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Probabilistic Accident Consequence Uncertainty Assessment Using COSYMA:

Uncertainty from the Food Chain Module

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FOREWORD

This is one of a series of reports describing an uncertainty analysis on the predictions of the accident consequence assessment code COSYMA. A complete list of the reports produced in this project is given in Appendix A, where the reports are divided into those describing the expert judgement study on the distributions of the input parameter values and those describing the results of the analysis. This report describes the results of the analysis of the uncertainty in the predicted consequences of accidental releases reflecting the uncertainty in the values of the input parameters of the models for calculating concentrations of material in foods.

All of the reports describing the results of the analysis have common material in their introductory sections, so that any single report can be read without having to refer to background material in other reports of the series. This is one of four reports which describe the different module analyses. Section 1 (Background to the study) is identical in each of these reports. Sections 2.1and 2.4 are very similar in each of the module analysis reports. Those parts of section 2 describing the general approach, the methods for combining distributions and sampling from them are identical in these reports apart from a few sentences referring to particular features of the module in question. The opening part of section 3 is also the same in these reports.

Sections 1.1 and 1.2 of this report are almost identical to the first chapter of the "Methodology Report", with differences for references to material that is explained in more detail in that report. Section 1.2 of the Methodology Report includes a final paragraph that is not in the other reports.

Sections 1.1, 1.2 and 1.4 and the opening part of section 3 are very similar to the equivalent sections of the overall analysis report.

Appendices A (list of reports from the project) and B (description of the models in COSYMA) are included in each of the reports on the uncertainty analysis.

Abstract

A study to perform an uncertainty analysis of the European accident consequence assessment system, COSYMA, has been carried out under contract to the European Commission. The study involved a series of analyses of the uncertainty in different sections of the system, followed by a final analysis of the uncertainty in the whole system.

The overall aims of the study can be summarised as:

1 to formulate a state-of-the-art expert judgement methodology which is capable of finding broad acceptance,
2 to apply the methodology to estimate uncertainties associated with the predictions of the probabilistic accident consequence assessment system COSYMA
3 to provide an input to identifying future R&D priorities.

This report describes the analysis of the uncertainty in the model predictions resulting from uncertainty in the values to be assigned to the input parameters describing transfer of radionuclides along food chains. The main aim of this part of the study was to identify the input parameters whose uncertainties make large contributions to the overall uncertainty; the parameters identified would then be included in the final analysis of the uncertainty in the whole system.

Uncertainty analysis involves specifying probability distributions for the values of each of the parameters involved, sampling sets of values from those distributions and propagating them through the model to derive information on the uncertainty in the model prediction. Those parameters whose uncertainties make major contributions to the overall uncertainty can then be identified using correlation coefficients between the input values and the model outputs. Earlier expert judgement studies have provided distributions on the values of the parameters describing the behaviour in food chains of those nuclides that make major contributions to the doses following reactor accidents. This information has been extended by the project staff to include distributions on other nuclides considered in COSYMA.

The study evaluated the uncertainty on individual doses and risks, the extent of countermeasures and the numbers of health effects in the population. The calculations were undertaken for a number of situations with and without allowing for the effects of countermeasures. Some licensing procedures require estimates of the potential individual doses and risks at points near the reactor site. Potential doses are calculated assuming people are outdoors for the whole of the period of interest, and so make no allowance for countermeasures or shielding by normal occupation of buildings. The study evaluated such potential doses, and the associated risks of health effects. Consequences assuming normal living (ie allowing for shielding by buildings but no countermeasures) are considered in the licensing procedures of several countries. Hence calculations were undertaken for individual and collective doses and risks for normal living.

The source terms chosen encompass a wide range of characteristics (eg magnitude and composition) of source terms that have been postulated for LWRs. They are taken from analyses of the pressurised water reactor proposed for the Hinkley Point site in the UK. UK1 is a very large release; it is the risk-dominant source term for early health effects and a major contributor to the overall risk of

late health effects from the reactor. CB2 is a smaller, but less unlikely, sequence that also makes a major contribution to the overall risk of late health effects from the reactor. DBA is a design basis accident.

The study showed that the uncertainty (expressed as the ratio of the 95th to the 5th percentile of the probability distribution on the expectation value of the consequence) on the extent of the area where food restrictions would be imposed, and its time integral, lies between about 5 and about 70 for the CB2 source term, and between about 70 and about 500 for the DBA source term. The uncertainty on the extent of the area where restrictions would be imposed on grain production is larger as the area could be very small for some of the parameter values considered. The parameters whose uncertainty makes the largest contribution to the overall uncertainty on the extent of milk and beef restrictions are the interception factors for pasture and for hay/silage, the retention time on hay/silage and the F_m and F_f transfer factors for caesium. The F_m factor for iodine is identified as important for the DBA source term. The most important uncertainty for green vegetable restrictions is the soil contamination, while those for the extent of cereal restrictions are the interception factor and processing loss factor for cereals and the retention time of caesium on cereals.

The study showed that the uncertainty on the numbers of fatal cancers are between factors of about 3 and 100, with larger uncertainties on the numbers of effects if no countermeasures are taken. The uncertainties making the most important contributions to the overall uncertainty are those on the values of F_m for iodine and caesium, the interception factor for pasture and the retention time for hay and silage.

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1 BACKGROUND TO THE STUDY

1.1 Introduction

Despite the elaborate precautions taken in the design, construction and operation of nuclear facilities, there will always remain the possibility, however small, of accidental releases of radioactivity into the environment. There is a need to evaluate the risks arising from potential accidents, on a probabilistic basis, taking into account the spectrum of possible consequences of accidents and their associated probability of occurrence. Probabilistic risk assessment (PRA) or accident consequence assessment (ACA) is the process whereby the consequences of potential accidental releases are assessed, taking into account the range of conditions which may prevail at the time of the accident, and the associated probability of these conditions. Such assessments have applications in the design, siting, licensing and operating phases of a nuclear installation. They can be used to evaluate the risks posed by a specific or representative nuclear site, for example for comparison with safety criteria. They can be used for evaluating the effects of design changes or of plant modifications. They also have an input into emergency planning and to some aspects of siting studies.

A number of computer systems have been developed for use in such assessments. Such systems include models for describing the pathways by which people are irradiated following discharges of material, and for calculating the doses and the associated health risks. The models require values to be specified for a large number of input parameters. The predictions of such models are uncertain for two main reasons, which can be summarised as:

(a) *modelling uncertainties,* arising from a lack of knowledge about the most appropriate mathematical formulation to represent environmental processes,
(b) *parameter value uncertainties,* arising from inadequate knowledge about the most appropriate values to be assigned to the many parameters in the model.

The models adopted are not perfect as they contain idealisations and simplifying assumptions. They may not describe all features concerned; features which have been omitted because they make only a small contribution to the "best estimate" model prediction may make larger contributions to the uncertainty. The most appropriate values to be assigned to the many parameters involved in the model may not be known with certainty, leading to uncertainty in the final predictions of the model.

Two computer systems for use in probabilistic accident consequence assessments (COSYMA[1] in the European Union and MACCS[2] in the US) were developed around 1990, and made generally available. There has been an interest in quantifying the uncertainty in the predictions of such systems, and extensive analyses of the uncertainty on predecessors of both programs have been carried out [3,4, 5]. An important feature of an uncertainty analysis is the derivation of a joint distribution[*] on the values of the many parameters involved. In the earlier studies, the joint distribution was largely specified by the system developers, rather than experts in the many different fields involved in accident consequence modelling.

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[*] The joint distribution assigns a probability to each feasible set of values of the input parameters.

In 1991, both the European Commission (EC) and the United States Nuclear Regulatory Commission (USNRC) were considering initiating studies to better quantify the uncertainty in the input parameter values and in the predictions of the systems. An essential aspect of these studies was to obtain distributions and information on the dependencies between parameter values using formal expert judgement elicitation techniques. The studies were combined into a single EC/USNRC project intended to develop credible and traceable uncertainty distributions for the respective system input parameters. A further intention was for these distributions to be propagated through the two systems, and so quantify the uncertainty in the predictions.

The broad objectives of both the EC and USNRC for this study can be summarised as:

1 to formulate a state-of-the-art expert judgement methodology which is capable of finding broad acceptance;

2 to apply the methodology to estimate uncertainties associated with the predictions of the probabilistic accident consequence systems COSYMA and MACCS;

3 to provide an input to identifying future R&D priorities.

Within these broad objectives, small differences in emphasis exist between the EC and USNRC. This report concentrates on the analysis using COSYMA, and the EC aims and objectives.

The first objective was met in two ways. First, the collaboration between research teams from the US and Europe led to the development of agreed methods for the study, and in particular for the formal elicitation of expert judgement. Second, a protocol document describing the methods to be used for the final uncertainty analyses on COSYMA was distributed to a number of researchers in the field for comment. The views expressed on that document have been incorporated into the methods used for the analysis.

The second objective was met by using the joint distribution on the uncertain parameter values derived from the expert elicitation in an analysis of the uncertainty in the predictions of the consequences of accidental releases using COSYMA. Undertaking rigorous uncertainty analyses involves considerable computational costs and substantial effort. It is not possible to carry out such analyses on every occasion when accident consequence assessments are undertaken. It was intended that the levels of uncertainty obtained in this study would indicate the likely levels of uncertainty in other, similar, situations. Therefore, this analysis has been undertaken for several combinations of source term and types of population behaviour with the intention of deriving indicative levels of uncertainty should COSYMA be applied in other situations. For example, if the study shows that the uncertainty in a particular endpoint for a particular countermeasures strategy is a factor of 10, then it can be assumed that in similar situations the uncertainty is also a factor of 10, not 100.

There are several aspects to the third objective above. The uncertainty was better quantified because the distributions on the parameter values were determined from formal techniques of expert judgement. In addition to calculating the uncertainty on the model predictions, the study also identified the input parameters whose uncertainties make major contributions to the overall uncertainty. This can form an input into identifying research priorities.

Uncertainty analyses can be considered to consist of three broad stages, each of which could be further divided into smaller steps. The first step is to determine what types of uncertainty are present in the model being analysed, which types will be considered in the analysis and which of the model's input parameters will be considered to be uncertain. This step also includes identifying those model endpoints for which the uncertainty will be analysed. The second broad step is to determine the joint distribution on the values of the model input parameters that are being considered. This joint distribution includes not only the ranges of each of the parameter values, but also the probability distribution of the input parameter taking different values within that range and any dependencies between the values of the different parameters within their ranges. In this study, the joint distribution over the model input parameters has been obtained using formal techniques for eliciting expert judgement. These parts of the study have been described in a series of reports, as listed in Appendix A. The final broad step is to sample sets of input parameter values from the joint distribution, to propagate those values through the model, to determine the uncertainty on the model endpoints and identify those parameters whose uncertainties make large contributions to the overall uncertainty.

The models included in COSYMA are described in Appendix B. There are many hundreds of parameters involved in describing the transfer of radioactive material from its release through the environment to man and calculating the subsequent doses and risks. It would not be possible to consider all these parameters in a single analysis, because of the complexity of the analyses and amount of computation that would be required. Therefore, a series of analyses of parts of the complete COSYMA system have been carried out. These are described as "module analyses", although the parts of the code considered in these analyses do not necessarily correspond exactly to the defined modules of COSYMA[1]. Throughout this report, the term "module" is used to refer to the part of the system under analysis, unless indicated otherwise. Each module includes a number of different models. Those parameters whose uncertainties make major contributions to the overall uncertainty for each module were identified and included in a final overall analysis. The following module analyses were carried out before the final analysis:

1) Dispersion and deposition
2) Foodchain transfer
3) Dosimetry - external, inhalation and ingestion doses
4) Early and late health effects.

The main aim of the module analyses was to identify the parameters which should be included in the final overall analysis, and the list of parameters constitutes the main conclusions of this report. A further part of the overall analysis is to explain the relative uncertainties on the different quantities considered. This report gives explanations for the relative uncertainties within this module, and so contributes to the process of understanding the results of the final analysis. These explanations are also one of the conclusions of this section of the study. These explanations are included in section 3 of this report, where the endpoints are discussed in turn. This means that the main conclusions of this report are presented in section 3, rather than being drawn together in a separate "conclusions" section.

The module analysis reports do not include any discussions of the extent to which the results of the analysis might be applicable in other situations (e.g. other sites or source terms). The report on the overall analysis(6) does include a discussion on the extent to which the results of this study can be applied in other situations.

The analyses reported here calculated the uncertainty on the overall endpoints of COSYMA coming from the uncertainty in the input parameters for the particular module, rather than simply considering the uncertainty on the endpoints of that particular module. In this way, the importance of the parameter uncertainties can be judged in terms of their contribution to the overall uncertainty and not simply in terms of their contribution to some intermediate quantity in the calculation. Default values were allocated to the parameters of the other modules for which the uncertainty was not considered in the particular analysis. Thus the analysis of the uncertainty on the dispersion and deposition module assumed default values for the parameters describing food chain transfer, dose models and health effects models. This division into modules is such that no single parameter is input to more than one module, and there are no large correlations between the values of the input parameters for the different modules.

Since the study was intended to derive indicative levels for the uncertainty to be expected under normal applications of COSYMA, it was necessary to make as few changes as possible to COSYMA for this analysis. For this reason, the models used in COSYMA were not modified to give a better fit to the distributions provided by the experts. In some cases, the models included in COSYMA are complex and an uncertainty analysis of the full version of the system would have required excessive amounts of computer resources. In these cases, the models were simplified so that the uncertainty analysis could be carried out more easily. Simplifications were introduced in the calculation of the risk of late health effects, the models for transfer of some radionuclides to animal products, and the model for human metabolism of actinides. These simplifications will not have significantly altered the extent of the uncertainty on the predictions of COSYMA, though they may have altered slightly the central values about which the uncertainty is expressed. They have not affected the aims of the study, as the objective was to evaluate the extent of the uncertainty in the predictions for typical COSYMA calculations, rather than the absolute value of the consequences of particular accidental releases.

This is one of a series of reports describing the overall analysis of the uncertainty in the predictions of COSYMA. The starting point for this series of reports is taken as the end of the expert elicitation process. Appendix A gives a complete list of the reports relating to the project. The remainder of this chapter gives information relating to the study that is common to all the analyses, namely the source terms, endpoints, uncertainties and selection of atmospheric conditions adopted in the study. Further information on the methods adopted, and on the way in which the results are presented, is given in one of the companion reports(7).

1.2 Situations considered

Three source terms, encompassing a wide range of characteristics of source terms that have been postulated for LWRs (e.g. magnitude and composition), have been considered in this study. They were taken from analyses of the pressurised water reactor proposed for the Hinkley Point site in the UK. UK1 is a very large release; it was identified as the risk-dominant source term for early health effects and a major contributor to the overall risk of late health effects from the reactor[8]. CB2 is a smaller, but less unlikely, sequence that also makes a major contribution to the overall risk of late health effects from the reactor[9]. DBA is a design basis accident[10]. This is a fault which the plant is designed to take or can be shown to withstand without unacceptable consequences, by virtue of the plant's inherent characteristics or safety systems. The amounts of material released for the UK1 and CB2 source terms were calculated from the reactor inventory and the release fractions which apply to groups of elements; the amount of each isotope released for the DBA source term was specified directly. The source terms are summarised in Table 1.1 to Table 1.3. Table 1.1 shows the assumed inventory of the reactor; Table 1.2 gives the release fractions used for the UK1 and CB2 source terms, and Table 1.3 gives the amount of each nuclide released in the DBA source term. Table 1.2 also gives approximate release fractions for the DBA source term, to enable easy comparisons of the magnitude of this and the other source terms.

The calculations were undertaken for a range of patterns of population behaviour. Some licensing procedures require estimates of the potential individual doses and risks at points near the reactor site. Potential doses are calculated assuming people are outdoors for the whole of the period of interest, and so make no allowance for countermeasures or shielding by normal occupation of buildings. The study evaluated such potential doses, and the associated risks of health effects. Consequences assuming normal living (i.e. allowing for shielding by buildings but no countermeasures) are considered in the licensing procedures of several countries. Hence calculations were also undertaken for individual and collective doses and risks for normal living.

There is also an interest in calculating the uncertainty on the predictions of COSYMA if allowance is made for the countermeasures that might be imposed following a reactor accident. International organisations have suggested ranges of criteria for implementing countermeasures, recognising that intervention levels might depend on the situation and scale of accident that occurs. A countermeasures strategy based on the IAEA[11] intervention levels for sheltering, evacuation, iodine tablets and relocation together with the EU levels for banning food[12,13,14] was used. The intervention levels and implementation times used for this study are given in Table 1.4 Doses and risks are calculated assuming normal living for those not subject to countermeasures, or not subject to countermeasures in a given time period.

COSYMA gives information on a wide variety of consequences of an accident. It was not possible to generate information on all of these endpoints in this study. Therefore, the study evaluated the uncertainty on a selection of endpoints; information on the uncertainty in other endpoints can be deduced from these results. A complete list of endpoints is given in Table 1.5; they can be summarised as follows:

- air concentration and deposition of ^{131}I and ^{137}Cs at selected distances.
- individual dose to 7 days in bone marrow, thyroid and skin at selected distances.
- individual and collective risks of early health effects (total risks of mortality, and of the haematopoietic syndrome, the total risks of morbidities and of lung morbidity and hypothyroidism).
- the areas with emergency actions for sheltering, evacuation and distribution of stable iodine tablets.
- individual and collective committed effective dose and doses in bone marrow and thyroid.

- individual and collective risks of the numbers of fatal cancers (total and from thyroid) and leukaemia.
- the areas and their time integrals affected by relocation and by food restrictions, for meat, milk, green vegetables and grain.

Different sub-sets of the complete list of endpoints are considered in the different module analyses, as some of the input parameter values for some of the modules do not influence all the endpoints. The endpoints considered in this module are identified in Section 3.

The collective health effects were evaluated for a hypothetical site in central Europe, as defined in a recent international intercomparison of reactor accident programs[15].

As stated earlier, the aim of the exercise was to derive indicative levels of uncertainty that should be appropriate for other, similar analyses using COSYMA. The size of uncertainty associated with the predictions may change for different magnitudes of the source term, and for calculations with and without countermeasures. The following set of situations was chosen for analysis, where NE and NL refer to the separate sub-systems of COSYMA relating to the calculation of early effects (NE sub-system) and late effects (NL sub-system):-

UK1 potential outdoor doses and risks, for those NE endpoints relating to individual doses and risks.
UK1 normal living with no countermeasures, for those NE endpoints relating to individual doses and risks, and to numbers of health effects.
UK1 with countermeasures, for those NE endpoints relating to individual doses and risks, and to numbers of health effects.
CB2 normal living with no countermeasures, for those NL endpoints relating to individual doses and risks, collective doses and numbers of late health effects.
CB2 with countermeasures, for all NE and NL endpoints.
DBA potential outdoor doses and risks, for those NL endpoints relating to individual doses and risks.
DBA with countermeasures, for all NL endpoints.

The following terminology is used when the results are presented in Section 3 for the three situations considered. “Potential doses” is used to refer to the calculation of doses outdoors and with no countermeasures; this is adopted as the calculations give the highest doses that could potentially be received after the accident. “Normal living” is used to refer to the situation with no countermeasures; these calculations include the effects of buildings in reducing exposure, allowing for average behaviour of the population and occupancy of buildings. “With countermeasures” is used for the final situation; these calculations assume that all members of the population follow the adopted countermeasures strategy, but use the normal living assumptions for other aspects of the calculations.

The uncertainty on individual doses and risks for early effects (the NE endpoints) were evaluated at 0.875, 5 and 20 km, while the uncertainties on individual doses and risks for late effects (the NL endpoints) were evaluated at 5, 20 and 100 km. COSYMA calculates doses at discrete points on a spatial grid, and assumes that the dose at the centre of each grid area applies throughout that area. Thus the dose at 0.875 km is calculated as representing the doses over the distance band between 0.75 and 1 km.

This combination of conditions means that information on the uncertainty of the numbers of early health effects in the population was obtained mainly from the analyses for the UK1 source term. Little information on the uncertainty on these endpoints could be obtained from the analyses with the CB2 source term as doses from this source term were generally below the thresholds for producing early health effects. Information on the uncertainties in doses over short time periods and risks of early health effects for people who are outdoors at the time of the accident, for people who are living normally with no countermeasures taken, and if countermeasures are taken on the basis of doses in the exposed population were obtained from the analyses for the UK1 source term. The predicted risks of early health effects, and the associated uncertainties in the predictions, will not depend on the criteria used to invoke countermeasures unless they are such that some people who receive doses above the threshold for deterministic effects are not sheltered and evacuated. Although the analysis for the CB2 source term could not give much information on risks of early health effects, it did give results for the doses in short time periods, both for normal living and if countermeasures were taken.

Information on the uncertainty in the predicted extent of early countermeasures (sheltering, evacuation and distribution of stable iodine tablets) was obtained from the analyses for the CB2 source term. Information on the uncertainty on the late countermeasures (relocation and food restrictions) was obtained from the analyses for the CB2 and DBA source terms. Two source terms were selected for this part of the analysis as they have different relative contributions from the iodine and caesium isotopes.

Information on the predicted risks of late health effects was also obtained from the CB2 and DBA source terms, for both individual and collective risks. Again, the two source terms were used because of the different relative contributions of the iodine and caesium isotopes.

The extent of the uncertainty on the predicted air concentration and deposition does not depend on the size of the release. The endpoints relating to concentration and deposition were only considered in the analysis for the CB2 source term, as this is the only source term for which all four distances (from NE and NL) were considered.

The results from a single run of COSYMA are presented using the complementary cumulative frequency distribution function (ccdf), which gives the probability that the consequence is greater than a particular value. The distribution can be summarised using various characteristic quantities such as the expectation value (the mean or average of the distribution) and various percentiles. The *nth* percentile is the level of consequence that is exceeded with a probability of (100-n) percent. This study concentrates on the uncertainty on the mean value, the 95^{th} and 99^{th} percentiles.

The uncertainty analysis involved running COSYMA many times, so that many different values for the various endpoints were obtained. A probability distribution can be derived from these results, for each endpoint, and the uncertainty on the predicted consequence is then described by percentiles of that probability distribution. The general discussion of the extent of the uncertainty is presented using the ratio of the 95th to the 5th percentiles of the uncertainty distribution; the term “uncertainty factor” is used in this report to represent this factor. The same quantity is used in the reports describing the results of the expert elicitation, where it is termed “range factor”. More detailed information is presented in Appendix C, where the 5th, 10th, 25th, 50th, 75th, 90th and 95th percentiles of the uncertainty distributions on the different parts of the ccdf considered are given. These descriptions of the uncertainty are evaluated for the mean value and the 95th and 99th percentiles of the ccdf. Some results are also presented in terms of the “mean curve”, which is the average of the ccdfs from each of the COSYMA runs. The process is described in more detail in the “methodology report”.(7) There is also an interest in the extent to which predictions obtained using the default value for each input parameter could underestimate the results. Therefore the ratio of the 95th percentile of the uncertainty distribution to the value obtained with the default values for the input parameters was also determined. This quantity is termed the “reference uncertainty coefficient”.

One of the aims of the module analysis reports is to explain the relative magnitude of the uncertainty on different quantities, and to identify those parameters whose uncertainties make large contributions to the overall uncertainty. The explanations concentrate on the results for the mean value and the 99th percentile of the distribution, rather than on the 95th percentile. To some extent this reflects the difficulties in trying to explain the findings for the 95th percentile. The results for the 99th percentile reflect those for essentially the worst conditions that can arise. If individual doses or risks are being considered, this is on the plume centre line in adverse weather conditions. It is less clear, however, what conditions correspond to the 95th percentile. In general, this could occur in a variety of situations depending on values allocated to the many parameters involved in the analyses. In extreme cases of broad plumes, it could represent doses off the centre line. The mean value, representing the average across all conditions, is also easier to relate to the values of the parameters involved.

1.3 Items considered uncertain in the module analyses

The analyses look at the uncertainty on the COSYMA endpoints resulting from the uncertainty on the parameters for the particular module considered in the analysis, using default values for the parameters of the other modules. The doses calculated in each of the module analyses are those summed over all routes of exposure considered in COSYMA, even though the particular uncertainties considered may not affect the doses from some of the routes. Equally, the runs with countermeasures consider all the countermeasures considered in this analysis, even though the imposition of some of them may not be affected by the uncertainty on the parameters for the module being analysed.

1.4 Choice of sequences of atmospheric conditions for the analysis

Runs of COSYMA, when not considering uncertainty, assume that there is a single value for all parameters except the atmospheric conditions during the period of the release and the time taken for material to travel over the region of interest. Therefore, COSYMA predicts the probability distribution of consequences should an accident occur in any of the wide range of atmospheric conditions (including the changes of conditions during the travel of the plume) which might occur at the site of interest during the period in which the site operates. The sequences of conditions are obtained by using a data file giving atmospheric conditions every hour over a period of a few years, and assuming that the conditions during the future operation of the site will be similar to those observed in the past. It is not possible to undertake the calculations for every sequence of conditions over the operating period of the site, and even considering every sequence recorded over a one-year period would require excessive computer resources in an uncertainty analysis. Therefore a representative sample of starting times must be used. The predictions of COSYMA depend on the way in which these sequences are chosen. This source of uncertainty is not considered in the module analyses or in the overall analysis incorporating the parameters identified from the module analyses of this study. A separate study of the uncertainty from meteorological sampling was undertaken alongside the overall analysis and is described in reference 6.

The atmospheric conditions at the time of the release can affect the predictions of all the modules of COSYMA, not simply the dispersion and deposition module. Some radionuclides deposit at different rates relative to each other in wet and dry conditions. This can affect the relative mix of radionuclides contributing to doses from all pathways of exposure. The travel time of the plume to different distances can affect the extent to which countermeasures can reduce the doses received by the population, since countermeasures are modelled to require time for organisation and implementation before they are effective. Therefore the uncertainty analysis of all the modules must consider the possible range of atmospheric conditions that can occur.

Each of the module analyses was undertaken using runs of COSYMA considering 144 sequences of conditions selected using cyclic sampling. The reasons for this choice of sampling scheme are described in the "methodology report"[(7)] on this study.

1.5 Method of identifying important parameter uncertainties

The method of identifying the important uncertain parameters is described in the "methodology report"[(7)], which also describes the reasons for the choice of the particular method. It is summarised here to provide the background for the discussions in Section 3 of this report. Two indicators of importance were used in this project.

The first indicator is the partial rank correlation coefficients (PRCC) between the input parameter values and the COSYMA predictions. These measure the strength of monotonic relationships between values of an input parameter and a model prediction, when account has been taken of the simultaneous effects of monotonic relationships with all other parameters.

The second indicator is the contribution of each parameter to the overall uncertainty. The coefficient of determination (R^2) measures the fraction of the variation of the model output that can be explained by linear relationships between the model prediction and all of the input parameter values. The ratio of R^2 values from an analysis with only one parameter considered to be uncertain to that from an analysis with all parameters considered to be uncertain represents the fraction of the overall uncertainty caused by the particular parameter.

The important uncertain parameters were identified for the mean value, 95th and 99th percentiles of the ccdf, for each of the endpoints and source terms considered. Parameters were included in the overall analysis if they were placed in the first or second rank according to their PRCC or if they were identified as contributing more than 15% of the overall uncertainty according to their contribution to the value of R^2. The justification for these criteria are given in the "methodology report"[(7)].

1.6 References

1. KfK and NRPB. COSYMA - a new program package for accident consequence assessment. CEC Brussels, EUR 13028 (1991).
2. Chanin D I et al. MELCOR accident consequence code system (MACCS), User's Guide. NUREG/CR-4691. Albuquerque (1990).
3. Jones J A, Mansfield P A and Crick M J. An uncertainty analysis of the predicted consequences of nuclear accidents using the NRPB code MARC-2A. Chilton, NRPB-R274 (London HMSO) (1995).
4. Fischer F, Ehrhardt J and Hasemann I. Uncertainty and sensitivity analyses of the complete program system UFOMOD and of selected submodels. Karlsruhe KfK 4627 (1990).
5. Kocher D C, Ward R C, Killough G G et al. Sensitivity and uncertaitny studies of the CRAC2 computer code. NUREG/CR-4038 (1985).
6. J A Jones, J Ehrhardt, L H J. Goossens, F Fischer, I Hasemann, B C P Kraan, R M Cooke. Probabilistic accident consequence uncertainty assessment using COSYMA: Overall uncertainty analysis. EUR 18826 and FZKA 6312 (2000).
7. Jones J A, Kraan B C P, Cooke R M, Goossens L H J, Fischer F and Hasemann I. Probabilistic accident consiequence uncertainty assessments using COSYMA: Methodology and processing techniques. EUR 18827 and FZKA 6313 (2000).
8. Jones J A and J A Williams J A. An assessment of the radiological consequences of releases from degraded core accidents from a proposed PWR at Hinkley Point: Results using MARC-1. Chilton, NRPB-M152 (1988).
9. Jones J A and Williams J A. An assessment of the radiological consequences of releases from containment bypass accidents from a proposed PWR at Hinkley Point: Results using MARC-1. Chilton. NRPB-M154 (1988)
10. Jones J A and Williams J A. An assessment of the radiological consequences of releases from design basis accidents from a proposed PWR at Hinkley Point: Results using MARC-1. Chilton. NRPB-M153 (1988)
11. FAO, IAEA, ILO, OECD/NEA, PAHO, WHO. International basic safety standards for protection against ionizing radiation and for the safety of radiation sources. Vienna, IAEA, Safety Series 115 (1996)
12. CEC. Council Regulation (Euratom) No 3954/87 laying down the maximum permitted levels of radioactive contamination of foodstuffs and feedingstuffs following a nuclear accident or any other case of radiological emergency. *Off. J. Eur. Commun.* L371/1/11 (1987), amended by Council Regulation 2218/89. *Off. J. Eur. Commun.* L211/1 (1989).
13. CEC. Council Regulation (Euratom) No 944/89 laying down the maximum permitted levels of radioactive contamination in minor foodstuffs following a nuclear accident or any other case of radiological emergency. *Off. J. Eur. Commun.* L101/17 1989.
14. CEC. Council Regulation (Euratom) No 770/90 laying down maximum permitted levels of radioactive contamination of feedingstuffs following a nuclear accident or any other case of radiological emergency. *Off. J. Eur. Commun.* L83/78 (1990).

15. Nuclear Energy Agency and Commission of the European Communities. Probabilistic accident consequence assessment codes. Second international comparison. Paris, OECD (1994).

Table 1.1 Reactor inventory considered

Radionuclide	Inventory (Bq)	Half-life	Radionuclide	Inventory (Bq)	Half-life
^{58}Co	$3.08\ 10^{16}$	70.8 d	^{131m}Te	$3.47\ 10^{17}$	30.0 h
^{60}Co	$1.14\ 10^{16}$	5.27 y	^{132}Te	$4.85\ 10^{18}$	78.2 h
^{85}Kr	$2.17\ 10^{16}$	10.7 y	^{131}I	$3.39\ 10^{18}$	8.04 d
^{85m}Kr	$9.25\ 10^{17}$	4.48 h	^{132}I	$4.96\ 10^{8}$	2.30 h
^{87}Kr	$1.70\ 10^{18}$	76.3 min	^{133}I	$6.81\ 10^{18}$	20.8 h
^{88}Kr	$2.34\ 10^{18}$	2.84 h	^{134}I	$7.84\ 10^{18}$	52.6 min
^{86}Rb	$7.96\ 10^{15}$	18.6 d	^{135}I	$6.40\ 10^{18}$	6.61 h
^{89}Sr	$3.37\ 10^{18}$	50.5 d	^{133}Xe	$6.85\ 10^{18}$	5.25 d
^{90}Sr	$1.75\ 10^{17}$	29.1 y	^{135}Xe	$1.67\ 10^{18}$	9.09 h
^{91}Sr	$4.37\ 10^{18}$	8.48 h	^{134}Cs	$3.85\ 10^{17}$	2.06 y
^{90}Y	$1.82\ 10^{17}$	2.67 d	^{136}Cs	$1.33\ 10^{17}$	13.2 d
^{91}Y	$4.51\ 10^{18}$	58.6 d	^{137}Cs	$2.29\ 10^{17}$	30.0 y
^{95}Zr	$5.88\ 10^{18}$	65.5 d	^{140}Ba	$6.14\ 10^{18}$	12.7 d
^{95}Nb	$5.81\ 10^{18}$	35.1 d	^{140}La	$6.32\ 10^{18}$	40.3 h
^{97}Zr	$5.88\ 10^{18}$	16.9 h	^{141}Ce	$5.92\ 10^{18}$	32.5 d
^{99}Mo	$6.44\ 10^{18}$	66.02 h	^{143}Ce	$5.44\ 10^{18}$	33.0 h
^{99m}Tc	$5.55\ 10^{18}$	6.02 h	^{144}Ce	$3.59\ 10^{18}$	285 d
^{103}Ru	$5.25\ 10^{18}$	39.4 d	^{143}Pr	$5.40\ 10^{18}$	13.6 d
^{105}Ru	$3.51\ 10^{18}$	4.44 h	^{147}Nd	$2.36\ 10^{18}$	11.0 d
^{106}Rh	$3.18\ 10^{18}$	1.47 d	^{239}Np	$7.32\ 10^{19}$	2.36 d
^{106}Ru	$1.30\ 10^{18}$	368 d	^{238}Pu	$3.17\ 10^{15}$	87.7 y
^{127}Sb	$2.93\ 10^{17}$	3.89 d	^{239}Pu	$1.11\ 10^{15}$	$2.41\ 10^{4}$ y
^{129}Sb	$9.95\ 10^{17}$	4.31 h	^{240}Pu	$1.06\ 10^{15}$	6550 y
^{127}Te	$2.85\ 10^{17}$	9.35 h	^{241}Pu	$3.12\ 10^{17}$	14.4 y
^{127m}Te	$4.37\ 10^{16}$	109 d	^{241}Am	$2.06\ 10^{14}$	432 y
^{129}Te	$9.40\ 10^{17}$	69.6 min	^{242}Cm	$6.62\ 10^{16}$	163 d
^{129m}Te	$1.67\ 10^{17}$	33.6 d	^{244}Cm	$2.75\ 10^{15}$	18.1 y

Table 1.2 Source terms considered for the assessment

Source term	Fraction of core inventory released to the environment								
	Xe-Kr	Organic iodine	Inorganic iodine	Cs-Rb	Te-Sb	Ba-Sr	Ru[(a)]	La[(b)]	Pu□
UK1	9 10^{-1}	7 10^{-3}	7 10^{-1}	5 10^{-1}	3 10^{-1}	6 10^{-2}	2 10^{-2}	4 10^{-3}	4 10^{-3}
CB2	1 10^{-2}	5 10^{-6}	2 10^{-3}	8 10^{-3}	8 10^{-6}	8 10^{-7}	8 10^{-7}	8 10^{-7}	3 10^{-7}
DBA[(d)]	1 10^{-7}	-	1 10^{-6}	1 10^{-6}	1 10^{-8}	1 10^{-8}	1 10^{-8}	1 10^{-8}	1 10^{-10}

<u>Notes</u>

a Includes Ru, Rh, Co, Mo, Tc.
b Includes Y, La, Zr, Nb, Ce, Pr, Nd.
c Includes Np, Pu, Am, Cm.
d This source term is defined in terms of the amount of each radionuclide released. The information has been converted into the form presented here for comparison with the other source terms. The release fractions for different isotopes of the same element and for different elements differ from the values given here by up to a factor of 3.

Table 1.3 Activity released in the DBA source term

Radionuclide	Release (Bq)	Radionuclide	Release (Bq)	Radionuclide	Release (Bq)
^{24}Na	$7.0\ 10^{10}$	^{51}Cr	$1.4\ 10^{11}$	^{54}Mn	$1.4\ 10^{11}$
^{55}Fe	$5.2\ 10^{9}$	^{59}Fe	$5.2\ 10^{9}$	^{58}Co	$3.4\ 10^{11}$
^{60}Co	$3.2\ 10^{10}$	^{63}Ni	$5.6\ 10^{9}$	^{65}Zn	$1.4\ 10^{11}$
^{83}Br	$9.3\ 10^{10}$	^{84}Br	$2.6\ 10^{12}$	^{85}Br$^{(a)}$	$4.8\ 10^{9}$
^{83m}Kr	$5.2\ 10^{9}$	^{85m}Kr	$1.1\ 10^{11}$	^{85}Kr	$2.3\ 10^{9}$
^{87}Kr	$9.3\ 10^{10}$	^{88}Kr	$1.1\ 10^{11}$	^{89}Kr	$8.1\ 10^{10}$
^{86}Rb	$4.4\ 10^{9}$	^{88}Rb	$3.5\ 10^{13}$	^{89}Rb	$8.1\ 10^{12}$
^{89}Sr	$4.4\ 10^{10}$	^{90}Sr	$3.7\ 10^{8}$	^{91}Sr	$2.3\ 10^{11}$
^{90}Y	$4.4\ 10^{8}$	^{91m}Y	$6.3\ 10^{10}$	^{91}Y	$4.8\ 10^{8}$
^{93}Y	$3.7\ 10^{11}$	^{95}Zr	$4.1\ 10^{10}$	^{95}Nb	$4.4\ 10^{10}$
^{99}Mo	$1.6\ 10^{11}$	^{99m}Tc	$3.7\ 10^{10}$	^{103}Ru	$2.7\ 10^{10}$
^{106}Ru	$1.6\ 10^{10}$	^{103m}Rh	$6.3\ 10^{10}$	^{106}Rh	$3.5\ 10^{10}$
^{110m}Ag	$5.6\ 10^{10}$	^{122}Sb	$1.0\ 10^{11}$	^{124}Sb	$2.5\ 10^{10}$
^{125m}Te	1.7 10	^{127m}Te	$1.8\ 10^{9}$	^{127}Te	$8.5\ 10^{9}$
^{129m}Te	$3.3\ 10^{10}$	^{129}Te	$8.9\ 10^{12}$	^{131m}Te	$1.2\ 10^{11}$
^{131}Te	$2.3\ 10^{12}$	^{132}Te	$1.8\ 10^{10}$	^{130}I	$1.9\ 10^{10}$
^{131}I	$1.9\ 10^{12}$	^{132}I	$5.2\ 10^{12}$	^{133}I	$8.1\ 10^{12}$
^{134}I	$6.3\ 10^{12}$	^{135}I	$3.6\ 10^{12}$	^{131m}Xe	$2.3\ 10^{10}$
^{133m}Xe	$2.8\ 10^{10}$	^{133}Xe	$1.5\ 10^{12}$	^{135m}Xe	$9.3\ 10^{10}$
^{135}Xe	$3.4\ 10^{11}$	^{137}Xe	$8.1\ 10^{11}$	^{138}Xe	$4.1\ 10^{11}$
^{134}Cs	$2.1\ 10^{11}$	^{136}Cs	$2.5\ 10^{10}$	^{137}Cs	$2.7\ 10^{11}$
^{138}Cs	$5.9\ 10^{12}$	^{139}Cs	$2.0\ 10^{13}$	^{137m}Ba	$8.9\ 10^{11}$
^{139}Ba	$4.4\ 10^{12}$	^{140}Ba	$6.7\ 10^{10}$	^{140}La	$3.5\ 10^{10}$
^{141}Ce	$1.0\ 10^{10}$	^{143}Ce	$3.7\ 10^{10}$	^{144}Ce	$3.7\ 10^{10}$
^{143}Pr	$3.6\ 10^{8}$	^{144}Pr	$3.7\ 10^{10}$	^{187}W	$2.2\ 10^{11}$
^{237}U	$2.5\ 10^{8}$	^{239}U	$1.0\ 10^{10}$	^{239}Np	$4.1\ 10^{9}$
^{236}Pu	$1.7\ 10^{5}$	^{238}Pu	$3.7\ 10^{5}$	^{239}Pu	$1.5\ 10^{5}$
^{240}Pu	$1.4\ 10^{5}$	^{241}Pu	$4.1\ 10^{7}$	^{242}Pu	$4.4\ 10^{2}$
^{243}Pu	$8.5\ 10^{7}$	^{241}Am	$7.0\ 10^{4}$	^{242m}Am	$2.4\ 10^{3}$
^{242}Am	$4.8\ 10^{7}$	^{243}Am	$8.1\ 10^{3}$	^{244}Am	$2.7\ 10^{6}$
^{242}Cm	$1.6\ 10^{6}$	^{243}Cm	$6.3\ 10^{2}$	^{244}Cm	$9.6\ 10^{4}$

Table 1.4 Countermeasures criteria and timings adopted in the study

Action	**Criteria**		
Sheltering	10 mSv effective dose, total of committed inhalation dose and external dose to 7 days to a person outdoors		
Evacuation	50 mSv effective dose, total of committed inhalation dose and external dose to 7 days to a person outdoors		
Iodine tablets	100 mSv committed inhalation dose to thyroid to a person outdoors		
Relocation	30 mSv external dose in 30 days to a person in normal living		
Return from relocation	10 mSv external dose in 30 days to a person in normal living		
Food restrictions	Activity concentration levels in food		
	Radionuclide	Milk (Bq l^{-1})	Other foods (Bq kg^{-1})
	Strontium	125	750
	Iodine	500	2000
	Caesium and other long-lived radionuclides	1000	1250
	α - emitters	20	80

Action	**Time when action initiated**	**Time when action withdrawn**
Sheltering	2 hours	8 hours
Evacuation	6 hours	2 days
Iodine tablets	4 hours	-[a]
Relocation	Depends on relocation area[b]	When dose rate drops below criterion
Food restrictions	Start of first time period in which concentrations are above the criterion	End of last time period in which concentrations are above the criterion

Notes:

a COSYMA assumes that iodine tablets are taken on a single occasion only.

b COSYMA calculates an average relocation time, assuming that the area affected can be relocated at a rate of 100 km^2 per day, and assumes that everyone is relocated at that time

Table 1.5 List of endpoints considered in the analysis

For COSYMA NE[a] runs

Activity concentrations, at 0.875, 5 and 20 km.
in air and on the ground, for Cs-137 and I-131.

Individual doses, at 0.875, 5 and 20 km
integrated to 7 days for both inhalation and external dose
for bone marrow, thyroid and skin.

Individual risks of deterministic health effects, at 0.875, 5 and 20 km.
for mortality, the sum and the risk of the haematopoietic syndrome,
for morbidity, the sum and the risk of lung morbidity, hypothyroidism and skin burns.

Areas with emergency actions,
for sheltering only, evacuation and distribution of stable iodine tablets.

Number of deterministic health effects
for mortality, the sum and haematopoietic syndrome.
for morbidity, the sum and numbers of cases of lung morbidity, hypothyroidism and of skin burns.

For COSYMA NL[b] runs

Activity concentrations, at 5, 20 and 100 km
in air and on the ground, for Cs-137 and I-131.

Individual doses, at 5, 20 and 100 km
integrated to 50 years for both inhalation and external dose
effective dose and for bone marrow and thyroid.

Individual risk of fatal stochastic health effects, at 5, 20 and 100 km
for total, and the risks of death from leukaemia and thyroid cancer.

Areas with countermeasures
for relocation, the initial area and its time integral
for restrictions of milk, grain, leafy vegetables and beef, the initial area and its time integral.

Collective doses
effective dose and for bone marrow and thyroid.

Numbers of fatal stochastic health effects
the sum, and numbers of deaths from leukaemia and thyroid cancer.

Notes:

a NE refers to the sub-system of COSYMA calculating short term doses, early health effects and the appropriate countermeasures.

b NL refers to the sub-system of COSYMA calculating long term doses, late health effects and the appropriate countermeasures.

2 DISTRIBUTIONS ON THE INPUT PARAMETER VALUES

2.5 Introduction

The main stages of an uncertainty analysis were summarised in Section 1 of this report. The first stage is to take information from expert panels, supplemented from other sources where necessary, and to generate marginal distributions* for those module input parameters considered to be uncertain, together with a correlation matrix describing the relationships between the marginal distributions for the different parameters. Sets of input parameter values are then sampled from these correlated marginal distributions for use in the uncertainty analysis. Section 2 describes this process for the food chain module.

Code input parameters for which marginal distributions and a correlation matrix have to be specified (ie the uncertain input parameters) are called target variables. Variables for which the experts have to give assessments are called elicitation variables. A fundamental aspect of the methodology of formal expert judgement elicitation is that experts should only be asked to provide assessments on elicitation variables that are physically observable, potentially measurable and with which the expert is familiar. Different experts may prefer different models for certain phenomena. An expert may be unwilling to give assessments on model dependent target variables. He may not relate to these target variables, if he does not agree with the model which is described by these target variables. Therefore it is better to have elicitation variables which are not related to a certain model, and so to have elicitation variables which can be considered as model independent. Some of the parameters in accident consequence models represent quantities that can, in principle, be measured and for which distributions can be obtained directly from expert judgement. Others cannot and so must be derived from distributions on the values of other measurable quantities.

This process yields distributions on the parameters for the different models considered within the module analysis. These distributions must then be combined into a single joint distribution** on all of the parameters considered in the module analysis. The program used for the sampling could only handle joint distributions when they are expressed as marginal distributions for each of the parameters and the correlations between them. Therefore the distribution has to be expressed in this form. The steps required to obtain samples of target variables are summarised below, and described in more detail in the later parts of section 2.

1. Identify the models comprising the module and the uncertain target variables in those models.
2. Identify suitable elicitation variables from which distributions on the target variables can be obtained. Construct joint distributions, expressed in terms of marginal distributions and correlations, on the elicitation variables for the different models. The distributions come directly from information provided by the experts supplemented, in some cases by further information provided by project staff.

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* The marginal distribution assigns a probability to each feasible value of a single parameter.

** The joint distribution assigns a probability to each feasible set of values of the input parameters.

3. Obtain the joint distribution on the target variables for each model from the joint distribution on the elicitation variables obtained from step 2; this procedure is known as "probabilistic inversion". Express the joint distribution on the target variables in terms of marginal distributions for each of the target variables involved, together with a correlation matrix between these distributions, for each model, as required by the program used for the sampling.
4. Combine the distributions on the target variables for each of the models into a distribution over the whole set of target variables involved in this module analysis, allowing for correlations between the different sub-sets of parameters. This distribution is expressed in terms of marginal distributions for each of the variables and correlations between them, so that it can be input to the program used for the final sampling.
5. Finally, the input values for the COSYMA module analysis are sampled from the distribution resulting from step 4.

As a check on the inversion process, a sub-step 3a was added. In this the COSYMA food chain models and the joint distribution on the target variables are used to replicate the marginal distributions on the elicitation variables. The resulting distributions can then be compared with those obtained from the experts, as a check on the adequacy of the inversion process.

The summary above identified a number of steps which must be carried out for the parameters in each of the models considered in the module analysis. The structure of the remainder of Section 2 is as follows:

- Section 2.6 briefly describes step 1 above, namely the models used in COSYMA, and the groups of parameters that were considered to be uncertain.
- Section 2.7 describes step 2 above, namely the identification of the elicitation variables and the derivation of distributions on them from information derived from that provided by the expert panel, supplemented where necessary by information from the project staff. This section considers groups of quantities rather than individual quantities.
- Section 2.8 outlines the methods used for probabilistic inversion, which is step 3 above.
- Section 2.9 describes details of steps 3 and 3a above for this module analysis. This section describes the derivation of distributions on the target variables and gives the distributions used in this study, together with the comparison of the distributions on the elicitation variables as reconstructed from the target variables and as specified by the experts.
- Section 2.10 describes step 4 above, namely the construction of the overall distribution on the whole set of target variables, in a form which is suitable for input to the sampling program used.
- Section 2.11 describes step 5 above, namely the sampling from the overall distribution.

2.6 Calculation of ingestion doses in COSYMA and uncertain target variables

This section describes the way in which dose calculations for ingestion are undertaken in COSYMA, and the parts of the calculations that were considered to be uncertain. Identifying the parameters that are regarded as uncertain (the target variables) is step 1 from Section 2.5.

Ingestion dose is calculated in COSYMA as the product of the time-integrated activity concentration in food, the consumption rate and the dose coefficient. For this study, it was assumed that the average concentration of material in foods was equal to that which would have been obtained if all food was produced at the point at which it was consumed. This module analysis considers only the uncertainty on the activity concentrations in food; the uncertainties on the dose coefficients and the food consumption rates are considered in the dose module analysis[(1)].

COSYMA itself does not calculate the concentration of activity in foods, using instead values taken from data libraries generated using other programs which incorporate models describing the transfer of activity through food chains. These programs are the NRPB program FARMLAND[(2)] and the GSF program ECOSYS. For convenience only the uncertainties on the activity concentrations provided by the data libraries from the FARMLAND model were estimated in this study. However, since the distributions on the values of the parameters of the FARMLAND model were obtained by fitting the model to distributions on the values of observable quantities, the results of the study should be similar whether the FARMLAND or ECOSYS models were used for this process. The distributions obtained also include some allowance for the uncertainty of the models themselves.

The calculations in COSYMA allow for a delay time between food being harvested and being consumed, during which the activity concentration is reduced by radioactive decay. The uncertainty on the delay period was considered in this analysis. FARMLAND considers the removal of activity from the edible portion of some foods (particularly vegetables) during their preparation. The uncertainty on the fraction of activity lost during this process was also considered in this analysis.

The models in FARMLAND for metabolism of cows and sheep are complex and were simplified slightly for this study. It is considered that the simpler models, together with the distributions of parameter values obtained from expert judgement, will adequately reflect the uncertainty on the activity concentrations in food because the distributions on the parameter values are those which give the best available fit to the distributions specified by the experts. Therefore it is reasonable to assume that the use of simplified models will not seriously affect the results of this study. The models used in this study are illustrated in Figure 2.1 to Figure 2.7. The model parameters are transfer coefficients, designated k_{ij} which is the fraction of activity in compartment i transferring to compartment j in unit time. A loss from compartment i is designated by k_{ii}. The target variables are either the transfer coefficients in the models or quantities which can be easily related to those coefficients. The target variables are summarised in the second column of Table 2.1, which presents groups of parameters. The models are described in more detail in the following sub-sections, where the specific target variables for each model are identified.

2.6.1 Model for activity concentrations in green vegetables

The model adopted for calculating concentrations in green vegetables is shown in Figure 2.1.

Deposition occurs to the "soil" and "external plant 1" compartment, with the relative deposition being determined by the interception factor (item 1 in Table 2.1), which is the ratio of deposition on "external plant 1" to that on "soil" plus "external plant 1".

The removal of activity from the "external plant 1" compartment to soil is calculated from the retention time on vegetables (item 2 in Table 2.1), so that

$$k_{21} = \ln 2 / (\text{retention half time})$$

Transfer between the "soil" and the "internal plant 1" compartments reflects root uptake (item 5 in Table 2.1); the transfer coefficient is given by

$$k_{15} = \frac{\text{wet mass of green vegetables}}{\text{mass of soil}} . k_{51} . \text{root uptake factor}$$

and k_{51} is given a very high value to ensure that the system reaches equilibrium rapidly.

The removal of activity during food preparation is described by the processing loss (item 13 in Table 2.1).

Transfer between "soil" and "external plant 1" is the result of resuspension (item 14 in Table 2.1 is the resuspension factor) with the transfer coefficient given by

$$k_{12} = \text{resuspension factor} . \text{deposition velocity} . \text{interception factor}$$

and the default value of the deposition velocity is used in this module analysis.

Transfer between "soil" and "external plant 2" is the result of actual contamination of vegetables by soil (item 15 in Table 2.1 is the soil contamination factor); the transfer coefficient is given by

$$k_{13} = \frac{\text{dry mass of green vegetables}}{\text{mass of soil}} . k_{31} . \text{soil contamination factor}$$

and k_{31} is given a very high value to ensure that the system reaches equilibrium rapidly.

The transfers between the two "external plant" compartments, and the "internal plant" compartments, and from there to "soil" were assumed not to be uncertain.

2.6.2 Model for activity concentrations in root vegetables

The model adopted for calculating activity concentrations in root vegetables is shown in Figure 2.2. Separate calculations were made of the activity concentrations in potatoes and in other root vegetables.

Deposition occurs to the “soil” and “external plant 1” compartments, with the relative deposition being determined by the interception factor (item 1 in Table 2.1). The interception factor is the ratio of deposition on “external plant 1” to that on “soil” plus “external plant 1”.

The removal of activity from the “external plant 1” compartment to “soil” is calculated from the retention time on root vegetables or potatoes (item 2 in Table 2.1), so that

$$k_{21} = \ln 2 \, / \, (retention\ half\ time)$$

The transfer between the soil and the “tuber 2” compartment represents root uptake (items 6 and 7 in Table 2.1 are the root uptake factors for potatoes and root crops respectively); the transfer coefficient is given by

$$k_{16} = \frac{wet\ mass\ of\ root\ vegetables}{mass\ of\ soil} . k_{61} . root\ uptake\ factor$$

and k_{61} is given a very high value to ensure that the system reaches equilibrium rapidly.

The transfers between the “soil” and the “external plant 1” compartment, the “external plant 1” compartment and the “internal plant” compartment, the “internal plant” compartment and the “tuber 1” compartment and the return from “tuber 1” to “soil” (the parameters k_{12}, k_{24}, k_{45} and k_{51}, in Figure 2.2) are item 8 in Table 2.1.

The removal of activity during food preparation is described by the processing loss (item 13 in Table 2.1).

The transfer between “soil” and the “external plant 2” compartments represents contamination of the crop by soil; the transfer coefficient is given by

$$k_{13} = \frac{dry\ mass\ of\ root\ vegetables}{mass\ of\ soil} . k_{31} . \ soil\ contamination\ factor$$

and k_{31} is given a very high value to ensure that the system reaches equilibrium rapidly. The “soil contamination factor” is the item 15 in Table 2.1.

2.6.3 Model for activity concentrations in cereals

The model adopted for calculating activity concentrations in cereals is shown in Figure 2.3.

Deposition occurs to the “soil”, “external plant” and “external grain 1” compartments. The deposition to “external grain 1” represents deposition actually onto the outer part of the grain; the very much larger deposition to the other parts of the plant is represented by deposition to “external plant”. The uncertainty in the deposition to the outer part of the grain was considered to be very small compared to the overall uncertainty, and default parameter values were used for this part of the model. The relative deposition between the soil and plant compartments was determined by the interception factor (item 1 in Table 2.1). The interception factor is the ratio of deposition on "external plant 1" to that on "soil" plus "external plant 1".

The transfer between the "soil" and the "internal grain 2" compartment represents root uptake (item 4 in Table 2.1 is the root uptake factor); the transfer coefficient is given by

$$k_{15} = \frac{wet\,mass\,of\ cereals}{mass\,of\ soil}.k_{51}.root\,uptake\ factor$$

and k_{51} is given a very high value to ensure that the system reaches equilibrium rapidly.

The transfers between the "soil" and the "external plant" compartments, the "external plant" and the "internal plant" compartments, the "internal plant" and "internal grain" compartments and the return from "internal grain" to soil (the transfer coefficients k_{12}, k_{23}, k_{34} and k_{41}, in Figure 2.3) represent item 8 in Table 2.1.

The removal of activity during food preparation is described by the processing loss (item 13 in Table 2.1).

The uncertainty on the transfers between "soil" and the "external grain" was considered to be only a small part of the overall uncertainty, and was not considered in this study.

2.6.4 Model for activity concentrations in pasture and in silage

The activity concentrations in pasture and silage are used in calculating the concentrations in animal products (milk, meat and liver). The model for pasture and silage is described here as a separate step for convenience. In FARMLAND the model for caesium is amended to take into account the fixation of some caesium within the soil which is subsequently unavailable for root uptake by plants.

The model used for calculating the activity concentration of radionuclides other than caesium in pasture grass is shown in Figure 2.4. The distributions for some of the parameter values were obtained directly from the information provided by the experts; some of the distributions were obtained using probabilistic inversion processes.

Deposition occurs to the "soil" and "external plant" compartment, with the relative deposition being determined by the interception factor (item 1 in Table 2.1). The interception factor is the ratio of deposition on "external plant 1" to that on "soil" plus "external plant 1".

The removal of activity from the "external plant 1" compartment to soil is calculated from the retention time on pasture (item 2 in Table 2.1), so that

$$K_{10,1} = \ln 2 / (retention\ half\ time).$$

Transfer between the “soil” and the “internal plant” compartments reflects root uptake (item 3 in Table 2.1 is the root uptake factor); the transfer coefficient is given by

$$k_{17} = \frac{wet\ mass\ of\ pasture\ grass}{mass\ of\ soil} . k_{71} . root\ uptake\ factor$$

and k_{71} is given a very high value to ensure that the system reaches equilibrium rapidly. Here the transfer relates to that from the top cm of soil to plants and the mass of soil refers to that in the top 1 cm layer of soil. Similar equations are used for uptake from the other soil layers, related to the mass of soil in the appropriate soil layer. It is assumed that the distributions on the root uptake factor are equal for uptake from any of the soil layers.

The transfer of material down the soil column is represented in the model by transfers between the different soil compartments representing fixed depths within the soil column; the transfer coefficients k_{12}, k_{23}, k_{34}, k_{43} and k_{54} in Figure 2.4 represent item 11 in Table 2.1.

Transfer between the “soil” and “external plant 1” compartments is the result of resuspension (item 14 in Table 2.1 is the resuspension factor), with the transfer coefficient given by

$$k_{1,10} = resuspension\ factor\ .\ deposition\ velocity\ .\ interception\ factor$$

and the default value of the deposition velocity is used in this module.

Transfer between the “soil” and “external plant 2” compartments represent contamination of grass by soil (item 15 of Table 2.1) and the resulting consumption of soil by animals. The transfer coefficient is given by

$$k_{16} = \frac{dry\ mass\ of\ pasture\ grass}{mass\ of\ soil} . k_{61} . soil\ contamination\ factor$$

and k_{61} is given a very high value to ensure that the system reaches equilibrium rapidly.

The model used for transfer of caesium to pasture grass differs slightly from that used for other radionuclides because of the fixation of caesium in soil; it is illustrated in Figure 2.5. Most parts of the model are common to both caesium and other radionuclides. The “fixed soil” compartment represents caesium that is unavailable for uptake plants; the transfer coefficient into it is item 12 in Table 2.1.

The transfers between the “fixed soil” and “external plant” compartments represent resuspension and ingestion of soil by animals; the coefficients were assumed to be equal to those for transfer between the other “soil” and “external plant” compartments.

The models used for pasture grass were also used to calculate the activity concentration in hay and silage with harvesting at appropriate times through the year and an additional compartment to model radioactive decay of activity in the stored hay/silage between harvest and consumption.

2.6.5 Model for activity concentrations in meat and milk of dairy cows

A simplified version of the FARMLAND model for dairy cows was used in this study. The model is illustrated in Figure 2.6, and was used for all radionuclides with appropriate distributions of parameter values.

The animal's intake of radioactive material is calculated from the intake rates of the different feedstuffs and of soil (item 16 in Table 2.1) and the calculated activity concentrations in each feedstuff and soil calculated using the appropriate FARMLAND model. The animal model is linked directly with that for the concentration of activity in pasture and in hay/silage, shown in Figure 2.4 and Figure 2.5, with the transfer coefficients from pasture to the animals derived from the consumption rates.

The transfers between the gut and milk, meat and liver are based on the fraction of the daily intake found in 1 kg of the product at equilibrium, termed the equilibrium transfer factors (items 18 and 19 in Table 2.1). The losses from meat and liver are based on the biological half-lives of the activity in the animals (item 21 in Table 2.1). The loss from the gut, representing excretion, is based on the retention time of material in the animal's gut (item 17 in Table 2.1). The equations defining the transfer coefficients are:

$$k_{11} = \ln 2/(\text{gut retention time})$$

$$k_{33} = k_{44} = \ln 2/(\text{biological half life})$$

$$k_{12} = L\, F_M\, k_{11} / B$$

$$k_{13} = M_M\, F_F\, k_{11}\, k_{33} / B$$

$$k_{14} = M_L\, F_{FL}\, k_{11}\, k_{44} / B$$

where L is the number of litres of milk produced per day
M_M is the mass of meat
M_L is the mass of liver
F_f is the fraction of the daily intake transferred to each kg of meat
F_{FL} is the fraction of the daily intake transferred to each kg of liver
F_M is the fraction of the daily intake transferred to each kg of milk
and $B = 1 - (M_M\, F_f\, k_{33} + M_L\, F_{FL}\, k_{44} + L\, F_M)$.

2.6.6 Model for activity concentrations in meat of beef cattle and sheep

The model adopted for the calculation of activity concentrations in the meat of beef cattle and sheep is illustrated in Figure 2.7; it is the same as that adopted for dairy cattle except that it does not have a milk compartment. The animal model is linked directly with that for the concentration of activity in pasture and in hay/silage, shown in Figure 2.4 and Figure 2.5, with the transfer coefficients from pasture to the animals derived from the consumption rates.

The target variables describing the movement of activity within the animals are items 17, 19 and 20 in Table 2.1. The equations relating the target variables to the transfer coefficients are:

$$k_{11} = \ln 2/(\text{gut retention time})$$
$$k_{22} = k_{33} = \ln 2/(\text{biological half life})$$
$$k_{12} = M_M F_F k_{11} k_{33} / B$$
$$k_{13} = M_L F_{FL} k_{11} k_{44} / B$$

where M_M is the mass of meat
M_L is the mass of liver
F_f is the fraction of the daily intake transferred to each kg of meat
F_{FL} is the fraction of the daily intake transferred to each kg of liver
and $B = 1 - (M_M F_f k_{22} + M_L F_{FL} k_{33})$.

2.6.7 Model for activity concentrations in meat of pigs

FARMLAND uses a very simple model for the prediction of activity concentrations in pork. The activity concentrations in pork were calculated assuming that pigs consume only locally produced cereals, (consumption rate is item 16 in Table 2.1) and that the activity concentration in pork is in equilibrium with that in the cereal crop (item 18 in Table 2.1).

2.7 Distributions for the elicitation variables

Identifying suitable elicitation variables and determining distributions on them is step 2 from Section 2.1. The distributions on the elicitation variables for this module analysis were expressed as marginal distributions for each parameter together with correlations between them. They were derived from information provided by two expert panels, supplemented by information from project staff. One panel provided information on the uncertainty on the transfer processes affecting radioactive material in soils and plants while the other panel gave information on the uncertainty on the processes affecting the intake and metabolism of radioactive material in animals. The expert judgement aspects of the study were undertaken jointly by the USNRC and EC. The method for undertaking expert judgement elicitations was based on methods used in earlier American[3] and European[4] studies. The method used in this project, together with some comments and suggestions for further improvements, is described in reference 5. The expert judgement elicitation process is described in detail in the report on the panels[6].

The elicitation variables are summarised in Table 2.2, which identifies only groups of parameters. The distributions on the elicitation variables, where these were provided by the experts, are presented in the report on the panels[6].

Distributions were elicited from the expert panels for the important parameters governing iodine, caesium and strontium transfer through the food chain. These include

- the migration of strontium and caesium down the soil column following deposition,
- the root uptake concentration factors for the different crops,
- the interception factors for different crops
- the transfer of soil to crops as a result of resuspension
- concentrations in grain and in root vegetables at harvest for depositions occurring at a range of times before harvest
- animal consumption rates of a range of foodstuffs and of soil,
- the availability of ingested feed for uptake from the animal's gut,
- the transfer to meat, milk and eggs of ingested activity
- the biological half-life in animals.

Distributions on the other parameters used within the FARMLAND model have been obtained by project staff from reviews of the literature[7-19] and from past experience gained at NRPB in undertaking uncertainty analyses on foodchain parameters. Although unlikely to contribute significantly to the overall uncertainty in the transfer to terrestrial foods, these parameters were included for completeness and to ensure that the overall uncertainty in the predicted activity concentrations was captured. The values adopted are discussed in Section 2.5.

For iodine, some parameters were not considered important for elicitation by expert judgement due to the relative unimportance of these long-term processes for the radioisotopes of iodine released in a nuclear accident. These were parameters for soil migration, root uptake to crops and transfer to meat of all animals considered. The distribution for the migration rates within arable and undisturbed pasture soils have been assumed to be the same as those adopted in reference 7. A single distribution for root uptake for all crops has been derived from the literature[8-10]. Distributions for the transfer of iodine to beef, lamb and pork (F_f) have also been derived from the literature[10,11].

The process of soil contamination from soil splash has not been considered by expert judgement. This is, however, included for completeness in this study and because there is some evidence that this pathway can be important when root uptake is very low. Following a review of the literature[10,12-14] distributions have been obtained for green vegetables, cereals, and silage / hay. Soil contamination of the part of the root vegetable plant which is above ground has been assumed to be the same as for green vegetables. The soil contamination of pasture is considered separately and is expressed as the intake of soil by animals.

The parameter describing residence time in the gut of animals has not been considered by expert judgement. The distributions given in reference 7 are taken as being appropriate for this study.

Losses of contamination from the edible crop due to basic preparation are included in some of the calculations performed. In the FARMLAND model, losses are modelled by removing external contamination from the edible part of the crop and distributions on this parameter have been obtained from the literature for each crop type(16-18).

The uncertainty on the values for delay times between harvest and consumption of food are taken from literature consistent with the modelling approach adopted in FARMLAND(2,7,19).

Within the uncertainty analysis, elements other than iodine, caesium and strontium have been included in the calculation of ingestion doses from the chosen source terms; these elements are Mn, Zn, Ag, Ce, Co and Te. Distributions on the input parameters for these elements have also been obtained by the project staff based on experience and the available literature(7-15).

2.7.1 Conditions included in the uncertainty distributions

The experts were asked to provide uncertainty distributions as if the elicitation variables had been measured in defined conditions. However, the conditions were defined in a way that did not specify values for every quantity that each expert might feel could influence the value of the variable. The distributions were intended to be representative of the majority of commercial reactors within Europe and the US, and so related to the main agricultural production areas in warm temperate climates. Mediterranean countries, arid areas and arctic areas were excluded. Unique food producing areas, such as seminatural environments (areas that are used for grazing but which are not managed), were only to be considered insofar as they contribute to food production for the regions of interest.

The experts were asked to include any variation in the elicitation variables, reflecting the range of possible conditions within the above regions, within the distributions they provided. The distributions were also to include the effects of uncertainty in the composition of a generic soil, average weather conditions, form of the deposited material, different ages and weights of animals, species of crops or animals, crop yield and the time of year.

2.8 Probabilistic inversion

Step 3 from Section 2.5 is to generate joint distributions on the target variables and express then as marginal distributions and correlations. The details for each model are given in Section 2.9, the general method is described here.

Some of the target variables are quantities which could be measured and so served as elicitation variables. In this case, the distribution derived from step 2 could be used directly. In other cases, the target variables are quantities that cannot be measured and they could not be used as elicitation variables. In this situation, it is the task of the uncertainty analyst to design the elicitation in such a way that, based on the information available on elicitation variables, a joint distribution on the target variables can be determined. This problem is called probabilistic inversion. The problems which arise are similar to other inversion problems, yet different enough to require different methods to be used. Techniques for performing probabilistic inversion in the context of expert judgement have been under development for some years, and are still being developed. The methods adopted for this process in this study are summarised in the "Methodology Report"[20] and described in more detail in references 21 and 22. The computer programs used to implement these methods in this project are described in reference 23. The methods adopted may be characterized as follows.

For a given model, a set of observable quantities can be predicted by the model when suitable values are assigned to various model parameters. Starting with values for the observables, and inverting the model, gives model parameter values which, when used with the model, ideally yield the observed values. Such an inversion is not always possible; for example the model may not adequately represent the processes occurring in the environment. Furthermore, in probabilistic inversion, the starting point is a (joint) distribution (in this study, obtained from expert judgement) over possible values of the observables, rather than single values. A (joint) distribution over model parameters is sought which, when used with the model, returns the original distribution on the observables. Here again, it may not be possible to find a joint distribution that accurately reproduces the original joint distribution for the values of the observed quantities. In such cases a distribution over model parameters is sought which reproduces 'as well as possible' the distributions over the input values.

2.9 Uncertainty distributions on food chain model parameters

The following sections summarise the processing required to obtain distributions on the model parameter values (target variables) from distributions on the elicitation variables, which is step 3 of Section 2.5. The final column of Table 2.1 identifies which of the elicitation variables were used to derive the distributions on the target variables. The following sections also describe the comparisons between distributions on the elicitation variables as reconstructed from the distributions on the target variables and as given by the experts (step 3a of Section 2.5). The models used in this study were described in Section 2.2. Note that all information for elements other than strontium, iodine and caesium was provided by project staff, rather than the expert panels.

The distributions on the target variables used in the food chain model are given in Table 2.3 and Table 2.4, which show the marginal distributions of each parameter and those pairs of parameters with large correlations between their values. It should be noted that these distributions were derived for application in the models adopted in COSYMA, and they should only be used in other models if the parameters have the same meanings as in the models adopted here.

2.9.1 Model for activity concentrations in green vegetables

The model adopted for calculating concentrations in green vegetables is shown in Figure 2.1. In this case, all the target variables could be used as elicitation variables, and no inversion processes were required. The distributions on root uptake of iodine, soil contamination, losses during preparation and delay times were provided by project staff rather than the expert panels.

The distributions on the parameter values are given in the "green vegetable" part of Table 2.3, where they are compared with the default values used in FARMLAND. The default values lie towards the centre of the uncertainty distributions, other than for the root uptake factor for zinc, where the default value lies above the 95th percentile of the distribution.

2.9.2 Model for activity concentrations in root vegetables

The model adopted for calculating activity concentrations in root vegetables is shown in Figure 2.2. Separate calculations were made of the activity concentrations in potatoes and in other root vegetables. All the target variables, other than the translocation parameters (item 8 in Table 2.1), were suitable for use as elicitation variables. The distributions on root uptake of iodine, soil contamination, losses during preparation and delay times were provided by project staff rather than the expert panels

The transfers between the "soil" and the "external plant 1" compartment, the "external plant 1" compartment and the "internal plant" compartment, the "internal plant" compartment and the "tuber 1" compartment and the return from "tuber 1" to "soil" (the parameters k_{12}, k_{24}, k_{45} and k_{51}, in Figure 2.2, and "translocation potatoes k24 Sr" or similar names in Table 2.3) were obtained by probabilistic inversion of information provided by the experts on activity concentrations in root vegetables (items 7 and 8 in Table 2.2). A comparison of the distributions provided by the experts with those obtained using the FARMLAND models, and the distributions of parameter values obtained from this process are given in Table 2.5. This shows that a reasonable fit could be obtained for the 50th and 95th percentiles of the distribution for strontium, but that the fit to the 5th percentile is poor at most of the times considered. The quality of the fits for caesium are similar to those for strontium, other than at the first time considered where a good fit is also obtained for the 5th percentile of the distribution. Project staff specified that the transfer coefficients between "external plant 1" and "internal plant" and between "external plant 2" and "internal plant" were equal.

The distributions on the parameter values for this model are shown in the "root vegetables" part of Table 2.3, where they are compared to the default values used in FARMLAND. This shows that the default values are generally near the centre of the uncertainty distribution, other than for the processing loss for potatoes and the root uptake factors to potatoes for manganese and zinc which are near or above the upper limits of distributions, and one of the transfer coefficients for strontium which is near the lower end of the distributions.

2.9.3 Model for activity concentrations in cereals

The model adopted for calculating activity concentrations in cereals is shown in Figure 2.3. All the target variables, other than the translocation parameters (item 8 in Table 2.1) were suitable for use as elicitation variables. The distributions on root uptake of iodine, losses during preparation and delay times were provided by project staff rather than the expert panels.

The transfers between the "soil" and the "external plant" compartments, the "external plant" compartments and the "internal plant" compartment, the "internal plant" compartment and the "internal grain" compartment and the return from "internal grain" to soil (the transfer coefficients k_{12}, k_{23}, k_{34} and k_{41}, in Figure 2.3, and "translocation cereals k23 Sr" or similar names in Table 2.3) were obtained by probabilistic inversion of information provided by the experts on the activity concentrations in cereals (items 7 and 8 in Table 2.2). The process is explained in more detail in the "Methodology report". A comparison of the distributions provided by the experts with those obtained using the FARMLAND models and the distributions of parameter values obtained from this process are given in Table 2.6. For some of the percentiles and times considered, the fit is good. However, in other cases the fit is poor with the parameter values obtained substantially underestimating the activity concentrations in grain suggested by the experts. These fits, however, represent the best that can be achieved with the current methodology and models and have been used in this study.

The distributions obtained for the parameters of this model are shown in Table 2.3, where they are compared to the default values used in FARMLAND. The default values are generally near the centre of the distribution, other than for one of the transfer coefficients for strontium and the processing loss for cereals, which are near the minimum value of the uncertainty distribution.

2.9.4 Model for activity concentrations in pasture and in silage

The activity concentrations in pasture and silage are used in calculating the concentrations in animal products (milk, meat and liver). The target variables could be used as elicitation variables other than for those describing the transfer rates down the soil column and the fixation of caesium in soil.

The transfer of material down the soil column is represented in the model by transfers between the different soil compartments representing fixed depths within the soil column (the transfer coefficients k_{12}, k_{23}, k_{34}, k_{43} and k_{54} in Figure 2.4, item 10 in Table 2.1 and the parameters identified as "soil migration pasture – k12, Sr" and similar names in Table 2.3). The uncertainty on these parameters could not be obtained directly from the experts. For strontium and caesium, the distributions were obtained by probabilistic inversion using the experts' distributions of the time taken for half of the activity to pass below the different levels considered in soil (item 1 of Table 2.2). The distributions for other nuclides were specified by project staff. Table 2.7 shows a comparison of the distributions provided by the experts with those obtained from the inversion process. It is seen that the model provides a good fit to the distributions for the times taken for material to migrate down the soil column.

The model used for transfer of caesium to pasture grass differs slightly from that used for other radionuclides because of the fixation of caesium in soil; it is illustrated in Figure 2.5. Most parts of the model are common to both caesium and other radionuclides, and the distributions of parameter values for those parts were obtained in the same way as described above. The "fixed soil" compartment represents caesium that is unavailable for uptake by plants; the transfer coefficient into it (identified as "soil fixation pasture k1,11" in Table 2.3) is item 12 in Table 2.1. The transfer coefficients for the movement of activity between the soil compartments were obtained by probabilistic inversion using information provided by the experts on the times taken for half of the deposited material to migrate below different levels in soil, and on the rates at which caesium becomes fixed in soil (items 1 and 2 of Table 2.2). Table 2.7 and Table 2.8 show a comparison of the distributions provided by the experts with those obtained from the inversion process, for the migration times and for the fixation fraction. It is seen that the model provides a good fit to the distributions for the times taken for material to migrate down the soil column, but a poorer distribution for the fraction of caesium that is fixed. Here the predictions underestimate the experts' views on the amount fixed, particularly at short times after deposition, at all parts of the probability distribution.

The distributions obtained for the parameters in the model are shown in Table 2.3, where they are compared to the default values used in FARMLAND. The default values are generally near the centre of the distributions, other than for the root uptake factor to pasture for zinc and the soil fixation parameter for caesium which are near the maximum values of their distributions and one of the transfer coefficients for strontium and the soil contamination of hay/silage, which are near the lower end of their distributions.

2.9.5 Models for activity concentrations in meat and milk of dairy cows, and meat of beef cattle, sheep and pigs

The models are illustrated in Figure 2.6 for dairy cattle and Figure 2.7 for beef cattle and sheep. The model for pigs is described in Section 2.2.7. The target variables were all suitable for use as elicitation variables, and no inversion processes were required for these models. The distributions for residence time in the animal's gut and the F_f values for iodine were provided by project staff, rather than the expert panels.

The distributions obtained for the parameters of this model are shown in Table 2.3, where they are compared to the default values used in FARMLAND. The default values of the parameters in the model for dairy cows are generally near the centre of the uncertainty range though some (the F_m value for silver, the F_f values for meat for manganese and cerium and the F_f value for liver for cerium) are near the upper end of their distributions, while that for the F_f for meat for silver is near the lower end of its distribution. The default values of the parameters in the models for beef cattle and sheep are generally near the centre of the distributions, other than for intake rate of silage/hay by beef cattle and the F_f factors for meat and liver of sheep for manganese and zinc, which are near the upper ends of their distributions, and the F_f factor for meat of sheep for zinc which is near the lower end of its distribution. The default values of the parameters in the model for pigs are generally near the centre of the distributions, other than the F_f factor for cobalt, which is above the maximum value of its distribution.

2.10 Combining the distributions from the different parts of the model

The preceding sections have described the methods used to derive the joint distributions (expressed as marginal distributions and correlations) for the target variables for the models for concentration of each nuclide in each of the foods considered in COSYMA. Step 4 of Section 2.5 is to combine these distributions into a single distribution, also expressed as marginal distributions and correlations. In total, 162 parameters were considered to be uncertain in this module analysis. The experts were also asked if they felt there would be any correlations between the elicitation variables they considered, and in some cases they specified correlations between elicitation variables relating to different models. There is a large number of correlations between the values of parameters in different models. Many of these come from correlations between the root uptake factors in different crops or the metabolic parameters for different animals. The joint distribution over the complete set of parameters was constructed using the simulation program UNICORN[24] in a way which maintained the correlations within each of the groups and introduced the further correlations between the groups specified by the experts. There may be several distributions which achieve this combination, and so the minimum information distribution was used. Marginal distributions of each parameter value and the correlations between them were then extracted from the joint distribution. This process does not alter the marginal distributions, but may introduce correlations between groups of parameters for the different models.

The complete distribution is summarised in Table 2.3, which shows the marginal distribution for each parameter, and Table 2.4, which shows those pairs of parameters with large correlations. This table also shows the occasions where there are correlations between pairs of parameters from different models. Note that these distributions were derived for application in the models adopted in COSYMA. They should only be used in other models if the parameters have the same meanings as in the models adopted here.

The distribution as calculated using UNICORN includes the values for each percentile from 0 to 100) of the marginal distributions, which are thus described by 101 values. The sampling program used (the Sandia LHS program[25]) cannot use such a large number of points, and so the distributions were simplified slightly by describing them in terms of the values at the smaller number of percentiles given in Table 2.3.

2.11 Sampling from the distribution

The final step from Section 2.5 is to sample sets of input parameter values from the complete distribution. This was undertaken using the Sandia LHS code[25]; the input to this code is the joint distribution on the input parameters expressed as marginal distributions on the values for each of the parameters together with a correlation matrix between those values. This program ensures that the correlations specified between the input parameter values are reflected in the sets of input parameter values obtained.

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2.12 References

1. Jones J A, Fischer F, Hasemann I, Goossens L H J, Kraan B C P, Cooke R M, Phipps A, Khursheed A. Probabilistic accident consequence uncertainty assessment using COSYMA: Uncertainty from the dose module. EUR18825 and FZKA 6311 (2000)
2. Brown J and Simmonds J R. FARMLAND: a dynamic model for the transfer of radionuclides through terrestrial foodchains, Chilton. NRPB-R273 (London HMSO) (1995)
3. US Nuclear Regulatory Commission. Severe accident risks; an assessment for five US nuclear power plants. Washington NUREG-1150 (1990)
4. Cooke R. Expert judgement study on atmospheric dispersion and deposition. Delft. TUD report 91-81 (1991)
5. Cooke R M, Goossens L H J and Kraan B C P. Probabilistic accident consequence uncertainty assessment - procedures guide using structured expert judgement. EUR 18820
6. Brown J, Goossens L H J, Kraan B C P, Cooke R M, Jones J A, Harper F T, Haskin F E, Abbott M L, Young M L, Hora S C, Rood A. Probabilistic accident consequence uncertainty analysis. Food chain uncertainty assessment. NUREG/CR-6523, EUR 16771, SAND97-0335 Washington, DC/USA, and Brussels-Luxembourg, (1997)
7. Jones J A, Mansfield P A and Crick M J. Uncertainty analysis of the predicted consequences of nuclear accidents using the NRPB code MARC-2A, Chilton, NRPB-R274 (London HMSO) (1995)
8. IUR. 6th report of the Working Group on Soil-to-plant transfer Factors. Bilthoven, Rijksinstituut vor de Volksgezondheid en Milieuhygiene (1989)

9. IUR. 8th report of the Working Group on Soil-to-plant transfer Factors, Balen, Belgium (1992)
10. IAEA Handbook of parameter values for the prediction of radionuclide transfer in temperate environments. Technical Report Series No 364. IAEA Vienna (1994)
11. Müller H and Pröhl G. ECOSYS-87: A dynamic model for assessing radiological consequences of nuclear accidents. Health Physics 64 (3) 232-252 (1993)
12. Pinder III J E and McLeod K W. Mass loading of soil particles on plant surfaces. Health Physics 57 (6) 935 – 942 (1989)
13. EC, Belarus, the Russian Federation, Ukraine, Experimental collaboration project no 2: The transfer of radionuclides through the terrestrial environment to agricultural products, including the evaluation of agrochemical practices, EC EUR 16528, Brussels (1996)
14. Hinton T G, McDonald M et al. Foliar absorption of resuspended Cs-137 relative to other pathways of plant contamination. J Environ Radioactivity, Tran 30 (1) 15-30 (1996)
15. Green N, Wilkins B T, Hammond D J and Davidson M F. Transfer of radionuclides to vegetables and other crops in an area of land reclaimed from the sea: a compilation of data. Chilton NRPB-M538 (1995)
16. Mayall A. FARMLAND: transfer of radionuclides to fruit. Chilton NRPB-M545 (1995)
17. IAEA. Modelling of resuspension, seasonality and losses during food processing. First report of the VAMP terrestrial working group. IAEA-TECDOC-647,IAEA, Vienna, (1992)
18. Green N and Wilkins B T. Effects of processing on radionuclide content of foods: derivation of parameter values for use in radiological assessments. Chilton NRPB-M587 (1995)
19. Haywood S M. A review of the data on the time delay between harvesting or collection of food products and consumption. Chilton NRPB-M83 (1983)
20. Jones J A, Kraan B C P, Cooke R M, Goossens L H J, Fischer F and Hasemann I. Probabilistic accident consequence uncertainty assessment using COSYMA: Methodology and processing techniques. EUR 18827
21. Cooke R M. Parameter fitting for uncertain models: modelling uncertainty in small models. Reliability Engineering and system safety. 44 89-102 (1994)
22. Kraan B C P and Cooke R M. Post-processing techniques for the joint CEC-USNRC uncertainty analysis of accident consequence codes. Journal of Statistical Computation and Simulation 57 (1-4) 243-261, (1996)
23. Kraan B C P and Cooke R M. Uncertainty in compartmental models for hazardous material – a case study. Journal of Hazardous Material 71 253-268 (2000)
24. Cooke R M. UNICORN: Methods and code for uncertainty analysis. AEA Technology Warrington, UK (1995)
25. Iman R L and Shortencarier M J. A Fortran 77 program and user's guide for the generation of Latin Hypercube and random samples for use with computer models. Sandia National Labs, Albuquerque, SAND 83-2365, NUREG/CR-3624 (1984)

Table 2.1 Summary of uncertain input parameters for food chain models, and the quantities from which they were derived

Identifier	Uncertain input parameter	Obtained from[a]
1	Interception factors for pasture, hay/silage, cereals, green vegetables, potatoes and root vegetables[b]	4
2	Retention times on hay/silage, green vegetables, cereals, potatoes and root vegetables[b]	6
3	Root uptake factor for Sr, Cs, I, Mn, Zn, Co, Te, Ag, Ce to pasture	3 and project staff
4	Root uptake factor for Sr, Cs, I[c], Mn[c], Zn, Co, Te[c], Ag[c], Ce[c] to cereals	7 and project staff
5	Root uptake factor for Sr, Cs, I[c], Mn, Zn, Co, Te[c], Ag[c], Ce[c] to green vegetables	3 and project staff
6	Root uptake factor for Sr, Cs, I[c], Mn, Zn, Co, Te[c], Ag[c], Ce[c] to potatoes	8 and project staff
7	Root uptake factor for Sr, Cs, I[c], Mn[b], Zn[b], Co[b], Te[b], Ag[b], Ce[b] to root crops	8
8	Translocation parameters for Sr and Cs in cereals, potatoes and root vegetables[b]	7, 8
9	Soil migration parameters for Sr, Cs, I, Mn, Zn, Co, Te, Ag, Ce in pasture grass	1 and project staff
10	Soil migration parameters for Sr, and Cs for green vegetables, cereals, potatoes and root crops	1
11	Soil migration parameters for I, Mn, Zn, Co, Te, Ag and Ce for vegetables, cereals, potatoes and root vegetables	Project staff
12	Soil fixation parameters for Cs in pasture grass	2
13	Processing loss for cereals, green vegetables, potatoes and root vegetables[b]	Project staff
14	Resuspension factor for pasture grass and surface crops	5
15	Soil contamination of hay/silage, cereals, green vegetables, potatoes and root vegetables[d]	Project staff
16	Daily intake rates of feedstuffs (pasture grass, silage/hay, cereals) and soil for dairy cows, beef cattle, sheep and pigs	9
17	Gut retention times for dairy cows and sheep for I, Sr, Cs[e], Mn[e], Zn[e], Co[e] Te[e], Ag[e] and Ce[e]	Project staff
18	Equilibrium transfer factors, F_m, for Sr, Cs, I, Mn, Zn, Co, Te, Ag, Ce to milk of dairy cows	13 and project staff
19	Equilibrium transfer factors, F_f, for Sr, Cs, I, Mn, Zn, Co, Te, Ag, Ce to meat of dairy cows, beef cattle, sheep and pigs	3 and project staff
20	Equilibrium transfer factors, F_f, for Sr, Cs, I, Mn, Zn, Co, Te, Ag, Ce to liver of dairy cows, beef cattle and sheep	3 and project staff
21	Biological half lives in meat for dairy cows, beef cattle, sheep and pigs for Sr, Cs, I, Mn, Zn, Co, Te, Ag, Ce	14 and project staff
22	Delay times between harvest and consumption for green vegetables, cereals, potatoes, root vegetables, milk, milk products, meat from cattle, sheep and pigs, and offal	Project staff

Notes

a) This column denotes the elicitation variables in Table 2.2 used to determine the distributions on each of the groups of target variables and indicates where information came from project staff.
b) assumed to be the same value as potatoes
c) assumed to be the same value as pasture
d) assumed to be the same value as green vegetables
e) assumed to be the same value as for Sr

Table 2.2 Summary of elicitation variables for which distributions were obtained from expert judgement

Identifier	Quantity for which distributions were obtained
Quantities obtained from the soil – plant panel	
1	Soil migration: time taken for 50% of initial deposit of strontium and caesium to migrate below depths of 1cm, 5cm, 15cm and 30cm for a generic soil in Europe, a sandy soil and a highly organic soil.
2	Fixation of caesium and strontium in soil: fraction of each element that becomes unavailable for uptake by plants after 1 year, 3 years, 5 years and 10 years following deposition.
3	Root uptake concentration factors: activity concentrations of caesium and strontium in green vegetables, pasture grass, root vegetables, potatoes and cereals at maturity which are grown on soil containing 1 Bq kg^{-1}. Elicited for a generic European soil, sandy soil and a highly organic soil at 6 months, 1 year, 3 years and 10 years following deposition. Information was also obtained on the uptake of material of marine origin.
4	Interception factor: fraction of total deposition that is intercepted by the plant surface for green vegetables, cereals, root vegetables, grass for silage/hay and pasture at maturity.
5	Resuspension factor: resuspension factor for typical surface crop and pasture grass from resuspension of a fresh deposit to soil by wind driven processes
6	Retention times: time taken for the original activity on the plant to be reduced by 50% for green vegetables, cereals, root vegetables, grass for hay/silage and pasture.
7	Concentration in grain at harvest: activity concentration in grain at harvest following deposition to the crop 15 days, 30 days, 90 days and 120 days before harvest.
8	Concentration in root vegetables at harvest: activity concentration of strontium and caesium in grain at harvest following deposition to the crop 15 days, 30 days, 90 days and 120 days before harvest.
Quantities obtained from the animal panel	
9	Animals' consumption rates: daily consumption rates of pasture grass, hay/silage and cereals by dairy cows, beef cattle, sheep, pigs and poultry.
10	Consumption rate of soil: daily consumption rate of soil for cattle and sheep grazing outdoors and pigs and poultry consuming cereals/grass.
11	Availability of ingested feed: fraction of activity associated with pasture grass available for transfer across the gut for activity freshly deposited, biologically incorporated and associated with soil, for Sr, Cs and I.
12	Transfer to meat: the fraction of the daily intake transferred to a kg of meat in dairy cows, beef cattle, sheep, pigs and poultry at equilibrium under constant feeding of activity for Cs and Sr
13	Transfer to eggs: the fraction of the daily intake transferred to a kg of eggs at equilibrium under constant feeding of activity for Cs and Sr
14	Transfer to milk: the fraction of the daily intake transferred to a litre of milk in dairy cows, sheep and goats at equilibrium under constant feeding of activity for Cs, Sr and I.
15	Biological half-life in animals: weighted average residence time of Sr, Cs and I in meat of dairy cows, beef cattle, sheep, pigs and poultry after equilibrium in the animal has been reached.

Table 2.3 Distributions on the input parameters to FARMLAND[(a)]

FARMLAND parameter	Units	Default	Percentiles of the distribution on the parameter value								
			Minimum	5%	20%	35%	50%	65%	80%	95%	Maximum
Parameters of the model for concentration in green vegetables											
Resuspension factor- surface crops	m-1	$7.63\ 10^{-8}$	$1.00\ 10^{-10}$	$1.34\ 10^{-9}$	$2.62\ 10^{-8}$	$5.10\ 10^{-8}$	$7.58\ 10^{-8}$	$6.10\ 10^{-6}$	$1.21\ 10^{-5}$	$1.81\ 10^{-5}$	$6.60\ 10^{-5}$
Interception factor - green vegetables		$3.00\ 10^{-1}$	$1.00\ 10^{-3}$	$7.34\ 10^{-2}$	$2.13\ 10^{-1}$	$3.52\ 10^{-1}$	$4.91\ 10^{-1}$	$6.18\ 10^{-1}$	$7.45\ 10^{-1}$	$8.72\ 10^{-1}$	$1.00\ 10^{0}$
Retention time - green vegetables	days	$1.40\ 10^{1}$	$1.00\ 10^{-1}$	$3.60\ 10^{0}$	$8.53\ 10^{0}$	$1.35\ 10^{1}$	$1.84\ 10^{1}$	$2.82\ 10^{1}$	$3.80\ 10^{1}$	$4.78\ 10^{1}$	$5.48\ 10^{1}$
Soil contamination - green vegetables	fraction of dry mass	0.1	$1.30\ 10^{-2}$	$9.88\ 10^{-2}$	$3.05\ 10^{-1}$	$5.79\ 10^{-1}$	$9.94\ 10^{-1}$	$1.71\ 10^{0}$	$3.24\ 10^{0}$	$1.00\ 10^{1}$	$7.60\ 10^{1}$
Processing loss - green vegetables	Bq kg-1 / Bq kg-1	0.2	$5.00\ 10^{-2}$	$1.00\ 10^{-1}$	$1.33\ 10^{-1}$	$1.67\ 10^{-1}$	$2.00\ 10^{-1}$	$3.33\ 10^{-1}$	$4.67\ 10^{-1}$	$6.00\ 10^{-1}$	$9.00\ 10^{-1}$
Root uptake - green vegetables, Sr	Bq kg-1 / Bq kg-1	$3.00\ 10^{-1}$	$1.00\ 10^{-3}$	$2.02\ 10^{-2}$	$1.64\ 10^{-1}$	$3.08\ 10^{-1}$	$4.53\ 10^{-1}$	$1.25\ 10^{0}$	$2.05\ 10^{0}$	$2.85\ 10^{0}$	$5.50\ 10^{0}$
Root uptake - green vegetables, Cs	Bq kg-1 / Bq kg-1	$7.00\ 10^{-3}$	$1.00\ 10^{-4}$	$1.08\ 10^{-3}$	$8.74\ 10^{-3}$	$1.64\ 10^{-2}$	$2.40\ 10^{-2}$	$9.16\ 10^{-2}$	$1.59\ 10^{-1}$	$2.27\ 10^{-1}$	$3.41\ 10^{-1}$
Root uptake - green vegetables, Mn	Bq kg-1 / Bq kg-1	$1.00\ 10^{-1}$	$6.60\ 10^{-4}$	$5.00\ 10^{-3}$	$1.50\ 10^{-2}$	$2.90\ 10^{-2}$	$5.00\ 10^{-2}$	$8.60\ 10^{-2}$	$1.63\ 10^{-1}$	$5.02\ 10^{-1}$	$3.80\ 10^{0}$
Root uptake - green vegetables, Zn	Bq kg-1 / Bq kg-1	1	$3.60\ 10^{-2}$	$8.00\ 10^{-2}$	$1.25\ 10^{-1}$	$1.61\ 10^{-1}$	$2.00\ 10^{-1}$	$2.46\ 10^{-1}$	$3.17\ 10^{-1}$	$4.94\ 10^{-1}$	$1.10\ 10^{0}$
Root uptake - green vegetables, Co	Bq kg-1 / Bq kg-1	$1.00\ 10^{-2}$	$2.60\ 10^{-4}$	$1.97\ 10^{-3}$	$6.07\ 10^{-3}$	$1.15\ 10^{-2}$	$1.98\ 10^{-2}$	$3.39\ 10^{-2}$	$6.42\ 10^{-2}$	$1.98\ 10^{-1}$	$1.50\ 10^{0}$
Delay time - green vegetables	Days	5	$3.00\ 10^{0}$	$3.63\ 10^{0}$	$4.26\ 10^{0}$	$4.67\ 10^{0}$	$5.00\ 10^{0}$	$5.33\ 10^{0}$	$5.74\ 10^{0}$	$6.37\ 10^{0}$	$7.00\ 10^{0}$
Delay time - processed green vegetables	Days	$1.80\ 10^{2}$	$1.20\ 10^{2}$	$1.39\ 10^{2}$	$1.58\ 10^{2}$	$1.70\ 10^{2}$	$1.80\ 10^{2}$	$1.90\ 10^{2}$	$2.02\ 10^{2}$	$2.21\ 10^{2}$	$2.40\ 10^{2}$
Parameters of the model for concentration in root vegetables											
Interception factor- potatoes		0.4	$1.00\ 10^{-4}$	$5.38\ 10^{-3}$	$1.39\ 10^{-1}$	$2.73\ 10^{-1}$	$4.07\ 10^{-1}$	$5.83\ 10^{-1}$	$7.58\ 10^{-1}$	$9.34\ 10^{-1}$	$1.00\ 10^{0}$
Retention time - potatoes, k21, Sr	d-1	$4.95\ 10^{-2}$	$1.13\ 10^{-5}$	$2.54\ 10^{-4}$	$1.50\ 10^{-3}$	$4.66\ 10^{-3}$	$9.00\ 10^{-3}$	$1.70\ 10^{-2}$	$3.41\ 10^{-2}$	$9.53\ 10^{-2}$	$1.49\ 10^{-1}$
Retention time - potatoes, k21, Cs	d-1	$4.95\ 10^{-2}$	$1.16\ 10^{-5}$	$2.43\ 10^{-4}$	$7.19\ 10^{-4}$	$1.39\ 10^{-3}$	$2.22\ 10^{-3}$	$1.12\ 10^{-2}$	$9.64\ 10^{-2}$	$4.09\ 10^{-1}$	$6.38\ 10^{-1}$
Soil contamination - potatoes	fraction of dry mass	0.1	$1.30\ 10^{-2}$	$9.88\ 10^{-2}$	$3.05\ 10^{-1}$	$5.79\ 10^{-1}$	$9.94\ 10^{-1}$	$1.71\ 10^{0}$	$3.24\ 10^{0}$	$1.00\ 10^{2}$	$7.60\ 10^{1}$
Processing loss - potatoes		1	$5.00\ 10^{-1}$	$6.00\ 10^{-1}$	$6.66\ 10^{-1}$	$7.33\ 10^{-1}$	$8.00\ 10^{-1}$	$8.50\ 10^{-1}$	$9.00\ 10^{-1}$	$9.50\ 10^{-1}$	$1.00\ 10^{0}$
Root uptake- potatoes, Sr	Bq kg-1 / Bq kg-1	$5.00\ 10^{-2}$	$1.00\ 10^{-4}$	$3.15\ 10^{-3}$	$1.55\ 10^{-2}$	$2.78\ 10^{-2}$	$4.01\ 10^{-2}$	$1.06\ 10^{-1}$	$1.71\ 10^{-1}$	$2.37\ 10^{-1}$	$3.30\ 10^{-1}$
Root uptake - potatoes, Cs	Bq kg-1 / Bq kg-1	$7.00\ 10^{-3}$	$1.00\ 10^{-5}$	$8.57\ 10^{-4}$	$6.37\ 10^{-3}$	$1.19\ 10^{-2}$	$1.74\ 10^{-2}$	$6.51\ 10^{-2}$	$1.13\ 10^{-1}$	$1.61\ 10^{-1}$	$2.90\ 10^{-1}$
Root uptake - potatoes, Mn	Bq kg-1 / Bq kg-1	$1.00\ 10^{-1}$	$1.30\ 10^{-4}$	$9.90\ 10^{-4}$	$3.05\ 10^{-3}$	$5.79\ 10^{-3}$	$9.94\ 10^{-3}$	$1.71\ 10^{-2}$	$3.24\ 10^{-2}$	$1.00\ 10^{-1}$	$7.60\ 10^{-1}$
Root uptake - potatoes, Zn	Bq kg-1 / Bq kg-1	$5.00\ 10^{-1}$	$7.40\ 10^{-3}$	$2.52\ 10^{-2}$	$4.98\ 10^{-2}$	$7.34\ 10^{-2}$	$1.02\ 10^{-1}$	$1.41\ 10^{-1}$	$2.08\ 10^{-1}$	$4.11\ 10^{-1}$	$1.40\ 10^{0}$

			Percentiles of the distribution on the parameter value									
Root uptake - potaotes, Co	Bq kg-1 / Bq kg-1	1.00 10^{-2}	1.30 10^{-4}	9.90 10^{-4}	3.05 10^{-3}	5.79 10^{-3}	9.94 10^{-3}	1.71 10^{-2}	3.24 10^{-2}	1.00 10^{-1}	7.60 10^{-1}
Translocation potatoes- k24, Sr	d-1	4.46 10^{-5}	1.98 10^{-8}	4.27 10^{-7}	7.23 10^{-7}	1.39 10^{-6}	3.11 10^{-6}	5.42 10^{-6}	1.14 10^{-5}	2.31 10^{-4}	6.32 10^{-4}
Translocation potatoes - k45, Sr	d-1	4.46 10^{-5}	3.69 10^{-5}	8.36 10^{-3}	2.96 10^{-2}	3.54 10^{-2}	4.27 10^{-2}	5.44 10^{-2}	6.15 10^{-2}	2.28 10^{-1}	3.61 10^{-1}
Translocation potatoes - k51, Sr	d-1	3.73 10^{-3}	1.99 10^{-6}	5.39 10^{-6}	3.49 10^{-5}	6.13 10^{-4}	1.98 10^{-3}	4.30 10^{-3}	1.14 10^{-2}	2.96 10^{-2}	8.08 10^{-2}
Translocation potatoes - k24, Cs	d-1	4.20 10^{-2}	9.56 10^{-8}	6.58 10^{-6}	5.86 10^{-4}	2.39 10^{-3}	5.42 10^{-3}	9.85 10^{-3}	2.81 10^{-2}	4.25 10^{-2}	9.12 10^{-2}
Translocation potatoes - k45, Cs	d-1	4.20 10^{-2}	2.13 10^{-6}	6.29 10^{-4}	4.68 10^{-3}	1.34 10^{-2}	2.58 10^{-2}	4.63 10^{-2}	7.19 10^{-2}	2.94 10^{-1}	3.70 10^{-1}
Translocation potatoes - k51, Cs	d-1	5.80 10^{-2}	1.87 10^{-6}	2.81 10^{-5}	4.72 10^{-3}	1.34 10^{-2}	3.10 10^{-2}	5.91 10^{-2}	7.14 10^{-2}	1.47 10^{-1}	2.89 10^{-1}
Root uptake - root crops, Sr	Bq kg-1 / Bq kg-1	1.00 10^{-1}	1.00 10^{-3}	2.02 10^{-2}	9.99 10^{-2}	1.80 10^{-1}	2.59 10^{-1}	7.00 10^{-1}	1.14 10^{0}	1.58 10^{0}	2.37 10^{0}
Root uptake - root crops, Cs	Bq kg-1 / Bq kg-1	5.00 10^{-3}	1.00 10^{-5}	1.18 10^{-4}	1.70 10^{-3}	3.28 10^{-3}	4.86 10^{-3}	2.39 10^{-2}	4.28 10^{-2}	6.18 10^{-2}	9.90 10^{-2}
Delay time - fresh potatoes and root crops	Days	1.40 10^{1}	5.00 10^{0}	8.00 10^{0}	1.10 10^{1}	1.29 10^{1}	1.55 10^{1}	1.71 10^{1}	1.90 10^{1}	2.20 10^{1}	2.50 10^{1}
Delay time - processed potatoes and root crops	Days	9.00 10^{1}	5.00 10^{1}	6.27 10^{1}	7.53 10^{1}	8.35 10^{1}	9.00 10^{1}	9.65 10^{1}	1.05 10^{2}	1.17 10^{2}	1.30 10^{2}
Parameters of the model for concentration in cereals												
Soil migration - cereals - k11, Sr	d-1	1.90 10^{-5}	3.21 10^{-6}	6.41 10^{-6}	8.88 10^{-6}	1.51 10^{-5}	5.03 10^{-5}	8.46 10^{-5}	1.62 10^{-4}	1.17 10^{-3}	2.23 10^{-3}
Soil migration - cereals - k11, Cs	d-1	1.90 10^{-5}	1.07 10^{-6}	2.13 10^{-6}	3.01 10^{-6}	5.14 10^{-6}	1.78 10^{-5}	2.50 10^{-5}	4.40 10^{-5}	1.82 10^{-4}	3.48 10^{-4}
Soil migration - cereals - k11, I, Mn, Zn, Co, Te, Ag, Ce	d-1	1.90 10^{-5}	5.00 10^{-1}	1.08 10^{0}	1.66 10^{0}	2.91 10^{0}	3.16 10^{0}	3.46 10^{0}	3.84 10^{0}	4.42 10^{0}	5.00 10^{0}
Interception factor - cereals		0.3	1.00 10^{-3}	2.63 10^{-2}	1.61 10^{-1}	2.96 10^{-1}	4.31 10^{-1}	6.13 10^{-1}	7.96 10^{-1}	9.78 10^{-1}	1.00 10^{0}
Retention time - cereals - k21, Sr	d -1	4.95 10^{-2}	1.20 10^{-2}	4.10 10^{-2}	9.86 10^{-2}	9.88 10^{-2}	9.90 10^{-2}	9.91 10^{-2}	1.11 10^{-1}	1.11 10^{-1}	3.15 10^{-1}
Retention time - cereals - k21, Cs	d-1	4.95 10^{-2}	1.20 10^{-6}	1.46 10^{-5}	1.54 10^{-3}	1.44 10^{-2}	2.53 10^{-2}	4.16 10^{-2}	6.32 10^{-2}	1.12 10^{-1}	1.68 10^{-1}
Soil contamination - cereals	fraction of dry mass	1.00 10^{-2}	1.30 10^{-3}	9.88 10^{-3}	3.05 10^{-2}	5.79 10^{-2}	9.94 10^{-2}	1.71 10^{-1}	3.24 10^{-1}	1.00 10^{0}	7.60 10^{0}
Processing loss - cereals		0.1	5.00 10^{-2}	1.00 10^{-1}	1.33 10^{-1}	1.66 10^{-1}	2.00 10^{-1}	3.00 10^{-1}	4.00 10^{-1}	5.00 10^{-1}	6.00 10^{-1}
Root uptake - cereals, Sr	Bq kg-1 / Bq kg-1	2.00 10^{-1}	1.00 10^{-3}	1.06 10^{-2}	5.23 10^{-2}	9.40 10^{-2}	1.36 10^{-1}	5.02 10^{-1}	8.68 10^{-1}	1.23 10^{0}	2.11 10^{0}
Root uptake - cereals, Cs	Bq kg-1 / Bq kg-1	1.00 10^{-2}	1.00 10^{-5}	7.54 10^{-4}	5.66 10^{-3}	1.06 10^{-2}	1.55 10^{-2}	7.05 10^{-2}	1.26 10^{-1}	1.81 10^{-1}	3.49 10^{-1}
Root uptake - cereals, Mn	Bq kg-1 / Bq kg-1	1.00 10^{-1}	1.90 10^{-3}	2.04 10^{-2}	7.65 10^{-2}	1.62 10^{-1}	3.05 10^{-1}	5.75 10^{-1}	1.22 10^{0}	4.56 10^{0}	4.90 10^{1}
Root uptake - cereals, Zn	Bq kg-1 / Bq kg-1	1	1.10 10^{-1}	3.02 10^{-1}	5.30 10^{-1}	7.30 10^{-1}	9.56 10^{-1}	1.25 10^{0}	1.72 10^{0}	3.02 10^{0}	8.30 10^{0}
Root uptake - cereals, Co	Bq kg-1 / Bq kg-1	5.00 10^{-3}	3.90 10^{-6}	9.98 10^{-5}	6.05 10^{-4}	1.69 10^{-3}	4.00 10^{-3}	9.49 10^{-3}	2.64 10^{-2}	1.60 10^{-1}	4.10 10^{0}

			Percentiles of the distribution on the parameter value									
Translocation cereals - k23, Sr	d-1	$3.71\ 10^{-2}$	$1.82\ 10^{-6}$	$1.65\ 10^{-2}$	$1.69\ 10^{-2}$	$6.54\ 10^{-2}$	$6.63\ 10^{-2}$	$6.72\ 10^{-2}$	$7.21\ 10^{-2}$	$1.13\ 10^{-1}$	$1.13\ 10^{-1}$
Translocation cereals - k34, Sr	d-1	$6.90\ 10^{-2}$	$8.43\ 10^{-2}$	$9.90\ 10^{-2}$	$1.13\ 10^{-1}$	$1.35\ 10^{-1}$	$1.57\ 10^{-1}$	$2.30\ 10^{-1}$	$9.32\ 10^{-1}$	$9.32\ 10^{-1}$	$9.32\ 10^{-1}$
Translocation cereals - k41, Sr	d-1	$4.52\ 10^{-1}$	$2.74\ 10^{-2}$	$4.25\ 10^{-2}$	$9.22\ 10^{-2}$	$9.44\ 10^{-2}$	$2.00\ 10^{-1}$	$3.45\ 10^{-1}$	$8.29\ 10^{-1}$	$9.67\ 10^{-1}$	$1.01\ 10^{0}$
Translocation cereals - k23, Cs	d-1	$3.41\ 10^{-2}$	$1.18\ 10^{-5}$	$1.42\ 10^{-2}$	$3.23\ 10^{-2}$	$5.40\ 10^{-2}$	$7.19\ 10^{-2}$	$1.10\ 10^{-1}$	$2.00\ 10^{-1}$	$4.86\ 10^{-1}$	$1.12\ 10^{0}$
Translocation cereals - k34, Cs	d-1	$6.44\ 10^{-2}$	$2.52\ 10^{-2}$	$3.43\ 10^{-2}$	$5.02\ 10^{-2}$	$6.88\ 10^{-2}$	$9.40\ 10^{-2}$	$1.04\ 10^{-1}$	$1.88\ 10^{-1}$	$4.29\ 10^{-1}$	$6.26\ 10^{-1}$
Translocation cereals - k41, Cs	d-1	$5.21\ 10^{-2}$	$6.30\ 10^{-5}$	$1.61\ 10^{-2}$	$2.70\ 10^{-2}$	$3.17\ 10^{-2}$	$4.10\ 10^{-2}$	$5.45\ 10^{-2}$	$6.64\ 10^{-2}$	$1.07\ 10^{-1}$	$1.71\ 10^{-1}$
Delay time - cereals	Days	$6.00\ 10^{1}$	$4.00\ 10^{1}$	$4.77\ 10^{1}$	$5.55\ 10^{1}$	$7.21\ 10^{1}$	$7.55\ 10^{1}$	$7.95\ 10^{1}$	$8.45\ 10^{1}$	$9.23\ 10^{1}$	$1.00\ 10^{2}$
Parameters of the model for concentration in pasture and silage												
Interception factor - pasture		0.25	$1.00\ 10^{-3}$	$2.73\ 10^{-2}$	$1.16\ 10^{-1}$	$2.04\ 10^{-1}$	$2.92\ 10^{-1}$	$4.71\ 10^{-1}$	$6.50\ 10^{-1}$	$8.29\ 10^{-1}$	$9.56\ 10^{-1}$
Retention time - hay/silage	days	$1.40\ 10^{1}$	$1.00\ 10^{-1}$	$2.33\ 10^{0}$	$7.24\ 10^{0}$	$1.22\ 10^{1}$	$1.71\ 10^{1}$	$2.60\ 10^{1}$	$3.50\ 10^{1}$	$4.39\ 10^{1}$	$5.50\ 10^{1}$
Interception factor - hay/silage		0.62	$1.00\ 10^{-3}$	$6.97\ 10^{-2}$	$2.40\ 10^{-1}$	$4.11\ 10^{-1}$	$5.81\ 10^{-1}$	$7.03\ 10^{-1}$	$8.25\ 10^{-1}$	$9.46\ 10^{-1}$	$1.00\ 10^{0}$
Root uptake pasture, Sr	Bq kg-1 / Bq kg-1	$5.00\ 10^{-2}$	$1.00\ 10^{-3}$	$2.13\ 10^{-2}$	$1.11\ 10^{-1}$	$2.02\ 10^{-1}$	$2.92\ 10^{-1}$	$6.92\ 10^{-1}$	$1.09\ 10^{0}$	$1.49\ 10^{0}$	$2.20\ 10^{0}$
Root uptake pasture, Cs	Bq kg-1 / Bq kg-1	$3.00\ 10^{-2}$	$1.00\ 10^{-4}$	$2.11\ 10^{-3}$	$1.24\ 10^{-2}$	$2.27\ 10^{-2}$	$3.30\ 10^{-2}$	$1.02\ 10^{-1}$	$1.70\ 10^{-1}$	$2.39\ 10^{-1}$	$3.46\ 10^{-1}$
Root uptake pasture, I	Bq kg-1 / Bq kg-1	$2.00\ 10^{-2}$	$5.00\ 10^{-4}$	$1.00\ 10^{-3}$	$7.33\ 10^{-3}$	$1.37\ 10^{-2}$	$2.00\ 10^{-2}$	$4.66\ 10^{-2}$	$7.33\ 10^{-2}$	$1.00\ 10^{-1}$	$2.00\ 10^{-1}$
Root uptake pasture, Mn	Bq kg-1 / Bq kg-1	$1.00\ 10^{-1}$	$1.30\ 10^{-3}$	$9.88\ 10^{-3}$	$3.05\ 10^{-2}$	$5.79\ 10^{-2}$	$9.94\ 10^{-2}$	$1.70\ 10^{-1}$	$3.24\ 10^{-1}$	$1.00\ 10^{0}$	$7.60\ 10^{0}$
Root uptake pasture, Zn	Bq kg-1 / Bq kg-1	1	$1.10\ 10^{-2}$	$3.02\ 10^{-2}$	$5.30\ 10^{-2}$	$7.30\ 10^{-2}$	$9.56\ 10^{-2}$	$1.25\ 10^{-1}$	$1.72\ 10^{-1}$	$3.02\ 10^{-1}$	$8.30\ 10^{-1}$
Root uptake pasture, Co	Bq kg-1 / Bq kg-1	$1.00\ 10^{-2}$	$3.20\ 10^{-6}$	$9.97\ 10^{-5}$	$6.74\ 10^{-4}$	$2.00\ 10^{-3}$	$5.00\ 10^{-3}$	$1.25\ 10^{-2}$	$3.70\ 10^{-2}$	$2.50\ 10^{-1}$	$7.80\ 10^{0}$
Root uptake pasture, Te	Bq kg-1 / Bq kg-1	$5.00\ 10^{-3}$	$5.00\ 10^{-4}$	$1.47\ 10^{-3}$	$2.67\ 10^{-3}$	$3.75\ 10^{-3}$	$5.00\ 10^{-3}$	$6.66\ 10^{-3}$	$9.36\ 10^{-3}$	$1.70\ 10^{-2}$	$5.00\ 10^{-2}$
Root uptake pasture, Ag	Bq kg-1 / Bq kg-1	$2.00\ 10^{-1}$	$1.30\ 10^{-3}$	$9.88\ 10^{-3}$	$3.05\ 10^{-2}$	$5.79\ 10^{-2}$	$9.94\ 10^{-2}$	$1.71\ 10^{-1}$	$3.24\ 10^{-1}$	$1.00\ 10^{0}$	$7.60\ 10^{0}$
Root uptake pasture, Ce	Bq kg-1 / Bq kg-1	$1.00\ 10^{-3}$	$1.30\ 10^{-5}$	$9.88\ 10^{-5}$	$3.05\ 10^{-4}$	$5.79\ 10^{-4}$	$9.94\ 10^{-4}$	$1.71\ 10^{-3}$	$3.24\ 10^{-3}$	$1.00\ 10^{-2}$	$7.60\ 10^{-2}$
Soil migration pasture - k12, Sr	d-1	$6.65\ 10^{-4}$	$6.40\ 10^{-5}$	$6.69\ 10^{-4}$	$1.42\ 10^{-3}$	$2.06\ 10^{-3}$	$3.22\ 10^{-3}$	$7.15\ 10^{-3}$	$1.39\ 10^{-2}$	$1.87\ 10^{-2}$	$2.18\ 10^{-2}$
Soil migration pasture - k23, Sr	d-1	$1.72\ 10^{-4}$	$4.67\ 10^{-5}$	$8.11\ 10^{-5}$	$1.21\ 10^{-4}$	$1.60\ 10^{-4}$	$3.43\ 10^{-4}$	$7.22\ 10^{-4}$	$1.88\ 10^{-3}$	$2.41\ 10^{-2}$	$2.83\ 10^{-2}$
Soil migration pasture - k34, Sr	d-1	$1.07\ 10^{-4}$	$1.35\ 10^{-5}$	$1.78\ 10^{-5}$	$9.14\ 10^{-5}$	$3.47\ 10^{-4}$	$6.93\ 10^{-4}$	$1.36\ 10^{-3}$	$3.25\ 10^{-3}$	$4.52\ 10^{-3}$	$7.94\ 10^{-1}$
Soil migration pasture - k43, Sr	d-1	$4.03\ 10^{-6}$	$8.67\ 10^{-12}$	$2.74\ 10^{-11}$	$1.95\ 10^{-5}$	$1.12\ 10^{-4}$	$2.26\ 10^{-4}$	$5.00\ 10^{-4}$	$1.16\ 10^{-3}$	$3.00\ 10^{-3}$	$1.15\ 10^{-1}$
Soil migration pasture - k45, Sr	d-1	$3.80\ 10^{-5}$	$7.38\ 10^{-6}$	$1.63\ 10^{-5}$	$2.24\ 10^{-5}$	$3.81\ 10^{-5}$	$1.27\ 10^{-4}$	$2.88\ 10^{-4}$	$5.74\ 10^{-4}$	$1.36\ 10^{-2}$	$5.28\ 10^{-2}$
Soil migration pasture- k12, Cs	d-1	$6.65\ 10^{-4}$	$1.73\ 10^{-5}$	$2.34\ 10^{-4}$	$5.72\ 10^{-4}$	$9.04\ 10^{-4}$	$1.18\ 10^{-3}$	$2.34\ 10^{-3}$	$3.64\ 10^{-3}$	$5.47\ 10^{-3}$	$6.45\ 10^{-3}$

			Percentiles of the distribution on the parameter value									
Soil migration pasture - k23, Cs	d-1	$1.72\ 10^{-4}$	$1.99\ 10^{-5}$	$3.07\ 10^{-5}$	$4.73\ 10^{-5}$	$1.14\ 10^{-4}$	$1.54\ 10^{-4}$	$2.96\ 10^{-4}$	$7.23\ 10^{-4}$	$9.94\ 10^{-3}$	$1.34\ 10^{-2}$
Soil migration pasture - k34, Cs	d-1	$1.07\ 10^{-4}$	$2.23\ 10^{-5}$	$5.90\ 10^{-5}$	$4.82\ 10^{-4}$	$9.35\ 10^{-4}$	$1.47\ 10^{-3}$	$2.07\ 10^{-3}$	$4.12\ 10^{-3}$	$1.83\ 10^{-2}$	$4.38\ 10^{-1}$
Soil migration pasture - k43, Cs	d-1	$4.03\ 10^{-6}$	$3.23\ 10^{-7}$	$8.85\ 10^{-5}$	$6.29\ 10^{-4}$	$1.42\ 10^{-3}$	$2.18\ 10^{-3}$	$3.52\ 10^{-3}$	$6.79\ 10^{-3}$	$2.45\ 10^{-2}$	$1.48\ 10^{0}$
Soil migration pasture - k45, Cs	d-1	$3.80\ 10^{-5}$	$2.65\ 10^{-6}$	$4.62\ 10^{-6}$	$7.45\ 10^{-6}$	$2.94\ 10^{-5}$	$4.95\ 10^{-5}$	$6.13\ 10^{-5}$	$1.11\ 10^{-4}$	$6.52\ 10^{-4}$	$8.31\ 10^{-3}$
Soil fixation pasture, k1,11, Cs	d-1	$2.11\ 10^{-3}$	$6.55\ 10^{-5}$	$1.83\ 10^{-4}$	$2.77\ 10^{-4}$	$3.61\ 10^{-4}$	$4.71\ 10^{-4}$	$6.26\ 10^{-4}$	$8.70\ 10^{-4}$	$1.47\ 10^{-3}$	$2.56\ 10^{-3}$
Resuspension factor pasture	m-1	$1.00\ 10^{-8}$	$1.00\ 10^{-10}$	$1.64\ 10^{-9}$	$2.63\ 10^{-8}$	$5.10\ 10^{-8}$	$7.57\ 10^{-8}$	$5.87\ 10^{-6}$	$1.17\ 10^{-5}$	$1.75\ 10^{-5}$	$6.60\ 10^{-5}$
Soil contamination hay/silage	fraction of dry mass	0.04	$1.30\ 10^{-2}$	$9.88\ 10^{-2}$	$3.05\ 10^{-1}$	$5.79\ 10^{-1}$	$9.94\ 10^{-1}$	$1.71\ 10^{0}$	$3.24\ 10^{0}$	$1.00\ 10^{1}$	$7.60\ 10^{1}$
Parameters of the model for concentration in meat and milk of dairy cows												
Daily intake of soil - dairy cows	kg d-1	0.52	$1.00\ 10^{-3}$	$1.03\ 10^{-2}$	$1.35\ 10^{-1}$	$2.61\ 10^{-1}$	$3.86\ 10^{-1}$	$9.07\ 10^{-1}$	$1.43\ 10^{0}$	$1.95\ 10^{0}$	$2.75\ 10^{0}$
Daily intake of pasture - dairy cows	kg d-1	$1.30\ 10^{1}$	$3.00\ 10^{0}$	$6.22\ 10^{0}$	$8.95\ 10^{0}$	$1.17\ 10^{1}$	$1.44\ 10^{1}$	$1.76\ 10^{1}$	$2.07\ 10^{1}$	$2.39\ 10^{1}$	$2.70\ 10^{1}$
Daily intake of hay/silage - dairy cows	kg d-1	$1.55\ 10^{1}$	$1.90\ 10^{0}$	$5.07\ 10^{0}$	$7.51\ 10^{0}$	$9.95\ 10^{0}$	$1.24\ 10^{1}$	$1.57\ 10^{1}$	$1.90\ 10^{1}$	$2.23\ 10^{1}$	$2.71\ 10^{1}$
Gut retention - dairy cows, Sr	days	$3.40\ 10^{1}$	$2.00\ 10^{1}$	$2.40\ 10^{1}$	$2.73\ 10^{1}$	$3.06\ 10^{1}$	$3.40\ 10^{1}$	$3.68\ 10^{1}$	$3.97\ 10^{1}$	$4.25\ 10^{1}$	$4.50\ 10^{1}$
Gut retention - dairy cows, I	days	5.5	$5.00\ 10^{-1}$	$7.50\ 10^{-1}$	$2.33\ 10^{0}$	$3.92\ 10^{0}$	$5.50\ 10^{0}$	$7.83\ 10^{0}$	$1.02\ 10^{1}$	$1.25\ 10^{1}$	$1.50\ 10^{1}$
Fm transfer to milk - dairy cows, Sr	d l-1	$2.00\ 10^{-3}$	$1.00\ 10^{-5}$	$4.32\ 10^{-4}$	$1.05\ 10^{-3}$	$1.67\ 10^{-3}$	$2.29\ 10^{-3}$	$3.13\ 10^{-3}$	$3.97\ 10^{-3}$	$4.82\ 10^{-3}$	$5.47\ 10^{-3}$
Fm transfer to milk - dairy cows, Cs	d l-1	$5.00\ 10^{-3}$	$1.00\ 10^{-4}$	$1.01\ 10^{-3}$	$2.57\ 10^{-3}$	$4.13\ 10^{-3}$	$5.68\ 10^{-3}$	$1.18\ 10^{-2}$	$1.79\ 10^{-2}$	$2.41\ 10^{-2}$	$3.29\ 10^{-2}$
Fm transfer to milk - dairy cows, I	d l-1	$5.00\ 10^{-3}$	$1.00\ 10^{-5}$	$5.33\ 10^{-4}$	$2.90\ 10^{-3}$	$5.27\ 10^{-3}$	$7.63\ 10^{-3}$	$1.76\ 10^{-2}$	$2.75\ 10^{-2}$	$3.74\ 10^{-2}$	$5.49\ 10^{-2}$
Fm transfer to milk - dairy cows, Mn	d l-1	$3.00\ 10^{-3}$	$1.30\ 10^{-6}$	$9.88\ 10^{-6}$	$3.05\ 10^{-5}$	$5.79\ 10^{-5}$	$9.94\ 10^{-5}$	$1.71\ 10^{-4}$	$3.24\ 10^{-4}$	$1.00\ 10^{-3}$	$7.60\ 10^{-3}$
Fm transfer to milk - dairy cows, Zn	d l-1	$1.00\ 10^{-2}$	$4.00\ 10^{-5}$	$3.03\ 10^{-4}$	$9.33\ 10^{-4}$	$1.77\ 10^{-3}$	$3.03\ 10^{-3}$	$5.20\ 10^{-3}$	$9.86\ 10^{-3}$	$3.04\ 10^{-2}$	$2.30\ 10^{-1}$
Fm transfer to milk - dairy cows, Co	d l-1	$2.00\ 10^{-3}$	$3.60\ 10^{-6}$	$5.01\ 10^{-5}$	$2.17\ 10^{-4}$	$4.97\ 10^{-4}$	$1.00\ 10^{-3}$	$2.03\ 10^{-3}$	$4.65\ 10^{-3}$	$2.01\ 10^{-2}$	$2.80\ 10^{-1}$
Fm transfer to milk - dairy cows, Te	d l-1	$5.00\ 10^{-4}$	$6.60\ 10^{-6}$	$5.00\ 10^{-4}$	$1.54\ 10^{-4}$	$2.92\ 10^{-4}$	$5.00\ 10^{-4}$	$8.59\ 10^{-4}$	$1.63\ 10^{-3}$	$5.02\ 10^{-3}$	$3.80\ 10^{-2}$
Fm transfer to milk - dairy cows, Ag	d l-1	$3.00\ 10^{-2}$	$1.00\ 10^{-5}$	$2.00\ 10^{-5}$	$3.00\ 10^{-5}$	$4.00\ 10^{-5}$	$5.00\ 10^{-5}$	$3.37\ 10^{-3}$	$6.68\ 10^{-3}$	$1.00\ 10^{-2}$	$3.00\ 10^{-2}$
Fm transfer to milk - dairy cows, Ce	d l-1	$2.00\ 10^{-5}$	$4.00\ 10^{-7}$	$3.03\ 10^{-6}$	$9.33\ 10^{-6}$	$1.77\ 10^{-5}$	$3.03\ 10^{-5}$	$5.20\ 10^{-5}$	$9.86\ 10^{-5}$	$3.04\ 10^{-4}$	$2.30\ 10^{-3}$
Ff transfer to meat - dairy cows, Sr	d kg-1	$3.00\ 10^{-4}$	$1.00\ 10^{-6}$	$3.77\ 10^{-5}$	$8.26\ 10^{-4}$	$1.61\ 10^{-3}$	$2.40\ 10^{-3}$	$4.65\ 10^{-3}$	$6.89\ 10^{-3}$	$9.14\ 10^{-3}$	$1.10\ 10^{-2}$
Ff transfer to meat - dairy cows, Cs	d kg-1	$3.00\ 10^{-2}$	$1.00\ 10^{-6}$	$1.10\ 10^{-3}$	$7.63\ 10^{-3}$	$1.42\ 10^{-2}$	$2.07\ 10^{-2}$	$3.90\ 10^{-2}$	$5.73\ 10^{-2}$	$7.56\ 10^{-2}$	$1.32\ 10^{-1}$
Ff transfer to meat - dairy cows, I	d kg-1	$2.00\ 10^{-3}$	$7.00\ 10^{-4}$	$1.00\ 10^{-3}$	$1.33\ 10^{-3}$	$1.66\ 10^{-3}$	$2.00\ 10^{-3}$	$4.66\ 10^{-3}$	$7.33\ 10^{-3}$	$1.00\ 10^{-2}$	$5.00\ 10^{-2}$
Ff transfer to meat - dairy cows, Mn	d kg-1	$5.00\ 10^{-3}$	$2.40\ 10^{-5}$	$9.84\ 10^{-5}$	$2.16\ 10^{-4}$	$3.36\ 10^{-4}$	$4.90\ 10^{-4}$	$7.14\ 10^{-4}$	$1.11\ 10^{-3}$	$2.44\ 10^{-3}$	$1.00\ 10^{-2}$

			Percentiles of the distribution on the parameter value								
Ff transfer to meat - dairy cows, Zn	d kg-1	2.00 10^{-3}	1.80 10^{-2}	4.02 10^{-2}	6.29 10^{-2}	8.10 10^{-2}	1.00 10^{-1}	1.24 10^{-1}	1.60 10^{-1}	2.51 10^{-1}	5.60 10^{-1}
Ff transfer to meat - dairy cows, Co	d kg-1	1.00 10^{-3}	3.60 10^{-6}	5.01 10^{-5}	2.17 10^{-4}	4.97 10^{-4}	1.00 10^{-3}	2.03 10^{-3}	4.65 10^{-3}	2.01 10^{-2}	2.80 10^{-1}
Ff transfer to meat - dairy cows, Te	d kg-1	5.00 10^{-3}	6.60 10^{-5}	5.00 10^{-3}	1.54 10^{-3}	2.92 10^{-3}	5.01 10^{-3}	8.59 10^{-3}	1.63 10^{-2}	5.02 10^{-2}	3.80 10^{-1}
Ff transfer to meat - dairy cows, Ag	d kg-1	1.00 10^{-3}	8.20 10^{-4}	1.51 10^{-3}	2.11 10^{-3}	2.55 10^{-3}	3.00 10^{-3}	3.53 10^{-3}	4.28 10^{-3}	5.99 10^{-3}	1.10 10^{-2}
Ff transfer to meat - dairy cows, Ce	d kg-1	1.00 10^{-3}	1.30 10^{-6}	9.88 10^{-6}	3.05 10^{-5}	5.79 10^{-5}	9.94 10^{-5}	1.71 10^{-4}	3.24 10^{-4}	1.00 10^{-3}	7.60 10^{-3}
Ff transfer to liver - dairy cows, Mn	d kg-1	2.00 10^{-1}	2.60 10^{-4}	1.97 10^{-3}	6.07 10^{-3}	1.15 10^{-2}	1.97 10^{-2}	3.39 10^{-2}	6.42 10^{-2}	1.98 10^{-1}	1.50 10^{0}
Ff transfer to liver - dairy cows, Co	d kg-1	1.00 10^{-1}	1.30 10^{-3}	9.88 10^{-3}	3.05 10^{-2}	5.79 10^{-2}	9.94 10^{-2}	1.71 10^{-1}	3.23 10^{-1}	1.00 10^{0}	7.60 10^{0}
Ff transfer to liver - dairy cows, Ag	d kg-1	4.00 10^{-1}	1.60 10^{-2}	1.21 10^{-1}	3.72 10^{-1}	7.04 10^{-1}	1.21 10^{0}	2.07 10^{0}	3.92 10^{0}	1.21 10^{1}	9.10 10^{1}
Ff transfer to liver - dairy cows, Ce	d kg-1	2.00 10^{-1}	2.60 10^{-4}	1.97 10^{-3}	6.07 10^{-3}	1.15 10^{-2}	1.98 10^{-2}	3.39 10^{-2}	6.42 10^{-2}	1.98 10^{-1}	1.50 10^{0}
Biological half-life - dairy cows, Sr	days	2.80 10^{1}	1.00 10^{-2}	2.35 10^{-1}	6.50 10^{0}	1.28 10^{1}	1.90 10^{1}	6.39 10^{1}	1.09 10^{2}	1.54 10^{2}	2.20 10^{2}
Biological half-life - dairy cows, Cs	days	2.80 10^{1}	1.00 10^{-1}	4.17 10^{0}	1.14 10^{1}	1.86 10^{1}	2.58 10^{1}	3.34 10^{1}	4.10 10^{1}	4.86 10^{1}	6.56 10^{1}
Biological half-life - dairy cows, I	days	1.40 10^{1}	1.00 10^{-2}	1.16 10^{-1}	2.37 10^{0}	4.62 10^{0}	6.88 10^{0}	1.30 10^{1}	1.92 10^{1}	2.54 10^{1}	3.85 10^{1}
Biological half-life - dairy cows, Mn	days	2.00 10^{1}	2.00 10^{0}	5.87 10^{0}	1.07 10^{1}	1.50 10^{1}	2.00 10^{1}	2.67 10^{1}	3.74 10^{1}	6.81 10^{1}	2.00 10^{2}
Biological half-life - dairy cows, Zn	days	2.80 10^{2}	2.80 10^{1}	8.22 10^{1}	1.50 10^{2}	2.10 10^{2}	2.80 10^{2}	3.73 10^{2}	5.24 10^{2}	9.54 10^{2}	2.80 10^{3}
Biological half-life - dairy cows, Co	days	1.70 10^{2}	1.70 10^{1}	5.00 10^{1}	9.08 10^{1}	1.28 10^{2}	1.70 10^{2}	2.26 10^{2}	3.18 10^{2}	5.79 10^{2}	1.70 10^{3}
Biological half-life - dairy cows, Te	days	2.00 10^{1}	2.00 10^{0}	5.87 10^{0}	1.07 10^{1}	1.50 10^{1}	2.00 10^{1}	2.67 10^{1}	3.74 10^{1}	6.81 10^{1}	2.00 10^{2}
Biological half-life - dairy cows, Ag	days	5.00 10^{1}	5.00 10^{0}	1.47 10^{1}	2.67 10^{1}	3.75 10^{1}	5.00 10^{1}	6.66 10^{1}	9.36 10^{1}	1.70 10^{2}	5.00 10^{2}
Biological half-life - dairy cows, Ce	days	3.50 10^{3}	3.50 10^{2}	1.03 10^{3}	1.87 10^{3}	2.63 10^{3}	3.50 10^{3}	4.66 10^{3}	6.55 10^{3}	1.19 10^{4}	3.50 10^{4}
Delay time - milk	Days	2	1.50 10^{0}	1.69 10^{0}	1.89 10^{0}	2.30 10^{0}	2.39 10^{0}	2.49 10^{0}	2.61 10^{0}	2.81 10^{0}	3.00 10^{0}
Delay time - cream	Days	3.00 10^{1}[(a)]	3.00 10^{0}	3.39 10^{0}	3.77 10^{0}	4.60 10^{0}	4.78 10^{0}	4.98 10^{0}	5.23 10^{0}	5.61 10^{0}	6.00 10^{0}
Delay time - butter	Days		2.00 10^{1}	2.28 10^{1}	2.57 10^{1}	2.75 10^{1}	3.11 10^{1}	3.25 10^{1}	3.43 10^{1}	3.72 10^{1}	4.00 10^{1}
Delay time - cheese	Days		9.00 10^{1}	1.02 10^{2}	1.13 10^{2}	1.38 10^{2}	1.43 10^{2}	1.49 10^{2}	1.57 10^{2}	1.68 10^{2}	1.80 10^{2}
Parameters in the model for concentration in meat of beef cattle and sheep											
Daily intake of pasture - beef cattle	kg d-1	1.30 10^{1}	1.80 10^{0}	3.61 10^{0}	5.18 10^{0}	6.74 10^{0}	8.30 10^{0}	1.02 10^{1}	1.20 10^{1}	1.39 10^{1}	1.62 10^{1}
Daily intake of silage/hay - beef cattle	kg d-1	1.55 10^{1}	7.00 10^{-1}	2.97 10^{0}	4.62 10^{0}	6.27 10^{0}	7.92 10^{0}	9.84 10^{0}	1.18 10^{1}	1.37 10^{1}	1.63 10^{1}

			Percentiles of the distribution on the parameter value								
Ff transfer to meat - beef cattle, Sr	d kg-1	3.00 10^{-4}	1.00 10^{-5}	1.59 10^{-4}	1.70 10^{-3}	3.25 10^{-3}	4.80 10^{-3}	2.39 10^{-2}	4.30 10^{-2}	6.21 10^{-2}	1.10 10^{-1}
Ff transfer to meat - beef cattle, Cs	d kg-1	3.00 10^{-2}	1.00 10^{-4}	3.05 10^{-3}	1.52 10^{-2}	2.74 10^{-2}	3.95 10^{-2}	5.68 10^{-2}	7.41 10^{-2}	9.14 10^{-2}	1.32 10^{-1}
Daily intake of soil - sheep	kg d-1	3.00 10^{-1}	1.00 10^{-3}	1.03 10^{-2}	4.52 10^{-2}	8.02 10^{-2}	1.15 10^{-1}	2.14 10^{-1}	3.12 10^{-1}	4.11 10^{-1}	5.49 10^{-1}
Daily intake of pasture - sheep	kg d-1	1.5	1.40 10^{-1}	4.82 10^{-1}	7.64 10^{-1}	1.05 10^{0}	1.33 10^{0}	1.74 10^{0}	2.15 10^{0}	2.57 10^{0}	3.26 10^{0}
Daily intake of hay/silage - sheep	kg d-1	1.5	3.00 10^{-2}	3.93 10^{-1}	6.13 10^{-1}	8.33 10^{-1}	1.05 10^{0}	1.53 10^{0}	2.01 10^{0}	2.48 10^{0}	3.27 10^{0}
Gut retention - sheep, Sr	days	3.40 10^{1}	2.00 10^{1}	2.40 10^{0}	2.73 10^{1}	3.06 10^{1}	3.40 10^{1}	3.68 10^{1}	3.97 10^{1}	4.25 10^{1}	4.50 10^{1}
Gut retention - sheep, I	days	5.5	5.00 10^{-1}	7.50 10^{-1}	2.33 10^{0}	3.92 10^{0}	5.50 10^{0}	7.83 10^{0}	1.02 10^{1}	1.25 10^{1}	1.50 10^{1}
Ff transfer to meat - sheep, Sr	d kg-1	3.00 10^{-3}	1.00 10^{-5}	2.58 10^{-4}	7.44 10^{-3}	1.46 10^{-2}	2.18 10^{-2}	1.35 10^{-1}	2.49 10^{-1}	3.63 10^{-1}	6.60 10^{-1}
Ff transfer to meat - sheep, Cs	d kg-1	5.00 10^{-1}	1.00 10^{-3}	4.06 10^{-2}	1.34 10^{-1}	2.27 10^{-1}	3.21 10^{-1}	6.56 10^{-1}	9.92 10^{-1}	1.33 10^{0}	1.76 10^{0}
Ff transfer to meat - sheep, I	d kg-1	5.00 10^{-2}	3.60 10^{-3}	9.96 10^{-3}	1.76 10^{-2}	2.42 10^{-2}	3.17 10^{-2}	4.16 10^{-2}	5.74 10^{-2}	1.01 10^{-1}	2.80 10^{-1}
Ff transfer to meat - sheep, Mn	d kg-1	5.00 10^{-2}	2.40 10^{-4}	9.84 10^{-4}	2.16 10^{-3}	3.36 10^{-3}	4.90 10^{-3}	7.14 10^{-3}	1.11 10^{-2}	2.44 10^{-2}	1.00 10^{-1}
Ff transfer to meat - sheep, Zn	d kg-1	2.00 10^{-2}	7.40 10^{-2}	2.52 10^{-1}	5.00 10^{-1}	7.34 10^{-1}	1.02 10^{0}	1.41 10^{0}	2.08 10^{0}	4.11 10^{0}	1.40 10^{1}
Ff transfer to meat - sheep, Co	d kg-1	1.00 10^{-2}	3.60 10^{-5}	5.01 10^{-4}	2.17 10^{-3}	5.00 10^{-3}	1.00 10^{-2}	2.03 10^{-2}	4.65 10^{-2}	2.01 10^{-1}	2.80 10^{0}
Ff transfer to meat - sheep, Te	d kg-1	5.00 10^{-2}	6.60 10^{-4}	5.00 10^{-3}	1.54 10^{-2}	2.92 10^{-2}	5.01 10^{-2}	8.59 10^{-2}	1.63 10^{-1}	5.02 10^{-1}	3.80 10^{0}
Ff transfer to meat - sheep, Ag	d kg-1	1.00 10^{-2}	2.00 10^{-4}	5.00 10^{-4}	3.67 10^{-2}	6.83 10^{-3}	1.00 10^{-2}	1.33 10^{-2}	1.67 10^{-2}	2.00 10^{-2}	3.00 10^{-2}
Ff transfer to meat - sheep, Ce	d kg-1	1.00 10^{-2}	1.30 10^{-5}	9.88 10^{-5}	3.05 10^{-4}	5.79 10^{-4}	9.94 10^{-4}	1.71 10^{-3}	3.24 10^{-3}	1.00 10^{-2}	7.60 10^{-2}
Ff transfer to liver - sheep, Mn	d kg-1	2	2.60 10^{-3}	1.97 10^{-2}	6.07 10^{-2}	1.15 10^{-1}	1.98 10^{-1}	3.39 10^{-1}	6.42 10^{-1}	1.98 10^{0}	1.50 10^{1}
Ff transfer to liver - sheep, Co	d kg-1	1	1.30 10^{-2}	9.88 10^{-2}	3.05 10^{-1}	5.79 10^{-1}	9.94 10^{-1}	1.71 10^{0}	3.24 10^{0}	1.00 10^{1}	7.60 10^{1}
Ff transfer to liver - sheep, Ag	d kg-1	3	5.30 10^{-2}	4.00 10^{-1}	1.23 10^{0}	2.33 10^{0}	3.99 10^{0}	6.83 10^{0}	1.29 10^{1}	4.00 10^{1}	3.00 10^{2}
Ff transfer to liver - sheep, Ce	d kg-1	2	2.60 10^{-3}	1.97 10^{-2}	6.07 10^{-2}	1.15 10^{-1}	1.98 10^{-1}	3.39 10^{-1}	6.42 10^{-1}	1.98 10^{0}	1.50 10^{1}
Biological half-life - sheep, Sr	days	2.80 10^{1}	1.00 10^{-2}	1.22 10^{-1}	5.78 10^{0}	1.14 10^{1}	1.71 10^{1}	4.16 10^{1}	6.62 10^{1}	9.07 10^{1}	1.21 10^{2}
Biological half-life - sheep, Cs	days	2.80 10^{1}	1.00 10^{-1}	2.12 10^{0}	6.68 10^{0}	1.12 10^{1}	1.58 10^{1}	2.30 10^{1}	3.03 10^{1}	3.75 10^{1}	4.38 10^{1}
Biological half-life - sheep, I	days	1.40 10^{1}	1.00 10^{-3}	6.22 10^{-2}	2.42 10^{0}	4.77 10^{0}	7.13 10^{0}	1.49 10^{1}	2.28 10^{1}	3.06 10^{1}	4.40 10^{1}
Biological half-life - sheep, Mn	days	2.00 10^{1}	2.00 10^{0}	5.87 10^{0}	1.07 10^{1}	1.50 10^{1}	2.00 10^{1}	2.66 10^{1}	3.74 10^{1}	6.81 10^{1}	2.00 10^{2}
Biological half-life - sheep, Zn	days	2.80 10^{2}	2.80 10^{1}	8.22 10^{1}	1.49 10^{2}	2.10 10^{2}	2.80 10^{2}	3.73 10^{2}	5.24 10^{2}	9.54 10^{2}	2.80 10^{3}
Biological half-life - sheep, Co	days	1.70 10^{2}	1.70 10^{1}	5.00 10^{1}	9.10 10^{1}	1.28 10^{2}	1.70 10^{2}	2.27 10^{2}	3.18 10^{2}	5.79 10^{2}	1.70 10^{3}

			Percentiles of the distribution on the parameter value									
Biological half-life - sheep, Te	days	$2.00\ 10^{1}$	$2.00\ 10^{0}$	$5.87\ 10^{0}$	$1.07\ 10^{1}$	$1.50\ 10^{1}$	$2.00\ 10^{1}$	$2.67\ 10^{1}$	$3.74\ 10^{1}$	$6.81\ 10^{1}$	$2.00\ 10^{2}$
Biological half-life - sheep, Ag	days	$5.00\ 10^{1}$	$5.00\ 10^{0}$	$1.47\ 10^{1}$	$2.67\ 10^{1}$	$3.75\ 10^{1}$	$5.08\ 10^{1}$	$6.66\ 10^{1}$	$9.36\ 10^{1}$	$1.70\ 10^{2}$	$5.00\ 10^{2}$
Biological half-life - sheep, Ce	days	$3.50\ 10^{3}$	$3.50\ 10^{2}$	$1.03\ 10^{3}$	$1.87\ 10^{3}$	$2.63\ 10^{3}$	$3.50\ 10^{3}$	$4.66\ 10^{3}$	$6.55\ 10^{3}$	$1.19\ 10^{4}$	$3.50\ 10^{4}$
Delay time - meat from cow/cattle	Days	$1.00\ 10^{1}$	$8.00\ 10^{0}$	$9.55\ 10^{0}$	$1.11\ 10^{1}$	$1.44\ 10^{1}$	$1.51\ 10^{1}$	$1.59\ 10^{1}$	$1.69\ 10^{1}$	$1.85\ 10^{1}$	$2.00\ 10^{1}$
Delay time - sheep	Days	$1.00\ 10^{1}$	$8.00\ 10^{0}$	$9.55\ 10^{0}$	$1.11\ 10^{1}$	$1.44\ 10^{1}$	$1.51\ 10^{1}$	$1.59\ 10^{1}$	$1.69\ 10^{1}$	$1.85\ 10^{1}$	$2.00\ 10^{1}$
Delay time - offal	Days	7	$4.00\ 10^{0}$	$5.22\ 10^{0}$	$6.45\ 10^{0}$	$9.58\ 10^{0}$	$1.01\ 10^{1}$	$1.08\ 10^{1}$	$1.16\ 10^{1}$	$1.28\ 10^{1}$	$1.40\ 10^{1}$
Parameters in the model for concentration in meat of pigs												
Daily intake cereals - pigs	kg d-1	1	$1.00\ 10^{-6}$	$6.96\ 10^{-1}$	$1.22\ 10^{0}$	$1.75\ 10^{0}$	$2.27\ 10^{0}$	$6.44\ 10^{0}$	$1.06\ 10^{1}$	$1.48\ 10^{1}$	$1.75\ 10^{1}$
Ff transfer to meat - pigs, Sr	d kg-1	$2.00\ 10^{-3}$	$1.00\ 10^{-6}$	$1.33\ 10^{-4}$	$8.23\ 10^{-3}$	$1.63\ 10^{-2}$	$2.44\ 10^{-2}$	$4.29\ 10^{-2}$	$6.15\ 10^{-2}$	$8.00\ 10^{-2}$	$1.10\ 10^{-1}$
Ff transfer to meat - pigs, Cs	d kg-1	$4.00\ 10^{-1}$	$1.00\ 10^{-6}$	$3.03\ 10^{-2}$	$1.21\ 10^{-1}$	$2.11\ 10^{-1}$	$3.02\ 10^{-1}$	$5.83\ 10^{-1}$	$8.63\ 10^{-1}$	$1.14\ 10^{0}$	$1.65\ 10^{0}$
Ff transfer to meat - pigs, I	d kg-1	$5.00\ 10^{-3}$	$3.60\ 10^{-4}$	$9.64\ 10^{-4}$	$1.78\ 10^{-3}$	$2.42\ 10^{-3}$	$3.18\ 10^{-3}$	$4.17\ 10^{-3}$	$5.74\ 10^{-3}$	$1.01\ 10^{-2}$	$2.80\ 10^{-2}$
Ff transfer to meat - pigs, Mn	d kg-1	$4.00\ 10^{-3}$	$3.00\ 10^{-4}$	$1.01\ 10^{-3}$	$1.98\ 10^{-3}$	$2.91\ 10^{-3}$	$4.03\ 10^{-3}$	$5.56\ 10^{-3}$	$8.16\ 10^{-3}$	$1.60\ 10^{-2}$	$5.40\ 10^{-2}$
Ff transfer to meat - pigs, Zn	d kg-1	$2.00\ 10^{-1}$	$2.70\ 10^{-2}$	$4.98\ 10^{-2}$	$7.00\ 10^{-1}$	$8.49\ 10^{-2}$	$1.00\ 10^{-1}$	$1.18\ 10^{-1}$	$1.43\ 10^{-1}$	$2.01\ 10^{-1}$	$3.70\ 10^{-1}$
Ff transfer to meat - pigs, Co	d kg-1	$2.00\ 10^{-1}$	$4.90\ 10^{-5}$	$2.02\ 10^{-4}$	$4.44\ 10^{-4}$	$6.95\ 10^{-4}$	$1.01\ 10^{-3}$	$1.48\ 10^{-3}$	$2.32\ 10^{-3}$	$5.09\ 10^{-3}$	$2.10\ 10^{-2}$
Ff transfer to meat - pigs, Te	d kg-1	$3.00\ 10^{-2}$	$4.00\ 10^{-4}$	$3.03\ 10^{-3}$	$9.33\ 10^{-3}$	$1.77\ 10^{-2}$	$3.03\ 10^{-2}$	$5.20\ 10^{-2}$	$9.86\ 10^{-2}$	$3.04\ 10^{-1}$	$2.30\ 10^{0}$
Ff transfer to meat - pigs, Ag	d kg-1	$1.00\ 10^{-2}$	$1.30\ 10^{-4}$	$9.88\ 10^{-4}$	$3.05\ 10^{-3}$	$5.79\ 10^{-3}$	$9.94\ 10^{-3}$	$1.71\ 10^{-2}$	$3.24\ 10^{-2}$	$1.00\ 10^{-1}$	$7.60\ 10^{-1}$
Ff transfer to meat - pigs, Ce	d kg-1	$1.00\ 10^{-4}$	$6.60\ 10^{-6}$	$5.00\ 10^{-5}$	$1.54\ 10^{-4}$	$2.92\ 10^{-4}$	$5.01\ 10^{-4}$	$8.59\ 10^{-4}$	$1.63\ 10^{-3}$	$5.02\ 10^{-3}$	$3.80\ 10^{-2}$
Delay time - pigs	Days	7	$4.00\ 10^{0}$	$5.22\ 10^{0}$	$6.45\ 10^{0}$	$9.58\ 10^{0}$	$1.01\ 10^{1}$	$1.08\ 10^{1}$	$1.16\ 10^{1}$	$1.28\ 10^{1}$	$1.40\ 10^{1}$

Notes:

a: These distributions were derived for application in the models adopted in COSYMA. They should only be used in other models if the parameters have the same meanings as in the models adopted here.

b: The default delay time given for cream is the average for all milk products

Table 2.4 Correlations between input parameters

Correlated parameters		Correlation coefficient
Parameters of the root vegetable model		
Translocation potatoes - k45 Cs	Translocation potatoes - k51 Cs	0.21
Retention time - potatoes, k21, Cs	Translocation potatoes - k51 Cs	0.28
Translocation potatoes - k24 Cs	Translocation potatoes - k45 Cs	0.28
Root uptake - potatoes, Cs	Root uptake - root crops, Cs	0.33
Root uptake - potatoes, Sr	Root uptake - root crops, Sr	0.34
Retention time - potatoes, k21, Cs	Translocation potatoes - k24 Cs	0.41
Retention time - potatoes, k21, Cs	Translocation potatoes - k45 Cs	0.41
Translocation potatoes - k24 Cs	Translocation potatoes - k51 Cs	0.53
Translocation potatoes - k24 Sr	Translocation potatoes - k45 Sr	0.71
Retention time - potatoes, k21, Sr	Translocation potatoes - k24 Sr	0.77
Retention time - potatoes, k21, Sr	Translocation potatoes - k45 Sr	0.89
Parameters of the model for cereals		
Translocation cereals - k34 Cs	Translocation cereals - k41 Cs	0.21
Interception factor – cereals	Retention time - cereals, Sr	0.22
Retention time - cereals, Sr	Translocation cereals - k41 Sr	0.23
Interception factor – cereals	Translocation cereals - k23 Cs	0.24
Retention time - cereals, Sr	Translocation cereals - k34, Sr	-0.24
Interception factor – cereals	Translocation cereals - k41 Sr	0.28
Interception factor – cereals	Translocation cereals - k34, Sr	-0.29
Retention time - cereals, Sr	Translocation cereals - k23, Sr	-0.35
Interception factor – cereals	Translocation cereals - k23, Sr	-0.42
Soil migration - cereals - k11, Cs	Soil migration - cereals - k11, I, Mn, Zn, Co, Te, Ag, Ce	0.49
Translocation cereals - k23, Sr	Translocation cereals - k41 Sr	-0.5
Soil migration pasture - k34, Sr	Soil migration pasture - k43, Sr	0.5
Translocation cereals - k23, Sr	Translocation cereals - k34, Sr	0.5
Soil migration pasture - k43, Sr	Soil migration pasture - k45 Sr	0.51
Translocation potatoes - k24 Cs	Translocation potatoes - k51 Cs	0.53
Translocation cereals - k23 Cs	Translocation cereals - k34 Cs	0.56
Translocation cereals - k34, Sr	Translocation cereals - k41 Sr	-0.6
Parameters of the pasture model		
Soil migration pasture - k12, Sr	Soil migration pasture - k23, Sr	0.36
Soil migration pasture - k34, Sr	Soil migration pasture - k43, Sr	0.5
Soil migration pasture - k43, Sr	Soil migration pasture - k45 Sr	0.51
Soil migration, pasture - k34, Cs	Soil migration, pasture - k43, Cs	0.84
Correlations between parameters of different crop models		
Soil migration pasture - k45 Sr	Soil migration - cereals - k11, Sr	0.21
Resuspension factor – pasture	Resuspension factor - surface crops	0.21
Soil migration pasture - k45 Cs	Soil migration - cereals - k11, Cs	0.22
Interception factor – cereals	Translocation potatoes - k51 Cs	0.25
Root uptake - cereals, Sr	Root uptake - green vegetables, Sr	0.3
Root uptake - pasture, Sr	Root uptake - green vegetables, Sr	0.31
Root uptake - cereals, Cs	Root uptake - potatoes, Cs	0.31
Root uptake - pasture, Cs	Root uptake - cereals, Cs	0.32
Root uptake - cereals, Sr	Root uptake - potatoes, Sr	0.32
Root uptake - cereals, Cs	Root uptake - green vegetables, Cs	0.32
Root uptake - green vegetables, Sr	Root uptake - potatoes, Sr	0.32

Correlated parameters		Correlation coefficient
Root uptake - green vegetables, Cs	Root uptake - potatoes, Cs	0.32
Root uptake - pasture, Sr	Root uptake - cereals, Sr	0.33
Root uptake - pasture, Cs	Root uptake - green vegetables, Cs	0.33
Root uptake - pasture, Cs	Root uptake - potatoes, Cs	0.33
Root uptake - cereals, Sr	Root uptake - root crops, Sr	0.33
Root uptake - green vegetables, Sr	Root uptake - root crops, Sr	0.33
Root uptake - cereals, Cs	Root uptake - root crops, Cs	0.34
Root uptake - green vegetables, Cs	Root uptake - root crops, Cs	0.34
Root uptake - pasture, Cs	Root uptake - root crops, Cs	0.35
Root uptake - pasture, Co	Root uptake - cereals, Co	0.35
Root uptake - pasture, Sr	Root uptake - potatoes, Sr	0.34
Root uptake - pasture, Sr	Root uptake - root crops, Sr	0.34
Root uptake - green vegetables, Zn	Root uptake - potatoes, Zn	0.35
Root uptake - pasture, Co	Root uptake - green vegetables, Co	0.36
Root uptake - pasture, Co	Root uptake - potatoes, Co	0.36
Interception factor – cereals	Translocation potatoes – k24 Cs	0.36
Root uptake - cereals, Mn	Root uptake - potatoes, Mn	0.36
Root uptake - pasture, Zn	Root uptake - cereals, Zn	0.37
Root uptake - pasture, Zn	Root uptake - green vegetables, Zn	0.37
Root uptake - pasture, Zn	Root uptake - potatoes, Zn	0.37
Soil migration pasture - k12, Cs	Root uptake - green vegetables, Cs	0.37
Root uptake - cereals, Zn	Root uptake - green vegetables, Zn	0.37
Root uptake - cereals, Zn	Root uptake - potatoes, Zn	0.37
Root uptake - cereals, Co	Root uptake - potatoes, Co	0.37
Root uptake - green vegetables, Mn	Root uptake - potatoes, Mn	0.37
Root uptake - pasture, Mn	Root uptake - cereals, Mn	0.38
Root uptake - pasture, Mn	Root uptake - green vegetables, Mn	0.38
Root uptake - pasture, Mn	Root uptake - potatoes, Mn	0.38
Root uptake - cereals, Mn	Root uptake - green vegetables, Mn	0.38
Root uptake - cereals, Co	Root uptake - green vegetables, Co	0.38
Root uptake - green vegetables, Co	Root uptake - potatoes, Co	0.38
Retention time, hay/silage	Retention time, green vegetables	0.39
Soil contamination – cereals	Soil contamination – potatoes	0.41
Soil contamination, hay/silage	Soil contamination - green vegetables	0.42
Soil contamination, hay/silage	Soil contamination – potatoes	0.42
Soil contamination – cereals	Soil contamination - green vegetables	0.42
Soil contamination - green vegetables	Soil contamination – potatoes	0.44
Soil contamination, hay/silage	Soil contamination – cereals	0.41
Parameters of the animal models		
Gut retention - dairy cows, others than I	Gut retention - dairy cows, I	0.22
Daily intake of pasture - beef cattle	Daily intake of pasture – sheep	0.22
Daily intake of soil, dairy cows	Daily intake of soil, sheep	0.25
Fm transfer to milk, dairy cows, Sr	Biological half-life - dairy cows, Sr	0.26
Ff transfer to meet - pigs, Sr	Ff transfer to meet - pigs, Cs	0.26
Fm transfer to milk, dairy cows, Cs	Fm transfer to milk - dairy cows, I	0.28
Ff transfer to meat - dairy cows, Sr	Ff transfer to meat - dairy cows, Cs	0.34
Biological half-life - sheep, Sr	Biological half-life - sheep, Cs	0.36
Ff transfer to meat – dairy cows, Sr	Ff transfer to meat - beef cattle, Cs	0.37
Ff transfer to meat - dairy cows, Cs	Ff transfer to meat - beef cattle, Sr	0.37
Biological half-life - sheep, Cs	Biological half-life - sheep, I	0.37
Ff transfer to meat - beef cattle, Sr	Ff transfer to meat - beef cattle, Cs	0.4

Correlated parameters		Correlation coefficient
Biological half-life - dairy cows, Sr	Biological half-life - dairy cows, Cs	0.41
Daily intake of pasture - dairy cows	Daily intake of pasture - beef cattle	0.43
Soil migration pasture - k34, Sr	Soil migration pasture - k45 Sr	0.65
Gut retention - dairy cows, I	Gut retention - sheep, I	0.79
Gut retention - dairy cows, others than I	Gut retention - sheep, others than I	0.8
Ff transfer to meat - dairy cows, Sr	Ff transfer to meat - beef cattle, Sr	0.89
Ff transfer to meat - dairy cows, Cs	Ff transfer to meat - beef cattle, Cs	0.9
Biological half-life - dairy cows, Mn	Biological half-life - sheep, Mn	0.9
Biological half-life - dairy cows, Zn	Biological half-life - sheep, Zn	0.9
Biological half-life - dairy cows, Ag	Biological half-life - sheep, Ag	0.9
Biological half-life - dairy cows, Ce	Biological half-life - sheep, Ce	0.9
Biological half-life - dairy cows, Co	Biological half-life - sheep, Co	0.91
Biological half-life - dairy cows, Te	Biological half-life - sheep, Te	0.91

Table 2.5 Comparison between marginal distributions of elicitation variables obtained from the experts and from the distributions on target variables for the activity concentration in root vegetables

	Concentration in edible portion of root vegetables per unit deposition to the plant (1 Bq m^{-2}) at different times before harvest							
	15 days		30 days		60 days		90 days	
	DM	Pred	DM	Pred	DM	Pred	DM	Pred
Strontium								
5%	$9.61\ 10^{-7}$	$3.61\ 10^{-7}$	$1.42\ 10^{-6}$	$1.41\ 10^{-6}$	$3.48\ 10^{-6}$	$5.22\ 10^{-6}$	$9.73\ 10^{-6}$	$9.66\ 10^{-7}$
50%	$6.18\ 10^{-6}$	$6.18\ 10^{-6}$	$9.63\ 10^{-6}$	$2.04\ 10^{-5}$	$3.48\ 10^{-5}$	$3.49\ 10^{-5}$	$1.15\ 10^{-4}$	$7.15\ 10^{-5}$
95%	$1.59\ 10^{-3}$	$1.59\ 10^{-3}$	$1.61\ 10^{-3}$	$2.01\ 10^{-3}$	$1.96\ 10^{-3}$	$1.79\ 10^{-3}$	$2.06\ 10^{-3}$	$1.99\ 10^{-3}$
Caesium								
5%	$1.72\ 10^{-6}$	$1.72\ 10^{-6}$	$1.46\ 10^{-5}$	$5.80\ 10^{-6}$	$1.34\ 10^{-4}$	$1.76\ 10^{-5}$	$1.42\ 10^{-4}$	$2.04\ 10^{-5}$
50%	$8.08\ 10^{-3}$	$8.08\ 10^{-3}$	$1.02\ 10^{-2}$	$1.02\ 10^{-2}$	$1.96\ 10^{-2}$	$1.97\ 10^{-2}$	$2.83\ 10^{-2}$	$6.60\ 10^{-3}$
95%	$1.06\ 10^{-1}$	$1.06\ 10^{-1}$	$1.14\ 10^{-1}$	$1.13\ 10^{-1}$	$1.37\ 10^{-1}$	$1.37\ 10^{-1}$	$1.80\ 10^{-1}$	$1.85\ 10^{-1}$

Notes
The columns labelled DM give the distributions obtained from the experts.
The columns labelled Pred give the distributions obtained by fitting the model in FARMLAND to the expert distributions

Table 2.6 Comparison between marginal distributions of elicitation variables obtained from the experts and from the distributions on target variables for the activity concentration in cereals

	Concentration in edible portion of grain per unit deposition to the ground (1 Bq m^{-2}) at different times before harvest							
	15 days		30 days		60 days		90 days	
	DM	Pred	DM	Pred	DM	Pred	DM	Pred
Strontium								
5%	$8.43\ 10^{-4}$	$1.20\ 10^{-4}$	$5.26\ 10^{-4}$	$4.26\ 10^{-5}$	$4.47\ 10^{-5}$	$3.27\ 10^{-6}$	$2.08\ 10^{-7}$	$2.10\ 10^{-7}$
50%	$1.79\ 10^{-2}$	$1.77\ 10^{-2}$	$1.34\ 10^{-2}$	$9.76\ 10^{-3}$	$1.30\ 10^{-3}$	$4.30\ 10^{-4}$	$5.93\ 10^{-6}$	$5.90\ 10^{-6}$
95%	$8.38\ 10^{-2}$	$8.31\ 10^{-2}$	$8.86\ 10^{-2}$	$3.27\ 10^{-2}$	$1.17\ 10^{-2}$	$1.63\ 10^{-3}$	$9.05\ 10^{-5}$	$9.00\ 10^{-5}$
Caesium								
5%	$2.66\ 10^{-4}$	$1.64\ 10^{-4}$	$4.24\ 10^{-3}$	$2.59\ 10^{-3}$	$3.13\ 10^{-3}$	$2.75\ 10^{-4}$	$1.83\ 10^{-4}$	$1.83\ 10^{-4}$
50%	$4.57\ 10^{-2}$	$4.55\ 10^{-2}$	$9.18\ 10^{-2}$	$9.20\ 10^{-2}$	$5.25\ 10^{-2}$	$3.46\ 10^{-2}$	$3.93\ 10^{-2}$	$3.92\ 10^{-2}$
95%	$4.51\ 10^{-1}$	$4.46\ 10^{-1}$	$3.90\ 10^{-1}$	$3.77\ 10^{-1}$	$2.86\ 10^{-1}$	$2.10\ 10^{-1}$	$8.10\ 10^{-2}$	$8.07\ 10^{-2}$

Notes
The columns labelled DM give the distributions obtained from the experts.
The columns labelled Pred give the distributions obtained by fitting the model in FARMLAND to the expert distributions

Table 2.7 Comparison between marginal distributions of elicitation variables obtained from the experts and from the distributions on target variables for the parameters for soil migration

	Time for 50% to migrate below 1 cm (yrs)		Time for 50% to migrate below 5 cm (yrs)		Time for 50% to migrate below 15 cm (yrs)		Time for 50% to migrate below 30 cm (yrs)	
	DM	Pred	DM	Pred	DM	Pred	DM	Pred
Caesium								
5%	0.35	0.35	1.86	1.85	5.74	5.73	10.4	10.4
50%	1.61	1.60	14.8	14.8	55.4	55.4	109	109
95%	7.88	7.45	63.94	63.94	448	4.8	892	892
Strontium								
5%	0.1	0.01	0.22	0.22	0.76	0.76	1.62	1.62
50%	0.59	0.59	6.35	6.35	21.56	21.56	31.85	31.85
95%	2.82	2.76	24.29	24.28	150	150	296	296

Notes
The columns labelled DM give the distributions obtained from the experts.
The columns labelled Pred give the distributions obtained by fitting the model in FARMLAND to the expert distributions

Table 2.8 Comparison between marginal distributions of elicitation variables obtained from the experts and from the distributions on target variables for the parameters for caesium fixation in soil

	Fraction of caesium fixed by							
	1 year		3 years		5 years		10 years	
	DM	Pred	DM	Pred	DM	Pred	DM	Pred
5%	$6.96\ 10^{-2}$	$3.90\ 10^{-2}$	$2.05\ 10^{-1}$	$1.13\ 10^{-1}$	$2.88\ 10^{-1}$	$1.80\ 10^{-1}$	$3.29\ 10^{-1}$	$3.28\ 10^{-1}$
50%	$2.96\ 10^{-1}$	$1.55\ 10^{-1}$	$6.20\ 10^{-1}$	$3.97\ 10^{-1}$	$7.40\ 10^{-1}$	$5.69\ 10^{-1}$	$8.18\ 10^{-1}$	$8.14\ 10^{-1}$
95%	$9.16\ 10^{-1}$	$4.35\ 10^{-1}$	$9.84\ 10^{-1}$	$8.19\ 10^{-1}$	$9.87\ 10^{-1}$	$9.42\ 10^{-1}$	$9.97\ 10^{-1}$	$9.97\ 10^{-1}$

Notes
The columns labelled DM give the distributions obtained from the experts.
The columns labelled Pred give the distributions obtained by fitting the model in FARMLAND to the expert distributions

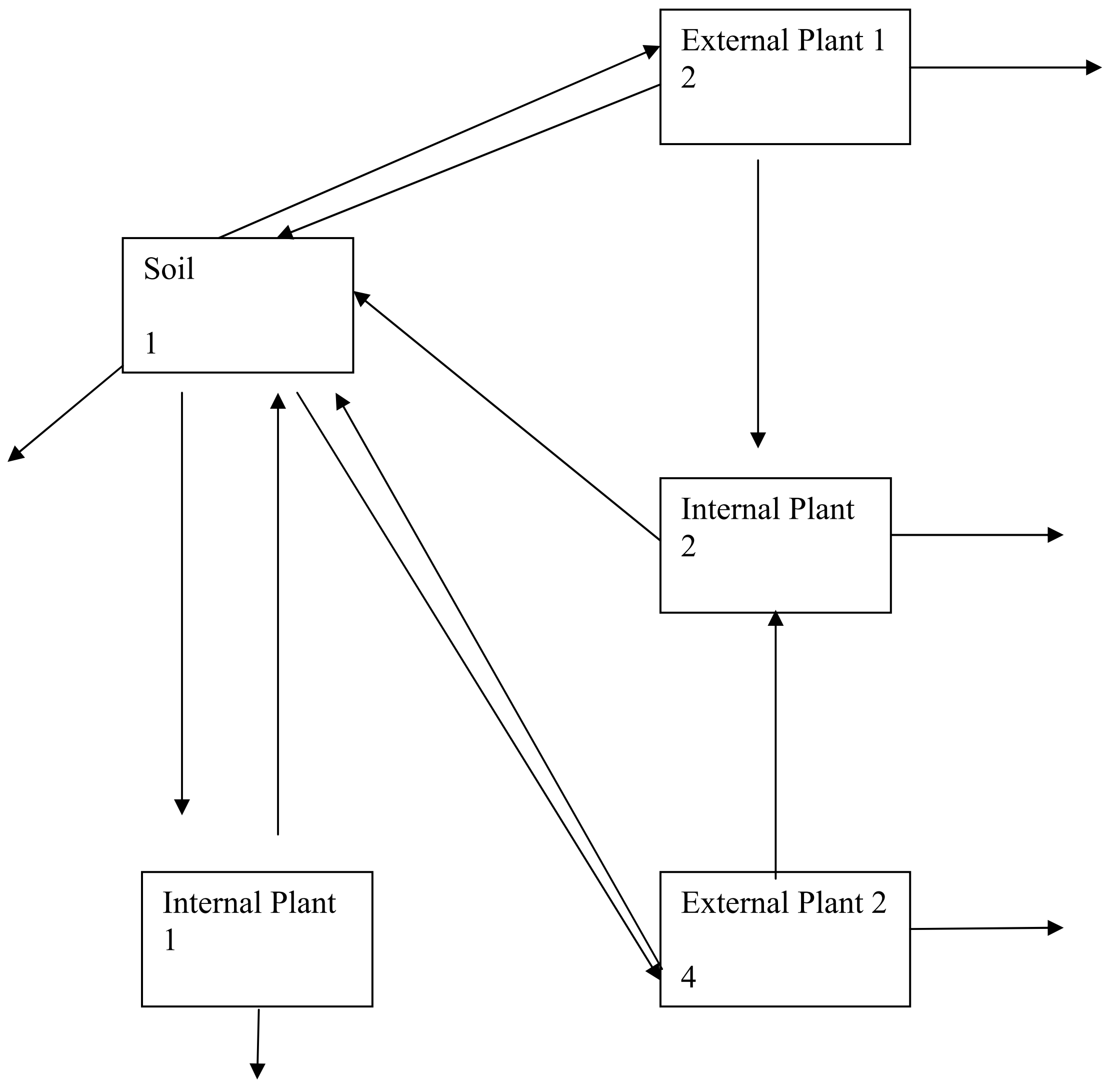

Figure 2.1 Model used for calculating the concentration of activity in green vegetables

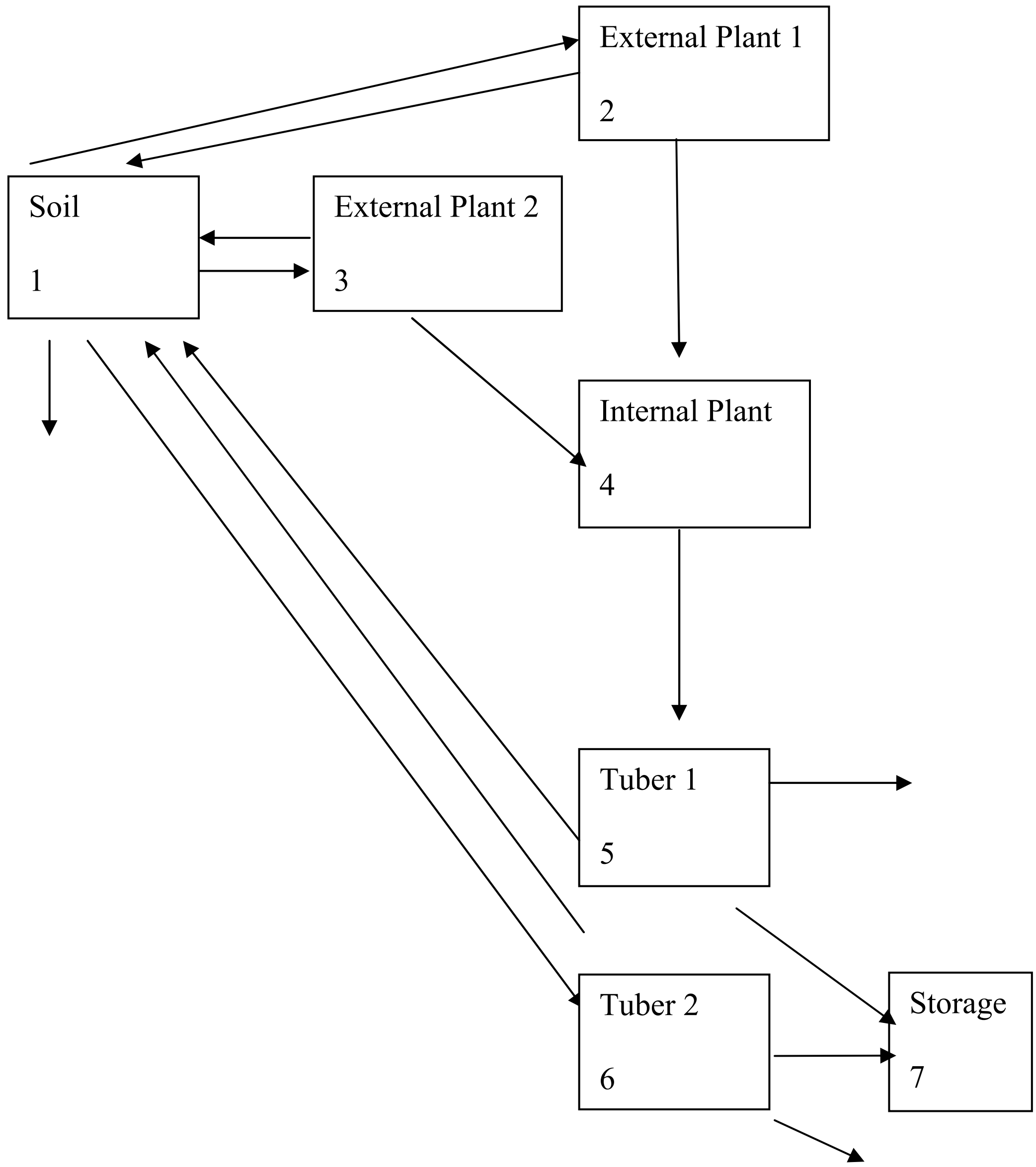

Figure 2.2 Model used for calculating the concentration of activity in root vegetables

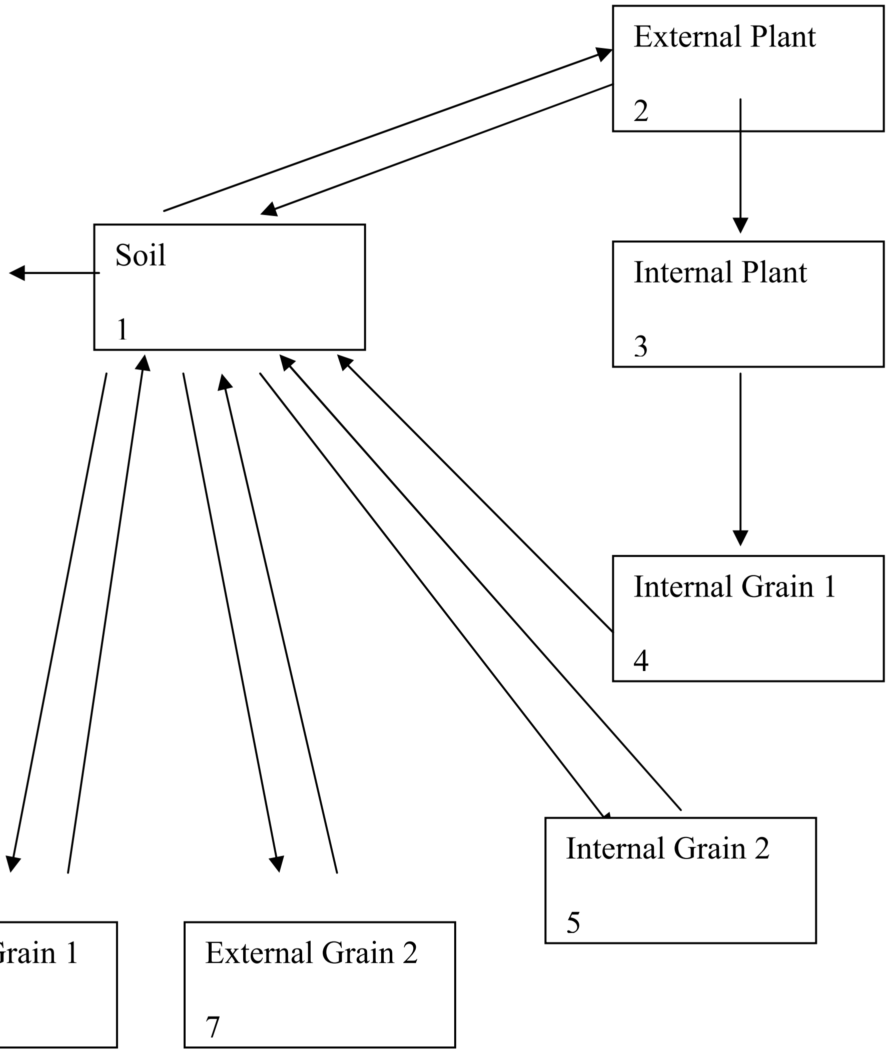

Figure 2.3 Model used for calculating the concentration of activity in cereals

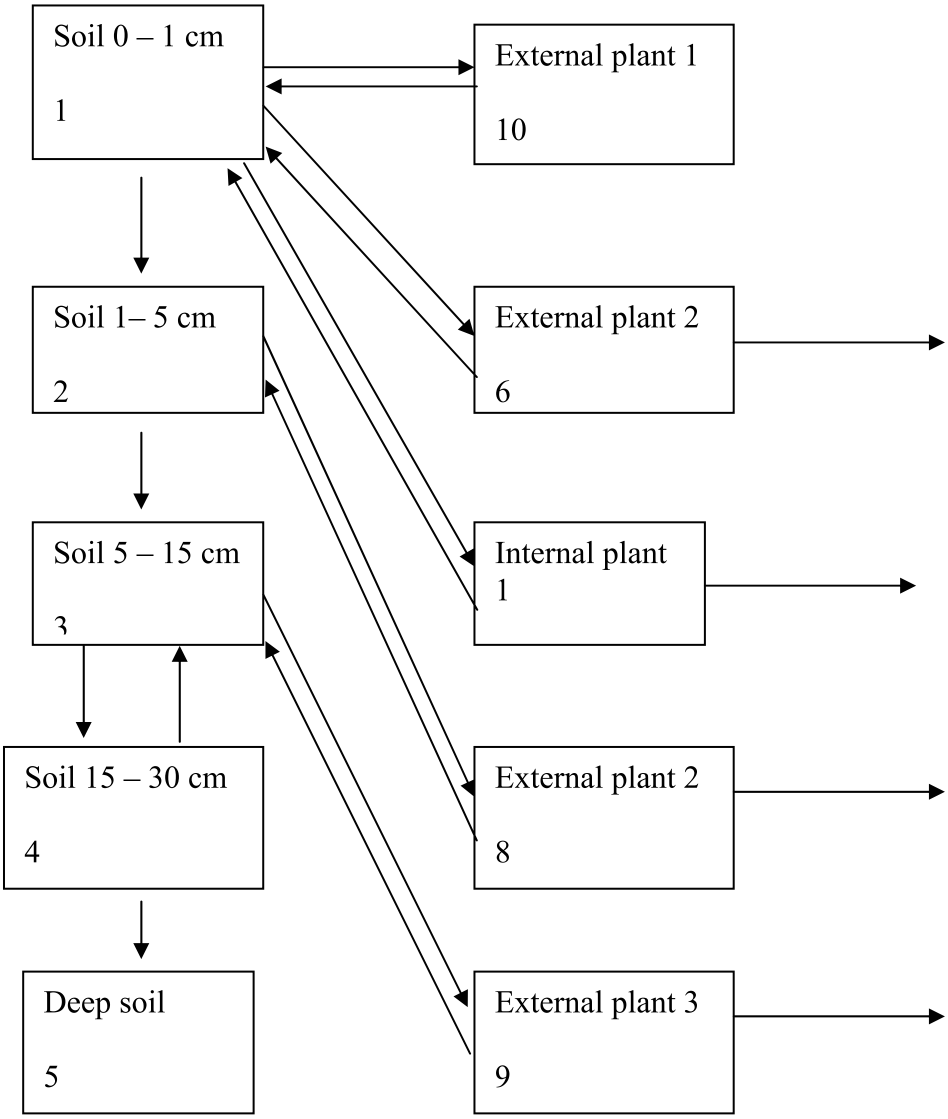

Figure 2.4 Model used for calculating the concentration of activity in pasture grass for radionuclides other than caesium

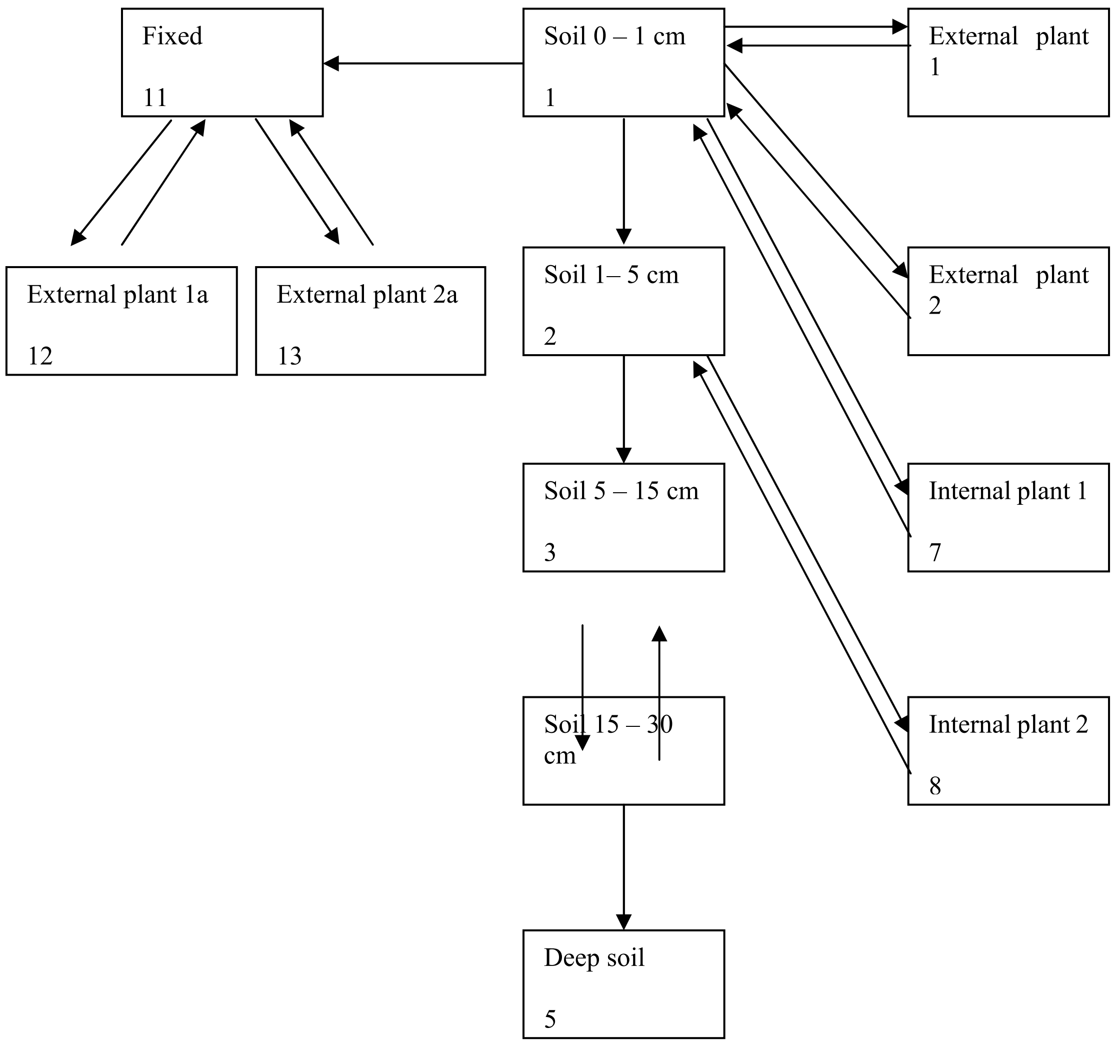

Figure 2.5 Model used for calculating the concentration of activity in pasture grass for caesium.

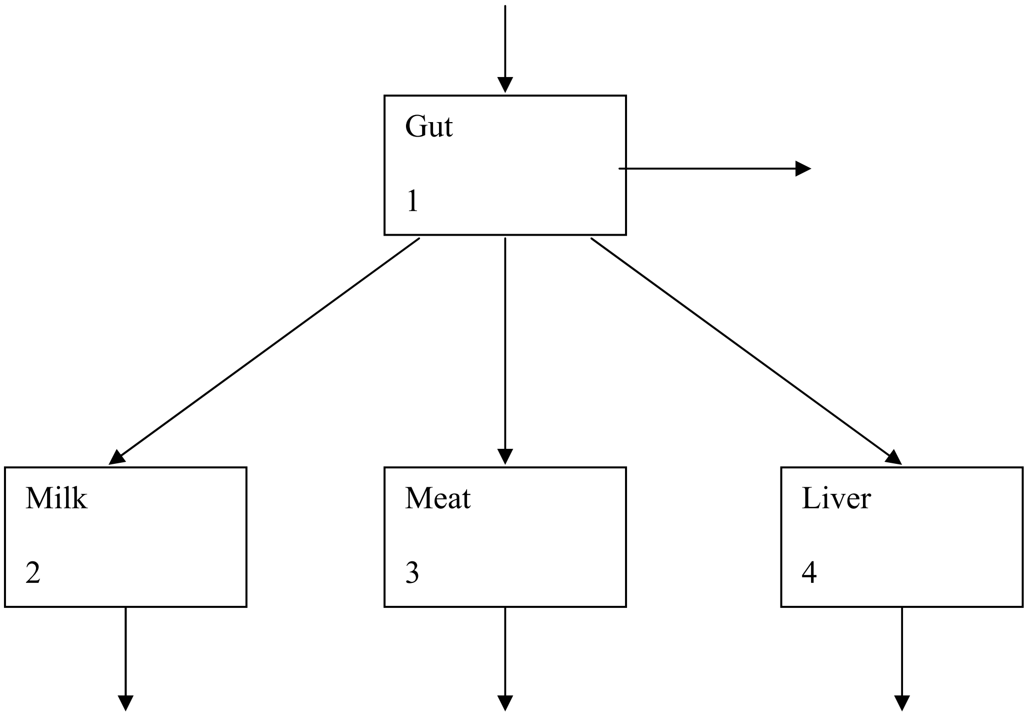

Figure 2.6 Model used for calculating the concentration in milk and meat from dairy cows

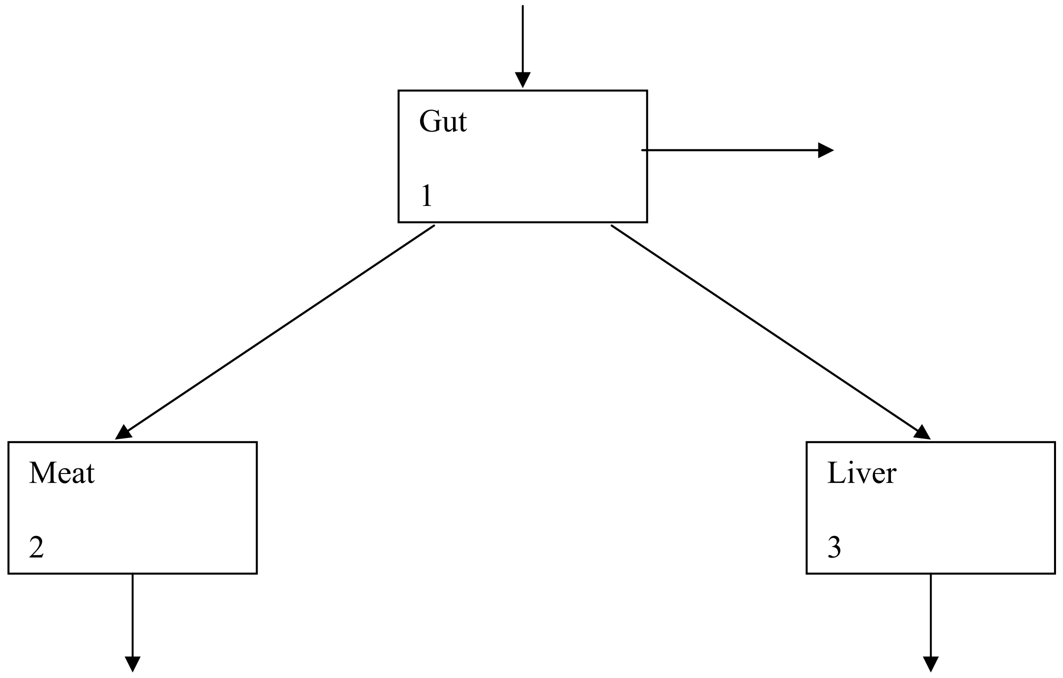

Figure 2.7 Model used for calculating the concentration of activity in meat from beef cattle and sheep

3 RESULTS

This section presents the results of the analysis of the food module and describes the extent of the uncertainty on the predictions and also those parameters whose uncertainties make important contributions to the overall uncertainty. The extent of the uncertainty is described using “uncertainty factors” (the ratio of the 95th to 5th percentiles of the distribution on the endpoint) and “reference uncertainty coefficients” (the ratio of the 95th percentile of the uncertainty distribution to the value obtained using default values for all the input parameters). Appendix C contains more extensive results on the extent of the uncertainty, giving 7 percentiles of the distribution on each of the endpoints, together with the reference value. The important parameter uncertainties are summarised in this chapter, which gives those parameters that are identified as important for groups of endpoints (either different parts of the ccdf for one quantity, or for related quantities). The criteria adopted to decide which parameters to include in the tables in this section are rather subjective. Appendix D contains more information on the contributions of the different parameter uncertainties to the overall uncertainty on the model predictions, listing those parameters that are identified in the top 3 ranks using PRCC and those making more than 10% contribution to the uncertainty. This appendix therefore identifies more parameters than are included in the overall analysis, using the criteria described in Section 1 of this report.

In the absence of any uncertainty, the results of COSYMA are presented in terms of probability distributions of the various quantities, where the probability reflects the occurrence of different atmospheric conditions at the time of the release. In this study, the probability distribution is characterised by its mean value and the 95th and 99th percentiles of the distribution. The methods and quantities used in this study to describe the uncertainty are described in the “Methodology Report”[1]. The food module analysis involved 300 runs of COSYMA and so generated 300 sets of ccdfs for each of the endpoints. One of the results of an uncertainty analysis is the uncertainty distribution on chosen percentiles, including the mean value, of the original probability distributions. This uncertainty is represented, in this study, by the “uncertainty factor” which is the ratio of the 95th and 5th percentiles of the uncertainty distribution on the chosen percentiles and mean value for the endpoints considered. COSYMA uses a binning system to derive its probability distributions. In some cases, the uncertainty range on a quantity includes values which are below the lower limit of the bottom bin used for the distribution; such values are reported as zero. In some cases the 5th (and higher) percentile is reported as zero, and the value of the uncertainty factor is infinite. The value of the 95th percentile is given in brackets in the results tables, in place of the uncertainty factor in these cases. Another quantity used is the “reference uncertainty coefficient”, which is the ratio of the 95th percentile of the uncertainty distribution for the chosen percentiles or mean value of the original probability distribution to the value predicted using the default values for the parameters in the model. A further ccdf, designated the “mean curve” is also used to present some of the results. This curve is obtained as the average of all the ccdfs obtained from the COSYMA runs.

The endpoints of the analysis were described in Section 1 of the report. The uncertainties on the parameters of the food module affects the uncertainty on the extent and duration of food restrictions, individual doses and individual and collective risks of late health effects. Information is given on individual doses and risks at three distances (5, 20 and 100 km). These endpoints are considered in turn. Calculations for CB2 include doses in normal living, while those for DBA include potential doses; these calculations do not consider the effects of food restrictions. They differ in other module analyses because normal living doses allow for the shielding properties of buildings, while potential doses do not. However, the calculations are the same for ingestion doses. The terminology is retained for comparison with the other reports of the analysis.

The results presented here are specific to the situations and source terms considered in this analysis. The extent to which the results can be applied in other situations is considered in the report on the overall analysis.

3.5 Extent and duration of food restrictions

The uncertainty on the extent and duration of food restrictions is presented in terms of the initial restricted area and the time integral of this area, ie the area restricted multiplied by the duration of the restriction. The results for the CB2 and DBA source terms are summarised in Table 3.1 in terms of the uncertainty factors for distributions on the mean values, 95^{th} and 99^{th} percentiles for the endpoints considered. The results are presented in Table 3.2 in terms of the reference uncertainty coefficient for distributions on the mean values, 95^{th} and 99^{th} percentiles for the endpoints considered.

For the CB2 source term, the uncertainty in the initial area restricted is similar for the different percentiles of the distributions. For milk, green vegetables and beef, the uncertainty on the probabilities for the initial area restricted is between 5 and 70 with the lowest uncertainty associated with green vegetables and milk. The uncertainty factors are a little larger for the time integrated areas. For cereals, the uncertainty factor is about 20000; this reflects the larger uncertainty associated with activity concentrations in cereals and the fact that there is a high probability that the activity concentrations are very close to the threshold at which a restriction on cereals is not required, so that the 5^{th} percentile of the uncertainty distributions on the areas and their time integrals are very small. For the DBA source term, the uncertainties tend to be larger than those seen for the CB2 source term. This is likely to be due to the activity concentrations in all the foods being close to the threshold at which restrictions are imposed as would be expected based on the size of the release and subsequent lower activity concentrations in foods. For both source terms the uncertainty factors on the mean value, the 95th and 99th percentiles for any one effect are fairly similar. The main exceptions to this are the time integral of the area with grain restrictions for CB2 and the initial area of milk restrictions for DBA. The reasons for these differences are not clear. The reference uncertainty coefficients for the extent of milk restrictions for the CB2 source term for the initial area of green vegetable restrictions for CB2 and for the initial area and time integral for DBA are greater than the uncertainty factors, showing that the reference curve is generally lower than the 5% envelope of the uncertainty distribution. The difference is larger for the time integrated area than for the initial area for milk restrictions for CB2 and green vegetable restrictions for DBA suggesting that the default parameter values also underestimate the duration of food restrictions as compared to the values obtained using the uncertainty distributions. For both source terms, the reference uncertainty coefficient for the extent of beef restrictions is much lower than the uncertainty factor, and the reference curve is near the centre of the uncertainty band. For grain restrictions the reference uncertainty coefficient is small (generally less than 2) and here the reference curve is very near the upper end of the uncertainty range for this endpoint. This is illustrated in Figure 3.1 and Figure 3.2 which show the 5% and 95% envelopes together with the reference curve and the mean curve for the time integrals of the areas in which milk and grain restrictions would be required.

The parameters whose uncertainties make major contributions to the overall uncertainty on the areas of food restrictions are summarised in Table 3.3. They are some of the parameters describing the interception and retention of radioactive material by the foods and some of the parameters for the iodine and caesium food chain models. The parameters are generally similar for the two source terms. For milk and beef for CB2, the important contributors to the uncertainty are the interception and retention onto pasture or onto hay and silage, and the transfer of caesium to milk and meat. For cereals, the parameters whose uncertainties contribute significantly to the uncertainty in the extent of restrictions are the interception and retention of caesium on the cereal plant and the loss of activity when processing the cereal seed into flour. For green vegetables, soil contamination of the vegetable is the most important contributor to the uncertainty; the interception factor for green vegetables is not identified as an important contributor. For the DBA release, the observations are similar, although the uncertainty on parameters for iodine transfer to milk contributes significantly to the overall uncertainty on the extent of restrictions for milk and the parameters relating to caesium are not identified as important. This reflects the relative amount of iodine and caesium in the two source terms. In addition, the uncertainty in the transfer of silver to liver in cattle also contributes significantly to the uncertainty in the extent of restrictions for beef. The uncertainty on parameters related to silver would not be expected to make important contributions to the overall uncertainty on concentrations in beef. Its inclusion reflects two features of the uncertainty distributions on the factors describing the transfer to meat (F_f); the uncertainty on the F_f factor for several radionuclides is similar when expressed as a multiplicative factor, and the median value for silver is higher than for most nuclides. These features may enhance the apparent importance of the uncertainty on the silver parameters when analysed on a linear basis. The uncertainty distribution for silver comes from project staff rather than the experts.

3.6 Long term individual doses

Table 3.4 and Table 3.5 show the uncertainty factors and reference uncertainty coefficients for long term individual doses predicted at three distances downwind, for the mean value, the 95th and 99th percentiles of the distributions for each endpoint. The doses considered in this analysis are summed over all routes of exposure considered in COSYMA, but only include the effects of uncertainties on the activity concentrations in food.

For the CB2 source term, doses with countermeasures (relocation and food restrictions) in place and doses for normal living with no countermeasures implemented are presented. The uncertainty factors for the doses with countermeasures are very small for all the organs considered and are similar for all the percentiles of the distribution. This reflects the fact that most of the food is banned so that dose comes mainly from other pathways and therefore the uncertainty on the activity concentrations in food has only a small influence on the uncertainty in the total dose. The uncertainty increases slightly with distance reflecting the higher contribution of ingestion to the total dose due to there being fewer food restrictions further from the site of the release. The reference uncertainty coefficients in this case are less than 1, showing that the reference value lies above the 95th percentile of the uncertainty distribution on these quantities. This is a consequence of the underestimation of the duration of food restrictions predicted using the default parameter values compared to the distribution obtained using the uncertainty ranges. Using default parameter values predicts a shorter duration of food restrictions, and hence a greater dose from the food after restrictions have been lifted, compared to the values obtained using the uncertainty distributions.

The uncertainty factors for CB2 on the doses with normal living (without countermeasures) are larger and are of the order of a few tens for effective and bone marrow doses and about a factor of 100 - 150 for thyroid doses. These factors reflect the uncertainty associated with the activity concentrations in food and radionuclides that contribute to the ingestion dose to these organs. The larger uncertainties associated with the thyroid doses probably largely reflect the uncertainty associated with iodine activity concentrations in the foods considered, although few iodine parameters are identified as important contributors to the uncertainty as described below. The reference uncertainty coefficients for the doses with normal living are around 10 to 20 for the effective and bone marrow doses and about 50 to 100 for the thyroid doses. The reference uncertainty coefficients are somewhat smaller than the uncertainty factors; the default value lies slightly below the median of the distribution for effective and bone marrow doses and below the 10^{th} percentile of the distribution for thyroid doses.

The results for the DBA source term are similar to those for CB2. However, for this scenario, as the release is smaller, relocation of the population is not warranted, and food restrictions are imposed in a much smaller area. The uncertainty factors associated with the doses with countermeasures reflect more the uncertainty associated with the ingestion dose, and are consequently larger. As for the CB2 source term, the uncertainty factors increase with distance although this is only really significant for the thyroid doses. The uncertainty on the potential outdoor doses is similar to that observed for normal living for the CB2 source term. There are no differences between the normal living dose and the potential outdoor dose (which do not allow for countermeasures) for food chain calculations, though the external and inhalation doses are different for these situations.

The parameters whose uncertainties contribute significantly to the uncertainties on individual doses are summarised in Table 3.6. For the CB2 release, the important parameters are those which influence the transfer processes in the long term after deposition and are mainly for caesium transfer, the only exception being the F_m value for iodine which is identified for the thyroid dose in normal living. This reflects the importance of these transfer processes and the caesium radionuclides in contributing to the activity concentrations in foods after any restrictions have been lifted. The important parameters are rather different for the cases where countermeasures are considered and for normal living. In the former case, the parameters whose uncertainties contribute significantly to the uncertainty on doses are migration of caesium from the top 1 cm of soil underlying pasture, the fixation of caesium in soil, and the uptake of caesium into pasture via the roots. In the latter case the parameters whose uncertainties contribute significantly are the interception factor for pasture and the F_m values for iodine and caesium. These findings show that uncertainty on doses where countermeasures are imposed is largely controlled by predictions of activity concentrations at long times, while uncertainty on doses when countermeasures are not imposed is largely controlled by predictions of activity concentrations at short times. This effect helps to explain why the uncertainties on the parameters of the iodine model are not identified as making important contributions to the uncertainty for CB2 with countermeasures. It is also part of the reason why the uncertainties on the thyroid dose with countermeasures for CB2 are similar to those for other organs, while they are rather larger for the doses in other situations.

For the DBA scenario, the parameters whose uncertainties contribute significantly to the individual doses are those which influence the transfer processes in the shorter term after deposition. This reflects the smaller impact that food restrictions have on the ingestion doses received. The parameters are broadly similar for the doses calculated at the different distances considered and for the three organs, and for the case with countermeasures and for potential outdoor doses. The parameters whose uncertainty contributes significantly to the doses are the transfer of iodine and caesium to milk, the interception of deposition onto pasture and the half-life of retention of activity on hay and silage. For bone marrow doses, the iodine transfer to milk is not a significant parameter and for thyroid doses at short to medium distances the uncertainty in the transfer of caesium to milk is not a significant contributor.

3.7 Numbers of late Health Effects

The uncertainty factors for the numbers of late health effects are shown in Table 3.7. In general, the magnitude of the uncertainty reflects that on the individual doses, presented in the previous section. For the CB2 source term, however, the uncertainty factors for the numbers of health effects with countermeasures implemented are slightly larger than those observed on the individual doses reflecting the fact that the health effects are calculated over all distances and at long distances there will be no or fewer food restrictions, and therefore greater uncertainty in the individual doses. The uncertainty factors if countermeasures are taken are smaller than those for normal living, for the CB2 source term, reflecting the uncertainty in the doses discussed in the previous section. The uncertainty factors for the DBA source term, if countermeasures are taken, are larger than those for the CB2 source term with countermeasures but smaller than those for CB2 in normal living, reflecting the smaller areas of food restrictions for DBA than for CB2.

The reference uncertainty coefficients are shown in Table 3.8. The values for the numbers of health effects with countermeasures are larger than the equivalent values for the individual doses; this again reflects the fact that health effects are summed over all distances and there are fewer countermeasures imposed at larger distances. The reference uncertainty coefficients for CB2 in normal living are similar to the values for individual doses at the largest distances considered in the previous section. The same is true for DBA, even when countermeasures are considered; this release is sufficiently small that countermeasures do not have a large impact on the collective dose and numbers of health effects.

The uncertainty for the numbers of fatal cancers if countermeasures are taken for the CB2 source term is illustrated in Figure 3.3. This shows that the reference curve is towards for upper end of the uncertainty distribution up to about the 50th percentile of the ccfd, but is nearer the centre of the uncertainty band at the higher percentiles of the ccfd.

The parameters whose uncertainties contribute significantly to the uncertainties on the numbers of fatal cancers, leukaemias and thyroid cancers are summarised in Table 3.9. They largely reflect the important parameters identified for the individual doses. However, because the numbers of health effects are calculated over all distances, the uncertainty in the transfer of iodine to milk is also a significant contributor to the overall uncertainty in fatal cancers and thyroid cancers for the CB2 scenario. This reflects the importance of iodine in milk at distances at which restrictions are either not imposed or where they are imposed for only a very short period.

3.8 Parameters selected for the overall analysis

As discussed in the Methodology report[1], the parameters included in the overall analysis are those identified in the first or second rank according to the value of their partial rank correlation coefficient, and those contributing more than 15% to the normalised R^2 value for any endpoint, any of the points on the ccdfs considered in the study, and for any source term. The parameters are summarised in Table 3.10, which shows the source term for which the parameters are identified and whether they are identified according to their rank or their contribution to the normalised R^2 value. The table shows that most of the parameters are identified for both source terms and for both rank and contribution to the R^2 value.

The table shows that two parameters for zinc are identified as important. They were identified only as contributing to the uncertainty on the probability of zero for one effect. Project staff identified problems with the results for the probability of zero consequences, and they were removed at a late stage of the analysis, after the parameters for the overall analysis had been identified, as described in reference 1. It is not clear why parameters for Zn were identified in this analysis.

The model used to calculate the activity concentrations in food uses a number of parameters for each element. Some, but not all, of the parameters for particular elements have been identified as having important contributions to the uncertainty. If the overall analysis were carried out using only some of the parameters from a compartment model, then the distribution on the outputs of that model would not reflect the distributions specified by the expert panel. Therefore, where some parameters from a model were identified as important, the remaining parameters derived from the same set of elicitation variables were also included in the overall analysis. The parameters included in the overall analysis for this reason are also included in Table 3.10; they can be identified as they are not indicated as being selected for either source term.

3.9 References

1. Jones J A, Kraan B C P, Cooke R M, Goossens L H J, Fischer F, and Hasemann I. Probabilistic accident consequence uncertainty assessment using COSYMA: Methodology and processing techniques. EUR 18827 and FZKA 6313 (2000)

Table 3.1 Uncertainty factors for the extent and duration of food restrictions

Quantity	For mean value	For 95th percentile	For 99th percentile
CB2			
Initial milk ban area	7.3	9.1	8.5
Time integral of milk ban area	26	26	23
Initial grain ban area[a]	25000	22000	15000
Time integral of grain ban area [a]	7700	5500	3600
Initial green vegetables ban area	5	7.2	7.6
Time integral of green vegetables ban area	56	71	68
Initial beef ban area	37	40	47
Time integral of beef ban area	58	53	53
DBA			
Initial milk ban area	580	510	290
Time integral of milk ban area	180	130	110
Initial grain ban area	(0.37)[b]	(2,1)[b]	(3.2)[b]
Time integral of grain ban area	(0.71)[b]	(1.7)[b]	(2.8)[b]
Initial green vegetables ban area	74	62	46
Time integral of green vegetables ban area	74	62	47
Initial beef ban area	450	390	350
Time integral of beef ban area	310	240	220

Notes

a) The values of the 95th and 5th percentiles of the uncertainty distributions on the areas over which grain is banned are 3.3 10^4 and 1.3, 1.0 10^5 and 4.6 and 1.4 10^5 and 9.3 for the mean value, 95th and 99th percentiles respectively. For the time integral of the area these values are 6.5 10^4 and 8.4, 2.0 10^5 and 4.6 and 2.6 10^5 and 72 respectively.

b) The 5th percentile of the uncertainty distribution for these quantities is zero; the value given in the brackets is the 95th percentile of the uncertainty distribution on the quantity given.

Table 3.2 Reference uncertainty coefficients for the extent and duration of food restrictions

Quantity	For mean value	For 95th percentile	For 99th percentile
CB2			
Initial milk ban area	7.0	9.3	8.5
Time integral of milk ban area	38	37	34
Initial grain ban area	1.3	1.4	1.4
Time integral of grain ban area	1.4	1.3	1.4
Initial green vegetables ban area	6.9	11	10
Time integral of green vegetables ban area	13	13	13
Initial beef ban area	3.3	4.0	4.7
Time integral of beef ban area	4.9	4.8	5.0
DBA			
Initial milk ban area	170	140	110
Time integral of milk ban area	180	140	110
Initial grain ban area	2.1	1.7	3.2
Time integral of grain ban area	2.1	1.7	2.8
Initial green vegetables ban area	140	96	66
Time integral of green vegetables ban area	110	89	65
Initial beef ban area	120	150	170
Time integral of beef ban area	170	140	220

Table 3.3 Important parameter contributing to the uncertainty on the extent and duration of food restrictions

Food	Important parameters for CB2	Important parameters for DBA
Milk	F_m transfer to milk - dairy cows, Cs Interception factor – pasture Retention time – hay/silage	F_m transfer to milk – dairy cows, I Interception factor – pasture Retention time – hay/silage
Grain	Interception factor - Cereals Processing loss – Cereals Retention time – cereals – $k_{2,1}$ Cs	Interception factor – Cereals Processing loss – Cereals Retention time – cereals – $k_{2,1}$ Cs
Green vegetables	Soil contamination – green vegetables	Soil contamination – green vegetables
Beef	Interception factor - pasture[(a] Interception factor – hay/silage[(b))] Retention time – hay/silage F_f transfer to meat – beef cattle, Cs F_f transfer to meat – dairy cattle, Cs Biological half-life – dairy cows,Cs[(a)]	Interception factor – pasture Retention time – hay/silage F_f transfer to liver – dairy cows, Ag

Notes

a Important for the initial extent of the food restriction area but not for its time integral

b Important for the time integral of the food restriction area, but not its initial extent

Table 3.4 Uncertainty factors for long term individual doses at three distances

Quantity	For mean value[a]			For 95th percentile[a]			For 99th percentile[a]		
CB2									
Effective dose with countermeasures	1.1	1.6	3.2	1.2	2.2	5.6	1	1.1	2.3
Bone marrow dose with countermeasures	1.1	1.6	3.2	1.2	2.2	5.8	1	1.1	2.3
Thyroid dose with countermeasures	1.1	1.4	2.6	1.1	1.5	4.5	1	1.1	1.8
Effective dose for normal living	31	29	25	25	23	22	35	32	25
Bone marrow dose for normal living	33	33	33	22	26	30	35	36	32
Thyroid dose for normal living	150	130	85	130	100	53	170	160	110
DBA									
Effective dose with countermeasures	8.6	9.5	15	7.1	12	18	12	9.6	18
Bone marrow dose with countermeasures	11	17	21	14	17	18	14	20	23
Thyroid dose with countermeasures	4.3	11	43	5.5	23	66	4.2	10	65
Potential effective dose	23	20	14	16	15	9.6	25	25	15
Potential bone marrow dose	9.3	9.4	9.7	6.3	7.8	7.2	11	9.6	8.7
Potential thyroid dose	170	150	98	110	100	48	210	200	120

Note:
a The values are given at distances of 5, 20 and 100 km.

Table 3.5 Reference uncertainty coefficients for long term individual doses at three distances

Quantity	For mean value[a]			For 95th percentile[a]			For 99th percentile[a]		
CB2									
Effective dose with countermeasures	0.51	0.68	1.2	0.53	0.98	2.0	0.48	0.53	1.1
Bone marrow dose with countermeasures	0.50	0.68	1.2	0.53	0.98	2.0	0.49	0.53	1.1
Thyroid dose with countermeasures	0.66	0.75	1.2	0.78	0.96	1.9	0.69	0.69	1.1
Effective dose for normal living	16	15	12	15	12	10	17	17	12
Bone marrow dose for normal living	11	11	11	8.5	9.1	10	11	11	11
Thyroid dose for normal living	78	71	50	49	49	28	98	91	66
DBA									
Effective dose with countermeasures	2.9	5.1	8.6	3.7	6.9	9.8	3.2	5.5	10
Bone marrow dose with countermeasures	3.1	5.5	7.8	5.0	6.8	7.8	3.6	6.6	9.1
Thyroid dose with countermeasures	1.9	4.4	21	2.0	7.4	30	2.1	4.1	29
Potential effective dose	17	15	10	12	11	7.1	18	18	12
Potential bone marrow dose	6.1	6.1	6.2	4.4	5.4	4.8	6.8	6.8	5.9
Potential thyroid dose	87	82	62	50	49	29	120	100	71

Note:
a The values are given at distances of 5, 20 and 100 km.

Table 3.6 Important parameters for the uncertainty on long term Individual doses

	For CB2	For DBA
Doses with countermeasures	Soil migration pasture – $k_{1,2}$ Cs Soil fixation pasture – $k_{1,11}$ Cs Root uptake pasture – Cs F_m transfer to milk - dairy cows, Cs	F_m transfer to milk – dairy cows, Cs F_m transfer to milk – dairy cows, I Interception factor – pasture Root uptake pasture - Cs
Doses for normal living	Interception factor – pasture F_m transfer to milk - dairy cows, Cs F_m transfer to milk - dairy cows, I Retention time – hay/silage	Not considered
Potential outdoor doses	Not considered	F_m transfer to milk – dairy cows, Cs F_m transfer to milk – dairy cows, I Interception factor - pasture Retention time – hay/silage

Table 3.7 Uncertainty factors for the numbers of late health effects

Quantity	For mean value	For 95th percentile	For 99th percentile
CB2			
Number of fatal cancers with countermeasures	3.7	6.2	6.5
Number of leukaemias with countermeasures	3.6	6	6.5
Number of thyroid cancers with countermeasures	2.9	4.7	5
Number of fatal cancers for normal living	21	23	25
Number of leukaemias for normal living	32	36	36
Number of thyroid cancers for normal living	86	100	126
DBA			
Number of fatal cancers with countermeasures	12	13	14
Number of leukaemias with countermeasures	18	20	19
Number of thyroid cancers with countermeasures	22	26	30

Table 3.8 Reference uncertainty coefficients for the numbers of late health effects

Quantity	For mean value	For 95th percentile	For 99th percentile
CB2			
Numbers of fatal cancers with countermeasures	1.5	2.1	2.0
Numbers of leukaemias with countermeasures	1.5	2.1	2.0
Numbers of thyroid cancers with countermeasures	1.4	1.9	1.9
Numbers of fatal cancers for normal living	10	10	11
Numbers of leukaemias for normal living	11	11	11
Numbers of thyroid cancers, for normal living	50	60	79
DBA			
Numbers of fatal cancers with countermeasures	6.3	7.1	7.2
Numbers of leukaemias with countermeasures	6.2	6.5	7.4
Numbers of thyroid cancers with countermeasures	9.2	13	15

Table 3.9 Important parameters for the uncertainty on the numbers of late health effects

Situation	Important parameters
CB2 source term, with countermeasures	Fm transfer to milk – dairy cows, Cs Resusp Root uptake pasture, Cs Soil migration pasture – k12, Cs
CB2 source term, normal living	Fm transfer to milk – dairy cows, Cs Interception factor – pasture Retention time – hay/silage Fm transfer to milk – dairy cows, I
DBA source term, with countermeasures	Fm transfer to milk – dairy cows, Cs Interception factor – pasture Retention time – hay/silage Fm transfer to milk – dairy cows, I

Table 3.10 Summary of the parameters identified as making important contributions to the uncertainty

Selected input parameter	Selected using		Selected for source term	
	Ranks	Percentage contribution	CB2	DBA
Biological half-life - dairy cows, I	✔		✔	
Daily intake of hay/silage - dairy cows	✔			✔
Ff transfer to meat - beef cattle, Cs		✔	✔	
Ff transfer to meat - dairy cows, Cs		✔	✔	
Ff transfer to meat - pigs, Te	✔			✔
Ff transfer to meat – sheep, Zn[(a)]				
Soil fixation pasture - k1,11, Cs	✔	✔	✔	✔
Ff transfer to liver - dairy cows, Ag	✔	✔		✔
Fm transfer to milk - dairy cows, Cs	✔	✔	✔	✔
Fm transfer to milk - dairy cows, I	✔	✔	✔	✔
Fm transfer to milk - dairy cows, Zn[(a)]				
Interception Factor – Cereals	✔	✔	✔	✔
Interception factor - hay/silage	✔		✔	✔
Interception factor – pasture	✔	✔	✔	✔
Interception factor- potatoes	✔			✔
Processing loss – cereals		✔	✔	
Processing loss - green vegetables	✔			✔
Resuspension factor – pasture	✔		✔	
Retention time - cereals - k21, Cs	✔	✔	✔	✔
Translocation cereals - k23, Cs[(b)]				
Translocation cereals - k41, Cs[(b)]				
Retention time - green vegetables	✔		✔	
Retention time - hay/silage	✔	✔	✔	✔
Root uptake - pasture, Cs	✔	✔	✔	✔
Soil migration pasture - k12, Cs	✔	✔	✔	✔
Soil migration pasture - k23, Cs	✔	✔	✔	✔
Soil migration pasture - k34, Cs	✔		✔	
Soil migration pasture - k43, Cs[(b)]				
Soil migration pasture – k45, Cs[(b)]				
Soil contamination - green vegetables	✔	✔	✔	✔
Retention time – potatoes, k21, Sr[(b)]				
Translocation potatoes – k24, Sr[(b)]				
Translocation cereals - k34, Cs	✔			✔
Translocation potatoes - k45, Sr	✔			✔
Translocation potatoes - k51, Sr[(b)]				

Notes

a The parameters for zinc were identified from an analysis of the probability of zero (see text)

b Theses parameters were included as others from the same compartment model were identified

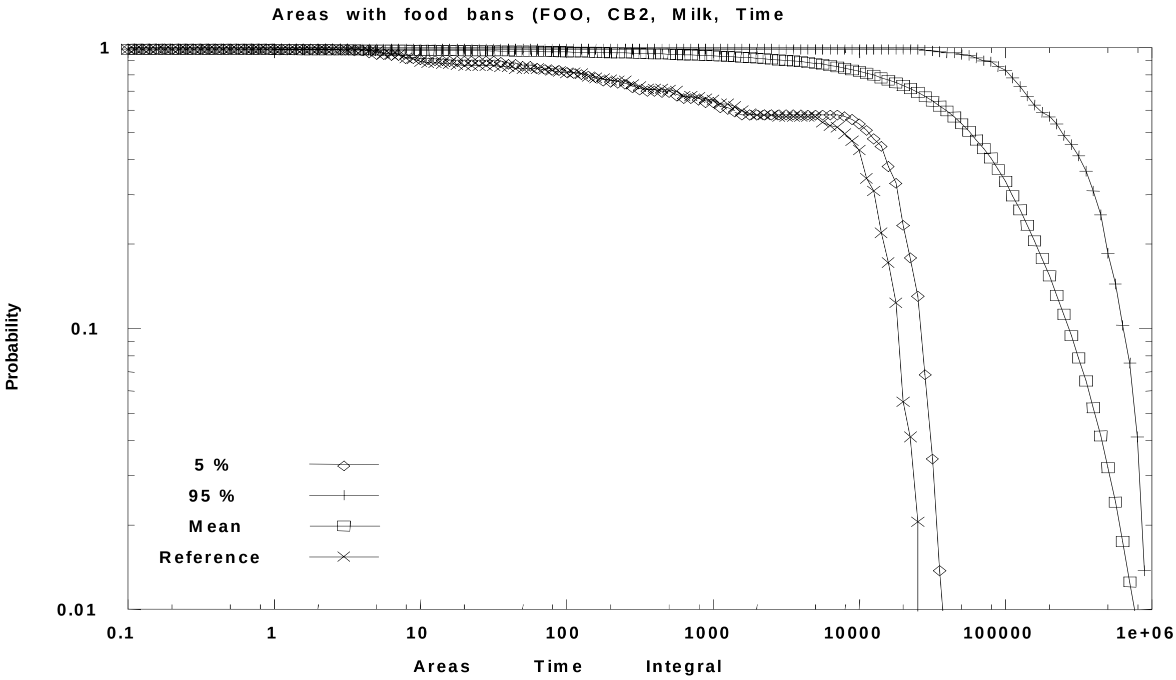

Figure 3.1 Extent of the uncertainty on the time integral of the area with milk restrictions, for the CB2 source term

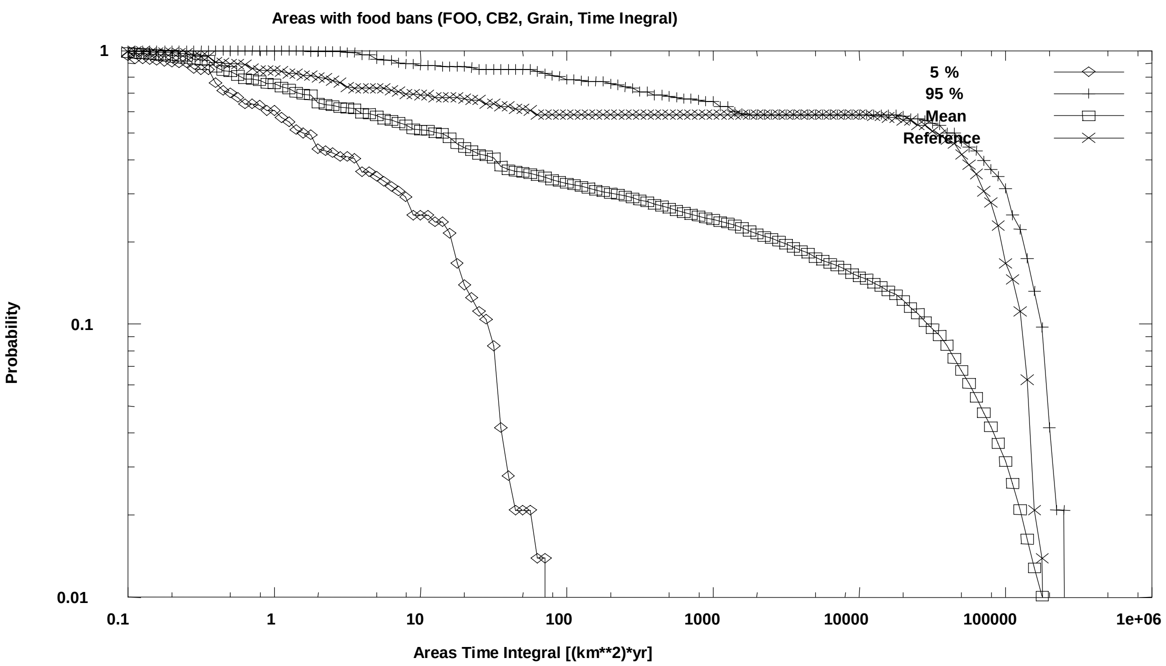

Figure 3.2 Extent of the uncertainty on the time integral of the area with grain restrictions, for the CB2 source term

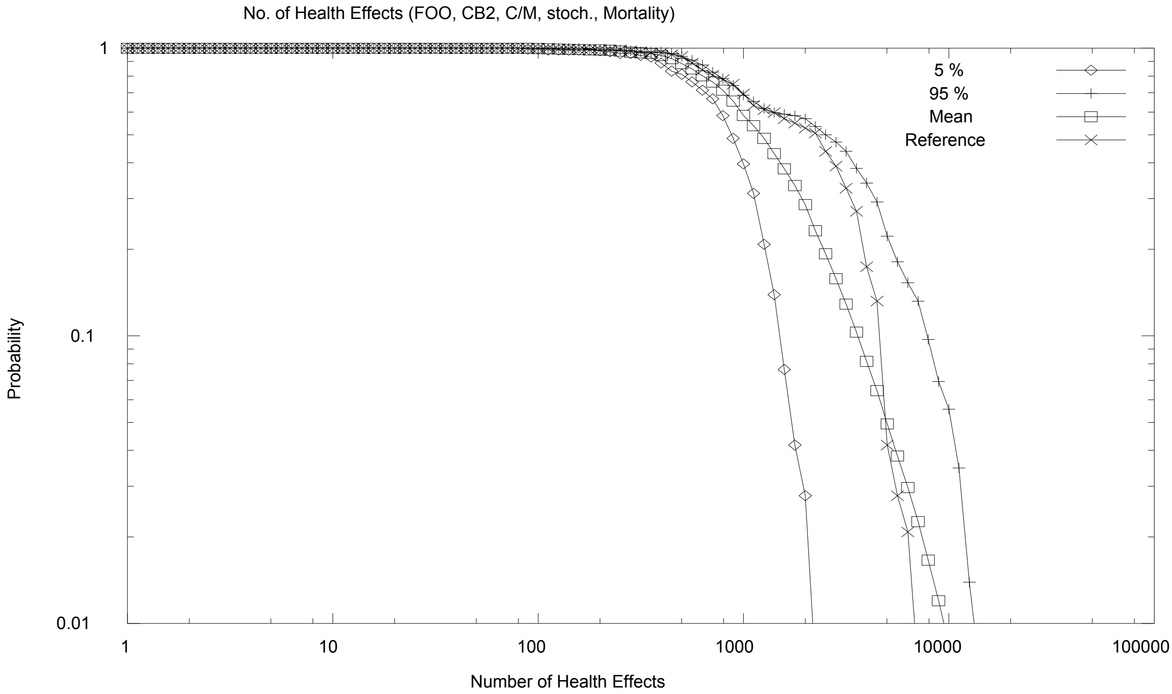

Figure 3.3 Extent of the uncertainty on the numbers of fatal cancers for the CB2 source term if countermeasures are invoked

APPENDIX A

Reports from the Project

Reports on the expert elicitation

Harper F T, Hora S C, Young M L, Miller L A, Lui C H, McKay M D, Helton J C, Goossens L H J, Cooke R M, Päsler-Sauer J, Kraan B and Jones J A. Probabilistic accident consequence uncertainty analysis. Dispersion and deposition uncertainty assessment. NUREG/CR-6244, EUR 15855, SAND94-1453, Washington, DC/USA, and Brussels-Luxembourg, (1995).

Brown J, Goossens L H J, Kraan B C P, Cooke R M, Jones J A, Harper F T, Haskin F E, Abbott M L, Young M L, Hora S C, Rood A. Probabilistic accident consequence uncertainty analysis. Food chain uncertainty assessment. NUREG/CR-6523, EUR 16771, SAND97-0335 Washington, DC/USA, and Brussels-Luxembourg, (1997).

Goossens L H J, Boardman J, Kraan B C P, Cooke R M, Jones J A, Harper F T, Young M L and Hora S C. Probabilistic accident consequence uncertainty analysis: Uncertainty assessment for deposited material and external doses. Report NUREG/CR-6526, EUR 16772, Washington, DC/USA, and Brussels-Luxembourg, (1997).

Goossens L H J., Harrison J.D, Kraan B.C.P, Cooke R.M, Harper F.T. and Hora S.C. Probabilistic accident consequence uncertainty analysis: Uncertainty assessment for internal dosimetry, Report NUREG/CR-6571, EUR 16773, Washington, DC/USA, and Brussels-Luxembourg, (1997).

Little M P, Muirhead C R, Goossens L H J, Kraan B C P, Cooke R M, Harper F T and Hora S C. Probabilistic accident consequence uncertainty analysis: Late health effects uncertainty assessment, Report NUREG/CR-6555, EUR 16774, Washington, DC/USA, and Brussels-Luxembourg, (1997).

Haskin F.E., Harper F.T, Goossens L H J, Randall J, Kraan B.C.P and Grupa J.B. Probabilistic accident consequence uncertainty analysis: Early health effects uncertainty assessment, Report NUREG/CR-6545, EUR 16775, Washington, DC/USA, and Brussels-Luxembourg, (1997).

Goossens L H J, Jones J A, Ehrhardt J, Kraan B C P. Probabilistic accident consequence uncertainty assessment: Countermeasures Uncertainty Assessments. EUR 18821 and FZKA 6307 (2000).

Reports on the COSYMA uncertainty analysis

Cooke R M, Goossens L H J, Kraan B C P. Probabilistic accident consequence uncertainty assessment - procedures guide using structured expert judgement. EUR 18820 (2000).

Jones J A, Ehrhardt J, Fischer F, Hasemann I, Goossens L H J, Kraan B C P, Cooke R M. Probabilistic accident consequence uncertainty assessment using COSYMA: Uncertainty from the Atmospheric Dispersion and Deposition Module. EUR 18822 and FZKA 6308 (2000).

Brown J, Jones J A, Fischer F, Hasemann I, Goossens L H J, Kraan B C P, Cooke R M. Probabilistic accident consequence uncertainty assessment using COSYMA: Uncertainty from the Food Chain Module. EUR 18823 and FZKA 6309 (2000).

Jones J A, Fischer F, Hasemann I, Goossens L H J, Kraan B C P, Cooke R M. Probabilistic accident consequence uncertainty assessment using COSYMA: Uncertainty from the Health Effects Module. EUR 18824 and FZKA 6310 (2000).

Jones J A, Fischer F, Hasemann I, Goossens L H J, Kraan B C P, Cooke R M. Phipps A, and Khursheed A. Probabilistic accident consequence uncertainty assessment using COSYMA: Uncertainty from the dose module. EUR18825 and FZKA 6311 (2000).

Jones J A, Ehrhardt J, Goossens L H J, Fischer F, Hasemann I, Kraan B C P, Cooke R M. Probabilistic accident consequence uncertainty assessment using COSYMA: Overall uncertainty analysis. EUR 18826 and FZKA 6312 (2000).

Jones J A, Kraan B C P, Cooke R M, Goossens L H J, Fischer F, and Hasemann I. Probabilistic accident consequence uncertainty assessment using COSYMA: Methodology and processing techniques. EUR 18827 and FZKA 6313 (2000).

APPENDIX B

Summary of the COSYMA Accident Consequence Code

COSYMA is intended for probabilistic calculations of the off-site consequences of hypothetical accidental releases of radioactive material to atmosphere at nuclear sites. It calculates the health effects, impact of countermeasures and economic costs of the releases. The processes considered in the calculations, and the routes of exposure following accidental releases to atmosphere, are illustrated in Figure B.1. The calculation is divided into a number of steps, as is also illustrated in Figure 1. COSYMA is a modular code, with different modules addressing the different stages of the calculation. However, while Figure 1 illustrates the steps in the calculation, the modules of the codes do not correspond exactly with the boxes shown in that figure. The following sections give brief descriptions of the models included in COSYMA. In some cases, COSYMA includes more than one model for a particular feature. This appendix also specifies which of the models was used for this uncertainty analysis.

COSYMA was developed by the National Radiological Protection Board (NRPB) of the UK and Forschungszentrum Karlsruhe (FZK) of Germany, as part of the European Commission's MARIA project[1]. It represents a fusion of ideas from the NRPB program MARC[2], the FZK program system UFOMOD[3] and input from other MARIA contractors. The program package was first made available in 1990 for use on mainframe computers, and several updates have been released since then. A PC version was first released in 1993 and has since been updated[4].*

COSYMA is a package of programs and data bases, rather than a single program. The mainframe version contains three main accident consequence assessment programs together with a number of preprocessing and evaluation programs. The three main sub-systems of COSYMA are known as the NE, NL and FL sub-systems. The NE (near, early) sub-system is limited to calculating early health effects and the influence of emergency actions to reduce those effects and is intended for use in the region near to the site. The NL (near, late) subsystem is limited to calculating late health effects and the associated countermeasures, and is intended mainly for use in the region near to the site. The FL (far, late) sub-system is concerned with calculating late health effects and appropriate countermeasures at larger distances from the site. Each of these programs is further sub-divided into a series of modules for the various steps in the calculation. PC COSYMA incorporates the NE and NL sub-systems of the mainframe version.

The main endpoints of COSYMA are the numbers of health effects, the impact of countermeasures and the economic costs resulting from an accidental release. A large number of intermediate results are obtained in the process of calculating the major endpoints; these results include activity concentrations, individual and collective doses and the countermeasures that would be imposed at different locations. The package contains a series of evaluation programs that allow these results to be presented in a variety of ways.

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* The mainframe and PC versions of COSYMA are made available on behalf of the European Commission. People wishing to obtain the mainframe version of the system should contact Dr J Ehrhardt, FZK, Germany (e-mail RODOS@RODOS.FZK.DE; those wishing to obtain the PC version of the system should contact Dr J A Jones, NRPB, UK (e-mail Arthur.Jones@NRPB.ORG.UK).

Following an accidental release to atmosphere, people can be irradiated by a number of routes of exposure. The ones considered in COSYMA are:-

- external γ irradiation from material in the plume,
- external γ irradiation from material deposited on the ground
- external β irradiation of skin from material deposited on skin and clothes
- internal irradiation following the inhalation of material from the plume or of material that has been deposited and subsequently resuspended
- internal irradiation from the ingestion of contaminated foods.

COSYMA includes some models directly within the various modules or subsidiary programs, but in other cases it uses results of models taken from data libraries. Thus the atmospheric dispersion models are used directly. COSYMA does not however, include models for the contamination of food or dosimetric calculations, using instead data libraries giving the results of other models, which are not part of COSYMA, itself, but whose uncertainty is considered within the current study.

B.1 Atmospheric dispersion and deposition

Mainframe COSYMA contains five different models of atmospheric dispersion that are appropriate for different applications or are based on different assumptions and approximations(5).

The NE and NL sub-system include the MUSEMET(6) model, which was originally written at Forschungsanlage Julich but has been extensively modified at FZK for use with COSYMA. This is a segmented Gaussian plume model allowing for changes of atmospheric conditions and wind direction during plume travel. This model derives the sequences of atmospheric conditions affecting the plume from a data file giving hourly averages for wind speed and direction, stability category, precipitation intensity and mixing layer depth. It allows for the effects on the subsequent dispersion of plume rise and buildings near the release point. It also includes the effects of wet and dry deposition of the dispersing material. This model is also included in PC COSYMA.

The NE and NL sub-systems can also be used with the COSGAP or RIMPUFF dispersion models, which are provided as separate programs. COSGAP(7) is a Gaussian plume dispersion model, which is similar to MUSEMET but does not consider changes of wind direction during plume travel. It is based on the dispersion model in MARC. RIMPUFF(8), developed by Risø National Laboratory, Denmark, is a Gaussian puff trajectory model which derives the atmospheric conditions affecting the plume by interpolating between data from a number of meteorological stations in the region of interest.

The NL sub-system also contains the ISOLA(9) model for very long release durations. This uses statistics of atmospheric conditions and is only appropriate for releases that are sufficiently small that no countermeasures and no early health effects would be expected.

The FL sub-system is linked to the Mesos model(10), developed by Imperial College, UK. This is a trajectory model for dispersion over long distances that uses meteorological data for a large area, such as the whole of Europe.

Accident consequence assessment programs need to consider the consequences should the accident occur in any of a wide range of atmospheric conditions. It is not possible to calculate the consequences for every sequence of conditions that might arise, and so some method is required to sample a representative set of conditions from those possible. Both the mainframe and PC versions of COSYMA include a flexible program to undertake this sampling.

Only the MUSEMET dispersion model is included in this study, using the NE and NL sub-systems. The uncertainty in dispersion modelling includes both the uncertainty on the spread of the plume around its trajectory, and the uncertainty on the location of the plume trajectory. The other Gaussian models included in COSYMA (RIMPUFF, COSGAP and ISOLA) use similar descriptions of the growth of plumes and of the trajectory. Therefore the uncertainty on consequences predicted using MUSEMET should be similar to the uncertainties predicted using the other Gaussian models. However, MESOS uses a different method of calculating plume trajectories, and the uncertainties on calculations using MESOS may not be the same as those using Gaussian plume or puff models.

B.2 Dose calculations

As stated earlier, COSYMA does not include dosimetric models but uses information from data libraries which are calculated with these models. The libraries include information on the doses from 197 radionuclides.

The data library used for calculating external exposure from γ emitting material deposited on the ground contains outdoor doses per unit deposit integrated to a series of times. These doses are combined with location factors representing the reduction of external γ irradiation by the shielding effects of buildings and typical behaviour of the population. The library is drawn from a number of sources, using results of models developed at NRPB(11,12) and Forschungszentrum für Umwelt und Gesundheit (GSF)(13), Germany. The doses for those radionuclides making major contributions to the dose from fission reactor accidents are derived from a model describing the deposition patterns in urban areas and the subsequent transfer of material between the different surfaces. Location factors are used to describe the protection offered by buildings.

The doses from internal irradiation following ingestion or inhalation are calculated using data libraries of dose per unit intake derived using models which are consistent with those in ICRP publications 56, 67 and 69. COSYMA needs information on the dose received in different periods after the accident, and so this information is included in the data libraries. The method used for calculating doses and risks of health effects in the mainframe version of COSYMA allows for the variation of dose per unit intake with age at intake, and so the libraries contain information on doses for different age groups in the population. The PC version uses a simpler method which only considers the doses to adults.

B.3 Food chain models

COSYMA requires information on the concentration of material in foods as a function of time after the accident. It does not include a food chain model, but uses the results of such models through data libraries which give the activity concentration for a range of radionuclides in a number of foods at a series of times following unit deposition. The concentration of material in foods depends on the time of year at which the deposition occurs. COSYMA uses two data libraries, for deposition in summer and winter. Within a run of COSYMA, the "summer" or "winter" data library is used depending on the date in the year of the meteorological sequence being analysed.

COSYMA uses libraries derived from the NRPB model FARMLAND[14] and the GSF model ECOSYS[15]. The libraries were created using agreed values for the food chain parameters for application within the European Union, but there are differences because of other modelling assumptions made and because of the foods considered in each. The foods which can be considered with FARMLAND are milk, meat and liver from cattle, pork, meat and liver from sheep, green vegetables, grain products, potatoes and other root vegetables. The foods which can be considered with ECOSYS are milk, beef pork, grain products, potatoes and other root vegetables, and leafy and non-leafy green vegetables.

The intakes of these foods are calculated within COSYMA using one of two assumptions about the distribution of food between harvest and consumption. One method assumes that all food consumed is produced locally, and is used in calculating individual ingestion doses. The other method uses information on the amount of food produced in the area of interest, and calculates collective doses on the assumption that all food produced is consumed somewhere.

For this study, the FARMLAND food chain model was used to calculate the uncertainty on concentrations of activity in foods. Doses from ingestion of food were calculated on the assumption that all food consumed is produced locally.

B.4 Countermeasures

COSYMA allows the user to consider the effect of a wide range of countermeasures in reducing the exposure of the population, and gives the user considerable freedom in specifying the criteria at which the actions will be imposed or withdrawn[16].

Sheltering as the only action and sheltering combined with evacuation may be implemented automatically or on the basis of dose. The distribution of iodine tablets, automatically or on the basis of dose, can also be considered. These actions are assumed to be implemented sufficiently rapidly to reduce the risks of both early and late health effects. Relocation is considered as an action to reduce doses and risks over longer time periods. It can be implemented on a dose criterion. Return from evacuation or relocation is also considered on a dose criterion. The effects of decontamination in reducing the period of relocation can be considered. If these actions are initiated on the basis of dose, the user can specify the intervention levels, organs and pathways to be considered, and the time over which the dose is to be integrated. The behaviour of the population considered in the dose criteria can also be described using location factors.

Food restrictions can also be considered[17]. They can be implemented or withdrawn on the basis of doses received within specified time periods or on the basis of the instantaneous concentration of radionuclides in foods.

B.5 Health effects

COSYMA considers both early and late health effects in the population, using methods recommended by NRPB[18,19], the US Nuclear Regulatory Commission[20] and GSF[21].

The risk of early health effects is calculated using "hazard functions". The method allows for the variation of risk with the rate at which dose is accumulated over the first few days following the accident. Ten different fatal and non-fatal effects are considered by COSYMA, though not all are considered for this study.

The risk of late health effects is calculated using the linear dose response relationship. COSYMA considers the risk of fatal and non-fatal cancers in ten organs, and the risk of leukaemia. It also considers the risk of hereditary effects. The method adopted in the mainframe version of COSYMA allows for the variation of risk with age at exposure[22]. PC COSYMA uses a simpler method which only considers the doses and risks to adults, assuming that the risk is the product of committed dose and risk coefficient. The mainframe version of COSYMA can provide information on the numbers of cancers in the people alive at the time of the accident, and in their descendants. It also gives information on the times at which the cancers occur. For this study, the approximation used in PC COSYMA for calculating the risks of late health effects was adopted.

B.6 Economic effects

COSYMA can calculate the off-site economic cost of the accident, considering the costs arising from the countermeasures and the costs of health effects. The assumptions and models are described in references 23 and 24. The countermeasures for which costs are considered are movement of the population, food restrictions and decontamination. The costs arising from lost production in the area from which people are moved can be assessed in terms of the per capita contribution of the relocated population to gross domestic product (GDP) or in terms of the value of the land affected. For longer periods of relocation, the lost capital value of the land and its assets may be calculated. The costs of food restrictions include contributions to GDP as well as the lost capital value and the disposal costs of the food affected. The cost arising from health effects may be calculated in terms of the treatment costs and the lost economic productivity of the affected individuals or an estimation of the cost of health effects may be obtained using a more subjective approach to the valuation of life.

This study did not consider the uncertainty on economic effects.

B.7 References

1 KfK and NRPB. COSYMA: A new program package for accident consequence assessment. CEC. Brussels, EUR-13028 (1991).
2 Hill M D, Simmonds J R and Jones J A. NRPB methodology for assessing the radiological consequences of accidental releases of radionuclides to atmosphere - MARC-1. Chilton, NRPB-R224 (1988) (London HMSO).
3 Ehrhardt J, Burkart K, Hasemann I, Matzerath C, Panitz H-J and Steinhauer C. The program system UFOMOD for assessing the consequences of nuclear accidents. KfK-4330 (1988).
4 Jones J A, Mansfield P A , Haywood S M , Hasemann I, Steinhauer C, Ehrhardt J and Faude D. PC COSYMA (Version 2): an accident consequence assessment package for use on a PC. EUR report 16239 (1995).
5 Panitz H-J, Päsler-Sauer J and Matzerath C. UFOMOD: Atmospheric dispersion and

deposition. KfK-4332 (1989).
6 Straka J, Geiβ H and Vogt K J. Diffusion of waste air puffs and plumes under changing weather conditions. Contr. Atmos. Phys. 54 207-221, (1981).
7 Jones J A and Charles D. AD-MARC: The atmospheric dispersion module in the methodology for assessing the radiological consequences of accidental releases. Chilton, NRPB-M72, (1982).
8 Mikkelsen T, Larsen S E and Thykier-Nielsen S. Description of the Riso puff model. Nuclear Technol 76 56-65 (1984).
9 Hübschmann W and Raskob W. ISOLA V: a Fortran-77 code for the calculation of the long-term concentration distribution in the environment of nuclear installations.
10 ApSimon H M and Goddard A J H. Atmospheric transport of radioisotopes and the assessment of population doses on a European scale. CEC Luxembourg EUR-9128 (1983).
11 Charles D, Crick M J, Fell T P and Greenhalgh J R. DOSE-MARC: The dosimetric module in the methodology for assessing the radiological consequences of accidental releases. Chilton NRPB-M74 (1982).
12 Crick M J and Brown J. EXPURT: A model for evaluating exposure from radioactive material deposited in the urban environment. Chilton NRPB-R235 (1990).
13 Jacob P, Paretzke H G, Rosenbaum H, Zankl M. Organ doses from radionuclides on the ground. Part 1: Simple time dependencies. Health Physics 54 617-633 (1988).
14 Brown J and Simmonds J R. FARMLAND a dynamic model for the transfer of radionuclides through terrestrial foodchains. Chilton. NRPB-R273 (1995).
15 Matthies M, Eisfeld K, Müller H, Paretzke H G, Pröhl G and Wirth G. Simulation des Transfers von Radionukliden in landwirtschaflichen Nahrungsketten. GSF Bericht S-882 (1982).
16 Hasemann I and Ehrhardt J. COSYMA: dose models and countermeasures for external exposure and inhalation. Karlsruhe KFK 4333, (1994).
17 Steinhauer C. COSYMA: ingestion pathways and foodbans. Karlsruhe. KfK 4334 (1992)
18 Edwards A A. Private communication (1995).
19 NRPB. Estimates of late radiation risks to the UK population. Documents of the NRPB 4 (4) 15-157 (1993).
20 Evans J S, Moeller D W and Cooper D W. Health effects models for nuclear power plant accident consequence analysis. NUREG/CR-4214 (1985), Rev 1, (1990).
21 Paretzke H G, Stather J W and Muirhead C R. Risk factors for late somatic effects. In Proceedings of the CEC Seminar on methods and codes for assessing the off-site consequences of nuclear accidents, Athens 1990, Luxembourg EUR 13013 (1991).
22 Ehrhardt J, Hasemann I, Matzerath-Boccaccini C, Steinhauer C and Raicevic J. COSYMA: health effects models. Karlsruhe FZKA 5567 (1995).
23 Haywood S M, Robinson C A and Heady C. COCO-1: model for assessing the cost of offsite consequences of accidental releases of radioactivity. Chilton NRPB-R243 (1991).
24 Faude D. COSYMA: Modelling of economic consequences. Karlsruhe, KfK Report 4336 (1992)

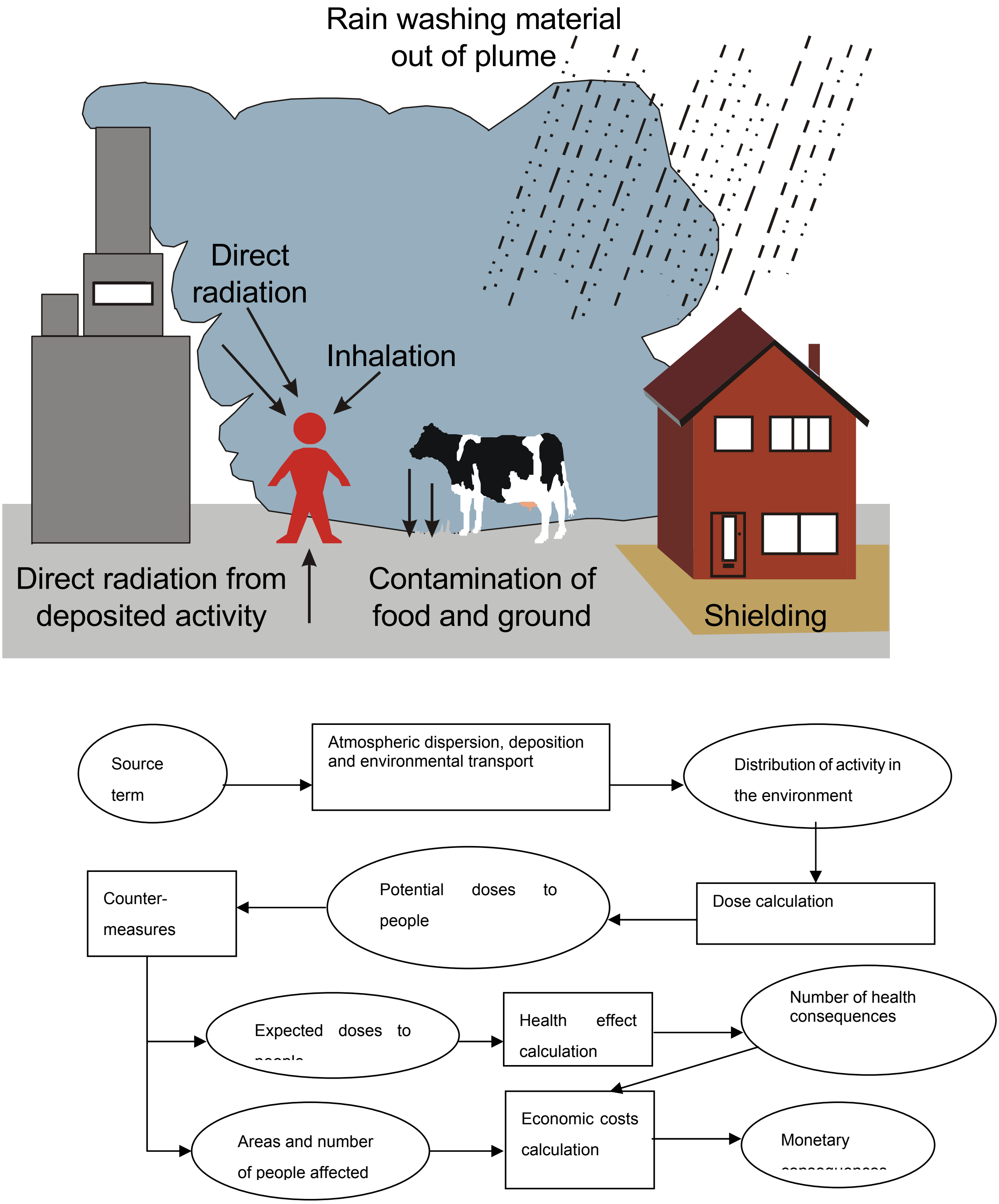

Figure B.1 Processes modelled in COSYMA

Appendix C

Extent of the uncertainty on the predicted consequences

This appendix includes tables giving various percentiles of the distribution of uncertainty on all of the model endpoints considered in the study. The endpoints are identified using a short code. The short codes for all of the endpoints considered are listed in Table C.1

The remaining tables give some of the percentiles of the uncertainty distributions on the mean value, the 95th and 99th percentiles and the probability of zero effects for each of the endpoints considered, for each of the three source terms. The table contains the following information:

REF — the value obtained in a single run of COSYMA using the default values for all of the input parameters.

MEDIAN — the median value from the uncertainty distribution on the quantity given.

5 % etc — the percentiles of the uncertainty distribution on the quantity given.

FAC1 — the ratio of the 95th to 5th percentiles of the uncertainty distribution on the quantity given. (the uncertainty factor)

FAC2 — the ratio of the 90th to 10th percentiles of the uncertainty distribution on the quantity given.

FAC3 — the ratio of the 75th to 25th percentiles of the uncertainty distribution on the quantity given.

The final column gives the ratio of the 95th percentile of the uncertainty distribution to the reference value (the reference uncertainty coefficient)

The analysis has resulted in sets of values for the each of the endpoints from each of the runs of COSYMA considered. The percentiles of the uncertainty distribution on each endpoint is evaluated from this set of values. The program used to evaluate the percentiles first specifies a series of bins. Each of the values for the endpoint are allocated to one of the bins, and the probability distribution on the endpoint constructed. The value assigned to a percentile of the distribution is the value of the lower end of the bin containing that percentile. The values allocated to the highest bin are 6 to 9 orders of magnitude greater than those allocated to the lowest bin, depending on the particular endpoint considered. There are some situations where percentiles of the uncertainty distribution for the quantities considered fall below the value that would be allocated to the lowest bin. In this case the value is reported as zero, and the ratio of the percentiles is reported as "9.99E+99".

Some of the values of the endpoints from the default run for CB2 given in this report do not agree with those for the same situation in the other reports. The food module is contained in the COSYMA NL sub-system, and so this module analysis could be undertaken without running the NE sub-system. This means that the uncertainty distributions to not take account of the effects on the predictions of the small risk of early effects for this source term, or of the effects of the early countermeasures (sheltering, evacuation and iodine tablets). For consistency, therefore, the default run was repeated so that it only included the NL sub-system, and so does not include effects of those things that are only considered in the NE sub-system. This does not affect the results for the DBA source term, as this release is sufficiently small that the analysis for all modules was undertaken using only the NL sub-system.

Table C.1 Description of the endpoint codes used in the following tables

Short code	Description of endpoint
AFBIBEE	Time integral of area subject to beef ban
AFBIGRA	Initial area subject to grain restrictions
AFBIMIL	Initial area subject to milk restrictions
AFBIVEG	Initial area subject to green vegetables restrictions
AFBTBEE	Time integral of area subject to beef restrictions
AFBTGRA	Time integral of area subject to grain restrictions
AFBTMIL	Time integral of area subject to milk restrictions
AFBTVEG	Time integral of area subject to green vegetables restrictions
CDCMBM	Collective dose to bone marrow, with countermeasures
CDCMED	Collective effective dose, with countermeasures
CDCMTH	Collective dose to thyroid, with countermeasures
CDLVBM	Collective dose to bone marrow, for normal living
CDLVED	Collective effective dose, for normal living
CDLVTH	Collective dose to thyroid, for normal living
DLCMBM[(a)]	Individual committed dose to bone marrow from inhalation, ingestion and external exposure, with countermeasures
DLCMED[(a)]	Individual committed effective dose from inhalation, ingestion and external exposure, with countermeasures
DLCMTH[(a)]	Individual committed dose to thyroid from inhalation, ingestion and external exposure, with countermeasures
DLLVBM[(a)]	Individual committed dose to bone marrow from inhalation, ingestion and external exposure, for normal living
DLLVED[(a)]	Individual committed effective dose from inhalation, ingestion and external exposure, for normal living
DLLVTH[(a)]	Individual committed dose to thyroid from inhalation, ingestion and external exposure, for normal living
DLOUBM[(a)]	Individual committed dose to bone marrow from inhalation, ingestion and external exposure, potential outdoor dose
DLOUED[(a)]	Individual committed effective dose from inhalation, ingestion and external exposure, potential outdoor dose
DLOUTH[(a)]	Individual committed dose to thyroid from inhalation, ingestion and external exposure, potential outdoor dose
PLCMBM	Number of deaths from leukaemia, with countermeasures
PLCMMT	Number of fatal cancers, with countermeasures
PLCMTH	Number of cases of fatal thyroid cancer, with countermeasures
PLLVBM	Number of deaths from leukaemia, for normal living
PLLVMT	Number of fatal cancers, for normal living
PLLVTH	Number of cases of fatal thyroid cancer, for normal living
RLCMBM[(a)]	Individual risk of death from leukaemia, with countermeasures
RLCMMT[(a)]	Individual risk of fatal cancer, with countermeasures
RLCMTH[(a)]	Individual risk of death from thyroid cancer, with countermeasures
RLLVBM[(a)]	Individual risk of death from leukaemia, for normal living

RLLVMT[a]	Individual risk of fatal cancer, for normal living
RLLVTH[a]	Individual risk of death from thyroid cancer, for normal living
RLOUBM[a]	Individual risk of death from leukaemia, for potential outdoor exposure
RLOUMT[a]	Individual risk of fatal cancer, for potential outdoor exposure
RLOUTH[a]	Individual risk of death from thyroid cancer, for potential outdoor exposure

Note:

a Some endpoints are evaluated at a series of distances (0.875, 5, 20 and 100 km). The names include a number 1 to 4 to indicate which distance is considered. Note that the endpoints relating to late effects are evaluated at distances from 5 to 100 km.

Table C.2 Uncertainty distributions on the endpoints for each of the source terms

EXTENT OF THE UNCERTAINTY FOR THE MEAN VALUE OF THE ENDPOINTS FOR THE CB2 SOURCE TERM

MEAN VAL	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
DLCMED2	2.53E-02	1.19E-02	1.15E-02	1.28E-02	1.11E+00	1.15E-02	1.25E-02	1.08E+00	1.17E-02	1.22E-02	1.04E+00	5.06E-01
DLCMED3	4.24E-03	2.09E-03	1.77E-03	2.88E-03	1.63E+00	1.79E-03	2.60E-03	1.45E+00	1.91E-03	2.33E-03	1.22E+00	6.79E-01
DLCMED4	7.69E-04	4.57E-04	2.92E-04	9.27E-04	3.18E+00	3.09E-04	7.90E-04	2.55E+00	3.60E-04	5.99E-04	1.67E+00	1.21E+00
DLCMBM2	2.41E-02	1.12E-02	1.08E-02	1.21E-02	1.12E+00	1.09E-02	1.18E-02	1.08E+00	1.10E-02	1.15E-02	1.05E+00	5.01E-01
DLCMBM3	4.07E-03	2.00E-03	1.70E-03	2.77E-03	1.63E+00	1.72E-03	2.51E-03	1.46E+00	1.83E-03	2.24E-03	1.22E+00	6.81E-01
DLCMBM4	7.42E-04	4.43E-04	2.84E-04	8.98E-04	3.17E+00	3.00E-04	7.64E-04	2.55E+00	3.49E-04	5.80E-04	1.66E+00	1.21E+00
DLCMTH2	3.55E-02	2.26E-02	2.22E-02	2.34E-02	1.06E+00	2.22E-02	2.31E-02	1.04E+00	2.24E-02	2.29E-02	1.02E+00	6.60E-01
DLCMTH3	5.28E-03	3.18E-03	2.88E-03	3.95E-03	1.37E+00	2.90E-03	3.69E-03	1.27E+00	3.01E-03	3.43E-03	1.14E+00	7.48E-01
DLCMTH4	8.52E-04	5.34E-04	3.78E-04	9.85E-04	2.60E+00	3.94E-04	8.59E-04	2.18E+00	4.45E-04	6.78E-04	1.53E+00	1.16E+00
DLLVED2	1.53E-01	4.64E-01	8.14E-02	2.51E+00	3.09E+01	1.16E-01	1.82E+00	1.57E+01	2.20E-01	9.63E-01	4.38E+00	1.64E+01
DLLVED3	2.01E-02	5.70E-02	1.01E-02	2.93E-01	2.89E+01	1.42E-02	2.33E-01	1.63E+01	2.74E-02	1.20E-01	4.38E+00	1.46E+01
DLLVED4	2.75E-03	6.73E-03	1.26E-03	3.21E-02	2.54E+01	1.70E-03	2.68E-02	1.58E+01	3.10E-03	1.34E-02	4.32E+00	1.17E+01
DLLVBM2	1.36E-01	2.36E-01	4.50E-02	1.47E+00	3.27E+01	6.54E-02	1.06E+00	1.63E+01	1.10E-01	5.20E-01	4.73E+00	1.08E+01
DLLVBM3	1.82E-02	3.14E-02	5.99E-03	1.96E-01	3.27E+01	8.70E-03	1.42E-01	1.63E+01	1.47E-02	6.92E-02	4.72E+00	1.08E+01
DLLVBM4	2.58E-03	4.46E-03	8.42E-04	2.78E-02	3.30E+01	1.23E-03	2.01E-02	1.63E+01	2.07E-03	9.82E-03	4.73E+00	1.08E+01
DLLVTH2	3.69E-01	3.00E+00	1.95E-01	2.88E+01	1.48E+02	4.17E-01	1.84E+01	4.42E+01	1.10E+00	8.16E+00	7.40E+00	7.81E+01
DLLVTH3	4.25E-02	3.26E-01	2.31E-02	3.03E+00	1.31E+02	4.90E-02	1.97E+00	4.02E+01	1.24E-01	8.71E-01	7.02E+00	7.13E+01
DLLVTH4	4.14E-03	2.44E-02	2.46E-03	2.08E-01	8.46E+01	4.62E-03	1.36E-01	2.94E+01	1.03E-02	6.24E-02	6.07E+00	5.03E+01
AFBIMIL	3.23E+04	1.24E+05	3.10E+04	2.27E+05	7.31E+00	5.32E+04	2.08E+05	3.91E+00	9.29E+04	1.65E+05	1.77E+00	7.02E+00
AFBIGRA	2.52E+04	1.29E+02	1.35E+00	3.33E+04	2.47E+04	1.35E+00	1.84E+04	1.36E+04	1.47E+00	2.66E+03	1.81E+03	1.32E+00
AFBIVEG	4.10E+04	1.62E+05	5.67E+04	2.83E+05	4.99E+00	7.66E+04	2.57E+05	3.36E+00	1.14E+05	2.11E+05	1.86E+00	6.89E+00
AFBIBEE	3.20E+04	4.27E+04	2.82E+03	1.05E+05	3.70E+01	8.05E+03	9.51E+04	1.18E+01	2.03E+04	6.76E+04	3.34E+00	3.27E+00
AFBTMIL	7.99E+03	7.48E+04	1.19E+04	3.07E+05	2.58E+01	1.99E+04	2.41E+05	1.21E+01	3.79E+04	1.48E+05	3.90E+00	3.84E+01
AFBTGRA	4.69E+04	2.55E+02	8.37E+00	6.46E+04	7.71E+03	8.37E+00	3.48E+04	4.15E+03	8.59E+00	5.07E+03	5.90E+02	1.38E+00
AFBTVEG	6.08E+03	5.78E+03	1.43E+03	7.94E+04	5.57E+01	1.76E+03	4.77E+04	2.71E+01	3.14E+03	1.91E+04	6.07E+00	1.31E+01
AFBTBEE	2.67E+04	3.55E+04	2.26E+03	1.30E+05	5.75E+01	4.21E+03	1.01E+05	2.40E+01	1.53E+04	6.92E+04	4.51E+00	4.88E+00
RLCMMT2	1.21E-03	5.75E-04	5.54E-04	6.18E-04	1.12E+00	5.57E-04	6.02E-04	1.08E+00	5.63E-04	5.89E-04	1.05E+00	5.11E-01
RLCMMT3	2.06E-04	1.02E-04	8.60E-05	1.41E-04	1.64E+00	8.73E-05	1.27E-04	1.46E+00	9.29E-05	1.14E-04	1.22E+00	6.85E-01
RLCMMT4	3.75E-05	2.24E-05	1.43E-05	4.55E-05	3.19E+00	1.51E-05	3.87E-05	2.56E+00	1.76E-05	2.93E-05	1.67E+00	1.21E+00
RLCMBM2	1.25E-04	5.80E-05	5.60E-05	6.24E-05	1.12E+00	5.62E-05	6.08E-05	1.08E+00	5.69E-05	5.95E-05	1.05E+00	5.01E-01
RLCMBM3	2.10E-05	1.03E-05	8.75E-06	1.43E-05	1.63E+00	8.88E-06	1.29E-05	1.46E+00	9.45E-06	1.16E-05	1.22E+00	6.81E-01
RLCMBM4	3.83E-06	2.29E-06	1.46E-06	4.63E-06	3.17E+00	1.55E-06	3.94E-06	2.55E+00	1.80E-06	2.99E-06	1.66E+00	1.21E+00
RLCMTH2	6.29E-05	4.00E-05	3.93E-05	4.15E-05	1.06E+00	3.93E-05	4.10E-05	1.04E+00	3.96E-05	4.05E-05	1.02E+00	6.60E-01
RLCMTH3	9.34E-06	5.63E-06	5.09E-06	6.99E-06	1.37E+00	5.14E-06	6.53E-06	1.27E+00	5.33E-06	6.07E-06	1.14E+00	7.48E-01
RLCMTH4	1.51E-06	9.46E-07	6.70E-07	1.74E-06	2.60E+00	6.97E-07	1.52E-06	2.18E+00	7.87E-07	1.20E-06	1.53E+00	1.16E+00
RLLVMT2	6.21E-03	1.45E-02	3.39E-03	3.79E-02	1.12E+01	4.62E-03	3.24E-02	7.00E+00	8.20E-03	2.30E-02	2.81E+00	6.10E+00
RLLVMT3	9.33E-04	2.34E-03	4.51E-04	9.77E-03	2.17E+01	6.26E-04	8.20E-03	1.31E+01	1.15E-03	4.53E-03	3.93E+00	1.05E+01
RLLVMT4	1.32E-04	2.95E-04	5.92E-05	1.44E-03	2.43E+01	8.03E-05	1.12E-03	1.39E+01	1.42E-04	5.79E-04	4.08E+00	1.09E+01
RLLVBM2	7.04E-04	1.22E-03	2.32E-04	7.30E-03	3.14E+01	3.37E-04	5.44E-03	1.61E+01	5.67E-04			

										2.68E-03	4.73E+00	1.04E+01
RLLVBM3	9.38E-05	1.62E-04	3.09E-05	1.01E-03	3.27E+01	4.49E-05	7.31E-04	1.63E+01	7.56E-05	3.57E-04	4.72E+00	1.08E+01
RLLVBM4	1.33E-05	2.30E-05	4.35E-06	1.44E-04	3.30E+01	6.35E-06	1.04E-04	1.63E+01	1.07E-05	5.07E-05	4.73E+00	1.08E+01
RLLVTH2	6.53E-04	5.30E-03	3.45E-04	3.00E-02	8.70E+01	7.39E-04	2.40E-02	3.25E+01	1.95E-03	1.39E-02	7.14E+00	4.59E+01
RLLVTH3	7.51E-05	5.77E-04	4.10E-05	5.35E-03	1.31E+02	8.67E-05	3.48E-03	4.02E+01	2.20E-04	1.54E-03	7.02E+00	7.13E+01
RLLVTH4	7.33E-06	4.32E-05	4.36E-06	3.68E-04	8.46E+01	8.17E-06	2.40E-04	2.94E+01	1.82E-05	1.10E-04	6.07E+00	5.03E+01
CDCMED	4.81E+04	3.16E+04	1.91E+04	6.94E+04	3.63E+00	2.07E+04	5.63E+04	2.72E+00	2.46E+04	4.23E+04	1.72E+00	1.44E+00
CDCMBM	4.63E+04	3.05E+04	1.85E+04	6.70E+04	3.63E+00	1.99E+04	5.43E+04	2.72E+00	2.38E+04	4.09E+04	1.72E+00	1.45E+00
CDCMTH	5.42E+04	3.75E+04	2.61E+04	7.43E+04	2.85E+00	2.77E+04	6.21E+04	2.24E+00	3.09E+04	4.83E+04	1.56E+00	1.37E+00
CDLVED	1.57E+05	3.96E+05	7.43E+04	1.82E+06	2.45E+01	9.90E+04	1.59E+06	1.60E+01	1.88E+05	7.73E+05	4.11E+00	1.16E+01
CDLVBM	1.46E+05	2.51E+05	4.84E+04	1.56E+06	3.22E+01	7.01E+04	1.13E+06	1.61E+01	1.18E+05	5.52E+05	4.67E+00	1.07E+01
MEAN VAL	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
CDLVTH	2.56E+05	1.62E+06	1.48E+05	1.38E+07	9.27E+01	2.87E+05	9.15E+06	3.18E+01	6.50E+05	4.09E+06	6.29E+00	5.38E+01
PLCMMT	2.34E+03	1.54E+03	9.33E+02	3.40E+03	3.65E+00	1.01E+03	2.75E+03	2.74E+00	1.20E+03	2.07E+03	1.72E+00	1.45E+00
PLCMBM	2.39E+02	1.58E+02	9.53E+01	3.46E+02	3.63E+00	1.03E+02	2.80E+02	2.72E+00	1.23E+02	2.11E+02	1.72E+00	1.45E+00
PLCMTH	9.59E+01	6.63E+01	4.62E+01	1.31E+02	2.85E+00	4.90E+01	1.10E+02	2.24E+00	5.47E+01	8.54E+01	1.56E+00	1.37E+00
PLLVMT	7.39E+03	1.69E+04	3.49E+03	7.46E+04	2.14E+01	4.66E+03	5.90E+04	1.26E+01	7.97E+03	3.15E+04	3.96E+00	1.01E+01
PLLVBM	7.54E+02	1.29E+03	2.50E+02	7.98E+03	3.20E+01	3.62E+02	5.78E+03	1.60E+01	6.10E+02	2.84E+03	4.67E+00	1.06E+01
PLLVTH	4.52E+02	2.78E+03	2.63E+02	2.27E+04	8.62E+01	5.07E+02	1.52E+04	3.00E+01	1.13E+03	7.00E+03	6.19E+00	5.01E+01

C.6

EXTENT OF THE UNCERTAINTY FOR THE 95TH PERCENTILE OF THE ENDPOINTS FOR THE CB2 SOURCE TERM

95 %-FRT	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
DLCMED2	7.94E-02	3.72E-02	3.63E-02	4.17E-02	1.15E+00	3.63E-02	3.98E-02	1.10E+00	3.63E-02	3.80E-02	1.05E+00	5.25E-01
DLCMED3	1.20E-02	7.24E-03	5.25E-03	1.17E-02	2.24E+00	5.50E-03	1.02E-02	1.86E+00	6.31E-03	8.51E-03	1.35E+00	9.77E-01
DLCMED4	2.95E-03	2.14E-03	1.07E-03	6.03E-03	5.62E+00	1.15E-03	4.68E-03	4.07E+00	1.41E-03	3.31E-03	2.34E+00	2.04E+00
DLCMBM2	7.41E-02	3.47E-02	3.39E-02	3.89E-02	1.15E+00	3.39E-02	3.72E-02	1.10E+00	3.47E-02	3.55E-02	1.02E+00	5.25E-01
DLCMBM3	1.15E-02	6.76E-03	5.01E-03	1.12E-02	2.24E+00	5.13E-03	9.77E-03	1.91E+00	5.89E-03	7.94E-03	1.35E+00	9.77E-01
DLCMBM4	2.88E-03	2.04E-03	1.02E-03	5.89E-03	5.75E+00	1.10E-03	4.47E-03	4.07E+00	1.38E-03	3.16E-03	2.29E+00	2.04E+00
DLCMTH2	1.23E-01	9.12E-02	8.91E-02	9.55E-02	1.07E+00	8.91E-02	9.33E-02	1.05E+00	9.12E-02	9.33E-02	1.02E+00	7.76E-01
DLCMTH3	1.74E-02	1.26E-02	1.15E-02	1.66E-02	1.45E+00	1.17E-02	1.51E-02	1.29E+00	1.20E-02	1.35E-02	1.12E+00	9.55E-01
DLCMTH4	3.31E-03	2.51E-03	1.38E-03	6.17E-03	4.47E+00	1.45E-03	4.79E-03	3.31E+00	1.70E-03	3.55E-03	2.09E+00	1.86E+00
DLLVED2	3.31E-01	9.33E-01	1.95E-01	4.79E+00	2.45E+01	2.69E-01	3.55E+00	1.32E+01	4.57E-01	1.86E+00	4.07E+00	1.45E+01
DLLVED3	5.37E-02	1.38E-01	2.75E-02	6.46E-01	2.34E+01	3.80E-02	5.37E-01	1.41E+01	6.61E-02	2.82E-01	4.27E+00	1.20E+01
DLLVED4	7.94E-03	1.74E-02	3.72E-03	8.32E-02	2.24E+01	5.01E-03	6.76E-02	1.35E+01	8.32E-03	3.47E-02	4.17E+00	1.05E+01
DLLVBM2	2.63E-01	4.07E-01	1.00E-01	2.24E+00	2.24E+01	1.41E-01	1.70E+00	1.20E+01	2.24E-01	9.33E-01	4.17E+00	8.51E+00
DLLVBM3	4.79E-02	7.41E-02	1.66E-02	4.37E-01	2.63E+01	2.34E-02	3.16E-01	1.35E+01	3.89E-02	1.66E-01	4.27E+00	9.12E+00
DLLVBM4	7.24E-03	1.20E-02	2.45E-03	7.24E-02	2.95E+01	3.63E-03	5.13E-02	1.41E+01	6.03E-03	2.63E-02	4.37E+00	1.00E+01
DLLVTH2	1.20E+00	6.31E+00	4.68E-01	5.89E+01	1.26E+02	8.71E-01	3.80E+01	4.37E+01	2.34E+00	1.66E+01	7.08E+00	4.90E+01
DLLVTH3	1.35E-01	7.24E-01	6.31E-02	6.61E+00	1.05E+02	1.12E-01	4.27E+00	3.80E+01	2.88E-01	1.91E+00	6.61E+00	4.90E+01
DLLVTH4	1.29E-02	5.01E-02	6.76E-03	3.55E-01	5.25E+01	1.15E-02	2.34E-01	2.04E+01	2.34E-02	1.15E-01	4.90E+00	2.75E+01
AFBIMIL	9.33E+04	4.27E+05	9.55E+04	8.71E+05	9.12E+00	1.70E+05	7.76E+05	4.57E+00	3.31E+05	5.25E+05	1.58E+00	9.33E+00
AFBIGRA	7.59E+04	7.08E+02	4.57E+00	1.02E+05	2.24E+04	4.57E+00	5.75E+04	1.26E+04	4.68E+00	9.55E+03	2.04E+03	1.35E+00
AFBIVEG	7.41E+04	4.47E+05	1.07E+05	7.76E+05	7.24E+00	1.66E+05	7.24E+05	4.37E+00	2.82E+05	5.62E+05	2.00E+00	1.05E+01
AFBIBEE	9.55E+04	1.38E+05	9.55E+03	3.80E+05	3.98E+01	2.34E+04	3.39E+05	1.45E+01	6.17E+04	2.19E+05	3.55E+00	3.98E+00
AFBTMIL	2.09E+04	2.04E+05	3.02E+04	7.76E+05	2.57E+01	4.79E+04	6.17E+05	1.29E+01	8.71E+04	3.72E+05	4.27E+00	3.72E+01
AFBTGRA	1.48E+05	1.29E+03	3.55E+01	1.95E+05	5.50E+03	3.55E+01	1.10E+05	3.09E+03	3.55E+01	1.82E+04	5.13E+02	1.32E+00
AFBTVEG	1.38E+04	1.35E+04	2.57E+03	1.82E+05	7.08E+01	3.72E+03	1.07E+05	2.88E+01	7.24E+03	4.47E+04	6.17E+00	1.32E+01
AFBTBEE	6.92E+04	8.71E+04	6.31E+03	3.31E+05	5.25E+01	1.05E+04	2.75E+05	2.63E+01	3.80E+04	1.78E+05	4.68E+00	4.79E+00
RLCMMT2	3.80E-03	1.78E-03	1.74E-03	2.04E-03	1.17E+00	1.74E-03	1.95E-03	1.12E+00	1.78E-03	1.86E-03	1.05E+00	5.37E-01
RLCMMT3	5.89E-04	3.55E-04	2.57E-04	5.75E-04	2.24E+00	2.63E-04	5.01E-04	1.91E+00	3.02E-04	4.07E-04	1.35E+00	9.77E-01
RLCMMT4	1.45E-04	1.05E-04	5.25E-05	2.95E-04	5.62E+00	5.62E-05	2.29E-04	4.07E+00	6.92E-05	1.62E-04	2.34E+00	2.04E+00
RLCMBM2	3.80E-04	1.82E-04	1.74E-04	2.00E-04	1.15E+00	1.78E-04	1.95E-04	1.10E+00	1.78E-04	1.86E-04	1.05E+00	5.25E-01
RLCMBM3	5.89E-05	3.47E-05	2.57E-05	5.75E-05	2.24E+00	2.63E-05	5.01E-05	1.91E+00	3.02E-05	4.17E-05	1.38E+00	9.77E-01
RLCMBM4	1.48E-05	1.07E-05	5.25E-06	3.02E-05	5.75E+00	5.75E-06	2.34E-05	4.07E+00	7.08E-06	1.66E-05	2.34E+00	2.04E+00
RLCMTH2	2.19E-04	1.62E-04	1.58E-04	1.70E-04	1.07E+00	1.58E-04	1.66E-04	1.05E+00	1.62E-04	1.62E-04	1.00E+00	7.76E-01
RLCMTH3	3.02E-05	2.24E-05	2.04E-05	2.88E-05	1.41E+00	2.09E-05	2.69E-05	1.29E+00	2.14E-05	2.40E-05	1.12E+00	9.55E-01
RLCMTH4	5.89E-06	4.47E-06	2.40E-06	1.10E-05	4.57E+00	2.57E-06	8.51E-06	3.31E+00	2.95E-06	6.31E-06	2.14E+00	1.86E+00
RLLVMT2	1.51E-02	4.17E-02	8.51E-03	1.86E-01	2.19E+01	1.20E-02	1.41E-01	1.17E+01	2.09E-02	7.94E-02	3.80E+00	1.23E+01
RLLVMT3	2.51E-03	6.03E-03	1.26E-03	2.75E-02	2.19E+01	1.66E-03	2.40E-02	1.45E+01	3.02E-03	1.23E-02	4.07E+00	1.10E+01
RLLVMT4	3.80E-04	7.76E-04	1.78E-04	3.98E-03	2.24E+01	2.34E-04	3.16E-03	1.35E+01	3.98E-04	1.62E-03	4.07E+00	1.05E+01
RLLVBM2	1.38E-03	2.14E-03	5.25E-04	1.15E-02	2.19E+01	7.24E-04	8.71E-03	1.20E+01	1.15E-03	4.79E-03	4.17E+00	8.32E+00
RLLVBM3	2.45E-04	3.80E-04	8.51E-05	2.29E-03	2.69E+01	1.23E-04	1.62E-03	1.32E+01	2.00E-04	8.51E-04	4.27E+00	9.33E+00
RLLVBM4	3.80E-05	6.17E-05	1.29E-05	3.72E-04	2.88E+01	1.86E-05	2.69E-05	1.45E+01	3.09E-05	1.35E-04	4.37E+00	9.77E+00
RLLVTH2	2.14E-03	1.12E-02	8.32E-04	1.05E-01	1.26E+02	1.51E-03	6.61E-02	4.37E+01	4.17E-03			

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                                    2.95E-02  7.08E+00  ||  4.90E+01
RLLVTH3  2.40E-04  1.29E-03  | 1.10E-04  1.17E-02  1.07E+02  | 1.95E-04  7.59E-03  3.89E+01  | 5.01E-04
                                    3.39E-03  6.76E+00  ||  4.90E+01
RLLVTH4  2.29E-05  8.71E-05  | 1.20E-05  6.17E-04  5.13E+01  | 2.00E-05  4.17E-04  2.09E+01  | 4.07E-05
                                    2.04E-04  5.01E+00  ||  2.69E+01
CDCMED   1.00E+05  7.24E+04  | 3.47E+04  2.09E+05  6.03E+00  | 4.17E+04  1.70E+05  4.07E+00  | 5.13E+04
                                    1.12E+05  2.19E+00  ||  2.09E+00
CDCMBM   9.77E+04  6.92E+04  | 3.31E+04  2.04E+05  6.17E+00  | 3.98E+04  1.66E+05  4.17E+00  | 4.90E+04
                                    1.10E+05  2.24E+00  ||  2.09E+00
CDCMTH   1.10E+05  7.94E+04  | 4.57E+04  2.09E+05  4.57E+00  | 5.01E+04  1.70E+05  3.39E+00  | 5.75E+04
                                    1.15E+05  2.00E+00  ||  1.91E+00
CDLVED   4.17E+05  1.05E+06  | 1.86E+05  5.13E+06  2.75E+01  | 2.57E+05  4.47E+06  1.74E+01  | 5.01E+05
                                    2.09E+06  4.17E+00  ||  1.23E+01
CDLVBM   3.89E+05  7.08E+05  | 1.23E+05  4.37E+06  3.55E+01  | 1.82E+05  3.16E+06  1.74E+01  | 3.09E+05
                                    1.55E+06  5.01E+00  ||  1.12E+01
CDLVTH   6.31E+05  4.57E+06  | 3.80E+05  3.89E+07  1.02E+02  | 7.76E+05  2.57E+07  3.31E+01  | 1.78E+06
                                    1.15E+07  6.46E+00  ||  6.17E+01
PLCMMT   4.90E+03  3.55E+03  | 1.66E+03  1.02E+04  6.17E+00  | 2.00E+03  8.32E+03  4.17E+00  | 2.51E+03
                                    5.50E+03  2.19E+00  ||  2.09E+00
PLCMBM   5.01E+02  3.63E+02  | 1.74E+02  1.05E+03  6.03E+00  | 2.04E+02  8.51E+02  4.17E+00  | 2.57E+02
                                    5.62E+02  2.19E+00  ||  2.09E+00
PLCMTH   1.95E+02  1.38E+02  | 7.94E+01  3.72E+02  4.68E+00  | 8.91E+01  3.02E+02  3.39E+00  | 1.02E+02
                                    2.04E+02  2.00E+00  ||  1.91E+00
PLLVMT   1.95E+04  4.47E+04  | 8.71E+03  2.00E+05  2.29E+01  | 1.20E+04  1.62E+05  1.35E+01  | 2.19E+04
                                    8.71E+04  3.98E+00  ||  1.02E+01
 95 %-FRT    REF     MEDIAN   |     5 %      95 %      FAC1    |   10 %      90 %      FAC2    |   25 %
                                      75 %      FAC3    ||   95%/REF
-----------------------------------------------------------------------------------------------------
                                   --------------------------------
PLLVBM   2.04E+03  3.63E+03  | 6.31E+02  2.29E+04  3.63E+01  | 9.33E+02  1.62E+04  1.74E+01  | 1.58E+03
                                    7.94E+03  5.01E+00  ||  1.12E+01
PLLVTH   1.12E+03  8.13E+03  | 6.76E+02  6.76E+04  1.00E+02  | 1.38E+03  4.57E+04  3.31E+01  | 3.16E+03
                                    2.04E+04  6.46E+00  ||  6.03E+01
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C.8

Extent of the uncertainty for the 99th percentile of the endpoints for the CB2 source term

99 %-FRT	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
DLCMED2	6.92E-01	3.24E-01	3.24E-01	3.31E-01	1.02E+00	3.24E-01	3.31E-01	1.02E+00	3.24E-01	3.24E-01	1.00E+00	4.79E-01
DLCMED3	7.94E-02	3.72E-02	3.72E-02	4.17E-02	1.12E+00	3.72E-02	3.98E-02	1.07E+00	3.72E-02	3.89E-02	1.05E+00	5.25E-01
DLCMED4	9.77E-03	6.31E-03	4.68E-03	1.10E-02	2.34E+00	4.79E-03	9.12E-03	1.91E+00	5.37E-03	7.41E-03	1.38E+00	1.12E+00
DLCMBM2	6.61E-01	3.16E-01	3.16E-01	3.24E-01	1.02E+00	3.16E-01	3.24E-01	1.02E+00	3.16E-01	3.24E-01	1.02E+00	4.90E-01
DLCMBM3	7.59E-02	3.63E-02	3.55E-02	3.98E-02	1.12E+00	3.55E-02	3.80E-02	1.07E+00	3.55E-02	3.63E-02	1.02E+00	5.25E-01
DLCMBM4	9.55E-03	6.03E-03	4.47E-03	1.05E-02	2.34E+00	4.68E-03	8.91E-03	1.91E+00	5.25E-03	7.24E-03	1.38E+00	1.10E+00
DLCMTH2	9.33E-01	6.46E-01	6.46E-01	6.46E-01	1.00E+00	6.46E-01	6.46E-01	1.00E+00	6.46E-01	6.46E-01	1.00E+00	6.92E-01
DLCMTH3	1.02E-01	6.61E-02	6.61E-02	7.08E-02	1.07E+00	6.61E-02	6.92E-02	1.05E+00	6.61E-02	6.76E-02	1.02E+00	6.92E-01
DLCMTH4	1.12E-02	7.94E-03	6.76E-03	1.23E-02	1.82E+00	6.92E-03	1.05E-02	1.51E+00	7.24E-03	8.91E-03	1.23E+00	1.10E+00
DLLVED2	4.68E+00	1.38E+01	2.34E+00	8.13E+01	3.47E+01	3.39E+00	5.62E+01	1.66E+01	6.61E+00	2.95E+01	4.47E+00	1.74E+01
DLLVED3	4.07E-01	1.23E+00	2.14E-01	6.92E+00	3.24E+01	2.95E-01	4.90E+00	1.66E+01	6.03E-01	2.63E+00	4.37E+00	1.70E+01
DLLVED4	4.68E-02	1.15E-01	2.19E-02	5.37E-01	2.45E+01	3.02E-02	4.68E-01	1.55E+01	5.62E-02	2.29E-01	4.07E+00	1.15E+01
DLLVBM2	3.89E+00	6.92E+00	1.26E+00	4.37E+01	3.47E+01	1.82E+00	3.16E+01	1.74E+01	3.16E+00	1.55E+01	4.90E+00	1.12E+01
DLLVBM3	3.63E-01	6.46E-01	1.15E-01	4.07E+00	3.55E+01	1.70E-01	2.95E+00	1.74E+01	2.88E-01	1.41E+00	4.90E+00	1.12E+01
DLLVBM4	4.17E-02	7.24E-02	1.41E-02	4.47E-01	3.16E+01	2.04E-02	3.16E-01	1.55E+01	3.39E-02	1.58E-01	4.68E+00	1.07E+01
DLLVTH2	1.00E+01	9.77E+01	5.89E+00	9.77E+02	1.66E+02	1.23E+01	6.03E+02	4.90E+01	3.39E+01	2.69E+02	7.94E+00	9.77E+01
DLLVTH3	8.91E-01	8.51E+00	5.13E-01	8.13E+01	1.58E+02	1.10E+00	5.25E+01	4.79E+01	2.95E+00	2.29E+01	7.76E+00	9.12E+01
DLLVTH4	7.24E-02	5.37E-01	4.47E-02	4.79E+00	1.07E+02	8.71E-02	3.09E+00	3.55E+01	2.09E-01	1.41E+00	6.76E+00	6.61E+01
AFBIMIL	1.17E+05	6.61E+05	1.17E+05	1.00E+06	8.51E+00	2.14E+05	1.00E+06	4.68E+00	4.07E+05	8.44E+05	2.07E+00	8.51E+00
AFBIGRA	1.00E+05	1.62E+03	9.33E+00	1.35E+05	1.45E+04	9.33E+00	6.31E+04	6.76E+03	1.17E+01	1.25E+04	1.07E+03	1.35E+00
AFBIVEG	9.77E+04	6.31E+05	1.32E+05	1.00E+06	7.59E+00	2.24E+05	9.12E+05	4.07E+00	3.63E+05	7.59E+05	2.09E+00	1.02E+01
AFBIBEE	1.26E+05	1.62E+05	1.25E+04	5.89E+05	4.69E+01	2.82E+04	4.57E+05	1.62E+01	7.08E+04	3.16E+05	4.47E+00	4.68E+00
AFBTMIL	2.69E+04	2.45E+05	3.98E+04	9.21E+05	2.31E+01	6.17E+04	7.59E+05	1.23E+01	1.07E+05	5.01E+05	4.68E+00	3.42E+01
AFBTGRA	1.91E+05	3.24E+03	7.24E+01	2.57E+05	3.55E+03	7.24E+01	1.26E+05	1.74E+03	8.32E+01	2.40E+04	2.88E+02	1.35E+00
AFBTVEG	1.78E+04	1.62E+04	3.39E+03	2.29E+05	6.76E+01	4.90E+03	1.35E+05	2.75E+01	8.91E+03	5.50E+04	6.17E+00	1.29E+01
AFBTBEE	8.13E+04	1.05E+05	7.76E+03	4.07E+05	5.25E+01	1.45E+04	3.39E+05	2.34E+01	4.90E+04	2.09E+05	4.27E+00	5.01E+00
RLCMMT2	3.31E-02	1.58E-02	1.58E-02	1.62E-02	1.02E+00	1.58E-02	1.58E-02	1.00E+00	1.58E-02	1.58E-02	1.00E+00	4.90E-01
RLCMMT3	3.80E-03	1.82E-03	1.82E-03	2.00E-03	1.10E+00	1.82E-03	1.95E-03	1.07E+00	1.82E-03	1.91E-03	1.05E+00	5.25E-01
RLCMMT4	4.79E-04	3.02E-04	2.29E-04	5.37E-04	2.34E+00	2.34E-04	4.47E-04	1.91E+00	2.57E-04	3.63E-04	1.41E+00	1.12E+00
RLCMBM2	3.47E-03	1.66E-03	1.62E-03	1.70E-03	1.05E+00	1.66E-03	1.66E-03	1.00E+00	1.66E-03	1.66E-03	1.00E+00	4.90E-01
RLCMBM3	3.89E-04	1.86E-04	1.82E-04	2.04E-04	1.12E+00	1.82E-04	1.95E-04	1.07E+00	1.86E-04	1.86E-04	1.00E+00	5.25E-01
RLCMBM4	4.90E-05	3.09E-05	2.34E-05	5.37E-05	2.29E+00	2.40E-05	4.57E-05	1.91E+00	2.69E-05	3.72E-05	1.38E+00	1.10E+00
RLCMTH2	1.66E-03	1.12E-03	1.12E-03	1.12E-03	1.00E+00	1.12E-03	1.12E-03	1.00E+00	1.12E-03	1.12E-03	1.00E+00	6.76E-01
RLCMTH3	1.82E-04	1.17E-04	1.15E-04	1.26E-04	1.10E+00	1.17E-04	1.23E-04	1.05E+00	1.17E-04	1.20E-04	1.02E+00	6.92E-01
RLCMTH4	2.00E-05	1.41E-05	1.20E-05	2.14E-05	1.78E+00	1.23E-05	1.86E-05	1.51E+00	1.26E-05	1.58E-05	1.26E+00	1.07E+00
RLLVMT2	2.00E-01	4.90E-01	1.00E-01	1.00E+00	1.00E+01	1.41E-01	1.00E+00	7.08E+00	2.63E-01	8.13E-01	3.09E+00	5.01E+00
RLLVMT3	1.91E-02	5.37E-02	9.55E-03	2.75E-01	2.88E+01	1.32E-02	2.09E-01	1.58E+01	2.63E-02	1.10E-01	4.17E+00	1.45E+01
RLLVMT4	2.29E-03	5.37E-03	1.02E-03	2.51E-02	2.45E+01	1.38E-03	2.04E-02	1.48E+01	2.40E-03	1.05E-02	4.37E+00	1.10E+01
RLLVBM2	2.04E-02	3.63E-02	6.46E-03	2.24E-01	3.47E+01	9.33E-03	1.62E-01	1.74E+01	1.62E-02	7.94E-02	4.90E+00	1.10E+01
RLLVBM3	1.86E-03	3.31E-03	6.03E-04	2.09E-02	3.47E+01	8.91E-04	1.51E-02	1.70E+01	1.51E-03	7.24E-03	4.79E+00	1.12E+01
RLLVBM4	2.19E-04	3.72E-04	7.24E-05	2.29E-03	3.16E+01	1.05E-04	1.66E-03	1.58E+01	1.74E-04	8.13E-04	4.68E+00	1.05E+01
RLLVTH2	1.78E-02	1.74E-01	1.02E-02	1.00E+00	9.77E+01	2.19E-02	1.00E+00	4.57E+01	5.89E-02	4.79E-01	8.13E+00	5.62E+01

RLLVTH3	1.58E-03	1.51E-02	9.12E-04	1.45E-01	1.58E+02	1.95E-03	9.33E-02	4.79E+01	5.25E-03	4.07E-02	7.76E+00	9.12E+01
RLLVTH4	1.29E-04	9.55E-04	7.94E-05	8.51E-03	1.07E+02	1.55E-04	5.50E-03	3.55E+01	3.72E-04	2.51E-03	6.76E+00	6.61E+01
CDCMED	1.41E+05	9.33E+04	4.37E+04	2.82E+05	6.46E+00	5.25E+04	2.28E+05	4.35E+00	6.61E+04	1.51E+05	2.29E+00	2.00E+00
CDCMBM	1.35E+05	8.91E+04	4.27E+04	2.69E+05	6.31E+00	5.01E+04	2.19E+05	4.37E+00	6.31E+04	1.45E+05	2.29E+00	2.00E+00
CDCMTH	1.48E+05	9.77E+04	5.62E+04	2.75E+05	4.90E+00	6.31E+04	2.27E+05	3.60E+00	7.24E+04	1.51E+05	2.09E+00	1.86E+00
CDLVED	4.57E+05	1.17E+06	2.04E+05	5.75E+06	2.82E+01	2.82E+05	4.90E+06	1.74E+01	5.50E+05	2.40E+06	4.37E+00	1.26E+01
CDLVBM	4.37E+05	7.76E+05	1.35E+05	4.90E+06	3.63E+01	2.04E+05	3.55E+06	1.74E+01	3.47E+05	1.70E+06	4.90E+00	1.12E+01
CDLVTH	6.76E+05	6.03E+06	4.27E+05	5.50E+07	1.29E+02	8.71E+05	3.55E+07	4.07E+01	2.24E+06	1.58E+07	7.08E+00	8.13E+01
PLCMMT	6.76E+03	4.47E+03	2.14E+03	1.38E+04	6.46E+00	2.57E+03	1.12E+04	4.35E+00	3.24E+03	7.41E+03	2.29E+00	2.04E+00
PLCMBM	6.92E+02	4.57E+02	2.19E+02	1.41E+03	6.46E+00	2.63E+02	1.14E+03	4.32E+00	3.31E+02	7.59E+02	2.29E+00	2.04E+00
PLCMTH	2.63E+02	1.74E+02	1.00E+02	4.90E+02	4.90E+00	1.12E+02	3.98E+02	3.55E+00	1.29E+02	2.69E+02	2.09E+00	1.86E+00
99 %-FRT	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
PLLVMT	2.19E+04	5.25E+04	9.77E+03	2.45E+05	2.51E+01	1.32E+04	1.91E+05	1.45E+01	2.45E+04	1.05E+05	4.27E+00	1.12E+01
PLLVBM	2.24E+03	3.98E+03	7.08E+02	2.51E+04	3.55E+01	1.05E+03	1.82E+04	1.74E+01	1.78E+03	8.71E+03	4.90E+00	1.12E+01
PLLVTH	1.20E+03	1.07E+04	7.59E+02	9.55E+04	1.26E+02	1.55E+03	6.17E+04	3.98E+01	3.98E+03	2.82E+04	7.08E+00	7.94E+01

C.10

EXTENT OF THE UNCERTAINTY FOR THE MEAN VALUES OF THE ENDPOINTS FOR THE DBA SOURCE TERM

MEAN VAL	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
DLCMED2	1.63E-05	1.47E-05	5.48E-06	4.73E-05	8.63E+00	6.90E-06	3.97E-05	5.76E+00	8.99E-06	2.39E-05	2.65E+00	2.89E+00
DLCMED3	2.36E-06	3.65E-06	1.28E-06	1.21E-05	9.46E+00	1.52E-06	9.27E-06	6.09E+00	2.22E-06	6.09E-06	2.75E+00	5.14E+00
DLCMED4	2.75E-07	6.79E-07	1.59E-07	2.37E-06	1.49E+01	2.12E-07	1.80E-06	8.50E+00	3.83E-07	1.13E-06	2.95E+00	8.61E+00
DLCMBM2	1.45E-05	1.29E-05	4.08E-06	4.48E-05	1.10E+01	5.38E-06	3.71E-05	6.89E+00	7.66E-06	2.16E-05	2.81E+00	3.08E+00
DLCMBM3	1.97E-06	2.72E-06	6.23E-07	1.07E-05	1.72E+01	9.05E-07	7.94E-06	8.78E+00	1.31E-06	5.04E-06	3.85E+00	5.45E+00
DLCMBM4	2.48E-07	3.92E-07	9.23E-08	1.92E-06	2.08E+01	1.25E-07	1.39E-06	1.11E+01	1.93E-07	7.85E-07	4.06E+00	7.75E+00
DLCMTH2	4.18E-05	4.06E-05	1.87E-05	8.05E-05	4.32E+00	2.54E-05	6.72E-05	2.64E+00	3.24E-05	5.35E-05	1.65E+00	1.93E+00
DLCMTH3	8.56E-06	2.07E-05	3.31E-06	3.72E-05	1.13E+01	7.77E-06	3.34E-05	4.30E+00	1.33E-05	2.84E-05	2.13E+00	4.35E+00
DLCMTH4	6.67E-07	4.58E-06	3.20E-07	1.39E-05	4.34E+01	7.15E-07	1.13E-05	1.59E+01	1.69E-06	8.39E-06	4.96E+00	2.08E+01
DLOUED2	2.93E-05	8.49E-05	2.22E-05	5.03E-04	2.27E+01	2.90E-05	3.44E-04	1.19E+01	4.61E-05	1.82E-04	3.94E+00	1.72E+01
DLOUED3	3.76E-06	1.03E-05	2.84E-06	5.65E-05	1.99E+01	3.67E-06	3.91E-05	1.06E+01	5.67E-06	2.04E-05	3.60E+00	1.50E+01
DLOUED4	4.46E-07	1.02E-06	3.32E-07	4.59E-06	1.38E+01	3.88E-07	3.36E-06	8.66E+00	5.93E-07	1.87E-06	3.15E+00	1.03E+01
DLOUBM2	2.52E-05	3.58E-05	1.66E-05	1.55E-04	9.31E+00	1.82E-05	1.12E-04	6.16E+00	2.40E-05	6.39E-05	2.66E+00	6.15E+00
DLOUBM3	3.32E-06	4.73E-06	2.18E-06	2.04E-05	9.35E+00	2.40E-06	1.48E-05	6.16E+00	3.17E-06	8.43E-06	2.66E+00	6.14E+00
DLOUBM4	4.15E-07	5.92E-07	2.66E-07	2.57E-06	9.67E+00	2.98E-07	1.86E-06	6.23E+00	3.89E-07	1.05E-06	2.71E+00	6.19E+00
DLOUTH2	9.49E-05	7.98E-04	4.77E-05	8.25E-03	1.73E+02	9.24E-05	5.01E-03	5.42E+01	2.55E-04	2.21E-03	8.69E+00	8.70E+01
DLOUTH3	1.06E-05	8.48E-05	5.57E-06	8.64E-04	1.55E+02	1.05E-05	5.28E-04	5.03E+01	2.78E-05	2.33E-04	8.38E+00	8.17E+01
DLOUTH4	8.73E-07	5.70E-06	5.47E-07	5.38E-05	9.84E+01	9.43E-07	3.40E-05	3.60E+01	2.17E-06	1.52E-05	7.02E+00	6.17E+01
AFBIMIL	6.45E+00	1.47E+02	1.84E+00	1.07E+03	5.82E+02	9.21E+00	8.32E+02	9.04E+01	3.78E+01	4.19E+02	1.11E+01	1.66E+02
AFBIGRA	1.80E-01	0.00E+00	0.00E+00	3.74E-01	9.99E+99	0.00E+00	1.00E-01	9.99E+99	0.00E+00	6.28E-03	9.99E+99	2.08E+00
AFBIVEG	1.48E+01	4.15E+02	2.72E+01	2.01E+03	7.37E+01	5.35E+01	1.59E+03	2.97E+01	1.44E+02	9.30E+02	6.46E+00	1.36E+02
AFBIBEE	5.63E-01	7.06E+00	1.51E-01	6.75E+01	4.47E+02	5.68E-01	3.80E+01	6.69E+01	1.54E+00	2.34E+01	1.52E+01	1.20E+02
AFBTMIL	5.37E-01	1.40E+01	5.15E-01	9.45E+01	1.83E+02	1.75E+00	7.52E+01	4.29E+01	4.46E+00	3.94E+01	8.83E+00	1.76E+02
AFBTGRA	3.33E-01	0.00E+00	0.00E+00	7.13E-01	9.99E+99	0.00E+00	1.91E-01	9.99E+99	0.00E+00	9.36E-03	9.99E+99	2.14E+00
AFBTVEG	3.86E-01	8.47E+00	5.45E-01	4.04E+01	7.42E+01	1.07E+00	3.26E+01	3.05E+01	2.91E+00	1.89E+01	6.51E+00	1.05E+02
AFBTBEE	1.77E-01	3.36E+00	9.86E-02	3.05E+01	3.09E+02	3.06E-01	1.82E+01	5.95E+01	1.08E+00	9.45E+00	8.77E+00	1.72E+02
RLCMMT2	7.82E-07	7.06E-07	2.52E-07	2.31E-06	9.19E+00	3.19E-07	1.93E-06	6.06E+00	4.22E-07	1.15E-06	2.72E+00	2.96E+00
RLCMMT3	1.11E-07	1.71E-07	5.58E-08	5.80E-07	1.04E+01	6.65E-08	4.40E-07	6.61E+00	9.59E-08	2.83E-07	2.95E+00	5.24E+00
RLCMMT4	1.32E-08	2.98E-08	7.16E-09	1.10E-07	1.53E+01	9.84E-09	8.33E-08	8.46E+00	1.64E-08	4.98E-08	3.04E+00	8.32E+00
RLCMBM2	7.49E-08	6.68E-08	2.10E-08	2.31E-07	1.10E+01	2.78E-08	1.91E-07	6.89E+00	3.95E-08	1.11E-07	2.81E+00	3.08E+00
RLCMBM3	1.02E-08	1.40E-08	3.22E-09	5.54E-08	1.72E+01	4.67E-09	4.10E-08	8.78E+00	6.76E-09	2.60E-08	3.85E+00	5.45E+00
RLCMBM4	1.28E-09	2.02E-09	4.76E-10	9.90E-09	2.08E+01	6.46E-10	7.19E-09	1.11E+01	9.97E-10	4.05E-09	4.06E+00	7.75E+00
RLCMTH2	7.40E-08	7.18E-08	3.30E-08	1.43E-07	4.32E+00	4.50E-08	1.19E-07	2.64E+00	5.73E-08	9.46E-08	1.65E+00	1.93E+00
RLCMTH3	1.52E-08	3.66E-08	5.86E-09	6.59E-08	1.13E+01	1.38E-08	5.92E-08	4.30E+00	2.36E-08	5.02E-08	2.13E+00	4.35E+00
RLCMTH4	1.18E-09	8.10E-09	5.67E-10	2.46E-08	4.34E+01	1.27E-09	2.01E-08	1.59E+01	2.99E-09	1.48E-08	4.96E+00	2.08E+01
RLOUMT2	1.39E-06	3.68E-06	1.06E-06	2.01E-05	1.89E+01	1.34E-06	1.37E-05	1.03E+01	2.08E-06	7.15E-06	3.44E+00	1.44E+01
RLOUMT3	1.80E-07	4.60E-07	1.36E-07	2.33E-06	1.72E+01	1.67E-07	1.59E-06	9.51E+00	2.57E-07	8.46E-07	3.30E+00	1.29E+01
RLOUMT4	2.16E-08	4.51E-08	1.59E-08	1.94E-07	1.22E+01	1.84E-08	1.50E-07	8.14E+00	2.69E-08	8.26E-08	3.07E+00	8.96E+00
RLOUBM2	1.30E-07	1.85E-07	8.57E-08	7.98E-07	9.31E+00	9.39E-08	5.78E-07	6.16E+00	1.24E-07	3.30E-07	2.66E+00	6.15E+00
RLOUBM3	1.71E-08	2.44E-08	1.13E-08	1.05E-07	9.35E+00	1.24E-08	7.63E-08	6.16E+00	1.64E-08	4.35E-08	2.66E+00	6.14E+00
RLOUBM4	2.14E-09	3.05E-09	1.37E-09	1.32E-08	9.67E+00	1.54E-09	9.58E-09	6.23E+00	2.00E-09	5.43E-09	2.71E+00	6.19E+00
RLOUTH2	1.68E-07	1.41E-06	8.44E-08	1.46E-05	1.73E+02	1.63E-07	8.86E-06	5.42E+01	4.51E-07			

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			3.92E-06	8.69E+00		8.70E+01			
RLOUTH3	1.87E-08	1.50E-07	9.85E-09	1.53E-06	1.55E+02	1.86E-08	9.35E-07	5.03E+01	4.92E-08
			4.12E-07	8.38E+00		8.17E+01			
RLOUTH4	1.55E-09	1.01E-08	9.69E-10	9.53E-08	9.84E+01	1.67E-09	6.01E-08	3.60E+01	3.84E-09
			2.69E-08	7.02E+00		6.17E+01			
CDCMED	1.04E+01	1.95E+01	5.65E+00	6.58E+01	1.16E+01	7.41E+00	5.02E+01	6.77E+00	1.19E+01
			3.13E+01	2.63E+00		6.30E+00			
CDCMBM	9.11E+00	1.26E+01	3.11E+00	5.66E+01	1.82E+01	4.31E+00	4.08E+01	9.47E+00	6.35E+00
			2.41E+01	3.79E+00		6.21E+00			
CDCMTH	3.09E+01	1.32E+02	1.32E+01	2.85E+02	2.16E+01	2.85E+01	2.40E+02	8.41E+00	6.19E+01
			1.94E+02	3.13E+00		9.19E+00			
PLCMMT	4.96E-01	8.40E-01	2.61E-01	3.13E+00	1.20E+01	3.27E-01	2.38E+00	7.27E+00	5.17E-01
			1.46E+00	2.83E+00		6.30E+00			
PLCMBM	4.70E-02	6.52E-02	1.60E-02	2.92E-01	1.82E+01	2.22E-02	2.11E-01	9.47E+00	3.28E-02
			1.24E-01	3.79E+00		6.21E+00			
PLCMTH	5.48E-02	2.33E-01	2.33E-02	5.04E-01	2.16E+01	5.05E-02	4.25E-01	8.41E+00	1.10E-01
			3.43E-01	3.13E+00		9.19E+00			

EXTENT OF THE UNCERTAINTY FOR THE 95TH PERCENTILE OF THE ENDPOINTS FOR THE DBA SOURCE TERM

95 %-FRT	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
DLCMED2	4.57E-05	5.37E-05	2.40E-05	1.70E-04	7.08E+00	2.75E-05	1.38E-04	5.01E+00	3.55E-05	8.51E-05	2.40E+00	3.72E+00
DLCMED3	6.92E-06	1.58E-05	3.98E-06	4.79E-05	1.20E+01	5.75E-06	3.89E-05	6.76E+00	1.00E-05	2.51E-05	2.51E+00	6.92E+00
DLCMED4	6.76E-07	1.66E-06	3.72E-07	6.61E-06	1.78E+01	5.13E-07	5.75E-06	1.12E+01	8.71E-07	3.16E-06	3.63E+00	9.77E+00
DLCMBM2	3.24E-05	3.98E-05	1.17E-05	1.62E-04	1.38E+01	1.58E-05	1.26E-04	7.94E+00	2.19E-05	7.59E-05	3.47E+00	5.01E+00
DLCMBM3	5.37E-06	7.94E-06	2.19E-06	3.63E-05	1.66E+01	2.75E-06	2.57E-05	9.33E+00	4.17E-06	1.55E-05	3.72E+00	6.76E+00
DLCMBM4	5.50E-07	8.51E-07	2.34E-07	4.27E-06	1.82E+01	3.02E-07	3.16E-06	1.05E+01	4.68E-07	1.70E-06	3.63E+00	7.76E+00
DLCMTH2	2.19E-04	2.57E-04	8.13E-05	4.47E-04	5.50E+00	1.38E-04	4.17E-04	3.02E+00	2.09E-04	3.16E-04	1.51E+00	2.04E+00
DLCMTH3	3.02E-05	1.12E-04	9.77E-06	2.24E-04	2.29E+01	2.00E-05	2.09E-04	1.05E+01	5.37E-05	1.74E-04	3.24E+00	7.41E+00
DLCMTH4	1.86E-06	8.71E-06	8.32E-07	5.50E-05	6.61E+01	1.51E-06	3.98E-05	2.63E+01	3.39E-06	2.09E-05	6.17E+00	2.95E+01
DLOUED2	8.32E-05	2.09E-04	6.31E-05	1.00E-03	1.58E+01	8.32E-05	7.08E-04	8.51E+00	1.26E-04	3.89E-04	3.09E+00	1.20E+01
DLOUED3	1.15E-05	2.82E-05	8.71E-06	1.26E-04	1.45E+01	1.12E-05	8.71E-05	7.76E+00	1.66E-05	4.90E-05	2.95E+00	1.10E+01
DLOUED4	1.20E-06	2.40E-06	8.91E-07	8.51E-06	9.55E+00	1.07E-06	6.76E-06	6.31E+00	1.58E-06	4.07E-06	2.57E+00	7.08E+00
DLOUBM2	6.76E-05	8.91E-05	4.68E-05	2.95E-04	6.31E+00	5.13E-05	2.24E-04	4.37E+00	6.46E-05	1.38E-04	2.14E+00	4.37E+00
DLOUBM3	9.55E-06	1.35E-05	6.61E-06	5.13E-05	7.76E+00	7.08E-06	3.80E-05	5.37E+00	9.12E-06	2.34E-05	2.57E+00	5.37E+00
DLOUBM4	1.07E-06	1.41E-06	7.08E-07	5.13E-06	7.24E+00	7.94E-07	3.89E-06	4.90E+00	1.00E-06	2.34E-06	2.34E+00	4.79E+00
DLOUTH2	3.31E-04	1.66E-03	1.55E-04	1.66E-02	1.07E+02	2.57E-04	1.00E-02	3.89E+01	6.03E-04	4.47E-03	7.41E+00	5.01E+01
DLOUTH3	3.80E-05	1.86E-04	1.86E-05	1.86E-03	1.00E+02	3.02E-05	1.15E-03	3.80E+01	6.92E-05	5.01E-04	7.24E+00	4.90E+01
DLOUTH4	2.57E-06	9.77E-06	1.55E-06	7.41E-05	4.79E+01	2.40E-06	4.90E-05	2.04E+01	4.68E-06	2.29E-05	4.90E+00	2.88E+01
AFBIMIL	3.02E+01	6.31E+02	8.32E+00	4.27E+03	5.13E+02	5.13E+01	3.16E+03	6.17E+01	1.70E+02	1.55E+03	9.12E+00	1.41E+02
AFBIGRA	1.23E+00	0.00E+00	0.00E+00	2.14E+00	9.99E+99	0.00E+00	7.24E-01	9.99E+99	0.00E+00	0.00E+00	9.99E+99	1.74E+00
AFBIVEG	5.13E+01	1.05E+03	7.94E+01	4.90E+03	6.17E+01	1.66E+02	3.63E+03	2.19E+01	3.72E+02	1.86E+03	5.01E+00	9.55E+01
AFBIBEE	2.63E+00	5.01E+01	1.00E+00	3.89E+02	3.89E+02	2.63E+00	1.95E+02	7.41E+01	9.33E+00	1.26E+02	1.35E+01	1.48E+02
AFBTMIL	2.51E+00	5.89E+01	2.57E+00	3.39E+02	1.32E+02	7.59E+00	2.63E+02	3.47E+01	1.82E+01	1.35E+02	7.41E+00	1.35E+02
AFBTGRA	2.29E+00	0.00E+00	0.00E+00	3.98E+00	9.99E+99	0.00E+00	1.35E+00	9.99E+99	0.00E+00	0.00E+00	9.99E+99	1.74E+00
AFBTVEG	1.10E+00	2.09E+01	1.58E+00	9.77E+01	6.17E+01	3.31E+00	7.24E+01	2.19E+01	7.59E+00	3.72E+01	4.90E+00	8.91E+01
AFBTBEE	1.10E+00	1.82E+01	6.31E-01	1.51E+02	2.40E+02	1.70E+00	9.55E+01	5.62E+01	5.75E+00	5.50E+01	9.55E+00	1.38E+02
RLCMMT2	2.09E-06	2.40E-06	1.05E-06	8.32E-06	7.94E+00	1.20E-06	6.76E-06	5.62E+00	1.55E-06	3.98E-06	2.57E+00	3.98E+00
RLCMMT3	3.16E-07	6.92E-07	1.86E-07	2.19E-06	1.17E+01	2.57E-07	1.74E-06	6.76E+00	4.17E-07	1.07E-06	2.57E+00	6.92E+00
RLCMMT4	3.16E-08	7.24E-08	1.78E-08	2.82E-07	1.58E+01	2.29E-08	2.51E-07	1.10E+01	3.80E-08	1.32E-07	3.47E+00	8.91E+00
RLCMBM2	1.66E-07	2.04E-07	6.03E-08	8.32E-07	1.38E+01	8.13E-08	6.46E-07	7.94E+00	1.12E-07	3.98E-07	3.55E+00	5.01E+00
RLCMBM3	2.82E-08	4.07E-08	1.15E-08	1.86E-07	1.62E+01	1.45E-08	1.35E-07	9.33E+00	2.14E-08	7.94E-08	3.72E+00	6.61E+00
RLCMBM4	2.82E-09	4.37E-09	1.20E-09	2.24E-08	1.86E+01	1.55E-09	1.66E-08	1.07E+01	2.40E-09	8.71E-09	3.63E+00	7.94E+00
RLCMTH2	3.89E-07	4.57E-07	1.41E-07	7.94E-07	5.62E+00	2.45E-07	7.41E-07	3.02E+00	3.63E-07	5.62E-07	1.55E+00	2.04E+00
RLCMTH3	5.37E-08	2.00E-07	1.74E-08	3.98E-07	2.29E+01	3.55E-08	3.72E-07	1.05E+01	9.55E-08	3.09E-07	3.24E+00	7.41E+00
RLCMTH4	3.24E-09	1.55E-08	1.45E-09	9.55E-08	6.61E+01	2.69E-09	7.08E-08	2.63E+01	6.03E-09	3.72E-08	6.17E+00	2.95E+01
RLOUMT2	3.89E-06	9.12E-06	3.02E-06	3.98E-05	1.32E+01	3.80E-06	2.88E-05	7.59E+00	5.62E-06	1.62E-05	2.88E+00	1.02E+01
RLOUMT3	5.37E-07	1.26E-06	4.17E-07	5.25E-06	1.26E+01	5.13E-07	3.72E-06	7.24E+00	7.59E-07	2.14E-06	2.82E+00	9.77E+00
RLOUMT4	5.89E-08	1.07E-07	4.27E-08	3.55E-07	8.32E+00	5.01E-08	3.02E-07	6.03E+00	7.08E-08	1.78E-07	2.51E+00	6.03E+00
RLOUBM2	3.47E-07	4.57E-07	2.40E-07	1.51E-06	6.31E+00	2.63E-07	1.15E-06	4.37E+00	3.31E-07	7.24E-07	2.19E+00	4.37E+00
RLOUBM3	4.90E-08	6.92E-08	3.39E-08	2.63E-07	7.76E+00	3.63E-08	1.95E-07	5.37E+00	4.68E-08	1.20E-07	2.57E+00	5.37E+00
RLOUBM4	5.50E-09	7.24E-09	0.00E+00	2.63E-08	9.99E+99	3.72E-09	2.00E-08	5.37E+00	4.79E-09	1.20E-08	2.51E+00	4.79E+00

RLOUTH2	5.89E-07	2.88E-06	2.75E-07	2.95E-05	1.07E+02	4.57E-07	1.78E-05	3.89E+01	1.07E-06	7.94E-06	7.41E+00	5.01E+01
RLOUTH3	6.76E-08	3.31E-07	3.31E-08	3.31E-06	1.00E+02	5.37E-08	2.04E-06	3.80E+01	1.20E-07	8.91E-07	7.41E+00	4.90E+01
RLOUTH4	4.57E-09	1.74E-08	2.69E-09	1.32E-07	4.90E+01	3.89E-09	8.71E-08	2.24E+01	8.13E-09	4.07E-08	5.01E+00	2.88E+01
CDCMED	3.39E+01	6.92E+01	1.95E+01	2.40E+02	1.23E+01	2.34E+01	1.91E+02	8.13E+00	4.27E+01	1.17E+02	2.75E+00	7.08E+00
CDCMBM	3.16E+01	4.68E+01	1.00E+01	2.04E+02	2.04E+01	1.51E+01	1.55E+02	1.02E+01	2.24E+01	9.12E+01	4.07E+00	6.46E+00
CDCMTH	8.91E+01	5.01E+02	4.37E+01	1.12E+03	2.57E+01	9.33E+01	9.12E+02	9.77E+00	2.09E+02	7.59E+02	3.63E+00	1.26E+01
PLCMMT	1.62E+00	3.09E+00	8.71E-01	1.15E+01	1.32E+01	1.07E+00	8.71E+00	8.13E+00	1.86E+00	5.37E+00	2.88E+00	7.08E+00
PLCMBM	1.62E-01	2.40E-01	5.13E-02	1.05E+00	2.04E+01	7.94E-02	7.94E-01	1.00E+01	1.15E-01	4.68E-01	4.07E+00	6.46E+00
PLCMTH	1.58E-01	8.71E-01	7.76E-02	2.00E+00	2.57E+01	1.66E-01	1.58E+00	9.55E+00	3.63E-01	1.35E+00	3.72E+00	1.26E+01

EXTENT OF THE UNCERTAINTY FOR THE 99TH PERCENTILE OF THE ENDPOINTS FOR THE DBA SOURCE TERM

99 %-FRT	REF	MEDIAN	5 %	95 %	FAC1	10 %	90 %	FAC2	25 %	75 %	FAC3	95%/REF
DLCMED2	4.57E-04	3.89E-04	1.17E-04	1.45E-03	1.23E+01	1.62E-04	1.05E-03	6.46E+00	2.29E-04	6.46E-04	2.82E+00	3.16E+00
DLCMED3	4.79E-05	7.08E-05	2.75E-05	2.63E-04	9.55E+00	3.39E-05	1.95E-04	5.75E+00	4.37E-05	1.20E-04	2.75E+00	5.50E+00
DLCMED4	5.25E-06	1.58E-05	3.02E-06	5.37E-05	1.78E+01	4.27E-06	4.37E-05	1.02E+01	8.32E-06	2.69E-05	3.24E+00	1.02E+01
DLCMBM2	3.98E-04	3.72E-04	1.05E-04	1.41E-03	1.35E+01	1.45E-04	1.00E-03	6.92E+00	2.19E-04	6.31E-04	2.88E+00	3.55E+00
DLCMBM3	3.89E-05	5.62E-05	1.29E-05	2.57E-04	2.00E+01	1.82E-05	1.86E-04	1.02E+01	2.75E-05	1.10E-04	3.98E+00	6.61E+00
DLCMBM4	4.68E-06	7.76E-06	1.86E-06	4.27E-05	2.29E+01	2.45E-06	2.88E-05	1.17E+01	3.80E-06	1.58E-05	4.17E+00	9.12E+00
DLCMTH2	9.12E-04	7.41E-04	4.57E-04	1.91E-03	4.17E+00	5.37E-04	1.35E-03	2.51E+00	6.31E-04	9.12E-04	1.45E+00	2.09E+00
DLCMTH3	1.95E-04	5.13E-04	7.76E-05	7.94E-04	1.02E+01	1.82E-04	7.08E-04	3.89E+00	3.55E-04	6.31E-04	1.78E+00	4.07E+00
DLCMTH4	1.41E-05	1.26E-04	6.31E-06	4.07E-04	6.46E+01	1.45E-05	3.31E-04	2.29E+01	3.98E-05	2.40E-04	6.03E+00	2.88E+01
DLOUED2	8.51E-04	2.51E-03	6.17E-04	1.55E-02	2.51E+01	7.94E-04	1.10E-02	1.38E+01	1.32E-03	5.50E-03	4.17E+00	1.82E+01
DLOUED3	7.76E-05	2.19E-04	5.75E-05	1.41E-03	2.45E+01	7.76E-05	9.55E-04	1.23E+01	1.20E-04	4.79E-04	3.98E+00	1.82E+01
DLOUED4	8.51E-06	2.04E-05	6.61E-06	9.77E-05	1.48E+01	7.59E-06	6.76E-05	8.91E+00	1.17E-05	3.72E-05	3.16E+00	1.15E+01
DLOUBM2	6.76E-04	1.00E-03	4.27E-04	4.57E-03	1.07E+01	4.79E-04	3.24E-03	6.76E+00	6.61E-04	1.86E-03	2.82E+00	6.76E+00
DLOUBM3	6.61E-05	9.33E-05	4.37E-05	4.17E-04	9.55E+00	4.79E-05	3.02E-04	6.31E+00	6.31E-05	1.70E-04	2.69E+00	6.31E+00
DLOUBM4	8.13E-06	1.15E-05	5.50E-06	4.79E-05	8.71E+00	6.03E-06	3.47E-05	5.75E+00	7.41E-06	2.00E-05	2.69E+00	5.89E+00
DLOUTH2	2.45E-03	2.63E-02	1.32E-03	2.82E-01	2.14E+02	2.69E-03	1.70E-01	6.31E+01	8.32E-03	7.41E-02	8.91E+00	1.15E+02
DLOUTH3	2.29E-04	2.19E-03	1.17E-04	2.34E-02	2.00E+02	2.34E-04	1.41E-02	6.03E+01	6.92E-04	6.17E-03	8.91E+00	1.02E+02
DLOUTH4	1.91E-05	1.32E-04	1.10E-05	1.35E-03	1.23E+02	1.78E-05	8.32E-04	4.68E+01	4.68E-05	3.63E-04	7.76E+00	7.08E+01
AFBIMIL	4.90E+01	8.71E+02	2.04E+01	5.50E+03	2.69E+02	7.41E+01	4.79E+03	6.46E+01	2.75E+02	2.40E+03	8.71E+00	1.12E+02
AFBIGRA	2.04E+00	0.00E+00	0.00E+00	6.61E+00	9.99E+99	0.00E+00	1.17E+00	9.99E+99	0.00E+00	0.00E+00	9.99E+99	3.24E+00
AFBIVEG	9.22E+01	1.23E+03	1.32E+02	6.11E+03	4.63E+01	2.19E+02	5.01E+03	2.29E+01	7.24E+02	2.45E+03	3.39E+00	6.62E+01
AFBIBEE	4.07E+00	7.19E+01	2.04E+00	7.08E+02	3.47E+02	7.24E+00	4.68E+02	6.46E+01	2.14E+01	2.00E+02	9.33E+00	1.74E+02
AFBTMIL	4.07E+00	7.59E+01	4.37E+00	4.57E+02	1.05E+02	1.62E+01	3.89E+02	2.40E+01	3.09E+01	2.00E+02	6.46E+00	1.12E+02
AFBTGRA	4.07E+00	0.00E+00	0.00E+00	1.15E+01	9.99E+99	0.00E+00	2.34E+00	9.99E+99	0.00E+00	0.00E+00	9.99E+99	2.82E+00
AFBTVEG	1.88E+00	2.45E+01	2.63E+00	1.22E+02	4.65E+01	4.37E+00	1.00E+02	2.29E+01	1.45E+01	5.01E+01	3.47E+00	6.50E+01
AFBTBEE	1.86E+00	3.39E+01	1.15E+00	2.51E+02	2.19E+02	3.63E+00	1.55E+02	4.27E+01	1.55E+01	7.94E+01	5.13E+00	1.35E+02
RLCMMT2	2.19E-05	1.91E-05	5.62E-06	7.08E-05	1.26E+01	7.76E-06	5.13E-05	6.61E+00	1.10E-05	3.16E-05	2.88E+00	3.24E+00
RLCMMT3	2.19E-06	3.16E-06	1.23E-06	1.29E-05	1.05E+01	1.41E-06	9.55E-06	6.76E+00	1.82E-06	5.62E-06	3.09E+00	5.89E+00
RLCMMT4	2.51E-07	6.61E-07	1.35E-07	2.40E-06	1.78E+01	1.86E-07	1.86E-06	1.00E+01	3.63E-07	1.15E-06	3.16E+00	9.55E+00
RLCMBM2	2.09E-06	1.95E-06	5.37E-07	7.24E-06	1.35E+01	7.41E-07	5.25E-06	7.08E+00	1.12E-06	3.24E-06	2.88E+00	3.47E+00
RLCMBM3	2.00E-07	2.95E-07	6.76E-08	1.32E-06	1.95E+01	9.33E-08	9.77E-07	1.05E+01	1.41E-07	5.62E-07	3.98E+00	6.61E+00
RLCMBM4	2.40E-08	3.98E-08	9.55E-09	2.19E-07	2.29E+01	1.26E-08	1.51E-07	1.20E+01	1.95E-08	8.13E-08	4.17E+00	9.12E+00
RLCMTH2	1.62E-06	1.32E-06	8.13E-07	3.31E-06	4.07E+00	9.55E-07	2.40E-06	2.51E+00	1.10E-06	1.62E-06	1.48E+00	2.04E+00
RLCMTH3	3.47E-07	9.12E-07	1.35E-07	1.41E-06	1.05E+01	3.24E-07	1.26E-06	3.89E+00	6.17E-07	1.12E-06	1.82E+00	4.07E+00
RLCMTH4	2.51E-08	2.24E-07	1.12E-08	7.08E-07	6.31E+01	2.57E-08	5.75E-07	2.24E+01	7.08E-08	4.27E-07	6.03E+00	2.82E+01
RLOUMT2	3.98E-05	1.07E-04	2.88E-05	6.17E-04	2.14E+01	3.72E-05	4.17E-04	1.12E+01	5.75E-05	2.14E-04	3.72E+00	1.55E+01
RLOUMT3	3.72E-06	9.55E-06	2.82E-06	5.50E-05	1.95E+01	3.63E-06	3.72E-05	1.02E+01	5.50E-06	1.91E-05	3.47E+00	1.48E+01
RLOUMT4	4.17E-07	8.71E-07	3.16E-07	3.98E-06	1.26E+01	3.63E-07	2.88E-06	7.94E+00	5.25E-07	1.62E-06	3.09E+00	9.55E+00
RLOUBM2	3.55E-06	5.13E-06	2.19E-06	2.34E-05	1.07E+01	2.45E-06	1.70E-05	6.92E+00	3.39E-06	9.55E-06	2.82E+00	6.61E+00
RLOUBM3	3.39E-07	4.79E-07	2.24E-07	2.14E-06	9.55E+00	2.51E-07	1.55E-06	6.17E+00	3.24E-07	8.71E-07	2.69E+00	6.31E+00
RLOUBM4	4.17E-08	5.89E-08	2.82E-08	2.45E-07	8.71E+00	3.09E-08	1.78E-07	5.75E+00	3.89E-08	1.02E-07	2.63E+00	5.89E+00

RLOUTH2	4.37E-06	4.68E-05	2.34E-06	5.01E-04	2.14E+02	4.79E-06	2.95E-04	6.17E+01	1.48E-05	1.32E-04	8.91E+00	1.15E+02
RLOUTH3	4.07E-07	3.89E-06	2.09E-07	4.17E-05	2.00E+02	4.17E-07	2.51E-05	6.03E+01	1.23E-06	1.10E-05	8.91E+00	1.02E+02
RLOUTH4	3.39E-08	2.34E-07	1.95E-08	2.40E-06	1.23E+02	3.16E-08	1.48E-06	4.68E+01	8.13E-08	6.46E-07	7.94E+00	7.08E+01
CDCMED	4.79E+01	1.07E+02	2.69E+01	3.47E+02	1.29E+01	3.72E+01	2.75E+02	7.41E+00	6.61E+01	1.74E+02	2.63E+00	7.24E+00
CDCMBM	4.27E+01	7.08E+01	1.62E+01	3.09E+02	1.91E+01	2.19E+01	2.34E+02	1.07E+01	3.39E+01	1.35E+02	3.98E+00	7.24E+00
CDCMTH	1.15E+02	8.51E+02	5.62E+01	1.66E+03	2.95E+01	1.35E+02	1.45E+03	1.07E+01	3.31E+02	1.17E+03	3.55E+00	1.45E+01
PLCMMT	2.29E+00	4.68E+00	1.23E+00	1.66E+01	1.35E+01	1.66E+00	1.32E+01	7.94E+00	2.75E+00	8.13E+00	2.95E+00	7.24E+00
PLCMBM	2.19E-01	3.72E-01	8.51E-02	1.62E+00	1.91E+01	1.12E-01	1.22E+00	1.09E+01	1.74E-01	7.08E-01	4.07E+00	7.41E+00
PLCMTH	2.04E-01	1.48E+00	1.00E-01	2.95E+00	2.95E+01	2.40E-01	2.57E+00	1.07E+01	5.89E-01	2.04E+00	3.47E+00	1.45E+01

Appendix D

Parameters making major contributions to the overall uncertainty

This appendix lists those parameters whose uncertainty makes a major contribution to the overall uncertainty on the model predictions. The parameters are selected on the basis of being ranked in the top 5 positions according to the absolute value of the partial rank correlation coefficient, provided that the PRCC s above the level that might be observed by chance.

The endpoints are identified using the short code listed in Table C.1 of Appendix C. The input parameters are also identified using a short code, which is given for all the parameters in Table D.1. The remaining tables list the input parameters meeting the criteria specified above for each of the endpoints considered. The tables give the following information:

ENDP	Short code name for the endpoint
INP.VAR.	Short code name for the input parameters
RK	Rank according to PRCC
PRCC	Value of the partial rank correlation coefficient
SUM%	The sum of the percentage contributions of the parameters to the uncertainty on the endpoint. The percentage contributions do not add up to 100% because of the effects of correlations between input parameter values, as discussed in the "Methodology Report"
%CON	The percentage contribution to the uncertainty on the endpoint made by the uncertainty in the value of the parameter
%SCON	The percentage contribution to the uncertainty on the endpoint made by the uncertainty in the value of the parameter, if the overall uncertainty is normalised to 100% (ie %CON/SUM%)
FAC1	The ratio of the 95th to the 5th percentile of the uncertainty distribution for this endpoint.
RSQ	The coefficient of determination, R^2.

The quantities PRCC, percentage contribution and R^2 are described in the "Methodology Report".

The results given in Appendix C show that there are some endpoints and source terms where the results for many of the sets of parameter values are so small that they are below the lowest bin used in determining the uncertainty distribution on the endpoint. In some cases, it was not possible to determine the 95th percentile of the uncertainty distribution as the values are so low. In these cases there are so few "non-zero" values that an analysis of the important uncertain parameters is meaningless, and so results for those situations are not included in this appendix.

Table D.1 Description of the short names of the input parameters used in the following tables

Short name of parameter	Description of parameter
INTFACP	Interception factor - pasture
RTHS	Retention time - hay/silage
INTFACHS	Interception factor - hay/silage
RUP_SR	Root uptake pasture, Sr
RUP_CS	Root uptake pasture, Cs
RUP_I	Root uptake pasture, I
RUP_MN	Root uptake pasture, Mn
RUP_ZN	Root uptake pasture, Zn
RUP_CO	Root uptake pasture, Co
RUP_TE	Root uptake pasture, Te
RUP_AG	Root uptake pasture, Ag
RUP_CE	Root uptake pasture, Ce
SMP12_SR	Soil migration pasture - k12, Sr
SMP23_SR	Soil migration pasture - k23, Sr
SMP34_SR	Soil migration pasture - k34, Sr
SMP43_SR	Soil migration pasture - k43, Sr
SMP45_SR	Soil migration pasture - k45, Sr
SMP12_CS	Soil migration pasture - k12, Cs
SMP23_CS	Soil migration pasture - k23, Cs
SMP34_CS	Soil migration pasture - k34, Cs
SMP43_CS	Soil migration pasture - k43, Cs
SMP45_CS	Soil migration pasture - k45, Cs
FIX_CS	Soil fixation pasture - k1,11, Cs
RESUSP	Resuspension factor pasture
SOLCONHS	Soil contamination hay/silage
DISOLDC	Daily intake of soil - dairy cows
DIPDC	Daily intake of pasture - dairy cows
DIHSDC	Daily intake of hay/silage - dairy cows
GUTDC_OT	Gut retention - dairy cows, others than I
GUTDC_I	Gut retention - dairy cows, I
FMDC_SR	Fm transfer to milk - dairy cows, Sr
FMDC_CS	Fm transfer to milk - dairy cows, Cs
FMDC_I	Fm transfer to milk - dairy cows, I
FMDC_MN	Fm transfer to milk - dairy cows, Mn
FMDC_ZN	Fm transfer to milk - dairy cows, Zn
FMDC_CO	Fm transfer to milk - dairy cows, Co
FMDC_TE	Fm transfer to milk - dairy cows, Te
FMDC_AG	Fm transfer to milk - dairy cows, Ag
FMDC_CE	Fm transfer to milk - dairy cows, Ce

FFDC_SR	Ff transfer to meat - dairy cows, Sr
FFDC_CS	Ff transfer to meat - dairy cows, Cs
FFDC_I	Ff transfer to meat - dairy cows, I
FFDC_MN	Ff transfer to meat - dairy cows, Mn
FFDC_ZN	Ff transfer to meat - dairy cows, Zn
FFDC_CO	Ff transfer to meat - dairy cows, Co
FFDC_TE	Ff transfer to meat - dairy cows, Te
FFDC_AG	Ff transfer to meat - dairy cows, Ag
FFDC_CE	Ff transfer to meat - dairy cows, Ce
FLDC_MN	Ff transfer to liver - dairy cows, Mn
FLDC_CO	Ff transfer to liver - dairy cows, Co
FLDC_AG	Ff transfer to liver - dairy cows, Ag
FLDC_CE	Ff transfer to liver - dairy cows, Ce
BIODC_SR	Biological half-life - dairy cows, Sr
BIODC_CS	Biological half-life - dairy cows, Cs
BIODC_I	Biological half-life - dairy cows, I
BIODC_MN	Biological half-life - dairy cows, Mn
BIODC_ZN	Biological half-life - dairy cows, Zn
BIODC_CO	Biological half-life - dairy cows, Co
BIODC_TE	Biological half-life - dairy cows, Te
BIODC_AG	Biological half-life - dairy cows, Ag
BIODC_CE	Biological half-life - dairy cows, Ce
DIPBC	Daily intake of pasture - beef cattle
DIHSBC	Daily intake of silage/hay - beef cattle
FFBC_SR	Ff transfer to meat - beef cattle, Sr
FFBC_CS	Ff transfer to meat - beef cattle, Cs
DISOLS	Daily intake of soil - sheep
DIPS	Daily intake of pasture - sheep
DIHSS	Daily intake of hay/silage - sheep
GUTS_OTH	Gut retention - sheep, others than I
GUTS_I	Gut retention - sheep, I
FFS_SR	Ff transfer to meat - sheep, Sr
FFS_CS	Ff transfer to meat - sheep, Cs
FFS_I	Ff transfer to meat - sheep, I
FFS_MN	Ff transfer to meat - sheep, Mn
FFS_ZN	Ff transfer to meat - sheep, Zn
FFS_CO	Ff transfer to meat - sheep, Co
FFS_TE	Ff transfer to meat - sheep, Te
FFS_AG	Ff transfer to meat - sheep, Ag
FFS_CE	Ff transfer to meat - sheep, Ce
FLS_MN	Ff transfer to liver - sheep, Mn
FLS_CO	Ff transfer to liver - sheep, Co
FLS_AG	Ff transfer to liver - sheep, Ag
FLS_CE	Ff transfer to liver - sheep, Ce
BIOS_SR	Biological half-life - sheep, Sr
BIOS_CS	Biological half-life - sheep, Cs

BIOS_I	Biological half-life - sheep, I
BIOS_MN	Biological half-life - sheep, Mn
BIOS_ZN	Biological half-life - sheep, Zn
BIOS_CO	Biological half-life - sheep, Co
BIOS_TE	Biological half-life - sheep, Te
BIOS_AG	Biological half-life - sheep, Ag
BIOS_CE	Biological half-life - sheep, Ce
DICP	Daily intake cereals - pigs
FFP_SR	Ff transfer to meat - pigs, Sr
FFP_CS	Ff transfer to meat - pigs, Cs
FFP_I	Ff transfer to meat - pigs, I
FFP_MN	Ff transfer to meat - pigs, Mn
FFP_ZN	Ff transfer to meat - pigs, Zn
FFP_CO	Ff transfer to meat - pigs, Co
FFP_TE	Ff transfer to meat - pigs, TE
FFP_AG	Ff transfer to meat - pigs, Ag
FFP_CE	Ff transfer to meat - pigs, Ce
SMC11_SR	Soil migration - cereals - k11, Sr
SMC11_CS	Soil migration - cereals - k11, Cs
SMC11_OT	Soil migration - cereals - k11, I, Mn, Zn, Co, Te, Ag, Ce
INTFACC	Interception Factor - Cereals
RESUSS	Resuspension factor- surface crops
RTC_SR	Retention time - cereals - k21, Sr
RTC_CS	Retention time - cereals - k21i, Cs
SOLCONC	Soil contamination - cereals
PLOSSC	Processing loss - cereals
RUC_SR	Root uptake - cereals, Sr
RUC_CS	Root uptake - cereals, Cs
RUC_MN	Root uptake - cereals, Mn
RUC_ZN	Root uptake - cereals, Zn
RUC_CO	Root uptake - cereals, Co
TC23_SR	Translocation cereals - k23, Sr
TC34_SR	Translocation cereals - k34, Sr
TC41_SR	Translocation cereals - k41, Sr
TC23_CS	Translocation cereals - k23, Cs
TC34_CS	Translocation cereals - k34, Cs
TC41_CS	Translocation cereals - k41, Cs
INTFACG	Interception factor - green vegetables
RTG	Retention time - green vegetables
SOLCONG	Soil contamination - green vegetables
PLOSSG	Processing loss - green vegetables
RUG_SR	Root uptake - green vegetables, Sr
RUG_CS	Root uptake - green vegetables, Cs
RUG_MN	Root uptake - green vegetables, Mn
RUG_ZN	Root uptake - green vegetables, Zn
RUG_CO	Root uptake - green vegetables, Co

INTFACPO	Interception factor- potatoes
RTPO_SR	Retention time - potatoes, k21, Sr
RTPO_CS	Retention time - potatoes, k21, Cs
SOLCONPO	Soil contamination - potatoes
PLOSSPO	Processing loss - potatoes
RUPO_SR	Root uptake- potatoes, Sr
RUPO_CS	Root uptake - potatoes, Cs
RUPO_MN	Root uptake - potatoes, Mn
RUPO_ZN	Root uptake - potatoes, Zn
RUPO_CO	Root uptake - potaotes, Co
TPO24_SR	Translocation potatoes - k24, Sr
TPO45_SR	Translocation potatoes - k45, Sr
TPO51_SR	Translocation potatoes - k51, Sr
TPO24_CS	Translocation potatoes - k24, Cs
TPO45_CS	Translocation potatoes - k45, Cs
TPO51_CS	Translocation potatoes - k51, Cs
RURC_SR	Root uptake - root crops, Sr
RURC_CS	Root uptake - root crops, Cs
DT-GVEG	Delay time - fresh green vegetables
DT-PVEG	Delay time - processed green vegetables
DT-CERL	Delay time - cereals
DT-CRPO	Delay time - fresh potatoes and root crops
DT-PCRPO	Delay time - processed potatoes and root crops
DT-MK	Delay time - milk, fresh
DT-MP	Delay time - milk products (cream)
DT-BT	Delay time - butter
DT-CH	Delay time - cheese
DT-DCBC	Delay time - meat from cow/cattle
DT-SHP	Delay time - sheep
DT-OF	Delay time - offal
DT-PIG	Delay time – pigs

Table D.2 Contributions of parameter uncertainties to the overall uncertainty on the endpoints

RESULTS FOR THE MEAN VALUE OF THE ENDPOINTS FOR THE CB2 SOURCE TERM

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
AFBIBEE	FFBC_CS	004	.59	138.05	46.74	33.86	3.70E+01	.92
AFBIBEE	FFDC_CS	006	.38	138.05	43.48	31.50	3.70E+01	.92
AFBIBEE	INTFACP	001	.87	138.05	29.35	21.26	3.70E+01	.92
AFBIBEE	RTHS	002	.67	138.05	08.70	06.30	3.70E+01	.92
AFBIBEE	BIODC_CS	003	-.65	138.05	01.09	00.79	3.70E+01	.92
AFBIGRA	RTC_CS	001	.85	119.09	41.57	34.91	2.47E+04	.89
AFBIGRA	INTFACC	002	-.82	119.09	39.33	33.03	2.47E+04	.89
AFBIGRA	PLOSSC	003	-.77	119.09	21.35	17.93	2.47E+04	.89
AFBIMIL	FMDC_CS	001	.89	104.50	51.69	49.46	7.31E+00	.89
AFBIMIL	INTFACP	002	.85	104.50	31.46	30.11	7.31E+00	.89
AFBIMIL	RTHS	003	.56	104.50	07.87	07.53	7.31E+00	.89
AFBIVEG	SOLCONG	001	1.0	155.00	100.00	64.52	4.99E+00	1.00
AFBIVEG	SOLCONC	012	.11	155.00	19.00	12.26	4.99E+00	1.00
AFBIVEG	SOLCONPO	068	.01	155.00	19.00	12.26	4.99E+00	1.00
AFBIVEG	SOLCONHS	051	-.02	155.00	17.00	10.97	4.99E+00	1.00
AFBIVEG	SMP34_CS	002	-.22	155.00	00.00	00.00	4.99E+00	1.00
AFBIVEG	SMP43_CS	003	.21	155.00	00.00	00.00	4.99E+00	1.00
AFBTBEE	FFBC_CS	004	.54	161.11	62.22	38.62	5.75E+01	.90
AFBTBEE	FFDC_CS	007	.36	161.11	57.78	35.86	5.75E+01	.90
AFBTBEE	RTHS	001	.64	161.11	10.00	06.21	5.75E+01	.90
AFBTBEE	INTFACHS	002	.56	161.11	07.78	04.83	5.75E+01	.90
AFBTBEE	RUP_CS	003	.55	161.11	05.56	03.45	5.75E+01	.90
AFBTGRA	RTC_CS	001	.85	119.09	41.57	34.91	7.71E+03	.89
AFBTGRA	INTFACC	002	-.82	119.09	39.33	33.03	7.71E+03	.89
AFBTGRA	PLOSSC	003	-.77	119.09	21.35	17.93	7.71E+03	.89
AFBTMIL	FMDC_CS	001	.92	104.45	65.56	62.77	2.58E+01	.90
AFBTMIL	RUP_CS	002	.70	104.45	08.89	08.51	2.58E+01	.90
AFBTMIL	RTHS	003	.53	104.45	05.56	05.32	2.58E+01	.90
AFBTVEG	SOLCONG	001	.88	142.87	58.24	40.76	5.57E+01	.91
AFBTVEG	RTC_CS	002	.78	142.87	20.88	14.61	5.57E+01	.91
AFBTVEG	INTFACC	003	-.73	142.87	19.78	13.84	5.57E+01	.91
CDCMBM	FMDC_CS	001	.76	092.95	25.88	27.84	3.63E+00	.85
CDCMBM	RUP_CS	002	.76	092.95	22.35	24.05	3.63E+00	.85
CDCMBM	SMP12_CS	003	-.73	092.95	15.29	16.45	3.63E+00	.85
CDCMBM	RESUSP	004	.57	092.95	09.41	10.12	3.63E+00	.85
CDCMED	FMDC_CS	001	.76	092.95	25.88	27.84	3.63E+00	.85
CDCMED	RUP_CS	002	.76	092.95	22.35	24.05	3.63E+00	.85
CDCMED	SMP12_CS	003	-.72	092.95	15.29	16.45	3.63E+00	.85
CDCMED	RESUSP	004	.57	092.95	09.41	10.12	3.63E+00	.85
CDCMTH	FMDC_CS	002	.73	094.04	25.00	26.58	2.85E+00	.84
CDCMTH	RUP_CS	001	.75	094.04	21.43	22.79	2.85E+00	.84
CDCMTH	SMP12_CS	003	-.72	094.04	15.48	16.46	2.85E+00	.84
CDCMTH	RESUSP	004	.57	094.04	09.52	10.12	2.85E+00	.84
CDLVBM	FMDC_CS	001	.93	107.62	64.13	59.59	3.22E+01	.92
CDLVBM	RTHS	002	.70	107.62	10.87	10.10	3.22E+01	.92
CDLVBM	INTFACP	003	.70	107.62	09.78	09.09	3.22E+01	.92
CDLVED	FMDC_CS	001	.86	113.46	48.31	42.58	2.45E+01	.89
CDLVED	FMDC_I	003	.65	113.46	20.22	17.82	2.45E+01	.89
CDLVED	INTFACP	002	.78	113.46	20.22	17.82	2.45E+01	.89
CDLVTH	FMDC_I	001	.87	104.55	53.41	51.09	9.27E+01	.88
CDLVTH	INTFACP	002	.83	104.55	30.68	29.34	9.27E+01	.88
CDLVTH	RTHS	003	.47	104.55	05.68	05.43	9.27E+01	.88
DLCMBM2	SMP12_CS	001	-.73	085.31	32.00	37.51	1.12E+00	.75
DLCMBM2	FIX_CS	002	-.57	085.31	17.33	20.31	1.12E+00	.75
DLCMBM2	RUP_CS	003	.55	085.31	12.00	14.07	1.12E+00	.75
DLCMBM3	SMP12_CS	001	-.75	087.17	29.49	33.83	1.63E+00	.78
DLCMBM3	RUP_CS	002	.64	087.17	16.67	19.12	1.63E+00	.78
DLCMBM3	FIX_CS	003	-.53	087.17	12.82	14.71	1.63E+00	.78
DLCMBM3	FMDC_CS	004	.50	087.17	10.26	11.77	1.63E+00	.78
DLCMBM4	RUP_CS	002	.73	090.25	21.95	24.32	3.17E+00	.82
DLCMBM4	SMP12_CS	001	-.75	090.25	21.95	24.32	3.17E+00	.82
DLCMBM4	FMDC_CS	003	.66	090.25	17.07	18.91	3.17E+00	.82

DLCMED2	SMP12_CS	001	-.73	086.64	32.00	36.93	1.11E+00	.75
DLCMED2	FIX_CS	002	-.56	086.64	17.33	20.00	1.11E+00	.75
DLCMED2	RUP_CS	003	.55	086.64	12.00	13.85	1.11E+00	.75

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
DLCMED3	SMP12_CS	001	-.75	087.17	29.49	33.83	1.63E+00	.78
DLCMED3	RUP_CS	002	.64	087.17	16.67	19.12	1.63E+00	.78
DLCMED3	FIX_CS	003	-.53	087.17	12.82	14.71	1.63E+00	.78
DLCMED3	FMDC_CS	004	.50	087.17	10.26	11.77	1.63E+00	.78
DLCMED4	RUP_CS	002	.73	090.25	21.95	24.32	3.18E+00	.82
DLCMED4	SMP12_CS	001	-.75	090.25	21.95	24.32	3.18E+00	.82
DLCMED4	FMDC_CS	003	.66	090.25	17.07	18.91	3.18E+00	.82
DLCMTH2	SMP12_CS	001	-.72	090.30	33.33	36.91	1.06E+00	.72
DLCMTH2	FIX_CS	002	-.52	090.30	15.28	16.92	1.06E+00	.72
DLCMTH2	RUP_CS	003	.49	090.30	11.11	12.30	1.06E+00	.72
DLCMTH3	SMP12_CS	001	-.73	086.65	30.67	35.40	1.37E+00	.75
DLCMTH3	RUP_CS	002	.59	086.65	16.00	18.47	1.37E+00	.75
DLCMTH3	FIX_CS	003	-.48	086.65	10.67	12.31	1.37E+00	.75
DLCMTH3	FMDC_CS	004	.46	086.65	09.33	10.77	1.37E+00	.75
DLCMTH4	SMP12_CS	001	-.74	088.85	22.22	25.01	2.60E+00	.81
DLCMTH4	RUP_CS	002	.70	088.85	20.99	23.62	2.60E+00	.81
DLCMTH4	FMDC_CS	003	.62	088.85	16.05	18.06	2.60E+00	.81
DLLVBM2	FMDC_CS	001	.93	107.62	64.13	59.59	3.27E+01	.92
DLLVBM2	RTHS	003	.70	107.62	10.87	10.10	3.27E+01	.92
DLLVBM2	INTFACP	002	.70	107.62	09.78	09.09	3.27E+01	.92
DLLVBM3	FMDC_CS	001	.93	107.62	64.13	59.59	3.27E+01	.92
DLLVBM3	RTHS	003	.70	107.62	10.87	10.10	3.27E+01	.92
DLLVBM3	INTFACP	002	.70	107.62	09.78	09.09	3.27E+01	.92
DLLVBM4	FMDC_CS	001	.93	107.62	64.13	59.59	3.30E+01	.92
DLLVBM4	RTHS	002	.70	107.62	10.87	10.10	3.30E+01	.92
DLLVBM4	INTFACP	003	.70	107.62	09.78	09.09	3.30E+01	.92
DLLVED2	FMDC_CS	002	.79	112.51	35.23	31.31	3.09E+01	.88
DLLVED2	FMDC_I	003	.77	112.51	31.82	28.28	3.09E+01	.88
DLLVED2	INTFACP	001	.80	112.51	26.14	23.23	3.09E+01	.88
DLLVED3	FMDC_CS	001	.81	112.36	38.20	34.00	2.89E+01	.89
DLLVED3	FMDC_I	003	.74	112.36	28.09	25.00	2.89E+01	.89
DLLVED3	INTFACP	002	.79	112.36	24.72	22.00	2.89E+01	.89
DLLVED4	FMDC_CS	001	.88	111.11	50.00	45.00	2.54E+01	.90
DLLVED4	INTFACP	002	.77	111.11	18.89	17.00	2.54E+01	.90
DLLVED4	FMDC_I	004	.61	111.11	17.78	16.00	2.54E+01	.90
DLLVED4	RTHS	003	.62	111.11	10.00	09.00	2.54E+01	.90
DLLVTH2	FMDC_I	001	.88	102.29	55.68	54.43	1.48E+02	.88
DLLVTH2	INTFACP	002	.82	102.29	30.68	29.99	1.48E+02	.88
DLLVTH2	RTHS	003	.45	102.29	04.55	04.45	1.48E+02	.88
DLLVTH3	FMDC_I	001	.88	103.42	55.68	53.84	1.31E+02	.88
DLLVTH3	INTFACP	002	.82	103.42	30.68	29.67	1.31E+02	.88
DLLVTH3	RTHS	003	.46	103.42	04.55	04.40	1.31E+02	.88
DLLVTH4	FMDC_I	001	.87	105.69	52.27	49.46	8.46E+01	.88
DLLVTH4	INTFACP	002	.83	105.69	31.82	30.11	8.46E+01	.88
DLLVTH4	RTHS	003	.47	105.69	05.68	05.37	8.46E+01	.88
PLCMBM	FMDC_CS	001	.76	092.95	25.88	27.84	3.63E+00	.85
PLCMBM	RUP_CS	002	.76	092.95	22.35	24.05	3.63E+00	.85
PLCMBM	SMP12_CS	003	-.73	092.95	15.29	16.45	3.63E+00	.85
PLCMBM	RESUSP	004	.57	092.95	09.41	10.12	3.63E+00	.85
PLCMMT	FMDC_CS	001	.76	092.95	25.88	27.84	3.65E+00	.85
PLCMMT	RUP_CS	002	.76	092.95	22.35	24.05	3.65E+00	.85
PLCMMT	SMP12_CS	003	-.73	092.95	15.29	16.45	3.65E+00	.85
PLCMMT	RESUSP	004	.57	092.95	09.41	10.12	3.65E+00	.85
PLCMTH	FMDC_CS	002	.73	094.04	25.00	26.58	2.85E+00	.84
PLCMTH	RUP_CS	001	.75	094.04	21.43	22.79	2.85E+00	.84
PLCMTH	SMP12_CS	003	-.72	094.04	15.48	16.46	2.85E+00	.84
PLCMTH	RESUSP	004	.57	094.04	09.52	10.12	2.85E+00	.84
PLLVBM	FMDC_CS	001	.93	107.62	64.13	59.59	3.20E+01	.92
PLLVBM	RTHS	002	.70	107.62	10.87	10.10	3.20E+01	.92
PLLVBM	INTFACP	003	.70	107.62	09.78	09.09	3.20E+01	.92
PLLVMT	FMDC_CS	001	.89	111.11	52.22	47.00	2.14E+01	.90
PLLVMT	INTFACP	002	.77	111.11	17.78	16.00	2.14E+01	.90
PLLVMT	FMDC_I	004	.58	111.11	16.67	15.00	2.14E+01	.90
PLLVMT	RTHS	003	.63	111.11	10.00	09.00	2.14E+01	.90
PLLVTH	FMDC_I	001	.87	106.83	53.41	50.00	8.62E+01	.88
PLLVTH	INTFACP	002	.83	106.83	31.82	29.79	8.62E+01	.88
PLLVTH	RTHS	003	.47	106.83	05.68	05.32	8.62E+01	.88

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
RLCMBM2	SMP12_CS	001	-.73	085.31	32.00	37.51	1.12E+00	.75
RLCMBM2	FIX_CS	002	-.57	085.31	17.33	20.31	1.12E+00	.75
RLCMBM2	RUP_CS	003	.55	085.31	12.00	14.07	1.12E+00	.75
RLCMBM3	SMP12_CS	001	-.75	087.17	29.49	33.83	1.63E+00	.78
RLCMBM3	RUP_CS	002	.64	087.17	16.67	19.12	1.63E+00	.78
RLCMBM3	FIX_CS	003	-.53	087.17	12.82	14.71	1.63E+00	.78
RLCMBM3	FMDC_CS	004	.50	087.17	10.26	11.77	1.63E+00	.78
RLCMBM4	RUP_CS	002	.73	090.25	21.95	24.32	3.17E+00	.82
RLCMBM4	SMP12_CS	001	-.75	090.25	21.95	24.32	3.17E+00	.82
RLCMBM4	FMDC_CS	003	.66	090.25	17.07	18.91	3.17E+00	.82
RLCMMT2	SMP12_CS	001	-.73	085.31	32.00	37.51	1.12E+00	.75
RLCMMT2	FIX_CS	002	-.56	085.31	17.33	20.31	1.12E+00	.75
RLCMMT2	RUP_CS	003	.55	085.31	12.00	14.07	1.12E+00	.75
RLCMMT3	SMP12_CS	001	-.75	087.17	29.49	33.83	1.64E+00	.78
RLCMMT3	RUP_CS	002	.64	087.17	16.67	19.12	1.64E+00	.78
RLCMMT3	FIX_CS	003	-.53	087.17	12.82	14.71	1.64E+00	.78
RLCMMT3	FMDC_CS	004	.50	087.17	10.26	11.77	1.64E+00	.78
RLCMMT4	RUP_CS	002	.73	090.25	21.95	24.32	3.19E+00	.82
RLCMMT4	SMP12_CS	001	-.75	090.25	21.95	24.32	3.19E+00	.82
RLCMMT4	FMDC_CS	003	.66	090.25	17.07	18.91	3.19E+00	.82
RLCMTH2	SMP12_CS	001	-.72	090.30	33.33	36.91	1.06E+00	.72
RLCMTH2	FIX_CS	002	-.52	090.30	15.28	16.92	1.06E+00	.72
RLCMTH2	RUP_CS	003	.49	090.30	11.11	12.30	1.06E+00	.72
RLCMTH3	SMP12_CS	001	-.73	087.98	30.67	34.86	1.37E+00	.75
RLCMTH3	RUP_CS	002	.59	087.98	16.00	18.19	1.37E+00	.75
RLCMTH3	FIX_CS	003	-.48	087.98	12.00	13.64	1.37E+00	.75
RLCMTH3	FMDC_CS	004	.46	087.98	09.33	10.60	1.37E+00	.75
RLCMTH4	SMP12_CS	001	-.74	088.85	22.22	25.01	2.60E+00	.81
RLCMTH4	RUP_CS	002	.70	088.85	20.99	23.62	2.60E+00	.81
RLCMTH4	FMDC_CS	003	.62	088.85	16.05	18.06	2.60E+00	.81
RLLVBM2	FMDC_CS	001	.93	107.62	64.13	59.59	3.14E+01	.92
RLLVBM2	RTHS	003	.70	107.62	10.87	10.10	3.14E+01	.92
RLLVBM2	INTFACP	002	.70	107.62	09.78	09.09	3.14E+01	.92
RLLVBM3	FMDC_CS	001	.93	107.62	64.13	59.59	3.27E+01	.92
RLLVBM3	RTHS	003	.70	107.62	10.87	10.10	3.27E+01	.92
RLLVBM3	INTFACP	002	.70	107.62	09.78	09.09	3.27E+01	.92
RLLVBM4	FMDC_CS	001	.93	107.62	64.13	59.59	3.30E+01	.92
RLLVBM4	RTHS	002	.70	107.62	10.87	10.10	3.30E+01	.92
RLLVBM4	INTFACP	003	.70	107.62	09.78	09.09	3.30E+01	.92
RLLVMT2	FMDC_CS	002	.77	113.64	34.09	30.00	1.12E+01	.88
RLLVMT2	FMDC_I	003	.77	113.64	32.95	29.00	1.12E+01	.88
RLLVMT2	INTFACP	001	.79	113.64	26.14	23.00	1.12E+01	.88
RLLVMT3	FMDC_CS	001	.83	112.35	41.57	37.00	2.17E+01	.89
RLLVMT3	FMDC_I	003	.71	112.35	25.84	23.00	2.17E+01	.89
RLLVMT3	INTFACP	002	.79	112.35	22.47	20.00	2.17E+01	.89
RLLVMT4	FMDC_CS	001	.89	112.22	54.44	48.51	2.43E+01	.90
RLLVMT4	INTFACP	002	.77	112.22	17.78	15.84	2.43E+01	.90
RLLVMT4	FMDC_I	004	.56	112.22	15.56	13.87	2.43E+01	.90
RLLVMT4	RTHS	003	.63	112.22	10.00	08.91	2.43E+01	.90
RLLVTH2	FMDC_I	001	.88	103.43	55.68	53.83	8.70E+01	.88
RLLVTH2	INTFACP	002	.82	103.43	30.68	29.66	8.70E+01	.88
RLLVTH2	RTHS	003	.45	103.43	04.55	04.40	8.70E+01	.88
RLLVTH3	FMDC_I	001	.88	103.42	55.68	53.84	1.31E+02	.88
RLLVTH3	INTFACP	002	.82	103.42	30.68	29.67	1.31E+02	.88
RLLVTH3	RTHS	003	.46	103.42	04.55	04.40	1.31E+02	.88
RLLVTH4	FMDC_I	001	.87	105.69	52.27	49.46	8.46E+01	.88
RLLVTH4	INTFACP	002	.83	105.69	31.82	30.11	8.46E+01	.88
RLLVTH4	RTHS	003	.47	105.69	05.68	05.37	8.46E+01	.88

RESULTS FOR THE 95TH PERCENTILE OF THE ENDPOINTS FOR THE CB2 SOURCE TERM

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
AFBIBEE	FFBC_CS	004	.58	134.78	44.57	33.07	3.98E+01	.92
AFBIBEE	FFDC_CS	006	.37	134.78	40.22	29.84	3.98E+01	.92
AFBIBEE	INTFACP	001	.88	134.78	31.52	23.39	3.98E+01	.92
AFBIBEE	RTHS	002	.68	134.78	08.70	06.45	3.98E+01	.92
AFBIBEE	BIODC_CS	003	-.66	134.78	02.17	01.61	3.98E+01	.92
AFBIGRA	RTC_CS	001	.85	121.32	41.57	34.26	2.24E+04	.89
AFBIGRA	INTFACC	002	-.82	121.32	40.45	33.34	2.24E+04	.89
AFBIGRA	PLOSSC	003	-.77	121.32	20.22	16.67	2.24E+04	.89
AFBIMIL	FMDC_CS	001	.87	102.28	47.73	46.67	9.12E+00	.88
AFBIMIL	INTFACP	002	.85	102.28	36.36	35.55	9.12E+00	.88
AFBIMIL	RTHS	003	.56	102.28	09.09	08.89	9.12E+00	.88
AFBIVEG	SOLCONG	001	1.0	155.00	100.00	64.52	7.24E+00	1.00
AFBIVEG	SOLCONC	024	.06	155.00	19.00	12.26	7.24E+00	1.00
AFBIVEG	SOLCONPO	036	-.05	155.00	19.00	12.26	7.24E+00	1.00
AFBIVEG	SOLCONHS	069	-.01	155.00	17.00	10.97	7.24E+00	1.00
AFBIVEG	RTG	002	-.16	155.00	00.00	00.00	7.24E+00	1.00
AFBIVEG	RTHS	003	.14	155.00	00.00	00.00	7.24E+00	1.00
AFBTBEE	FFBC_CS	003	.54	161.10	62.22	38.62	5.25E+01	.90
AFBTBEE	FFDC_CS	006	.37	161.10	57.78	35.87	5.25E+01	.90
AFBTBEE	RTHS	001	.68	161.10	12.22	07.59	5.25E+01	.90
AFBTBEE	INTFACHS	002	.62	161.10	10.00	06.21	5.25E+01	.90
AFBTGRA	RTC_CS	001	.85	120.21	42.70	35.52	5.50E+03	.89
AFBTGRA	INTFACC	002	-.82	120.21	39.33	32.72	5.50E+03	.89
AFBTGRA	PLOSSC	003	-.76	120.21	19.10	15.89	5.50E+03	.89
AFBTMIL	FMDC_CS	001	.91	104.44	68.89	65.96	2.57E+01	.90
AFBTMIL	RTHS	002	.61	104.44	10.00	09.57	2.57E+01	.90
AFBTMIL	INTFACHS	003	.58	104.44	08.89	08.51	2.57E+01	.90
AFBTVEG	SOLCONG	001	.89	146.66	65.56	44.70	7.08E+01	.90
AFBTVEG	RTC_CS	002	.74	146.66	17.78	12.12	7.08E+01	.90
AFBTVEG	INTFACC	003	-.69	146.66	16.67	11.37	7.08E+01	.90
CDCMBM	FMDC_CS	001	.78	097.68	29.41	30.11	6.17E+00	.85
CDCMBM	RUP_CS	002	.75	097.68	21.18	21.68	6.17E+00	.85
CDCMBM	SMP12_CS	003	-.70	097.68	12.94	13.25	6.17E+00	.85
CDCMED	FMDC_CS	001	.78	096.50	29.41	30.48	6.03E+00	.85
CDCMED	RUP_CS	002	.75	096.50	21.18	21.95	6.03E+00	.85
CDCMED	SMP12_CS	003	-.70	096.50	12.94	13.41	6.03E+00	.85
CDCMTH	FMDC_CS	001	.75	096.42	27.38	28.40	4.57E+00	.84
CDCMTH	RUP_CS	002	.74	096.42	20.24	20.99	4.57E+00	.84
CDCMTH	SMP12_CS	003	-.71	096.42	14.29	14.82	4.57E+00	.84
CDLVBM	FMDC_CS	001	.93	107.62	64.13	59.59	3.55E+01	.92
CDLVBM	RTHS	003	.70	107.62	10.87	10.10	3.55E+01	.92
CDLVBM	INTFACP	002	.70	107.62	09.78	09.09	3.55E+01	.92
CDLVED	FMDC_CS	001	.86	113.46	48.31	42.58	2.75E+01	.89
CDLVED	FMDC_I	003	.64	113.46	20.22	17.82	2.75E+01	.89
CDLVED	INTFACP	002	.78	113.46	20.22	17.82	2.75E+01	.89
CDLVTH	FMDC_I	001	.88	106.83	53.41	50.00	1.02E+02	.88
CDLVTH	INTFACP	002	.83	106.83	31.82	29.79	1.02E+02	.88
CDLVTH	RTHS	003	.48	106.83	05.68	05.32	1.02E+02	.88
DLCMBM2	FIX_CS	002	-.29	076.87	15.38	20.01	1.15E+00	.39
DLCMBM2	SMP12_CS	001	-.33	076.87	15.38	20.01	1.15E+00	.39
DLCMBM2	INTFACG	006	-.17	076.87	07.69	10.00	1.15E+00	.39
DLCMBM2	SMP23_CS	003	-.25	076.87	07.69	10.00	1.15E+00	.39
DLCMBM3	SMP12_CS	001	-.69	088.22	35.29	40.00	2.24E+00	.68
DLCMBM3	FIX_CS	002	-.48	088.22	16.18	18.34	2.24E+00	.68
DLCMBM3	RUP_CS	003	.45	088.22	10.29	11.66	2.24E+00	.68
DLCMBM4	RUP_CS	002	.71	086.25	22.50	26.09	5.75E+00	.80
DLCMBM4	SMP12_CS	001	-.72	086.25	21.25	24.64	5.75E+00	.80
DLCMBM4	FMDC_CS	003	.60	086.25	13.75	15.94	5.75E+00	.80
DLCMBM4	RESUSP	004	.50	086.25	08.75	10.14	5.75E+00	.80
DLCMED2	SMP12_CS	001	-.37	080.94	16.67	20.60	1.15E+00	.42
DLCMED2	FIX_CS	002	-.28	080.94	14.29	17.66	1.15E+00	.42
DLCMED2	SMP23_CS	003	-.26	080.94	09.52	11.76	1.15E+00	.42
DLCMED3	SMP12_CS	001	-.70	086.75	36.76	42.37	2.24E+00	.68
DLCMED3	FIX_CS	002	-.48	086.75	16.18	18.65	2.24E+00	.68
DLCMED3	RUP_CS	003	.44	086.75	08.82	10.17	2.24E+00	.68

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
DLCMED4	RUP_CS	002	.71	087.36	22.78	26.08	5.62E+00	.79
DLCMED4	SMP12_CS	001	-.71	087.36	21.52	24.63	5.62E+00	.79
DLCMED4	FMDC_CS	003	.59	087.36	13.92	15.93	5.62E+00	.79
DLCMED4	RESUSP	004	.50	087.36	08.86	10.14	5.62E+00	.79
DLCMTH2	FIX_CS	002	-.32	089.46	18.42	20.59	1.07E+00	.38
DLCMTH2	SMP12_CS	001	-.32	089.46	13.16	14.71	1.07E+00	.38
DLCMTH2	SMP23_CS	003	-.29	089.46	13.16	14.71	1.07E+00	.38
DLCMTH2	INTFACG	004	-.20	089.46	10.53	11.77	1.07E+00	.38
DLCMTH3	SMP12_CS	001	-.68	084.35	39.06	46.31	1.45E+00	.64
DLCMTH3	FIX_CS	002	-.45	084.35	17.19	20.38	1.45E+00	.64
DLCMTH3	SMP23_CS	003	-.39	084.35	06.25	07.41	1.45E+00	.64
DLCMTH4	SMP12_CS	001	-.70	088.44	23.08	26.10	4.47E+00	.78
DLCMTH4	RUP_CS	002	.68	088.44	20.51	23.19	4.47E+00	.78
DLCMTH4	FMDC_CS	003	.56	088.44	12.82	14.50	4.47E+00	.78
DLCMTH4	RESUSP	004	.47	088.44	08.97	10.14	4.47E+00	.78
DLLVBM2	FMDC_CS	001	.93	105.43	64.13	60.83	2.24E+01	.92
DLLVBM2	RTHS	002	.68	105.43	09.78	09.28	2.24E+01	.92
DLLVBM2	INTFACP	003	.67	105.43	07.61	07.22	2.24E+01	.92
DLLVBM3	FMDC_CS	001	.93	105.44	65.22	61.86	2.63E+01	.92
DLLVBM3	RTHS	002	.69	105.44	09.78	09.28	2.63E+01	.92
DLLVBM3	INTFACP	003	.69	105.44	08.70	08.25	2.63E+01	.92
DLLVBM4	FMDC_CS	001	.93	105.45	65.22	61.85	2.95E+01	.92
DLLVBM4	RTHS	002	.69	105.45	10.87	10.31	2.95E+01	.92
DLLVBM4	INTFACP	003	.69	105.45	08.70	08.25	2.95E+01	.92
DLLVED2	FMDC_I	002	.79	114.79	36.36	31.68	2.45E+01	.88
DLLVED2	FMDC_CS	003	.76	114.79	31.82	27.72	2.45E+01	.88
DLLVED2	INTFACP	001	.79	114.79	25.00	21.78	2.45E+01	.88
DLLVED3	FMDC_CS	001	.83	112.36	41.57	37.00	2.34E+01	.89
DLLVED3	FMDC_I	003	.73	112.36	26.97	24.00	2.34E+01	.89
DLLVED3	INTFACP	002	.79	112.36	22.47	20.00	2.34E+01	.89
DLLVED4	FMDC_CS	001	.90	110.99	53.85	48.52	2.24E+01	.91
DLLVED4	INTFACP	002	.77	110.99	16.48	14.85	2.24E+01	.91
DLLVED4	FMDC_I	004	.58	110.99	15.38	13.86	2.24E+01	.91
DLLVED4	RTHS	003	.64	110.99	09.89	08.91	2.24E+01	.91
DLLVTH2	FMDC_I	001	.88	102.31	56.32	55.05	1.26E+02	.87
DLLVTH2	INTFACP	002	.81	102.31	29.89	29.22	1.26E+02	.87
DLLVTH2	RTHS	003	.44	102.31	04.60	04.50	1.26E+02	.87
DLLVTH3	FMDC_I	001	.88	103.45	55.17	53.33	1.05E+02	.87
DLLVTH3	INTFACP	002	.82	103.45	31.03	30.00	1.05E+02	.87
DLLVTH3	RTHS	003	.45	103.45	04.60	04.45	1.05E+02	.87
DLLVTH4	FMDC_I	001	.85	110.24	47.73	43.30	5.25E+01	.88
DLLVTH4	INTFACP	002	.82	110.24	30.68	27.83	5.25E+01	.88
DLLVTH4	FMDC_CS	003	.53	110.24	15.91	14.43	5.25E+01	.88
PLCMBM	FMDC_CS	001	.78	097.68	29.41	30.11	6.03E+00	.85
PLCMBM	RUP_CS	002	.75	097.68	21.18	21.68	6.03E+00	.85
PLCMBM	SMP12_CS	003	-.70	097.68	12.94	13.25	6.03E+00	.85
PLCMMT	FMDC_CS	001	.78	097.68	29.41	30.11	6.17E+00	.85
PLCMMT	RUP_CS	002	.75	097.68	21.18	21.68	6.17E+00	.85
PLCMMT	SMP12_CS	003	-.70	097.68	12.94	13.25	6.17E+00	.85
PLCMTH	FMDC_CS	001	.75	095.23	27.38	28.75	4.68E+00	.84
PLCMTH	RUP_CS	002	.74	095.23	20.24	21.25	4.68E+00	.84
PLCMTH	SMP12_CS	003	-.70	095.23	14.29	15.01	4.68E+00	.84
PLCMTH	RESUSP	004	.55	095.23	09.52	10.00	4.68E+00	.84
PLLVBM	FMDC_CS	001	.93	107.62	64.13	59.59	3.63E+01	.92
PLLVBM	RTHS	003	.70	107.62	10.87	10.10	3.63E+01	.92
PLLVBM	INTFACP	002	.71	107.62	09.78	09.09	3.63E+01	.92
PLLVMT	FMDC_CS	001	.88	112.22	50.00	44.56	2.29E+01	.90
PLLVMT	INTFACP	002	.77	112.22	18.89	16.83	2.29E+01	.90
PLLVMT	FMDC_I	004	.61	112.22	17.78	15.84	2.29E+01	.90
PLLVMT	RTHS	003	.62	112.22	10.00	08.91	2.29E+01	.90
PLLVTH	FMDC_I	001	.88	106.83	53.41	50.00	1.00E+02	.88
PLLVTH	INTFACP	002	.83	106.83	31.82	29.79	1.00E+02	.88
PLLVTH	RTHS	003	.48	106.83	05.68	05.32	1.00E+02	.88
RLCMBM2	FIX_CS	002	-.28	079.44	15.38	19.36	1.15E+00	.39
RLCMBM2	SMP12_CS	001	-.32	079.44	12.82	16.14	1.15E+00	.39
RLCMBM2	SMP23_CS	003	-.24	079.44	07.69	09.68	1.15E+00	.39

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
RLCMBM3	SMP12_CS	001	-.69	085.28	35.29	41.38	2.24E+00	.68
RLCMBM3	FIX_CS	002	-.48	085.28	16.18	18.97	2.24E+00	.68
RLCMBM3	RUP_CS	003	.45	085.28	10.29	12.07	2.24E+00	.68
RLCMBM4	RUP_CS	002	.71	086.25	22.50	26.09	5.75E+00	.80
RLCMBM4	SMP12_CS	001	-.71	086.25	21.25	24.64	5.75E+00	.80
RLCMBM4	FMDC_CS	003	.59	086.25	13.75	15.94	5.75E+00	.80
RLCMBM4	RESUSP	004	.50	086.25	10.00	11.59	5.75E+00	.80
RLCMMT2	FIX_CS	002	-.29	079.52	13.64	17.15	1.17E+00	.44
RLCMMT2	SMP12_CS	001	-.37	079.52	13.64	17.15	1.17E+00	.44
RLCMMT2	SMP23_CS	003	-.28	079.52	09.09	11.43	1.17E+00	.44
RLCMMT3	SMP12_CS	001	-.70	084.06	36.23	43.10	2.24E+00	.69
RLCMMT3	FIX_CS	002	-.49	084.06	15.94	18.96	2.24E+00	.69
RLCMMT3	RUP_CS	003	.45	084.06	10.14	12.06	2.24E+00	.69
RLCMMT4	RUP_CS	002	.71	086.25	22.50	26.09	5.62E+00	.80
RLCMMT4	SMP12_CS	001	-.71	086.25	21.25	24.64	5.62E+00	.80
RLCMMT4	FMDC_CS	003	.60	086.25	13.75	15.94	5.62E+00	.80
RLCMMT4	RESUSP	004	.50	086.25	08.75	10.14	5.62E+00	.80
RLCMTH2	FIX_CS	002	-.29	082.88	20.00	24.13	1.07E+00	.35
RLCMTH2	SMP12_CS	001	-.33	082.88	17.14	20.68	1.07E+00	.35
RLCMTH2	SMP23_CS	003	-.23	082.88	08.57	10.34	1.07E+00	.35
RLCMTH3	SMP12_CS	001	-.67	087.48	37.50	42.87	1.41E+00	.64
RLCMTH3	FIX_CS	002	-.45	087.48	17.19	19.65	1.41E+00	.64
RLCMTH3	SMP23_CS	003	-.39	087.48	06.25	07.14	1.41E+00	.64
RLCMTH4	SMP12_CS	001	-.70	087.15	21.79	25.00	4.57E+00	.78
RLCMTH4	RUP_CS	002	.68	087.15	20.51	23.53	4.57E+00	.78
RLCMTH4	FMDC_CS	003	.56	087.15	12.82	14.71	4.57E+00	.78
RLCMTH4	RESUSP	004	.47	087.15	08.97	10.29	4.57E+00	.78
RLLVBM2	FMDC_CS	001	.93	106.52	64.13	60.20	2.19E+01	.92
RLLVBM2	RTHS	002	.68	106.52	09.78	09.18	2.19E+01	.92
RLLVBM2	INTFACP	003	.67	106.52	08.70	08.17	2.19E+01	.92
RLLVBM3	FMDC_CS	001	.93	105.45	65.22	61.85	2.69E+01	.92
RLLVBM3	RTHS	002	.69	105.45	10.87	10.31	2.69E+01	.92
RLLVBM3	INTFACP	003	.69	105.45	08.70	08.25	2.69E+01	.92
RLLVBM4	FMDC_CS	001	.93	105.45	65.22	61.85	2.88E+01	.92
RLLVBM4	RTHS	002	.69	105.45	10.87	10.31	2.88E+01	.92
RLLVBM4	INTFACP	003	.69	105.45	08.70	08.25	2.88E+01	.92
RLLVMT2	FMDC_CS	001	.80	115.91	37.50	32.35	2.19E+01	.88
RLLVMT2	FMDC_I	003	.76	115.91	31.82	27.45	2.19E+01	.88
RLLVMT2	INTFACP	002	.79	115.91	23.86	20.58	2.19E+01	.88
RLLVMT3	FMDC_CS	001	.86	114.60	46.07	40.20	2.19E+01	.89
RLLVMT3	FMDC_I	003	.69	114.60	23.60	20.59	2.19E+01	.89
RLLVMT3	INTFACP	002	.78	114.60	20.22	17.64	2.19E+01	.89
RLLVMT4	FMDC_CS	001	.91	110.99	57.14	51.48	2.24E+01	.91
RLLVMT4	INTFACP	002	.77	110.99	15.38	13.86	2.24E+01	.91
RLLVMT4	FMDC_I	005	.52	110.99	13.19	11.88	2.24E+01	.91
RLLVMT4	RTHS	003	.65	110.99	09.89	08.91	2.24E+01	.91
RLLVTH2	FMDC_I	001	.88	102.31	56.32	55.05	1.26E+02	.87
RLLVTH2	INTFACP	002	.81	102.31	29.89	29.22	1.26E+02	.87
RLLVTH2	RTHS	003	.43	102.31	04.60	04.50	1.26E+02	.87
RLLVTH3	FMDC_I	001	.88	103.45	55.17	53.33	1.07E+02	.87
RLLVTH3	INTFACP	002	.82	103.45	31.03	30.00	1.07E+02	.87
RLLVTH3	RTHS	003	.45	103.45	04.60	04.45	1.07E+02	.87
RLLVTH4	FMDC_I	001	.85	111.50	48.28	43.30	5.13E+01	.87
RLLVTH4	INTFACP	002	.82	111.50	31.03	27.83	5.13E+01	.87
RLLVTH4	FMDC_CS	003	.53	111.50	16.09	14.43	5.13E+01	.87

RESULTS FOR THE 99TH PERCENTILE OF THE ENDPOINTS FOR THE CB2 SOURCE TERM

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
AFBIBEE	FFBC_CS	004	.58	135.86	44.57	32.81	4.69E+01	.92
AFBIBEE	FFDC_CS	006	.37	135.86	41.30	30.40	4.69E+01	.92
AFBIBEE	INTFACP	001	.88	135.86	31.52	23.20	4.69E+01	.92
AFBIBEE	RTHS	002	.68	135.86	08.70	06.40	4.69E+01	.92
AFBIBEE	BIODC_CS	003	-.66	135.86	02.17	01.60	4.69E+01	.92
AFBIGRA	RTC_CS	001	.85	119.09	41.57	34.91	1.45E+04	.89
AFBIGRA	INTFACC	002	-.82	119.09	39.33	33.03	1.45E+04	.89
AFBIGRA	PLOSSC	003	-.77	119.09	21.35	17.93	1.45E+04	.89
AFBIMIL	FMDC_CS	001	.88	101.14	50.00	49.44	8.51E+00	.88
AFBIMIL	INTFACP	002	.85	101.14	34.09	33.71	8.51E+00	.88
AFBIMIL	RTHS	003	.56	101.14	09.09	08.99	8.51E+00	.88
AFBIVEG	SOLCONG	001	1.0	155.00	100.00	64.52	7.59E+00	1.00
AFBIVEG	SOLCONC	014	.08	155.00	19.00	12.26	7.59E+00	1.00
AFBIVEG	SOLCONPO	049	-.03	155.00	19.00	12.26	7.59E+00	1.00
AFBIVEG	SOLCONHS	035	.05	155.00	17.00	10.97	7.59E+00	1.00
AFBIVEG	DT-CERL	002	.14	155.00	00.00	00.00	7.59E+00	1.00
AFBIVEG	FMDC_I	003	-.13	155.00	00.00	00.00	7.59E+00	1.00
AFBTBEE	FFBC_CS	003	.55	162.21	63.33	39.04	5.25E+01	.90
AFBTBEE	FFDC_CS	006	.37	162.21	57.78	35.62	5.25E+01	.90
AFBTBEE	RTHS	001	.68	162.21	12.22	07.53	5.25E+01	.90
AFBTBEE	INTFACHS	002	.63	162.21	10.00	06.16	5.25E+01	.90
AFBTGRA	RTC_CS	001	.85	120.20	41.57	34.58	3.55E+03	.89
AFBTGRA	INTFACC	002	-.82	120.20	40.45	33.65	3.55E+03	.89
AFBTGRA	PLOSSC	003	-.77	120.20	20.22	16.82	3.55E+03	.89
AFBTMIL	FMDC_CS	001	.92	107.77	70.00	64.95	2.31E+01	.90
AFBTMIL	INTFACHS	003	.61	107.77	10.00	09.28	2.31E+01	.90
AFBTMIL	RTHS	002	.64	107.77	10.00	09.28	2.31E+01	.90
AFBTVEG	SOLCONG	001	.89	146.66	67.78	46.22	6.76E+01	.90
AFBTVEG	RTC_CS	002	.72	146.66	16.67	11.37	6.76E+01	.90
AFBTVEG	INTFACC	003	-.67	146.66	15.56	10.61	6.76E+01	.90
CDCMBM	FMDC_CS	001	.80	095.30	34.12	35.80	6.31E+00	.85
CDCMBM	RUP_CS	002	.74	095.30	18.82	19.75	6.31E+00	.85
CDCMBM	SMP12_CS	003	-.68	095.30	11.76	12.34	6.31E+00	.85
CDCMED	FMDC_CS	001	.80	096.48	34.12	35.36	6.46E+00	.85
CDCMED	RUP_CS	002	.74	096.48	18.82	19.51	6.46E+00	.85
CDCMED	SMP12_CS	003	-.67	096.48	11.76	12.19	6.46E+00	.85
CDCMTH	FMDC_CS	001	.79	095.32	32.94	34.56	4.90E+00	.85
CDCMTH	RUP_CS	002	.73	095.32	17.65	18.52	4.90E+00	.85
CDCMTH	SMP12_CS	003	-.69	095.32	12.94	13.58	4.90E+00	.85
CDLVBM	FMDC_CS	001	.93	107.62	64.13	59.59	3.63E+01	.92
CDLVBM	RTHS	003	.70	107.62	10.87	10.10	3.63E+01	.92
CDLVBM	INTFACP	002	.71	107.62	09.78	09.09	3.63E+01	.92
CDLVED	FMDC_CS	001	.84	114.78	45.45	39.60	2.82E+01	.88
CDLVED	FMDC_I	003	.66	114.78	22.73	19.80	2.82E+01	.88
CDLVED	INTFACP	002	.77	114.78	22.73	19.80	2.82E+01	.88
CDLVTH	FMDC_I	001	.88	105.70	55.68	52.68	1.29E+02	.88
CDLVTH	INTFACP	002	.83	105.70	31.82	30.10	1.29E+02	.88
CDLVTH	RTHS	003	.46	105.70	04.55	04.30	1.29E+02	.88
DLCMBM2	FMDC_I	003	-.18	094.08	11.76	12.50	1.02E+00	.34
DLCMBM2	INTFACC	001	.26	094.08	11.76	12.50	1.02E+00	.34
DLCMBM2	RESUSP	002	-.19	094.08	05.88	06.25	1.02E+00	.34
DLCMBM3	FIX_CS	002	-.26	087.84	12.20	13.89	1.12E+00	.41
DLCMBM3	SMP12_CS	001	-.33	087.84	12.20	13.89	1.12E+00	.41
DLCMBM3	RUG_CS	003	.24	087.84	02.44	02.78	1.12E+00	.41
DLCMBM4	SMP12_CS	001	-.69	083.81	35.29	42.11	2.34E+00	.68
DLCMBM4	FIX_CS	002	-.47	083.81	16.18	19.31	2.34E+00	.68
DLCMBM4	RUP_CS	003	.45	083.81	10.29	12.28	2.34E+00	.68
DLCMED2	INTFACC	001	.27	072.44	10.34	14.27	1.02E+00	.29
DLCMED2	BIODC_I	002	-.17	072.44	06.90	09.53	1.02E+00	.29
DLCMED2	SMP45_CS	003	-.16	072.44	06.90	09.53	1.02E+00	.29
DLCMED3	FIX_CS	003	-.26	075.00	12.50	16.67	1.12E+00	.40
DLCMED3	SMP23_CS	002	-.26	075.00	10.00	13.33	1.12E+00	.40
DLCMED3	INTFACG	006	-.18	075.00	07.50	10.00	1.12E+00	.40
DLCMED3	SMP12_CS	001	-.28	075.00	07.50	10.00	1.12E+00	.40

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
DLCMED4	SMP12_CS	001	-.69	085.28	36.76	43.11	2.34E+00	.68
DLCMED4	FIX_CS	002	-.47	085.28	16.18	18.97	2.34E+00	.68
DLCMED4	RUP_CS	003	.45	085.28	10.29	12.07	2.34E+00	.68
DLCMTH2	FFS_CS	002	.12	091.35	04.35	04.76	1.00E+00	.23
DLCMTH2	TPO51_CS	001	.13	091.35	04.35	04.76	1.00E+00	.23
DLCMTH2	TPO24_CS	003	-.11	091.35	00.00	00.00	1.00E+00	.23
DLCMTH3	FIX_CS	002	-.29	084.58	15.38	18.18	1.07E+00	.39
DLCMTH3	SMP12_CS	001	-.32	084.58	10.26	12.13	1.07E+00	.39
DLCMTH3	RUG_CS	003	.23	084.58	05.13	06.07	1.07E+00	.39
DLCMTH4	SMP12_CS	001	-.69	084.89	39.39	46.40	1.82E+00	.66
DLCMTH4	FIX_CS	002	-.44	084.89	15.15	17.85	1.82E+00	.66
DLCMTH4	RUP_CS	003	.41	084.89	09.09	10.71	1.82E+00	.66
DLLVBM2	FMDC_CS	001	.93	107.62	64.13	59.59	3.47E+01	.92
DLLVBM2	RTHS	003	.70	107.62	10.87	10.10	3.47E+01	.92
DLLVBM2	INTFACP	002	.71	107.62	09.78	09.09	3.47E+01	.92
DLLVBM3	FMDC_CS	001	.93	107.62	64.13	59.59	3.55E+01	.92
DLLVBM3	RTHS	003	.70	107.62	10.87	10.10	3.55E+01	.92
DLLVBM3	INTFACP	002	.71	107.62	09.78	09.09	3.55E+01	.92
DLLVBM4	FMDC_CS	001	.93	106.53	64.13	60.20	3.16E+01	.92
DLLVBM4	RTHS	002	.70	106.53	10.87	10.20	3.16E+01	.92
DLLVBM4	INTFACP	003	.70	106.53	09.78	09.18	3.16E+01	.92
DLLVED2	FMDC_CS	002	.78	113.64	34.09	30.00	3.47E+01	.88
DLLVED2	FMDC_I	003	.77	113.64	32.95	29.00	3.47E+01	.88
DLLVED2	INTFACP	001	.80	113.64	26.14	23.00	3.47E+01	.88
DLLVED3	FMDC_CS	002	.78	111.37	34.09	30.61	3.24E+01	.88
DLLVED3	FMDC_I	003	.77	111.37	31.82	28.57	3.24E+01	.88
DLLVED3	INTFACP	001	.80	111.37	26.14	23.47	3.24E+01	.88
DLLVED4	FMDC_CS	001	.85	112.36	46.07	41.00	2.45E+01	.89
DLLVED4	FMDC_I	003	.67	112.36	22.47	20.00	2.45E+01	.89
DLLVED4	INTFACP	002	.78	112.36	21.35	19.00	2.45E+01	.89
DLLVTH2	FMDC_I	001	.88	103.43	56.82	54.94	1.66E+02	.88
DLLVTH2	INTFACP	002	.82	103.43	30.68	29.66	1.66E+02	.88
DLLVTH2	RTHS	003	.44	103.43	04.55	04.40	1.66E+02	.88
DLLVTH3	FMDC_I	001	.88	103.43	55.68	53.83	1.58E+02	.88
DLLVTH3	INTFACP	002	.82	103.43	30.68	29.66	1.58E+02	.88
DLLVTH3	RTHS	003	.45	103.43	04.55	04.40	1.58E+02	.88
DLLVTH4	FMDC_I	001	.88	104.56	54.55	52.17	1.07E+02	.88
DLLVTH4	INTFACP	002	.82	104.56	30.68	29.34	1.07E+02	.88
DLLVTH4	RTHS	003	.46	104.56	05.68	05.43	1.07E+02	.88
PLCMBM	FMDC_CS	001	.80	094.12	34.12	36.25	6.46E+00	.85
PLCMBM	RUP_CS	002	.74	094.12	18.82	20.00	6.46E+00	.85
PLCMBM	SMP12_CS	003	-.68	094.12	11.76	12.49	6.46E+00	.85
PLCMBM	RESUSP	004	.57	094.12	09.41	10.00	6.46E+00	.85
PLCMMT	FMDC_CS	001	.80	094.12	34.12	36.25	6.46E+00	.85
PLCMMT	RUP_CS	002	.74	094.12	18.82	20.00	6.46E+00	.85
PLCMMT	SMP12_CS	003	-.67	094.12	11.76	12.49	6.46E+00	.85
PLCMMT	RESUSP	004	.57	094.12	09.41	10.00	6.46E+00	.85
PLCMTH	FMDC_CS	001	.79	095.32	32.94	34.56	4.90E+00	.85
PLCMTH	RUP_CS	002	.73	095.32	17.65	18.52	4.90E+00	.85
PLCMTH	SMP12_CS	003	-.69	095.32	12.94	13.58	4.90E+00	.85
PLLVBM	FMDC_CS	001	.93	107.62	64.13	59.59	3.55E+01	.92
PLLVBM	RTHS	003	.70	107.62	10.87	10.10	3.55E+01	.92
PLLVBM	INTFACP	002	.70	107.62	09.78	09.09	3.55E+01	.92
PLLVMT	FMDC_CS	001	.87	113.47	50.56	44.56	2.51E+01	.89
PLLVMT	INTFACP	002	.77	113.47	20.22	17.82	2.51E+01	.89
PLLVMT	FMDC_I	003	.60	113.47	17.98	15.85	2.51E+01	.89
PLLVTH	FMDC_I	001	.88	105.70	55.68	52.68	1.26E+02	.88
PLLVTH	INTFACP	002	.83	105.70	31.82	30.10	1.26E+02	.88
PLLVTH	RTHS	003	.46	105.70	04.55	04.30	1.26E+02	.88
RLCMBM2	DT-SHP	005	.13	087.00	08.70	10.00	1.05E+00	.23
RLCMBM2	INTFACC	001	.16	087.00	08.70	10.00	1.05E+00	.23
RLCMBM2	PLOSSC	002	.15	087.00	08.70	10.00	1.05E+00	.23
RLCMBM2	SMP45_CS	007	-.11	087.00	08.70	10.00	1.05E+00	.23
RLCMBM2	SOLCONG	004	-.13	087.00	08.70	10.00	1.05E+00	.23
RLCMBM2	INTFACHS	003	.13	087.00	04.35	05.00	1.05E+00	.23
RLCMBM3	SMP12_CS	001	-.34	082.00	17.95	21.89	1.12E+00	.39
RLCMBM3	FIX_CS	002	-.26	082.00	12.82	15.63	1.12E+00	.39
RLCMBM3	SMP23_CS	003	-.25	082.00	07.69	09.38	1.12E+00	.39

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
RLCMBM4	SMP12_CS	001	-.69	085.28	36.76	43.11	2.29E+00	.68
RLCMBM4	FIX_CS	002	-.47	085.28	16.18	18.97	2.29E+00	.68
RLCMBM4	RUP_CS	003	.46	085.28	10.29	12.07	2.29E+00	.68
RLCMMT2	BIODC_I	002	-.16	092.00	08.00	08.70	1.02E+00	.25
RLCMMT2	INTFACC	001	.19	092.00	08.00	08.70	1.02E+00	.25
RLCMMT2	RESUSP	003	-.16	092.00	08.00	08.70	1.02E+00	.25
RLCMMT3	FIX_CS	001	-.28	084.56	15.38	18.19	1.10E+00	.39
RLCMMT3	INTFACG	004	-.20	084.56	10.26	12.13	1.10E+00	.39
RLCMMT3	SMP12_CS	002	-.25	084.56	07.69	09.09	1.10E+00	.39
RLCMMT3	SMP23_CS	003	-.24	084.56	07.69	09.09	1.10E+00	.39
RLCMMT4	SMP12_CS	001	-.69	085.28	36.76	43.11	2.34E+00	.68
RLCMMT4	FIX_CS	002	-.47	085.28	16.18	18.97	2.34E+00	.68
RLCMMT4	RUP_CS	003	.46	085.28	10.29	12.07	2.34E+00	.68
RLCMTH2	DIHSDC	001	-.15	092.82	07.14	07.69	1.00E+00	.28
RLCMTH2	FFP_I	003	-.13	092.82	03.57	03.85	1.00E+00	.28
RLCMTH2	RTG	002	-.14	092.82	03.57	03.85	1.00E+00	.28
RLCMTH3	FIX_CS	003	-.28	076.88	15.38	20.01	1.10E+00	.39
RLCMTH3	SMP23_CS	002	-.29	076.88	12.82	16.68	1.10E+00	.39
RLCMTH3	FMDC_CS	005	-.19	076.88	07.69	10.00	1.10E+00	.39
RLCMTH3	SMC11_CS	004	-.19	076.88	07.69	10.00	1.10E+00	.39
RLCMTH3	SMP12_CS	001	-.29	076.88	07.69	10.00	1.10E+00	.39
RLCMTH4	SMP12_CS	001	-.69	083.37	39.39	47.25	1.78E+00	.66
RLCMTH4	FIX_CS	002	-.44	083.37	15.15	18.17	1.78E+00	.66
RLCMTH4	RUP_CS	003	.40	083.37	07.58	09.09	1.78E+00	.66
RLLVBM2	FMDC_CS	001	.93	107.62	64.13	59.59	3.47E+01	.92
RLLVBM2	RTHS	003	.70	107.62	10.87	10.10	3.47E+01	.92
RLLVBM2	INTFACP	002	.71	107.62	09.78	09.09	3.47E+01	.92
RLLVBM3	FMDC_CS	001	.93	108.71	64.13	58.99	3.47E+01	.92
RLLVBM3	RTHS	003	.70	108.71	11.96	11.00	3.47E+01	.92
RLLVBM3	INTFACP	002	.71	108.71	09.78	09.00	3.47E+01	.92
RLLVBM4	FMDC_CS	001	.93	105.44	64.13	60.82	3.16E+01	.92
RLLVBM4	RTHS	003	.70	105.44	10.87	10.31	3.16E+01	.92
RLLVBM4	INTFACP	002	.70	105.44	09.78	09.28	3.16E+01	.92
RLLVMT2	FMDC_I	002	.75	115.10	33.72	29.30	1.00E+01	.86
RLLVMT2	FMDC_CS	003	.73	115.10	31.40	27.28	1.00E+01	.86
RLLVMT2	INTFACP	001	.78	115.10	26.74	23.23	1.00E+01	.86
RLLVMT3	FMDC_CS	001	.81	114.78	39.77	34.65	2.88E+01	.88
RLLVMT3	FMDC_I	003	.73	114.78	28.41	24.75	2.88E+01	.88
RLLVMT3	INTFACP	002	.79	114.78	25.00	21.78	2.88E+01	.88
RLLVMT4	FMDC_CS	001	.87	111.11	50.00	45.00	2.45E+01	.90
RLLVMT4	FMDC_I	003	.62	111.11	18.89	17.00	2.45E+01	.90
RLLVMT4	INTFACP	002	.77	111.11	18.89	17.00	2.45E+01	.90
RLLVTH2	FMDC_I	001	.88	103.45	56.32	54.44	9.77E+01	.87
RLLVTH2	INTFACP	002	.82	103.45	31.03	30.00	9.77E+01	.87
RLLVTH2	RTHS	003	.44	103.45	04.60	04.45	9.77E+01	.87
RLLVTH3	FMDC_I	001	.88	103.43	55.68	53.83	1.58E+02	.88
RLLVTH3	INTFACP	002	.82	103.43	30.68	29.66	1.58E+02	.88
RLLVTH3	RTHS	003	.45	103.43	04.55	04.40	1.58E+02	.88
RLLVTH4	FMDC_I	001	.88	104.56	54.55	52.17	1.07E+02	.88
RLLVTH4	INTFACP	002	.82	104.56	30.68	29.34	1.07E+02	.88
RLLVTH4	RTHS	003	.46	104.56	05.68	05.43	1.07E+02	.88

RESULTS FOR THE MEAN VALUE OF THE ENDPOINTS FOR THE DBA SOURCE TERM

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
AFBIBEE	INTFACP	001	.92	101.06	42.55	42.10	4.47E+02	.94
AFBIBEE	FLDC_AG	002	.89	101.06	27.66	27.37	4.47E+02	.94
AFBIBEE	RTHS	003	.75	101.06	10.64	10.53	4.47E+02	.94
AFBIGRA	RTC_CS	001	.70	125.00	35.00	28.00	9.99E+99	.80
AFBIGRA	INTFACC	002	-.68	125.00	33.75	27.00	9.99E+99	.80
AFBIGRA	PLOSSC	003	-.45	125.00	08.75	07.00	9.99E+99	.80
AFBIMIL	FMDC_I	001	.89	103.30	40.22	38.94	5.82E+02	.92
AFBIMIL	INTFACP	002	.89	103.30	35.87	34.72	5.82E+02	.92
AFBIMIL	RTHS	003	.69	103.30	09.78	09.47	5.82E+02	.92
AFBIVEG	SOLCONG	045	.00	155.00	100.00	64.52	7.37E+01	1.00
AFBIVEG	SOLCONC	114	.00	155.00	19.00	12.26	7.37E+01	1.00
AFBIVEG	SOLCONPO	036	.00	155.00	19.00	12.26	7.37E+01	1.00
AFBIVEG	SOLCONHS	070	.00	155.00	17.00	10.97	7.37E+01	1.00
AFBIVEG	FFBC_SR	002	.00	155.00	00.00	00.00	7.37E+01	1.00
AFBIVEG	FMDC_CS	003	.00	155.00	00.00	00.00	7.37E+01	1.00
AFBIVEG	RUG_CS	001	.00	155.00	00.00	00.00	7.37E+01	1.00
AFBTBEE	FLDC_AG	001	.90	103.27	35.48	34.36	3.09E+02	.93
AFBTBEE	INTFACP	002	.84	103.27	24.73	23.95	3.09E+02	.93
AFBTBEE	RTHS	003	.81	103.27	18.28	17.70	3.09E+02	.93
AFBTGRA	INTFACC	002	-.68	126.25	35.00	27.72	9.99E+99	.80
AFBTGRA	RTC_CS	001	.70	126.25	35.00	27.72	9.99E+99	.80
AFBTGRA	PLOSSC	003	-.46	126.25	08.75	06.93	9.99E+99	.80
AFBTMIL	FMDC_I	001	.87	105.46	36.96	35.05	1.83E+02	.92
AFBTMIL	INTFACP	002	.86	105.46	31.52	29.89	1.83E+02	.92
AFBTMIL	RTHS	003	.72	105.46	13.04	12.36	1.83E+02	.92
AFBTVEG	SOLCONG	001	1.0	155.00	100.00	64.52	7.42E+01	1.00
AFBTVEG	SOLCONC	056	.07	155.00	19.00	12.26	7.42E+01	1.00
AFBTVEG	SOLCONPO	139	-.02	155.00	19.00	12.26	7.42E+01	1.00
AFBTVEG	SOLCONHS	154	-.01	155.00	17.00	10.97	7.42E+01	1.00
AFBTVEG	INTFACC	002	-.44	155.00	00.00	00.00	7.42E+01	1.00
AFBTVEG	PLOSSG	003	.31	155.00	00.00	00.00	7.42E+01	1.00
CDCMBM	FMDC_CS	001	.95	101.04	58.51	57.91	1.82E+01	.94
CDCMBM	RTHS	002	.76	101.04	10.64	10.53	1.82E+01	.94
CDCMBM	RUP_CS	003	.72	101.04	05.32	05.27	1.82E+01	.94
CDCMED	FMDC_CS	001	.92	111.88	51.61	46.13	1.16E+01	.93
CDCMED	FMDC_I	003	.66	111.88	16.13	14.42	1.16E+01	.93
CDCMED	INTFACP	002	.78	111.88	12.90	11.53	1.16E+01	.93
CDCMTH	FMDC_I	001	.92	101.09	54.35	53.76	2.16E+01	.92
CDCMTH	INTFACP	002	.86	101.09	27.17	26.88	2.16E+01	.92
CDCMTH	DIPDC	003	.46	101.09	02.17	02.15	2.16E+01	.92
DLCMBM2	FMDC_CS	001	.92	098.98	52.69	53.23	1.10E+01	.93
DLCMBM2	RUP_CS	002	.79	098.98	11.83	11.95	1.10E+01	.93
DLCMBM2	RESUSP	003	.66	098.98	06.45	06.52	1.10E+01	.93
DLCMBM3	FMDC_CS	001	.94	103.15	58.51	56.72	1.72E+01	.94
DLCMBM3	RTHS	002	.75	103.15	09.57	09.28	1.72E+01	.94
DLCMBM3	RUP_CS	003	.73	103.15	05.32	05.16	1.72E+01	.94
DLCMBM4	FMDC_CS	001	.95	103.17	58.51	56.71	2.08E+01	.94
DLCMBM4	RTHS	002	.78	103.17	11.70	11.34	2.08E+01	.94
DLCMBM4	INTFACP	003	.69	103.17	06.38	06.18	2.08E+01	.94
DLCMED2	FMDC_CS	001	.92	101.13	54.84	54.23	8.63E+00	.93
DLCMED2	RUP_CS	002	.79	101.13	10.75	10.63	8.63E+00	.93
DLCMED2	RESUSP	003	.66	101.13	06.45	06.38	8.63E+00	.93
DLCMED3	FMDC_CS	001	.92	107.56	55.91	51.98	9.46E+00	.93
DLCMED3	INTFACP	002	.70	107.56	08.60	08.00	9.46E+00	.93
DLCMED3	RUP_CS	003	.66	107.56	04.30	04.00	9.46E+00	.93
DLCMED4	FMDC_CS	001	.90	109.54	43.62	39.82	1.49E+01	.94
DLCMED4	FMDC_I	003	.76	109.54	21.28	19.43	1.49E+01	.94
DLCMED4	INTFACP	002	.83	109.54	17.02	15.54	1.49E+01	.94
DLCMTH2	FMDC_I	001	.74	102.31	33.72	32.96	4.32E+00	.86
DLCMTH2	FMDC_CS	002	.72	102.31	31.40	30.69	4.32E+00	.86
DLCMTH2	INTFACP	003	.63	102.31	11.63	11.37	4.32E+00	.86
DLCMTH3	FMDC_I	001	.88	098.85	50.56	51.15	1.13E+01	.89
DLCMTH3	INTFACP	002	.81	098.85	25.84	26.14	1.13E+01	.89
DLCMTH3	DIPDC	003	.43	098.85	02.25	02.28	1.13E+01	.89

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
DLCMTH4	FMDC_I	001	.93	097.88	54.84	56.03	4.34E+01	.93
DLCMTH4	INTFACP	002	.87	097.88	26.88	27.46	4.34E+01	.93
DLCMTH4	RTHS	003	.48	097.88	03.23	03.30	4.34E+01	.93
DLOUBM2	FMDC_CS	001	.94	104.20	55.79	53.54	9.31E+00	.95
DLOUBM2	RTHS	003	.79	104.20	12.63	12.12	9.31E+00	.95
DLOUBM2	INTFACP	002	.79	104.20	11.58	11.11	9.31E+00	.95
DLOUBM3	FMDC_CS	001	.94	104.24	56.38	54.09	9.35E+00	.94
DLOUBM3	RTHS	003	.78	104.24	12.77	12.25	9.35E+00	.94
DLOUBM3	INTFACP	002	.79	104.24	10.64	10.21	9.35E+00	.94
DLOUBM4	FMDC_CS	001	.94	104.24	56.38	54.09	9.67E+00	.94
DLOUBM4	RTHS	002	.78	104.24	12.77	12.25	9.67E+00	.94
DLOUBM4	INTFACP	003	.78	104.24	10.64	10.21	9.67E+00	.94
DLOUED2	FMDC_I	001	.90	106.50	41.94	39.38	2.27E+01	.93
DLOUED2	INTFACP	002	.89	106.50	30.11	28.27	2.27E+01	.93
DLOUED2	FMDC_CS	003	.68	106.50	16.13	15.15	2.27E+01	.93
DLOUED3	FMDC_I	001	.89	106.48	39.78	37.36	1.99E+01	.93
DLOUED3	INTFACP	002	.88	106.48	29.03	27.26	1.99E+01	.93
DLOUED3	FMDC_CS	003	.73	106.48	19.35	18.17	1.99E+01	.93
DLOUED4	FMDC_I	002	.85	106.37	30.85	29.00	1.38E+01	.94
DLOUED4	FMDC_CS	003	.84	106.37	28.72	27.00	1.38E+01	.94
DLOUED4	INTFACP	001	.88	106.37	26.60	25.01	1.38E+01	.94
DLOUTH2	FMDC_I	001	.93	097.88	53.76	54.92	1.73E+02	.93
DLOUTH2	INTFACP	002	.88	097.88	27.96	28.57	1.73E+02	.93
DLOUTH2	RTHS	003	.53	097.88	04.30	04.39	1.73E+02	.93
DLOUTH3	FMDC_I	001	.93	098.96	53.76	54.32	1.55E+02	.93
DLOUTH3	INTFACP	002	.88	098.96	27.96	28.25	1.55E+02	.93
DLOUTH3	RTHS	003	.54	098.96	04.30	04.35	1.55E+02	.93
DLOUTH4	FMDC_I	001	.92	101.11	52.69	52.11	9.84E+01	.93
DLOUTH4	INTFACP	002	.88	101.11	29.03	28.71	9.84E+01	.93
DLOUTH4	RTHS	003	.56	101.11	04.30	04.25	9.84E+01	.93
PLCMBM	FMDC_CS	001	.95	101.04	58.51	57.91	1.82E+01	.94
PLCMBM	RTHS	002	.76	101.04	10.64	10.53	1.82E+01	.94
PLCMBM	RUP_CS	003	.72	101.04	05.32	05.27	1.82E+01	.94
PLCMMT	FMDC_CS	001	.93	108.50	54.26	50.01	1.20E+01	.94
PLCMMT	FMDC_I	006	.58	108.50	12.77	11.77	1.20E+01	.94
PLCMMT	INTFACP	002	.77	108.50	10.64	09.81	1.20E+01	.94
PLCMMT	RTHS	003	.68	108.50	07.45	06.87	1.20E+01	.94
PLCMTH	FMDC_I	001	.92	101.09	54.35	53.76	2.16E+01	.92
PLCMTH	INTFACP	002	.86	101.09	27.17	26.88	2.16E+01	.92
PLCMTH	DIPDC	003	.46	101.09	02.17	02.15	2.16E+01	.92
RLCMBM2	FMDC_CS	001	.92	098.98	52.69	53.23	1.10E+01	.93
RLCMBM2	RUP_CS	002	.79	098.98	11.83	11.95	1.10E+01	.93
RLCMBM2	RESUSP	003	.66	098.98	06.45	06.52	1.10E+01	.93
RLCMBM3	FMDC_CS	001	.94	103.15	58.51	56.72	1.72E+01	.94
RLCMBM3	RTHS	002	.75	103.15	09.57	09.28	1.72E+01	.94
RLCMBM3	RUP_CS	003	.73	103.15	05.32	05.16	1.72E+01	.94
RLCMBM4	FMDC_CS	001	.95	103.17	58.51	56.71	2.08E+01	.94
RLCMBM4	RTHS	002	.78	103.17	11.70	11.34	2.08E+01	.94
RLCMBM4	INTFACP	003	.69	103.17	06.38	06.18	2.08E+01	.94
RLCMMT2	FMDC_CS	001	.92	101.12	53.76	53.16	9.19E+00	.93
RLCMMT2	RUP_CS	002	.79	101.12	11.83	11.70	9.19E+00	.93
RLCMMT2	RESUSP	003	.66	101.12	06.45	06.38	9.19E+00	.93
RLCMMT3	FMDC_CS	001	.93	107.57	58.06	53.97	1.04E+01	.93
RLCMMT3	INTFACP	003	.68	107.57	07.53	07.00	1.04E+01	.93
RLCMMT3	RUP_CS	002	.68	107.57	05.38	05.00	1.04E+01	.93
RLCMMT4	FMDC_CS	001	.92	110.61	48.94	44.25	1.53E+01	.94
RLCMMT4	FMDC_I	004	.70	110.61	17.02	15.39	1.53E+01	.94
RLCMMT4	INTFACP	002	.82	110.61	14.89	13.46	1.53E+01	.94
RLCMMT4	RTHS	003	.71	110.61	08.51	07.69	1.53E+01	.94
RLCMTH2	FMDC_I	001	.74	102.31	33.72	32.96	4.32E+00	.86
RLCMTH2	FMDC_CS	002	.72	102.31	31.40	30.69	4.32E+00	.86
RLCMTH2	INTFACP	003	.63	102.31	11.63	11.37	4.32E+00	.86
RLCMTH3	FMDC_I	001	.88	098.85	50.56	51.15	1.13E+01	.89
RLCMTH3	INTFACP	002	.81	098.85	25.84	26.14	1.13E+01	.89
RLCMTH3	DIPDC	003	.43	098.85	02.25	02.28	1.13E+01	.89

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
RLCMTH4	FMDC_I	001	.93	097.88	54.84	56.03	4.34E+01	.93
RLCMTH4	INTFACP	002	.87	097.88	26.88	27.46	4.34E+01	.93
RLCMTH4	RTHS	003	.48	097.88	03.23	03.30	4.34E+01	.93
RLOUBM2	FMDC_CS	001	.94	104.20	55.79	53.54	9.31E+00	.95
RLOUBM2	RTHS	003	.79	104.20	12.63	12.12	9.31E+00	.95
RLOUBM2	INTFACP	002	.79	104.20	11.58	11.11	9.31E+00	.95
RLOUBM3	FMDC_CS	001	.94	104.24	56.38	54.09	9.35E+00	.94
RLOUBM3	RTHS	003	.78	104.24	12.77	12.25	9.35E+00	.94
RLOUBM3	INTFACP	002	.79	104.24	10.64	10.21	9.35E+00	.94
RLOUBM4	FMDC_CS	001	.94	104.24	56.38	54.09	9.67E+00	.94
RLOUBM4	RTHS	002	.78	104.24	12.77	12.25	9.67E+00	.94
RLOUBM4	INTFACP	003	.78	104.24	10.64	10.21	9.67E+00	.94
RLOUMT2	FMDC_I	001	.88	107.56	38.71	35.99	1.89E+01	.93
RLOUMT2	INTFACP	002	.88	107.56	29.03	26.99	1.89E+01	.93
RLOUMT2	FMDC_CS	003	.74	107.56	20.43	18.99	1.89E+01	.93
RLOUMT3	FMDC_I	002	.87	106.49	35.48	33.32	1.72E+01	.93
RLOUMT3	INTFACP	001	.88	106.49	27.96	26.26	1.72E+01	.93
RLOUMT3	FMDC_CS	003	.78	106.49	23.66	22.22	1.72E+01	.93
RLOUMT4	FMDC_CS	002	.86	107.44	32.98	30.70	1.22E+01	.94
RLOUMT4	FMDC_I	003	.82	107.44	26.60	24.76	1.22E+01	.94
RLOUMT4	INTFACP	001	.87	107.44	24.47	22.78	1.22E+01	.94
RLOUTH2	FMDC_I	001	.93	097.88	53.76	54.92	1.73E+02	.93
RLOUTH2	INTFACP	002	.88	097.88	27.96	28.57	1.73E+02	.93
RLOUTH2	RTHS	003	.53	097.88	04.30	04.39	1.73E+02	.93
RLOUTH3	FMDC_I	001	.93	098.96	53.76	54.32	1.55E+02	.93
RLOUTH3	INTFACP	002	.88	098.96	27.96	28.25	1.55E+02	.93
RLOUTH3	RTHS	003	.54	098.96	04.30	04.35	1.55E+02	.93
RLOUTH4	FMDC_I	001	.92	101.11	52.69	52.11	9.84E+01	.93
RLOUTH4	INTFACP	002	.88	101.11	29.03	28.71	9.84E+01	.93
RLOUTH4	RTHS	003	.56	101.11	04.30	04.25	9.84E+01	.93

RESULTS FOR THE 95TH PERCENTILE OF THE ENDPOINTS FOR THE DBA SOURCE TERM

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
AFBIBEE	INTFACP	001	.92	101.06	42.55	42.10	3.89E+02	.94
AFBIBEE	FLDC_AG	002	.89	101.06	27.66	27.37	3.89E+02	.94
AFBIBEE	RTHS	003	.75	101.06	10.64	10.53	3.89E+02	.94
AFBIGRA	INTFACC	001	-.66	117.15	38.16	32.57	9.99E+99	.76
AFBIGRA	RTC_CS	002	.63	117.15	30.26	25.83	9.99E+99	.76
AFBIGRA	PLOSSC	003	-.42	117.15	09.21	07.86	9.99E+99	.76
AFBIMIL	INTFACP	001	.89	102.21	38.04	37.22	5.13E+02	.92
AFBIMIL	FMDC_I	002	.88	102.21	36.96	36.16	5.13E+02	.92
AFBIMIL	RTHS	003	.69	102.21	09.78	09.57	5.13E+02	.92
AFBIVEG	SOLCONG	001	1.0	155.00	100.00	64.52	6.17E+01	1.00
AFBIVEG	SOLCONC	110	-.03	155.00	19.00	12.26	6.17E+01	1.00
AFBIVEG	SOLCONPO	034	.10	155.00	19.00	12.26	6.17E+01	1.00
AFBIVEG	SOLCONHS	062	.07	155.00	17.00	10.97	6.17E+01	1.00
AFBIVEG	DIHSDC	002	-.24	155.00	00.00	00.00	6.17E+01	1.00
AFBIVEG	FFDC_ZN	003	-.20	155.00	00.00	00.00	6.17E+01	1.00
AFBTBEE	FLDC_AG	001	.90	102.20	35.87	35.10	2.40E+02	.92
AFBTBEE	INTFACP	002	.83	102.20	22.83	22.34	2.40E+02	.92
AFBTBEE	RTHS	003	.81	102.20	18.48	18.08	2.40E+02	.92
AFBTGRA	INTFACC	001	-.69	112.80	39.74	35.23	9.99E+99	.78
AFBTGRA	RTC_CS	002	.66	112.80	30.77	27.28	9.99E+99	.78
AFBTGRA	PLOSSC	003	-.41	112.80	07.69	06.82	9.99E+99	.78
AFBTMIL	FMDC_I	002	.85	104.41	35.16	33.67	1.32E+02	.91
AFBTMIL	INTFACP	001	.85	104.41	31.87	30.52	1.32E+02	.91
AFBTMIL	RTHS	003	.71	104.41	13.19	12.63	1.32E+02	.91
AFBTVEG	SOLCONG	001	1.0	155.00	100.00	64.52	6.17E+01	1.00
AFBTVEG	SOLCONC	054	.08	155.00	19.00	12.26	6.17E+01	1.00
AFBTVEG	SOLCONPO	072	.07	155.00	19.00	12.26	6.17E+01	1.00
AFBTVEG	SOLCONHS	106	.04	155.00	17.00	10.97	6.17E+01	1.00
AFBTVEG	INTFACC	002	-.23	155.00	00.00	00.00	6.17E+01	1.00
AFBTVEG	SMP43_CS	003	.23	155.00	00.00	00.00	6.17E+01	1.00
CDCMBM	FMDC_CS	001	.95	103.17	59.57	57.74	2.04E+01	.94
CDCMBM	RTHS	002	.76	103.17	10.64	10.31	2.04E+01	.94
CDCMBM	RUP_CS	003	.69	103.17	04.26	04.13	2.04E+01	.94
CDCMED	FMDC_CS	001	.92	110.61	50.00	45.20	1.23E+01	.94
CDCMED	FMDC_I	003	.69	110.61	17.02	15.39	1.23E+01	.94
CDCMED	INTFACP	002	.80	110.61	13.83	12.50	1.23E+01	.94
CDCMTH	FMDC_I	001	.92	100.01	54.35	54.34	2.57E+01	.92
CDCMTH	INTFACP	002	.86	100.01	27.17	27.17	2.57E+01	.92
CDCMTH	DIPDC	003	.44	100.01	01.09	01.09	2.57E+01	.92
DLCMBM2	FMDC_CS	001	.94	102.09	56.38	55.23	1.38E+01	.94
DLCMBM2	RTHS	003	.75	102.09	09.57	09.37	1.38E+01	.94
DLCMBM2	RUP_CS	002	.77	102.09	08.51	08.34	1.38E+01	.94
DLCMBM3	FMDC_CS	001	.94	105.31	58.51	55.56	1.66E+01	.94
DLCMBM3	RTHS	002	.76	105.31	10.64	10.10	1.66E+01	.94
DLCMBM3	INTFACP	003	.71	105.31	07.45	07.07	1.66E+01	.94
DLCMBM4	FMDC_CS	001	.94	106.37	57.45	54.01	1.82E+01	.94
DLCMBM4	RTHS	002	.78	106.37	11.70	11.00	1.82E+01	.94
DLCMBM4	INTFACP	003	.77	106.37	09.57	09.00	1.82E+01	.94
DLCMED2	FMDC_CS	001	.92	106.55	58.70	55.09	7.08E+00	.92
DLCMED2	INTFACHS	003	.58	106.55	08.70	08.17	7.08E+00	.92
DLCMED2	RUP_CS	002	.67	106.55	06.52	06.12	7.08E+00	.92
DLCMED3	FMDC_CS	001	.89	110.79	45.16	40.76	1.20E+01	.93
DLCMED3	FMDC_I	003	.69	110.79	19.35	17.47	1.20E+01	.93
DLCMED3	INTFACP	002	.82	110.79	18.28	16.50	1.20E+01	.93
DLCMED4	FMDC_CS	002	.87	110.61	34.04	30.77	1.78E+01	.94
DLCMED4	FMDC_I	003	.84	110.61	27.66	25.01	1.78E+01	.94
DLCMED4	INTFACP	001	.87	110.61	23.40	21.16	1.78E+01	.94
DLCMTH2	FMDC_I	001	.72	102.38	30.59	29.88	5.50E+00	.85
DLCMTH2	FMDC_CS	002	.69	102.38	29.41	28.73	5.50E+00	.85
DLCMTH2	INTFACP	003	.67	102.38	15.29	14.93	5.50E+00	.85
DLCMTH3	FMDC_I	001	.89	098.91	49.45	49.99	2.29E+01	.91
DLCMTH3	INTFACP	002	.84	098.91	27.47	27.77	2.29E+01	.91
DLCMTH3	RTHS	003	.51	098.91	04.40	04.45	2.29E+01	.91
DLCMTH4	FMDC_I	001	.92	103.26	51.61	49.98	6.61E+01	.93
DLCMTH4	INTFACP	002	.89	103.26	30.11	29.16	6.61E+01	.93

DLCMTH4	RTHS	003	.60	103.26	05.38	05.21	6.61E+01	.93

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
DLOUBM2	FMDC_CS	001	.94	105.30	56.38	53.54	6.31E+00	.94
DLOUBM2	RTHS	003	.78	105.30	11.70	11.11	6.31E+00	.94
DLOUBM2	INTFACP	002	.78	105.30	10.64	10.10	6.31E+00	.94
DLOUBM3	FMDC_CS	001	.94	103.17	56.38	54.65	7.76E+00	.94
DLOUBM3	RTHS	003	.78	103.17	11.70	11.34	7.76E+00	.94
DLOUBM3	INTFACP	002	.79	103.17	10.64	10.31	7.76E+00	.94
DLOUBM4	FMDC_CS	001	.94	106.31	56.84	53.47	7.24E+00	.95
DLOUBM4	RTHS	003	.78	106.31	11.58	10.89	7.24E+00	.95
DLOUBM4	INTFACP	002	.78	106.31	10.53	09.90	7.24E+00	.95
DLOUED2	FMDC_I	001	.90	107.56	44.09	40.99	1.58E+01	.93
DLOUED2	INTFACP	002	.88	107.56	29.03	26.99	1.58E+01	.93
DLOUED2	FMDC_CS	003	.65	107.56	15.05	13.99	1.58E+01	.93
DLOUED3	FMDC_I	001	.88	104.34	38.71	37.10	1.45E+01	.93
DLOUED3	INTFACP	002	.88	104.34	27.96	26.80	1.45E+01	.93
DLOUED3	FMDC_CS	003	.74	104.34	20.43	19.58	1.45E+01	.93
DLOUED4	FMDC_I	002	.85	109.56	30.85	28.16	9.55E+00	.94
DLOUED4	FMDC_CS	003	.85	109.56	29.79	27.19	9.55E+00	.94
DLOUED4	INTFACP	001	.88	109.56	25.53	23.30	9.55E+00	.94
DLOUTH2	FMDC_I	001	.92	097.88	53.76	54.92	1.07E+02	.93
DLOUTH2	INTFACP	002	.87	097.88	27.96	28.57	1.07E+02	.93
DLOUTH2	RTHS	003	.53	097.88	04.30	04.39	1.07E+02	.93
DLOUTH3	FMDC_I	001	.92	098.96	53.76	54.32	1.00E+02	.93
DLOUTH3	INTFACP	002	.87	098.96	27.96	28.25	1.00E+02	.93
DLOUTH3	RTHS	003	.53	098.96	04.30	04.35	1.00E+02	.93
DLOUTH4	FMDC_I	001	.92	100.03	51.61	51.59	4.79E+01	.93
DLOUTH4	INTFACP	002	.88	100.03	29.03	29.02	4.79E+01	.93
DLOUTH4	RTHS	003	.58	100.03	05.38	05.38	4.79E+01	.93
PLCMBM	FMDC_CS	001	.95	103.17	59.57	57.74	2.04E+01	.94
PLCMBM	RTHS	002	.76	103.17	10.64	10.31	2.04E+01	.94
PLCMBM	RUP_CS	003	.68	103.17	04.26	04.13	2.04E+01	.94
PLCMMT	FMDC_CS	001	.93	109.54	53.19	48.56	1.32E+01	.94
PLCMMT	FMDC_I	005	.61	109.54	13.83	12.63	1.32E+01	.94
PLCMMT	INTFACP	002	.78	109.54	11.70	10.68	1.32E+01	.94
PLCMMT	RTHS	003	.69	109.54	08.51	07.77	1.32E+01	.94
PLCMTH	FMDC_I	001	.92	100.01	54.35	54.34	2.57E+01	.92
PLCMTH	INTFACP	002	.86	100.01	27.17	27.17	2.57E+01	.92
PLCMTH	DIPDC	003	.44	100.01	01.09	01.09	2.57E+01	.92
RLCMBM2	FMDC_CS	001	.94	103.15	56.38	54.66	1.38E+01	.94
RLCMBM2	RTHS	003	.75	103.15	09.57	09.28	1.38E+01	.94
RLCMBM2	RUP_CS	002	.77	103.15	08.51	08.25	1.38E+01	.94
RLCMBM3	FMDC_CS	001	.94	104.24	58.51	56.13	1.62E+01	.94
RLCMBM3	RTHS	002	.77	104.24	10.64	10.21	1.62E+01	.94
RLCMBM3	INTFACP	003	.70	104.24	07.45	07.15	1.62E+01	.94
RLCMBM4	FMDC_CS	001	.94	105.25	56.84	54.00	1.86E+01	.95
RLCMBM4	RTHS	002	.78	105.25	11.58	11.00	1.86E+01	.95
RLCMBM4	INTFACP	003	.77	105.25	09.47	09.00	1.86E+01	.95
RLCMMT2	FMDC_CS	001	.93	103.27	58.06	56.22	7.94E+00	.93
RLCMMT2	INTFACHS	003	.62	103.27	08.60	08.33	7.94E+00	.93
RLCMMT2	RUP_CS	002	.70	103.27	06.45	06.25	7.94E+00	.93
RLCMMT3	FMDC_CS	001	.90	111.88	48.39	43.25	1.17E+01	.93
RLCMMT3	FMDC_I	004	.63	111.88	16.13	14.42	1.17E+01	.93
RLCMMT3	INTFACP	002	.80	111.88	16.13	14.42	1.17E+01	.93
RLCMMT3	RTHS	003	.67	111.88	08.60	07.69	1.17E+01	.93
RLCMMT4	FMDC_CS	001	.89	111.68	38.30	34.29	1.58E+01	.94
RLCMMT4	FMDC_I	003	.81	111.68	24.47	21.91	1.58E+01	.94
RLCMMT4	INTFACP	002	.87	111.68	22.34	20.00	1.58E+01	.94
RLCMTH2	FMDC_I	001	.72	101.20	30.59	30.23	5.62E+00	.85
RLCMTH2	FMDC_CS	002	.69	101.20	29.41	29.06	5.62E+00	.85
RLCMTH2	INTFACP	003	.67	101.20	15.29	15.11	5.62E+00	.85
RLCMTH3	FMDC_I	001	.89	098.91	49.45	49.99	2.29E+01	.91
RLCMTH3	INTFACP	002	.84	098.91	27.47	27.77	2.29E+01	.91
RLCMTH3	RTHS	003	.51	098.91	04.40	04.45	2.29E+01	.91
RLCMTH4	FMDC_I	001	.92	103.26	51.61	49.98	6.61E+01	.93
RLCMTH4	INTFACP	002	.89	103.26	30.11	29.16	6.61E+01	.93
RLCMTH4	RTHS	003	.59	103.26	05.38	05.21	6.61E+01	.93

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
RLOUBM2	FMDC_CS	001	.94	105.30	56.38	53.54	6.31E+00	.94
RLOUBM2	RTHS	003	.78	105.30	11.70	11.11	6.31E+00	.94
RLOUBM2	INTFACP	002	.78	105.30	10.64	10.10	6.31E+00	.94
RLOUBM3	FMDC_CS	001	.94	102.10	55.79	54.64	7.76E+00	.95
RLOUBM3	RTHS	003	.78	102.10	12.63	12.37	7.76E+00	.95
RLOUBM3	INTFACP	002	.79	102.10	10.53	10.31	7.76E+00	.95
RLOUBM4	FMDC_CS	001	.90	102.20	57.30	56.07	9.99E+99	.89
RLOUBM4	RTHS	002	.66	102.20	12.36	12.09	9.99E+99	.89
RLOUBM4	INTFACP	003	.56	102.20	06.74	06.59	9.99E+99	.89
RLOUMT2	FMDC_I	001	.89	105.41	40.86	38.76	1.32E+01	.93
RLOUMT2	INTFACP	002	.88	105.41	27.96	26.52	1.32E+01	.93
RLOUMT2	FMDC_CS	003	.72	105.41	19.35	18.36	1.32E+01	.93
RLOUMT3	FMDC_I	002	.87	104.26	35.11	33.68	1.26E+01	.94
RLOUMT3	INTFACP	001	.88	104.26	26.60	25.51	1.26E+01	.94
RLOUMT3	FMDC_CS	003	.80	104.26	24.47	23.47	1.26E+01	.94
RLOUMT4	FMDC_CS	002	.87	109.55	34.04	31.07	8.32E+00	.94
RLOUMT4	FMDC_I	003	.83	109.55	27.66	25.25	8.32E+00	.94
RLOUMT4	INTFACP	001	.87	109.55	23.40	21.36	8.32E+00	.94
RLOUTH2	FMDC_I	001	.92	097.88	53.76	54.92	1.07E+02	.93
RLOUTH2	INTFACP	002	.87	097.88	27.96	28.57	1.07E+02	.93
RLOUTH2	RTHS	003	.53	097.88	04.30	04.39	1.07E+02	.93
RLOUTH3	FMDC_I	001	.92	097.88	53.76	54.92	1.00E+02	.93
RLOUTH3	INTFACP	002	.87	097.88	27.96	28.57	1.00E+02	.93
RLOUTH3	RTHS	003	.53	097.88	04.30	04.39	1.00E+02	.93
RLOUTH4	FMDC_I	001	.92	102.19	51.61	50.50	4.90E+01	.93
RLOUTH4	INTFACP	002	.88	102.19	29.03	28.41	4.90E+01	.93
RLOUTH4	RTHS	003	.58	102.19	04.30	04.21	4.90E+01	.93

RESULTS FOR THE 99TH PERCENTILE OF THE ENDPOINTS FOR THE DBA SOURCE TERM

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
AFBIBEE	INTFACP	001	.92	098.93	42.55	43.01	3.47E+02	.94
AFBIBEE	FLDC_AG	002	.89	098.93	27.66	27.96	3.47E+02	.94
AFBIBEE	RTHS	003	.75	098.93	09.57	09.67	3.47E+02	.94
AFBIGRA	INTFACC	001	-.69	111.71	38.96	34.88	9.99E+99	.77
AFBIGRA	RTC_CS	002	.65	111.71	29.87	26.74	9.99E+99	.77
AFBIGRA	PLOSSC	003	-.42	111.71	09.09	08.14	9.99E+99	.77
AFBIMIL	INTFACP	001	.89	106.55	40.22	37.75	2.69E+02	.92
AFBIMIL	FMDC_I	002	.86	106.55	33.70	31.63	2.69E+02	.92
AFBIMIL	RTHS	003	.69	106.55	10.87	10.20	2.69E+02	.92
AFBIVEG	SOLCONG	001	1.0	155.00	100.00	64.52	4.63E+01	1.00
AFBIVEG	SOLCONC	089	-.05	155.00	19.00	12.26	4.63E+01	1.00
AFBIVEG	SOLCONPO	074	-.07	155.00	19.00	12.26	4.63E+01	1.00
AFBIVEG	SOLCONHS	116	.03	155.00	17.00	10.97	4.63E+01	1.00
AFBIVEG	INTFACG	003	.20	155.00	00.00	00.00	4.63E+01	1.00
AFBIVEG	INTFACPO	002	-.23	155.00	00.00	00.00	4.63E+01	1.00
AFBTBEE	FLDC_AG	001	.90	104.38	36.96	35.41	2.19E+02	.92
AFBTBEE	INTFACP	003	.80	104.38	19.57	18.75	2.19E+02	.92
AFBTBEE	RTHS	002	.82	104.38	19.57	18.75	2.19E+02	.92
AFBTGRA	INTFACC	001	-.69	112.80	39.74	35.23	9.99E+99	.78
AFBTGRA	RTC_CS	002	.66	112.80	30.77	27.28	9.99E+99	.78
AFBTGRA	PLOSSC	003	-.41	112.80	07.69	06.82	9.99E+99	.78
AFBTMIL	FMDC_I	002	.83	107.75	33.33	30.93	1.05E+02	.90
AFBTMIL	INTFACP	001	.85	107.75	33.33	30.93	1.05E+02	.90
AFBTMIL	RTHS	003	.70	107.75	13.33	12.37	1.05E+02	.90
AFBTVEG	SOLCONG	001	1.0	155.00	100.00	64.52	4.65E+01	1.00
AFBTVEG	SOLCONC	087	.07	155.00	19.00	12.26	4.65E+01	1.00
AFBTVEG	SOLCONPO	052	-.10	155.00	19.00	12.26	4.65E+01	1.00
AFBTVEG	SOLCONHS	132	.02	155.00	17.00	10.97	4.65E+01	1.00
AFBTVEG	PLOSSG	002	.27	155.00	00.00	00.00	4.65E+01	1.00
AFBTVEG	TPO45_SR	003	.24	155.00	00.00	00.00	4.65E+01	1.00
CDCMBM	FMDC_CS	001	.94	099.98	58.51	58.52	1.91E+01	.94
CDCMBM	RTHS	002	.77	099.98	11.70	11.70	1.91E+01	.94
CDCMBM	RUP_CS	003	.66	099.98	03.19	03.19	1.91E+01	.94
CDCMED	FMDC_CS	001	.91	111.98	53.26	47.56	1.29E+01	.92
CDCMED	FMDC_I	004	.55	111.98	13.04	11.64	1.29E+01	.92
CDCMED	INTFACP	002	.75	111.98	13.04	11.64	1.29E+01	.92
CDCMED	RTHS	003	.64	111.98	07.61	06.80	1.29E+01	.92
CDCMTH	FMDC_I	001	.91	098.93	54.35	54.94	2.95E+01	.92
CDCMTH	INTFACP	002	.86	098.93	27.17	27.46	2.95E+01	.92
CDCMTH	DIPDC	003	.45	098.93	01.09	01.10	2.95E+01	.92
DLCMBM2	FMDC_CS	001	.89	096.72	48.35	49.99	1.35E+01	.91
DLCMBM2	RUP_CS	002	.76	096.72	12.09	12.50	1.35E+01	.91
DLCMBM2	RESUSP	003	.61	096.72	06.59	06.81	1.35E+01	.91
DLCMBM3	FMDC_CS	001	.94	103.16	57.45	55.69	2.00E+01	.94
DLCMBM3	INTFACHS	004	.71	103.16	10.64	10.31	2.00E+01	.94
DLCMBM3	RTHS	002	.76	103.16	10.64	10.31	2.00E+01	.94
DLCMBM3	RUP_CS	003	.71	103.16	05.32	05.16	2.00E+01	.94
DLCMBM4	FMDC_CS	001	.94	105.30	57.45	54.56	2.29E+01	.94
DLCMBM4	RTHS	002	.78	105.30	12.77	12.13	2.29E+01	.94
DLCMBM4	INTFACP	003	.75	105.30	09.57	09.09	2.29E+01	.94
DLCMED2	FMDC_CS	001	.90	096.72	50.55	52.26	1.23E+01	.91
DLCMED2	RUP_CS	002	.77	096.72	12.09	12.50	1.23E+01	.91
DLCMED2	RESUSP	003	.63	096.72	06.59	06.81	1.23E+01	.91
DLCMED3	FMDC_CS	001	.91	106.60	57.14	53.60	9.55E+00	.91
DLCMED3	INTFACHS	003	.58	106.60	09.89	09.28	9.55E+00	.91
DLCMED3	INTFACP	002	.59	106.60	06.59	06.18	9.55E+00	.91
DLCMED4	FMDC_CS	001	.87	107.41	35.11	32.69	1.78E+01	.94
DLCMED4	FMDC_I	003	.81	107.41	25.53	23.77	1.78E+01	.94
DLCMED4	INTFACP	002	.87	107.41	23.40	21.79	1.78E+01	.94
DLCMTH2	FMDC_CS	001	.68	089.93	32.91	36.60	4.17E+00	.79
DLCMTH2	FMDC_I	004	.44	089.93	13.92	15.48	4.17E+00	.79
DLCMTH2	RESUSP	003	.45	089.93	06.33	07.04	4.17E+00	.79
DLCMTH2	RUP_CS	002	.46	089.93	05.06	05.63	4.17E+00	.79
DLCMTH3	FMDC_I	001	.86	096.63	50.00	51.74	1.02E+01	.88
DLCMTH3	INTFACP	002	.77	096.63	22.73	23.52	1.02E+01	.88
DLCMTH3	DIPDC	003	.46	096.63	03.41	03.53	1.02E+01	.88

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
DLCMTH4	FMDC_I	001	.93	096.81	54.84	56.65	6.46E+01	.93
DLCMTH4	INTFACP	002	.88	096.81	27.96	28.88	6.46E+01	.93
DLCMTH4	RTHS	003	.50	096.81	03.23	03.34	6.46E+01	.93
DLOUBM2	FMDC_CS	001	.94	105.30	56.38	53.54	1.07E+01	.94
DLOUBM2	RTHS	003	.78	105.30	12.77	12.13	1.07E+01	.94
DLOUBM2	INTFACP	002	.79	105.30	11.70	11.11	1.07E+01	.94
DLOUBM3	FMDC_CS	001	.94	105.30	56.38	53.54	9.55E+00	.94
DLOUBM3	RTHS	003	.78	105.30	12.77	12.13	9.55E+00	.94
DLOUBM3	INTFACP	002	.79	105.30	11.70	11.11	9.55E+00	.94
DLOUBM4	FMDC_CS	001	.94	105.31	57.45	54.55	8.71E+00	.94
DLOUBM4	RTHS	002	.78	105.31	12.77	12.13	8.71E+00	.94
DLOUBM4	INTFACP	003	.78	105.31	10.64	10.10	8.71E+00	.94
DLOUED2	FMDC_I	001	.90	106.50	41.94	39.38	2.51E+01	.93
DLOUED2	INTFACP	002	.89	106.50	30.11	28.27	2.51E+01	.93
DLOUED2	FMDC_CS	003	.66	106.50	16.13	15.15	2.51E+01	.93
DLOUED3	FMDC_I	001	.90	107.58	41.94	38.98	2.45E+01	.93
DLOUED3	INTFACP	002	.88	107.58	30.11	27.99	2.45E+01	.93
DLOUED3	FMDC_CS	003	.67	107.58	16.13	14.99	2.45E+01	.93
DLOUED4	FMDC_I	002	.86	110.80	34.41	31.06	1.48E+01	.93
DLOUED4	INTFACP	001	.87	110.80	26.88	24.26	1.48E+01	.93
DLOUED4	FMDC_CS	003	.79	110.80	25.81	23.29	1.48E+01	.93
DLOUTH2	FMDC_I	001	.93	096.80	53.76	55.54	2.14E+02	.93
DLOUTH2	INTFACP	002	.88	096.80	27.96	28.88	2.14E+02	.93
DLOUTH2	RTHS	003	.53	096.80	04.30	04.44	2.14E+02	.93
DLOUTH3	FMDC_I	001	.93	097.88	53.76	54.92	2.00E+02	.93
DLOUTH3	INTFACP	002	.88	097.88	27.96	28.57	2.00E+02	.93
DLOUTH3	RTHS	003	.53	097.88	04.30	04.39	2.00E+02	.93
DLOUTH4	FMDC_I	001	.93	098.96	53.76	54.32	1.23E+02	.93
DLOUTH4	INTFACP	002	.88	098.96	27.96	28.25	1.23E+02	.93
DLOUTH4	RTHS	003	.54	098.96	04.30	04.35	1.23E+02	.93
PLCMBM	FMDC_CS	001	.94	099.98	58.51	58.52	1.91E+01	.94
PLCMBM	RTHS	002	.77	099.98	11.70	11.70	1.91E+01	.94
PLCMBM	RUP_CS	003	.66	099.98	03.19	03.19	1.91E+01	.94
PLCMMT	FMDC_CS	001	.92	104.34	54.84	52.56	1.35E+01	.93
PLCMMT	INTFACP	002	.74	104.34	10.75	10.30	1.35E+01	.93
PLCMMT	RTHS	003	.66	104.34	08.60	08.24	1.35E+01	.93
PLCMTH	FMDC_I	001	.92	098.93	54.35	54.94	2.95E+01	.92
PLCMTH	INTFACP	002	.86	098.93	27.17	27.46	2.95E+01	.92
PLCMTH	DIPDC	003	.44	098.93	01.09	01.10	2.95E+01	.92
RLCMBM2	FMDC_CS	001	.89	096.72	48.35	49.99	1.35E+01	.91
RLCMBM2	RUP_CS	002	.76	096.72	12.09	12.50	1.35E+01	.91
RLCMBM2	RESUSP	003	.61	096.72	06.59	06.81	1.35E+01	.91
RLCMBM3	FMDC_CS	001	.94	102.09	56.38	55.23	1.95E+01	.94
RLCMBM3	INTFACHS	004	.71	102.09	10.64	10.42	1.95E+01	.94
RLCMBM3	RTHS	002	.76	102.09	10.64	10.42	1.95E+01	.94
RLCMBM3	RUP_CS	003	.71	102.09	05.32	05.21	1.95E+01	.94
RLCMBM4	FMDC_CS	001	.94	105.30	57.45	54.56	2.29E+01	.94
RLCMBM4	RTHS	002	.78	105.30	12.77	12.13	2.29E+01	.94
RLCMBM4	INTFACP	003	.76	105.30	09.57	09.09	2.29E+01	.94
RLCMMT2	FMDC_CS	001	.90	097.82	50.55	51.68	1.26E+01	.91
RLCMMT2	RUP_CS	002	.77	097.82	12.09	12.36	1.26E+01	.91
RLCMMT2	RESUSP	003	.62	097.82	06.59	06.74	1.26E+01	.91
RLCMMT3	FMDC_CS	001	.92	102.19	57.61	56.38	1.05E+01	.92
RLCMMT3	INTFACHS	003	.61	102.19	09.78	09.57	1.05E+01	.92
RLCMMT3	RUP_CS	002	.63	102.19	04.35	04.26	1.05E+01	.92
RLCMMT4	FMDC_CS	001	.90	111.68	41.49	37.15	1.78E+01	.94
RLCMMT4	FMDC_I	003	.78	111.68	22.34	20.00	1.78E+01	.94
RLCMMT4	INTFACP	002	.86	111.68	21.28	19.05	1.78E+01	.94
RLCMTH2	FMDC_CS	001	.68	092.47	32.91	35.59	4.07E+00	.79
RLCMTH2	FMDC_I	004	.44	092.47	15.19	16.43	4.07E+00	.79
RLCMTH2	RESUSP	003	.44	092.47	06.33	06.85	4.07E+00	.79
RLCMTH2	RUP_CS	002	.46	092.47	05.06	05.47	4.07E+00	.79
RLCMTH3	FMDC_I	001	.86	100.05	50.00	49.98	1.05E+01	.88
RLCMTH3	INTFACP	002	.77	100.05	22.73	22.72	1.05E+01	.88
RLCMTH3	DIPDC	003	.46	100.05	03.41	03.41	1.05E+01	.88

ENDP	INP.VAR	RK	PRCC	SUM%	%CON	%SCON	FAC1	RSQ
RLCMTH4	FMDC_I	001	.93	097.89	54.84	56.02	6.31E+01	.93
RLCMTH4	INTFACP	002	.88	097.89	27.96	28.56	6.31E+01	.93
RLCMTH4	RTHS	003	.51	097.89	03.23	03.30	6.31E+01	.93
RLOUBM2	FMDC_CS	001	.94	105.30	56.38	53.54	1.07E+01	.94
RLOUBM2	RTHS	003	.78	105.30	12.77	12.13	1.07E+01	.94
RLOUBM2	INTFACP	002	.80	105.30	11.70	11.11	1.07E+01	.94
RLOUBM3	FMDC_CS	001	.94	105.30	56.38	53.54	9.55E+00	.94
RLOUBM3	RTHS	003	.78	105.30	12.77	12.13	9.55E+00	.94
RLOUBM3	INTFACP	002	.79	105.30	11.70	11.11	9.55E+00	.94
RLOUBM4	FMDC_CS	001	.94	103.15	56.84	55.10	8.71E+00	.95
RLOUBM4	RTHS	002	.78	103.15	11.58	11.23	8.71E+00	.95
RLOUBM4	INTFACP	003	.78	103.15	10.53	10.21	8.71E+00	.95
RLOUMT2	FMDC_I	001	.89	105.40	38.71	36.73	2.14E+01	.93
RLOUMT2	INTFACP	002	.88	105.40	29.03	27.54	2.14E+01	.93
RLOUMT2	FMDC_CS	003	.74	105.40	19.35	18.36	2.14E+01	.93
RLOUMT3	FMDC_I	001	.88	105.40	38.71	36.73	1.95E+01	.93
RLOUMT3	INTFACP	002	.88	105.40	29.03	27.54	1.95E+01	.93
RLOUMT3	FMDC_CS	003	.74	105.40	20.43	19.38	1.95E+01	.93
RLOUMT4	FMDC_CS	003	.84	107.56	30.11	27.99	1.26E+01	.93
RLOUMT4	FMDC_I	002	.84	107.56	30.11	27.99	1.26E+01	.93
RLOUMT4	INTFACP	001	.87	107.56	25.81	24.00	1.26E+01	.93
RLOUTH2	FMDC_I	001	.93	096.80	53.76	55.54	2.14E+02	.93
RLOUTH2	INTFACP	002	.88	096.80	27.96	28.88	2.14E+02	.93
RLOUTH2	RTHS	003	.53	096.80	04.30	04.44	2.14E+02	.93
RLOUTH3	FMDC_I	001	.93	097.88	53.76	54.92	2.00E+02	.93
RLOUTH3	INTFACP	002	.88	097.88	27.96	28.57	2.00E+02	.93
RLOUTH3	RTHS	003	.53	097.88	04.30	04.39	2.00E+02	.93
RLOUTH4	FMDC_I	001	.93	098.96	53.76	54.32	1.23E+02	.93
RLOUTH4	INTFACP	002	.88	098.96	27.96	28.25	1.23E+02	.93
RLOUTH4	RTHS	003	.54	098.96	04.30	04.35	1.23E+02	.93