TRANSMISSIBLE SPONGIFORM ENCEPHALOPATHIES MANAGEMENT AT THE SLAUGHTERHOUSE

1. GENERAL CONCEPTS

In the slaughterhouse, TSE management focuses on preventing material containing infectious prion protein from entering the food and feed chains. This is accomplished by identification and removal of BSE suspect cattle, separation and safe disposal of material potentially containing an infectious agent (specified risk material/[SRM]) and control of cross contamination.

In this chapter, only slaughterhouse aspects directly related to control of BSE are included and, in general, procedures are described for larger slaughterhouses. These concepts remain the same for all slaughtering of cattle, but must be adapted for other situations (i.e. when the carcass is not split). Overall good manufacturing practices (GMP) for slaughtering are available from Codex (www.codexalimentarius.net), and are given in the FAO manual *Good practices for the meat industry* (FAO, 2004).

2. ANIMAL IDENTIFICATION

To ensure traceability of and to guarantee proper payment for the slaughtered animal, every animal must be identified and carcasses must be trackable through the slaughterhouse. Each slaughterhouse decides on its own system, but it must be possible to trace back to the animal's identity on the farm of origin from each piece of cut meat.

3. ARRIVAL AND ANTE MORTEM EXAMINATION

The first point where BSE could possibly be detected is at initial unloading of the animals at the slaughterhouse. It is therefore very important to have cattle inspected as they come off the truck (ante mortem examination) and enter the lairage. At minimum, the cattle should be examined when moving around the lairage. In slaughterhouses in many countries, including the European Union (EU) member states, the United States of America (USA) and Japan (and all slaughterhouses slaughtering beef for exportation to one of these countries), an ante mortem veterinary examination is compulsory. Generally this examination is conducted to assess the overall health of an animal; therefore it is important that all potential diseases (not just BSE) should be recognized. This requires that veterinarians conducting ante mortem examinations be well trained and aware of all potential clinical manifestations of disease.

In Switzerland, it is compulsory for the ante mortem examination to include assessment of the five BSE-relevant points listed in the previous chapter of this course manual. In the EU, as well as in other countries, there are no defined specific requirements for ante mortem inspection related to BSE. There are no regulations so far elaborated either as GMP rules of FAO or from the industry.

If an animal is positive on more than one point of the ante mortem testing scheme for BSE, the animal is suspected to be infected with BSE and must be separated. In some cases further extensive clinical testing is carried out. All BSE suspect animals must be killed and a sample collected for testing. The animal must be made easily identifiable

so that if it enters the slaughter line, the collection of a sample for BSE testing and the exclusion of the carcass from the feed and food chains are ensured. Suspects should also be killed last, at the end of the slaughtering day, in order to minimize both sampling and exclusion mistakes and cross contamination of other carcasses. Official notification of the animal as a suspect must be given to the appropriate authorities, and the carcasses should be held until the results of the BSE test are available.

Other BSE risk animals (and animals that could be ill with other important diseases) such as emergency slaughter or down-in-truck animals should either be killed in a slaughterhouse specifically designated for this purpose or be killed last, at the end of the slaughtering day, as with BSE suspects. These animals should also be tested for BSE, for reasons described in the *Capacity Building for Surveillance and Prevention of BSE and Other Zoonotic Diseases* course manual entitled *Epidemiology, surveillance, and risk assessment for transmissible spongiform encephalopathies* (FAO, 2007). These animals should also be examined especially carefully for other diseases during subsequent veterinary inspections. If slaughtered on the regular line (and if not condemned for other reasons), the carcasses should be held until the results of the BSE test are available.

The ante mortem inspection is especially important, because subsequent veterinary inspections of the carcass are not useful in diagnosing BSE. Inspections for carcass hygiene and spinal cord removal are, however, important for control of cross contamination.

4. STUNNING, PITHING AND BLEEDING

Stunning is the first step of the slaughter process. In many countries, official regulations do not allow killing of an animal without stunning it prior to bleeding. In ritual (halal or kosher) slaughtering, animals are killed and bled without first stunning.

There are different methods and techniques available for stunning. The most common stunning method in Europe and the USA is captive bolt stunning. It has been suggested that because the skull is opened and the brain is damaged by penetration of the stunning bolt with this technique, there is a potential for contamination of the working environment and the slaughter line. Therefore, any brain tissue found outside the skull should be collected and discarded. Because brain tissue can stick to the bolt's concave and sharpened end point, the bolt should be cleaned at a regular frequency using swabs or paper. Used swabs or paper must be discarded appropriately.

A technique called "concussion stunning" was launched by a company in the UK in 2000 in an attempt to minimize damage to the skull and thus minimize contamination, as well as minimize both the risk to workers and the risk of brain particles entering the blood vessels and lungs. The technique is controversial, as the European Food Safety Authority (EFSA) showed that there is no real improvement in security (EFSA, 2004). Another technique quite commonly used in New Zealand is electrical stunning, which is now under development in Europe. There are some negative animal welfare aspects to electrical stunning, which are not yet thoroughly solved.

The goal is to achieve immediate unconsciousness of the animal without stressing it before and during stunning. Therefore the correct functioning, handling and positioning of the stunning device are very important. An excellent description of captive bolt stunning is available in Grandin (2006). All non-conformities such as double stunning or failures should be documented.

Pithing is the severe damaging of the brain and spinal cord of slaughtered cattle by inserting a metal rod through the hole in the skull made by the captive bolt stunner. The goal of pithing is to protect the safety of slaughterhouse workers shackling the limbs of stunned animals, as it prevents violent limb movement after stunning. Pithing has been forbidden in the EU and Switzerland since 2001 because of the risk of contaminating the carcass and the environment with brain tissue. As an alternative some slaughterhouses introduced electrical depolarization (fixing a clip with electrical low tension at the muzzle) to control limb movement.

For animal welfare reasons, a minimum waiting period of three minutes should be given after bleeding until the next step in order to allow the animal to die.

5. HIDE AND HEAD REMOVAL

To control cross contamination at head removal, a two-knife technique is the optimal method to used. With a first knife, the muscles, connective tissue and tendons of the dorsal neck are cut in a circular cut. Then, with a second knife, the spinal cord is cut between the skull and the first vertebra. The rest of the neck is then cut with the first knife to remove the head from the carcass.

Hide removal can be done manually or by means of a hide puller. Older hide pullers work from bottom up whereas hide pullers of the newer generation work from top down. Also, if the hide is removed manually, it is worked from top down to prevent contamination of the carcass.

Head removal can be done before or after hide removal. In slaughterhouses with hide pulling from the top down, the hide is often pulled with the head on and head removal is done only after hide removal. Sampling for BSE testing can be done either before head removal or after, but optimally when the carcass and head are easily identifiable. The eyes are considered as SRM and must be discarded with the head; thus it is important that the eyes remain attached.

If the head is to be removed after the hide, it may be necessary before the hide is removed, first to cut the spinal cord by means of a neck stick (through the hide). The contamination left by the retracting knife is negligible because the potentially contaminated tissue of the *ligamentum nuchae* will not enter the food chain. Cutting the spinal cord first is necessary with some hide pullers for technical reasons, i.e. the carcass becomes so stretched that the spinal cord is under tension at head removal, causing the cord to retract or even break from the brainstem, affecting the ability to collect the correct brainstem samples for BSE testing.

6. SAMPLING

Sampling for BSE testing is straightforward and the technique is easy after some practice (DEFRA, 2004). The anatomy of the brainstem and the rationale behind the sample taken are fully described in the *Capacity Building for Surveillance and Prevention of BSE and Other Zoonotic Diseases* project course manual *Diagnostic techniques for transmissible spongiform encephalopathies* (FAO, 2007b). It must be emphasized that unless the correct brain samples are taken and handled appropriately, false negative tests may result.

Samples can be collected after the head has been separated from the body between the skull and the first vertebra, with the head either still attached or removed from the

body. The choice will depend on the layout of the line, the available space and the design of the working place during dehiding, head removal and meat inspection.

Samples are collected through the foramen magnum with a special spoon. Specially-marketed spoons are available from BSE test suppliers or a medium size metal spoon may be sharpened on both sides for cutting off the brainstem inside of the skull. With the removed head lying on its dorsal surface (in removed heads), the spoon is introduced along the dorsal edge of the foramen magnum and is rotated to the left -or to the right-hand side for cutting of the brain sample before pulling out through the hole. Samples are then placed into marked plastic cups with screw caps and transported to the laboratory. Plastic sample ("whirl") bags may be used, but are less desirable as they are more complicated to use in a completely hygienic way. The tissue anatomy can become distorted if the samples are crushed during shipment.

All samples have to be identified with sampling date, slaughterhouse identification, identification of person responsible for sampling, the animal's unique identifier number, the slaughter number, indication about the origin of the animal and animal risk category.

Special attention must be paid to developing a system on the slaughter line to optimize the correct identification and matching of carcass and sample. Systems of double checks should be implemented in order to follow the process correctly. In many countries, when BSE positive results are determined, the positive carcass as well as the carcass before and the carcass after in line are all blocked in the cooler in order to be able to ensure the correct identity. In Switzerland, the DNA of the ear, carcass meat and brain of all three animals are compared to the positive sample for confirmation.

Different systems with different goals for sampling must be developed and implemented in countries where carcasses are not held in the cooler but are immediately disseminated for consumption.

7. CARCASS SPLITTING AND SPINAL CORD REMOVAL

Following evisceration, the carcass is split vertically in half so that the carcass can be further inspected and reduced to a manageable size. Carcass splitting is the point in the slaughter process with the highest risk of contamination with the BSE agent.

Meat cleavers or other means of splitting are often used in smaller slaughterhouses, and band saws, reciprocating saws or circular saws are used in larger slaughterhouses. The cut is made through the midline of the spinal column although some veering from the midline inevitably takes place. If splitting is not precisely in the midline of the spinal column, there might be the formation of a persisting "tunnel", which has to be opened manually by sawing or with a chopper. After splitting, the spinal cord is removed either manually by scratching out with a thumb knife or by specially designed power devices that suck or scratch or both (BVS-Kreis, 2001; Jarvis, 2006). It is very important that no carcass arrives at chilling with the remains of the spinal cord in the canal.

A spinal cord removal device was developed in 2001 to decrease contamination during splitting and was termed the 'Armin Kreis method'. With this method, a tube is introduced into the spinal canal prior to splitting. As the tube is driven forward in the canal, it continuously aspires the spinal cord and removes it. The advantage of this technique is that there is no splashing and therefore no contamination through splitting. The disadvantage – and thus the reason for poor success in the industry – is that parts of the

dura mater remain, requiring time and labour to clean the canal again manually after splitting.

8. CONTROL OF CROSS CONTAMINATION

Cross contamination risk exists mostly through utensils, knives, saws and sucking devices at spinal cord removal. Although controversy exists as to the extent of the risk, it is clear that some preventive measures are necessary.

The best practice for control of cross contamination during the slaughter process is a "two-knife" technique (including that for head removal, described in section 5 of this chapter), with knives exchanged after each animal or after a cut in "dirty" parts. For example, during preparation for hide removal, the first knife is used to cut through the hide and the second knife is used to remove the skin, because during removal the knife has contact with the "clean" meat surface. For all knife cuts with SRM contact, separate knives have to be used, with the best practice being to use a knife of a different colour (e.g. red for SRM contact).

It has been shown that the splashing of rinsing water from the splitting saw can contaminate the backs of the carcasses in a 10-cm-large area that increases from the top down. Therefore, measures should be implemented to decrease the splashing, and the use of water for rinsing carcasses during slaughter must be reduced to the minimum.

It is also important to collect wastewater and particles on the floor, and to ensure that workers in contact with SRM wear protective glasses and gloves. Special attention should be given to regular sanitization of protective clothes and the hands of personnel. Moreover, personnel should not follow carcasses from dirty to clean zones, i.e. personnel remain either at working places between stunning and dehiding or between hide removal through evisceration to weighing of carcasses.

9. INSPECTION AND IDENTIFICATION OF SPECIFIED RISK MATERIAL

Veterinary inspection of the carcass generally follows carcass splitting. The inspection is meant to identify signs of disease in the carcass and ensure the safety of the meat. It is no longer possible to diagnose BSE at this point.

In the veterinary examination, in addition to the visual inspection of the slaughtered animal, certain organs (e.g. lungs, liver, spleen, uterus, udder and tongue) should be palpated and some organs (including lymph nodes) should be cut open and inspected to determine whether or not the animal was suffering from any disease.

The EU requires that the tongue should be freed to permit a detailed inspection of the mouth and the pharynx. The head, throat, retro-pharyngeal, submaxillary and parotid lymph nodes and the tonsils should be examined. The tonsils must be removed after inspection and treated as SRM. The lungs, trachea, oesophagus, and bronchial and mediastinal lymph nodes must also be inspected, as well as the pericardium, heart, diaphragm, liver, gallbladder, bile ducts and the hepatic and pancreatic lymph nodes (which are not SRM). Signs of disease should be further investigated and samples taken as required by national regulations.

At this time, the inspector must also ensure that all SRM has been removed. SRM is defined differently by different countries, and may include age-specific categorization of risk tissues. SRM is also defined differently for sheep and goats. More information on SRM can be found in the chapter 1 of this course manual. In all countries brain and

spinal cord are considered SRM (though the age may vary). Thus, the spinal canal and the area around it should be specifically examined and confirmed free of spinal cord tissue and *dura mater*.

Although blood is not considered as SRM, it should be kept in mind that the blood from cattle testing positive for BSE has probably been collected. Measures for elimination or further treatment of the blood might be considered.

In certain slaughter line layouts, this final SRM inspection point might be later (e.g. before weighing carcasses). In any case it is important to define responsibility for ensuring the total absence of SRM, either by a trained member of the meat inspection team or a designated trained and responsible employee from the slaughterhouse. No remains of SRM should be found on carcasses after weighing and grading.

10. DISPOSAL OF SPECIFIED RISK MATERIAL

All SRM separated during slaughter should be collected in specially marked containers and kept separated from all other by-products. Cross contamination should be prevented either through geographical separation (i.e. a different room for collector bins) or installations (e.g. panels, covers) for splash protection. Eliminated SRM must not re-enter the food/feed chain and should optimally be burned. Burning can be by direct incineration of the waste, or after processing (e.g. rendering into MBM). The latter only works if all MBM is burned or separate lines for MBM production exist. In Switzerland, SRM is rendered into MBM, and all MBM is then burned during the production of concrete.

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TRANSMISSIBLE SPONGIFORM ENCEPHALOPATHIES MANAGEMENT AT THE PROCESSING PLANT

1. GENERAL CONCEPTS

After slaughter, further processing of meat and production of meat products are often carried out at a different location. Carcasses may be delivered to the processing plant from one or more slaughterhouses. Alternatively, there may be a cutting and deboning section within the slaughterhouse. Normally, in this latter case, personnel and material flow are completely separated from the slaughtering area with the only connection through the chilling area, and barriers must be installed and respected. In either case, it is crucial that all meat is free from specified risk material (SRM) before it is processed. The only SRM that should be permitted to enter the processing plant (or processing area) are vertebral columns.

For food safety reasons it is crucial to maintain traceability through processing. All recalls of potentially contaminated meat and meat products rely on the ability to trace the products back to the slaughterhouse of origin, although some countries or individual retailers require further traceability to the farm of origin.

2. SRM CONTROL

A routine procedure should be established for inspection for SRM on arrival at either the cutting/deboning plant, or at the processing section of the slaughterhouse. This inspection should be enforced even if the carcasses arrive from an attached slaughterhouse. This is particularly important when quarters or halves of carcasses arrive, as the absence of spinal cord material in the vertebral column has to be ensured.

3. DEBONING AND HANDLING OF SRM

In the EU, the vertebral column of cattle older than 12 months, including the dorsal root ganglia (DRG), is classified as SRM. Removal of the DRG is difficult to control fully visually, because the channels leading from the spinal column are very narrow. In Plate 1, the vertebral channels have been opened to show the relative anatomy of the spinal cord and DRG.

The individual spinal cord sections correspond to the vertebral column sections, as the spinal cord sends out a spinal cord nerve into the periphery between two vertebrae one on each side. Thus, the spinal cord is divided into neck, chest, loin and cross cord sections and the number of spinal cord nerves corresponds to the number of vertebrae of the single section. Only the neck has seven vertebrae and eight neck nerves, as the first neck nerve leaves the spinal cord between the occipital bone and the atlas and the last neck nerve between the last neck vertebrae and the first chest vertebrae.

Considering the anatomy, appropriate measures have to be in place so that DRG are eliminated completely from the muscle cuts. It is important that no SRM contacts the knives or cutting/deboning tables to minimize the risk that surfaces become contaminated. The best practice for adjusted deboning procedures would be to leave meat in the angles of the vertebrae near the location of the DRG.

PHOTO: J. LÖPFE/SWISS TECHNICAL SERVICES, BERNE

Plate 1

Spinal cord, dorsal root ganglia and associated tissues

4. MECHANICALLY RECOVERED MEAT

Mechanical recovery of meat (MRM; called advanced meat recovery/[AMR] in North America) is a process that can be used after traditional deboning to maximize the removal of meat from the bones. In this process, developed in the 1970s, carcass bones that have already been stripped of most meat are put through a machine that crushes the bones and applies pressure so that further meat is removed. The extracted meat slurry that is produced can be used for sausages, pies, burgers and other products. Because of the fragments of bone that are present in the slurry, the level of calcium present in the product (also referred to as MRM) is higher than in normal meat, but this is not thought to be a major problem.

The MRM can be recovered from both cooked and uncooked bones. Traditionally, only the vertebrae, ribs, shoulder blade and pelvis are used for MRM due to the difficulties in effectively hand boning these regions. Long bones with high marrow content are considered unsuitable because of the high concentration of calcium, iron and purines (which may lead to disease in humans ingesting large quantities) in the marrow that is extruded from the bones during processing. Heads are also generally not subjected to this process.

The machines used to recover the residual meat vary in design and action. Many use a piston to subject bones to very high pressure in order to extract the muscle from them. They then force the resultant slurry through a series of sieves to remove any large particles. Connective tissue and collagen are also removed at this point.

Because of the risk of spinal cord or DRG being present in vertebral columns, many countries have issued BSE-relevant regulations banning or restricting the production of MRM, either from bovine vertebrae, from all bovine bones, or entirely.

Another type of meat recovery is called "Baadering" or soft separation (Baader, 2006). Using machinery manufactured by Baader, products are gently squeezed through a perforated drum so that softer tissues (meat and fat) are separated from the harder tissues (tendons, ligaments, cartilage, bones). This process is still used in Europe to remove red meat from tendons and ligaments.

5. REFERENCES

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QUALITY CONTROL CONCEPTS, HYGIENE AND HACCP IN THE MEAT INDUSTRY

1. GENERAL CONCEPTS

Modern legislation is no longer based entirely upon official control of food production. More and more, it is the responsibility of each producer to be able to demonstrate that the products produced are safe, conform to legal requirements, and are of good quality (i.e. acceptable by the consumer). Therefore, the tools for control have had to change.

Conceptually, there is a difference between "quality control" and "quality management." Quality control refers to measures taken for supervision of production. Quality management goes further, and is not only product related but includes organizational parameters such as staff responsibilities and competences, and is directed to production environment and product flow. These parameters are considered "prerequisite programmes" (PRPs), which are established measures or programmes that are well implemented, maintained and continually improved. The PRPs include both quality control and autocontrol measures. These measures are important not specifically for TSE management, but for the production of safe and quality products in general.

The Codex document *General Principles of Food Hygiene* provides standard principles for the production of safe food. These principles help to ensure food hygiene when used with the code of hygienic practice and the guidelines on microbiological criteria for each specific product. The document follows the food chain from primary production through to final consumption, highlighting the key hygiene controls at each stage. It recommends a Hazard Analysis and Critical Control Point (HACCP)-based approach wherever possible to enhance food safety (Codex Alimentarius, 2003).

2. QUALITY CONTROL

Quality control systems are usually systems or programmes that enable an organization to produce continuously products of a determined and consistent quality and thus fulfil customer requirements. The PRPs are the basis of a HACCP system, are an essential part of good manufacturing practices (GMPs) or good hygienic practices (GHPs), and include the following aspects:

- Hygiene monitoring
- Hygiene rules (e.g. personnel, visitors, contractors)
- Facility design (e.g. production layout, production flows)
- Maintenance programme
- Hygiene and sanitation
- Pest control
- Product control
- Temperature control
- Traceability (e.g. recall procedure, batch control)
- Incident management
- Water/air/energy control
- Hygiene training
- Product analysis (intermediate and end product)

In this chapter, only facility design and hygiene and sanitation (of facilities and personnel) are described, as they have a direct impact on control of cross contamination for BSE and other infectious zoonotic diseases.

3. FACILITY DESIGN

Facilities should be designed to optimize the safety and quality of products produced. There are no international regulations for facility layouts, but the legislation of most countries (e.g. Canada, EU, Switzerland, USA) include general requirements for the design of the working environment (floors, walls and ceilings, as well as installations). There are no special requests relating to TSE management in slaughtering and deboning, nor in further processing. However, animal by-products must be handled in a way that guarantees separation and prevention of cross contamination at all times. This refers to SRM and all Risk Category 3 by-products from slaughter (as described in the *Capacity Building for Surveillance and Prevention of BSE and Other Zoonotic Diseases* project course manual *Management of transmissible spongiform encephalopathies in livestock feeds and feeding*, (FAO, 2007), as well as by-products from deboning and further processing (e.g. vertebral column).

4. HYGIENE AND SANITATION

The general principles of Codex Alimentarius (2003) state that appropriate facilities and procedures should be in place to ensure that any necessary cleaning and maintenance are carried out effectively and an appropriate degree of personal hygiene is maintained.

4.1. Facility

There are many different ways to keep a facility in a clean and hygienic condition. Cleaning is either done by internal personnel after finishing other work or staff hired specifically for this purpose, or it is done by a subcontracted specialized cleaning company. Cleaning agents and equipment should be appropriate for the task(s), including using the appropriate disinfectants. Personnel engaged for cleaning must undergo special training for hygiene, cleansing technique and security.

The effectiveness of the cleaning should be regularly verified by personnel not involved in the cleaning. This can be visually or using microbiological testing of high-risk surfaces or, optimally, both.

4.2. Personnel

Significant effort and attention must be given to establishing and maintaining effective personal hygiene for all staff, both to prevent cross contamination of products and to reduce the risk of staff exposure to infective agents.

Personal hygiene requires continuous training to ensure that personnel understand the rules, and there should be supervision to ensure that personal hygiene is maintained (clean clothes, hand washing, changing gloves, etc.).

Visitors to facilities should be minimized. When visitors are present, appropriate hygiene measures should be taken (e.g. disposable shoe covers, external clothing, and hair covers worn). All visitors should be supervised at all times. Attention must also be paid to maintaining hygiene during visits of facility staff not normally working in production areas.

5. HACCP

HACCP is a risk management system that was developed in the late 1960s. HACCP has been recognised by the Codex Alimentarius Committee since 1996 (Codex Alimentarius, 2003), which defines it as "a system which identifies, evaluates, and controls hazards which are significant for food safety". HACCP is not a quality control system, but references such systems to manage identified risks. All prerequisite (risk management) programmes are based on GMPs to ensure food hygiene and safety. Thus, HACCP can only work if appropriate GMPs are in place.

HACCP can be applied to nearly any process (e.g. slaughterhouses, rendering plants, processing plants). If correctly implemented, HACCP can improve the product security of all these processors. However, it is crucial that the hazard analysis be done correctly, including using a scientific approach specific to the process, identifying all possible and relevant microbiological, chemical and physical hazards, and providing an accurate qualitative and quantitative estimation of the risk. All the twelve steps for the application of a HACCP must be followed, and optimally the HACCP documentation should contain full comments or explanations regarding each CCP with the site/product specific action. Staff in all facilities implementing HACCP, and particularly the HACCP team leader, should be trained and optimally should have practical experience in the field.

HACCP is an efficient tool if potential hazards can be analysed, critical limits can be established and tested, and (if limits are exceeded) corrective action is possible. If these criteria are not met for a hazard, there is no CCP for control of the hazard and therefore no possibility to eliminate, to prevent or even to reduce it, and a CCP should not be defined (although GMPs and quality controls may still be applied). A CCP which is defined but which cannot improve safety of the produced product may lead to a false assumption of security and thus must be avoided.

Thus, as there is no way to test for TSE contamination in the slaughterhouse or for the presence of the agent in meat or meat products, HACCP is largely not applicable to TSE management.

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APPENDIX 1

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Participants from the partner countries have also contributed significantly to the production and translation of the course manuals, and to many other aspects of the courses.

APPENDIX 2

Related background reading and Web links*

* These references and Web links refer to all four *Capacity Building for Surveillance and Prevention of BSE and Other Zoonotic Diseases* project course manuals. Therefore, all documents and links may not be applicable to the topics covered in this manual.

RELATED BACKGROUND READING AND WEB LINKS

TSE pages of selected ministries and other general data sources

Department of Environment Food and Rural Affairs. United Kingdom, BSE homepage: http://www.defra.gov.uk/animalh/bse/index.html

FAO. BSE pages: http://www.fao.org/ag/AGAinfo/subjects/en/health/bse/default.html

Ministry of Agriculture of New Zealand. BSE homepage: http://www.biosecurity.govt.nz/node/7650

Swiss Federal Veterinary Office. BSE homepage: http://www.bvet.admin.ch/gesundheit_tiere/01752/01804/02075/index.html?lang=de

TAFS. Position papers: http://www.tseandfoodsafety.org/startseite.htm

United States Department of Agriculture. Animal and Plant Health Inspection Service, BSE homepage: http://www.aphis.usda.gov/lpa/issues/bse/bse.html

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International standards

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APPENDIX 3

Glossary of technical terms and acronyms*

* This glossary refers to all four *Capacity Building for Surveillance and Prevention of BSE and Other Zoonotic Diseases* project course manuals. Therefore, all documents and links may not be applicable to the topics covered in this manual.

GLOSSARY OF TECHNICAL TERMS AND ACRONYMS

AAFCO	Association of American Feed Control Officials
Ab	Antibody
AFIA	American Feed Industry Association
Animal by-products	Tissues and other materials (including fallen stock) discarded at the slaughterhouse, which generally go to incineration, burial or rendering (depending on the country)
Animal waste	Animal by-products
Ante mortem	Before death (generally refers to the period immediately before slaughter)
AP	Apparent prevalence
BAB	Born after the ban; animals with BSE that were born after implementation of a feed ban
BARB	Born after the real ban; animals with BSE that were born after implementation of a comprehensive and effectively-enforced feed ban
BSC	Biosafety cabinet
BSE	Bovine spongiform encephalopathy
BL	Biosafety level
By-pass proteins	Proteins that are not degraded in the rumen but are digested in the small intestine to provide additional amino acids
CCP	Critical Control Point: a step in a production chain that is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level and at which a control can be applied
CEN	Europan Committee for Standardization
CJD	Creutzfeldt-Jakob Disease
CNS	Central nervous system
Combinable crops	Those able to be harvested with a combine
Contaminants	Materials that should not be present in a given product; e.g. rodents, birds, rodent droppings, toxins and mould are contaminants that should not be present in any livestock feed
Control (noun)	The state wherein correct procedures are being followed and criteria are being met (HACCP context)
Control (verb)	To take all necessary actions to ensure and maintain compliance with criteria established in a HACCP (or other control) plan (HACCP context)
Core fragment	The part of PrP^{Sc} that is not digested by proteinase K (also called PrP^{Res})

Critical limit	A criterion that separates acceptability from unacceptability (e.g. during audits)
Cross contaminants	Substances carried from areas or materials where they are not prohibited to areas or materials where they are prohibited
Cross feeding	The feeding of a livestock group with prohibited feeds intended for another livestock group
CP	Crude protein
CWD	Chronic wasting disease.
DNA	Deoxyribonucleic acid; the genetic material for all living organisms except bacteria
Downer cattle	Cattle too sick to walk to slaughter (definition differs among countries)
EC	European Commission
EFSA	European Food Safety Authority
ELISA	Enzyme-linked immunosorbent assay
Emergency slaughter	Slaughter cattle with clinical signs non-specific for BSE (definition differs among countries)
Epitope	Structural part of an antigen that reacts with antibodies
Epitope demasking	Process in which the epitope becomes available for antibody binding (for example, by denaturation)
Essential amino acids	Those that cannot be synthesized and therefore must be provided by the feed/food
EU	European Union
Fallen stock	Cattle that died or were killed for unknown reasons (definition differs among countries)
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration (United States of America)
FEFAC	European Feed Manufacturers' Federation
FIFO	First in first out; a production concept to optimize quality
Flushing batches	Batches of feed processed or transported in-between feed batches containing prohibited and non-prohibited materials, and intended to remove traces of prohibited materials from the equipment
FMD	Foot-and-mouth disease
FN	False negatives; truly-diseased animals that test negative on a diagnostic test
FP	False positives; truly non diseased animals that test positive on a diagnostic test
FSE	Feline spongiform encephalopathy; TSE in cats, believed to be caused by ingestion of the BSE agent.
GAFTA	Grain and Feed Trade Association

GAP	Good agricultural practices
GBR	Geographical BSE risk assessment
GHP	Good hygiene practices
GMP	Good Manufacturing Practices
GMT	Good microbiological technique
Greaves	A proteinaceous by-product of the rendering process
GTM	GAFTA Traders Manual
H & E	Haematoxylin and eosin stain
HACCP	Hazard Analysis and Critical Control Points: a method to identify process steps where a loss or significant deviance from the required product quality and safety could occur if no targeted control is applied
HACCP plan	A document prepared in accordance with the principles of HACCP to ensure control of hazards that are significant for the segment of the production under consideration
Hazard	A biological, chemical or physical agent with the potential to cause an adverse health effect
Hazard analysis	The process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for the segment of the production under consideration and therefore which should be addressed in the control (or HACCP) plan
High quality protein	Protein sources that match the requirements of a particular species or production class well
HPLC	High performance liquid chromatography
IAG	European Feed Microscopists working group
IFIF	International Feed Industry Federation
IHC	Immunohistochemistry
Indigenous BSE case	Domestic BSE case; non-imported BSE case
M+C	Methionine plus cysteine; amino acids generally considered together, because cysteine can be derived from methionine in animals
ISO	International Organization for Standardization
Mammal	An animal that lactates; in this context, livestock excluding aquatic species and poultry
MBM	Meat and bone meal; the solid protein product of the rendering process
Medulla oblongata	Caudal portion of the brainstem
MMBM	Mammalian meat and bone meal
Monitoring	An ongoing process of specific animal health data collection over a defined period of time
Monogastric species	Animals with simple stomachs (e.g. swine, poultry, horses, humans)

MOSS	Monitoring and surveillance system
MRM	Mechanically recovered meat
NIRC	Near infrared camera
NIRM	Near infrared microscopy
NIRS	Near infrared spectrography
Notifiable disease	A disease for which there is a national legal requirement to report cases and suspects to an official authority
Obex	The point on the midline of the dorsal surface of the medulla oblongata that marks the caudal angle of the fourth brain ventricle; a marker for the region of the brain stem where some of the predilection areas for histological lesions and PrP^{Sc} deposition in BSE are located (such as the dorsal nucleus of the vagus)
OD	Optical density
OIE	World Organization for Animal Health
OR	Odds ratio
Pathogenicity	Ability of an organism to invade a host organism and to cause disease
PCR	Polymerase chain reaction
Pithing	The laceration of central nervous tissue by means of an elongated rod-shaped instrument introduced into the cranial cavity of slaughter cattle after stunning.
PK	Proteinase K; a serine proteinase that digests PrP^{C} completely but PrP^{Sc} only partially under certain conditions
Post mortem	After death
Prion	Infectious agent causing TSE
Proteolysis	Cleavage of a protein by proteases; also referred to as "digestion"
PrP	Prion protein, encoded by the gene *PRNP*, expressed by many cell types and many organisms
PrP^{BSE}	Resistant prion protein associated with bovine spongiform encephalopathy; also called PrP^{Sc}
PrP^{C}	Normal prion protein found in eukaryotic cells
PrP^{Res}	Resistant prion protein core remaining after proteolysis of PrP^{Sc} using proteinase K
PrP^{Sc}	Resistant prion protein associated with transmissible spongiform encephalopathies, including BSE
PrP^{Sens}	Normal prion protein found in eukaryotic cells; also called PrP^{C}
PV	Predictive value
Rapid test	Test systems using immunological assays that detect the presence of infectious agents in animal tissues or other materials within hours

RR	Relative risk
Ruminant species	Animals with multichambered stomachs that allow bacterial fermentation of feeds prior to intestinal digestion (e.g. cattle, sheep, goats, camellids)
Scrapie	A TSE of sheep and goats
SE	Sensitivity of a diagnostic test
Segregation	Undesirable separation of raw ingredients in a compound feed after processing
SFT	Swiss Institute of Feed Technology
Sick slaughter	Cattle with non-specific signs (definition differs among countries)
SP	Specificity of a diagnostic test
SPS Agreement	Agreement on the Application of Sanitary and Phytosanitary Measures
SRM	Specified risk materials; those animal tissues most likely to contain TSE infective material
SSC	Scientific Steering Committee of the European Commission
Strip test	Lateral flow immunochromatographic test for rapid detection of proteins in feed samples
Surveillance	Extension of monitoring in which control or eradication action is taken once a predefined level of the health-related event has been reached
TAFS	International Forum for TSE and Food Safety
TBT Agreement	Agreement on Technical Barriers to Trade
Terrestrial animal	In this context all livestock excluding aquatic species (e.g. poultry, ruminants, pigs, horses)
TME	Transmissible mink encephalopathy
TP	True prevalence
Tracing	Determining where an animal or product originated or has been
Tracking	Following an animal or product forward through the system
TSE	Transmissible spongiform encephalopathy
UK	United Kingdom of Great Britain and Northern Ireland
USA	United States of America
vCJD	Variant (or new variant) Creutzfeldt-Jakob disease of humans; believed to be caused by ingestion of the BSE agent
WB	Western blot
WHO	World Health Organization
WTO	World Trade Organization

Additional definitions can be found in

- the OIE *Terrestrial Animal Code*, Chapter 1.1.1. http://www.oie.int/eng/normes/MCode/en_chapitre_1.1.1.htm
- the FAO/WHO Codex Alimentarius "Current official standards". http://www.codexalimentarius.net/web/standard_list.do?lang=en

APPENDIX 4

Project summary

PROJECT SUMMARY

This course is a part of the project *Capacity Building for Surveillance and Prevention of BSE and Other Zoonotic Diseases*. The aim of the project is to build capacity, establish preventive measures and analyse risks for bovine spongiform encephalopathy (BSE), so that, ultimately, partner countries are able either to prove themselves to be BSE-free or are able to decrease their BSE risk to an acceptable level. Governmental and private veterinary services, diagnostic laboratories, and the livestock, food and animal feed industries will be strengthened and supported, and technical capacity built at every step along the food production chain. In the future, the knowledge gained during this project could be used by the countries to establish similar programmes for control of other zoonotic food-borne pathogens.

The project is funded by Swiss governmental agencies and utilizes expertise available in Switzerland and worldwide and infrastructure available from the Food and Agriculture Organization of the United Nations (FAO) to assist the governments of the partner countries to achieve the project's aim. The executing agency is Safe Food Solutions Inc. (SAFOSO) of Berne, Switzerland.

The direct project partner in each country is the National Veterinary Office. The countries commit and pay a salary to at least one individual, situated in the National Veterinary Office, to act as a National Project Coordinator (NPC), commit three trainees per course and provide the necessary infrastructure for implementation of the project in the country. The NPC is responsible for coordinating the activities of the project within the country, including offering training courses, identifying and organizing trainees, and promoting communication between the project, the government, the scientific community in the country, the livestock and food industries, and the public. Other commitments by the countries include providing paid leave time for employees to attend courses, providing infrastructure and facilities for in-country courses, providing historical and current data (surveillance data, animal movement data, import/export records) and the staff required to identify those data, and providing adequate staff for and facilitating the initial needs assessment and final comprehensive risk assessment.

A National Project Board in each of the participating countries regularly evaluates the operational progress and needs of the project, and provides a regular venue for communication among the project team, national partners and stakeholders. This Board is comprised of the NPC, representatives of the national government, a project representative, the local FAO representative, and local stakeholders from private industry and the veterinary community.

ACTIVITIES OF THE PROJECT

1. The specific needs of each participating country are assessed.
2. Comprehensive courses to "train the trainers" are provided in Switzerland (or elsewhere) to selected participants to improve understanding of the epidemiology of and relevant risk factors for BSE and to develop specific knowledge and skills for implementing appropriate controls.

Three trainees from each country, as well as the NPC, travel to Switzerland (or elsewhere) to participate in each course.

The courses are:

- Diagnostic Techniques for transmissible spongiform encephalopathies
- Epidemiology, Surveillance and Risk Assessment for transmissible spongiform encephalopathies
- Transmissible spongiform encephalopathies management in livestock feeds and Feeding
- Transmissible spongiform encephalopathies Management in Meat Production

Each course is preceded by an introduction to BSE covering the background of transmissible spongiform encephalopathies, BSE, biosafety, general concepts of epidemiology and risk assessment, and risk communication. Each course also includes discussion of aspects of risk communication that are relevant to the topic being presented.

Only those motivated individuals who will be implementing the relevant information into the national BSE programme, who have some experience (e.g. ability to use a microscope, veterinary training) and have adequate English skills, are accepted.

After each course, the relative success of the course is evaluated focusing on the success of the training methods and effectiveness of the knowledge transfer rather than on the learning of the individual trainees. Therefore, no written test is given, but close contact is maintained with the trainees after they return to their countries, and their progress and success in implementation of their training into the national BSE programme is followed and evaluated in the field.

3. Each of the TSE-specific courses is then offered as an in-country course in the native language, and is organized by the trainees and the National Veterinary Offices with technical support from the project. In-country courses use the same curriculum and expected outcomes as the original courses, and are provided with support, technical assistance and materials (translated into their own language). The introductory TSE and biosafety course curriculum is also presented. At least one expert trainer assists in presenting these courses. Participants are chosen according to strict selection criteria, but the number of participants and the frequency and location of courses given depends on the needs of the country and the type of course.
4. The knowledge gained through the courses should then be integrated by the partner country through development and implementation of a national BSE control programme. The programme is promoted and supported by the countries to ensure the sustainability of the system. Contact, technical support and follow-up with the countries is ongoing throughout the project.
5. Information campaigns to improve BSE awareness are targeted to national governments, producers and consumers.
6. Partner countries are supported in the submission of a comprehensive national BSE risk assessment to the World Organisation for Animal Health (OIE) in order to document their BSE status to the international community.

To support countries with economies in transition and developing countries in the control and prevention of bovine spongiform encephalopathy (BSE), the project Capacity Building for Surveillance and Prevention of BSE and Other Zoonotic Diseases, involves collaboration between FAO, SAFOSO and National Veterinary Offices in partner countries, and is funded by the Government of Switzerland. The aim of the project is to build capacity, establish preventive measures and analyse risks for BSE. Partner countries are thus enabled to decrease their BSE risk to an acceptable level or demonstrate that their risk is negligible, and thereby facilitate regional and international trade under the SPS agreement of the WTO. The project includes comprehensive training courses to improve understanding of the epidemiology of and relevant risk factors for BSE and TSE and to develop specific knowledge and skills for implementing appropriate controls.

This manual is a supplement to the training course on Management of transmissible spongiform encephalopathies in meat production and it targeted at governmental and industry personnel who will contribute to the development and implementation of the national BSE surveillance and control programme and to the BSE risk assessment for the partner countries.