

Report on
the Assessment of
the Geographical BSE-Risk
(GBR) of
PORTUGAL

July 2000

NOTE TO THE READER

Independent experts have produced this report, applying an innovative methodology by a complex process to data that were voluntarily supplied by the responsible country authorities. Both, the methodology and the process are described in detail in the final opinion of the SSC on "the Geographical Risk of Bovine Spongiform Encephalopathy (GBR)", 6 July 2000. This opinion is available at the following Internet address:

<http://europa.eu.int/comm/food/fs/sc/ssc/out113_en.pdf>

In order to understand the rationale of the report leading to its conclusions and the terminology used in the report, it is highly advisable to have read the opinion before reading the report. The opinion also provides an overview of the assessments for another 24 countries.

P A R T I

Description of the method and its
limitations, and definitions and
process used for assessing the GBR
of PORTUGAL

1. INTRODUCTION

The Geographical BSE-Risk (GBR) is a qualitative indicator of the likelihood of the presence of one or more cattle being infected with BSE (Bovine Spongiforme Encephalopathy), pre-clinically as well as clinically, at a given point in time, in a country. Where its presence is confirmed, the GBR gives an indication of the level of infection.

This opinion describes a transparent methodology that the Scientific Steering Committee (SSC) has developed, over about two years, to assess the GBR for any country that provides the information required for the assessment. This methodology is limited to bovines and feed based transmission of BSE. It does not take into account any other initial sources of BSE than the import of infected cattle or contaminated feed. It is assumed that the disease first appeared in the UK from a still unknown initial source. An important characteristic of the methodology is that it does not depend on the confirmed incidence of clinical BSE, which is sometimes difficult to assess due to serious intrinsic limitations of surveillance¹ systems. The other advantage of this methodology is that it allows an easy identification of possible additional measures that in a given situation may improve the ability of a country to cope with BSE.

The qualitative nature of this methodology and its limitations should be understood in the context of present scientific knowledge on BSE and of the availability and quality of data. As they both evolve, and with the possible advancement of diagnostic methods, the need may arise for the methodology to be revised and/or its application to particular countries to be repeated.

In parallel with the work of the SSC, the OIE (Office International des Epizooties) has developed further the BSE-chapter in its Animal Health Code, which makes reference to risk analysis as an integrated part of the procedure to establish the BSE-status of countries or zones. The compatibility of the OIE approach and the SSC methodology for assessing the GBR is extensively discussed in this opinion.

The present opinion also describes the highly interactive procedure through which the methodology has been applied to those countries that have submitted information and data so far, and the results of this application.

The SSC wants to underline that its main task is to assess whether the presence of one or more infected cattle in a given country is « highly unlikely », « unlikely, but not excluded », « likely, but not confirmed », or « confirmed at lower or higher level » and what the future trend might be. In making this assessment, the SSC has used a reasonable worst-case approach (i.e. a conservative approach) every time data availability was insufficient.

¹ Surveillance should be understood as the process of identifying BSE-cases and animals at risk of being infected.

It should be clear that the GBR has no direct bearing on human exposure to BSE. In fact, at a given GBR, the risk that food is contaminated with the BSE agent depends on three main factors:

- the likelihood that infected bovines are processed;
- the amount and distribution of infectivity in BSE-infected cattle at slaughter; and
- the ways in which the various tissues that contain infectivity are processed.

Also the risk that animals are exposed to the BSE agent is strongly influenced by a range of other parameters.

The SSC believes that decisions aimed at managing the BSE-risk are the responsibility of the authorities in charge and might need to take into account other aspects than those covered by this risk assessment.

2. THE GEOGRAPHICAL BSE-RISK (GBR) - METHODOLOGY AND PROCEDURE

2.1 DEFINITION OF THE GEOGRAPHICAL BSE-RISK (GBR)

The Geographical BSE-Risk (GBR) is a qualitative indicator of the likelihood of the presence of one or more cattle being infected with BSE, pre-clinically as well as clinically, at a given point in time, in a country. Where presence is confirmed, the GBR gives an indication of the level of infection as specified in the table below.

GBR level	Presence of one or more cattle clinically or pre-clinically infected with the BSE agent in a geographical region/country
I	Highly unlikely
II	Unlikely but not excluded
III	Likely but not confirmed or confirmed, at a lower level
IV	Confirmed, at a higher level

Table 1 - Definition of GBR and its levels

The SSC is well aware that the borderline between GBR level III and IV has to remain arbitrary, as no clear scientific justification can be provided for this differentiation. The SSC adopts for the time being the OIE threshold, i.e. an incidence of more than 100 confirmed BSE cases per million within the cattle population over 24 months of age in the country or zone, calculated over the past 12 months.

The SSC also agrees with the OIE (see also section 2.6 of this document) that, under certain circumstances, countries with an observed domestic incidence between 1 and 100 BSE-cases per million adult cattle calculated over the past 12

months, should be put into the highest risk level if, for example, there are clear indications that the true clinical incidence is in fact higher than 100 per million adult cattle calculated over the past 12 months.

Active² surveillance exercises in Switzerland (of adult cattle not notified as BSE or CNS suspect in fallen stock, emergency slaughter, and normal slaughter) and the UK (OTMS-survey³) both detected several confirmed BSE-cases that would have remained undetected by normal, passive⁴ surveillance, even if targeted at animals with neurological symptoms. The SSC therefore assumed that passive surveillance does not give a true estimate of the existing BSE-cases. The Swiss and UK results indicate that it is likely that passive surveillance, based solely on notification of symptomatic BSE-suspects, will not detect more than half or one third of all clinical cases, or even fewer. However, as long as it is impossible to detect pre-clinical cases in the early phases of the incubation period, active surveillance of apparently healthy animals younger than 24 months cannot be expected to improve the detection level.

At this stage it should be reiterated that the applied 4 GBR-levels are only used to illustrate in qualitative terms different risk levels. Each of these levels includes a range of different potential risks. This range is not considered in the current classification.

2.2 METHODOLOGY FOR ASSESSING THE GBR

2.21 Basic assumptions

The present application of the SSC-methodology for the assessment of the GBR is based on the assumption that BSE arose in the United Kingdom (UK) and was propagated through the recycling of bovine tissues into animal feed. Later the export of infected animals and infected feed provided the means for the spread of the BSE-agent to other countries where it was again recycled and propagated via the feed chain.

For all countries other than the UK, import of contaminated feed or infected animals is the only possible initial source of BSE that is taken into account. Potential sources such as a spontaneous occurrence of BSE at very low frequency or the transformation into BSE of other (animal) TSEs (scrapie, CWD, TME, FSE⁵) being present in a country are not considered, as they are not scientifically confirmed.

² Active surveillance = testing of cattle that are not notified as BSE-suspects but belong to risk sub-populations.

³ OTMS=Over Thirty Months Scheme. This scheme excludes all cattle older than 30 months from the animal feed and human food chain. The survey involved sampling about 3000 cattle older than 60 months and which did not show any symptoms compatible with BSE and found 18 BSE-cases.

⁴ Passive surveillance = surveillance of notified BSE-suspects, i.e. cattle that are notified because of clinical signs compatible with BSE.

⁵ TSE=Transmissible Spongiform Encephalopathy; CWD=Chronic Wasting Disease; TME=Transmissible Mink Encephalopathy; FSE=Feline Spongiform Encephalopathy

The only transmission mode considered in the model is feed. Contaminated feed is taken as the only possible route of infection because epidemiological research showed clearly that the origin and maintenance of the BSE epidemic in the UK was directly linked to the consumption of infected meat and bone meal by cattle. Blood, semen and embryos are not seen to be effective transmission vectors⁶. Accordingly, blood-meal is not taken into account, neither.

During the assessment, it became obvious from different sources that cross-contamination of MMBM⁷-free cattle feed with other feeds that contain such ingredients can be a way of propagating the disease. Therefore, it is important to understand that, as long as feeding of MMBM, BM (Bone meal) or Greaves to other farmed animals is legally possible, cross-contamination of cattle feed with animal (ruminant) protein can not be eliminated. Dedicated production lines and transport channels and control of the use and possession of MMBM at farm level would be required to fully control cross-contamination. It should be clear that any cross contamination of cattle feed with MMBM, even well below 0.5%, represents a risk of transmitting the disease⁸. However, the influence of cross-contamination on the GBR has to be seen in the light of the risk that the animal protein under consideration could carry BSE-infectivity.

In the light of the qualitative nature of the exercise, its relatively lesser importance in comparison to feed, and the lack of final scientific confirmation of its existence, the possible impact of maternal transmission on the GBR has not been taken into account⁹ in this methodology.

Similarly no "third route of transmission" was taken into account. The existence of a third mode of transmission of BSE, in addition to feed and vertical transmission, such as horizontal transmission via the environment, cannot be excluded. However, to date there is no scientific evidence for such a third potential mode of transmission¹⁰. The assessment also does not take into account the possibility that sheep and goats may have become infected with BSE¹¹.

The present GBR risk assessments (see chapter 3 and annex III) are only addressing entire countries and national herds. This is because of the limited availability of detailed, regionalised data. The SSC does not discount the issue of regional differences, for example in the types of animal husbandry e.g. dairy or beef, of feeding or of slaughtering ages. If complete data sets were to be provided on a regional scale, i.e. clearly relating to a defined geographical area, these could be assessed in the same way as data referring to entire countries.

⁶ See SSC-opinion on vertical transmission, 18-19 March 1999 and on the safety of ruminant blood (13/14 April 2000)

⁷ MMBM = Mammalian MBM

⁸ In its opinion on cross-contamination (n° 12 in annex I) the SSC already expressed this position.

⁹ There are statistical indications that the disease may be vertically transmitted from dam to calf. It was statistically shown that the risk of maternal transmission occurring is higher if the calf was born within 6 months before the onset of the clinical signs in the dam. Offspring cull and assurance that the dam has survived without BSE for at least six months after calving will thus provide a certain degree of assurance that its offspring is safe (see Opinions N°s 2, 4, 23, 24 and 30 listed in Annex 1).

¹⁰ See SSC-opinions N°s 4, 23, and 30 listed in Annex 1

¹¹ See SSC opinion on the risk of infection of sheep and goats with BSE, 24/25 September 1998

2.22 Information factors and model of the BSE cattle system

The methodology is based on information on 8 factors that were originally identified by the SSC in January 1998. In table 2 the most relevant information is listed that was finally found to be important for carrying out the assessment.

<p>Structure and dynamics of the bovine population</p> <ul style="list-style-type: none"> - Number and age distribution of beef and dairy cattle, both alive and slaughtered - Husbandry systems, proportional to the total cattle population (beef/dairy, intensive/extensive, productivity of dairy cattle, co-farming of pig/poultry and cattle, geographical distribution of cattle and pig/poultry populations and of different husbandry systems)
<p>Surveillance of BSE</p> <p><u>Measures in place to ensure detection of BSE-cases:</u></p> <ul style="list-style-type: none"> - Identification system and its tracing capacity - Date since when BSE is compulsory notifiable and criteria for a BSE-suspect - Awareness training (when, how, who was trained) - Compensation (since when, how much in relation to market value, payment conditions) - Other measures taken to ensure notification of BSE suspects - Specific BSE-surveillance programs and actions - Methods and procedures (sampling and laboratory procedures) used for the confirmation of BSE-cases <p><u>Results of BSE-surveillance:</u></p> <ul style="list-style-type: none"> - Number of cattle, by origin (domestic/imported), type (beef/dairy), age, method used to confirm the diagnosis and reason why the animal was examined (CNS, BSE-suspect, BSE-related culling, other) - Incidence of reported BSE-cases by year of confirmation, by birth cohort of the confirmed cases, and – if possible – type of cattle
<p>BSE related culling</p> <ul style="list-style-type: none"> - Culling schemes, date of introduction & criteria used to identify animals that are to be culled - Information on animals already culled in the context of BSE
<p>Import of Cattle and MBM (Note: Semen, embryos or ova not seen as an effective transmission route. MBM is used as proxy for mammalian protein as animal feed)</p> <ul style="list-style-type: none"> - Imports of live cattle and/or MBM from UK and other BSE-affected countries - Information that could influence the risk of imports to carry the BSE agent (BSE-status of the herds of origin of imported cattle, precise definition of the imported animal protein, etc.) - Main imports of live cattle and/or MBM from other countries - Use made of the imported cattle or MBM
<p>Feeding</p> <ul style="list-style-type: none"> - Domestic production of MBM and use of MBM (domestic and imported) - Domestic production of composite animal feed and its use - Potential for cross-contamination of feed for cattle with MBM during feed production, during transport and on-farm, measures taken to reduce and control it, results of the controls
<p>MBM-bans</p> <ul style="list-style-type: none"> - Dates of introduction and scope (type of animal protein banned for the use in feed in different species, exceptions, etc.) - Measures taken to ensure and to control compliance - Methods and results of compliance control
<p>SBM-bans (SBM: Specified Risk Material, i.e. material posing the highest risk of infection)</p> <ul style="list-style-type: none"> - Dates of introduction and scope (definition of SRM, use made of SRM, exceptions from /target animals of the ban, etc.) - Measures taken to ensure and to control compliance - Methods and results of compliance control
<p>Rendering</p> <ul style="list-style-type: none"> - Raw material used (type: Slaughterhouse offal including SRM or not, other animal waste, fallen stock, etc.; annual amounts by type of raw material) - Process conditions applied (time, temperature, pressure; batch/continuous;) and their share of the annual total domestic production)

Table 2 – Information factors for assessing the GBR *Note: all information should be available for the period from 1980 onwards and be presented on an annual base. For the purpose of the GBR-assessment reasonable worst case assumptions have been used whenever the information was not complete.*

In order to clarify the (often-delayed) interaction between these factors, the SSC has adopted a simplified strictly qualitative model of the cattle/BSE system¹² (Figure 1) which focuses on the feed-back loop that needs to be activated to spark a BSE-epidemic. This feed-back loop consists essentially of the processing of (parts of) cattle that carry the BSE-agent into feed and the feeding of this to cattle who then get infected and multiply the BSE-agent inside their bodies leading to very different concentration of infectivity in different tissues.

This feed-back loop is influenced by a number of factors that, on the one hand, may activate the loop and, on the other hand, might prevent this activation or slow down or reverse the building up of BSE-infectivity within the system.

In the model used by the SSC the initial introduction of the BSE-agent has to come from outside – it is therefore called an external challenge of the system¹³. Two possible routes of introduction are considered: import of infected cattle or import

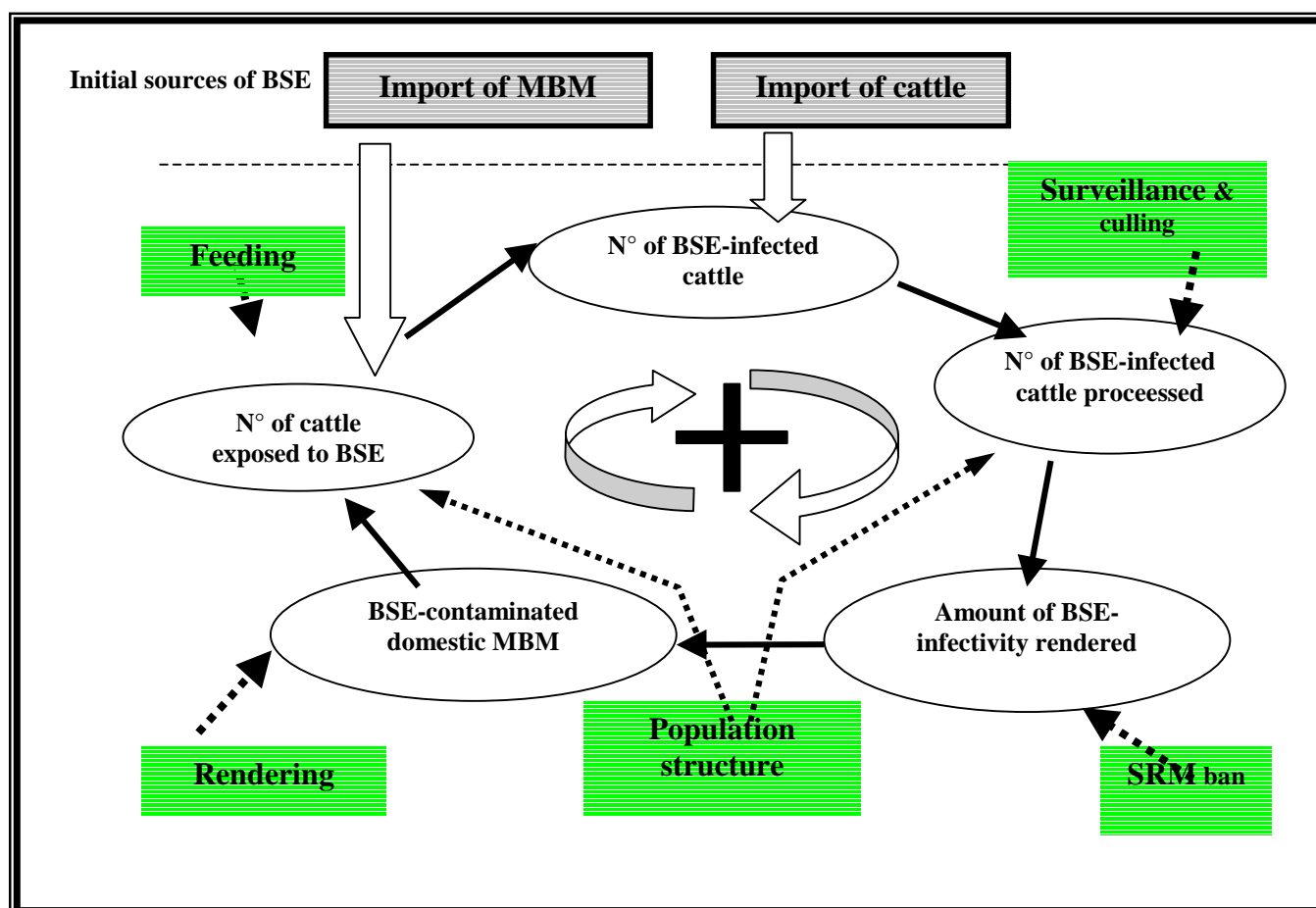


Figure 1: The model of the BSE/cattle system used by the SSC

¹² A BSE/cattle system of a country or region comprises the cattle population and all factors that are of relevance for the propagation of the BSE-agent, should it be present within its boundaries. The model used by the SSC to describe this system is presented in figure 1, it is a deliberately kept simple.

of contaminated MBM.

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

- ⇒ Surveillance and culling. By identifying BSE-cases (by passive and active surveillance including testing and laboratory confirmation) and excluding them and related cattle at risk of being infected from processing (by “culling” and destruction), the risk of introducing the BSE-agent into the feed chain is reduced.
- ⇒ SRM-removal. By excluding those tissues known to carry the bulk of the infectivity that can be harboured by a (pre-)clinical BSE-case from rendering, it reduces the infectivity that could enter the feed chain. Excluding fallen stock from the feed chain is seen to be equally effective as a “partial” SRM-ban because, according to Swiss experience, the frequency of infective (pre-) clinical cases in fallen stock seems to be higher than in normal slaughter.
- ⇒ Rendering. Appropriate rendering processes reduce BSE-infectivity that is carried by the raw material by a factor of up-to 1,000 (see footnote ¹⁴).
- ⇒ Feeding. By ensuring that no feed that could carry the BSE-agent reached cattle this effectively reduces the risk of new infections in the domestic cattle population.

In summary, the model basically can be broken down into two parts relating to challenge (chapter 2.23 and 2.25) and stability (chapter 2.24). The model assumes a mechanism for their interaction.

2.23 External challenge

The term “**external challenge**” is referring to both 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.

2.231 Assessing the external challenge

During the GBR-assessment exercise it became necessary to establish guidelines for assessing the external challenge in order to ensure that comparable challenges were always assessed similarly.

To this end it was first decided to regard the external challenge independent from the size of the challenged BSE/cattle system and in particular the size and structure of the total cattle population (see also section 2.25)

Secondly, it was decided to use the assumed challenge resulting from imports from the UK during the peak of the BSE-epidemic in the UK as the point of reference and to establish the challenge resulting from imports during other periods and from other BSE-affected countries in relation to this baseline.

¹³ For the UK it is assumed that the initial introduction of the agent happened before the period taken into account in this model.

¹⁴ See SSC-opinion on the Safety of Meat and Bone Meal, 26/27 March 1998

Therefore, the figures given in table 3 below refer to imports from the country (UK) and the period of time where the risk of contamination of exports with the BSE-agent was regarded to be highest. For live cattle imports this was assumed to be the period 1988 to 1993. As a reasonable worst case assumption it was assumed¹⁵ that during this period the average BSE-prevalence of infected animals in exported cattle was around 5%¹⁶, i.e. of 20 animals one could have been infected. Therefore, a moderate external challenge would 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 differences from this level of potentially imported infection.

The assessment of the challenge posed by MBM imports (also table 3) were similarly chosen in accordance with the following events and steps:

- The critical period, i.e. the period of highest risk that MBM imports from the UK were contaminated was set to 1986 –1990. This is the period with the highest case incidence in the birth cohorts.
- The risk peaked in 1988 when SBO¹⁷ were excluded from the human food chain but included into rendering and feed production. It was reduced with the exclusion of SBO¹¹ from rendering at the end of 1989.
- The table below indicates that the import of one ton of MBM is seen to pose the same challenge as the import of one live animal. This is justified by the fact that available import statistics do not allow the differentiation between different forms of animal proteins and that practically all MBM produced in Europe is always a mixture of ruminant and non-ruminant material. It should also be seen in the context that the probability that more than one infected cattle was processed per ton of final MBM is very low, even in the UK¹⁸.

¹⁵ The period 88-93 was chosen as highest risk period for live cattle imports because it covers the period of roughly one incubation period before the highest incidence (1992/93). Recent data on case incidence in birth cohorts show that this was already high in 1985/86 and 1986/87. However, as cattle are normally exported at an age between 6 (veal) and 24 (breeding stock) months, it was felt justified to keep this range. Nevertheless it might be possible that the risk carried by imports in 1987 was slightly underestimated by this approach.

¹⁶ The value of 5% was used because at normal survival probabilities only one in 5 calves reaches an age of 5 years. If the case incidence in a birth cohort was about 1%, about 5% of the calves in that birth cohort could have been infected.

¹⁷ Specified Bovine Offal = those bovine offal that contain the highest concentration of BSE-infectivity in a clinical BSE-case.

¹⁸ As one cattle carcass is rendered into about 65 kg MBM, 18 carcasses would be needed per ton of MBM.

<u>EXTERNAL CHALLENGE</u>	Cattle (n° of heads) imports		MBM ¹ (tons) imports			
	1988 - 93 from UK	UK-imports before 88 and 94-97: * 10; after 97: * 100	Imports from other countries with BSE: * 100	1986 - 90 from UK	UK-imports before 86 & 91-93: * 10, after 93 * 100	Imports from other BSE-countries * 10
Extremely High	≥10.000					
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		

¹ The abbreviation "MBM" refers to different animal meals (MBM, MMBM, BM, Greaves) that could carry the BSE-agent because it contains animal (ruminant) proteins. It does not refer to composite feed that could potentially contain MBM, MMBM, BM or Greaves.

Table 3: Definition of BSE-challenge levels

In other countries affected by BSE and, in the UK, at other periods the risk that exported cattle were carrying the BSE-agent or that MBM was contaminated with BSE was lower. Accordingly the challenge posed by the same amount of imports would be much lower or the same level of challenge would only occur at higher imports. To adapt the thresholds accordingly, the following multipliers were used:

Import from UK in other periods:

Cattle: before 1988 and from 1994 to 1997: multiply all thresholds by **10**;
1998 and after: multiply all thresholds by **100**;
MBM: before 1986 and from 1991 to 1993: multiply all thresholds by **10**;
1993 and after: multiply all thresholds by **100**.

Import from other countries than UK affected by BSE: regardless of period and whenever there is reason to assume that BSE was already present at time of export:

Cattle: multiply all thresholds by **100**,
MBM: multiply all thresholds by **10**.

It has to be underlined that the above figures in the table and the multipliers are only indicative. It is obvious that the final external challenge associated with imported cattle and their impact will largely depend of a number of factors including their age at slaughter. Excluding imported animals from the feed chain would reduce the challenge that the excluded animals represent to a negligible level. Accordingly imported animals that are slaughtered before reaching an age of 24 months would represent a lower challenge than imported animals used for breeding and then rendered at an age high enough to be approaching the end of the incubation period. If available, this and similar information are used to modulate the criteria in the table.

2.24 Stability

Stability is defined as the ability of a BSE/cattle system to prevent the introduction and to reduce the spread of the BSE agent within its borders. Stability relies on the avoidance of processing of infected cattle and the avoidance of recycling of the

BSE agent via the feed chain. A “stable” system would eliminate BSE over time; an “unstable” system would amplify it.

The most important stability factors are those which reduce the risk of recycling of BSE, in particular:

- avoiding feeding of MBM to cattle,
- a rendering system (“rendering”), able to largely inactivate BSE-infectivity (e.g. by applying “standard¹⁹” treatment at $133^{\circ}/20^{\text{min}}/3^{\text{bar}}$), and
- exclusion of those tissues/organs from rendering where BSE infectivity could be particularly high (“SRM-removal”). Excluding fallen-stock from the feed chain will also reduce the amount of BSE infectivity that could enter the feed chain and is necessary for a fully efficient SRM-removal. Excluding fallen stock from rendering alone, i.e. without exclusion of SRM from other cattle, would have some effect but is not as efficient as a “reasonably OK” system of SRM-removal.

A comprehensive surveillance system (including passive and active elements) and related activities that ensure detection and isolation (and destruction) of BSE-cases and cattle at risk of being infected would also enhance the stability of the system.

These stability factors were already relevant before their contribution to prevent spreading the BSE epidemic was scientifically understood. It is therefore clear that even compliance with a regulation that at that time was scientifically up-to-date may not always have guaranteed stability.

2.241 Stability levels

A BSE/cattle system can only be regarded to be “**optimally stable**” if all three main stability factors (feeding, rendering, SRM-removal including fallen stock) are in place, well controlled, implemented and audited (“OK”). Ideally such a system would also exclude fallen stock from processing into feed and integrate a highly effective capacity to identify BSE-cases and exclude them together with cattle at risk of being infected from being processed. Such a system would fully prevent propagation of BSE-infectivity and eliminate BSE-infectivity from the system very fast.

If two of the three factors are assessed to be “OK” but one of these factors is only reasonably implemented (“reasonably OK”), the system could at best be assumed to be “**very stable**”. Propagation would be largely prevented but the elimination of BSE-infectivity from the system is slower than in an “optimally stable” system.

A system can still be assumed to be “**stable**” as long as two of the three factors are “OK”, or one is “OK” and two are “reasonably OK”. BSE will be eliminated from the system over time but propagation may still take place – only at a lower rate than the elimination of BSE from the system.

If all three factors are “reasonably OK”, the system can nevertheless only be assessed as “**neutrally stable**”, i.e. it would neither amplify nor reduce circulating

¹⁹ As defined in the SSC-opinion on MBM, see n°8 in annex 1

BSE-infectivity over time. The same is true if only one factor is “OK” and two are not present or only badly implemented.

If only two factors are “reasonably OK”, the system is seen to be “**unstable**”. It will amplify BSE, should it be introduced. This means the propagation rate is higher than the elimination rate, if there is any.

With only one “reasonably OK” factor in place, the system is assumed to be “**very unstable**”, i.e. recycling a large proportion of the BSE-agent and propagating the disease rather fast.

If none of the three factors can even be considered as “reasonably OK”, the system would be “**extremely unstable**”, quickly propagating the BSE-agent, should it enter, and amplifying the BSE-load of the system.

These considerations are summarised in table 4 below that was used as guidance for ensuring comparability of approaches used for assessing the degree of stability of a given BSE/cattle system between the different country assessments.

<u>STABILITY</u>	Level	<i>Effect on BSE-infectivity</i>	Most important stability factors		
			Feeding	Rendering	SRM-removal
Stable: <i>The system will reduce BSE-infectivity</i>	Optimally* stable	<i>Very fast</i>	Feeding OK, rendering OK, SRM-removal OK		
	Very stable	<i>Fast</i>	Two of the three factors OK, one reasonably OK.		
	Stable	<i>Slow</i>	Two OK or 1 OK and two reasonably OK.		
Neutrally stable		<i>+ - constant</i>	3 reasonably OK or 1 OK		
Unstable: <i>The system will amplify BSE-infectivity</i>	Unstable	<i>Slow</i>	2 reasonably OK		
	Very Unstable	<i>Fast</i>	1 reasonably OK		
	Extremely Unstable	<i>Very Fast</i>	None even reasonably OK		

Table 4: BSE-stability levels (*“Optimally” should be understood as “as good as possible according to current knowledge”.)

Explanation concerning the three main stability-factors:

Feeding: OK = evidence provided that it is highly unlikely that any cattle received MMBM.

Reasonably OK = voluntary feeding unlikely but cross contamination cannot be excluded.

Rendering: OK = only plants that reliably operate at 133°/20^{min}/3^{bar}-standard.
Reasonably OK = all plants processing high-risk material (SRM, fallen stock, material not fit for human consumption) operating at 133°/20^{min}/3^{bar} – standard, low-risk material is processed at more gentle conditions.

SRM-removal: OK=SRM-removal from imported and domestic cattle in place, well implemented and evidence provided. Fallen stock is excluded from the feed chain.

Reasonably OK = SRM- removal from imported and domestic cattle in place but not well implemented or documented. If in addition to a “reasonable OK” SRM-removal fallen-stock is excluded from rendering, the “SRM-removal” might be considered “OK”. Exclusion of fallen stock from rendering alone is regarded to be useful but not as effective as a “reasonably OK” SRM-removal.

Note:

Surveillance and culling are essential for the ability of a system to identify clinical BSE-cases and to avoid that they, and related at-risk animals, enter processing. A good surveillance system can therefore, in combination with appropriate culling, improve the stability by supporting the exclusion of BSE-infectivity from the system. It would, however, not be sufficient to make a system more stable (move it into the next higher stability level) than it would be due to the three main stability factors.

2.25 Internal challenge

The term “internal challenge” is referring to the likelihood and the amount of the BSE-agent being present and circulating in a specific geographical area in a given time period.

If present, the agent could be there in infected domestic animals, where it would be replicated, in particular in SRMs, and in domestic MBM made from the infected domestic cattle. The internal challenge in a given period is a consequence of the interaction of the stability of the system and the combined external and internal challenge to which it was exposed in a previous period.

- If a fully stable BSE/cattle system is exposed to an external challenge, processing and recycling of the BSE-load entering the system will be prevented and the infectivity load will be neutralised over time. No internal challenge will result from this external challenge because the system is able to cope with it.
- If an unstable BSE/cattle system is exposed to an external challenge, processing and recycling of the BSE-load entering the system will take place and the agent will start circulating in the system. It will first be present in contaminated domestic MBM and, if this is fed to domestic cattle, these are likely to become infected. After approximately another 5 years (average incubation period) a certain number of them, which have survived until that age, could become clinical-BSE cases. Others might be processed before developing clinical symptoms and the infectivity harboured by them will again be recycled. By this way the internal BSE-load of the system is going to be amplified and a BSE-epidemic could develop (see fig.2).

The number of domestic cattle that are pre-clinically or clinically infected with the BSE-agent while being alive in the system at a given point in time could be taken as an indicator of the size of the internal challenge. However, it is currently impossible to detect pre-clinical BSE-cases and early clinical phases of BSE are

easily misdiagnosed. Therefore the time frame required for an internal challenge to be detected in an unstable country challenged by BSE will normally be at least one incubation period after the initial challenge (approximately 5 years). It may be much longer, depending on a number of factors including the following ones:

- ⇒ the extent of the BSE challenge (a larger challenge would lead to more new infections with a higher number of cases reaching the clinical phase);
- ⇒ the extent of the instability of the country (a very unstable system would amplify the infectivity faster and lead more rapidly to a higher number of cases);
- ⇒ the size of the national cattle population (within a smaller population the same number of cases might be more easily discovered than in a large population, i.e. given a similar initial challenge and similar rates of propagation it would take longer to reach the same incidence level), animal demographics and agricultural and marketing practices of the challenged countries (e.g. if cattle are hardly reaching an age of 5 or more years, the probability that incubating animals turn into clinical cases is reduced); and
- ⇒ the quality and validity of the BSE surveillance in the challenged country (the better the surveillance the earlier the detection as the risk of missing a case is smaller).

Depending on the many specifications of each case, detection of an internal challenge may take from a minimum of an average of 5 years from the initial challenge (average incubation period) up to several incubation periods. The longer periods might be valid because several cycles of about one incubation-period each are needed to reach numbers of clinical BSE-cases that are detectable by existing surveillance systems.

In principle, it cannot be excluded that, under certain circumstances, even an infectious load entering an unstable BSE/cattle-system may have no impact. This may happen if it is unintentionally eliminated, e.g. if contaminated imported MBM is all fed to pigs or poultry and does not reach cattle, even if during that period feeding MBM to cattle was legally possible and generally done. However, the SSC has assumed, as a reasonable worst case scenario, that exposure of an unstable system to the BSE agent would always result sooner or later in an internal challenge. The speed of this development depends on the degree of stability of the system.

2.26 Interaction of overall challenge and stability over time

The overall challenge is the combination of the external and internal challenges being present in a BSE/cattle system at a given point of time.

Four different basic combinations of stability and challenge can be seen.

- A **“stable”** system that is not or only slightly **“challenged”**: this is obviously the best situation.
- A **“stable”** system that is highly **“challenged”**: this is still rather good because the system will be able to remove the BSE, even if this might need some time.

- An “unstable” system is not or only slightly “challenged”: as long as BSE is not entering the system, the situation is good. However, if BSE would enter the system it could be amplified.
- An “unstable” system is “challenged”: obviously this is an unfortunate situation. BSE-infectivity entering the system will be amplified and an epidemic will develop.

These “stability” and “challenge” situations are illustrated by the two-dimensional diagram given in Figure 2, where both axes spread between the respective lowest and highest feasible level.

		Overall Challenge						
		Negligible	Very low	Low	Moderate	High	Very high	Extremely high
Stability Reduction Amplification	Optimally stable							
	Very stable	Best					Good	
	Stable							
	Neutral							
	Unstable				→			
	Very Unstable		X→	→				
	Extremely Unstable	Good					Worst	

Figure 2: Stability/challenge combination, four principal situations and a hypothetical development over time

Since the above-mentioned 8 factors, on which challenge (external and internal) and stability depend, change over time, it is necessary to assess the challenge and stability at different periods. These periods might, for example, be determined in function of changes of stability (e.g. by an MBM-ban) and/or challenge (e.g. preventing BSE from entering the system).

The arrows in figure 2 indicate an example for a hypothetical development over time. A very unstable system is exposed to a very low initial (external) challenge. Because of the low stability and as it is assumed that no special measures are taken to prevent the “dangerous” imports from entering the feed cycle, e.g. by putting the imported animals under strict monitoring and prohibiting them to be rendered, the BSE-infectivity is recycled and, over time, amplified. After some time (several years) the challenge (external plus internal) is reaching a moderate level but in the hypothetical example the stability is improving, too, for example by excluding ruminant MBM from cattle feed. The system, however, remains unstable and

therefore the BSE-infectivity that is present in the system continues to be recycled and amplified. A high challenge develops. Fortunately the stability of the system is increasing. As soon as it is stable the system eliminates BSE-infectivity and the challenge decreases (as long as no new external challenges occur). With a further improvement of the stability the decrease of the challenge will be quicker.

From the above explanations it becomes clear that the past stability and overall challenge of the system are the reason for the current internal challenge and hence the current GBR. The impact of most risk management measures on the number of clinical BSE-cases is delayed by at least one incubation period of BSE, in bovines on average 5 years. Therefore measures taken in the last five years may have had an immediate effect on the recycling and amplification of the BSE-agent and hence the internal challenge and the current GBR but will only be reflected in the number of clinical BSE-cases around one incubation period after their effective implementation.

It is also clear that the future development of the GBR is influenced by the occurrence of additional external challenges and the continued ability of the system to reduce any incoming or already existing BSE infectivity. Assuming that new challenges can be avoided, the current stability determines the slope of the GBR-trend. An optimally stable system will very quickly reduce the GBR-level and an extremely unstable system will very quickly amplify any BSE-infectivity that is already in the system and increase the GBR-level.

2.3 PROCEDURE FOR ASSESSING THE GBR

2.31 Development of the methodology

In January 1998, the SSC established a list of factors on which it would require information for assessing the Geographical BSE-Risk (GBR)²⁰.

In July 1998, the Commission recommended to Member States and interested Third Countries to provide information on these factors²¹.

In December 1998, the SSC issued a draft opinion on a method for assessing the Geographical BSE-Risk of a country or region. This was adopted in February 1999²², taking into account comments received and the method was first applied in March 1999 to 11 Member States of the European Union (MS) that had supplied dossiers at that time. The methodology and process were repeatedly updated. The basis for these updates was the experience gained with its application to 26²³ countries who had voluntarily submitted information and the comments received from several of these countries on

- the drafts of their reports (April/May and June 1999 and 2000),

²⁰Opinion of the SSC on defining the BSE-risk for specified geographical areas. 22/23 January 1998

²¹Commission recommendation of 22 July 1998 concerning information necessary to support applications or the evaluation of the epidemiological status of countries with respect to TSEs. (C(1998) 2268); 98/ 447/EC)

²²Opinion of the SSC on a method to assess the Geographical BSE-Risk of countries or regions. 18-19/02/99

²³The reports for the Czech Republic, India and the Slovak Republic are still pending finalisation.

- a working document of the SSC on the GBR (April 2000), and
- the preliminary opinion of the SSC on the Geographical risk of BSE and the preliminary country reports on the BSE-risk assessment (May 2000).

2.32 The process

The application of the SSC methodology was carried out with the help of about 50 independent experts, coming from most of the Member States and Third Countries.

More than three independent experts assessed each country and discussed their analyses with the country's experts in order to clarify the available information. These discussions proved to be very valuable. To date, July 2000, twenty-three countries have been assessed.

The assessed countries have openly co-operated in the assessment by sending their country experts and by reacting to the draft reports forwarded to them for comments. During the process many countries provided additional information that improved the basis for the risk assessment.

The process by which the independent experts²⁴ assessed the GBR of a given country is outlined in table 5. The report on the assessment of the GBR of each country followed the same scheme. The interaction of the countries was essentially contributing to the tasks in step 1 (data appreciation) and the appraisal of the appropriateness of the conclusions drawn and presented under the points 2-5.

Notwithstanding the efforts made to harmonise the approaches taken by the different experts, a certain degree of difference in appraisal of comparable data could not have been avoided. With a view to harmonise the different country reports and to ensure consistency a final review of all assessments was carried out from January 2000.

Having taken account of the draft country reports available in January 2000, the SSC charged 20 independent experts to review them. In order to do so they were asked to establish criteria for determining the respective degrees of stability and challenge of each country, and to apply these consistently to all assessments. The experts were also requested to apply a consistent approach to estimating the current and future GBR derived from the past and current interaction of stability and challenge.

²⁴ In order to identify these independent experts the ad-hoc TSE/BSE group discussed the importance of the quality of the experts and developed a set of criteria that was subsequently adopted by the SSC (October 1998). Members of the ad-hoc group and of the SSC were invited to submit names and a list of possible candidates was established, also including experts known to the secretariat from previous work. This list was discussed at the TSE/BSE ad-hoc group and also given to the SSC. There were no objections to the list and it was left to the secretariat to invite the experts taking account of the selection criteria agreed on and the availability of the experts.

1. Appraisal of the quality of the available data
2. Assessment of the Stability of the BSE/cattle system (over time). 2.1 Ability to identify BSE-cases & to exclude cattle at-risk of being infected from processing 2.2 Ability to avoid recycling BSE-infectivity, should it enter processing 2.3 Overall assessment of the stability (over time)
3. Assessment of the challenges to the system (over time) 3.1 External challenge resulting from importing BSE 3.2 Internal challenge resulting from the interaction of external challenge and stability. 3.3 Overall challenge (over time)
4. Conclusion on the resulting risks (over time) 4.1 Interaction of stability and overall challenge (over time) 4.2 Risk that BSE-infectivity enters processing (over time) 4.3 Risk that BSE-infectivity is recycled and the disease propagated (over time)
5. Conclusion on the Geographical BSE-Risk 5.1 The current GBR as function of the past stability and challenge 5.2 The expected development of the GBR as function of past and present stability & challenge. 5.3 Recommendations to influence the expected development of the GBR.

Table 5: - Outline for the assessment procedure established by the SSC and applied by the independent experts. This outline was also used to structure the Country reports.

In order to do so, the 20 independent experts:

- agreed on practical criteria of assessing challenge and stability to be used as "orientation" to avoid inconsistencies between countries and
- established guidelines for revising and harmonising the reports & their presentation and
- agreed on the current GBR-level and the expected trend for each of the countries assessed on the basis of the information available to them early in February 2000.

The reports that had been prepared by the 20 independent experts were then examined by the TSE/BSE ad-hoc-group and the SSC.

On 2/3 March 2000 the SSC indicated a general agreement with the assessments while still pinpointing to room for improvement in terms of consistency within and between reports and terminology-standardisation. The SSC also recognised the need to up-date them in the light of additional information that became available between May 1999 and early March 2000. It charged a small group of its members and some assessors to carry out this task, taking due account of comments received by the members of the TSE/BSE ad-hoc group, the SSC and the Commission services, which were also invited to comment on the factual correctness of the reports. Subsequently the reports were sent to the respective countries together with a copy of a draft of this opinion. Comments on both documents were requested from the countries by early May 2000. The comments received were taken into account for revising the methodology of the SSC for assessing the Geographical Risk of Bovine Spongiform Encephalopathy (GBR) and preparing preliminary versions of the country reports. It was assumed that countries, which did not submit comments, agreed to the provided documents.

On 25/26 May 2000 the SSC adopted the preliminary opinion and the preliminary GBR-country reports and requested their immediate publication on the Internet, inviting comments on both, the opinion and the reports, until 19 June 2000. Being aware of the sensitivity of the topic, the SSC made it clear that it would only consider comments related to the Risk-Assessment dimension of the issue, not those on the Risk-Management aspects.

The current final opinion and the related final GBR-country-reports take due account of the comments received. These documents now set out the SSC's final views on both the methodology issues and the GBR in each country that has been considered.

In reviewing this opinion and the related country reports it should be understood that in the view of the SSC it is expected that the framework of analysis will need to be revised if novel findings emerge, i.e. this opinion is dynamic in process as more scientific evidence will be available. These may relate to the source of BSE, to the diagnosis and transmissibility of BSE or to the infective dose for man. It can also be expected that novel developments in surveillance and management techniques or new tests to assess the prevalence of sub-clinical BSE conducted in a country may also precipitate the need for a selective re-assessment of a particular GBR.

The SSC's experience in assessing changes in the challenges and stability of countries, however, suggests that trends in incidence figures may allow different conclusions to be drawn only after 3 –5 years. In any case, the current assessments have to be up-dated from time to time.

2.4 AVAILABILITY AND QUALITY OF DATA

The SSC is well aware of the critical importance of the availability and quality of data for any risk assessment. It is, therefore, necessary to appreciate that the current GBR assessments are mainly based on information provided by the assessed countries and that it is essential to assume that the information provided is correct. In essence the provision of an appropriate basis for the GBR-assessment was the responsibility of the competent national authorities.

In general the available data were seen to be adequate to carry out the assessment of the GBR. Despite all efforts, however, considerable differences in the availability and quality of data remain of concern.

Additional sources of information, such as reports from the missions of the EC-Veterinary Inspection Services (the Food and Veterinary Office, FVO) and UK trade statistics were also used as available.

To complement insufficient information, and in line with the recommendation of the Commission of July 1998, "reasonable worst case assumptions" were used whenever extrapolation, interpolation or similar approaches were not possible.

A shortcoming in many dossiers, which had to be overcome by reasonable worst case assumptions, was insufficient information on compliance with the preventive measures put in place by the competent national authorities. For most countries

additional information on this issue could therefore improve the basis for the risk assessment further.

While for E.U. Member States reports from the missions of the FVO were generally available, this is not the case for Third Countries, with the exception of Switzerland. This is important because in case of conflicting information the FVO-mission reports were generally taken as the authoritative source. Mission reports have also been demonstrated to be very useful sources to fill gaps in the available information.

In addition the information base for third countries could also be improved by extensive exploitation of additional publicly available sources. Given these considerations it might be argued that the foundation on which the assessments for third countries are based is not in all cases fully equivalent to the one for the Member States.

Another problem with data availability was recognised, as some countries did not provide data before 1988. In view of the importance of this period for possible initial challenges and recycling of BSE, and in order to treat all countries equally the independent experts stated the following:

“Whenever the available information does not cover the period 1980 to 1988, an open question remains as to the challenge and stability of the system during that period. To this end the following was generally applied:

Challenge: *Given the fact that the UK-epidemic was building up during that period, the implication is that any country that traded live cattle or MBM with the UK in this period could have imported some BSE-infectivity. If the system was unstable during that period (what was frequently the case) the potentially incoming BSE-infectivity could have been amplified.*

In order to have a first approximation of the possible external challenge, UK-export data to the country in question were used. The Commission is also invited to provide the appropriate EUROSTAT data for the same purpose. An analysis of the different import/export figures from different sources would be most useful to improve the information basis for the period in question for all countries.

Stability: *The stability of the system prior to 1988 is estimated on the basis of the available information, if necessary through extrapolation from the last known data.*

If it is not possible to base an assessment of imports on the UK export data or to extrapolate the stability, it will be assumed that the country was subject to a low challenge while its BSE/cattle system was not fully stable. This unfavourable situation is assumed to have lasted until the available data allow assessing the situation differently”.

The impact of incoming cattle on the GBR of the receiving country is assessed on appraisal of the BSE situation in the exporting countries at time of export. Should it become apparent that this appraisal was wrong, the assessment of the

geographical BSE-risk of the receiving country would have to be reviewed. Imports from not-assessed Countries could not be taken into account. It was also in principle impossible to take account of triangular trade as a route for external challenges to develop.

2.5 MONITORING THE EVOLUTION OF THE GEOGRAPHICAL BSE-RISK

In order to monitor the evolution of the GBR, it is very important to improve the ability to identify clinically and sub-clinically BSE-infected animals and potentially infected MBM.

According to field observations in Switzerland, the incidence of BSE is higher in fallen stock and in cows offered for emergency slaughter than in healthy looking animals presented at routine slaughter.

Since the GBR-assessment exercise started, three rapid post-mortem tests for BSE became available. These make appropriate intensive surveillance programmes possible, targeting at-risk sub-populations such as adult cattle in fallen stock or in emergency slaughter, cohorts of confirmed BSE cases. Results from such programmes, applied to statistically justified samples, could improve the basis for future assessments of the GBR, or help to verify the current risk assessment.

Three rapid tests in bovines have been shown by the European Commission (European Commission, 1999, *The Evaluation of Tests for the Diagnosis of Transmissible Spongiform Encephalopathies in Bovines* – see DG-SANCO internet site at http://europa.eu.int/comm/dgs/health_consumer/index_en.htm) to have excellent potential (high sensitivity and specificity) for detecting or confirming clinical BSE for diagnostic purposes or for screening dead or slaughtered animals, particularly casualty animals or carcasses to be used for rendering.

The above tests are:

- *Prionics* : an immuno-blotting test based on a western blotting procedure for the detection of the protease-resistant fragment PrP^{Res} using a monoclonal antibody
- *Enfer* : a chemiluminiscent ELISA, using a polyclonal anti-PrP antibody for detection
- *CEA* : a sandwich immunoassay for PrP^{Res} carried out following denaturation and concentration steps. Two monoclonal antibodies are used.

The currently available rapid post-mortem tests are able to prove the presence of PrP^{Res} in the CNS of cattle that are close to the end of the incubation period or already clinically ill. However, these tests cannot be considered to be able to identify pre-clinical cases at earlier stages of the incubation. The SSC, therefore, regards these tests to be useful for complementing existing surveillance efforts based on notification of BSE-suspects and detection of infected cattle with heavy loads of infectivity.

They should not, however, be used to guarantee the absence of the BSE-agent from an individual animal tested and found to be negative. The SSC wants to underline its support for the development of improved rapid BSE-diagnostic tests ultimately aimed at having reliable ante-mortem tests able to detect pre-clinical BSE.

Moreover, for an accurate assessment of the future trends in GBR, compliance data (from farming/slaughtering/rendering¹² industries) will be especially important. This information will be needed to determine the effectiveness of the various preventive measures, including bans, adopted and hence their impact on the GBR.

2.6 RELATION OF THE GBR TO THE OIE CODE ON BSE

2.61 *The role of Risk Assessment*

The OIE International Animal Health Code, Chapter 3.2.13 related to BSE, adopted May 2000, states that the status of a country or zone can only be determined from the outcome of a risk analysis. The OIE – International Animal Health Code, Section on Risk Analysis (section 1.4) outlines methods for this process as they are related to issues for the importation of animals or animal products. The OIE identifies the components of the risk analysis process as: hazard identification, risk assessment, risk management and risk communication. The risk assessment is the component of a risk analysis that estimates the risk associated with a hazard. Risk assessment methods should be chosen in relation to the specific situation. They may be qualitative or quantitative. The SSC method for the assessment of the Geographical BSE-Risk is one of the possible qualitative methods that can be used for the risk assessment component of this process. It is, however, an innovative approach using terminology different to those applied in the risk assessment literature and the OIE-section on risk analysis.

The SSC method for the assessment of the geographical BSE-risk is comparable to the OIE-guidance on risk analysis and in particular the chapter on risk assessment. The following points should be taken into consideration when determining the comparability of the SSC-method to other potentially proposed methods:

- The hazard identification is not included in the SSC-method for the assessment of the GBR as it was taken for granted that the BSE-agent is the hazard (see also the SSC-opinion on Human Exposure Risk).
- The release assessment required according to the OIE-guidance could be compared with the assessment of the “external challenge” and the “internal challenge” and their interaction as described in this opinion. The SSC assessment is not completed if the risk of an external challenge has been identified as negligible. This is contrary to the OIE-guidance. This SSC approach is justified by the high degree of uncertainty with the epidemiology and biology of the BSE-agent as well as with its monitoring and surveillance. The SSC method attempts to address the stability of the assessed BSE/cattle systems as a means to establish its capacity to resist future challenges that are currently unknown.

¹²As a follow-up to its earlier validation studies on appropriate heat treatments of animals meals, the Joint Research Centre has conducted a study on the Prevention of Epidemic Diseases by appropriate Sterilisation of Animal Waste. According to SSC Opinion (20-21 January 2000), the test may become, after further validation, a useful additional part of verification and control protocols for verifying the appropriateness of processing equipment in rendering plants (effective wet sterilisation carried out at least at 133°C/20’/3 bars), provided a sample of appropriate test material is available to be processed.

- One might, however, compare the thrust of the SSC-method with an exposure assessment. The assessment of the inherent stability of a given BSE/cattle system with regard to BSE might be compared, to a certain degree with an analysis of the pathways needed to allow the exposure of animals to BSE. In an unstable system the pathways are open and would lead to exposure whereas in a stable system the risk of exposure occurring is much lower because the pathways are closed. Typically, a pathway assessment would depend on the specific situation and could, according to the OIE, vary from country to country. The SSC-method applies systematically one model of the BSE/cattle system that describes the pathways in a fully transparent and standardised manner. This provides a basis for obtaining comparable results in different countries.

The SSC-method derives a similar end-point as an exposure assessment described in the OIE-guidelines for risk assessment: it provides a qualitative estimation of the likelihood of the exposure to an identified hazard (the BSE-agent), at a given point in time. However, the SSC-method requires assessing the consequences of past exposures, in the SSC-terminology the internal challenges, which together with the external challenges again interact with the stability and create a new exposure situation. Because of the importance of the time dimension in this delayed process the SSC-terminology seems to be more adequate to describe the positive feed-back loop that is responsible for the BSE risk than the more static terms used in conventional Risk Analysis and Risk Assessment.

The SSC-risk assessment is well in keeping with the recommendation in the BSE-chapter of the OIE code. There it is requested to include all factors that could have lead to a risk of introducing or propagating the BSE agent in the country/region under consideration. This list is in fact very similar to the list of risk factors used by the SSC.

According to the BSE-chapter of the animal health code of the OIE, a BSE-risk analysis has to evaluate whether potentially infected material was imported, and, in such a case, whether the conditions in the country were/are sufficient to cope with potentially infected material, i.e. to prevent the disease being propagated. This is, indeed, exactly the objective of the SSC-method.

The OIE's list of factors that should be taken into account when analysing the BSE-risk includes:

- importation of meat-and-bone meal (MBM) or greaves potentially contaminated with a transmissible spongiform encephalopathy (TSE) or feedstuffs containing either; (note: MBM-imports are a very important part of the external challenge which is assumed by the SSC to be the only initial source (except in the UK). Due to lack of data the SSC currently did not take account of greaves or feedstuff-imports);
- importation of animals, embryos or ova potentially infected with a TSE; (note: while animal imports are an essential element of the external challenge assessment, the SSC does not take account of embryos or ova as the risk of transmitting the disease via these routes is regarded to be insignificant in comparison to the import of MBM and infected live cattle);

- consumption by cattle of MBM or greaves of ruminant origin; (note: the use of MBM is a central point of the SSC-assessment and greaves, and bone meal have been addressed whenever data were differentiated enough to allow for this);
- origin of animal waste, the parameters of the rendering processes and the methods of animal feed production; (note: this is one of the central points of the SSC-method, determining the stability of the system It is covered under the headings SRM-ban, rendering, and cross-contamination in the reports);
- epidemiological situation concerning all animal TSE in the country or zone; (note: the SSC does not take account of other animal TSEs because (a) the available data were very poor and (b) the link with BSE is not scientifically established, even for scrapie); and
- extent of knowledge of the population structure of cattle, sheep and goats in the country or zone. (note: while the information on the population structure – and dynamics- of the cattle population is taken account of, the information on small ruminants is, for the time being, not considered by the SSC).

The OIE also requests that the following measures, and their date of effective implementation (“relevant period of time”), be considered when determining the BSE- status. The SSC-method, however, considers them together with the other risk factors:

- compulsory notification and investigation of all cattle showing clinical signs compatible with BSE; *(note: this factor is taken into account in the SSC-methodology when assessing the capacity of the system to identify clinical BSE-cases and to eliminate animals at risk of being infected before processing)*;
- a BSE surveillance and monitoring system with emphasis on risks identified; *(note: also taken into account by the SSC when assessing the BSE-surveillance and when assessing the compliance with the feed and SRM bans)*;
- an on-going education programme for veterinarians, farmers, and workers involved in transportation, marketing and slaughter of cattle, so as to encourage reporting of all cases of neurological disease in adult cattle; *(note: this is an integral part of the SSC-assessment of the surveillance system)*;
- examination in an approved laboratory of brain or other tissues collected within the framework of the aforementioned surveillance system; *(note: again taken into account by the SSC in the context of the surveillance assessment)*;
- treatment of at-risk animals linked to confirmed cases (culling) *(note: covered by the SSC as a separate point contributing to the ability of the system to identify clinical cases and to eliminate at risk animals)*.

From the above it is clear that there is a close similarity between the relevant factors identified by OIE and those being used by the SSC to assess the GBR.

The SSC provides a detailed methodology for assessing the geographical BSE-risk, taking account of all relevant factors, including those listed in the BSE-chapter of the International Animal Health Code of the OIE. The SSC method also involves an external review of the GBR on the basis of information provided by countries and, in view of the long incubation period of the disease and its initially probably slow progress, it tries to cover the last twenty years. As it is based on a prescribed model of the dynamics of the BSE-disease, this methodology can be applied

consistently and transparently to available information. The application of the principle of reasonable worst case assumptions and special care to ensure consistency of these assumptions allows a reasonable estimation of the GBR even in cases where the available information is not fully satisfactory.

3. IMPLICATION OF THE GBR ON FOOD AND FEED SAFETY

From the definition of the GBR (see section 2.1) it is clear that it refers to the risk situation at the live-animal level.

At a given GBR the risk that food or feed is contaminated with the BSE-agent, depends on three main factors:

1. the likelihood that bovines infected with BSE are processed;
2. the amount and distribution of infectivity in BSE-infected cattle at slaughter;
3. the ways in which the various tissues that contain infectivity are used.

In addition the trading of potentially contaminated foods and feeds also influences this risk.

3.1 LIKELIHOOD THAT BOVINES INFECTED WITH BSE ARE PROCESSED

The likelihood that processed bovines are infected with BSE (processing risk) depends obviously on the GBR. However, the processing risk may differ for different cattle sub-populations, defined on the basis of criteria such as herd history, feeding history, date of birth in relation to identified challenges.²⁵

If the difference in processing risk of different sub-populations is known, excluding those that carry a higher specific processing risk would reduce the overall processing risk below the level that is indicated by the overall GBR.

This is for example possible by excluding birth cohorts born before an effective MBM-ban from slaughter²⁶. The exclusion of fallen-stock (in particular adult cattle) from rendering also reduces the processing risk. Ensuring that as many as possible of the infected (clinically and pre-clinically) cattle are excluded from processing also reduces the processing risk. The quality of the BSE-surveillance and the related measures (culling) are essential in this context.

3.2 AMOUNT AND DISTRIBUTION OF INFECTIVITY IN BSE ANIMALS

3.21 Amount

The amount of infectivity carried by an infected animal strongly depends on the incubation stage it is in. Assuming that most infection happen close to birth, the age of an animal is a good approximation of the potentially possible incubation stage and hence its infective load.

²⁵ See, for example the SSC opinion on “closed herds”, or on the “Date based export scheme” for criteria that are used to define sub-populations with a much lower BSE-risk.

²⁶ The Date based export scheme, excluding animals born in the UK before the ultimate MBM ban of 01/8/1996 from export, is an example for the application of this principle.

For instance, the infective load of animals below 24 months of age is in general very much lower than it would be possible for an animal of 60 months, assuming that both were infected shortly after birth.

Reducing the age at slaughter can hence reduce the infective load that potentially could enter the human food chain. Excluding older animals from rendering would have a similar effect on the feed chain.

The OTMS (Over Thirty Months Scheme) that excludes in the UK all animals older than 30 months from the human food and animal feed chain makes use of this effect. As, in the meantime, all animals that are allowed to be processed are also born after the latest MBM-ban (01/08/1996), it can be assumed that the combined effect of the OTMS and the feed-ban very effectively reduces the processing risk below the level expected from the current GBR (level IV).

3.22 Distribution

It is known that in an infected cattle that is approaching the end of the incubation period, the BSE infectivity is very unequally distributed. Certain tissues (the so-called SRM – Specified Risk Material) represent a particularly high risk. Their exclusion from further use (food or feed) reduces the infective load that could enter the respective chains. (See also the opinion of the SSC on SRM of Dec. 1997).

3.3 USE OF THE VARIOUS ORGANS AND TISSUES FROM BSE-ANIMALS

Each tissue/organ of a bovine can be used for a range of uses. Some of them require processing that is known to be capable to reduce BSE-infectivity.

The SSC has expressed its opinion on the production of gelatine, tallow, MBM, and a range of other bovine based products that may be used for food, feed or non-food/feed purposes. It has defined the conditions that have to be met to achieve maximal BSE-infectivity reduction and/or the BSE-infectivity reduction that can be expected from the normally applied/applicable processes. It has also included into these conditions considerations of the BSE-risk carried by the raw material with regard to tissues and the geographical origin of the animals.

With regard to process conditions it has been shown that some reduce BSE-infectivity²⁷, others (e.g. normal cooking, sub-standard rendering) have no measurable impact on it.

4. CONCLUSION

The assessment clearly shows that the current GBRs reflect, more than anything else, differences among the commercial and agricultural practices existing between the early 80s and the early 90s, a time when knowledge on BSE, and its public health impact, was very limited. Since then, however, the awareness has

²⁷ See the various SSC-opinions on the safety of Gelatine, Tallow, MBM, Hydrolysed proteins, Fertilisers, etc.

tremendously increased and effective measures have been put in place to minimise the impact of BSE on public health.

In fact, at a given GBR, the risk of humans or animals to be exposed to the BSE-agent can be influenced by measures

- before slaughter, that exclude at-risk animals (such as fallen-stock²⁸) and/or reduce their age at processing;
- during slaughter by excluding SRM from further processing,
- after slaughter by applying appropriate processes, able to reduce BSE-infectivity.

These measures might also be modulated in view of the intended end use of the meat or other bovine derived products. If control can be ensured, products that are only used for non-food/non-feed uses (also called industrial uses) could carry a higher risk than food or feed products. The SSC has the intention to address this issue in more detail in a specific opinion.

²⁸ See the opinion of the SSC on “fallen-stock”

PART II

REPORT ON THE ASSESSMENT OF THE
GEOGRAPHICAL BSE RISK OF
PORTUGAL

EXECUTIVE SUMMARY

OVERALL ASSESSMENT

The current geographical BSE-risk (GBR) level is IV: BSE is confirmed in domestic cattle at a higher level.

The observed incidence of clinical cases over the last 12 months (16 June 1999-15 June 2000) was 215.8 per Million adult cattle. This figure is generated by a passive surveillance system not able to identify all cases, that has only recently acquired some active components.

Stability: Before 1990 the Portuguese system was extremely unstable. The situation improved to some extent in 1990 by making BSE a notifiable disease and awareness building measures but due to the continued feeding of MBM to cattle and inappropriate rendering, including SRM, the system remained extremely unstable until 1994. In 1994 the implementation of an MBM ban for ruminants improved the stability but the system remained very unstable because of insufficient compliance and continuing shortcomings in rendering and feed production. In 1996 compensation was introduced which increased notification of suspects but the system remained very unstable until late 1997, when improvements in rendering started. Measures taken in 1998 significantly improved the system, which since 1998 is regarded to be stable, i.e. able to reduce, over time, the BSE-infectivity circulating in the system. Most important were the extension of the MBM ban to all farmed animals, the exclusion of SRM from the feed chain, the improvement of rendering and the improvement of the surveillance system. In the year 2000 the system could be regarded as very stable, as all three main stability-building measures are in place but compliance data would be needed to confirm this positive assessment.

External challenge: Between 1985 and 1989 Portugal was exposed to very high external challenges mainly by imports of cattle from the UK. Within these imports 7 BSE-cases were identified but more than 8,200 cattle entered the Portuguese system and were processed. Imports of cattle from other countries known to have BSE and some imports of MBM added to this external challenge and maintained a certain level of inflow of BSE-infectivity until at least 1996.

Interaction between stability and challenge: Given the extremely unstable Portuguese system the incoming BSE-infectivity was amplified and a domestic prevalence developed at the latest since 1984, the first birth cohort wherein a BSE-case was confirmed. Together the internal and the external challenge are at very high and extremely high levels since the late 80s and early 90s, while the system was still extremely unstable. This challenge/stability combination led to the observed building-up of an epidemic, where the numbers of newly infected cattle increased every year. It seems to be likely that this trend decreased with the MBM-ban of 1994 but significant numbers of new infections continued to appear until 1998, when the preventive measures taken were finally sufficient to make the system stable. Since stability has only been reached in 1998/99 and the challenge is still assessed to be extremely high, even a temporary increase of the incidence cannot be excluded for the next few years, although so far no new cases of BSE have been registered that were born after January 1996. The

incidence will decrease quickly once the pre-1999 birth cohorts will have left the system.

Assuming that measures in place, which render the system very stable continue to be appropriately implemented and no new external challenge occurs, the GBR will decrease over time, even if the incidence figures will only decrease sharply once the birth cohorts before 1999 will have left the system.

JUSTIFICATION

1. Available data

- The information available was sufficient to complete the assessment.

2. Assessment of the Stability of the BSE/cattle system

2.1 Ability to identify BSE-cases and to eliminate animals at risk of being infected before they are processed

- Before 1989, the ability of the system to identify and remove BSE-infected animals before processing was considered to be very low. The introduction of the mandatory reporting in 1990 improved the situation slightly, but it remained sub-optimal. Since the mid-90s increased disease awareness, improved compensation schemes and culling of cohabitants improved the situation.
- The 1998 introduced improvements in monitoring and registration established a good basis for a passive surveillance system, including an appropriate back-tracing capacity. They should, if appropriately implemented, improve the ability to identify and remove animals at risk of being infected with BSE before they are processed.
- Surveillance of fallen stock has improved since mid 1999 when instructions were divulged in Portugal for sampling and laboratory examination of adult cattle in fallen stock for BSE.

2.2 Ability to avoid recycling BSE-infectivity should it enter processing

- Prior to 1994, the system was not able to avoid recycling of BSE infectivity, since the rendering technique was insufficient to reduce infectivity and ruminant-derived MBM was fed to cattle.
- The MBM-to-ruminant ban, introduced in 1994, decreased the potential of recycling BSE-infectivity to some extent. However, it is likely that it continued at lower rates, due to insufficient compliance and cross-contamination of cattle feed with MBM that still contained SRM and was produced by inappropriate rendering.
- From 1997 to 1998 SRM were excluded from human consumption but included in non-ruminant feed. This increased the amount of BSE-infectivity entering the feed chain and hence the risk of recycling BSE-infectivity.
- Since 1998, the ability to avoid recycling of the BSE agent is assumed to have improved significantly. Main factors were the improved rendering, the MBM-

to-all farmed animals ban, better feed controls, banning SRM from the feed cycle and improved surveillance. This judgement is supported by compliance data for the feed ban for 1999 and the start of active surveillance of fallen stock in mid 1999.

2.3 Overall assessment of the stability (over time)

- Until July 1994 the system was extremely unstable.
- In 1994, with the implementation of the MBM-to-ruminants ban, the stability improved to some extent but the system remained very unstable, i.e. it was still amplifying fast BSE-infectivity entering or circulating in the system.
- Improvements in the rendering industry started in 1997. They improved the stability of the system to some extent, but it remained unstable, continuing to amplify BSE-infectivity but at a lower rate.
- Since 1998, the stability improved significantly and the system became increasingly able to remove BSE-infectivity from the system not at least because of an improved capacity to detect and trace back BSE-cases. Since 1999 the system is stable.
- In 2000 the system could be very stable. Compliance data would be needed to confirm this.

3. Assessment of the challenges to the system

- A high external challenge was posed by the importation of UK cattle, particularly over the period 1985-1989.
- An internal challenge developed at least since 1984, the first birth cohort including a BSE-case. It most likely over-compensated any decline in the external challenge and led to extremely high levels of the overall challenge, which probably peaked in the early 90s but which is still likely to be extremely high.

4. Conclusion on the resulting risk

4.1 Interaction of stability and challenge

- In the mid to late 80s an extremely unstable system was faced with very high external challenges. The imported BSE-infectivity entered the domestic system and was amplified, together with the apparently already circulating BSE-infectivity. This led to an increasing internal challenge reaching extremely high levels in the mid-90s.
- Although improvements were made in 1994, the system remained unstable until 1998 and an extremely high internal challenge is still present, even if the system is regarded to be stable, but not very stable, since early 1999 and possibly very stable in 2000. This stability should be able to cope, over time, with the still existing challenge and reduce the BSE-infectivity circulating in the system.

4.2 Risk that BSE-infectivity enters processing

- Since the 80s and until 1998 it has to be assumed that BSE-infectivity entered processing at increasing amounts, mainly because of slaughtering infected imported and domestic cattle at different stages of incubation.
- Since 1998, the risk that BSE-infectivity enters processing is reduced, thanks to the SRM-ban, but remains at a high level due to the still high number of infected animals being present.
- The processing risk decreased to some extent when animals born after the first MBM-ban started being processed. It will significantly decrease once the birth cohorts 1999 and later are slaughtered.

4.3 Risk that BSE-infectivity is recycled and propagated

- Given the extremely unstable system and the high and extremely high challenge it was exposed to, the propagation risk increased since the 80s and was extremely high until 1994.
- The introduction of a feed ban in 1994 decreased the potential of propagation to some extent but was counteracted by insufficient compliance and cross-contamination.
- The temporary exclusion of SRM from the human food chain and inclusion of it into the animal feed cycle might have increased the propagation risk during the period 1997-98.
- Extension of the feed and of the SRM ban, improved rendering and other measures in 1997/8 have further reduced the propagation risk, but compliance data will be needed to confirm that it is now negligible.

5. Conclusion on the Geographical BSE-Risk (GBR)

5.1 The current GBR

The current geographical BSE-risk (GBR) level is IV: BSE is confirmed in domestic cattle at a higher level.

- The observed incidence of clinical cases over the last 12 months (16 June 1999-15 June 2000) was 215.8 per Million adult cattle. This figure is generated by a passive surveillance system, not able to identify all cases that only recently has been amended by some active components.

5.2 The expected development of the GBR

- Assuming that measures in place continue to be appropriately implemented and no new external challenge occurs, the GBR will decrease over time, even if the incidence figures will only decrease sharply once the birth cohorts before 1999 will have left the system.

5.3 Recommendations for influencing the future GBR

- Ensuring optimal compliance with the introduced measures is of utmost importance for supporting the decline of the GBR.

- Further improved active surveillance, targeting at-risk sub-populations such as fallen stock and emergency slaughter will be most useful to better assess the current extend and to monitor the development of the epidemic. By improving the ability of the system to exclude animals being at risk to incubate BSE it will also accelerate the decline of the epidemic.

FULL REPORT

1. Available data

1.1 Consistency, completeness and treatment of gaps in the available data

The information provided in the dossier and by additional sources was largely complete, consistent and considered reliable. Extrapolation, interpolation and realistic worst case assumptions were used to bridge gaps that could not be closed otherwise.

1.2 Sources of information used

- Information provided by the country authorities and by the country experts.
- FVO mission reports 1996, 1997, 1998 and 1999 (February, June and October).
- The BSE web site maintained by the Portuguese Ministry of Agriculture (<http://www.min-agricultura.pt>)
- 15th report on the implementation of the Commission Decision of 18/11/98
- Annual report on TSE-surveillance for 1999, according to 98/272/EC.

1.4 Recommendations for improving the basis for assessing the Geographical BSE-Risk

- Detailed compliance data would allow verifying the efficiency of the preventive measures, in particular with regard to feeding, rendering and SRM-ban.
- Detailed information on the efficiency of cohabitant tracing would be helpful.

1.5 Overall assessment of the suitability of the available information for the assessment

- The information available was sufficient to complete the assessment.

2. Assessment of the Stability of the BSE/cattle system

2.1 Ability to identify BSE-cases and to eliminate animals at risk of being infected before they are processed

2.11 Factor 1: Population structure

(If not otherwise indicated figures do refer to information available in June 1999.)

2.111 Population data

- Total size of the cattle herd is between 1.3 and 1.4 million, 722,000 being older than 24 months.
- Slightly over 50% of the adult cattle are dairy animals.
- There has been no major changes in these figures over the last 10 years.

2.112 *Age distribution of cattle, alive and at slaughter*

- Due to the format used in the dossier, the following assumptions had to be made concerning the approximate age of different classes of cattle: Calves < 1 year, Steers and heifers: 1 - 2 years, Bullocks and cows > 2 years. The derived age structure of the national herd is therefore approximately 28% at an age of 0-1 year, 17% at 1-2 years, 55% >2 years. Dairy cattle were described as generally having 2 or 3 productive years.
- According to the Portuguese Annual Report on TSE-surveillance of 1999 since the period August 97 to July 98 722,000 cattle are over 24 months old, before it were 729,000.
- A small proportion of adult cows is slaughtered each year. The National Association of Dairy Cow Breeders provided an estimate of the average age at death of 5.25 years (based on the records for 359,000 animals over the period 1993 – 1998). Detailed data for the age distribution at slaughter in 1999 are given in the table below.

Classes		Definition	Number of heads	Percent
Light		Carcass weight <220 Kg and complete milk-tooth	143,657	35.1%
Heavy	A	Steers <2 years	135,759	33.1%
	B	Bullock >= 2 years	9,488	2.3%
	C	Castrated males	2,675	0.7%
	D	Cow > 2 years	75,147	18.3%
	E	Heifer <= 2 Years	42,869	10.5%
	Total			409,595

Table 1: Age distribution at slaughter of cattle in Portugal, 1999

2.113 *Husbandry systems*

- Most dairy herds are very small, having 1 to 3 animals, and are concentrated in the North and Northwest (Regional Agricultural Directorates 1, 2 and 3).
- Of 250 BSE-cases that were studied in detail, 78.4% came from farms raising cattle and pigs (3.6%), cattle and poultry (55.2%) and 19.6% raising cattle, pigs and poultry.
- Beef farming is mainly extensive, with larger herds located in the mid- and south regions (predominantly Regional Agricultural Directorate 6).

2.114 *Cattle identification and monitoring system*

- Registration and ear-tagging schemes for dairy cattle have been in place for more than 20 years, initiated for an ongoing Bovine Tuberculosis and Brucellosis eradication campaign.
- Due to reliability problems, in particular the loss of tags, almost all dairy cattle born since 1996 were marked with an improved plastic (rather than metal) tag, recording a region and individual animal code.
- Each farm also has a unique registration number (recorded in the PISA database on animal health). However, significant shortcomings of that system were identified by a FVO-mission.
- Pedigree animals were also identified by a sketch card and an ID sheet.

- The system has been further improved by the introduction of double-tagging of animals born after October 1998, and modification of the existing database.
- Since breeding records are not always kept, tracing of progeny was difficult. New formats of compulsory herd registers (introduced 1st September 1998) record the identity of the dam. Monitoring of progeny may also be possible through milk quality recording systems.
- After June 1999 a new system for animal identification including a central database was introduced (SNIRB). According to the 15th report on the implementation of the Commission Decision of 18/11/98, now, January 2000, 1,157,986 (of 1,267,000) bovines are registered in the SNIRB database. However, the mission report of Oct. 99 noted still several shortcomings.

2.12 Factor 6: Surveillance

2.121 Description of the surveillance system and its development over time

- Before 1990 no specific mechanisms were in place to identify BSE cases.
- 1990: BSE was made notifiable in 1990. Initial identification of suspect cases is the responsibility of the farmer or vet. These then contact regional directors to organise confirmation in one of two laboratories.
Between 1990 and 1998, 804 cattle were reported to the authorities for which BSE could not be excluded on clinical grounds. Within this sample, on average 49.1% (37.5%-100%) were confirmed as BSE cases on the basis of histology.
- Since late 1998, laboratory diagnostic methods were improved. All samples are initially examined by histopathology. If positive, no more tests are made. If negative or doubtful, IHC (immunohistochemistry) is used to confirm the diagnosis. If material was autolysed or not suitable for examination by histopathology or IHC, the tissues are subjected to Western Blot.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Suspects (n°)	1	1	2	8	17	20	62	51	203	439
BSE+ (n°)	1	1	1	3	12	14	29	30	106	170
BSE+ % samples	100	100	50	37.5	70.6	70.0	47.0	58.8	52.2	38.7

Table 2: Number of BSE-suspects annually examined and confirmed as BSE-cases.

- Awareness: Seminars were introduced in 1990 to increase knowledge and vigilance, in particular for practitioners and veterinarians of slaughterhouses. Since 1994, courses for veterinary officers and technicians have been organised twice a year. By the end of 1998, an information leaflet was sent to every holding. The mission in October 1999 assumed that this could have triggered the increase in n° of suspects in 1998/99 but also found some shortcomings in the training efforts with regard to practitioners and veterinary inspectors in abattoirs. Overall it can be expected that awareness of BSE has increased over the last 10 years, but is likely to have been poor for much of this period. It is assumed to be better in the regions with BSE.
- Since 1996 the incentive to report cases is increased by a compensation scheme, with full compensation for suspect animals and cohabitants.
- 1998/99: Attempts have been made to trace 'cohabitants', i.e. animals that shared a farm at any time with an animal that subsequently developed BSE. All cohabitants that can be found are destroyed and tested for BSE. By 30.4.2000 14,504 cohabitants had been traced, and until mid 1999 twelve new cases were

detected in the analysed cohabitants. According to a declaration of the Portuguese authorities, 90% of all cohabitants found were already dead, the other 10% were destroyed (on average 36 per confirmed case) and tested for BSE.

- Ante-mortem examination of animals for clinical signs of BSE occurs at the slaughterhouse. However, few or no suspects or cases have been identified in Portugal by this method. The specific data are contradictory. According to the Fifth (and the 15th) Portuguese Report on the Implementation of the Commission Decision Dated 18 November 1998 (March 1999, January 2000) no suspect animals have been found at slaughterhouses. A FVO-mission report states that 5 suspect animals were recognized at ante-mortem examination between 1994 and 1996. Two were later confirmed as cases. However, according to the mission report of October 1999, the ante mortem inspection is not satisfactory and the training system is weak (see above).
- Fallen stock has been traditionally buried on site. Notification of fallen stock was not compulsory and very little information was available on these animals which were therefore largely outside the surveillance system. In the new identification rules the necessary registration of the death of the animal in the farm/herd-register is adopted. But no information was requested on how and where the dead animal was destroyed/eliminated.
- Surveillance of fallen stock has improved since mid 1999 when instruments were divulged in Portugal for sampling and laboratory examination of fallen stock for BSE.

2.122 Quality of the surveillance system with regard to BSE

- The main requirements for a passive BSE surveillance system (mandatory reporting and full compensation for suspect cases) have been fulfilled only since 1996 but there are still problems in tracing animals at risk.
- Before 1998 the BSE-surveillance did not meet the requirements of OIE and 98/272/EC. Since 1998 the numbers of BSE-suspects annually examined exceeds the requirements of OIE and EC 98/272.
- The surveillance system was passive, and therefore insufficient to ensure identification of all BSE infected animals. The rate of detection was most probably significantly lower before 1998. Since then the system has been remarkably improved and since mid 1999 active components have been included, targeting fallen stock. Also the number of BSE-suspects is remarkably increased while the rate of confirmation declined. Today the system must be regarded to be much more performant than before 1998.

2.13 Factor 8: Culling

- Between 1994 and 1996 cattle in a herd with a suspect or confirmed case were subject to some limitations, but could be moved to other herds. As about 30% of moved animals were lost to the PISA database, these cohabitants could not be monitored appropriately.
- Since 1996, if a suspect case is confirmed the culling policy include the cohabitants i.e. all cattle that have resided at any time in the same herd. Following confirmation of BSE, all cohabitants that can be traced are culled and compensation paid.

- Previously, exceptions to the cohabitant culling policy were potentially made when the confirmed case resided in the herd for short periods.
- Efforts are made to extend the trace-back and cull of cohabitants to earlier BSE cases. In Oct. 1999 the total n° of culled cohabitants represented 10% of all at-risk animals that could be traced – the other 90% were already dead. Until 30/4/2000 there were 43 slaughter operations and 14,504 cohabitants have been culled and tested (on average 36 per BSE-case).
- In addition to cohabitants, all UK imports (mainly 1985 - 1989) and their progeny that can be traced are also destroyed.

2.14 Overall appreciation of the ability to identify BSE-cases and to eliminate animals at risk of being infected before they are processed

- Before 1990, the ability of the system was not able to identify and remove BSE-infected animals before processing.
- The introduction of the mandatory reporting in 1990 and slowly increased disease awareness improved the situation but it remained sub-optimal until 1998, with n° of suspects annually examined below the OIE criteria.
- Since 1996 improved compensation schemes and culling of cohabitants improved the ability.
- The improvements in tracing capabilities (SNIRB database) and increased efforts to raise awareness and to trace cohabitants, further improved the system which could now, depending on the quality of implementation of the measures, enable a good performance.
- Given the fact that the surveillance remains passive, the system can still not identify all clinical BSE-cases. The fact of uncontrolled burial of fallen stock further reduces the percentage of all clinical cases the system is able to detect.

2.2 Ability to avoid recycling BSE-infectivity, should it enter processing

2.21 Factors 3 and 4: Domestic MBM production and use

2.211 Domestic production of MBM

- Data were available for 1997 and 1998: approximately 43,000 tons of MBM were produced each year.

Raw material	Product: Meals (tons)	Product: Fats (tons)
SRM	14,933	7,423
Healthy animals	34,016	22,618
Total	48,949	30,041

Table 3: MBM and fats produced from SRM and from other (healthy) material in 1999.

2.212 Description and history of feed ban(s) and their compliance

- A ban on the incorporation of MBM in ruminant feed stuffs was introduced in July 1994.
- In 1998 MMBM was banned from feeding to all farmed animals.
- In view of the fact that 28 confirmed BSE cases have been reported that were borne after the 1994-ban, it was assumed that initial compliance with the 1994 ban was low and improved only slowly. The situation has further improved since 1998, as shown by the compliance data for 1999 when 3 positive were found in 1,689 samples analysed (0.18%; source: 15th progress report).

- In the past ELISA testing for animal protein in animal feed was abandoned very soon after initiation because it was felt to be unreliable.

2.213 Use of MBM (before and after feed ban)

- MBM was routinely fed to cattle until 1994.
- After the first feed ban, MBM was used extensively in the poultry and pig industries. During this time, it is also likely that some MBM still reached cattle, due to lack of compliance and cross contamination.
- Since 1998, use of MBM in all farmed animal feed is forbidden.

2.22 Factor 5: SRM ban and treatment of SRM

2.221 Description and history of SRM bans

- In 1997 SRM/SBO have been removed from human food chain but were still included in rendered materials and hence pig and poultry feed.
- Since 1998 all SRM are rendered separately and stored for incineration.
- SRM include: Head (tongue excluded, skull, brain, eyes, TRG, tonsils, and other tissues included), spinal cord, thymus, intestines and spleen of all cattle.

2.222 Fate of SRMs

- Between 1997 and 1998 SRM were included into MBM used in poultry and pig feed.
- First SRM and material from at-risk cattle (cohabitants) was rendered in the same plants as “normal” material, operating on a special day basis.
- Currently, all SRM (and all suspect animal material) is rendered in one specialised plant; up to 31.03.2000, a total of 60,491 tons of MBM was produced. The available incineration systems have insufficient capacity to dispose of the processed material, which is therefore stored at military bases awaiting export for incineration.

2.23 Factor 7: Rendering

2.231 Raw material used for rendering

- The rendering industry used raw material of all species including SRM for MBM production until 1998.
- Since end 1998 the SRM and material at risk are rendered separately. First on a special-day basis, now in a specialised plant.

2.232 Rendering processes

- Until 1998, most rendering plants operated atmospheric batch or continuous atmospheric processes. The first plant to move to pressurised processes did so in October 1997. After this date other plants were required to send MBM to this plant for sterilisation. No compliance data for this requirement is available.
- After March 1998 all relevant plants were declared to be implementing the pressure standard. However, lack of compliance was detected at inspection of one plant. Full details of the temperatures used are not known. The FVO mission reports indicate that monitoring procedures (e.g. HACCP) are poor or simply not in place.

2.233 *Capacity of the rendering system to reduce any potential BSE-infectivity in the raw material*

- Until 1998 the rendering system was unable to significantly reduce BSE-infectivity entering it.
- Since 1998 rendering should be according to standard but compliance data were not available.

2.24 Cross-contamination

2.241 *Possible types of cross-contamination*

- Cross-contamination of “normal” rendering raw material with SRM was possible until 1998 as ruminant material, including SRM, was rendered together with other materials. Furthermore, before 1998, up to 9 rendering plants dealt with BSE cases, suspects and cohabitants and operated on a dedicated day system. Hence, potentially infected material was rendered in plants that also produced material used in animal feed.
- Cross-contamination in feed mills was possible because feed manufacturers did not use separate lines for feed for different species. Hence cross contamination of cattle feed with potentially contaminated (R)-MBM could have occurred after the 1994 ban.
- Cross-contamination at transport was/is possible.
- Cross-contamination at the farm level was likely until 1998 because MBM (including ruminant protein also made from SRM) was permitted in poultry and pig feed and mixed farming is common. There is some evidence that at least one domestic case arose as the result of cross feeding.

2.242 *Measures undertaken to control cross-contamination*

- Since December 1998, all SRM and all confirmed cases, suspect animals, fallen stock and cohabitants are rendered in a single specific plant, thus reducing significantly the risk of cross-contamination during rendering.
- Intensified controls of composite cattle feed are introduced and 1,689 samples were analysed in 1999, three being positive for MBM.
- A recall of stocks of MBM and compound animal feed containing MBM was finished on 7/5/99.
- On-farm feed sampling started on 31 May 1999 and in June 1999 1825 controls on dairy farms were carried out.
- There was no information on attempts to label pig, poultry and cattle feed differently in order to reduce on-farm cross-contamination.

2.243 *Assessment of the potential level of cross-contamination*

- A high degree of cross-contamination of ruminant feed with (potentially infective (ruminant)) MBM was possible at all levels until at least 1998.
- Since May 1999 (end of recall action) it seems to be under control, as demonstrated by the feed sampling results of 1999.

2.25 Overall appreciation of the ability to avoid recycling BSE infectivity, should it enter processing

- Prior to 1994, the system was not able to avoid recycling of BSE infectivity, since the rendering technique was insufficient to reduce infectivity while high

risk material (SRM, fallen stock) was rendered for feed production and ruminant-derived MBM was fed to cattle.

- The MBM-to-ruminant ban, introduced in 1994, decreased the potential of recycling BSE-infectivity to some extent. However, it is likely that it continued at lower rates, due to insufficient compliance and cross-contamination of cattle feed with MBM that still was produced inter alia from ruminant material including SRM and fallen stock and by inappropriate rendering processes.
- From 1997 to 1998 SRM were excluded from human consumption but included in non-ruminant feed. This increased the amount of BSE-infectivity entering the feed chain and hence the risk of recycling and amplifying BSE-infectivity and propagating the disease.
- Since 1998, the ability to avoid recycling of the BSE agent is assumed to have improved significantly. Main factors are the improved rendering, the MMBM-to-all farmed animals ban, better feed controls and banning SRM from the feed cycle. This judgement is supported by compliance data for the feed ban for 1999.

2.3 Overall assessment of the stability

- Until July 1994 the system was extremely unstable.
- In 1994, with the implementation of the MBM-to-ruminants ban, the stability improved to some extent but the system remained very unstable, i.e. it was still amplifying BSE-infectivity entering or circulating in the system at a rather fast pace.
- Improvements in the rendering industry started in 1997. They increased the stability of the system to some extent, but it remained unstable, continuing to amplify BSE-infectivity but at a lower rate.
- Since 1998, the stability improved significantly (assuming an efficient application of the measures) and the system became increasingly able to remove BSE-infectivity from the system. This was supported by the improved surveillance and tracing capabilities.
- The system is stable since 1998/99 and stability should have increased further with improved implementation and control of the measures taken. In 2000 the system could be regarded to be very stable with the introduction of active components into the surveillance system. Compliance data would be useful to confirm this positive assessment.

3. Assessment of the challenges to the system

3.1 External challenge resulting from importing BSE-infectivity

3.1.1 Factor 2: Import of live cattle

- Between 1985-1989 Portugal imported 8,648 cattle from the UK. Of these animals, 7 were identified as cases and only 352 were traced and disposed off. It is likely that many of the remaining 8,289 animals entered the food and feed chains. Only 14 of the progeny of the UK animals were traced. The remainder are either alive or likely to have entered the food and feed chains. All in all these imports are considered to represent a very high external challenge until they have left the system.
- An additional, but lower challenge occurred due to importing, until at least 1996, of live animals from other countries reporting cases of BSE. The data provided for 1996 indicated the following imports: France 9,286; Netherlands

875; and Switzerland 666 cattle. These animals have not been included in surveillance efforts to trace suspect animals.

3.12 Factor 3: Import of MBM or feed containing MBM

- According to UK records, exports of MBM from the UK to Portugal between 1987-1997 totalled 650 tonnes. It is, however, unclear to which extent the imported material was of mammalian origin. The information provided in the FVO report (mission of 28/09-02/10/1998) is not consistent with the UK data for the period 1988-1995 and suggests less MBM was imported. Following the principle of (realistic) worst case assumptions, it was therefore assumed that an additional high challenge occurred by this route, even if probably not all or only fractions of the import were indeed ruminant proteins.

3.2 Internal challenge resulting from domestic infected animals

3.21 Interaction of external challenges and stability

- High and very high external challenges occurred in the mid to late 80s and early 90s. They clearly met an extremely unstable system. The result was the amplification of the incoming BSE infectivity, and the development of an increasing internal challenge.
- An internal challenge could already have started developing in the early 80s (earliest birth cohort of a BSE case reported in Portugal: 1984). This would have increased the overall challenge to a system that recycle and amplify BSE.

3.22 Assumed development of the domestic prevalence

- From the stability/challenge interaction described above it has to be expected that incoming BSE-infectivity was amplified, leading to an increasing internal challenge, from the early 80s onwards.
- The infected domestic animals were processed and infectivity recycled by an extremely unstable system. Subsequently the domestic prevalence increased and very high levels of internal challenge were reached by mid-90s. The continuing external challenges, albeit much smaller than in the late 80s, supported this trend. Due to the long incubation period, and deficiencies in the system's stability until 98/99, the internal challenge remains extremely high.
- From this a steady increase of the domestic prevalence would be expected since the early 80s. However, the constant low level of BSE incidence between 1990 and 1993 seems not to support this. A possible interpretation is significant underreporting of the initial incidence, due to unawareness and unfamiliarity with symptoms, inappropriate compensation schemes, etc.
- A sizeable prevention of new infections was unlikely before the measures in 1998/99 were implemented. Since then the domestic prevalence of BSE-infected cattle should have started to decrease, but this development will only become visible in the incidence figures once the preceding birth cohorts have left the system. Until then, a further increase of the incidence figures cannot be excluded.

Year	90	91	92	93	94	95	96	97	98	99
Cases	1	1	1	3	12	14	29	30	106	170

Table 3: Number of reported cases of BSE by year of detection (as of Dec. 1999)

Year	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97
Cases	2	1	4	3	32	24	17	37	87	195	27	1	0

Table 4: Number of cases of BSE by year (July/June) of birth (as of March 2000)

- The current prevalence of domestic infected animals, the internal challenge, is still assessed to be extremely high, but decreasing. Until now no BSE-cases born after 1/1/1996 have been registered.

3.3 Overall assessment of the combined challenges

- A high external challenge was posed by the importation of UK cattle, particularly over the period 1985-1989. MBM imports from UK and imports of MBM and live cattle from other countries affected by BSE added to this challenge.
- An internal challenge developed at least since 1984, the first birth cohort including a BSE-case. It most likely over-compensated any decline in the external challenge and lead to extremely high levels of the overall challenge, which probably peaked in the early 90s but which is still likely to be extremely high.

4. Conclusion on the resulting risk

4.1 Interaction of stability and challenge

- In the mid- to late 80s an extremely unstable system was faced with very high external challenges. The imported BSE-infectivity entered the domestic system and was amplified, together with the apparently already circulating BSE-infectivity. This lead to an increasing internal challenge reaching extremely high levels in the mid-90s.
- Although improvements were made in 1994, the system remained unstable until 1998 and the extremely high internal challenge was further amplified. It is still present, even if the system is regarded to be stable, but not very stable, since early 1999 and possibly very stable in 2000. This stability should be able to reduce, over time, the still existing internal challenge by slowly reducing the BSE-infectivity circulating in the system.

		Overall Challenge						
STABILITY		negligible	Very low	low	moderate	high	Very high	Extremely high
Optimally stable								
Very stable							? 2000 ?	
Stable								99
Neutral								1998
Unstable								94-97
Very Unstable								
Extremely Unstable						85-89	→90-93↑	

Figure 1: Development of Stability and Challenge over time.

4.2 Risk that BSE-infectivity enters processing

- Since the 80s and until 1998 it has to be assumed that BSE-infectivity entered processing at increasing amounts, mainly because of slaughtering infected imported (at first) and domestic (later) cattle at different stages of incubation.
- Since 1998, the risk that BSE-infectivity enters processing is reduced, thanks to the SRM-ban and improved surveillance, but remains at a high level due to the still high number of infected (pre-clinical) animals being present.
- The processing risk decreased to some extent when animals born after the first MBM-ban started being processed. It will significantly decrease once the birth cohorts 1999 and later are slaughtered.

4.3 Risk that BSE-infectivity is recycled and propagated

- In view of the apparent inability of the system to avoid recycling and propagating BSE-infectivity, the propagation risk increased since the 80s and was extremely high until 1994, following the assumed development of the domestic prevalence.
- The introduction of a feed ban in 1994 improved the ability to avoid recycling of BSE-infectivity and its propagation to some extent but its efficiency was counteracted by insufficient compliance and cross-contamination. At the same time the amount of BSE-infectivity that entered processing continued to grow and so did the propagation risk, albeit at a lower pace than without the feed ban.
- The temporary exclusion of SRM from the human food chain and inclusion of it into the animal feed cycle might have increased the growth of the propagation risk during the period 1997-98.
- Extension of the feed and of the SRM ban, improved rendering and other measures in 1997/8 have made it likely that the propagation risk is no significantly reduced but compliance data will be needed to confirm that it is negligible. However, it is assumed that the rate of new-infection is now below the rate of infectivity leaving the system and hence a net reduction of the circulating BSE-infectivity is achieved.

5. Conclusion on the Geographical BSE-Risk (GBR)

5.1 The current GBR

The current geographical BSE-risk (GBR) level is IV: BSE is confirmed in domestic cattle at a higher level.

- The observed incidence of clinical cases over the last 12 months (16 June 1999-15 June 2000) was 215.8 per Million adult cattle. This figure is generated by a surveillance system that was only depending on notification of suspects until recently (end 99, early 2000) some active components, targeting fallen stock, were introduced.

5.2 The expected development of the GBR

- Assuming that measures in place continue to be appropriately implemented and no new external challenge occurs, the GBR will decrease over time, even if the incidence figures will only decrease sharply once the birth cohorts before 1999 will have left the system. The degree of compliance with the measures will determine the rate of decrease of the GBR.

5.3 Recommendations for influencing the future GBR

- Ensuring optimal compliance with the introduced measures is of utmost importance for supporting the decline of the GBR. All additional measures that could enhance the stability of the system further are helpful.

Strengthening the active surveillance, targeting at-risk sub-populations such as fallen stock and emergency slaughter will be most useful to better assess the current extend and to monitor the development of the epidemic. By improving the ability of the system to exclude animals being at risk to incubate BSE it will also accelerate the decline of the epidemic.