FOOD SAFETY AND INSPECTION SERVICE (FSIS)
CURRENT THINKING ON MEASURES THAT COULD BE IMPLEMENTED TO MINIMIZE HUMAN EXPOSURE TO MATERIALS THAT COULD POTENTIALLY CONTAIN THE BOVINE SPONGIFORM ENCEPHALOPATHY AGENT

FSIS is considering implementing a number of measures to minimize human exposure to materials that could potentially contain the agent that causes Bovine Spongiform Encephalopathy (BSE). Scientific and epidemiological studies have linked variant Creutzfeldt-Jakob Disease (vCJD), a chronic and fatal neurodegenerative disease that affects humans, to the consumption of beef products contaminated with the BSE agent. Neither vCJD nor BSE has been detected in the U.S. and the recently released Harvard Risk Assessment on BSE finds that, owing to already ongoing Federal programs, the U.S. is highly resistant to the introduction and spread of BSE in the U.S. cattle herd. However, FSIS believes that additional measures should be considered to minimize human exposure to BSE agents in the unlikely event that it is introduced in the U.S. This paper provides FSIS's thinking on policy options currently under consideration. FSIS requests public comment on the options discussed in this paper. Comments may be submitted to the FSIS Docket Room, Room 102, 300 12th Street SW, Washington, DC 20250-3700 and should be marked "FSIS current thinking on BSE." Copies of the Harvard Risk Assessment and this paper are available for viewing or copying in the FSIS Docket Room and on the Internet at: http://www.fsis.usda.gov/oa/topics/bse.htm.

Background

Bovine Spongiform Encephalopathy and Variant Creutzfeldt-Jakob Disease

BSE, commonly referred to as "Mad Cow Disease," is a slowly progressive degenerative disease that affects the central nervous system (CNS) of adult cattle. The typical incubation period (the time from when an animal becomes infected until it first shows disease signs) for BSE is from two to eight years. Following the onset of clinical signs, the animal's condition deteriorates until it either dies or is destroyed. This process usually takes from two weeks to six months. BSE is so named because of the spongy appearance of the brain tissue of infected cattle when sections are examined under a microscope.

BSE belongs to the family of diseases known as the transmissible spongiform encephalopathies (TSE's). Other TSE's include scrapie in sheep and goats, transmissible mink encephalopathy, feline spongiform encephalopathy, chronic wasting disease (CWD) in deer and elk, and in humans, kuru, classic Creutzfeldt-Jakob Disease (CJD), Gerstmann-Straussler-Scheinker syndrome, fatal familial insomnia, and variant Creutzfeldt-Jakob Disease (vCJD). The agent that causes BSE and other TSE's has yet to be fully characterized. There are three main theories on the nature of the agent: (1) the agent is a virus with unusual characteristics; (2) the agent is a prion—an abnormal form of a normal protein known as cellular prion protein; and (3) the agent is a virino—an "incomplete" virus composed of nucleic acid protected by host proteins. The agent is

highly resistant to heat, ultraviolet light, ionizing radiation, and common disinfectants that normally inactivate viruses or bacteria.

The BSE agent has only been detected in certain tissues of cattle that have with BSE. In the vast majority of cases, except in the distal ileum, the BSE agent has only been detected in those tissues when the cattle are over 24 months of age, and most often in cattle over 32 months of age (although there has been one case in which the agent was detected in a 20-month old cow). In cattle naturally infected with BSE (i.e., commercially reared animals not part of a specially designed experiment), the BSE agent has been found only in brain tissue, in the spinal cord, and in the retina of the eye. In specially designed experiments, the BSE agent has been detected in the brain, spinal cord, distal ileum, dorsal root ganglia (DRG), trigeminal ganglia, and, possibly, the bone marrow of deliberately infected cattle from whose tissues were collected and analyzed for the BSE agent. Some tissues, such as brain and spinal cord, contain higher levels of BSE infectivity than others. The BSE agent has never been detected in the muscle tissue of BSE-infected cattle, regardless of the age of the animal.

BSE was first diagnosed in 1986 in the United Kingdom (U.K.) and since then has been confirmed in native-born cattle in many other European countries and, most recently, in Japan. The disease is most likely spread by feeding rendered parts of cattle infected with BSE to other cattle in the form of meat and bone meal. Worldwide, more than 180,000 cases of BSE have been detected since the disease was first diagnosed, with over 95% of those cases reported from the U.K. No cases of BSE have been detected in the United States (U.S.) despite active surveillance for the disease since May 1990. Other animal TSE's, such as scrapie and CWD, are present in the U.S.

In 1996, a newly recognized form of CJD was reported in 10 patients in the U.K. CJD is a chronic, neurodegenerative disease that affects humans. However, in contrast to the classic form of CJD, patients with this new form of CJD, known as variant CJD (vCJD), characteristically experience early psychiatric symptoms, early painful sensory symptoms, a later onset of dementia, and an EEG that does not show the typical appearance of sporadic CJD. Both forms of CJD are always fatal. Patients with vCJD tend to be younger than those with classic CJD (average age of onset 28 years, as opposed to the mid 60's) and have a relatively longer duration of illness (median of 13 months as opposed to 4.5 months). The classic form of CJD occurs spontaneously at a rate of about one to two cases per one million people per year throughout the world, while vCJD has only been detected in people who resided in countries in which BSE is known to exist. Scientific and epidemiological studies have linked vCJD to exposure to BSE, probably through human consumption of beef products contaminated with the agent that causes BSE. Like BSE, vCJD has never been detected in the U.S., although a U.K resident with vCJD did visit the United States for medical care and advice.

From October 1996 to early November 2001, 111 cases of vCJD had been reported in the U.K., 4 in France, and single cases in the Republic of Ireland and Hong Kong. Mortality data on vCJD cases indicate that all persons who have developed vCJD may share a common genetic pattern that may be related to contracting the disease. One study that

used computer modeling to estimate the total number of deaths in the U.K. from vCJD predicted that between fewer than 100 and as many as 136,000 people could die from the disease. However, another study that used an approach called "back calculation" concludes that the epidemic of vCJD might be nearing its peak and that the maximum number of cases might number no more than "several thousand." Other researchers believe this latter prediction underestimates the possible size of the epidemic. Considerable uncertainty remains about the ultimate size and duration of the vCJD epidemic.

Recent European Union actions to prevent the spread of vCJD in the European Union

Because of concerns about vCJD, in 2000 the European Union (E.U.) prohibited for use as human food certain materials known to contain the BSE agent in BSE-infected cattle. These banned materials are referred to as Specified Risk Materials (SRMs) and include the head, including the brain and eyes, the tonsils, and the spinal cord from cattle over 12 months of age and the intestine of all cattle regardless of age. The list of materials designated as SRMs in the U.K. is more expansive. The U.K. list includes the entire head (excluding the tongue but including the brains, eyes, trigeminal ganglia), tonsils, the thymus, the spleen, and the spinal cord of cattle over six months of age, and the vertebral column, including dorsal root ganglia (DRG), of all cattle over thirty months of age, and the intestine of all cattle regardless of age.

In addition to prohibiting certain materials for human food, the E.U. has banned the use of bovine vertebral column in the production of mechanically recovered meat and has banned the use of stunning techniques that could introduce large pieces of brain into the circulatory systems of cattle. Generally, the E.U. also prohibits cattle over 30 months of age from being used as human food unless such cattle have been tested for BSE and the test result does not indicate that they have BSE. However, some countries (e.g., Germany, France, and Italy) prohibit cattle over 24 months of age from being used as human food unless such cattle have been tested.

Further, in 2000, the European Commission decided to test all cattle over 30 months of age. All animals over 30 months of age that cannot be tested or that test positive for BSE must be destroyed.

U.S. government actions to prevent the introduction of BSE into the U.S.

The U.S. government has implemented a number of measures to prevent BSE from entering the U.S. and to prevent the spread of the disease should it be introduced into the U.S. Some of these measures include the following:

(a) Since 1989, the USDA's Animal and Plant Health Inspection Service (APHIS) has prohibited the importation of live cattle and certain cattle products, including rendered protein products, from countries where BSE is known to exist. In 1997, due to concerns about widespread risk factors and inadequate surveillance for BSE in

many European countries, these importation restrictions were extended to include all of the countries in Europe.

(b) As of December 7, 2000, APHIS has prohibited all imports of rendered animal protein products, regardless of species, from BSE-restricted countries because of concern that feed intended for cattle may have been cross-contaminated with the BSE agent.

(c) APHIS leads an ongoing, comprehensive, interagency surveillance system for BSE in the U.S. and, in cooperation with FSIS, has drafted an emergency response plan to be used in the event that BSE is identified in the U.S. Other Federal agencies also have contingency plans that work in concert with the USDA plan.

(d) In 1997, FDA prohibited the use of most mammalian protein in the manufacture of animal feeds given to cattle and other ruminants. Firms must keep specified records on the manufacture of their feed, must have processes in place to prohibit co-mingling between ruminant feed and non-ruminant feed containing materials prohibited in ruminant feed, and must assure that non-ruminant feed containing materials prohibited in ruminant feed is labeled conspicuously with the statement "*Do not feed to cattle and other ruminants.*" These regulations are intended to prevent the introduction and spread of BSE in U.S. cattle through feed contaminated with the BSE agent.

(e) The Centers for Disease Control and Prevention (CDC) leads a surveillance system for vCJD.

The Harvard risk assessment on BSE

In 1998, as an additional step in the measures taken to prevent BSE from entering the U.S., USDA entered into a cooperative agreement with Harvard University's School of Public Health to conduct an analysis and evaluation of the current measures implemented by to U.S. government to prevent the entry and spread of the BSE agent within the U.S. cattle herd and to reduce the potential exposure of Americans to the agent of BSE. The study, referred to as the Harvard risk assessment on BSE, reviews current scientific information related to BSE and other TSE's, assesses pathways by which BSE could potentially occur in the U.S., and identifies additional measures that could be taken to protect human and animal health in the U.S. The risk assessment also identifies pathways by which humans could potentially be exposed to the BSE agent through bovine materials or products.

Given the actions already taken by USDA and FDA to prevent the introduction of BSE into the U.S., the results of the Harvard risk assessment show that the U.S. is "highly resistant" to any introduction of BSE and that BSE is extremely unlikely to become established in the U.S. If BSE should enter the U.S., the assessment indicates that most probably, only a small amount of potentially dangerous tissues would reach the human food supply. Because the exact quantitative relationship between human exposure to BSE

agents and the likelihood of human disease is unknown, the risk assessment does not evaluate the quantitative likelihood that humans will develop vCJD under various scenarios. Similarly, potential human exposure to the BSE agent through products containing ingredients of bovine origin, such as some pharmaceuticals, gelatin, and beef stocks, extracts, and flavorings are not addressed in the risk assessment. Some of these products are regulated by FDA and some are regulated by FSIS. However, the model developed in this risk assessment and the results of the risk assessment can be used by both FDA and FSIS in the development of preventive measures targeted at those products that were not initially considered by Harvard.

The Harvard study also provides a systematic overview of the pathways that could lead to the spread of BSE within the U.S. production system for beef – from farm to table. The creation of this overview allows for the identification of specific pathways that would contribute most to the spread of BSE and to the amount of potentially dangerous tissues in the human food supply. It also identifies opportunities for the mitigation of risk along the farm to table continuum and allows for the evaluation of mitigation measures within the context of the overall production system. More specifically, it identifies the following three pathways or practices as those that could contribute the most to the spread of BSE and the amount of potentially dangerous tissues in the human food supply:

- Noncompliance with the FDA feed ban, including misfeeding on the farm and the mislabeling of feed and feed products prohibited for consumption by cattle.
- Rendering of downer cattle, including cattle that die on the farm.
- Inclusion of high-risk tissue, such as brain and spinal cord, in edible products.

While human health considerations and the handling of meat products remain FSIS' highest priority, FSIS believes that the most effective way to prevent the introduction and spread of BSE and vCJD in the U.S. is to continue to collaborate with other government agencies to ensure a coordinated approach to mitigating the risk of the spread of BSE and of potential human exposure. For this reason, this document includes both actions that FSIS may take to directly address human health concerns and actions that FSIS may implement to assist FDA and APHIS as they address human and animal health concerns.

Although the Harvard risk assessment provides the most likely routes by which humans could be exposed to the BSE agent, FSIS did not originally ask Harvard to assess the possible reduction in potential human exposure to the BSE agent that may be associated with the policy options contained in this paper. As discussed below, FSIS has requested that Harvard use the risk assessment model that it developed to evaluate the level of reduction in human exposure to the BSE agent under various mitigation measures. FSIS will use the results of the additional modeling to refine the policy options under consideration, to determine the effectiveness of the measures in reducing the risk of potential human exposure to the BSE agent, and to evaluate the benefits of various alternatives. In addition, the risk assessment will be peer reviewed and, depending on the results of the review, FSIS may modify some of the measures that it is considering implementing and which are presented in the policy options below.

General description of the measures that FSIS may implement to minimize human exposure to materials that could potentially contain the BSE agent

To further minimize the risk of human exposure to the agent of BSE, FSIS believes that it would be prudent to consider implementing additional measures to further minimize human exposure to materials that could potentially contain the BSE agent. The measures that FSIS may implement target the materials of cattle that available scientific studies and the Harvard risk assessment have identified as the most likely to contain the BSE agent if the animal is infected with BSE.

In devising measures to further minimize human exposure, FSIS believes it is appropriate to consider not only the materials identified as containing BSE, but also the factors that may result in greater levels of infectivity in cattle brought to slaughter. FSIS also believes that any measure implemented should retain a level of flexibility to allow for advances in diagnostic testing. In the discussion below, measures to address materials containing BSE agents are described first, followed by a discussion of factors that may result in greater levels of infectivity in cattle brought to slaughter.

Materials Containing the BSE agent.

The Harvard risk assessment divides potential sources of human exposure to BSE infectivity into two categories: specific high-risk tissues and contamination of low risk tissues. Specific high-risk tissues identified by Harvard, in order of infectivity, include: brain, spinal cord, dorsal root ganglia DRG, distal ileum, and the trigeminal ganglia and other tissues found in the head (e.g., eyes). The Harvard analysis indicates that the most important means by which low risk tissue can become contaminated is through the use of advanced meat recovery systems, which can leave spinal cord or dorsal root ganglia in the recovered meat. It also identifies the potential for contamination from cuts of meat sold with vertebrae attached, from the contamination of cheek meat by brain or other tissues when the head is split, and from the use of captive bolt stunning that uses air injection.

To address infectivity from high-risk tissues, FSIS will consider classifying certain tissues as SRMs and prohibiting their use in human food. FSIS recognizes that classifying all high-risk tissue as SRMS may be unnecessary. Brain and spinal cord pose the greatest risk of exposure to the BSE agent and direct human consumption, though not common, does occur in the U.S. Similarly, distal ileum, though possibly not as risky, is consumed as a variety meat. However, neither DRG nor trigeminal ganglia are consumer products and the risk they pose may be more appropriately considered in terms of their potential for contamination of low risk tissue. FSIS believes it would be more appropriate to treat them separately (See below).

To address infectivity from contamination of low risk tissue, FSIS believes that several actions should be considered. In the case of contamination of meat from advanced meat recovery systems (AMRS), FSIS believes that adding vertebral column, including the dorsal root ganglia (except when the vertebral column is part of a cut of bone-in beef) to

the list of SRMs could effectively address the risk associated with meat recovery systems. Establishments that use pressure to separate beef meat or beef products from the bone try to remove the spinal cord before the bones of the vertebral column enter the system. However, sometimes the spinal cord is not completely removed, especially when a carcass is mis-split. Furthermore, removing the spinal cord from the vertebral column does not remove the DRG. Thus, bones from the vertebral column of cattle may contain spinal cord and DRG. When bones from the vertebral column are used as a source material in these advanced recovery systems, it is possible for these materials to be incorporated into the end product, thereby exposing humans to materials known to contain the BSE agent in BSE infected cattle.

To address potential contamination from brain and other tissues in the head, FSIS believes that requiring cheek meat to be removed before the skull is fragmented or split will minimize the risk from contamination. In rare instances, the skulls of cattle are intentionally split to remove materials contained within the cranial cavity, such as the pituitary gland. Sometimes, the skulls of cattle are unintentionally fragmented and the brains of the animals exposed when a mechanical device is used to remove horns from cattle. In some instances, the brain has also been penetrated by the captive bolt of a stun gun, resulting in a hole with weeping material that may contain CNS tissue. In these cases, when the cheek meat is removed, the heads of the cattle may be manipulated in such a way as to potentially contaminate cheek meat. Requiring cheek meat to be removed prior to skull fragmentation or splitting will eliminate this potential source of contamination.

FSIS is not considering banning bone-in beef at this time. The U.K. adopted such a measure in 1997 after scientific studies indicated that DRG of cattle infected with BSE contained the BSE agent. The bone-in-beef ban was enacted to reduce the already small risk that DRG in bone-in beef may be eaten by consumers. In December 1999, the U.K lifted the ban on the sale of bone-in beef at the retail level because scientific experts determined that the additional risk of exposure to the BSE agent from bone-in beef was unquantifiable in light of the continuing decline of the BSE epidemic in the U.K. and the other control measures that had been implemented to exclude materials that could potentially contain the BSE agent from the human food chain.

As announced on November 30, 2001, FSIS plans to issue a proposed rule to prohibit the use of certain stunning devices used to immobilize cattle during slaughter. In this rulemaking FSIS will address the risk posed by stunning devices that may inadvertently force large pieces of brain, known as macro-emboli, into the circulatory system of stunned cattle, thereby causing macro-emboli to lodge in edible boneless tissues.

Cattle whose materials are most likely to contain the BSE agent

In developing policy options for applying prohibitions on the use of SRMs or addressing contamination of low risk tissue, FSIS believes it is important to consider the risk that cattle presented for slaughter are infected with BSE. As the Harvard risk assessment shows, levels of infectivity in cattle brought to slaughter vary. The discussion above did

not incorporate consideration of the variation in risk of cattle brought to slaughter. The Agency believes that in crafting its policy it should consider targeting materials according to the risk posed by the animal brought to slaughter. More specifically, the agency will consider tailoring some or all of the measures for addressing the risk posed by materials containing the BSE agent discussed above to downer cattle and cattle aged 24 months or older rather than prohibiting all such materials for human food. Targeting certain materials from these cattle is also intended to reduce the regulatory burden that would be associated with imposing certain requirements on those businesses that slaughter and process cattle.

Cattle aged 24 months and older: FSIS believes that cattle aged 24 months and older should be targeted because, based on surveillance data from Europe, most cattle that have been diagnosed with BSE have been over 24 months of age. Furthermore, in studies intended to identify which bovine tissues contain the BSE agent, the agent has only been detected in certain materials from BSE-infected cattle when the cattle are over 24 months of age (except for the distal ileum in which the BSE agent has been detected as early as 10 months of age, which was 6 months post-exposure to infected material). In fact, in these studies, the BSE agent was not detected in most cattle until they were over 32 months of age. In some European countries (e.g. Germany, France, and Italy), cattle aged 24 months and older are prohibited for use as human food unless they have been tested for BSE and the test result does not indicate that the animal has BSE. The E.U. prohibits cattle over 30 months of age to be used for human food unless such cattle have been tested for BSE . Unlike other countries where cattle are generally older than 24 months when offered for slaughter, particularly Europe, FSIS believes that the cattle offered for slaughter in U.S. are primarily young cattle (less than 24 months of age), with a smaller portion of older cattle being slaughtered. Finally, FSIS believes that objective criteria, including dentition characteristics, can be established for distinguishing older cattle (i.e., at least 24 months of age) from younger cattle.

Downer cattle: In addition to certain materials from cattle aged 24 months and older, surveillance data from European countries in which BSE has been detected, indicate that cattle with clinical signs of a central nervous system (CNS) disorder, dead cattle, and cattle that can not rise from a recumbent position or “downer” cattle (in Europe these cattle are distinguished either as “fallen stock” if not for human consumption or “emergency slaughter” cattle if for human consumption) have a greater incidence of BSE. In the U.S., cattle with clinical signs of a CNS disorder and cattle that died otherwise than by slaughter are already prohibited for use as human food. All downer cattle presented for slaughter are automatically suspected of being affected with a disease or condition that may require condemnation of the animal, in whole or in part, and are identified as “U.S. Suspects.” Such cattle must be examined by an FSIS veterinarian and a record of the veterinarian’s clinical findings must accompany the carcass to post mortem inspection if the animal is not condemned. Postmortem inspections on the carcasses of downer cattle must be performed by a veterinarian rather that a food inspector and the results of this inspection must be recorded as well.

Downer cattle presented for slaughter that pass ante-mortem inspection may be slaughtered and the meat and meat food products from such cattle used for human food. However, surveillance for BSE in Europe has shown that the typical clinical signs associated with BSE cannot always be observed in downer cattle infected with BSE. Thus, if BSE were present in the U.S., downer cattle infected with BSE could potentially be offered for slaughter and, if the clinical signs of the disease were not detected, pass ante-mortem inspection. These cattle could then be slaughtered for human food. Although the muscle tissue from BSE-infected downer cattle would not contain the BSE agent, other tissues, identified above, could and the muscle tissue could be cross-contaminated at slaughter and processing.

Given that the BSE agent has been detected in cattle aged 24 months and older in the vast majority of cases, FSIS may also consider tailoring the measures aimed at reducing human exposures to material that may contain BSE agent to those downer cattle aged 24 months and older rather than all downer cattle regardless of age. However, FSIS does not currently favor this approach because the diagnostic tests for BSE that are available today are not likely to detect the BSE agent in the brain tissue of cattle under 24 months of age even if the animals were infected with BSE.

The FSIS approach to targeting downer cattle, may also be affected by actions taken by APHIS. Because European surveillance data show that neurologically ill cattle, which generally include dead and downer cattle, are among the cattle most likely to be infected with BSE, as part of its surveillance for BSE in the U.S., the USDA's APHIS has increased the number of downer cattle that it is testing for the disease. In addition, APHIS is developing a strategy to reduce the likelihood of BSE exposure to cattle and, as part of that strategy, is evaluating the need to extensively test dead and downer cattle on the farm for BSE. APHIS also is considering developing requirements for the disposal of dead and downer cattle on the farm that would ensure that the BSE agent, if present in these cattle, would not be recycled to expose other animals. Implementation of a disposal policy that removes downer cattle on the farm, would likely eliminate most of the downer cattle that represent the highest risk of having BSE from the downer population presented for slaughter for human food. Under these circumstances, the majority of downer cattle presented for slaughter then would be those cattle that are non-ambulatory because they were injured in route to the slaughter facility, which, in most cases, would not preclude their use for human food.

If APHIS develops and implements such a disposal policy for dead and downed cattle, FSIS may consider permitting downer cattle to be used for human food without the restrictions on the use of certain materials designated as SRMs if the establishment can demonstrate that an animal's non-ambulatory condition is the result of an acute physical injury as opposed to an underlying pathological condition, and in particular, that the non-ambulatory condition is not associated with BSE. The Agency will consider developing compliance guidelines that will contain objective criteria for establishments to use to justify a determination that a downer cow does not have an underlying condition associated with BSE. FSIS would then verify that the animal's condition meets the

criteria established in the compliance guidelines before if could be used for human food without restrictions on the use of tissues designated as SRMs.

In addition to the greater incidence of BSE identified in downer cattle and cattle aged 24 months and over, cattle that have been identified as having been fed materials (meat and bone meal etc.) prohibited by FDA's regulations may have the potential for greater incidence of BSE. Most scientific experts agree that BSE is transmitted to cattle through the consumption of meat and bone meal contaminated with the BSE agent. Thus, cattle that consumed materials prohibited by FDA's regulations are among the animals whose materials could potentially contain the BSE agent if BSE were present in the U.S. As discussed below, FDA is developing a policy on the disposition of cattle and certain materials from cattle that have been fed materials prohibited by its regulations. FSIS will work with FDA to ensure that any measures that FSIS may implement regarding the disposition of such cattle or the materials from such cattle are consistent with FDA's policy.

Issues associated with testing cattle for BSE

FSIS recognizes that live animal tests may provide valuable information about the level of BSE infectivity in all animals, including downer cattle and cattle aged 24 months or older. However, currently there is no sensitive and reliable live animal test for BSE and the available post mortem diagnostic tests can only indicate that cattle have the disease two to three months prior to the onset of clinical disease or after the onset of clinical disease. Thus, given the limitations of the diagnostics available today, certain tissues of cattle infected with BSE may contain the BSE agent before a diagnostic test could indicate that the animal has BSE.

Given that, under the diagnostic methods available today, certain materials from cattle infected with BSE may contain the BSE agent before a test can confirm that the animal is infected with BSE, exempting cattle that have tested negative for BSE from restrictions on the use of certain materials known to contain the BSE agent in infected cattle would not provide the same level of protection against potential human exposure to the BSE agent as would removing those materials for use as, or in the production of, human food. Thus, until a sensitive and reliable live-animal or post mortem test for BSE becomes available and is approved by the USDA (specifically the Administrator of USDA's APHIS), FSIS does not expect to permit cattle to "test-out" of some of the restrictions on the use of certain materials known to contain the BSE agent in BSE infected cattle that are discussed in this document. However, once such a test becomes available, FSIS expects that testing cattle for BSE will be a viable option. Therefore, FSIS believes that the measures under consideration should include the possibility of permitting such testing of cattle.

Measures that could be implemented to minimize human exposure to materials that could potentially contain the BSE agent

With full consideration of both materials that present the greatest risk to humans and the level of infectivity within cattle presented for slaughter, FSIS believes the following measures would reduce human exposure to bovine materials that could potentially contain the BSE agent by preventing such materials for use as, or in the production of, human food. Because they are intended to protect the public from a potential food safety hazard, the policy options discussed in this document are intended to apply to both official establishments and custom exempt operations that slaughter and process cattle. Because state inspection programs must impose requirements at least equal to those imposed at the Federal level, the policy options discussed in this document are also intended to apply to state inspected establishments that slaughter and process cattle. The policy options are not intended to apply to retail stores or restaurants, mainly because these operations do not slaughter or process cattle. However, beef products at the retail level are subject to the adulteration and misbranding provisions of the Federal Meat Inspection Act (FMIA), and thus, such products would be subject to enforcement action by FSIS if they contained materials that were incorporated into the product during slaughter or processing that would render the products adulterated or misbranded. Furthermore, if the additional risk assessment modeling that FSIS asked Harvard to conduct indicates that the Agency should implement measures that could be carried out at the retail level, such as removing beef from the bone, then FSIS would expect retail stores and restaurants to comply with such measures should FSIS make them requirements.

Option 1: Treatment of High-risk Tissue

Designate brain and spinal cord from cattle aged 24 months and older and downer cattle regardless of age as SRMs and prohibit their use for human food. Materials that have been contaminated with bovine brain and spinal cord from cattle aged 24 months and older or downer cattle regardless of age also may be prohibited for human food. Designate intestine from all cattle regardless of age as an SRM and prohibit its use for human food. FSIS may require that SRMs be removed at the time of slaughter and be handled, stored, and disposed of in a manner that ensures that they will not be used for human food. The restrictions on SRMs may not apply if the cattle (live or dead) have been tested for BSE using a test protocol that has been approved by the Administrator of APHIS and performed by a laboratory approved by APHIS and the diagnostic result does not indicate that the cattle have BSE.

Options to prevent contamination of low-risk tissues with high--risk material

Option 2: Meat recovery systems

Prohibit the use of the vertebral column from downer cattle regardless of age (and consider other populations of cattle, including all aged 24 months and older), as a source material in meat recovery systems that use pressure to separate beef meat or beef products from bone. The restriction may not apply if the cattle (live or dead) have been tested for BSE using a test protocol that has been approved by the Administrator, APHIS

and performed by a laboratory approved by the Administrator, APHIS, and the diagnostic result does not indicate that the cattle have BSE.

FSIS is also considering finalizing a proposed rule on AMRS that clarifies the prohibition of CNS tissue and related material, in boneless comminuted meat produced using AMRS and, in a separate rulemaking, extending this policy to MS(Beef) meat food product. This policy is intended to prevent product that is not "meat" from being misrepresented as meat (i.e., misbranding and economic adulteration). It also prevents materials known to contain the BSE agent in BSE-infected cattle from being incorporated into comminuted boneless meat produced using AMRS. FSIS may also extend the prohibition of the incorporation of CNS tissue and related materials to MS(Beef) meat food product. This action could also prevent materials known to contain the BSE agent in BSE-infected cattle from being incorporated into boneless comminuted meat food products.

In addition, FSIS is considering the potential risk associated with the use of the vertebral column as source material in rendering systems that do not use pressure. These systems are used to produce products such as beef stocks, beef flavorings, and beef extracts. The vertebral column is a significant source of bovine materials for these rendering systems because the product yield is high. The potential for dislodging CNS materials into beef stocks, beef flavorings, and beef extracts is unknown.

Option 3: Cheek Meat

Prohibit the use of cheek meat from cattle aged 24 months and older and downer cattle regardless of age for human food if the meat is not removed before the skull is fragmented or split.

FSIS requests comments on these options, their feasibility, potential costs and benefits, and any data that would support refining or expanding them. Comments should be sent to the address listed on the first page.

Emergency measures to prevent human exposure to meat and meat products that may contain the BSE agent in the event BSE is detected in the U.S.

Once it determines which measures to prevent human exposure to materials that could potentially contain the BSE agent that it will implement, FSIS intends to publish them as a proposed rule in the Federal Register. However, if BSE is detected in the U.S. before the Agency has an opportunity to do so, FSIS may require immediate implementation of any measures that have not been implemented by issuing an emergency interim rule. Furthermore, if BSE is detected in the U.S., in addition to the measures discussed in this document, any emergency interim regulation published by FSIS would address the need for: sanitation requirements for equipment that has come in contact with a BSE-infected animal; nationwide versus regional implementation of emergency measures; and the identification of all cattle aged 24 months and older offered for slaughter.

Potential economic impacts of the measures that FSIS may implement to minimize human exposure to materials that could potentially contain the BSE agent

Before FSIS would implement any of the measures to minimize human exposure to materials that could potentially contain the BSE agent that are discussed in this document, the Agency would conduct a formal economic analysis for each policy option. The economic analysis would help to determine the feasibility of implementing each measure. Some of the potential economic impacts associated with implementing the measures discussed in this document are presented below. However, to assist in its formal economic analysis, the Agency is interested in obtaining additional economic data and is soliciting comments on these potential impacts.

Benefits

The purpose of each policy option discussed in this document is to prevent human cases of vCJD due to exposure to beef products that could contain the BSE agent in the unlikely event that BSE is present, or ever becomes present, in the U.S., and, thereby provide public health benefits. Because the relationship between human exposure to BSE agents and the likelihood of vCJD is not known, it is not possible to provide an accurate, quantitative, estimate of the extent of the human health benefits that would result from implementing the measures presented above. However, the model developed for the Harvard risk assessment of BSE will allow for the evaluation these options in terms of reduction in potential exposure to BSE in the human food supply. Other potential economic impacts of each of the policy options are discussed below.

Option 1: Designate brain and spinal cord from cattle aged 24 months and older and downer cattle regardless of age as SRMs and prohibit their use for human food. Designate bovine intestine from all cattle regardless of age as an SRM and prohibit its use as human food.

- Establishments may be required to make minor adjustments in slaughter procedures to ensure that SRMs are not used for human food.

- Establishments may incur costs associated with record keeping and verification of the handling, storage, and disposition of SRMs.

- Establishments may incur costs associated with the disposal of SRMs.

- There are approximately 484 very small establishments that slaughter cattle aged 24 months and older. The regulatory burden may be the most significant for these very small establishments. The prohibition on intestines is not likely to have a significant impact on these entities because most small establishments that slaughter and process cattle do not save the small intestine for human food.

- Impacts on consumers of prohibiting brain and spinal cord for human food are likely to be minimal because most brain and spinal cord sold for human food comes from cattle that are less than 24 months of age. Brain and spinal cord from older animals are used for pet food and non-ruminant feed. FDA may be reluctant to permit the use of these prohibited cattle materials as animal feed/food. If these prohibited cattle materials are not permitted for animal feed/food, the industry may incur additional costs associated with disposal of cattle materials prohibited by these FSIS proposed measures.

Option 2: Prohibit the use of the vertebral column from downer cattle regardless of age (and consider other populations of cattle, including all aged 24 months and older) as a source material in meat or meat food product recovery systems that use pressure to separate beef meat or beef products from bone.

- Establishments may incur a net yield reduction of up to 4 pounds of boneless meat per vertebral column.

- Net loss of boneless meat produced using AMRS may be as high as 25 million pounds per year valued at $17 million (based on an estimate of the number of downer cattle and cattle aged 24 months and older offered for slaughter; FSIS does not yet have a refined estimate of the various populations of cattle used in AMRS production).

- Establishments may continue to use other bones besides the vertebral column from downer cattle regardless of age, as well as the bones from other populations of cattle, including those aged 24 months and older. However, if they chose to use meat from the vertebral column, some establishments may revert to hand trimming to recover meat from the vertebral column. An increase in hand trimming may result in increased costs for additional labor and a rise in repetitive motion injuries in workers.

Option 3: Prohibit the use of cheek meat from cattle aged 24 months and older and downer cattle regardless of age for human food if the meat is not removed before the skull is fragmented or split.

- Establishments that do not remove cheek meat prior to splitting skulls would either have to change their slaughtering process or no longer use the cheek meat for human food

- Establishments that use mechanical devises to remove the horns of cattle may have to revise their processes or no longer use cheek meat for human food.

- The demand for labor associated with hand trimming of cheek meat may be reduced for those establishments that split or fragment the skulls prior to removing the cheek meat of cattle.

Measures that could be implemented to support the FDA and USDA's APHIS to efforts to enforce measures that they have implemented, or that they may implement, to help prevent BSE or vCJD.

As discussed earlier, FSIS believes that the most effective way to prevent the introduction and spread of BSE and vCJD in the U.S. is to continue its collaboration with other government agencies to ensure a coordinated approach to the U.S. activities related to BSE. Therefore, in addition to the measures that FSIS may implement to minimize human exposure to materials that could potentially contain the BSE agent, FSIS may implement additional measures that would support FDA and USDA's APHIS efforts to enforce measures that they have implemented, or that they may implement, to help prevent human or animal exposure to the BSE agent. These additional measures are discussed in the policy options presented below.

Option 1: Increase enforcement of FSIS's record keeping and registration requirements for renderers and persons who engage in the business of buying, selling, and transporting dead, dying, disabled, or diseased livestock (4-D), or parts of the carcasses of any such livestock that died other than by slaughter.

By law, every person that engages in business as a renderer or as a buyer, seller, or transporter of 4-D livestock, or parts of the carcasses of any such livestock that died other than by slaughter, must register with FSIS and provide the Agency with specific information about his or her business. These same persons must also keep records that fully and correctly disclose all transactions involved in their business and make such records available to FSIS program employees upon request. The information that renderers and buyers, sellers, or transporters of 4-D animals must provide to FSIS under the registration and record keeping requirements could be useful to FDA in enforcing its feed ban regulations. Thus, FSIS plans to increase its enforcement of these requirements and will announce its intention to do so by publishing a notice in the Federal Register.

This action could support FDA in enforcing its regulations that prohibit most mammalian protein in ruminant feed. FDA implemented its regulations that prohibit mammalian meat and bone meal in cattle feed to prevent the introduction and spread of BSE in U.S. cattle and to minimize the potential for human exposure to the BSE agent through meat and meat products.

Option 2: Require that all cattle offered for slaughter be accompanied by a written certification by the cattle supplier that states that, to the best of the supplier's knowledge, the cattle have not been fed materials prohibited by FDA's regulations during their lifetime.

FSIS may consider cattle that are offered for slaughter and that are not accompanied by such certification to be cattle that have been fed materials prohibited by FDA's regulations. The disposition of cattle and certain materials from cattle that have been fed prohibited materials are discussed below under policy option number three.

This action could reduce the likelihood that cattle that have been fed prohibited will enter the human food supply.

Option 3: Implement measures that will be consistent with any policy that FDA adopts on the disposition of cattle that have been fed prohibited materials

Certain materials from cattle that have been fed materials prohibited by FDA's regulations could potentially contain the BSE agent if BSE were present in the U.S. or in the country of origin of such feed. FSIS intends to work with FDA on a coordinated, consistent policy on the disposition of cattle that have been fed materials prohibited by FDA regulations.

Option 4: Where necessary, revise the FSIS regulations that prescribe handling and transportation requirements for inedible products to ensure that inedible materials that contain SRMs are disposed of in a manner that will prevent such materials from being incorporated into or used to manufacture FDA-regulated products.

FSIS may revise its regulations to cross-reference any regulations that FDA may develop regarding the use of materials that contain SRMs in FDA-regulated products or amend the FSIS regulations to reflect any policy that FDA may develop regarding the use of materials that contain SRMs in FDA-regulated products. This action could support FDA in preventing materials that may contain SRMs from being incorporated into or used to manufacture FDA-regulated products.

Option 5: Revise the FSIS regulations that prescribe handling and transportation requirements for dead, dying, disabled, or diseased livestock to ensure that the carcasses of dead and downer cattle that are condemned on ante-mortem inspection are disposed of in accordance with any policy on the disposal of dead and downer cattle on the farm that APHIS may develop, and to provide for a sufficient number of animals to be tested by APHIS for BSE.

Revisions to the FSIS regulations would help to ensure that carcasses of dead and downer cattle are disposed of properly so as to prevent the spread of BSE. Revisions also would complement FSIS's work with APHIS to ensure that a sufficient number of downer cattle that are offered for slaughter, especially those that are condemned on ante-mortem inspection and possibly those that pass on ante-mortem inspection, are tested for BSE. As discussed above, surveillance for BSE in Europe indicates that, in countries where BSE has been detected, dead and downer cattle are among the animals that are most likely to be infected with BSE.

Current thinking on meat products that could potentially contain other TSE agents

As previously mentioned, although BSE has never been detected in the U.S., other animal TSE's, including scrapie and CWD, have. Scrapie is a chronic, degenerative disease that affects the CNS of sheep and goats. There is no epidemiological evidence to indicate that scrapie poses a risk to human health. CWD is a chronic degenerative disease that affects

the CNS of deer and elk. CWD is endemic in wild deer and elk populations in certain areas of the western U.S. and has also been identified in domesticated elk in six western states. Although there also is no epidemiological evidence of transmission of CWD to humans, at least one published study has reported that abnormal CWD prion proteins *in vitro* can convert normal human prion proteins into abnormal forms, albeit inefficiently.

Although deer and elk are not required to be slaughtered under Federal inspection, the facilities in which these animals are slaughtered and processed may be used to slaughter and process livestock that are subject to mandatory Federal inspection (i.e., cattle, sheep, swine, goats, horses, mules, and other equines). If deer or elk that contain the CWD agent are slaughtered in a facility that also slaughters livestock subject to mandatory Federal inspection, the equipment in the facility could be contaminated with the CWD agent, thereby potentially spreading the agent to federally inspected cattle and carcasses intended for human food.

FSIS believes that it would be prudent to develop methods that could prevent the CWD agent from contaminating equipment used to slaughter livestock subject to mandatory Federal inspection. The agents that cause BSE, CWD, and other TSE's are highly resistant to heat, ultra violet light, ionizing radiation, and common disinfectants and FSIS is not aware of any practical methods that could be used to sanitize equipment that has been contaminated with a TSE agent. Certain sanitation measures, such as treatment with sodium hypochlorite (20,000 ppm of available chlorine) and treatment with hot 2N sodium hydroxide solution for one hour, appear to be effective. But these sanitation methods are harsh on equipment and can be hazardous. FSIS is interested in receiving any scientifically based information on this subject.

Additional risk assessment modeling to be performed by Harvard

As mentioned above, the Harvard risk assessment identifies the pathways by which humans could potentially be exposed to the BSE agent from beef products. It does not provide an assessment of the possible reduction in human exposure that may be associated with the policy options contained in this paper. Therefore, FSIS has requested that Harvard assist FSIS in using the risk assessment model to evaluate the policy options discussed in this paper and alternatives. FSIS will use the results of the additional modeling to refine the policy options under consideration, to determine the effectiveness of measures in reducing the risk of potential exposure to the BSE agent, and to evaluate the benefits of various alternatives.

The measures that FSIS will evaluate with assistance from Harvard include:

- Prohibiting the use of bovine intestine for human food.

- Prohibiting the use of vertebral column as a source material in meat or meat food product recovery systems that use pressure to separate beef meat or beef meat food product from bone for cattle older than 24 months.

- Prohibiting bone-in-beef for human food from cattle older than 24 months.

FSIS may also evaluate additional measures using the Harvard risk assessment including the following:

- Prohibiting the use of brain and spinal cord for human food;

- Prohibiting the use of the head, except the tongue, for human food;

- Prohibiting the use of bovine vertebral column in the production of human food;

- Prohibiting the slaughter of cattle older than 24 months of age (other ages, such as younger or older than 24 months, could be considered).

The Harvard Risk Assessment computer model only tracks a specific list of potentially infected organs and AMR meat. Evaluating policy options for other cattle parts, such as the head and vertebral column, will entail that these parts be considered as combinations of relevant potentially infected organs through the simulation.