations (see Figure 22) there is no monotone behaviour of $R^2$ - values. The parameter with rank 4 has a $R^2$ - value greater than the parameter with rank 2. Arguing as before, not all deposition parameters are significant, but *all* are correlated. This leads to the ('group') $R^2$ - value of about 50% for the group of separately taken non significant variables

- In the case of early fatalities no wet deposition parameters and only some of the dispersion parameters belong to the group of important variables. But the parameters within the group of deposition or within the dispersion parameters are correlated (see item 8 in the explanatory remarks to Figures 3 to 8). The group of non important parameters separately taken results in a value of 42% for $R^2$.

□

| PARAMETER NAME | VARIABLE | |
|---|---|---|
| 1. Q | Thermal energy | |
| 2. R | Quantity to describe error in wind speed | |
| 3. HQ | Height of source | |
| 4. FPR(A-D) | Plume rise factor | DC=A,B,C,D |
| 5. FPR(E,F) | Plume rise factor | DC=E,F |
| 6. DA | Quantity to correct plume rise | |
| 7. C1 | Atmospheric dilution parameter | |
| 8. HM(A) | Mixing height | DC=A |
| 9. HM(B) | Mixing height | DC=B |
| 10. HM(C) | Mixing height | DC=C |
| 11. HM(D) | Mixing height | DC=D |
| 12. HM(E) | Mixing height | DC=E |
| 13. HM(F) | Mixing height | DC=F |
| 14. SIGY(A) | Horizontal dispersion | DC=A |
| 15. SIGY(B) | Horizontal dispersion | DC=B |
| 16. SIGY(C) | Horizontal dispersion | DC=C |
| 17. SIGY(D) | Horizontal dispersion | DC=D |
| 18. SIGY(E) | Horizontal dispersion | DC=E |
| 19. SIGY(F) | Horizontal dispersion | DC=F |

DC := Diffusion category

Figure 17. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3

| PARAMETER NAME | VARIABLE | |
|---|---|---|
| 20. SIGZ(A) | Vertical dispersion | DC=A |
| 21. SIGZ(B) | Vertical dispersion | DC=B |
| 22. SIGZ(C) | Vertical dispersion | DC=C |
| 23. SIGZ(D) | Vertical dispersion | DC=D |
| 24. SIGZ(E) | Vertical dispersion | DC=E |
| 25. SIGZ(F) | Vertical dispersion | DC=F |
| 26. P(A) | Wind profile exponent | DC=A |
| 27. P(B) | Wind profile exponent | DC=B |
| 28. P(C) | Wind profile exponent | DC=C |
| 29. P(D) | Wind profile exponent | DC=D |
| 30. P(E) | Wind profile exponent | DC=E |
| 31. P(F) | Wind profile exponent | DC=F |
| 32. VD(IO) | Dry deposition velocity (m/s) | Iodine |
| 32. VD(AE) | Dry deposition velocity (m/s) | Aerosols |
| 34. LAMB(IO,0-1) | Washout coefficient | (Iodine 0-1mm/s) |
| 35. LAMB(AE,0-1) | Washout coefficient | (Aerosols 0-1mm/s) |
| 36. LAMB(IO,1-3) | Washout coefficient | (Iodine 1-3mm/s) |
| 37. LAMB(AE,1-3) | Washout coefficient | (Aerosols 1-3mm/s) |
| 38. LAMB(IO,>3) | Washout coefficient | (Iodine >3mm/s) |
| 39. LAMB(AE,>3) | Washout coefficient | (Aerosols >3mm/s) |

DC := Diffusion category

Figure 18. Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD/B3 (cont'd)

| INDEPENDENT VARIABLE | RANK | R-sq.(%) |
|---|---|---|
| 1. VD(AER) | 1 | 78 |
| 2. LAMB(AE,0-1) | 2 | 9 |
| 3. SIGY(D) | 3 | 5 |
| 4. R | 4 | 3 |
| 5. HM(D) | 5 | 2 |
| 6. HM(C) | 6 | 1 |
| 7. SIGY(E) | 7 | 0 |
| 8. SIGY(C) | 8 | 0 |
| 9. LAMB(AE,1-3) | 9 | 0 |
| 10. Q | 10 | 0 |
| 11. FPR(A - D) | 11 | 0 |
| 12. LAMB(AE,>3) | 12 | 0 |
| 13. VD(AER) LAMB(AE,0-1) | 1 2 | 87 |
| 14. SIGY(A - F) | 26 17 8 | |
| | 3 7 16 | 2 |
| 15. LAMB(AE,0-1) LAMB(AE,1-3) | 2 9 | |
| LAMB(AER,>3) | 12 | 9 |
| 16. Indep. var. | | |
| with ranks <13 | 1 - 12 | 99 |
| 17. Indep. var. | | |
| with ranks >12 | 13 - 39 | 2 |

Figure 19. $R^2$ - values for the consequence variable CAECGD4 (n=200 runs): There are *no* correlations between the model parameters.
R-sq.(%)=$Rs^2/Rt^2*100$. $Rt^2$ is the $R^2$ - value when all model parameters are included. For this case $Rt^2$=0.95.

| INDEPENDENT VARIABLE | RANK | R-sq.(%) |
|---|---|---|
| 1. VD(AER) | 1 | 83 |
| 2. LAMB(AE,0-1) | 2 | 42 |
| 3. R | 3 | 2 |
| 4. SIGY(D) | 4 | 5 |
| 5. HM(D) | 5 | 2 |
| 6. SIGY(C) | 6 | 3 |
| 7. HM(C) | 7 | 1 |
| 8. SIGY(E) | 8 | 3 |
| 9. HM(B) | 9 | 2 |
| 10. SIGY(F) | 10 | 3 |
| 11. SIGY(B) | 11 | 3 |
| 12. LAMB(AE,1-3) | 12 | 36 |
| 13. SIGZ(C) | 13 | 0 |
| 14. Q | 14 | 0 |
| 15. VD(AER) LDAERO-1 | 1 2 | 88 |
| 16. LAMB(AE,>3) | 31 | 39 |
| 17. LAMB(AE,0-1) LAMB(AE,1-3) | 2 12 | |
| LAMB(AE,>3) | 31 | 55 |
| 18. VD(AER) LAMB(AE,0-1) | 1 2 | |
| LAMB(AE,1-3) LAMB(AE,>3) | 12 31 | 88 |

Figure 20. $R^2$ - values for the consequence variable CAECGD4 (n=200 runs): There *are* correlations between the model parameters.
R-sq.(%)=$Rs^2/Rt^2*100$. $Rt^2$ is the $R^2$ - value when all model parameters are included. For this case $Rt^2$=0.98.

| INDEPENDENT VARIABLE | RANK | R-sq.(%) |
|---|---|---|
| 1. VD(AER) | 1 | 63 |
| 2. VD(IOD) | 2 | 12 |
| 3. LAMB(AE,0-1) | 3 | 11 |
| 4. HM(C) | 4 | 2 |
| 5. HM(D) | 5 | 4 |
| 6. R | 6 | 3 |
| 7. HM(F) | 7 | 1 |
| 8. VD(AER) VD(IOD) | 1 2 | 76 |
| 9. HM(A - F) | 21 15 4 | |
| | 5 24 7 | 7 |
| 10. LAMB(AE,0-1) LAMB(AE,1-3) | 3 29 | |
| LAMB(AE,>3) | 10 | 11 |
| 11. LAMB(IO,0-1) LAMB(IO,1-3) | 12 28 | |
| LAMB(IO,>3) | 19 | 1 |
| 12. Indep. var. | | |
| with ranks <8 | 1 - 7 | 95 |
| 13. Indep. var. | | |
| with ranks >7 | 8 - 39 | 11 |

Figure 21. $R^2$ - values for the consequence variable BMDOSE4 (n=59 runs): There are *no* correlations between the model parameters.
R-sq.(%)=$Rs^2/Rt^2*100$. $Rt^2$ is the $R^2$ - value when all model parameters are included. For this case $Rt^2$=0.95.

| INDEPENDENT VARIABLE | RANK | R-sq.(%) |
|---|---|---|
| 1. VD(AER) | 1 | 70 |
| 2. VD(IOD) | 2 | 11 |
| 3. R | 3 | 3 |
| 4. LAMB(AE,0-1) | 4 | 32 |
| 5. HM(C) | 5 | 7 |
| 6. HM(D) | 6 | 9 |
| 7. HM(B) | 7 | 9 |
| 8. VD(AER) VD(IOD) | 1 2 | 81 |
| 9. HM(A - F) | 32 7 5<br>6 30 20 | 12 |
| 10. VD(AER) VD(IOD)<br>R | 1 2<br>3 | 84 |
| 11. LAMB(AE,0-1) LAMB(AE,1-3)<br>LAMB(AE,>3) | 4 10<br>19 | 44 |
| 12. VD(AER) VD(IOD)<br>R LAMB(AE,0-1)<br>LAMB(AE,1-3) LAMB(AE,>3) | 1 2<br>3 4<br>10 19 | 87 |
| 13. Indep. var.<br>with ranks <8 | 1 - 7 | 99 |
| 14. Indep. var.<br>with ranks >7 | 8 - 39 | 50 |

Figure 22. $R^2$ - values for the consequence variable BMDOSE4 (n=200 runs): There *are* correlations between the model parameters.
R-sq.(%)=$Rs^2/Rt^2 * 100$. $Rt^2$ is the $R^2$ - value when all model parameters are included. For this case $Rt^2$=0.94.

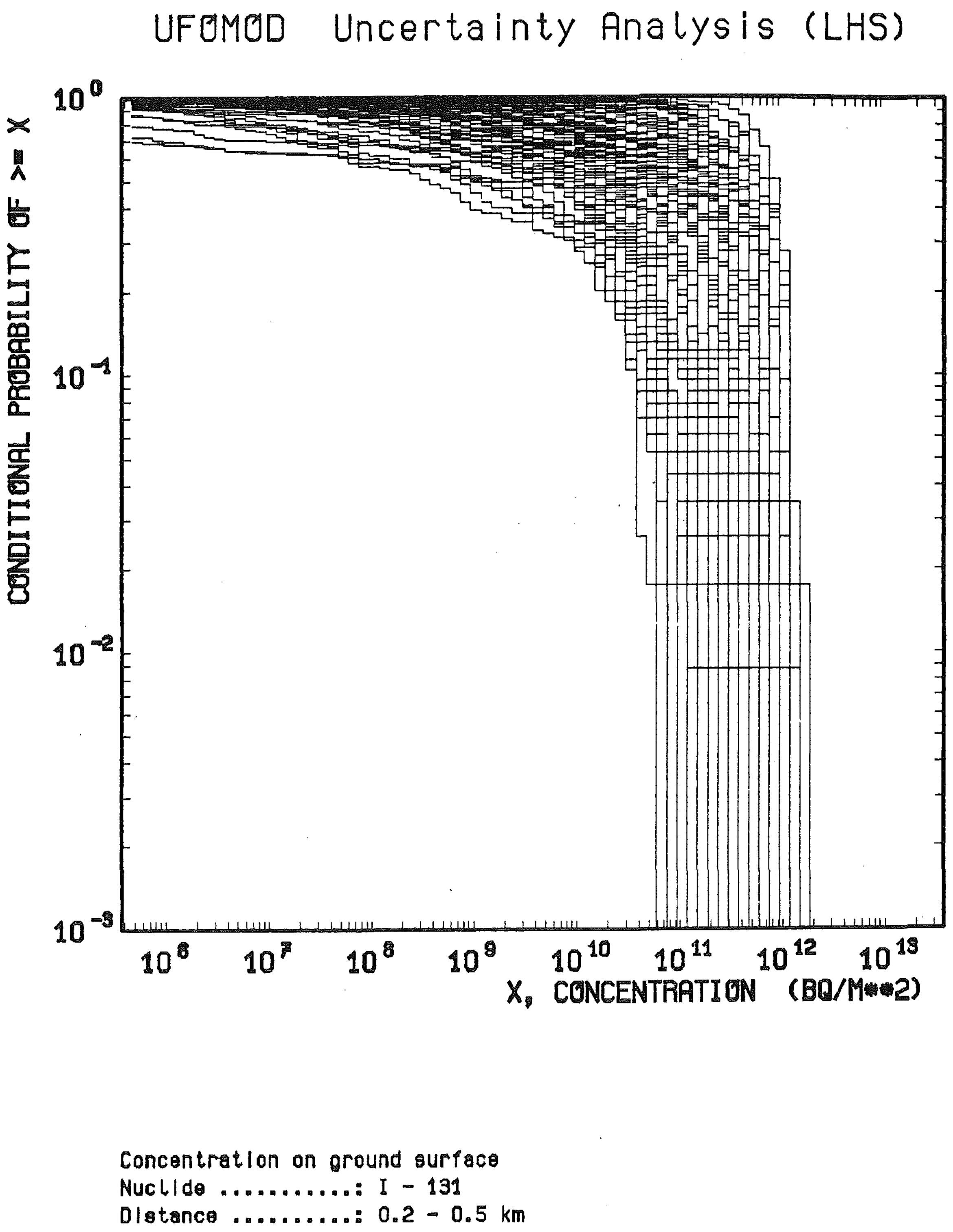
# APPENDIX B. UNCERTAINTY ANALYSES (FIGURES)

## B.1 ACTIVITY CONCENTRATIONS (LHS AT KFK, N=100 RUNS)

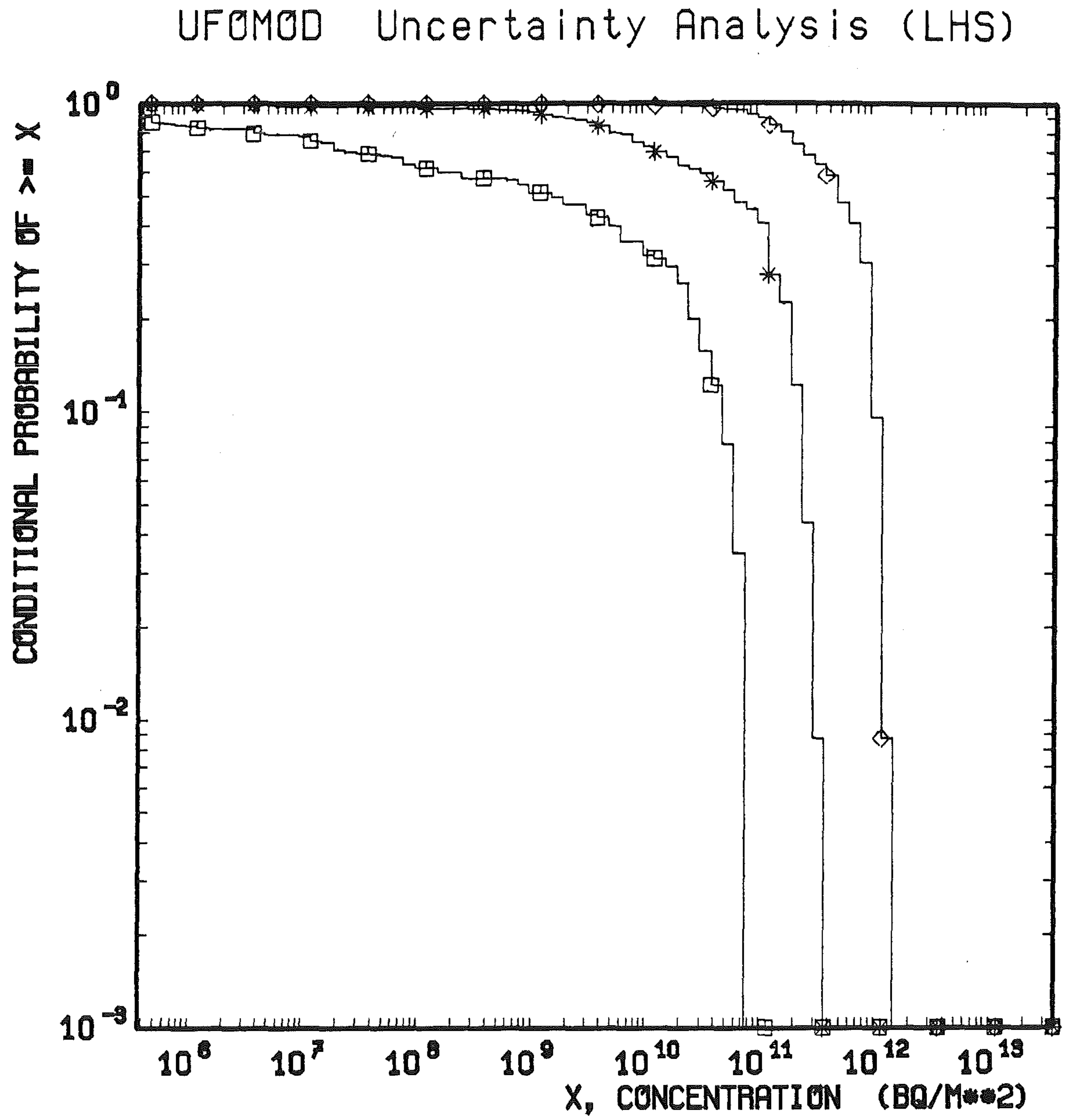
In this section CCFDs and the corresponding confidence curves are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface, in the air near ground and in the plume.

**Sequence of figures:**

- Iodine
  - on ground surface
  - in the air near ground
  - in the plume
- Aerosols
  - on ground surface
  - in the air near ground
  - in the plume




COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

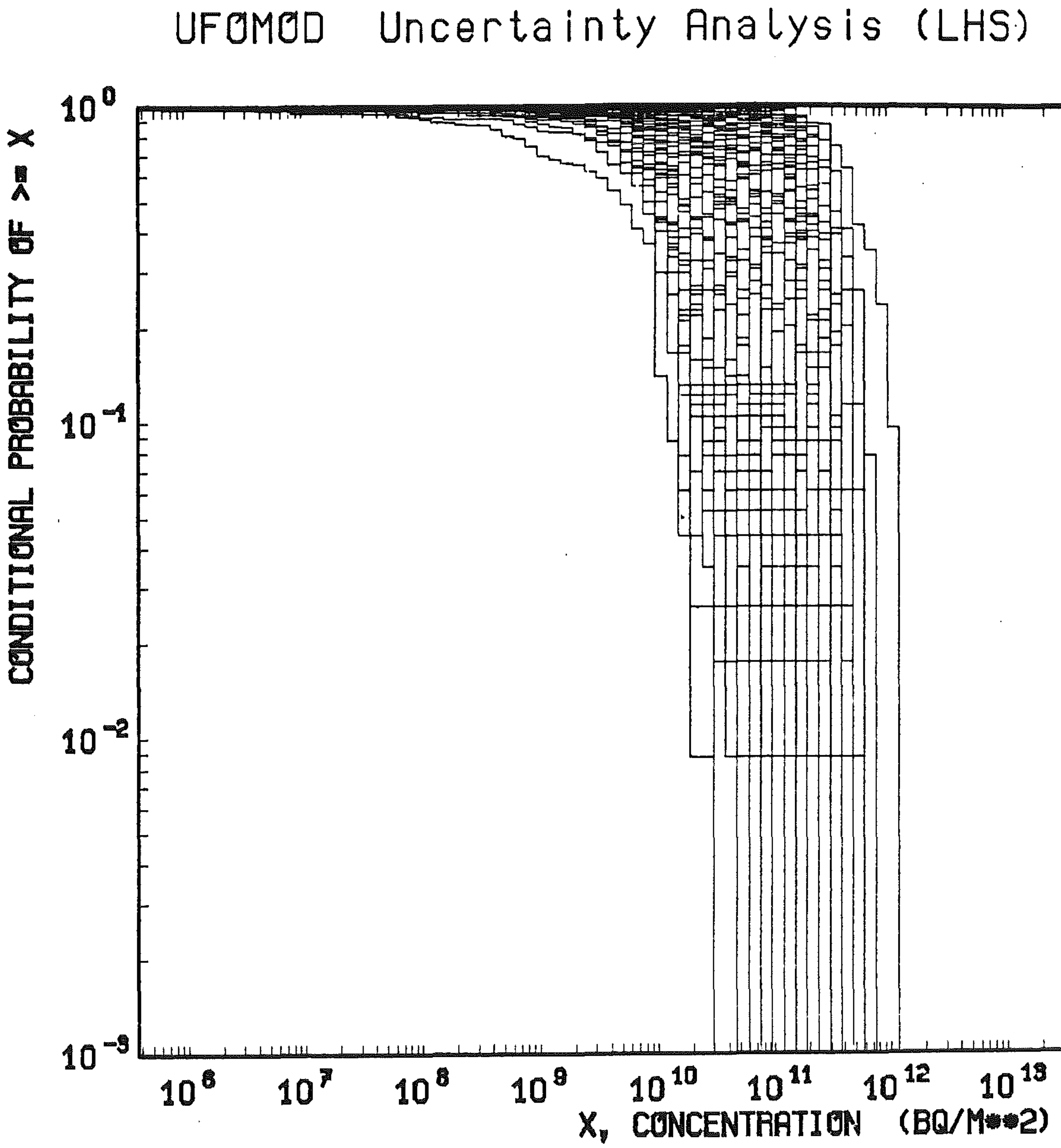



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

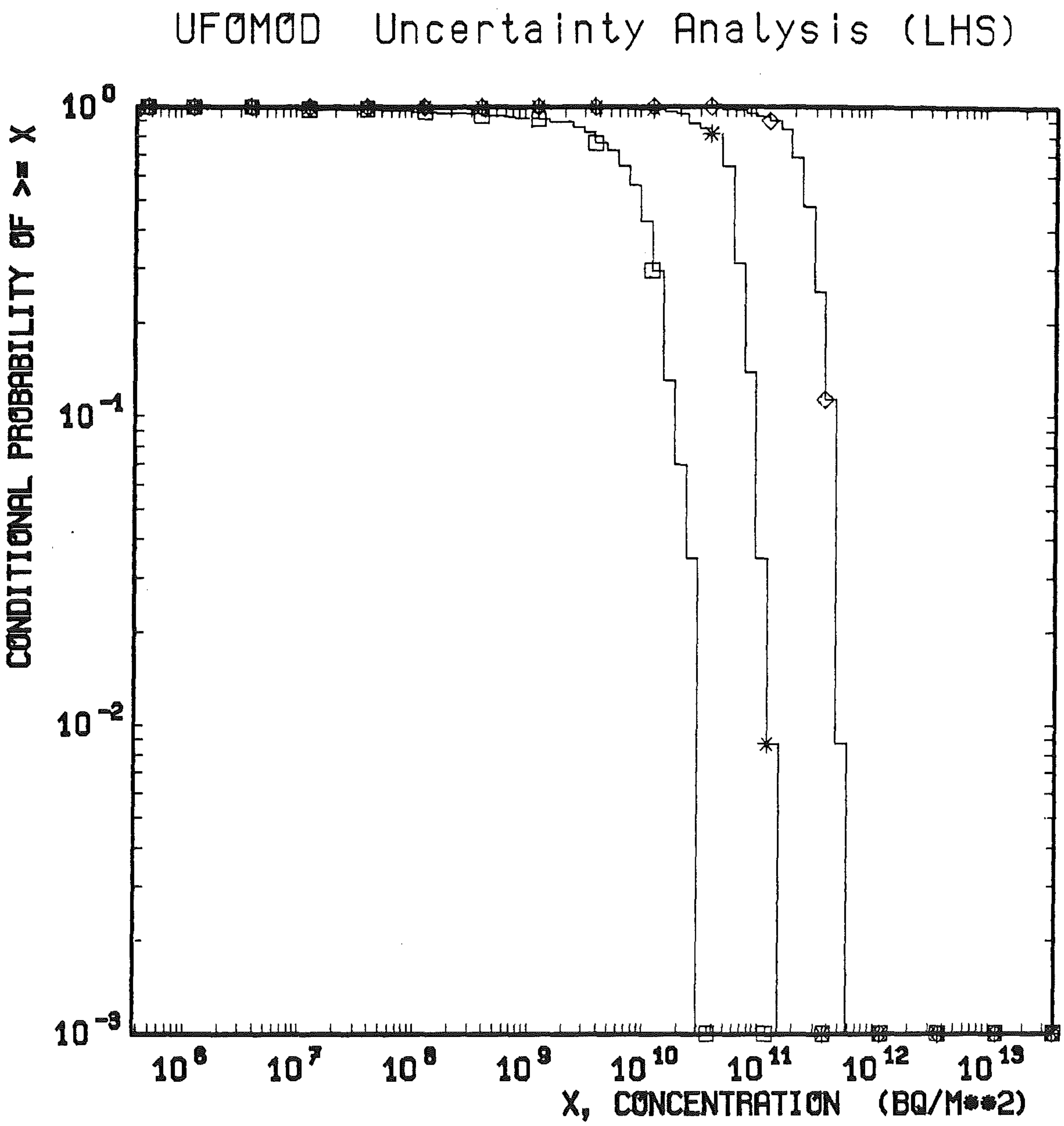
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

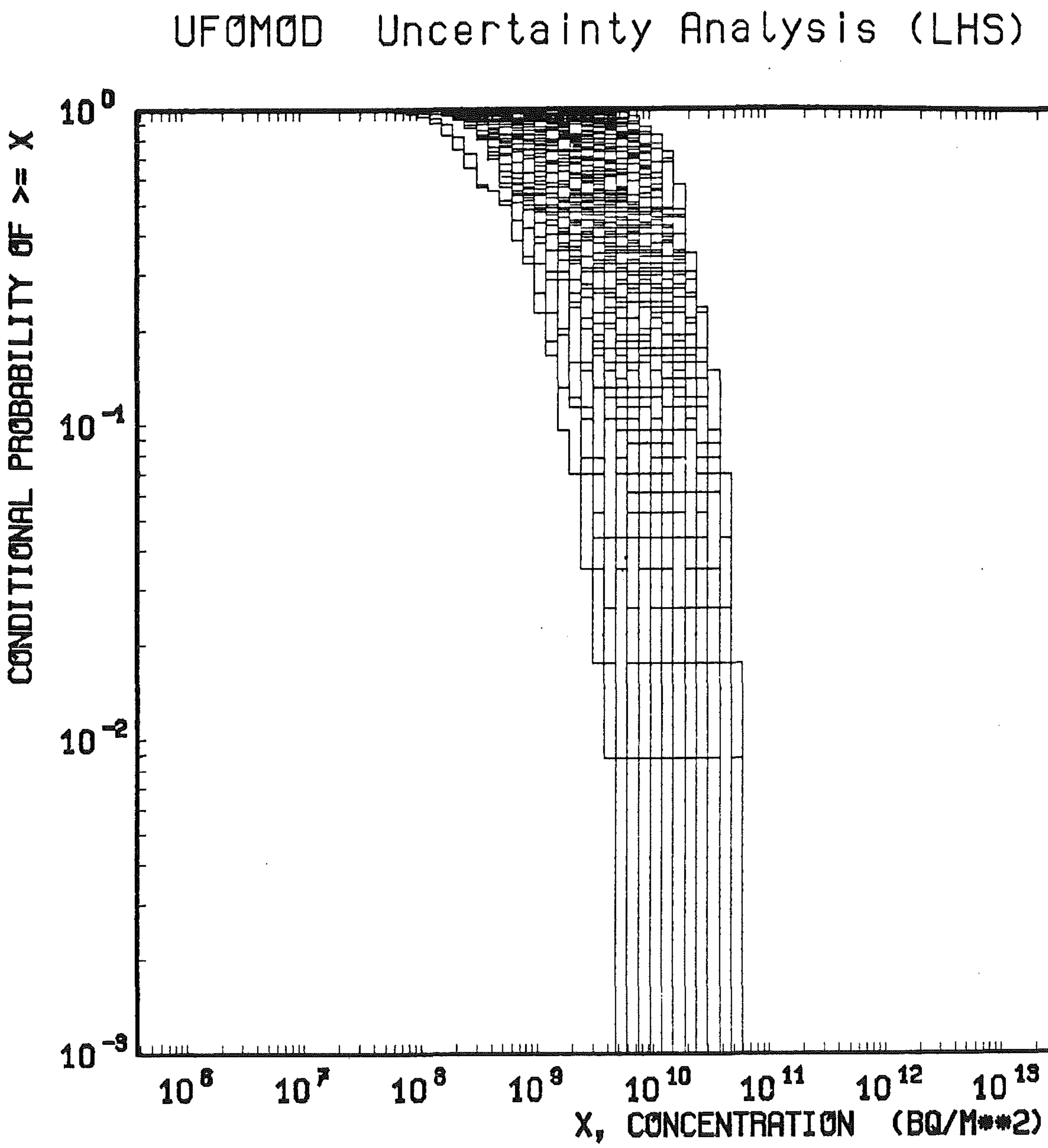



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

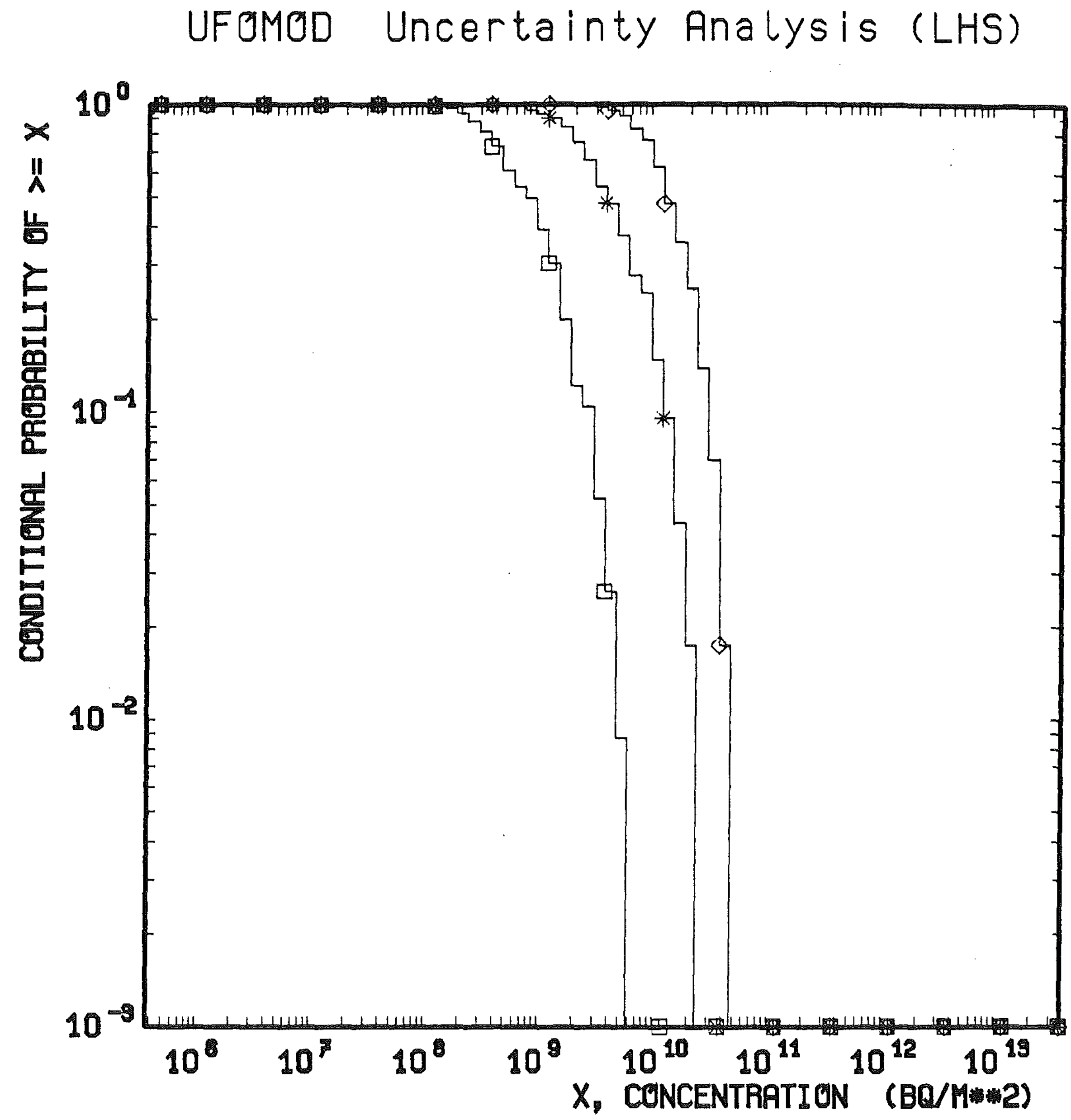
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

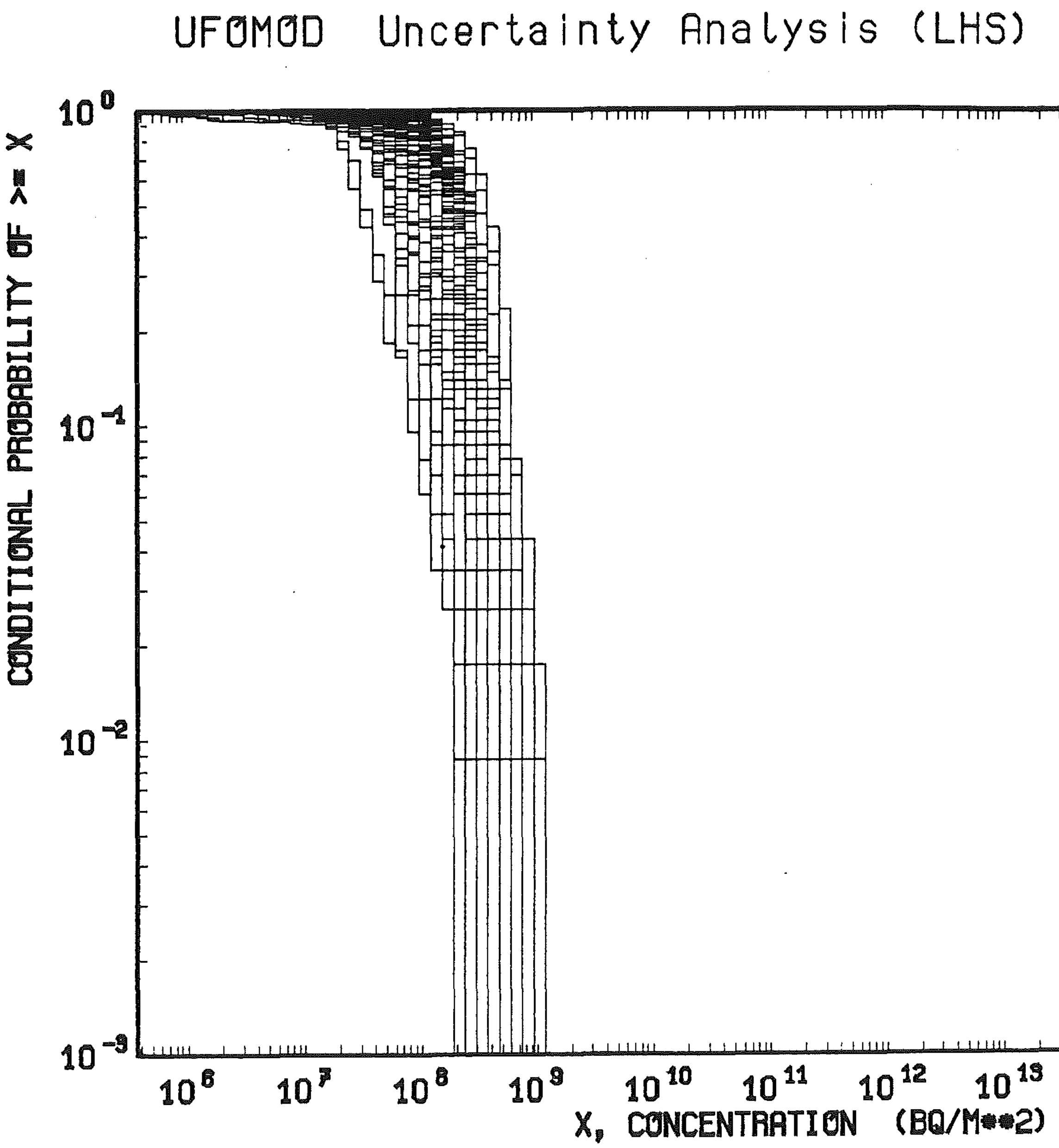



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

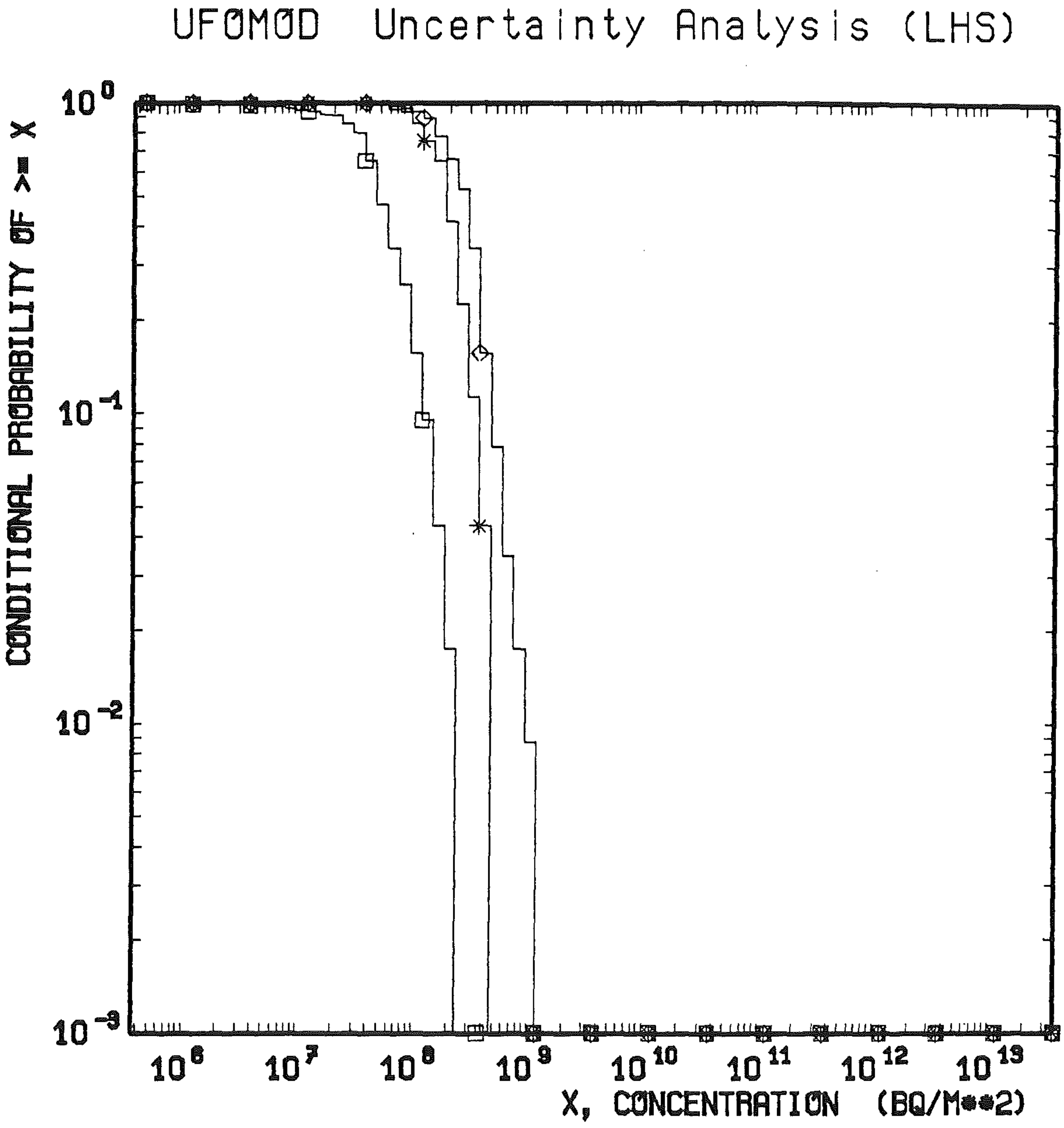
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

KfK INR

CØMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE ØF SIZE 100.

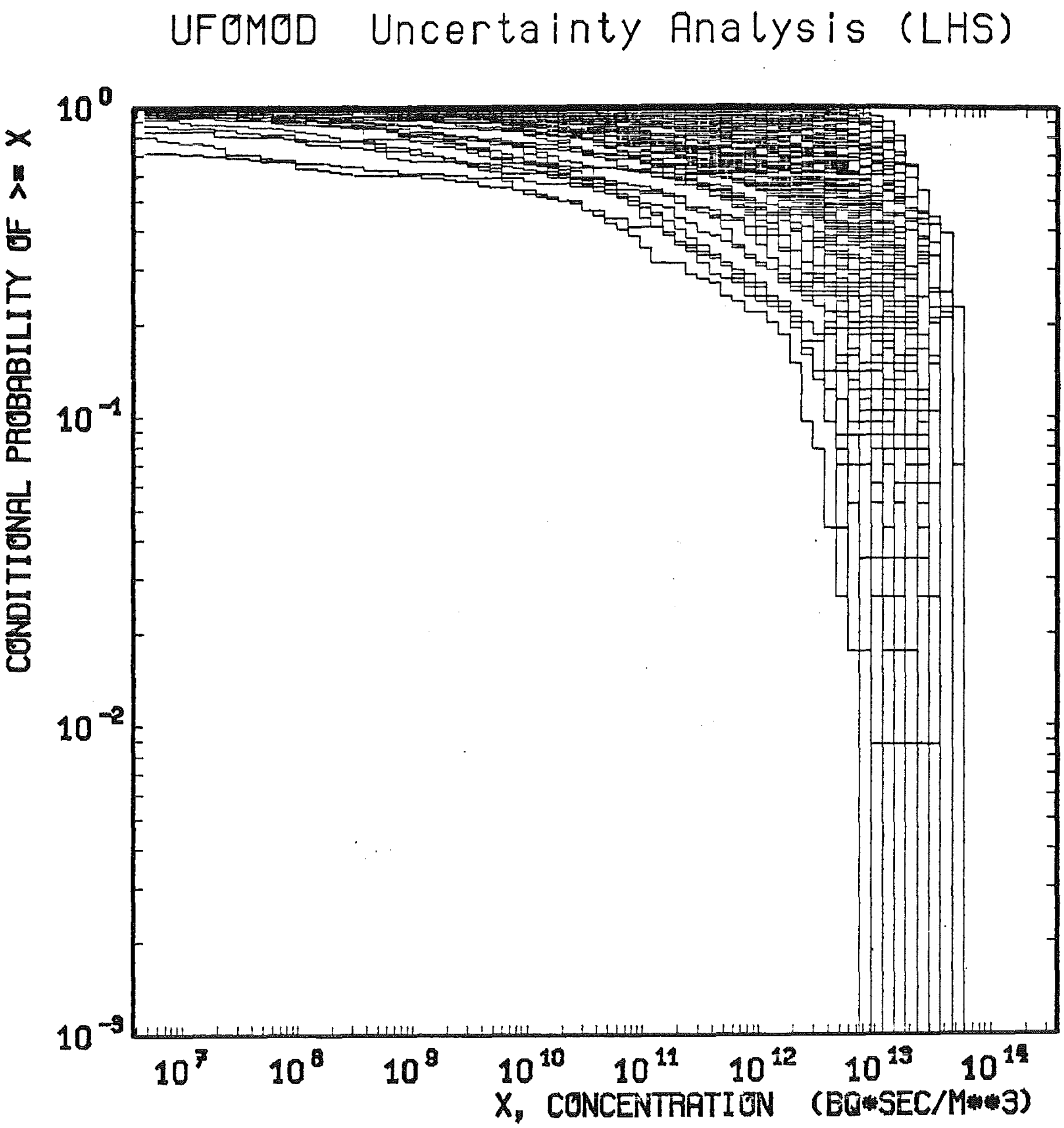



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

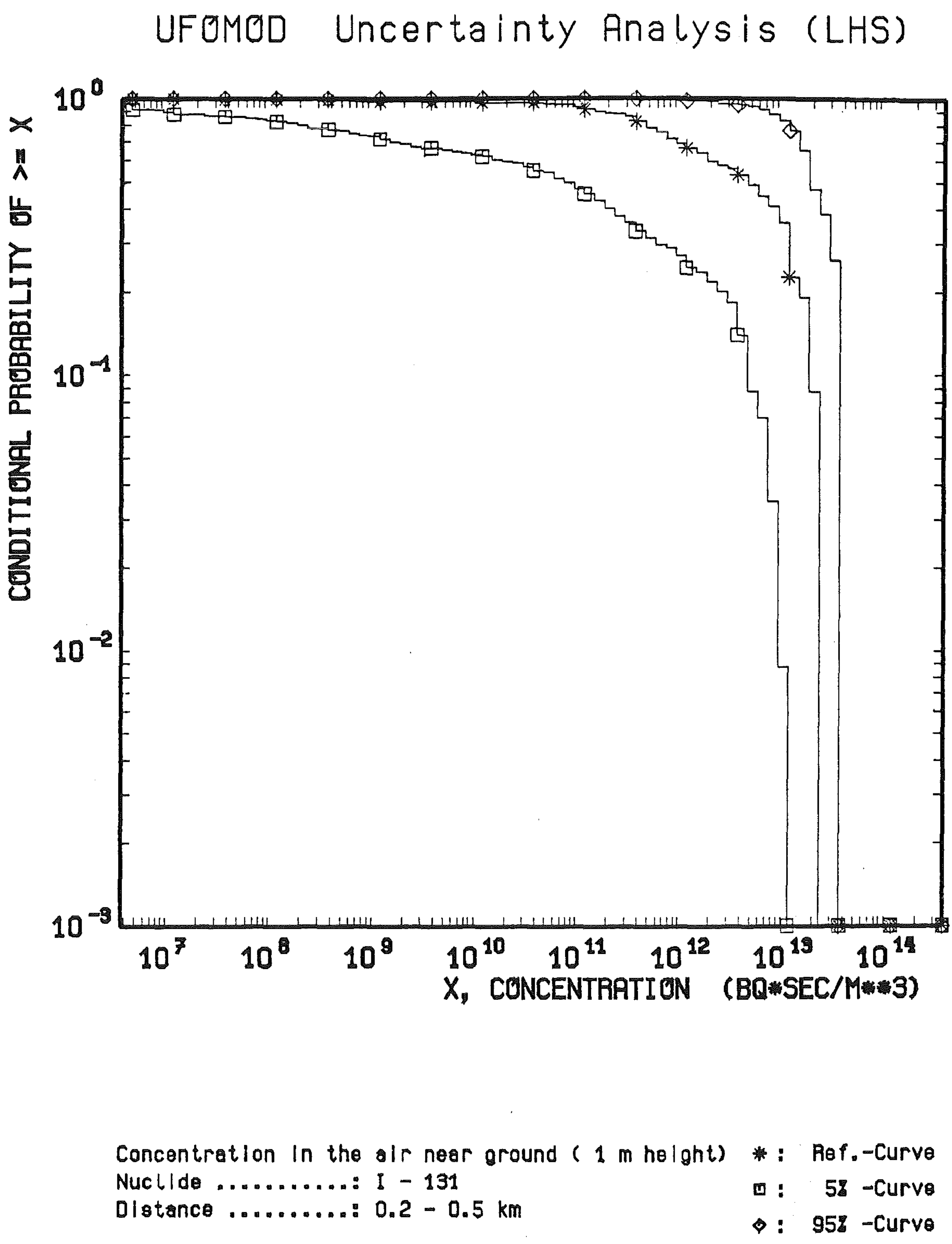
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.



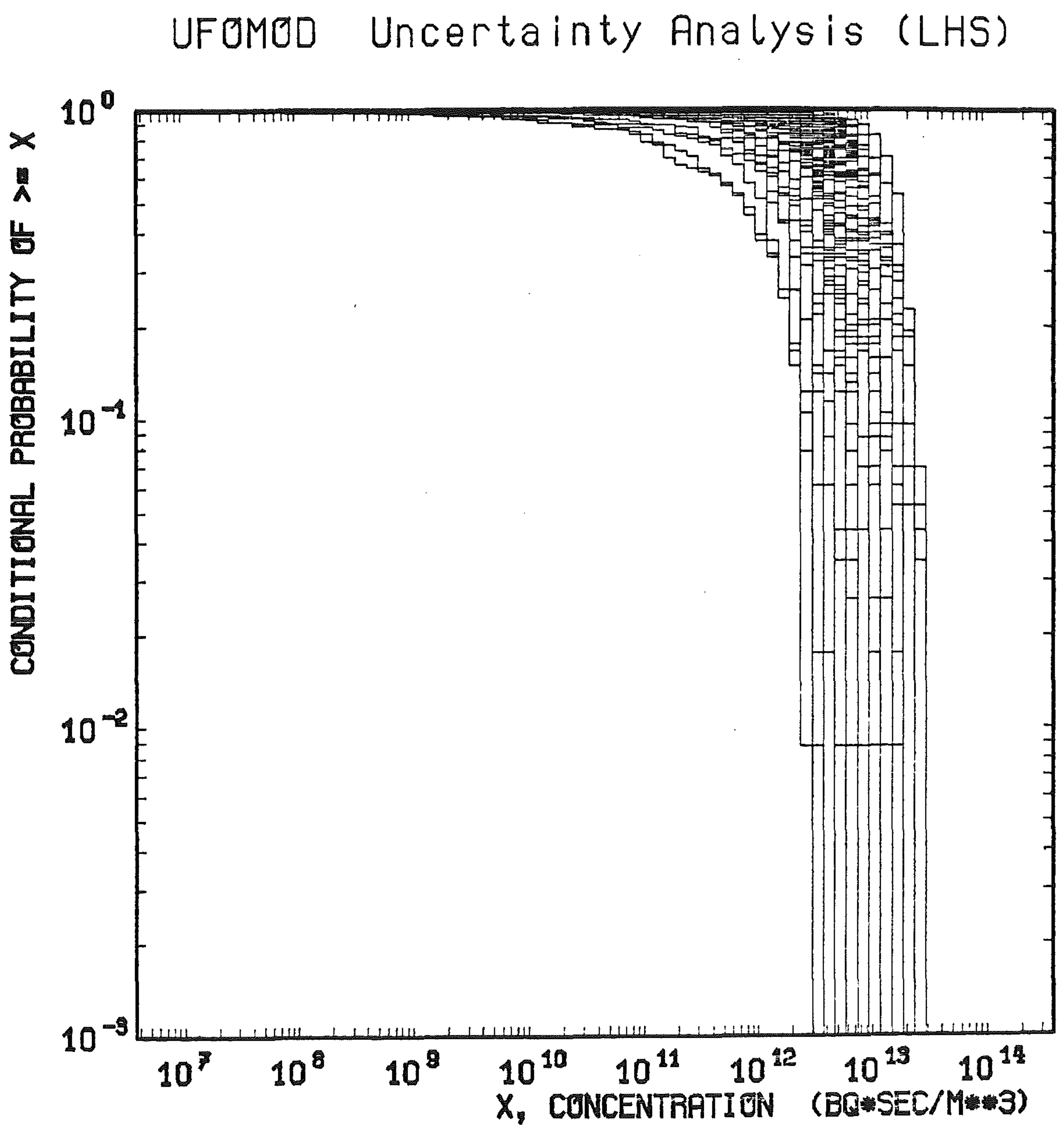

Concentration in the air near ground ( 1 m height)
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.



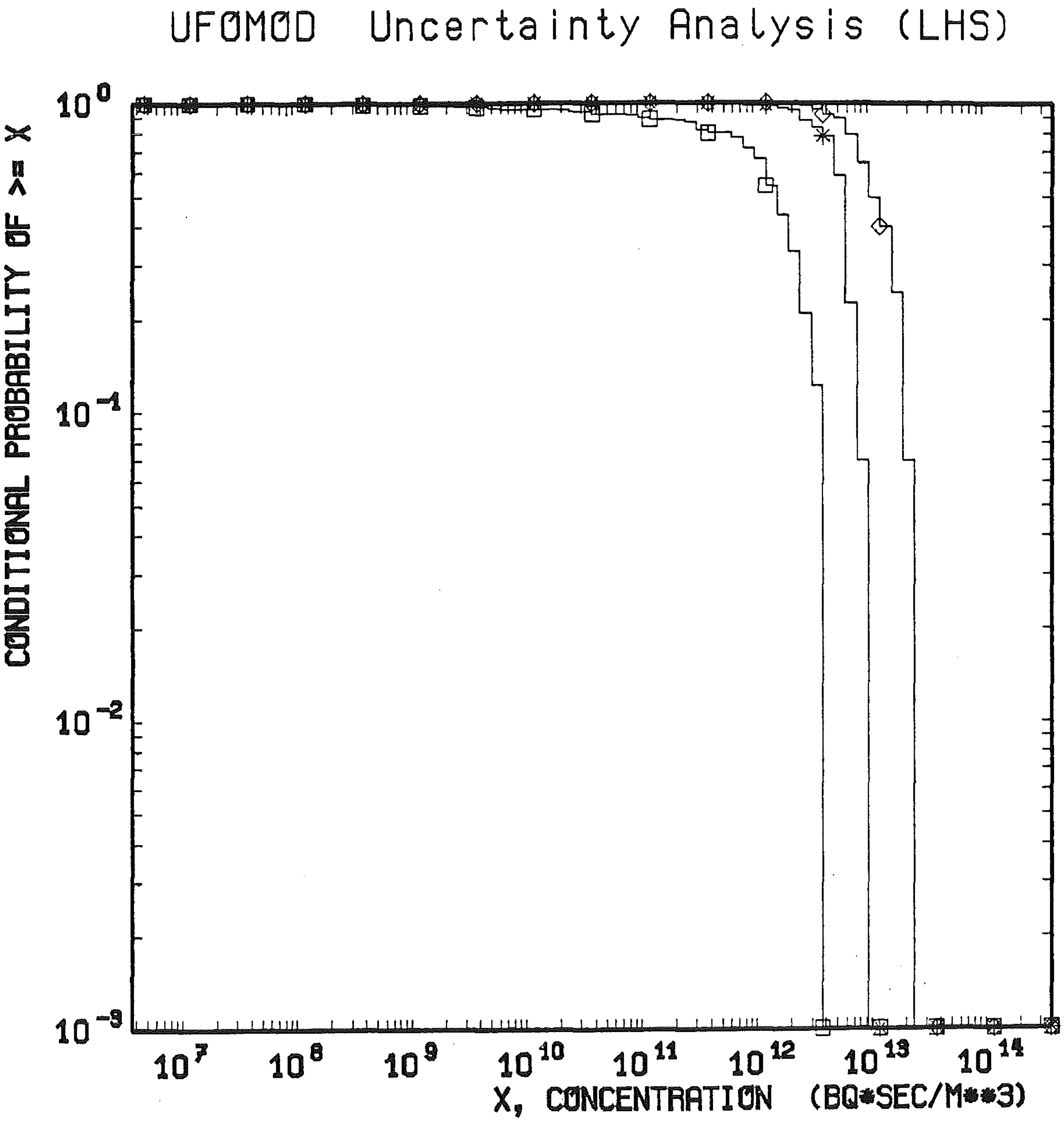

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration in the air near ground ( 1 m height)
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

KfK INR

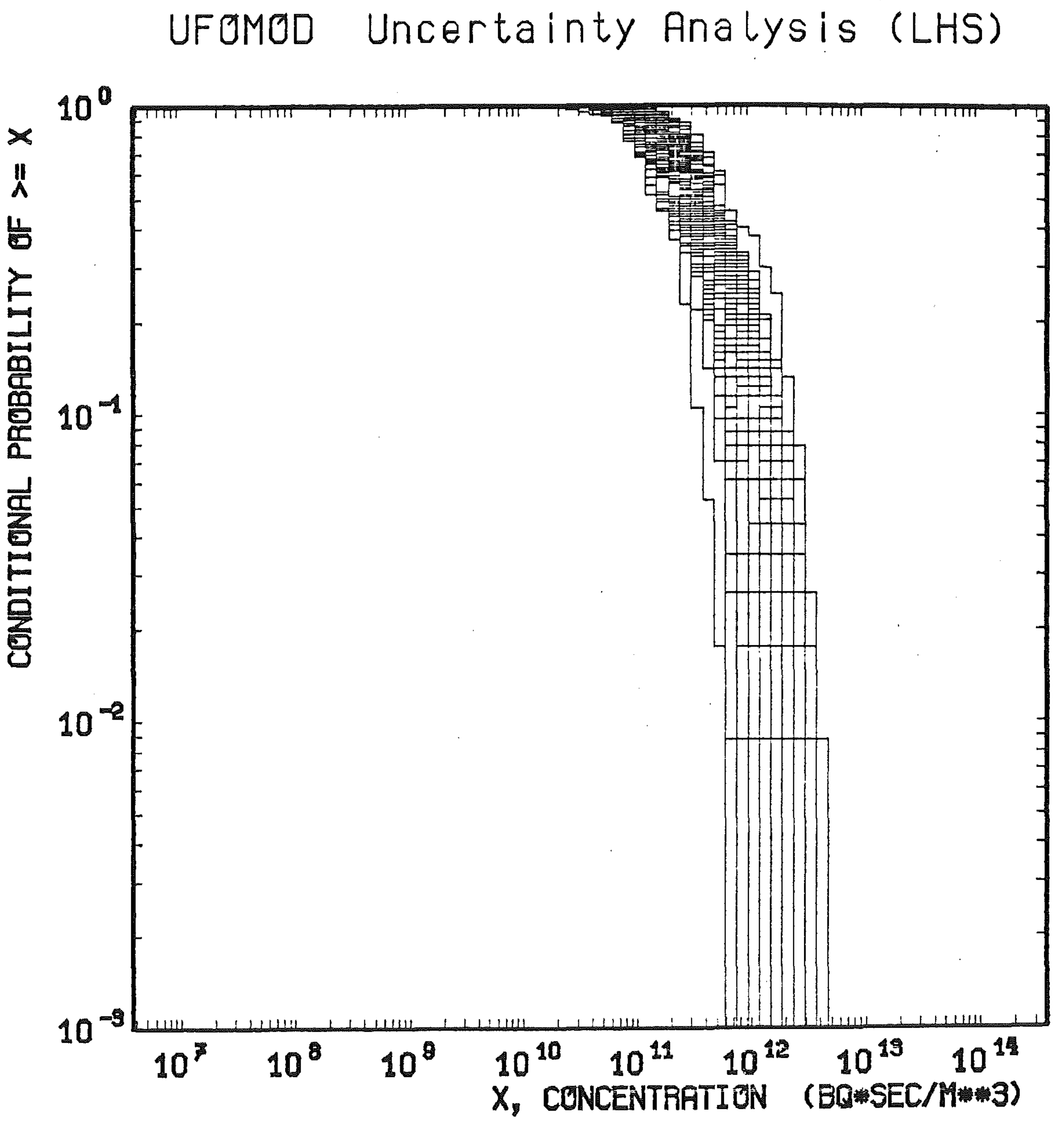
COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.




Concentration in the air near ground ( 1 m height)
Nuclide ............: I - 131
Distance ...........: 0.8 - 1.2 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

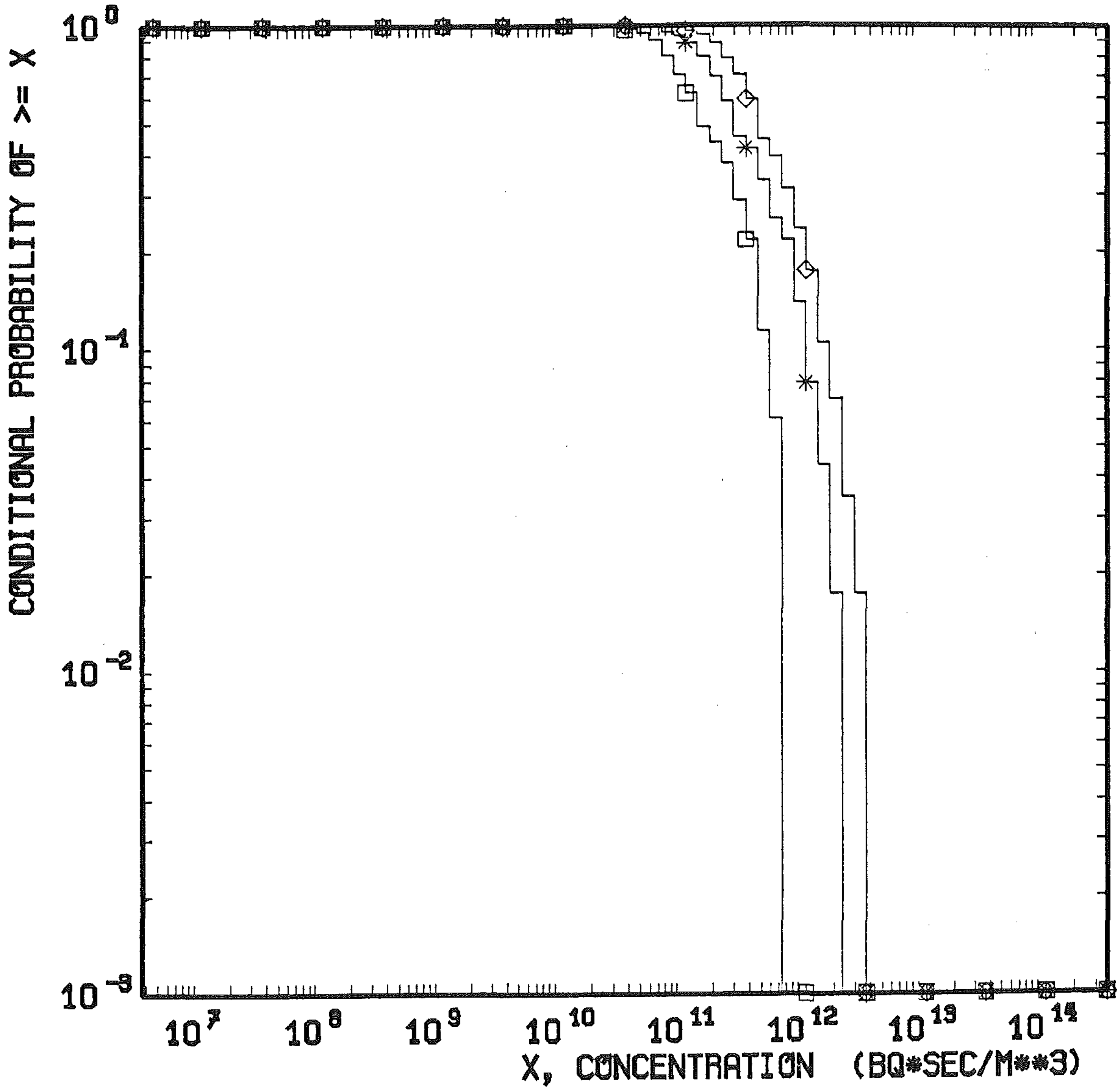



Concentration in the air near ground ( 1 m height)
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

CØMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØN-CENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCUR-RED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 100 RUNS IN LATIN HYPERCU-BE SAMPLE ØF SIZE 100.

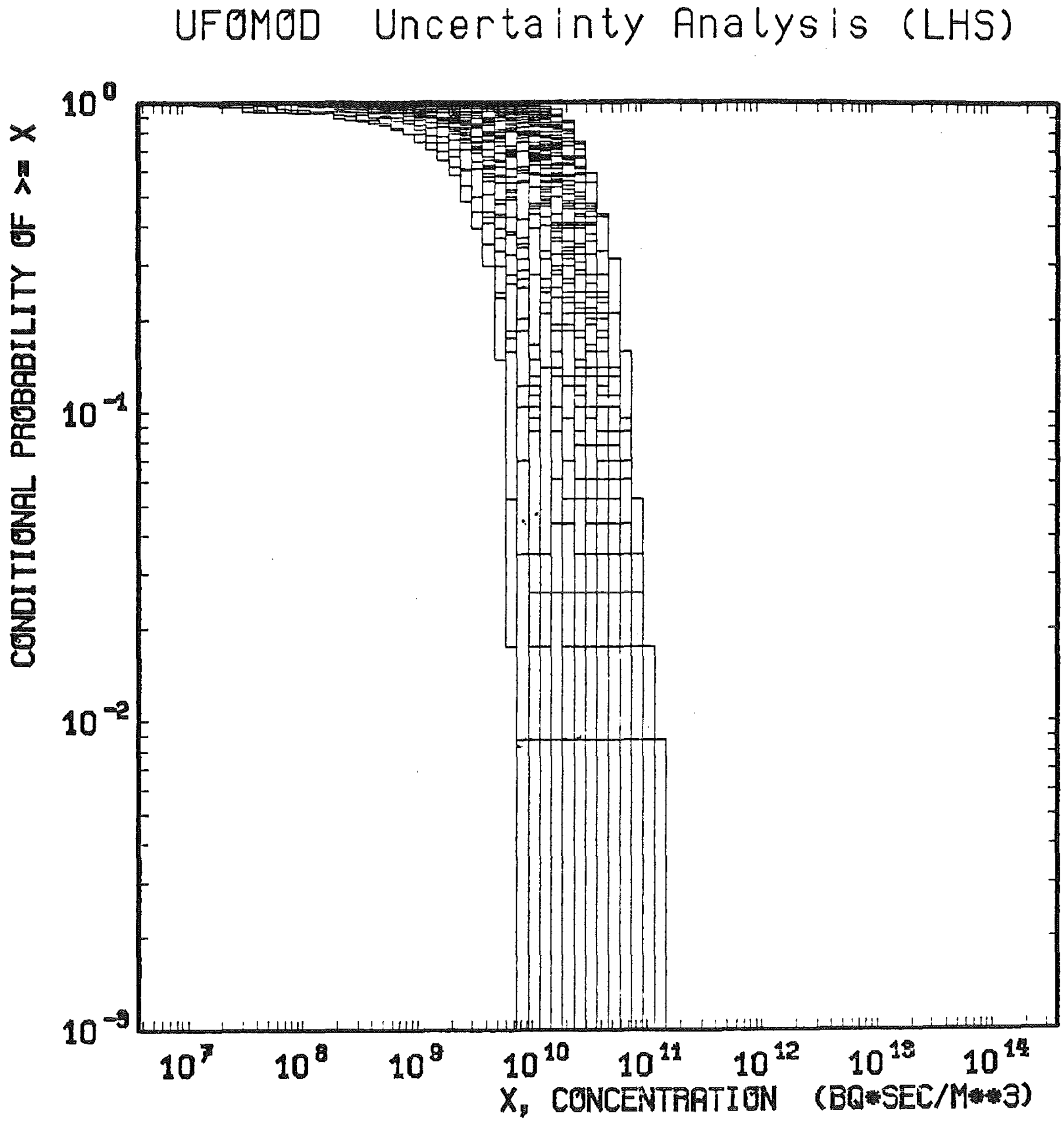
UFOMOD Uncertainty Analysis (LHS)




Concentration in the air near ground ( 1 m height)
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

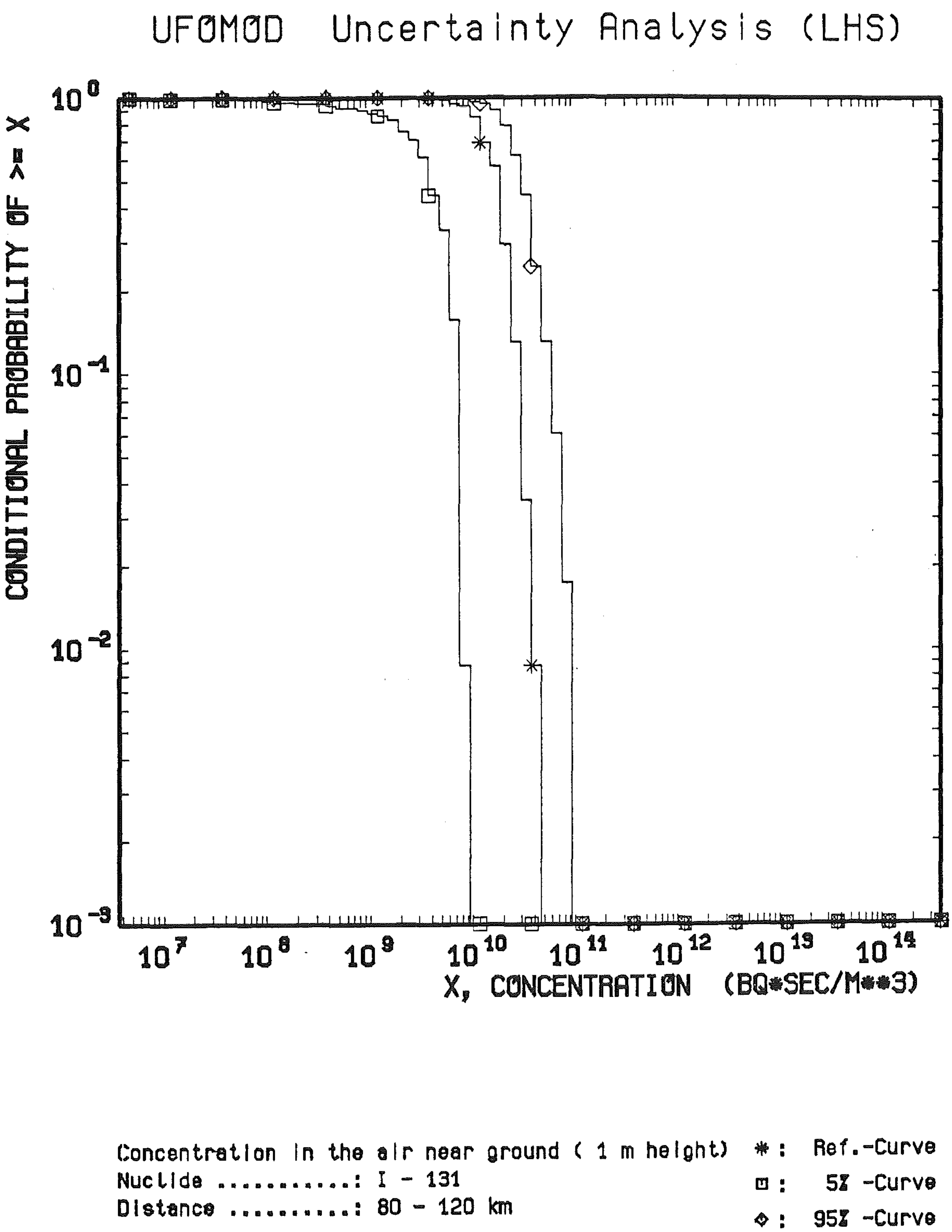
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.



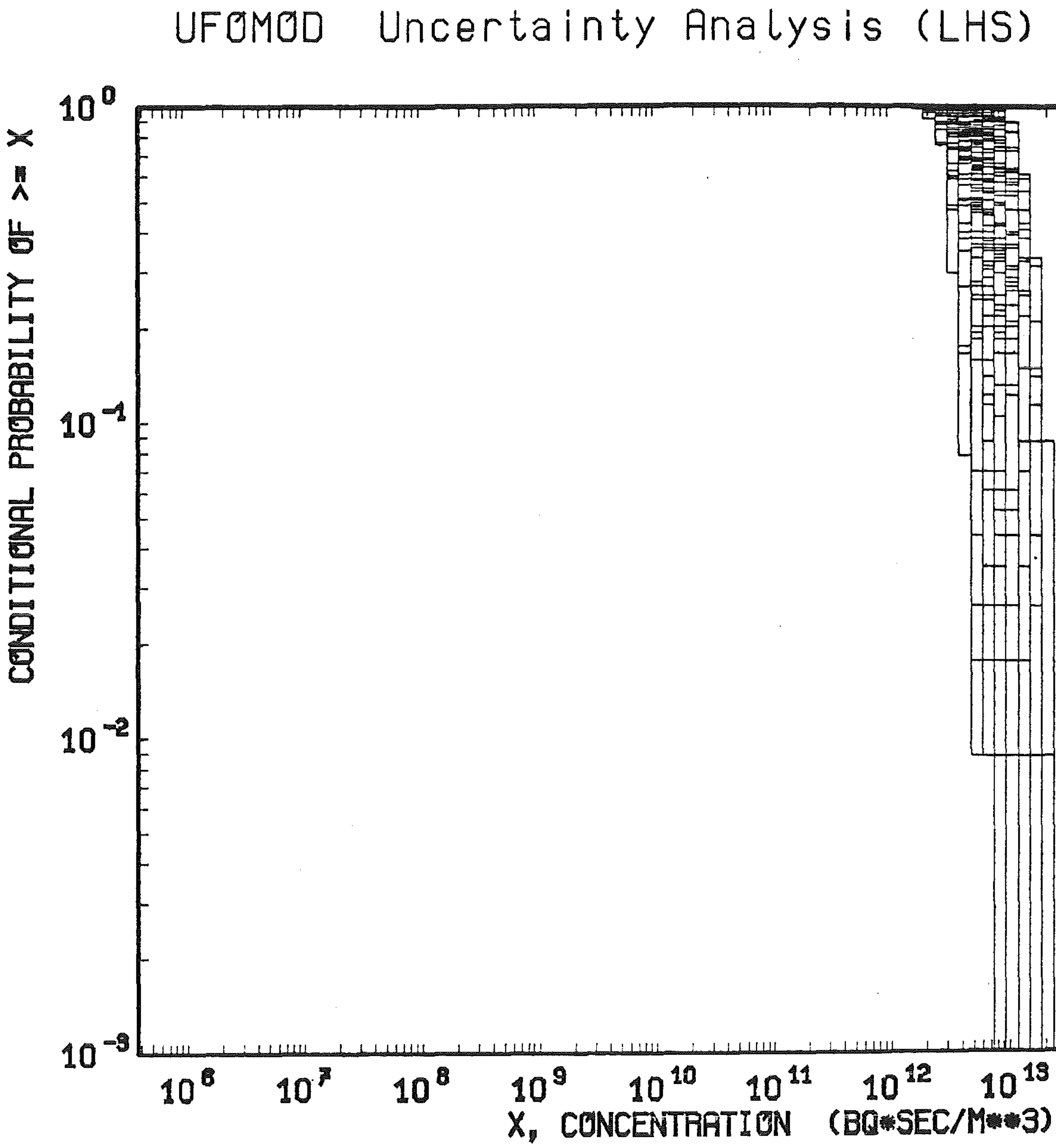

Concentration in the air near ground ( 1 m height)
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.




REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

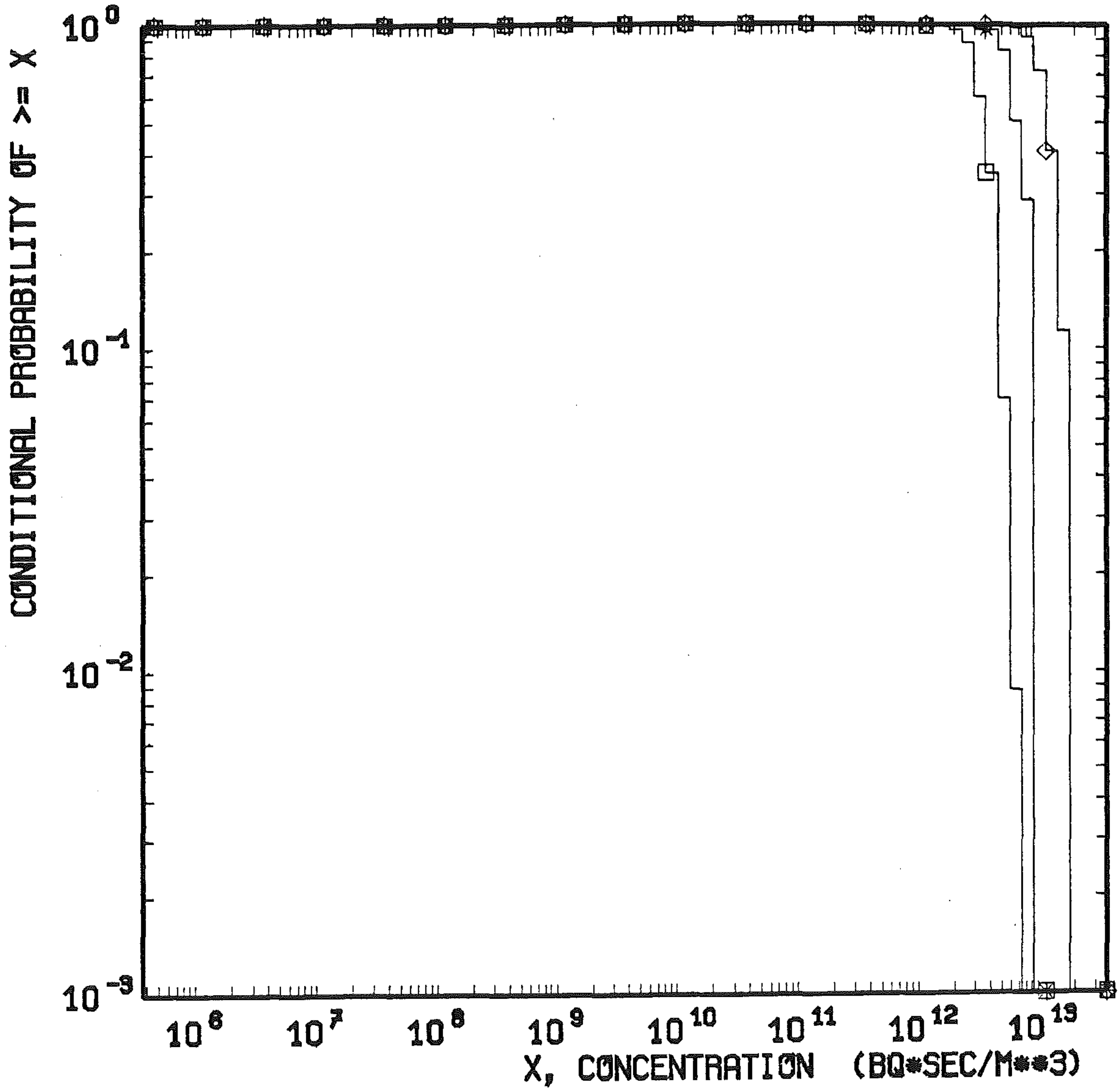



Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

UFØMØD Uncertainty Analysis (LHS)

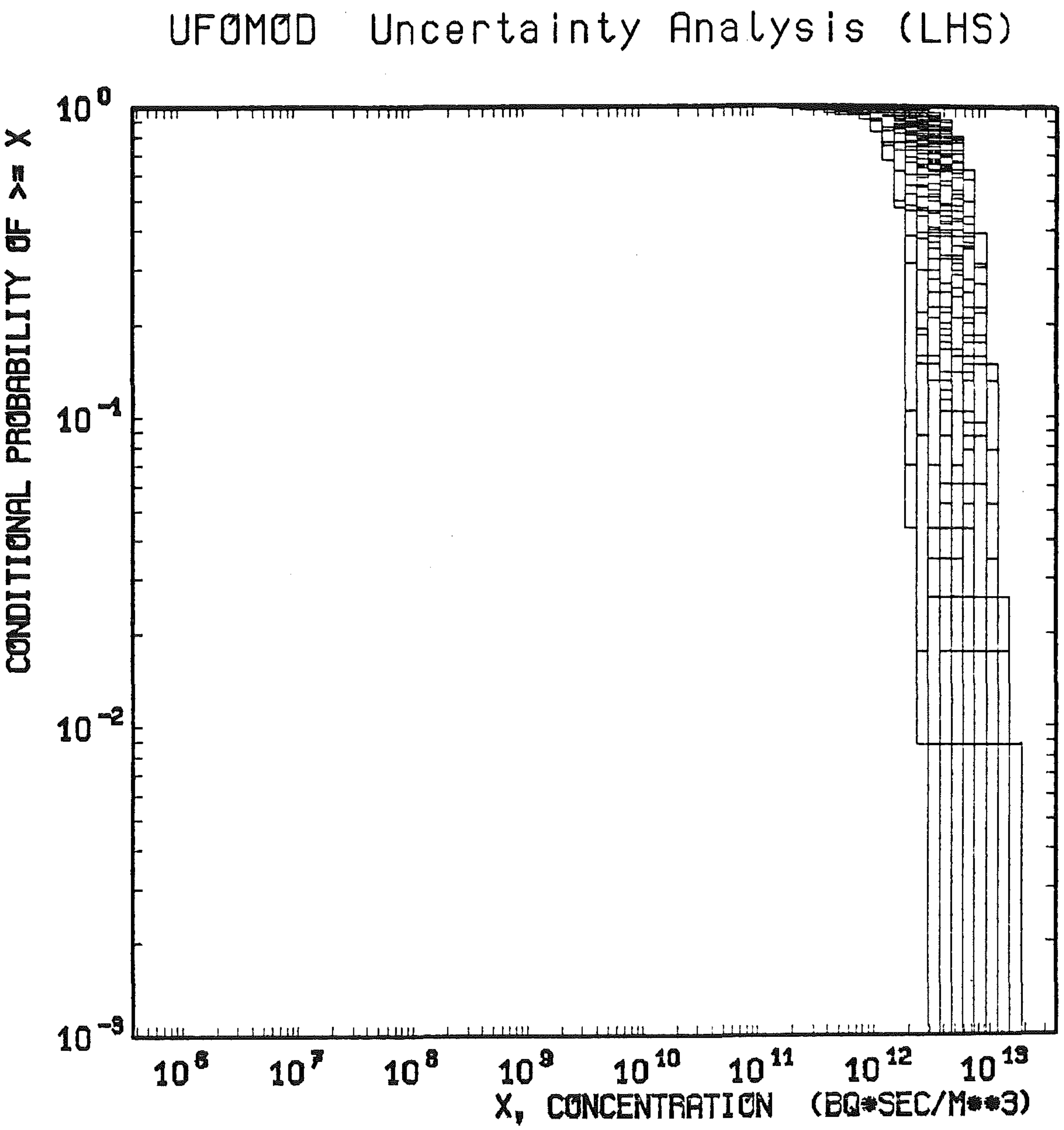



Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

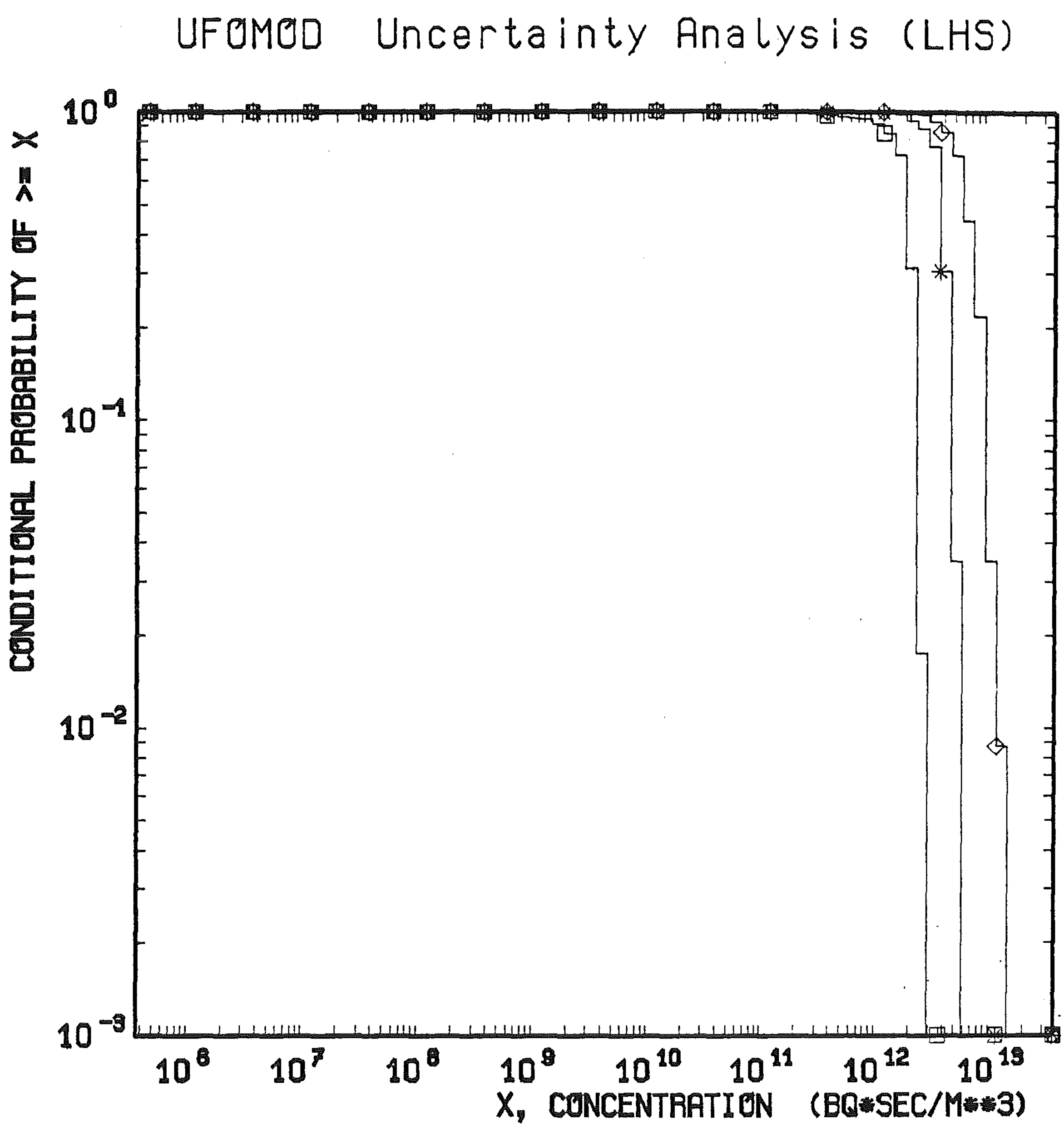
KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.




Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

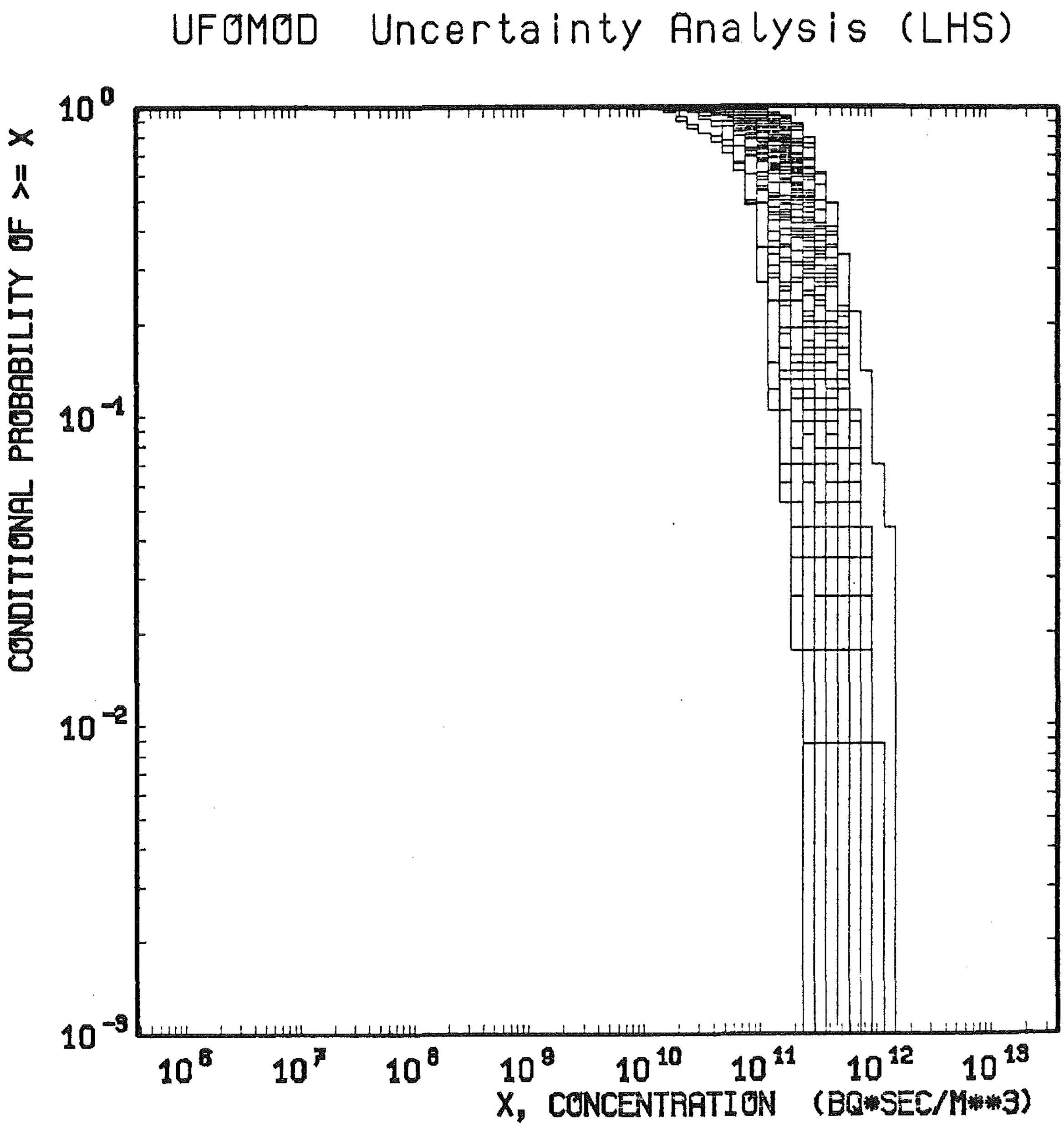
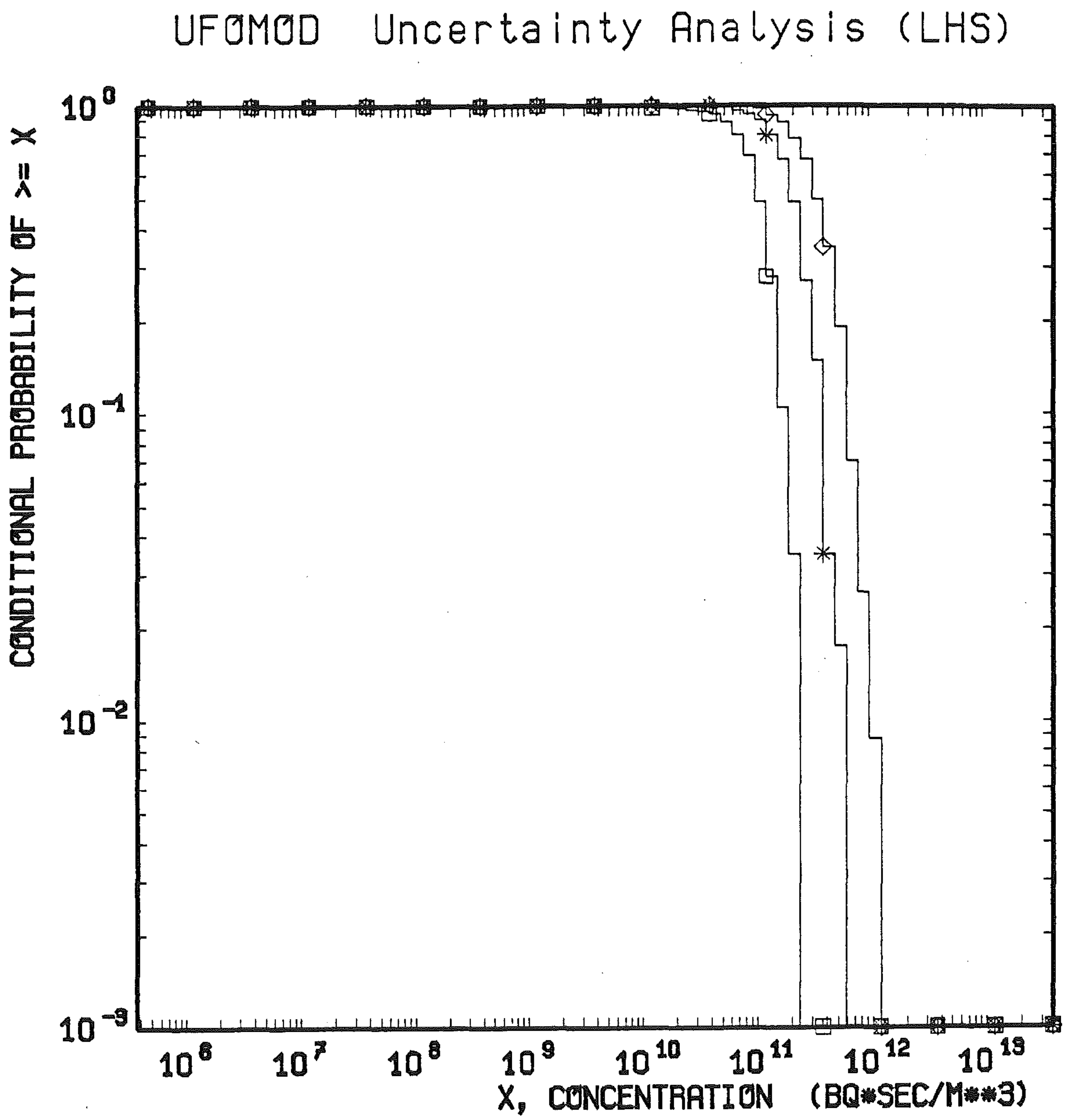



FIG.

Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

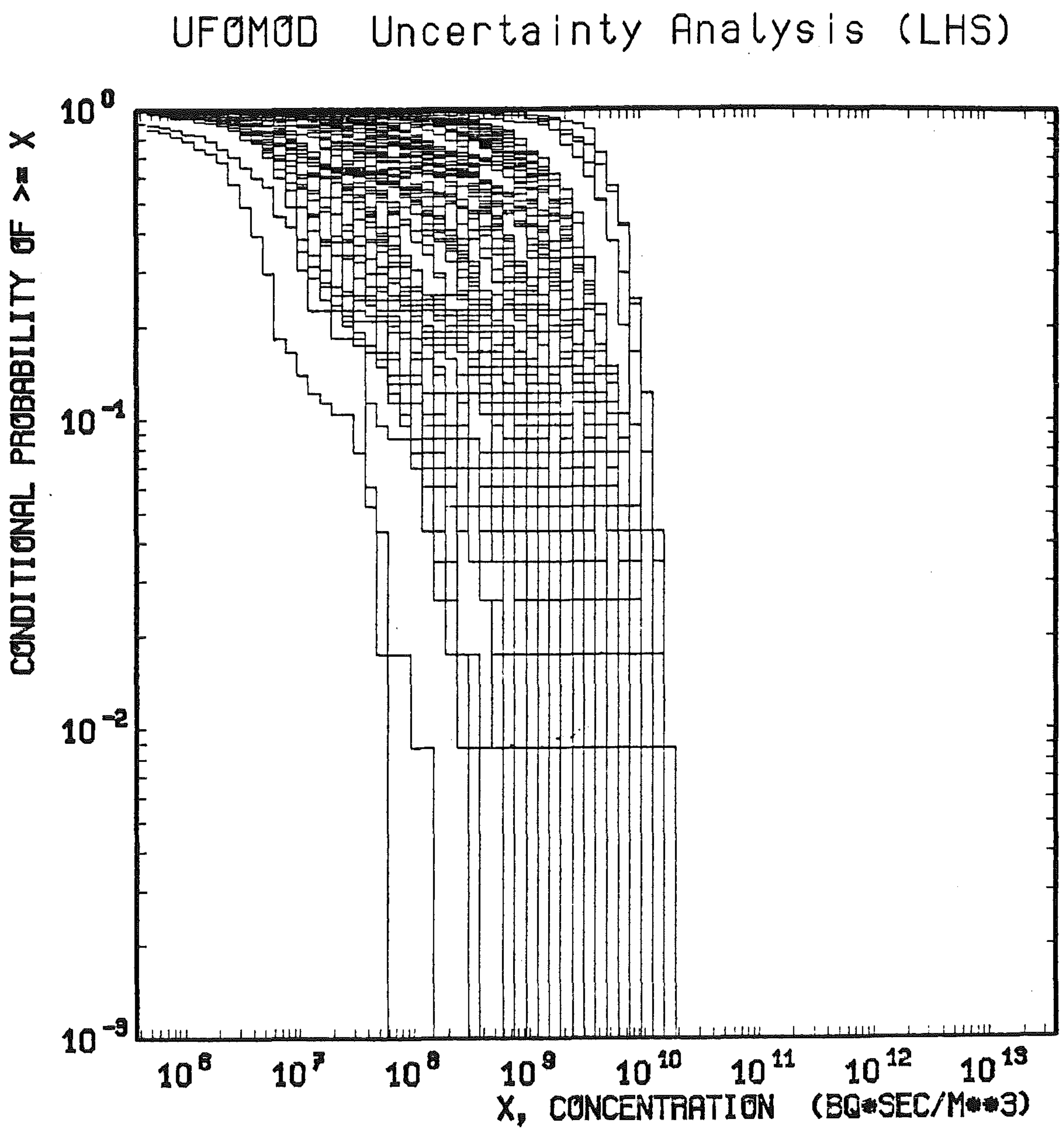
COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.




Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

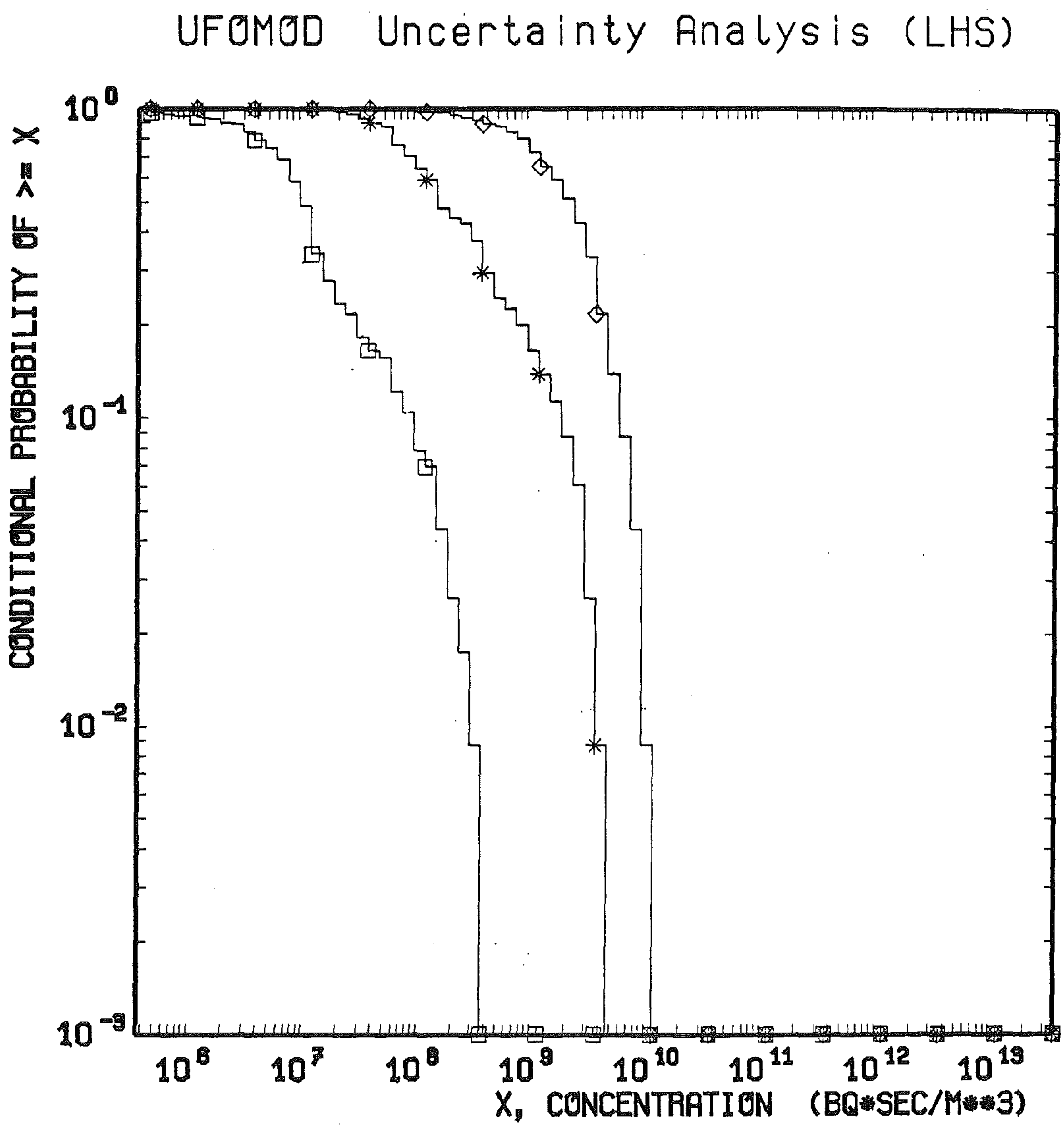
*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

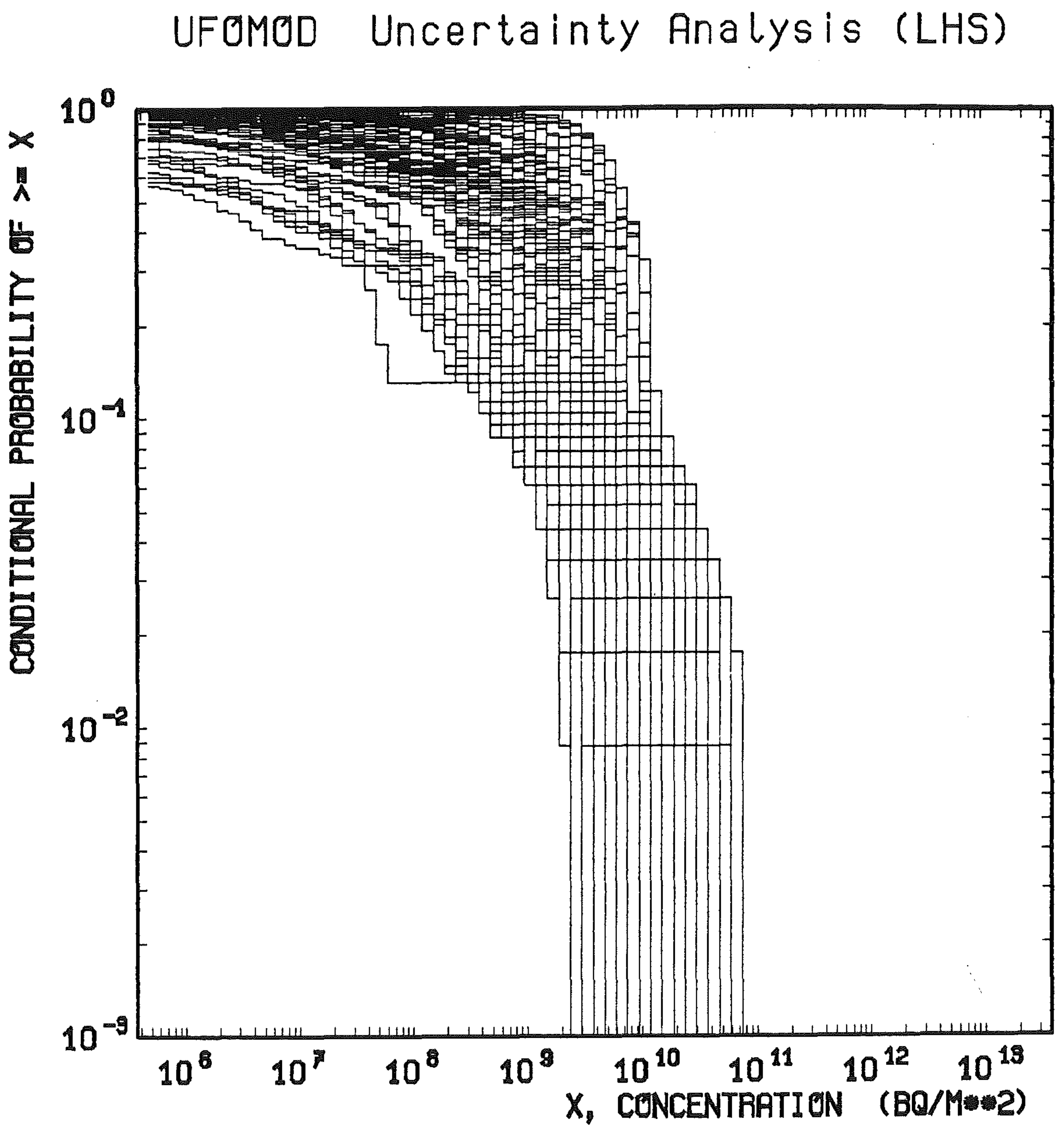



Concentration in the plume
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

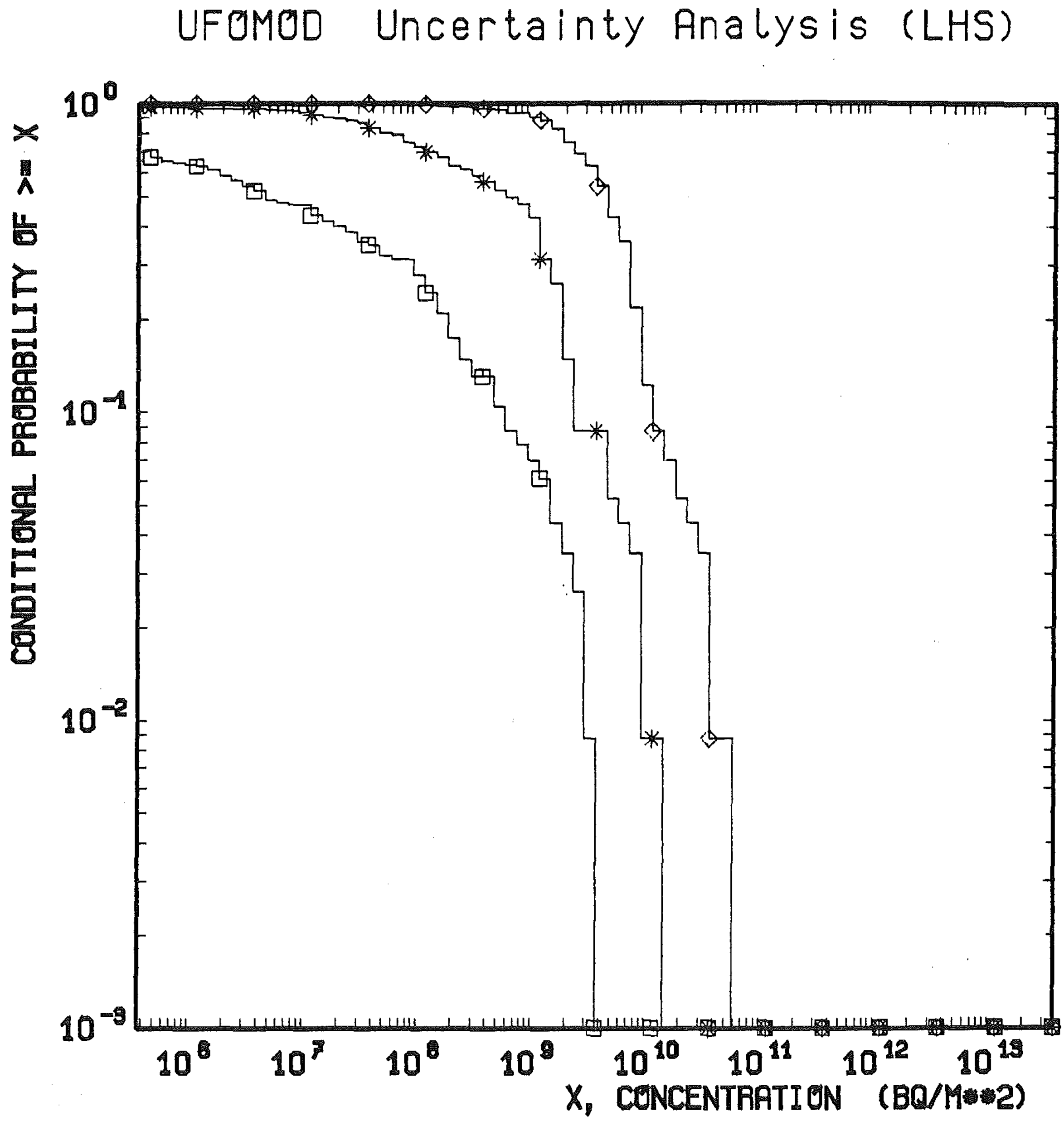
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

KfK INR

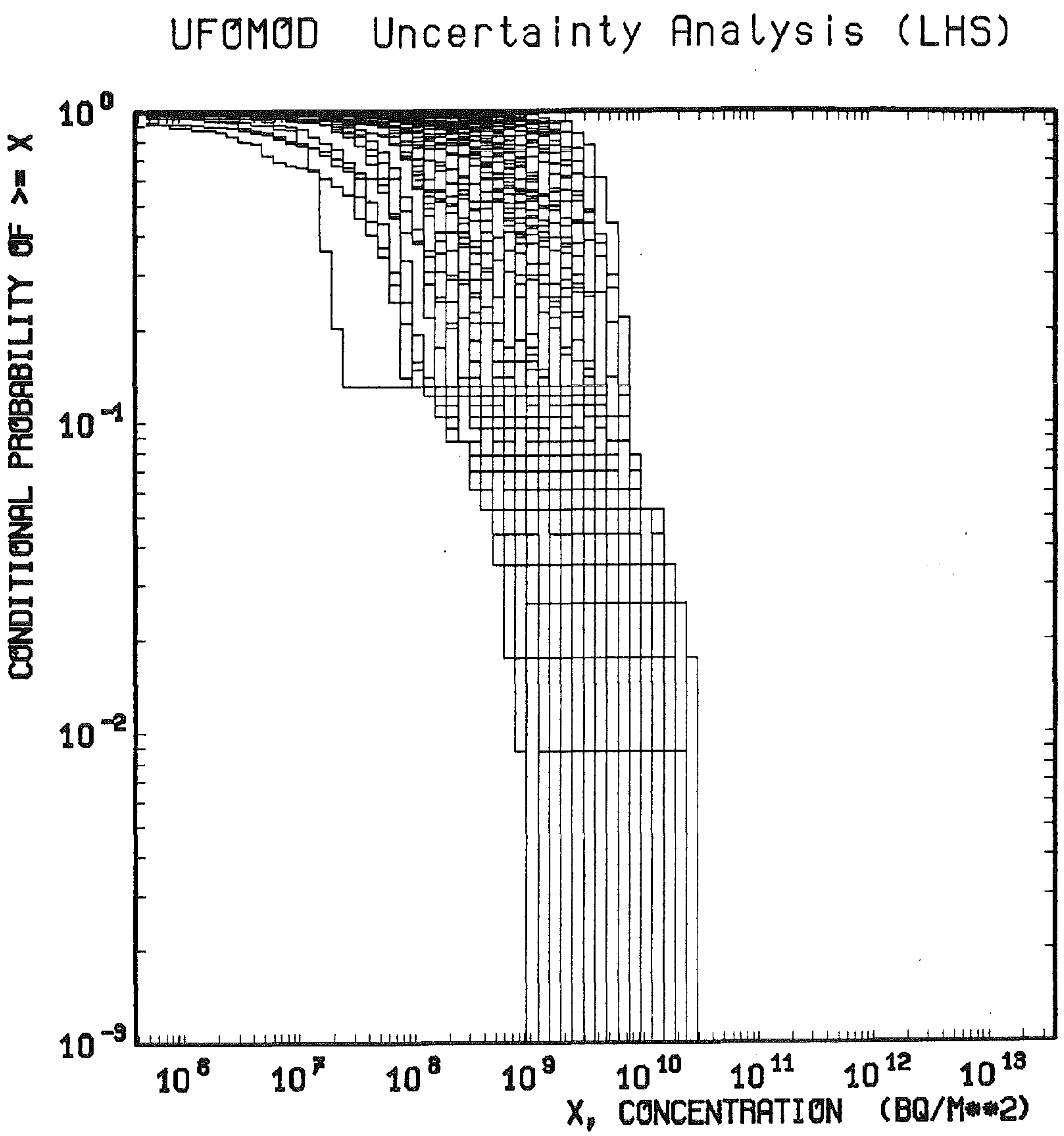
COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

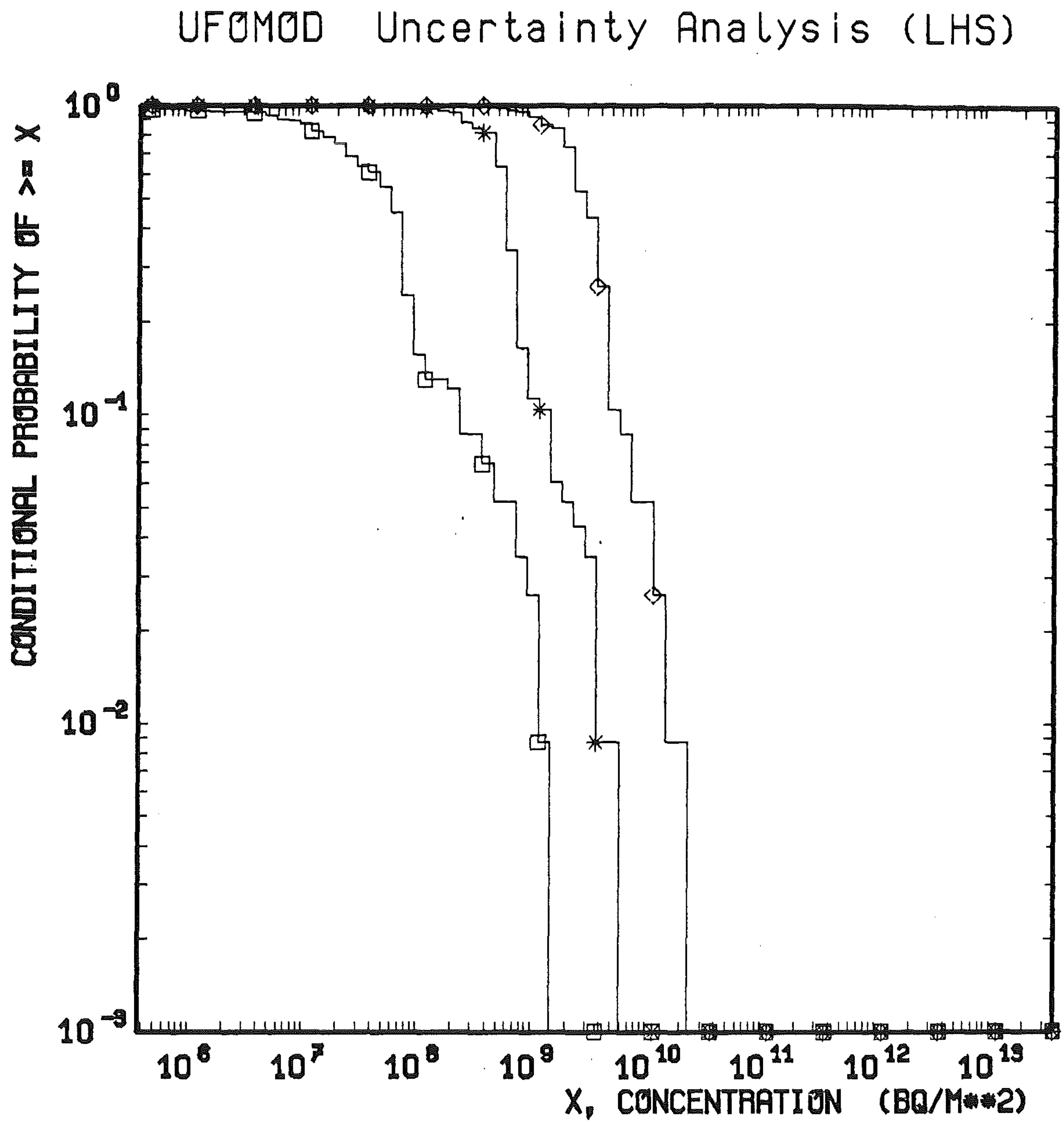
*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

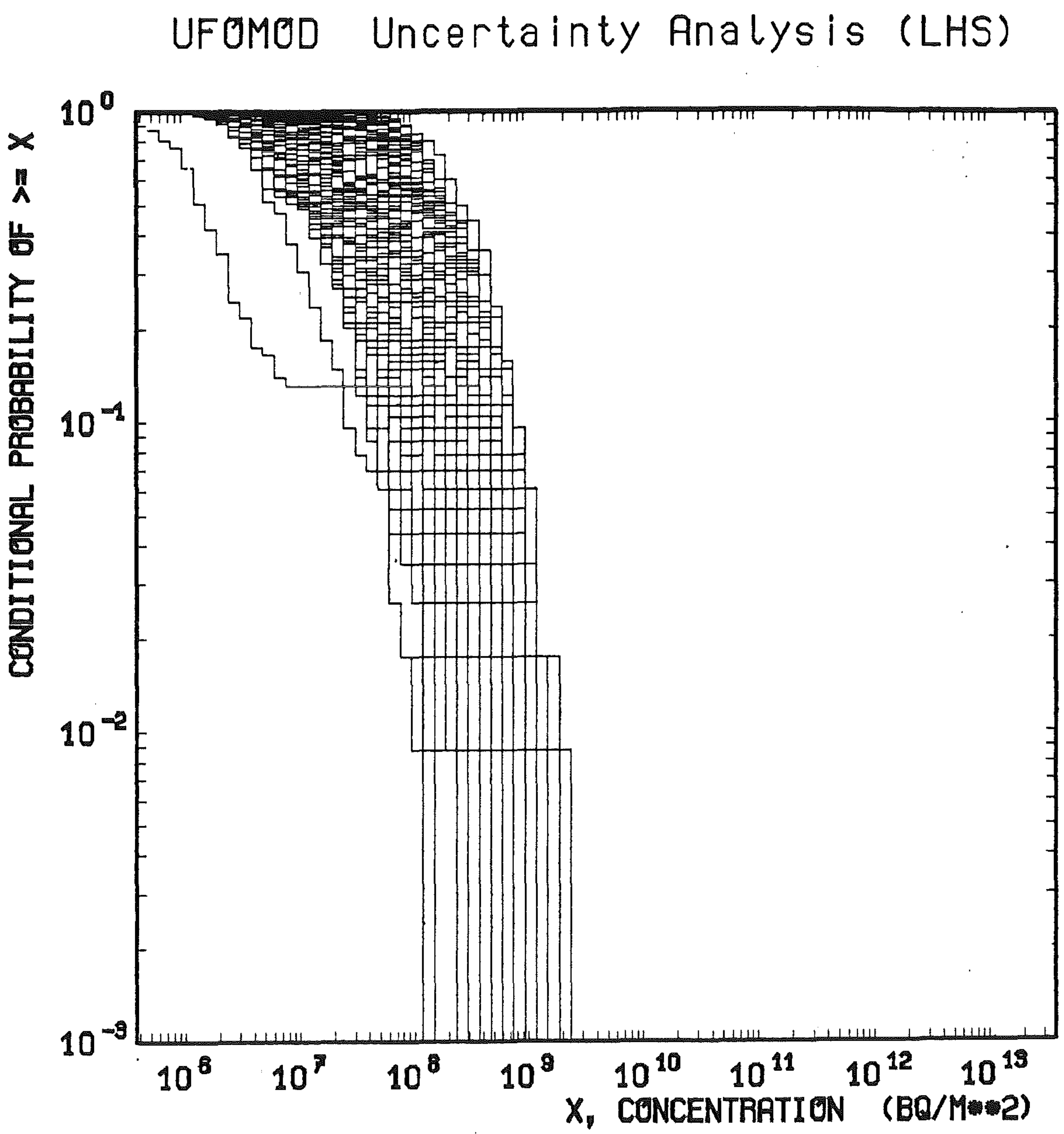



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

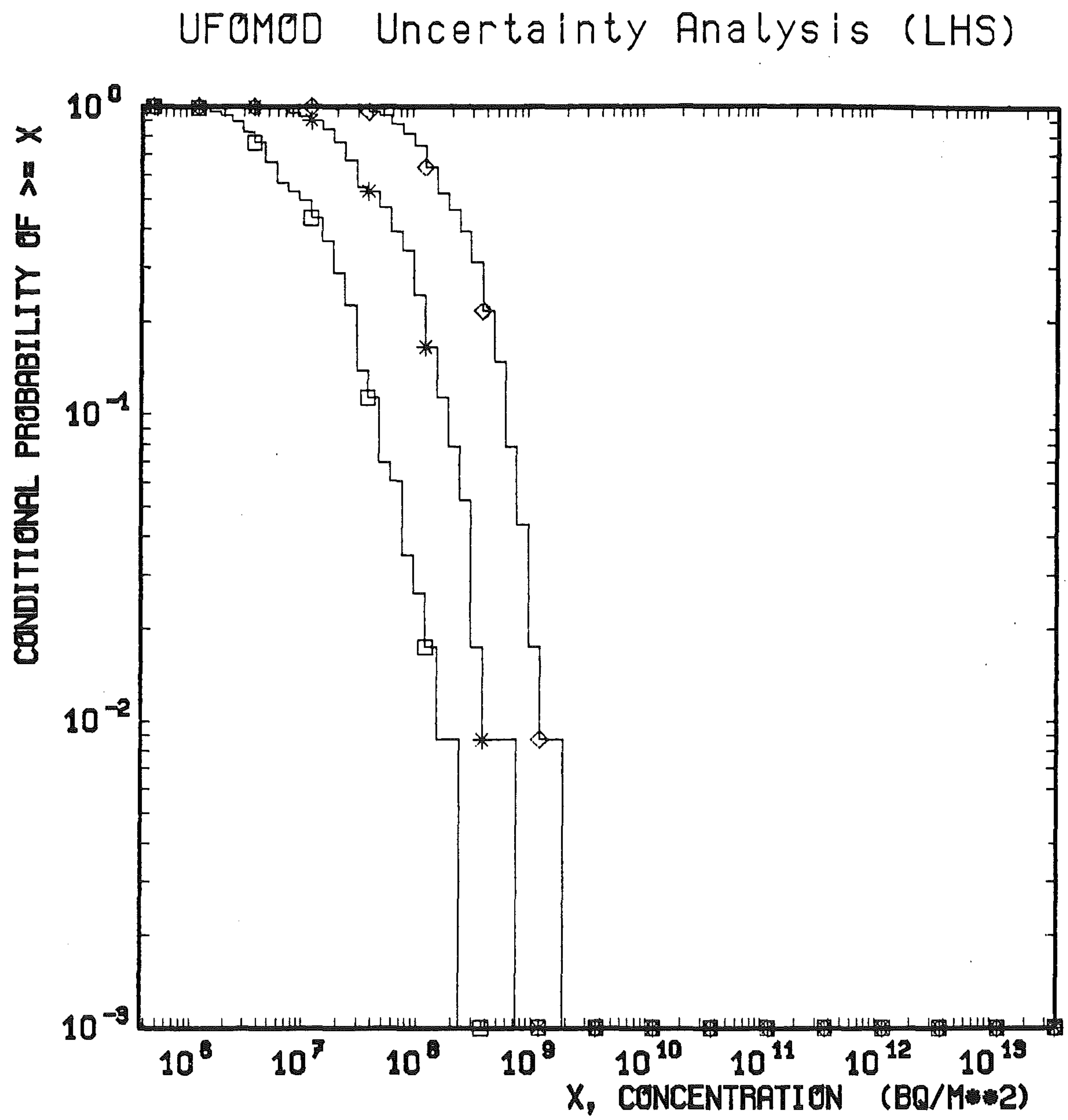
KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration on ground surface
Nuclide ............: Cs - 137
Distance ...........: 8 - 12 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

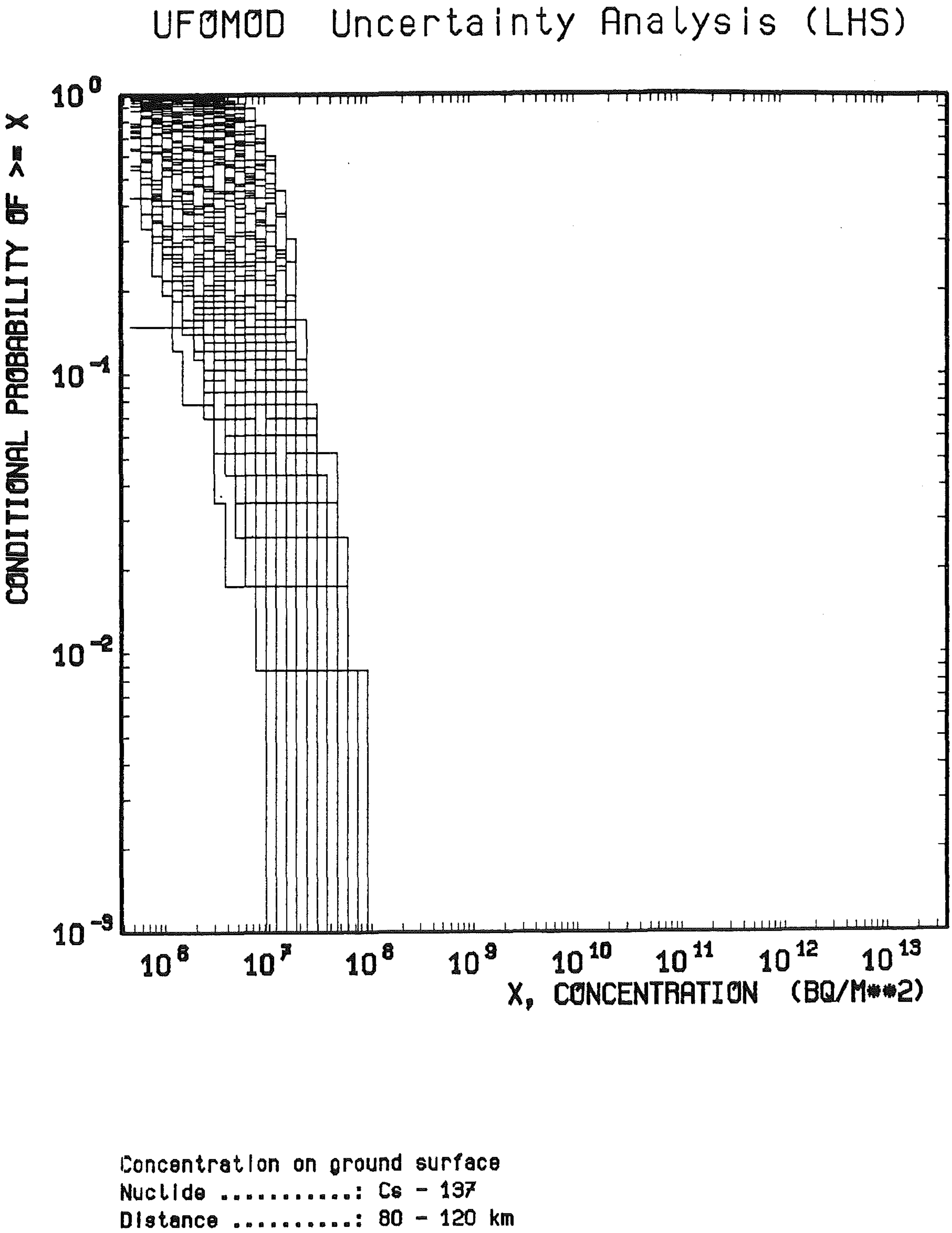



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

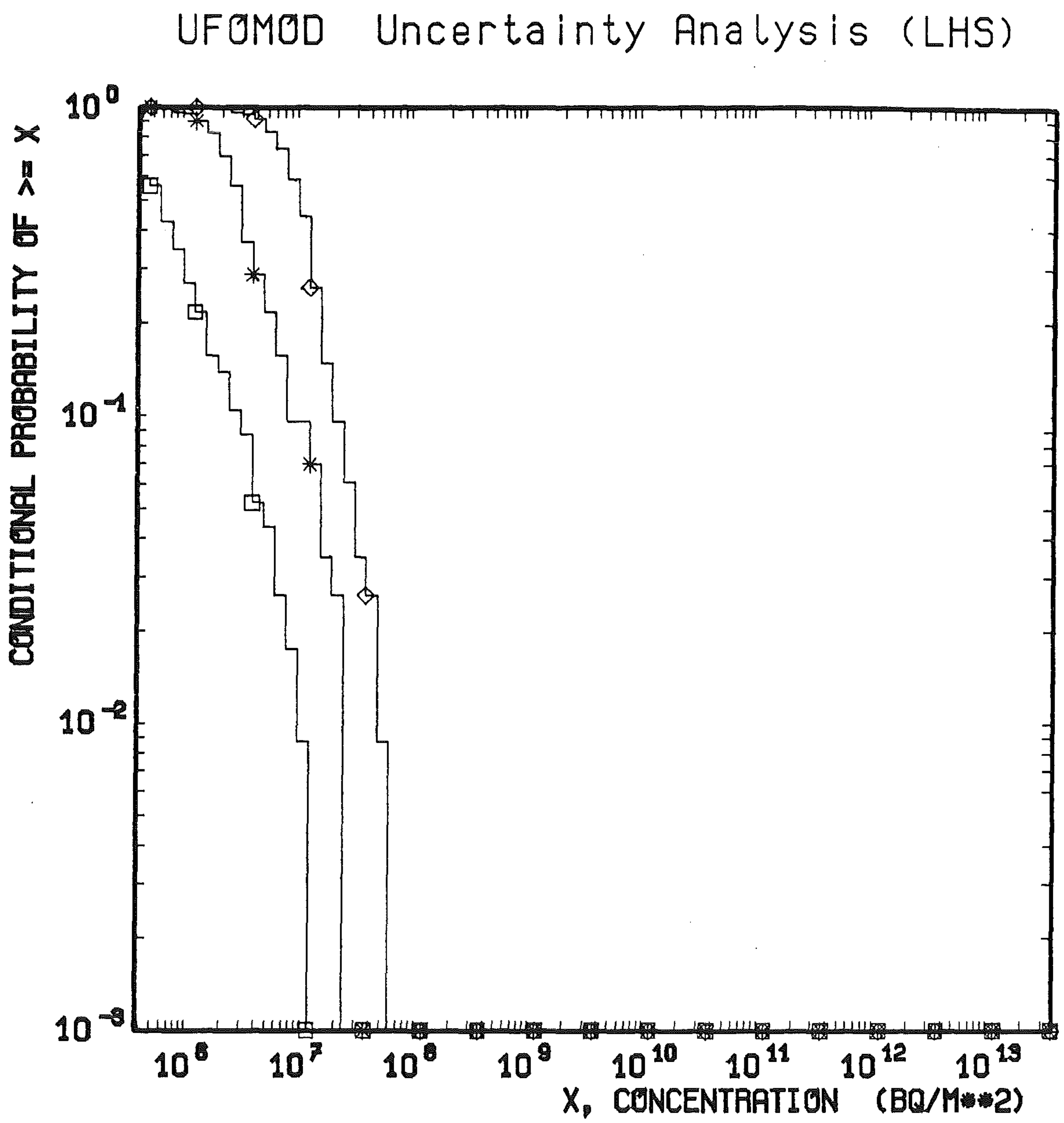
*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% -QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

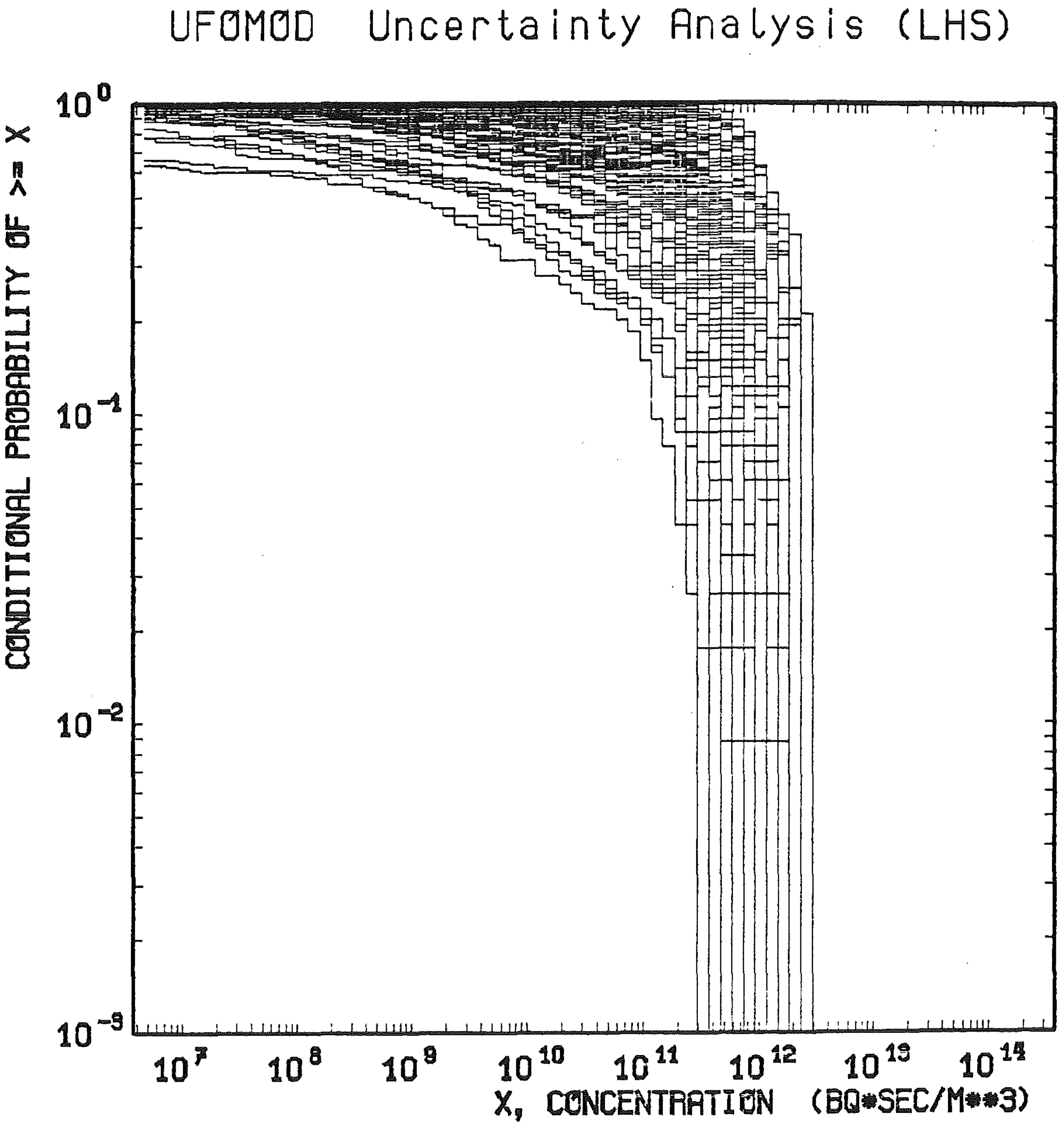



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

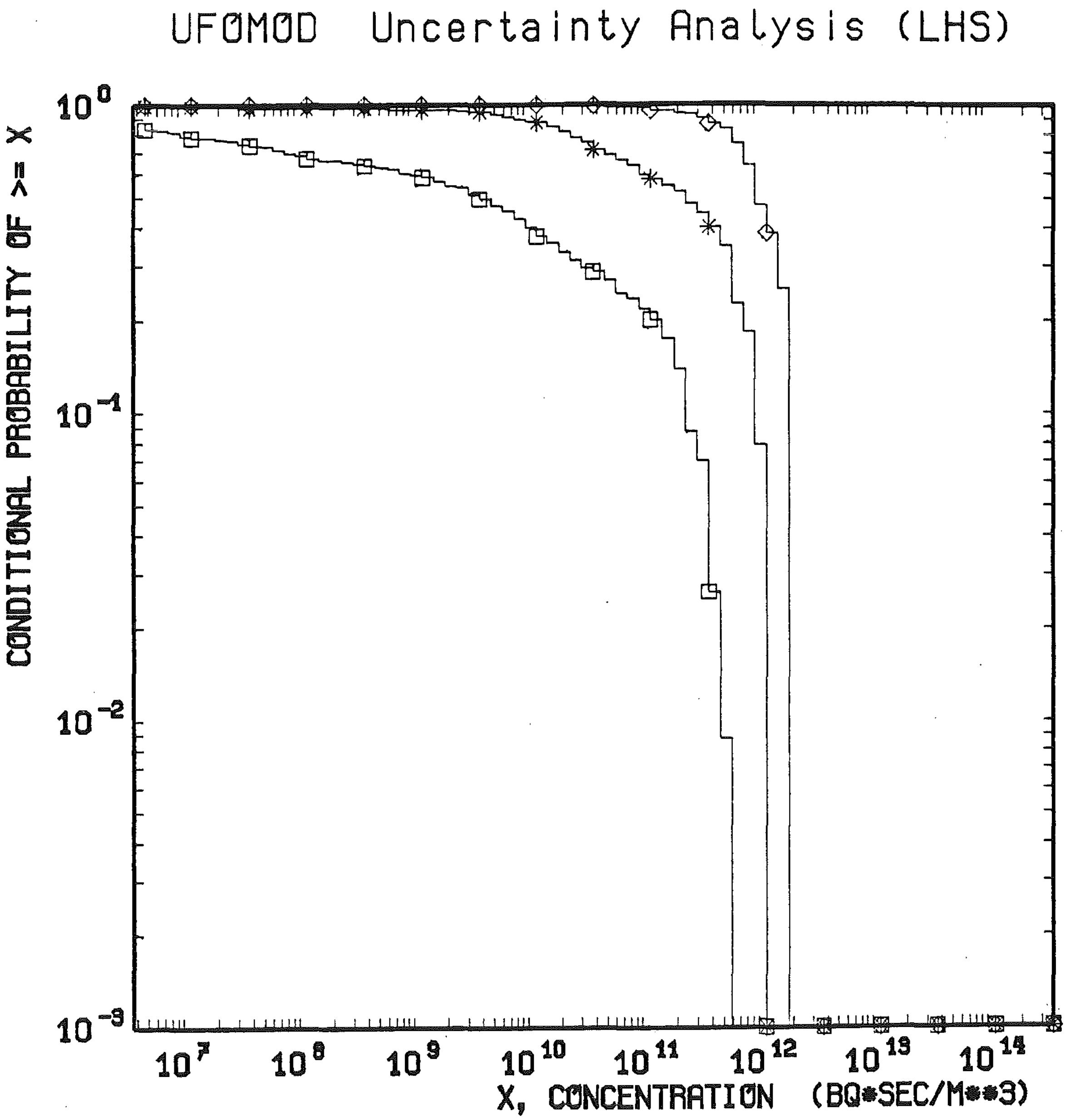
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration in the air near ground ( 1 m height)
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

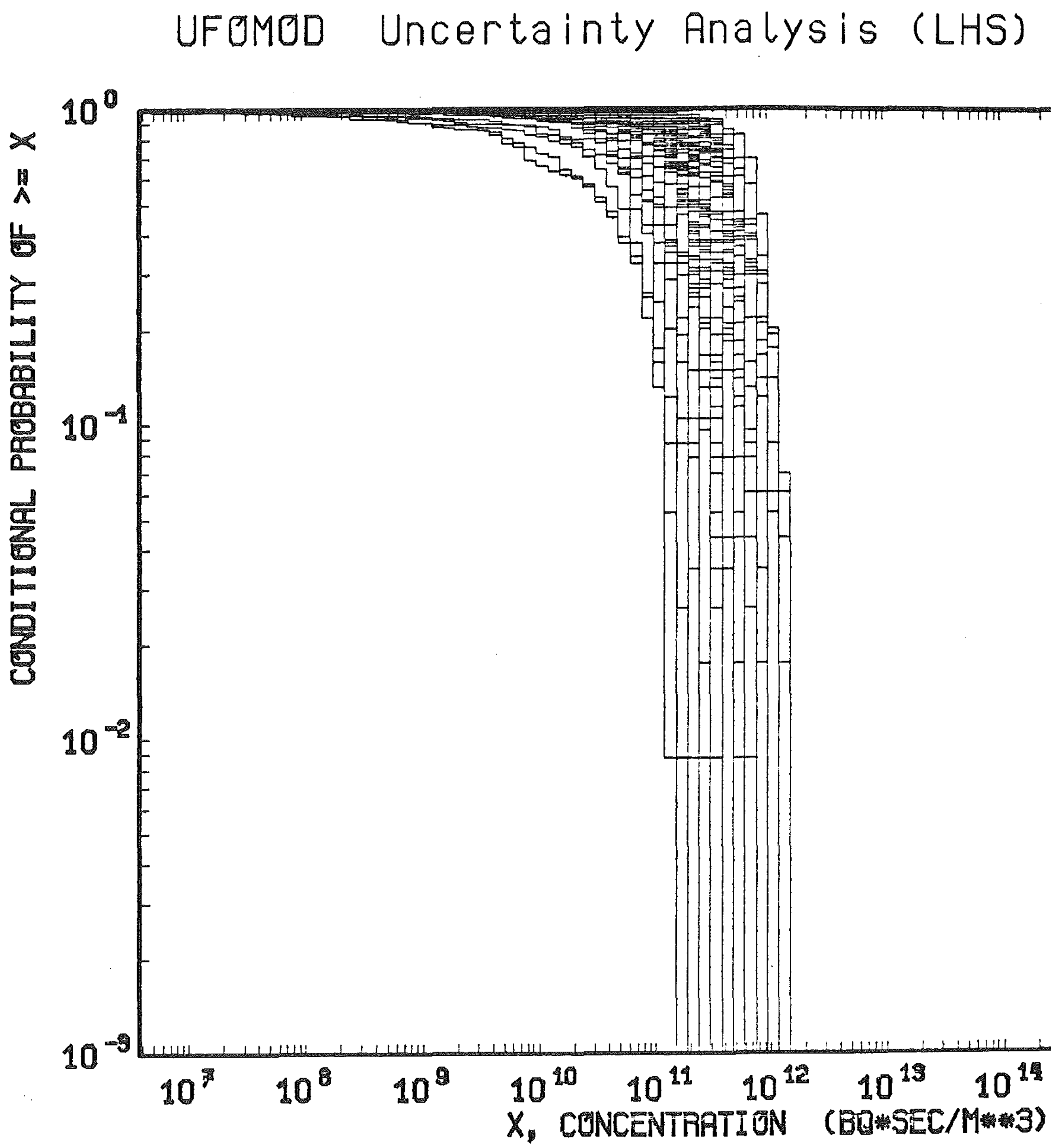



Concentration in the air near ground ( 1 m height)
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

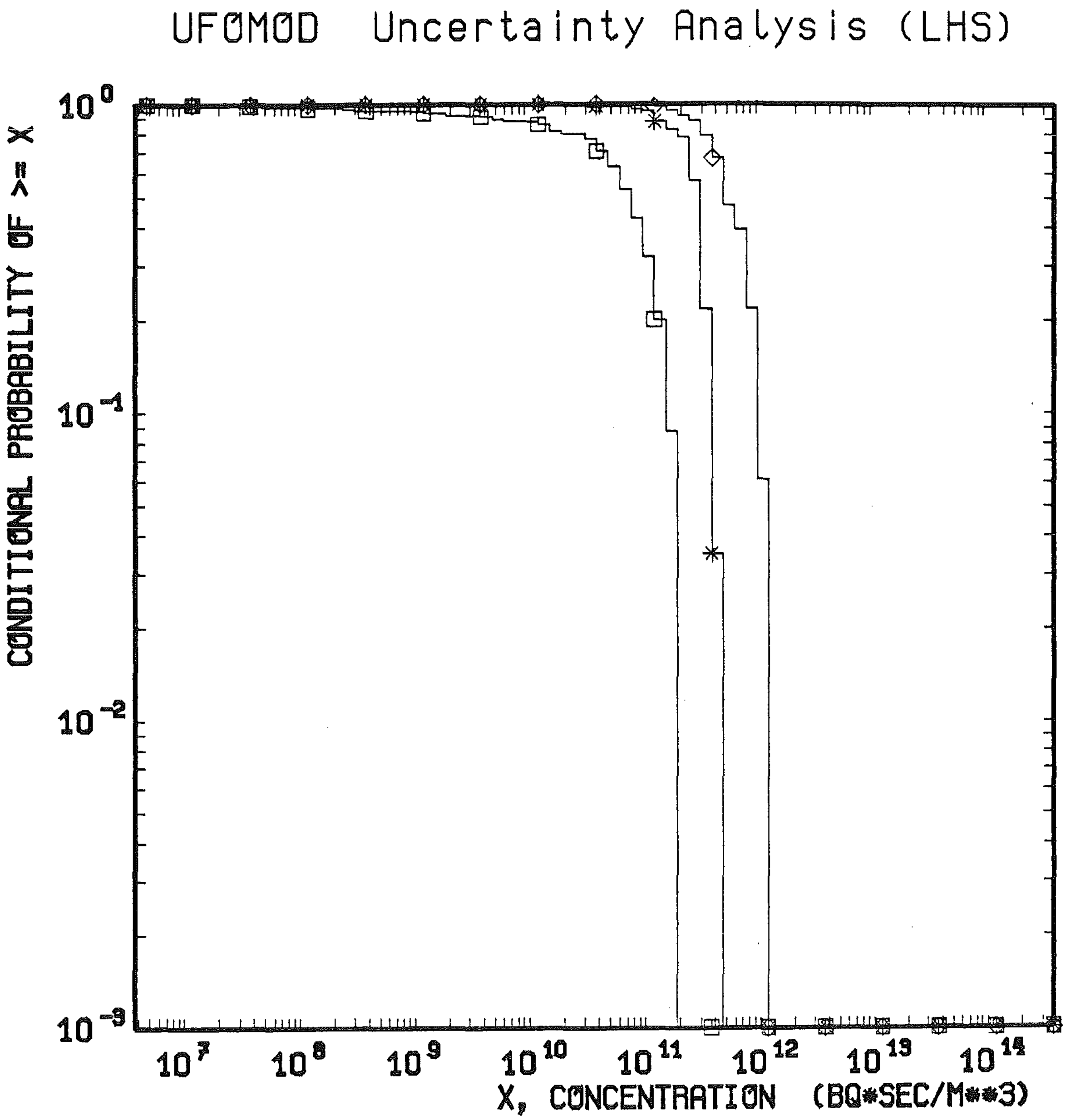
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% -QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration in the air near ground ( 1 m height)
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

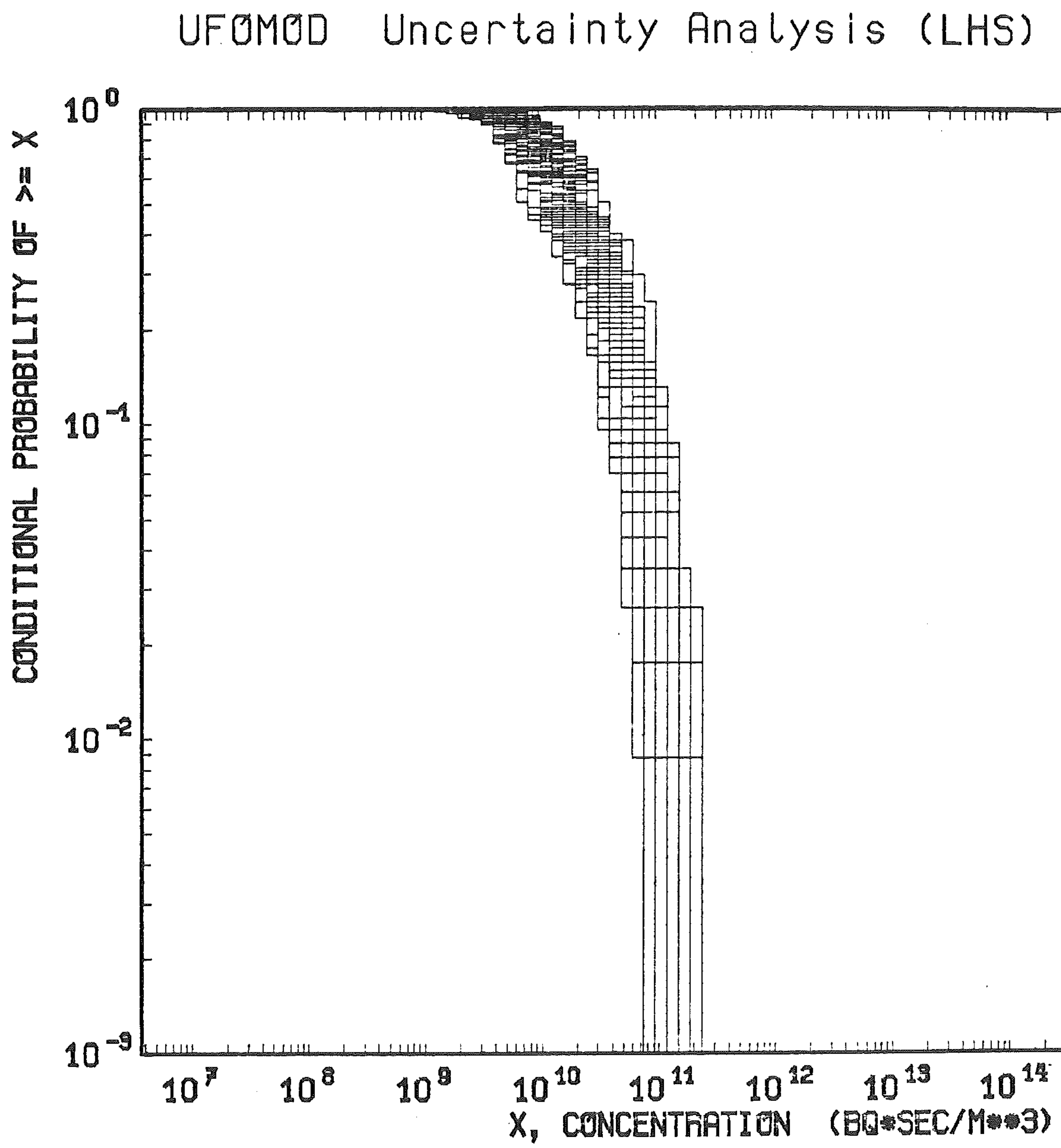



Concentration in the air near ground ( 1 m height)
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

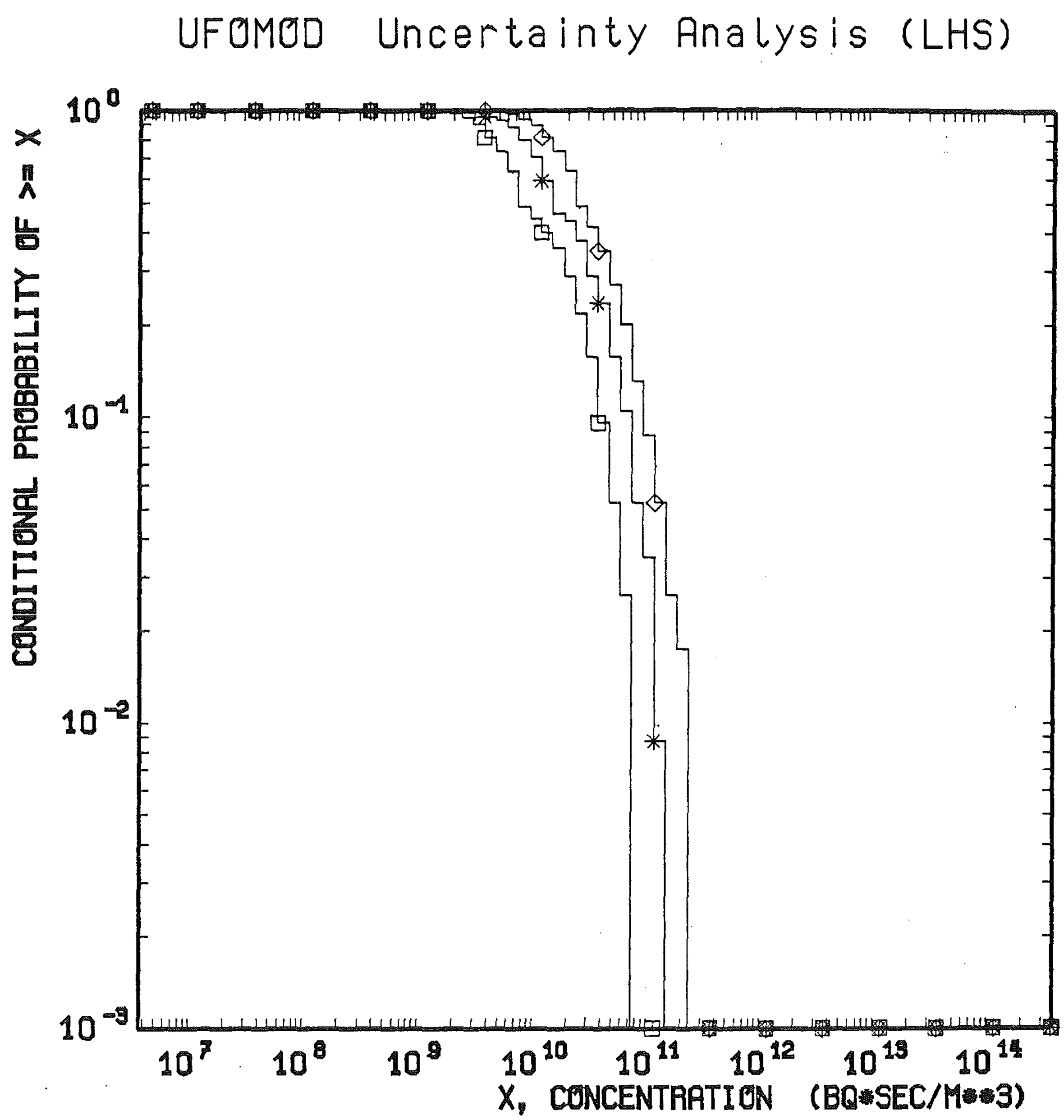
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% -QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration in the air near ground ( 1 m height)
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

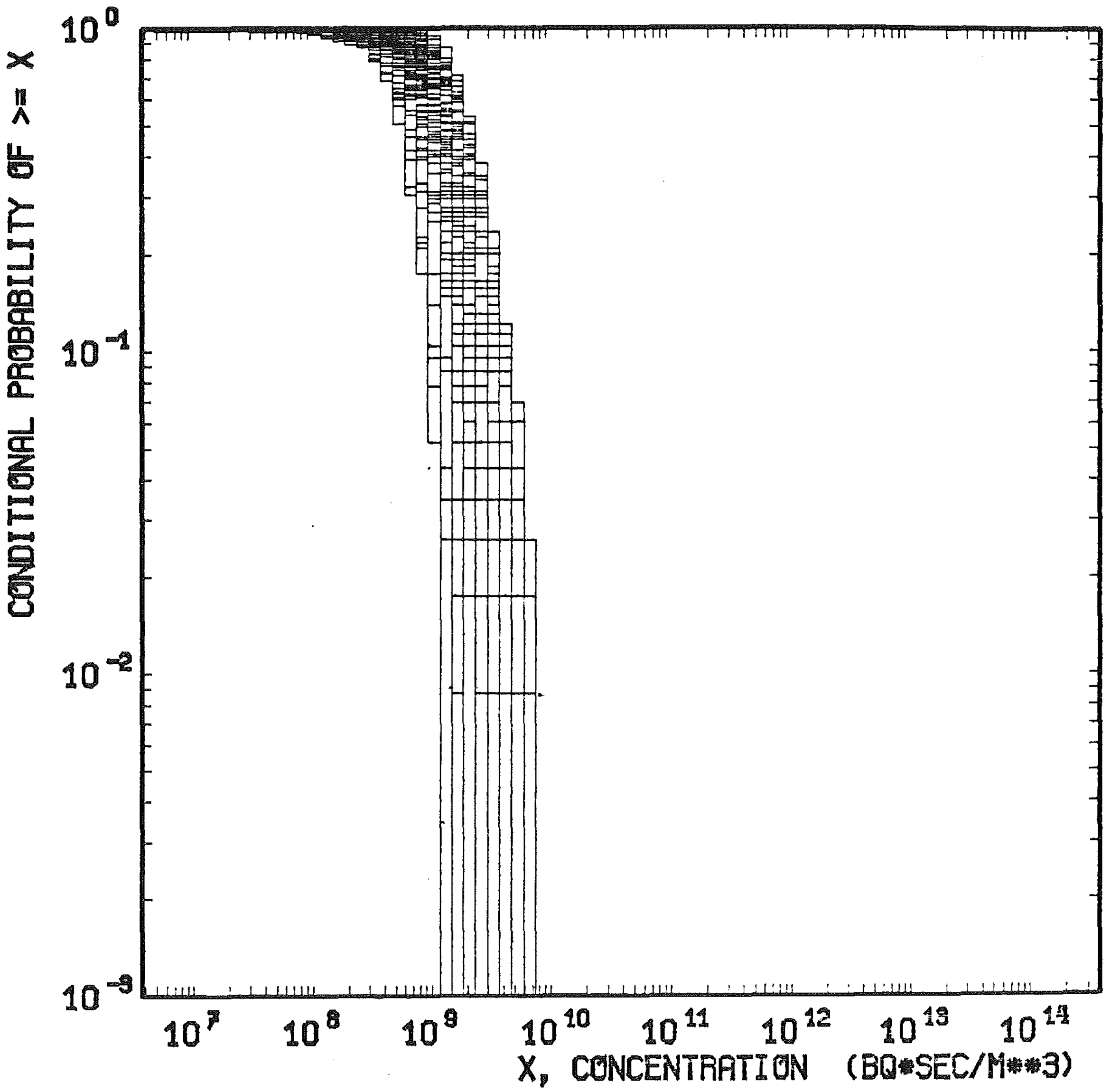



Concentration in the air near ground ( 1 m height) *: Ref.-Curve
Nuclide ...........: Cs - 137 □: 5% -Curve
Distance ..........: 8 - 12 km ◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

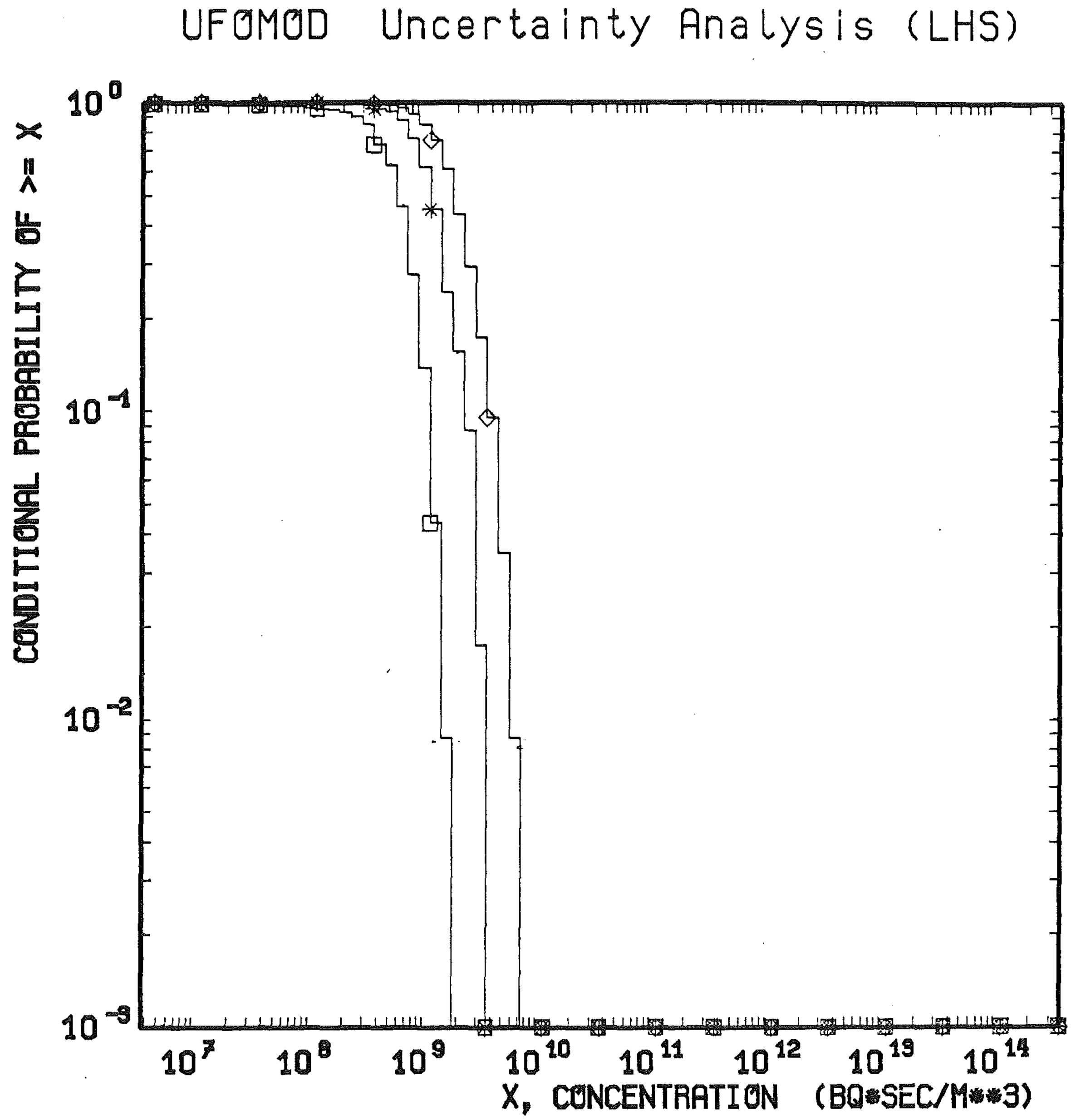
UFOMOD Uncertainty Analysis (LHS)




Concentration in the air near ground ( 1 m height)
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.



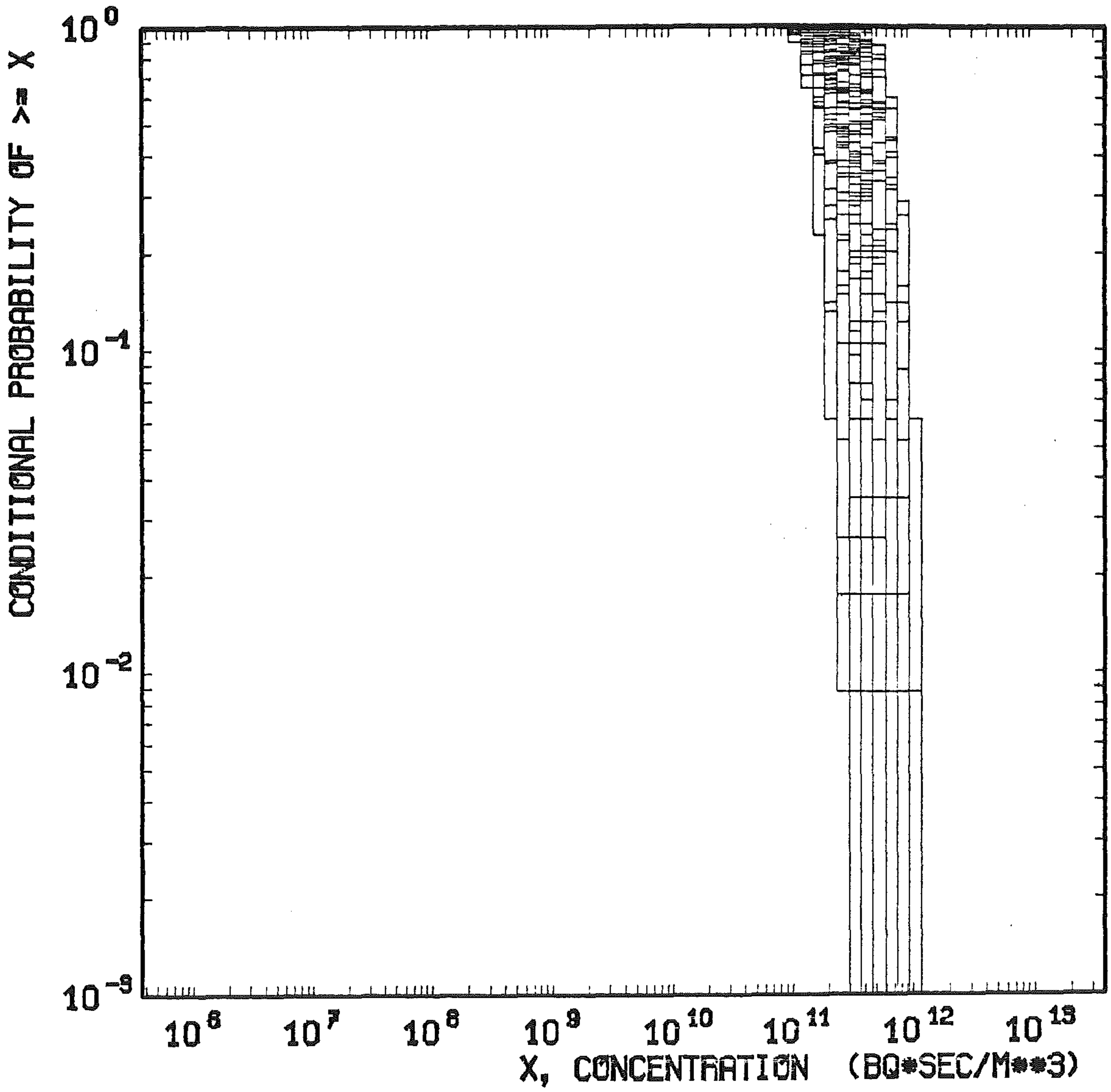

Concentration in the air near ground ( 1 m height)
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

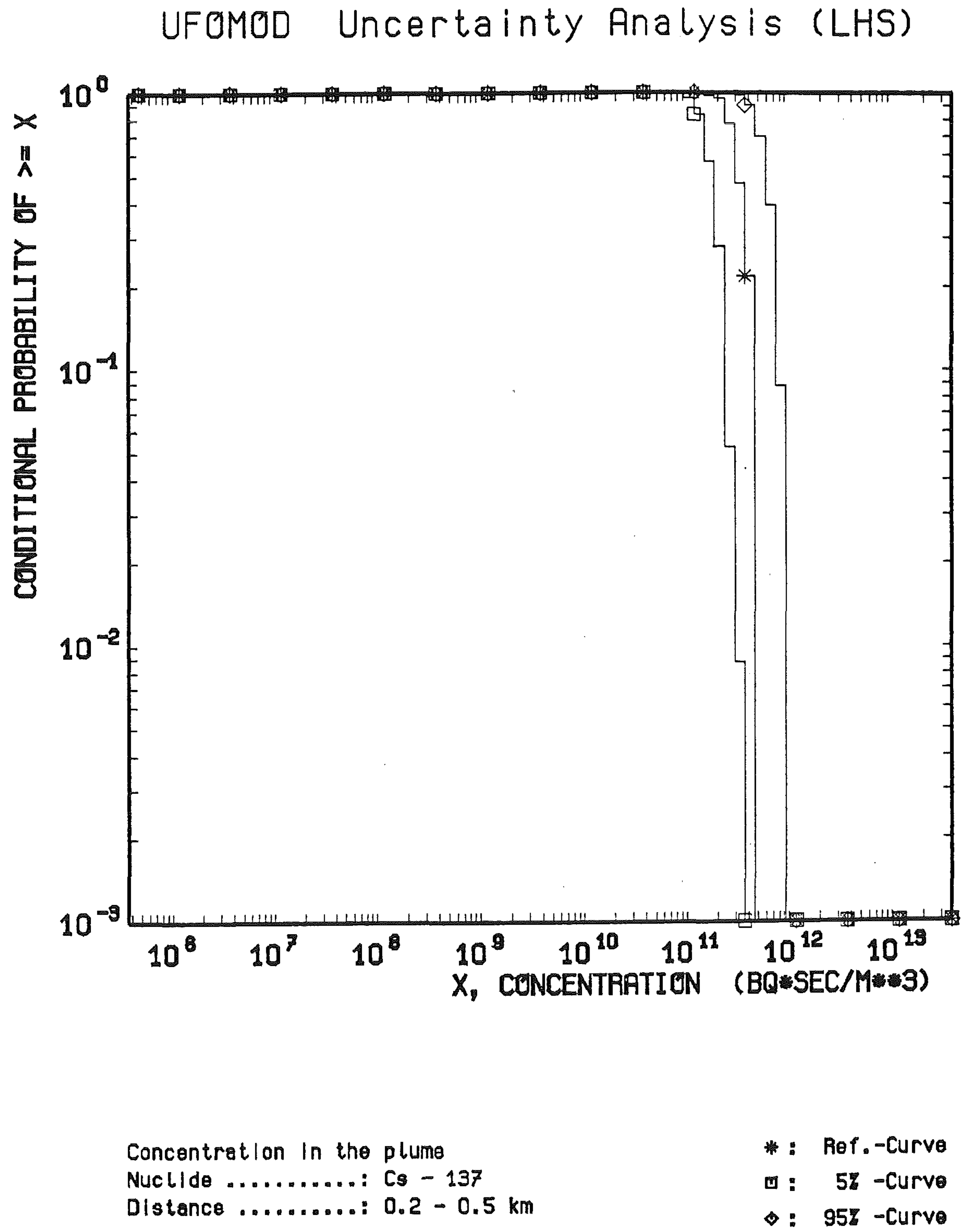
UFOMOD Uncertainty Analysis (LHS)




Concentration in the plume
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

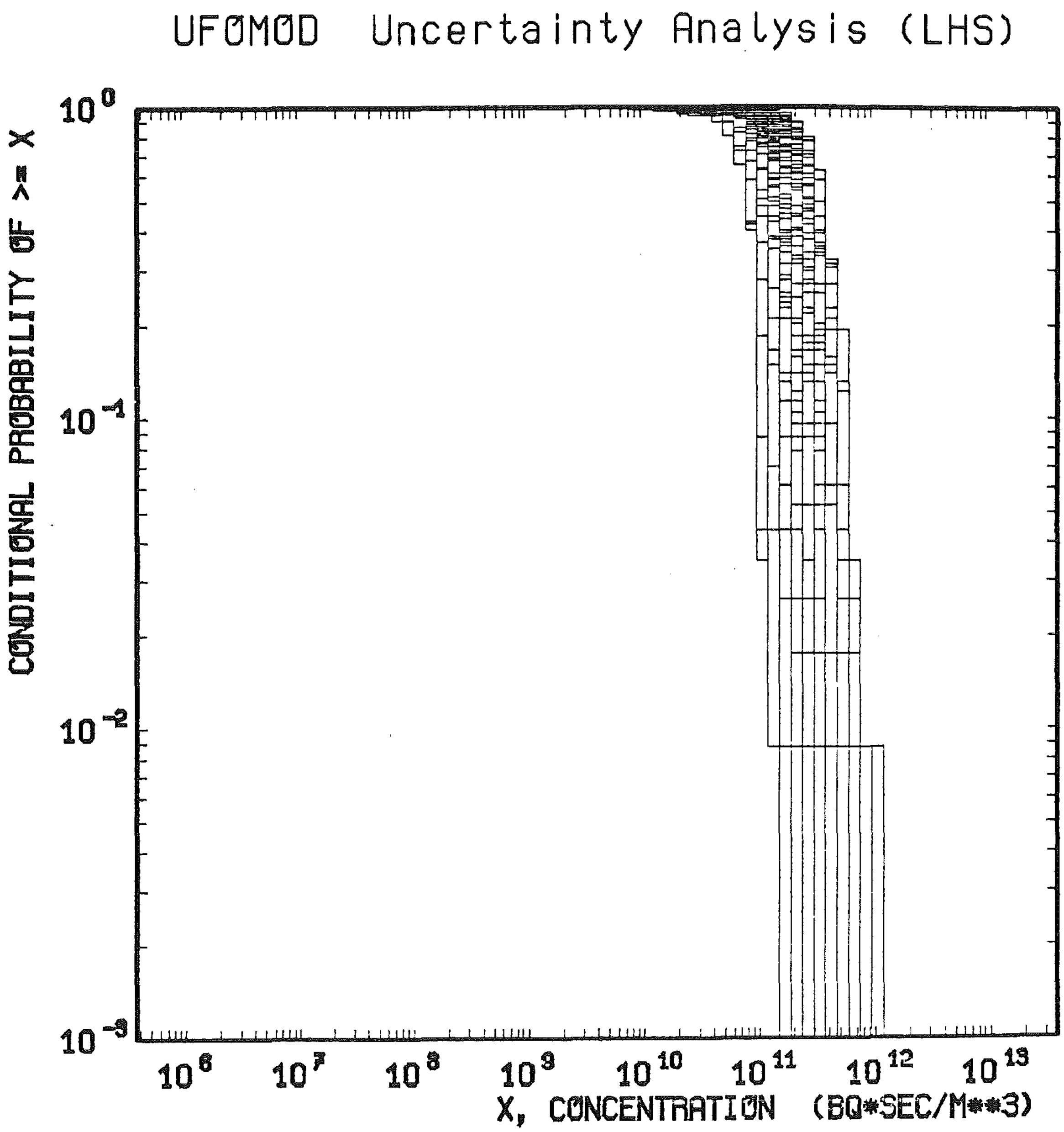
KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.




KfK INR

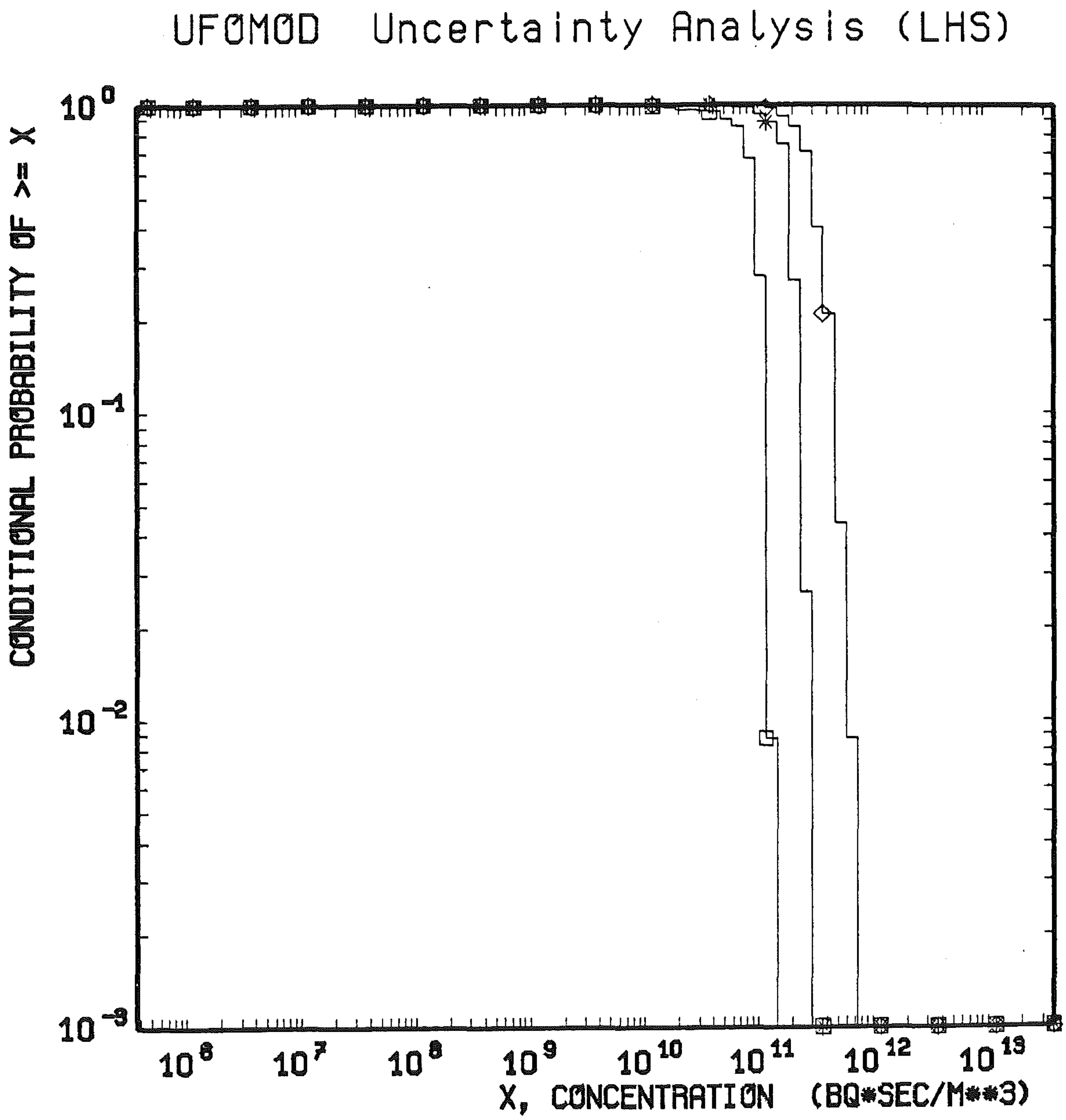
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration in the plume
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.

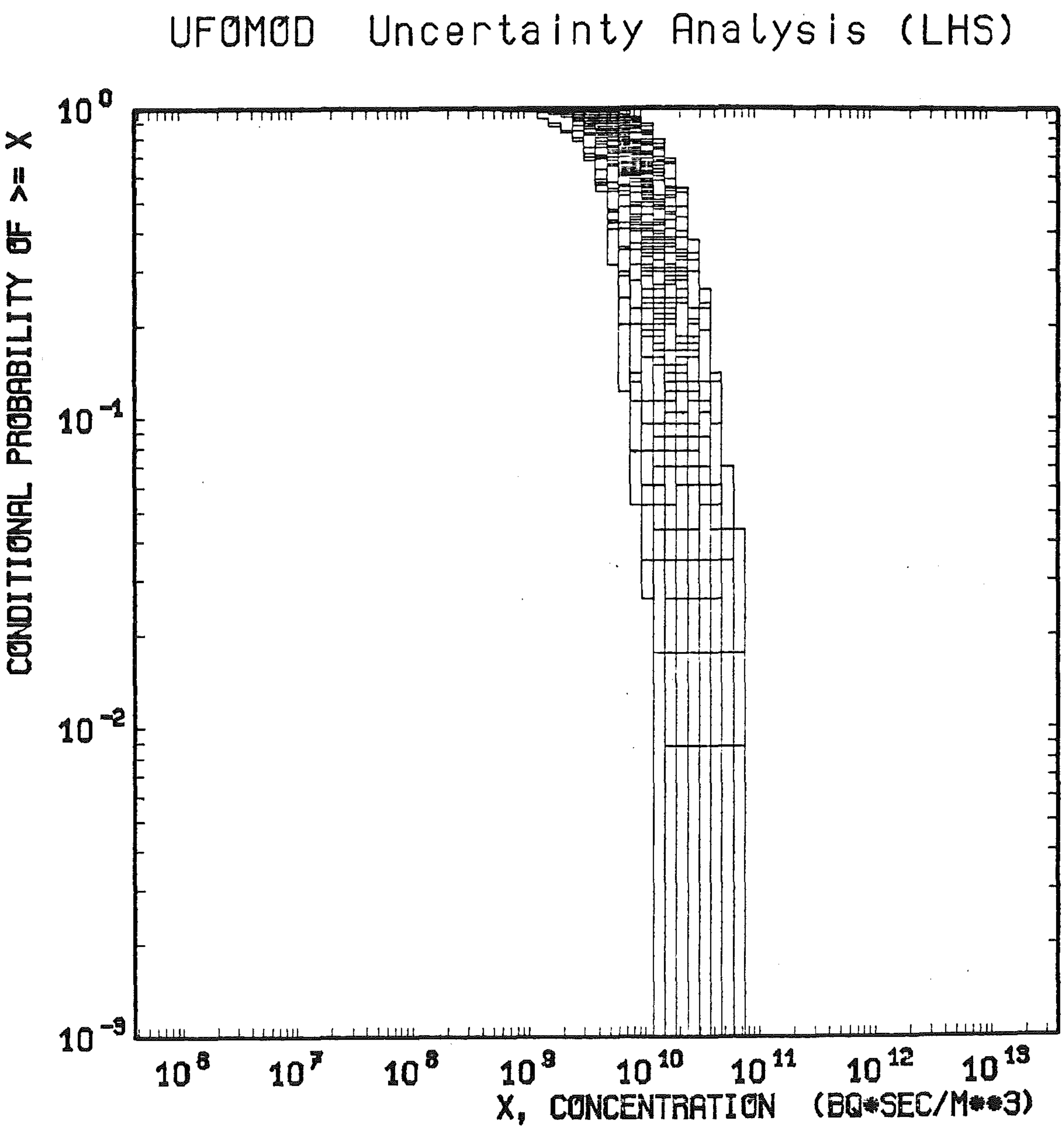



Concentration in the plume
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
⊡ : 5% -Curve
◇ : 95% -Curve

KfK INR

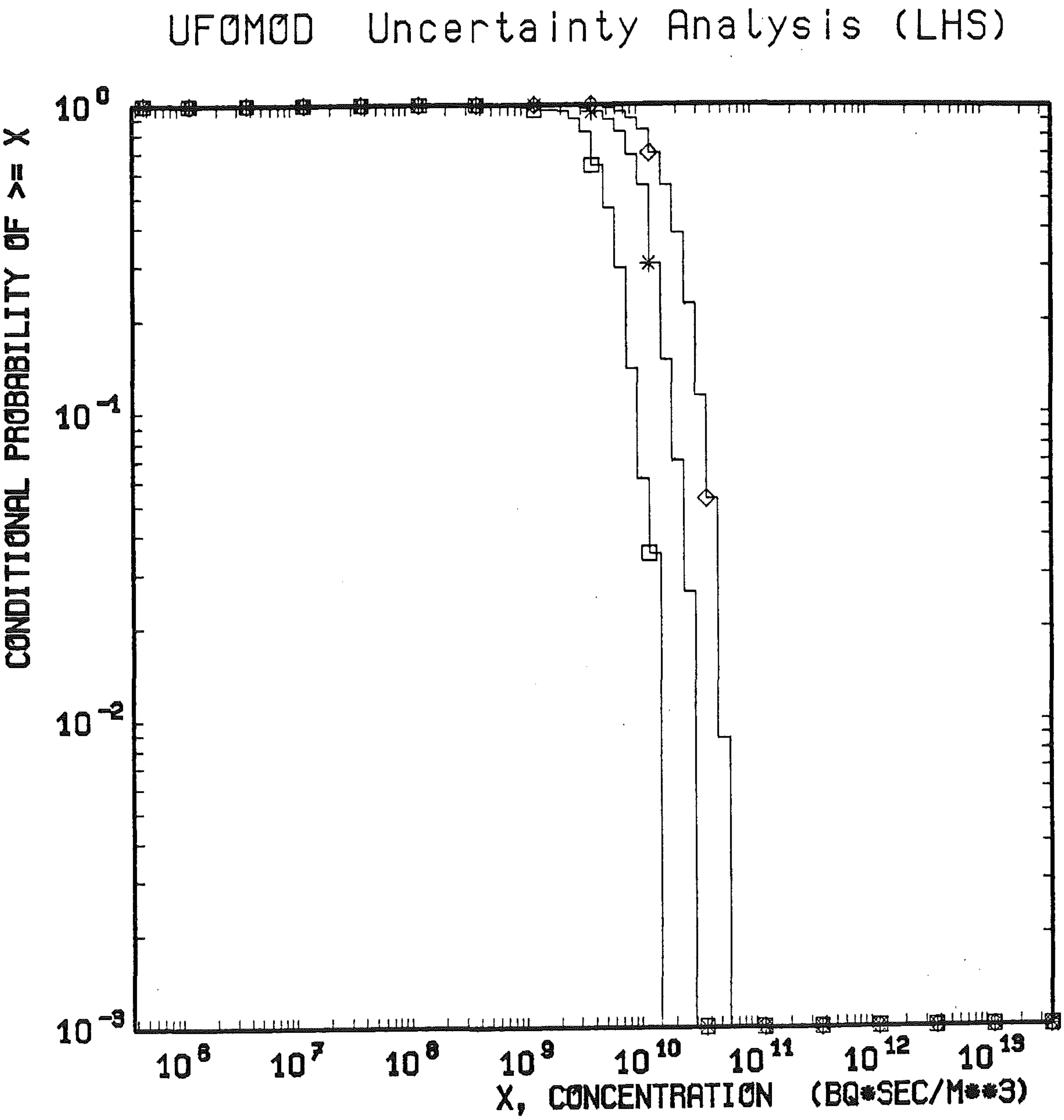
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration in the plume
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

KfK INR

CØMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE ØF SIZE 100.

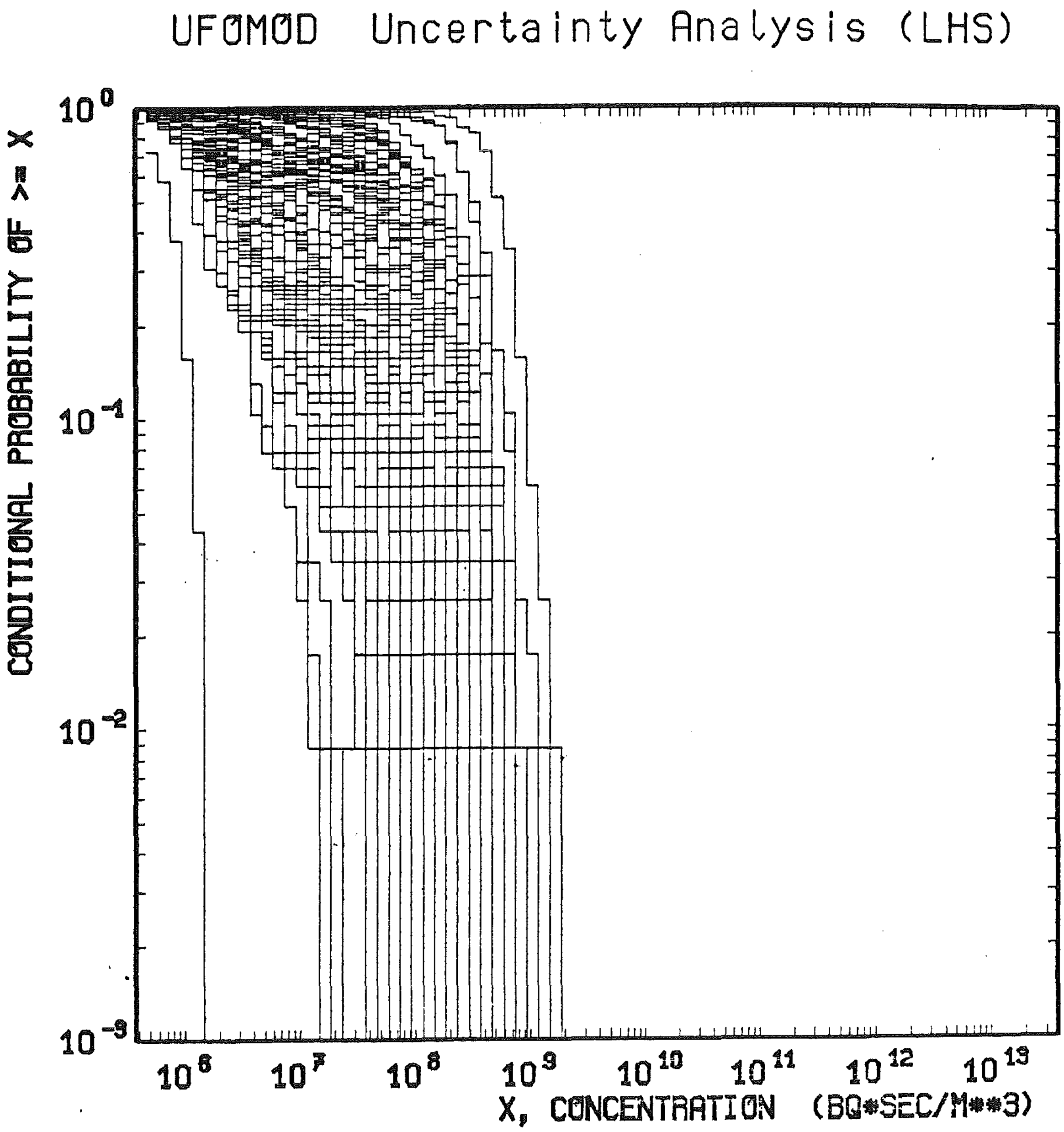



Concentration in the plume
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

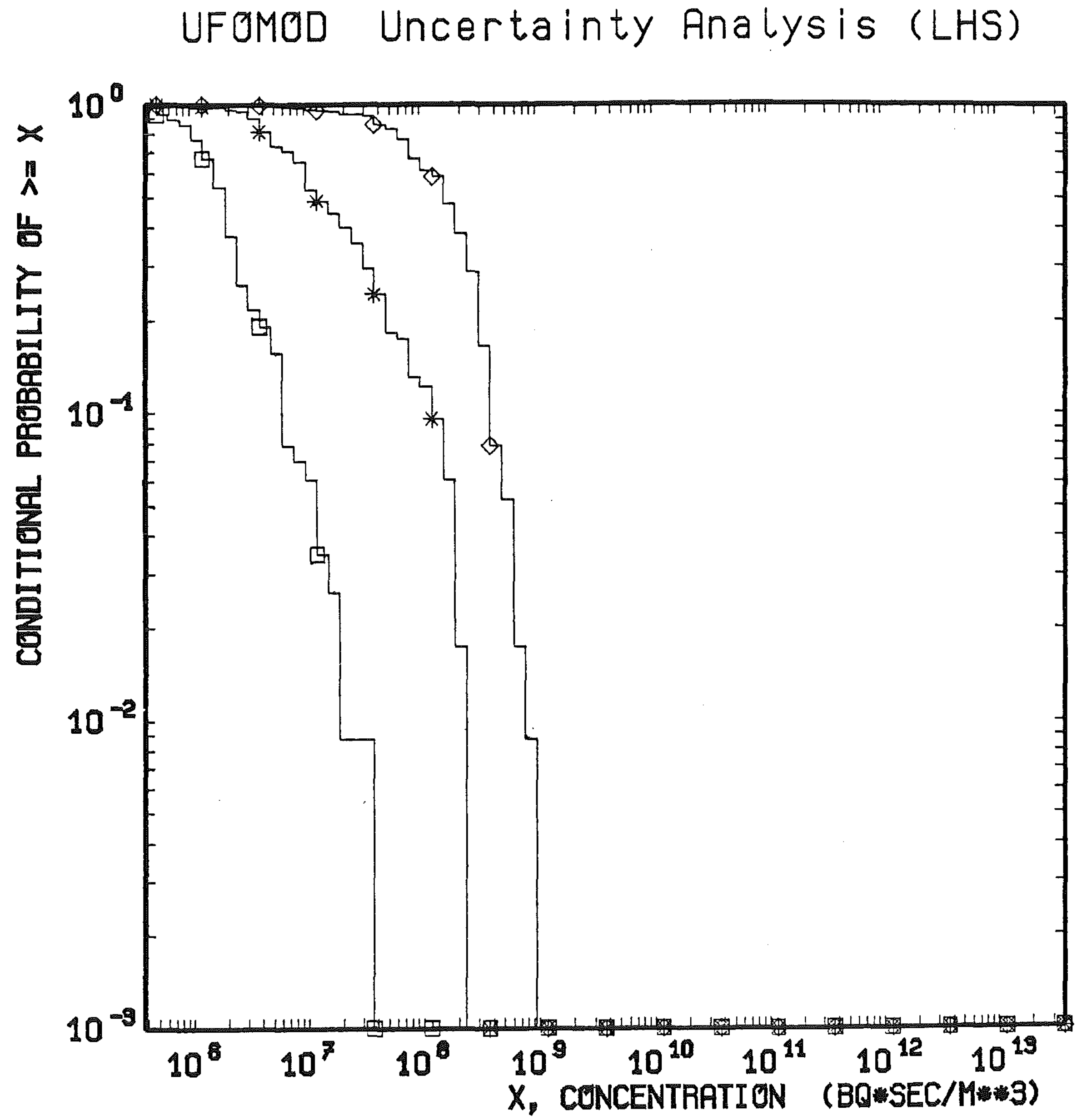
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration in the plume
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 100.




Concentration in the plume
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

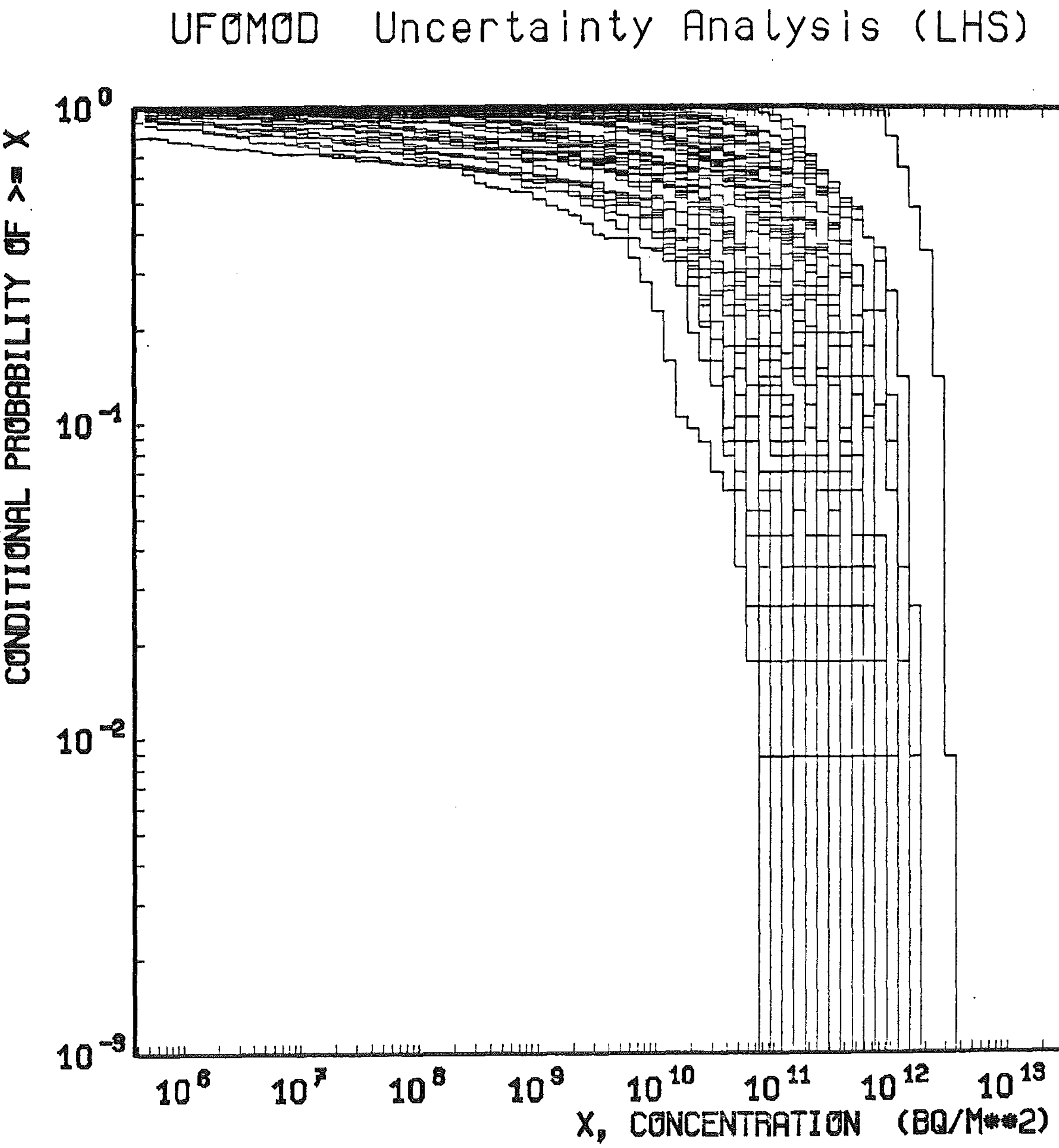
*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

## B.2 ACTIVITY CONCENTRATIONS (LHS AT KFK, N= 59 RUNS)

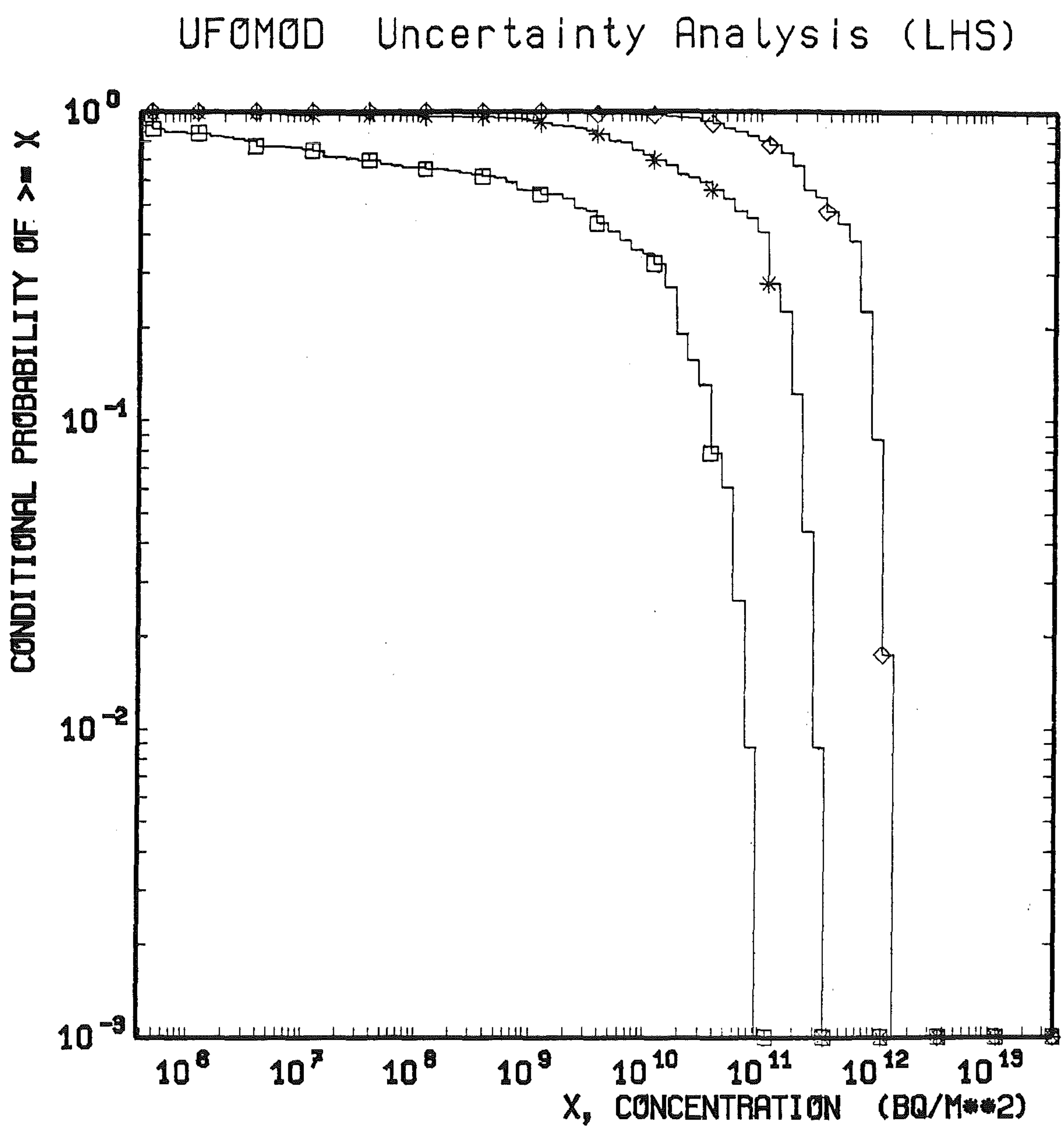
In this section CCFDs and the corresponding confidence curves are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

KfK INR

CØMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE ØF SIZE 59.

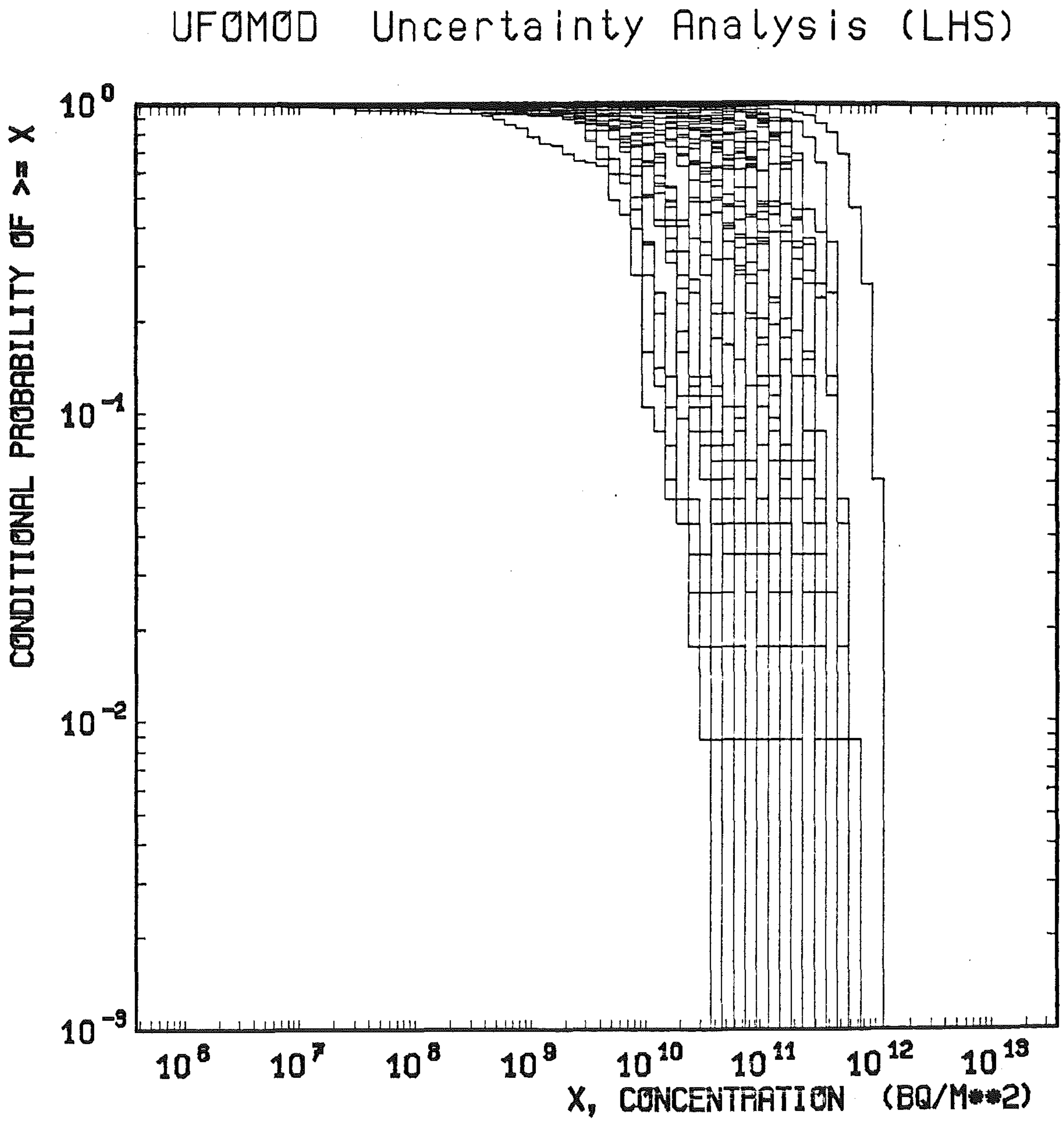



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

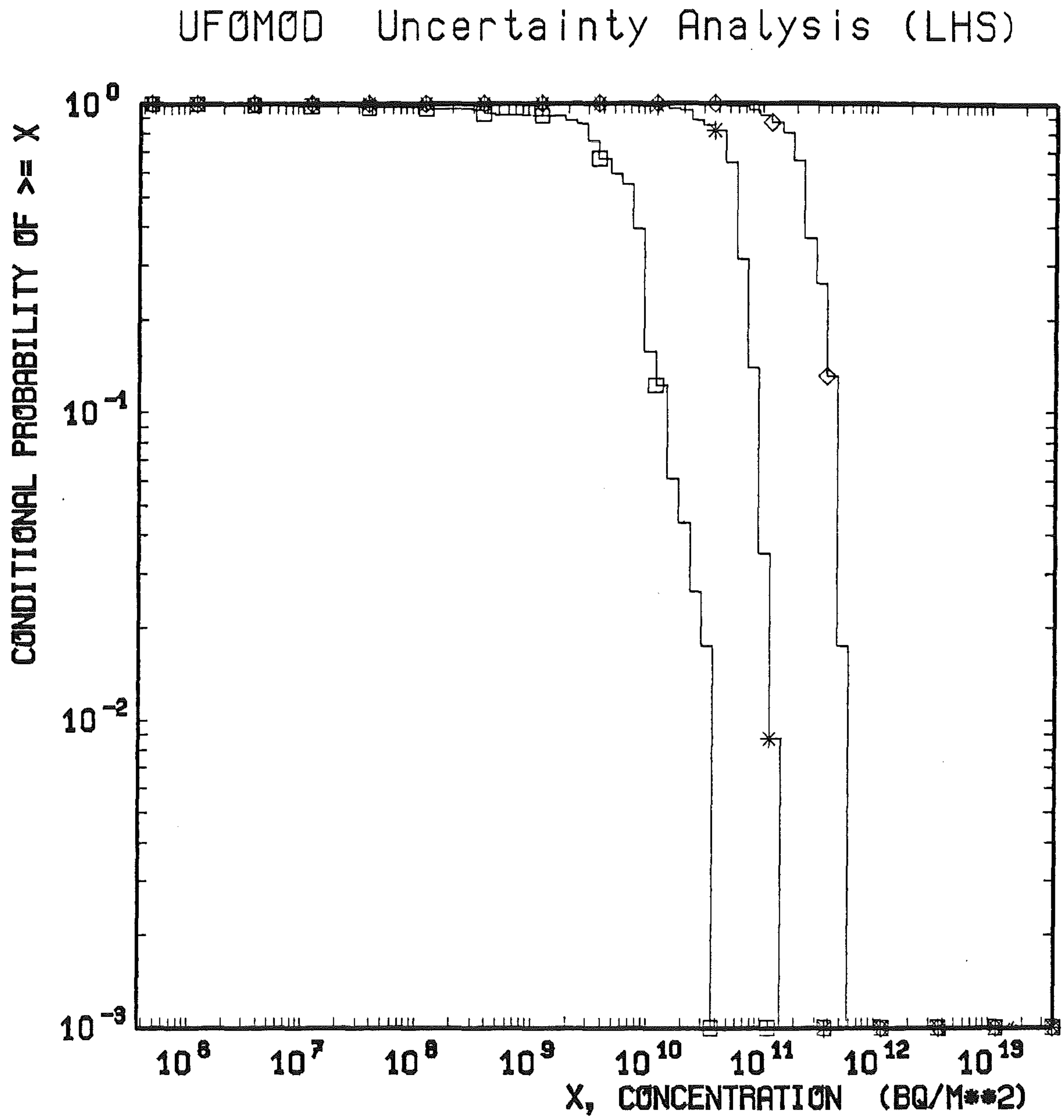
KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

CØMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE ØF SIZE 59.

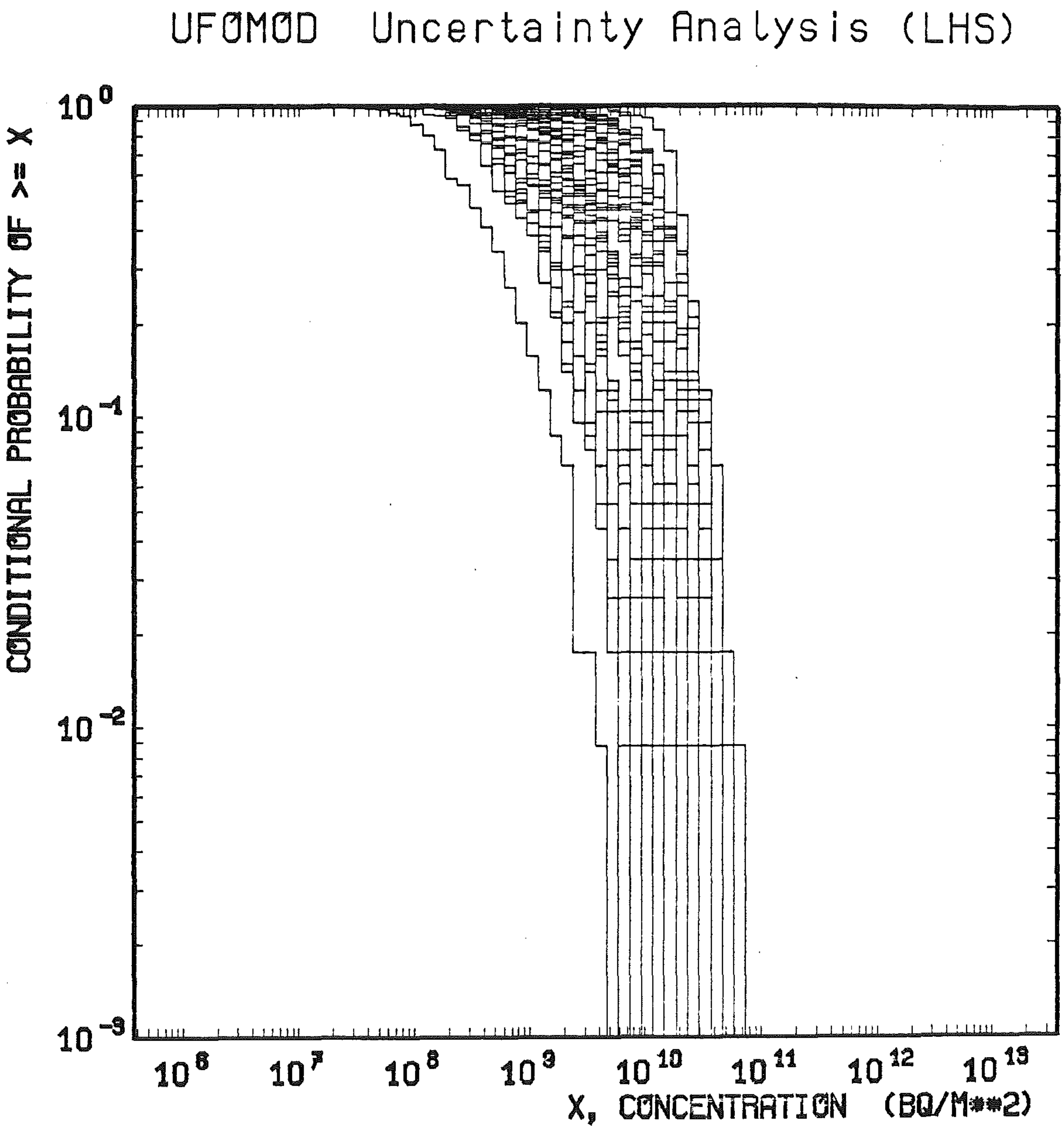



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
⊡ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

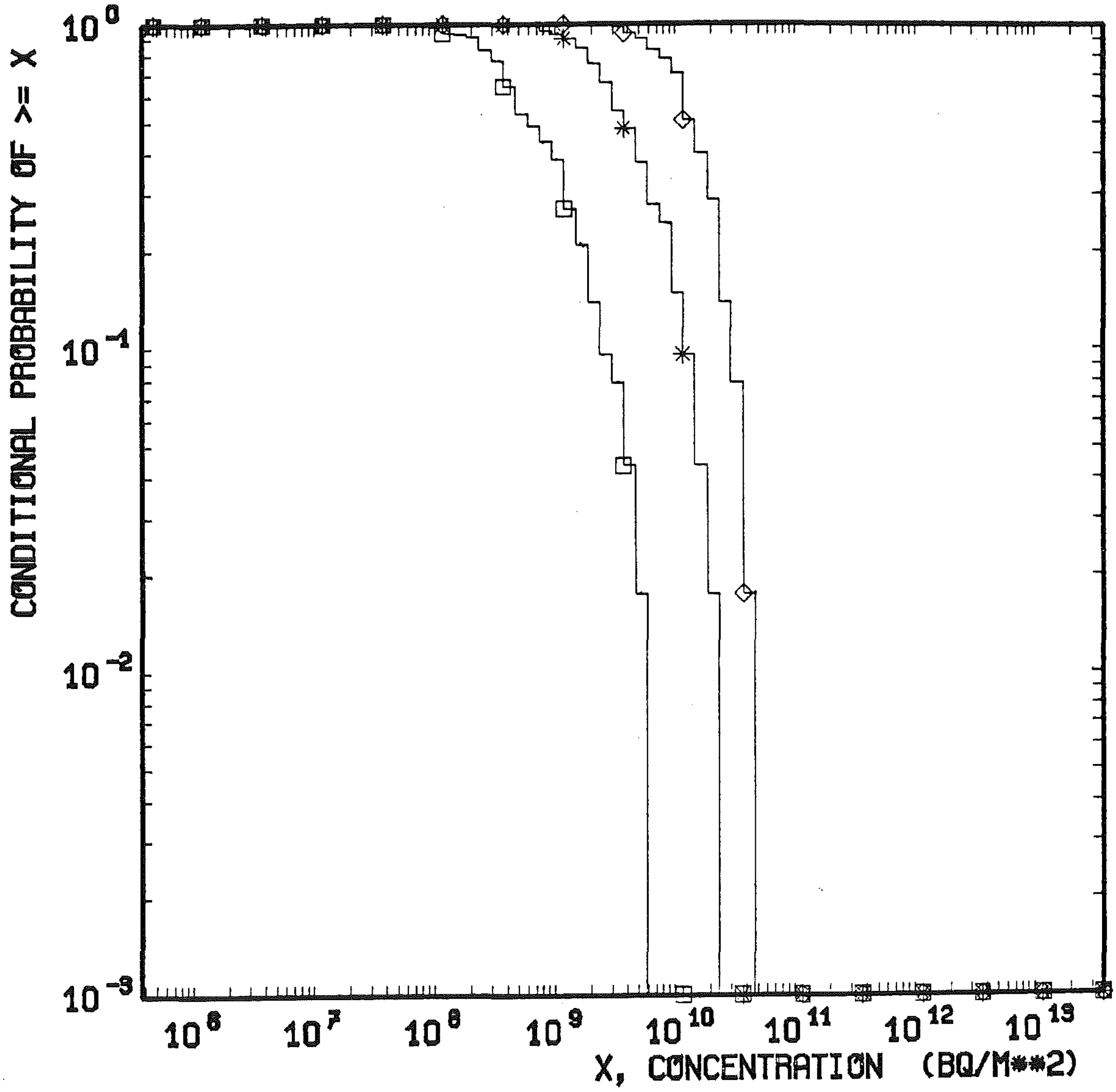



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 59.

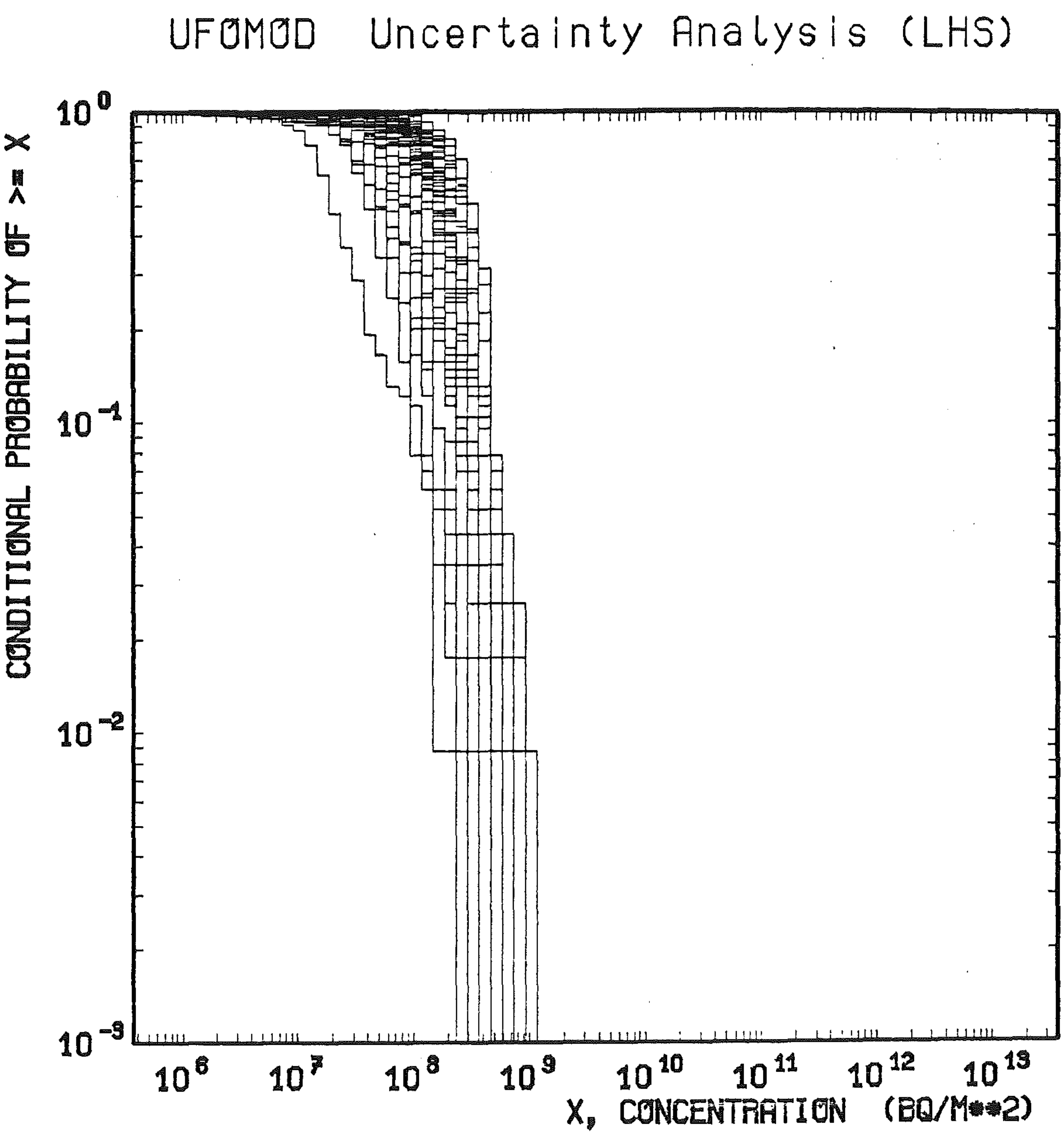
UFØMØD Uncertainty Analysis (LHS)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

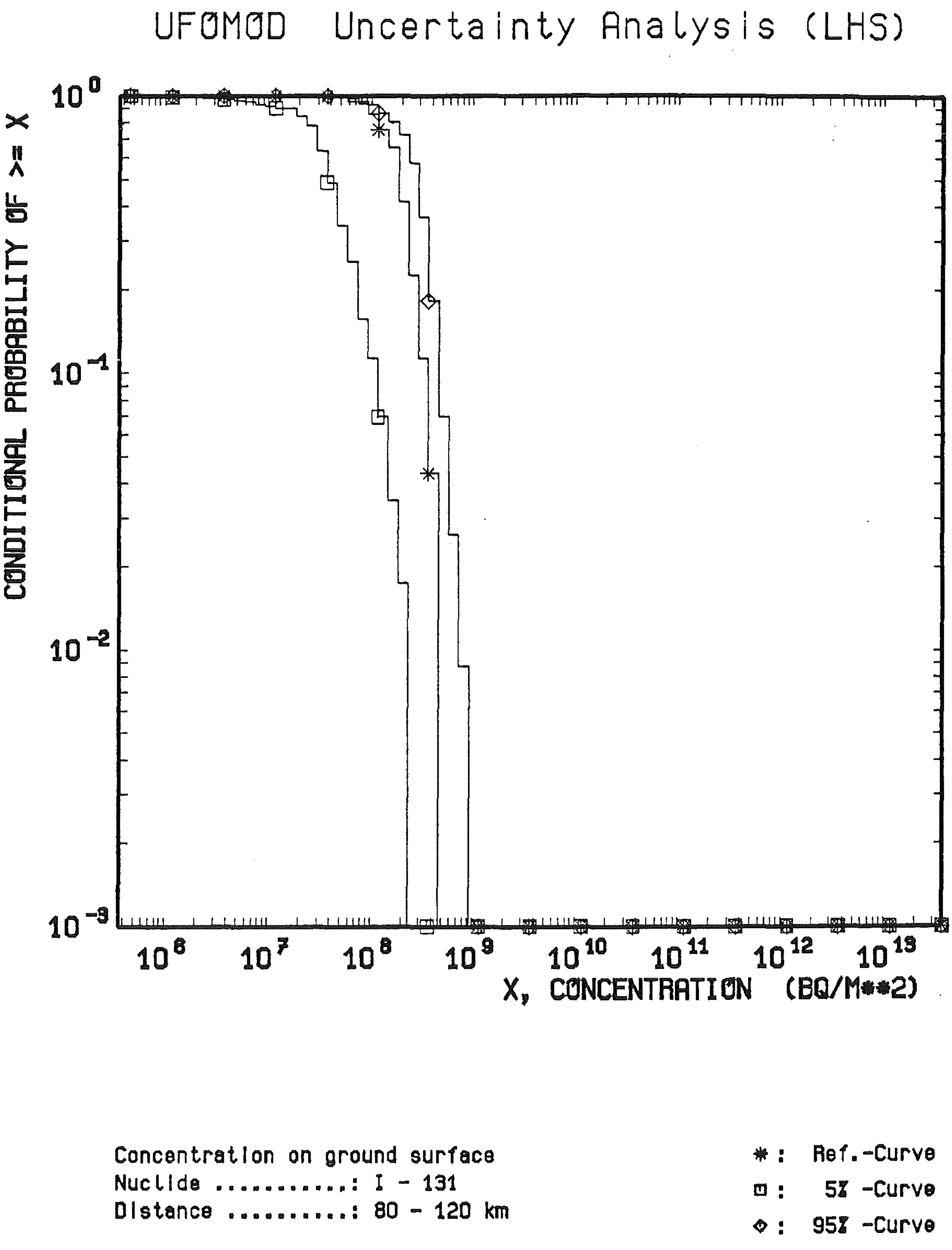
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

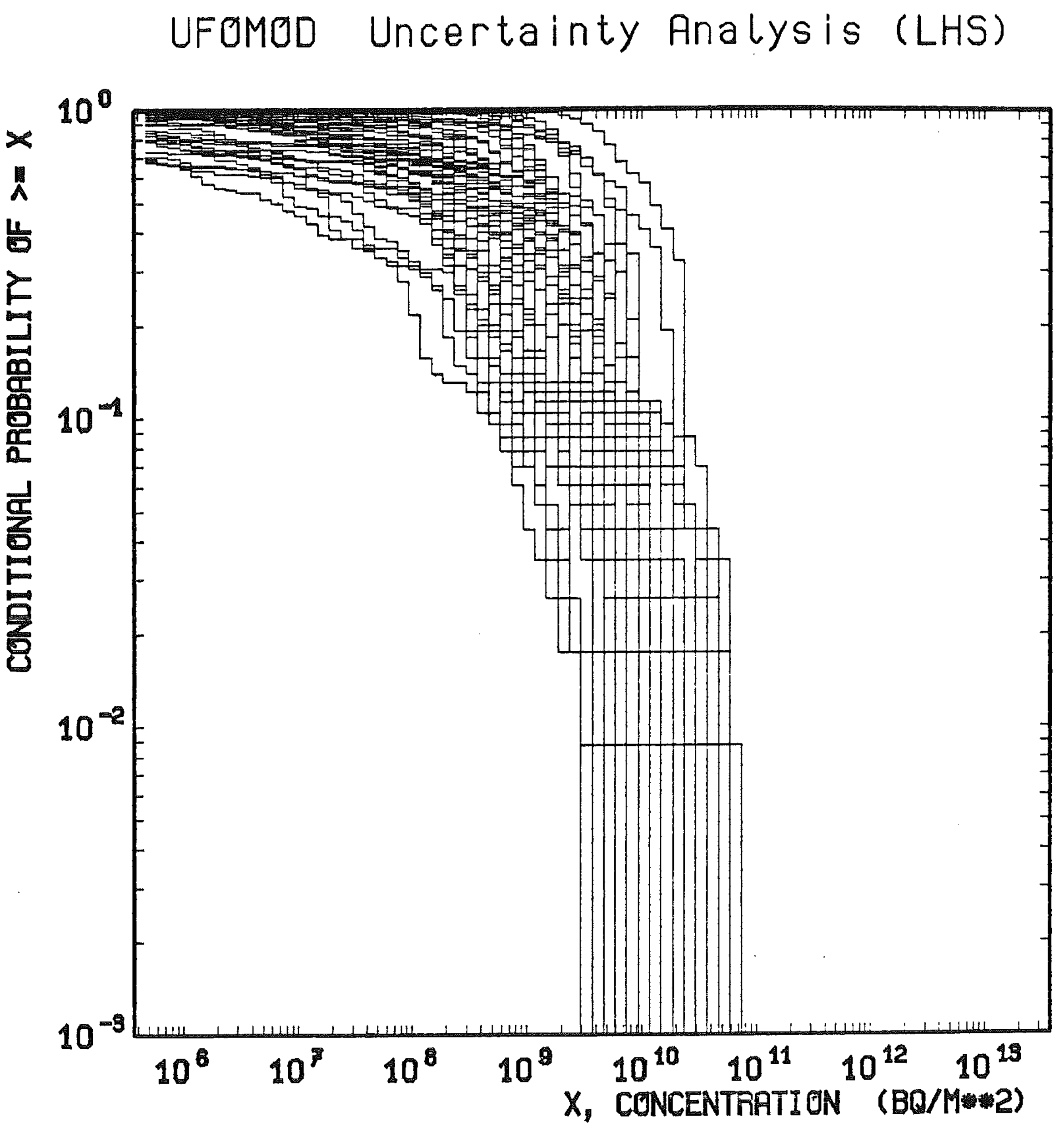
KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE ØF SIZE 59.




KfK INR

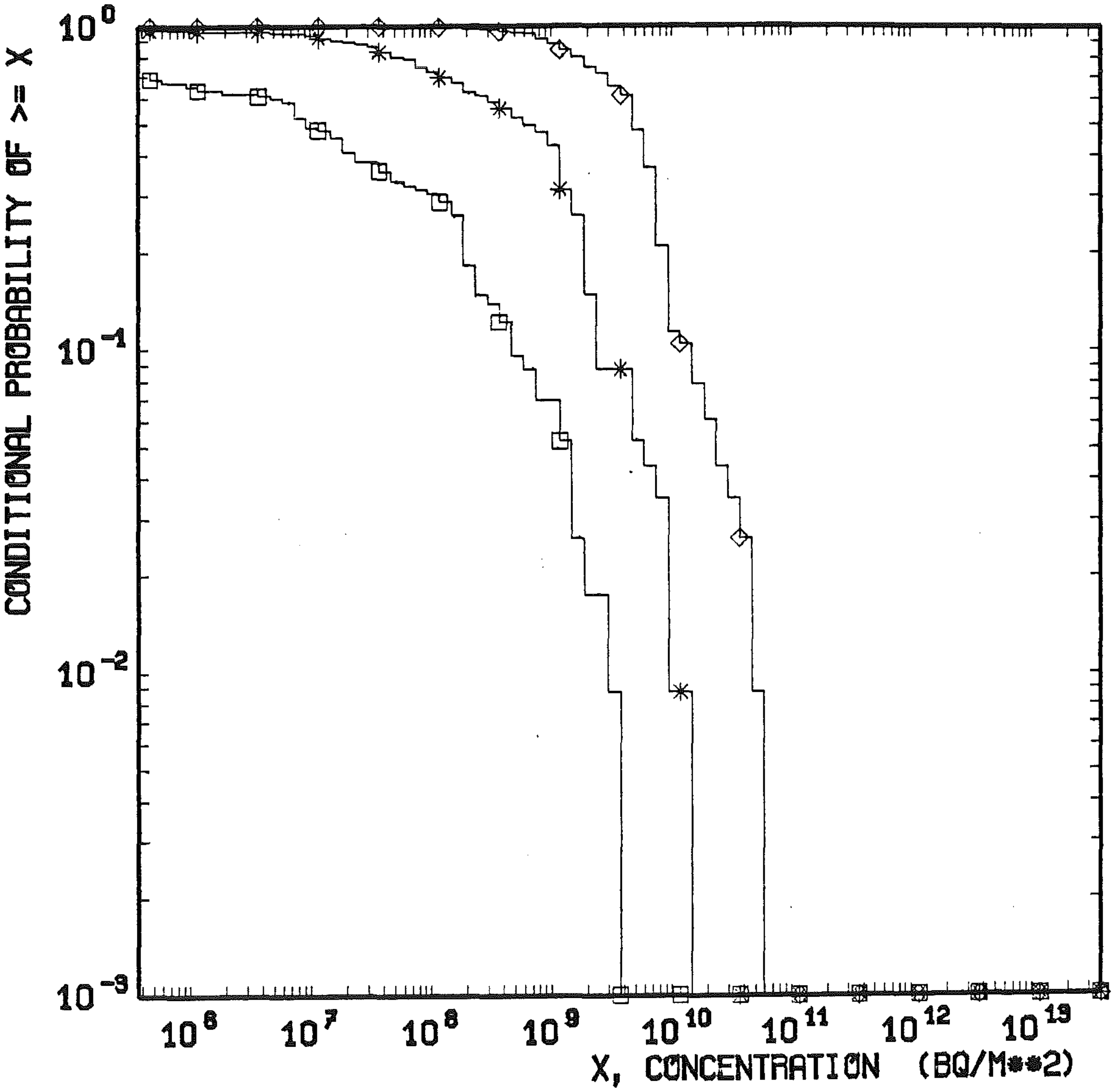
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 59.

## UFØMØD Uncertainty Analysis (LHS)



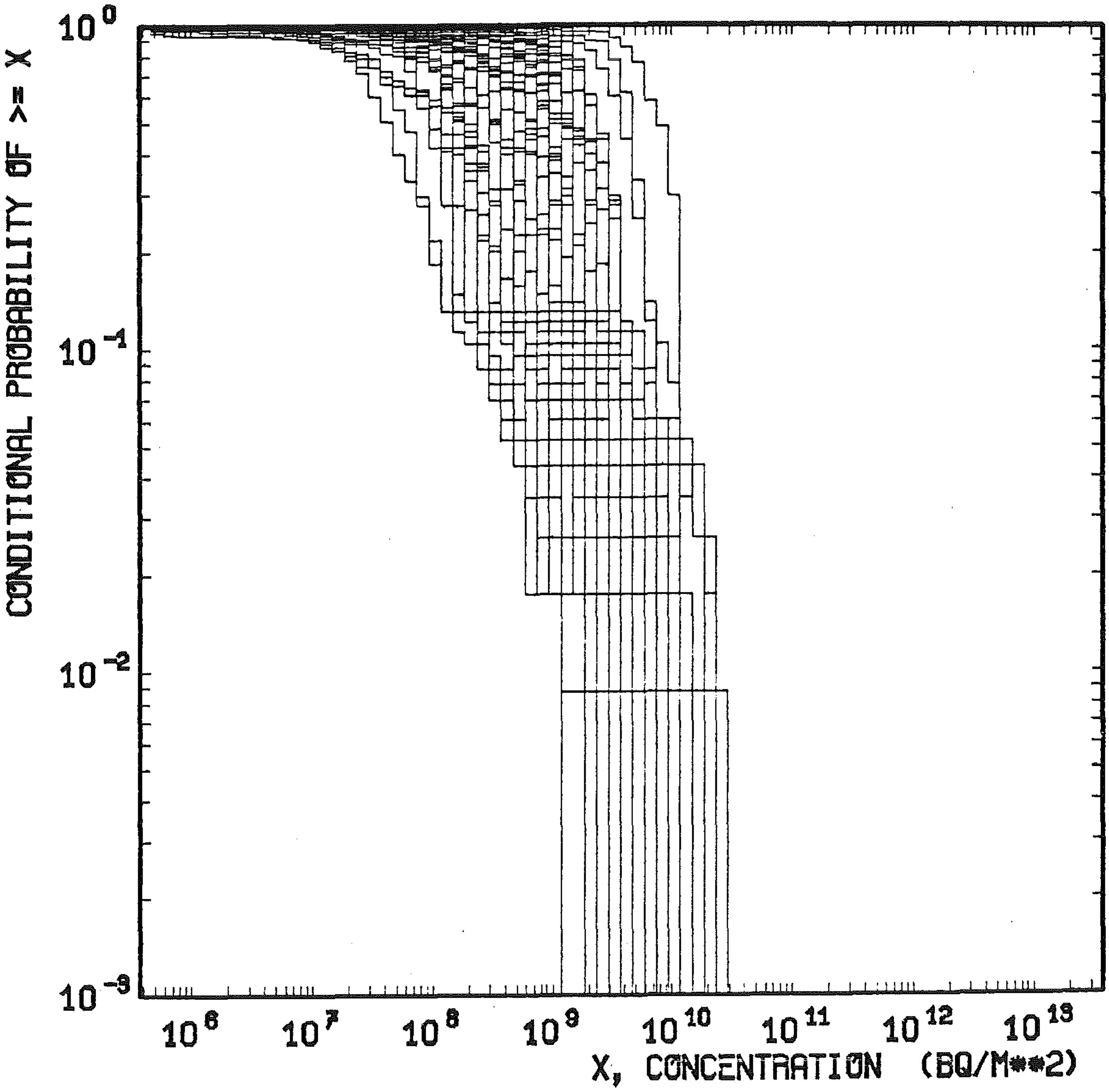

Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

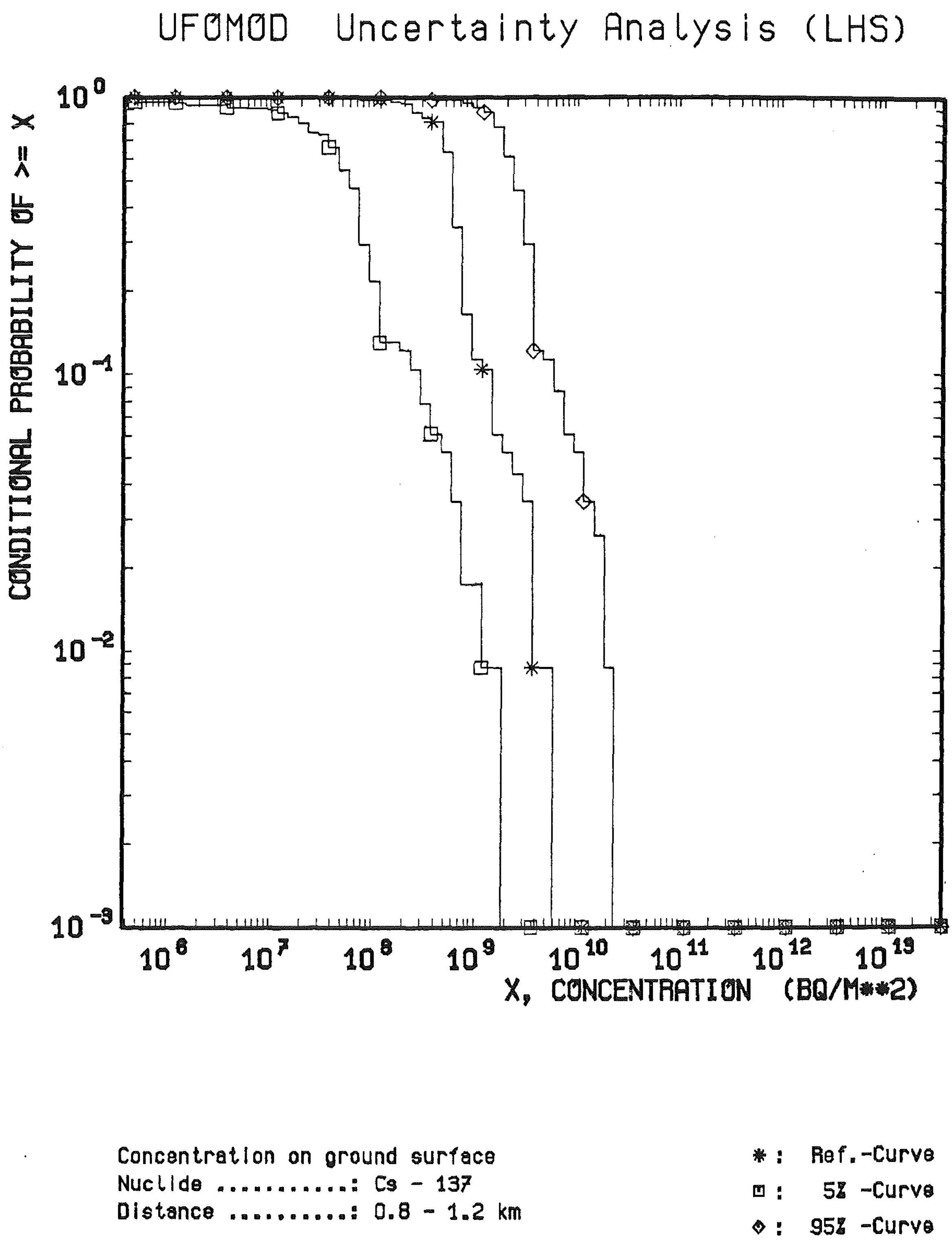
UFØMØD Uncertainty Analysis (LHS)



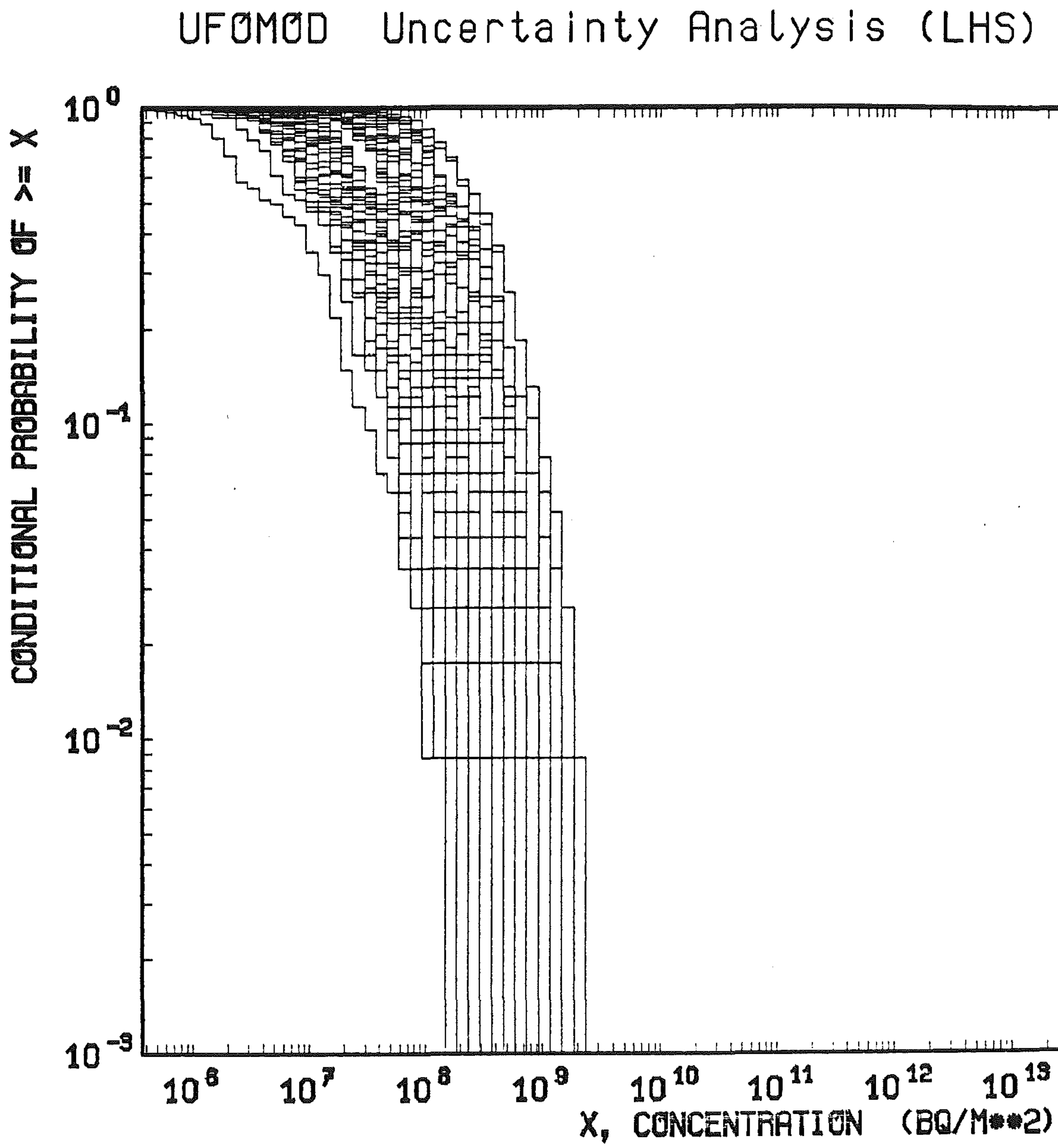

Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE ØF SIZE 59.

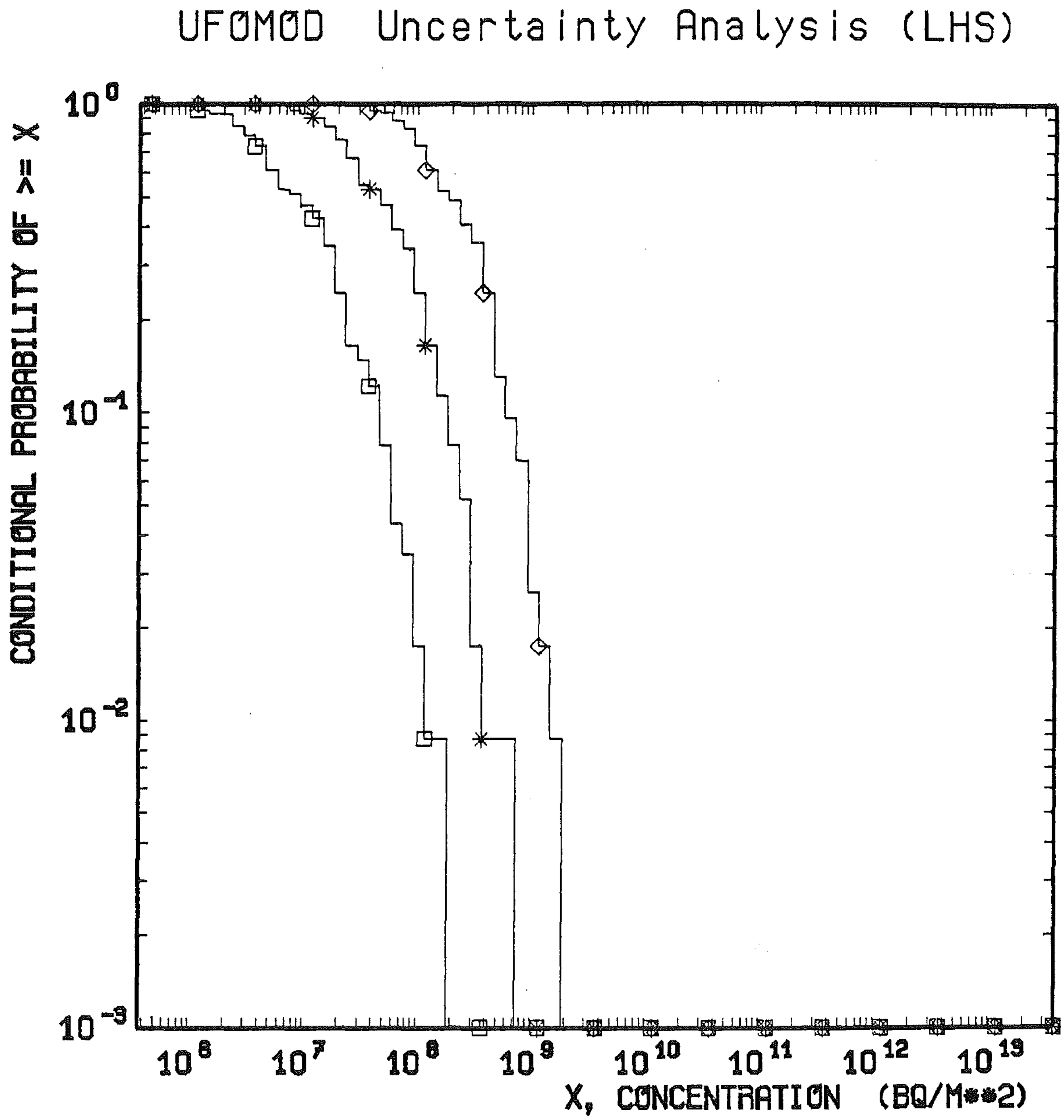



REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 59.

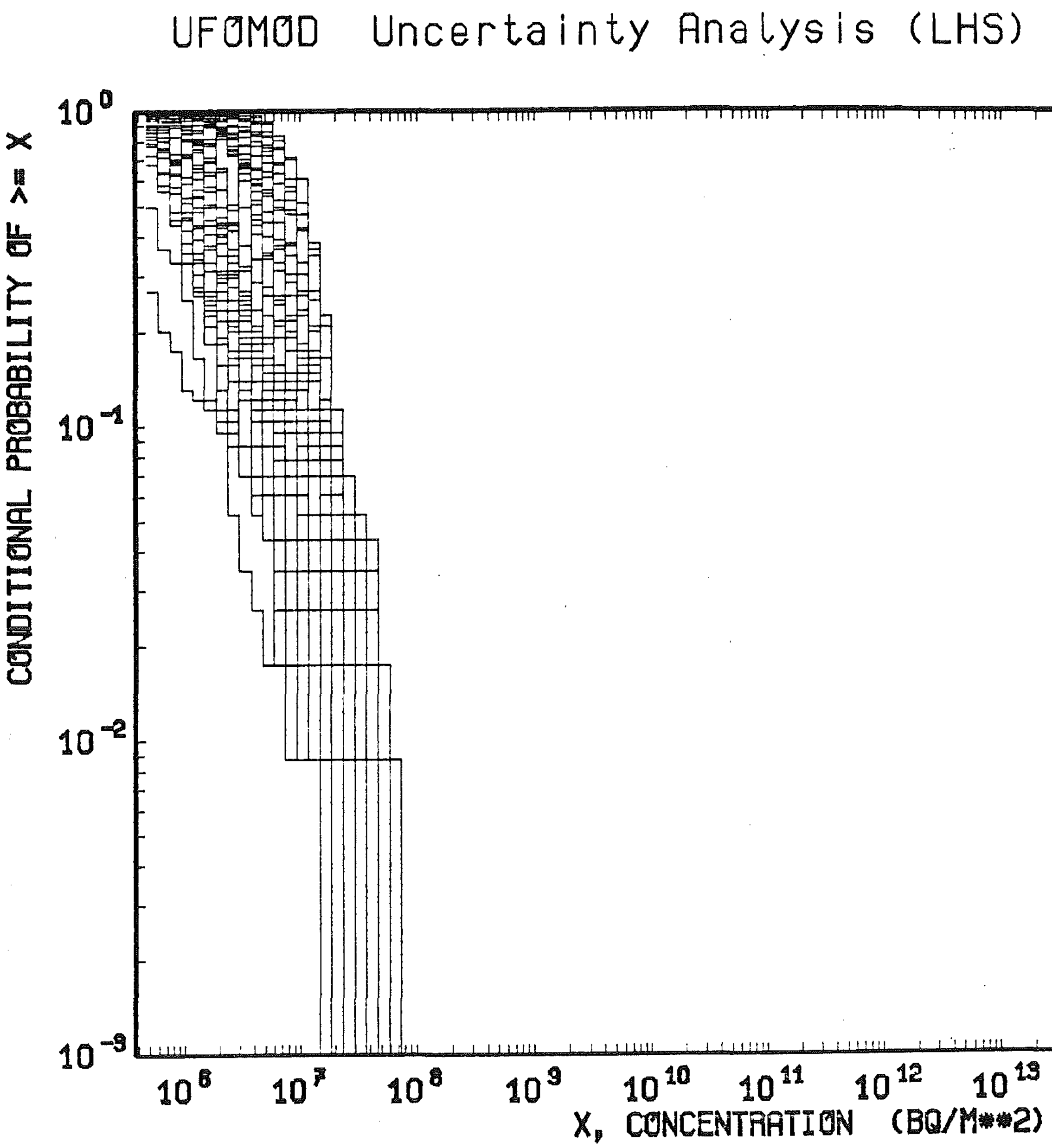



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

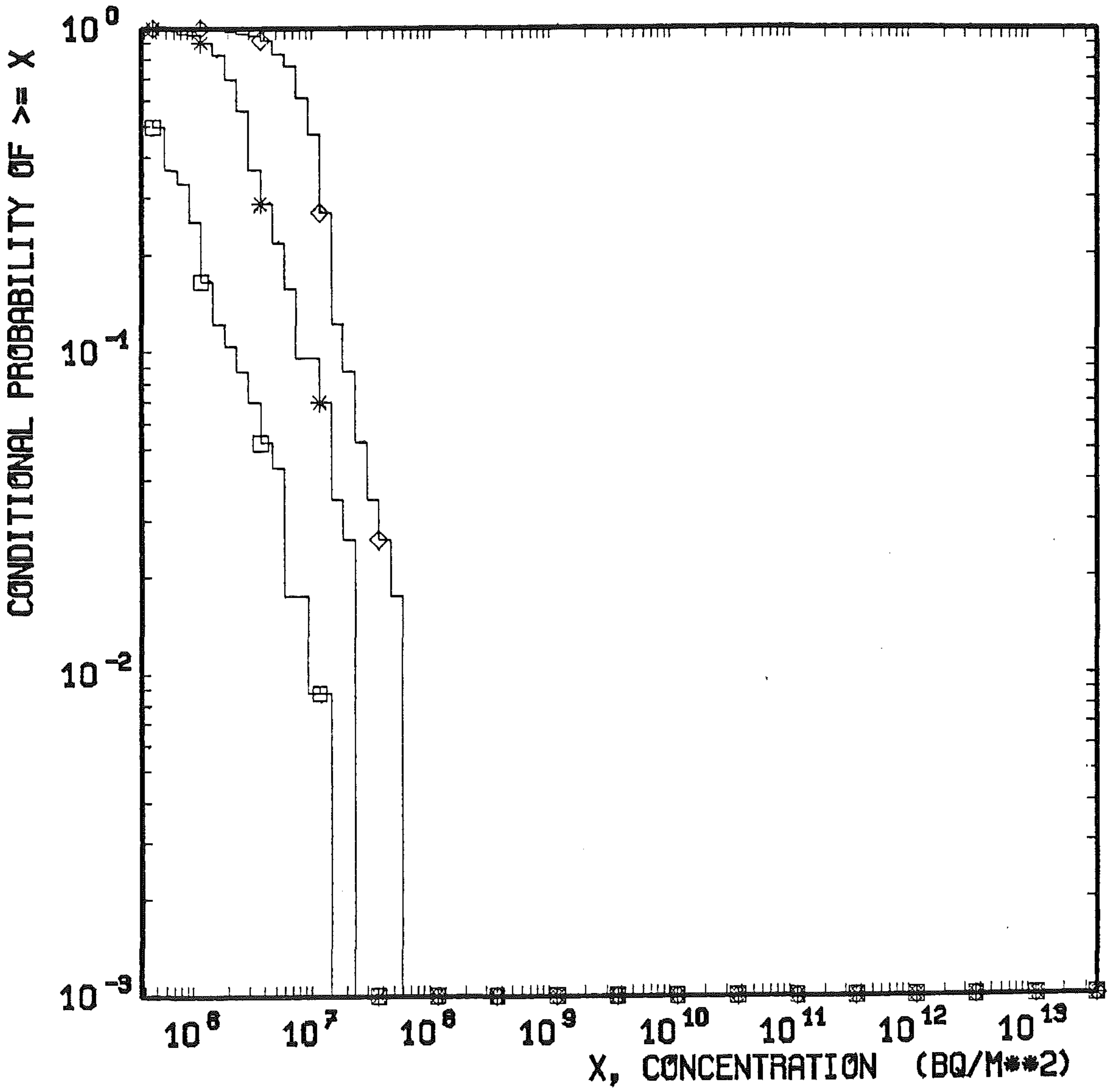



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN LATIN HYPERCUBE SAMPLE OF SIZE 59.

UFØMØD Uncertainty Analysis (LHS)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

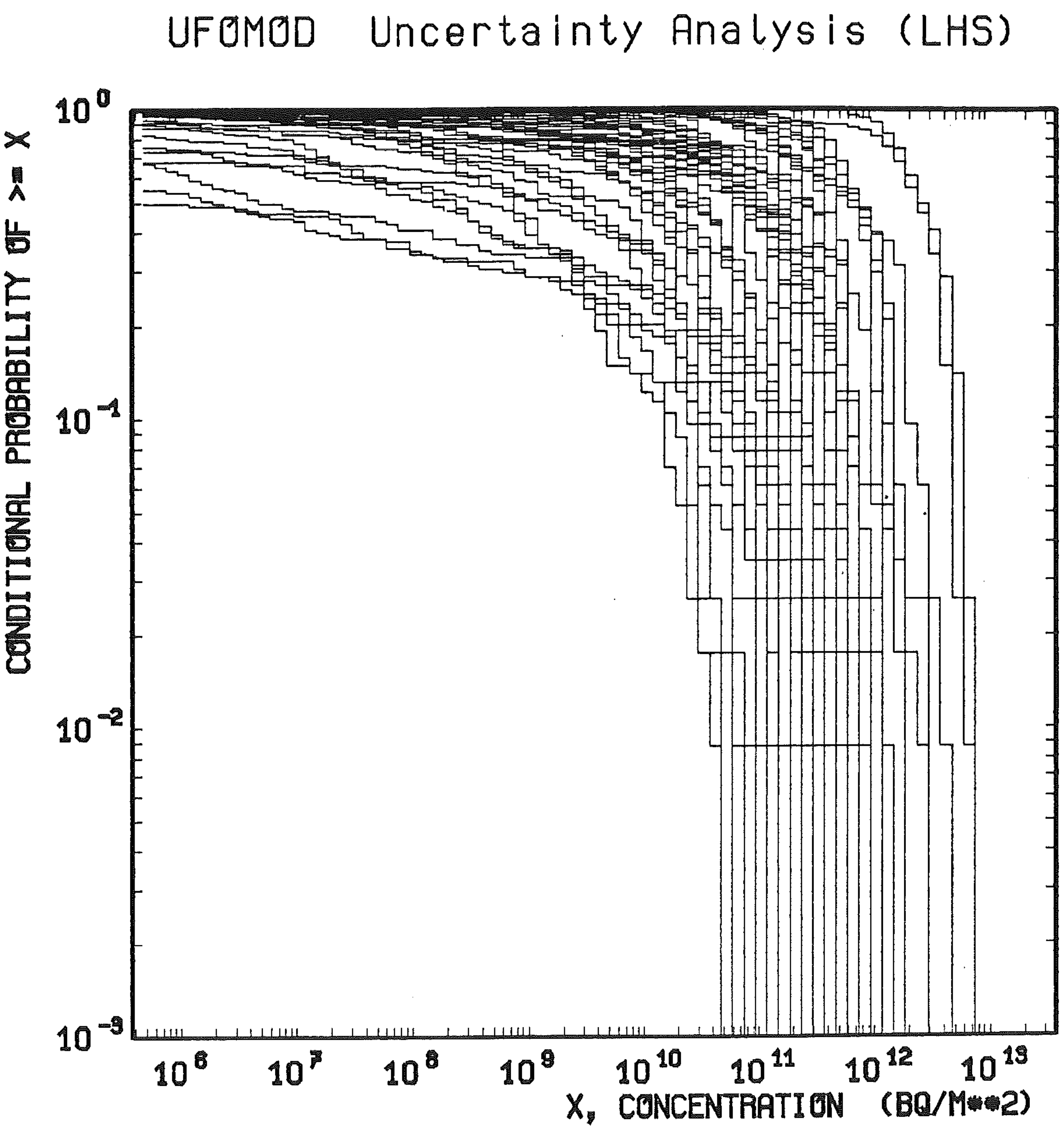
* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

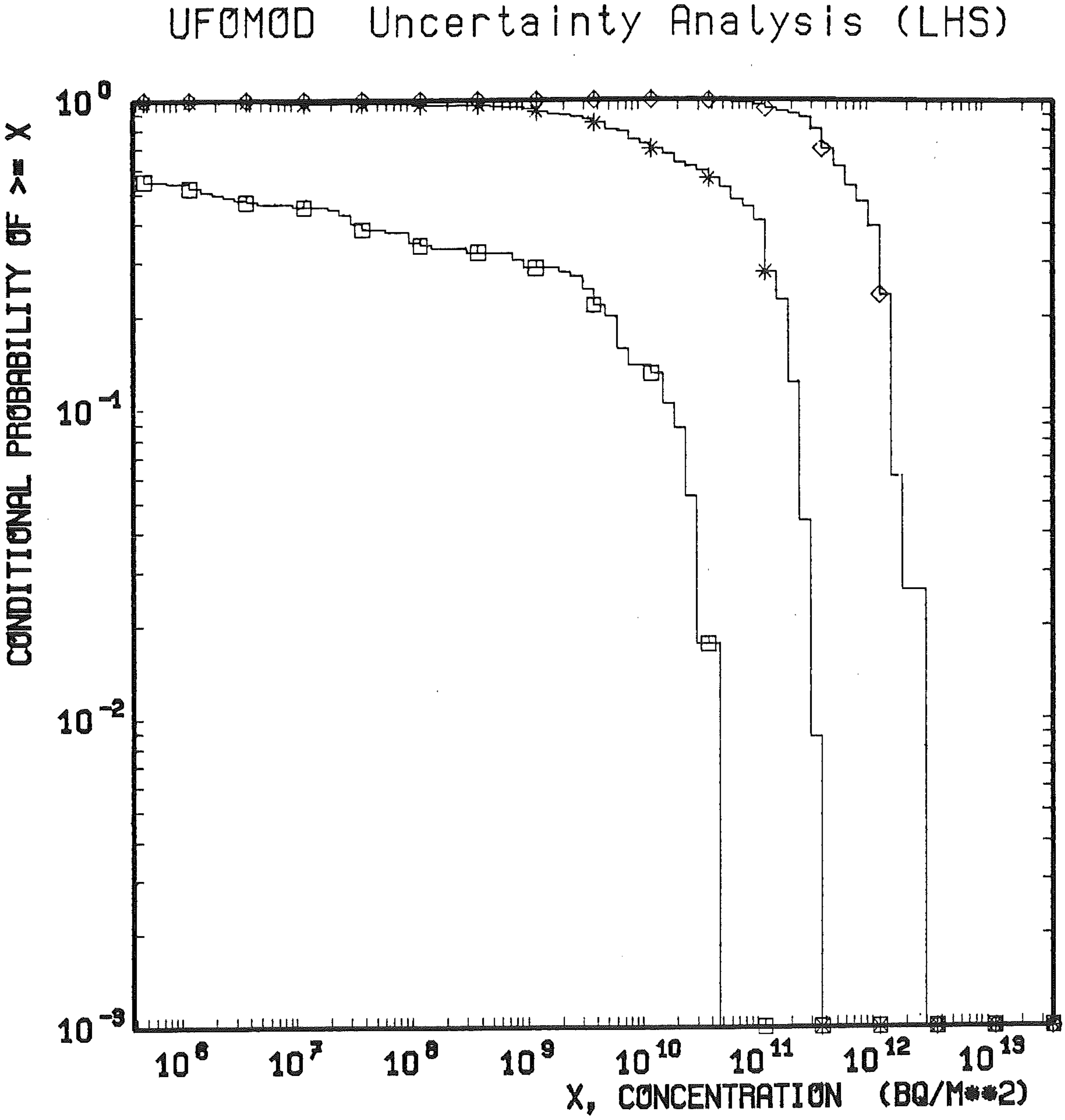
## B.3 ACTIVITY CONCENTRATIONS (LHS AT GRS, N= 59 RUNS)

In this section CCFDs and the corresponding confidence curves are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 59. (GRS - DESIGN)

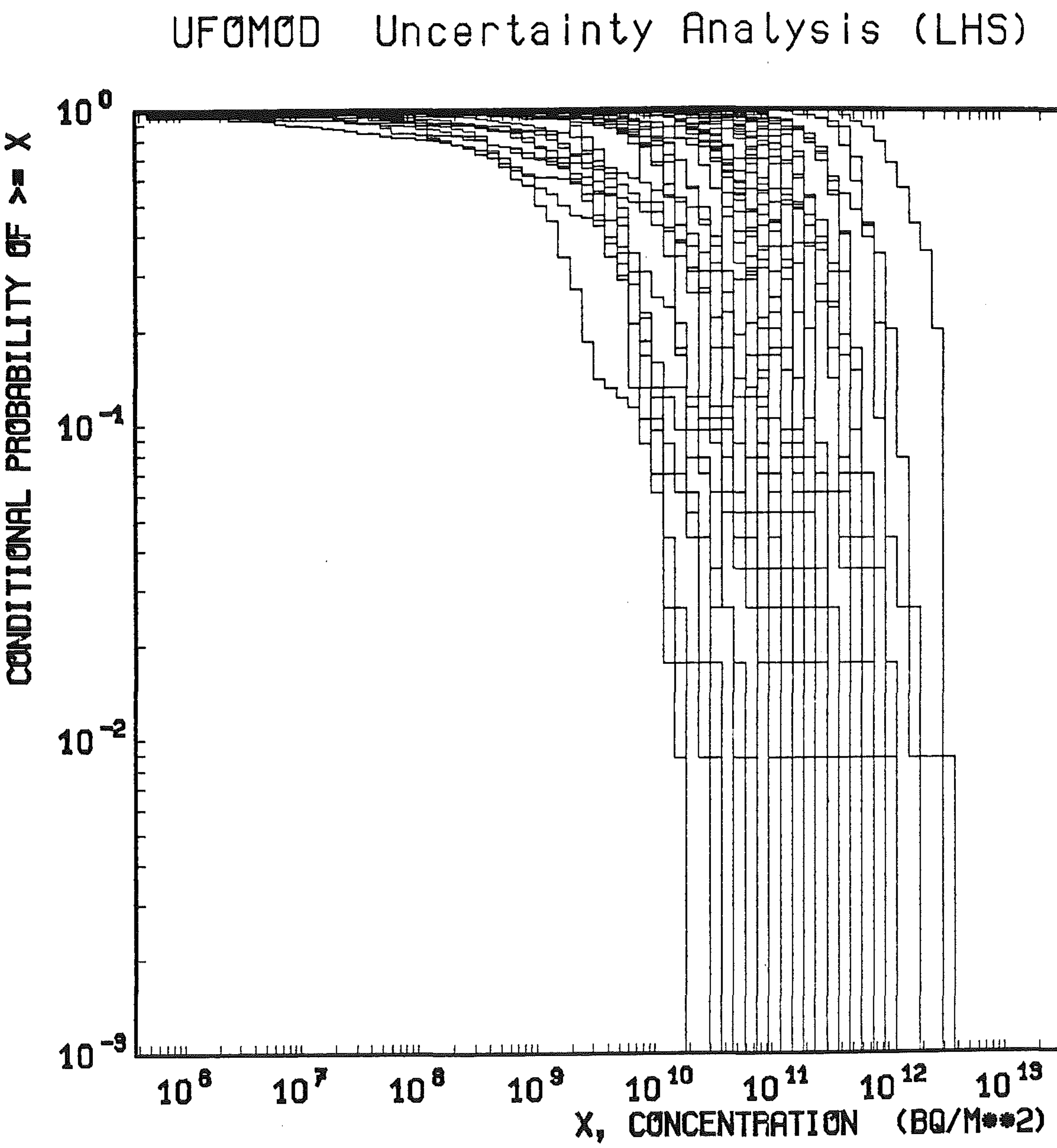



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

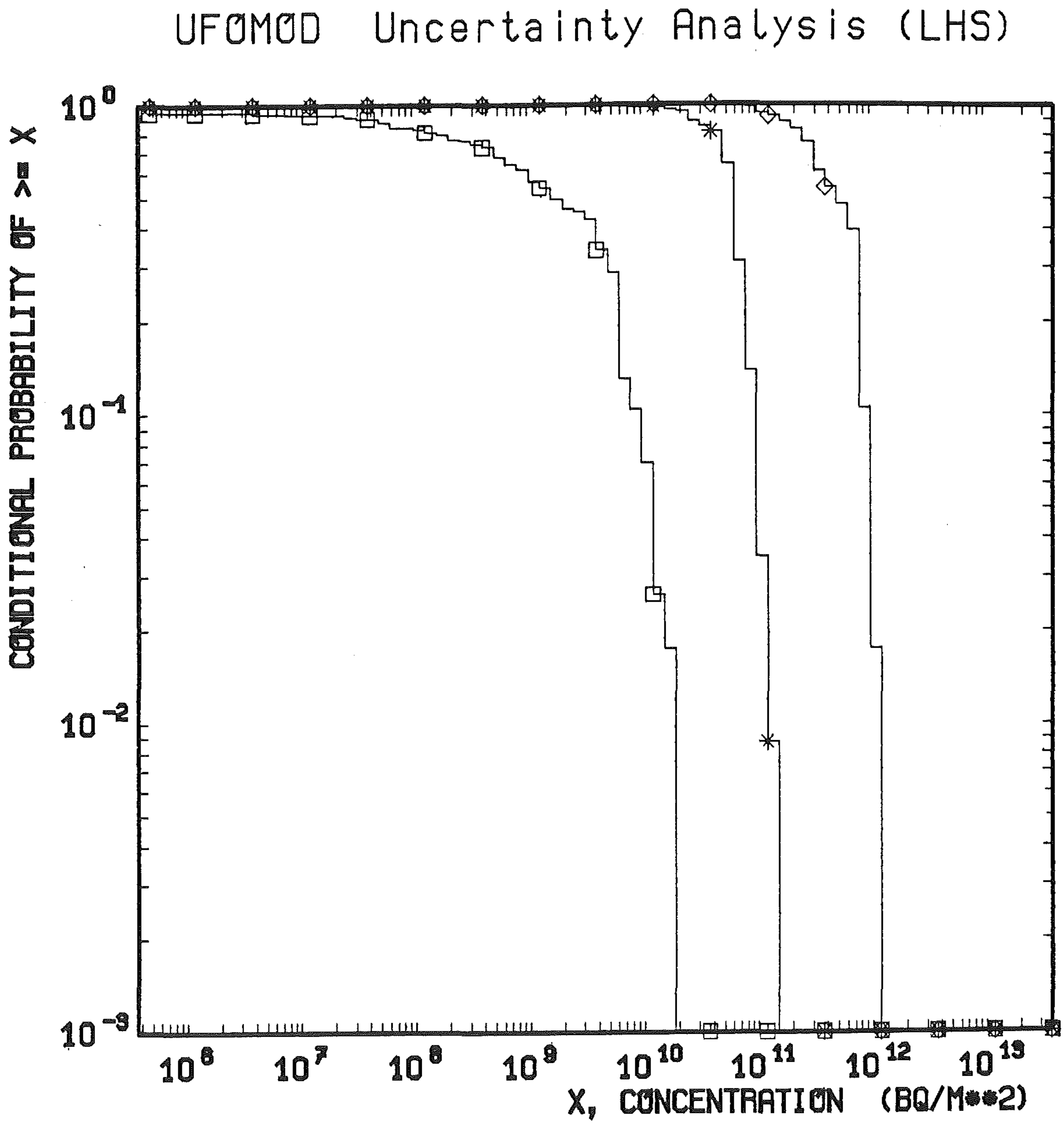
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (AS-SUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 59. (GRS - DESIGN)



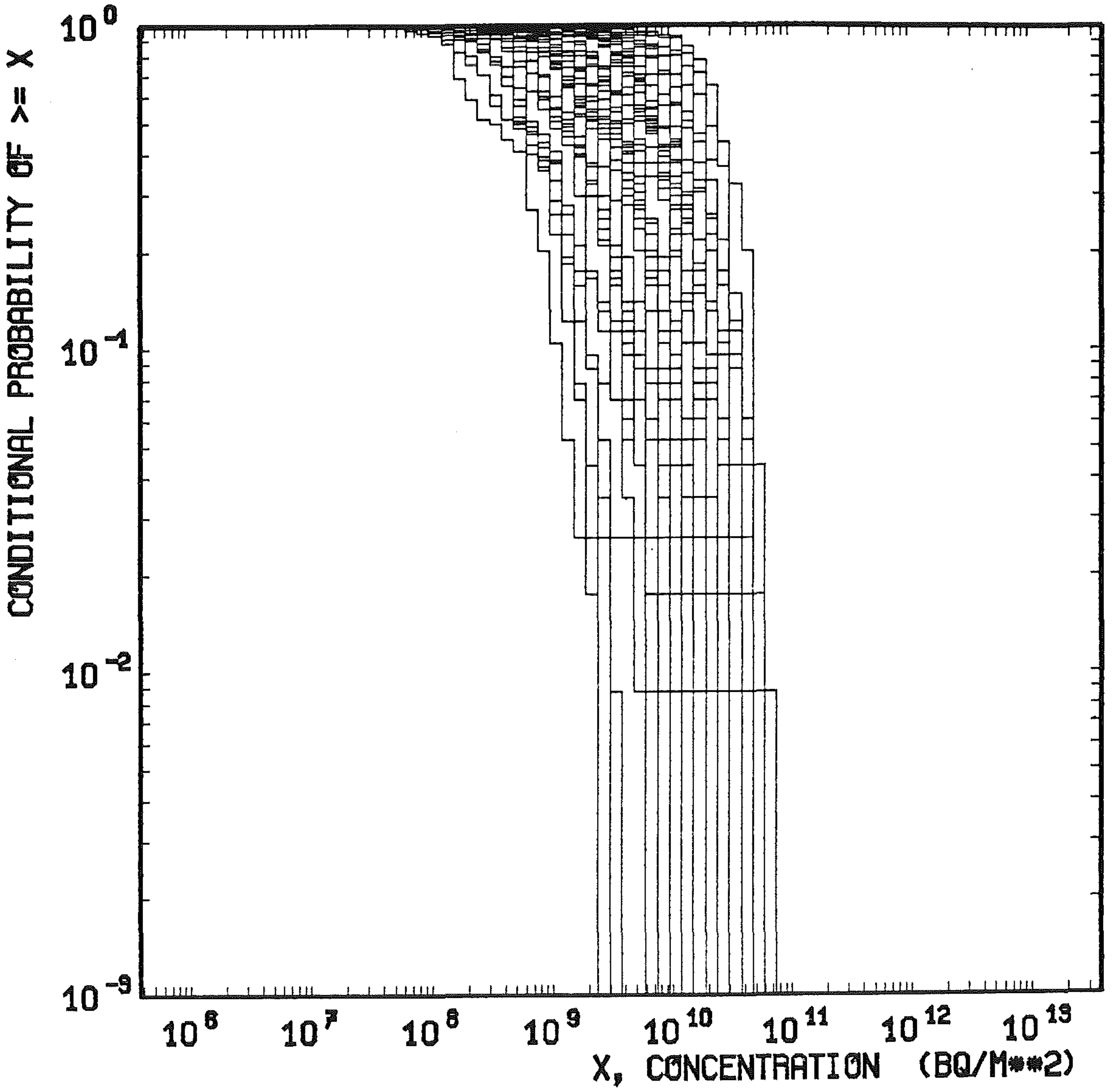

Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS. (GRS - DESIGN)

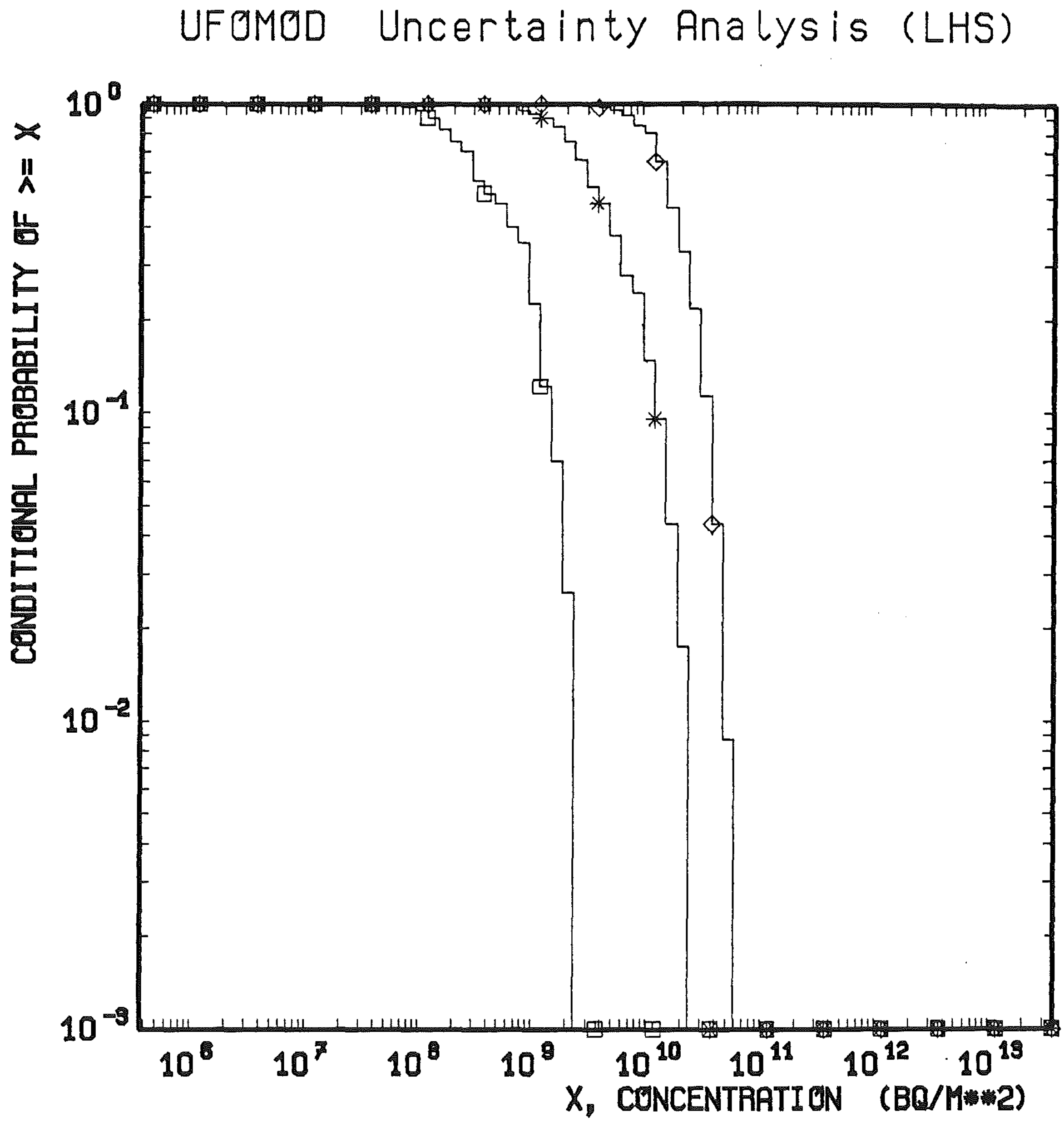
## UFØMØD Uncertainty Analysis (LHS)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

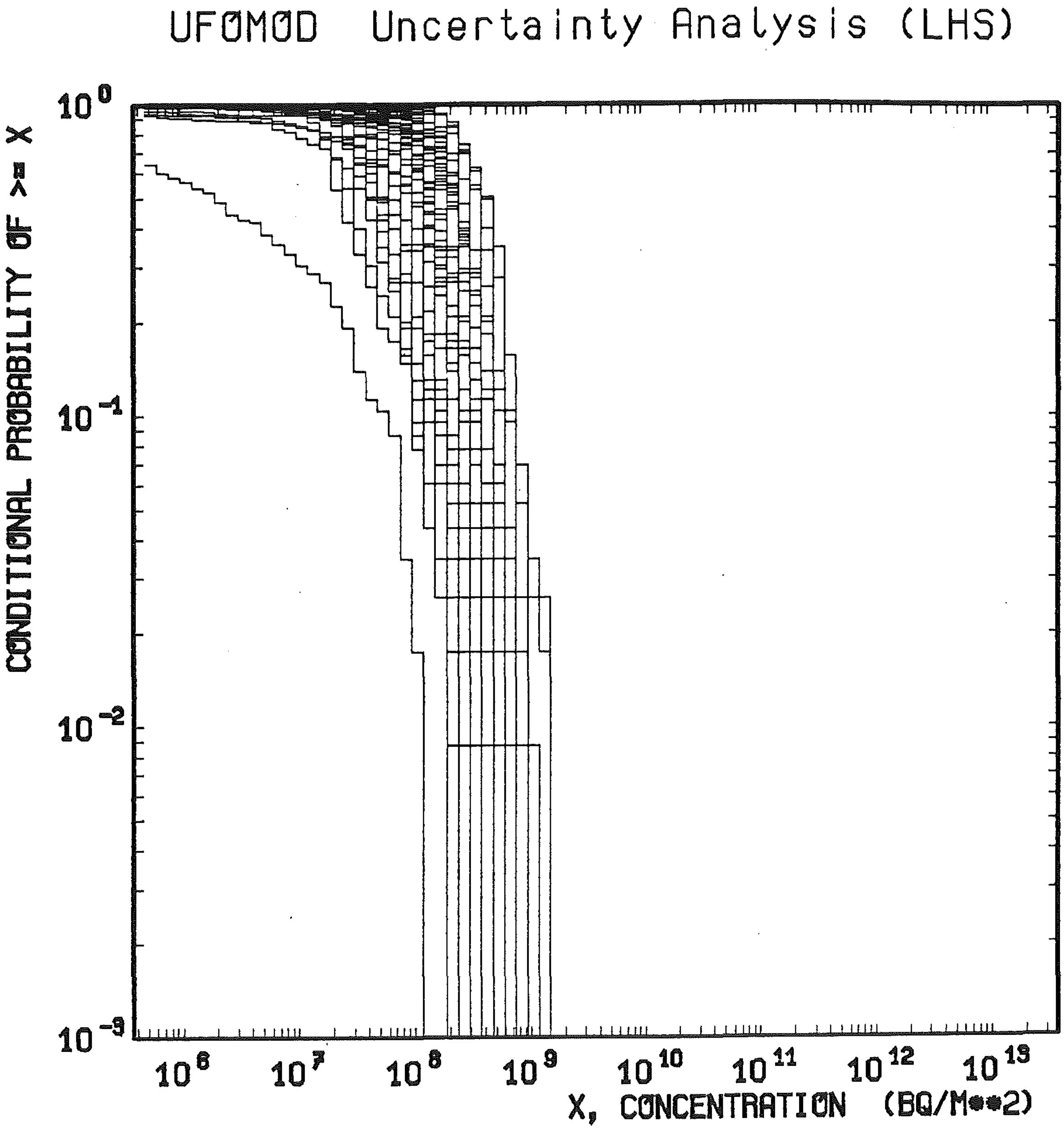
COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE ØF SIZE 59. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

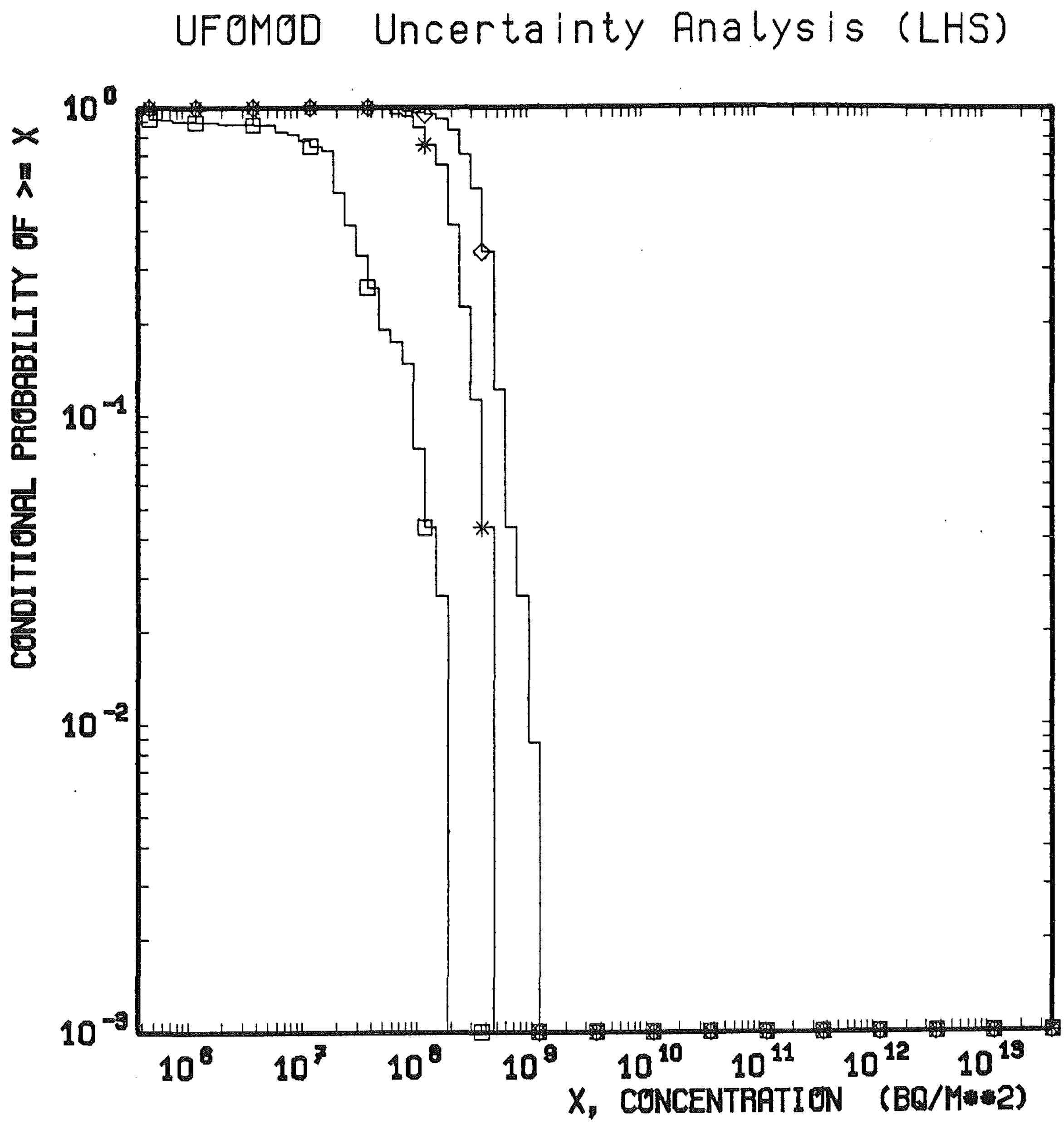
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

KfK INR

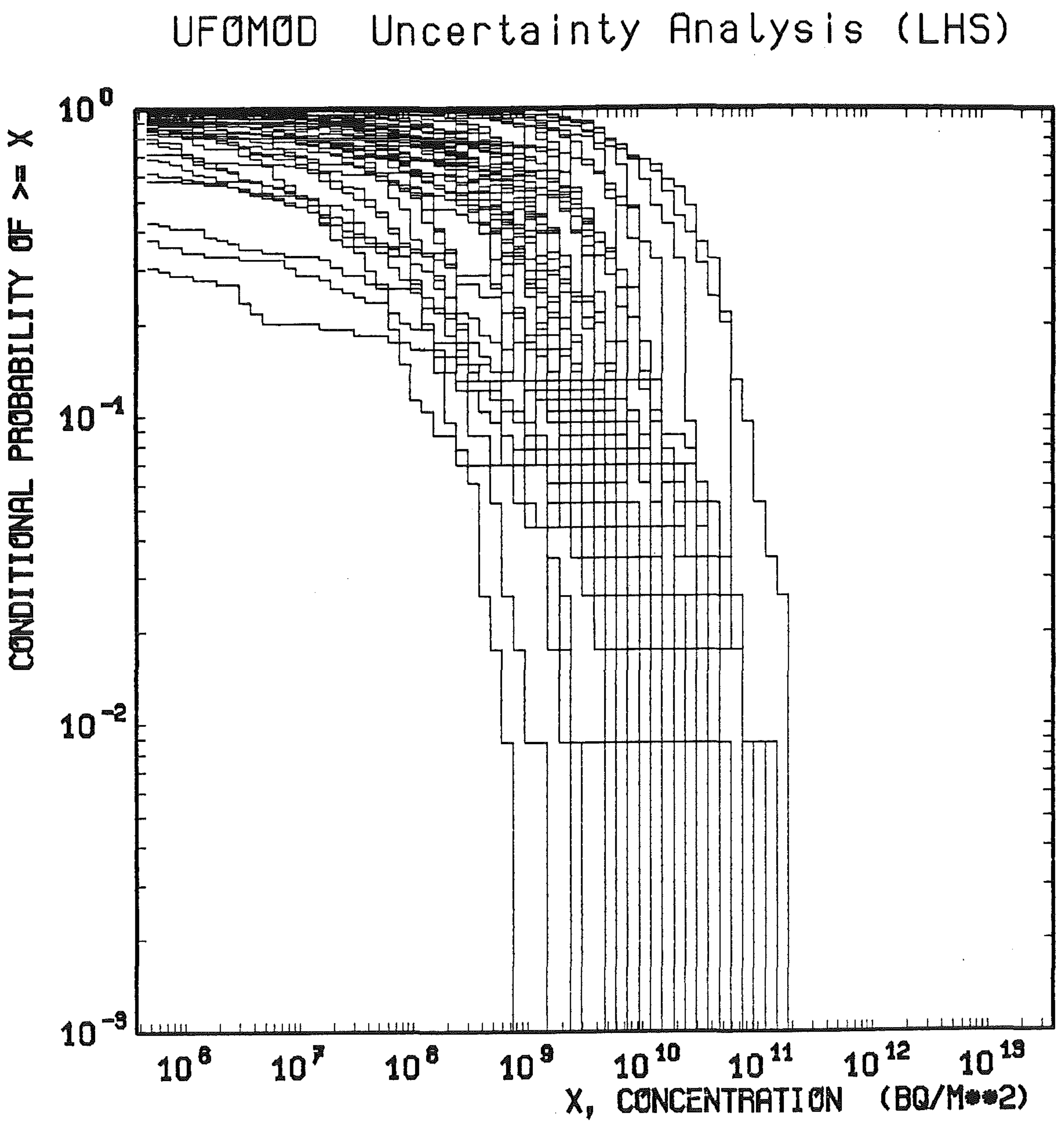
COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 59. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

* : Ref.-Curve
□ : 5% -Curve
◊ : 95% -Curve

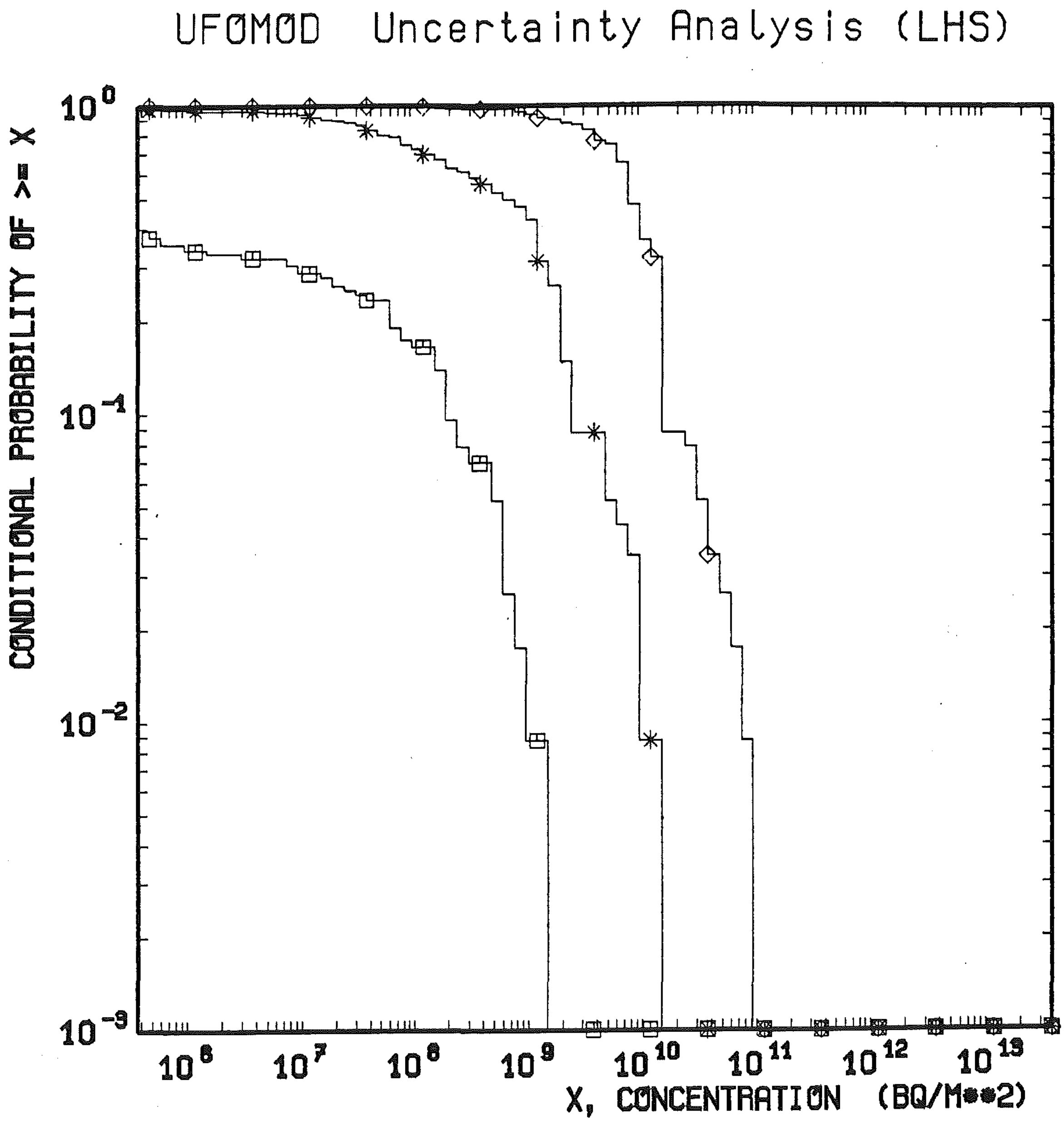
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

KfK INR

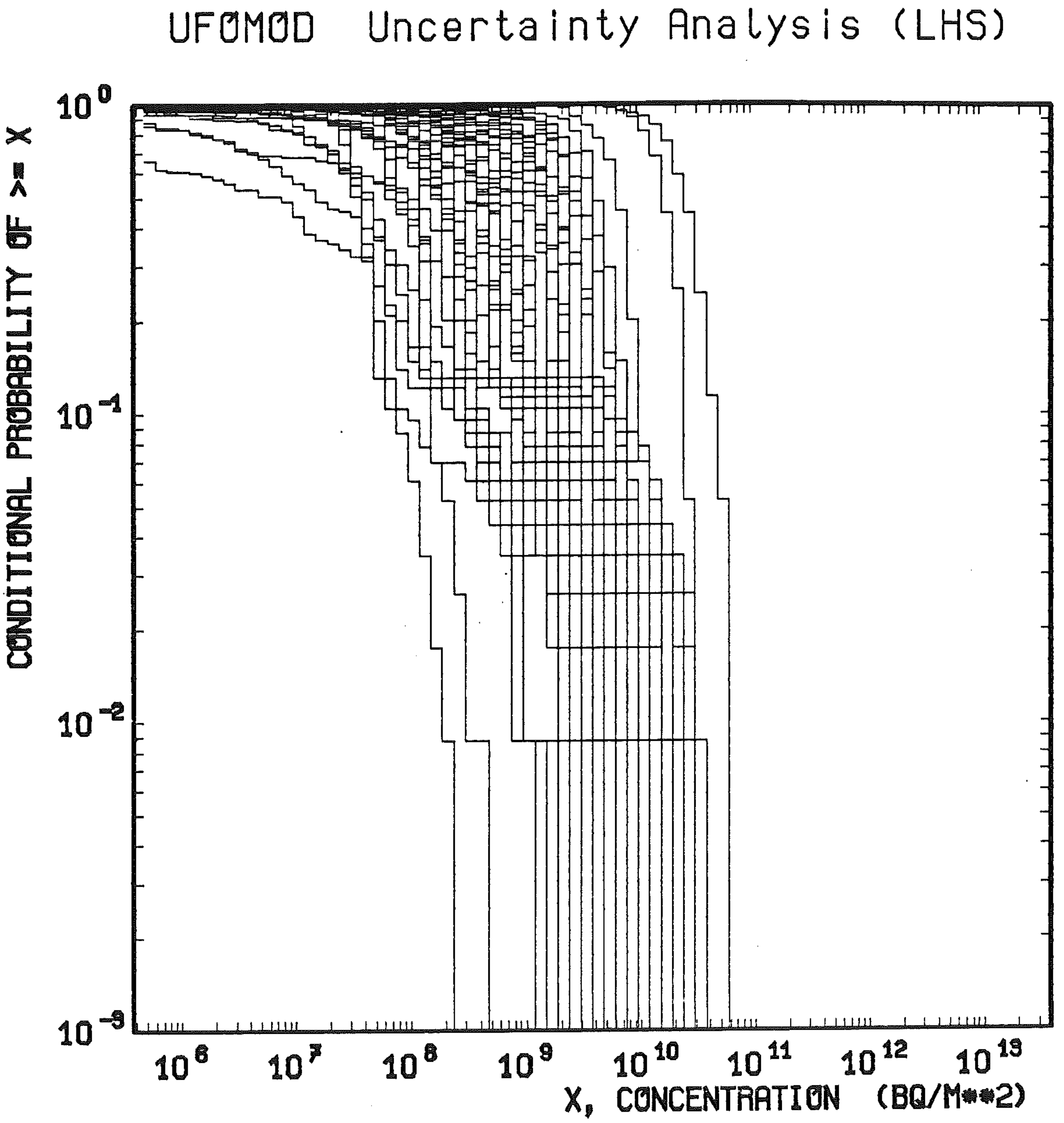
CØMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE ØF SIZE 59. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

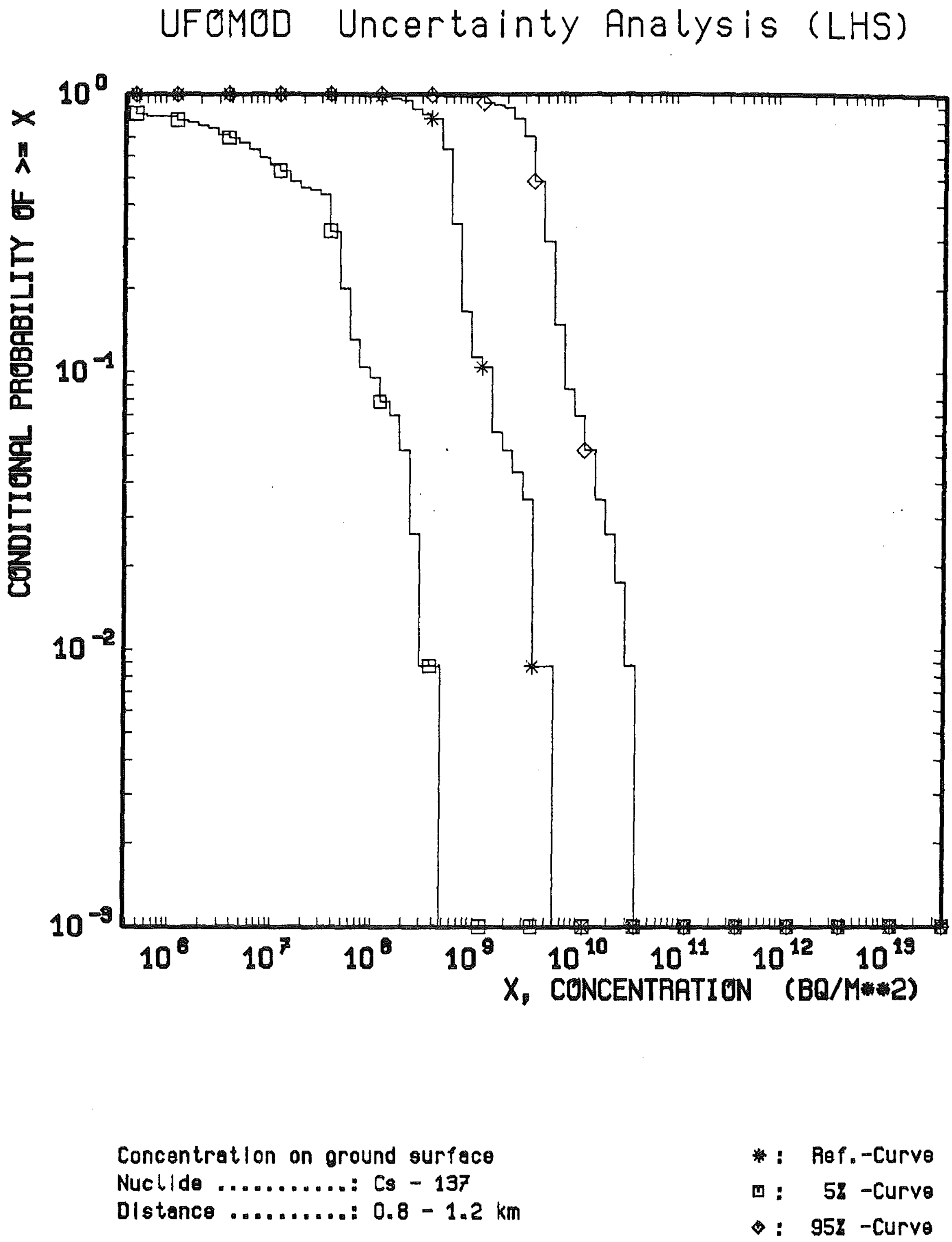
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

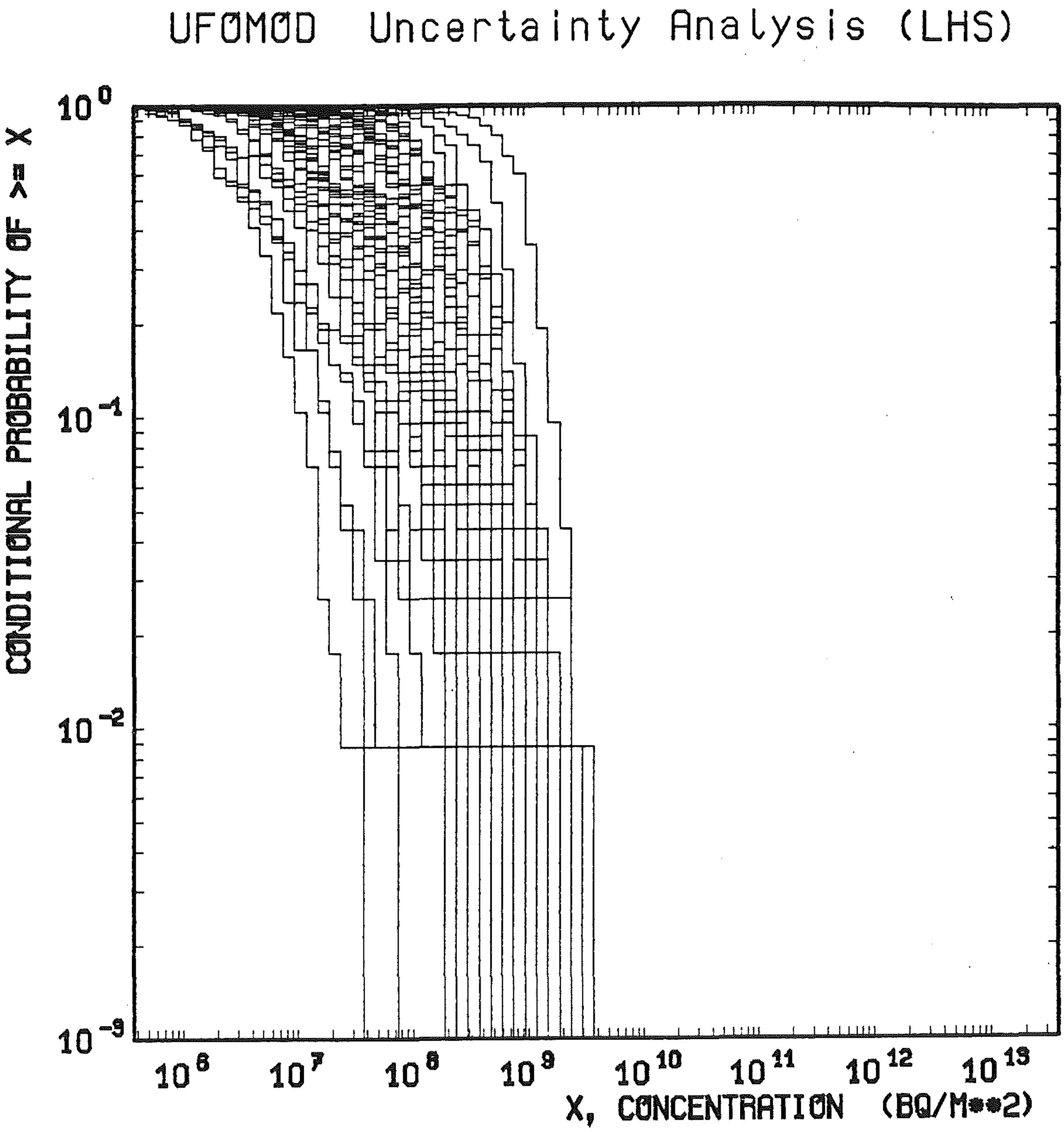
KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 59. (GRS - DESIGN)




KfK INR

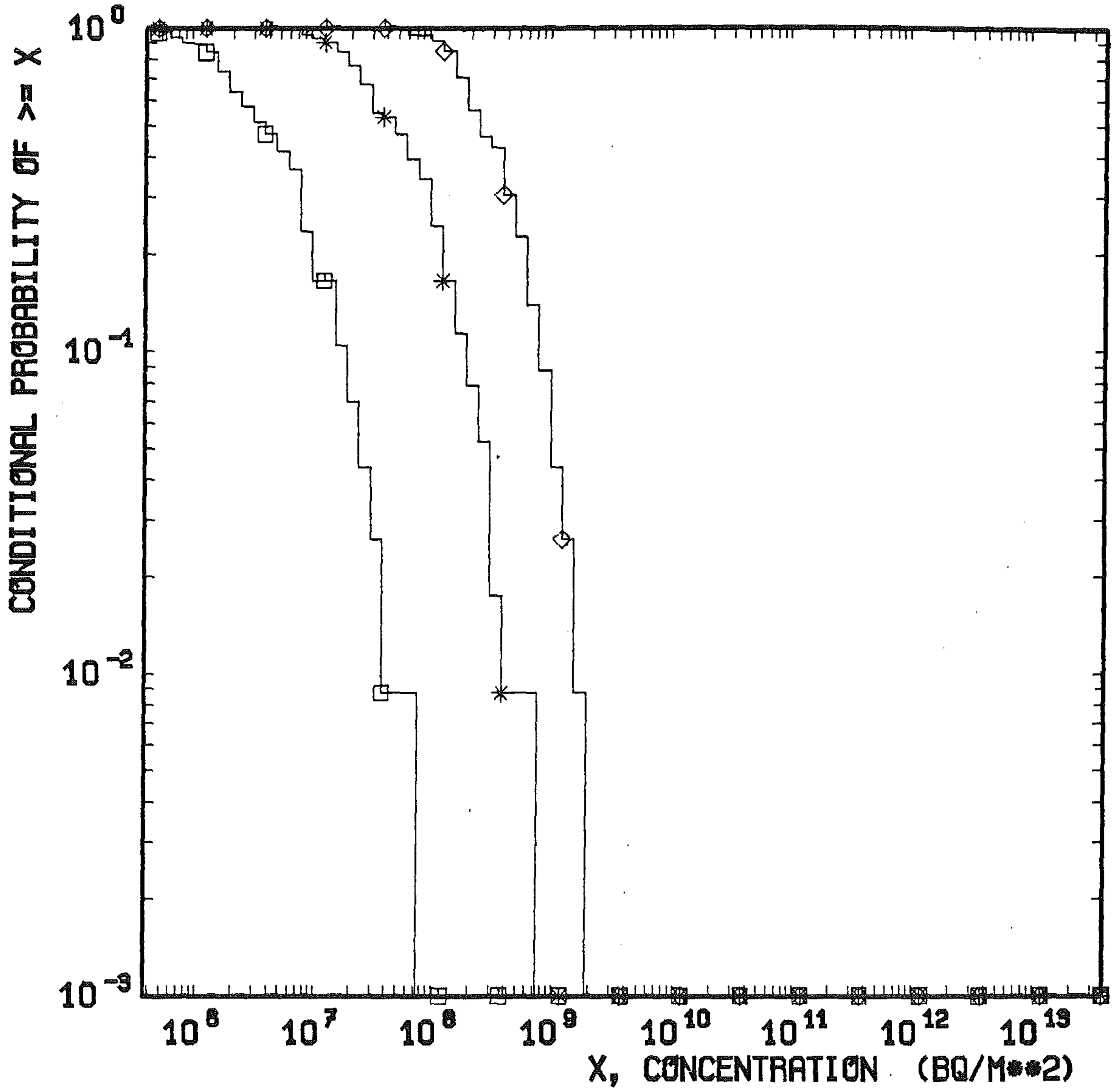
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)




Concentration on ground surface
Nuclide ............: Cs - 137
Distance ...........: 8 - 12 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 59. (GRS - DESIGN)

UFØMØD Uncertainty Analysis (LHS)

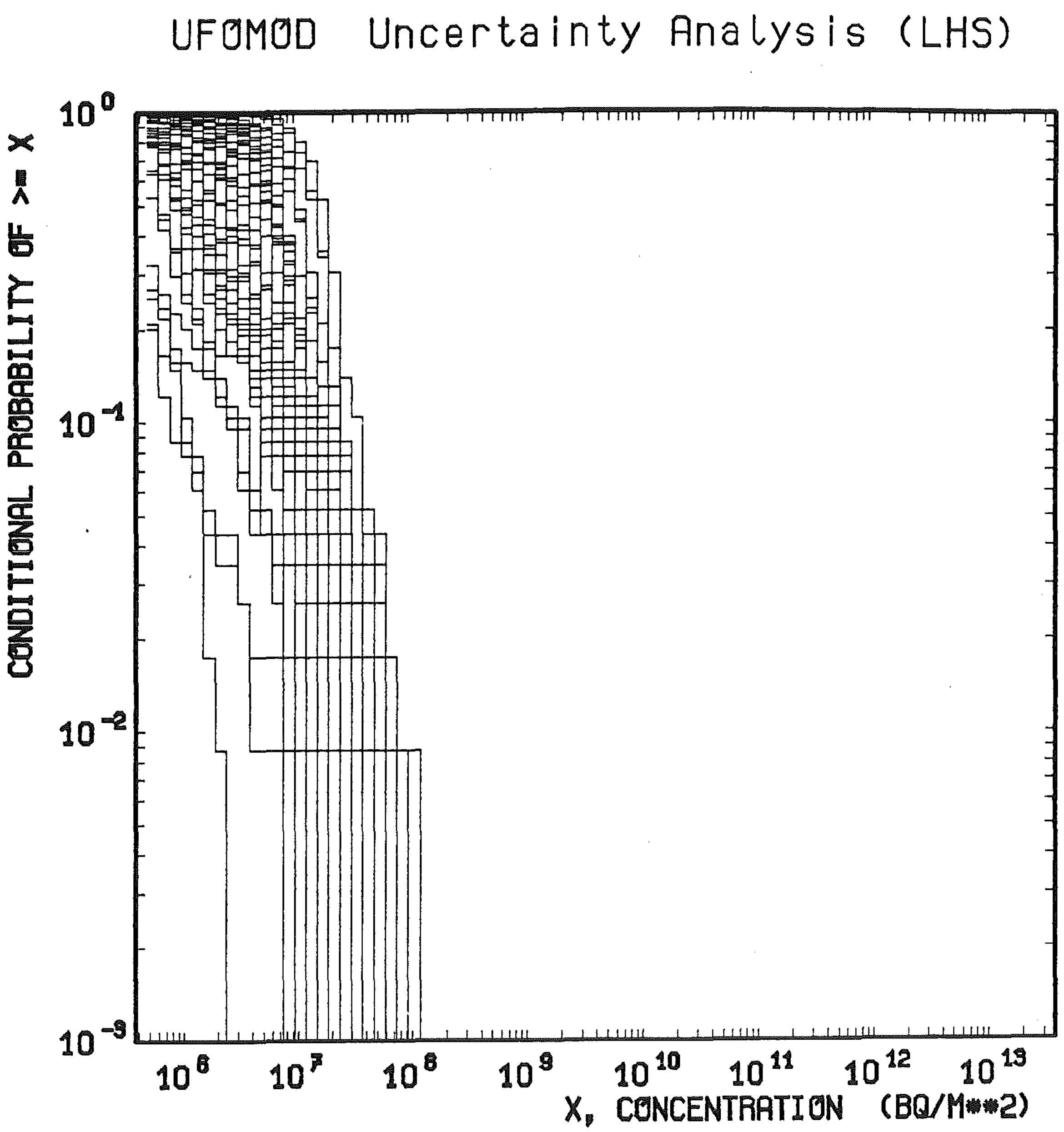



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)

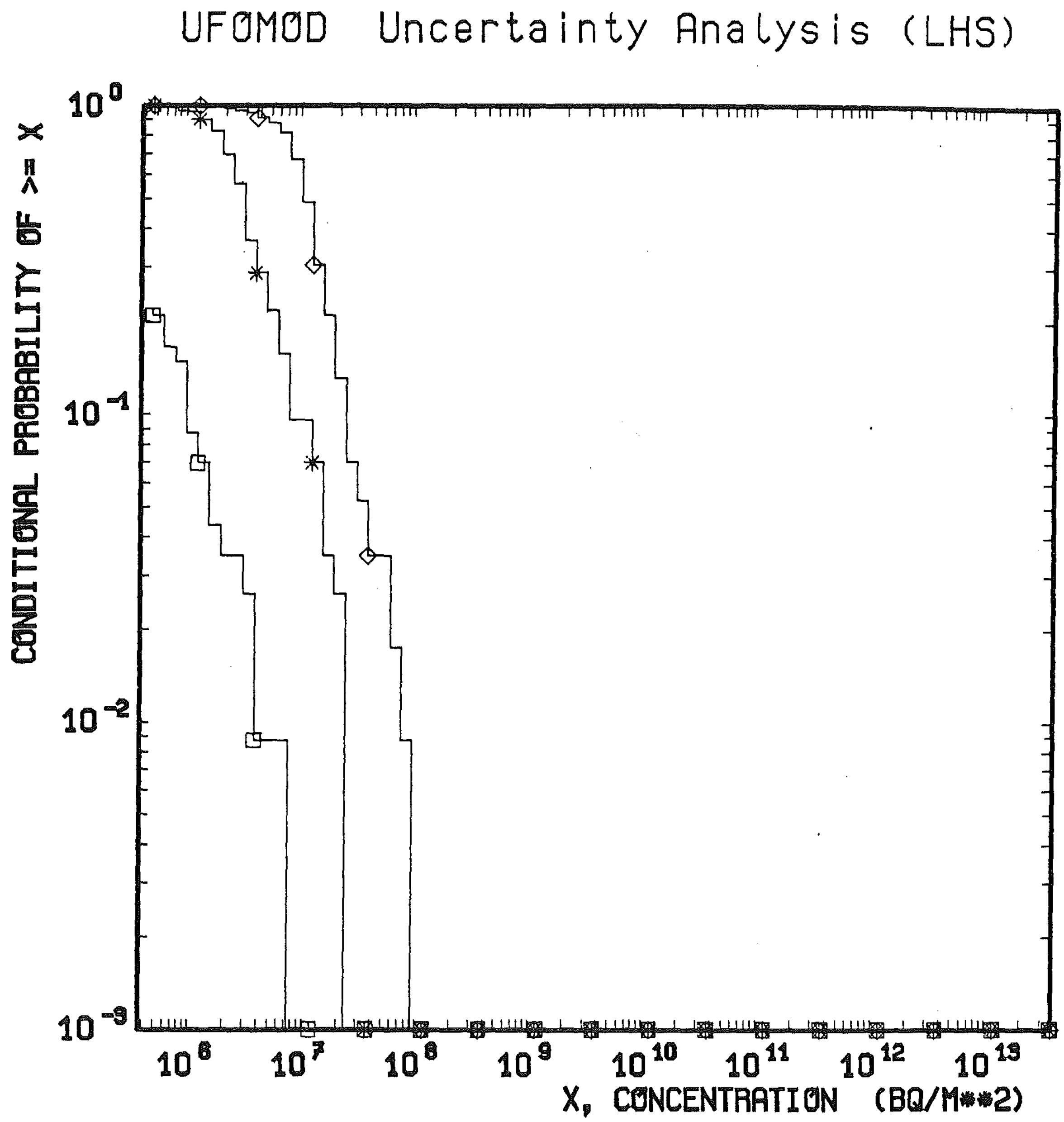



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

KfK INR

CØMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) ØF THE CØNCENTRATIØN UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED). EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 59 RUNS IN A LATIN HYPERCUBE SAMPLE ØF SIZE 59.

(GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

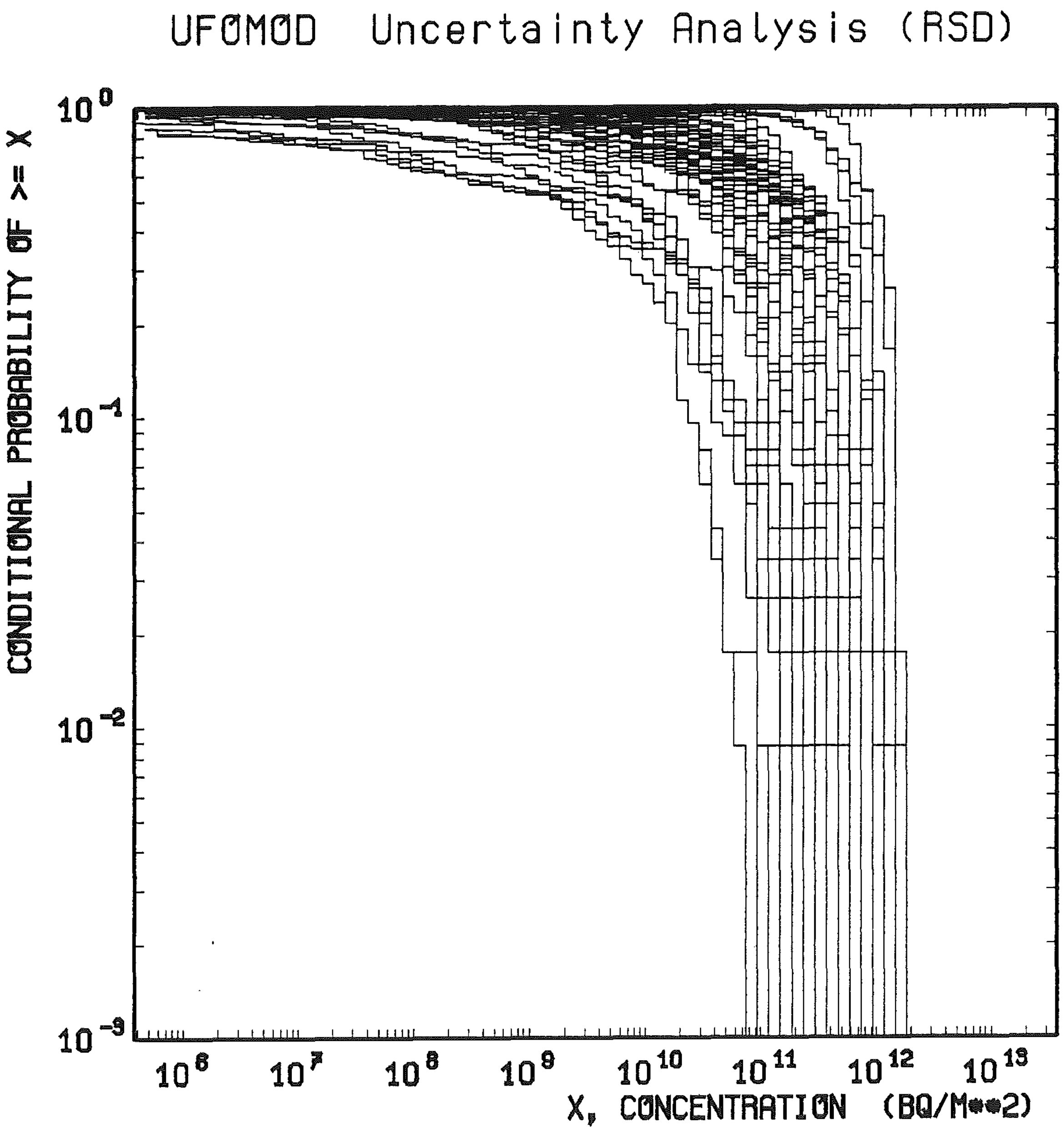
*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)

## B.4 ACTIVITY CONCENTRATIONS (RSD AT KFK, N= 59 RUNS)

In this section CCFDs and the corresponding confidence curves are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface.

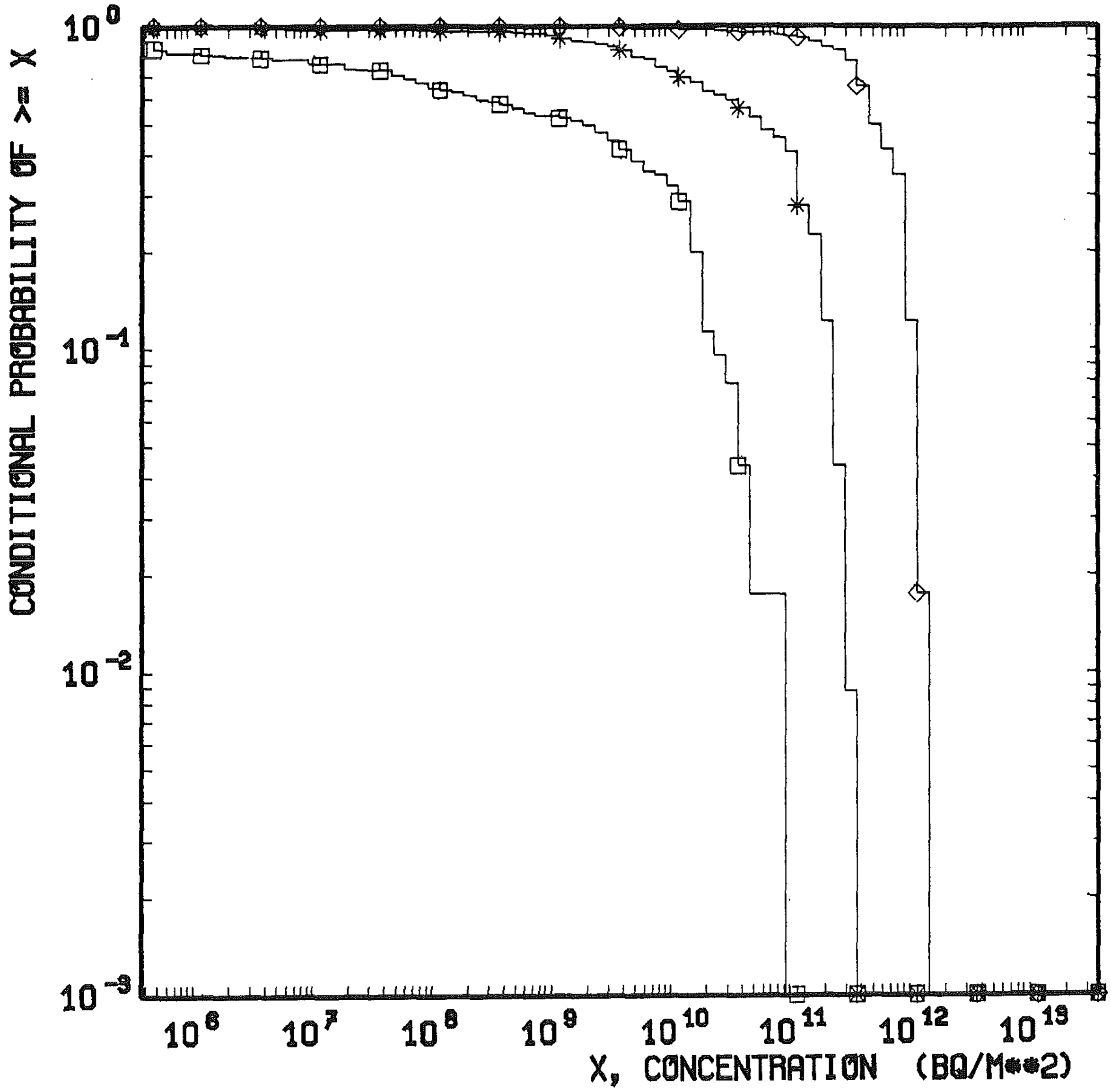



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.

## UFØMØD Uncertainty Analysis (RSD)

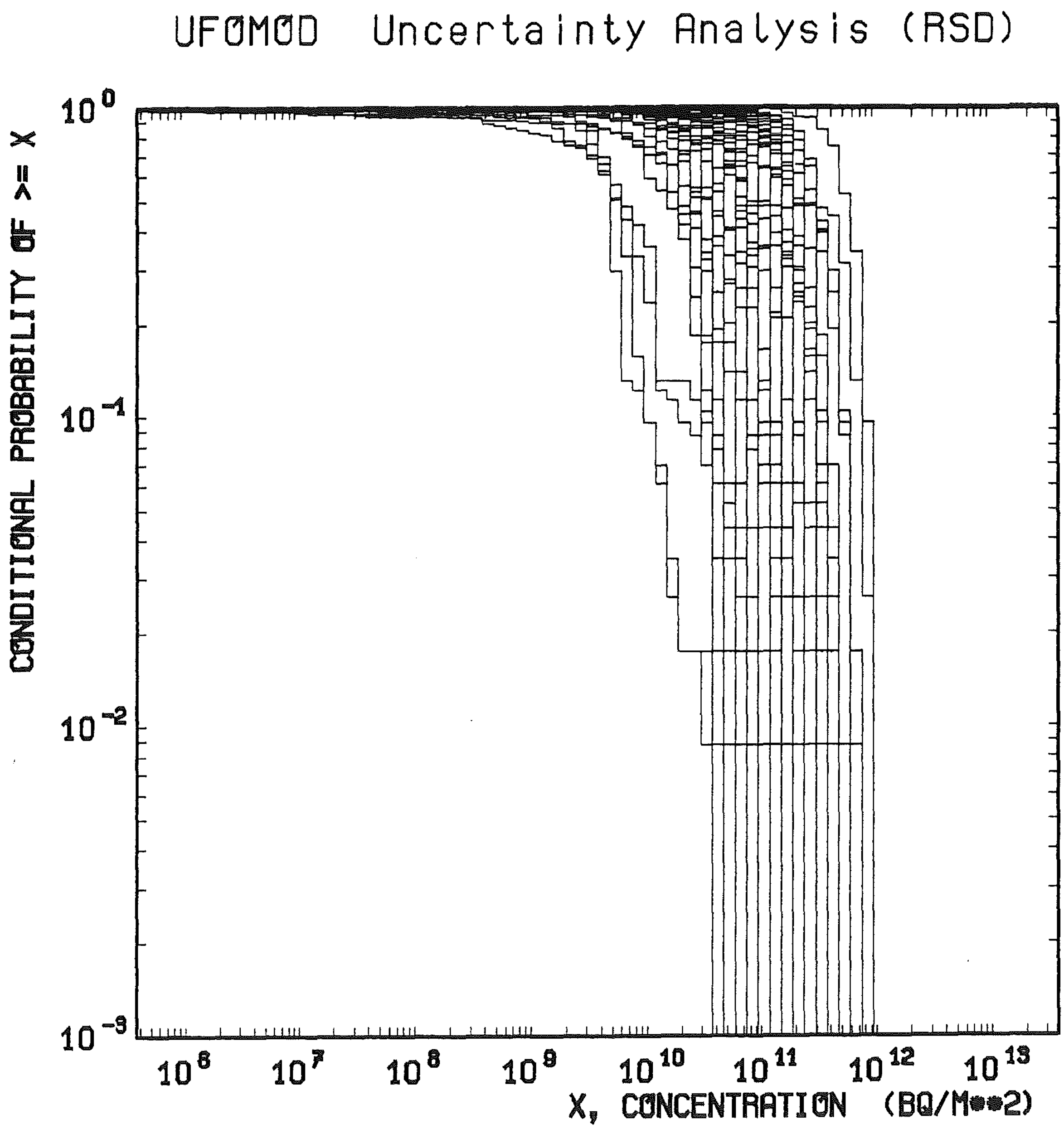



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

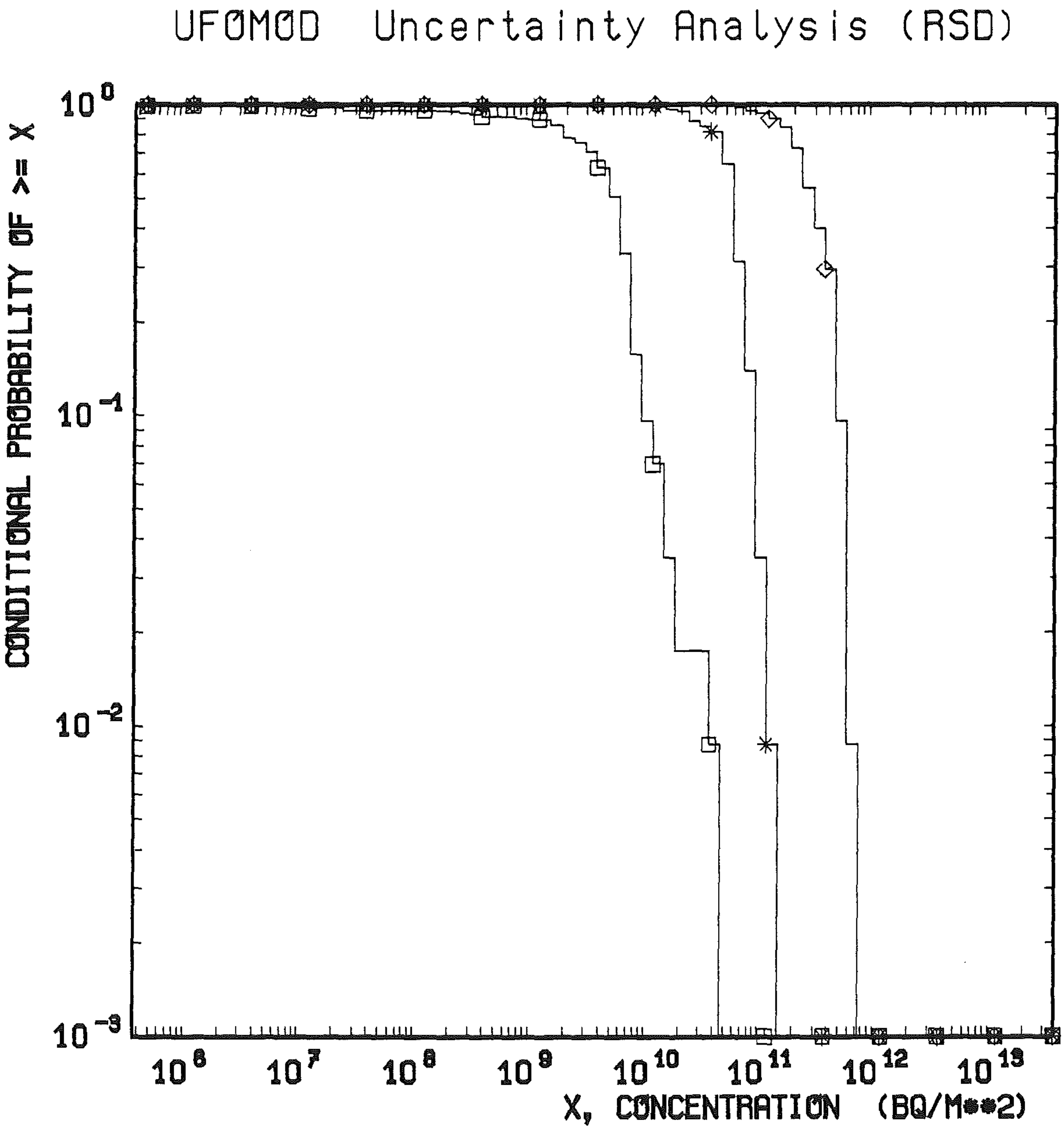
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

KfK INR

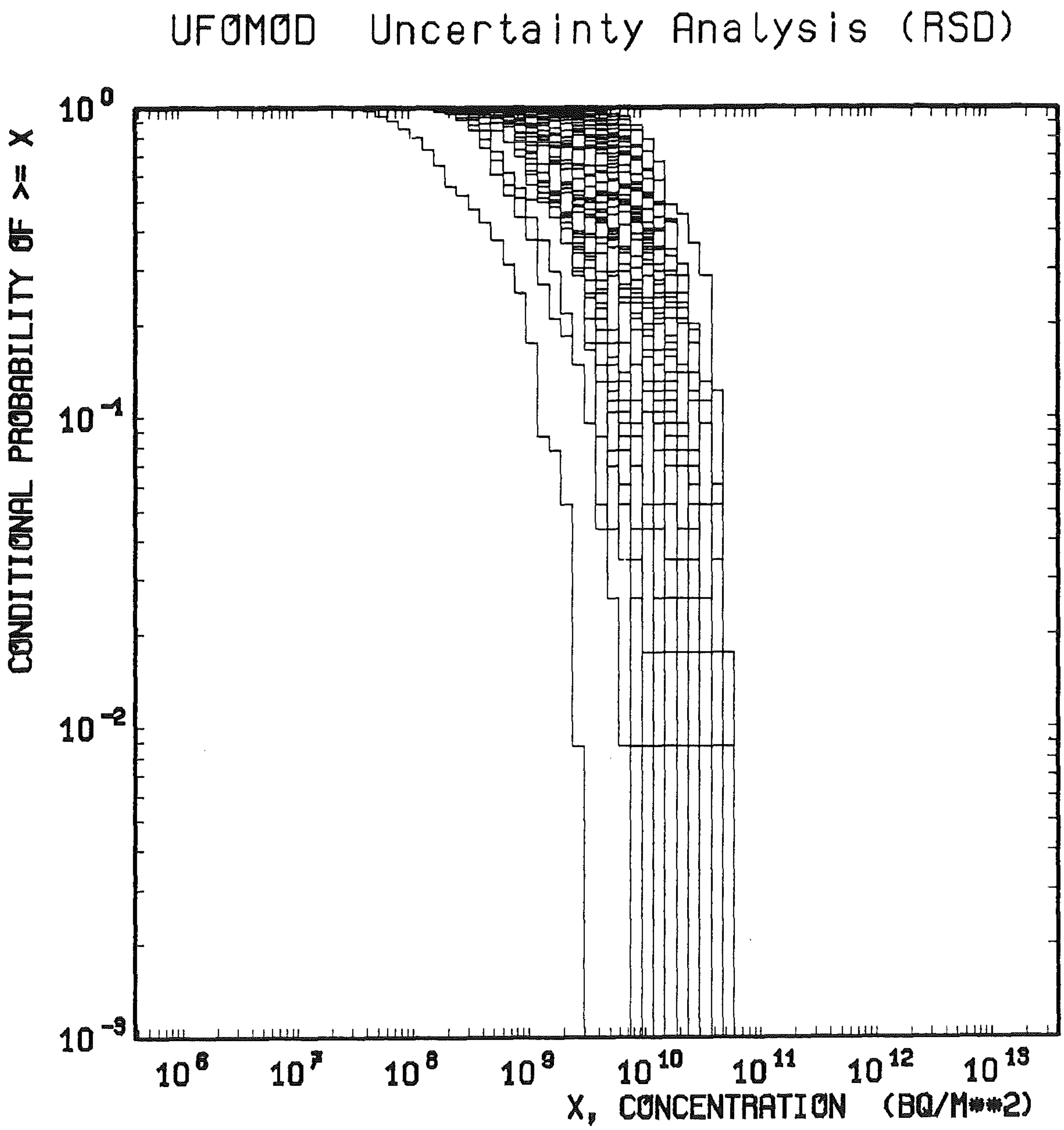
COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

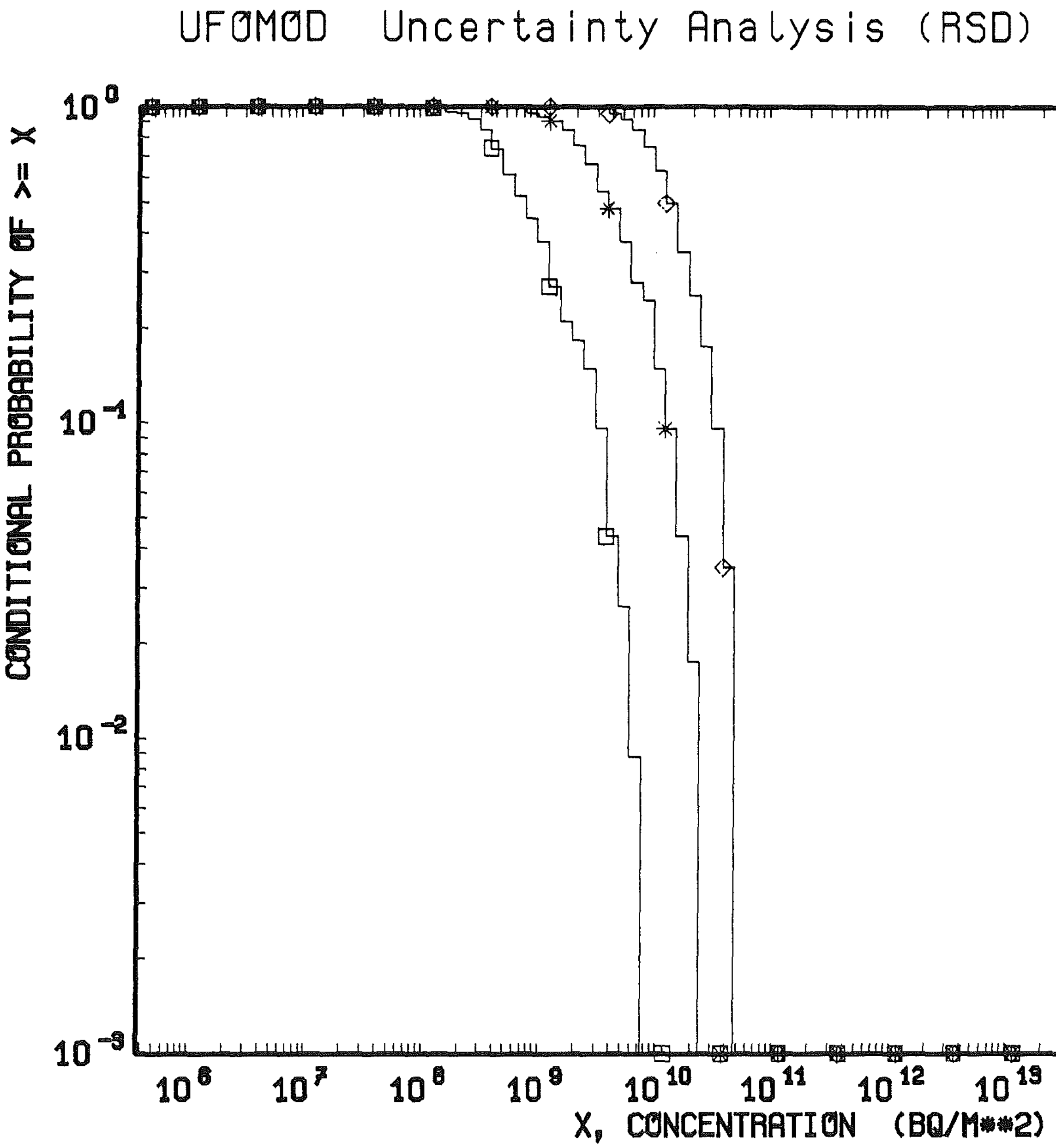
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.



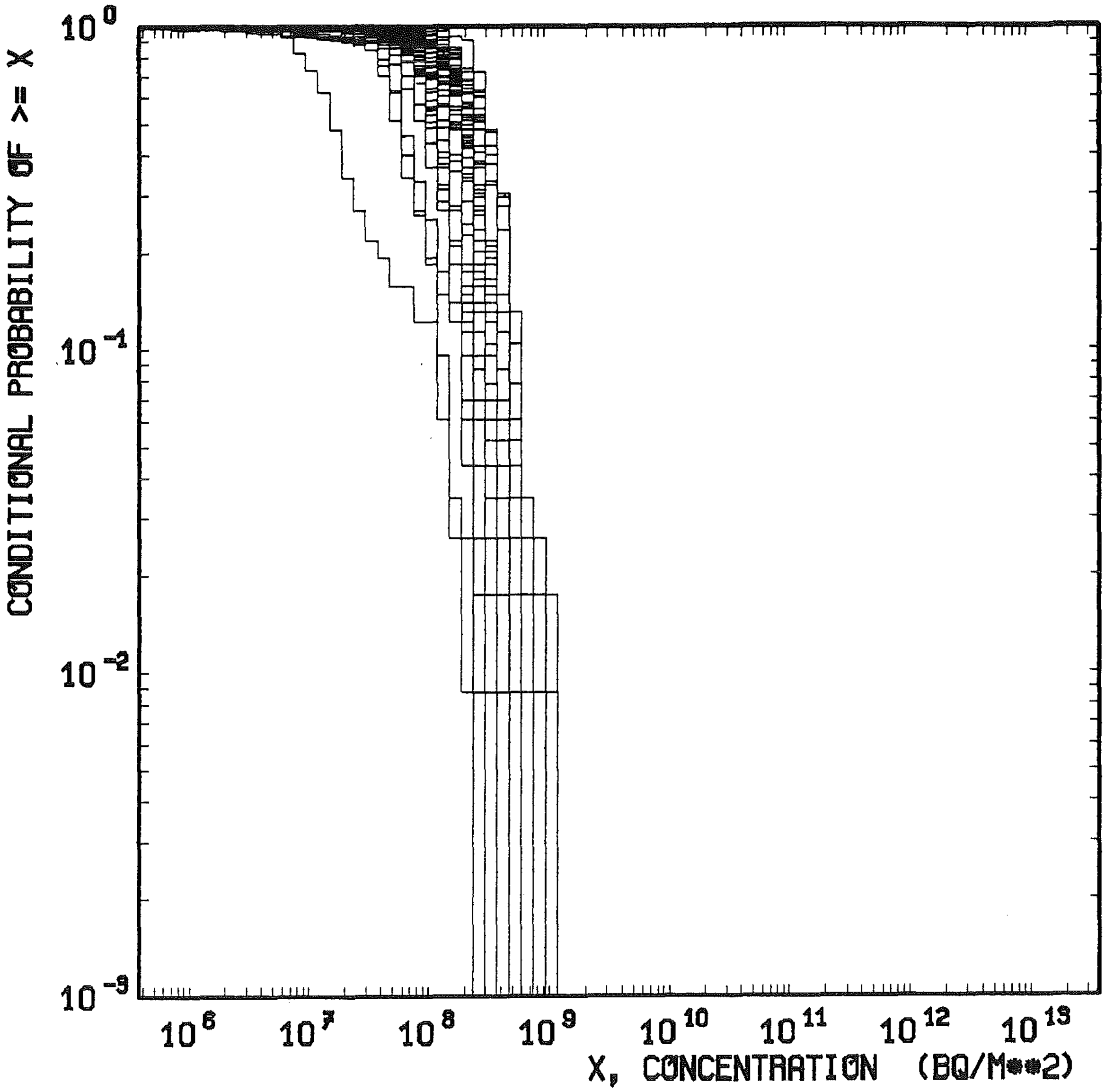

Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

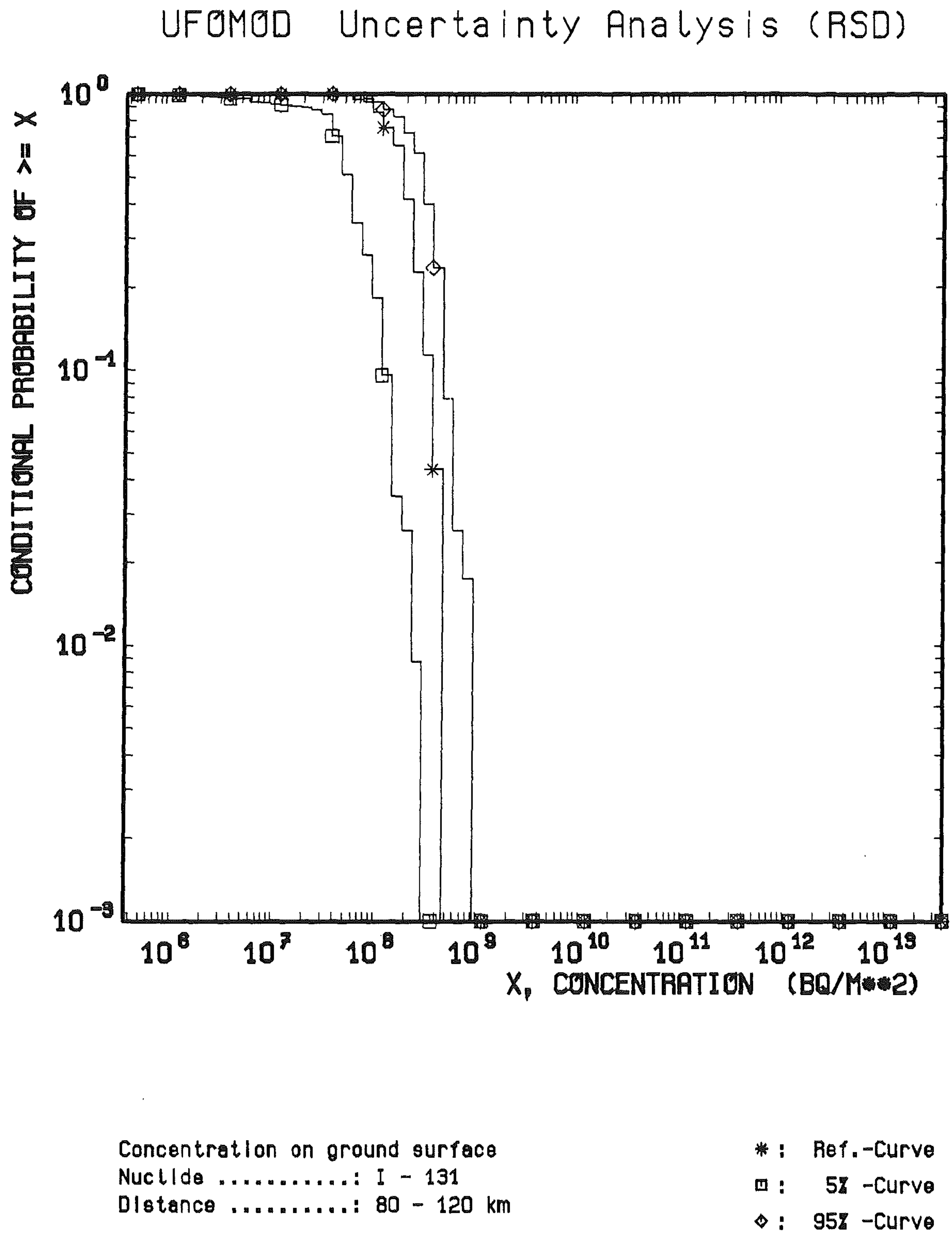
## UFOMOD Uncertainty Analysis (RSD)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

KfK INR

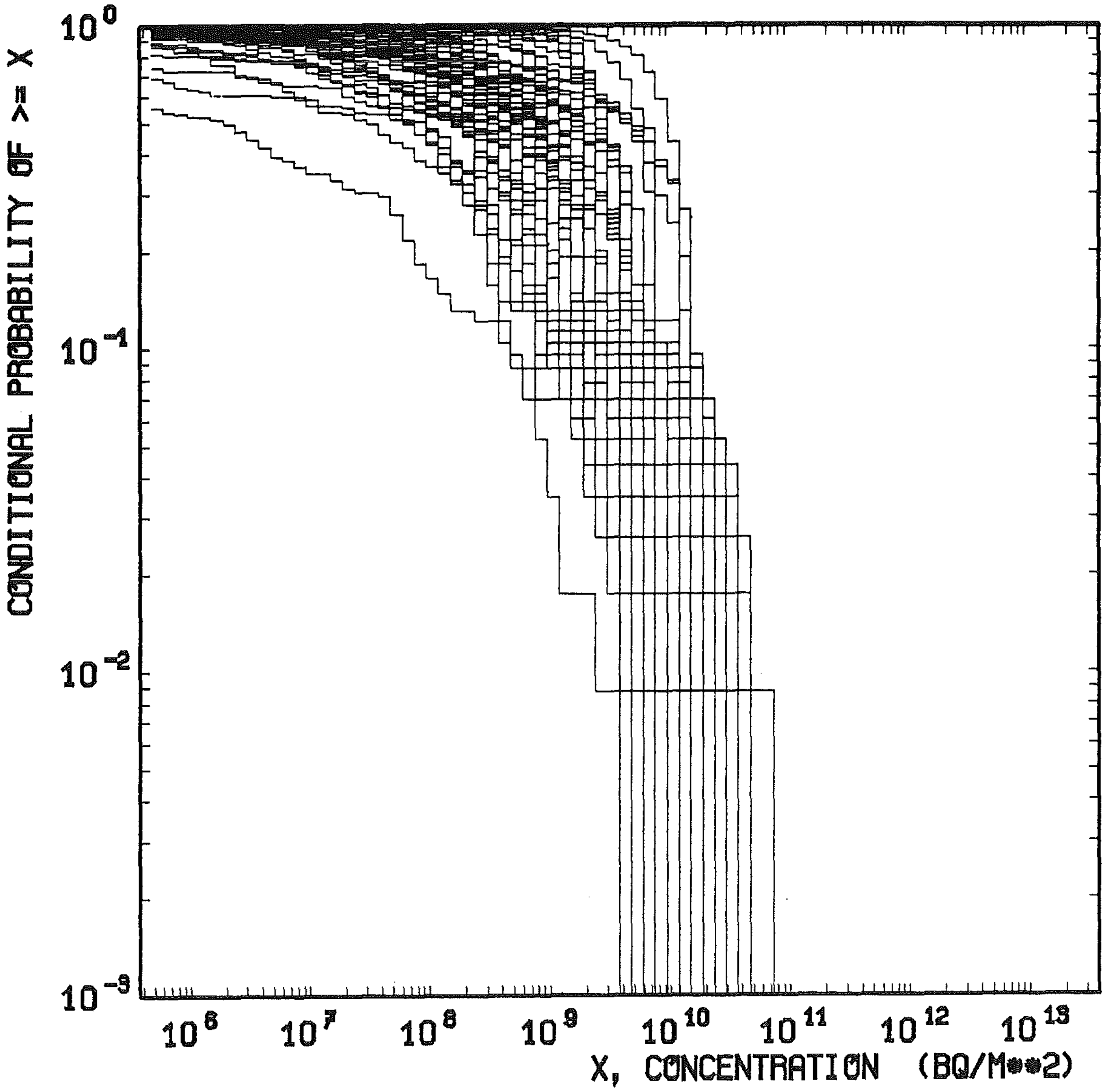
COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.




KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

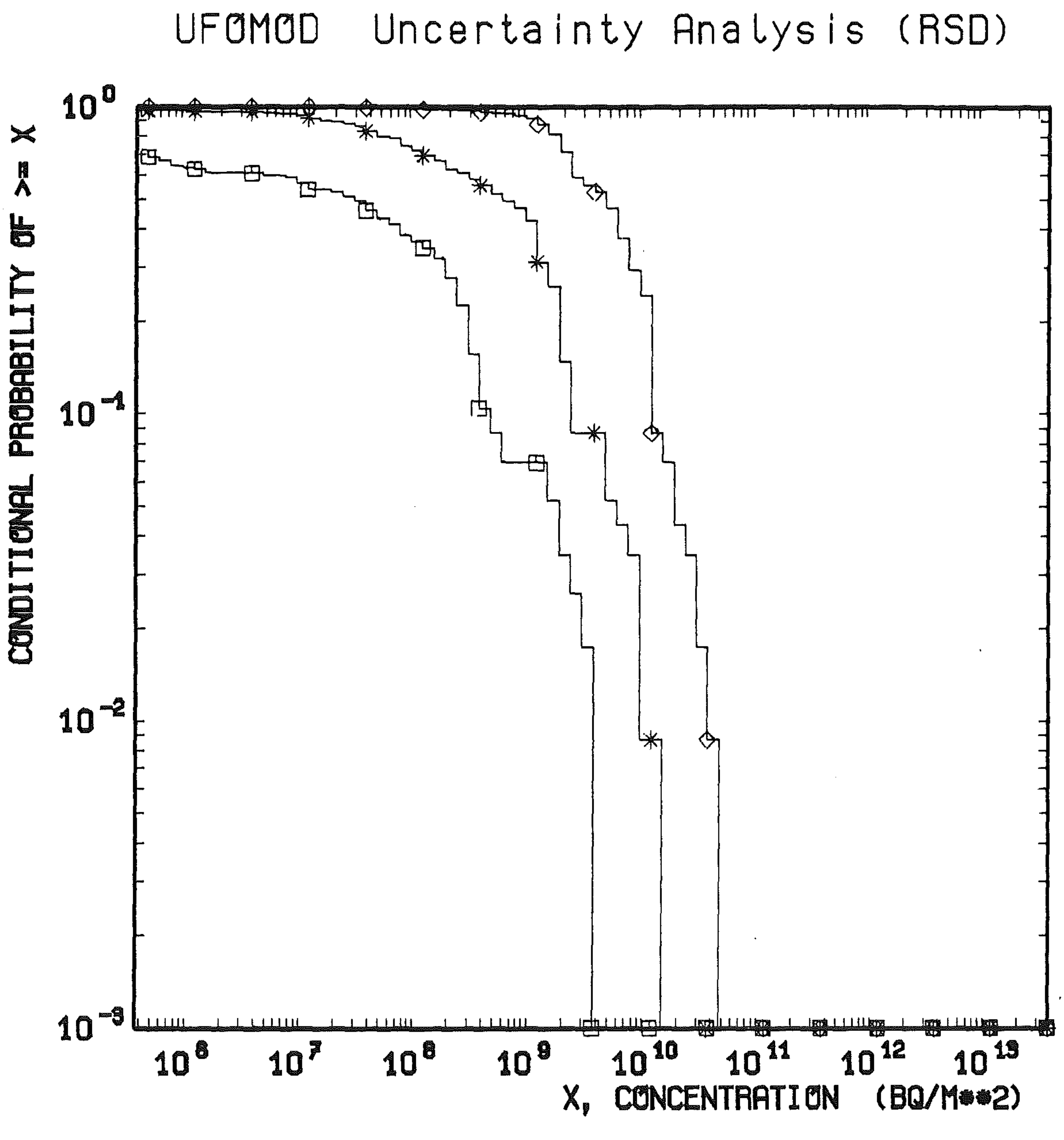
# UFØMØD Uncertainty Analysis (RSD)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.

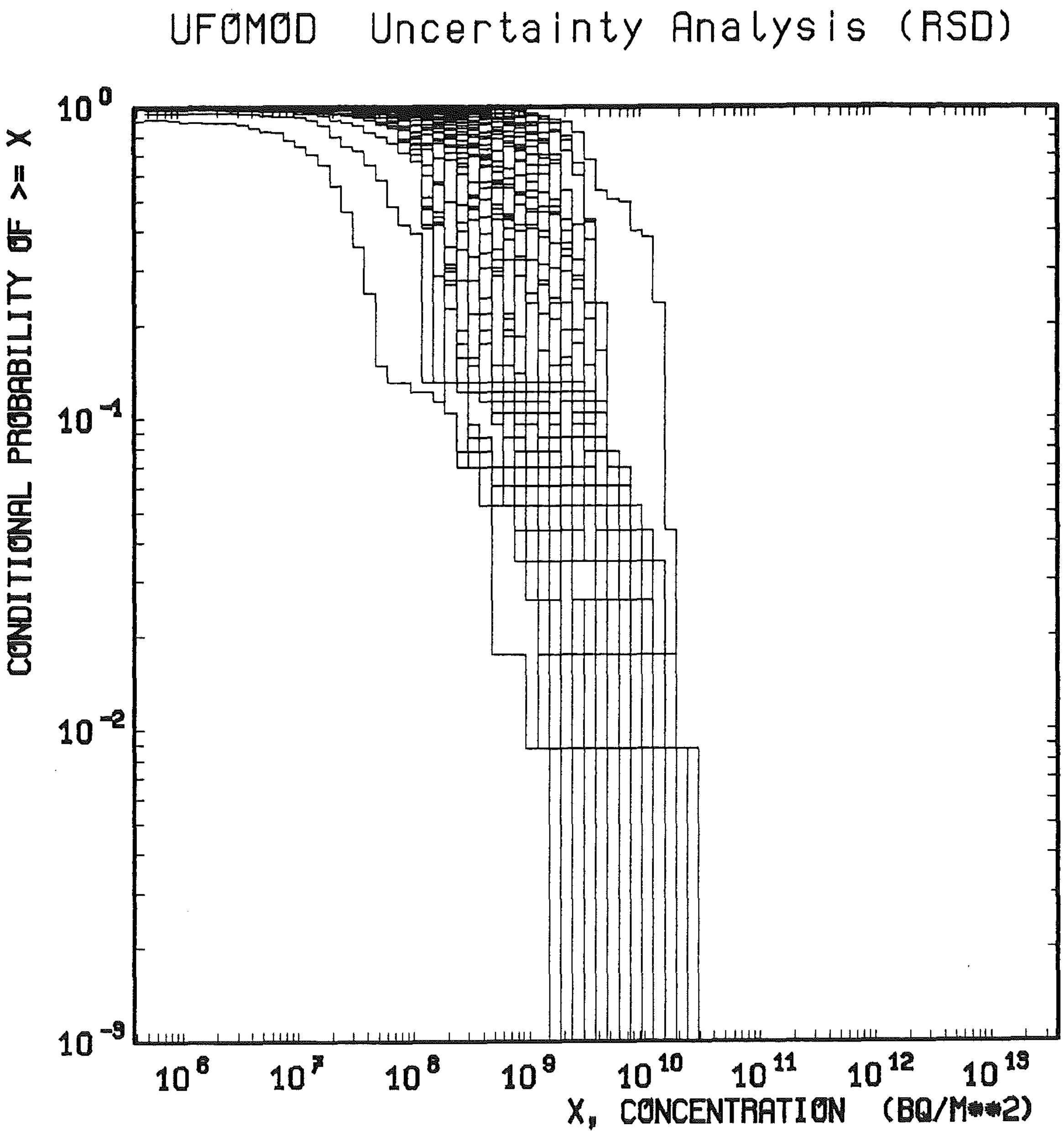



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

*: Ref.-Curve
⊡: 5% -Curve
◇: 95% -Curve

KfK INR

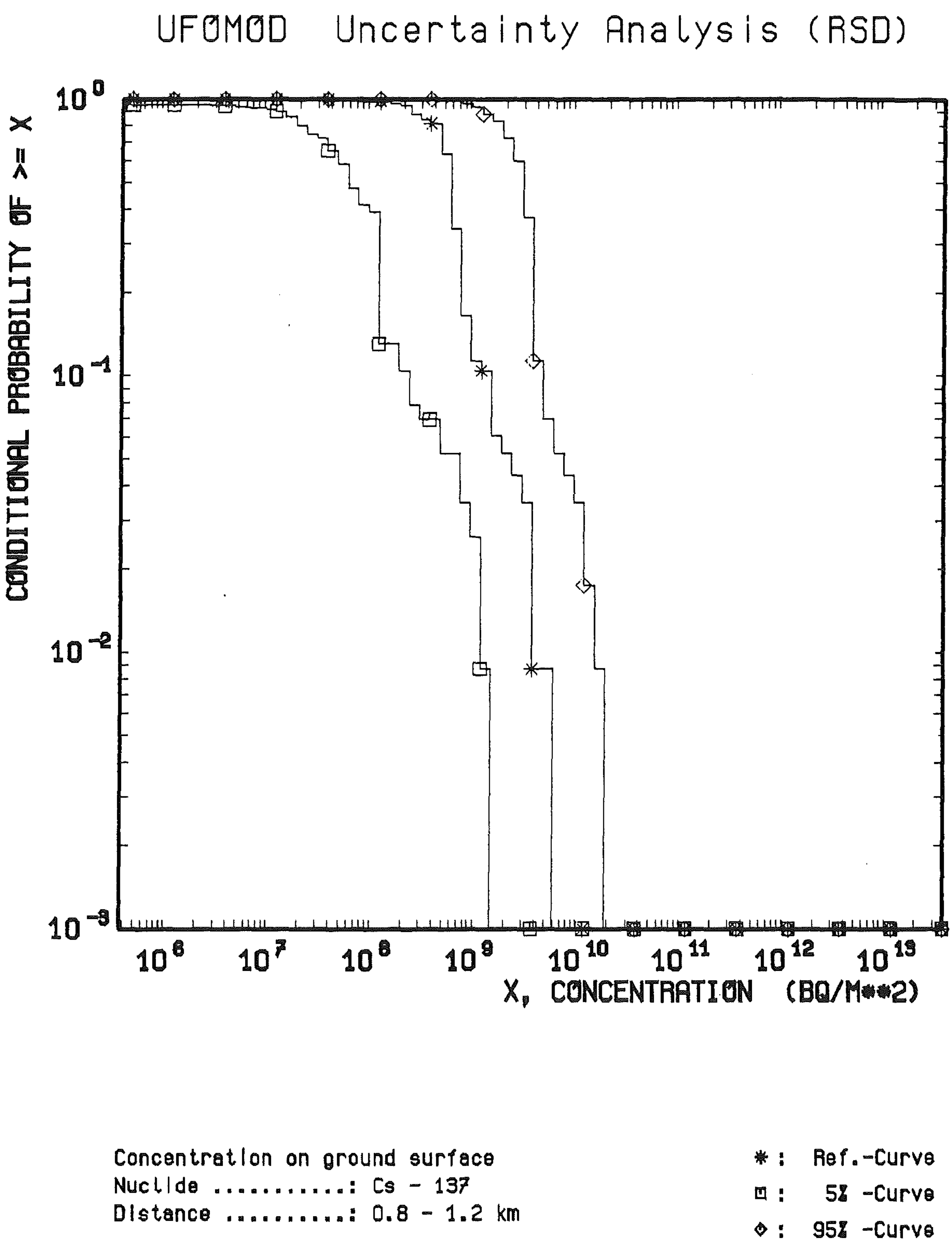
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.



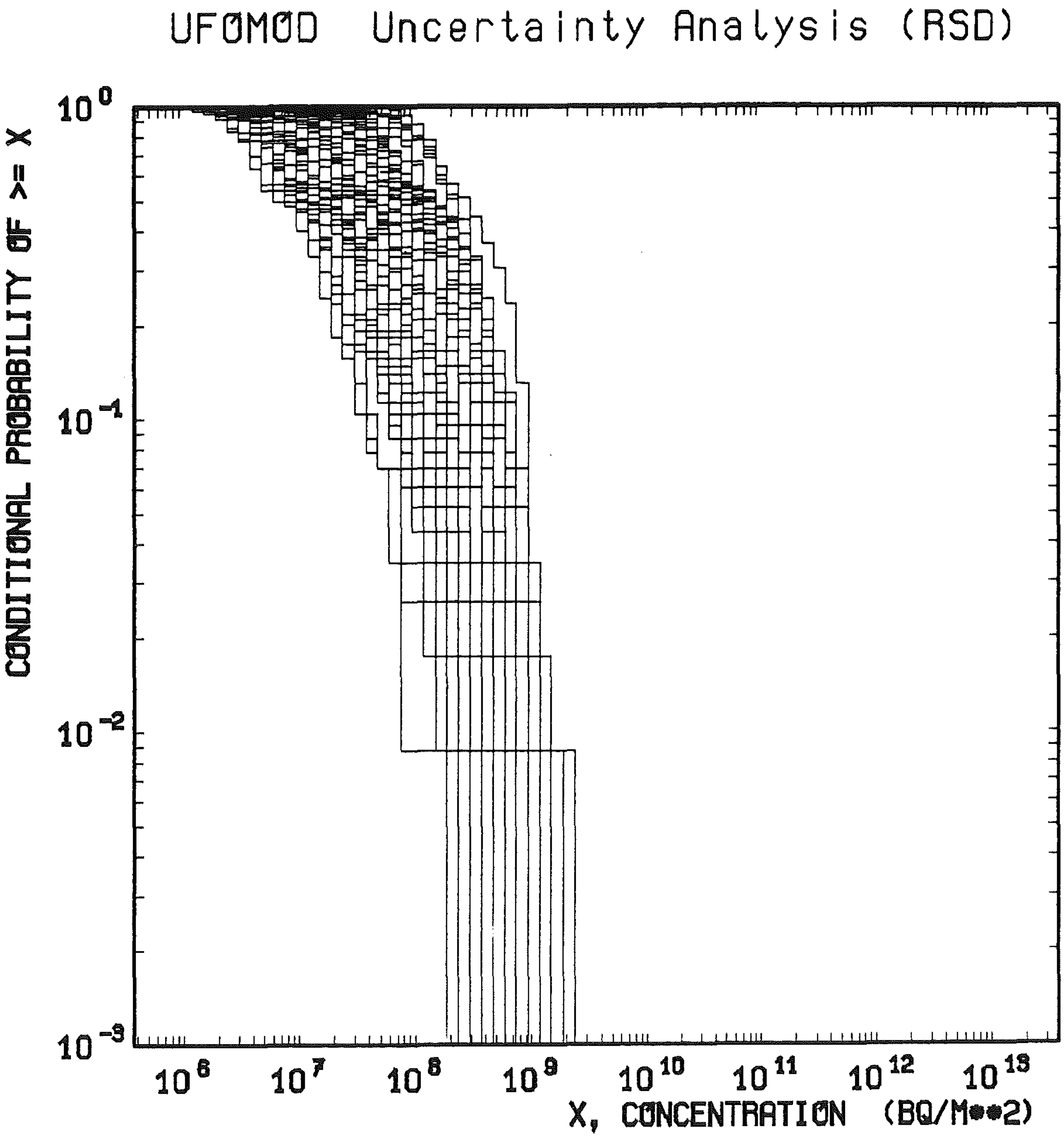

Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.



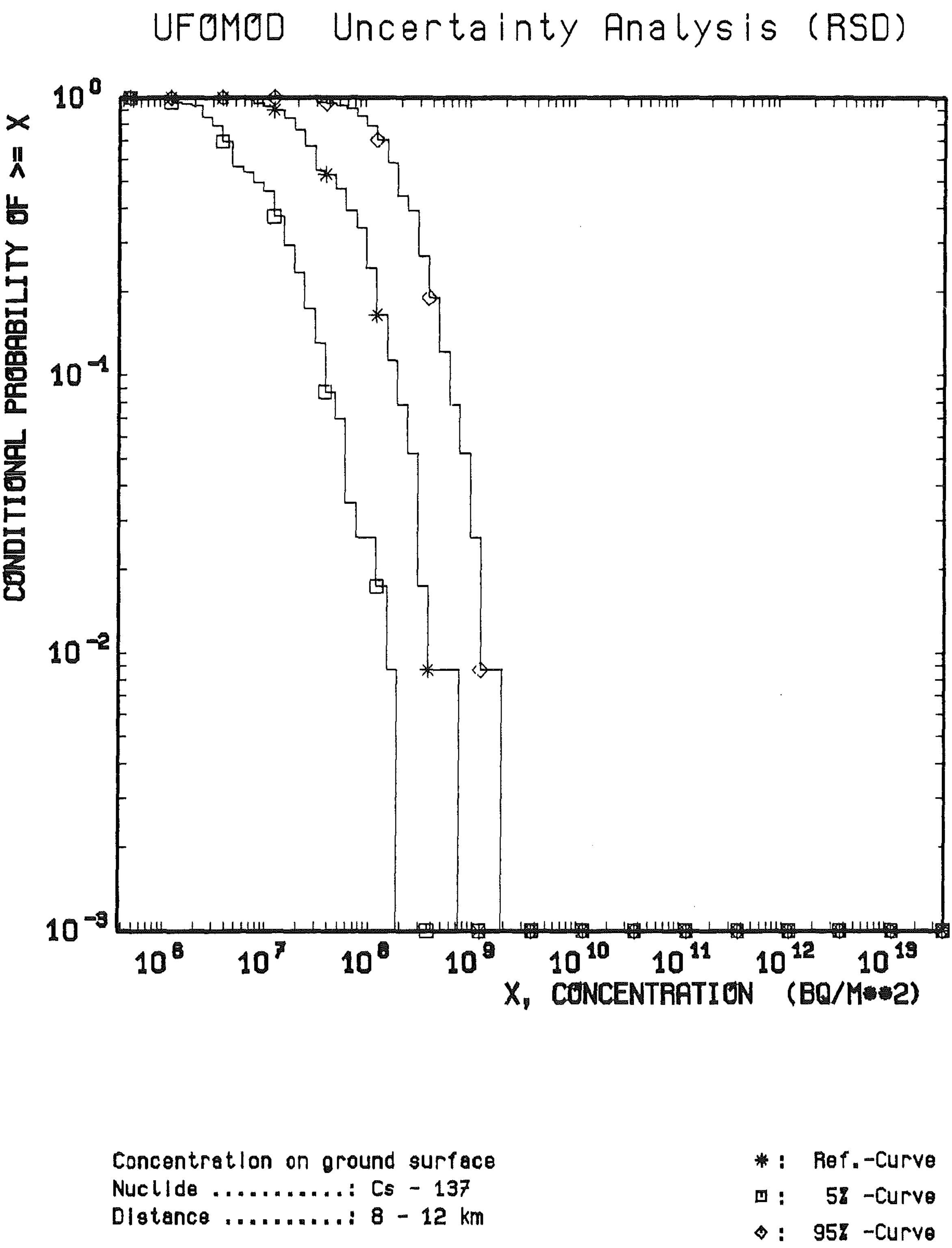

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

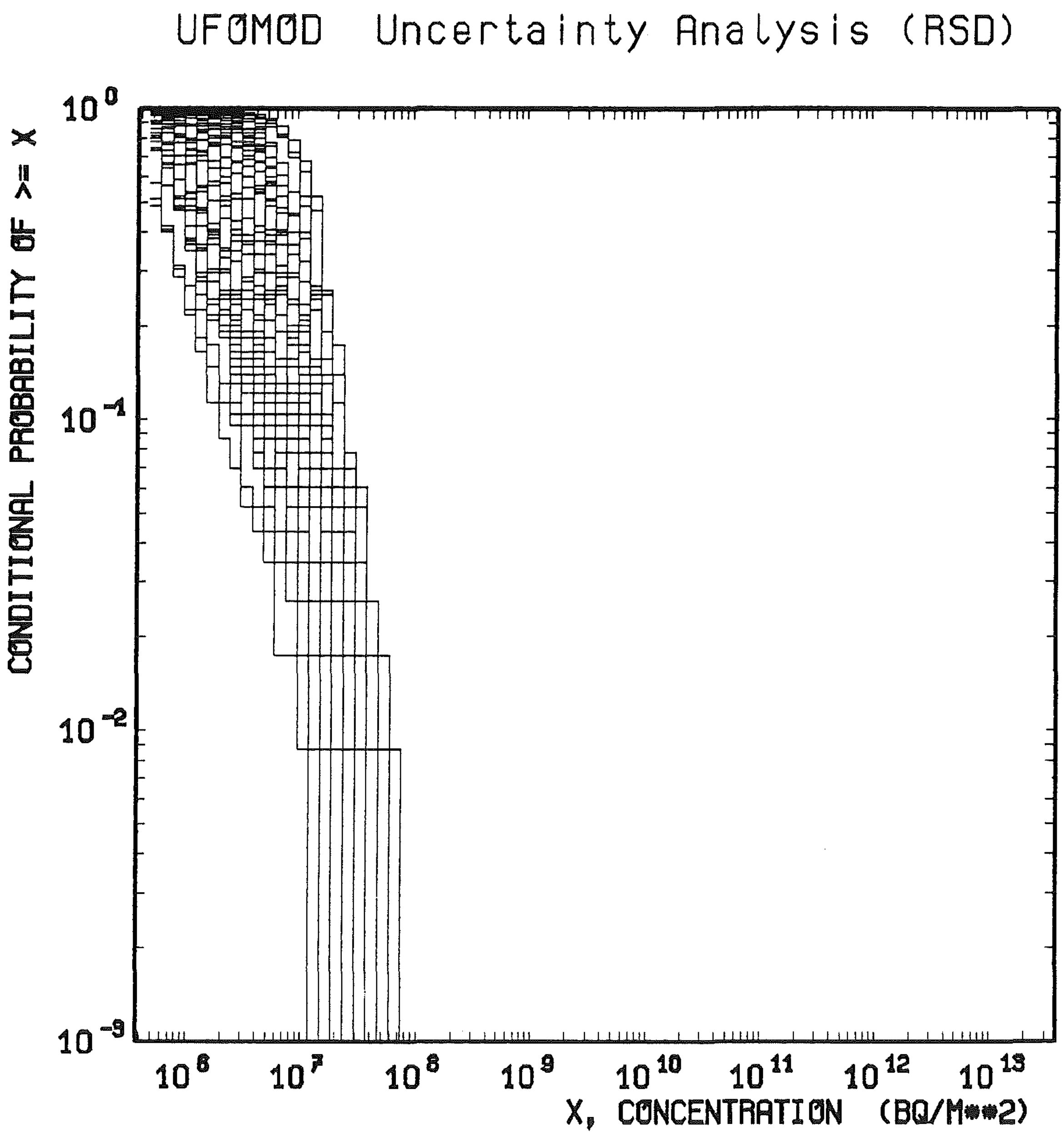
KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.



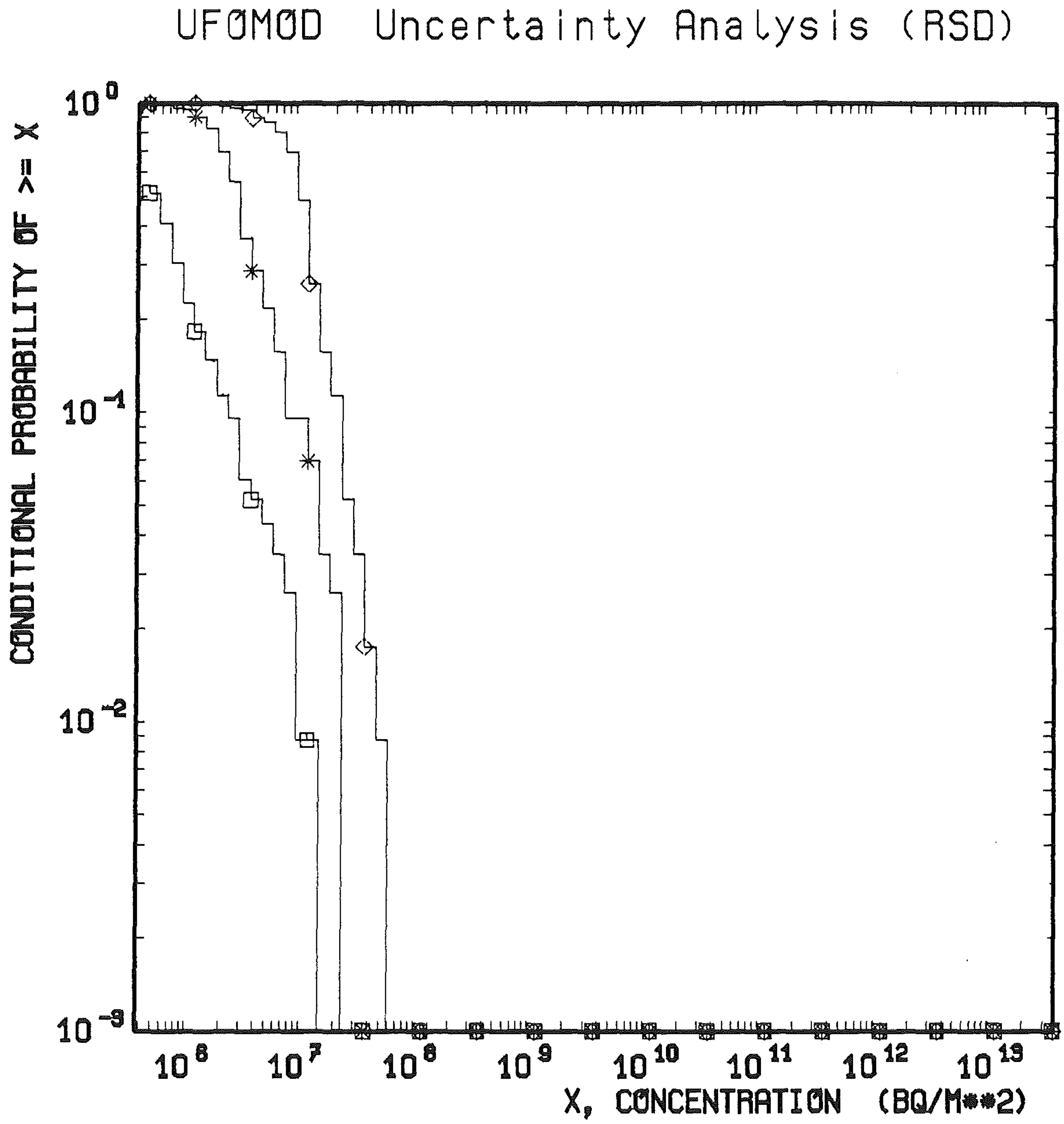

KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




Concentration on ground surface
Nuclide ............: Cs - 137
Distance ..........: 80 - 120 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

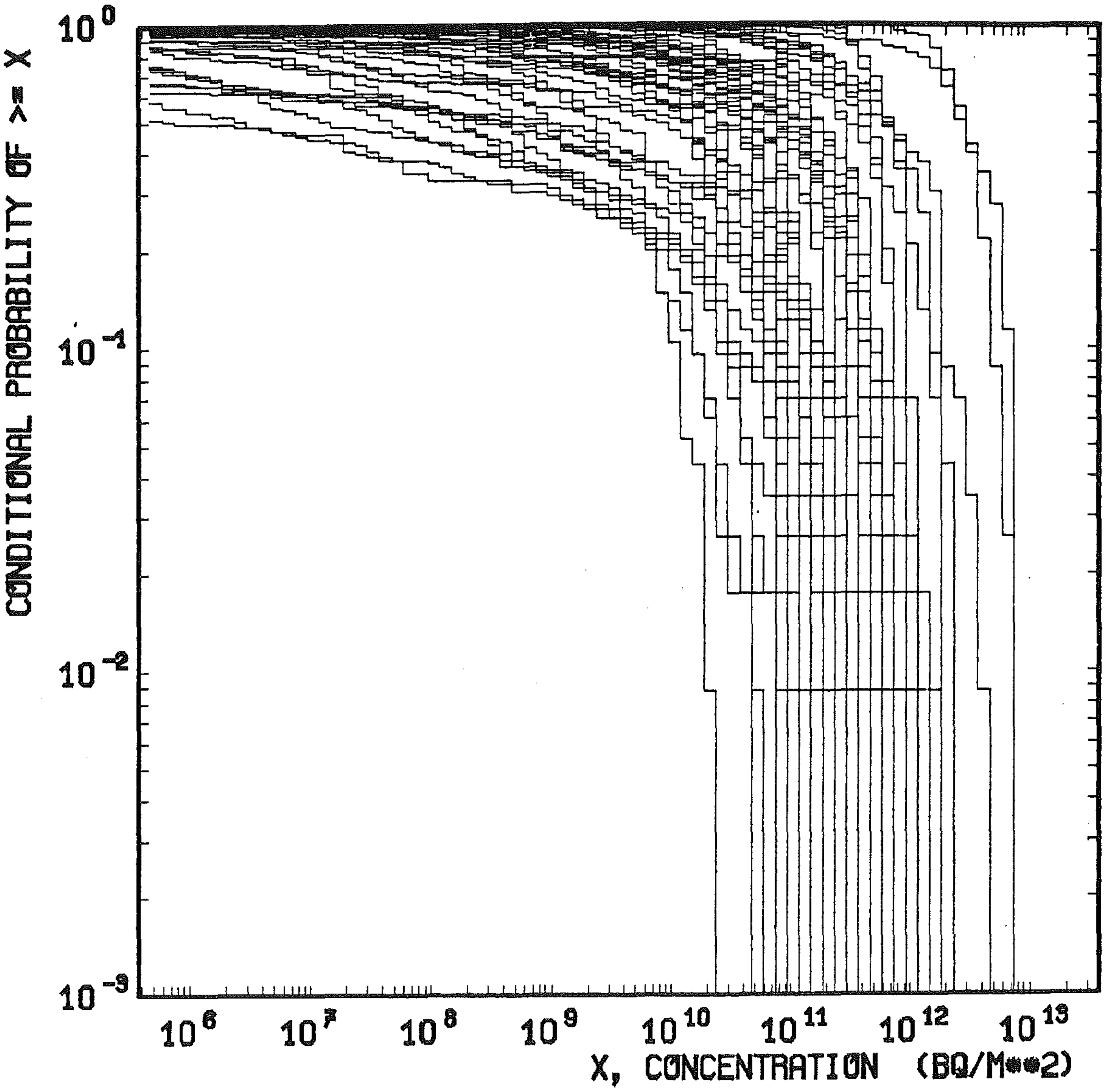
KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

## B.5 ACTIVITY CONCENTRATIONS (RSD AT GRS, N= 59 RUNS)

In this section CCFDs and the corresponding confidence curves are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface.

UFØMØD Uncertainty Analysis (RSD)

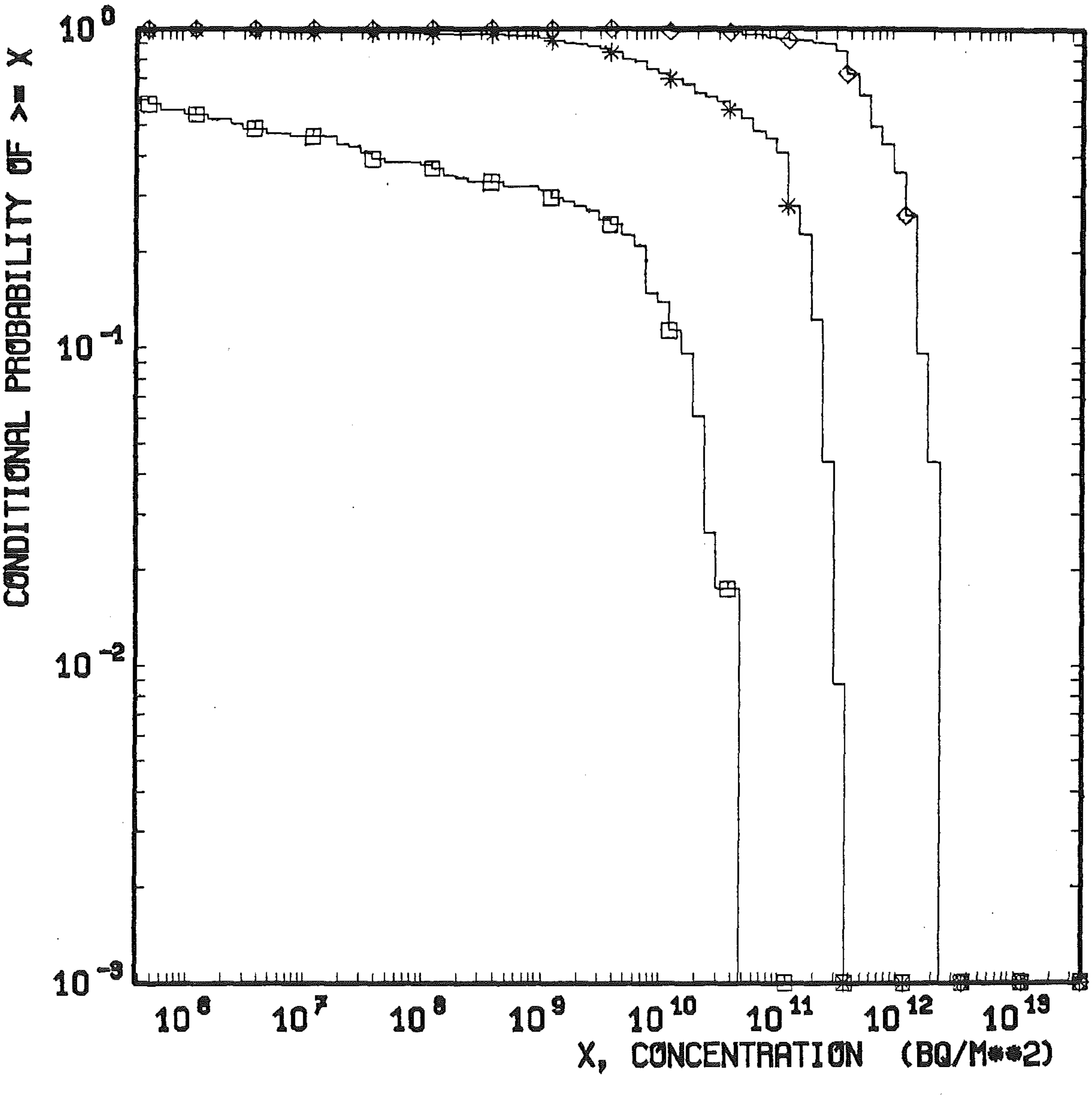



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GRS - DESIGN)

## UFOMOD Uncertainty Analysis (RSD)



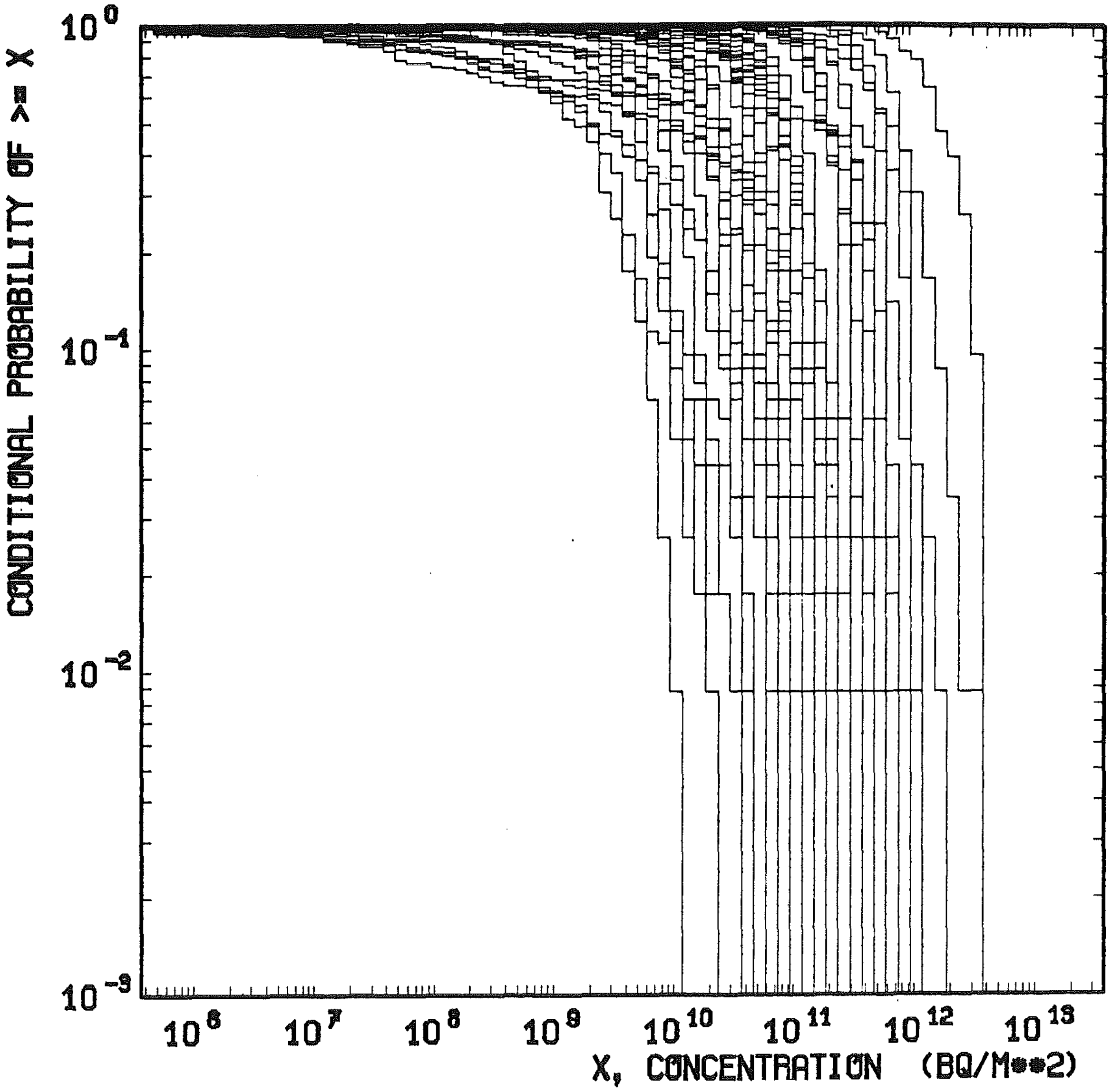

Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◆ : 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)

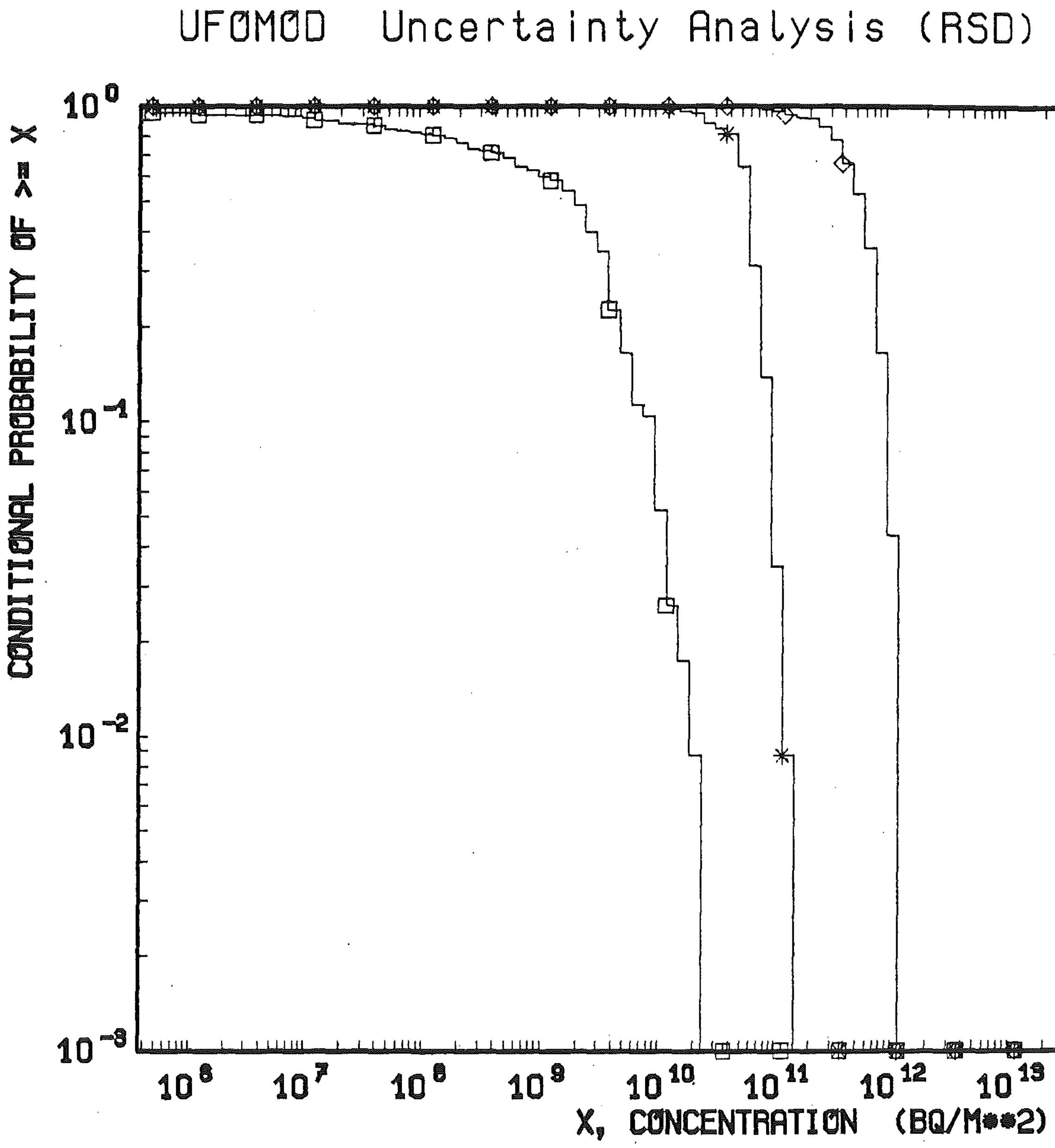
UFOMOD Uncertainty Analysis (RSD)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GRS - DESIGN)

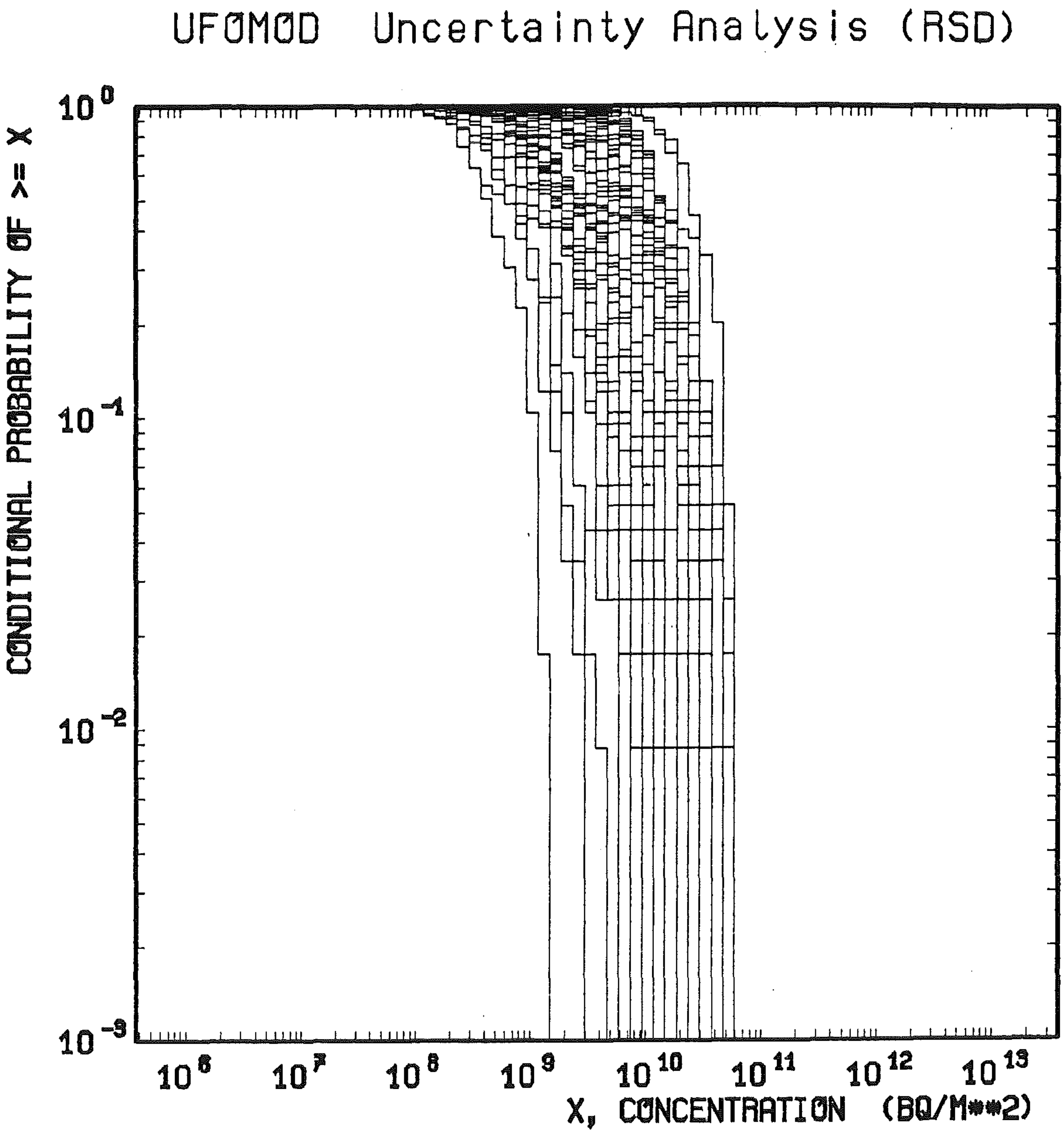



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

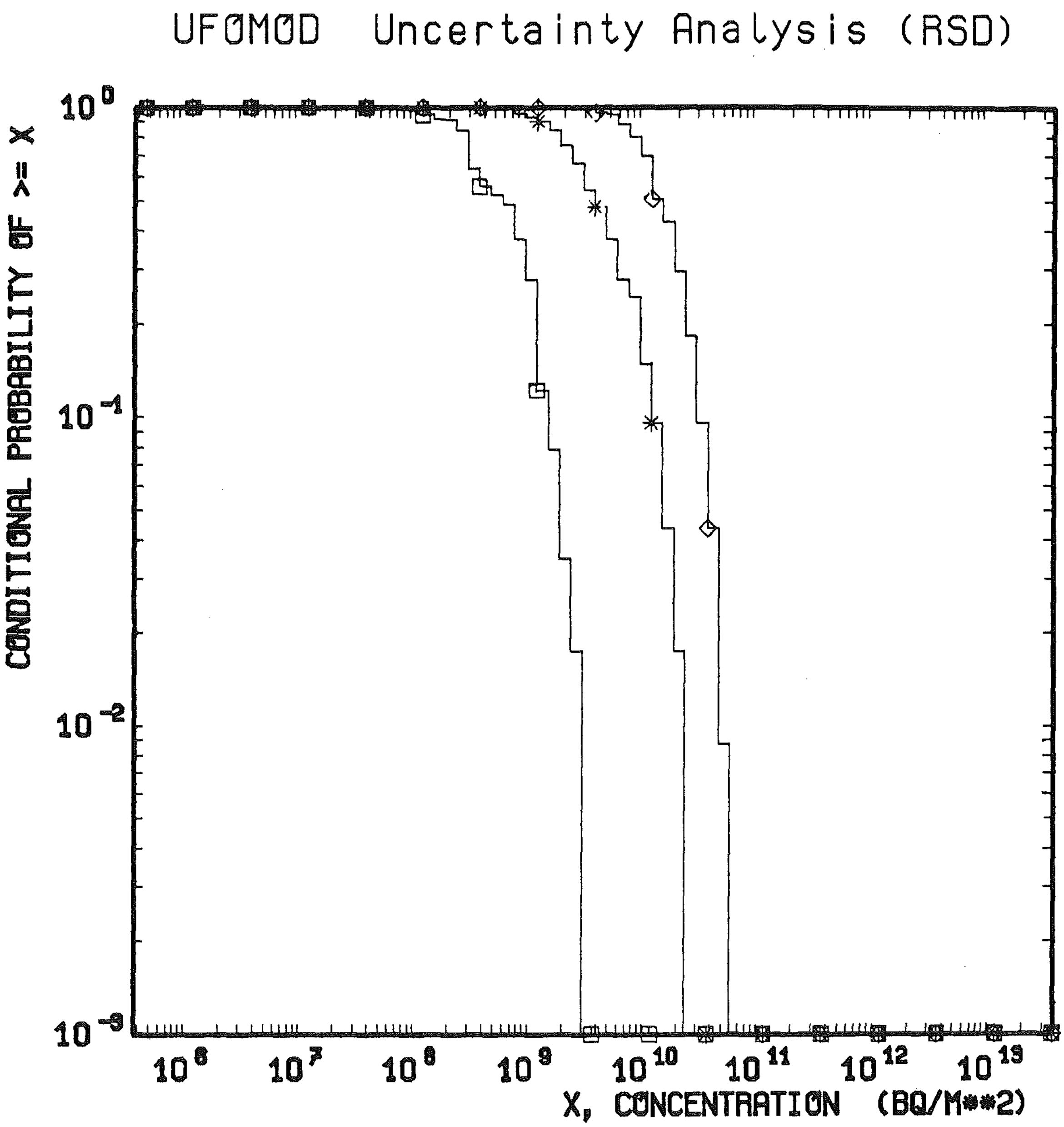
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GRS - DESIGN)

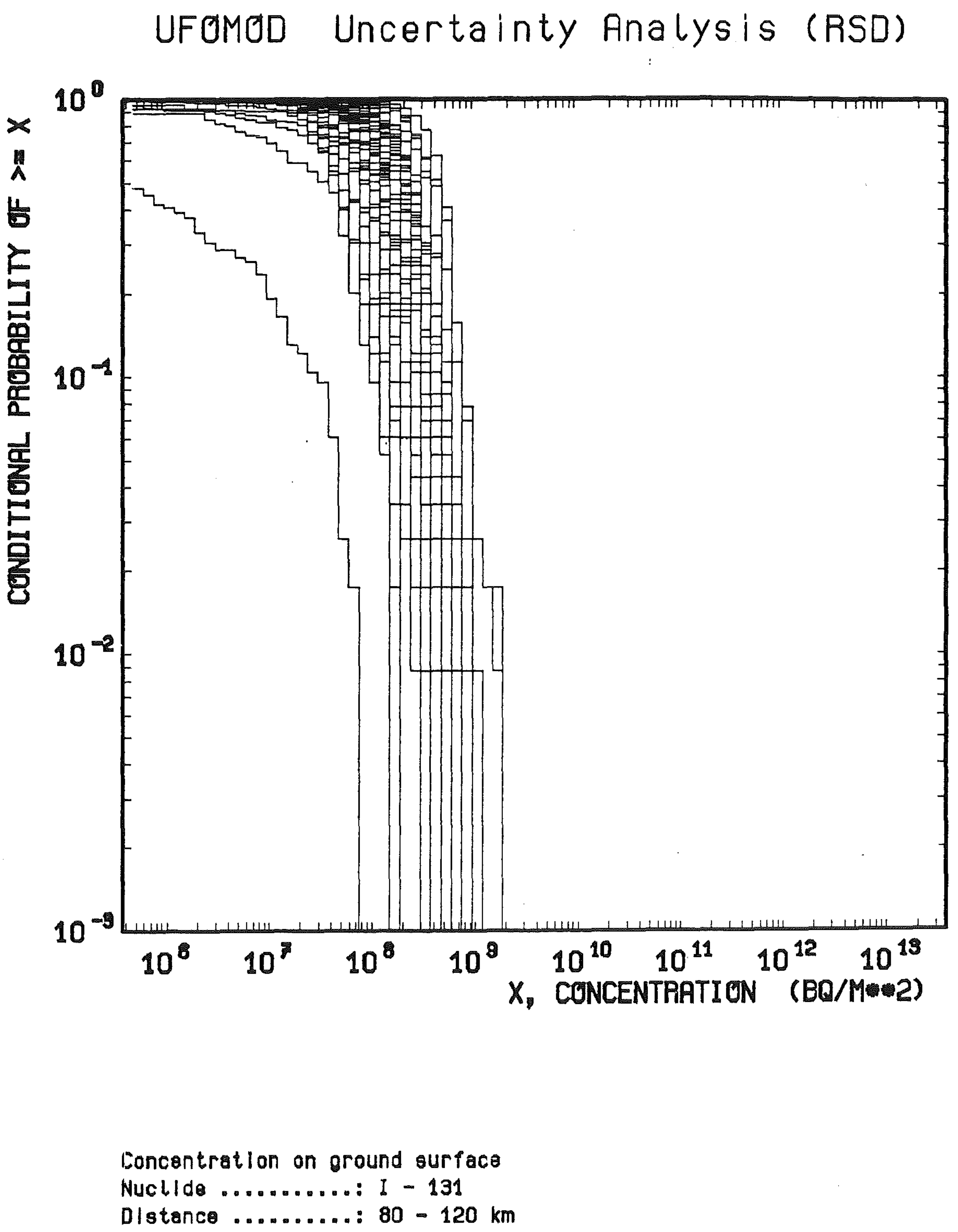



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

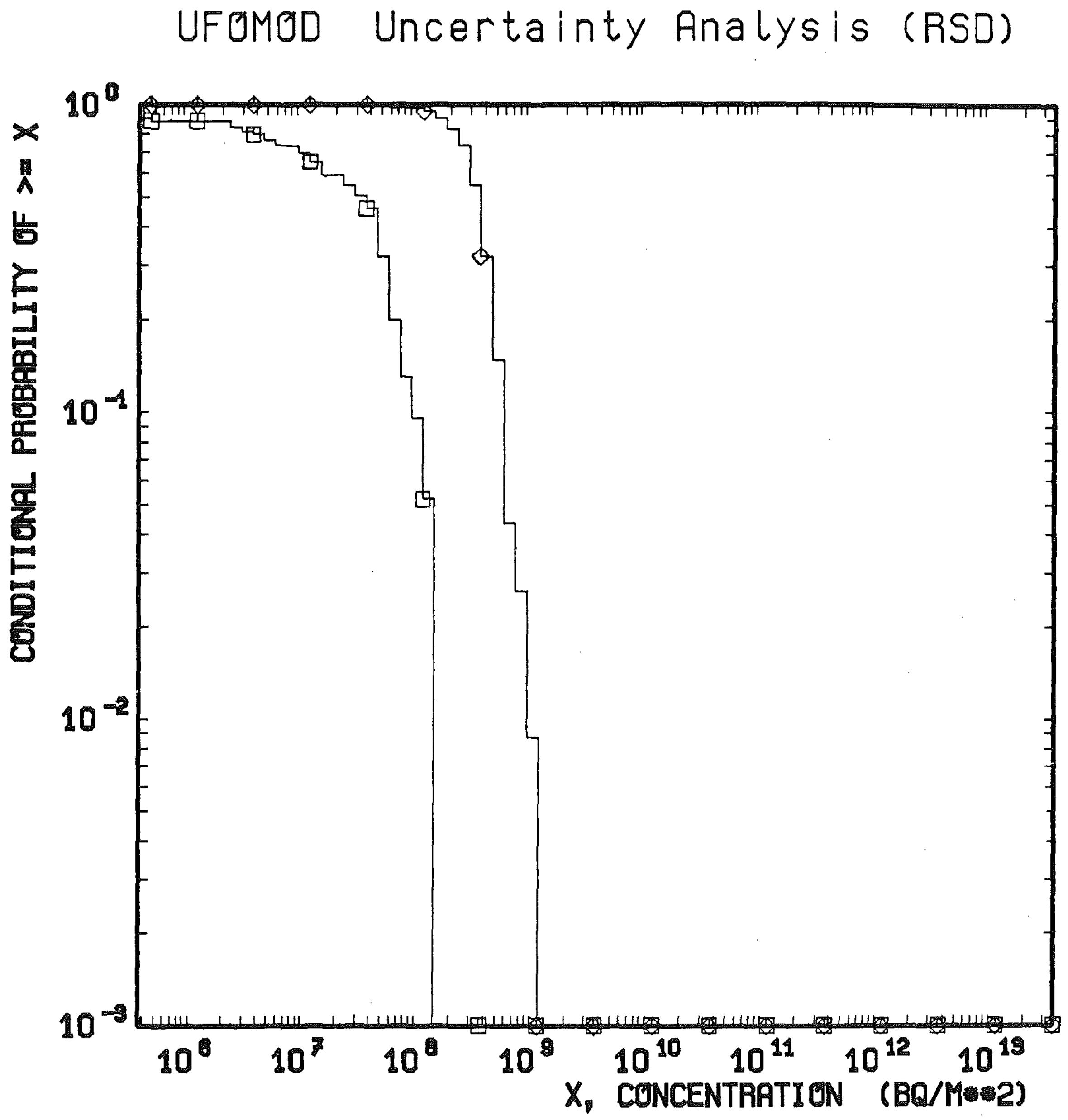
*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)



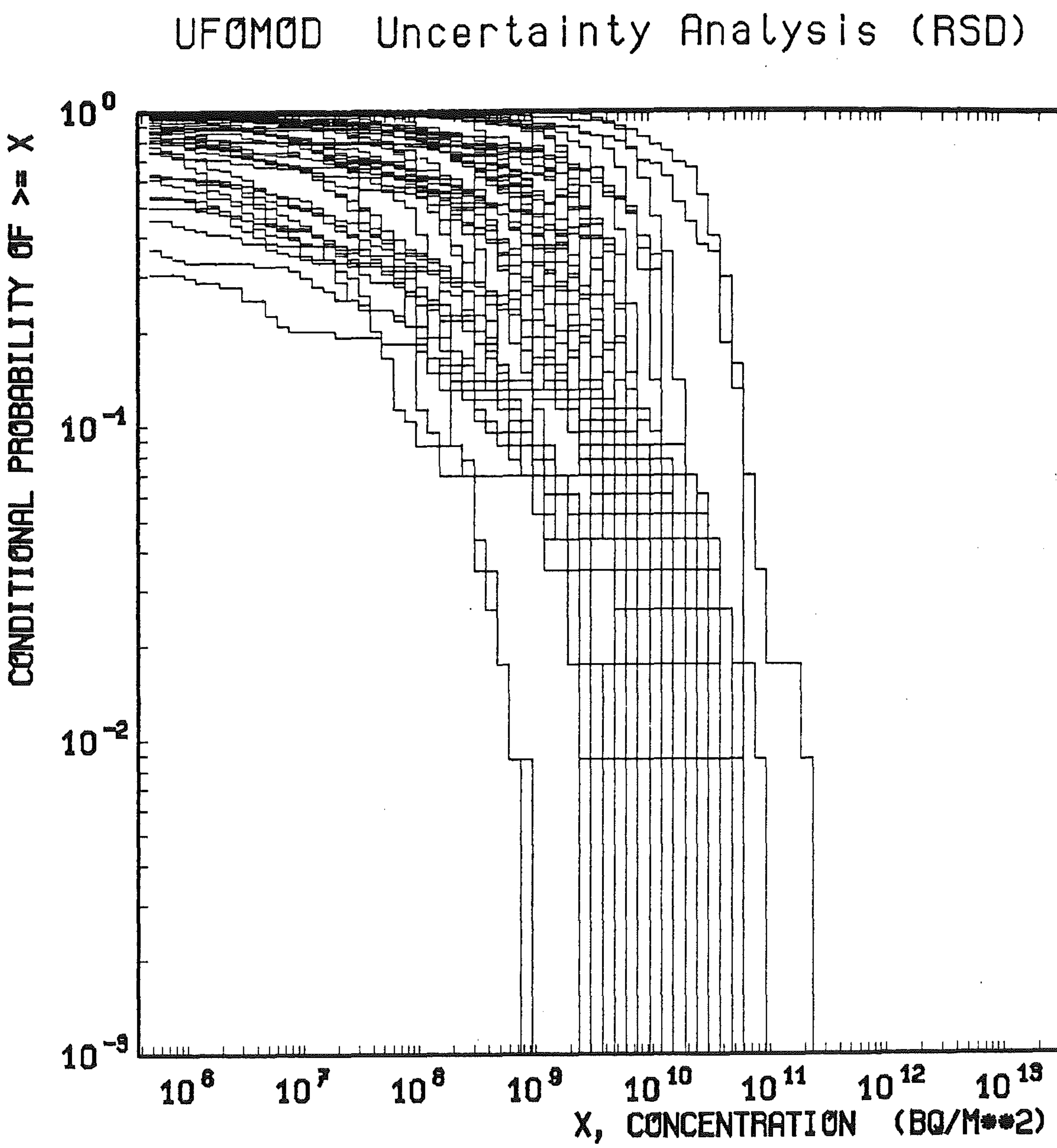

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 80 - 120 km

✱ : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

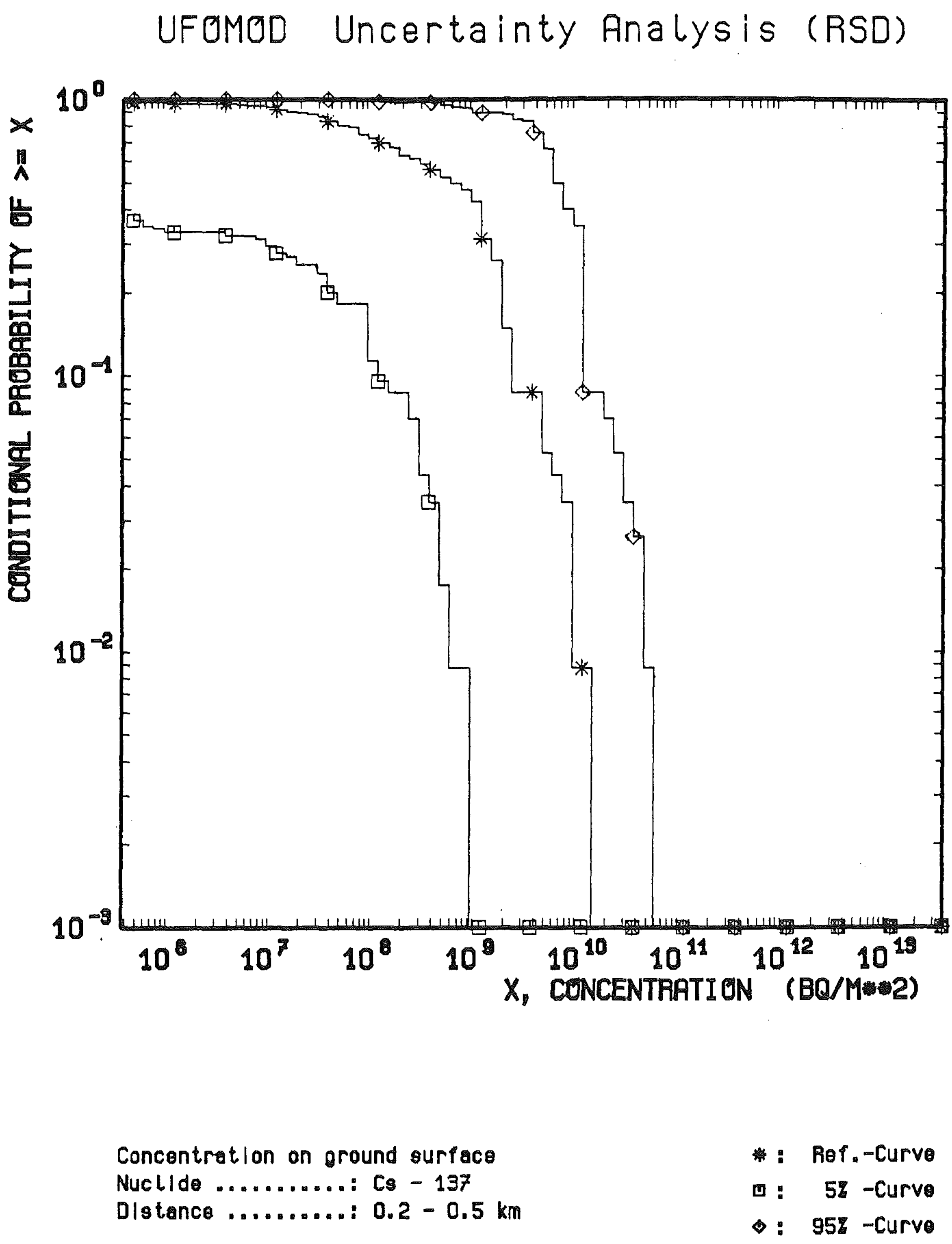
REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS. (GRS - DESIGN)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

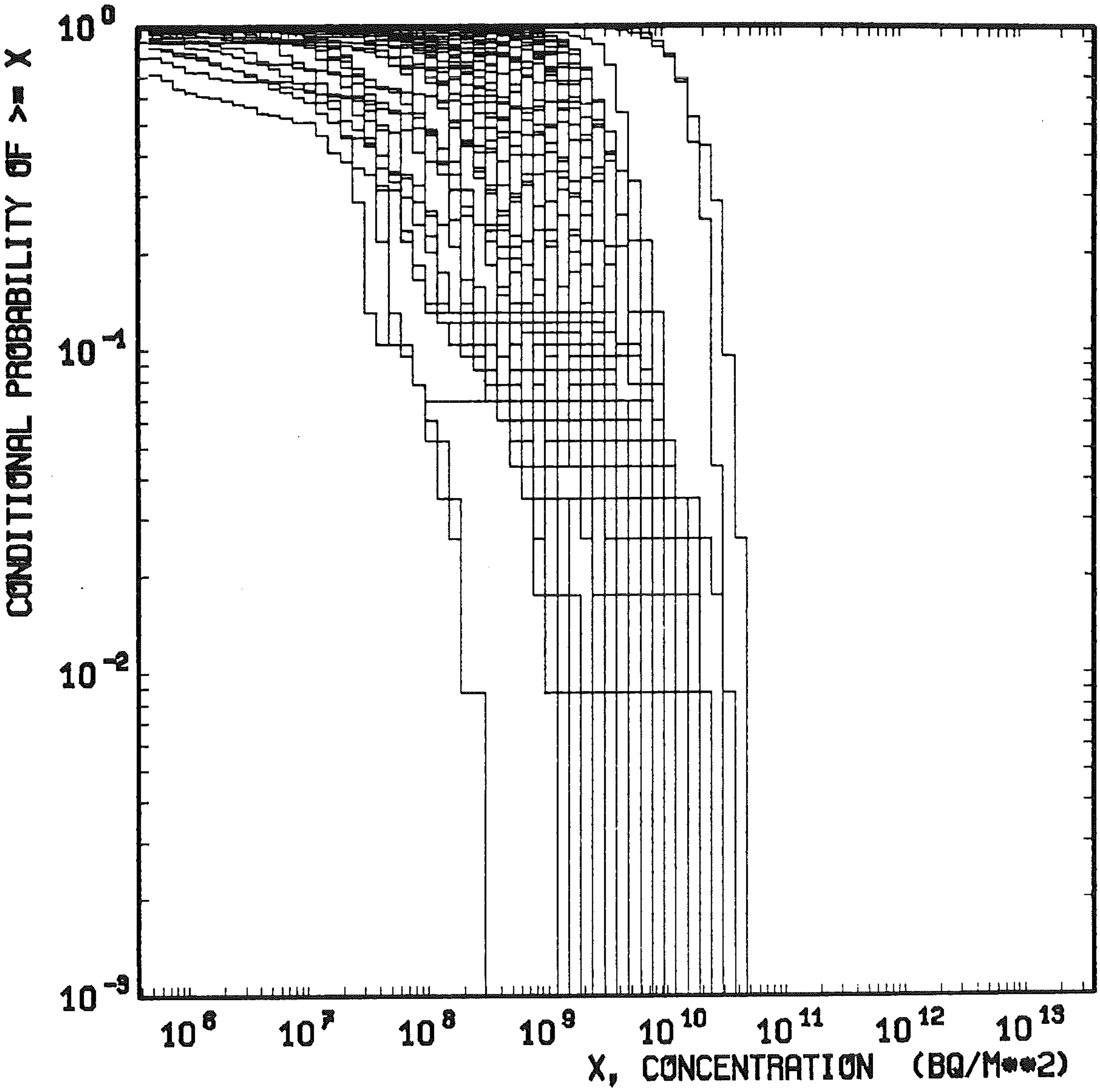
KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GRS - DESIGN)




REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)

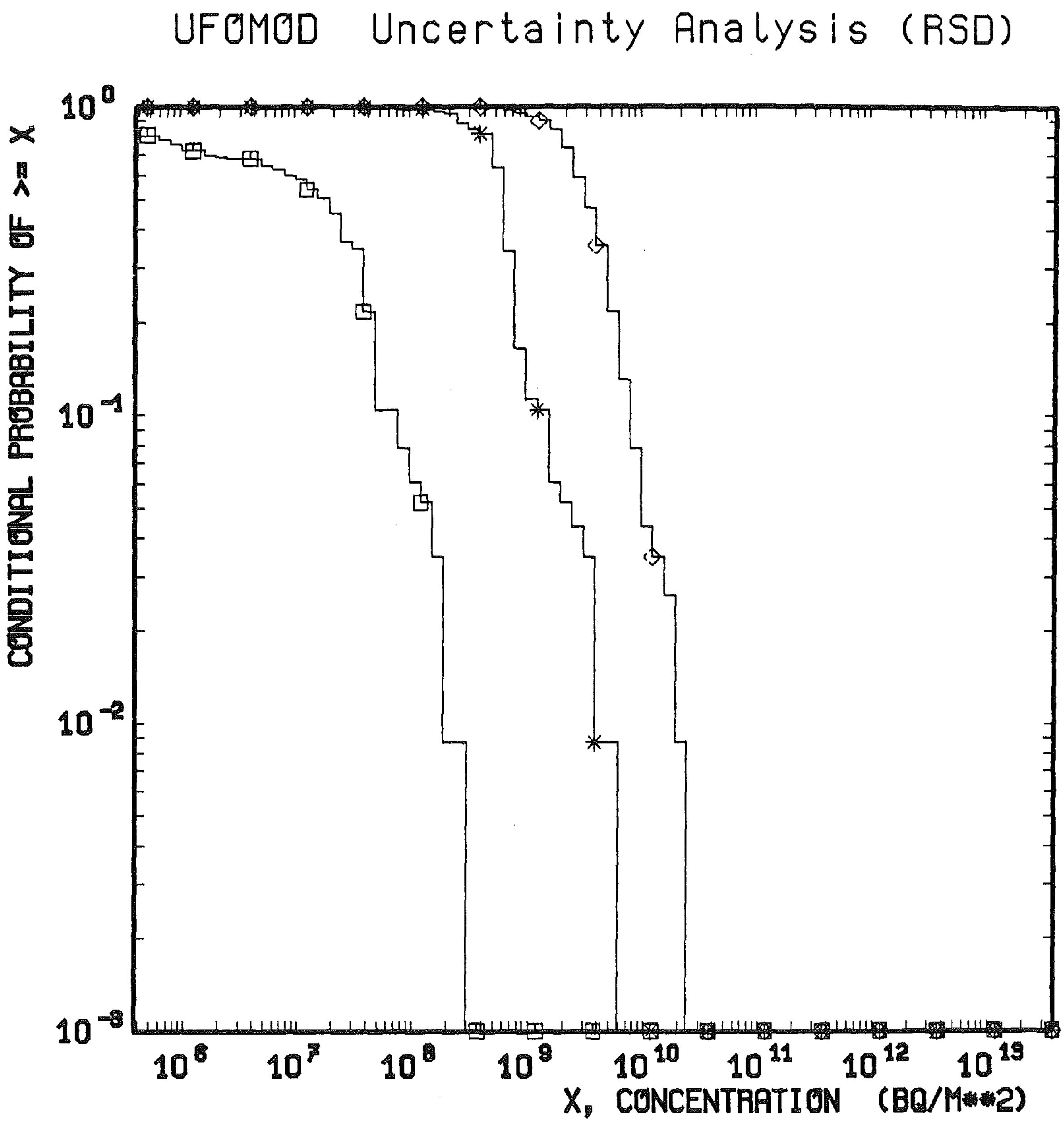
UFOMOD Uncertainty Analysis (RSD)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GAS - DESIGN)



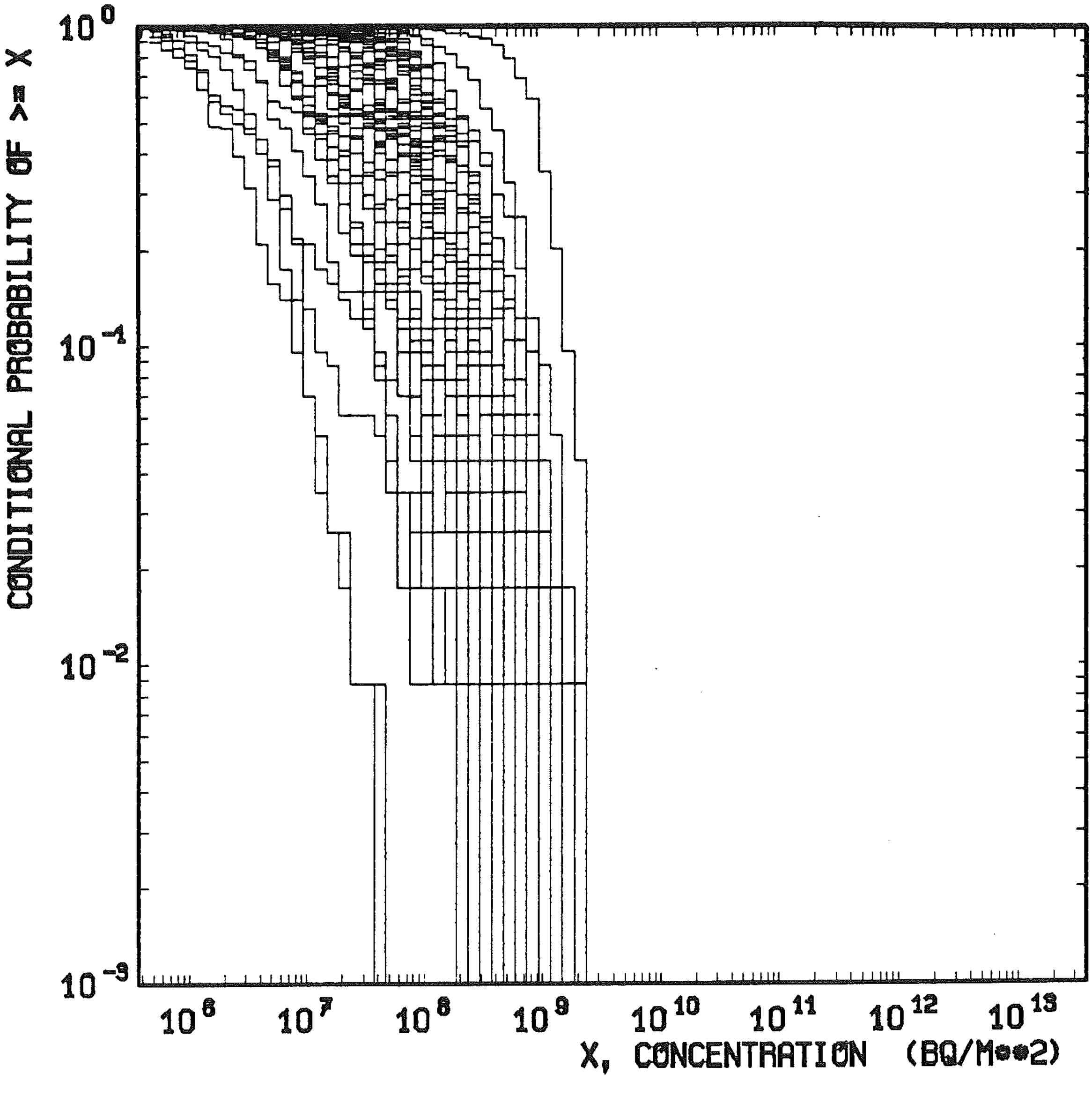

Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS. (GRS - DESIGN)

UFOMOD Uncertainty Analysis (RSD)

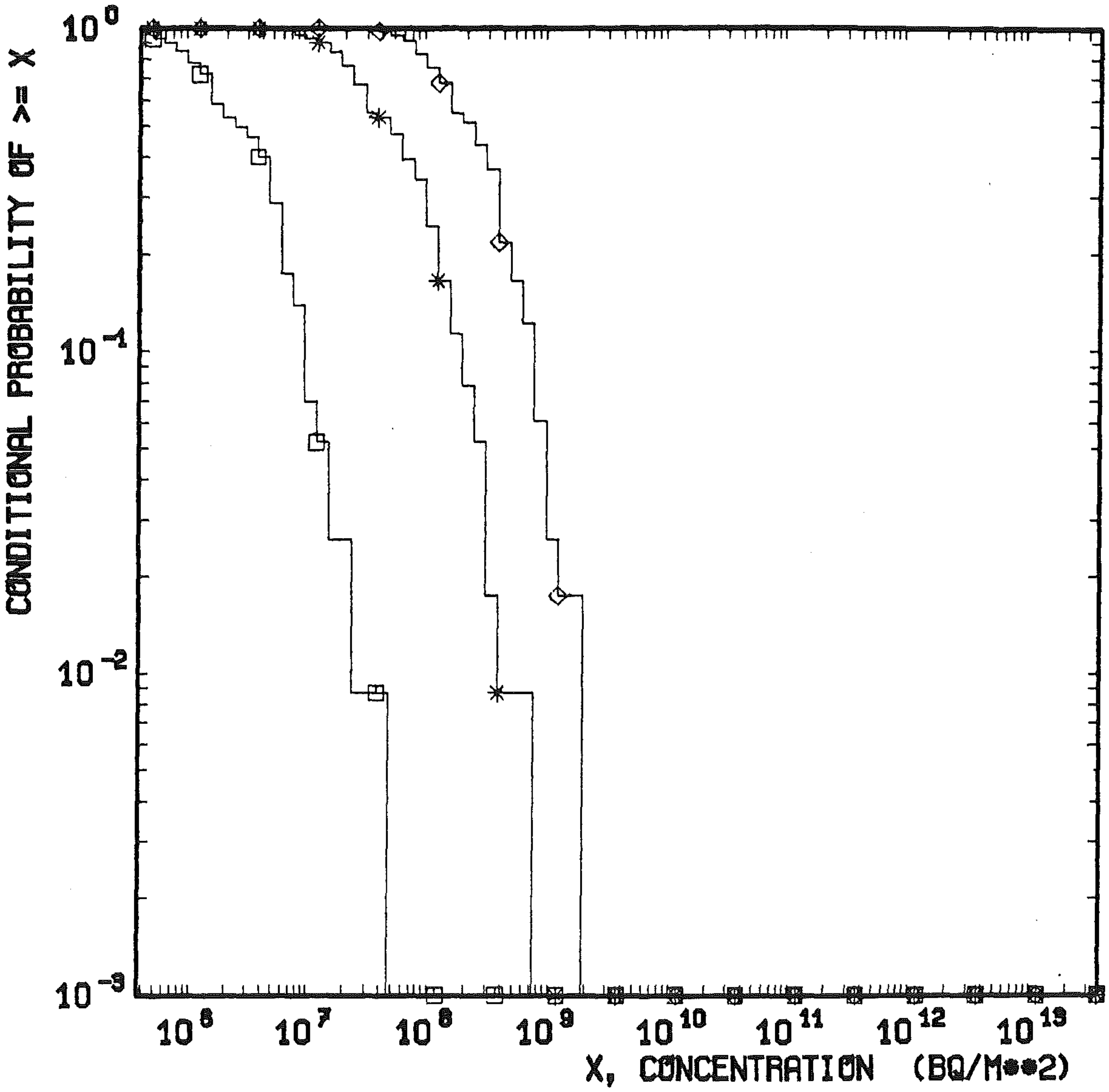



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GRS - DESIGN)

# UFOMOD Uncertainty Analysis (RSD)

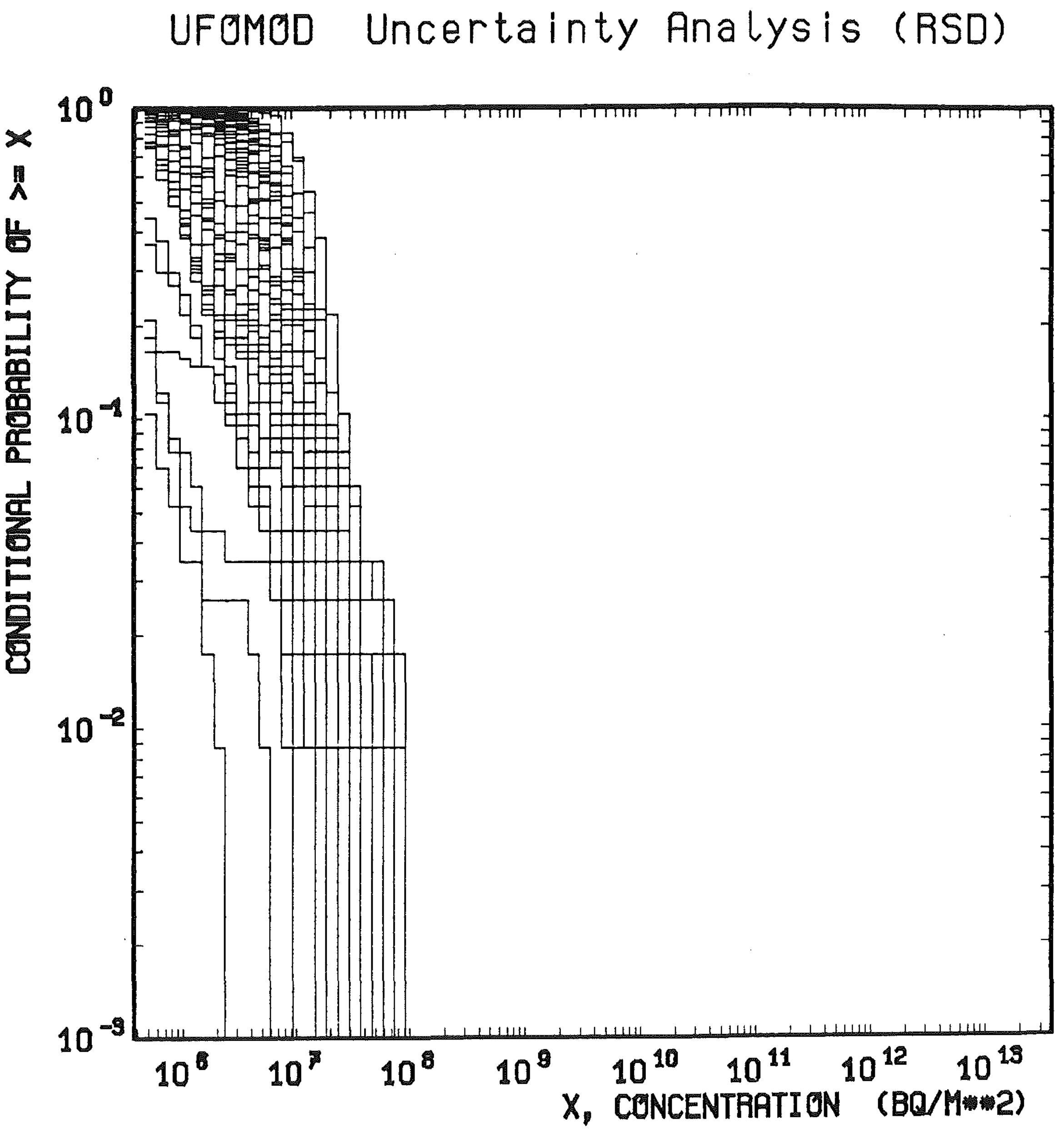



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% -QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)

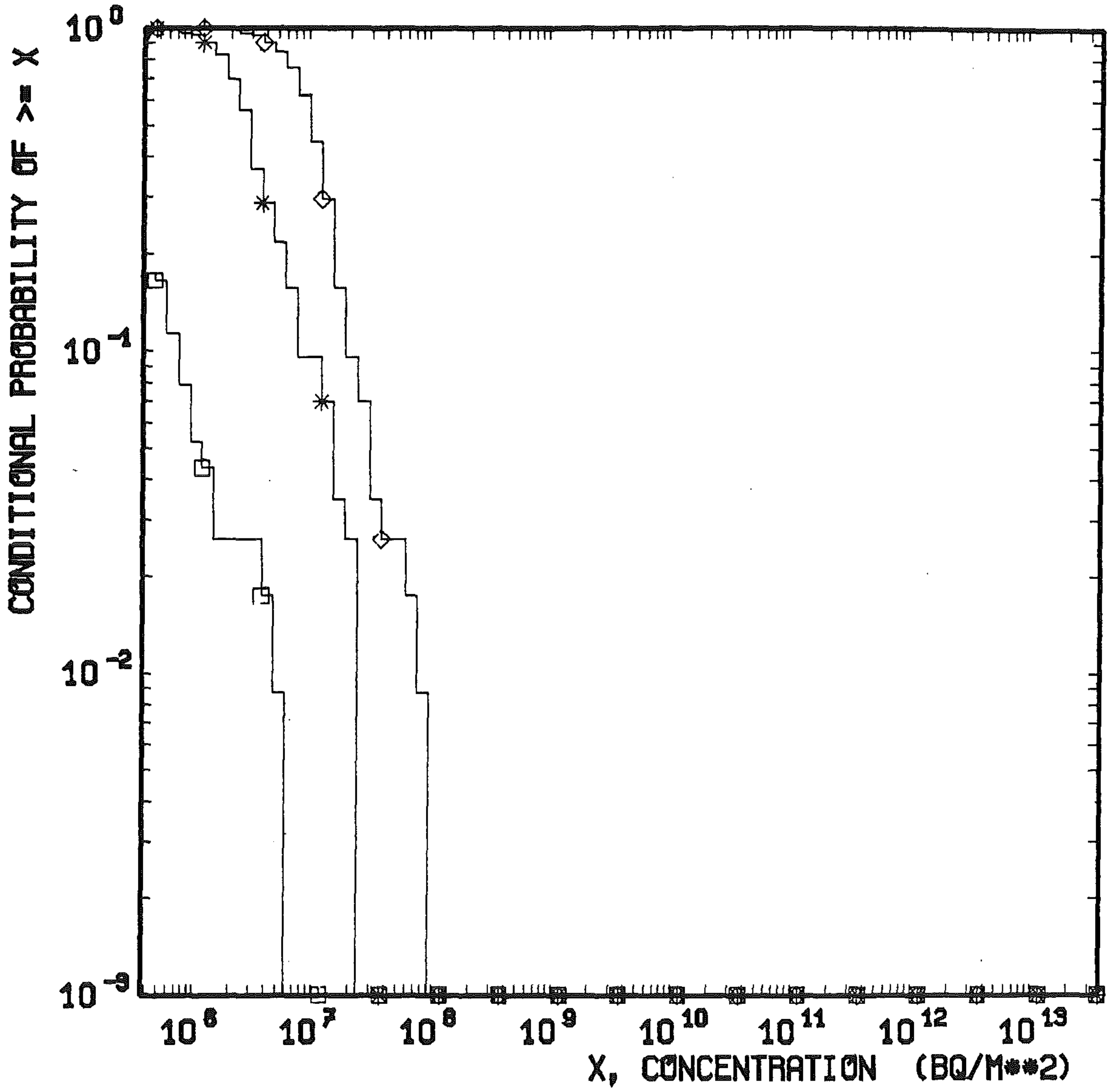



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 59 RUNS IN A RANDOM SAMPLE OF SIZE 59. (GRS - DESIGN)

# UFOMOD Uncertainty Analysis (RSD)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

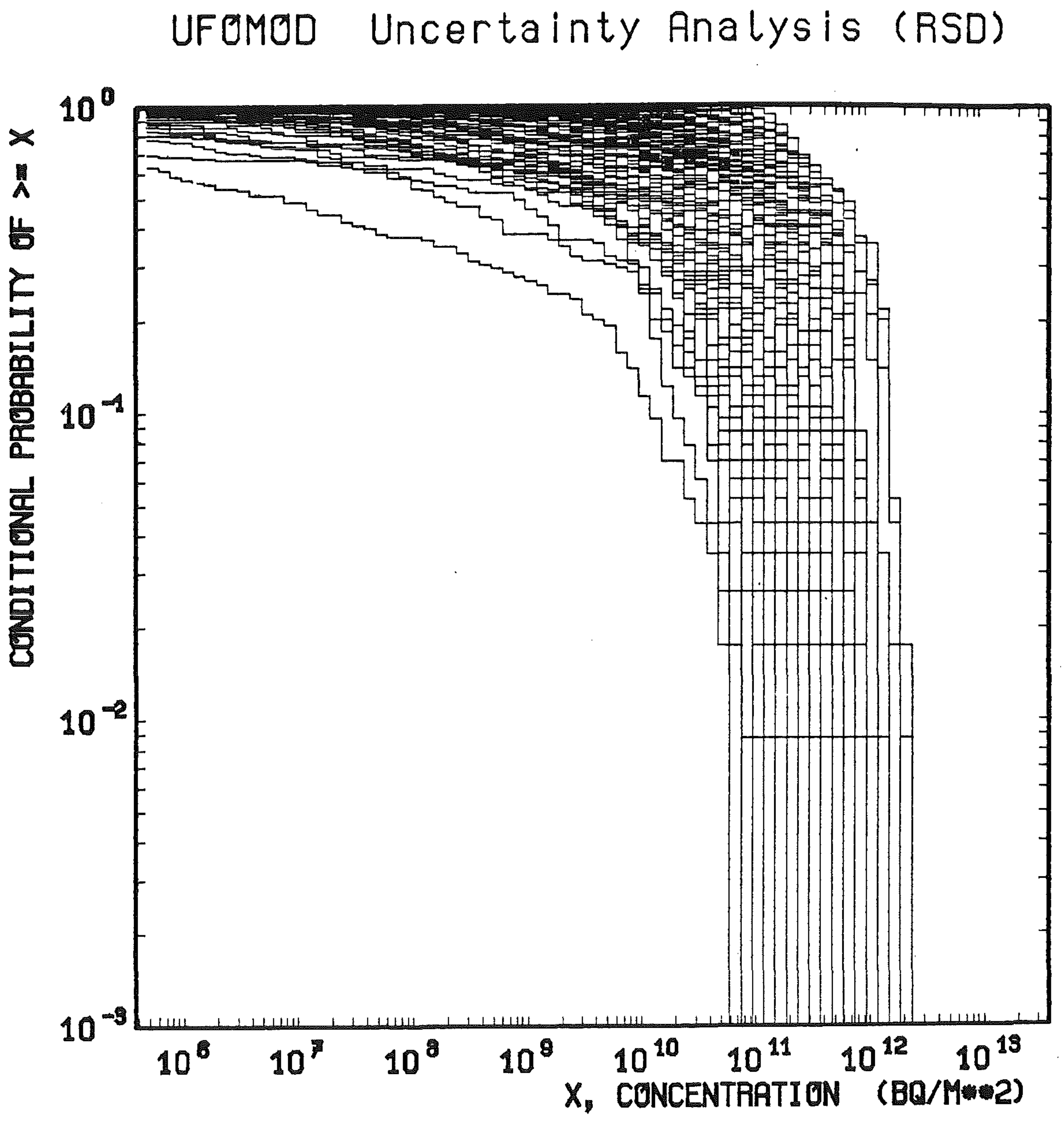
* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS. (GRS - DESIGN)

## B.6 ACTIVITY CONCENTRATIONS (RSD AT KFK, N=100 RUNS)

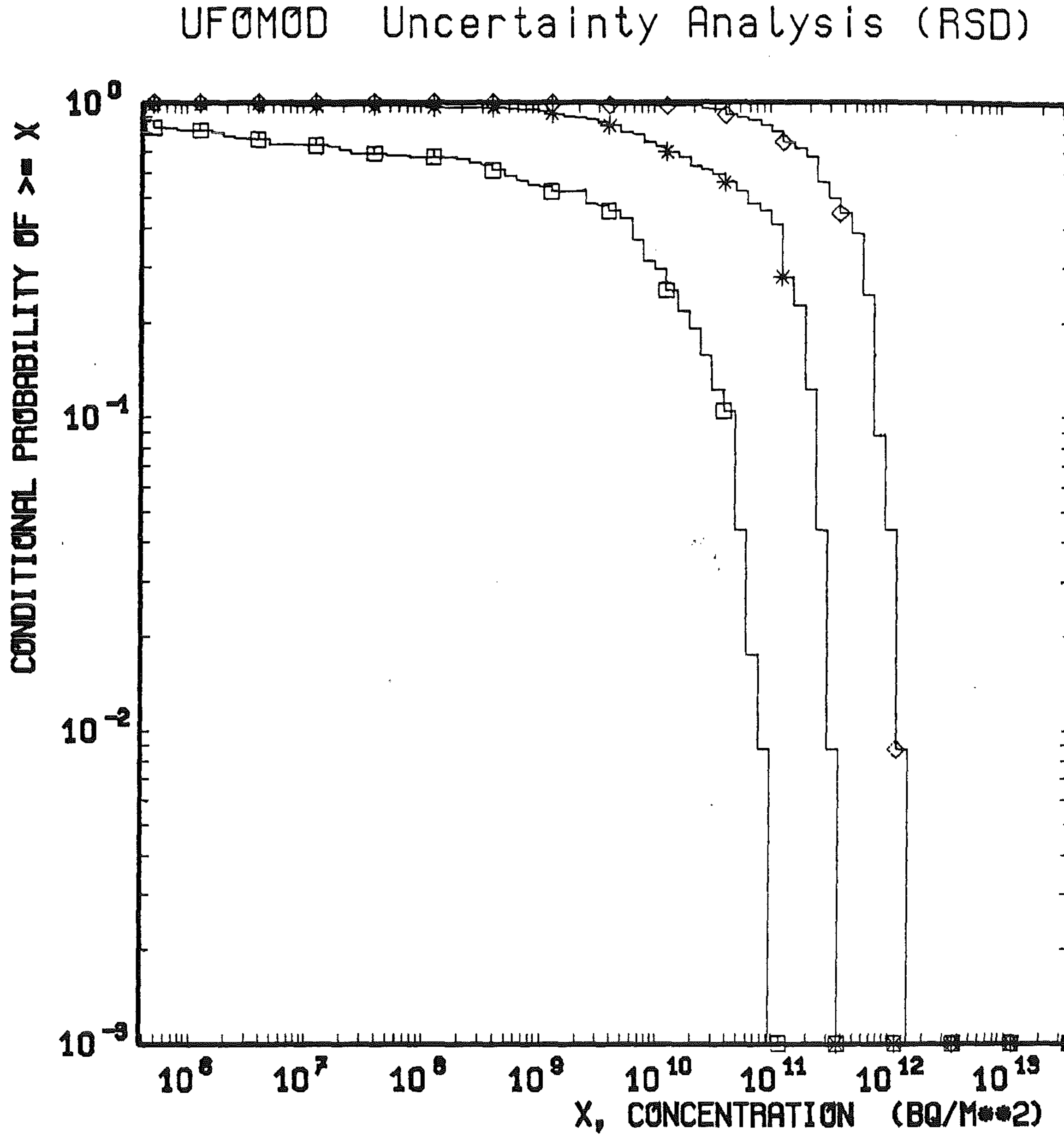
In this section CCFDs and the corresponding confidence curves are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.

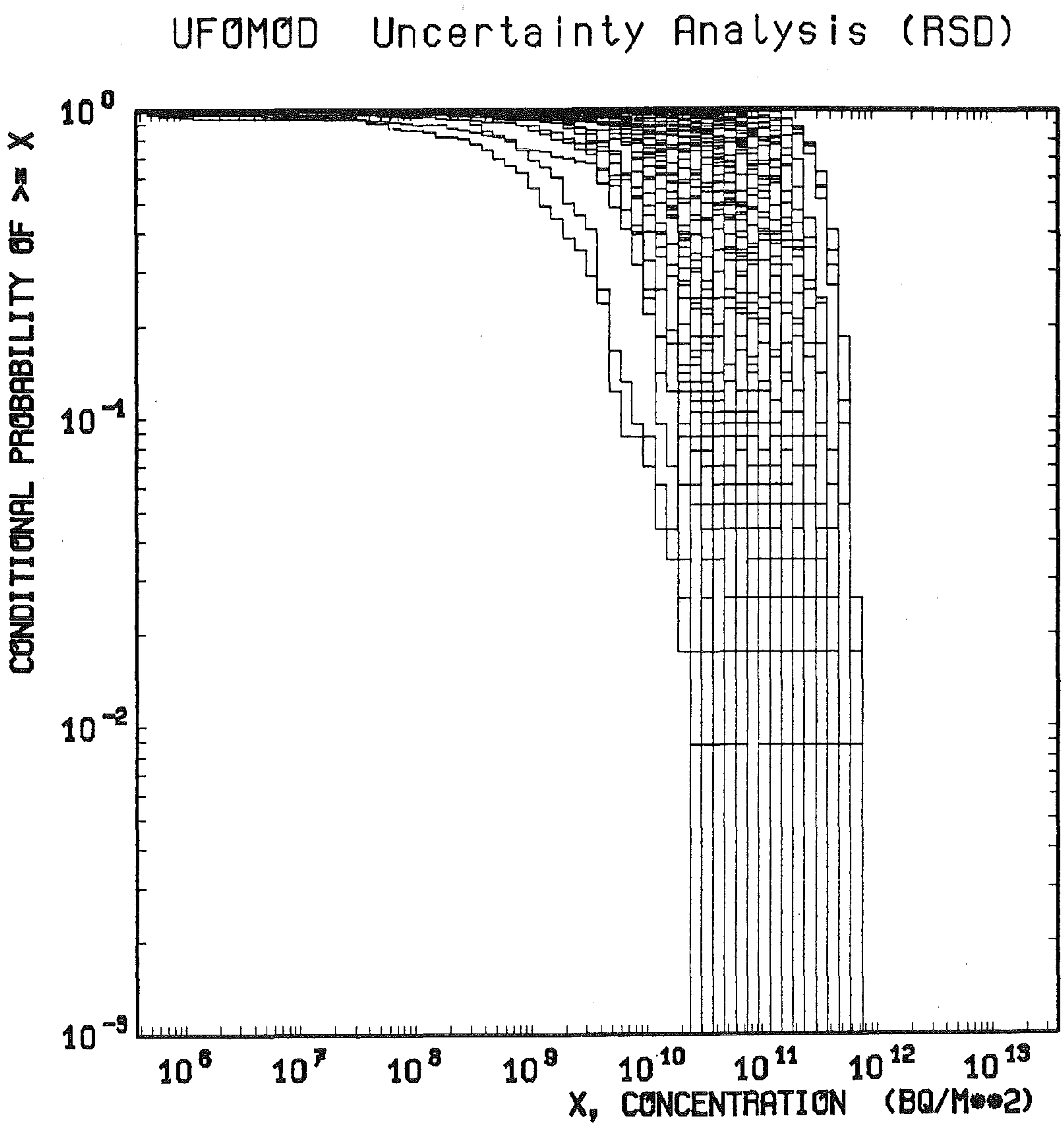



Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.2 - 0.5 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

KfK INR

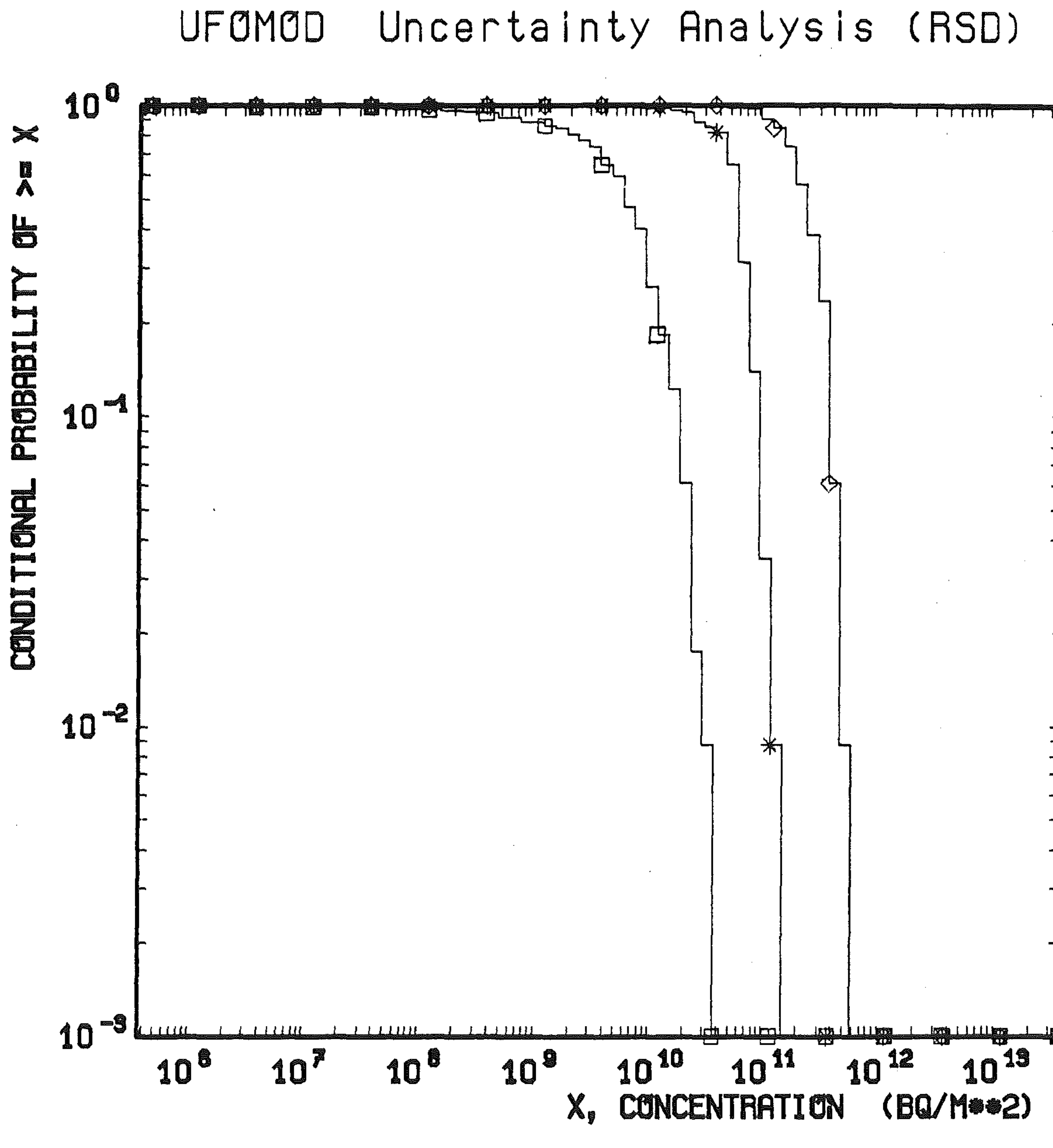
REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.



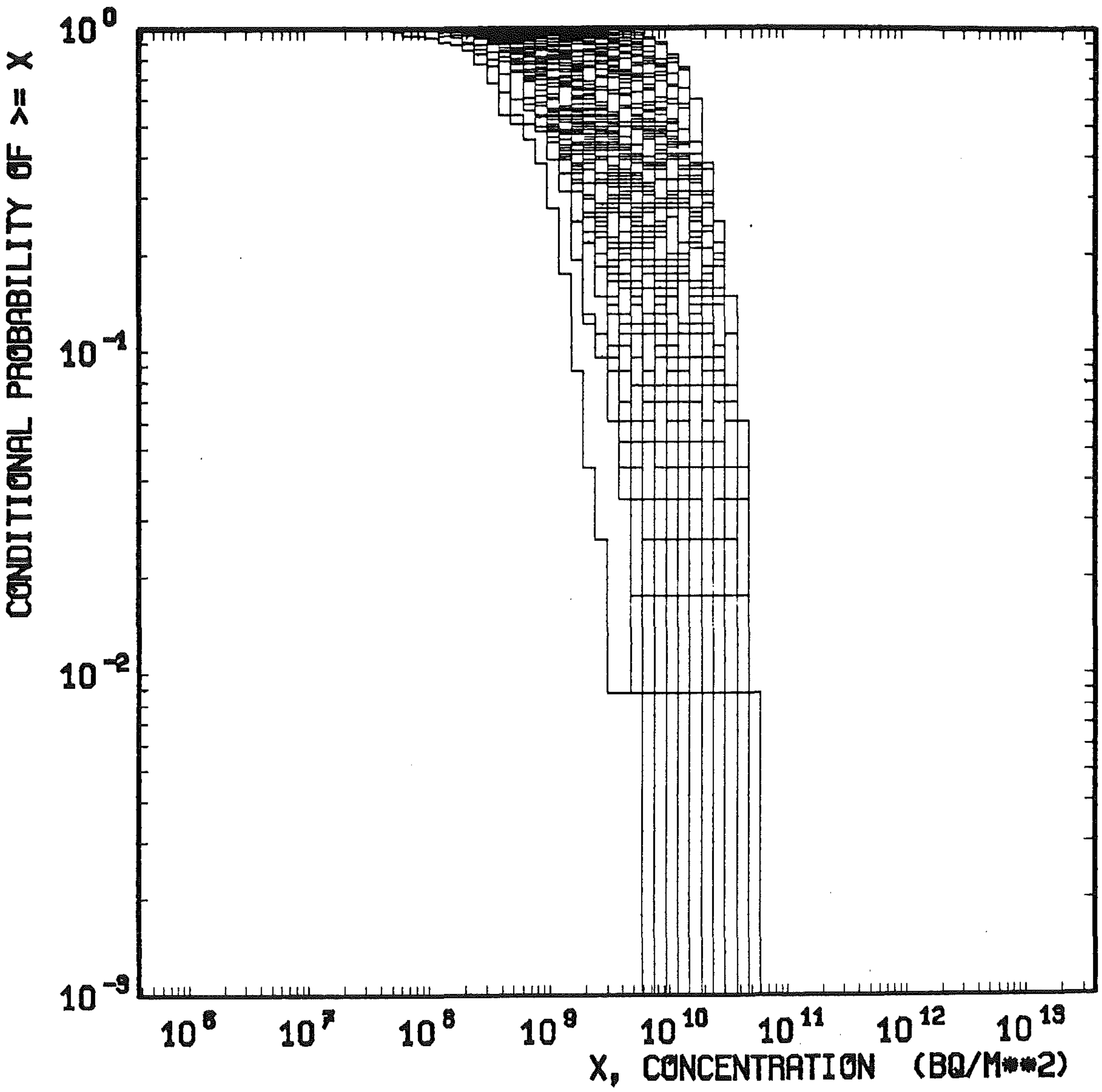

Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 0.8 - 1.2 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

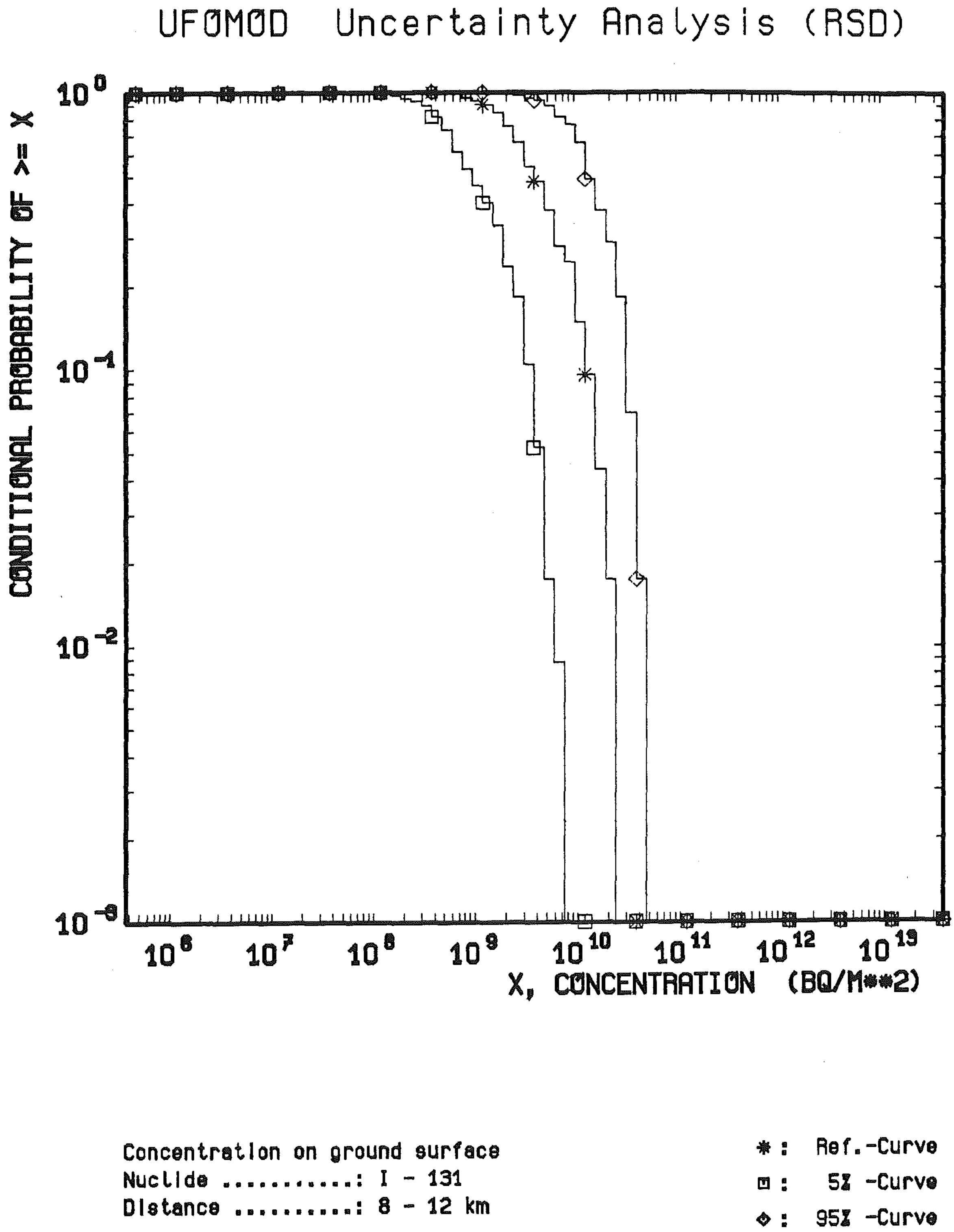
## UFOMOD Uncertainty Analysis (RSD)



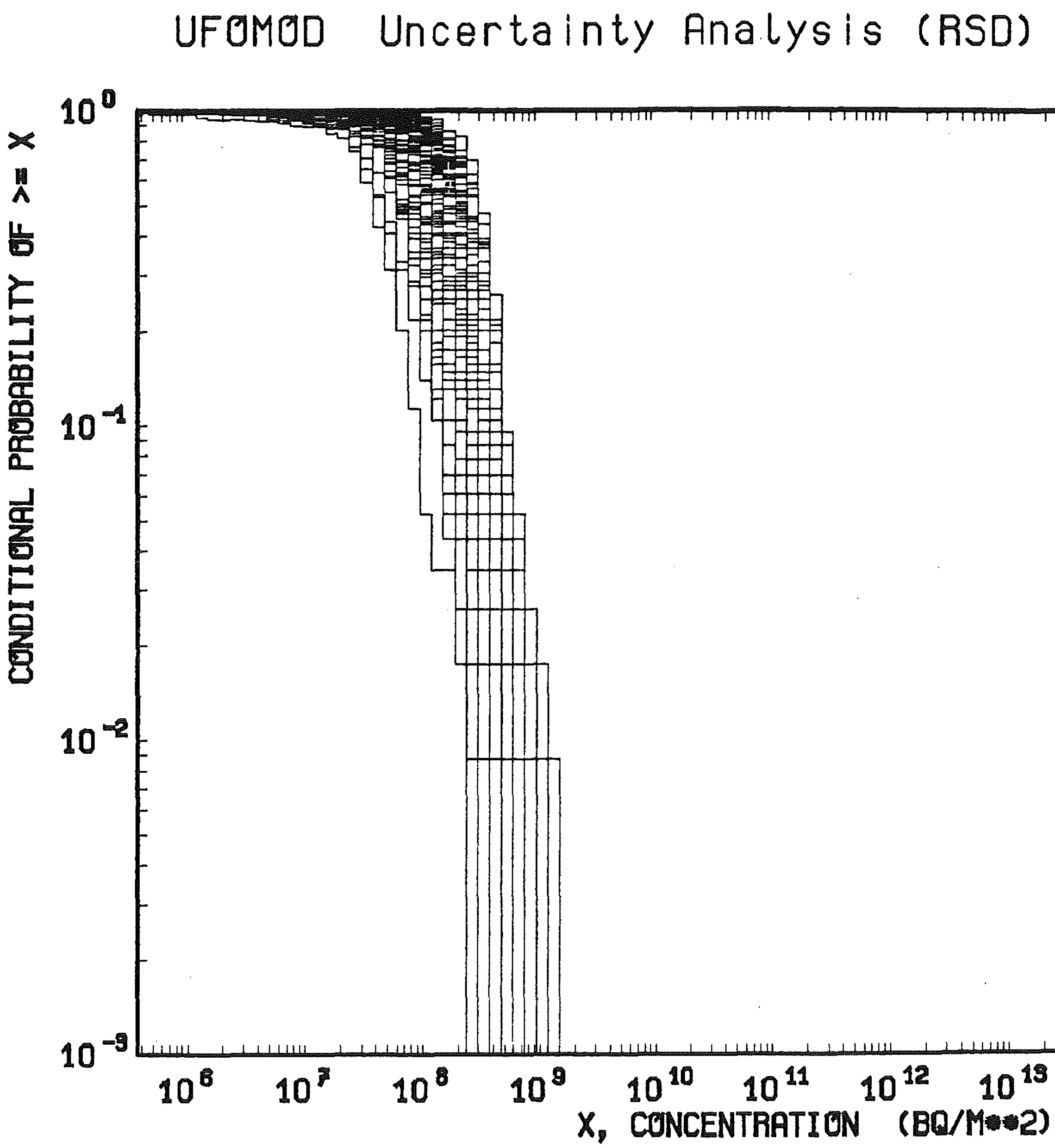

Concentration on ground surface
Nuclide ...........: I - 131
Distance ..........: 8 - 12 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.



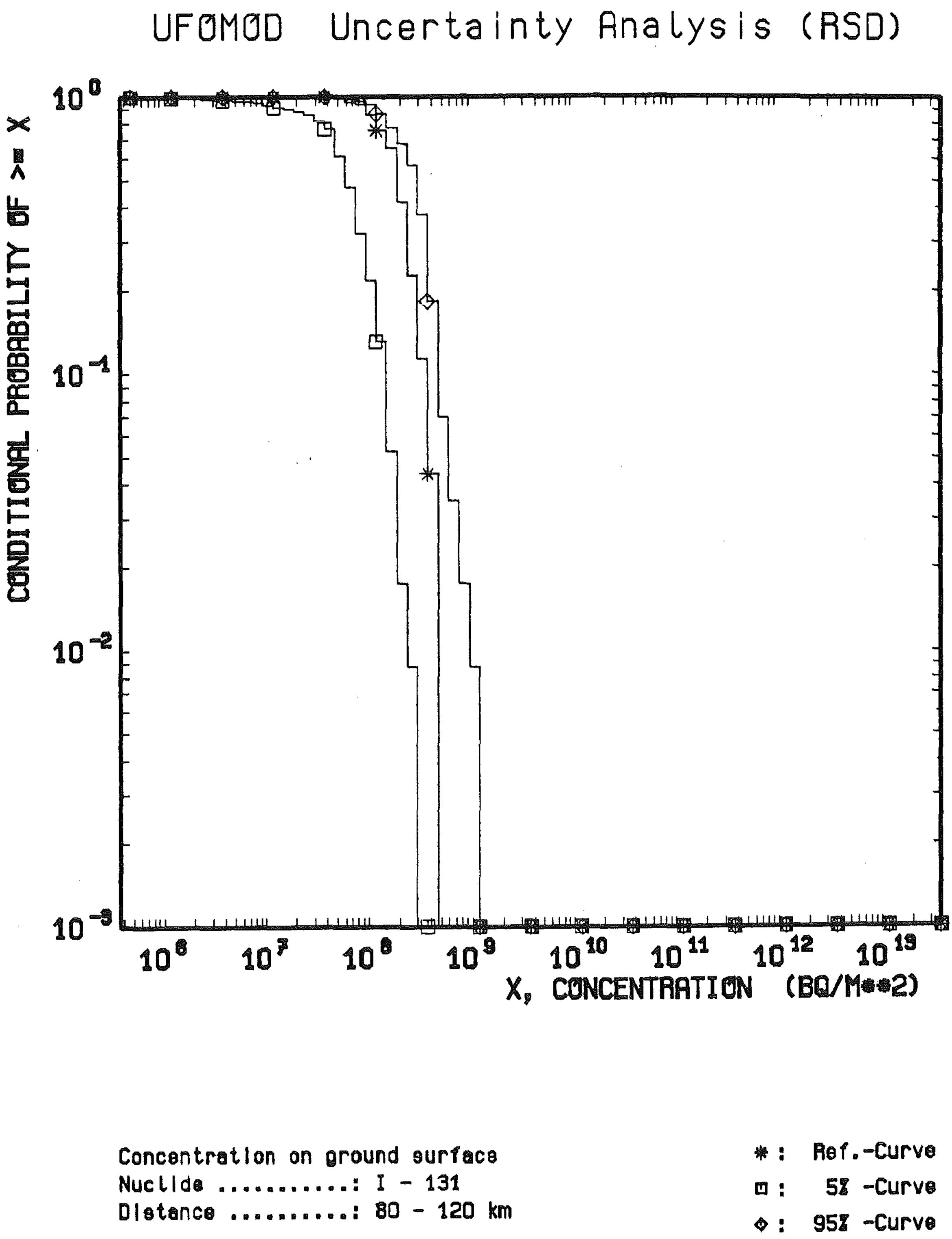

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.



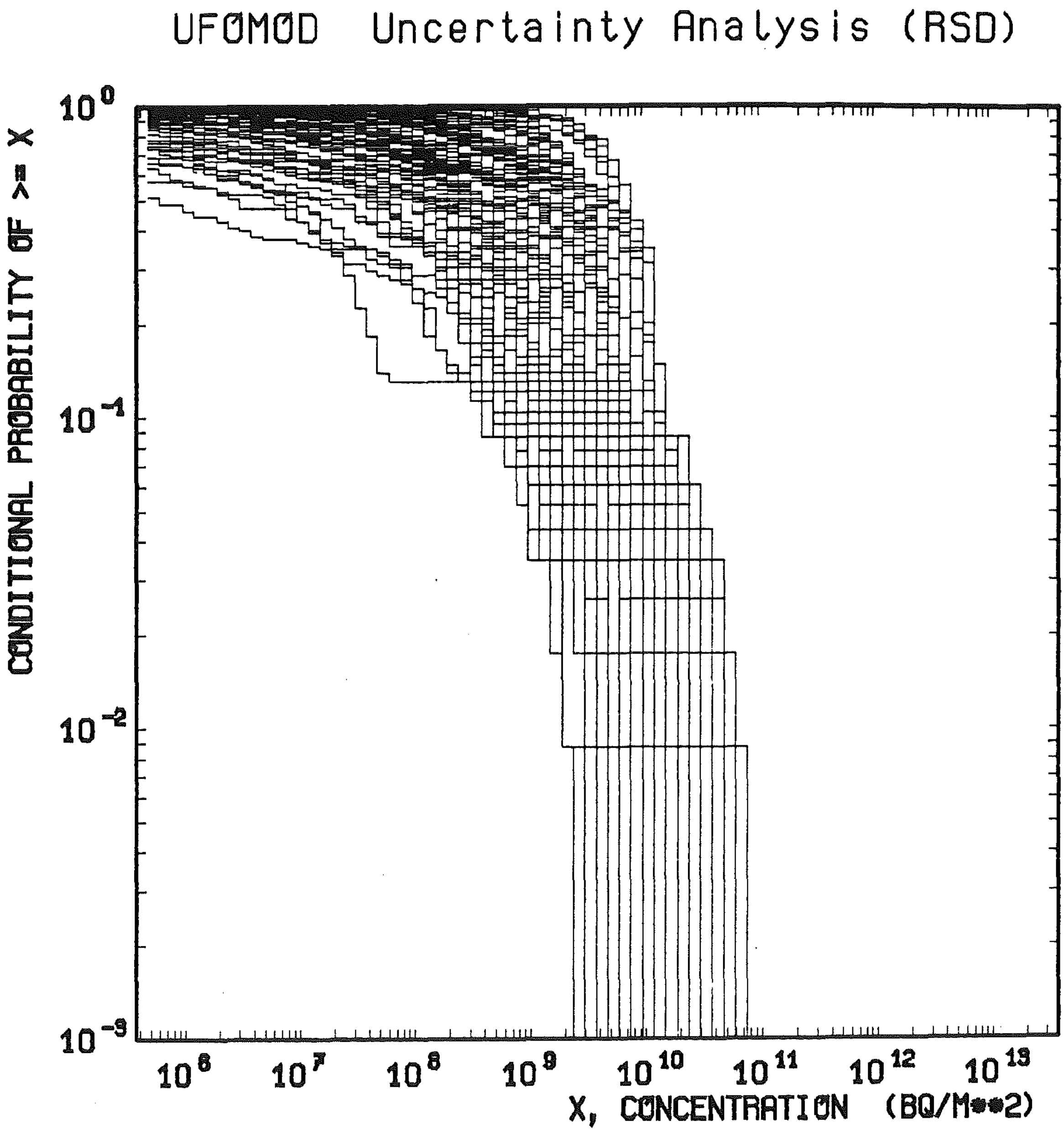

Concentration on ground surface
Nuclide ............: I - 131
Distance ...........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.



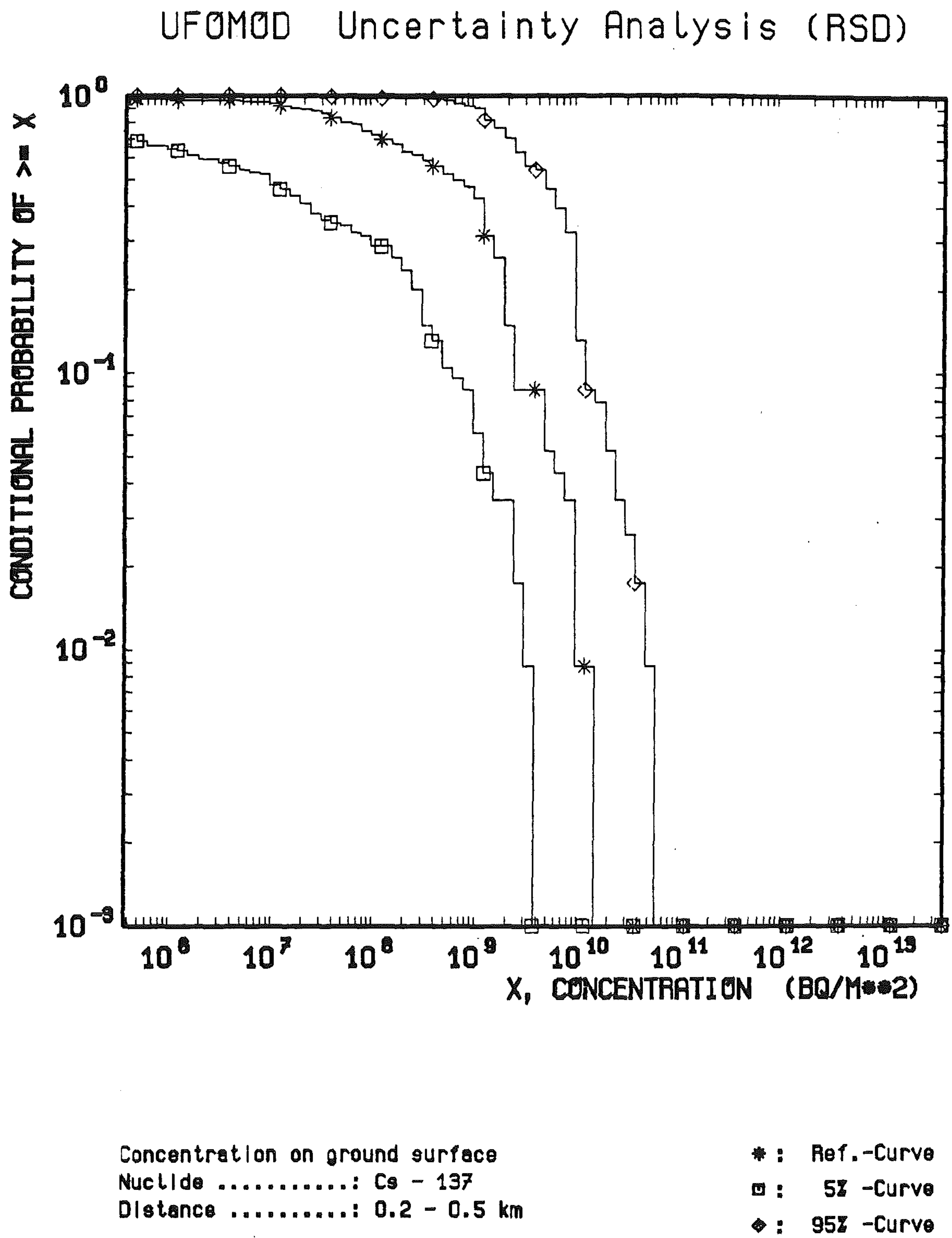

REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.



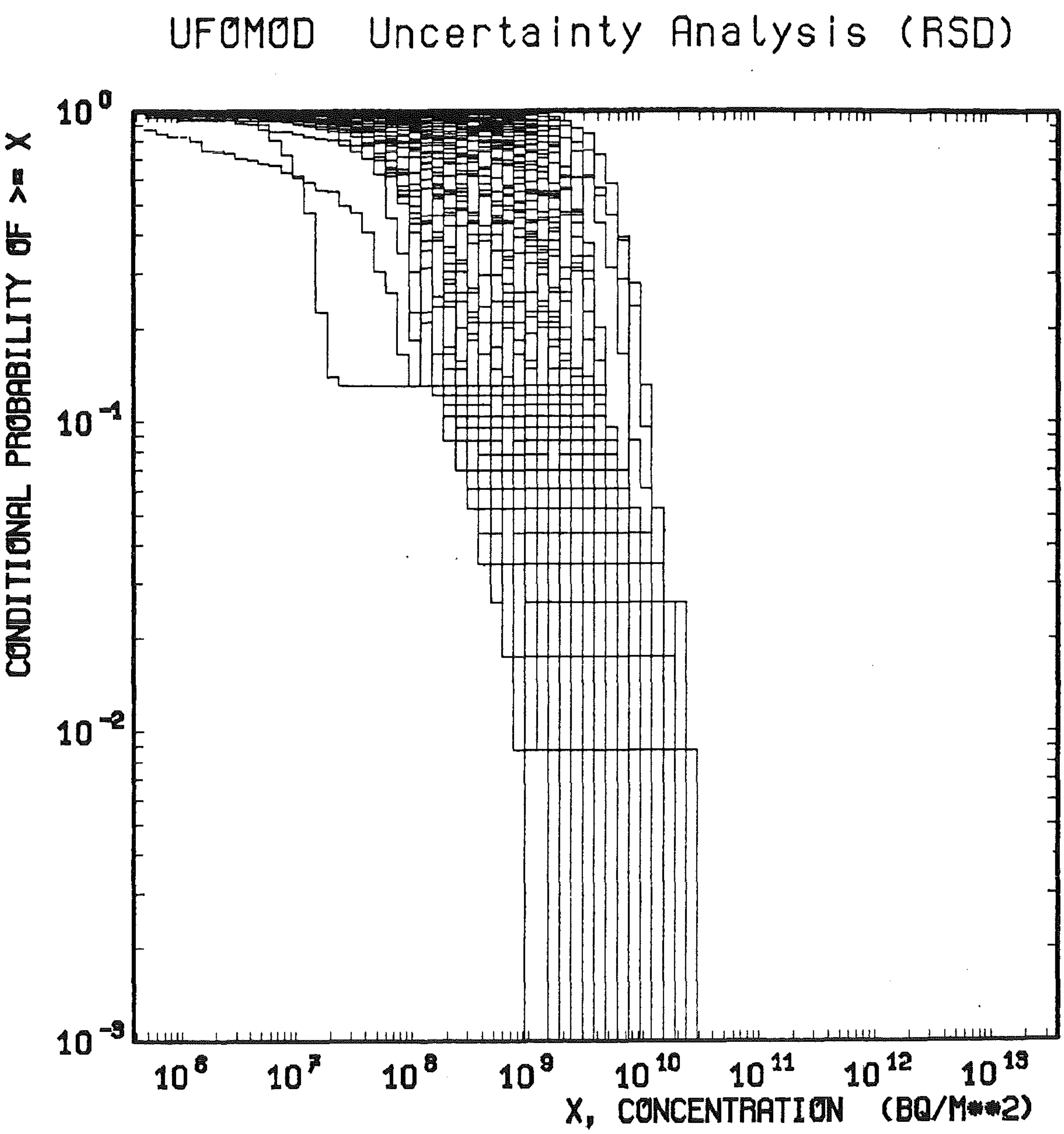

Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.

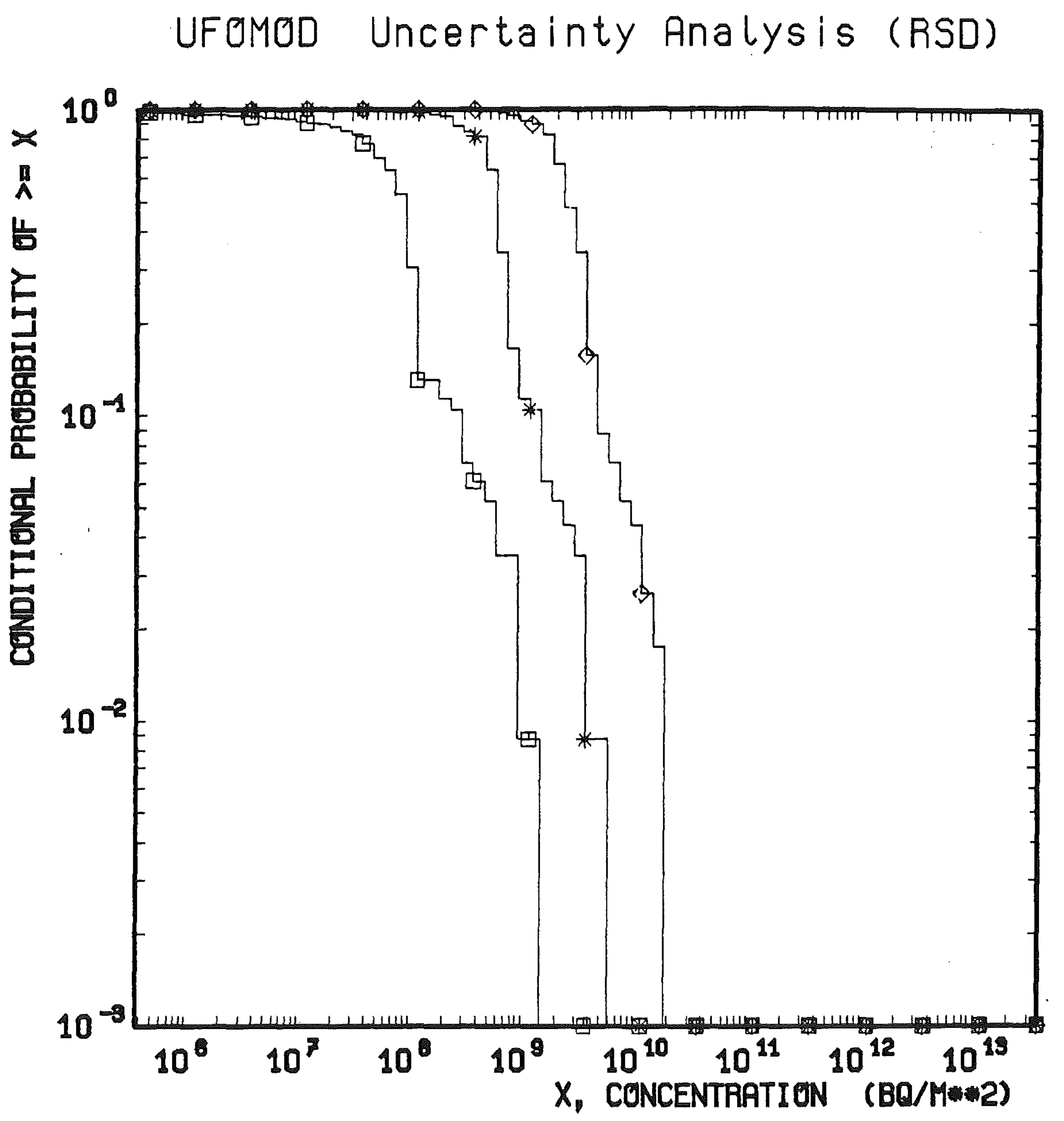



REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.

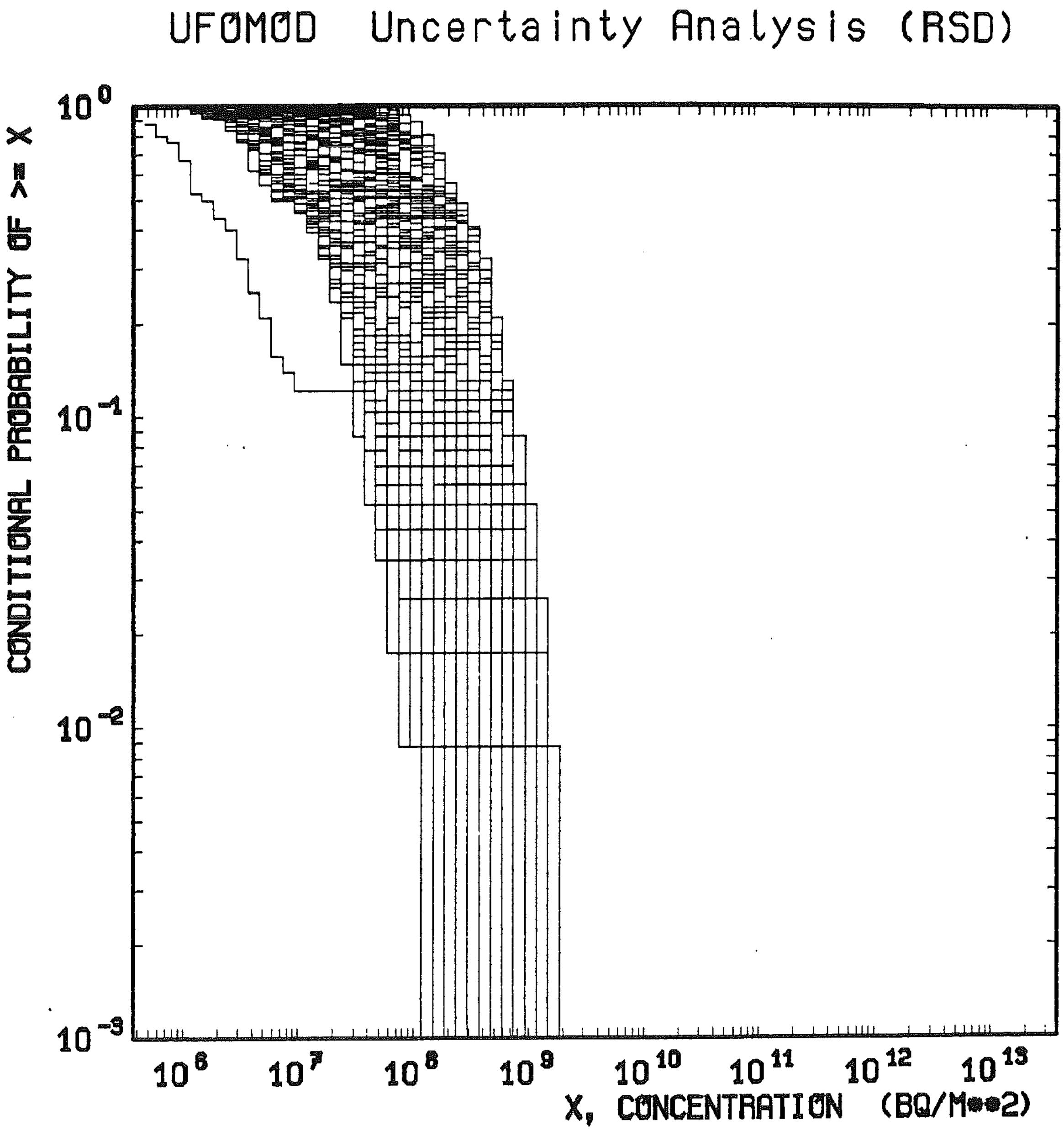



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 0.8 - 1.2 km

* : Ref.-Curve
□ : 5% -Curve
◇ : 95% -Curve

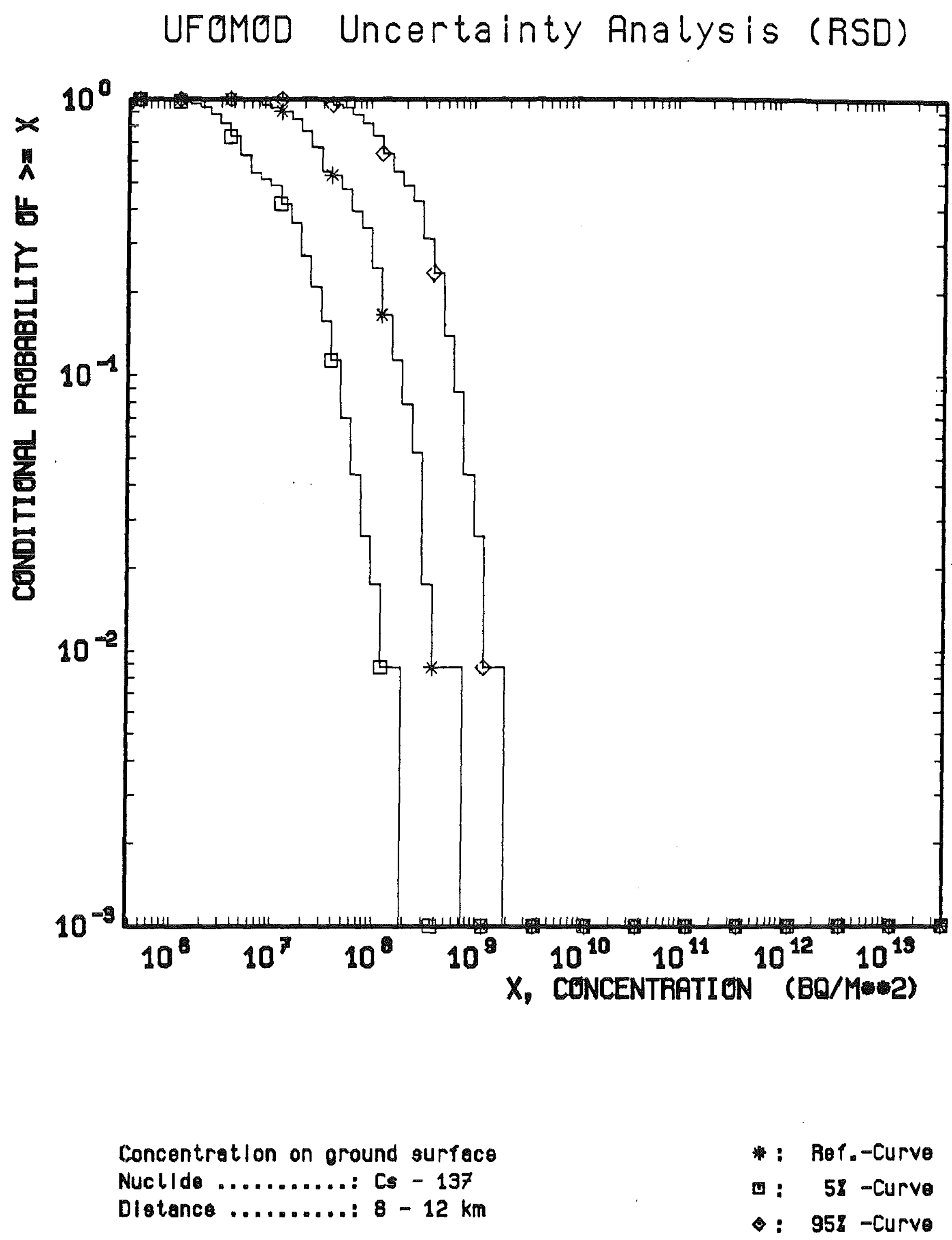
KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

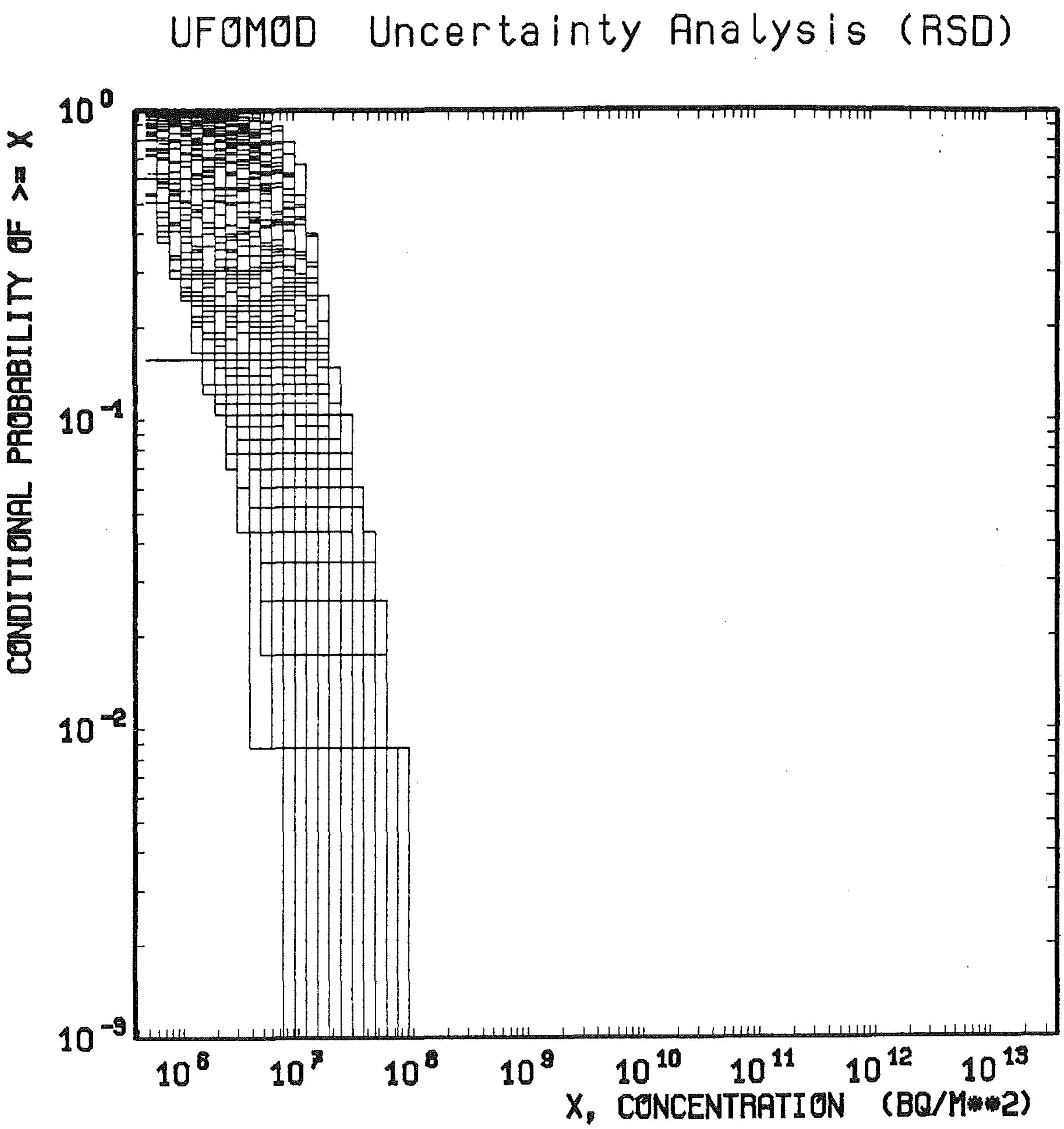



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 8 - 12 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.




REFERENCE CCFD ØF THE CØNCENTRATIØN UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

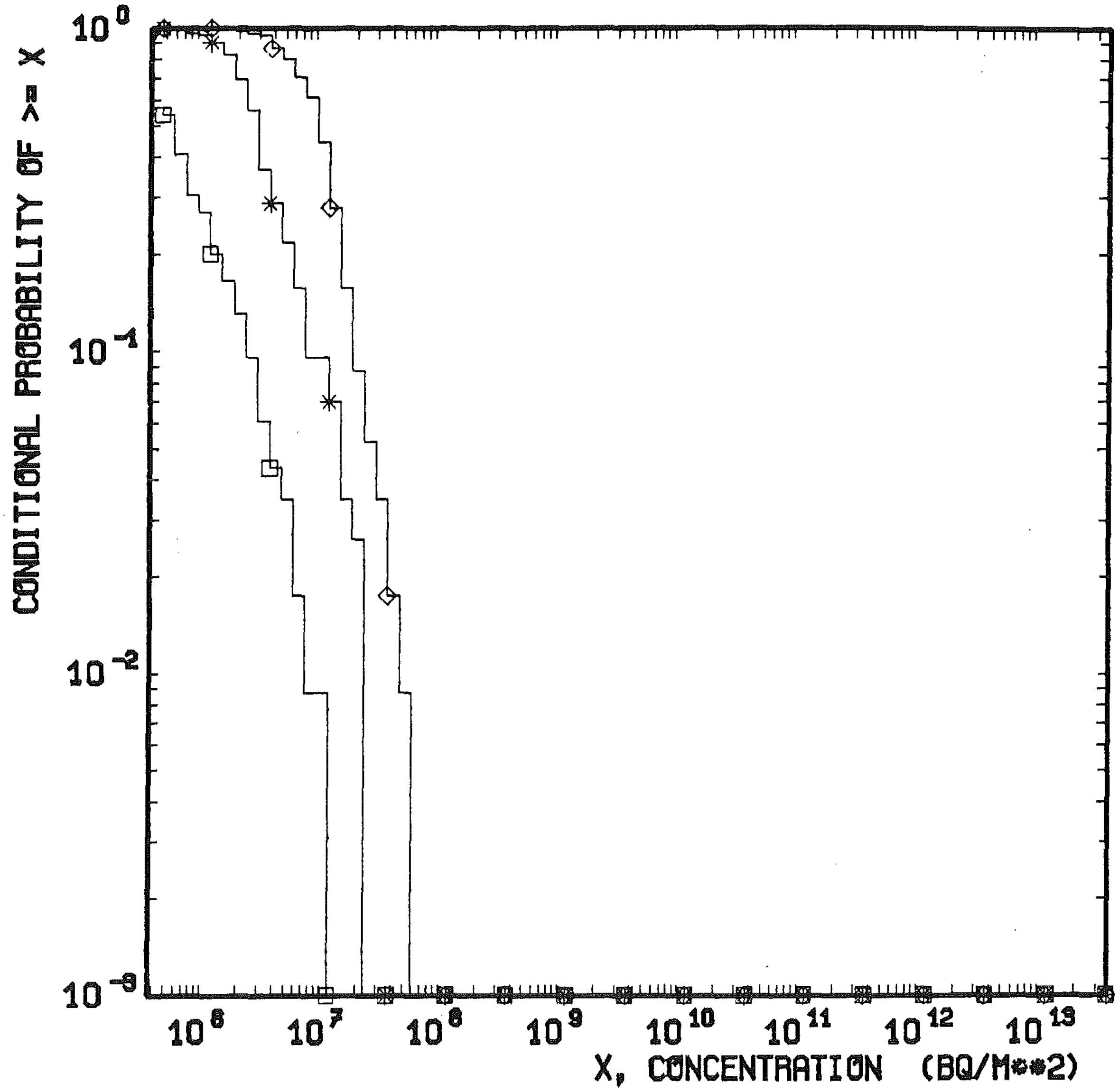



Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) OF THE CONCENTRATION UNDER PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED). EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A RANDOM SAMPLE OF SIZE 100.

UFØMØD Uncertainty Analysis (RSD)




Concentration on ground surface
Nuclide ...........: Cs - 137
Distance ..........: 80 - 120 km

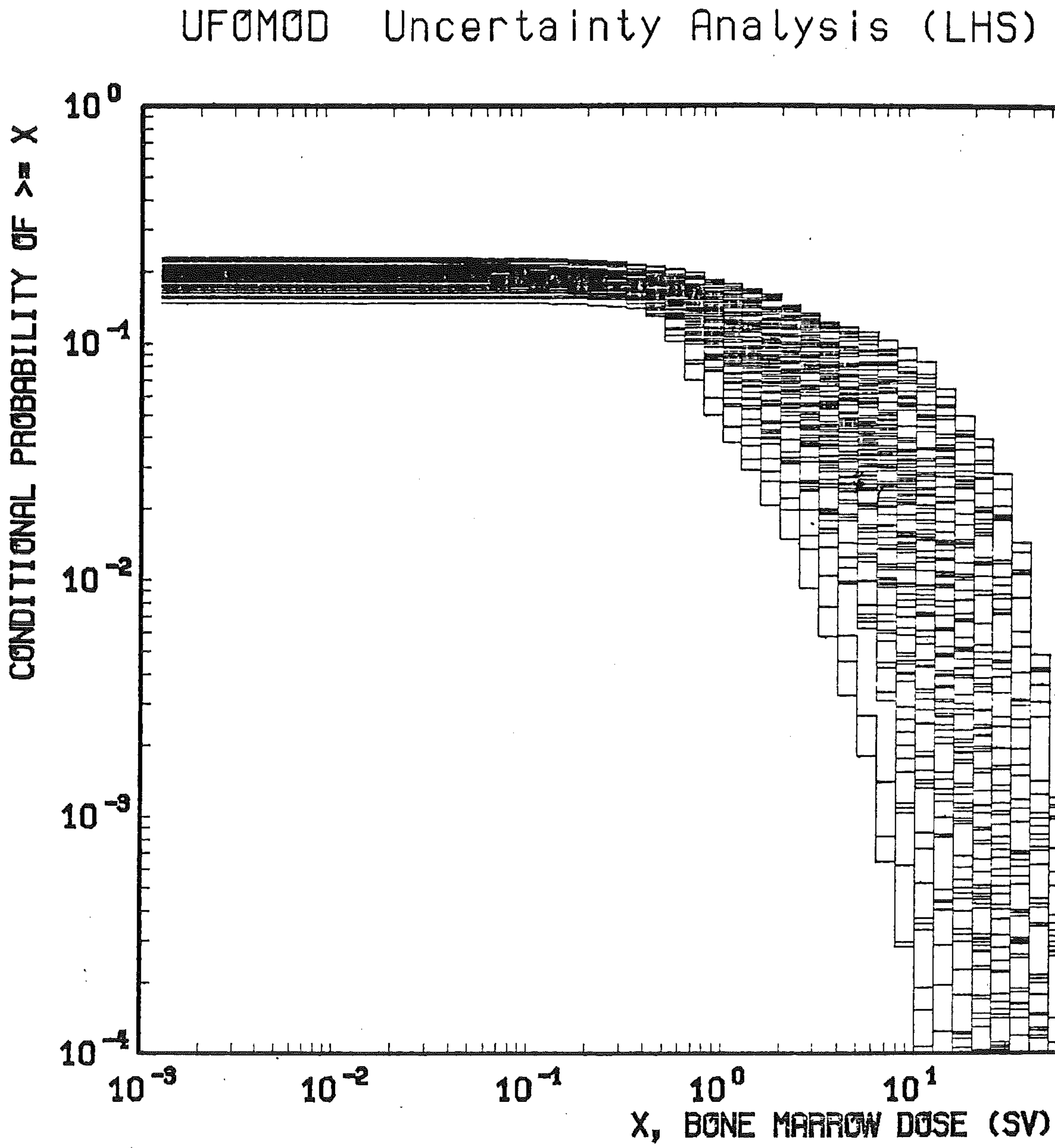
*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD OF THE CONCENTRATION UNDER THE PLUME CENTERLINE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

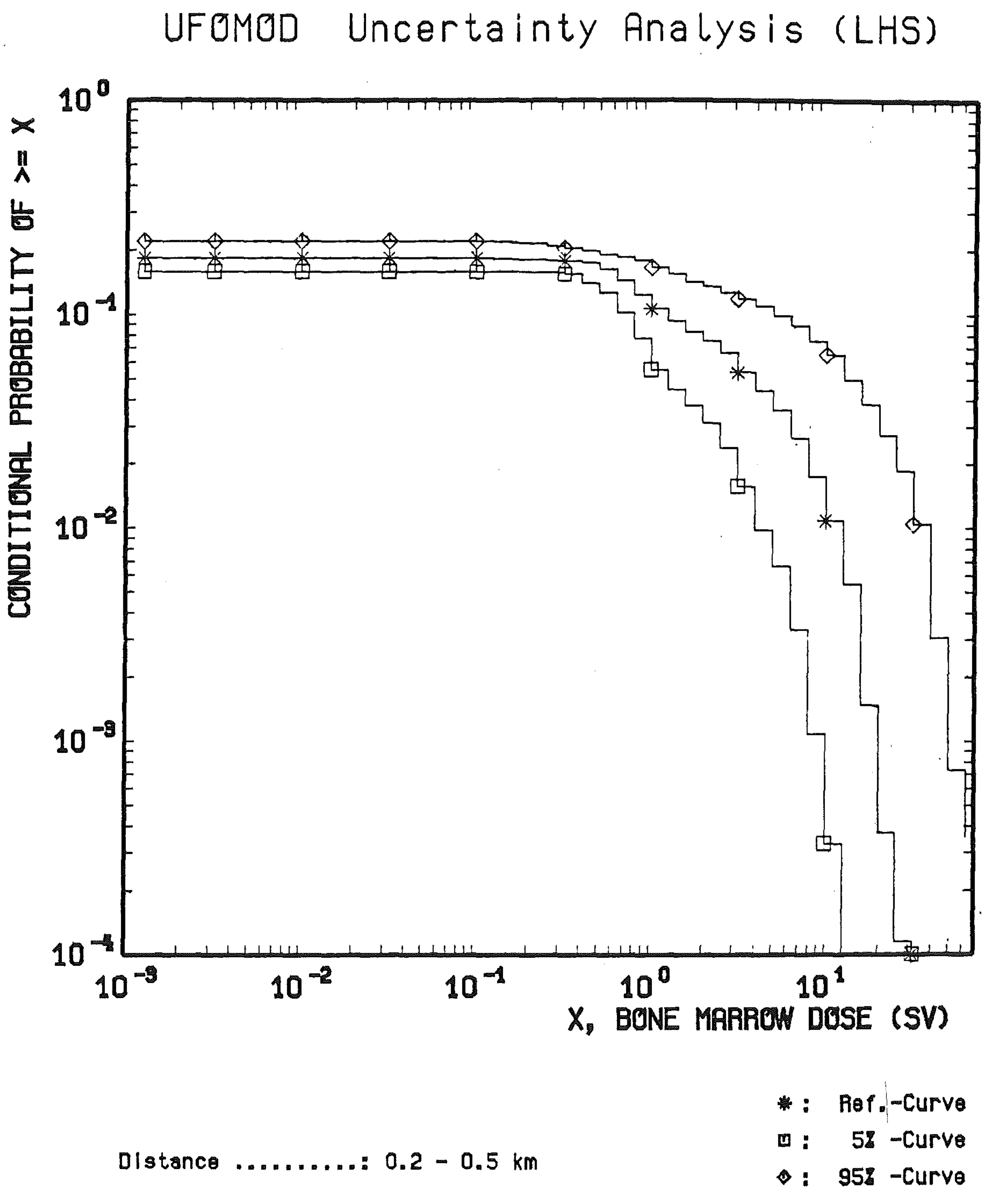
## B.7 DOSES (LHS AT KFK, N=100 RUNS)

In this section CCFDs and the corresponding confidence curves are shown for doses (bone marrow, whole body) at four distance intervals.



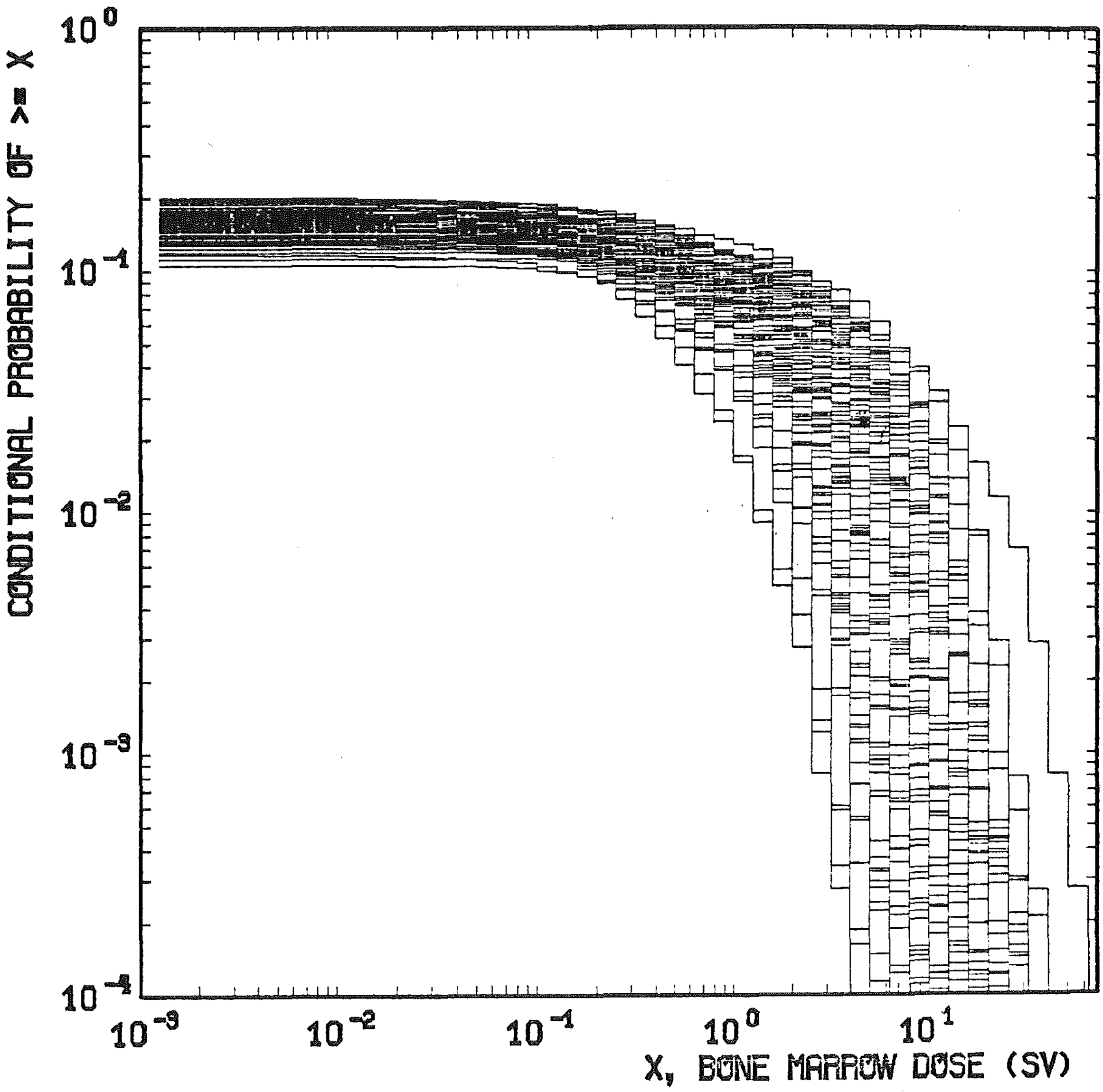

Distance ..........: 0.2 - 0.5 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE BONE MARROW DOSE. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.



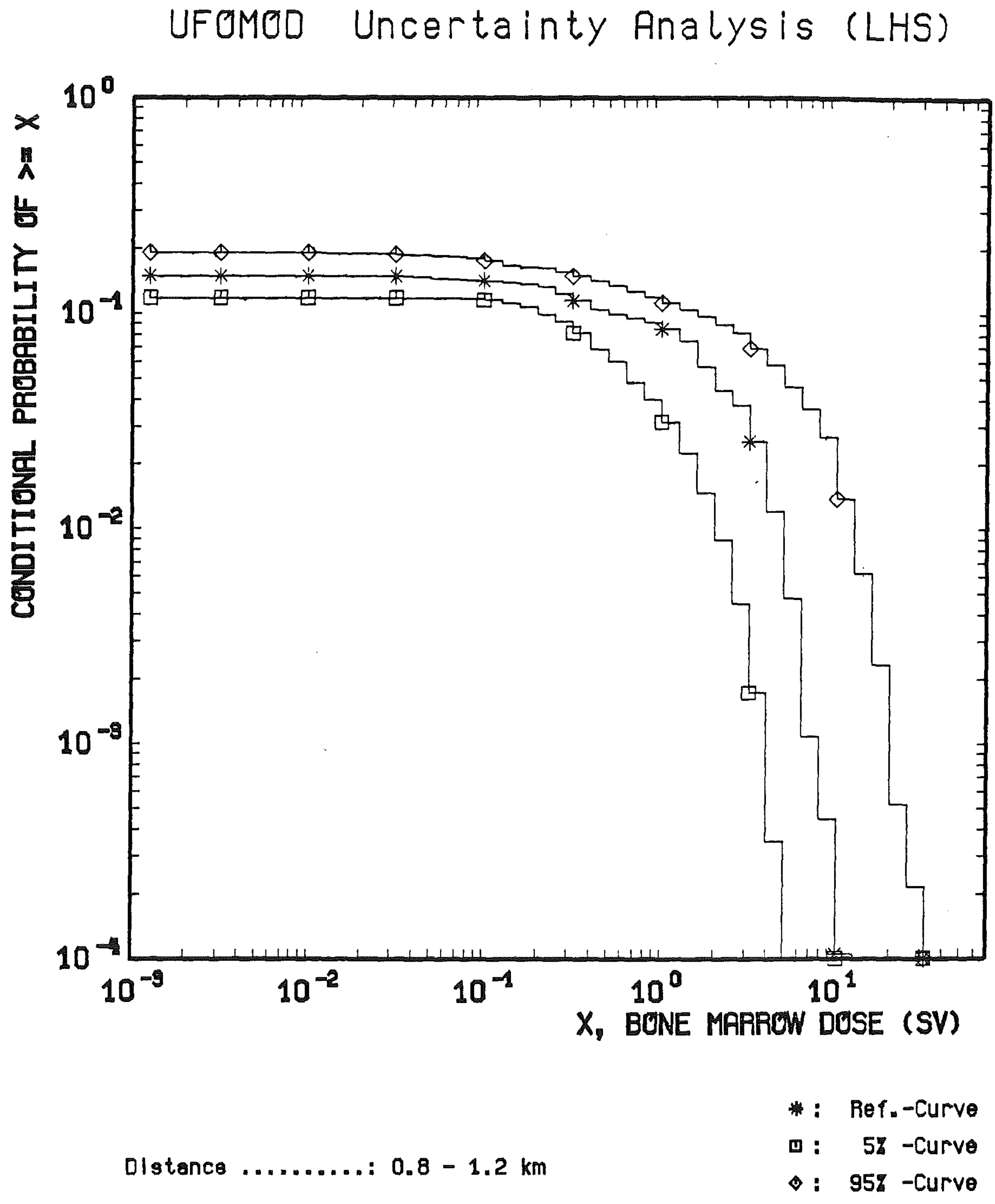

REFERENCE CCFD ØF BØNE MARRØW DØSE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CONFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

UFØMØD Uncertainty Analysis (LHS)

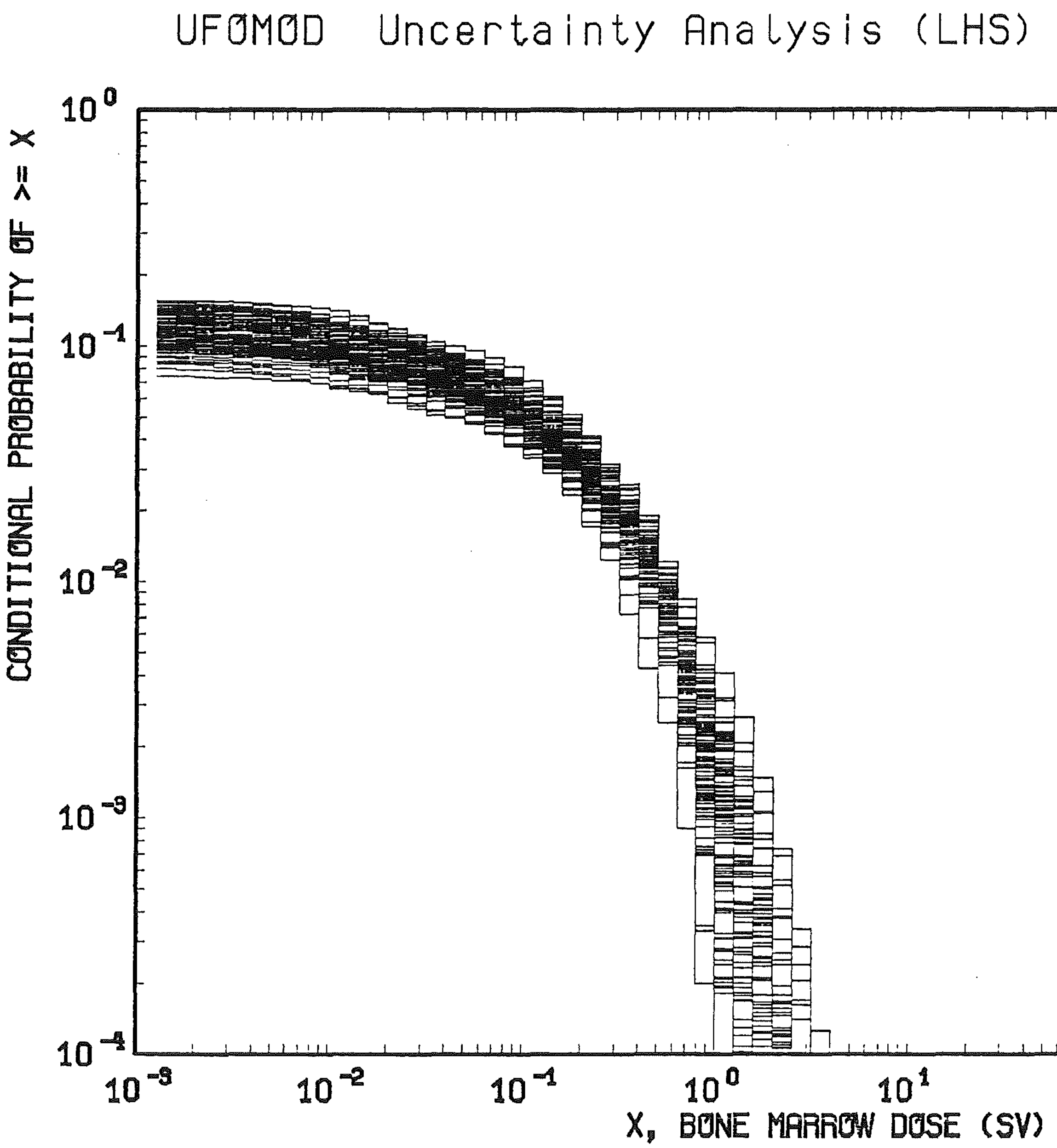



Distance ..........: 0.8 - 1.2 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) (ASSUMING FK 2 RELEASE HAS ØCCURRED) ØF THE BØNE MARRØW DØSE. EACH CCFD CORRESPONDS TØ ØNE ØF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE ØF SIZE 100.

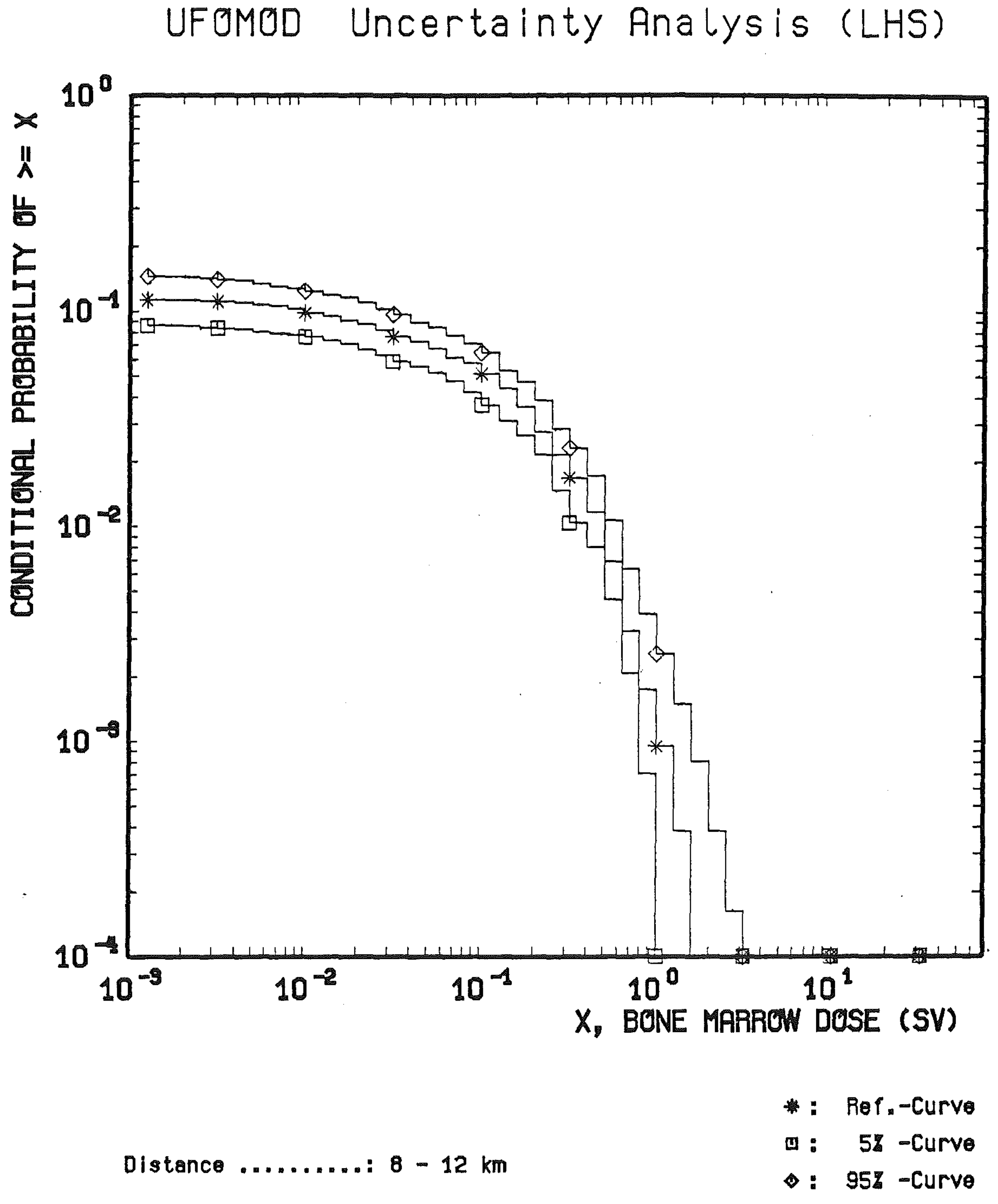



REFERENCE CCFD OF BONE MARROW DOSE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

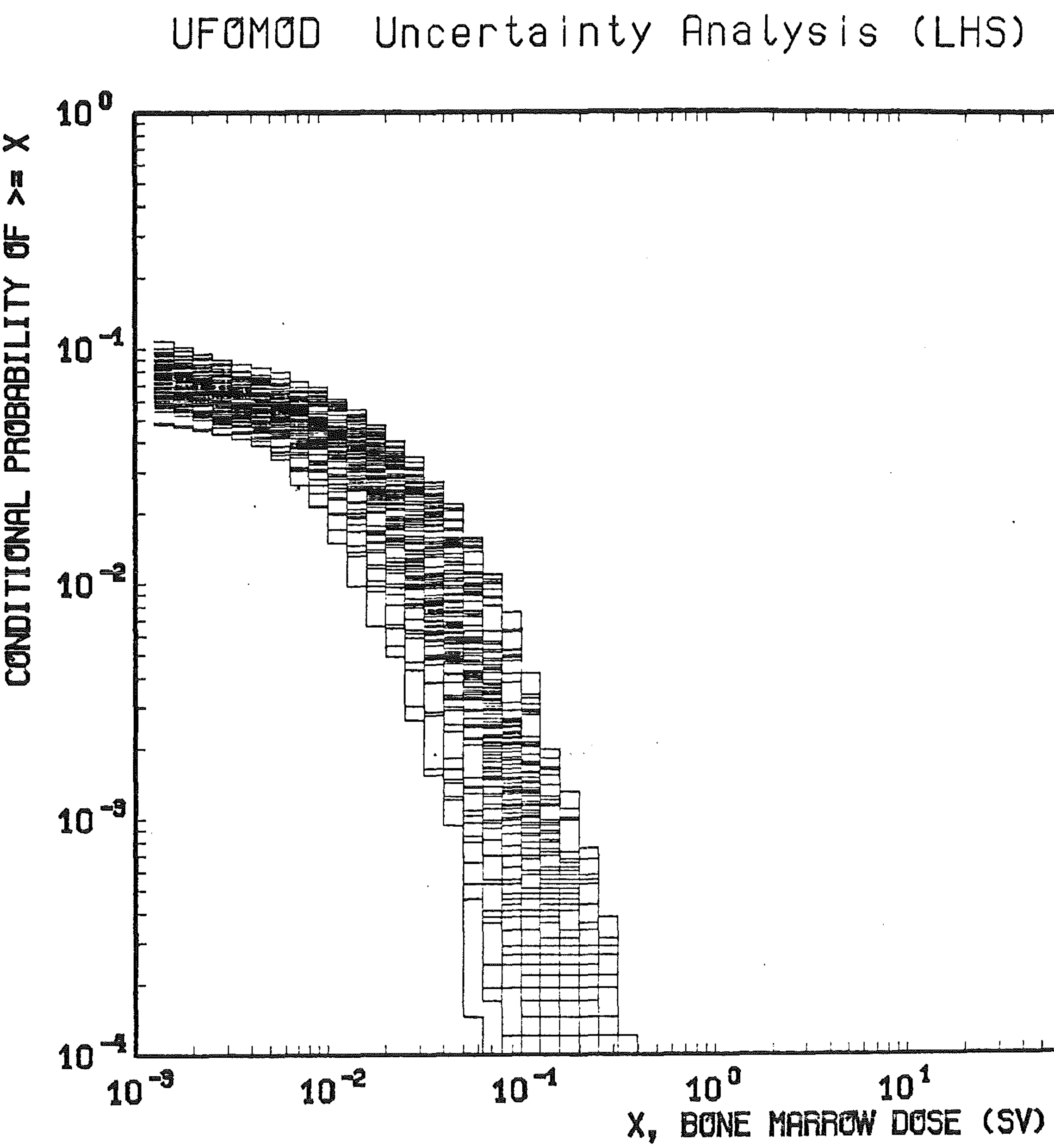



Distance ..........: 8 - 12 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE BONE MARROW DOSE. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.



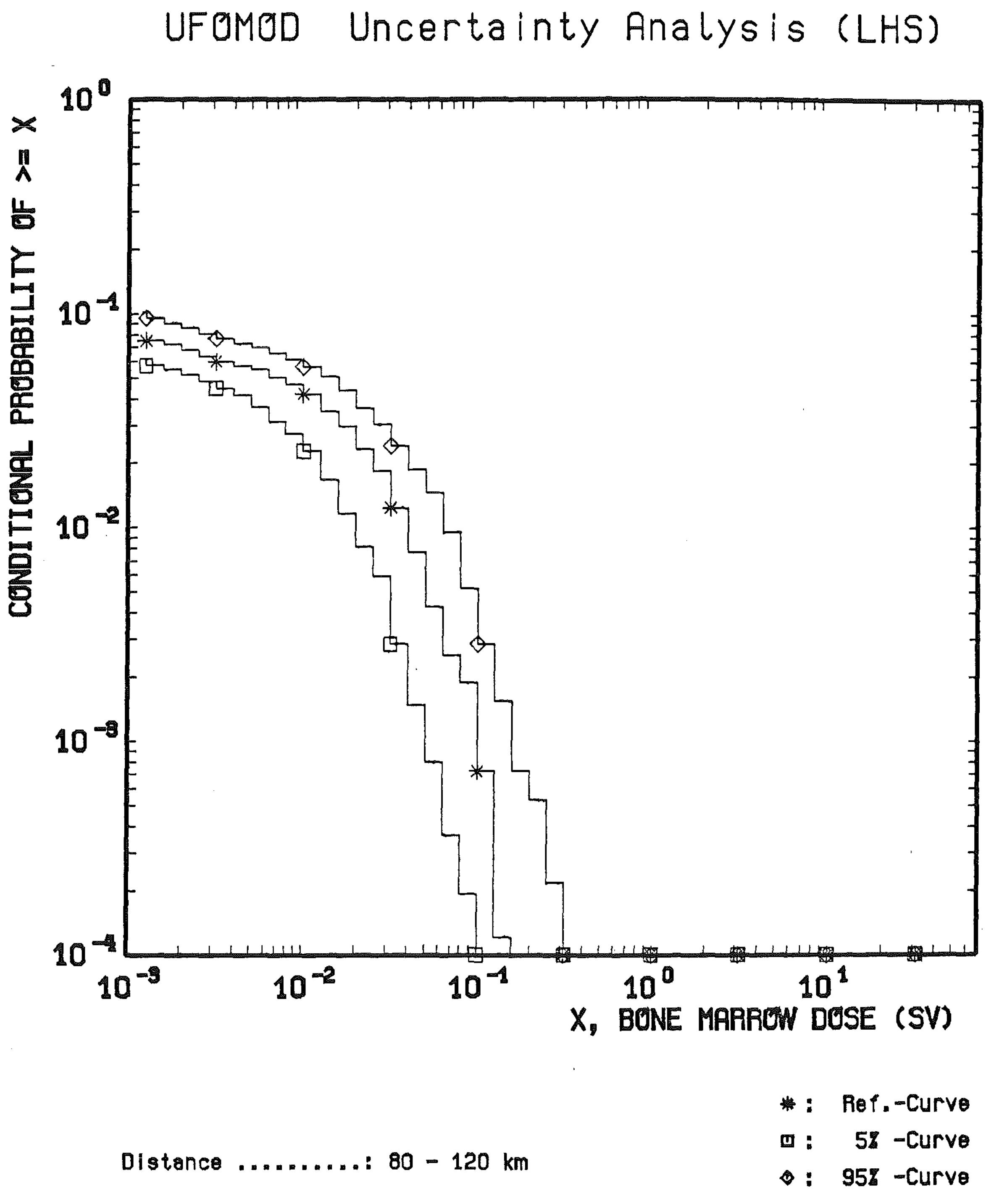

REFERENCE CCFD ØF BØNE MARRØW DØSE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.



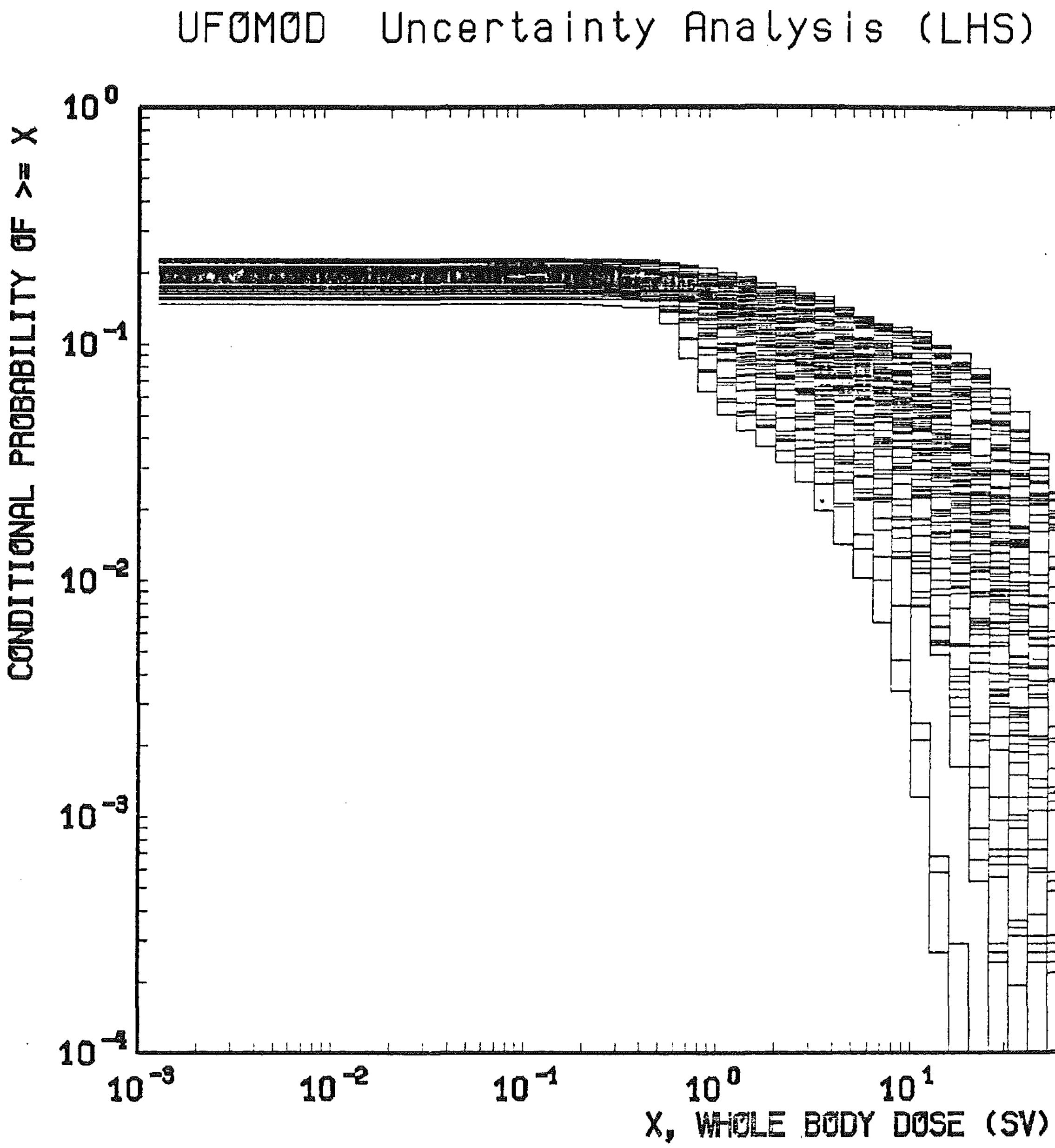

Distance ..........: 80 - 120 km



COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE BONE MARROW DOSE. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.




REFERENCE CCFD ØF BØNE MARRØW DØSE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

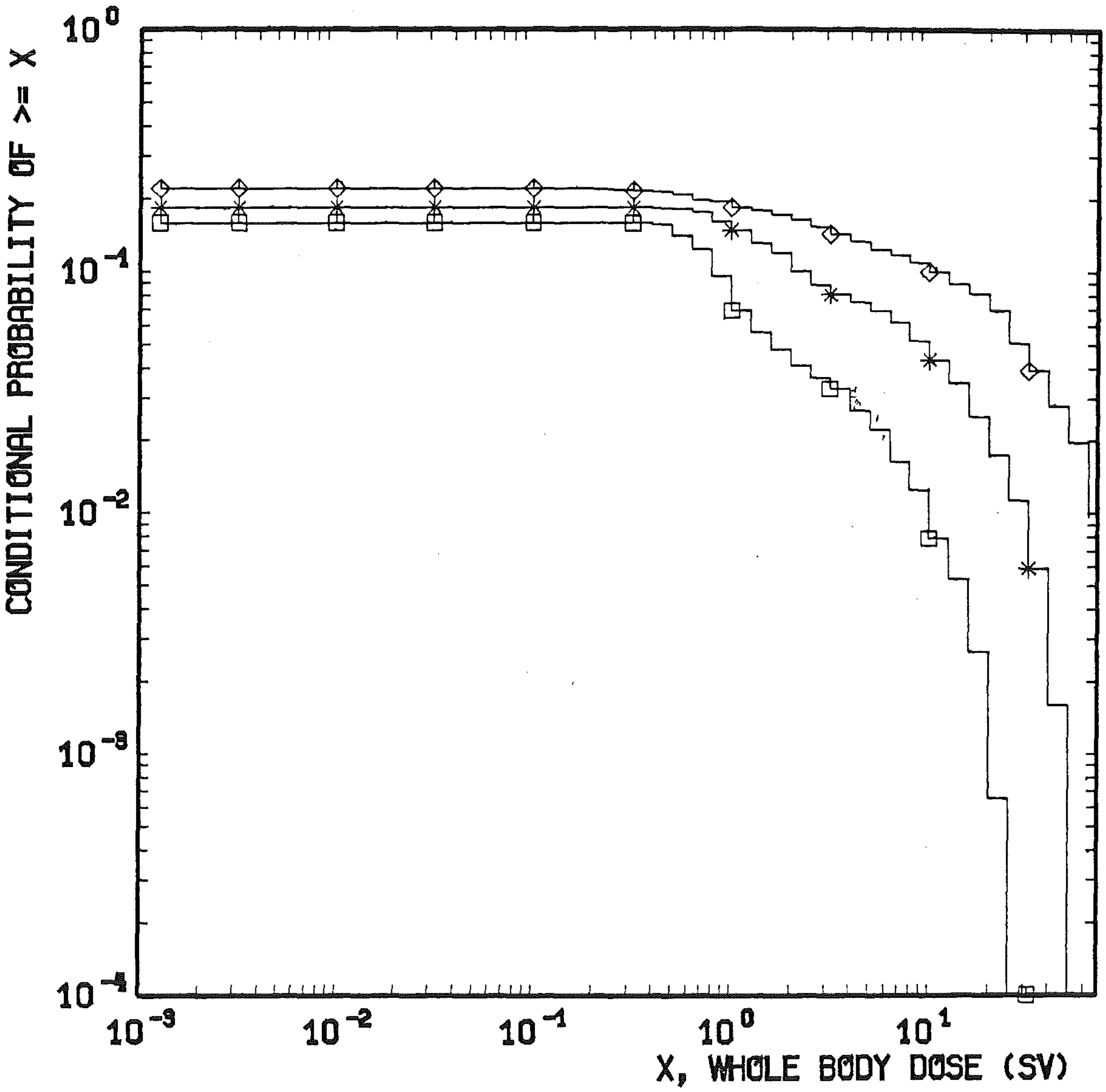



Distance ..........: 0.2 - 0.5 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE WHOLE BODY DOSE. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.

UFØMØD Uncertainty Analysis (LHS)




Distance ..........: 0.2 - 0.5 km

*: Ref.-Curve
□: 5% -Curve
◇: 95% -Curve

KfK INR

REFERENCE CCFD ØF WHØLE BØDY DØSE (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CONFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

# UFØMØD Uncertainty Analysis (LHS)

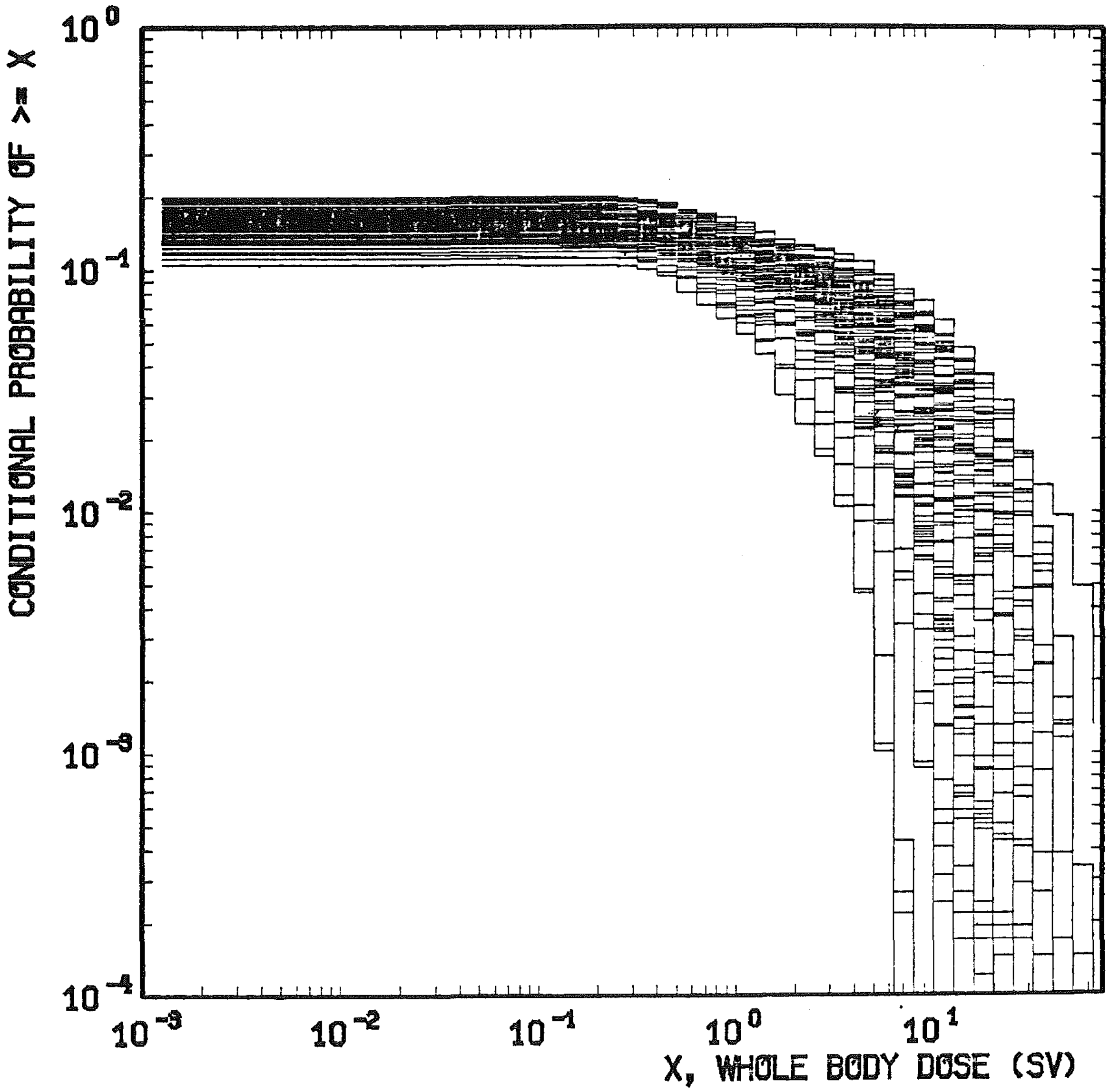
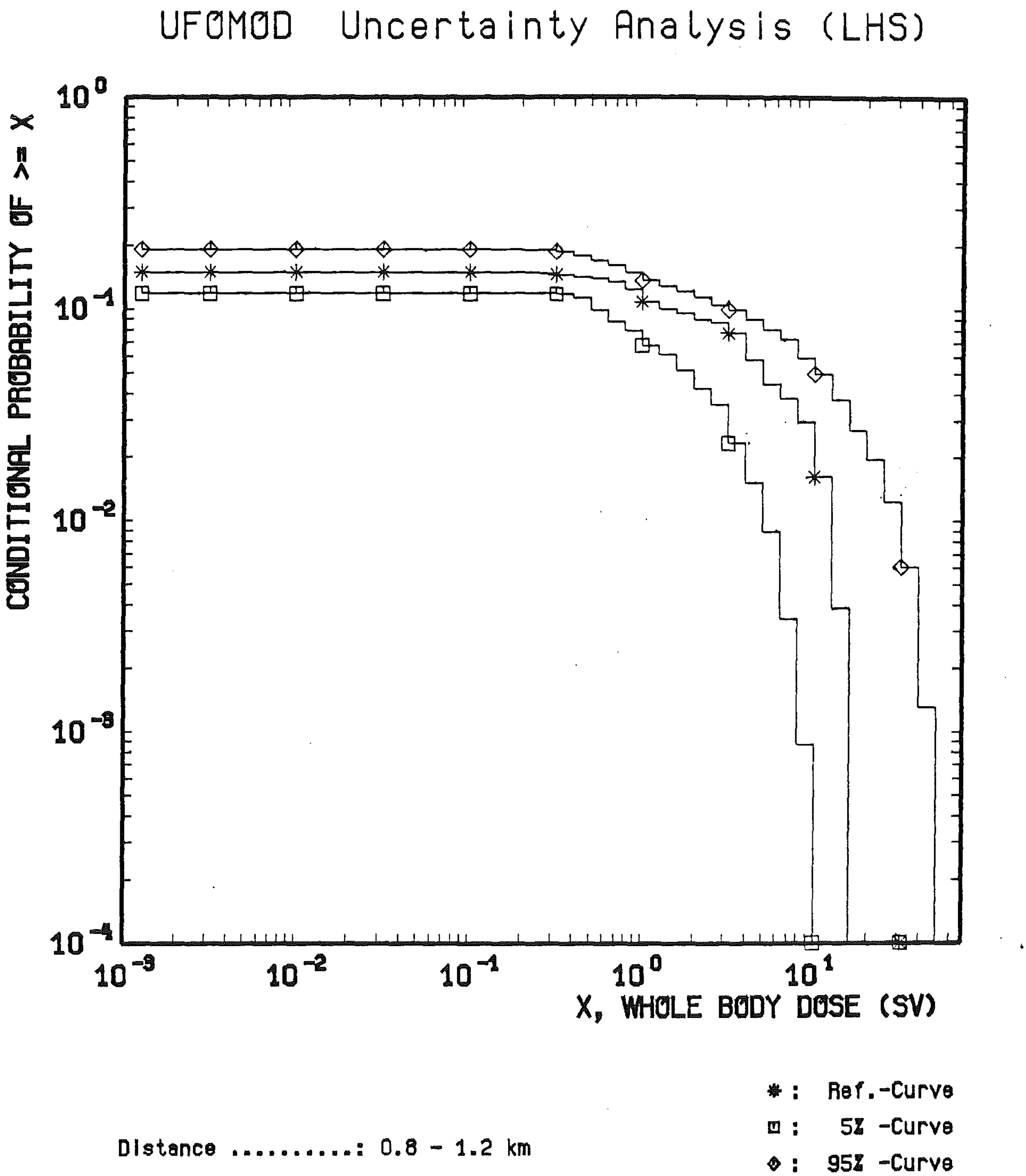



FIG.

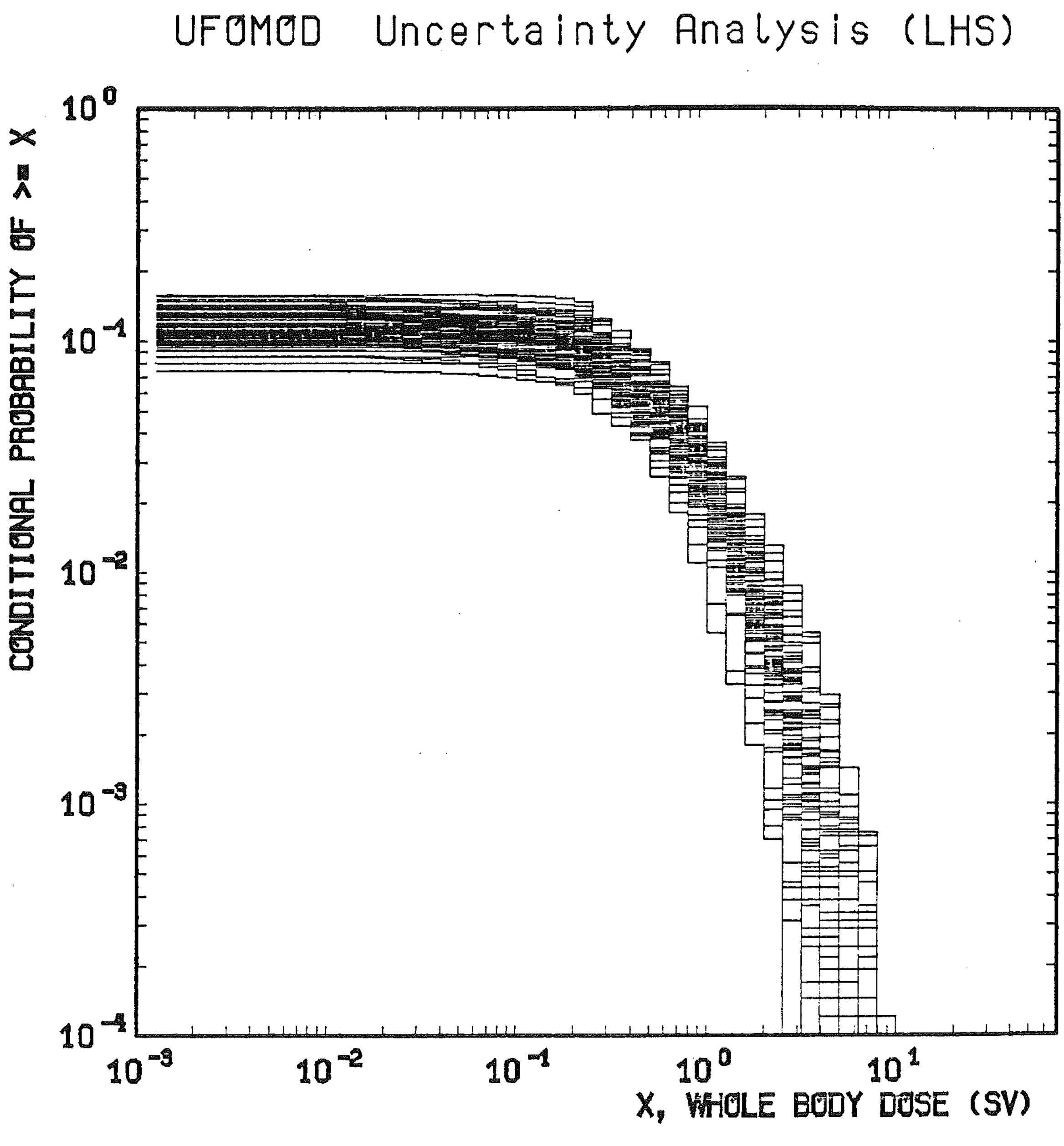
Distance ..........: 0.8 - 1.2 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE WHOLE BODY DOSE. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.



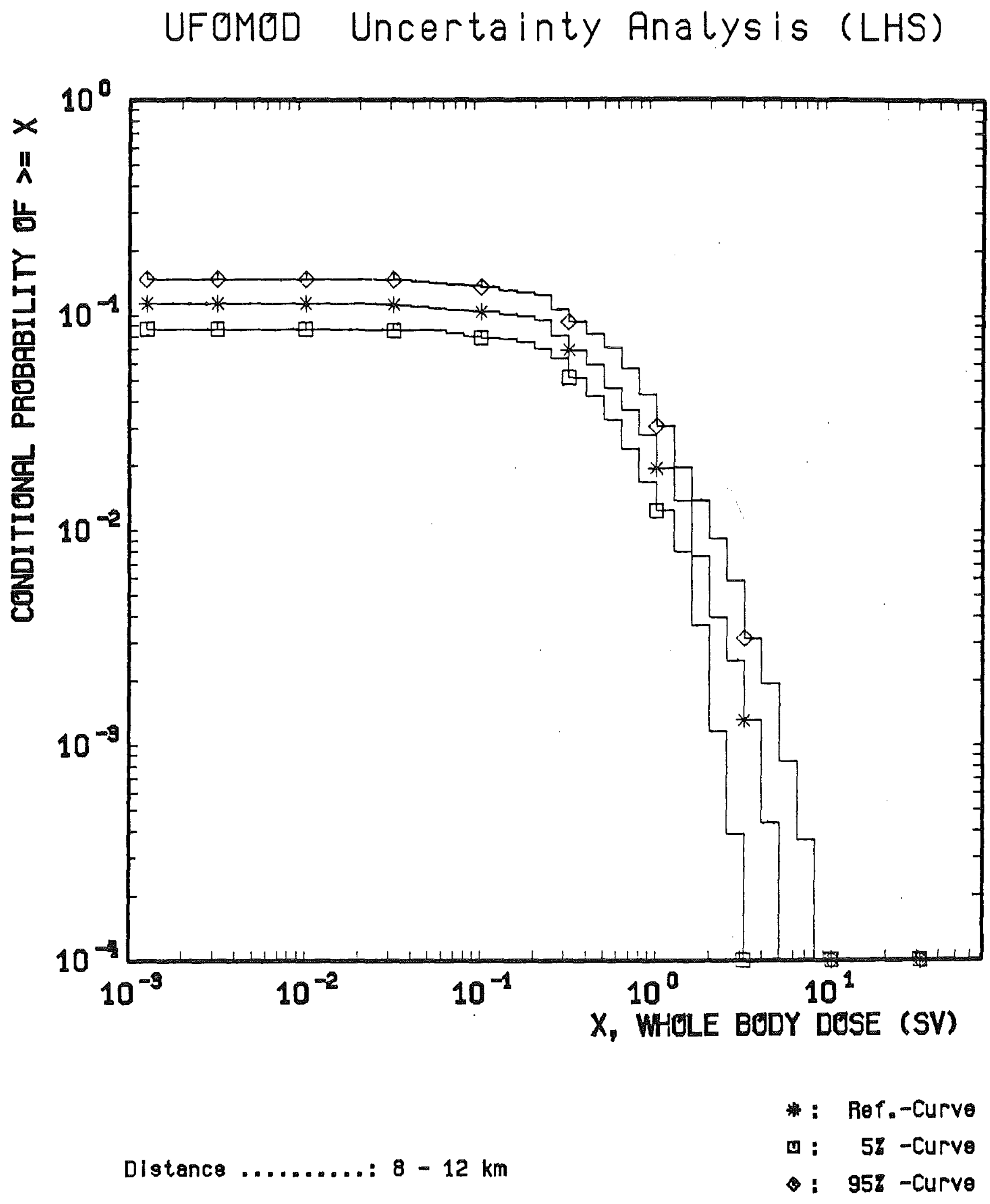

KfK INR

REFERENCE CCFD OF WHOLE BODY DOSE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

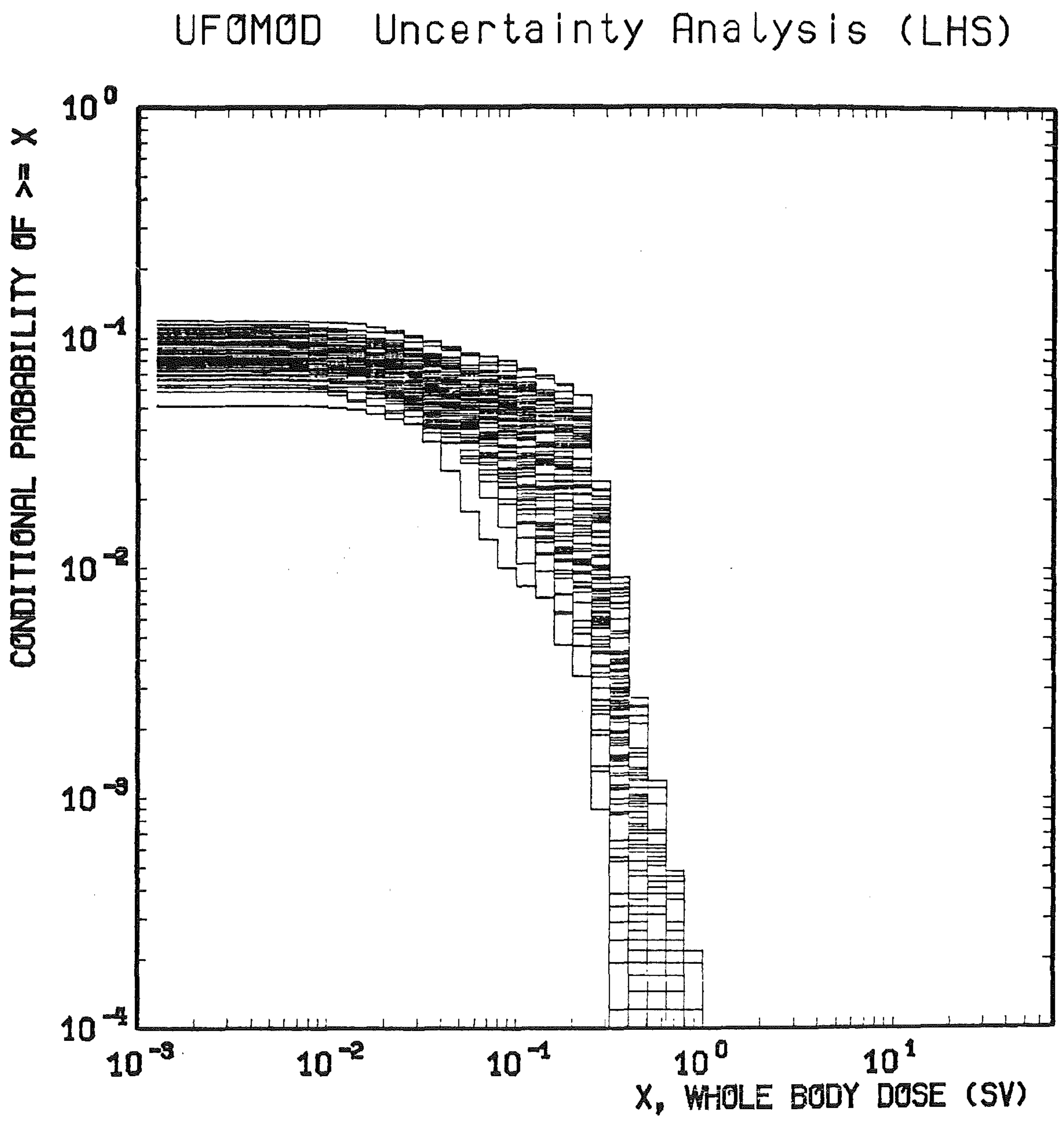



Distance ..........: 8 - 12 km

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE WHOLE BODY DOSE. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.



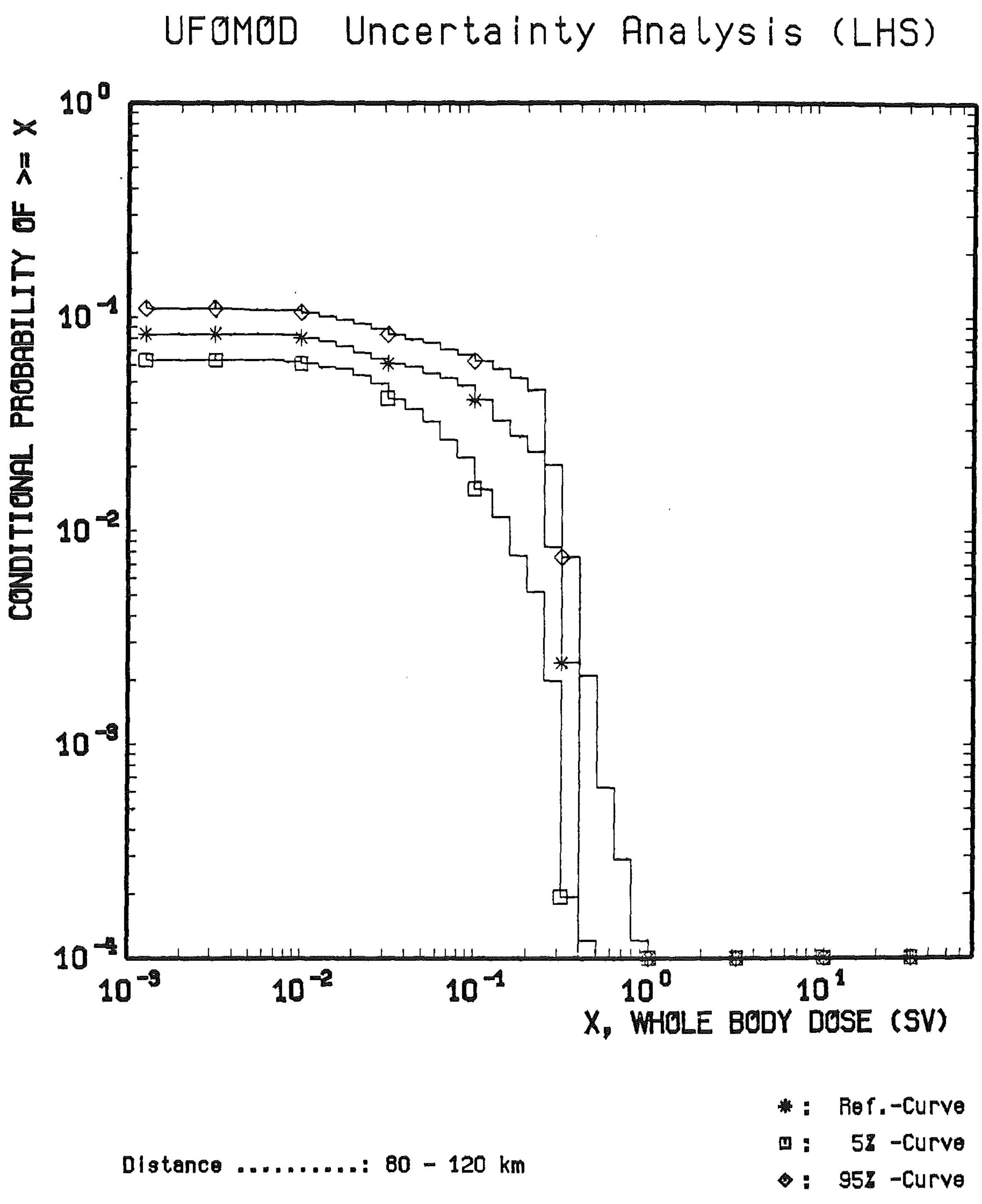

REFERENCE CCFD OF WHOLE BODY DOSE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.




Distance ..........: 80 - 120 km

KfK INR

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE WHOLE BODY DOSE. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.

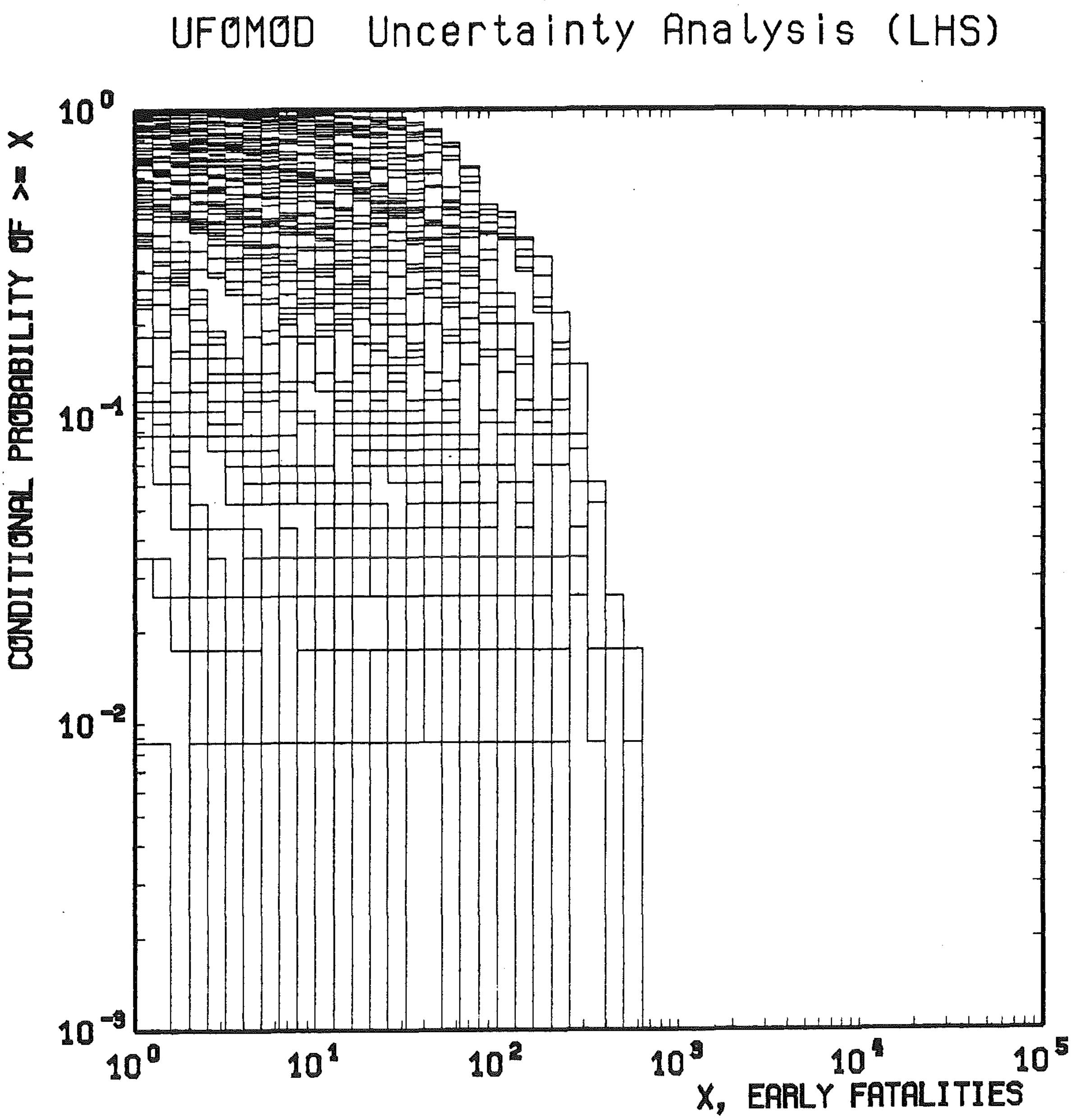



KfK INR

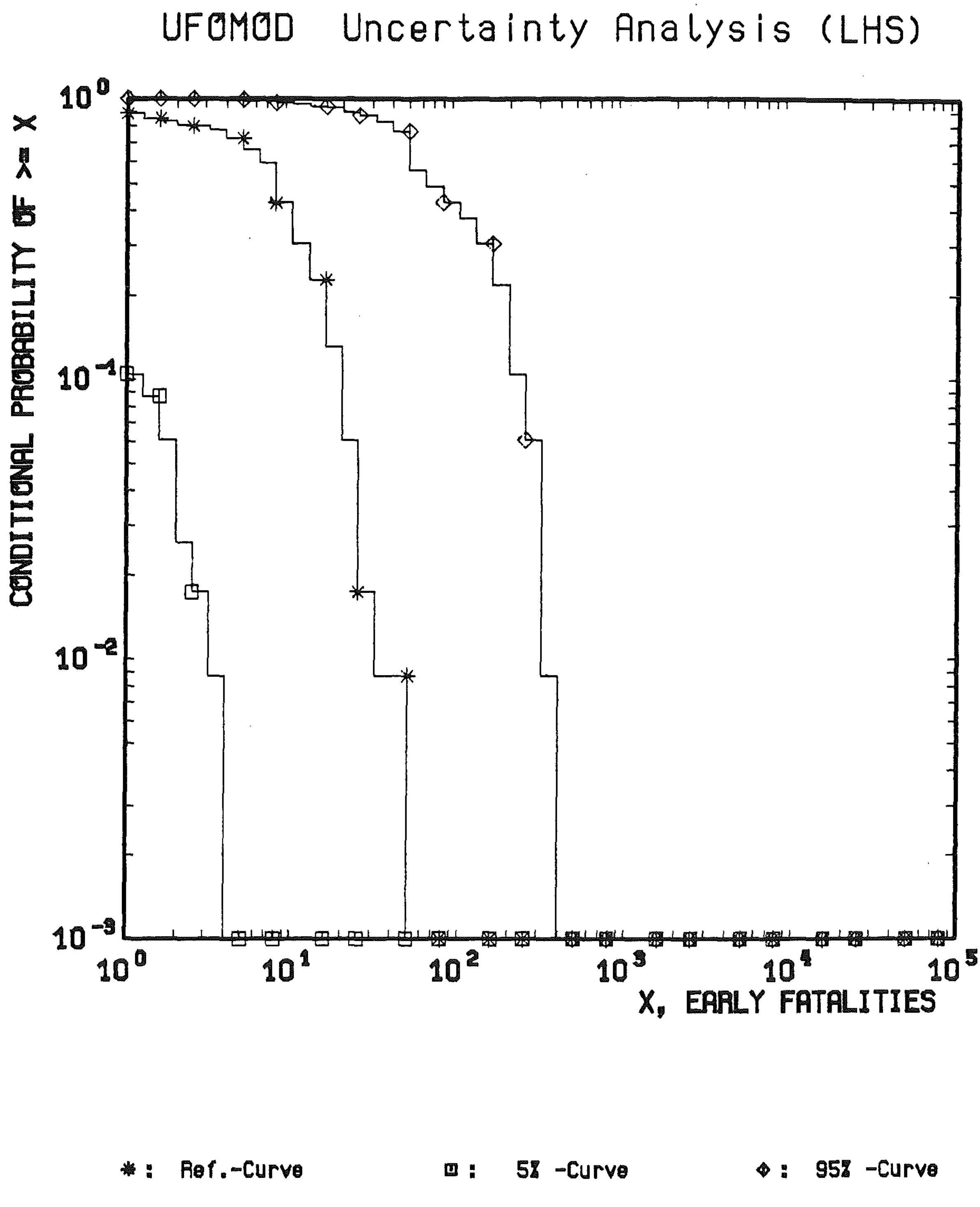
REFERENCE CCFD OF WHOLE BODY DOSE (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.

## B.8 HEALTH EFFECTS (LHS AT KFK, N=100 RUNS)

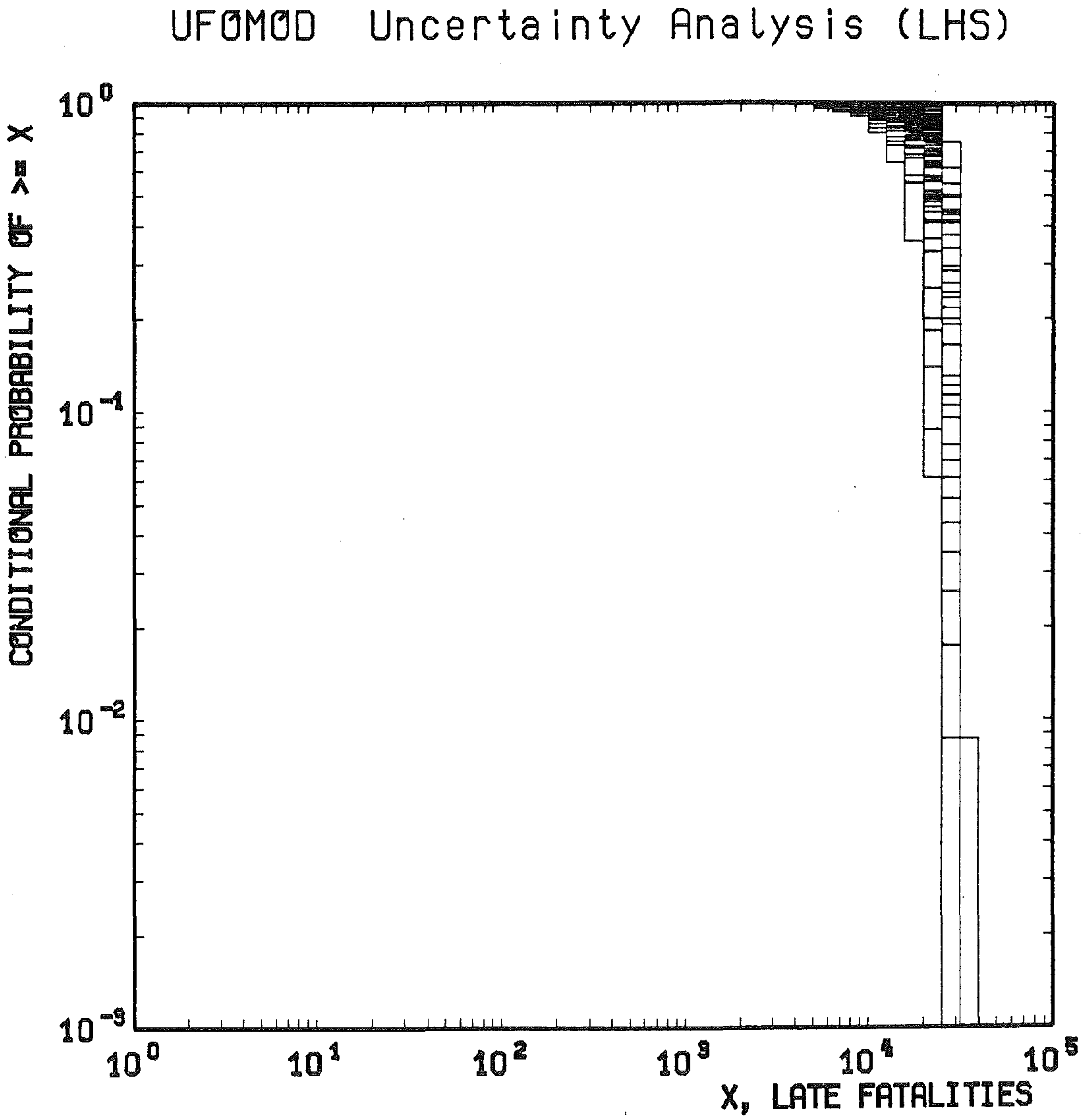
In this section CCFDs and the corresponding confidence curves are shown for health effects (early and late fatalities, areas affected by the counter-measure 'relocation'



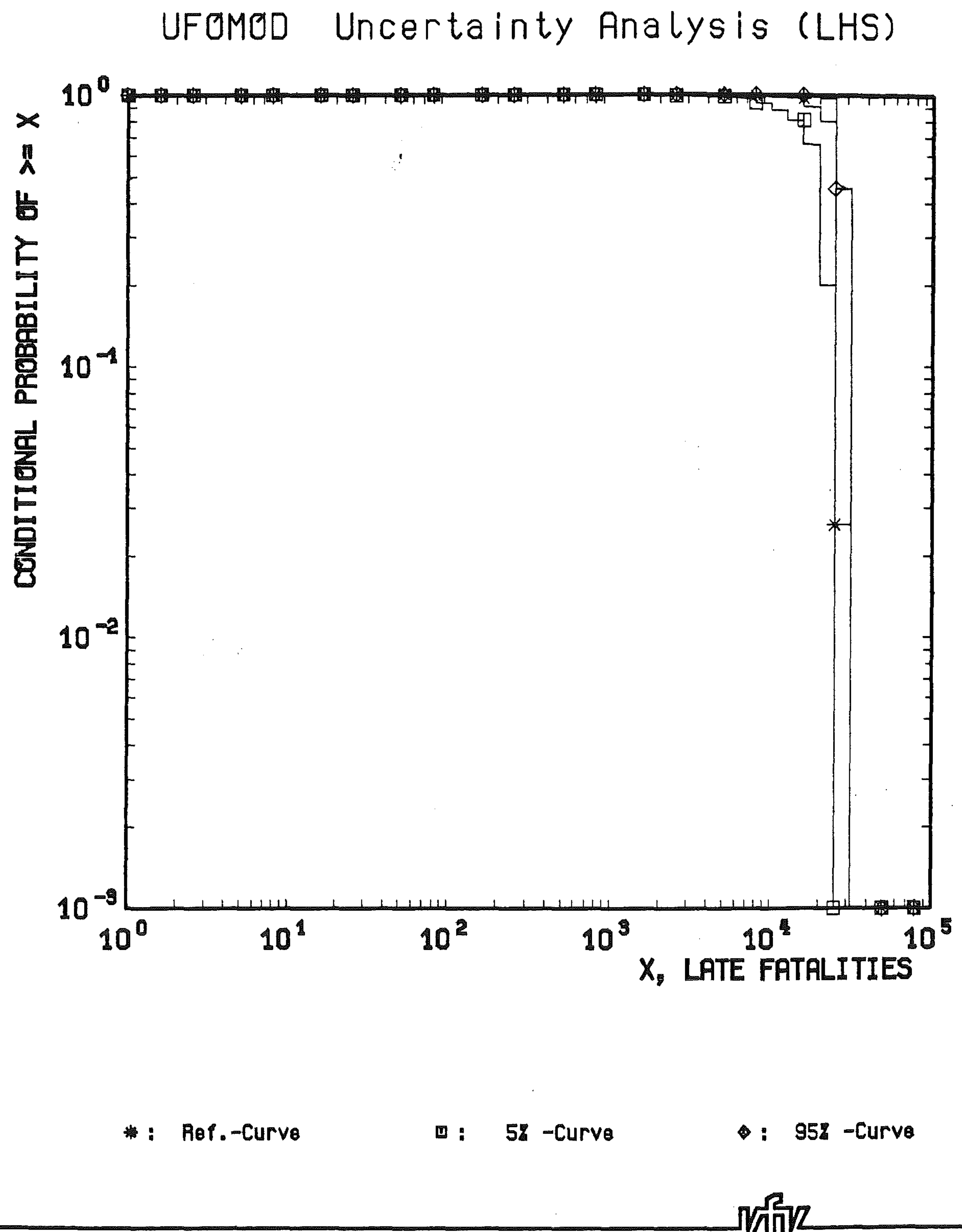

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIØNS (CCFDS) (ASSUMING FK 2 RELEASE HAS ØCCURRED) ØF EARLY FATALITIES . EACH CCFD CØRRESPØNDS TØ ØNE ØF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE ØF SIZE 100.



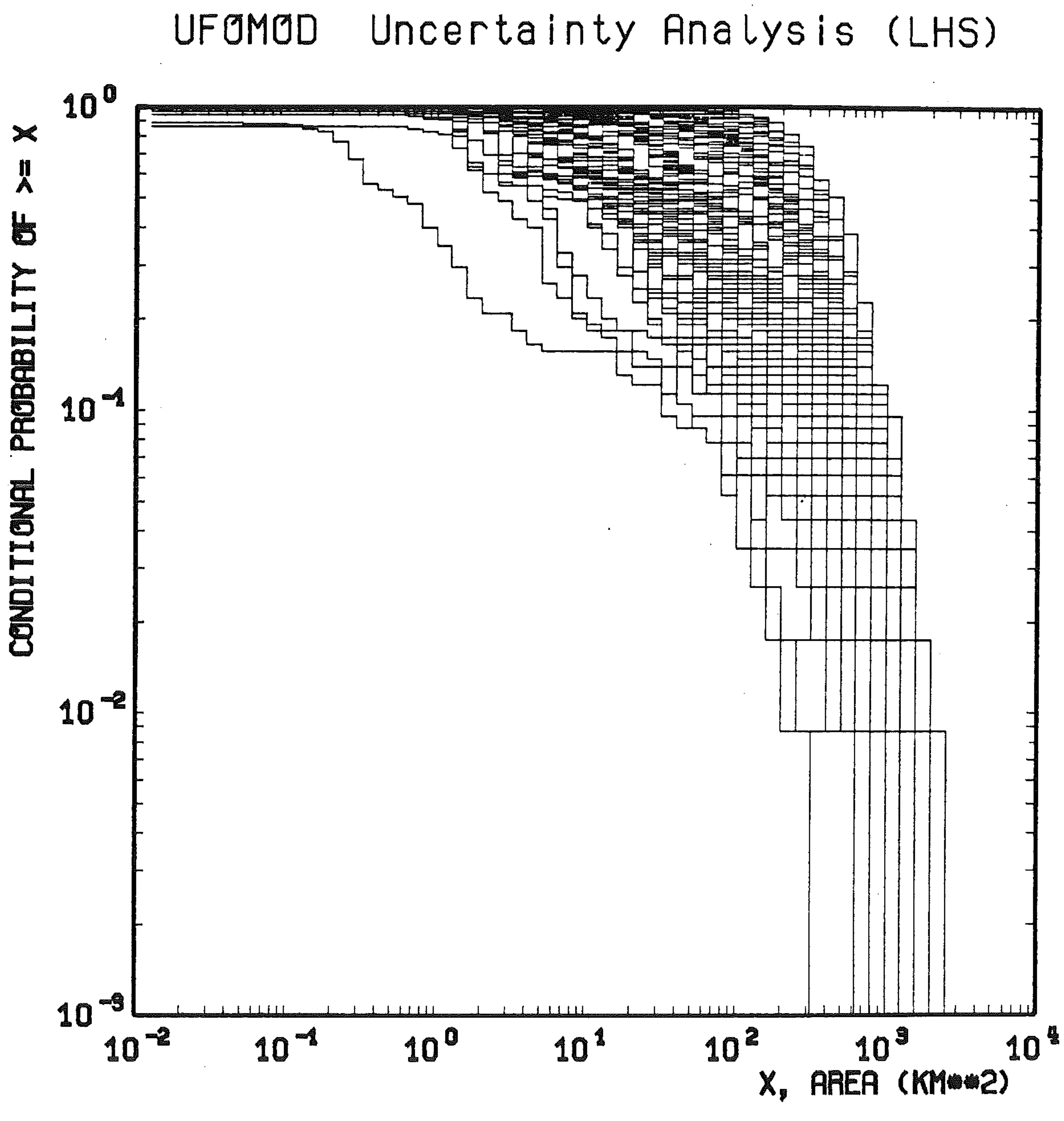

REFERENCE CCFD OF EARLY FATALITIES (ASSUMING FK 2 RELEASE HAS OCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CONFIDENCE BOUNDS AT DISCRETE POINTS OF THE X - AXIS.



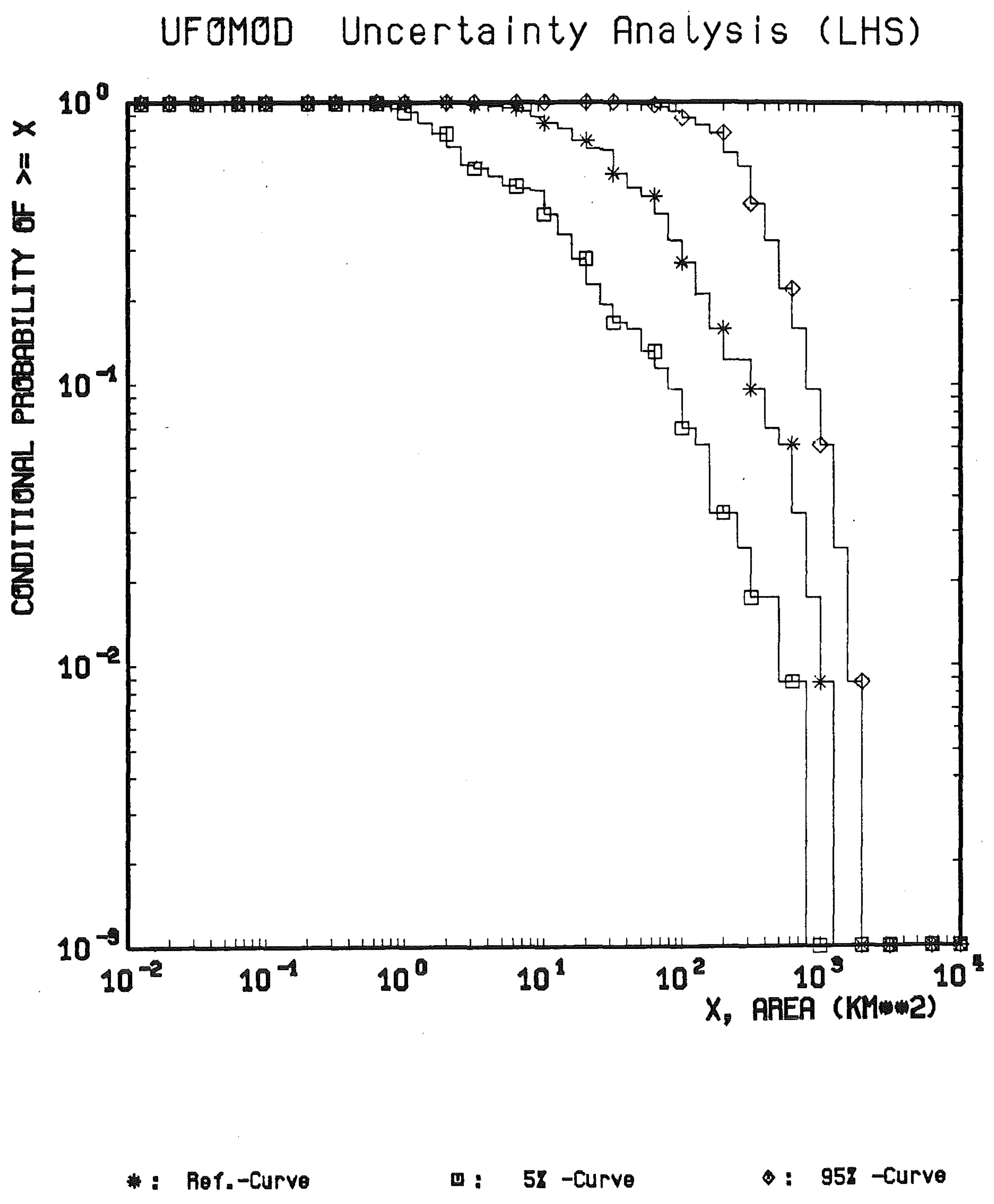

COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF LATE FATALITIES. EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.




REFERENCE CCFD ØF LATE FATALITIES (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.




COMPLEMENTARY CUMULATIVE FREQUENCY DISTRIBUTIONS (CCFDS) (ASSUMING FK 2 RELEASE HAS OCCURRED) OF THE AREAS AFFECTED BY THE COUNTERMEASURE "RELOCATION". EACH CCFD CORRESPONDS TO ONE OF THE 100 RUNS IN A LATIN HYPERCUBE SAMPLE OF SIZE 100.




REFERENCE CCFD ØF THE AREAS AFFECTED BY THE CØUNTERMEASURE "RELØCATIØN" (ASSUMING FK 2 RELEASE HAS ØCCURRED) AND THE EMPIRICAL 5% -, 95% - QUANTILES RESPECTIVELY ARE GIVEN AS ESTIMATED CØNFIDENCE BØUNDS AT DISCRETE PØINTS ØF THE X - AXIS.

# APPENDIX C. SENSITIVITY ANALYSES (TABLES OF PRCC VALUES)

**Legends for reading the PRCC - tables**

| PARAMETER NAME | VARIABLE | |
|---|---|---|
| 1. Q | Thermal energy | |
| 2. R | Quantity to describe error in wind speed | |
| 3. HQ | Height of source | |
| 4. FPR(A-D) | Plume rise factor | DC=A,B,C,D |
| 5. FPR(E,F) | Plume rise factor | DC=E,F |
| 6. DA | Quantity to correct plume rise | |
| 7. C1 | Atmospheric dilution parameter | |
| 8. HM(A) | Mixing height | DC=A |
| 9. HM(B) | Mixing height | DC=B |
| 10. HM(C) | Mixing height | DC=C |
| 11. HM(D) | Mixing height | DC=D |
| 12. HM(E) | Mixing height | DC=E |
| 13. HM(F) | Mixing height | DC=F |
| 14. SIGY(A) | Horizontal dispersion | DC=A |
| 15. SIGY(B) | Horizontal dispersion | DC=B |
| 16. SIGY(C) | Horizontal dispersion | DC=C |
| 17. SIGY(D) | Horizontal dispersion | DC=D |
| 18. SIGY(E) | Horizontal dispersion | DC=E |
| 19. SIGY(F) | Horizontal dispersion | DC=F |

DC := Diffusion category

Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD

| PARAMETER NAME | VARIABLE | |
|---|---|---|
| 20. SIGZ(A) | Vertical dispersion | DC=A |
| 21. SIGZ(B) | Vertical dispersion | DC=B |
| 22. SIGZ(C) | Vertical dispersion | DC=C |
| 23. SIGZ(D) | Vertical dispersion | DC=D |
| 24. SIGZ(E) | Vertical dispersion | DC=E |
| 25. SIGZ(F) | Vertical dispersion | DC=F |
| 26. P(A) | Wind profile exponent | DC=A |
| 27. P(B) | Wind profile exponent | DC=B |
| 28. P(C) | Wind profile exponent | DC=C |
| 29. P(D) | Wind profile exponent | DC=D |
| 30. P(E) | Wind profile exponent | DC=E |
| 31. P(F) | Wind profile exponent | DC=F |
| 32. VD(IO) | Dry deposition velocity (m/s) | Iodine |
| 32. VD(AE) | Dry deposition velocity (m/s) | Aerosols |
| 34. LAMB(IO,0-1) | Washout coefficient | (Iodine 0-1mm/s) |
| 35. LAMB(AE,0-1) | Washout coefficient | (Aerosols 0-1mm/s) |
| 36. LAMB(IO,1-3) | Washout coefficient | (Iodine 1-3mm/s) |
| 37. LAMB(AE,1-3) | Washout coefficient | (Aerosols 1-3mm/s) |
| 38. LAMB(IO,>3) | Washout coefficient | (Iodine >3mm/s) |
| 39. LAMB(AE,>3) | Washout coefficient | (Aerosols >3mm/s) |

DC := Diffusion category

Parameter list for the atmospheric dispersion and deposition submodel of UFOMOD (cont'd)

| PARAMETER NAME | VARIABLE |
|---|---|
| 1. IODCGD1, IODCGD2 IODCGD3, IODCGD4 | Concentration of iodine on ground surface for four distances |
| 2. IODCAD1, IODCAD2 IODCAD3, IODCAD4 | Concentration of iodine in the air near ground surface for four distances |
| 3. IODCPD1, IODCPD2 IODCPD3, IODCPD4 | Concentration of iodine in the plume for four distances |
| 4. CAECGD1, CAECGD2 CAECGD3, CAECGD4 | Concentration of caesium on ground surface for four distances |
| 5. CAECAD1, CAECAD2 CAECAD3, CAECAD4 | Concentration of caesium in the air near ground surface for four distances |
| 6. CAECPD1, CAECPD2 CAECPD3, CAECPD4 | Concentration of caesium in the plume for four distances |
| 6. BMDOSE1, BMDOSE2 BMDOSE3, BMDOSE4 | Bone marrow doses for four different distances |
| 5. WBDOSE1, WBDOSE2 WBDOSE3, WBDOSE4 | Whole body doses for four different distances |
| 6. EARFATA | Mean number of early fatalities |
| 7. LATFATA | Mean number of late fatalities |
| 8. RELOCAT | Mean areas affected by 'relocation' |

List of consequence variables (Abbreviations)

## C.1 COMPARISON OF CONCENTRATION RUNS (LHS; N=59,100,200)

In this section PRCCs are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface, in the air near ground and in the plume.

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TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | IODCGD1 | IODCGD1 | IODCGD1 | IODCGD2 | IODCGD2 | IODCGD2 | IODCGD3 | IODCGD3 | IODCGD3 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.89( 3) | -.87( 3) | -.82( 2) | -.96( 2) | -.92( 2) | -.90( 2) | | | -.23(10) |
| R | .66( 6) | .56( 6) | .44( 6) | | .29( 9) | .18(11) | -.65( 4) | -.55( 2) | -.62( 2) |
| HQ | | | | | | | | | |
| FPR(A-D) | -.92( 2) | -.88( 2) | -.80( 3) | -.77( 4) | -.61( 3) | -.57( 4) | | | |
| FPR(E,F) | | | | | | | | | |
| DA | .87( 4) | .73( 4) | .68( 4) | .83( 3) | .61( 4) | .62( 3) | .46( 8) | | |
| C1 | | | | | | | | .26( 8) | |
| HM(A) | | | | | | | | | |
| HM(B) | .55( 7) | | | | -.26(10) | -.17(12) | | | |
| HM(C) | | | | | | | | | |
| HM(D) | | | | | | | -.51( 6) | -.37( 5) | -.43( 5) |
| HM(E) | -.51( 9) | | | | | | | | |
| HM(F) | | | | -.45(11) | | | -.70( 2) | | |
| SIGY0(A) | | -.34( 9) | -.18(11) | | | -.19( 9) | | | |
| SIGY0(B) | | | | | | | | | |
| SIGY0(C) | | | | | | | | | |
| SIGY0(D) | | | -.20( 9) | -.56( 8) | -.31( 8) | -.31( 6) | -.62( 5) | -.34( 6) | -.42( 6) |
| SIGY0(E) | | | -.17(12) | | -.41( 6) | -.29( 8) | | -.45( 4) | -.51( 3) |
| SIGY0(F) | | | | -.52(10) | | | | -.51( 3) | -.46( 4) |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | | | | | | | .50( 7) | | |
| SIGZ0(C) | | | .18(10) | | | | | | |
| SIGZ0(D) | .74( 5) | .60( 5) | .52( 5) | | | | | | |
| SIGZ0(E) | | | .23( 7) | .61( 6) | .49( 5) | .53( 5) | -.66( 3) | -.26( 9) | -.28( 8) |
| SIGZ0(F) | .53( 8) | | | .69( 5) | .34( 7) | .29( 7) | | | -.24( 9) |
| P(A) | .48(10) | | | .58( 7) | | | | | |
| P(B) | | | | | | | | | |
| P(C) | | | | | | | | | |
| P(D) | | | | .56( 9) | | | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | .98( 1) | .97( 1) | .94( 1) | .99( 1) | .98( 1) | .97( 1) | .99( 1) | .98( 1) | .98( 1) |
| VD(AER) | | | | | | | | | |
| LDIOD0-1 | .47(11) | | .17(13) | | | .19(10) | | .33( 7) | .37( 7) |
| LDAER0-1 | | | | | | | | | |
| LDIOD1-3 | | .37( 7) | .22( 8) | | | | | | |
| LDAER1-3 | | .34( 8) | | | | | | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | | |

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TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | IODCGD4 | IODCGD4 | IODCGD4 | IODCAD1 | IODCAD1 | IODCAD1 | IODCAD2 | IODCAD2 | IODCAD2 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | | | | -.89( 2) | -.91( 2) | -.89( 1) | -.98( 1) | -.97( 1) | -.96( 1) |
| R | | -.29( 4) | -.20( 4) | .72( 5) | .67( 4) | .62( 5) | | .42( 8) | .29( 8) |
| HQ | | | | | -.28(12) | | | -.29( 9) | |
| FPR(A-D) | | | | -.92( 1) | -.91( 1) | -.89( 2) | -.84( 3) | -.73( 3) | -.72( 3) |
| FPR(E,F) | | | | | -.30( 9) | | | | |
| DA | | | | .83( 3) | .85( 3) | .82( 3) | .88( 2) | .84( 2) | .83( 2) |
| C1 | | | | | | | | | |
| HM(A) | .45( 3) | | | | | | | | |
| HM(B) | | | | | | | | | |
| HM(C) | | | -.19( 5) | | | | | | |
| HM(D) | | | | | | | | | |
| HM(E) | | | | | | | | | |
| HM(F) | | | | | -.29(10) | | | | |
| SIGY0(A) | | | | | | | | | |
| SIGY0(B) | | | | | | | | | |
| SIGY0(C) | | | | | | | | | -.17( 9) |
| SIGY0(D) | -.45( 4) | -.58( 2) | -.43( 2) | | -.39( 6) | -.39( 6) | -.59( 8) | -.56( 6) | -.49( 6) |
| SIGY0(E) | | -.47( 3) | -.39( 3) | | | -.27( 8) | | -.43( 7) | -.41( 7) |
| SIGY0(F) | -.48( 2) | | | | | | -.61( 7) | | |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | | | | | | | | | -.17(10) |
| SIGZ0(C) | | | | | .29(11) | .26( 9) | | | |
| SIGZ0(D) | | | | .79( 4) | .65( 5) | .62( 4) | | | |
| SIGZ0(E) | | | | | .36( 7) | .37( 7) | .79( 4) | .71( 4) | .70( 4) |
| SIGZ0(F) | | | | | .32( 8) | .17(10) | .75( 5) | .61( 5) | .54( 5) |
| P(A) | | | | | | | .46(10) | | |
| P(B) | | | | | | | .54( 9) | | |
| P(C) | | | | | | | | | |
| P(D) | | | | | | | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | .85( 1) | .74( 1) | .70( 1) | | | | -.66( 6) | | |
| VD(AER) | | | | | | | | | |
| LDIOD0-1 | | | .17( 6) | | | | | | |
| LDAER0-1 | | | | | | | | | |
| LDIOD1-3 | | | | | | | | | |
| LDAER1-3 | | | | | | | | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | IODCAD3 | IODCAD3 | IODCAD3 | IODCAD4 | IODCAD4 | IODCAD4 | IODCPD1 | IODCPD1 | IODCPD1 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.69( 3) | -.31(10) | -.36( 8) | | | | -.92( 1) | -.94( 1) | -.93( 1) |
| R | -.71( 2) | -.71( 2) | -.72( 2) | -.44( 2) | | -.23( 6) | | | |
| HQ | | -.36( 7) | -.16(11) | | -.29( 6) | | | -.27(13) | -.17(14) |
| FPR(A-D) | | | | | | | -.91( 2) | -.92( 2) | -.89( 2) |
| FPR(E,F) | | | | | | | | -.43( 9) | -.20(11) |
| DA | .46( 9) | | .22(10) | | | | .82( 3) | .87( 3) | .84( 3) |
| C1 | | | | | -.30( 5) | | | | |
| HM(A) | | | | | -.29( 7) | -.18( 8) | | .29(12) | .17(13) |
| HM(B) | | | | | | | | | |
| HM(C) | | | | | | -.26( 5) | | | |
| HM(D) | -.58( 6) | -.35( 8) | -.48( 5) | | -.31( 4) | -.29( 3) | | | .17(12) |
| HM(E) | | | | | | | | | |
| HM(F) | | | | | | | | -.26(15) | |
| SIGY0(A) | | | | | | | | | |
| SIGY0(B) | | | | | | | | | |
| SIGY0(C) | | | | | | | | | -.23(10) |
| SIGY0(D) | -.62( 5) | -.34( 9) | -.41( 7) | | -.49( 2) | -.46( 2) | -.62( 5) | -.66( 5) | -.61( 4) |
| SIGY0(E) | -.62( 4) | -.63( 3) | -.58( 3) | | -.37( 3) | -.27( 4) | | -.46( 8) | -.43( 7) |
| SIGY0(F) | -.44(10) | -.55( 4) | -.50( 4) | | | | | -.34(10) | |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | | | | | | | | | |
| SIGZ0(C) | | | | -.44( 3) | | | | .29(11) | .27( 9) |
| SIGZ0(D) | | | | | | | .69( 4) | .69( 4) | .60( 5) |
| SIGZ0(E) | -.51( 7) | -.52( 5) | -.47( 6) | | | | | .57( 6) | .50( 6) |
| SIGZ0(F) | -.49( 8) | -.40( 6) | -.27( 9) | | | | | .48( 7) | .31( 8) |
| P(A) | | | | | | | | | |
| P(B) | | | | | | -.16( 9) | | | |
| P(C) | | | | | | | | | |
| P(D) | | | | | | | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | -.87( 1) | -.78( 1) | -.82( 1) | -.96( 1) | -.96( 1) | -.94( 1) | | | |
| VD(AER) | | | | | | | | | |
| LDIOD0-1 | | | | | | -.21( 7) | | | |
| LDAER0-1 | | | | | | | | | |
| LDIOD1-3 | | | | | | | | | |
| LDAER1-3 | | | | | | | | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | -.26( 8) | | | -.26(14) | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | IODCPD2 | IODCPD2 | IODCPD2 | IODCPD3 | IODCPD3 | IODCPD3 | IODCPD4 | IODCPD4 | IODCPD4 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.97( 1) | -.96( 1) | -.95( 1) | -.66( 6) | | -.29( 7) | | | |
| R | -.64( 9) | -.29(12) | -.29( 9) | -.89( 1) | -.79( 2) | -.76( 2) | | -.37( 8) | -.31( 8) |
| HQ | | -.25(13) | -.17(13) | | -.36( 7) | | | | |
| FPR(A-D) | -.87( 2) | -.82( 2) | -.79( 2) | | -.33( 9) | -.22( 9) | | | |
| FPR(E,F) | | -.29(11) | | | | | | | |
| DA | .74( 4) | .75( 3) | .75( 3) | | | | | | |
| C1 | | | | | | | | | |
| HM(A) | | | | | | | .50( 6) | | .27( 9) |
| HM(B) | | | | | | | .71( 1) | .47( 6) | .48( 5) |
| HM(C) | | | | -.47( 8) | | | .65( 3) | .71( 1) | .59( 2) |
| HM(D) | | | | -.75( 5) | -.48( 6) | -.50( 5) | | .43( 7) | .32( 7) |
| HM(E) | | | | | | | | | |
| HM(F) | -.65( 8) | | | | | | | | |
| SIGY0(A) | | | | | | | | | |
| SIGY0(B) | | | | | | | -.51( 5) | | -.22(12) |
| SIGY0(C) | | -.33( 9) | -.31( 8) | | | -.20(10) | -.46( 7) | -.61( 4) | -.49( 4) |
| SIGY0(D) | -.74( 3) | -.69( 5) | -.68( 4) | -.88( 2) | -.78( 3) | -.72( 3) | -.56( 4) | -.67( 2) | -.62( 1) |
| SIGY0(E) | -.66( 7) | -.70( 4) | -.62( 5) | -.87( 3) | -.85( 1) | -.77( 1) | | -.50( 5) | -.43( 6) |
| SIGY0(F) | -.70( 5) | -.42( 8) | -.24(10) | -.47( 9) | -.50( 5) | -.39( 6) | | | -.25(10) |
| SIGZ0(A) | | | | .44(11) | | | | | |
| SIGZ0(B) | | | -.17(12) | | | | | | |
| SIGZ0(C) | | | | | | | | .27(10) | |
| SIGZ0(D) | | .31(10) | .22(11) | | | | | | .16(14) |
| SIGZ0(E) | .67( 6) | .61( 6) | .60( 6) | .61( 7) | .34( 8) | .26( 8) | | | |
| SIGZ0(F) | .56(12) | .57( 7) | .43( 7) | | | | | | |
| P(A) | | | | | | | | | -.22(11) |
| P(B) | .63(10) | | | | | | | | |
| P(C) | | | | | | | | | |
| P(D) | | | | .45(10) | | | | | -.18(13) |
| P(E) | | | | | | | | | |
| P(F) | | | | | .25(11) | .17(11) | | .29( 9) | |
| VD(IOD) | -.57(11) | | | -.85( 4) | -.74( 4) | -.68( 4) | -.66( 2) | -.65( 3) | -.57( 3) |
| VD(AER) | | | | | | | | | |
| LDIOD0-1 | | | | | -.29(10) | | | | |
| LDAER0-1 | | | | | | | | | |
| LDIOD1-3 | | | | | | | | | |
| LDAER1-3 | | | | | | | | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | CAECGD1 | CAECGD1 | CAECGD1 | CAECGD2 | CAECGD2 | CAECGD2 | CAECGD3 | CAECGD3 | CAECGD3 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.65( 4) | -.70( 3) | -.65( 3) | -.88( 2) | -.86( 2) | -.82( 2) | | -.26(12) | -.36( 9) |
| R | | | | | | | -.75( 3) | -.65( 2) | -.68( 2) |
| HQ | | | -.18(12) | | -.28(14) | -.22(12) | | | |
| FPR(A-D) | -.79( 2) | -.75( 2) | -.69( 2) | | -.52( 5) | -.43( 7) | | | |
| FPR(E,F) | | | | | | | | | |
| DA | .70( 3) | .53( 5) | .55( 4) | .80( 3) | .50( 6) | .55( 3) | .53( 9) | | .21(13) |
| C1 | | | | | | | | | |
| HM(A) | | | | | | | | | |
| HM(B) | | | | | -.27(15) | | | -.32( 8) | -.24(11) |
| HM(C) | | | | | | | | | |
| HM(D) | | | | | | | -.50(12) | -.26(13) | -.30(10) |
| HM(E) | | | | | | | | | |
| HM(F) | | | | | | .17(14) | | | |
| SIGY0(A) | | | | | | | | | |
| SIGY0(B) | | | | .56( 7) | | | | | |
| SIGY0(C) | | | | | -.27(16) | | | | |
| SIGY0(D) | | -.32( 9) | -.30( 9) | -.64( 5) | -.40( 9) | -.37( 9) | -.57( 7) | -.58( 3) | -.58( 4) |
| SIGY0(E) | | | -.19(11) | | -.25(17) | -.28(10) | -.77( 2) | -.31(10) | -.44( 6) |
| SIGY0(F) | | | | | | | -.44(14) | -.32( 9) | -.42( 7) |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | | | | | | -.16(15) | | | |
| SIGZ0(C) | | | | -.48( 8) | -.30(11) | | | | |
| SIGZ0(D) | .56( 5) | .53( 6) | .45( 7) | | .32(10) | .17(13) | .51(10) | | |
| SIGZ0(E) | | .32(10) | .21(10) | | .55( 3) | .44( 6) | -.54( 8) | -.35( 7) | -.24(12) |
| SIGZ0(F) | | | | .65( 4) | .28(13) | .26(11) | | -.28(11) | |
| P(A) | | | | | | | | | |
| P(B) | | | | | | | | | |
| P(C) | | | | | | | | | |
| P(D) | | | | | .29(12) | | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | | | | | | | .50(11) | | |
| VD(AER) | .93( 1) | .91( 1) | .89( 1) | .98( 1) | .95( 1) | .95( 1) | .99( 1) | .97( 1) | .98( 1) |
| LDIODO-1 | | | | | | | | | |
| LDAERO-1 | .56( 6) | .49( 7) | .55( 6) | .47( 9) | .48( 7) | .49( 4) | .67( 4) | .56( 4) | .63( 3) |
| LDIOD1-3 | | | | | | | -.48(13) | | |
| LDAER1-3 | | .63( 4) | .55( 5) | | .54( 4) | .46( 5) | .58( 6) | .43( 5) | .49( 5) |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | .48( 8) | .43( 8) | .59( 6) | .46( 8) | .43( 8) | .64( 5) | .41( 6) | .41( 8) |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | CAECGD4 | CAECGD4 | CAECGD4 | CAECAD1 | CAECAD1 | CAECAD1 | CAECAD2 | CAECAD2 | CAECAD2 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | | | -.20(14) | -.90( 2) | -.91( 1) | -.89( 1) | -.98( 1) | -.97( 1) | -.96( 1) |
| R | -.75( 3) | -.73( 3) | -.69( 3) | .73( 5) | .65( 5) | .61( 5) | | .42( 8) | .28( 8) |
| HQ | | | | | -.27(12) | | | -.30( 9) | -.18( 9) |
| FPR(A-D) | | | | -.93( 1) | -.91( 2) | -.89( 2) | -.85( 3) | -.73( 3) | -.72( 3) |
| FPR(E,F) | | | | | -.30( 9) | | | | |
| DA | | | | .84( 3) | .85( 3) | .82( 3) | .90( 2) | .85( 2) | .83( 2) |
| C1 | .45( 7) | | | | | | | | |
| HM(A) | | | | | | | | | |
| HM(B) | | -.37( 7) | -.25( 9) | | | | | | |
| HM(C) | | -.27( 9) | -.30( 7) | | | | | | |
| HM(D) | -.60( 6) | -.52( 5) | -.43( 5) | | | | | | |
| HM(E) | | | | | | | | | |
| HM(F) | | | | | -.30(10) | | | | |
| SIGY0(A) | | | | | | | | | -.17(10) |
| SIGY0(B) | | | -.23(11) | | | | | | |
| SIGY0(C) | | -.41( 6) | -.32( 6) | | | | | | -.16(11) |
| SIGY0(D) | -.60( 5) | -.68( 4) | -.65( 4) | | -.38( 6) | -.39( 6) | -.58( 7) | -.56( 6) | -.49( 6) |
| SIGY0(E) | -.74( 4) | | -.28( 8) | | | -.27( 8) | | -.43( 7) | -.40( 7) |
| SIGY0(F) | | | -.23(10) | | | | -.57( 8) | | |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | | | | | | | | | |
| SIGZ0(C) | | | -.21(13) | | .28(11) | .25( 9) | | | |
| SIGZ0(D) | | | | .80( 4) | .65( 4) | .62( 4) | | | |
| SIGZ0(E) | | | | | .34( 7) | .37( 7) | .84( 4) | .72( 4) | .70( 4) |
| SIGZ0(F) | | | | | .33( 8) | .17(10) | .79( 5) | .62( 5) | .56( 5) |
| P(A) | | | | | | | .44(10) | | |
| P(B) | | | | | | | .55( 9) | | |
| P(C) | | | | | | | | | |
| P(D) | | | | | | | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | | | | | | | -.64( 6) | | |
| VD(AER) | .98( 1) | .97( 1) | .97( 1) | | | | | | |
| LDIODO-1 | | | | | | | | | |
| LDAERO-1 | .76( 2) | .79( 2) | .78( 2) | | | | | | |
| LDIOD1-3 | | | | | | | | | |
| LDAER1-3 | | .33( 8) | .21(12) | | | | | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | CAECAD3 | CAECAD3 | CAECAD3 | CAECAD4 | CAECAD4 | CAECAD4 | CAECPD1 | CAECPD1 | CAECPD1 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.88( 2) | -.77( 2) | -.65( 2) | | -.27( 8) | -.27( 8) | -.91( 1) | -.95( 1) | -.93( 1) |
| R | -.93( 1) | -.85( 1) | -.81( 1) | -.87( 2) | -.68( 3) | -.67( 3) | | | |
| HQ | | -.26(14) | | | | | | -.32(11) | -.19(11) |
| FPR(A-D) | -.48(11) | -.40(11) | -.24(10) | -.46(10) | | | -.91( 2) | -.92( 2) | -.89( 2) |
| FPR(E,F) | | | | | | | | -.41( 9) | -.18(12) |
| DA | .67( 8) | .37(12) | .37( 8) | | | | .81( 3) | .88( 3) | .84( 3) |
| C1 | | .43( 9) | .24(12) | | | .18(12) | | | |
| HM(A) | | | | | | | | .30(12) | |
| HM(B) | | -.37(13) | | | | | | | |
| HM(C) | | | | -.82( 5) | -.60( 4) | -.57( 5) | | | |
| HM(D) | -.76( 6) | -.66( 5) | -.55( 5) | -.82( 4) | -.79( 2) | -.73( 2) | | | .17(13) |
| HM(E) | | | | | | -.21(10) | | | |
| HM(F) | | | | | | | | -.27(14) | |
| SIGY0(A) | | | | | | | | | |
| SIGY0(B) | | | | | | | | | |
| SIGY0(C) | | | | | | -.26( 9) | | | -.21(10) |
| SIGY0(D) | -.80( 4) | -.45( 8) | -.47( 6) | -.85( 3) | -.55( 5) | -.59( 4) | -.62( 5) | -.65( 5) | -.60( 4) |
| SIGY0(E) | -.87( 3) | -.76( 4) | -.65( 3) | -.69( 6) | -.51( 6) | -.42( 6) | | -.47( 8) | -.43( 7) |
| SIGY0(F) | -.78( 5) | -.76( 3) | -.63( 4) | -.68( 7) | -.49( 7) | -.33( 7) | | -.36(10) | |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | .46(12) | | | | | | | | |
| SIGZ0(C) | | | | | | | | .28(13) | .26( 9) |
| SIGZ0(D) | | | | | | | .69( 4) | .68( 4) | .60( 5) |
| SIGZ0(E) | -.76( 7) | -.59( 6) | -.46( 7) | | | .16(13) | | .56( 6) | .50( 6) |
| SIGZ0(F) | -.51(10) | -.41(10) | -.24(11) | | | | | .50( 7) | .31( 8) |
| P(A) | | | | | | | | | |
| P(B) | | | | | | | | | |
| P(C) | | | | | | | | | |
| P(D) | .60( 9) | | | | | | | | |
| P(E) | | | | -.48( 9) | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | | | | | | | | | |
| VD(AER) | | -.51( 7) | -.29( 9) | -.92( 1) | -.81( 1) | -.76( 1) | | | |
| LDIOD0-1 | | | | | | | | | |
| LDAER0-1 | | | | -.49( 8) | | -.19(11) | | | |
| LDIOD1-3 | | | | | | | | | |
| LDAER1-3 | | | | | | | | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | -.26(15) | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | CAECPD2 | CAECPD2 | CAECPD2 | CAECPD3 | CAECPD3 | CAECPD3 | CAECPD4 | CAECPD4 | CAECPD4 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.97( 1) | -.96( 1) | -.95( 1) | -.76( 5) | -.51( 6) | -.52( 5) | | | -.28(11) |
| R | -.66( 8) | -.30(10) | -.31( 8) | -.94( 1) | -.84( 2) | -.84( 1) | -.45( 7) | -.49( 5) | -.46( 6) |
| HQ | | | | | | | | | |
| FPR(A-D) | -.90( 2) | -.81( 2) | -.79( 2) | -.44( 9) | -.30( 9) | -.29( 8) | | | -.18(14) |
| FPR(E,F) | | -.30(11) | | | | | | | |
| DA | .75( 3) | .75( 3) | .75( 3) | | | | | | |
| C1 | | | | | | | | | |
| HM(A) | | | | | | | | .25(10) | .30( 9) |
| HM(B) | | | -.16(14) | | | | .79( 1) | .49( 6) | .51( 4) |
| HM(C) | | | | | | -.18(12) | .79( 2) | .71( 2) | .68( 2) |
| HM(D) | | | | -.79( 4) | -.52( 5) | -.58( 4) | | .38( 7) | .38( 7) |
| HM(E) | | | | | | | | | |
| HM(F) | -.63( 9) | | | | | | | | |
| SIGY0(A) | | | -.16(12) | | | | | | |
| SIGY0(B) | | | | | | | -.71( 3) | | -.28(10) |
| SIGY0(C) | | -.29(12) | -.28( 9) | | | -.23(10) | -.67( 5) | -.62( 3) | -.60( 3) |
| SIGY0(D) | -.71( 5) | -.67( 4) | -.68( 4) | -.90( 3) | -.76( 3) | -.77( 3) | -.69( 4) | -.74( 1) | -.70( 1) |
| SIGY0(E) | -.68( 7) | -.67( 5) | -.61( 5) | -.91( 2) | -.85( 1) | -.82( 2) | -.56( 6) | -.52( 4) | -.49( 5) |
| SIGY0(F) | -.73( 4) | -.38( 8) | -.24(10) | -.74( 6) | -.54( 4) | -.51( 6) | | | -.32( 8) |
| SIGZ0(A) | | | | | | | | -.25(11) | -.17(17) |
| SIGZ0(B) | | | -.16(13) | | | | | | |
| SIGZ0(C) | | | | | | | | | |
| SIGZ0(D) | | .31( 9) | .21(11) | | | -.23(11) | | | .18(15) |
| SIGZ0(E) | .68( 6) | .61( 6) | .60( 6) | .59( 7) | .44( 7) | .39( 7) | | | |
| SIGZ0(F) | .61(10) | .58( 7) | .44( 7) | | .33( 8) | .28( 9) | | | |
| P(A) | | | | | | | | | -.18(16) |
| P(B) | .61(11) | | | | | | | | |
| P(C) | | | | | | | | | |
| P(D) | | | | .47( 8) | | | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | .16(14) | | | |
| VD(IOD) | -.49(13) | | | | | | | | |
| VD(AER) | | | | | | -.17(13) | -.45( 8) | -.38( 8) | -.25(12) |
| LDIOD0-1 | .52(12) | | | | | | | .31( 9) | .23(13) |
| LDAER0-1 | | | | | | | | | |
| LDIOD1-3 | | | | | | | | | |
| LDAER1-3 | | | | | | | | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | | |

## C.2 COMPARISON OF DOSE RUNS (LHS; N=59,100,200)

In this section PRCCs are shown for dose runs (bone marrow, whole body) at four distance intervals.

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TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUIE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | BMDOSE1 | BMDOSE1 | BMDOSE1 | BMDOSE2 | BMDOSE2 | BMDOSE2 | BMDOSE3 | BMDOSE3 | BMDOSE3 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.94( 2) | -.90( 1) | -.86( 1) | -.97( 1) | -.94( 1) | -.92( 1) | -.59( 3) | -.35( 5) | -.30( 4) |
| R | .73( 6) | .57( 6) | .48( 6) | | .44( 6) | .20( 8) | -.72( 1) | -.64( 1) | -.56( 1) |
| HQ | | | | | | | | | |
| FPR(A-D) | -.94( 1) | -.89( 2) | -.86( 2) | -.78( 4) | -.64( 4) | -.66( 3) | | | |
| FPR(E,F) | | | | | | | | | |
| DA | .89( 4) | .79( 4) | .74( 4) | .84( 3) | .69( 3) | .64( 4) | .54( 5) | | |
| C1 | | | | | | | | | |
| HM(A) | | | | | | | | | |
| HM(B) | | | | | | | | -.26( 8) | -.23( 6) |
| HM(C) | | | | | | | | | |
| HM(D) | | | | | | | | | |
| HM(E) | .49( 8) | | | | | | | | |
| HM(F) | | | | | | | | | |
| SIGY0(A) | | | | | -.28( 8) | -.20( 7) | | | |
| SIGY0(B) | | | | | | | | | |
| SIGY0(C) | | | | | | | | .37( 4) | .17( 9) |
| SIGY0(D) | | | | | | | .56( 4) | .45( 3) | .44( 3) |
| SIGY0(E) | | | | | | | | | .16(10) |
| SIGY0(F) | | | | | -.26( 9) | | | | |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | | | | | | | | | |
| SIGZ0(C) | .45(10) | | | | | | | | |
| SIGZ0(D) | .86( 5) | .66( 5) | .58( 5) | .57( 5) | | | | | |
| SIGZ0(E) | | | .27( 7) | | .53( 5) | .50( 5) | | -.32( 7) | -.20( 7) |
| SIGZ0(F) | | | | .50( 6) | .40( 7) | .36( 6) | -.54( 6) | -.33( 6) | -.26( 5) |
| P(A) | | | | | | | | | |
| P(B) | | | | | | | | | |
| P(C) | | | | -.49( 7) | | | | | |
| P(D) | | | | | | | | | |
| P(E) | -.48( 9) | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | .91( 3) | .86( 3) | .78( 3) | .94( 2) | .89( 2) | .85( 2) | .68( 2) | .53( 2) | .45( 2) |
| VD(AER) | .51( 7) | | | | | .18( 9) | | | |
| LDIOD0-1 | | | | | | | | | |
| LDAER0-1 | | | | | | | | | |
| LDIOD1-3 | | | | | .25(10) | | | | |
| LDAER1-3 | | | | | | | | | |
| LDIOD>3 | | | | | | | | | .18( 8) |
| LDAER>3 | | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | BMDOSE4 | BMDOSE4 | BMDOSE4 | WBDOSE1 | WBDOSE1 | WBDOSE1 | WBDOSE2 | WBDOSE2 | WBDOSE2 |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | | | | -.96( 1) | -.91( 1) | -.88( 1) | -.98( 1) | -.96( 1) | -.95( 1) |
| R | -.77( 3) | -.60( 3) | -.55( 3) | .75( 5) | .67( 4) | .58( 5) | | .51( 6) | .26( 7) |
| HQ | .54( 6) | | | | | | | | |
| FPR(A-D) | | | | -.95( 2) | -.91( 2) | -.88( 2) | -.81( 3) | -.68( 4) | -.69( 3) |
| FPR(E,F) | | | | | -.32( 8) | | | | |
| DA | | | | .91( 3) | .83( 3) | .79( 3) | .91( 2) | .80( 2) | .75( 2) |
| C1 | | | | | | | | | |
| HM(A) | | | | | .26(12) | | | | |
| HM(B) | | -.28( 7) | -.31( 7) | | | | | | |
| HM(C) | | -.42( 5) | -.43( 5) | | | | | | |
| HM(D) | -.75( 4) | -.38( 6) | -.39( 6) | | | | | | |
| HM(E) | | | | .51( 7) | | | | | |
| HM(F) | | | | | -.26(11) | | | | |
| SIGY0(A) | | | | | | | | -.27( 8) | -.18( 8) |
| SIGY0(B) | | | | | | | | | |
| SIGY0(C) | | | | | | | | | |
| SIGY0(D) | | | | | | | | | |
| SIGY0(E) | | | | | | | | | |
| SIGY0(F) | | | | | | | | | |
| SIGZ0(A) | | | | | | | | | |
| SIGZ0(B) | | | | | | | | | |
| SIGZ0(C) | | | | .47( 8) | | .19( 8) | | | |
| SIGZ0(D) | | | | .88( 4) | .66( 5) | .59( 4) | .46( 7) | | |
| SIGZ0(E) | -.52( 7) | | | | .32( 7) | .31( 7) | .65( 5) | .61( 5) | .60( 5) |
| SIGZ0(F) | | | | | | .17( 9) | .58( 6) | .51( 7) | .46( 6) |
| P(A) | | | | | | | | | |
| P(B) | -.51( 8) | | | | | | | | |
| P(C) | | | | | | | | | |
| P(D) | | | | | | | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | .86( 2) | .70( 2) | .69( 2) | .73( 6) | .63( 6) | .44( 6) | .80( 4) | .71( 3) | .62( 4) |
| VD(AER) | .95( 1) | .92( 1) | .91( 1) | | | | | | |
| LDIOD0-1 | | | | | | | | | |
| LDAER0-1 | .66( 5) | .56( 4) | .53( 4) | | | | | | |
| LDIOD1-3 | | | | | .29( 9) | | | | |
| LDAER1-3 | | | | | .28(10) | | .45( 8) | | |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | WBDOSE3 | WBDOSE3 | WBDOSE3 | WBDOSE4 | WBDOSE4 | WBDOSE4 |
|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.80( 4) | -.64( 4) | -.64( 4) | | -.29( 7) | -.20( 8) |
| R | -.91( 2) | -.84( 2) | -.82( 2) | -.75( 2) | -.62( 2) | -.61( 2) |
| HQ | | -.27(14) | | | | |
| FPR(A-D) | -.54( 7) | -.46( 8) | -.34( 9) | | | |
| FPR(E,F) | | | .18(15) | | | |
| DA | | | .17(16) | | | |
| C1 | | | | | | -.17(13) |
| HM(A) | | | | | -.25( 9) | -.18(11) |
| HM(B) | | -.40(10) | -.28(10) | -.45( 8) | -.26( 8) | -.28( 7) |
| HM(C) | | | -.22(12) | -.61( 3) | -.56( 4) | -.50( 3) |
| HM(D) | -.62( 6) | -.56( 5) | -.54( 5) | -.60( 4) | -.59( 3) | -.47( 5) |
| HM(E) | | | | | | |
| HM(F) | | .30(11) | | | | |
| SIGY0(A) | | | | | | |
| SIGY0(B) | | | | | | |
| SIGY0(C) | | .25(17) | .20(13) | .58( 5) | | .19(10) |
| SIGY0(D) | | .50( 6) | .44( 7) | .55( 6) | .50( 6) | .49( 4) |
| SIGY0(E) | | .26(16) | .24(11) | | | .20( 9) |
| SIGY0(F) | | | | | | .16(14) |
| SIGZ0(A) | | .26(15) | | | | |
| SIGZ0(B) | | | | | | |
| SIGZ0(C) | | | | | | |
| SIGZ0(D) | | | | | | |
| SIGZ0(E) | -.75( 5) | -.45( 9) | -.45( 6) | | | |
| SIGZ0(F) | -.47( 8) | -.48( 7) | -.37( 8) | | | |
| P(A) | | -.29(13) | | | | |
| P(B) | | | | | | |
| P(C) | | | | | | |
| P(D) | | | .16(17) | | | |
| P(E) | | | | | | |
| P(F) | | | | | | |
| VD(IOD) | .86( 3) | .74( 3) | .72( 3) | .46( 7) | | .18(12) |
| VD(AER) | .94( 1) | .91( 1) | .90( 1) | .98( 1) | .97( 1) | .97( 1) |
| LDIOD0-1 | | | | | | |
| LDAER0-1 | | | .18(14) | | .52( 5) | .41( 6) |
| LDIOD1-3 | | | | | | |
| LDAER1-3 | .46( 9) | .30(12) | | | | |
| LDIOD>3 | | | | | | |
| LDAER>3 | | | | | | |

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## C.3 COMPARISON OF FATALITY RUNS (LHS; N=59,100,200)

In this section PRCCS are shown for health effects (early and late fatalities, areas affected by the countermeasure 'relocation'.

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TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS), 0.25 (100 RUNS) OR 0.16 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.05 SIGNIFICANCE LEVEL
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS), 0.41 (100 RUNS) OR 0.26 (200 RUNS) RESPECTIVELY FOR ALPHA = 0.001 SIGNIFICANCE LEVEL)

| | EARFATA | EARFATA | EARFATA | LATFATA | LATFATA | LATFATA | RELOCAT | RELOCAT | RELOCAT |
|---|---|---|---|---|---|---|---|---|---|
| #RUNS | 59 | 100 | 200 | 59 | 100 | 200 | 59 | 100 | 200 |
| Q | -.76( 2) | -.60( 2) | -.58( 2) | | | | | | |
| R | | | | | .40( 3) | .28( 4) | -.68( 3) | -.68( 2) | -.60( 3) |
| HQ | | | | | | | | | |
| FPR(A-D) | -.74( 3) | -.36( 6) | -.53( 3) | | .39( 4) | | | | |
| FPR(E,F) | | | | | | | -.45( 6) | | |
| DA | | .49( 3) | .49( 4) | | | | | | |
| C1 | | | | | | | | | |
| HM(A) | | | | | | | | | |
| HM(B) | | | -.22( 9) | | | | | -.31( 6) | -.19( 9) |
| HM(C) | | | | | | -.16(11) | | | |
| HM(D) | | | | | | | | | -.24( 7) |
| HM(E) | | | | | | | | -.29( 8) | |
| HM(F) | | | .17(10) | | | | | .26(12) | |
| SIGY0(A) | | | | | | | | | |
| SIGY0(B) | | | | | | .21( 8) | | | -.18(11) |
| SIGY0(C) | | | | | | .17(10) | | | |
| SIGY0(D) | -.45( 5) | | | | .36( 6) | .27( 5) | | -.34( 5) | -.23( 8) |
| SIGY0(E) | -.53( 4) | -.40( 4) | -.23( 8) | | | | | | |
| SIGY0(F) | | | | | | | | | |
| SIGZ0(A) | | | | -.48( 3) | | | | | |
| SIGZ0(B) | | | | | | | | | |
| SIGZ0(C) | | | | | | | | | |
| SIGZ0(D) | | | | | -.27( 7) | | | | |
| SIGZ0(E) | | .37( 5) | .29( 5) | | | | | | |
| SIGZ0(F) | | .28( 8) | .23( 7) | | | | | | |
| P(A) | | | | | | | | | -.17(12) |
| P(B) | | | | | | | | -.28( 9) | -.18(10) |
| P(C) | | | | | | | | | |
| P(D) | | | | | -.39( 5) | -.17( 9) | | | |
| P(E) | | | | | | | | | |
| P(F) | | | | | | | | | |
| VD(IOD) | .90( 1) | .83( 1) | .78( 1) | -.88( 1) | -.82( 1) | -.76( 1) | .49( 4) | .27(11) | .27( 6) |
| VD(AER) | | .29( 7) | .26( 6) | -.78( 2) | -.72( 2) | -.62( 2) | .96( 1) | .93( 1) | .92( 1) |
| LDIOD0-1 | | | | | | -.26( 6) | | | |
| LDAER0-1 | | | | | -.26( 8) | -.24( 7) | .81( 2) | .62( 3) | .66( 2) |
| LDIOD1-3 | | | | | | | | .27(10) | |
| LDAER1-3 | | | | | | -.30( 3) | .47( 5) | .57( 4) | .53( 4) |
| LDIOD>3 | | | | | | | | | |
| LDAER>3 | | | | | | | | .30( 7) | .29( 5) |

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## C.4 COMPARISON OF CONCENTRATION RUNS (RSD/LHS; N=59,100,200)

In this section PRCCs are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface, in the air near ground and in the plume.

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AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD/LHS - DESIGN ) (PART 1 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCGD1 | IODCGD1 | IODCGD2 | IODCGD2 | IODCGD3 | IODCGD3 | IODCGD4 | IODCGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.86( 2) | -.89( 3) | -.91( 2) | -.96( 2) | -.49( 6) | | | |
| R | | .66( 6) | | | -.69( 3) | -.65( 4) | -.66( 3) | |
| HQ | | | | | | | | |
| FPR(A-D) | -.83( 3) | -.92( 2) | -.56( 4) | -.77( 4) | | | .53( 9) | |
| FPR(E,F) | | | | | | | | |
| DA | .67( 4) | .87( 4) | .61( 3) | .83( 3) | | .46( 8) | -.56( 6) | |
| C1 | | | | | | | .56( 7) | |
| HM(A) | | | | | | | | .45( 3) |
| HM(B) | | .55( 7) | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | | -.45( 7) | -.51( 6) | -.53(10) | |
| HM(E) | | -.51( 9) | | | | | .49(11) | |
| HM(F) | | | | -.45(11) | | -.70( 2) | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.53( 5) | -.56( 8) | -.66( 4) | -.62( 5) | -.61( 4) | -.45( 4) |
| SIGY0(E) | | | | | -.74( 2) | | -.45(13) | |
| SIGY0(F) | | | | -.52(10) | | | | -.48( 2) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | .50( 7) | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .57( 5) | .74( 5) | | | | | | |
| SIGZ0(E) | | | | .61( 6) | | -.66( 3) | | |
| SIGZ0(F) | | .53( 8) | | .69( 5) | | | | |
| P(A) | | .48(10) | | .58( 7) | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | .58( 5) | |
| P(D) | | | | .56( 9) | -.50( 5) | | -.67( 2) | |
| P(E) | | | | | | | -.55( 8) | |
| P(F) | | | | | | | | |
| VD(IOD) | .95( 1) | .98( 1) | .97( 1) | .99( 1) | .99( 1) | .99( 1) | .90( 1) | .85( 1) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | | .47(11) | | | | | .46(12) | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | .48( 6) | | .51( 6) | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCAD1 | IODCAD1 | IODCAD2 | IODCAD2 | IODCAD3 | IODCAD3 | IODCAD4 | IODCAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.93( 1) | -.89( 2) | -.98( 1) | -.98( 1) | -.82( 3) | -.69( 3) | | |
| R | .45( 5) | .72( 5) | | | -.92( 1) | -.71( 2) | -.49( 4) | -.44( 2) |
| HQ | | | -.48( 7) | | | | | |
| FPR(A-D) | -.91( 2) | -.92( 1) | -.77( 3) | -.84( 3) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | .83( 3) | .81( 2) | .88( 2) | | .46( 9) | | |
| C1 | | | | | .49( 9) | | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | -.48( 5) | |
| HM(D) | | | | | -.72( 5) | -.58( 6) | -.59( 3) | |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.47( 8) | -.59( 8) | -.66( 7) | -.62( 5) | | |
| SIGY0(E) | | | -.58( 4) | | -.77( 4) | -.62( 4) | -.61( 2) | |
| SIGY0(F) | | | | -.61( 7) | -.69( 6) | -.44(10) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | .46( 6) | |
| SIGZ0(C) | | | | | | | | -.44( 3) |
| SIGZ0(D) | .85( 3) | .79( 4) | | | | | | |
| SIGZ0(E) | | | .55( 6) | .79( 4) | -.61( 8) | -.51( 7) | | |
| SIGZ0(F) | | | .57( 5) | .75( 5) | | -.49( 8) | | |
| P(A) | | | | .46(10) | | | | |
| P(B) | | | | .54( 9) | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | -.66( 6) | -.90( 2) | -.87( 1) | -.98( 1) | -.96( 1) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCPD1 | IODCPD1 | IODCPD2 | IODCPD2 | IODCPD3 | IODCPD3 | IODCPD4 | IODCPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.96( 1) | -.92( 1) | -.97( 1) | -.97( 1) | -.74( 6) | -.66( 6) | | |
| R | | | -.68( 6) | -.64( 9) | -.92( 1) | -.89( 1) | | |
| HQ | | | | | | | | |
| FPR(A-D) | -.91( 2) | -.91( 2) | -.85( 2) | -.87( 2) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | .82( 3) | .76( 3) | .74( 4) | | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | .62( 5) | .50( 6) |
| HM(B) | | | | | | | .78( 1) | .71( 1) |
| HM(C) | | | .46(11) | | | -.47( 8) | .61( 7) | .65( 3) |
| HM(D) | | | | | -.74( 5) | -.75( 5) | | |
| HM(E) | | | | | | | | |
| HM(F) | | | | -.65( 8) | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | -.51( 5) |
| SIGY0(C) | -.44( 7) | | | | -.58( 8) | | -.61( 6) | -.46( 7) |
| SIGY0(D) | -.66( 5) | -.62( 5) | -.75( 4) | -.74( 3) | -.87( 3) | -.88( 2) | -.78( 2) | -.56( 4) |
| SIGY0(E) | | | -.73( 5) | -.66( 7) | -.91( 2) | -.87( 3) | -.68( 4) | |
| SIGY0(F) | | | -.46(10) | -.70( 5) | -.58( 7) | -.47( 9) | | |
| SIGZ0(A) | | | | | | .44(11) | | |
| SIGZ0(B) | .47( 6) | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .83( 3) | .69( 4) | .48( 8) | | | | | |
| SIGZ0(E) | | | .47( 9) | .67( 6) | .57( 9) | .61( 7) | | |
| SIGZ0(F) | | | .48( 7) | .56(12) | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | .63(10) | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | .45(10) | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | -.57(11) | -.84( 4) | -.85( 4) | -.74( 3) | -.66( 2) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECGD1 | CAECGD1 | CAECGD2 | CAECGD2 | CAECGD3 | CAECGD3 | CAECGD4 | CAECGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.79( 2) | -.65( 4) | -.84( 2) | -.88( 2) | -.56( 5) | | -.54( 5) | |
| R | | | | | -.63( 4) | -.75( 3) | -.68( 3) | -.75( 3) |
| HQ | | | | | | | | |
| FPR(A-D) | -.72( 4) | -.79( 2) | | | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .50( 7) | .70( 3) | | .80( 3) | | .53( 9) | | |
| C1 | | | | | | | | .45( 7) |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | | | -.50(12) | -.46( 7) | -.60( 6) |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | .56( 7) | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | | -.64( 5) | | -.57( 7) | -.52( 6) | -.60( 5) |
| SIGY0(E) | -.58( 6) | | -.68( 4) | | -.71( 3) | -.77( 2) | -.56( 4) | -.74( 4) |
| SIGY0(F) | | | | | | -.44(14) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | | | -.48( 8) | | | | |
| SIGZ0(D) | .46( 8) | .56( 5) | | | | .51(10) | | |
| SIGZ0(E) | | | | | | -.54( 8) | | |
| SIGZ0(F) | | | | .65( 4) | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | | .50(11) | | |
| VD(AER) | .87( 1) | .93( 1) | .91( 1) | .98( 1) | .96( 1) | .99( 1) | .96( 1) | .98( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | .71( 5) | .56( 6) | .70( 3) | .47( 9) | .78( 2) | .67( 4) | .84( 2) | .76( 2) |
| LDIOD1-3 | | | | | | -.48(13) | | |
| LDAER1-3 | .74( 3) | | .64( 5) | | .47( 6) | .58( 6) | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | .59( 6) | | .64( 5) | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECAD1 | CAECAD1 | CAECAD2 | CAECAD2 | CAECAD3 | CAECAD3 | CAECAD4 | CAECAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.93( 1) | -.90( 2) | -.97( 1) | -.98( 1) | -.87( 2) | -.88( 2) | -.69( 8) | |
| R | .44( 5) | .73( 5) | | | -.93( 1) | -.93( 1) | -.78( 6) | -.87( 2) |
| HQ | | | -.46( 7) | | -.47(10) | | | |
| FPR(A-D) | -.91( 2) | -.93( 1) | -.77( 3) | -.85( 3) | | -.48(11) | | -.46(10) |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | .84( 3) | .81( 2) | .90( 2) | .56( 9) | .67( 8) | | |
| C1 | | | | | | | .50(10) | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | -.80( 5) | |
| HM(C) | | | | | | | -.72( 7) | -.82( 5) |
| HM(D) | | | | | -.74( 7) | -.76( 6) | -.86( 2) | -.82( 4) |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | -.44(11) | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.45( 8) | -.58( 7) | -.73( 8) | -.80( 4) | -.84( 3) | -.85( 3) |
| SIGY0(E) | | | -.57( 4) | | -.84( 3) | -.87( 3) | | -.69( 6) |
| SIGY0(F) | | | | -.57( 8) | -.77( 5) | -.78( 5) | -.81( 4) | -.68( 7) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | .46(12) | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .85( 3) | .80( 4) | | | -.46(11) | | | |
| SIGZ0(E) | | | .52( 6) | .84( 4) | -.80( 4) | -.76( 7) | | |
| SIGZ0(F) | | | .55( 5) | .79( 5) | | -.51(10) | | |
| P(A) | | | | .44(10) | | | | |
| P(B) | | | | .55( 9) | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | .60( 9) | | |
| P(E) | | | | | | | | -.48( 9) |
| P(F) | | | | | | | | |
| VD(IOD) | | | | -.64( 6) | | | | |
| VD(AER) | | | | | -.75( 6) | | -.94( 1) | -.92( 1) |
| LDIODO-1 | | | | | | | .57( 9) | |
| LDAERO-1 | | | | | | | | -.49( 8) |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECPD1 | CAECPD1 | CAECPD2 | CAECPD2 | CAECPD3 | CAECPD3 | CAECPD4 | CAECPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.96( 1) | -.91( 1) | -.98( 1) | -.97( 1) | -.82( 4) | -.76( 5) | | |
| R | | | -.72( 5) | -.66( 8) | -.94( 2) | -.94( 1) | -.57( 7) | -.45( 7) |
| HQ | | | | | | | | |
| FPR(A-D) | -.91( 2) | -.91( 2) | -.86( 2) | -.90( 2) | | -.44( 9) | | |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | .81( 3) | .78( 3) | .75( 3) | | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | .62( 6) | |
| HM(B) | | | | | -.44(12) | | .70( 5) | .79( 1) |
| HM(C) | | | .46(10) | | | | .77( 3) | .79( 2) |
| HM(D) | | | | | -.79( 5) | -.79( 4) | .49( 8) | |
| HM(E) | | | | | | | | |
| HM(F) | | | | -.63( 9) | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | -.46( 8) | | | | | | | -.71( 3) |
| SIGY0(C) | -.46( 7) | | | | -.47( 9) | | -.72( 4) | -.67( 5) |
| SIGY0(D) | -.67( 5) | -.62( 5) | -.77( 4) | -.71( 5) | -.91( 3) | -.90( 3) | -.86( 1) | -.69( 4) |
| SIGY0(E) | | | -.72( 6) | -.68( 7) | -.96( 1) | -.91( 2) | -.78( 2) | -.56( 6) |
| SIGY0(F) | | | -.46( 9) | -.73( 4) | -.73( 6) | -.74( 6) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | .49( 6) | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .83( 3) | .69( 4) | .50( 8) | | | | | |
| SIGZ0(E) | | | | .68( 6) | .67( 7) | .59( 7) | | |
| SIGZ0(F) | | | .50( 7) | .61(10) | .46(10) | | | |
| P(A) | | | | | | | | |
| P(B) | | | | .61(11) | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | .45(11) | .47( 8) | | |
| P(E) | | | | | | | | |
| P(F) | | | | | .61( 8) | | | |
| VD(IOD) | | | | -.49(13) | | | | |
| VD(AER) | | | | | | | | -.45( 8) |
| LDIOD0-1 | | | | .52(12) | | | | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.25 (100 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.41 (100 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCGD1 | IODCGD1 | IODCGD2 | IODCGD2 | IODCGD3 | IODCGD3 | IODCGD4 | IODCGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.86( 2) | -.87( 3) | -.90( 2) | -.92( 2) | -.38( 6) | | | |
| R | .54( 6) | .56( 6) | | .29( 9) | -.44( 4) | -.55( 2) | | -.29( 4) |
| HQ | | | | | | | | |
| FPR(A-D) | -.83( 3) | -.88( 2) | -.52( 4) | -.61( 3) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .75( 4) | .73( 4) | .63( 3) | .61( 4) | | | -.30( 3) | |
| C1 | .29( 8) | | | | | .26( 8) | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | -.26(10) | | | | |
| HM(C) | | | | | | | | |
| HM(D) | -.28( 9) | | -.30( 7) | | -.49( 2) | -.37( 5) | | |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | -.34( 9) | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.36( 6) | -.31( 8) | -.28( 8) | -.34( 6) | -.41( 2) | -.58( 2) |
| SIGY0(E) | | | | -.41( 6) | -.47( 3) | -.45( 4) | | -.47( 3) |
| SIGY0(F) | | | | | -.43( 5) | -.51( 3) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .62( 5) | .60( 5) | | | | | | |
| SIGZ0(E) | .33( 7) | | .47( 5) | .49( 5) | -.29( 7) | -.26( 9) | | |
| SIGZ0(F) | | | .28( 8) | .34( 7) | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | .96( 1) | .97( 1) | .97( 1) | .98( 1) | .98( 1) | .98( 1) | .74( 1) | .74( 1) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | | | | | | .33( 7) | | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | .37( 7) | | | | | | |
| LDAER1-3 | | .34( 8) | | | -.27( 9) | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.25 (100 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.41 (100 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCAD1 | IODCAD1 | IODCAD2 | IODCAD2 | IODCAD3 | IODCAD3 | IODCAD4 | IODCAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.91( 1) | -.91( 2) | -.97( 1) | -.97( 1) | -.44( 5) | -.31(10) | | |
| R | .59( 5) | .67( 4) | | .42( 8) | -.70( 2) | -.71( 2) | | |
| HQ | | -.28(12) | -.28(12) | -.29( 9) | | -.36( 7) | | -.29( 6) |
| FPR(A-D) | -.89( 2) | -.91( 1) | -.73( 3) | -.73( 3) | | | | |
| FPR(E,F) | -.27( 9) | -.30( 9) | | | | | | |
| DA | .81( 3) | .85( 3) | .80( 2) | .84( 2) | | | -.34( 3) | |
| C1 | .26(10) | | | | | | | -.30( 5) |
| HM(A) | | | | | | | | -.29( 7) |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | | -.41( 7) | -.35( 8) | | -.31( 4) |
| HM(E) | | | | | -.25( 9) | | -.33( 4) | |
| HM(F) | | -.29(10) | .27(14) | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | -.30( 7) | | -.32(10) | | | | -.32( 6) | |
| SIGY0(D) | | -.39( 6) | -.44( 5) | -.56( 6) | -.40( 8) | -.34( 9) | -.59( 2) | -.49( 2) |
| SIGY0(E) | | | -.39( 6) | -.43( 7) | -.46( 3) | -.63( 3) | -.32( 5) | -.37( 3) |
| SIGY0(F) | | | -.33( 8) | | -.45( 4) | -.55( 4) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | .27( 8) | |
| SIGZ0(C) | | .29(11) | | | | | | |
| SIGZ0(D) | .75( 4) | .65( 5) | | | | | -.30( 7) | |
| SIGZ0(E) | .38( 6) | .36( 7) | .69( 4) | .71( 4) | -.43( 6) | -.52( 5) | | |
| SIGZ0(F) | | .32( 8) | .35( 7) | .61( 5) | | -.40( 6) | | |
| P(A) | | | | | | | | |
| P(B) | | | .31(11) | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | -.75( 1) | -.78( 1) | -.96( 1) | -.96( 1) |
| VD(AER) | | | .27(13) | | | | | |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | -.28( 8) | | -.32( 9) | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | -.26( 8) |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD/LHS - DESIGN ) (PART 3 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.25 (100 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.41 (100 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCPD1 | IODCPD1 | IODCPD2 | IODCPD2 | IODCPD3 | IODCPD3 | IODCPD4 | IODCPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.95( 1) | -.94( 1) | -.97( 1) | -.96( 1) | -.48( 5) | | | |
| R | | | -.29(13) | -.29(12) | -.82( 2) | -.79( 2) | -.30(13) | -.37( 8) |
| HQ | -.38( 8) | -.27(13) | -.43( 9) | -.25(13) | | -.36( 7) | | |
| FPR(A-D) | -.90( 2) | -.92( 2) | -.84( 2) | -.82( 2) | -.29( 9) | -.33( 9) | | |
| FPR(E,F) | | -.43( 9) | | -.29(11) | | | | |
| DA | .87( 3) | .87( 3) | .74( 3) | .75( 3) | | | | |
| C1 | .31(12) | | | | | | | |
| HM(A) | | .29(12) | | | | | .45( 7) | |
| HM(B) | | | | | | | .74( 2) | .47( 6) |
| HM(C) | | | | | | | .65( 4) | .71( 1) |
| HM(D) | | | | | -.48( 6) | -.48( 6) | .51( 6) | .43( 7) |
| HM(E) | | | | | | | -.31(12) | |
| HM(F) | .27(15) | -.26(15) | .32(10) | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | -.32(10) | |
| SIGY0(C) | -.54( 6) | | -.47( 8) | -.33( 9) | -.28(10) | | -.63( 5) | -.61( 4) |
| SIGY0(D) | -.62( 5) | -.66( 5) | -.72( 4) | -.69( 5) | -.85( 1) | -.78( 3) | -.76( 1) | -.67( 2) |
| SIGY0(E) | -.27(14) | -.46( 8) | -.64( 6) | -.70( 4) | -.81( 3) | -.85( 1) | -.35( 9) | -.50( 5) |
| SIGY0(F) | -.37( 9) | -.34(10) | -.50( 7) | -.42( 8) | -.44( 8) | -.50( 5) | -.41( 8) | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | .29(13) | .29(11) | | | | | | .27(10) |
| SIGZ0(D) | .74( 4) | .69( 4) | .31(11) | .31(10) | | | | |
| SIGZ0(E) | .44( 7) | .57( 6) | .67( 5) | .61( 6) | .46( 7) | .34( 8) | .32(11) | |
| SIGZ0(F) | | .48( 7) | .27(14) | .57( 7) | | | | |
| P(A) | | | | | | | | |
| P(B) | | | .30(12) | | | | | |
| P(C) | | | | | | | | |
| P(D) | .35(11) | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | .25(11) | | .29( 9) |
| VD(IOD) | | | | | -.72( 4) | -.74( 4) | -.71( 3) | -.65( 3) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | | | | | | -.29(10) | | |
| LDAER0-1 | -.36(10) | | -.27(15) | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | -.26(14) | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.25 (100 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.41 (100 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECGD1 | CAECGD1 | CAECGD2 | CAECGD2 | CAECGD3 | CAECGD3 | CAECGD4 | CAECGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.82( 2) | -.70( 3) | -.90( 2) | -.86( 2) | -.48( 6) | -.26(12) | | |
| R | | | | | -.52( 5) | -.65( 2) | -.53( 5) | -.73( 3) |
| HQ | -.26(13) | | -.25(11) | -.28(14) | | | | |
| FPR(A-D) | -.79( 3) | -.75( 2) | -.58( 5) | -.52( 5) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .73( 4) | .53( 5) | .73( 3) | .50( 6) | .27(12) | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | -.27(15) | | -.32( 8) | | -.37( 7) |
| HM(C) | | | | | | | -.36( 6) | -.27( 9) |
| HM(D) | | | | | -.31( 8) | -.26(13) | -.53( 4) | -.52( 5) |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | -.27(16) | | | | -.41( 6) |
| SIGY0(D) | -.41( 9) | -.32( 9) | -.54( 7) | -.40( 9) | -.57( 4) | -.58( 3) | -.64( 3) | -.68( 4) |
| SIGY0(E) | | | | -.25(17) | -.27(11) | -.31(10) | -.28( 7) | |
| SIGY0(F) | -.27(11) | | | | -.29(10) | -.32( 9) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | .26(12) | | | | | | | |
| SIGZ0(C) | | | | -.30(11) | | | | |
| SIGZ0(D) | .44( 8) | .53( 6) | | .32(10) | | | | |
| SIGZ0(E) | | .32(10) | .42( 9) | .55( 3) | -.29( 9) | -.35( 7) | | |
| SIGZ0(F) | .30(10) | | .31(10) | .28(13) | | -.28(11) | | |
| P(A) | | | | | | | -.26( 9) | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | .29(12) | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | .87( 1) | .91( 1) | .93( 1) | .95( 1) | .96( 1) | .97( 1) | .94( 1) | .97( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | .68( 5) | .49( 7) | .66( 4) | .48( 7) | .58( 3) | .56( 4) | .73( 2) | .79( 2) |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | .61( 6) | .63( 4) | .51( 8) | .54( 4) | .38( 7) | .43( 5) | .28( 8) | .33( 8) |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | .60( 7) | .48( 8) | .57( 6) | .46( 8) | .58( 2) | .41( 6) | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.25 (100 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.41 (100 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECAD1 | CAECAD1 | CAECAD2 | CAECAD2 | CAECAD3 | CAECAD3 | CAECAD4 | CAECAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.91( 1) | -.91( 1) | -.97( 1) | -.97( 1) | -.78( 2) | -.77( 2) | | -.27( 8) |
| R | .60( 5) | .65( 5) | | .42( 8) | -.83( 1) | -.85( 1) | -.52( 5) | -.68( 3) |
| HQ | | -.27(12) | -.28(12) | -.30( 9) | -.26(11) | -.26(14) | | |
| FPR(A-D) | -.89( 2) | -.91( 2) | -.74( 3) | -.73( 3) | | -.40(11) | -.38( 6) | |
| FPR(E,F) | -.27( 9) | -.30( 9) | | | | | | |
| DA | .81( 3) | .85( 3) | .80( 2) | .85( 2) | .41( 9) | .37(12) | | |
| C1 | | | | | | .43( 9) | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | -.37(13) | | |
| HM(C) | | | | | | | -.56( 4) | -.60( 4) |
| HM(D) | | | | | -.58( 6) | -.66( 5) | -.78( 1) | -.79( 2) |
| HM(E) | | | | | -.26(12) | | | |
| HM(F) | | -.30(10) | .26(13) | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | -.29( 8) | | -.33( 8) | | | | -.31( 7) | |
| SIGY0(D) | -.25(10) | -.38( 6) | -.45( 5) | -.56( 6) | -.51( 7) | -.45( 8) | -.69( 3) | -.55( 5) |
| SIGY0(E) | | | -.40( 6) | -.43( 7) | -.68( 4) | -.76( 4) | -.26( 9) | -.51( 6) |
| SIGY0(F) | | | -.30(11) | | -.69( 3) | -.76( 3) | -.28( 8) | -.49( 7) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | .28(11) | | | | | | |
| SIGZ0(D) | .75( 4) | .65( 4) | | | | | | |
| SIGZ0(E) | .37( 6) | .34( 7) | .69( 4) | .72( 4) | -.67( 5) | -.59( 6) | | |
| SIGZ0(F) | | .33( 8) | .34( 7) | .62( 5) | | -.41(10) | | |
| P(A) | | | | | | | | |
| P(B) | | | .33( 9) | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | .39(10) | | | |
| VD(AER) | | | | | -.47( 8) | -.51( 7) | -.74( 2) | -.81( 1) |
| LDIOD0-1 | | | | | -.26(13) | | -.25(10) | |
| LDAER0-1 | -.29( 7) | | -.32(10) | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.25 (100 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.41 (100 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECPD1 | CAECPD1 | CAECPD2 | CAECPD2 | CAECPD3 | CAECPD3 | CAECPD4 | CAECPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.95( 1) | -.95( 1) | -.97( 1) | -.96( 1) | -.65( 4) | -.51( 6) | -.32(10) | |
| R | | | -.28(14) | -.30(10) | -.85( 3) | -.84( 2) | -.48( 5) | -.49( 5) |
| HQ | -.40( 8) | -.32(11) | -.43( 9) | | | | .25(13) | |
| FPR(A-D) | -.90( 2) | -.92( 2) | -.83( 2) | -.81( 2) | -.34( 7) | -.30( 9) | | |
| FPR(E,F) | | -.41( 9) | | -.30(11) | | | | |
| DA | .86( 3) | .88( 3) | .74( 3) | .75( 3) | | | | |
| C1 | .30(13) | | | | | | | |
| HM(A) | | .30(12) | | | | | .43( 6) | .25(10) |
| HM(B) | | | | | | | .72( 1) | .49( 6) |
| HM(C) | | | | | | | .61( 3) | .71( 2) |
| HM(D) | | | | | -.64( 5) | -.52( 5) | .29(11) | .38( 7) |
| HM(E) | | | | | | | | |
| HM(F) | .30(12) | -.27(14) | .30(12) | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | -.37( 9) | |
| SIGY0(C) | -.52( 6) | | -.49( 7) | -.29(12) | | | -.60( 4) | -.62( 3) |
| SIGY0(D) | -.62( 5) | -.65( 5) | -.71( 4) | -.67( 4) | -.87( 2) | -.76( 3) | -.70( 2) | -.74( 1) |
| SIGY0(E) | -.28(14) | -.47( 8) | -.62( 6) | -.67( 5) | -.88( 1) | -.85( 1) | -.37( 8) | -.52( 4) |
| SIGY0(F) | -.35(11) | -.36(10) | -.45( 8) | -.38( 8) | -.54( 6) | -.54( 4) | -.38( 7) | |
| SIGZ0(A) | | | | | | | | -.25(11) |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | .26(15) | .28(13) | | | | | | |
| SIGZ0(D) | .74( 4) | .68( 4) | .30(11) | .31( 9) | | | | |
| SIGZ0(E) | .43( 7) | .56( 6) | .65( 5) | .61( 6) | .33( 8) | .44( 7) | .28(12) | |
| SIGZ0(F) | | .50( 7) | | .58( 7) | | .33( 8) | | |
| P(A) | | | | | | | | |
| P(B) | | | .32(10) | | | | | |
| P(C) | | | | | | | | |
| P(D) | .35(10) | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | | | | | | | | -.38( 8) |
| LDIOD0-1 | | | | | -.27( 9) | | | .31( 9) |
| LDAER0-1 | -.36( 9) | | -.29(13) | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | -.26(15) | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCGD1 | IODCGD1 | IODCGD2 | IODCGD2 | IODCGD3 | IODCGD3 | IODCGD4 | IODCGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.83( 2) | -.82( 2) | -.89( 2) | -.90( 2) | -.35( 8) | -.23(10) | | |
| R | .43( 6) | .44( 6) | | .18(11) | -.51( 3) | -.62( 2) | | -.20( 4) |
| HQ | | | | | | | | |
| FPR(A-D) | -.79( 3) | -.80( 3) | -.41( 4) | -.57( 4) | | | | |
| FPR(E,F) | -.22( 8) | | | | | | | |
| DA | .71( 4) | .68( 4) | .60( 3) | .62( 3) | | | -.23( 4) | |
| C1 | | | | | | | | |
| HM(A) | | | | | -.19(11) | | -.16( 6) | |
| HM(B) | | | | -.17(12) | | | | |
| HM(C) | .17(13) | | | | | | | -.19( 5) |
| HM(D) | -.18(11) | | -.26( 7) | | -.43( 4) | -.43( 5) | | |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | -.18(11) | | -.19( 9) | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | -.16(14) | | | | -.21( 5) | |
| SIGY0(D) | -.17(14) | -.20( 9) | -.25( 8) | -.31( 6) | -.42( 6) | -.42( 6) | -.38( 2) | -.43( 2) |
| SIGY0(E) | | -.17(12) | -.31( 6) | -.29( 8) | -.52( 2) | -.51( 3) | -.26( 3) | -.39( 3) |
| SIGY0(F) | | | | | -.42( 5) | -.46( 4) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | .16(15) | | | | | | | |
| SIGZ0(C) | | .18(10) | | | | | | |
| SIGZ0(D) | .63( 5) | .52( 5) | .19(13) | | | | | |
| SIGZ0(E) | .19( 9) | .23( 7) | .38( 5) | .53( 5) | -.35( 7) | -.28( 8) | | |
| SIGZ0(F) | | | .21(10) | .29( 7) | | -.24( 9) | | |
| P(A) | | | | | | | | |
| P(B) | | | .21( 9) | | | | | |
| P(C) | | | | | | | | |
| P(D) | .19(10) | | .20(11) | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | .95( 1) | .94( 1) | .96( 1) | .97( 1) | .98( 1) | .98( 1) | .72( 1) | .70( 1) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | .30( 7) | .17(13) | | .19(10) | .26( 9) | .37( 7) | | .17( 6) |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | .17(12) | .22( 8) | .19(12) | | .20(10) | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCAD1 | IODCAD1 | IODCAD2 | IODCAD2 | IODCAD3 | IODCAD3 | IODCAD4 | IODCAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.91( 1) | -.89( 1) | -.96( 1) | -.96( 1) | -.46( 5) | -.36( 8) | | |
| R | .58( 5) | .62( 5) | | .29( 8) | -.62( 2) | -.72( 2) | | -.23( 6) |
| HQ | -.16(13) | | -.29( 8) | | | -.16(11) | | |
| FPR(A-D) | -.88( 2) | -.89( 2) | -.68( 3) | -.72( 3) | | | | |
| FPR(E,F) | -.20( 8) | | | | | | | |
| DA | .78( 3) | .82( 3) | .77( 2) | .83( 2) | | .22(10) | | |
| C1 | .16(12) | | .18(11) | | | | | |
| HM(A) | | | | | -.21(10) | | | -.18( 8) |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | -.22( 4) | -.26( 5) |
| HM(D) | | | | | -.34( 7) | -.48( 5) | -.20( 5) | -.29( 3) |
| HM(E) | -.19( 9) | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | -.19(10) | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | -.29( 9) | -.17( 9) | | | -.17( 7) | |
| SIGY0(D) | -.20( 7) | -.39( 6) | -.28(10) | -.49( 6) | -.41( 6) | -.41( 7) | -.42( 2) | -.46( 2) |
| SIGY0(E) | -.19(11) | -.27( 8) | -.45( 5) | -.41( 7) | -.48( 3) | -.58( 3) | -.27( 3) | -.27( 4) |
| SIGY0(F) | | | | | -.46( 4) | -.50( 4) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | -.17(10) | | | | |
| SIGZ0(C) | | .26( 9) | | | | | | |
| SIGZ0(D) | .73( 4) | .62( 4) | | | -.27( 9) | | -.18( 6) | |
| SIGZ0(E) | .28( 6) | .37( 7) | .64( 4) | .70( 4) | -.32( 8) | -.47( 6) | | |
| SIGZ0(F) | | .17(10) | .37( 6) | .54( 5) | | -.27( 9) | | |
| P(A) | | | | | | | | |
| P(B) | | | .18(12) | | | | | -.16( 9) |
| P(C) | | | | | | | | |
| P(D) | | | .30( 7) | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | -.78( 1) | -.82( 1) | -.92( 1) | -.94( 1) |
| VD(AER) | | | | | | | | |
| LDIODO-1 | | | | | | | | -.21( 7) |
| LDAERO-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD/LHS - DESIGN ) (PART 3 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCPD1 | IODCPD1 | IODCPD2 | IODCPD2 | IODCPD3 | IODCPD3 | IODCPD4 | IODCPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.94( 1) | -.93( 1) | -.96( 1) | -.95( 1) | -.51( 6) | -.29( 7) | -.19(12) | |
| R | | | -.37( 9) | -.29( 9) | -.75( 3) | -.76( 2) | -.31( 8) | -.31( 8) |
| HQ | -.30(10) | -.17(14) | -.30(11) | -.17(13) | | | | |
| FPR(A-D) | -.88( 2) | -.89( 2) | -.80( 2) | -.79( 2) | -.20(10) | -.22( 9) | -.18(13) | |
| FPR(E,F) | | -.20(11) | | | | | | |
| DA | .81( 3) | .84( 3) | .69( 3) | .75( 3) | | | | |
| C1 | | | .16(16) | | | | | |
| HM(A) | | .17(13) | | | | | .31( 9) | .27( 9) |
| HM(B) | | | | | | | .55( 4) | .48( 5) |
| HM(C) | | | | | | | .67( 2) | .59( 2) |
| HM(D) | | .17(12) | | | -.40( 8) | -.50( 5) | .46( 6) | .32( 7) |
| HM(E) | -.17(16) | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | -.22(13) | | | | | | | |
| SIGY0(B) | -.22(12) | | | | | | -.21(11) | -.22(12) |
| SIGY0(C) | -.34( 8) | -.23(10) | -.45( 7) | -.31( 8) | -.18(11) | -.20(10) | -.53( 5) | -.49( 4) |
| SIGY0(D) | -.50( 5) | -.61( 4) | -.58( 5) | -.68( 4) | -.78( 2) | -.72( 3) | -.70( 1) | -.62( 1) |
| SIGY0(E) | -.37( 7) | -.43( 7) | -.66( 4) | -.62( 5) | -.79( 1) | -.77( 1) | -.33( 7) | -.43( 6) |
| SIGY0(F) | -.18(15) | | -.40( 8) | -.24(10) | -.52( 5) | -.39( 6) | -.31(10) | -.25(10) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | -.17(12) | | | | |
| SIGZ0(C) | .28(11) | .27( 9) | | | | | | |
| SIGZ0(D) | .70( 4) | .60( 5) | .25(13) | .22(11) | | | | .16(14) |
| SIGZ0(E) | .38( 6) | .50( 6) | .56( 6) | .60( 6) | .45( 7) | .26( 8) | | |
| SIGZ0(F) | .19(14) | .31( 8) | .27(12) | .43( 7) | .17(12) | | | |
| P(A) | | | | | | | | -.22(11) |
| P(B) | | | .19(14) | | | | | |
| P(C) | | | | | | | | |
| P(D) | .33( 9) | | .31(10) | | | | | -.18(13) |
| P(E) | | | | | | | | |
| P(F) | | | | | .22( 9) | .17(11) | | |
| VD(IOD) | | | | | -.70( 4) | -.68( 4) | -.63( 3) | -.57( 3) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | -.18(15) | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECGD1 | CAECGD1 | CAECGD2 | CAECGD2 | CAECGD3 | CAECGD3 | CAECGD4 | CAECGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.76( 3) | -.65( 3) | -.85( 2) | -.82( 2) | -.48( 6) | -.36( 9) | | -.20(14) |
| R | | | -.20(12) | | -.60( 2) | -.68( 2) | -.54( 4) | -.69( 3) |
| HQ | | -.18(12) | | -.22(12) | | | | |
| FPR(A-D) | -.78( 2) | -.69( 2) | -.55( 5) | -.43( 7) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .61( 5) | .55( 4) | .59( 3) | .55( 3) | .26(11) | .21(13) | | |
| C1 | | | | | | | .22(10) | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | -.24(11) | | -.25( 9) |
| HM(C) | | | | | | | -.31( 7) | -.30( 7) |
| HM(D) | | | | | -.30(10) | -.30(10) | -.46( 5) | -.43( 5) |
| HM(E) | | | | | | | | |
| HM(F) | | | | .17(14) | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | -.23(11) |
| SIGY0(C) | | | -.21(11) | | | | -.25( 9) | -.32( 6) |
| SIGY0(D) | -.40( 9) | -.30( 9) | -.43( 7) | -.37( 9) | -.55( 3) | -.58( 4) | -.59( 3) | -.65( 4) |
| SIGY0(E) | | -.19(11) | -.22(10) | -.28(10) | -.33( 9) | -.44( 6) | -.30( 8) | -.28( 8) |
| SIGY0(F) | -.21(11) | | -.20(13) | | -.40( 8) | -.42( 7) | | -.23(10) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | -.16(15) | | | | |
| SIGZ0(C) | | | | | | | | -.21(13) |
| SIGZ0(D) | .41( 8) | .45( 7) | | .17(13) | | | | |
| SIGZ0(E) | .21(10) | .21(10) | .42( 8) | .44( 6) | -.26(12) | -.24(12) | | |
| SIGZ0(F) | | | | .26(11) | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | .88( 1) | .89( 1) | .93( 1) | .95( 1) | .97( 1) | .98( 1) | .95( 1) | .97( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | .58( 6) | .55( 6) | .50( 6) | .49( 4) | .53( 5) | .63( 3) | .67( 2) | .78( 2) |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | .64( 4) | .55( 5) | .56( 4) | .46( 5) | .54( 4) | .49( 5) | .36( 6) | .21(12) |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | .48( 7) | .43( 8) | .40( 9) | .43( 8) | .41( 7) | .41( 8) | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECAD1 | CAECAD1 | CAECAD2 | CAECAD2 | CAECAD3 | CAECAD3 | CAECAD4 | CAECAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.91( 1) | -.89( 1) | -.96( 1) | -.96( 1) | -.73( 2) | -.65( 2) | -.24( 8) | -.27( 8) |
| R | .58( 5) | .61( 5) | | .28( 8) | -.82( 1) | -.81( 1) | -.53( 4) | -.67( 3) |
| HQ | | | -.30( 7) | -.18( 9) | | | | |
| FPR(A-D) | -.88( 2) | -.89( 2) | -.67( 3) | -.72( 3) | | -.24(10) | -.27( 7) | |
| FPR(E,F) | -.20( 8) | | | | | | | |
| DA | .78( 3) | .82( 3) | .77( 2) | .83( 2) | .42( 8) | .37( 8) | | |
| C1 | | | .17(12) | | | .24(12) | | .18(12) |
| HM(A) | | | | | -.17(12) | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | -.52( 5) | -.57( 5) |
| HM(D) | | | | | -.51( 6) | -.55( 5) | -.70( 2) | -.73( 2) |
| HM(E) | -.18(11) | | | | | | -.17(10) | -.21(10) |
| HM(F) | | | | | | | | |
| SIGY0(A) | -.19( 9) | | | -.17(10) | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | -.27(10) | -.16(11) | -.19(11) | | -.22( 9) | -.26( 9) |
| SIGY0(D) | -.20( 7) | -.39( 6) | -.28( 9) | -.49( 6) | -.48( 7) | -.47( 6) | -.65( 3) | -.59( 4) |
| SIGY0(E) | -.19(10) | -.27( 8) | -.46( 5) | -.40( 7) | -.65( 3) | -.65( 3) | -.33( 6) | -.42( 6) |
| SIGY0(F) | | | | | -.61( 4) | -.63( 4) | | -.33( 7) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | .16(13) | | | | | | | |
| SIGZ0(C) | | .25( 9) | | | | | | |
| SIGZ0(D) | .73( 4) | .62( 4) | | | -.16(14) | | | |
| SIGZ0(E) | .28( 6) | .37( 7) | .63( 4) | .70( 4) | -.58( 5) | -.46( 7) | | .16(13) |
| SIGZ0(F) | | .17(10) | .36( 6) | .56( 5) | -.17(13) | -.24(11) | | |
| P(A) | | | | | | | | |
| P(B) | | | .19(11) | | | | | |
| P(C) | | | | | | | | |
| P(D) | .16(12) | | .30( 8) | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | .26(10) | | | |
| VD(AER) | | | | | -.39( 9) | -.29( 9) | -.71( 1) | -.76( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | | | | | | | | -.19(11) |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECPD1 | CAECPD1 | CAECPD2 | CAECPD2 | CAECPD3 | CAECPD3 | CAECPD4 | CAECPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | RSD | LHS | RSD | LHS | RSD | LHS | RSD | LHS |
| Q | -.94( 1) | -.93( 1) | -.96( 1) | -.95( 1) | -.61( 4) | -.52( 5) | -.26(11) | -.28(11) |
| R | | | -.35( 9) | -.31( 8) | -.83( 2) | -.84( 1) | -.46( 5) | -.46( 6) |
| HQ | -.30(10) | -.19(11) | -.30(11) | | | | | |
| FPR(A-D) | -.88( 2) | -.89( 2) | -.80( 2) | -.79( 2) | -.29( 8) | -.29( 8) | | -.18(14) |
| FPR(E,F) | | -.18(12) | | | | | | |
| DA | .81( 3) | .84( 3) | .70( 3) | .75( 3) | | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | .32( 8) | .30( 9) |
| HM(B) | | | | -.16(14) | | | .58( 3) | .51( 4) |
| HM(C) | | | | | | -.18(12) | .68( 2) | .68( 2) |
| HM(D) | | .17(13) | | | -.55( 5) | -.58( 4) | .35( 7) | .38( 7) |
| HM(E) | -.17(15) | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | -.20(13) | | | -.16(12) | | | | |
| SIGY0(B) | -.24(12) | | | | | | -.27(10) | -.28(10) |
| SIGY0(C) | -.33( 8) | -.21(10) | -.44( 7) | -.28( 9) | -.20(10) | -.23(10) | -.53( 4) | -.60( 3) |
| SIGY0(D) | -.51( 5) | -.60( 4) | -.57( 5) | -.68( 4) | -.80( 3) | -.77( 3) | -.69( 1) | -.70( 1) |
| SIGY0(E) | -.36( 7) | -.43( 7) | -.65( 4) | -.61( 5) | -.84( 1) | -.82( 2) | -.41( 6) | -.49( 5) |
| SIGY0(F) | -.17(16) | | -.35( 8) | -.24(10) | -.55( 6) | -.51( 6) | -.31( 9) | -.32( 8) |
| SIGZ0(A) | | | | | | | | -.17(17) |
| SIGZ0(B) | | | | -.16(13) | | | | |
| SIGZ0(C) | .26(11) | .26( 9) | | | | | | |
| SIGZ0(D) | .70( 4) | .60( 5) | .26(12) | .21(11) | | -.23(11) | | .18(15) |
| SIGZ0(E) | .38( 6) | .50( 6) | .55( 6) | .60( 6) | .40( 7) | .39( 7) | | |
| SIGZ0(F) | .18(14) | .31( 8) | .25(13) | .44( 7) | | .28( 9) | | |
| P(A) | | | | | | | | -.18(16) |
| P(B) | | | .19(14) | | | | | |
| P(C) | | | | | | | | |
| P(D) | .32( 9) | | .31(10) | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | .16(14) | -.17(12) | |
| VD(IOD) | | | | | | | | |
| VD(AER) | | | | | -.21( 9) | -.17(13) | | -.25(12) |
| LDIODO-1 | | | | | | | | .23(13) |
| LDAERO-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | -.17(15) | | | | | |
| LDAER>3 | | | | | | | | |

## C.5 COMPARISON OF CONCENTRATION RUNS (LHS; 1X200,2X100)

In this section PRCCs are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface, in the air near ground and in the plume.

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AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN (1X200/2X100) (PART 1 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCGD1 | IODCGD1 | IODCGD2 | IODCGD2 | IODCGD3 | IODCGD3 | IODCGD4 | IODCGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 |
| Q | -.83( 2) | -.82( 2) | -.90( 2) | -.90( 2) | -.25( 9) | -.23(10) | | |
| R | .37( 6) | .44( 6) | | .18(11) | -.69( 2) | -.62( 2) | | -.20( 4) |
| HQ | | | | | -.18(13) | | | |
| FPR(A-D) | -.83( 3) | -.80( 3) | -.54( 4) | -.57( 4) | -.19(11) | | | |
| FPR(E,F) | | | | | | | | |
| DA | .74( 4) | .68( 4) | .69( 3) | .62( 3) | | | | |
| C1 | .17(10) | | | | | | | |
| HM(A) | | | | | | | -.16( 5) | |
| HM(B) | -.17( 9) | | | -.17(12) | | | | |
| HM(C) | | | | | | | | -.19( 5) |
| HM(D) | | | | | -.53( 4) | -.43( 5) | | |
| HM(E) | | | | | | | | |
| HM(F) | -.17(11) | | -.17(11) | | | | | |
| SIGY0(A) | | -.18(11) | | -.19( 9) | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | -.18(10) | | -.23(10) | | -.17( 4) | |
| SIGY0(D) | | -.20( 9) | -.31( 7) | -.31( 6) | -.39( 7) | -.42( 6) | -.26( 3) | -.43( 2) |
| SIGY0(E) | | -.17(12) | -.24( 8) | -.29( 8) | -.59( 3) | -.51( 3) | -.32( 2) | -.39( 3) |
| SIGY0(F) | | | | | -.49( 5) | -.46( 4) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | .23( 8) | .18(10) | | | | | | |
| SIGZ0(D) | .58( 5) | .52( 5) | | | | | | |
| SIGZ0(E) | | .23( 7) | .48( 5) | .53( 5) | -.42( 6) | -.28( 8) | | |
| SIGZ0(F) | | | .34( 6) | .29( 7) | -.18(14) | -.24( 9) | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | -.17(12) | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | .96( 1) | .94( 1) | .97( 1) | .97( 1) | .99( 1) | .98( 1) | .70( 1) | .70( 1) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | .27( 7) | .17(13) | .21( 9) | .19(10) | .34( 8) | .37( 7) | | .17( 6) |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | .22( 8) | | | .19(12) | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN (1X200/2X100) (PART 2 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCAD1 | IODCAD1 | IODCAD2 | IODCAD2 | IODCAD3 | IODCAD3 | IODCAD4 | IODCAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 |
| Q | -.91( 1) | -.89( 1) | -.97( 1) | -.96( 1) | -.28( 7) | -.36( 8) | | |
| R | .60( 5) | .62( 5) | .23( 8) | .29( 8) | -.67( 2) | -.72( 2) | -.18( 7) | -.23( 6) |
| HQ | | | | | | -.16(11) | | |
| FPR(A-D) | -.90( 2) | -.89( 2) | -.77( 3) | -.72( 3) | -.24( 9) | | | |
| FPR(E,F) | | | | | | | | |
| DA | .83( 3) | .82( 3) | .87( 2) | .83( 2) | | .22(10) | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | -.17( 8) | -.18( 8) |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | -.22( 5) | -.26( 5) |
| HM(D) | | | | | -.45( 4) | -.48( 5) | -.40( 3) | -.29( 3) |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | -.17( 9) | -.17(12) | | -.19( 6) | |
| SIGY0(D) | -.20( 9) | -.39( 6) | -.48( 7) | -.49( 6) | -.19(11) | -.41( 7) | -.42( 2) | -.46( 2) |
| SIGY0(E) | -.22( 8) | -.27( 8) | -.52( 5) | -.41( 7) | -.60( 3) | -.58( 3) | -.27( 4) | -.27( 4) |
| SIGY0(F) | | | -.18( 9) | | -.36( 5) | -.50( 4) | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | -.17(10) | | | | |
| SIGZ0(C) | .29( 7) | .26( 9) | | | | | | |
| SIGZ0(D) | .72( 4) | .62( 4) | .18(10) | | | | | |
| SIGZ0(E) | .30( 6) | .37( 7) | .69( 4) | .70( 4) | -.36( 6) | -.47( 6) | | |
| SIGZ0(F) | | .17(10) | .51( 6) | .54( 5) | -.26( 8) | -.27( 9) | | |
| P(A) | | | | | .21(10) | | | |
| P(B) | | | | | | | | -.16( 9) |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | -.82( 1) | -.82( 1) | -.94( 1) | -.94( 1) |
| VD(AER) | | | | | | | | |
| LDIODO-1 | | | | | | | | -.21( 7) |
| LDAERO-1 | | | -.16(11) | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA)
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCPD1 | IODCPD1 | IODCPD2 | IODCPD2 | IODCPD3 | IODCPD3 | IODCPD4 | IODCPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 |
| Q | -.94( 1) | -.93( 1) | -.96( 1) | -.95( 1) | -.27( 9) | -.29( 7) | -.23(12) | |
| R | | | -.50( 7) | -.29( 9) | -.79( 2) | -.76( 2) | -.27( 9) | -.31( 8) |
| HQ | | -.17(14) | | -.17(13) | | | | |
| FPR(A-D) | -.91( 2) | -.89( 2) | -.82( 2) | -.79( 2) | -.38( 8) | -.22( 9) | | |
| FPR(E,F) | | -.20(11) | | | | | | |
| DA | .87( 3) | .84( 3) | .79( 3) | .75( 3) | | | | |
| C1 | | | | | | | | |
| HM(A) | | .17(13) | | | | | .35( 7) | .27( 9) |
| HM(B) | | | | | | | .60( 4) | .48( 5) |
| HM(C) | | | | | -.18(11) | | .66( 2) | .59( 2) |
| HM(D) | | .17(12) | | | -.57( 5) | -.50( 5) | .35( 8) | .32( 7) |
| HM(E) | | | | | .16(13) | | | |
| HM(F) | | | | | | | | |
| SIGYO(A) | | | | | | | -.23(11) | |
| SIGYO(B) | | | | | | | -.24(10) | -.22(12) |
| SIGYO(C) | | -.23(10) | -.20(11) | -.31( 8) | -.23(10) | -.20(10) | -.51( 5) | -.49( 4) |
| SIGYO(D) | -.56( 5) | -.61( 4) | -.65( 5) | -.68( 4) | -.69( 3) | -.72( 3) | -.66( 1) | -.62( 1) |
| SIGYO(E) | -.46( 6) | -.43( 7) | -.70( 4) | -.62( 5) | -.80( 1) | -.77( 1) | -.40( 6) | -.43( 6) |
| SIGYO(F) | | | -.33(10) | -.24(10) | -.39( 7) | -.39( 6) | | -.25(10) |
| SIGZO(A) | | | | | | | | |
| SIGZO(B) | | | | -.17(12) | | | | |
| SIGZO(C) | .29( 8) | .27( 9) | | | -.17(12) | | | |
| SIGZO(D) | .73( 4) | .60( 5) | .34( 9) | .22(11) | | | .17(13) | .16(14) |
| SIGZO(E) | .45( 7) | .50( 6) | .61( 6) | .60( 6) | .41( 6) | .26( 8) | | |
| SIGZO(F) | .22( 9) | .31( 8) | .35( 8) | .43( 7) | | | | |
| P(A) | | | | | | | | -.22(11) |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | -.18(13) |
| P(E) | | | | | | | | |
| P(F) | | | | | | .17(11) | | |
| VD(IOD) | | | | | -.69( 4) | -.68( 4) | -.61( 3) | -.57( 3) |
| VD(AER) | | | | | | | | |
| LDIODO-1 | | | | | | | | |
| LDAERO-1 | | | | | | | | |
| LDIOD1-3 | -.18(10) | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN (1X200/2X100) (PART 4 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECGD1 | CAECGD1 | CAECGD2 | CAECGD2 | CAECGD3 | CAECGD3 | CAECGD4 | CAECGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 |
| Q | -.77( 2) | -.65( 3) | -.85( 2) | -.82( 2) | -.48( 5) | -.36( 9) | -.27( 8) | -.20(14) |
| R | | | | | -.65( 3) | -.68( 2) | -.64( 3) | -.69( 3) |
| HQ | | -.18(12) | | -.22(12) | | | | |
| FPR(A-D) | -.75( 3) | -.69( 2) | -.49( 5) | -.43( 7) | | | -.23( 9) | |
| FPR(E,F) | | | | | | | | |
| DA | .55( 5) | .55( 4) | .51( 4) | .55( 3) | .20(14) | .21(13) | | |
| C1 | | | | | | | | |
| HM(A) | .17(12) | | | | | | | |
| HM(B) | | | | | | -.24(11) | | -.25( 9) |
| HM(C) | | | | | | | -.38( 6) | -.30( 7) |
| HM(D) | | | | | -.25(10) | -.30(10) | -.44( 5) | -.43( 5) |
| HM(E) | -.17(13) | | | | | | | |
| HM(F) | -.20(10) | | -.17(10) | .17(14) | -.21(13) | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | -.23(11) |
| SIGY0(C) | | | | | -.17(16) | | -.23(10) | -.32( 6) |
| SIGY0(D) | -.35( 9) | -.30( 9) | -.38( 7) | -.37( 9) | -.46( 7) | -.58( 4) | -.56( 4) | -.65( 4) |
| SIGY0(E) | | -.19(11) | -.16(11) | -.28(10) | -.49( 4) | -.44( 6) | -.37( 7) | -.28( 8) |
| SIGY0(F) | | | | | -.35( 8) | -.42( 7) | -.21(11) | -.23(10) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | -.16(15) | | | | |
| SIGZ0(C) | | | | | | | | -.21(13) |
| SIGZ0(D) | .43( 8) | .45( 7) | | .17(13) | | | | |
| SIGZ0(E) | .18(11) | .21(10) | .38( 6) | .44( 6) | -.22(12) | -.24(12) | | |
| SIGZ0(F) | | | | .26(11) | -.19(15) | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | .17(12) | |
| P(C) | | | | | | | | |
| P(D) | | | | | -.22(11) | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | .91( 1) | .89( 1) | .94( 1) | .95( 1) | .98( 1) | .98( 1) | .96( 1) | .97( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | .60( 4) | .55( 6) | .54( 3) | .49( 4) | .70( 2) | .63( 3) | .81( 2) | .78( 2) |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | .46( 7) | .55( 5) | .36( 8) | .46( 5) | .48( 6) | .49( 5) | | .21(12) |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | .47( 6) | .43( 8) | .27( 9) | .43( 8) | .32( 9) | .41( 8) | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN (1X200/2X100) (PART 5 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAFCAD1 | CAECAD1 | CAECAD2 | CAECAD2 | CAECAD3 | CAECAD3 | CAECAD4 | CAECAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 |
| Q | -.91( 1) | -.89( 1) | -.97( 1) | -.96( 1) | -.71( 3) | -.65( 2) | -.22(11) | -.27( 8) |
| R | .60( 5) | .61( 5) | .23( 8) | .28( 8) | -.85( 1) | -.81( 1) | -.66( 3) | -.67( 3) |
| HQ | | | | -.18( 9) | | | | |
| FPR(A-D) | -.90( 2) | -.89( 2) | -.77( 3) | -.72( 3) | -.34(11) | -.24(10) | -.28( 9) | |
| FPR(E,F) | | | | | | | | |
| DA | .83( 3) | .82( 3) | .88( 2) | .83( 2) | .46( 7) | .37( 8) | | |
| C1 | | | | | | .24(12) | | .18(12) |
| HM(A) | | | | | | | | |
| HM(B) | | | | | -.17(14) | | -.26(10) | |
| HM(C) | | | | | -.21(12) | | -.63( 4) | -.57( 5) |
| HM(D) | | | | | -.67( 4) | -.55( 5) | -.78( 2) | -.73( 2) |
| HM(E) | | | | | | | -.19(12) | -.21(10) |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | -.17(10) | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | -.16(11) | | | -.30( 8) | -.26( 9) |
| SIGY0(D) | -.20( 9) | -.39( 6) | -.48( 7) | -.49( 6) | -.43( 8) | -.47( 6) | -.59( 5) | -.59( 4) |
| SIGY0(E) | -.20( 8) | -.27( 8) | -.53( 5) | -.40( 7) | -.73( 2) | -.65( 3) | -.53( 6) | -.42( 6) |
| SIGY0(F) | | | -.17(10) | | -.66( 5) | -.63( 4) | -.34( 7) | -.33( 7) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | .30( 6) | .25( 9) | | | | | | |
| SIGZ0(D) | .72( 4) | .62( 4) | .18( 9) | | | | | |
| SIGZ0(E) | .29( 7) | .37( 7) | .69( 4) | .70( 4) | -.57( 6) | -.46( 7) | | .16(13) |
| SIGZ0(F) | | .17(10) | .52( 6) | .56( 5) | -.37(10) | -.24(11) | | |
| P(A) | | | | | | | -.19(13) | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | .17(15) | |
| P(E) | | | | | | | | |
| P(F) | | | | | .17(13) | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | | | | | -.39( 9) | -.29( 9) | -.80( 1) | -.76( 1) |
| LDIODO-1 | | | | | | | | |
| LDAERO-1 | | | | | | | -.18(14) | -.19(11) |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN (1X200/2X100) (PART 6 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.16 (200 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.26 (200 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECPD1 | CAECPD1 | CAECPD2 | CAECPD2 | CAECPD3 | CAECPD3 | CAECPD4 | CAECPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 | 1X200 | 2X100 |
| Q | -.94( 1) | -.93( 1) | -.97( 1) | -.95( 1) | -.61( 6) | -.52( 5) | -.32( 9) | -.28(11) |
| R | | | -.49( 7) | -.31( 8) | -.90( 1) | -.84( 1) | -.45( 5) | -.46( 6) |
| HQ | | -.19(11) | | | | | | |
| FPR(A-D) | -.91( 2) | -.89( 2) | -.84( 2) | -.79( 2) | -.51( 8) | -.29( 8) | | -.18(14) |
| FPR(E,F) | | -.18(12) | | | | | | |
| DA | .87( 3) | .84( 3) | .80( 3) | .75( 3) | | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | .34( 8) | .30( 9) |
| HM(B) | | | | -.16(14) | -.20(14) | | .60( 3) | .51( 4) |
| HM(C) | | | | | -.33( 9) | -.18(12) | .69( 2) | .68( 2) |
| HM(D) | | .17(13) | | | -.70( 4) | -.58( 4) | .40( 7) | .38( 7) |
| HM(E) | | | | | .19(16) | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | -.16(12) | | | -.29(10) | |
| SIGY0(B) | | | | | | | -.29(11) | -.28(10) |
| SIGY0(C) | | -.21(10) | -.19(11) | -.28( 9) | -.31(11) | -.23(10) | -.51( 4) | -.60( 3) |
| SIGY0(D) | -.56( 5) | -.60( 4) | -.67( 5) | -.68( 4) | -.81( 3) | -.77( 3) | -.69( 1) | -.70( 1) |
| SIGY0(E) | -.46( 7) | -.43( 7) | -.70( 4) | -.61( 5) | -.88( 2) | -.82( 2) | -.43( 6) | -.49( 5) |
| SIGY0(F) | | | -.36( 9) | -.24(10) | -.63( 5) | -.51( 6) | | -.32( 8) |
| SIGZ0(A) | | | | | | | | -.17(17) |
| SIGZ0(B) | | | | -.16(13) | | | | |
| SIGZ0(C) | .30( 8) | .26( 9) | | | -.21(13) | | | |
| SIGZ0(D) | .73( 4) | .60( 5) | .35(10) | .21(11) | | -.23(11) | | .18(15) |
| SIGZ0(E) | .46( 6) | .50( 6) | .62( 6) | .60( 6) | .59( 7) | .39( 7) | | |
| SIGZ0(F) | .21( 9) | .31( 8) | .36( 8) | .44( 7) | | .28( 9) | | |
| P(A) | | | | | | | | -.18(16) |
| P(B) | | | | | -.17(18) | | | |
| P(C) | .17(11) | | | | .19(15) | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | .22(12) | .16(14) | | |
| VD(IOD) | | | | | .17(17) | | | |
| VD(AER) | | | | | -.32(10) | -.17(13) | -.17(12) | -.25(12) |
| LDIOD0-1 | | | | | | | | .23(13) |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | -.18(10) | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

## C.6 COMPARISON OF CONCENTRATION RUNS (LHS AT KFK/GRS, N=59)

In this section PRCCs are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface, in the air near ground and in the plume.

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AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN AT KFK/GRS) (PART 1 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCGD1 | IODCGD1 | IODCGD2 | IODCGD2 | IODCGD3 | IODCGD3 | IODCGD4 | IODCGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.89( 3) | -.87( 2) | -.96( 2) | -.90( 2) | | | | |
| R | .66( 6) | .46( 7) | | | -.65( 4) | | | |
| HQ | | | | | | | | |
| FPR(A-D) | -.92( 2) | -.68( 3) | -.77( 4) | -.50( 6) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .87( 4) | .48( 6) | .83( 3) | .51( 5) | .46( 8) | | | |
| C1 | | | | | | .51( 4) | | .53( 2) |
| HM(A) | | | | | | | .45( 3) | |
| HM(B) | .55( 7) | | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | .45( 8) | -.51( 6) | | | |
| HM(E) | -.51( 9) | | | | | | | |
| HM(F) | | | -.45(11) | | -.70( 2) | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.56( 8) | -.60( 4) | -.62( 5) | | -.45( 4) | |
| SIGY0(E) | | | | | | -.75( 2) | | |
| SIGY0(F) | | | -.52(10) | | | | -.48( 2) | |
| SIGZ0(A) | | | | | | .53( 3) | | .46( 3) |
| SIGZ0(B) | | | | | .50( 7) | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .74( 5) | | | | | | | |
| SIGZ0(E) | | .59( 4) | .61( 6) | .68( 3) | -.66( 3) | | | |
| SIGZ0(F) | .53( 8) | | .69( 5) | | | | | |
| P(A) | .48(10) | | .58( 7) | | | | | |
| P(B) | | | | -.48( 7) | | | | |
| P(C) | | | | | | | | |
| P(D) | | | .56( 9) | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | .98( 1) | .94( 1) | .99( 1) | .96( 1) | .99( 1) | .98( 1) | .85( 1) | .77( 1) |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | .47(11) | | | | | | | |
| LDAER0-1 | | | | | | .48( 5) | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | -.56( 5) | | -.44( 9) | | -.47( 6) | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCAD1 | IODCAD1 | IODCAD2 | IODCAD2 | IODCAD3 | IODCAD3 | IODCAD4 | IODCAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.89( 2) | -.85( 1) | -.98( 1) | -.94( 1) | -.69( 3) | -.58( 7) | | |
| R | .72( 5) | | | | -.71( 2) | | -.44( 2) | |
| HQ | | | | | | | | |
| FPR(A-D) | -.92( 1) | -.55( 2) | -.84( 3) | -.52( 3) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .83( 3) | | .88( 2) | | .46( 9) | | | |
| C1 | | | | | | .64( 4) | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | | -.58( 6) | -.62( 6) | | -.47( 3) |
| HM(E) | | | | | | .46(12) | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | -.45(14) | | -.51( 2) |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.59( 8) | | -.62( 5) | .50( 9) | | |
| SIGY0(E) | | | | | -.62( 4) | -.71( 1) | | |
| SIGY0(F) | | | -.61( 7) | | -.44(10) | | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | | | | | | -.44( 3) | |
| SIGZ0(D) | .79( 4) | | | | | | | |
| SIGZ0(E) | | | .79( 4) | .50( 4) | -.51( 7) | -.63( 5) | | |
| SIGZ0(F) | | | .75( 5) | .52( 2) | -.49( 8) | | | |
| P(A) | | | .46(10) | | | | | |
| P(B) | | | .54( 9) | | | | | |
| P(C) | | | | | | | | -.45( 4) |
| P(D) | | | | | | .49(11) | | |
| P(E) | | | | | | .54( 8) | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | -.66( 6) | | -.87( 1) | | -.96( 1) | -.90( 1) |
| VD(AER) | | | | | | .49(10) | | |
| LDIOD0-1 | | | | | | -.65( 3) | | |
| LDAER0-1 | | | | | | .46(13) | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | -.68( 2) | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN AT KFK/GRS) (PART 3 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| DESIGN | IODCPD1 KFK | IODCPD1 GRS | IODCPD2 KFK | IODCPD2 GRS | IODCPD3 KFK | IODCPD3 GRS | IODCPD4 KFK | IODCPD4 GRS |
|---|---|---|---|---|---|---|---|---|
| Q | -.92( 1) | -.88( 1) | -.97( 1) | -.92( 1) | -.66( 6) | | | |
| R | | | -.64( 9) | | -.89( 1) | -.46( 9) | | |
| HQ | | | | | | | | |
| FPR(A-D) | -.91( 2) | -.59( 2) | -.87( 2) | -.56( 2) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .82( 3) | | .74( 4) | | | | | |
| C1 | | | | | | .56( 4) | | .53( 4) |
| HM(A) | | | | | | | .50( 6) | |
| HM(B) | | | | | | | .71( 1) | .49( 5) |
| HM(C) | | | | | -.47( 8) | | .65( 3) | |
| HM(D) | | | | | -.75( 5) | | | |
| HM(E) | | | | | | .60( 3) | | |
| HM(F) | | | -.65( 8) | | | | | |
| SIGY0(A) | | -.45( 4) | | | | | | |
| SIGY0(B) | | | | | | -.55( 5) | -.51( 5) | |
| SIGY0(C) | | | | | | -.46(10) | -.46( 7) | -.63( 2) |
| SIGY0(D) | -.62( 5) | | -.74( 3) | -.46( 5) | -.88( 2) | | -.56( 4) | -.57( 3) |
| SIGY0(E) | | | -.66( 7) | -.47( 4) | -.87( 3) | -.71( 1) | | -.65( 1) |
| SIGY0(F) | | | -.70( 5) | | -.47( 9) | | | |
| SIGZ0(A) | | | | | .44(11) | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .69( 4) | | | | | | | |
| SIGZ0(E) | | | .67( 6) | | .61( 7) | | | |
| SIGZ0(F) | | | .56(12) | | | | | |
| P(A) | | | | | | | | |
| P(B) | | | .63(10) | | | | | |
| P(C) | | | | | | | | |
| P(D) | | .49( 3) | | .47( 3) | .45(10) | .44(11) | | |
| P(E) | | | | | | .49( 6) | | .49( 6) |
| P(F) | | | | | | | | |
| VD(IOD) | | | -.57(11) | | -.85( 4) | | -.66( 2) | |
| VD(AER) | | | | | | | | |
| LDIOD0-1 | | | | | | -.47( 8) | | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | -.48( 7) | | |
| LDAER>3 | | | | | | -.61( 2) | | -.48( 7) |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN AT KFK/GRS) (PART 4 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECGD1 | CAECGD1 | CAECGD2 | CAECGD2 | CAECGD3 | CAECGD3 | CAECGD4 | CAECGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.65( 4) | -.74( 1) | -.88( 2) | -.79( 2) | | -.54( 3) | | |
| R | | | | | -.75( 3) | | -.75( 3) | |
| HQ | | | | | | -.48( 5) | | |
| FPR(A-D) | -.79( 2) | | | | | | | |
| FPR(E,F) | | | | .60( 3) | | | | |
| DA | .70( 3) | .48( 3) | .80( 3) | .47( 5) | .53( 9) | | | |
| C1 | | | | | | | .45( 7) | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | | -.50(12) | | -.60( 6) | |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | .56( 7) | | | -.49( 4) | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.64( 5) | | -.57( 7) | | -.60( 5) | -.49( 3) |
| SIGY0(E) | | | | | -.77( 2) | | -.74( 4) | |
| SIGY0(F) | | | | | -.44(14) | | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | | -.48( 8) | | | | | |
| SIGZ0(D) | .56( 5) | | | | .51(10) | | | |
| SIGZ0(E) | | | | | -.54( 8) | | | |
| SIGZ0(F) | | | .65( 4) | | | | | -.48( 4) |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | .50(11) | | | |
| VD(AER) | .93( 1) | .69( 2) | .98( 1) | .88( 1) | .99( 1) | .97( 1) | .98( 1) | .89( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | .56( 6) | | .47( 9) | .51( 4) | .67( 4) | .72( 2) | .76( 2) | .52( 2) |
| LDIOD1-3 | | | | | -.48(13) | | | |
| LDAER1-3 | | | | | .58( 6) | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | .59( 6) | | .64( 5) | | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECAD1 | CAECAD1 | CAECAD2 | CAECAD2 | CAECAD3 | CAECAD3 | CAECAD4 | CAECAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.90( 2) | -.84( 1) | -.98( 1) | -.94( 1) | -.88( 2) | -.49( 1) | | |
| R | .73( 5) | | | | -.93( 1) | | -.87( 2) | |
| HQ | | | | | | | | |
| FPR(A-D) | -.93( 1) | -.55( 2) | -.85( 3) | -.49( 3) | -.48(11) | | -.46(10) | |
| FPR(E,F) | | | | | | | | |
| DA | .84( 3) | | .90( 2) | | .67( 8) | .48( 2) | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | -.82( 5) | |
| HM(D) | | | | | -.76( 6) | | -.82( 4) | -.49( 2) |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.58( 7) | | -.80( 4) | | -.85( 3) | |
| SIGY0(E) | | | | | -.87( 3) | | -.69( 6) | |
| SIGY0(F) | | | -.57( 8) | | -.78( 5) | | -.68( 7) | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | .46(12) | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .80( 4) | | | | | | | |
| SIGZ0(E) | | | .84( 4) | .53( 2) | -.76( 7) | | | |
| SIGZ0(F) | | | .79( 5) | .44( 4) | -.51(10) | | | |
| P(A) | | | .44(10) | | | | | |
| P(B) | | | .55( 9) | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | .60( 9) | | | |
| P(E) | | | | | | | -.48( 9) | |
| P(F) | | | | | | | | |
| VD(IOD) | | | -.64( 6) | | | | | |
| VD(AER) | | | | | | | -.92( 1) | -.62( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | | | | | | | -.49( 8) | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON LHS - DESIGN AT KFK/GRS) (PART 6 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECPD1 | CAECPD1 | CAECPD2 | CAECPD2 | CAECPD3 | CAECPD3 | CAECPD4 | CAECPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.91( 1) | -.88( 1) | -.97( 1) | -.92( 1) | -.76( 5) | -.51( 4) | | |
| R | | | -.66( 8) | | -.94( 1) | -.51( 5) | -.45( 7) | |
| HQ | | | | | | | | |
| FPR(A-D) | -.91( 2) | -.60( 2) | -.90( 2) | -.58( 2) | -.44( 9) | | | |
| FPR(E,F) | | | | | | | | |
| DA | .81( 3) | | .75( 3) | | | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | .79( 1) | .69( 3) |
| HM(C) | | | | | | | .79( 2) | .73( 2) |
| HM(D) | | | | | -.79( 4) | | | |
| HM(E) | | | | | | | | |
| HM(F) | | | -.63( 9) | | | | | |
| SIGY0(A) | | -.46( 4) | | | | | | |
| SIGY0(B) | | | | | | | -.71( 3) | |
| SIGY0(C) | | | | | | -.55( 3) | -.67( 5) | -.74( 1) |
| SIGY0(D) | -.62( 5) | | -.71( 5) | -.49( 3) | -.90( 3) | -.70( 1) | -.69( 4) | -.65( 5) |
| SIGY0(E) | | | -.68( 7) | | -.91( 2) | -.65( 2) | -.56( 6) | -.62( 6) |
| SIGY0(F) | | | -.73( 4) | | -.74( 6) | | | |
| SIGZ0(A) | | | | | | | | .67( 4) |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .69( 4) | | | | | | | |
| SIGZ0(E) | | | .68( 6) | | .59( 7) | | | |
| SIGZ0(F) | | | .61(10) | | | | | |
| P(A) | | | | | | | | |
| P(B) | | | .61(11) | | | | | |
| P(C) | | | | | | | | |
| P(D) | | .48( 3) | | | .47( 8) | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | -.49(13) | | | | | |
| VD(AER) | | | | | | -.45( 6) | -.45( 8) | |
| LDIOD0-1 | | | .52(12) | | | | | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | |

## C.7 COMPARISON OF CONCENTRATION RUNS (RSD AT KFK/GRS, N=59)

In this section PRCCs are shown for activity concentrations (I-131, Cs-137) at four distance intervals on ground surface, in the air near ground and in the plume.

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AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD - DESIGN AT KFK/GRS) (PART 1 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCGD1 | IODCGD1 | IODCGD2 | IODCGD2 | IODCGD3 | IODCGD3 | IODCGD4 | IODCGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.86( 2) | -.88( 2) | -.91( 2) | -.85( 2) | -.49( 6) | | | |
| R | | | | | -.69( 3) | -.45( 3) | -.66( 3) | |
| HQ | | -.57( 5) | | | | | | |
| FPR(A-D) | -.83( 3) | -.55( 6) | -.56( 4) | | | | .53( 9) | |
| FPR(E,F) | | | | | | | | |
| DA | .67( 4) | | .61( 3) | | | | -.56( 6) | |
| C1 | | | | | | | .56( 7) | |
| HM(A) | | -.47(11) | | -.47( 6) | | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | | -.45( 7) | | -.53(10) | |
| HM(E) | | | | | | | .49(11) | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | -.46(13) | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | -.48( 3) |
| SIGY0(D) | | | -.53( 5) | | -.66( 4) | | -.61( 4) | |
| SIGY0(E) | | -.64( 4) | | -.56( 3) | -.74( 2) | -.60( 2) | -.45(13) | |
| SIGY0(F) | | | | | | | | .52( 2) |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | -.51( 8) | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .57( 5) | | | | | | | |
| SIGZ0(E) | | | | | | | | |
| SIGZ0(F) | | .48(10) | | | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | -.47( 4) |
| P(C) | | | | | | | .58( 5) | |
| P(D) | | | | | -.50( 5) | | -.67( 2) | |
| P(E) | | | | | | | -.55( 8) | |
| P(F) | | | | | | | | |
| VD(IOD) | .95( 1) | .92( 1) | .97( 1) | .91( 1) | .99( 1) | .94( 1) | .90( 1) | .67( 1) |
| VD(AER) | | .46(12) | | | | | | |
| LDIOD0-1 | | | | | | | .46(12) | |
| LDAER0-1 | | | | | | | | |
| LDIOD1-3 | | -.48( 9) | | -.53( 4) | | | | |
| LDAER1-3 | | .53( 7) | | | | | | |
| LDIOD>3 | .48( 6) | | .51( 6) | | | | | |
| LDAER>3 | | -.66( 3) | | -.52( 5) | | -.45( 4) | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD - DESIGN AT KFK/GRS) (PART 2 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCAD1 | IODCAD1 | IODCAD2 | IODCAD2 | IODCAD3 | IODCAD3 | IODCAD4 | IODCAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.93( 1) | -.87( 1) | -.98( 1) | -.95( 1) | -.82( 3) | -.54( 2) | | |
| R | .45( 5) | | | | -.92( 1) | | -.49( 4) | |
| HQ | | | -.48( 7) | | | | | |
| FPR(A-D) | -.91( 2) | | -.77( 3) | | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | .45( 2) | .81( 2) | .45( 7) | | | | |
| C1 | | | | | .49( 9) | | | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | -.48( 5) | -.46( 5) |
| HM(D) | | | | | -.72( 5) | | -.59( 3) | -.48( 3) |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | -.47( 8) | | -.66( 7) | | | |
| SIGY0(E) | | | -.58( 4) | | -.77( 4) | -.54( 1) | -.61( 2) | |
| SIGY0(F) | | | | | -.69( 6) | | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | .46( 6) | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .85( 3) | | | | | | | -.53( 2) |
| SIGZ0(E) | | | .55( 6) | .48( 6) | -.61( 8) | | | |
| SIGZ0(F) | | | .57( 5) | .51( 5) | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | .56( 3) | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | -.90( 2) | | -.98( 1) | -.89( 1) |
| VD(AER) | | | | | | | | |
| LDIODO-1 | | | | | | | | |
| LDAERO-1 | | | | .55( 4) | | | | |
| LDIOD1-3 | | | | | | | | .47( 4) |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | -.57( 2) | | -.50( 3) | | |

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | IODCPD1 | IODCPD1 | IODCPD2 | IODCPD2 | IODCPD3 | IODCPD3 | IODCPD4 | IODCPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.96( 1) | -.88( 1) | -.97( 1) | -.94( 1) | -.74( 6) | | | |
| R | | | -.68( 6) | -.60( 3) | -.92( 1) | | | |
| HQ | | | | | | | | |
| FPR(A-D) | -.91( 2) | | -.85( 2) | | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | .46( 4) | .76( 3) | .44( 9) | | | | |
| C1 | | | | | | .45( 3) | | .49( 7) |
| HM(A) | | | | | | | .62( 5) | |
| HM(B) | | | | | | | .78( 1) | .54( 5) |
| HM(C) | | | .46(11) | | | | .61( 7) | |
| HM(D) | | | | | -.74( 5) | | | |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | -.46( 3) | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | -.44( 7) | | | | -.58( 8) | | -.61( 6) | -.67( 1) |
| SIGY0(D) | -.66( 5) | | -.75( 4) | | -.87( 3) | | -.78( 2) | -.53( 6) |
| SIGY0(E) | | | -.73( 5) | -.51( 8) | -.91( 2) | -.56( 1) | -.68( 4) | -.63( 2) |
| SIGY0(F) | | | -.46(10) | | -.58( 7) | | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | .47( 6) | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .83( 3) | | .48( 8) | | | | | |
| SIGZ0(E) | | | .47( 9) | | .57( 9) | | | |
| SIGZ0(F) | | | .48( 7) | | | | | .47( 8) |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | .58( 2) | | .67( 2) | | | | |
| P(E) | | | | | | | | .60( 4) |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | -.84( 4) | | -.74( 3) | |
| VD(AER) | | | | .53( 6) | | | | |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | | | | .52( 7) | | | | |
| LDIOD1-3 | | | | -.58( 5) | | | | -.45( 9) |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | -.60( 4) | | -.54( 2) | | -.61( 3) |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD - DESIGN AT KFK/GRS)    (PART 4 OF 6)    CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECGD1 | CAECGD1 | CAECGD2 | CAECGD2 | CAECGD3 | CAECGD3 | CAECGD4 | CAECGD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.79( 2) | -.80( 1) | -.84( 2) | -.78( 2) | -.56( 5) | | -.54( 5) | |
| R | | | | | -.63( 4) | | -.68( 3) | |
| HQ | | | | | | | | |
| FPR(A-D) | -.72( 4) | | | | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .50( 7) | .58( 3) | | | | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | -.44( 5) | | |
| HM(B) | | | | | | | | |
| HM(C) | | | | | | | | |
| HM(D) | | | | | | | -.46( 7) | |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | | | | | | | |
| SIGY0(B) | | | | | | | | |
| SIGY0(C) | | | | | | | | |
| SIGY0(D) | | | | | | -.45( 4) | -.52( 6) | -.62( 3) |
| SIGY0(E) | -.58( 6) | | -.68( 4) | | -.71( 3) | | -.56( 4) | |
| SIGY0(F) | | | | | | | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .46( 8) | | | | | | | |
| SIGZ0(E) | | | | | | | | |
| SIGZ0(F) | | | | | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | .87( 1) | .79( 2) | .91( 1) | .86( 1) | .96( 1) | .95( 1) | .96( 1) | .93( 1) |
| LDIOD0-1 | | | | | | | | |
| LDAER0-1 | .71( 5) | .51( 5) | .70( 3) | .50( 3) | .78( 2) | .54( 2) | .84( 2) | .66( 2) |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | .74( 3) | .57( 4) | .64( 5) | | .47( 6) | .47( 3) | | .46( 5) |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | | | | | -.48( 4) |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD - DESIGN AT KFK/GRS) (PART 5 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECAD1 | CAECAD1 | CAECAD2 | CAECAD2 | CAECAD3 | CAECAD3 | CAECAD4 | CAECAD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.93( 1) | -.87( 1) | -.97( 1) | -.95( 1) | -.87( 2) | -.63( 1) | -.69( 8) | |
| R | .44( 5) | | | | -.93( 1) | | -.78( 6) | |
| HQ | | | -.46( 7) | | -.47(10) | | | |
| FPR(A-D) | -.91( 2) | | -.77( 3) | | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | | .81( 2) | | .56( 9) | | | |
| C1 | | | | | | | .50(10) | |
| HM(A) | | | | | | | | |
| HM(B) | | | | | | | -.80( 5) | |
| HM(C) | | | | | | | -.72( 7) | |
| HM(D) | | | | | -.74( 7) | | -.86( 2) | -.44( 3) |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | -.44(11) | |
| SIGYO(A) | | | | | | | | |
| SIGYO(B) | | | | | | | | |
| SIGYO(C) | | | | | | | | |
| SIGYO(D) | | | -.45( 8) | | -.73( 8) | | -.84( 3) | -.50( 2) |
| SIGYO(E) | | | -.57( 4) | | -.84( 3) | -.45( 2) | | |
| SIGYO(F) | | | | | -.77( 5) | | -.81( 4) | |
| SIGZO(A) | | | | | | | | |
| SIGZO(B) | | | | | | | | |
| SIGZO(C) | | | | | | | | |
| SIGZO(D) | .85( 3) | | | | -.46(11) | | | |
| SIGZO(E) | | | .52( 6) | .51( 3) | -.80( 4) | | | |
| SIGZO(F) | | | .55( 5) | .48( 6) | | | | |
| P(A) | | | | | | | | |
| P(B) | | | | .46( 7) | | | | |
| P(C) | | | | | | | | |
| P(D) | | | | .50( 4) | | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | | | | | -.75( 6) | | -.94( 1) | -.74( 1) |
| LDIODO-1 | | | | | | | .57( 9) | |
| LDAERO-1 | | | | .54( 2) | | | | |
| LDIOD1-3 | | | | | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | -.49( 5) | | | | |

AD-UFOMOD SENSITIVITY ANALYSIS ( COMPARISON RSD - DESIGN AT KFK/GRS) (PART 6 OF 6) CONCENTRATION RUNS

TABLE ENTRIES REPRESENT THE VALUE OF THE PARTIAL RANK CORRELATION COEFFICIENT (AND ITS RANK) FOR EACH COMBINATION OF SELECTED INDEPENDENT AND SELECTED DEPENDENT VARIABLE, PROVIDED THAT THE ABSOLUTE VALUE OF THIS COEFFICIENT IS GREATER THAN T(ALPHA) = 0.44 (59 RUNS) FOR ALPHA = 0.05 SIGNIFICANCE LEVEL )
(E.G. THE CRITICAL VALUE IS T(ALPHA) = 0.67 (59 RUNS) FOR ALPHA = 0.001 SIGNIFICANCE LEVEL )

| | CAECPD1 | CAECPD1 | CAECPD2 | CAECPD2 | CAECPD3 | CAECPD3 | CAECPD4 | CAECPD4 |
|---|---|---|---|---|---|---|---|---|
| DESIGN | KFK | GRS | KFK | GRS | KFK | GRS | KFK | GRS |
| Q | -.96( 1) | -.88( 1) | -.98( 1) | -.95( 1) | -.82( 4) | -.55( 3) | | |
| R | | | -.72( 5) | -.56( 3) | -.94( 2) | -.57( 2) | -.57( 7) | |
| HQ | | | | | | | | |
| FPR(A-D) | -.91( 2) | | -.86( 2) | -.44(11) | | | | |
| FPR(E,F) | | | | | | | | |
| DA | .80( 4) | .48( 3) | .78( 3) | .49( 6) | | | | |
| C1 | | | | | | | | |
| HM(A) | | | | | | | .62( 6) | |
| HM(B) | | | | | -.44(12) | | .70( 5) | .55( 4) |
| HM(C) | | | .46(10) | | | | .77( 3) | .57( 2) |
| HM(D) | | | | | -.79( 5) | | .49( 8) | |
| HM(E) | | | | | | | | |
| HM(F) | | | | | | | | |
| SIGY0(A) | | -.46( 4) | | | | | | |
| SIGY0(B) | -.46( 8) | | | | | | | |
| SIGY0(C) | -.46( 7) | | | | -.47( 9) | | -.72( 4) | -.56( 3) |
| SIGY0(D) | -.67( 5) | | -.77( 4) | -.46(10) | -.91( 3) | -.65( 1) | -.86( 1) | -.64( 1) |
| SIGY0(E) | | | -.72( 6) | -.47( 9) | -.96( 1) | -.51( 4) | -.78( 2) | -.49( 5) |
| SIGY0(F) | | | -.46( 9) | | -.73( 6) | | | |
| SIGZ0(A) | | | | | | | | |
| SIGZ0(B) | .49( 6) | | | | | | | |
| SIGZ0(C) | | | | | | | | |
| SIGZ0(D) | .83( 3) | | .50( 8) | | | | | |
| SIGZ0(E) | | | | | .67( 7) | | | |
| SIGZ0(F) | | | .50( 7) | | .46(10) | | | |
| P(A) | | | | | | | | |
| P(B) | | | | | | | | |
| P(C) | | | | | | | | |
| P(D) | | .56( 2) | | .69( 2) | .45(11) | | | |
| P(E) | | | | | | | | |
| P(F) | | | | | .61( 8) | | | |
| VD(IOD) | | | | | | | | |
| VD(AER) | | | | .48( 7) | | | | |
| LDIODO-1 | | | | | | | | |
| LDAERO-1 | | .44( 5) | | .48( 8) | | | | |
| LDIOD1-3 | | | | -.52( 5) | | | | |
| LDAER1-3 | | | | | | | | |
| LDIOD>3 | | | | | | | | |
| LDAER>3 | | | | -.53( 4) | | | | |

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