



**EUROPEAN COMMISSION**  
HEALTH & CONSUMER PROTECTION DIRECTORATE-GENERAL

**Scientific Steering Committee**

**OPINION ON:**

**THE GEOGRAPHICAL BSE RISK FOR SHEEP AND GOATS (GBR-S):  
ADAPTATION OF THE CATTLE GBR METHODOLOGY TO SMALL RUMINANTS, IN  
CASE BSE IN SMALL RUMINANTS WOULD BECOME PROBABLE OR EVIDENT  
UNDER FIELD CONDITIONS.**

**ADOPTED BY THE SCIENTIFIC STEERING COMMITTEE  
AT ITS MEETING OF 7-8 NOVEMBER 2002**

## OPINION

### Background

The Scientific Steering Committee (SSC) has been considering the risk of BSE in sheep since it first began the assessment of the risk relating to TSEs following the finding of the probable link between BSE in cattle and the development of vCJD in the UK in 1996. The relevance of this subject stems from the experimental evidence that some strains of sheep and goats developed BSE upon experimental ingestion of MBM made from BSE infected cattle material. On the other hand, there is no evidence that BSE is present in small ruminants under natural conditions.

The SSC has at several occasions addressed the question whether BSE is present or not in small ruminants under field conditions and it has produced a number of opinions related to this subject. Three recent SSC opinions<sup>1</sup> address the distribution of TSE infectivity in small ruminant tissues, advice a strategy to investigate the possible presence of BSE in sheep and suggest means for safe sourcing of small ruminants should BSE in small ruminants become probable or evident under field conditions, based on genotyping, breeding, rapid TSE testing, flock certification and elimination of specified risk materials. So far, however, the SSC did not yet address another request from Commission Services, namely to extend the existing Geographical BSE risk analysis (in cattle) to small ruminants, by taking into account factors that may be unique to small ruminants.

Regarding cattle, the SSC has been engaged in assessing the geographical risk of BSE being present in cattle in the different Member States and other countries and continues this work as part of the risk appraisal derived from BSE-cattle in different countries. In its opinion of 22 February 2002<sup>2</sup> it produced its latest evaluation of the appropriate methodology for assessing this geographical risk.

Regarding sheep, attempts to assess the risk of BSE in UK sheep flocks have recently been published in the scientific literature. If an assessment methodology for the geographical BSE risk in small ruminants could be developed, then it would also be important to set out the assumptions underlying such an analysis. In case BSE would be actually detected in sheep or goats in the field, this assessment would be particularly useful as, at present, the procedures being proposed for the reliable discrimination of BSE from scrapie in small ruminants are difficult to implement and time consuming processes.

### Scope

The present opinion is related to the request from Commission Services to extend the existing Geographical BSE risk analysis (in cattle) to small ruminants, by taking [in addition] into account factors that may be unique to sheep. It links assumptions and recommendations from the above 3 opinions with the relevant elements of the SSC's methodological approach for assessing the

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<sup>1</sup> **EC (European Commission), 2002.** Opinion on safe sourcing of small ruminant materials. (Safe sourcing of small ruminant materials should BSE in small ruminants become probable: genotype, breeding, rapid TSE testing, flocks certification and Specified Risk Materials). Adopted on 4-5 April 2002.

**EC (European Commission), 2002.** Strategy to investigate the possible presence of BSE in sheep. Opinion adopted on 4-5 April 2002.

**EC (European Commission), 2002.** Opinion on TSE infectivity distribution in ruminant tissues. Adopted on 10 and 11 January 2002 and amended on 7-8 November 2002.

<sup>2</sup> **EC (European Commission), 2002.** Opinion on the Geographical BSE-Risk (GBR) and its evolution over time in the European Union Member States. Adopted by the Scientific Steering Committee at its meeting of 22 February 2002.

geographical BSE risk in cattle, into a proposal for a coherent methodology for assessing the geographical BSE risk in small ruminants, in case BSE in small ruminants would become probable or evident under field conditions.

### **The hypothetical threat to human health.**

The probable link between BSE in cattle and the development of vCJD in humans is widely accepted. Therefore the presence of BSE in sheep and goats under field conditions will provide a similar link to human disease and thereby lead to a parallel set of precautionary measures towards potential human exposure to the BSE agent from products originating from small ruminants.

So far the BSE prion has not been identified in a diseased sheep or goat under field conditions. Sheep can be infected under laboratory conditions by intracerebral infection or by feeding infected cattle material brain. The symptoms they develop are similar to the symptoms in sheep, which under natural conditions develop scrapie. Actually the symptoms developed and the prions isolated are so much alike experimental BSE that it is necessary to distinguish the prion from each other by dosing infected brain material to panels of mice strains in long term studies.

Therefore the occurrence of endogenous scrapie in national sheep flocks will mask the possible presence of natural BSE in these animals, because no readily available diagnostic methods exist today. The diagnostic differentiation of natural prion diseases in sheep has so far only identified scrapie as the cause of the disease.

Therefore BSE in sheep is still a hypothetical risk to human health.

### **Scientific limitations for developing a GBR-S methodology.**

BSE in sheep has not been proven under field conditions, but still the information obtained so far can be used as a scientific plausible stepping-stone for a hypothetical model for the occurrence and spreading of a BSE epidemic in small ruminants, if it would occur.

This model for hypothetical BSE in sheep, combined with the experiences from the assessment of the geographical BSE risk in cattle, has led to the framework for assessing the geographical BSE risk in sheep and goats (GBR-S) described in the attached report.

It should be stressed that the development of a GBR-S model, building on the experience obtained with the GBR-C model, will be met with a number of specific problems related to differences between TSE's in cattle and small ruminants:

- The pathogenesis and epidemiology of TSE's in small ruminants differ from those cattle.
- The presence of BSE in small ruminants can be masked by the presence of scrapie. An assay discriminating between the presence of BSE and scrapie will be necessary to identify and quantify BSE cases in small ruminants as input parameters for the models.
- Only few precise and readily exploitable data are available on feeding practices in small ruminants, especially with regard to the amounts of ruminant-derived MBM used in the past and variations in this use according to region or husbandry type.

The SSC stresses that this GBR-S model will need adjustments when new scientific data regarding probable/possible presence of BSE in small ruminants under field conditions become available, but supports the further development (and its application) of the present model if an acute situation would occur.

## **REPORT**

**THE GEOGRAPHICAL BSE RISK FOR SHEEP AND GOATS (GBR-S): ADAPTATION OF THE CATTLE GBR METHODOLOGY TO SMALL RUMINANTS, IN CASE BSE IN SMALL RUMINANTS WOULD BECOME PROBABLE OR EVIDENT UNDER FIELD CONDITIONS.**

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## 1. BACKGROUND AND SCOPE

- a) The Scientific Steering Committee (SSC) has been considering the risk of BSE in sheep since it first began the assessment of the risk relating to TSEs following the finding of the probable link between BSE in cattle and the development of vCJD in the UK in 1996. The relevance of this subject stems from the experimental evidence that some strains of sheep and goats developed BSE upon experimental ingestion of MBM made from BSE infected cattle material. On the other hand, there is no evidence that BSE is present in small ruminants under natural conditions.

The SSC has at several occasions addressed the question whether BSE is present or not in small ruminants under field conditions and it has produced a number of opinions related to this subject. Three recent SSC opinions<sup>3</sup> address the distribution of TSE infectivity in ruminant tissues, advice a strategy to investigate the possible presence of BSE in sheep and suggest means for safe sourcing of small ruminants should BSE in small ruminants become probable or evident under field conditions, based on genotyping, breeding, rapid TSE testing, flock certification and elimination of specified risk materials. So far, however, the SSC did not yet address another request from Commission Services, namely to extend the existing Geographical BSE risk analysis (in cattle) to small ruminants, by taking into account factors that may be unique to sheep.

- b) The SSC has also been engaged in assessing the geographical risk of BSE being present in cattle in the different Member States and other countries and continues this work as part of the risk appraisal derived from BSE-cattle in different countries. The SSC recently produced its latest evaluation of the appropriate methodology for assessing this geographical risk (EC, 2002a).
- c) Recently there has been an attempt to assess the risk of BSE in UK sheep flocks (Ferguson *et al*, 2002; Kao *et al*, 2002). If an assessment methodology could be developed, then it would also be important to set out the assumptions underlying such an analysis. In case BSE would be actually detected in sheep or goats in the field, this assessment would be particularly useful as, at present, the procedures being proposed for the reliable discrimination of BSE from scrapie in small ruminants are difficult to implement and time consuming processes (EC, 2002c).

The report hereafter links assumptions and recommendations from the above 3 opinions with the relevant elements of the SSC's methodological approach for assessing the geographical BSE risk in cattle, into a proposal for a coherent methodology for assessing the geographical BSE risk in small ruminants, in case BSE in small ruminants would become probable or evident under field conditions.

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<sup>3</sup> See:

**EC (European Commission), 2002.** Opinion on safe sourcing of small ruminant materials. (Safe sourcing of small ruminant materials should BSE in small ruminants become probable: genotype, breeding, rapid TSE testing, flocks certification and Specified Risk Materials). Adopted on 4-5 April 2002.

**EC (European Commission), 2002.** Strategy to investigate the possible presence of BSE in sheep. Opinion adopted on 4-5 April 2002.

**EC (European Commission), 2002.** Opinion on TSE infectivity distribution in ruminant tissues. Adopted on 10 and 11 January 2002 and amended on 7-8 November 2002.

## 2. ASSESSMENT OF THE GEOGRAPHICAL RISK ASSESSMENT FOR CATTLE (GBR-C)

### 2.1 Information elements and assumptions

- BSE arose first in the UK;
- BSE propagated through the recycling of bovine tissues into animal feed;
- The export of infected animals and infected feed lead to the spread of the BSE-agent to other countries where it was again recycled and propagated via the feed chain;
- Blood, semen and embryos are not considered to be effective transmission vectors; and
- Cross-contamination can be a process of propagating the disease occurrence.
- Available infectivity data for tissues cattle and sheep.

The possible impact of *maternal transmission* is not considered because of:

- lesser importance in comparison to feed and
- in spite of some epidemiological evidence, there is a lack of rigorous experiments to yield final scientific confirmation of its existence.

Issues not considered because not scientifically confirmed are:

- transformation into BSE of other (animal) TSEs (scrapie, CWD, TME, FSE);
- “third route of transmission” ; and
- spontaneous occurrence of BSE at very low rate.

The main information elements for assessing the GBR-C are listed below:

<b><i>Structure and dynamics of the bovine population</i></b>
<b><i>Surveillance of BSE</i></b> Measures in place to ensure detection of BSE-cases Results of BSE-surveillance
<b><i>BSE related culling</i></b>
<b><i>Import of Cattle and MBM</i></b>
<b><i>Feeding</i></b>
<b><i>MBM-bans</i></b>
<b><i>SRM-bans (SRM: Specified Risk Material)</i></b>
<b><i>Rendering</i></b>

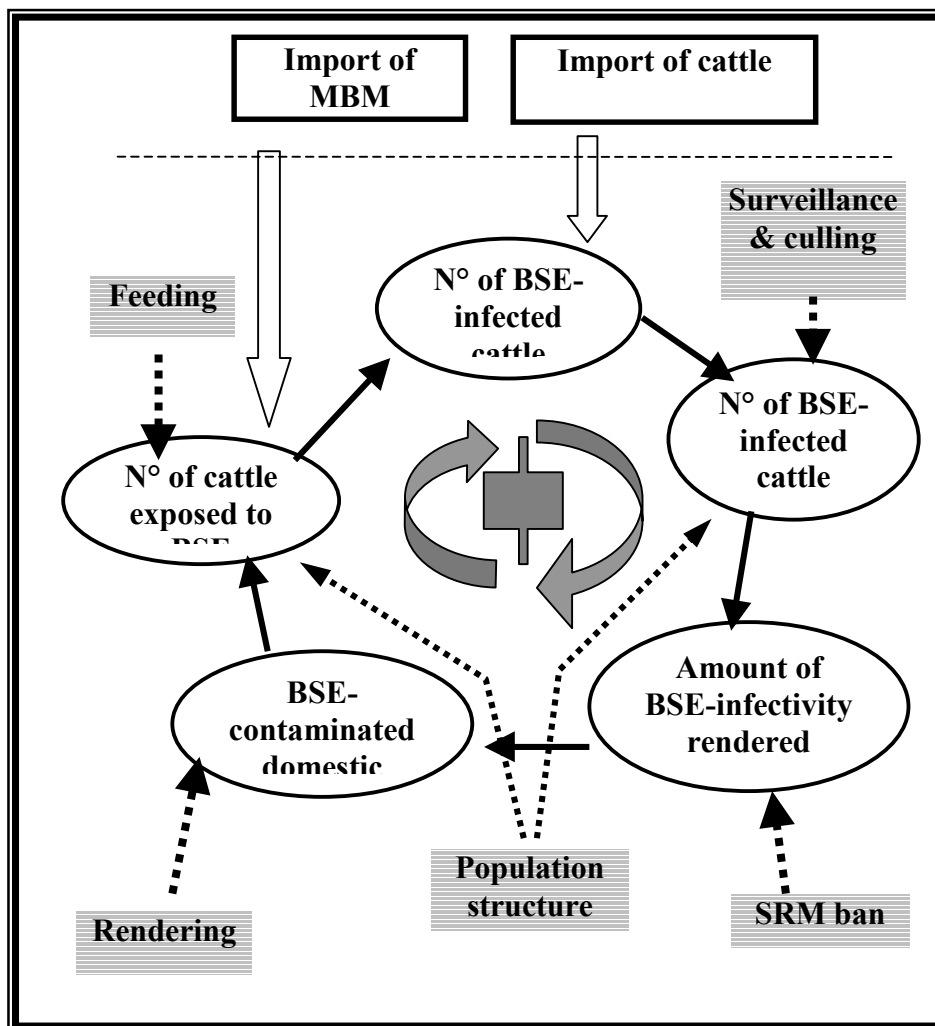
The factors assumed to be able to prevent the building-up of BSE-infectivity in the system are the following:

- Surveillance and culling;
- SRM-removal; exclusion of fallen stock
- Appropriate rendering and processing methods;
- Appropriate feed bans.

## 2.2- The methodology

The geographical BSE risk for cattle (GBR-C) is assessed by evaluating the “external challenge” presented to the cattle population either by the feeding of BSE contaminated meat and bone meal (MBM) or by the import of potentially infected animals from the United Kingdom or other BSE-risk countries. The amplification and persistence of BSE infectivity in the cattle stock of a country depends on the “stability” of the systems relating to BSE-cattle slaughter, disposal and rendering as well as to recycling of potentially BSE contaminated material. Full details are given in previous reports of the SSC (EC, 2002a). The model (see Figure) for assessing the GBR-C can be broken down basically into two parts relating to challenge and stability:

- *External Challenge*: the likelihood and the amount of the BSE agent entering into a defined geographical area in a given time period through infected cattle or MBM.
- *Stability*: the avoidance of the introduction and processing of infected cattle and the avoidance of recycling of the BSE agent via the feed chain.



The model of the BSE-cattle system used by the SSC.

From the interaction of these two parameters a conclusion is drawn on the risk that an “internal challenge” emerged through BSE-infectivity processing, recycling and propagation and on the level of that internal challenge, to be, subsequently, met by the system, in addition to the external challenges that occurred (see Figure).

### 3 THE METHODOLOGY FOR ASSESSING THE GBRS

This paper deals with a stepwise approach to assess the geographical BSE-risk for sheep and goats (GBR-S) based on the exploitation of the geographical BSE-risk for cattle (GBR-C) in order to make possible public health decisions while the very time consuming tests now being proposed for the reliable discrimination of BSE from scrapie are carried out (EC, 2002c). A working group who met on the 4 of September 2002 developed this approach. This matter had already been discussed in another working group on 19 March 2002. The implementation of this methodology is recommended only in the case BSE has been confirmed under natural conditions in at least one small ruminant (EC, 2002b). The present report should be read in connection with the SSC opinion on the pre-emptive risk assessment should BSE in small ruminants be found under domestic conditions (EC, 2002b).

#### 3.1. Information elements and assumptions

- (i) **Definitions and classification.** It is proposed to adopt for sheep the same classification of GBR already in use for cattle, i.e. levels from I to IV with exactly the same definitions after substitution of the word “cattle” with the word “sheep”. The Geographical BSE-Risk (GBR) is a qualitative indicator of the likelihood of the presence of one or more sheep being infected with BSE, pre-clinically as well as clinically, at a given point in time, in a country.

	<b>The presence of one or more sheep clinically or pre-clinically infected with the BSE agent in a region or country is....</b>
<b>I</b>	... Highly unlikely
<b>II</b>	... unlikely but not excluded
<b>III</b>	... Likely but not confirmed or confirmed, at a lower level
<b>IV</b>	... confirmed, at a higher level

- (ii) **Routes of infection.** Based on experimental evidence showing the susceptibility of some strains of sheep and goats to ingestion of BSE infected cattle material, it is assumed that BSE in small ruminants derived from ingestion of MBM made from cattle BSE-infected material. If small ruminants acquired the infection, then this infection is assumed to behave like scrapie in sheep and not like BSE in cattle. This means that, unlike cattle, BSE-infected small ruminants are assumed to be able to transmit the infection to other small ruminants, not only through the contamination of the feed chain, but also horizontally through direct contact or by contaminating the pasture on which the sheep graze. Transmission of scrapie (and supposedly of BSE) from one small ruminant to another by direct or indirect contact (including from dam to



offspring during parturition or in the immediate post-parturient period) is a more important mechanism than maternal transmission in transmitting scrapie to other animals.

It has been shown that horizontal transmission is likely to account for the majority of cases occurring within affected flocks; potential routes are via placenta (proven), milk, faeces or nasal discharges (all unproven so far). Therefore, also the so-called maternal transmission in natural sheep scrapie could be a form of horizontal transmission, as transmission of scrapie in small ruminants by semen, ova or embryos is unclear. It should also be mentioned that some circumstantial evidence exists for the transmission of natural scrapie from an infected environment. Laboratory strains of high titre hamster scrapie agent retain infectivity after burial for three years, though over 90% of the infectivity were lost; moreover, scrapie eradication programs in several countries have failed to eliminate the disease.

Thus, for the sheep flocks in Member States other than UK, small ruminants may have been externally challenged initially by the feeding of imported BSE-contaminated cattle MBM from the UK, but, as the flocks of UK sheep may have become infected, the import of MBM from infected small ruminants and of live small ruminants from the UK would then have provided a new external challenge. This scheme would then be amplified by an “internal challenge” of infective material derived from the Member States own feed systems if BSE infected material could be recycled within the country and the amplification of the “external challenge” if other Member States feeds and flocks became infected and were then imported and fed to small ruminants. This additional route of infection (i.e. MBM from both cattle and small ruminants), albeit less heavily infected than UK sources, has already been taken into account in the GBR cattle analyses as Member States became classified as level III in the SSC assessment of BSE cattle risk; an analysis now amply confirmed by the widespread findings of multiple cases of BSE positive in apparently healthy cattle populations.

- (iii) **Susceptibility of different small ruminants strains.** As far as the susceptibility of different strains of sheep and goats to TSEs, it is known that, particularly in sheep, it varies substantially depending on the breed and on the presence of specific genotypes. This issue has been considered in detail in the SSC opinion and TSE/BSE ad hoc Committee’s report on Safe Sourcing (EC, 2002b). For the present analysis there are insufficient data on the range of genotypes, breeds and BSE susceptibility of the flocks in the EU. However, as available data indicate that it is reasonable to assume that resistant small ruminants will not become infected and most likely will not harbour and shed the BSE agent, this situation may change in the future depending on the results of genotyping program of genotype in the frame of testing adult sheep and of other on-going investigations aiming at clarifying the range of genotypes, breeds and BSE susceptibility of the flocks in the E.U. In such a case, this new situation should be reflected in an updating of the present report. Moreover, Kao *et al* (2002) have presented a rationale for considering the speed of spread of BSE infectivity within the heterozygous semi-resistant sheep to be slower than in the fully susceptible animals. Thus the

incubation period for infectivity is assumed from limited experimental data to be 3 years longer than the susceptible group.

- (iv) **Dose-response.** Clearly it would be beneficial to have feeding experiments with BSE contaminated MBM rather than the current limited data using infected brains and data on larger numbers of sheep and goats fed at lower levels of infectivity. The issue of dose-response has been considered recently in some details by Kao *et al* (2002). They conclude that the probability of infection can be given by a logistic regression equation. In sheep the dose response was estimated from titrations of scrapie in mice with an intercept determined from the limited data on the proportion of susceptible sheep succumbing to BSE after consuming 0.5 g of infected cattle brain. When the chances of BSE infectivity are considered at very low levels of exposure to BSE contaminated material, the current evidence does not allow any threshold dose to be shown to exist. Indeed, given the nature of the experiments needed to demonstrate infectivity rates at very low doses, which require huge numbers of animals all exposed to low doses, it is unlikely that this information will become available. At present, the limited data on dose response curves gives no evidence of a change in the slope consistent with a threshold. The recognition that single molecules of abnormal prions can induce pathological reconfiguration of adjacent prions points to the need to assume a linear dose response curve with no threshold, even though animal and human physiologists might have doubts about the practicality of single prion incorporation into the gut transport system when so much intestinal luminal turnover, mucosal secretion and other dietary factors are likely to bind or otherwise inhibit the prions' uptake. Nevertheless, a conservative scenario is to assume a linear dose response down to very low levels of infectivity so that minute contamination of feeds can, when millions of animals are fed, lead to sporadic animal infections. In the absence of other data on this issue, it is concluded that the approach set out by Kao *et al* on the dose response should be adopted and that there is at present no evidence to take a different view for goat infectivity
- (v) **Infectivity distribution and total infectivity load:** It is extremely difficult to compare the total BSE infectivity load in cattle and small ruminants showing clinical signs, due to the different distributions of infectivity in organs and tissue and the lack of comparative tests to measure infectivity levels. The SSC opinion of 7-8 November 2002 on TSE infectivity distribution in ruminant tissues provides a summary of available infectivity data for tissues of cattle naturally and experimentally acquired BSE and of available evidence on distribution of infectivity in tissues of small ruminants affected by scrapie as being probably representative of BSE. It appears that the main difference between cattle and small ruminants is that lymphoreticular tissues in BSE in sheep and goats, and possibly their blood<sup>4</sup>, should, at least provisionally, be considered comparable in their level of infectivity with central nervous system tissues. Therefore, the assumption adopted in this

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<sup>4</sup> Through transfusion experiments in sheep, blood of TSE-infected sheep (scrapie and BSE) has been found to be infective (see also the SSC opinion of 12-13 September 2002 on The implications of the recent papers on transmission of BSE by blood transfusion in sheep However, the amount of infectivity detected in blood is very likely much smaller than that detected in most tissues listed in the opinion of the SSC of 7-8 November 2002.

report for total BSE- infectivity load in small ruminants is, in spite of the smaller size of sheep and goats as compared to cattle, the equivalence of the total infectious load of 1 adult sheep or goat to 1 adult cattle (EC, 2002d). Should a more precise evaluation for this equivalence become possible, the present assumption should be revised.

- (vi) **Prevalence of BSE in a sheep scrapie population.** There are indications that BSE is likely to be at a prevalence significantly below that of scrapie. The failure to detect the BSE-agent in a sample of 180 brains collected between 1996 and 2000 provided an upper bound for BSE-prevalence of 2% among scrapie-positive sheep (Ferguson *et al*, 2002). While monitoring for possible BSE in cases of suspect scrapie (clinical) sheep by Western Immunoblotting from 1st November 2001 until 31st July 2002, 648 submissions have been tested using the VLA hybrid method with mAb 6H4 and P4. Of these, 446 have been positive for scrapie. None have shown Western blot evidence of being similar to results found for sheep experimentally infected with BSE (1st passage Romney breed sheep (AA136RR154QQ171 genotype) and a Cheviot breed sheep (AA136HH154QQ171 genotype) (Gerard Wells, personal communication, October 2002). These figures provide an upper bound for BSE-prevalence of about 0.83% among scrapie-positive sheep (2.5% confidence level), which can be rounded up to 1%.
- (vii) **Prevalence of scrapie in small ruminants.** The available data for the prevalence of scrapie in small ruminants are very limited. Data from the UK suggest that TSE infection prevalence may be anywhere between 0.1 and 1.0% (Ferguson *et al*, 2002). Although available data are limited no evidence exists indicating any significant increase of TSE during the last 20 years. Most E.U. Member States have begun since April 2002 TSE-testing of small ruminants, but the available data are so far too preliminary to be relied upon. In any case, the results available are not in contrast with the above-mentioned figures; in fact, the TSE positives are 0.5% (134/26992) of risk sheep and 0.055% (44/80328) of healthy adult sheep. As the TSE-testing of small ruminants proceeds according to a pre-determined scheme, it should be possible to substitute the above-mentioned figures with more precise ones.
- (viii) **Prevalence of BSE in small ruminants.** A worst case hypothesis for the UK, that might also be considered for other countries, can be calculated, on the basis of a maximum TSE infection prevalence of 1.0% in the sheep population (see the above point vii) with no more than 1.0% of the scrapie sheep possibly being in reality BSE (see the above point vi), resulting in 1 BSE animal in 10 000 small ruminants (0.01%). However, calculated on the basis of a prevalence of scrapie in small ruminants of 0.5% and no more than 1% of the scrapie cases possibly being BSE, a reasonable worst case hypothesis for this prevalence is, however, assumed to be 1 animal in about 20 000 small ruminants (i.e. 0.05%).

### 3.2. The methodology

The methodology proposed to assess the GBR-S is a systematic process that follows steps (see below) and it is based on the methodology for assessing the GBR-C.

### 3.2.1. Step one –Countries in GBR-C levels III and IV

Based on the above mentioned assumptions, it is concluded that countries with GBRC levels III or IV should be classified, even in the absence of notified BSE or scrapie-cases among small ruminants, into GBR-S level III unless data can be provided showing that, since 1980, significant levels of potentially-infected MBM very unlikely or unlikely reached small ruminant through the feed chain. The methodology for assessing the data possibly provided by a country to show that small ruminants were not exposed since 1980 to significant levels of potentially-infected MBM would be the one already developed for cattle by making use of the available information highlighted in **Annex 1**. It should be understood that it would be extremely unlikely that such data would be available for most countries and that, in practice, classification in the level III GBRS would be the most common and logical consequence for all these countries.

Ideally it would be good to know the patterns of feeding of small ruminants in the different sub -regions of a country as well as in the whole country. The feeding system should be assessed in parallel to the diagnosis of scrapie as potential BSE cases. As noted in the SSC Opinion on Safe Sourcing of Small Ruminant Materials (EC, 2002b) the designation of flocks or regions with negligible risk of BSE infection will probably become important. For this the systematic appraisal of feeding systems in readily identified animals will become important. It is clear that often extensive data are available but have not as yet been collated at a national level. Information elements particularly important in this context are:

- a.1 **Feeding practices for different types of sheep flocks, preferably including the % relative amounts of MBM fed to sheep as compared to cattle.** It is recognised that there may be very different feeding systems used for example for sheep and goats kept in extensive hill grazing environments compared with intensive systems for rapid rearing of animals with high growth rates or in milking sheep flocks. A relatively simple breakdown of the proportions of animals in different regions and with particular feeding systems would help. In the absence of this evidence information of the following nature will have to be used:
- a.2 **Tons of compound feed sold annually for sheep and goats.** These statistics may be available directly or the fraction of MBM imported or produced and channeled or distributed to small ruminants is known or can be estimated
- a.3 **Inclusion rate of MBM in these feeds** It is recognised that the inclusion fraction varies in different countries and there are very different husbandry practices in various parts of the world.
- a.4 **Price charts for MBM and alternative protein sources.** Where feeding practices and the inclusion of MBM in small ruminant feeds is price sensitive then general prices may give some indication of the likely variations in MBM feeding at different time intervals in the past.
- a.5 **Cross contamination.** The previous analyses of the risk of BSE have recognised the importance of this problem, which depends on feed mill practices, whether particular mills are used exclusively for mixing feeds for one species or for all etc. In addition information on the uses of home mixers and other feeding devices will influence cross- contamination,

- a.6 **Regulatory situation re use of MBM for sheep.** Much of this issue has been covered in previous GBRC reports but further documentation and validation of the exclusion of MBM from small ruminant feeds would be useful.
- a.7 **Mixed farming practices** need to be documented and are often available. Some BSE infections of cattle have been explained on the basis that pig feed containing MBM on the farm in practice was fed to cattle and the same may therefore apply to sheep.

### 3.2.2. Step one –Countries in GBR-C level I and II

To assess the GBR-S of countries with GBR-C levels I or II, it would be necessary to check that the challenge deriving from potentially-BSE-infected materials, already assessed for cattle as being negligible or very low, remains as such even after consideration of the additional challenge for the feed chain that might have occurred since 1980 through live sheep imported from BSE risk countries (this import, in fact, might have given origin to an internal production of potentially-infected MBM which could have reached both small ruminants and cattle). Should the challenge through the feed chain due to live small ruminants be found to be negligible throughout, the GBR-S classification would remain identical to the GBR-C one. Otherwise the combined external challenge should be assessed and a stability analysis would be necessary for the sheep feeding system since 1980 and a higher GBR-S level would be likely. The issue depends crucially on the stability of the system with the exclusion of any possibility that BSE infectivity can contaminate the feeding systems for small ruminants.

In order to apply to small ruminants the methodology already developed for cattle, one could use the same external challenge categories in use in the GBR-C, taking advantage of the available information on the imports of live small ruminants (this is potentially very important as the EUROSTAT data reveal very large number of animals being traded every year) from BSE-risk countries and on the reasonable worst case assumption for the prevalence of BSE in small ruminants (see above point 3.1.viii).

#### 3.2.2.1 Assessment of the external challenge in the GBR-C

The two possible routes of introduction of the BSE agent into a BSE/cattle system taken into account in the GBRC methodology are the import of BSE-infected cattle and of BSE-contaminated "MBM" (it is important to take note that for practical reasons the MBM values used in that assessment included MBM from both bovine and small ruminant origin)<sup>5</sup>.

- The assumed challenge resulting from imports from the UK during the peak of the BSE-epidemic in the UK was taken as the point of reference
- The challenge resulting from imports during other periods and from other BSE-risk countries was assessed in relation to this baseline.

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<sup>5</sup> For the purpose of the GBR the term MBM is used as a shortcut for all kinds of feed stuffs that may contain ruminant protein, other than milk. It notably includes commodities such as Meat and Bone Meal as such, Meat Meal, Bone Meal, Greaves. As international trade statistics do not have a specific category for this type of products category 23010 is used to estimate the amount of imports. It is defined as "flours, meals and pellets made from meat and offal, not fit for human consumption; greaves".

- BSE risk countries are all countries that are already assessed as GBR III or IV or which have notified at least one domestic BSE case. These BSE risk countries have potentially exported the BSE agent since an internal challenge (see below) was likely to exist on their territory.
- Challenge levels were defined in function of imports from the UK at the time when the risk of BSE-contamination as regarded to be the highest.
- For the imports of live cattle this is the period 1988 to 1993. It was chosen as highest risk period for live cattle imports because it covers the period of roughly one incubation period before the highest incidence (1992 and 1993) and because data on case incidence in UK-birth cohorts show that this was already high in 1985/86 and 1986/87. However, breeding cattle that normally reach an age of 5 or more years in the importing country, are normally exported at an age around 24 months (e.g. as pregnant heifers). It therefore was felt justified to keep this range. (Even if it might be possible that the risk carried by imports in 1987 was slightly underestimated by this approach, it was kept constant throughout the GBR-exercise to ensure comparability of results). It is assumed that during this period the average BSE-prevalence of infected animals in exported cattle was around 5%, i.e. of 20 animals one could have been infected.

The value of 5% was used because at normal survival probabilities only one in 5 calves reaches an age of 5 year. As the case incidence in the critical birth cohorts was probably about 1%, at least 5% of the calves in that birth cohort must have been infected. A moderate external challenge was then defined as a challenge resulting from import of between 20 and 100 live cattle from the UK in the period 1988-1993. A moderate external challenge would therefore have made it likely that at least one infected animal was imported. The other levels of external challenge were established with the intention of indicating significant differences in the external challenge. The resulting scale mainly serves as a tool to ensure consistent judgement of the risk resulting from imports, rather than providing an objective measure of the level of risk.

- The period of highest risk that MBM imported from the UK was contaminated with BSE was set to 1986 - 1990. The risk peaked in 1988 when "Specified Bovine Offal" (SBO, more or less synonymous to SRM) were excluded in the UK from the human food chain but included into rendering and feed production. It was reduced with the exclusion of SBO from rendering and therefore feed at the end of 1989. As the appropriate application of that ban was delayed for some time, the risk born by MBM imports only declined since 1990 and then again in 1993, when the SBO-ban was better implemented.

**Table1** indicates that the import of one ton of MBM is considered to pose the same challenge as the import of one live animal. It is regarded to be unlikely to be higher because the probability that more than one infected cattle was processed per ton of MBM is very low, even in the UK. As one bovine carcass is rendered into about 65 kg MBM, 18 carcasses would be needed per ton of MBM. It is unlikely that more than one in 18 carcasses were BSE infected, even during the peak period in the UK. However, as rendering can only reduce BSE infectivity but not eliminates it, the risk from one ton of MBM is regarded unlikely to be lower than from one live cattle.

Table 1 - Level of external challenge resulting from import of live cattle or MBM from the UK or other BSE-risk countries						
Level of external challenge	Live cattle from the UK 1988 - 1993	UK	Other countries	MBM import from the UK 1986 - 1990	UK	Other countries
Extremely High	>10.000	UK-imports before 88 and 94-97: *10; after 97: *100	Imports from other countries with a BSE risk: R1*1000, R2*100	>10.000	UK-imports before 86 & 91-93: *10, after 93 *100	Imports from other countries with a BSE-risk: R1*100, R2*10
Very High	1.000-<10.000			1.000 -< 10.000		
High	100-<1.000			100 -<1.000		
Moderate	20-<100			20 -<100		
Low	10-<20			10 -<20		
Very low	5-<10			5 -<10		
Negligible	0-<5			0 -<5		

**Table 1: BSE-challenge levels**

- Given the much lower incidences in BSE-risk countries other than the UK or in the UK in other periods, it is assumed that the risk carried by live cattle exported from these other BSE-risk countries or from the UK in other periods is much lower. To reach the same level of risk either 100 times (R2) or 1000 times (R1) more cattle must be imported than from the UK between 1988 and 1993. For MBM 10 (R2) or 100 (R1) times more MBM must be imported than from the UK between 1986 and 1990 to represent a similar external challenge.

### 3.2.2.2 Adaptation of the assessment of the external challenge in GBR-S to take into account the contribution of live small ruminants

In order to add to the above mentioned external challenge (**Table 1**) the contribution possibly deriving from live small ruminants, it can be considered that, as compared to the average BSE-prevalence of infected animals in exported cattle from the UK in the order of 5%, the reasonable worst case assumption for the BSE-prevalence of infected small ruminants is in the order of 0.005% (see above point 3.1.viii). Assuming that the infectious load in one adult small ruminant is equivalent to that in one infected adult cattle (see the above 3.1.v), the additional external challenge deriving from small ruminants for the transmission through the feed chain could be calculated, as indicated in **Table 2**, by multiplying by a factor of 1000 the values for live cattle in **Table 1**.

<b>Table 2-Level of external challenge resulting from import of live small ruminants from the UK or other BSE-risk countries</b>			
<b>Level of external challenge</b>	<b>Live small ruminants from the UK 1988 – 1993</b>	<b>UK</b>	<b>Other countries</b>
<b>Extremely High</b>	>10.000.000	<b>UK-imports before 88 and 94-97: *10; after 97: *100</b>	<b>Imports from other countries with a BSE risk: R1*1000, R2* 100</b>
<b>Very High</b>	1.000-<10.000.000		
<b>High</b>	100-<1.000.000		
<b>Moderate</b>	20-<100.000		
<b>Low</b>	10-<20.000		
<b>Very low</b>	5-<10.000		
<b>Negligible</b>	0-<5.000		

**Table 2: BSE-external challenge levels**

These data should be fed to the GBR model and examined consequently.

### 3.2.3. STEP TWO

For countries that remain classified as GBRS level I or II at the end of step one, it would be necessary to estimate whether BSE might have entered the country through live small ruminants and transmitted through horizontal or vertical routes. To this end, use should be made of, when available, the information on the numbers of imported live small ruminants from BSE-risk country and dates. The intended use of these animals is important because it is expected that a substantial proportion of these animals are scheduled for slaughter but experience suggests that an appreciable proportion of the animals imported into one country may be rapidly exported to another country. This will reduce the risk in the first country, but amplify the potential spread of BSE infectivity.

In order to develop different challenge levels for the horizontal transmission of BSE in small ruminants, it could be considered, as a starting point, that information derived from scrapie indicates that even a small number of infected sheep (according to a worst case hypothesis, even 1 animal can be at the origin of disease spread within a flock) is sufficient to generate and sustain an epidemic and that such a probability increases with the number of potentially-infected animals imported. This evaluation should be based on the same prevalence factor reported above. Therefore, significant challenge of BSE epidemic in small ruminants would be associated to the import into a given flock of a few thousands breeding or milking sheep, whereas sheep imported for immediate slaughter are not expected to give any major contribution to this risk. For imports from the UK in periods of time other than 1988-1993 or for countries other than the UK, the challenge reduction factors indicated in **Table 2**, third and fourth columns, apply.

Obviously, this is a reasonable worst case scenario as there might be great variations among flocks dependent upon genetics, lambing conditions, age distribution of live animals, number of ewes and flock sizes. Additional details for the national breeding flock in relation to husbandry systems (e.g. stocking density and milking system may help in considering the likelihood of cross-infection), the exposure to the inflow of infected animals then has to



take account of estimates of the rates of horizontal transmission from imported sheep and through the slow spread of infection. Here again recourse could be made to estimates on the flock to flock transmission rates and the within flock infection rates.

#### 4. FINAL REMARK

Should in the future the presence of BSE in small ruminants become probable or evident under field conditions, and the need arise to apply the present methodology, the validity of the above-mentioned assumptions should be checked in the light of data available at that time.

#### 5. REFERENCES:

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**EC (European Commission), 2002b.** Opinion on safe sourcing of small ruminant materials. (Safe sourcing of small ruminant materials should BSE in small ruminants become probable: genotype, breeding, rapid TSE testing, flocks certification and Specified Risk Materials). Adopted by the Scientific Steering Committee at its meeting of 4-5 April 2002.

**EC (European Commission), 2002c.** Strategy to investigate the possible presence of BSE in sheep. Opinion adopted by the Scientific Steering Committee at its meeting of 4-5 April 2002.

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**EC (European Commission), 2002e.** Opinion on The implications of the recent papers on transmission of BSE by blood transfusion in sheep (Houston *et al*, 2000; Hunter *et al*, 2002). adopted by the Scientific Steering Committee at its meeting of 12-13 September 2002 [Revision and update of the SSC Opinion of 26-27 October 2000 on: the Implications of the Houston *et al* paper in *The Lancet* of 16 September 2000 on the Transmission of BSE by blood transfusion in sheep. (*The Lancet*, Vol. 356, pp 999-1000; 955-956; 1013)]

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## **ANNEX 1- INFORMATION ELEMENTS FOR ASSESSING THE GBR FOR SHEEP AND GOATS**

*All information should be provided, as far as feasible, on an annual basis and for the last 21 years (1980 to 2000). Information that is stable for several years might be provided only once together with a specification of the period it refers to.*

### **Structure and dynamics of the ovine/caprine population**

- Number and age distribution of sheep and goats, both alive and slaughtered
- Information on husbandry systems used for sheep and goats
  - type of main product: wool/meat/milk,
  - intensive/extensive,
  - productivity of milk-sheep/goats,
  - co-farming of pig/poultry/cattle with sheep/goats,
  - geographical distribution of sheep/goats, cattle and pig/poultry populations,
  - size distribution of sheep flocks and goat herds,
  - Internal animal trade: (n° and age distribution of sheep/goats annually traded between flocks/herds, and between different husbandry systems and/or between different regions of the country.)

### **Surveillance of TSEs in small ruminants**

Note : A description on the requirements for a high quality passive and targeted surveillance system for scrapie and BSE in small ruminants, is given in Annex 8 of EC (2001).

#### Measures in place to ensure detection of TSE (scrapie)-cases:

- Identification system and its tracing capacity (for sheep and goats)
- Date since when TSEs are (scrapie is) compulsory notifiable and criteria for a TSE (scrapie)-suspect
- Awareness training with regard to TSEs (scrapie) in small ruminants (when, how, who was trained)
- Compensation for animals culled in the context of scrapie eradication (since when, how much in relation to market value, payment conditions)
- Other measures taken to ensure notification of scrapie suspects
- Specific TSE/scrapie-surveillance programs and actions (detailed description, plans)
- Methods and procedures (sampling and laboratory procedures) used for the confirmation of TSE-cases

#### Results of TSE/scrapie-surveillance:

- Number of examined sheep and goats, by origin (domestic/imported), type (wool/milk/meat), age, method used to confirm the diagnosis and reason why the animal was examined (CNS, TSE-suspect, TSE-related culling, other)
- Result of the surveillance efforts
- Incidence of reported TSE-cases/n° of newly infected flocks by year of confirmation, by birth cohort of the confirmed cases, and – if possible – type of use (wool/meat/milk).

### ***TSE related culling***

- Eradication measures, including culling schemes, date of introduction & criteria used to identify animals that are to be culled
- Information on animals already culled in the context of TSE

### ***Import/export of live animals (bovine/ovine/caprine) and of MBM (Note: Blood, semen, embryos or ova not seen as an effective transmission route. MBM is used as proxy for mammalian protein (other than milk) as animal feed)***

- Imports/export of live animals (cattle/sheep/goats and/or MBM from/to UK, from/to other BSE-affected countries<sup>6</sup> and from/to other "BSE-free" countries; provide annual data per partner-country)
- Information that could influence the risk of imported live animals or MBM to carry the BSE agent (BSE-status of the herds/flocks of origin of imported cattle/sheep/goats, precise definition of the imported animal protein, information on the process conditions and raw material used for imported MBM, etc.)
- Use made of the imported animals and of the imported MBM.

### ***Feeding and cross-contamination***

- Composition of the feed for ruminants (for cattle/sheep/goats give the percentage of grass/pasture, roughage, industrial feeds, protein concentrates used in on-farm preparation of compound feed for ruminants, feed additives, ... per species) and measures taken to control this composition
- Use of MBM (domestic and imported: for farmed animals (ruminant/non-ruminant), in pet food, fertiliser, or in other uses (please specify); information on how this use was controlled)
- Domestic production of composite animal feed and its use (type of feed mills (single line/multiple line plants, single/multiple species production), annual production of feed by target species and by feed mill, information on how the use of the produced feed was controlled).
- Potential for cross-contamination of feed for ruminants with MBM or blood during feed production, during transport and on-farm,
  - measures taken to reduce it (labelling, awareness raising, technical installations);
  - measures taken to control it (feed sampling (specify n° of samples taken from compound feed for ruminants per year and species, method of examination, place of sampling (feed mills, during transport, on-farm), other controls in feed mills, during transport or on-farm);
  - results of the controls, handling of breaches.

<sup>6</sup> BSE-affected countries are all countries with confirmed BSE-cases and all countries classified by the SSC as GBR III, even if they have not notified any cases.

**MBM-bans**

- Dates of introduction and scope (type of animal protein banned for the use in feed for cattle, sheep and goats, exceptions, etc.)
- Measures taken to ensure compliance, and control methods and control results with regard to illegal voluntary inclusion and accidental in-voluntary inclusion (cross-contamination, cross-feeding) including information on breaches found and their handling

**SRM-bans (SRM: Specified Risk Material, i.e. material posing the highest risk of infection)**

- Dates of introduction and scope (definition of SRM per species, age limits per species, exceptions from the ban, etc.)
- Measures taken to ensure compliance
- Methods and results of compliance control
- If no ban exists: use made of SRMs (brain, spinal cord, head, vertebral column, intestine, spleen, blood etc.) of different species (provide evidence for this use)

**Rendering**

- Raw material used (species and type: slaughterhouse offal including SRM or not from ruminants and non-ruminants, other animal waste, fallen stock, etc.; annually processed amounts of raw material by species and type)
- Process conditions applied to the different types of raw material (time, temperature, pressure; batch/continuous;) and their share of the annual total domestic production
- Annual output in tons
  - per product (MBM, MM, BM, greaves, tallow)
  - per type of raw material (ruminant, non-ruminant mammalian species, non-mammalian species such as poultry or fish)
- Market outlets for the different products (feed mills, on-farm mixer, export (please specify type and amount of product exported per year and country of destination))

Note: It is understood that it is extremely unlikely that all the information listed above is available. In case a specific information element is not available, a reasonable worst case hypothesis should be used as a substitute.