



Animal &  
Plant Health  
Agency

# APHA Epidemiology Report

**RBSE 2018/0003**

October 2018



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The Animal and Plant Health Agency (APHA) is an executive agency of the Department for Environment, Food & Rural Affairs, and also works on behalf of the Scottish Government and Welsh Government.

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## Executive summary

On 18 October 2018, APHA confirmed a case of classical bovine spongiform encephalopathy (BSE) in Aberdeenshire, Scotland. This was the first case of classical BSE since 2015 to be confirmed in the UK. This report summarises the epidemiological investigations carried out in order to describe and explain this BSE case.

Epidemiological investigations to date have not revealed any evidence, or other cause for concern, that statutory official BSE controls have been breached at any point in relation to this born after the reinforced feed ban (BARB) case or its herd of origin.

The index case calved three times in her natal herd. Her first two offspring were slaughtered for human consumption by 22 months of age and were not TSE tested. The third calf has been culled as a result of this BSE case and underwent TSE testing with negative results. Investigations also identified a total of nine cohorts born and/or reared with the index case during the relevant risk period. Six of these were already dead and three were still alive and in their natal herd. These three were subsequently culled and underwent TSE testing with negative results.

There is a tenuous epidemiological link to previously confirmed BSE cases that were identified on a holding previously occupied by this cattle herd. Three previous cases were identified between 1992 and 1994 in the previous holding in England. The last of these cases occurred some ten years and five months prior to the owner of the current BARB case occupying the site and eleven years and four months prior to the birth of the dam of this case. A further six years elapsed until the birth of this BARB at the Scottish farm.

The likelihood of both horizontal and vertical transmission can therefore be considered to be negligible, since there is no evidence of infection or disease in the current case's siblings, offspring or birth/rearing cohort animals; and its dam and sire both remain alive, some six years after the case's birth.

The likelihood of environmental transmission through waste can be considered negligible given the waste management practiced by the farmer, however, it is noteworthy that during previous ownership the Scottish farm was used to store materials for gardening use which opens up the possibility that meat and bone meal based organic fertiliser could have inadvertently been stored on the holding. There is no evidence of on-farm practices that could result in cross contamination of cattle feed with meat and bone meal (or other products of animal origin) destined for other species with the dogs/cats always fed in the farm house.

Historically a number of local herds in the same parish as the holding of birth of this BARB case and the contiguous parishes have had confirmed BSE cases, which opens up further theoretical pathways for potential exposures:

- contamination of the cattle drinking water source as a result of groundwater run-off from surrounding premises where fallen stock could conceivably have been buried prior to the ban on on-farm burial in May 2003
- relocation of contaminated haylage and/or farm equipment from the previous holding in England (however the owner did not relocate any animal feeding equipment, other than sheep feed troughs, to the farm in Scotland).

However, the likelihood of either of these routes as a potential transmission pathway is considered to be very low, but they are included for completeness in the absence of identification of more likely source of infection.

**Detailed epidemiological investigations to date have not revealed a plausible source of infection for this BARB case, nor have they detected any evidence or other cause for concern that statutory official BSE/Feed controls have been breached at any point in relation to this BARB case or its herd of origin.**

**Prion Protein Open Reading Frame (ORF) gene sequencing for this case was undertaken and has ruled out mutation as a possible cause of BSE.**

**The material used to produce the feed stuffs and supplements that the BARB would have had a theoretical access to in its first 12 months of life and their potential contamination at source, processing and storage have been investigated and were not involved in any feed incident.**

## Introduction

On 18 October 2018, APHA confirmed a case of classical bovine spongiform encephalopathy (BSE). This was the first case of classical BSE since 2015 to be confirmed in the UK and was designated as 2018/0003. The affected animal was a pedigree cow born in 2013.

This report summarises the epidemiological investigations carried out in order to describe and explain the BSE case (RBSE 2018/0003) disclosed from a premises in Aberdeenshire, Scotland.

## Background

The affected animal was a cow, born in 2013 in a herd in Aberdeenshire. Conception of this animal occurred at the original location for this cattle herd in England prior to relocation to Scotland.

The animal remained in its herd of origin until its death on 02 October 2018. It had successfully calved on three occasions and was three months in calf at the time of its death.

The cow was initially noted to be unwell on 30 September 2018, showing clinical signs consistent with a diagnosis of hypomagnesemia. The cow was treated immediately by the private veterinary surgeon and made a partial recovery; however two days later she fell into a watercourse, and as a result, a decision was taken to cull. She died prior to the knackery attending

As a result of her age, the carcass was taken to a TSE testing site in Scotland, where it was tested for BSE as fallen stock, with an initial positive result reported on 08 October 2018. The case was confirmed on 18th October 2018 following statutory confirmation tests.

## Description of the herd of origin

The herd of origin is a small-medium size one and composed of pedigree suckler cattle. The farmer fattens a small number of animals mainly for his own consumption, with the majority of calves sold as stores via local markets, and a small number of heifer calves retained as replacements. Artificial insemination and embryo transfer have not been used in this herd.

The herd calves indoor in April on straw. After calving, the cows and calves are kept indoors for between three to ten days, depending on the weather conditions, before being moved outdoor to pasture until the following November, prior to rehousing. Weaning tends to occur at the beginning of January, at approximately seven to eight months of age.

In addition, the farmer has a medium size flock of ewes, split between a small pedigree flock with the remainder cross-bred ewes. During the spring of 2013, the sheep lambed in one of the barns and the following year the lambing accommodation was relocated to a new barn. Ewes are fed concentrate nuts prior to, during and after lambing both indoors and at pasture, however co-grazing with cattle does not occur. The best of the pedigree sheep are sold for further breeding, the remainder are sold as fat lambs.

This herd was moved to its current location from its farm of origin in England. The previous farm where the herd was located was historically a dairy and arable unit owned by the local Council. It was converted to a beef and arable unit by the owner of the current BARB case during his occupation of the holding. At the start of the tenancy no feed storage equipment (e.g. silos) were present on the holding from the previous tenant.

The previous owner of the Scottish Farm kept goats. They also supplied gardening products, which appear to have been kept at the farm, prior to sale.

The holding comprises various buildings, a garden, permanent grazing and a small amount of arable land.

In the previous months to the BARB case's birth, the cattle were moved into a shed, where the index case was born prior to being moved out onto pasture in the spring. The following autumn, the index case along with the rest of the herd was moved into the new cattle accommodation built in that year.

## Investigation on the premises

The investigations and analyses conducted used the following information sources:

1. Farms visits, including inspection of farm records.
2. A visit to the owner's private veterinary practice.
3. British Cattle Movement System (BCMS) data.
4. Historical BSE data.
5. National Feed Audit (NFA) information on the feed suppliers.

The description of the farming practices provided below can be assumed to apply for this particular animal, as well as all others in the relevant time period.

The records (feed, cattle movements and medicine) kept on farm appeared satisfactory and the recollection and account of the historical farming practices is consistent with the type of farming system in this area, nevertheless the possibility of inadvertently missing relevant information cannot be ruled out given the passage of time since the birth of this case.

Previous farming practices at the current location prior to the current owners moving there are difficult to ascertain; such as the presence of burial sites for fallen stock (prior to regulatory changes in 2003) and the use of organic fertilisers. The holding was free of cattle for at least seven years prior to the relocation of the herd.



## Cohorts

Investigations identified a total of nine cohorts born and/or reared with the index case during the relevant risk period. Six of these were already dead as detailed in Appendix 1, table 1, and three were still alive and in their natal herd (Appendix1, table 2). These three were subsequently slaughtered and BSE tested with negative results. (For offspring see 7.1, b below.)

## Source investigation

### I. Vertical Transmission

#### a. Dam to offspring:

The dam of this BARB case, was born at the previous holding in England. She moved to her current location when the farming business relocated to Aberdeenshire in 2012 and is currently still present in the herd.

She first calved at three years of age and has produced a calf every year since, up to and including her last calving 9 years later. Of her offspring only this born after the reinforced feed ban (BARB) case has undergone TSE testing, in accordance with current legislative requirements. All the remaining offspring from the BARB's dam are either still alive or were slaughtered as fit for human consumption by 27 months of age (and would therefore not have been eligible for statutory TSE surveillance testing).

**Table 1: Dam of BSE case**

| S | Species | Status | Location      | Age |
|---|---------|--------|---------------|-----|
| F | Bovine  | Alive  | Aberdeenshire |     |

**Table 2: Offspring of dam of BSE case**

| <b>S</b> | <b>Species</b> | <b>Status</b> | <b>Location</b>    | <b>Age</b>              |
|----------|----------------|---------------|--------------------|-------------------------|
| <b>M</b> | <b>Bovine</b>  | <b>Dead</b>   | <b>Slaughtered</b> | <b>25 months</b>        |
| <b>M</b> | <b>Bovine</b>  | <b>Dead</b>   | <b>Slaughtered</b> | <b>26 months</b>        |
| <b>F</b> | <b>Bovine</b>  | <b>Alive</b>  | <b>on farm</b>     | <b>7 years 7 months</b> |
| <b>F</b> | <b>Bovine</b>  | <b>Alive</b>  | <b>On farm</b>     | <b>6 years 8 months</b> |
| <b>F</b> | <b>Bovine</b>  | <b>Dead</b>   | <b>Index Case</b>  | <b>5 years 6 months</b> |
| <b>M</b> | <b>Bovine</b>  | <b>Dead</b>   | <b>Slaughtered</b> | <b>19 months</b>        |
| <b>F</b> | <b>Bovine</b>  | <b>Dead</b>   | <b>Slaughtered</b> | <b>21 months</b>        |
| <b>M</b> | <b>Bovine</b>  | <b>Dead</b>   | <b>Slaughtered</b> | <b>18 months</b>        |
| <b>F</b> | <b>Bovine</b>  | <b>Dead</b>   | <b>Slaughtered</b> | <b>17 months</b>        |
| <b>M</b> | <b>Bovine</b>  | <b>Alive</b>  | <b>On farm</b>     | <b>6 months</b>         |

***b. Index case to offspring:***

The index case, calved three times in her natal herd (table 3). Her first two offspring were slaughtered for human consumption by 22 months of age and were not BSE tested and the third calf, has been culled as a result of this BSE case. Brain stem testing of this offspring provided a negative result.

**Table 3: Offspring of BSE index case at date of disease confirmation**

| <b>DOB</b>  | <b>S</b> | <b>Species</b> | <b>Status</b>      | <b>Location</b> | <b>Date of death</b>  |
|-------------|----------|----------------|--------------------|-----------------|---|
| <b>2016</b> | <b>M</b> | <b>Bovine</b>  | <b>Slaughtered</b> | <b>n/a</b>      | <b>22 months</b>  |
| <b>2017</b> | <b>M</b> | <b>Bovine</b>  | <b>Slaughtered</b> | <b>n/a</b>      | <b>16 months</b>  |
| <b>2018</b> | <b>F</b> | <b>Bovine</b>  | <b>Alive</b>       | <b>On farm</b>  | <b>Subsequently culled on<br/>30/10/2018 under statutory<br/>offspring cull</b> |

***c. Sire to offspring:***

The sire of this case was born in England in 2008. He moved to the previous location of the herd in 2009, as a stock bull, and was eventually sold to his current location in 2012, where he currently resides at 130 months of age.

## **II. Feed**

According to the farmer, the feeding practices for this suckler herd have remained largely unchanged over the years, with just home-grown haylage, purchased straw and grass being fed until 2015. On moving to Scotland, the farmer brought haylage from his previous holding, some hay was left in the farm by the previous owner, and straw was purchased from a local farmer. Checks of the BSE database show that there are no records of any BSE cases having occurred on that holding.

The cows extensively graze the land, and until recently (2015) supplementary feeding of concentrate cereal based rations was not practiced. Supplementary feeding was provided (minerals and magnesium blocks) during high risk periods of the year.

For the first 48 hours after birth, the calf is kept in an individual pen with the dam, they are then both moved into a common pen, shared with other recently calved cows, before they are turned out to pasture. Placentas are not disposed of from the calving accommodation, but are removed with bedding and composted prior to spreading on arable land.

When indoors, cattle are fed fodder from a feed passage through a feed barrier. Buffer feeding with straw whilst at pasture is via ring feeders, and free access minerals and magnesium are supplied from feed tubs.

Milk replacers are not, and historically have not been, used for calves. Details of feed that the BARB case had access to during the first 12 months of its life are detailed in table 4 below.

**Table 4: Calves feeding practices**

| Age in Weeks                 | Milk   | Concentrate | Free access minerals | Roughage                       | Housing                                  |
|------------------------------|--|-------------|----------------------|--------------------------------|--|
| Day 0 – 2<br>Week 1          | Colostrum (dam)                              | None        | None                 | None                           | Individual pen                           |
| Day 3 - 7<br>Week 1          | Whole milk (dam and potentially other cows)) | None        | Potential            | None                           | Group pen                                |
| Week 2                       | Whole milk (dam, at foot)                    | None        | Potential            | None                           | None (field outside)                     |
| Week 3 - 12                  | Whole milk (dam, at foot)                    | None        | Potential            | Potential to graze             | None (field outside)                     |
| Week 13 - weaning            | Whole milk from Dam                          | None        | Potential            | Potential to graze and haylage | None (field outside), then group housing |
| Weaning at 10 months onwards | None   | None        | Yes                  | Haylage/straw                  | Group housed                             |

Recently (2015) the farmer has started to add supplementary feeding to the cattle's ration via a local supplier. This is outside the risk period. Details of all feedstuffs purchased are detailed in table 5 below.

During the winter of 2012/2013, haylage was kept in the farm yard and feed stuffs were stored as detailed in table 5 below.

During the winter of 2013/2014 haylage was stored in the forage store. During this time, feedstuff was stored in a building close to the cattle shed. This building is kept isolated by a roller door. All these buildings are part of a new area that is very well maintained and kept tidy. Purchased straw is kept in another shed inaccessible to livestock.

**Table 5: Feedstuffs received onto the premises within the first 12 months of life of the index case**

| Species | Name of ration           | Supplier      | Bulk | Bag    | Purchase Frequency             | Storage method   |
|---------|--------------------------|---------------|------|--------|--------------------------------|--|
| Sheep   | Nuts                     |               |      | X      | 5 years prior to the BARB case | Stored in the mill   |
| Horses  | Hay and straw            | Aberdeenshire |      |        | As above                       | Bought just the first year as didn't have enough.<br>Bales kept in the old farm yard on concrete.            |
| Cattle  | Straw                    | Aberdeenshire |      |        | As above                       | Used for cattle bedding. Cannot exclude it was fed to cattle.<br>Bales kept in the old farm yard on concrete |
| Dog     | Proprietary dry dog food |               |      | X      |                                | Garage   |
| Cat     | Proprietary cat food     | Supermarket   |      | X      |                                | House  |
| Poultry | Laying hens pellets      |               |      | X<br>X |                                | Stored in the mill.  |

| Species | Name of ration | Supplier | Bulk | Bag | Purchase Frequency | Storage method |
|---------|----------------|----------|------|-----|--------------------|----------------|
|         | Oyster shell   |          |      |     |                    |                |

**Table 6: Supplements available within the first 12 months of the index case life**

| Type of ration              | Bulk | Bag | Tub | Purchase Frequency                       | Storage method      |
|-----------------------------|------|-----|-----|--|---------------------|
| Minerals<br>beef cow ration |      | X   |     | 2 x 25kg in spring<br>2 x 25kg in autumn | Stored in the mill. |
| Magnesium Block             |      |     | X   | 2 x spring                               | Stored in the mill. |

An interrogation of the National Feed Audit databases for the feedstuffs in table 5, supplements in table 6 and their suppliers/manufactures did not reveal any problems associated with them. A search of the spread tracing records of previously investigated feed incidents in 2013 and 2015 did not associate this farm with them.

Water for the farm is supplied via a private spring, either through access to fenced watering areas in a burn that runs through some fields, or via a piped supply, also from the spring. Scottish Water have a reservoir that is situated next to the farm, however the water from this reservoir is not used to supply the farm.

### III. Horizontal Transmission

A review of the BSE database has shown that there have been no previous BSE cases identified at the Scottish farm.

Since active surveillance was established in 2001, only two cattle have been TSE tested (including the current BARB case) both as fallen stock in the Scottish farm. Out of the two animals sampled only the current case proved to be positive.

The single remaining offspring of the current BARB case and its three remaining birth/rearing cohort members were all TSE tested with negative results following culling and disposal after disclosure of this case.

A review of the previous location of the herd in England has revealed that three BSE cases have occurred on this holding, all prior to the current BARB's owner occupying the holding. No livestock were taken over by the herd's owner when he took occupation of it. Active TSE surveillance testing during that period was undertaken on two healthy cattle slaughtered for human consumption, both with negative results.

#### **IV. Environmental Contamination**

As stated above, there have been no previous BSE cases identified at the current location according to the BSE database. A previous owner farmed goats at this farm, and active TSE surveillance was carried out on three fallen goats. Two samples were negative, whilst the third was untestable. As stated previously, cattle were present on the farm until November 2004, and then absent until November 2012. There is no evidence of any TSE occurring on this holding in the past.

Historically there have been seven previously confirmed BSE cases in the same parish as the index holding, with the first identified in July 1990 and the last in March 1994. Contiguous parishes have had a further 21 BSE cases.

The previous location for the herd in England has had three confirmed BSE cases, between 1992 and 1994. These were all in excess of ten years prior to the owner of the current case farming at this location. No feed storage/feeding equipment was present on the holding at the start of the tenancy. Contiguous parishes have had 174 BSE cases

As stated previously, water is supplied from a farm spring either via watering stations in the burn that runs through the farm, or via a piped supply to the buildings and fields that have no access to the burn. No flooding is reported to have occurred at this premises.

There are no known animal by-products (ABP) premises in the surrounding area (hunt kennel, tannery, knackery etc.). A landfill was operating at the other side of the village's road until 1995. Slurry, compost or digestate have not been spread on fields during the current ownership. The holding's own farmyard manure is spread on arable land to improve the fertility of the soil. In 2012, the manure was spread on arable land used for growing turnips that were then used to feed sheep. The cattle did not have access to the turnips then, or in subsequent years. Purchased inorganic fertiliser was used in 2013, however the owner does not recollect the manufacturer of the product used. Lime has only been used once during the spring of 2017.

It has been noted that the previous owner of this holding stored gardening products. Pallets of compost were present during the farm viewing prior to the current owner purchasing the premises. It is conceivably possible that the compost could have contained fertiliser derived from meat and bone meal. The previous owner has confirmed that compost was stored on the farm however no other products were off-loaded at the farm.

APHA hold no records of unrecoverable carcasses at this holding, nor on the surrounding farms, and neither has the farmer reported lost or stolen animals. During the risk period no externally sourced contract machinery was used on the farm. A haulier was used to transport the farm livestock, haylage and machinery during the business relocation.

Fallen stock are collected by an ABP approved collector. The owner is pleased with their service and has never noticed any leakage of any material from their vehicles. Fallen stock are however stored prior to collection within the farm steading, so cross contamination of vehicles and protective clothing is possible.

## **V. Veterinary Treatment**

Details obtained by interview of the owner's private veterinary surgeon and close scrutiny of the on farm medicine records failed to identify any recorded medicinal product that was considered to provide a viable risk pathway e.g. hormones, blood or serum products. The index case had not required any surgical veterinary treatment during her life, nor had she been subject to any artificial breeding procedures such as artificial insemination or embryo transfer.

## **VI. Other Species**

From arrival in Scotland, the current owner of this holding has consistently had a variety of species present on the farm. These consist of a medium-sized sheep flock, mixed poultry/avian species, a small number of horses and a number of cats and dogs.

Feed for other animals is kept inaccessible to cattle and sheep. Dogs and cats are fed in the house, the mixed poultry/avian species are fed in an enclosure, and the horses in their paddock. The horses were fed in a field, where it was technically possible for cattle to gain access to the feed, however in reality this would be extremely unlikely.



## VII. Genetic susceptibility: Routine Prion Protein Open Reading Frame (ORF) gene sequencing to rule out mutation as a possible cause of BSE in RBSE 18/00003

The DNA of the Open reading Frame of the Prion protein gene is the DNA that encodes the Prion Protein's primary amino acid structure. The sequence of this gene from RBSE 18/00003 has been determined by DNA sequencing. Note that two alleles (gene copies) are present one of paternal and one of maternal origin.

| RBSE      | Sample type | CSU ref | Bovine Prion protein (PrP) ORF polymorphisms |                   |                   |                    |                    | ORF Genotype |          |
|-----------|-------------|---------|--|-------------------|-------------------|--------------------|--------------------|--------------|----------|
|           |             |         | Octapeptide repeats                          | L23 (65647 C>T/Y) | Q78 (65812 G>A/R) | P113 (65917 C>T/Y) | N192 (66154 C>T/Y) | Allele 1     | Allele 2 |
| 18/ 00003 | brain       | R53185  | 6:6  | -                 | -                 | Y                  | -                  | 6:wt         | 6:P113   |

### No mutations were found.

One polymorphism, a naturally occurring previously identified variation resulting in a single DNA base pair change was identified in the DNA. Referred to as P113, it is a silent polymorphism because the DNA change does not change the amino acid, and therefore does not affect the protein structure and so is of no significance in this case.

The polymorphism is not a mutation, it is a minor allele that has been found previously in the bovine DNA Open Reading frame (ORF), the DNA coding the prion protein's structure. The other allele (or copy) was considered to be the wild type (wt) which is the normal DNA sequence found in the Bovine cattle population.

The DNA of the animal's Prion Protein gene also contained six octapeptide repeats in both copies. Natural variation in this repeated section of DNA in cattle can also occur with five, six or seven octapeptide repeats being present, depending on the animal's parental genetics.

Research has not identified any significance relating to octapeptide repeats and cases born after the reinforced ban in 1996 (BARB) cases<sup>1</sup>. Other studies have also looked for, and failed to identify, an association between BSE and PrP gene ORF polymorphisms: neither Hunter et al. (1994)<sup>2</sup> nor Sander et al. (2004)<sup>3</sup> found associations with PrP octapeptide genotype or the N192 SNP, and the latter study also failed to find associations with Q78 or P113”

Of four BARB animals from crosses of the same breed as the index case that have previously undergone gene sequencing none had the silent polymorphism P113. Two of them had wild type 6 octapeptide repeats and the remaining two had 5 octapeptide repeats.

**Population data for BSE cases in the UK to date from over 180+ thousand cases and representing approximately 296 different breeds.**

Information on the same breed BSE cases recorded on APHA BSE system:

**In UK:**

- Same breed as the index case: in total 160 cases
- Crosses of the same breed as the index case breed: in total 719 cases

**In Scotland only:**

| Breed                | F   | M |
|----------------------|-----|---|
| BREED                | 36  | 1 |
| CROSS BRED (GENERIC) | 258 | 1 |
| BREED x AYRSHIRE     | 7   |   |
| BREED x CHAROLAIS    | 1   |   |
| BREED x FRIESIAN     | 285 |   |
| BREED x LIMOUSIN     | 9   |   |

# Summary of relevant control measures & dates

## I. The GB National Feed Audit

In Great Britain to confirm the effectiveness of the TSE Feed Ban controls an inspection and sampling programme, the National Feed Audit (NFA), is undertaken throughout the animal feed chain including imported feeds, bulk storage, production at feed mills, blending plants, mobile mixers & on farm mixers using fishmeal in feed production and livestock farms including home compounders.

All incidents are rigorously investigated and risk based actions taken to prevent further marketing of contaminated feed into the feed chain and where necessary restriction of ruminant animals and removal of those animals from the food chain is carried out.

Summary statistics for the National Feed Audit programme are available:

<https://www.gov.uk/government/statistics/national-feed-audit-summary-statistics>

## II. The Feed Ban

Feed controls were first introduced in the UK in 1988, when the cause of BSE was first epidemiologically linked to feed containing meat and bone meal. The 1<sup>st</sup> August 1996 is considered as the date of the effective Reinforced Feed Ban, when mammalian meat and bone meal was banned from all farm animal feed. A European Council Decision in 2000 (2000/76) extended the ban and provided harmonised BSE-related feed controls across all Member States. Current EU Feed Ban controls have been amended since then and are included in Regulation (EC) No. 999/2001.

## III. Ban on on-farm burial of fallen stock

Since May 2003, it has been illegal to bury fallen stock (dead animals) on farms throughout Europe under the EU Animal By-Products Regulation. A derogation exists within remote areas in Scotland for burial to occur however the farm concerned is out with the derogated area.

## Concluding remarks

- 1. Clinical signs:** Prior to her death, the animal showed clinical signs compatible with classical BSE.
- 2. Epidemiological links:** there is a tenuous epidemiological link to previously confirmed BSE cases that were identified on a holding previously occupied by this cattle herd. Three previous cases were identified between 1992 and 1994. The last of these cases occurred some ten years and five months prior to the owner of the current case occupying the site and eleven years and four months prior to the birth of this case's dam at the same location. A further six years elapsed until the birth of this BARB at a different location
- 3. Horizontal and vertical transmission:** the likelihood of both horizontal and vertical transmission can be considered to be negligible since there is no evidence of infection or disease in the current case's siblings, offspring and birth/rearing cohort members and its dam and sire both remain alive some six years after the case's birth. However it should be noted that there are medium levels of uncertainty associated with this as a limited amount of active TSE testing of eligible animals (e.g. fallen stock and over 30 month cattle, as required by the legislation) has been carried out on the current holding and previous holding (see Appendix 8) and it remains conceivably possible (albeit considered very low likelihood) that unrecognised disease might have occurred. However, the single remaining offspring of the BARB case and its three remaining birth/rearing cohort members were all TSE tested with negative results following statutory culling and disposal.

**It is important to note that all legally required TSE testing has been completed throughout the life of this herd.**

- 4. Environmental transmission:** the likelihood of environmental transmission through waste material can be considered to be negligible given the waste management procedures practiced by the farmer. However, it is noteworthy that during previous ownership the farm was used to store compost for gardening purposes which may have contained meat and bone meal based organic fertiliser

Historically a number of local herds in both this and the contiguous parishes have experienced confirmed BSE cases which opens up a further theoretical pathway for exposure. On-farm burial was not banned until May 2003, therefore cattle born on or after August 1996 potentially could have been buried on these farms. As mentioned, the water supply to this holding is via an on farm spring supplied by ground water so exposure to prions bound to soil is theoretically possible. This risk pathway is considered to be of negligible likelihood, but with high uncertainty; however its inclusion is justified due to the absence of an identified alternative likely route of exposure.

If the previous holding occupied by this herd is considered then the cases in surrounding farms noted at point two above need to be considered. Given the time and distance between these cases and this BARB case the likelihood of this being the source of the infection is considered to be negligible with low uncertainty.

Whilst there exists a precedent for environmental contamination and persistence of other TSE agents (e.g. Chronic Wasting Disease and up to 16 years for Scrapie<sup>4</sup>) there is a lack of documented unequivocal evidence for transmission of BSE via an environmental contamination route<sup>5</sup> and scant evidence for classical BSE prions being excreted into the environment by infected cattle<sup>6</sup>.

- 5. Husbandry practices:** there is no evidence of on-farm practices that could result in cross contamination of cattle feed with meat and bone meal (or other products of animal origin) destined for other species with the dogs/cats always fed in the farm house.
- 6. Feed:** purchased (as opposed to home grown) feedstuffs are usually considered to be the most likely risk factor for BSE cases as it provides a viable risk pathway for the introduction of the infectious agent. However, given the feed material available to this BARB case during its first 12 months of life and thereafter this is considered a very low risk. This risk is mitigated in that GB feed is routinely tested for the presence of mammalian proteins and that all incidents identified are rigorously investigated and acted upon.

It should be acknowledged that haylage was brought from the previous location in England to the current farm at the time the farm business was relocated and it is theoretically possible for soil contamination of this feed material (or other relocated farm equipment) to have occurred. There is therefore a theoretical transmission route if haylage contaminated by soil was fed to the BARB case either in the 14 days post birth or during the animals first winter housing period. This is considered to be a very low risk with medium uncertainty as it is likely that the haylage was consumed by adult cattle during the first winter and it is unlikely that a 14 day old calf would do more than investigate the material with its mouth. The only items of feeding equipment relocated from the previous farm were sheep feeding troughs that the cattle would not access.

Straw purchased following relocation of the herd to its current location in Scotland was sourced from premises that are not recorded as ever having had a BSE case.

- 7. General:** It is recognised that even so many years after implementation of the total feed ban detection of sporadic BARB cases is not an entirely unprecedented event (e.g. the 2015 cases in Wales and Ireland and the 2016 case in France) and continues to represent a significant epidemiological challenge in terms of

investigating and being able to identify a definitive source of infection for each case due to the significant time delay between exposure to the agent and the subsequent development of clinical signs/post-mortem laboratory detection and the potential associated recall bias/loss of records consequent to elapsed time<sup>5,7</sup>.

A recently published modelling study considering BARB cases across the EU concluded that there is a 44.9% probability that the last previous identified case in the UK in 2015 would be the final case, with a 55.1% probability remaining of additional cases occurring in 2016 or later, up to an extremely low (0.02%) but non-negligible probability of detecting a case up until 2026<sup>8</sup>.

**Detailed epidemiological investigations to date have not revealed a definitive plausible source of infection for this BARB case, nor have they detected any evidence or other cause for concern that statutory official BSE/Feed controls have been breached at any point in relation to this BARB case or its herd of origin.**

**Prion Protein Open Reading Frame (ORF) gene sequencing for this case was undertaken and has ruled out mutation as a possible cause of BSE.**

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## Appendices

### Appendix 1: Tables summarising cohorts of the BSE case

**Table 1: Dead Cohorts**

| DOB  | S | Status | Age       | Cohort Type | Status |
|------|---|--------|-----------|-------------|--------|
| 2012 | F | Dead   | 26 months | REARING     | Dead   |
| 2013 | M | Dead   | 18 months | REARING     | Dead   |
| 2013 | M | Dead   | 17 months | BIRTHING    | Dead   |
| 2013 | M | Dead   | 17 months | BIRTHING    | Dead   |
| 2014 | F | Dead   | 0 months? | BIRTHING    | Dead   |
| 2014 | F | Dead   | 19 months | REARING     | Dead   |

**Table 2: Live cohorts**

**\*subsequently culled and tested with negative results**

| DOB  | S | Status | Location   |
|------|---|--------|------------|
| 2013 | F | Alive* | On holding |
| 2013 | F | Alive* | On holding |
| 2013 | F | Alive* | On holding |



## Appendix 2: Details of active surveillance

### Summary of TSE tested animals from holdings -

| Species ID | Test Group Name             | Birth Date | Slaughter Date | Farm Location    | Result     |
|------------|-----------------------------|------------|----------------|------------------|------------|
| Goat       | Goat fallen stock survey    | unknown    | May-05         | Scottish Holding | negative   |
| Goat       | Goat fallen stock survey    | unknown    | Feb-07         | Scottish Holding | negative   |
| Goat       | Goat fallen stock survey    | unknown    | Feb-07         | Scottish Holding | unsuitable |
| Cattle     | Fallen Stock                | 16-Jul-00  | Mar-13         | Scottish Holding | negative   |
| Cattle     | Fallen Stock                | 05-Apr-13  | Oct-18         | Scottish Holding | positive   |
| Cattle     | Human Consumption - Healthy | 12-Sep-96  | Dec-12         | English Holding  | negative   |
| Cattle     | Human Consumption - Healthy | 15-Mar-01  | Dec-12         | English Holding  | negative   |

### Appendix 3: Historical BSE confirmed cases for same parish plus contiguous parishes in Scotland

| Location            | Notice Date | Final Result | Number of BSE positives |
|---------------------|-------------|--------------|-------------------------|
| Same Parish 1       | 02-Mar-93   | Pos          | 1                       |
| Same Parish 2       | 16-Jul-90   | Pos          | 1                       |
| Same Parish 3       | 02-Oct-18   | Pos          | 1                       |
| Same Parish 4       | 18-Feb-91   | Pos          | 1                       |
| Same Parish 5       | 28-Mar-94   | Pos          | 1                       |
| Same Parish 6       | 17-Mar-92   | Pos          | 2                       |
| Same Parish 6       | 05-Apr-93   | Pos          |                         |
| Contiguous Parish 1 | 30-Mar-93   | Pos          | 1                       |
| Contiguous parish 2 | 24-Mar-98   | Pos          | 1                       |
| Contiguous Parish 3 | 24-Mar-94   | Pos          | 3                       |
| Contiguous Parish 3 | 08-Feb-94   | Pos          |                         |
| Contiguous Parish 3 | 22-May-94   | Pos          |                         |
| Contiguous Parish 4 | 12-Jun-90   | Pos          | 1                       |

| <b>Location</b>      | <b>Notice Date</b> | <b>Final Result</b> | <b>Number of BSE positives</b> |
|----------------------|--------------------|---------------------|--------------------------------|
| Contiguous Parish 5  | 21-Jul-88          | Pos                 | 1                              |
| Contiguous parish 6  | 06-Jan-93          | Pos                 | 1                              |
| Contiguous Parish 7  | 10-Oct-91          | Pos                 | 7                              |
| Contiguous Parish 7  | 22-Mar-93          | Pos                 |                                |
| Contiguous Parish 7  | 09-Jan-91          | Pos                 |                                |
| Contiguous Parish 7  | 01-Oct-93          | Pos                 |                                |
| Contiguous Parish 7  | 30-Jul-91          | Pos                 |                                |
| Contiguous Parish 7  | 07-Jan-94          | Pos                 |                                |
| Contiguous Parish 7  | 06-May-93          | Pos                 |                                |
| Contiguous Parish 8  | 23-Feb-00          | Pos                 | 1                              |
| Contiguous Parish 9  | 02-Feb-94          | Pos                 | 1                              |
| Contiguous Parish 10 | 26-Apr-93          | Pos                 | 1                              |
| Contiguous           | 29-Oct-98          | Pos                 | 1                              |

| <b>Location</b>      | <b>Notice Date</b> | <b>Final Result</b> | <b>Number of BSE positives</b> |
|----------------------|--------------------|---------------------|--------------------------------|
| Parish 11            |                    |                     |                                |
| Contiguous Parish 12 | 05-Jan-93          | Pos                 | 1                              |
| Contiguous Parish 13 | 28-Apr-94          | Pos                 | 1                              |
| Contiguous Parish 14 | 29-Oct-91          | Pos                 | 1                              |

#### Appendix 4: Historical BSE confirmed cases for contiguous holdings in previous location of the herd in England

| Holding | Notice Date | Result | Number of BSE positives |
|---------|-------------|--------|-------------------------|
| 1       | 10-Oct-88   | Pos    | 18                      |
| 1       | 13-Dec-88   | Pos    |                         |
| 1       | 11-May-92   | Pos    |                         |
| 1       | 18-Oct-89   | Pos    |                         |
| 1       | 30-Jan-92   | Pos    |                         |
| 1       | 22-Jun-92   | Pos    |                         |
| 1       | 25-Aug-93   | Pos    |                         |
| 1       | 03-Apr-91   | Pos    |                         |
| 1       | 04-Oct-93   | Pos    |                         |
| 1       | 20-Nov-91   | Pos    |                         |
| 1       | 02-Sep-93   | Pos    |                         |
| 1       | 12-Jun-90   | Pos    |                         |
| 1       | 05-Nov-92   | Pos    |                         |
| 1       | 25-Aug-92   | Pos    |                         |
| 1       | 14-Apr-99   | Pos    |                         |
| 1       | 21-Jul-88   | Pos    |                         |

| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 1              | 01-Jan-97          | Pos           |                                |
| 1              | 25-Feb-99          | Pos           |                                |
| 2              | 04-Nov-94          | Pos           | 19                             |
| 2              | 10-Oct-89          | Pos           |                                |
| 2              | 21-Jun-93          | Pos           |                                |
| 2              | 25-May-92          | Pos           |                                |
| 2              | 21-Jan-91          | Pos           |                                |
| 2              | 13-Mar-90          | Pos           |                                |
| 2              | 16-Mar-90          | Pos           |                                |
| 2              | 04-Jan-90          | Pos           |                                |
| 2              | 17-Feb-92          | Pos           |                                |
| 2              | 03-Apr-90          | Pos           |                                |
| 2              | 22-Jul-93          | Pos           |                                |
| 2              | 20-Oct-88          | Pos           |                                |
| 2              | 30-Jul-97          | Pos           |                                |
| 2              | 08-Sep-98          | Pos           |                                |
| 2              | 05-Aug-98          | Pos           |                                |
| 2              | 07-Nov-97          | Pos           |                                |

| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 2              | 10-May-94          | Pos           |                                |
| 2              | 09-Jul-98          | Pos           |                                |
| 2              | 30-Aug-94          | Pos           |                                |
| 3              | 17-Apr-96          | Pos           | 31                             |
| 3              | 10-Mar-92          | Pos           |                                |
| 3              | 29-Jun-92          | Pos           |                                |
| 3              | 28-Aug-92          | Pos           |                                |
| 3              | 04-Dec-92          | Pos           |                                |
| 3              | 08-Jul-91          | Pos           |                                |
| 3              | 24-Aug-93          | Pos           |                                |
| 3              | 06-Jan-92          | Pos           |                                |
| 3              | 23-Jan-92          | Pos           |                                |
| 3              | 31-Mar-92          | Pos           |                                |
| 3              | 31-Mar-92          | Pos           |                                |
| 3              | 16-Feb-93          | Pos           |                                |
| 3              | 24-Aug-93          | Pos           |                                |
| 3              | 13-Aug-96          | Pos           |                                |
| 3              | 30-Dec-93          | Pos           |                                |

| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 3              | 19-Dec-94          | Pos           |                                |
| 3              | 30-Dec-93          | Pos           |                                |
| 3              | 19-Dec-94          | Pos           |                                |
| 3              | 06-Sep-95          | Pos           |                                |
| 3              | 30-Dec-93          | Pos           |                                |
| 3              | 30-Dec-93          | Pos           |                                |
| 3              | 25-Mar-94          | Pos           |                                |
| 3              | 20-Jun-95          | Pos           |                                |
| 3              | 26-Jul-90          | Pos           |                                |
| 3              | 17-Apr-96          | Pos           |                                |
| 3              | 25-Mar-94          | Pos           |                                |
| 3              | 31-May-94          | Pos           |                                |
| 3              | 09-Dec-96          | Pos           |                                |
| 3              | 20-Jun-95          | Pos           |                                |
| 3              | 13-Aug-96          | Pos           |                                |
| 3              | 11-Dec-95          | Pos           |                                |
| 4              | 02-Mar-94          | Pos           | 5                              |
| 4              | 09-Dec-92          | Pos           |                                |



| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 4              | 03-Jun-92          | Pos           |                                |
| 4              | 09-Jun-93          | Pos           |                                |
| 4              | 31-Dec-93          | Pos           |                                |
| 5              | 01-Sep-88          | Pos           | 28                             |
| 5              | 28-Jan-91          | Pos           |                                |
| 5              | 18-Nov-91          | Pos           |                                |
| 5              |                    |               |                                |
| 5              | 11-Jul-91          | Pos           |                                |
| 5              | 13-Jul-92          | Pos           |                                |
| 5              | 25-Mar-91          | Pos           |                                |
| 5              | 21-Sep-90          | Pos           |                                |
| 5              | 26-Mar-92          | Pos           |                                |
| 5              | 02-Oct-92          | Pos           |                                |
| 5              | 29-Jul-93          | Pos           |                                |
| 5              | 17-Dec-90          | Pos           |                                |
| 5              | 29-Jan-93          | Pos           |                                |
| 5              | 01-Oct-93          | Pos           |                                |
| 5              | 18-Feb-91          | Pos           |                                |

| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 5              | 05-Apr-93          | Pos           |                                |
| 5              | 24-May-89          | Pos           |                                |
| 5              | 02-Apr-91          | Pos           |                                |
| 5              | 14-Aug-92          | Pos           |                                |
| 5              | 06-Dec-91          | Pos           |                                |
| 5              | 26-Mar-92          | Pos           |                                |
| 5              | 01-Dec-92          | Pos           |                                |
| 5              | 21-Sep-91          | Pos           |                                |
| 5              | 15-Aug-95          | Pos           |                                |
| 5              | 04-Feb-94          | Pos           |                                |
| 5              | 31-Jan-96          | Pos           |                                |
| 5              | 04-Jan-95          | Pos           |                                |
| 5              | 20-Jul-99          | Pos           |                                |
| 5              | 04-May-95          | Pos           |                                |
| 6              | 14-May-02          | Pos           | 3                              |
| 6              | 07-May-93          | Pos           |                                |
| 6              | 06-Dec-94          | Pos           |                                |
| 7              | 04-Dec-91          | Pos           | 1                              |

| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 8              | 15-Jan-99          | Pos           | 1                              |
| 9              | 23-Jun-88          | Pos           | 7                              |
| 9              | 02-May-93          | Pos           |                                |
| 9              | 14-Oct-93          | Pos           |                                |
| 9              | 23-Jun-93          | Pos           |                                |
| 9              | 07-Feb-92          | Pos           |                                |
| 9              | 07-Aug-93          | Pos           |                                |
| 9              | 26-Jan-94          | Pos           |                                |
| 10             | 16-Jun-93          | Pos           | 2                              |
| 10             | 12-Aug-93          | Pos           |                                |
| 11             | 13-May-96          | Pos           | 16                             |
| 11             | 11-Sep-89          | Pos           |                                |
| 11             | 07-Jan-89          | Pos           |                                |
| 11             | 30-Nov-93          | Pos           |                                |
| 11             | 04-Jun-92          | Pos           |                                |
| 11             | 15-Apr-91          | Pos           |                                |
| 11             | 27-Mar-92          | Pos           |                                |
| 11             | 04-Jun-93          | Pos           |                                |

| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 11             | 18-Sep-90          | Pos           |                                |
| 11             | 03-Nov-92          | Pos           |                                |
| 11             | 18-Jun-92          | Pos           |                                |
| 11             | 16-Dec-92          | Pos           |                                |
| 11             | 07-Feb-94          | Pos           |                                |
| 11             | 07-Feb-94          | Pos           |                                |
| 11             | 13-May-96          | Pos           |                                |
| 11             | 04-Nov-94          | Pos           |                                |
| 12             | 06-Dec-94          | Pos           | 7                              |
| 12             | 26-Apr-91          | Pos           |                                |
| 12             | 07-Sep-93          | Pos           |                                |
| 12             | 12-Nov-93          | Pos           |                                |
| 12             | 10-Aug-92          | Pos           |                                |
| 12             | 11-Jan-91          | Pos           |                                |
| 12             | 19-Mar-90          | Pos           |                                |
| 13             | 05-Sep-97          | Pos           | 4                              |
| 13             | 02-Sep-91          | Pos           |                                |
| 13             | 02-May-90          | Pos           |                                |

| <b>Holding</b>       | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------------|--------------------|---------------|--------------------------------|
| 13                   | 20-Apr-94          | Pos           |                                |
| 14                   | 12-Aug-91          | Pos           | 5                              |
| 14                   | 07-Jul-92          | Pos           |                                |
| 14                   | 23-Jul-91          | Pos           |                                |
| 14                   | 14-Aug-91          | Pos           |                                |
| 14                   | 27-May-99          | Pos           |                                |
| 15- previous holding | 27-Nov-94          | Pos           | 3                              |
| 15                   | 02-Jul-93          | Pos           |                                |
| 15                   | 05-Jun-92          | Pos           |                                |
| 16                   | 24-Sep-93          | Pos           | 2                              |
| 16                   | 04-Nov-93          | Pos           |                                |
| 17                   | 13-Oct-92          | Pos           | 1                              |
| 18                   | 18-Jul-92          | Pos           | 1                              |
| 19                   | 22-Feb-94          | Pos           | 6                              |
| 19                   | 20-Jan-93          | Pos           |                                |
| 19                   | 08-Apr-92          | Pos           |                                |
| 19                   | 05-May-92          | Pos           |                                |
| 19                   | 02-Sep-95          | Pos           |                                |

| <b>Holding</b> | <b>Notice Date</b> | <b>Result</b> | <b>Number of BSE positives</b> |
|----------------|--------------------|---------------|--------------------------------|
| 19             | 22-Jul-94          | Pos           |                                |
| 20             | 12-Nov-93          | Pos           | 14                             |
| 20             | 04-Oct-93          | Pos           |                                |
| 20             | 03-May-94          | Pos           |                                |
| 20             | 04-Oct-88          | Pos           |                                |
| 20             | 04-Apr-96          | Pos           |                                |
| 20             | 27-Sep-96          | Pos           |                                |
| 20             | 21-Dec-94          | Pos           |                                |
| 20             | 01-Dec-92          | Pos           |                                |
| 20             | 06-Apr-93          | Pos           |                                |
| 20             | 07-Aug-92          | Pos           |                                |
| 20             | 29-Sep-93          | Pos           |                                |
| 20             | 01-Nov-93          | Pos           |                                |
| 20             | 20-Feb-91          | Pos           |                                |
| 20             | 18-Nov-91          | Pos           |                                |
| 21             | 28-Sep-95          | Pos           | 3                              |
| 21             | 14-Aug-92          | Pos           |                                |
| 21             | 24-Mar-92          | Pos           |                                |

**Appendix 5: Definitions of qualitative risk terms used in this report - based on EFSA (2006) and OIE (2004)**

| <b>Risk level</b> | <b>Definition</b>                              | <b>Expanded description</b>   |
|-------------------|--|---|
| Negligible        | Event is so rare, does not merit consideration | The chance of the event occurring is so small it does not merit consideration in practical terms (i.e. < 0.1% probability); it is not expected to happen for years; |
| Very low          | Event is very rare, but cannot be excluded     | The event is not expected to occur (very rare) but it is possible (i.e. >0.1-1% probability); it is expected to occur at least annually                             |
| Low               | Event is rare, but does occur                  | The event may occur occasionally (rare) (i.e. >1-10% probability); expected to occur at least monthly   |
| Medium            | Event occurs regularly                         | The event occurs regularly (i.e. >10-66% probability); expected to occur at least fortnightly   |
| High              | Event occurs very often                        | The event will happen more often than not (i.e. ≥66-90% probability); expected to occur at least weekly   |
| Very high         | Event occurs almost certainly                  | The event will undoubtedly happen (i.e. >90% probability); expected to occur at least daily   |