

## 1 Introduction

This memo describes the input parameter files for the Harvard Center for Risk Analysis Bovine Spongiform Encephalopathy (BSE) simulation and the output generated by this program.

All user-defined parameters are stored in a series of ASCII text files. Although neither the name or number of files used to specify the parameters matter, all text containing a parameter definition must be listed in a single text file. Moreover, the name of each of these parameter files must be listed in a single ASCII file that is located in the same directory as the executable and provided to the simulation as its sole argument from the DOS command line. Note that the names of the files may contain path information. If the path information is relative, the reference root directory is assumed to be the directory from which the simulation is executed.

For example, suppose the simulation is to be run from directory `c:\bse`, and the parameter files are named `parm1.txt`, `parm2.txt`, *etc.*, and they are located in `c:\bse\ParmDirectory`. The user must create a text file listing all the parameter files. Suppose the file listing the parameter files is called `fileList.txt`. The contents of `fileList.txt` is

```
ParmDirectory\parm1.txt  
ParmDirectory\parm2.txt  
etc..
```

The simulation is executed from the `c:\bse` directory by typing:

```
madcow fileList.txt
```

The output can be redirected to an ASCII file named `output.txt` by typing

```
madcow fileList.txt > output.txt
```

Most of the BSE simulation parameters belong to a top level element. Top level elements are entered into a text file by specifying their name within a set of angle brackets (*e.g.*, `<element name>`), listing the parameter definitions, and then concluding the element by again specifying the top level element name in angle brackets, with the name preceded by a backslash. There must be white space (a space, tab, or return) following the top level element label introductory label, and preceding the top level element concluding label. For example, the parameter definitions belonging to the `feedProducer` top level element must appear in a file that is organized as follows:

```
<feedProducer>
    parameter 1 definition
    parameter 2 definition
    etc..
</feedProducer>
```

Note that all top level elements must appear exactly once in the set of parameter files provided by the user. Section 2 lists all the top level elements and their member parameters.

Parameter specifications are preceded by a label with the name of the parameter in angle brackets and are followed by a label with the name of the parameter preceded by a slash in angle brackets. For example, suppose there is a parameter which is called Parm1. Its definition would be described as follows:

```
<Parm1>
    Specification for Parm1
</Parm1>
```

Each parameter is specified as a number, a distribution table, or a deterministic table.

### Distribution Tables

The first row of a distribution table contains one entry indicating the number of entries in the table. The second and all successive rows of the table each contain one table entry. Each table entry consists of two elements. The first value is the event value and the second value is the probability. For example, the distribution defined by the following table describes a distribution in which the render reduction factor of 1259 has a 5% probability of being selected, the render reduction factor of 100 has a 45% chance of being selected, and so on.

```
<renderFactor>
    4
        1259  0.05
        100   0.45
        10    0.45
        1     0.05
</renderFactor>
```

Deterministic Tables

The first row of a deterministic table will be ignored by the program and may therefore include any information (e.g., header labels for the values in the table). The second row in the table contains one entry that indicates the number of entries in the table. The third row contains the table's first entry, and so forth. The first element of each entry is the index value, and the second is the lookup value corresponding to that element. For example, the following table has three entries. The first entry has an index of "P\_FEED\_PRODUCER" and a lookup value of 0.01.

```
<probMisLabel>
  Producertype          ProbMislabel
  3
  P_FEED_PRODUCER      0.01
  NP_FEED_PRODUCER     0
  MIXED_FEED_PRODUCER  0.01
</probMisLabel>
```

Although the lookup values in the preceding table were all numbers, the lookup values can also be vectors of values or tables. For example, the following table has three entries. The first entry has an index value of P\_MBM\_PRODUCER. The corresponding lookup value is a table with three entries, the first of which has an index value of P\_MBM. The index value P\_MBM has a lookup value that is a table with four entries, the first of which has an index value of P\_FEED\_PRODUCER. The corresponding lookup value is 0.

```
<probDestination>
  producer              MATERIAL      Destination      Probability
  3
  P_MBM_PRODUCER      3
  P_MBM                4
  P_FEED_PRODUCER     0.63
  NP_FEED_PRODUCER    0
  MIXED_FEED_PRODUCER 0.05
  OUT                  0.32
  NP_MBM              4
  P_FEED_PRODUCER     0
  NP_FEED_PRODUCER    0
  MIXED_FEED_PRODUCER 0
  OUT                  1
  BLOOD                2
  BLOOD_PRODUCER      1
  OUT                  0
etc..
```

Note that index values may be numbers in some cases and labels in other cases. If the index values are numbers, then any number may be used. However, if the index values are labels, then only the predefined labels can be used without changing the code. The labels now defined are always spelled out in all capital letters and underscore characters ("\_").

Deterministic tables with numerical index values can use either of two interpolation methods. If no entry is included for index value  $i$ , then:

- A “floor interpolation” table assumes the lookup value for index  $i$  is the entry provided for the largest index less than  $i$ .
- A “linear interpolation” table assumes that the lookup value for index  $i$  is the straight-line interpolation value using the entry with the largest index less than  $i$  as the lower bound, and the entry with the smallest index less than  $i$  as the upper bound. If there is no entry with an index greater than  $i$ , then the table uses the lookup value for the largest index value in the table.

For tables that use neither floor or linear interpolation, a default value is returned for index values that are not explicitly specified. In the case of numerical lookup values, the default value is zero.

## 2 Elements and Parameters

This section lists all the top level elements and the parameters that they contain. Note that “FI” stands for “floor interpolation” and “LI” stands for “linear interpolation”. Tables that are not designated as either FI or LI do not perform any type of interpolation. Tables are deterministic unless otherwise specified.

| Top Level Element<br>Parameter | Comment   |
|--------------------------------|---|
| <AMInspector>                  |   |
| <probOK_OtherFactors>          | Table – This parameter specifies the probability that an animal passes the AM inspection for factors other than BSE status. It specifies these probabilities as a function of ambulatory status (NORMAL and NONAMB) and age in months.  |
| <probTestClinical>             | Table – This parameter specifies the probability that an animal will be declared as having clinical signs of BSE. It is a function of BSE status (NOSIGNS and CLINICAL) and ambulatory status (NORMAL and NONAMB).  |
| <okForFood>                    | Table – Specifies AM inspection rule for whether tissues from a carcass can be used in human food. The result (TRUE – can be used in human food, or FALSE – cannot be used in human food) depends on 1) the AM inspection result for non-BSE factors (TESTOK or TESTNOTOK), 2) whether clinical BSE signs were detected (TESTCLINICAL or TESTNOTCLINICAL), and 3) ambulatory status (NORMAL or NONAMB).   |
| <okForFeed>                    | Table – Specifies AM inspection rule for whether tissues from a carcass can be used in animal feed. The result (TRUE – can be used in human food, or FALSE – cannot be used in animal feed) depends on 1) the AM inspection result for non-BSE factors (TESTOK or TESTNOTOK), 2) whether clinical BSE signs were detected (TESTCLINICAL or TESTNOTCLINICAL), and 3) ambulatory status (NORMAL or NONAMB). |
| <birthVisitor>                 |   |
| <probBirth>                    | Numerical – The probability that a cow that can calf will give birth in any given month   |
| <probTrans>                    | Numerical – The probability that a newborn calf becomes infected if its mother is infected with BSE   |
| <beginCalving>                 | Numerical – Age in months when a cow can begin calving  |
| <endCalving>                   | Numerical – Maximum age at which a cow can calve  |
| <bloodInfector>                |   |

| Top Level Element<br>Parameter | Comment  |
|--------------------------------|--|
| <numCowsReceiving>             | Numerical – Number of bovines among which blood meal from a single slaughtered animal is divided   |
| <probInfection>                | LI Table – Indexed by dose in “effective” id50s. An effective id50 is the product of the number of id50s ingested and the animal’s susceptibility (see <susceptibility> below). Lookup value is the corresponding probability of infection.  |
| <consumption>                  | Table – Indexed by bovineType. Lookup value is a table indexed by Gender. Lookup value is an FI table indexed by Age. Lookup value is a relative consumption weight for that bovineType, gender, age combination. These relative weights are proportional to the probability that an animal will ingest infectivity in blood meal.   |
| <susceptibility>               | FI Table – Indexed by Age. Lookup value is the relative susceptibility of a bovine with the corresponding age. See <probInfection> above.  |
| <DeathVisitor>                 |  |
| <probDeath>                    | FI Table – Indexed by age. Lookup value is monthly probability of death by natural causes ( <i>i.e.</i> , excluding slaughter and death due to BSE)  |
| <feeder>                       |  |
| <probFeedOK>                   | Numerical – The probability that prohibited feed that is sent to the farm will <u>not</u> be fed to bovines  |
| <feedProducer>                 |  |
| <probFeedType>                 | Table – Indexed by MBM type. Lookup value is a table indexed by feed type. For <u>mixed feed producers only</u> , the lookup value is the proportion of MBM of the specified MBM type that is used to produce feed of the specified feed type. Note – The simulation assumes that prohibited feed producers produce only prohibited feed, and that non-prohibited feed producers produce only non-prohibited feed. |
| <probMisLabel>                 | Table – Indexed by feed producer type. Lookup value is the probability that that type of producer will mislabel prohibited feed that it produces as non-prohibited. Note that ordinarily, this probability should be 1.0 for non-prohibited feed producers because their output is exclusively labeled non-prohibited feed.  |
| <probContaminate>              | Table – Indexed by feed producer type. Lookup value is the probability that a batch of prohibited feed produced by that producer will contaminate a batch of non-prohibited feed.  |
| <fracContaminate>              | Number – The fraction of id50s in a batch of prohibited feed that ends up in non-prohibited feed if contamination occurs.  |

| Top Level Element<br>Parameter | Comment   |
|--------------------------------|---|
| <feedTransporter>              |   |
| <probDestination>              | Table – Indexed by feed producer type (actually an MBM destination type). Lookup value is a table indexed by feed type. Lookup value is a distribution table indexed by feed destination. The lookup value is the probability that feed produced by the specified producer type of the specified type will end up at the specified destination.                               |
| <fixedInfector>                |   |
| <numCases>                     | Table – Indexed by bovine type. Lookup value is a table indexed by gender. Lookup value is an FI table indexed by age. Lookup value is the number of infected cows of the specified bovine type, gender and age that are in the herd at the beginning of the simulation. The simulation assumes that the infected animals became infected at the beginning of the simulation. |
| <foodInspector>                |   |
| <probPassFood>                 | Table – Indexed by age and organ. Lookup value is the probability that an organ will <u>not</u> be rejected by the food inspector for the purpose of being sold for human consumption.  |
| <genesisVisitor>               |   |
| <initSize>                     | Table – Indexed by bovine type. Lookup value is a table indexed by gender. Lookup value is an FI table indexed by age. Lookup value is the number of animals in the herd at the beginning of the simulation of the specified bovine type, gender, and age. The age zero value specifies the number of cattle born each month for each bovine type/gender combination.         |
| <materializer>                 |   |
| <organDistribution>            | Table – Indexed by duration since infection. Lookup value is a table indexed by organ. Lookup value is the proportion of a bovine's BSE infectivity in that organ at the specified duration since infection.  |
| <totalInfectivity>             | FI Table – Indexed by months since infection. Lookup value is the total number of ID <sub>50</sub> s in an animal at the specified number of months since infection.  |
| <MBMTransporter>               |   |
| <probDestination>              | Table – Indexed by MBM producer type. Lookup value is a table indexed by MBM type. Lookup value is a distribution table indexed by MBM destination type. Lookup value is the probability that MBM of the specified type manufactured by the specified producer type ends up at the specified destination.   |

| Top Level Element<br>Parameter | Comment   |
|--------------------------------|---|
| <MBMTransporter_Dead>          | Same as MBM_Transporter, but for dead animals only.   |
| <PMInspector>                  |   |
| <probPassPM>                   | FI Table – Indexed by age. Lookup value is a table indexed by the presence of emboli (0 indicates no emboli are present, 1 indicates emboli are present). Lookup value is a table indexed by organ. Lookup value is the probability that the PM inspector will accept an organ in an animal of the specified age given that emboli are present/not present. |
| <proteinInfector>              |   |
| <numCowsReceiving>             | Numerical – Number of bovines among which recycled protein from a single slaughtered animal is divided  |
| <probInfection>                | LI Table – Indexed by dose in “effective” ID <sub>50</sub> s. An effective ID <sub>50</sub> is the product of the number of ID <sub>50</sub> s ingested and the animal’s susceptibility (see <susceptibility> below). Lookup value is the corresponding probability of infection.   |
| <consumption>                  | Table – Indexed by bovineType. Lookup value is a table indexed by Gender. Lookup value is an FI table indexed by Age. Lookup value is a relative consumption weight for that bovineType, gender, age combination. These relative weights are proportional to the probability that an animal will ingest infectivity in recycled protein.                    |
| <susceptibility>               | FI Table – Indexed by Age. Lookup value is the relative susceptibility of a bovine with the corresponding age. See <probInfection> above.   |
| <randomInfector>               |   |
| <numCowsReceiving>             | Numerical – Number of bovines among which a single month’s introduction of exogenous protein is divided   |
| <probInfection>                | LI Table – Indexed by dose in “effective” ID <sub>50</sub> s. An effective ID <sub>50</sub> is the product of the number of ID <sub>50</sub> s ingested and the animal’s susceptibility (see <susceptibility> below). Lookup value is the corresponding probability of infection.   |
| <consumption>                  | Table – Indexed by bovineType. Lookup value is a table indexed by Gender. Lookup value is an FI table indexed by Age. Lookup value is a relative consumption weight for that bovineType, gender, age combination. These relative weights are proportional to the probability that an animal will ingest infectivity in exogenous protein.                   |
| <susceptibility>               | FI Table – Indexed by Age. Lookup value is the relative susceptibility of a bovine with the corresponding age. See <probInfection> above.   |

| Top Level Element<br>Parameter | Comment   |
|--------------------------------|---|
| <renderer>                     |   |
| <renderFactor>                 | Distribution table – Indexed by render reduction factor. Lookup value is the probability that infectivity in bovine material sent to rendering will be reduced by that factor.  |
| <probContamination>            | Numerical – The probability that a batch of prohibited MBM produced by a MIXED MBM producer will contaminate a batch of non-prohibited feed.  |
| <probType>                     | Table – Indexed by MBM producer type. Lookup value is the probability that bovine material sent to rendering will be sent to a renderer of the specified type. (Note – This table behaves like a distribution table but is implemented as a deterministic table.  |
| <probMisLabel>                 | Table – Indexed by MBM producer type. Lookup value is the probability that that type of producer will mislabel prohibited MBM that it produces as non-prohibited. Note that this value must be set to 1.0 for non-prohibited MBM producers because their output is exclusively labeled non-prohibited feed. |
| <fracContaminate>              | Numerical – The fraction of id50s in a batch of prohibited MBM that ends up in non-prohibited MBM if contamination occurs.  |
| <renderer_Dead>                | Same as renderer, but for dead animals only.  |
| <sickBovine>                   |   |
| <clinicalDate>                 | Distribution table – Indexed by months between BSE infection and manifestation of clinical symptoms. Lookup value is the probability of that duration (if it does not die due to some other reason).  |
| <clinicalDuration>             | Distribution table – Indexed by months between the appearance of BSE clinical symptoms and the time when the animal will die due to BSE disease (if it does not die due to some other reason).  |
| <maternalContagiousPoint>      | Numerical – Fraction of the incubation period after which an infected cow can become contagious to her calf   |
| <probNonAmbulatory>            | Table – Probability that an animal is non-ambulatory as a function of BSE clinical status (NOSIGNS or SIGNS).   |
| <splitter>                     |   |
| <fracAerosol>                  | Numerical – Fraction of BSE in the spinal cord that is aerosolized and ends up on the carcass (in muscle meat) during splitting.  |
| <probMS_AMR_SCRRemove>         | FI table – Indexed by age. Lookup value is a distribution table indexed by the splitter practice-outcome code. Lookup value is the probability that an animal of the specified age will end up  |

| Top Level Element<br>Parameter | Comment  |
|--------------------------------|--|
| <fracSCInMuscle>               | with that splitter practice-outcome code.<br><br>FI table – Indexed by age. Lookup value is a table indexed by splitter practice-outcome code. Lookup value is a fraction of infectivity in spinal cord that ends up in muscle following splitting of the spinal cord for an animal of the specified age and the specified splitter practice-outcome code. |
| <fracSCInAMRMeat>              | FI table – Indexed by age. Lookup value is a table indexed by splitter practice-outcome code. Lookup value is a fraction of infectivity in spinal cord that ends up in AMR meat following splitting of the spinal cord for an animal of the specified age and the specified splitter practice-outcome code.  |
| <fracSCInBone>                 | FI table – Indexed by age. Lookup value is a table indexed by splitter practice-outcome code. Lookup value is a fraction of infectivity in spinal cord that ends up in bone following splitting of the spinal cord for an animal of the specified age and the specified splitter practice-outcome code.  |
| <fracDRGInMuscle>              | FI table – Indexed by age. Lookup value is a table indexed by splitter practice-outcome code. Lookup value is a fraction of infectivity in dorsal root ganglia that ends up in muscle following splitting of the spinal cord for an animal of the specified age and the specified splitter practice-outcome code.  |
| <fracDRGInAMRMeat>             | FI table – Indexed by age. Lookup value is a table indexed by splitter practice-outcome code. Lookup value is a fraction of infectivity in dorsal root ganglia that ends up in AMR meat following splitting of the spinal cord for an animal of the specified age and the specified splitter practice-outcome code.  |
| <fracDRGInBone>                | FI table – Indexed by age. Lookup value is a table indexed by splitter practice-outcome code. Lookup value is a fraction of infectivity in dorsal root ganglia that ends up in bone following splitting of the spinal cord for an animal of the specified age and the specified splitter practice-outcome code.  |
| <spontInfector>                |  |
| <spontRate>                    | FI table – Indexed by age. Lookup value is the proportion of animals in that age group who spontaneously develop BSE infection each month.   |
| <SRMInspector>                 |  |
| <fracElimBySRM>                | FI table – Indexed by age. Lookup value is a table indexed by organ. Lookup value is a distribution table over the set of elimination fraction values (first value is the fraction eliminated and the second value is the probability). The elimination fraction is the proportion of infectivity in an organ that is eliminated by the SRM inspector.     |

| Top Level Element<br>Parameter                    | Comment  |
|---|--|
| <SRMInspector_Dead>                               | Same SRM_Inspector, but for dead animals only.   |
| <stunner>   |  |
| <ProbDrip>  | Table – Indexed by stunner type. Lookup value is the probability that brain drip will result when the specified stunner type is used.  |
| <fracDrip>  | Numerical – The fraction of infectivity in brain that ends up in brain drip if it occurs.  |
| <probType>  | Table – Indexed by stunner type. Lookup value is the probability that the specified stunner type will be used during the slaughter process.  |
| <probOK>  | Table – Indexed by stunner type. Lookup value is the probability that there is <u>no</u> malfunction (operating status OK) when a stunner of the specified type is used.   |
| <emboli>  | Table – Indexed by stunner type. Lookup value is a table indexed by stunner operating status. Lookup value is a table indexed by organ. Lookup value is a vector of three numbers. The first is the probability that there will be emboli in the specified organ if the specified stunner is used and the specified operating status results. The second and third values are the upper and lower bounds on a log uniform distribution quantifying the fraction of infectivity in brain that ends up in that organ if emboli end up in that organ. |
| Parameters not belonging to any top level element |  |
| <rateSlaughter>                                   | Table – Indexed by bovine type. Lookup value is a table indexed by gender. Lookup value is an FI table indexed by age. Lookup value is the proportion of animals of that bovine type, gender, and age that are slaughtered each month.   |
| <numMonths>                                       | Numerical – Number of months the simulation runs.  |
| <outputInterval>                                  | Numerical – Simulation outputs statistics every outputInterval months. Output is also generated after month 0 and after the last month of the simulation.  |
| <probDeadRendered>                                | Numerical – Probability that an animal that dies prior to being sent to slaughter will be rendered, rather than being disposed of on the farm. Note that animals disposed of on the farm are assumed not to contaminate human food or animal feed.   |
| <importBolus>                                     | FI table – Indexed by simulation month. Lookup value is the number of exogenous id50s introduced into the cattle herd that month. The exposure characteristics and dose-response for this infectivity is governed by parameters specified within the randomInfector top level element.   |

| <b>Top Level Element<br/>Parameter</b> | <b>Comment</b>  |
|--|---|
| <dataFileList>                         | FI table – Indexed by simulation month. Lookup value is the name of a file listing files to be read in at the beginning of that month. If the lookup value is NOCHANGE, then no files are read in that month. |
| <reportDetailedFoodData>               | Numeric – When set to 1, the simulation details ID <sub>50s</sub> in human food by animal age and ambulatory status category. Setting this parameter to 0 turns this feature off.                             |

### 3 Parameters Organized by Function

#### 3.1 Slaughter, Rendering, and Feed Production

Parameters discussed in this section control the slaughter of cattle, their rendering, and production of feed from cattle protein. Aspects of the simulation controlled by these parameters include:

- Disposition of various portions of the carcass during the slaughter process, with material being sent for incineration (all infectivity destroyed), rendering, or to the human food supply;
- The potential transfer of infectivity from one portion of the carcass to another due to 1) the creation of emboli during stunning; 2) the contamination of blood meal by the flow of CNS-contaminated blood from the stun wound; 3) aerosolization of infectivity in the spinal cord during splitting; and 4) the impact of advanced meat recovery (AMR) on the spinal cord;
- The contamination of non-prohibited MBM with bovine protein due to physical contamination of transport and storage equipment, or due to mislabeling;
- The contamination of non-prohibited feed with either prohibited MBM or with bovine protein in MBM labeled as non-prohibited;
- The miss-use of prohibited feed to feed bovines.

The files with these parameters are listed in the following table. Preceding each parameter is the keyword that appears in the parameter file identifying that parameter.

| Top Level Element    | Parameters   |
|----------------------|--|
| AMInspector.data     | <probOK_OtherFactors><br><probTestClinical><br><okForFood><br><okForFeed>  |
| feeder.data          | <probFeedOK>   |
| feedProducer.data    | <probFeedType><br><probMisLabel><br><probContaminate><br><fracContaminate> |
| FeedTransporter.data | <probDestination>  |
| foodInspector.data   | <probPassFood>   |

| Top Level Element        | Parameters  |
|--------------------------|---|
| MBMTransporter.data      | <probDestination>   |
| MBMTransporter_Dead.data | <probDestination>   |
| PMInspector.data         | <probPassPM>  |
| renderer.data            | <renderFactor><br><probContamination><br><fracContaminate><br><probType><br><probMisLabel>  |
| Renderer_Dead.data       | <renderFactor><br><probContamination><br><fracContaminate><br><probType><br><probMisLabel>  |
| splitter.data            | <fracAerosol><br><probMS_AMR_SCRemove><br><fracSCInMuscle><br><fracSCInAMRMeat><br><fracSCInBone><br><fracDRGInMuscle><br><fracDRGInAMRMeat><br><fracDRGInBone> |
| SRMInspector.data        | <probPassSRM>   |
| SRMInspector_Dead.data   | <probPassSRM>   |
| stunner.data             | <probDrip><br><fracDrip><br><probType><br><probOK><br><emboli>  |
| No top level element     | < probDeadRendered><br><rateSlaughter>  |

### 3.2 Infection

Parameters in this section control the quantity of infectivity in a bovine as a function of the time since infection, the distribution of that infectivity among different organs, introduction of exogenous infection into the bovine herd (*e.g.*, imported contaminated MBM), the number of animals among which infected material from both exogenous sources and endogenous sources is divided, which animals (by age and type) receive various sources of infectivity, the rate at which

spontaneous infection occurs, the probability that a calf born to an infected cow will itself become infected, and the dose-response relationship quantifying the probability of infection, by age, following ingestion of infectivity.

| <b>File</b>          | <b>Parameters</b>  |
|----------------------|--|
| birthVisitor         | <probTrans>  |
| bloodInfector.data,  | <numCowsReceiving><br><probInfection><br><consumption><br><susceptibility>               |
| fixedInfector.data,  | <numCases>   |
| materializer.data.   | <organDistribution><br><totalInfectivity>  |
| proteinInfector.data | <numCowsReceiving><br><probInfection><br><consumption><br><susceptibility>               |
| randomInfector.data  | <numCowsReceiving><br><probInfection><br><consumption><br><susceptibility>               |
| sickBovine           | <clinicalDate><br><clinicalDuration><br><maternalContagiousPoint><br><probNonAmbulatory> |
| spontInfector.data   | <rate>   |
| No top level element | <importbolus>  |

### 3.3 Demographics

Parameters in this section control the initial size of the herd, the rate at which animals are born, the rate at which they die due to causes other than slaughter, and the rate at which they are slaughtered.

| <b>File</b>       | <b>Parameters</b>                         |
|-------------------|---|
| birthVisitor.data | <probBirth><br><beginCalve><br><endCalve> |

| <b>File</b>          | <b>Parameters</b> |
|----------------------|-------------------|
| deathVisitor.data    | <probDeath>       |
| genesisVisitor.data  | <initSize>        |
| No top level element | <rateSlaughter>   |

### 3.4 Control

| <b>File</b>          | <b>Parameters</b>   |
|----------------------|---|
| No top level element | <numMonths><br><outputInterval><br><dataFileList><br><reportDetailedFoodData> |

## 4 Output

Statistics are reported at the beginning of the simulation execution, at the end of each report period interval, and at the end of the simulation's execution. Section 4.1 lists incremental statistics and cumulative statistics. Section 4.2 lists stock statistics.

### 4.1 Cumulative and Incremental Statistics

Incremental statistics represent the change in the value of an output parameter during a report interval. Cumulative statistics represent the sum of these changes.

| Output Block                                      | Entries   |
|---|---|
| Month   | Simulation month  |
| Number dead by mode of death for infected animals | Slaughter<br>On farm with render<br>On farm with burial   |
| Number infected by mode of infection              | Maternal transmission<br>Spontaneous infection<br>Imported infections ("fixed")<br>Recycled bovine protein<br>Recycled bovine blood<br>Exogenous infectivity  |
| ID <sub>50S</sub> Disposition                     | Total from slaughter<br>Total from death on farm<br>Out – failed SRM ban<br>To P MBM<br>To NP MBM<br>Contamination of NP MBM<br>Mislabeling of P MBM as NP MBM<br>Lost to rendering<br>To P feed<br>To NP feed<br>Contamination of NP feed<br>Mislabeling of P feed as NP feed<br>To bovine blood<br>Out after rendering<br>Administered <i>via</i> misfeeding<br>Total to cattle<br>Out after feed production<br>Total to humans<br>Eliminated by the AM inspector |

| Output Block                           | Entries   |
|--|---|
| Source of ID <sub>50</sub> S to humans | Brain<br>Spinal<br>DRG<br>Blood<br>Gut<br>Heart<br>Lung<br>Liver<br>Kidney<br>Ileum<br>Eyes<br>Muscle<br>AMR Meat<br>Bone<br>TG Ganglia<br>Tonsils<br>Extra1 (place holder)<br>Extra2 (place holder)<br>Extra3 (place holder) |
| New Clinical <sup>a</sup>              |   |

Notes:

a. *Incremental only*

## 4.2 Stock statistics

A stock statistic is a “snapshot” value – *i.e.*, the value of a quantity at some point in time. The stock statistics reported by the simulation represent counts made at the end of the report interval period. The simulation reports three stock entries – total number of cattle (“all”), number of infected animals, and number of animals with clinical signs.