VRA 6 - What are the risks of causing a new outbreak of foot and mouth disease (FMD) by moving carcases of animals slaughtered on confirmation or suspicion of FMD for disposal?

1. SUMMARY OF OVERALL RISK

This risk assessment was compiled according to terms of reference provided by the Scottish Government regarding time of delivery, title of veterinary risk assessments (VRAs) and level of detail required. EPIC scientists created a generic framework suitable for the VRAs; collated and updated existing information on risks; filled gaps in the documents (including references where appropriate); and drafted new VRAs where necessary. These documents may require updating as new information becomes available or legislation develops, or if more in-depth assessment is necessary.

The purpose of this document is to qualitatively assess the risk of the specified activity in the face of an FMD outbreak in the UK. The assessment includes proposed actions to mitigate the risks associated with the specified activity, and which could form the basis of license conditions, should the activity be permitted. Risk is a combination of (i) the likelihood an event occurs and (ii) the consequences of the event if it does occur. For the purpose of these VRAs it is assumed that the consequence is equivalent in severity for all activities (for example, number of new outbreaks of disease).Therefore the summary of overall risk below represents the likelihood of new outbreaks of disease).

The summary of overall risk assumes that the risk mitigation measures in Section 8 are implemented with full compliance.

DEFINITIONS OF RISK LEVEL (OIE 2004; DEFRA 2011):
Negligible *So rare that it does not merit consideration*
Very low *Very rare but cannot be excluded*
Low *Rare but could occur*
Medium *Occurs regularly*
High *Occurs very often*
Very High*: Events occur almost certainly*

2. LEGISLATION, DEFINITIONS & ASSUMPTIONS

The principal control method to eradicate foot and mouth disease, as required under EU and National law, is the humane slaughter of affected animals to prevent further virus production, and the humane slaughter of animals which are considered to be dangerous contacts. Once animals have been slaughtered, movement of carcases is only permitted under a licence granted by the Scottish Ministers for disposal, (FMD (Scotland) Order 2006 Part 3 Paragraph 24).

NB: This VRA assesses risk associated with transport only. It does not consider other risks such as those associated with culling or disposal methods.

Disinfectants must be approved for use by the Diseases of Animals (Approved Disinfectants) (Scotland) Order 2008 as amended and used at the FMD Order dilution.

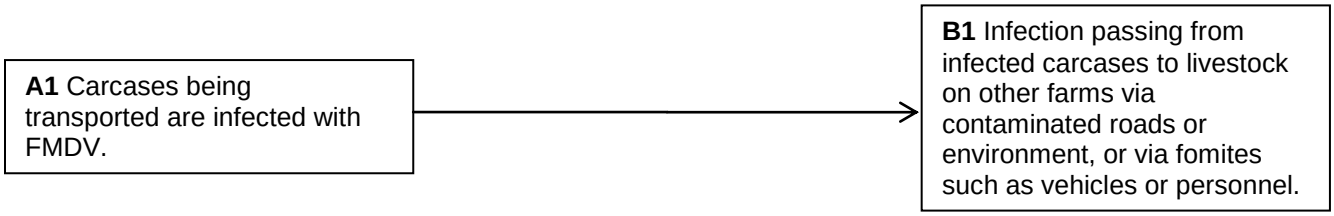
3. HAZARD IDENTIFICATION

(a) Hazard: FMD virus (FMDV)

(b) Risk hypothesis:
If animals are slaughtered on confirmation or suspicion of FMD infection, viable virus may be present on the carcase or in excretions and carcases remain a disease risk until properly disposed of. Carcases may need to be transported to

rendering, incineration or burial sites. However, the transport and handling of carcases presents a risk that uninfected premises could become infected via contamination of roads, vehicles and other machinery and personnel.

4. POTENTIAL RISK PATHWAYS



5. EXPOSURE ASSESSMENT

Factors which are likely to affect this probability of exposure are:	***Comments and risk estimates if/where appropriate:***
***Infection source:* A1 Carcases being transported are infected with FMDV**	
• Infection status of carcases	• Animals with acute clinical disease at the time of slaughter represent the greatest risk, followed by other animals in the same flock or herd which have not developed clinical signs as some of these animals are likely to have subclinical or pre-clinical infection. Flocks/herds with diagnosed FMD are known as “infected premises”. Herds or flocks slaughtered as high risk premises because of possible exposure to infection in the absence of clinical disease (known as “dangerous contacts”) represent a lower risk although these herds may also contain animals with subclinical or pre-clinical disease.
Amount of virus in carcase varies with: • Stage of clinical disease at time of slaughter	• Total viral burden varies with stage of clinical disease and is greatest around the time that clinical signs appear. Virus concentrations are greatest in vesicular fluid on day 2-3 after the onset of clinical signs. By day 4-5 virus titre is reduced (Sellers 1971). • In live animals the infectious period is most likely to start 0.5 days after the appearance of clinical signs and last for mean 1.7 days (Charleston et al. 2011). • FMDV may be present in fluids including blood, milk, urine and faeces of infected animals before the appearance of clinical signs (reviewed by Sanson 1994). • Any delay in slaughter is likely to allow FMDV to spread within the herd or flock and therefore allow further virus production.
• Species	• Pigs release the most aerosol virus and have the most vesicles so pig carcases are the greatest risk, followed by cattle then sheep. • FMD in sheep can be difficult to detect clinically as not all animals show clinical signs, and clinical signs are usually mild and short lived (Hughes *et al.* 2002).Therefore

	sheep carcases without overt clinical signs may still contain virus.
• Lactation stage at slaughter	• There is significant virus production in milk (Burrows 1971) so milk contamination from a full udder could increase dissemination of virus.
• Time between slaughter and transport	• FMDV is very sensitive to pH and becomes uninfective if the pH drops below 6. Muscle pH usually drops sufficiently following death to inactivate FMDV in muscle tissue within 24-48 hours. • However, FMDV can remain viable in tissues such as bone marrow, lymph nodes and blood for weeks to months (Cottral 1969). • At high temperatures (>50^{o}C), such as those found in composting conditions, decomposition may result in denaturing of the FMDV after several days. At ambient temperatures (20^{o}C), this would take considerably longer (Guan et al. 2010). • Large farms (i.e. with large numbers of animals to cull) may increase time to loading and removal of carcases from premises. • Unnecessary delay in removing loaded vehicles from premises may increase risk of leakage as carcases are liable to rapid decomposition and swelling/bursting of protective seals on disposal vehicles may occur.
• Method of slaughter	• Minimising the release of fluids from the carcase reduces risk of contamination.
• Handling of carcase after slaughter	• An increase in the time interval between the cull and loading of the carcase (which will be dependent on the size of the herd) will increase the risk of virus release. • Dismemberment and rough handling of the carcase may increase the risk of virus release via fluids such as blood and milk. Any rupture of vesicles increases the risk as the virus load in vesicular fluid is very high, although the likelihood of rupturing oral or interdigital vesicles through normal carcase handling is low.
• Likelihood of transmission is influenced by FMD virus strain	• There are 7 serotypes of FMDV: O, A, C, SAT1, SAT2, SAT3 and Asia 1. The different serotypes (and different strains within each serotype) have different characteristics for example in terms of host species susceptibility, length of incubation period, ease of detecting clinical signs and likelihood of air borne transmission (Kitching and Hughes 2002, Gloster *et al.* 2008). Much UK research is based on the 2001 outbreak, which was caused by serotype O, strain PanAsia. However future outbreaks may involve other serotypes/strains and therefore present different epidemiological situations. On confirmation of FMDV, the serotype and strain would be identified by The Pirbright Institute. This information would help to inform estimates of risk.
• Disinfection procedure	• FMDV is easily killed by approved disinfectants. Disinfection of carcases is likely to reduce virus contamination on the outside of the carcases, but there is little information on the degree of reduction likely to be achieved.

• Environmental conditions	• Low temperature (<4^{o}C) and relative humidity over 60% enhance survival of virus (Donaldson 1972, Bartley *et al.* 2002).
Transmission risk: **B1 Infection passing to other farms via contaminated roads or environment, from infected carcases or via fomites such as vehicle or personnel**	
• Method of loading	• Methods of loading which result in external contamination of the vehicle or leaking of the vehicle increase the risk that the vehicle will leave the premises contaminated in such a way as to pose a risk for transmission/ environmental contamination. • Rough handling of carcases increases risk of virus release, by rupturing vesicles, and allowing blood, milk, urine and faeces to escape. Although the likelihood of vesicles rupturing as a result of rough handling is low, the consequences of this occurring are severe due to the amount of virus contained within vesicles.
• Weather conditions at loading	• With conducive weather conditions (including medium wind strength and an inversion) airborne spread of FMD can occur. However this is more likely to occur due to virus production by live infected animals, with large pig farms presenting the highest risk. Aerosols can be created by splashing of infected fluids or use of high pressure hoses, but such aerosols are much less infective (Alexanderson et al. 2003). There is a low risk that corralling and culling infected animals could lead to airborne virus, but the likelihood of airborne virus sufficient for onward transmission resulting from loading and transportation of carcases is very low. • Ambient temperature may affect rate of putrefaction of carcases. This may increase risk of rapid decomposition of carcases resulting in swelling and rupturing of carcases and increased risk of leakage or contamination.
• Number of carcases	• Increased number of carcases increases total viral load. • Loading of vehicles with carcases to maximum capacity will increase risk of leakage and make effective disinfection of the load difficult.
• Amount of fluids and material released from carcases	• Increased fluid release increases risk of contamination, and increases risk of virus leakage, if a leak is present. • Unnecessary delay in removing loaded carcases from premises will increase risk of leakage or contamination as carcases are liable to rapid decomposition and swelling/bursting of protective seals may occur.
• Disinfectant inside transport vehicle	• Provided that the cargo is appropriately disinfected, with an approved disinfectant in the base of the vehicle/container, even if spillage occurs the probability is low of detecting viable virus in the effluent (Kitching 2001).
• Cleansing and disinfection of personnel, equipment and vehicle before leaving premises	• The risks associated with movement of carcases can be virtually eliminated by effective cleansing and disinfection. However, failure to conduct appropriate cleansing and disinfection is a significant risk. • Risk of contamination with and dissemination of infected material will increase if a driver leaves vehicle cab during loading.
• Effectiveness of sealing vehicle	• Ineffective sealing presents a high risk of releasing virus from the vehicle.

	• Leak testing should effectively reduce risk associated with poor sealage of disposal vehicles.
• Road traffic or other accident leading to spillage	• Likelihood of an accident occurring is very low. If an accident occurs, likelihood of container damage leading to virus release is very low. However potential consequences are severe. Risk can be reduced through use of routes with lower risk of onward transmission (for example avoiding areas of high frequency of farm traffic and if possible, avoid areas with a high density of susceptible species).
• Distance and time travelled, number of stops,	• Increasing journey distance increases risk of contamination from vehicle. Increasing number of stops increases risk of contamination from both vehicle and personnel.
• Proximity and density of susceptible livestock to transport route	• Increases risk that if any leakage of virus does occur, it will result in new outbreaks.
• Failure to fully empty the vehicle and undertake appropriate cleansing and disinfection of vehicle, personnel and equipment after transport	• Increases risk of onward virus transmission.
• Contact of personnel with susceptible livestock after transport	• Most risk reduction is achieved by reducing the number of people who are exposed to contamination, and the level of contamination of those who are, and then by appropriate cleansing and disinfection (including showering and changing all outerwear) (Amass *et al.* 2003). Personnel can potentially harbour virus in nasal passages for a period of time after exposure to FMDV so should not be in contact with susceptible livestock for this period. Previously a quarantine period of 3 days was enforced but recent studies have suggested this to be unnecessarily long (Wright *et al.* 2010, Amass *et al.* 2003, Amass *et al.* 2004).

6. CONSEQUENCE ASSESSMENT

Spread of FMD to uninfected premises. Potential for contamination of roads with FMDV over significant distances.

7. RISK MANAGEMENT OPTIONS

Transport of carcases potentially or actually infected with FMDV presents a risk of virus transmission to uninfected farms through contamination of roads and environment. However for reasons of disease transmission, public health (including welfare concerns for farmers and those working with animals) and public perception, carcases require prompt disposal. Highest risks are through vehicles contaminated with FMDV which are not adequately cleansed and disinfected or leakage of FMDV from unsealed vehicles, causing contamination of roads or environment.

Potential risk management options:
(i) Do not allow transport of carcases from infected premises and dangerous contacts. Limit carcase disposal to on farm options.
(ii) Allow transport only under licence, when absolutely necessary, under certain conditions and limit to a certain distance, or only within the surveillance zone and protection zone, or along defined routes
(iii) As (ii) but unlimited distance

Option (i) represents the lowest risk of causing further outbreaks via transport, but the alternative options of on farm disposal of burial or burning in pyres are not risk free. Availability and capacity of facilities for incineration or rendering will determine the route and distance travelled and may influence the disposal method chosen. If facilities are limited, option (iii) may be necessary, with carcases potentially transported over large distances.

It should be emphasised that with appropriate mitigation such as leakproof vehicles and appropriate cleansing and disinfection with an approved disinfectant, this risk can be reduced to negligible. However the greatest risks are that there is a failure somewhere in this procedure, which has the potential to have serious consequences. Measures to reduce the risk of failure of this procedure, such as the use of escort vehicles, help to reduce the risk.

Overall the risk of causing a new outbreak by moving carcases of animals slaughtered on confirmation or suspicion of disease is low.

This risk level was assigned based on scientific literature available and expert opinion where appropriate by considering the risk pathways and the factors affecting each risk pathway, as listed in sections 4 and 5.

8. SUGGESTED RISK MITIGATION MEASURES

Transport of carcases from their place of slaughter to a different place for disposal presents a low risk provided the following risk mitigation measures are in place.

The mitigation measures below are a summary of those specified in the AHVLA Operations Manual for transport of carcases from a premises where animals are culled on suspicion or confirmation of FMD. When resources are close to being overstretched, as predicted by the National Disease Control Centre (NDCC), the NDCC will communicate with the Disease Strategy Group (DSG) to discuss alternatives.

The loading of carcases at a premises where FMD is suspected or confirmed, and unloading of carcases at the disposal facility will be under the supervision of a Veterinary Inspector or AHVLA Case Officer.

A. Before movement (AHVLA Operations Manual)

1. Leak test should be performed.

- A successful leak test must be performed before every occasion where a vehicle is used to carry carcases or other infected material along a public road.
- If a bulker or containers with a door(s) is being used, the vehicle should be closed and seal checked for integrity. This should be done with 1000l of fluorescein dyed water (or other dye approved by Scottish Environmental Protection Agency SEPA). This is pumped in from a cube into the vehicle.
- The vehicle or container is tilted to 30 degrees and visually checked for leakages. If there is no leakage with the test, the water should be removed with a pump, keeping the seal intact. A tamper-proof unique numbered seal is applied to the tailgate.
- A vehicle has to arrive at a premises with a current leak test certificate. If the source of the vehicle/container does not have the facilities to perform the leak test, this may, in exceptional circumstances, be done on the IP prior to loading of the carcases or material. Where a leak test is undertaken away from the premises where carcases are, a certificate EXD52 must be provided and a tamper proof seal applied at that time, must be checked and found to be intact. If the disposal vehicle has good integral sealing capacity, such as a hydraulic tailgate the leak certificate is valid for 7 days. Before loading double check seal; ensure leak test certificate and unique numbered tamper-proof seal is applied to tailgate and the reference number is also recorded on the EXD61 form.

2. Carcase must be disinfected before loading. Approved disinfectants must be used at the correct concentration.

3. Disposal vehicle:

- The disposal vehicle must be clean before first arrival on an IP. Where possible, the vehicle should be parked and loaded to minimise contamination with infective material.
- If access to the premises is difficult or impossible, the AHVLA will make appropriate recommendations for parking and loading.
- A wedge of sawdust or other absorbent material must be placed in bottom of vehicle adjacent to tailgate before loading. Sawdust should be brought on board with vehicle.
- Vehicles should not be filled to maximum capacity due to potential expansion of carcases due to putrefaction (which is dependent on ambient temp and time until unloading). The load should not be filled to more than 2/3 capacity.

- Unnecessary delay in removing loaded carcases from premises should be avoided as they are liable to rapid decomposition and swelling/bursting of protective seals may occur.
- Once vehicle is loaded with carcases for disposal, it must be securely covered to minimise the risk of infective material coming into contact with susceptible livestock.
- Unless the disposal vehicle has a solid lid, carcases should be covered with a layer of suitable plastic which is then covered with a layer of absorbent material soaked in disinfectant and then covered by a normal tarpaulin in accordance with ADR UN 3373.
- The driver of the vehicle is responsible for security of any load on the vehicle (s)he is driving. Where a driver wishes to get out of the vehicle to conduct a check in accordance with this requirement, AHVLA staff must provide appropriate footwear, protective clothing and suitable advice to allow this inspection to be made. Where possible, and if the driver is prepared to do so, this inspection should be made after the vehicle has left the premises. Drivers should remain in the cab during loading or follow biosecurity advice from case officer.
- Immediately before leaving the premises where livestock have been culled, it is critical that the disposal vehicle undergoes appropriate cleansing and disinfection. A final visual check by an AHVLA inspector must be made for any evidence of leakage or damage that may lead to leakage in transit. If again, the vehicle or container shows any indication of leakage, it must be removed from use and contents transferred as soon as possible. These two processes should happen concurrently.

B. During movement

- Travel should be planned to minimise potential exposure to other livestock premises by farm traffic picking up any contamination and should be direct between the IP and the disposal facility. The route should take place on major roads and avoid areas of high frequency farm traffic.
- The route of travel and mileage are recorded on an EXD61 form that is presented by the driver to the AHVLA officer at the disposal facility.
- The route is “approved” by Association of Chief Police Officers/Scotland (ACPO/ACPOS) and they advise relevant agencies/authorities/services that infective waste is being transported through their territories – thus allowing responders to a traffic incident (eg accident or breakdown) to have prior knowledge of the types of cargo they may be dealing with.
- The vehicle must contain a ADR-certified person (trained about the risks of carrying hazardous cargo) and must carry certain emergency response equipment. Vehicles must also be placarded with ADR signage. Waste infectious to animals is classed as UN Code 2900, whilst waste infectious to humans and animals is classed as UN Code 2814.
- All disposal vehicles should be accompanied by an escort in a separate vehicle. The escort must have adequate training. The escort may be Rural Payments and Inspections Directorate (RPID) staff, local authority (LA) staff or SSPCA staff. The AHVLA also has other contractors which can be contacted in large scale outbreaks. Additional training will be provided in the event of a large scale outbreak.The escort will notify driver if leakage occurs; advise measures to minimise risk of disease spread in event of a leak; advise the Local Disease Control Centre (LDCC) of problem during journey; liaise with emergency services in the event of a leak (eg EA, SEPA, LA); prepare report of incidents, accidents, breach of biosecurity in a Biosecurity incident Form (EXD180). All drivers must carry a Transport Incident Certificate with telephone number of the Field Operation team.

C. After movement

- After unloading animals and before leaving the rendering plant/premises, the vehicle will undergo appropriate disinfection and cleansing of the vehicle under supervision of an AHVLA inspector. Approved disinfectants must be used at the correct concentration.

9. SOURCES OF EXPERT ADVICE

This VRA is based on:
VLA VRA2 “What is the risk of causing new outbreaks of FMD by moving livestock (sheep, cattle, pigs) carcases from their place of slaughter to a different place for disposal?” This VRA had received expert advice from Donaldson and Kitching.
Procedures on carcase removal from an infected premises from the AHVLA Operations Manual.
Michael Park and Matt Price (AHVLA) provided expert advice.

10. AUTHORS

Compiled by: Harriet Auty, Lisa Boden (EPIC CEADO)	Date: 31/04/2012
Reviewed by: Dom Mellor (EPIC CEADO)	Date: 04/05/2012

11. REFERENCES

Alexanderson S, Zhang Z, Donaldson A, Garland A (2003) The pathogenesis and diagnosis of foot-and-mouth disease, *Journal of Comparative Pathology* 129, pp1-36

Amass SF, Pacheco JM, Mason PW, Schneider JL, Alvarez RM, Clark LK, Ragland D (2003) Procedures for preventing the transmission of foot-and-mouth disease virus to pigs and sheep by personnel in contact with infected pigs, *Veterinary Record* 153, pp 137-140.

Amass SF, Mason PW, Pacheco JM, Miller CA, Ramirez A, Clark LK, Ragland D, Schneider JL, Kenyon SJ (2004) Procedures for preventing the transmission of foot-and-mouth disease virus (O/TAW/97) by people, *Veterinary Microbiology* 103, pp 143-149.

Bartley LM, Donelly CA, Anderson RM (2002) Review of foot-and-mouth disease virus survival in animal excretions and on fomites *Veterinary Record* 151, 22, pp 667-669.

Burrows R, Mann JA, Grieg A, Chapman WG, Goodridge D (1971) The growth and persistence of foot-and-mouth disease virus in the bovine mammary gland, *Journal of Hygiene* 69, pp 307-321.

Cottral GE (1969) Persistence of foot-and-mouth disease virus in animals, their products and the environment. *Office International des Epizooties Bulletin* 71, 549-568.

Charleston B, Bankowski BM, Gubbins S, Chase-Topping ME, Schley M, Howey R, Barnett PV, Gibson D, Juleff N, Woolhouse MEJ (2011) Relationship Between Clinical Signs and Transmission of an Infectious Disease and the Implications for Control. *Science* 332, 726 doiI: 10.1126/science.1199884

Defra, (2011) Qualitative analysis of the risk of introduction of Equine Infectious Anaemia (EIA) into Great Britain from an EIA endemic area through temporary movement of UK origin horses (Roberts, H. & Paterson, A.) Veterinary Science Team, 17 Smith Square, London, SW1P 3JR, United Kingdom. Version 1.0, Released 20 June 2011, p15

Donaldson AI (1972) The influence of relative humidity on the aerosol stability of different strains of foot-and-mouth disease virus suspended in saliva. *Journal of General Virology* 15, pp25-33.

Guan J, Chan M, Grenier C, Brooks BW, Spencer JL, Kranendonk C, Copps J, Clavijo A (2010) Degradation of foot-and-mouth disease virus during composting of infected pig carcasses. *The Canadian Journal of Veterinary Research* 74:40–44.

Kitching (2001) Cited as expert advice in VRA 2 What is the risk of causing new outbreaks of FMD by moving livestock (sheep, cattle, pigs) carcases from their place of slaughter to a different place for disposal.

Hughes GJ, Mioulet V, Kitching RP, Woolhouse MEJ, Alexanderson S, Donaldson AI (2002) Foot-and-mouth disease virus infection of sheep: implications for diagnosis and control, *Veterinary Record* 150, 23, pp 724-727.

OIE (2004) Handbook on Import Risk Analysis for Animals and Animal Products: Introduction and qualitative risk analysis, Vol.I. OIE Publications, Paris.

Sanson RL (1994) The epidemiology of foot-and-mouth disease: Implications for New Zealand, *New Zealand Veterinary Journal* 42, 2, pp 41-53.

Sellers RF (1971) Quantitative aspects of the spread of foot and mouth disease, *The Veterinary Bulletin* 41, 431-439.

Wright CF, Gloster J, Mazelet L, Paton DJ, Ryan ED (2010) Short-lived carriage of foot-and-mouth disease virus in human nasal cavities after exposure to infected animals, *Veterinary Record* 167, 928-931.

12. NOTES

None