AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Disease Strategy

Foot-and-mouth disease

Version 3.1, 2006

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AUSVETPLAN is a series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.

Primary Industries Ministerial Council

This disease strategy forms part of:

AUSVETPLAN Edition 3

This strategy will be reviewed regularly. Suggestions and recommendations for amendments should be forwarded to:

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IMPORTANT NOTE: Important regulatory information is contained in the OIE Terrestrial Animal Health Code for foot-and-mouth disease, which is updated annually and is available on the internet at the OIE website: http://www.oie.int/eng/normes/en_mcode.htm. Further details are given in Appendix 3 of this manual).

DISEASE WATCH HOTLINE

1800 675 888

The Disease Watch Hotline is a toll-free telephone number that connects callers to the relevant state or territory officer to report concerns about any potential emergency disease situation. Anyone suspecting an emergency disease outbreak should use this number to get immediate advice and assistance.

Preface

This disease strategy for the control and eradication of foot-and-mouth disease (FMD) is an integral part of the **Australian Veterinary Emergency Plan**, or **AUSVETPLAN (Edition 3)**. AUSVETPLAN structures and functions are described in the **AUSVETPLAN Summary Document**.

This strategy sets out the disease control principles that have been endorsed by the Animal Health Committee of the Primary Industries Ministerial Council (PIMC) out-of-session at meeting [INSERT NUMBER, MONTH, YEAR??] and by affected livestock industries for use in an animal health emergency caused by the occurrence of FMD in Australia. The original edition was endorsed by ARMCANZ/PIMC out-of-session in January 1996.

FMD is listed by the OIE (World Organisation for Animal Health, formerly Office International des Epizooties). Listed diseases are 'communicable diseases that have the potential for serious and rapid spread, irrespective of national borders; which are of serious socioeconomic or public health importance and which are of major importance in the international trade of animals and animal products'. The principles contained in this document for the diagnosis and management of an outbreak of FMD conform with the *OIE Terrestrial Animal Health Code* (see Appendix 3).

In Australia, FMD is included as a Category 2 emergency animal disease (EAD) in the *Government and Livestock Industry Cost Sharing Deed In Respect of Emergency Animal Disease Responses* (EAD Response Agreement).[1]

Category 2 diseases are EADs that have the potential to cause major national socioeconomic consequences through very serious international trade losses, national market disruptions and very severe production losses in the livestock industries that are involved. Category 2 also includes diseases that may have slightly lower national socioeconomic consequences, but also have significant public health and/or environmental consequences. For this category, the costs will be shared 80% by governments and 20% by the relevant industries (refer to the EAD Response Agreement for details).

Detailed instructions for the field implementation of AUSVETPLAN are contained in the disease strategies, operational procedures manuals, management manuals and wild animal manual. Industry-specific information is given in the relevant enterprise manuals. The full list of AUSVETPLAN manuals that may need to be accessed in an emergency is:

[1] Information about the EAD Response Agreement can be found at http://www.aahc.com.au/eadp/response.htm

Disease strategies
- Individual strategy for each disease
- Response policy briefs (for diseases not covered by individual manuals)

Operational procedures manuals
- Decontamination
- Destruction of animals
- Disposal
- Public relations
- Valuation and compensation

Management manuals
- Control centres management (Parts 1 and 2)
- Animal Emergency Management Information System
- Laboratory preparedness

Enterprise manuals
- Artificial breeding centres
- Dairy processing
- Feedlots
- Meat processing
- Poultry industry
- Saleyards and transport
- Veterinary practices
- Zoos

Wild animal manual
- Wild animal response strategy

Summary document

In addition, *Exotic Diseases of Animals: A Field Guide for Australian Veterinarians* by WA Geering, AJ Forman and MJ Nunn, Australian Government Publishing Service, Canberra, 1995 is a source for some of the information about the aetiology, diagnosis and epidemiology of the disease.

The basis of the Australian response has been developed from a wide range of experts with international experience in FMD. Standard veterinary texts should be consulted for further information about the aetiology, diagnosis and epidemiology of the disease and should be read in conjunction with this strategy.

Earlier versions of this manual were prepared by a writing group with representatives from the Australian national, state and territory governments and the livestock industry. This version was updated by DAFF staff. Scientific editing was by Dr Janet Salisbury of Biotext, Canberra.

The revised manual has been reviewed and endorsed by:

Government	**Industry**
Commonwealth of Australia	Cattle Council of Australia
State of New South Wales	Australian Lot Feeders Association
State of Queensland	Australian Dairy Farmers' Federation
State of South Australia	WoolProducers
State of Tasmania	Sheep Meat Council of Australia
State of Victoria	Australian Pork Limited
State of Western Australia	Australian Goat Industry Council
Northern Territory	
Australian Capital Territory	

The complete series of AUSVETPLAN documents is available on the internet at: http://www.aahc.com.au/ausvetplan/index.htm

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1 Nature of the disease

Foot-and-mouth disease (FMD) is an acute, highly contagious viral disease of cloven-hoofed animals. The disease is characterised by the formation of vesicles (fluid-filled blisters) and erosions in the mouth and nostrils, on the teats, and on the skin between and above the hoofs. FMD may cause serious production losses and is a major constraint to international trade in livestock and their products.

1.1 Aetiology

FMD is caused by a picornavirus. There are seven immunologically and serologically distinct serotypes of FMD virus, identified as types O, A, C, SAT 1, SAT 2, SAT 3 and Asia 1. Within these seven types there is a wide spectrum of antigenic diversity.

1.2 Susceptible species

Ungulates

Cloven-hoofed animals (ungulates) are the natural domestic and wild hosts of FMD virus. They include cattle, pigs, sheep, goats, water buffalo (*Bubalus bubalis*), camel, bison, African buffalo (*Syncerus caffer*), deer, antelope, reindeer, moose, llama, chamois, alpaca, vicuna, impala, giraffe, gazelle, wildebeest, eland, bushpig and warthog. In addition, elephants are also known to be susceptible.

Australia has large populations of domestic and wild animals that are fully susceptible to infection with FMD virus, ranging from intensively managed animals in dairies and piggeries, through those in more extensive cattle and sheep enterprises, to wild pig, cattle, goat, camel and buffalo herds.

Australian native animals and rabbits

Several Australian marsupial species (red kangaroo, grey kangaroo, tree kangaroo, wombat, brushtail possum, long-nosed bandicoot, potoroo, water rat, brown marsupial mouse, Bennett's wallaby) as well as echidnas and wild European rabbits have been tested overseas for susceptibility to FMD (Snowdon 1968). There was minimal disease or spread of infection between animals following experimental inoculation of FMD virus. The author concluded that it would be only under exceptional conditions that the Australian fauna tested would participate in the spread of FMD under field conditions. Close contact would be required between livestock and fauna at watering holes, for example in droughts.

Other animals

FMD virus may also be transmitted to mice, rats, guinea-pigs, rabbits, hamsters, embryonating chicken eggs, chickens and various wild species, including European hedgehogs, chinchillas, muskrats, armadillos and peccaries. These are not generally implicated in the spread of FMD.

Horses are resistant.

Suckling mice and guinea-pigs are used for FMD virus studies, for the production of diagnostic sera and in vaccine potency studies.

Humans

People can become infected through skin wounds or the mouth lining by handling diseased stock or the virus in the laboratory or by drinking infected milk, but not by eating meat from affected animals.

The infection is temporary and mild, only very occasionally resulting in clinical disease (fever, vesicles on the hands or feet or in the mouth). People are rarely affected by FMD virus, and FMD is not considered a public health problem (Acha and Szyfres 1987).

Hand, foot and mouth disease of humans is present in Australia and may be confused clinically with FMD. However, the condition in humans is most often caused by Coxsackievirus type A16, although other coxsackieviruses have also been implicated.

1.3 World distribution and occurrence in Australia

FMD is endemic throughout the Middle East, Africa, South America, Asia and parts of Europe. A major outbreak occurred in the United Kingdom in 2001. A list of FMD-free countries is maintained by the OIE (World Organisation for Animal Health, formerly Office International des Epizooties) and is available at the OIE website.[2]

Among our closest neighbours, Indonesia, Singapore, Papua New Guinea, New Zealand and the Pacific nations are free of FMD.

In Australia, there were minor outbreaks of possible FMD in 1801, 1804, 1871 and 1872. The last incident occurred in Victoria as a result of the import of a bull from England. Two farms were involved before the disease was eradicated. FMD has not been diagnosed in Australia since that time.

1.4 Diagnostic criteria

For terms not defined in the text, see the Glossary.

1.4.1 Clinical signs

FMD should be considered whenever vesicles are seen in cloven-hoofed animals. A provisional diagnosis of FMD should be made where there is a combination of the following signs:

[2] http://www.oie.int/eng/info/en_fmd.htm

- acute lameness in a number of animals;
- salivation;
- vesicles in the mouth, on the feet, and/or on the teats;
- fever; and
- in dairy cattle, a considerable drop in milk yield.

The classical signs and lesions of FMD are described below. However, a wide range of clinical syndromes may occur, ranging from inapparent disease with minimal lesions to severe clinical disease.

For further information on clinical signs, see the Australian Animal Health Laboratory (AAHL)/EXANDIS video *FMD – The Front Line*, Geering et al (1995) and Callis et al (1982).

Cattle

In cattle, the earliest clinical signs are dullness, poor appetite and a rise in temperature to 40–41°C. In dairy cows, milk yield drops considerably. Salivation and lameness may be observed, depending on the stage of infection. Affected animals move away from the herd and may be unwilling or unable to stand.

Vesicles may appear inside the mouth on the tongue, cheeks, gums, lips and/or palate. At first, they are small blanched areas under which fluid accumulates to form vesicles. These develop quickly and may reach 30 mm or more in diameter, especially on the dorsum of the tongue. Two or more blisters may join to form a larger one, sometimes covering as much as half of the surface of the tongue. However, intact vesicles are not often seen, because they usually burst easily and within 24 hours, leaving a raw surface fringed by blanched flaps of epithelium. Alternatively, the fluid may drain, leaving an intact area of blanched epithelium. There may be profuse, frothy saliva around the mouth and, at intervals, a smacking or sucking sound may be heard. The lesions heal rapidly over several days.

Vesicles may form between the claws of the feet and along the coronary band. Initially they appear as areas of blanched epithelium, and the underlying blisters may not be obvious unless the epithelium is torn away. Foot lesions may also be masked by dirt. There may be signs of pain in the feet. When forced to rise, the animal may walk gingerly, and occasionally shake a leg as if to dislodge some object wedged between the claws. As the lesions heal, dry separation of the heels along the coronary band may occur. From 2 to 6 weeks after infection, the feet appear to be 'slippered' as the horn of the heel separates and may be easily removed from the underlying corium. Cracks in the heels may take a long time to heal in some animals, causing chronic lameness and weight loss.

Lesions may also occur on the teats and udder, and reduced lactation, mastitis and abortion are common.

Mortality in adults is usually low to negligible, but up to 50% of calves may die due to cardiac involvement and complications such as secondary infection, exposure or malnutrition.

However, the disease may also be mild or inapparent, especially in *Bos indicus* (zebu) breeds.

Pigs

In pigs, the main sign is lameness, although this may be masked if the affected animals are on soft ground. Blisters form around the top of the foot, on the heels and between the claws. The epithelium may appear blanched or raw and ragged at the top of the hoofs (coronary band). Affected pigs prefer to lie down and, when made to move, hobble painfully and squeal loudly. The feet may become 'thimbled' as the horny layer separates and is easily removed from the underlying corium. After several days, granulation tissue and new horn growth will be evident. Snout lesions may develop but quickly rupture, and mouth lesions are difficult to see. Blisters may develop on the teats and spread over the skin of the mammary glands. Abortion is common and may even be the presenting clinical problem. Significant mortality can occur in piglets.

Sheep and goats

While the disease is usually mild in sheep and goats, with few lesions, severely affected animals may succumb to sudden, severe lameness affecting one or more feet. Blisters form around the top of the foot and between the claws. They are not often noticeable in the mouth, but may develop on the tongue and dental pad. Affected sheep look sick and are reluctant to stand. Significant mortality can occur in lambs.

During the 2001 epidemic in the United Kingdom, signs in sheep were sometimes so mild that the presence of the disease was revealed only by very close examination of all the sheep in a flock.

Ageing of lesions

The appearance of FMD lesions on the tongues of cattle and the feet of pigs may provide a guide to lesion age and hence to how long infection has been present in a herd (Henderson 1947, MAFF 1986):

- unruptured vesicles 0–2 days
- newly ruptured vesicles with epithelial remnants at the margins 1–3 days
- ruptured vesicles without epithelium or fibrous healing 3–10 days
- open lesions with marked fibrous tissue at the margins > 7 days

For illustrations of lesions, see MAFF (1986), the AAHL video *FMD – The Front Line* and Geering et al (1995).

The time of introduction of infection to a pig herd can be estimated as follows:

- allow seven days for the incubation period;
- allow seven days for the lesions to mature and new horn growth to begin;
- examine all eight cleaned claws on each of several pigs for lesions;

- measure the distance from the coronary band to the lesion;
- allow 2 mm per week in weaners and 1 mm per week in adult pigs.

Lesions in sheep are too transient to be used for gauging the time of infection.

1.4.2 Pathology

The most common route of infection, especially for ruminant species, is by inhalation of virus in droplets or aerosol. The virus primarily replicates in epithelial cells in the pharynx and dorsal soft palate and then spreads via the blood to secondary sites. Once a herd is infected and other animals are exposed to larger amounts of virus, infection can occur via other routes, particularly through minor abrasions to the integument of the feet, mouth, muzzle, nose and udder. Higher doses of virus are required for oral infection, and ruminants are much more resistant to oral infection than are pigs.

Replication in epithelial tissues occurs in the stratum spinosum. It results in the accumulation of intracellular and extracellular fluid, leading to the development of a vesicle. Sometimes, early rupture of this layer results in escape of fluid and a desiccated lesion. Other important secondary sites of replication include the mammary gland, ruminal lymph nodes and heart. In young animals, sudden death from myocardial necrosis may occur before the development of vesicles. Apart from the identification of vesicles and heart lesions, pathological examination is important only in the differential diagnosis of other diseases from FMD.

Virus is excreted in large quantities in the expired air, in all secretions and excretions (including milk and semen) and from ruptured vesicles. Pigs excrete about a thousand times more virus in expired air than do ruminants. Excretion of virus can begin four days before clinical disease is apparent, which is of great epidemiological importance. Most excretion of virus ceases within 6 days of the appearance of vesicles. FMD virus has been detected in the milk and semen of experimentally infected cattle for 23 and 56 days, respectively (Donaldson and Hofner 1990).

1.4.3 Laboratory tests

Specimens required

Specimens essential for the rapid confirmation of FMD include:

- *for virus isolation* — vesicular fluid, vesicular lesion epithelial coverings or flaps, oesophageal–pharyngeal fluid, whole blood and, from dead animals, tissue samples including lymph nodes, thyroid, adrenals, kidney, spleen and heart;
- *for serology* — serum; and
- *for histopathology* (for differential diagnosis) — lesion tissue, including lesions of the upper gastrointestinal tract, with duplicate tissues submitted unfixed.

For further details, see Geering et al (1995).

Transport of specimens

Specimens should initially be sent to the state or territory diagnostic laboratory, from where they will be forwarded to the CSIRO Australian Animal Health Laboratory (CSIRO-AAHL), Geelong for emergency disease testing, after obtaining the necessary clearance from the chief veterinary officer (CVO) of the state or territory of the disease outbreak and after informing the CVO of Victoria about the transport of the specimens to Geelong.

Unpreserved tissue and blood specimens should be forwarded with water ice or frozen gel packs (dry ice if a delay of more than 48 hours is expected) in an AAHL-approved specimen transport container. Unless oesophageal–pharyngeal fluid samples will be received at the laboratory the same day, they should be frozen and packed with dry ice. For further information, see the **Laboratory Preparedness Manual**.

Laboratory diagnosis

The laboratory tests currently available at AAHL are shown in Table 1. They include direct tests such as enzyme-linked immunosorbent assays (ELISAs) that can detect FMD virus antigens in vesicular fluid or homogenates of epithelial tissue from lesions and are used to screen new samples. These tests can provide serotype-specific results within 3–4 hours and provide the earliest possible laboratory confirmation of FMD virus. A negative result to these tests does not confirm the absence of FMD, and definitive diagnosis then depends on virus isolation in tissue culture.

AAHL can now also offer Taqman® PCR (polymerase chain reaction) as an extra rapid and reliable diagnostic test. The samples are the same as for the antigen-detection ELISA. Taqman PCRs also take 4 hours.

Virus isolation in cell culture is useful for specimens with small amounts of virus. This procedure takes 24–48 hours, or longer if passaging is required. Isolation of virus is important for FMD virus strain differentiation, although some direct testing is now possible.

Antibodies to the whole virus or nonstructural antigens appear in the serum 7–10 days after infection.

Additional diagnostic tests include reverse transcriptase PCR (RT-PCR) and electronmicroscopy. Nucleotide sequencing of prescribed genes can be used in molecular epidemiology. Animal transmission is rarely used for diagnosis, having been replaced by the more efficient and sensitive in vitro procedures described above.

Table 1 Laboratory tests currently available at CSIRO-AAHL for the diagnosis of foot-and-mouth disease

Test	Specimen required	Test detects	Time taken to obtain result
ELISA	vesicular fluids or epithelial tissue	antigen and serotype identification	3–4 hours
Electronmicroscopy	tissues	virus	3–4 hours
VIA antibody gel test	serum	VIA antibody (common to all FMD virus types)	1–3 days
Liquid phase ELISA	serum	specific antibody	1 day
Virus isolation and identification	tissues	virus	1–4 days
FMD PCR	tissues/cell culture	viral RNA	2 days
Taqman PCR	tissues/cell culture	viral RNA	4 hours

VIA = virus infection associated
Source: Information provided by CSIRO-AAHL, 2002 (refer to CSIRO-AAHL for most up-to-date information).

[XX Is it possible to give a later year than 2002 for source note to Table 1?]

1.4.4 Differential diagnosis

The following diseases should be considered in a differential diagnosis of foot-and-mouth disease.

Exotic viral diseases:

- swine vesicular disease
- vesicular stomatitis
- vesicular exanthema
- rinderpest
- bluetongue
- peste des petits ruminants.

Endemic infectious diseases:

- mucosal disease
- bovine papular stomatitis
- bovine ulcerative mammalitis
- pseudocowpox
- bovine malignant catarrh
- contagious ecthyma ('scabby mouth')
- infectious bovine rhinotracheitis/infectious pustular vulvovaginitis
- dermatophilosus infection.

Dermatitis:

- scalding, wetting, contact dermatitis, photosensitisation.

Phytophotodermatitis:

- contact with certain plants containing furocoumarins (especially Umbelliferae — parsnips, celery, parsley) resulting in photosensitisation (Montgomery et al 1987ab, Pathak et al 1962).

Trauma

Lameness:

- laminitis, hoof abscess, footrot, bad floors, new concrete, mud.

1.4.5 Treatment of infected animals

In areas of the world where slaughter of animals with clinical signs of FMD is not mandatory, and in the case of infection in very important animals for which an exception to an automatic slaughter policy might be given, nursing and supportive care are important for the welfare of the individual animal and to minimise the time for which it is clinically affected. Mild disinfectant and protective dressings may be applied to affected areas to prevent secondary infection.

However, with severe disease and particularly if there are severe secondary infections and complications, culling is preferable on the grounds of the welfare of the animal and also to prevent additional losses to the livestock owner because of animals that are 'poor doers'.

1.5 Resistance and immunity

1.5.1 Innate and passive immunity

In endemic countries, zebu breeds (*Bos indicus*) usually show milder clinical signs than introduced European breeds (*Bos taurus*). However, they can still become infected and transmit infection. Young animals are usually more susceptible to FMD than adults, unless protected by maternal antibodies.

1.5.2 Active immunity

The immunity conferred by natural infection and vaccination is largely strain specific. There is variable cross-protection between strains of FMD virus within the same serotype, and none between different serotypes. Animals can be infected by multiple serotypes. Ruminants, but not pigs, can develop a carrier status in which virus persists in the pharynx in the presence of circulating antibody (see Section 1.6.2).

1.5.3 Vaccination

Inactivated vaccines have been successfully used in many parts of the world to control FMD; the vaccines are either aqueous based (aluminium hydroxide) or double oil emulsion. However, improperly inactivated vaccines have led to spread of the disease — a factor to be kept in mind when looking at the safety of the vaccine to be used.

Resistance to clinical disease induced by these vaccines wanes rapidly after 4–6 months, so vaccination must be repeated at intervals. Although protected against

disease, vaccinated animals are not totally resistant and can still become infected with FMD virus, shed the virus and become transient carriers (see Section 1.6.2).

FMD virus frequently mutates during natural passage through various animal species or by passage through carriers with varying levels of antibody. If vaccination is used, it is necessary to check the strain variation of field isolates frequently, and to be prepared to adjust the viral composition of the vaccine accordingly during the course of a prolonged outbreak.

Development of genetically engineered virus protein subunit vaccines is underway but is still in the experimental stages, as is the use of synthetic polypeptide fragments of the immunogenic section of the FMD virus. There is currently no indication that a new-generation vaccine will become available in the immediate future. Until such bioengineered and synthetic vaccines are available, correctly inactivated and safety-tested FMD vaccines are the best option if vaccination must be resorted to. In 2002, the OIE coordinated a major review of the carrier status of vaccinated animals and the validation of specific tests to differentiate between vaccinated and infected animals. This has led to a number of significant changes in the OIE Terrestrial Code (still valid in the 2004 Code), including the reduction of time to declare freedom (from 12 to 6 months after the last case) when using vaccine and appropriate surveillance techniques (See Appendix 3).

1.6 Epidemiology

Key factors in the epidemiology of FMD are as follows:

- The disease is highly contagious, spreading by aerosols and with movements of infected or contaminated animals, products, objects and people.
- Large amounts of virus are excreted by infected animals before clinical signs are evident.
- Pigs are mainly infected through ingesting contaminated feedstuff.
- Pigs excrete large amounts of virus in respiratory aerosols and, as the main amplifying hosts, are extremely important in disease spread.
- Cattle are mainly infected by inhalation of contaminated aerosols.
- Infected sheep and goats may show mild or inapparent signs and therefore they may be important in the maintenance and spread of disease.
- Winds carrying virus can spread the disease over considerable distances if climatic and environmental conditions are suitable.
- Some recovered cattle, buffalo and sheep, but not pigs, remain long-term carriers (cattle may continue to harbour virus in the pharynx for over 2 years, and sheep for 9 months).

1.6.1 Incubation period

When susceptible animals are placed with clinically affected animals, transmission occurs readily. Clinical signs of FMD are usually seen in the exposed animals within 3–5 days.

The length of the incubation period is affected by the strain of FMD, the infecting dose, the route of infection, individual susceptibility, and the environment in which the animals are kept. With natural routes and high exposure doses, the period can be as short 2–3 days, but up to 10–14 days with very low doses (Donaldson 1987). In the 1967–68 outbreak of FMD in the United Kingdom, the incubation periods observed were:

- *cattle* — minimum 3–5 days
- *pigs* — 4–9 days (with younger pigs in the longer part of this range).

Clinical signs can be seen in pigs following infection with pig-adapted strains of FMD within less than 24 hrs after exposure in highly contaminated pens. More frequently, clinical signs are seen after 2 days or more, and the incubation period can be as long as 9 days (Kitching and Alexandersen 2002).

The incubation period in sheep following infection is usually between 3 and 8 days, but can be a short as 24 hours following experimental inoculation, or as long as 12 days, depending on the susceptibility of the animal, the dose of virus and the route of infection (Kitching and Hughes 2002).

For tracing purposes, the incubation period may be regarded as 7 ± 4 days, depending on the individual outbreak circumstances, with a maximum incubation period, for regulatory purposes, of 14 days (see OIE Terrestrial Code; Appendix 3).

See Section 1.4.1 for further information on incubation period, lesion ageing, and determining the time of introduction of the virus.

1.6.2 Persistence of agent

General properties

The FMD virus is small, with no lipid in the envelope. It is most susceptible to both acid and alkaline disinfectants (see Section 2.2.8).

The virus has the following general properties (Donaldson 1987):

- The virus is most stable at pH 7.4–7.6 but will survive at pH 6.7–9.5 if the temperature is reduced to 4°C or lower. Below pH 5.0 or above pH 11.0, inactivation is very rapid.
- Raising the temperature reduces the survival time. At temperatures below freezing point, the virus is stable almost indefinitely. Exposure to 56°C for 30 minutes is sufficient to destroy most strains, although there is some variation between strains in resistance to temperature and/or pH stress.
- Sunlight has little or no direct effect on infectivity; any loss is due to secondary drying and temperature.

- The survival of airborne virus is mainly influenced by relative humidity (RH) with good survival above 60% RH and rapid inactivation below 60% RH (Donaldson 1972).

Environment

FMD virus may remain infective in the environment for several weeks and possibly longer in the presence of organic matter, such as soil, manure and dried animal secretions, or on chemically inert materials, such as straw, hair and leather.

Other reported survival times in various conditions include (up to):

- 50 days in water (Sellers 1971, Mahnel et al 1977);
- 74 days on pasture at 8–18°C and high RH;
- 26–200 days in soil, sacking, hay or straw, depending on storage or climatic conditions (Morgan 1993);
- 35 days on cardboard, wood or metal contaminated with contaminated serum, blood or tissue (Gailiunas et al 1969);
- 398 days on wood contaminated with fat (Gailiunas et al 1969).

In 1924, the virus persisted for 345 days on one farm in California (Morgan 1993).

Airborne FMD virus may persist in animal rooms for at least 48 hours.

Live animals

Infected animals excrete virus in ruptured vesicular fluid, exhaled air, saliva, milk, semen, faeces and urine.

Infected, preclinical animals can excrete large amounts of virus. Excretion in semen and milk can occur for up to 4 days before the clinical phase, and sheep excrete virus in their breath for around 24 hours before signs are apparent (Burrows 1968). High titres of FMD virus have been found in such animals. Thus, infected animals may be moved, sold and/or slaughtered before clinical disease develops.

Clinically affected animals also shed large quantities of virus. Virus excretion from most sites diminishes rapidly with the appearance of circulating antibodies.

Ruminants, but not pigs, may remain long-term carriers. Cattle may continue to harbour virus in the pharynx for over 2 years and sheep for 9 months. Persistence of the virus in the udders of experimentally infected cattle has been reported (Burrows et al 1971).

Although difficult to demonstrate experimentally, there is good epidemiological evidence that virus transmission can occur from carrier animals to susceptible animals in close contact. Transmission of SAT 2 virus from carrier African buffalo to in-contact cattle has been demonstrated (Dawe et al 1994). Carrier animals should therefore be regarded as a potential, although uncommon, source of spread or persistence of FMD (Donaldson and Kitching 1989).

Infection could persist indefinitely in susceptible wild animals. For example, African buffalo may be infected with two or three serotypes simultaneously, and virus was recovered from one animal for over 5 years (Condy 1989). Persistence depends on the population dynamics of the species concerned, including population size, distribution, movement, breeding season, and the introduction of new and susceptible members.

Vaccinated cattle that became infected soon after vaccination did not develop clinical disease, but transmitted the virus to in-contact cattle at 7 days, but not at 30 days, after infection (Donaldson and Kitching 1989). FMD virus has been isolated from cattle in Zimbabwe 2–3 years after they were vaccinated in the face of an FMD outbreak (SK Hargreaves, Chief Veterinary Officer, Zimbabwe, pers comm, 1992).

Animal products and byproducts

Meat

FMD virus is inactivated within 3 days in the meat of carcases that have undergone normal post-slaughter acidification. However, prolonged survival of FMD virus can occur in meat if the pH does not fall below 6.2. This may happen when carcases are chilled rapidly (Cottral 1960). However, virus can also survive for months in chilled or frozen lymph nodes, bone marrow, viscera and residual blood clots. Deboning and removal of lymph nodes has been used for many years as an accepted processing strategy.

FMD virus may survive for prolonged periods in salted and cured meats (Dhennin et al 1980ab). The virus has been recovered from:

- sausages — up to 56 days
- ham fat — up to 183 days
- bacon — up to 190 days.

The virus has also been recovered from processed intestinal casings from experimentally infected sheep, stored for 14 days at 4°C (Bohm and Krebs 1974, Bohm 1975).

Dairy products

Survival time in dairy products increases at lower temperatures (especially freezing). The survival of FMD virus in milk and milk products was reviewed by Morgan (1993), who highlighted the following:

- milk and butter —virus survival for 14–45 days, if preserved under cold conditions (Blackwell and Hyde 1976); and
- dried skim milk — survival for up to 2 years (Cottral 1969).

Pasteurisation as required by the Australian New Zealand Food Standards Code (ANZFA 2000) at a temperature of 72°C for 15 seconds, and immediate shock cooling to 4.5°C, may not completely eliminate FMD virus from milk.

Dried casein produced from pasteurised milk of dairy cows infected with FMD virus retained infectivity for cattle in one of seven tests for 42 days storage at 25°C

(Cunliffe et al 1978). The whey byproduct from casein manufacture was noninfective.

Low pH greatly accelerates the rate of inactivation of the FMD virus in milk artificially inoculated with virus. For example:

- 4°C, pH 5.5 — inactivation in 30 minutes
- 72°C, pH 6.7 — inactivation in 17 seconds
- 72°C, pH 7.6 — inactivation in 55 seconds.

FMD virus has survived processing but not curing in cheddar cheese (Blackwell 1976).

Wool and hides

Factors influencing FMD virus survival on wool include organic material contact (faeces etc), temperature and RH in storage.

FMD virus has been recovered from wool from infected sheep following natural exposure (McColl et al 1995). Virus could be recovered from greasy wool for up to 14 days after experimental contamination. Approximate survival times were:

- 7 weeks at 4°C storage
- 2 weeks at 18°C storage
- 2 days at 37°C storage.

FMD virus has been recovered from green salted hides for up to:

- 90 days, at 15°C
- 352 days, at 4°C.

Hides cured for 20 hours in saturated brine with up to 500 ppm of available chlorine still had FMD virus after 4 weeks storage at 15°C. FMD virus was also detected in a hide sample dried for 42 days at 20°C and 40% RH.

Hides cured in salt for 7 days and then dried at 20°C were found to be infectious for 21 days.

Animal excretions

FMD virus has been shown to survive in animal manure for the following periods (Bauer and Eissner 1972, Rozov and Andryunin 1972, Callis et al 1980):

- dry manure — 14 days
- moist manure — 8 days
- 30-cm manure mounds, piles — less than 6 days
- liquid manure — 34–42 days at 12–22°C
- water from pen washings — 21 days at 17–21°C.

The pH of normal urine should inactivate FMD virus.

Semen

Virus has been recovered from bovine semen stored at –50°C for at least 320 days (Cottral et al 1968).

Tissue fluids and blood

Virus in tissue fluids or blood allowed to dry on various materials and kept indoors at room temperature may remain infective for the following periods (APHIS 1980, McKercher and Callis 1983):

- up to 2 weeks on wool
- 4 weeks on cows' hair
- 11 weeks on boot leather
- 13 weeks on rubber boots
- 15 weeks on hay
- 20 weeks on bran.

Equipment and personnel

It is possible for people examining the head area of clinically affected pigs to harbour the FMD virus in their nasal cavity. Usually the period is 4–5 hours, but virus was recovered after 28 hours from one person (Sellers et al 1970). Experimentally, infection has been transmitted by humans coughing and snorting into the noses of steers shortly after they had been exposed to infected pigs (Sellers 1971). During outbreaks, a common stand-down time before veterinarians and others directly exposed to the virus may enter clean areas has been 3 days.

Vectors

See Section 1.6.3.

1.6.3 Modes of transmission

FMD is one of the most contagious animal diseases. Very large amounts of virus are present in all tissues, secretions and excretions before and during the development of clinical signs. Animals are infected via inhalation, by ingestion and by artificial or natural breeding. The primary method of transmission is by direct contact, via respiratory aerosols.

Live animals

Transmission occurs most readily when animals are in close proximity, such as at watering and feeding points, stockyards and milking sheds. Spread of infection between properties and areas is often due to the movement of infected animals or contaminated vehicles, equipment, people and products. The movement patterns of animals in Australia will be a critical factor in the dissemination of FMD.

Interestingly, feral pigs presented only a low risk of infecting other feral pigs. This suggests that spread of FMD in feral pig populations will largely depend on close contact between groups.

Animal products and byproducts

Many FMD outbreaks have originated from swill feeding of pigs with infected animal products or meat scraps and bones from infected animals. Uncooked garbage from foreign ships has been a source of FMD in pigs. Milk from infected animals may contain considerable quantities of FMD virus. Animals, especially pigs, may become infected by ingestion of contaminated forage, grain, animal products or water, or by licking contaminated objects.

Outbreaks of FMD have been traced to the use of contaminated biological products, including improperly inactivated FMD vaccines, vaccinia vaccine, hog cholera vaccine and pituitary extract.

Equipment and personnel

The virus can be readily spread on contaminated vehicles and equipment. People can easily transfer infection to animals on contaminated boots, hands and clothing. Spread has been associated with veterinarians and rodent exterminators.

Healthy people may harbour FMD virus subclinically in the nasal passages and throat for up to 36 hours (although a safety period of at least 3 days should be allowed). During this time, virus is expelled during coughing, sneezing, talking and breathing, and in the saliva. It has been demonstrated experimentally that infected people can transmit FMD virus to other people and to susceptible animals.

Dogs, cats, rodents, and poultry and other birds can spread the virus mechanically.

Effluent from infected premises, particularly piggeries and dairies, that drains onto roads, stock routes or pastures or into creeks can infect or contaminate animals, vehicles, equipment and people coming into contact with it.

Vectors

Bachrach (1968) indicated that no biological insect vector has been identified as being important in the spread of FMD. A number of animal species, including humans (Sellers et al 1970, 1971) can act as mechanical vectors for the virus (see discussion of spread by equipment and personnel, above).

Artificial breeding

It has been demonstrated experimentally that FMD may be transmitted by insemination of infected semen. FMD virus has been found in bull semen 4 days before, during, and up to at least 37 days after the appearance of clinical signs. The virus enters semen as a result of viraemia or lesions around the preputial orifice.

Spread in cattle by embryo transfer should not occur, provided the embryos have been properly washed according to the International Embryo Transfer Society (IETS) protocols, the zona pellucida is intact, and people and equipment are free of contamination.

Transmission of infection via semen has not been reported in sheep or goats, but is possible, given the results for cattle. Appropriately handled and washed sheep or goat embryos are estimated to present only a moderate risk.

FMD virus has been recovered from the semen of pigs.

See also the **Artificial Breeding Centres Enterprise Manual**.

Windborne transmission

Although FMD will readily spread between animals in close contact via the respiratory route, 'windborne spread' refers to infection of animals some kilometres from known foci, without any history of contact (Donaldson 1983). Movement of virus on the wind is implied. This definition is used here.

Windborne spread can occur for many kilometres under the right conditions. Once liberated into the atmosphere, infected aerosols can form a 'plume' that is dispersed horizontally and vertically. For sufficiently high quantities of virus to be maintained near the ground, vertical dispersion must be limited. However, under certain atmospheric conditions, bodies of infected air may rise vertically, travel large distances, and then descend to ground level with little dilution of virus having occurred (see further discussion of windborne spread in Section 1.6.4).

The amount of virus emitted into the air is a function of:

- the species of animal;
- the stage of the disease — substantial quantities of virus may be emitted before the first lesions appear, and most virus is emitted between 4 and 7 days after infection, at the time of vesicle rupture;
- the number of infected animals; and
- the strain of virus.

Most windborne spread over land occurs over distances of up to 10 kilometres. As pigs are potent excretors of airborne virus and cattle are readily infected by inhalation, the pattern of spread most often observed is from pigs to cattle downwind.

Infected intensive piggeries pose the greatest threat of airborne spread. At the time of peak excretion, a pig can emit in the order of 10^8 IU (infectious units) per day compared to cattle or sheep at about 10^5 IU per day (Donaldson 1987). (See discussion in Section 1.6.4, Host factors.)

Because of their higher respiratory tidal volume, cattle are also more likely to become infected than are sheep or pigs. Larger cattle herds are more likely to be infected than smaller ones because of the greater probability that at least one animal will inhale an infectious dose (Donaldson 1987).

Other potential sources of airborne virus, such as the disposal of effluent by spraying, the splashing of rain from virus-contaminated ground and the burning of infected carcases, are unlikely to generate virus aerosols of a comparable infectivity to those produced by infected pigs. Nevertheless, bulk milk tankers have been implicated in spread in several outbreaks, when temperature and humidity favoured survival of the virus, by exhausting infected aerosols from air vents when taking on milk at unaffected dairies.

1.6.4 Factors influencing transmission

The extent to which FMD may spread in Australia will depend on climatic factors, the efficiency of detection and diagnosis of early cases, livestock movements, livestock density and, possibly, the presence of feral and native animals. Movement of infected animals is the most important method of spread of FMD

from one premises to another. However, on rare occasions, movement of airborne virus particles by wind has been responsible for infecting properties downwind. Under favourable climatic conditions, windborne spread can be an important factor in FMD epidemics.

Host factors

Species differ in their likelihood of infection with FMD virus, in their susceptibility to infection by different routes, and in the amount of virus subsequently shed. The first case of FMD in Australia would probably be in pigs. FMD virus is most likely to be introduced in contaminated animal products (Geering 1990). These materials are more likely to be eaten by pigs than by other livestock, and pigs are highly susceptible to infection by ingestion. If the infected pigs were wild or belonged to a swill feeder unconcerned about or reluctant to report sick animals, the initial outbreak could well go unnoticed and uncontrolled.

Pigs

Pigs are the major amplifying host for the disease. Although pigs are primarily infected while ingesting infected feedstuff, they are the most efficient producers of virus in respiratory aerosols (Donaldson et al 1970; see Table 2). Thus, spread of FMD from an infected piggery could be rapid and widespread, allowing the disease to gain a substantial foothold before the first clinical cases come to the attention of regulatory authorities. More recent reports by Donaldson (1983, 1987) suggest that during a 24-hour period pigs may excrete 2.8 x 10^8 IU of airborne virus per day, while cattle and sheep excrete a maximum of 1.8 x 10^5 IU (ie individual pigs can excrete about 3000 times more virus into the air than cattle).

Table 2 Strain differences in amount of airborne FMD virus emitted (IU per minute)

Strain	Cattle	Sheep	Pigs
O_1	57	43	7140
O_2	4	1.4	1430
A_5	93	0.6	570
A_{22}	7	0.3	200
$C_{Noville}$	21	57	42 860
$C_{Lebanon}$	6	0.4	260

1infectious unit (IU) = 1.4 TCID50; see Glossary
Source: Adapted from Donaldson et al (1970)

These factors must be considered when determining the size of restricted areas. If, for example, FMD is first detected in a large controlled-environment piggery with air extraction fans, and the atmospheric conditions are favourable for airborne spread of virus, then cattle for at least 10 kilometres downwind should be considered at risk.

Cattle, sheep and goats

Cattle are highly susceptible to aerosol infection because they have a higher respiratory tidal volume than other species. Cattle are considered the best indicator species for the presence of FMD virus in an area. Tropical breeds of cattle and pigs are reported to be less susceptible to infection and disease than European breeds. Sheep and goats may be important reservoirs of infection because they are usually only mildly clinically affected by FMD and infection may not be noticed.

Deer

FMD has been reported as a natural infection in several species of deer. Studies in the United Kingdom showed that red, fallow and roe deer were all susceptible to experimental infection. Clinical disease was mild or inapparent in red and fallow deer but more severe in roe deer, some of which died. The appearance and distribution of lesions were similar to those in sheep — in the mouth and on the feet. Viraemia and seroconversion were more reliable indicators of infection than the presence of clinical lesions. Virus does not commonly persist beyond 14 days in red or roe deer. In fallow deer, virus was isolated from the oropharynx up to 63 days after infection, but not at 91 days (Forman and Gibbs 1974).

Camelids

An Australian Quarantine and Inspection Service (AQIS) report considered that South American camelids (llama, alpaca, guanaco and vicuna) do not become carriers of FMD; nor was there any evidence that small camelids play any part in the epidemiology of the disease (AQIS 2000). However, reports submitted to the OIE in 2000 in relation to FMD type O in Mongolia identified a number of cases of infection involving camels, with some deaths being reported.

Windborne spread

Several factors affect the dispersal of infected aerosols and windborne spread (Rumney 1986):

- Wind speed — slow and steady wind speeds limit turbulence and plume disturbance.
- Wind direction — spread is greatest downwind. Plume widths generally grow at a less than linear rate with distance. Smith (1983) gives a value of $w = x^{0.875}$ where w is the plume width and x is the distance downwind.
- Relative humidity — optimal survival of FMD virus occurs at RH above 60% (see Section 1.6.2).
- Temperature — spread may be enhanced during cooler weather, when the temperature structure of the lower atmosphere may limit vertical dispersion of the aerosol plume. Overall, the effect of temperature on virus survival is relatively minor: the virus can survive subfreezing temperatures for a long time, and experimental studies show that it survives well at a temperature of 27°C for at least 30–60 minutes.
- Sunlight — windborne spread may be greater in weak sunlight. However, although ultraviolet light can kill the virus, it was found to be generally resistant to levels found in sunlight, and the virus is protected from ultraviolet radiation at night (see discussion in Section 1.6.2).
- Terrain — windborne spread occurs for greater distances over sea than over land. Spread over land is generally less than 10 kilometres due to turbulence and plume disturbance. On the other hand, FMD virus may have spread 250 kilometres over water (the English Channel) from France to the Isle of Wight in 1981. Topography will affect the path of a plume. An airstream will take the path of least resistance around hills and along watercourses and valleys (Donaldson 1988).
- Concentration of susceptible animals — the risk of spread grows with increasing density of livestock downwind, with large concentrations of

animals, such as at saleyards and feedlots, being particularly vulnerable. Cattle are more likely to be infected than are sheep or pigs because of their higher respiratory volume — sheep have one quarter, and pigs one twelfth, the risk of cattle. Hence, the typical pattern of windborne spread is from pigs to cattle. Once one animal has become infected, the disease will spread rapidly through the herd by direct contact.

- FMD strain — different strains of virus vary in their resistance to desiccation as measured by survival at various relative humidities. There appears to be an inverse relationship between the quantity of virus excreted and its stability in aerosols.

Therefore, windborne spread of FMD can occur only if the virus becomes airborne and remains airborne long enough to reach a potential recipient host in sufficiently large quantities to cause infection.

The weather conditions *at the time of the outbreak* will determine the survival of airborne virus and how far it spreads. These cannot be predicted in advance and must be analysed at the time, using a tactical model, to determine premises at risk. Surveillance effort can then be targeted accordingly.

Garner and Cannon (1995) undertook a modelling study of the potential for windborne spread under Australian conditions. By using data on livestock distributions and the proportion of the year conducive to virus survival, these authors ranked different areas of Australia on the potential for windborne spread to occur. The areas with the highest potential are in southern and eastern Australia, and correspond to the areas of highest livestock densities and higher valued livestock in Australia.

Night-time conditions are particularly important. Although there are pronounced seasonal effects on the number of days at risk, it is clear that even when conditions during the day are unsuitable, in many locations, night conditions would favour virus survival. The study indicated that for much of Australia, for much of the year, weather conditions will not be a limiting factor for windborne spread.

Simulated outbreaks have demonstrated that the threat of long-distance windborne spread from typical beef, dairy and sheep enterprises in Australia appears to be very low. Even a typical southeastern Victorian dairy farm poses a low risk. However, infected piggeries represent the greatest threat for plume creation, with spread greater than 10 kilometres possible. Even a small number of infected pigs pose a significant risk for windborne spread.

Cattle feedlots, because of their size and species susceptibility, pose a significant risk of becoming infected, especially if slaughtering of infected animals is delayed.

Livestock production and marketing

The marketing and production systems in Australia can result in the rapid dispersion of animals over wide areas. The ability to trace livestock movements and products is critically important to the early control of an FMD outbreak.

The movement patterns of sheep may be particularly important, because they may be infected without showing clinical signs.

In many pastoral areas of Australia, herds are extensively managed and rarely observed, and contain a high proportion of zebu breeds (which tend to show milder signs). FMD might therefore be harder to detect, and spread slowly and insidiously.

From experience of FMD in Africa, the spread of the disease in rangeland enterprises is more likely in the dry season, when animals congregate at watering points. On the other hand, infection is less likely to be maintained (because low stocking densities provide limited opportunity for spread), and the disease could die out naturally.

In the more intensively managed areas, livestock populations are denser and in closer contact. Frequent stock movements from individual enterprises to and from saleyards would facilitate rapid spread of infection over wide areas. Aerosol spread might occur over greater distances in cooler, wetter climates. The chances of an explosive outbreak of FMD are thus higher, but the disease might be more readily detected.

The presence of high-risk enterprises, such as intensive piggeries and feedlots, may influence the spread of FMD virus within a region. Large piggeries will increase the risk of transmission because pigs act as amplifiers of FMD virus. Cattle feedlots present similar problems due to their large concentrations of animals. Feedlots represent a special hazard, as they are likely to be more easily infected through aerosols.

In some areas, wild animals (pigs, buffalo, goats and cattle) are in close contact with livestock, which may make eradication harder to achieve.

1.7 Manner and risk of introduction to Australia

Europe and Southeast Asia have historically been the areas of highest disease threat for Australia — the former because of the many cultural, ethnic and trade links and the latter because of its proximity.

Sequencing of the FMD virus genome has facilitated tracing the movement of virus strains, with the most spectacular example being the expansion of the Pan-Asia strain of FMD virus type O, west and east from India during the 1990s. After being first identified in northern India in 1990, this strain has been detected in 28 countries in the Middle East, Europe and Asia. In 1999, the strain reached Japan, South Korea, the eastern seaboard of Russia, and Mongolia — areas free of FMD since 1908, 1934, 1964 and 1973, respectively. Similarly, the movement of other strains of FMD virus has been monitored in Africa, Asia, South America, the Middle East and Europe. In September 2000, type O FMD spread to South Africa via swill fed to pigs (which was the first outbreak of FMD reported in South Africa since 1957).

In February 2001, FMD in the United Kingdom was first detected in an abattoir in Essex. The outbreak was caused by the Pan-Asia strain of FMD virus type O. How the virus entered the United Kingdom is not yet confirmed, but the farm now thought to be the source of the outbreak is suspected of swill-feeding with meat from overseas, infected with the strain. There were subsequent cases in France, the Netherlands and the Republic of Ireland. All were linked to the British outbreak.

Modern quarantine procedures allow animals to be imported safely, and even germplasm can now be sourced safely from high-risk FMD countries by using embryo transfer technology.

Biosecurity Australia is responsible for developing new policy and reviewing existing quarantine policy on imports of animals, plants and animal and plant products. The development and review of quarantine policy is generally undertaken as an 'import risk analysis'. An import risk analysis is required where no quarantine policy exists or where a significant change in existing quarantine policy is to be considered.

The most significant risk of entry of FMD is through illegal entry of meat and dairy products. The virus can survive for long periods in a variety of fresh, partly cooked, cured and smoked meat products and in inadequately pasteurised dairy products. These could be brought in by passengers on aircraft or ships, or could be sent through the post. There is also a risk from garbage discarded by fishing vessels or yachts.

Swill-feeding in Australia is not permitted, and the introduction of substantial fines has reduced the risk of introduction of the FMD virus into the livestock population. The possibility of illegal swill feeding is of greater concern.

FMD has the potential to become established in Australian cattle, pig, sheep and goat populations and to spread rapidly through livestock movements over the continent unless diagnosed very early. Long-distance windborne spread of infection, except where piggeries are involved, is unlikely in most, if not all, of the country. However, the disease could be spread very rapidly through livestock saleyards, and by the movement of animals, contaminated trucks or other items.

An Australian overseas aid program includes an FMD eradication campaign in Southeast Asia, and a specific FMD control program in the Philippines. AQIS also runs the Northern Australia Quarantine Strategy, aimed at early detection of exotic disease in high-risk areas of northern Australia. The strategy has an offshore component that includes periodic disease surveys in West Papua, East Timor and Papua New Guinea. These activities provide added knowledge and assist in our risk management.

2 Principles of control and eradication

2.1 Introduction

Control of foot-and-mouth disease (FMD) relies on three basic principles:

- preventing contact between susceptible animals and FMD virus;
- stopping the production of virus by infected animals; and
- increasing the resistance of susceptible animals.

These principles can be applied by:

- stopping the spread of infection through quarantine and movement controls;
- eliminating sources of infection by slaughtering infected and exposed animals (stamping out);
- eliminating the virus by decontamination of premises, vehicles, equipment and materials, or disposal of contaminated materials; and
- establishing immunity by vaccination.

The OIE developed new trade guidelines for FMD in 1992, incorporating rules for zoning and the use of vaccination (OIE Terrestrial Code; see Appendix 3). The International Committee of OIE made an additional revision of vaccination at its 70th General Session in May 2002. This allows for countries that do not slaughter vaccinated animals to regain country freedom after 6 months instead of 12 months, provided 'non-structural protein' tests are used to verify lack of infection in vaccinated animals.

Zoning and regionalisation for FMD was also recognised by the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) in 1993, in the Sanitary and Phytosanitary Agreement. Implementation of these new principles is now under the jurisdiction of the World Trade Organization (WTO), which was established in 1995.

The adoption of zoning and the use of FMD vaccine will therefore have important implications for the control of an FMD outbreak and the subsequent re-establishment of FMD-free status and international trade.

2.2 Methods to prevent spread and eliminate pathogens

The first step will be to ensure that the virus is contained on the infected premises (IP). Strict movement controls must be imposed. Effluent should be prevented from draining onto roads, stock routes or pastures, or into creeks and other watercourses. Alternatively, it should be disinfected, or the affected areas closed. The contents of effluent tanks should be disinfected before being released into the environment. Rodents should be contained and if possible eliminated before they disperse as their habitat is disturbed.

The dangers of feeding animal products to pigs, and the fact that swill-feeding is not permitted in Australia, should be well publicised.

2.2.1 Quarantine and movement controls

Effective quarantine and movement controls are essential. Movement controls increase the speed and likelihood of successful eradication by helping to prevent further spread of the virus. Quarantine and movement controls should be imposed at several levels, based on declared areas (see Appendixes 1 and 2).

Initially, at least the whole state or territory involved should be declared as the control area (CA) and subject to movement restrictions that will be reviewed once the situation has been fully assessed. In addition to these movement controls, Australia will implement a risk-based national livestock standstill on the diagnosis of FMD. A national standstill may be initiated on strong suspicion of FMD.

The potential for windborne spread should be taken into account when determining the size and shape of a restricted area (RA). Predictive models have been developed in a range of countries for windborne spread under different scenarios. These models may provide a guide to the potential spread of FMD virus, but are not definitive and should be used with caution

Movement controls should be maintained to some degree until the disease is either eradicated or declared endemic.

Zoning

If FMD is established in only part of a country, it is possible to establish infected and disease-free zones in order to retain partial overseas market access. Zoning is the measure that could most dramatically reduce the adverse economic effects of endemic FMD in Australia (Johnston 1982). However, there are difficulties to be overcome in developing a zoning system and gaining its acceptance. Zoning would impose ongoing movement restrictions on livestock industries.

International acceptance for the principle of zoning for FMD was achieved through the OIE in 1992–93 and GATT/WTO in 1993. Since then, the principles of zoning have been applied in FMD outbreaks in Italy in 1993 and in Greece in 1994. Zoning has been successfully employed by Zimbabwe and some South American countries to gain access to European Union markets for deboned meat (beef from Zimbabwe, mutton from South America).

The OIE Terrestrial Code (see Appendix 3) outlines the requirements for a 'free zone', which must be effectively sealed off from disease-affected zones by extremely tight movement and quarantine controls. In the long term, it may be possible to eradicate FMD from the endemic zone.

Zoning declared within Australia might not automatically gain international recognition; provision of quantitative data to underpin the validity of the proclaimed FMD-free zones will be critical.

Initially, state/territory boundaries would provide the most acceptable limits because the case can be argued internationally that these are distinct geopolitical boundaries. The zone boundaries would then be contracted to smaller local government areas, such as parishes, but with a radius of at least 10 kilometres.

2.2.2 Tracing

Urgent and meticulous trace-back and trace-forward of all contacts with infected animals and premises will be vital if the disease is to be effectively contained. Trace-back should be applied for a minimum of 14 days before the onset of clinical signs. Trace-forward should be applied up to the time that quarantine is imposed.

Tracing should include:

- livestock;
- animal products — meat, offal, milk, wool, skins, hides, semen, embryos;
- vehicles — milk tankers, livestock transport vehicles, feed trucks, visitors' cars;
- materials — hay, straw, crops, grains;
- people — veterinarians, artificial insemination personnel, sales and feed representatives, tradespeople, technicians, visitors.

It is likely that the first reported case will not be the index case, and trace-back will identify other, earlier cases. *The appearance of a first case in ruminants should immediately raise the question as to whether there is an infected pig source that is the index case.*

2.2.3 Surveillance

Surveillance will be aimed at:

- defining the extent of the disease
- detecting new outbreaks
- establishing disease-free zones.

Surveillance within the RA will be primarily by inspection of livestock. Surveillance within the CA will involve abattoir surveillance, serological surveys and investigation of reports of suspected disease. The surveillance methods used in the CA will also be undertaken in the rest of the country not subject to movement controls, in order to prove disease freedom.

Surveillance during an outbreak should be carefully coordinated to optimise the available resources. Surveillance will be most intense in the RA and will be driven by findings from the veterinary investigations unit. Factors such as potential spread by wind or wild animals could warrant increased surveillance in some areas. The intervals between inspections and surveys will depend on the observed incubation period, the resources available and the level of exposure risk. Suspect premises (SPs) should be inspected at least every third day. Every effort must be made to educate producers about the clinical signs and the need to report lesions.

2.2.4 Treatment of infected animals

Treatment is not appropriate (see Section 1.4.5).

2.2.5 Destruction of animals

Animals that are considered to be most infective or at risk should be destroyed first (see the **Destruction of Animals Manual**).

Remote areas

Light stocking rates and contact rates in remote areas will mean that rapid spread is unlikely in cattle and buffalo, except at the end of the dry season when animals congregate around waterholes. Experience with FMD in tropical countries suggests that spread from cattle and buffalo to pigs during casual contact is rare. However, if a feral pig became infected through eating an infected carcase, the virus could spread over a wider area in the feral pig population.

In remote areas, two options may be considered for destroying cattle and buffalo:

- field shooting by helicopter without disposal of carcases; or
- mustering to a mobile control yard for destruction and proper disposal.

However, field shooting may be impossible and could be contra-indicated because it may create a source of infection for feral pigs and disperse the pig population. Therefore mustering would be preferred, and if immediate mustering is impossible because of seasonal or time constraints, the animals should be contained until mustering and proper disposal can be carried out (see the **Wild Animal Response Strategy**). In many situations, a combination of shooting and mustering would be likely because of difficulties in achieving clean musters: muster, and then shoot unmusterables.

2.2.6 Treatment of animal products and byproducts

An extremely cautious approach to the salvage of animal products and byproducts will be required.

Depending on the specific location of the outbreak, milk and cream for human consumption may be either destroyed or processed according to the recommendations of Article 3.6.2.5 of the OIE Terrestrial Code, using:

- a sterilisation process applying a minimum temperature of 132°C for at least one second (ultra-high temperature, or UHT)
- if the milk has a pH less than 7.0, a sterilisation process applying a minimum temperature of 72°C for at least 15 seconds (high temperature – short time pasteurisation, or HTST)

  or

- if the milk has a pH of 7.0 or over, the HTST process applied twice.

Such milk will not be allowed to be fed to animals.

Appropriate filters should be fitted to the air exhausts of milk tankers operating in the RA and CA.

Wool, skins and hides may be moved from IPs, dangerous contact premises (DCPs) and SPs after treatment, depending on when the animals were shorn or skinned in relation to the earliest likely onset of infection. Wool should be stored at 18°C for at least 12 weeks and/or should be industrially scoured at a minimum of 60°C and a minimum pH of 9 for at least 5 minutes (Biosecurity Australia 2002). Bales should be sprayed with 2% caustic soda before movement.

For further details, see Appendix 2.

2.2.7 Disposal of animal products and byproducts

The preferred method for disposal of carcases, milk and feedstuffs is by burial rather than burning. Burial is generally easier and quicker, uses fewer resources and is less polluting. However, several factors, such as topography, soil type and watertable depth, must be considered in selecting a burial site. Burial must be done in a way that prevents wild pigs gaining access to carcases. For complete information and procedures, see the **Disposal Procedures Manual**.

Under certain circumstances, alternative methods for disposal (such as rendering) may be possible and should be considered.

2.2.8 Decontamination

Equipment, materials and buildings that may be contaminated should be cleaned and disinfected. It is important to thoroughly clean contaminated objects before attempting to disinfect them.

The surfaces of roads and yards adjacent to and within the IP should be sprayed with an appropriate disinfectant. If disinfection cannot be achieved effectively and quickly, then contaminated materials, equipment and buildings should be destroyed. At all stages of decontamination, steps must be taken to prevent the generation and dispersal of infective dusts and aerosols.

Agents that destroy FMD virus include sunlight (by desiccation, not by the affects of ultraviolet radiation), acids, alkalis such as sodium hydroxide and sodium carbonate (washing soda), and formalin liquid or gas. For complete information and procedures, see the **Decontamination Manual**.

2.2.9 Vaccination

Vaccination for FMD is with an inactivated virus vaccine (see Section 1.5.3). The OIE Terrestrial Code defines criteria for vaccine standards (see Appendix 3). National operating procedures for the use of FMD vaccine are set out in Appendix 5.

Vaccination options to support an eradication policy include:

- *strategic vaccination around outbreaks* (barrier vaccination, such as ring vaccination, or high-risk enterprise vaccination) to help contain the disease whilst stamping-out operations are carried out; and
- *general vaccination over a wide area* (blanket vaccination) where other disease control methods would be too demanding of veterinary resources or too costly in terms of compensation payments.

In addition, vaccination in an emergency animal disease (EAD) outbreak can be employed in two main ways:

- *Suppressive.* Vaccination is applied to animals that are immediately at risk or are exposed in an infected area. This method is used when a decision has been made to reduce the viral load or the shedding of virus to assist other control measures being employed. It is often used because of resource constraints in

more intensive farming situations, or to buy time because of a 'bottleneck', such as constraints in carcase disposal.

- *Preventive.* Preventive vaccination, which may also be termed 'pre-emptive' vaccination (although that term may have a different meaning), is applied to high-risk animals or to enterprises that are not in an infected area but are likely to be exposed to infection in the near future. The method may be employed even for minimal risk animals, but this is not usual in an EAD response except for rare or endangered animals. Preventive vaccination lends itself to the concept of 'vaccination to live' for those diseases for which it is usual to employ a stamping-out policy to control the disease. However, a number of factors should be considered, including, but not limited to, the quality and efficacy of the vaccine, the accepted international standards for disease control, and the current trade environment.

The possibility of strategic vaccination around an EAD outbreak will depend on a number of factors, including the following:

- *Inadequate resources for stamping out.* Preventive vaccination (ring, belt or firebreak) could be considered in order to contain the EAD if resources are inadequate to implement or maintain an effective stamping-out response (eg in the case of a large, multifocal outbreak) and there is a significant risk that the outbreak could get out of control. In the early stages of an outbreak, it is likely to take some time to assemble sufficient resources and the necessary infrastructure. It is quicker to vaccinate large numbers of animals than it is to destroy and dispose of them, and vaccination might be a better option in such a situation.
- *High-density livestock areas.* Preventive or suppressive vaccination in an infected area could be considered if there is a risk that the outbreak will rapidly escalate. For example, such a situation might occur in areas with high livestock density, where pigs are present, when weather conditions are favourable to windborne spread, and when infected animals are believed to be producing high levels of virus. In some high-density livestock areas, the scale of operations might be such that resources are inadequate. In such circumstances, suppressive vaccination could be considered within an infected area as an interim measure to reduce the spread of virus within the area. Vaccinated animals would subsequently be slaughtered and disposed of in a more planned and orderly way.
- *High-risk enterprises*. Preventive vaccination could be used selectively to reduce the threat posed by high-risk enterprises (that is, large intensive piggeries and feedlots) outside the immediate IP but within the RA. Pre-emptive vaccination of such premises would not only reduce their risk of becoming infected, but would also reduce the amount of FMD virus produced should infection occur. However, vaccination cannot be expected to provide full herd protection under intensive conditions against a large or rising viral challenge during an outbreak. Vaccinated high-risk enterprises will need to be kept under close observation for any signs of FMD. Should infection occur, steps can be taken to minimise transmission within the enterprise and reduce the risk of spreading disease further by rapidly removing any clinically ill animals. Removal of infected animals and their immediate close contacts is likely to be even more effective, as this will remove both infected animals and animals incubating the disease.

- *Rare and endangered species*. Preventive vaccination could be selectively used to protect rare and endangered species, where such vaccination is accepted under the OIE Terrestrial Code as not jeopardising a country's FMD status. However, consideration would need to be given to obtaining prior agreement on the rare or endangered status of the species and on the vaccine regimens to be used for them. Other conditions would also apply, such as strict isolation and quarantine of the vaccinated animals.

  An FMD-free zone in which vaccination is practised can be established in an FMD-free country in which vaccination is otherwise not practised, or in a country of which parts are infected. Vaccination of zoo animals, animals belonging to rare species or breeds, or animals in research centres as a precaution for conservation purposes is an example of the implementation of such a zone. The free zone in which vaccination is practised is separated from the rest of the country and, if relevant, from neighbouring infected countries by a buffer zone, or physical or geographical barriers, and animal health measures that effectively prevent the entry of the virus must be implemented.

The following factors will also influence the decision to vaccinate:

- the trade implications of vaccinating;
- masking of clinical disease — while significant advances have been made in the technology to differentiate vaccinated from infected animals, it is still only accurate at the herd level; the issue of masking of infection in individual animals requires careful consideration;
- diversion of scarce human resources;
- the extent to which FMD has spread — vaccination might be considered if other options are not achieving eradication;
- availability of vaccine — the supply contract is for 0.5 million cattle-equivalent doses of each of nine FMD strains to be delivered within seven business days of notification.
- rare or specific vaccine strains may not be available within the vaccine bank; and
- discriminatory serology — with limitations (see the second point, above).

Susceptible livestock 2 weeks of age or older should be vaccinated, then revaccinated 1 month later and, if necessary, thereafter at 6-month intervals. Random serological checks should be carried out to verify that vaccination has been effective.

It has been recommended that pigs only be vaccinated in infected zones, and that no vaccination of animals should occur on premises where the disease has been confirmed (Donaldson and Davies 1987).

Difficult issues surround the vaccination of pigs. These include animal welfare concerns for vaccinated pigs.

Because vaccinated animals may carry virulent virus, towards the end of an eradication campaign vaccinated animals should either be slaughtered or be tested to demonstrate the absence of viral activity. It is therefore necessary to keep track of all vaccinated animals and herds through the use of permanent animal identification (see Appendix 5) and accurate stock records. Laboratory tests

available at AAHL can differentiate vaccinated from naturally infected animals (see Section 1.4.3).

For vaccination to be an option, a source of supply is essential. Australia has been a member of the International FMD Vaccine Bank (IVB) since 1985, and has recently reviewed the adequacy of the IVB arrangements. The IVB treaty was disbanded with the agreement of the eight member countries in June 2004, as the FMD vaccine produced by the IVB is no longer adequate to meet members' regulatory and strategic needs.

Concurrently, the Primary Industries Ministerial Council tasked Animal Health Australia (AHA) to broker a government–industry agreement to secure a commercial supply of FMD vaccine. The supply contract has been secured with Merial Australia Pty Ltd over five years (ending in 2009), for antigen sufficient to provide 500 000 cattle-equivalent doses of each of nine FMD strains.

The supply contract guarantees delivery of FMD vaccine within seven business days of notification. The nine antigens have been selected to provide broad coverage against potential FMD threats and will be regularly reviewed. Vaccine ordering and handling will be coordinated by AHA for delivery to the local disease control centre or to an approved nearby location.

For vaccination operating procedures, see Appendixes 5 and 6.

2.2.10 Wild animal control

Australia has large and widespread populations of wild animals that are susceptible to FMD: feral pigs, goats, cattle, water buffalo, camel and deer. These animals are frequently in close contact with domestic stock, sharing pastures and watering points. An outbreak of FMD involving wild animals in Australia may have serious consequences, delaying the detection of disease, increasing the rate and extent of an outbreak, complicating and delaying disease eradication, and compromising demonstration of disease freedom (Wilson and O'Brien 1989).

See the **Wild Animal Response Strategy** for details on performing wild animal population surveys, containment, control and disease surveillance.

Rodent control

Rodents (inhabiting buildings, silos or other areas) that are likely to be dispersed during operations on IPs and DCPs must be exterminated before decontamination begins. Rodents in paddocks are unlikely to present problems. Rodent control should be increased on all properties within the RA.

2.2.11 Vector control

Not applicable (see Section 1.6.3).

2.2.12 Sentinel animals and restocking

Sentinel animals should be placed on all former IPs and DCPs and monitored closely. The timing of sentinel placement is governed by local disease status, and placement would not normally begin until all IPs and DCPs in the immediate area have been decontaminated.

Sentinel animals (two cattle and/or two to four pigs) can be introduced onto IPs and DCPs 30 days after disinfection (see Appendix 3; the OIE Terrestrial Code gives the incubation period for FMD as 14 days). These animals must have contact with all parts of the premises and objects that might have been contaminated with FMD virus. They should be ground-fed on the high-risk areas of the premises and should be inspected by a veterinarian every 3 days.

Sentinel animals are maintained on the premises for 60 days, after which sera are collected and tested for evidence of seroconversion. Quarantine restrictions should be removed and restocking of clean premises should be permitted, based on seronegative results.

2.2.13 Public awareness

A media campaign must emphasise the importance of farmers inspecting susceptible animals regularly and of reporting suspicious lesions and unusual deaths promptly. The public must not be panicked into avoiding meat products. The ban on swill feeding should be reinforced, as well as the need to avoid contact between domestic animals and feral pigs. The importance of movement controls and what these mean to individuals needs to be strongly emphasised. For further details, see the **Public Relations Manual**.

Animal welfare is an important consideration for animal health authorities and the public during an EAD outbreak. This will especially be the case if large numbers of livestock and wildlife are slaughtered during an FMD outbreak. Communication strategies will take into account social and emotional reactions to the treatment and slaughter of livestock during the emergency response.

Vaccination is also an important subject to be managed by public relations officers. If vaccination is to be used, key messages (for example, that vaccine is being used as an adjunct to stamping out, and that vaccinated animals are safe for human consumption) should be relayed early.

2.3 Feasibility of control in Australia

Australia's policy for eradication of FMD is one of stamping out. This could be supplemented, if absolutely necessary, by vaccination. Eradication of all but very localised outbreaks would be a massive undertaking in terms of specialist human, physical and financial resources. Eradication would be even harder if the disease became well established in feral animal populations.

3 Policy and rationale

3.1 Overall policy

Foot-and-mouth disease (FMD) is an OIE-listed disease and represents the greatest threat to Australia's livestock industries and export markets. It has the potential for rapid and extensive spread, and an outbreak would jeopardise the export of all cloven-hoofed animals and their products, at least in the short term.

The policy is to eradicate FMD in the shortest possible time, while limiting economic impact, using a combination of strategies that includes:

- ***stamping out*, which involves quarantine, slaughter of all infected and exposed susceptible animals, and sanitary disposal of destroyed animals and contaminated animal products, to remove the source of infection;**
- ***possible pre-emptive depopulation* of susceptible animals to minimise spread of infection;**
- ***quarantine and movement controls* on animals, animal products and things in declared areas to prevent spread of infection;**
- ***a risk-based national stock standstill* to be implemented on the diagnosis of FMD or possibly on strong suspicion of FMD;**
- ***decontamination* of facilities, products and things to eliminate the virus on infected premises and to prevent spread in declared areas;**
- ***tracing and surveillance* to determine the source and extent of infection and to provide proof of freedom from the disease;**
- ***zoning* to define infected and disease-free areas, and to assist in market access; and**
- ***a public awareness campaign* to encourage industry and community cooperation, and to address issues or concerns relating to animal welfare.**

Although vaccination could extend market disruption, it may be approved in certain circumstances (for example, if the disease spreads beyond the limit of the available resources to control it, or to protect large animal concentrations, limit infection and minimise virus production).

The global risk from FMD is changing as countries and trading blocs achieve national or regional freedom from the disease. Under new international arrangements based on risk analysis, Australia, as an FMD-free country, will face increased trading competition from these countries in some markets. This emphasises the need to remain FMD-free or to quickly regain FMD-free status after an outbreak.

Successful implementation of the policy will depend on total industry cooperation and compliance with all control and eradication measures.

FMD is an Animal Health Australia Category 2 disease under the government–industry EAD Response Agreement for cost-sharing arrangements. Category 2 diseases are those for which costs will be shared 80% by government and 20% by industry.

The chief veterinary officer (CVO) in the state or territory in which the outbreak occurs will be responsible for developing an Emergency Animal Disease (EAD) Response Plan. This plan will be approved for technical soundness and consistency with AUSVETPLAN by governments and affected livestock industry technical representatives on the Consultative Committee on Emergency Animal Diseases (CCEAD). The plan will ultimately be approved and cost-shared by government chief executive officers and industry leaders through the national management group (NMG) of government and industry representatives established for the incident.

CVOs will implement disease control measures as agreed in the EAD Response Plan and in accordance with relevant legislation. They will make ongoing decisions on follow-up disease control measures in consultation with the CCEAD and the NMG. The detailed control measures adopted will be determined using the principles of control and eradication (Section 2) and epidemiological information about the outbreak.

For further information on the responsibilities of the state or territory disease control headquarters (SDCHQs) and local disease control centres (LDCCs), see the **Control Centres Management Manual**, Part 1.

3.2 Strategy for control and eradication

It is important to classify individual properties on the basis of an epidemiological risk assessment.

The strategy of stamping out will be implemented on all infected premises (IPs) and dangerous contact premises (DCPs); animals on suspect premises (SPs) will be subjected to regular inspection and observation over an agreed period of at least 14 days. Tracing and surveillance will play an important role in identifying infected and in-contact animals to determine the extent of the restricted area (RA) and free areas. Decontamination will be used to limit spread of the virus.

The primary objectives of the strategy are to:

- prevent contact between infected and susceptible animals; and
- prevent the production of large volumes of virus by infected animals.

This can best be achieved through quarantine and movement controls and the early establishment of zoning in compliance with internationally agreed standards so that export markets can be reclaimed as soon as possible. Vaccination may be used under certain circumstances where it is considered that it will assist eradication. Zoning will help to reduce the time for acceptance by international markets of Australian exports from free areas.

Wild animal reservoirs need to be assessed, as detailed in the **Wild Animal Response Strategy**, because the involvement of wild animals may complicate the eradication process.

The concerns that will be raised by such a policy will require a large, proactive and well thought-out public relations and liaison exercise with all affected groups, the media and the public.

Swill feeding

The practice of swill feeding of pigs carries a high risk of introduction of FMD. The effective enforcement of swill-feeding bans will involve a multi-agency approach. People illegally feeding or supplying material for swill should be prosecuted promptly, and successful prosecutions should be publicised. Security at municipal garbage tips should be improved, to prevent wild pigs gaining access to domestic food scraps.

3.2.1 Stamping out

Stamping out will be the initial strategy and will be applied throughout the eradication regardless of the introduction of other strategies. Stamping out can only be achieved in association with other methods of control, which will be used to improve the effectiveness of the strategy and to ensure that infected stock are contained and destroyed and that unnecessary slaughter of animals does not occur.

Animals that are considered to be most infective or at risk should be given priority for destruction. Clinically infected animals are to be slaughtered first to reduce virus excretion, with infected pigs slaughtered before cattle and cattle before sheep (based on the volumes of virus excreted by these various species). However, Australia's response plan does not automatically involve livestock slaughter on premises contiguous to IPs (see Appendixes 1 and 2 for more information).

A benefit–cost analysis (Johnston 1982) concluded that stamping out was economically more justifiable than vaccination in any but a near-nationwide FMD epidemic.

Garner et al (1997) concluded that vaccination, used with stamping out in some circumstances, can contain the spread of disease and reduce control costs and compensation costs, compared to stamping out on its own. However, the impact on trade would be great. Paradoxically, acceptance of zoning may make vaccination less attractive, because producers outside the infected zone may still be able to sell into traditional markets. Therefore, the potential gains may not justify the disadvantages that vaccination would bring.

Nationally compatible legislation is required to support the administrative and logistical arrangements for a stamping-out policy involving more than one state.

Remote areas

If FMD is diagnosed in remote areas, special control measures may be needed where logistical considerations (depending on situation and season) do not allow the rapid destruction and disposal of cattle and buffalo (see Section 2.2.5).

Consideration should be given to containing cattle until mustering is possible, and to a feral pig control program to prevent dispersal of infection if scavenging pigs become infected by eating carcases. This would delay the elimination of FMD from the cattle population, but may well be the quickest and most effective eradication technique in pastoral areas.

3.2.2 Quarantine and movement controls

Australia will implement a risk-based national livestock standstill on the diagnosis of FMD and may implement a national standstill on strong suspicion of the disease. The standstill will be triggered by the NMG acting on the advice of the CCEAD, will apply only to FMD-susceptible animals, and will be implemented for at least 72 hours. A decision to ease, lift or extend the standstill will be based on risk assessment and the known epidemiology of the outbreak.

All IPs, DCPs and suspect premises (SPs) will be quarantined, with no movement in or out while strict surveillance and inspections take place. Appropriate quarantine and movement controls will be imposed on risk enterprises to ensure that any product from infected or in-contact animals is disposed of and that suspect product is detained.

Restricted areas (RAs) and control areas (CAs) will be established to ensure the rapid and effective containment of the disease, and to clearly define infected and free areas.

The initial RA will be based on a minimum 3-kilometre radius around the IP. This will be modified as tracing and surveillance results become available and wildlife distributions become better defined. This distance takes into consideration possible windborne spread. It is essential that the IPs, DCPs and as many SPs as possible are included within the RA, together with some processing establishments to enable processing and trade to continue where this is possible.

The CA, at least in the initial stages, will be established based on the state/territory borders, which are easily recognisable and understood by the international community. This distance will be reduced, if possible, as epidemiological information becomes available, but will probably still be based on local government areas (eg shires, parishes). Any reduction will permit a reduction in resources and enable better management of animals and product movement. The CA will have a minimum radius of 10 kilometres, including the RA.

Under RA disease control measures, animals will not be able to leave the area; movement within the CA will be easier but still subject to permit.

People who exit an RA — particularly those who have been on or close to IPs, DCPs or SPs — should avoid contact with livestock for 3 days to prevent the mechanical spread of virus.

Zoning

While the boundaries given above are for disease control in the early stages of the eradication program, they will also form the basis of zoning to assist in the strategy to maintain market access, particularly if eradication operations are prolonged. Zoning for market access purposes will be considered as part of the FMD response plan subject to a national benefit–cost analysis and taking full account of resources

implications for the eradication process. To be able to meet international zoning guidelines, which prevent the movement of product from infected to free areas, it will be necessary to include processing facilities within the RA.

See Appendix 1 for further details on declared areas, Appendix 2 for quarantine and movement controls, and Appendix 6 for zoning.

3.2.3 Tracing and surveillance

Rapid trace-back and trace-forward are both important to assist in effectively containing the disease. Tracing should include all movements of susceptible livestock, animal products, vehicles, crops/grains and people. It should also include consideration of potential exposure to windborne virus and possible contact with feral animals.

It is highly likely that the first IP identified will not be the index case; trace-back will assist in locating the index case.

Surveillance is used to determine the spread of the disease so that an appropriately sized RA can be declared, and to determine FMD-free areas. This activity will involve inspection of stock, particularly in the RA, investigation of reports of suspected disease, and a serological survey. It will include risk enterprises and wildlife if they are present.

The level and direction of surveillance will be driven by the epidemiological information being collated. The potential for windborne spread is an important consideration.

For further information, see Section 2.2.10 (wild animal control), Section 1.6.3 (windborne spread) and Appendix 4 (surveillance and proof of freedom).

3.2.4 Vaccination

While vaccination may be approved under certain circumstances, its use may extend market disruption and mask clinical disease in partly protected animals. In discussions between affected livestock industries and governments, it has been agreed that emergency vaccination may have application in the face of uncontrolled spread of the disease, for example in risk enterprises such as large intensive piggeries and feedlots. These enterprises have the potential to generate large volumes of virus that could be spread by wind. This strategy may also 'buy time' for destruction, disposal and decontamination in such enterprises, but would need to be carefully considered, especially in regard to the final disposition of the animals.

Any decision to use vaccination as part of an eradication response will be made after taking into account a range of technical and socioeconomic factors.

Availability of the appropriate vaccine antigen will affect the decision (see Section 2.2.9). Vaccine manufacture, packaging, distribution and transport could take at least a week, so vaccine may not be available on demand. However, once the strain of FMD virus has been typed in an outbreak, vaccine will be ordered as soon as possible to ensure that supplies are readily available.

As described in Section 1.5.3, vaccine protects the animal against disease but does not prevent infection and shedding of virus at reduced levels. Immunity wanes rapidly (about 4–6 months) and vaccine strains can mutate, making it necessary to frequently check the strain variation of the field isolate and the composition of the vaccine.

If emergency vaccination is used during an outbreak, the following principles (endorsed by the Primary Industries Ministerial Council in early 2002) will apply to vaccinated animals:

- All vaccinates must be permanently identified.
- Vaccinates must be quarantined and subject to strict movement controls.
- Vaccinates must ultimately be slaughtered out.

The only exception to this policy will be for rare and endangered species as defined by the OIE (World Organisation for Animal Health, formerly Office International des Epizooties), including zoo animals, which may be exempt from slaughter (see Section 2.2.9).

Vaccination is a resource-intensive operation, particularly if revaccination is required. It is also expensive, can defer the declaration of freedom from disease and can exacerbate already devastating effects on producers. It should therefore be used with caution, particularly as there is a risk that vaccination teams may inadvertently spread virus. Vaccines will only be used in accordance with permits issued by the Australian Quarantine and Inspection Service and the Australian Pesticides and Veterinary Medicines Authority.

See Sections 1.5.3 and 2.2.9 for further details on vaccination, and Appendix 5 for national operating procedures for the use of FMD vaccine.

3.2.5 Treatment of infected animals

Treatment is not appropriate for FMD under the Australian policy for total eradication.

3.2.6 Treatment of animal products and byproducts

The treatment for further marketing of most products and byproducts from IPs and DCPs is not permitted under any circumstances. These products must be disposed of by an approved method, preferably by burial on the property. Products such as wool, semen and embryos may be permitted to be marketed under special conditions or after treatment, with their movement subject to permit.

It will be necessary to treat product from SPs in the same manner as for IPs while the SPs remain under intensive surveillance. However, specified products, such as meat and hides, may be permitted to leave the property for sale subject to treatment under OIE guidelines and permit, or after an agreed period.

Products and byproducts from disease-free premises within the RA will be subject to permit and/or treatment before release.

See Appendix 2 for further details.

3.2.7 Disposal of animal products and byproducts

Products and byproducts from IPs and DCPs must be disposed of by an approved method, preferably by burial on the property.

3.2.8 Decontamination

Decontamination of certain products such as hay, hides and wool, as well as materials, equipment, buildings and roadways on IPs, is essential to contain the spread of virus and is an integral part of the eradication plan. Decontamination involves cleaning and disinfection processes, and care needs to be taken to reduce the generation and dispersal of infective dust and aerosols. If items cannot be adequately decontaminated, their disposal will be necessary.

See the **Decontamination Manual** for further details.

3.2.9 Wild animal control

It is essential that wild animals, particularly feral pigs, be considered in the eradication and control of FMD. Australia has large and widespread populations of wild and feral animals that are susceptible to the disease.

There will be ongoing risk assessment of feral animals in relation to the entry, spread and maintenance of FMD. Risk mitigation programs will be implemented in feral animal populations that are assessed to pose an unacceptable risk. Assessment will require information about:

- density and distribution
- social organisation, including home ranges
- habitat
- perceived contact with domestic species
- strain of FMD virus
- length of time feral animals could have been exposed to the virus.

This information will then help to determine the level of measures to be applied, including:

- containment
- survey and surveillance
- population reduction
- restrictions on hunters.

The natural behaviour of feral deer suggests that they are unlikely to be a factor in the maintenance and transmission of FMD during an epidemic in domestic livestock. It is generally considered best to leave them undisturbed to avoid dispersing them from their normal range. Similarly, camels are unlikely to be important as carriers of FMD virus in Australia.

In some overseas outbreaks (eg Italy 1993), eradication procedures have not been undertaken against wild animals, and the lack of disease in domestic animals has been accepted as proof that there is no disease in wild animals (see Section 2.2.10).

Rodent control must be completed before decontamination begins.

See the **Wild Animal Response Strategy** for further details.

3.2.9 Vector control

Not applicable (see Section 1.6.3).

3.2.10 Public awareness and media

See Section 2.2.13 for details of what to include in a public awareness campaign.

3.3 Social and economic effects

The economic effects of an outbreak of FMD, even on a small scale, would be enormous to individuals, to the farming industry as a whole and to subsidiary and support industries (Hassall and Associates 1991; Australian Bureau of Agricultural and Resource Economics, pers comm, 2001). An FMD outbreak would result in the immediate closure of many of Australia's major export markets for livestock and livestock products.

There would be significant flow-on losses to the economy, including to many businesses reliant on livestock industry revenue in rural and regional Australia. Overall, the estimated cumulative loss to the national economy would be about $2–3 billion in gross domestic product for a short outbreak, rising to $8–13 billion for a 12-month outbreak (Productivity Commission 2002).

The direct impacts of an FMD outbreak in Australia would include a contraction in economic activity, particularly in the pastoral, livestock and meat-processing industries, resulting in an estimated 0.5% contraction in employment in the first year of an outbreak.

The likely fall in agricultural exports would be large enough to affect the exchange rate. The value of the Australian dollar would fall by an estimated 2.5% during the first year, and remain below pre-FMD levels for nine years.

There would be significant social costs. At the individual and family level, the social impacts could range from strains on family relationships to severe mental disorders. At the community level, the impacts could range from a breakdown of normal community activities in the midst of quarantine and movement restrictions, to changes in interpersonal relationships affecting longer term community cohesion.

This consideration of potential impacts highlights the need for a sound policy and a well-developed plan to combat any incursion of FMD into Australia.

The strategy of zoning for FMD, while accepted in the international arena, is relatively new to many of our market countries. For it to be accepted by our major trading partners, the proposal will need to be supported by sound information and evidence collected over a reasonable timeframe. In the absence of agreed protocols, it is not known how our trading partners would react to the importation of, for example, meat from the FMD-free areas of Australia.

Questions can be expected about the value and ethics of slaughtering large numbers of healthy livestock and wildlife. Australia's existing system of animal

welfare codes, animal care statements and quality assurance practices will form the basis for developing specific procedures for managing animal welfare during an FMD outbreak. There will also be environmental concerns, some of which are currently being addressed, about burial and/or burning of carcases and product.

Media and other communication strategies will take into account social and emotional reactions to the treatment and slaughter of livestock during an EAD response.

FMD vaccination might also be considered in response to public and/or political concerns at the scale of destruction of livestock in a large stamping-out response, because of concerns about ethics, animal welfare or the environment. Vaccination may reduce the associated potentially negative media images (eg mounds of carcases, burial pits and 'funeral pyres'), result in reduced stress for owners of IPs, and potentially provide better ethical, animal welfare and environmental outcomes.

For Australia to regain its FMD-free status as quickly as possible, under current OIE guidelines it would be necessary for all vaccinated animals to be removed from the population at the end of the outbreak, although the time needed to demonstrate freedom from disease is now much shorter than previously. Indeed, emergency vaccination of at-risk stock may result in the need to slaughter animals that would otherwise have avoided slaughter in a conventional stamping-out approach. It is critical to ensure that politicians, industry leaders and the general community appreciate this fact. However, vaccinated animals can be moved and slaughtered at designated abattoirs in a more orderly and socially acceptable way than might be the case with emergency slaughter on farm in a stamping-out response.

3.4 Criteria for proof of freedom

To regain disease-free status, a period of 3 months after the last case is required, during which serological surveillance must be carried out. If emergency vaccination is employed, the 3-month period begins after the slaughtering of the last vaccinated animal.

Reinstatement of disease-free status will require the submission of a formal report to the OIE, detailing eradication procedures, follow-up surveillance and monitoring, veterinary infrastructure and industry organisation.

See Appendix 4 for further details of proof of freedom.

3.5 Funding and compensation

FMD is classified as a Category 2 EAD under the EAD Response Agreement between the governments of Australia and the livestock industries.

Category 2 diseases are EADs that have the potential to cause major national socioeconomic consequences through very serious international trade losses, national market disruptions and very severe production losses in the livestock industries that are involved. Category 2 also includes diseases that may have slightly lower national socioeconomic consequences, but also have significant

public health and/or environmental consequences. For this category, the costs will be shared 80% by governments and 20% by the relevant industries (refer to the EAD Response Agreement for details).[3]

Information on the cost-sharing arrangements can be found in the AUSVETPLAN **Summary Document** and in the **Valuation and Compensation Manual**.

3.6 Strategy if the disease becomes established

Australia will maintain a strong capability and undertake economic and epidemiological research in advance of an FMD outbreak to assist decision making should an outbreak occur. As well, jurisdictions will maintain the expertise necessary to undertake epidemiological data collection and analysis in the event of an outbreak.

Australia has confidence in its system of veterinary surveillance and believes that if there is an incursion of FMD a rapid stamping-out policy can be carried out to prevent the disease from becoming endemic. It is possible that FMD could become established in a number of areas, however, particularly where wildlife populations are present and are in close association with domestic livestock.

The strategy will be to employ zoning in such endemic areas and continue with a stamping-out strategy and associated control measures. Under these circumstances, vaccination would need to play a major role, with animals being permanently identified and subject to slaughter at the end of the campaign. *Eradication by stamping out would remain as the primary strategy.*

The major task under such conditions would be to convince overseas markets that the disease is safely contained and under control, and that eradication is progressing.

[3] Information about the EAD Response Agreement can be found at http://www.aahc.com.au/eadp/response.htm

Appendix 1 Guidelines for classifying declared areas

National livestock standstill

A national livestock standstill will involve total movement controls imposed nationally for all FMD-susceptible species, based on the diagnosis of FMD or strong suspicion of FMD. The standstill will be triggered by the National Management Group acting on the advice of the CCEAD, and will be implemented for 72 hours. Easing, lifting or extending the standstill will be based on risk assessment and the known epidemiology of the outbreak.

Premises

The status of individual premises should be declared after an epidemiological risk assessment has been completed (including the use of ANEMIS forms 1, 2 and 3).

In the declaration of areas, the following factors need to be taken into account:

- industries involved
- environmental features
- livestock movement patterns
- processing options (livestock and products)
- natural versus artificial barriers/boundaries
- nature of the outbreak
- livestock species involved
- feral animal involvement.

Infected premises (IPs)

A premises classified as an IP will be a defined area (which may be all or part of a property) in which FMD or the FMD virus exists, or is believed to exist. An IP will be subject to quarantine served by notice and to eradication and control procedures.

Dangerous contact premises (DCPs)

Premises classified as DCPs will be those that contain susceptible animals that have been designated as being exposed to other infected animals or potentially infectious products following tracing and detailed epidemiological analysis. DCPs will be subject to disease-control measures.

Note: Some premises that do not fit this category may still be placed under enhanced surveillance because of their location or if there is assessed to be a very low risk of exposure.

Suspect premises (SPs)

Premises classified as SPs will be those that contain animals that have possibly been exposed to FMD virus, such that quarantine and surveillance, but not pre-emptive slaughter, are warranted; *or* animals not known to have been exposed to FMD but showing clinical signs requiring differential diagnosis.

'Suspect premises' is a temporary classification because the premises contains animals that are suspected of having the disease. High priority should be given to clarifying the status of the suspect animals so that the SP can be reclassified as either an IP and appropriate quarantine and movement controls implemented, or as free from disease, in which case no further disease control measures are required.

Areas

Restricted area (RA)

An RA will be a relatively small declared area (compared to a *control area*) around infected premises that is subject to intense surveillance and movement controls. Movement out of the area will, in general, be prohibited, while movement into the area will only be by permit (see Appendix 2). Multiple RAs may exist within one CA.

In the case of FMD, an RA of at least 3-kilometre radius will be drawn initially around all IPs and DCPs, and include as many SPs as practical. The boundaries must be modified as new information comes to hand. The actual distance in any one direction is determined by factors such as terrain, the pattern of livestock movements, livestock concentrations, the weather and prevailing winds, the distribution and movements of susceptible wild animals, and known characteristics of the virus serotype. A high level of movement control and surveillance will apply. While it would be convenient to declare the RA on the basis of local government areas, it may not be possible, as these are likely to be large and difficult to manage.

To meet international marketing considerations, it may be necessary to ensure the inclusion of product processing facilities within the RA (see Appendix 6).

Control area (CA)

The CA will be a larger declared area around the RA(s) and, initially, possibly as large as a state or territory where restrictions will reduce the risk of disease spreading from the RAs. The boundary of the CA will be adjusted as confidence about the extent of the outbreak increases, but must remain consistent with the OIE Terrestrial Code chapters on surveillance (Code Appendix 3.8.7) and zoning (Code Chapter 1.3.5; see Appendix 3). In general, surveillance and movement controls will be less intense in the CA than in the RA, and animals and products may be permitted to move under permit from the area.

In the case of FMD, the CA will initially be the whole state/territory in which the outbreak occurs. The purpose of the CA is to control movement of susceptible livestock for as long as is necessary to complete trace-back and epidemiological studies. Once the limits of the disease have been confidently defined, the CA boundaries and movement restrictions may be reduced. In line with OIE

guidelines, the CA will have a minimum radius of 10 kilometres, encompassing the RA, or be defined according to geography, climate and feral animal distribution.

Appendix 2 Recommended quarantine and movement controls

Premises

Quarantine/movement controls	Infected and dangerous contact premises	Suspect premises
Movement out of:		
– susceptible animals	Prohibited. All susceptible animals to be slaughtered.	Prohibited. Subject to intense surveillance.
– milk	Prohibited.	Prohibited.
– wool	Allowed under permit (1) for storage at 18°C for at least 12 weeks and/or industrial scouring.	Allowed under permit (1) or after quarantine lifted.
– skins, hides	Prohibited.	Allowed under permit (2) or after quarantine lifted.
– carcases, meats, offal, wastes from susceptible animals	Prohibited. Disposal on site is preferred; otherwise movement by CVO permit.	Allowed under permit (3) or after quarantine lifted.
– semen, embryos	Allowed under permit (4) in certain circumstances.	Allowed under permit (4) or after quarantine lifted.
– other animals	Prohibited.	Allowed under permit (5).
– crops and grains	Allowed under permit (6).	Allowed under permit (6).
Movement in and out of:		
– people	Allowed under permit (5).	Allowed under permit (5).
– vehicles and equipment	Allowed under permit (5).	Allowed under permit (5).

Area

Quarantine/ movement control	Restricted area	Control area
Movement out of:		
– susceptible stock	Prohibited (unless exceptional circumstances apply and approved by the CVO/CCEAD).	Prohibited, except under permit into contiguous RA or to slaughter.
– semen, embryos	Allowed under permit (4).	No restrictions.
Movement in of:		
– susceptible stock	Movement from a free area or contiguous CA to an abattoir for immediate slaughter may be allowed under permit. Essential movement to a property may be permitted (7).	Movement from free areas to a property or abattoir is allowed under permit (7).
Movement within of:		
– susceptible stock	Movement to an abattoir for immediate slaughter or to a farm (7) may be allowed under permit.	Movement to an abattoir or farm (7) is allowed under permit.
Movement through of:		
– susceptible stock	Prohibited.	Allowed under permit (8).
Movement of milk	Movement into or within the RA is allowed. Depending on the specific circumstances, milk in the RA may be destroyed or movement out of the RA may be allowed under permit (9).	Movement into or within the CA is allowed. Movement out of the CA may be allowed under permit, preferably after treatment.
Movement of wool, skins, hides	Movement into or within the RA is allowed (2). Movement out of the RA is allowed, provided that 21 days has elapsed since the date of shearing/skinning.	No restrictions.
Movement of carcases, meats, offal, from susceptible animals, including field-shot game	Movement into or within the RA is allowed under permit (3). Movement out of the RA is prohibited.	Movement into or within the CA is allowed. Movement out of the CA may be allowed under permit (3).

Quarantine/ movement control	Restricted area	Control area
Movement of other animals, people, equipment	Allowed, subject to conditions (5).	Allowed, subject to conditions (5).
Vehicles	Vehicles used to carry susceptible animals are to be decontaminated between loads under supervision.	No restrictions.
Risk enterprises	May continue to operate under permit.	May continue to operate under permit (based on surveillance).
Sales, shows etc	All concentrations of susceptible animals are prohibited.	Subject to CVO approval.
Stock routes, rights of way	Must be closed.	Must be closed.

Notes:

(1) Movement of wool from IPs, DCPs and SPs may be permitted after inspection and treatment. Wool heavily contaminated with faeces will require additional scouring), depending on when the animals were shorn or skinned in relation to the earliest likely onset of infection:

- *wool obtained before first infection* — store until cleaning and disinfection of premises is completed, then spray bales or skins with 2% caustic soda and allow off;
- *wool obtained during period of infection* — spray bales with 2% caustic soda before moving into storage at 18°C for at least 12 weeks and/or undertake industrial scouring at a minimum of 60°C for at least 5 minutes at a minimum pH of 9 (Biosecurity Australia 2002);
- *wool held off-property but identified by trace-back as having been obtained during period of infection* — identify, spray bales with 2% caustic soda and allow off, store at 18°C for at least 12 weeks and/or undertake industrial scouring at a minimum of 60°C for at least 5 minutes at a minimum pH of 9 (Biosecurity Australia 2002); spray neighbouring bales with 2% caustic soda.

(2) Movement of skins and hides from IPs, DCPs and SPs may be permitted after treatment, depending on when the animals were skinned in relation to the earliest likely onset of infection:

- *skins and hides obtained before first infection* — store until cleaning and disinfection of premises completed, then spray skins with 2% caustic soda and allow off;
- *skins and hides obtained during period of infection* — bury during cleaning of premises (do not burn);

– *skins and hides held off-property but identified by trace-back as having been obtained during period of infection* — identify, remove and bury; spray neighbouring skins with 2% caustic soda.

(3) Carcases, meats, offal and wastes from susceptible animals, including field-shot game, may be moved from SPs, within the RA, or out of the CA provided that:

– the material is not brought into direct or indirect contact with susceptible animals;

– every precaution is taken to ensure that effluent, other fluids or aerosols do not leak out of the transport vehicle;

– the transport vehicle and containers are decontaminated under supervision between loads;

– before being released, the material is treated or processed in a manner that will destroy FMD virus or that will ensure that it is not fed to susceptible animals;

– cross-contamination between treated/clean and infected material does not occur; and

– wastes are disposed of in an approved manner.

(4) Semen and embryos collected from susceptible animals on IPs and DCPs within 21 days preceding the first signs of FMD should be destroyed and disposed of on site. Genetic material handled at the same time and potentially cross-contaminated should also be destroyed. Material collected and stored before this time may be removed after decontamination has been completed and the outside surfaces of containers, vials and straws have been disinfected. Other genetic material collected within the RA should be held and only released if the animals and premises of origin remain free of FMD for 21 days after collection. If any doubt exists, the material should be disposed of.

(5) Movement of people, other animals, vehicles and equipment off IPs, DCPs and SPs should be restricted and subject to strict quarantine and decontamination procedures to prevent mechanical spread of FMD virus. Within the RA, people who regularly travel from farm to farm and come into contact with susceptible animals must clean and disinfect hands, overgear, tools and vehicles between properties and keep detailed records of their movements. Dogs are to be confined or tied up. Within the CA, less stringent control procedures may be required. *A permit must describe in detail the conditions of issue*.

(6) Crops and grains harvested from paddocks that were sprayed or treated with effluent from an IP within 21 days preceding the first signs of FMD must be disposed of on site by burial or ploughing in. Otherwise, crops and grains may be removed from IPs and DCPs after the completion of decontamination. The top 10 centimetres of grain or crop stored in open piles must be removed and disposed of on site, and the remainder spayed with citric acid or formalin. The material must not be fed to or used as bedding or litter for susceptible animals. If any doubt exists, the material should be disposed of on site.

(7) Permits for the movement of susceptible animals onto an SP or into the RA or CA should be issued only in exceptional circumstances. Although such

movements may pose no risk of spreading infection, compensation would be payable if these animals become infected. Stock must remain on the property for at least 21 days and be inspected before being moved again.

(8) Direct movement by road or rail may be allowed by permit, provided the origin and destination are both outside the RA and CA, and the stock are not unloaded within the CA. If transport is delayed within the CA, the stock should be regarded as suspect and their further movement carefully reassessed.

(9) Milk heated to 72°C for 15 seconds or 135°C for one second may be used for any purpose except for feeding (as whole milk, products, byproducts or waste) to susceptible livestock. The manufacture of cheddar cheese will be permitted from milk heated to 72°C for at least 15 seconds, provided that such cheese is cured for at least 90 days at a pH of not greater than 5.5. Milk may also be used for manufacture of acid casein, which is precipitated at a pH of less than 5.2. Appropriate filters should be fitted to the air exhausts of milk tankers operating in the RA and CA (see separate section at the end of this appendix).

For further information on disposal of carcases and other products and on decontamination procedures, see the **Decontamination Manual** and the **Disposal Procedures Manual**.

Guidance for issuing permits for the movement of milk

Background

FMD virus may be excreted in the milk of infected cows for up to 4 days before the onset of clinical signs. The virus may be contained in milk droplets released from tanker air vents when pumping is carried out, and may be carried from farm to farm on contaminated vehicles and clothing.

These guidelines set out the procedures to be followed by milk carriers and factory personnel who are involved in the transport of untreated milk originating from premises within the RA and CA. The local operations director may require additional precautions to be taken.

If an outbreak of FMD is suspected on a dairy farm, milk collection is prohibited until the status of the premises is determined.

The dairy companies concerned are to be advised by the local disease control centre (LDCC) of the boundaries of the RA and the location of IPs, DCPs and SPs.

Untreated milk from SPs and from premises within the RA can only be transported to a designated treatment facility (factory). The treatment facility will be proposed by industry and approved by the LDCC controller, after ensuring that adequate facilities are available to meet these guidelines.

Infected premises and dangerous contact premises

If the premises is determined to be an IP or a DCP, all milk is to be retained on the premises until disinfected and disposed of in accordance with instructions and permits issued by the site supervisor (see the **Decontamination Manual**).

Suspect premises

Milk cannot be moved from an SP except under strict conditions for destruction and disposal.

Restricted area

The dairy companies concerned are responsible for ensuring that the appropriate tanker drivers are instructed not to visit IPs, DCPs or SPs. If a vehicle arrives at such a premises before the driver can be informed, it will be stopped at the entrance and the driver advised that milk must not be collected.

All dairy factory staff working with untreated milk must avoid contact with susceptible livestock whilst restrictions are in place.

Government-approved filters must be fitted to the vacuum pump air outlets of all vacuum tankers, and the air exhaust vents of all positive pump tankers, carrying milk in the RA and CA.

Before leaving the depot, the milk vessel and all lines must be cleaned and sterilised using an approved AUSVETPLAN disinfectant. The whole vehicle must be in a clean condition. The body, steps, wheels, mudguards, splash guards and underside of the vehicle must be sprayed with an approved disinfectant. The inside of the cab must be clean and treated with an approved disinfectant (see the **Decontamination Manual**). Each tanker must carry a supply of an approved disinfectant and spray equipment. Milk sampling equipment must be cleaned and disinfected.

Factory staff should ask suppliers to ensure that stock do not have access to the farm access track used by the tanker.

On farms, drivers should minimise contact with the farm. If possible, producers should be trained to connect the tanker to the vat, or the vat room should be disinfected by the producer before the driver enters. Drivers must confine their movements to the minimum area necessary to carry out the collection tasks.

On arrival at the farm, the driver should don protective clothing (waterproof boots, coat and pants that can be disinfected on arrival, before leaving the premises and on return to the factory; or disposable overalls and boot covers). If milk sampling is conducted, the containers and equipment must be cleaned and disinfected after samples are collected. The outside and couplings of the milk collection hose should be washed with an approved disinfectant both before connection to the vat and before the return of the hose to the vehicle. Blank ends should be fitted to couplings before applying the disinfectant, and the disinfectant rinsed from the couplings with clean water.

Care must be taken to avoid spillage of milk, and contact with any spilt milk must be avoided. Any spilt milk is to be disinfected.

Before the tanker leaves the premises, its steps, wheels and mudguards must be sprayed with an approved disinfectant.

At the receiving factory, the following must be cleaned and disinfected:

- all areas where untreated milk is unloaded after each tanker discharges;
- all areas where untreated milk may have been spilt;
- the exterior surfaces of all equipment used in the transfer and handling of untreated milk; and
- floors and working surfaces used by staff involved in handling or transfer of untreated milk.

The usual cleaning and sterilisation routine for the internal surfaces of tankers and factory equipment must be carefully undertaken.

Milk sample containers must be disinfected with an approved disinfectant. All spilt and waste milk must be treated with an approved disinfectant.

Advice must be sought from the LDCC if there is any doubt about the appropriate action to be taken.

Control area

Dairy factories are to be advised by the state disease control headquarters (SDCHQ) of the boundaries of the CA and any proposed changes to those boundaries.

Dairy factories are to be advised by the SDCHQ of any SPs within the CA. Special consideration needs to be given to the risks posed by transport of milk from such premises through the CA. Options include:

- disposal of milk on premises until status is determined;
- short-term storage of milk on farm until status is determined; and
- collection as for SPs in the RA, but vehicle and route to be approved by the SDCHQ.

Milk and milk products from within the CA can only be transported out of the CA under permit from the SDCHQ. Permits will only be issued when conditions for collection, transport and treatment have been subjected to audit and approved.

Treatment of milk

Milk for human consumption from premises within the RA is to be treated in accordance with Section 2.2.6. Feeding of such milk to livestock is not permitted.

Filters to be fitted to tankers

Refer to the **Dairy Enterprise Manual** for technical details of filters for milk tankers.

Appendix 3 OIE animal health code and diagnostic manual for terrestrial animals

OIE Terrestrial Code

The objective of the *OIE Terrestrial Animal Health Code* is to prevent the spread of animal diseases, while facilitating international trade in live animals, semen, embryos and animal products. This annually updated volume is a reference document for use by veterinary departments, import/export services, epidemiologists and all those involved in international trade.

The OIE Terrestrial Code is amended in May each year. The current edition is published on the OIE website at:

http://www.oie.int/eng/normes/mcode/A_summry.htm

The following chapters are relevant to this manual:

Chapter 1.3.5 Zoning and compartmentalisation

Chapter 2.2.10 Foot and mouth disease

Appendix 3.6.2 Foot and mouth disease virus inactivation procedures

Appendix 3.8.7 Surveillance for foot and mouth disease

OIE Terrestrial Manual

The purpose of the *OIE Manual of Standards for Diagnostic Tests and Vaccines for Terrestrial Animals* is to contribute to the international harmonisation of methods for the surveillance and control of the most important animal diseases. Standards are described for laboratory diagnostic tests and the production and control of biological products (principally vaccines) for veterinary use across the globe.

The OIE Terrestrial Manual is updated approximately every four years. The 5th edition was published in 2004 and is available on the OIE website at:

http://www.oie.int/eng/normes/mmanual/A_summry.htm

The following chapter is relevant to this manual:

Chapter 2.1.1 Foot and mouth disease

Appendix 4 Procedures for surveillance and proof of freedom

Proof of freedom

The OIE Terrestrial Animal Health Code for FMD (see Appendix 3) identifies criteria for proof of freedom for outbreaks in previously FMD-free countries or zones. These are set out in Article 2.2.10.7 of the Code. The relevant part of the article in the 2004 version of the Code is reproduced below.

Recovery of free status

1. When an FMD *outbreak* or FMD virus [FMDV] infection occurs in an FMD free country or zone where vaccination is not practised, one of the following waiting periods is required to regain the status of FMD free country or zone where vaccination is not practised:

    a) 3 months after the last *case* where a *stamping-out policy* and serological surveillance are applied in accordance with Appendix 3.8.7., or

    b) 3 months after the slaughter of all vaccinated animals where a *stamping-out policy*, emergency vaccination and serological surveillance are applied in accordance with Appendix 3.8.7., or

    c) 6 months after the last *case* or the last vaccination (according to the event that occurs the latest), where a *stamping-out policy*, emergency vaccination not followed by the slaughtering of all vaccinated animals, and serological surveillance are applied in accordance with Appendix 3.8.7., provided that a serological survey based on the detection of antibodies to nonstructural proteins of FMDV demonstrates the absence of infection in the remaining vaccinated population.

2. When an FMD *outbreak* or FMDV infection occurs in an FMD free country or zone where vaccination is practised, one of the following waiting periods is required to regain the status of FMD free country or zone where vaccination is practised:

    a) 6 months after the last *case* where a *stamping-out policy*, emergency vaccination and serological surveillance in accordance with Appendix 3.8.7. are applied, provided that the serological surveillance based on the detection of antibodies to nonstructural proteins of FMDV demonstrates the absence of virus circulation, or

    b) 18 months after the last *case* where a *stamping-out policy* is not applied, but emergency vaccination and serological surveillance in accordance with Appendix 3.8.7. are applied, provided that the serological surveillance based on the detection of antibodies to nonstructural proteins of FMDV demonstrates the absence of virus circulation.

Immediate acceptance of these criteria by all countries is unlikely. Australia may be required to support its freedom claims by provision of relevant data and an inspection by an international panel of experts. The most up-to-date information and the forms detailing the required relevant data will be provided by:

Office of the Chief Veterinary Officer
Department of Agriculture, Fisheries and Forestry
Canberra ACT 2600
Tel (02) 6272 5540; Fax (02) 6272 3372

Surveillance

The OIE is continuing to develop specific criteria for surveillance requirements for FMD. However, in order to demonstrate after an outbreak that the disease has been successfully contained and eradicated and so regain access to export markets as quickly as possible, it will be essential to have a systematic and accurate disease surveillance program during and following the outbreak.

Accurate and detailed surveillance data collected from the whole country will be required, including serological data, farm and risk enterprise inspection reports, information from abattoir inspections, and laboratory data.

Surveillance will be concentrated within the RA, but the intensity of surveillance and size of the RA will depend largely on the size and severity of the outbreak. Outside this area, there will be heightened awareness, especially at saleyards, abattoirs and shows. If FMD is identified in wild animals, the surveillance program may include these populations (see the **Wild Animal Response Strategy**). Serological testing may be necessary to meet export certification requirements for certain game-meat exports.

Sentinel animals will need to be placed onto the previously contaminated areas of IPs and DCPs at least 30 days after slaughter, disposal and decontamination are completed. These animals will remain on these premises for at least 60 days and will be regularly inspected, and serologically tested for FMD at the end of this period.

The reinstatement of disease-free status will require the submission of a formal report to the OIE detailing the eradication procedures, including the policy and follow-up surveillance and monitoring, veterinary infrastructure and industry organisation. An inspection by an international panel of experts may need to review the eradication program and all available data to verify freedom.

Appendix 5 National operating procedures for use of FMD vaccine

Purpose

This appendix sets out nationally agreed, practical procedures for the receival, storage, distribution and administration of FMD vaccine. These procedures will be followed if a decision is made to use vaccine in an outbreak of FMD in Australia.

The appendix does not cover the national policy decisions that may trigger emergency vaccine use in the face an FMD outbreak. The decision to use vaccination as an adjunct to any eradication program will depend on a wide range of factors, many of which cannot be considered until the nature and extent of an outbreak are known.

This information is aimed particularly at lead disease-control agencies, and should be used by those agencies to develop detailed standard operating procedures that will ensure that these national procedures can be implemented in a timely and effective manner at the local level.

Introduction

A number of recent developments in Australia and internationally have led to changes in approach to the role of vaccination in FMD eradication programs.

These developments include:

- experiences in the United Kingdom, which demonstrated the difficulties with relying on mass slaughter alone as an eradication strategy for FMD;
- the growing unacceptability within the community of mass animal destruction;
- policy development in Australia that has seen the development of clearer decision criteria for vaccine use in an Australian outbreak;
- the finalisation of an emergency FMD vaccine supply arrangement with a commercial manufacturer; and
- development and ongoing evaluation of diagnostic tests that will distinguish between infected and uninfected vaccinates (a system known as 'differentiating infected from vaccinated animals', or DIVA; see Appendix 5).

In 2002, AHA's Veterinary Committee (now the Animal Health Committee) considered the circumstances under which FMD vaccination might be used in an Australian outbreak, and agreed that the following criteria were the most relevant to support any decision to deploy vaccination:

- inadequate resources and/or a rapidly spreading outbreak;
- the involvement of high-density livestock areas;
- the involvement of high-risk enterprises; and

- protection of rare and endangered species.

General consideration of these criteria indicates that the likelihood of using FMD vaccination in an outbreak is highest in the more intensive livestock production areas of southern Australia, and lowest in the extensive pastoral areas of northern, central and western Australia. Jurisdictions should take this into consideration in their FMD preparedness programs and activities, including in the documentation of local EAD standard operating procedures.

A decision to use emergency vaccination must be taken early, and be capable of immediate implementation, if it is to be effective and capture the full benefit of vaccination. Following Exercise Minotaur, there was general agreement to a policy that would see the NMG activating the FMD vaccine supply arrangements immediately following the identification of the FMD virus strain at the commencement of an Australian outbreak.

Movement controls over vaccinated livestock will be required. In general, these controls will reflect those operating in the area (restricted area, control area, etc) in which vaccination is conducted.

The Australian Pesticides and Veterinary Medicines Authority has issued an Emergency Use Permit to Merial Australia Pty Ltd for the supply and use of AFTPUR DOE® inactivated FMD vaccine with oil adjuvant. This vaccine is the subject of a supply agreement between AHA and Merial SAS on behalf of governments and livestock industries in Australia.

Decision to order vaccine

Under the FMD Vaccine Acquisition Funding Agreement, the NMG may, as part of an approved EAD Response Plan, request AHA to order a specified quantity of FMD vaccine. This can be done immediately the antigenic strain of the virus has been determined and matched to an appropriate antigen in the vaccine bank. This process is likely to take at least several days following receipt of an isolate at AAHL Geelong or the Pirbright FMD Reference Laboratory in the United Kingdom.

Delivery of vaccine to Australia

The FMD Vaccine Supply Agreement requires Merial SAS to deliver the specified strains and quantity of vaccine to AHA's agent at a nominated international airport in Australia within 7 days of the placement of an order, with AHA taking ownership of the vaccine once delivered. Considering the lead-in time for strain identification and antigen matching, it is unlikely that vaccine could be delivered to Australia until at least 7–10 days after first confirmation of an FMD outbreak.

In most instances, the vaccine will be delivered to an international airport in the capital city of the state/territory in which the outbreak has occurred, particularly when it is ordered as a precautionary measure at the start of an outbreak.

Initial storage, warehousing and distribution of vaccine

Under the supply agreement, Merial will assist AHA in organising ground transport and initial secure storage of the vaccine on arrival (preferably with a commercial company with experience in vaccine storage and distribution) and before its distribution. This may be Merial Australia or another company acting as AHA's agent.

Subsequent distribution of vaccine from the agreed initial secure storage facility will only occur through AHA with the authority and approval of the CVOs in the jurisdictions dispatching and receiving the vaccine, acting in accordance with an NMG decision to use the vaccine in Australian livestock.

Distribution from the initial storage facility will be to holding points approved by the CVO or delegate.

At an SDCHQ or LDCC responsible for vaccine use in its area, there must be a vaccination manager fulfilling the roles specified in the AUSVETPLAN **Control Centres Management Manual**, Part 2.

An auditable inventory control will be used at each stage of vaccine distribution, storage and use.

Transportation of vaccine from the initial storage point will be by commercial courier arranged by the company holding the vaccine on AHA's behalf.

Maintaining a cold chain (+2° to +8°C, without freezing) at all stages is essential. Data loggers can be used to monitor temperatures during transport and storage.

Vaccine storage will require a reliable refrigeration system with an uninterruptible power supply or backup capacity. This must be given careful thought during the setting up of a control centre where FMD vaccination may be a possible requirement during the eradication campaign.

Security of vaccine stocks from theft, inappropriate distribution or the local effects of natural disaster must be assured at all times.

Vaccine administration

FMD vaccine will be administered by veterinarians or trained lay personnel, approved by the CVO or delegate (eg vaccination manager).

Training of teams will cover:

- occupational health and safety issues, including but not limited to the dangers of receiving an injection of oil-based vaccine and the need for immediate medical attention in such an event;
- the use of equipment (eg vaccination guns), and where necessary, ear tag applicators and the like;
- cleaning and disinfection and related biosecurity procedures;
- record keeping and vaccine inventory controls; and

- organisational procedures for teams from LDCCs.

While this training is directed at induction of teams in an outbreak, jurisdictions should include these elements in ongoing EAD preparedness training as appropriate.

Vaccination teams should be small (typically three members) and utilise, as much as possible, on-farm labour to complete the task. Teams should be responsible for vaccination, animal identification and record keeping. It is not necessary that a veterinarian be a member of each vaccination team, but the teams must be under veterinary direction and supervision. Wherever possible, animal handling should be the responsibility of the livestock owner or manager. Where animals are already acceptably identified, such as by a National Livestock Identification System (NLIS) tag, and can be recorded electronically, teams of two may be adequate.

At all times, vaccine must be protected from light and stored between +2° and +8°C up to the point of administration. In warm and hot weather, only enough vaccine for about a half-hour's work at a time should be taken from refrigeration. Once opened, bottles must be used within 36 hours, and then only if they have been stored between +2° and +8°C.

Multidose vaccination syringes are recommended, and needles should be changed regularly (see Appendix 8).

Vaccination needles used for injecting must not be inserted into vaccine vials. Specific sterile needles must be used for withdrawing vaccine.

Multidose vaccination guns must be sterilised according to AUSVETPLAN standard operating procedures before their next use. Only new or sterilised material and equipment will be taken onto a farm.

Before vaccination, a clinical inspection of stock for signs of FMD will be undertaken. Only herds/flocks with no clinical signs of FMD will be vaccinated. Teams will be withdrawn from farms where clinical signs of FMD are suspected. If a team is withdrawn in these circumstances, biosecurity protocols must be followed and all relevant items sealed into clinical waste bags for disposal. Teams may be redeployed after suitable biosecurity protocols have been followed in accordance with AUSVETPLAN procedures for 'contaminated' personnel.

Farms will be identified for vaccination by the LDCC controller in consultation with the SDCHQ, in accordance with the approved EAD Response Plan for the jurisdiction.

On farms identified for vaccination, all susceptible stock more than two weeks of age will be vaccinated by administration of a single dose in accordance with the manufacturer's instructions. For the Merial AFTOPUR DOE vaccine, administration will be by an intramuscular injection. The preferred site is high on the neck in ruminants, and in the neck behind the ear in pigs.

Booster doses are unlikely to be necessary under most circumstances; nor should it be necessary to return to farms to vaccinate animals that were under two weeks old at the time the herd was vaccinated.

If required (eg if there is significant and ongoing challenge or risk of exposure) boosters should be given at four weeks after the first injection, both in ruminants and in pigs.

Owners of vaccinated livestock will be provided with a standard information sheet that includes advice on monitoring stock for adverse reactions, the general efficacy of vaccination (for example, that it will not stop current infection), vigilance for clinical signs of FMD, and who to contact to report any concerns. Vaccinated animals should be monitored by owners for adverse vaccination reactions up to 6 weeks post-vaccination. Any morbidity or mortality during this period must be reported to the CVO via the LDCC through the nominated contact point.

Biosecurity

Biosecurity for vaccination teams is critical. A personal decontamination site must be identified at the entrance/exit point of the property. Personal decontamination as specified in the **Decontamination Manual** must occur when personnel enter or leave the property. Vaccination teams should approach decontamination as if they have visited a medium-risk property.

All waste material must be returned to the LDCC for disposal under the authority of the LDCC controller. No contaminated waste materials must be left on farm or carried onto other farms.

It is preferable to operate a large number of small vaccination teams, rather than a smaller number of larger teams, to minimise farm-to-farm movement in any one day.

As appropriate equipment will be required for vaccine administration, all jurisdictions should prepare beforehand by investigating sources and supplies of equipment, to ensure that they are in a position to rapidly equip vaccination teams. Stockpiling of equipment that may be difficult to source in quantity should be considered as an FMD preparedness measure.

Required equipment should be assembled immediately the decision to draw down on the vaccine bank stocks is made.

Identification of vaccinated animals

Animals that have been vaccinated for FMD must be permanently identified.

Cattle

Vaccinated cattle will be individually identified using NLIS devices, using existing devices where cattle are already NLIS-identified, or by applying NLIS devices at the time of vaccination.

Meat & Livestock Australia maintains the NLIS database, which is used to register NLIS-approved radio frequency identification devices (eartags or boluses). The database also records the NLIS number assigned to each device (and associated transponder number), the movement history of the beast tagged with the device, and, if applicable, disease, residue and market eligibility status information.

The NLIS device status of 'FMD vaccinated' will be established on the NLIS database. Following vaccination, NLIS devices are to be read, and within 24 hours the NLIS database administrator is to receive an electronic file listing the NLIS device details (either NLIS numbers or transponder numbers) along with a request that each device be allocated the 'FMD vaccinated' status.

The NLIS database is able to generate email messages to relevant regulatory agencies when vaccinated cattle are reported as moving between properties, or following slaughter. Message content, the circumstances when messages will be automatically generated and the message recipients will be agreed, to allow implementation by the NLIS database administrator at short notice.

Sheep, goats, alpacas, llamas

Sheep, goats, alpacas, llamas and deer must be each identified with a distinctive tag bearing the Property Identification Code of the property on which they were vaccinated and the words 'FMD vaccinated' (or similar). NLIS (sheep) tags would be most suitable for this purpose, preferably in an unusual or distinctive colour.

As it is likely that these species will be slaughtered at some point as vaccinates (evaluation of 3ABC ELISA, which detects antibody to viral components only produced by multiplying virus, has not yet been undertaken in these species) *individual* (unique) identification is not justified.

Pigs

Intensively housed pig herds present logistic difficulties for individual identification. Quarantine and movement controls will provide sufficient security in lieu of individual identification. It is likely that vaccinated pig herds will subsequently be slaughtered out during the EAD response, further mitigating the need for individual identification of vaccinated pigs in intensive herds.

In the case of backyard pigs, or small pig herds on farms with other livestock, identification will be carried out as for those other livestock (for example, as for sheep and goats).

Zoo animals

Vaccinated zoo animals will be individually identified at the time of vaccination (if not already) and subject to the usual restrictions on movement for the area in which they are located (eg restricted area, control area).

Movement controls over vaccinated livestock

Vaccinated livestock will not be moved from the place of vaccination without authority from the LDCC, and will be subject to the movement controls applicable to the declared disease control area in which they reside (see Appendix 2).

Where vaccinated stock are required to be slaughtered, consignment to slaughter will be under permit, with direct consignment to the abattoir nominated in the permit.

Animal products derived from vaccinated livestock will be subject to the normal movement controls applying to those products in the declared disease control area in which the livestock and products originate. There is no risk to humans from consuming products from vaccinated animals.

Monitoring of vaccinated livestock

Evaluation of vaccine efficacy

Serological testing of some vaccinated herds/flocks to monitor the immunogenicity of vaccine stocks and the development of herd/flock immunity is required, particularly in the early stages of a vaccination program.

Flocks/herds to be monitored must be tested a minimum of 21 days after vaccination. Sampling may occur at the point of slaughter where such action is required.

Testing of a minimum of 10 animals per herd/flock will be sufficient for monitoring herd immunity, using conventional FMD ELISA.

Controlled slaughter of vaccinates

Under this approach, vaccinated animals are consigned in an orderly manner for controlled slaughter off farm at nominated abattoirs, at an appropriate time in the disease response program.

Such animals will be serologically monitored at the time of destocking/slaughter using both conventional FMD ELISA and 3ABC ELISA, to assist with epidemiological assessment and monitoring of vaccine efficacy, and for research purposes. Sampling for such testing may be carried out on farm, or at abattoirs at the time of slaughter.

Non-slaughter of vaccinates ('vaccinate to live')

DIVA ('differentiating infected from vaccinated animals') testing using the 3ABC ELISA may allow vaccinated animals to remain alive.

Under this approach, all vaccinates in each vaccinated herd/flock must be tested using both conventional and 3ABC ELISA, a minimum of 28 days after the last case of FMD in the region.

If any animals are positive to the 3ABC ELISA, these animals are retested, including by serology and probang, and possibly by slaughter, postmortem and sampling for virology. If infected, the herd is slaughtered out, and surrounding herds at risk are retested 28 days later.

This process is continued/repeated until all existing vaccinated herds/flocks have had a negative herd test using the 3ABC ELISA, at least 28 days following detection of the last infected animal in the region.

See Section 3.2.4 for a discussion of the basis for decisions to vaccinate.

Inventory control

A rigorous and auditable national inventory control system must be initiated to account for all vaccine imported, distributed, used, discarded and on hand. Each bottle is individually labelled (bar-coded) for this purpose.

It is essential that inventory control is practised at each step in the vaccine distribution chain:

- initial point of delivery and storage
- state distribution point(s)
- LDCC(s)
- vaccination teams.

ANEMIS has been upgraded to provide a 'Procedures' (eg vaccine management) module. LDCCs will use ANEMIS to record vaccinated property PICs, vaccination teams, numbers and ID of vaccinated animals, vaccine batch numbers, dates, etc. The 'Procedures' facility will also record vaccine stock movements into and out of the LDCC.

The LDCC vaccination manager will need to carefully plan vaccine allocation to teams to minimise wastage of vaccine.

Vaccine/antigen potency and purity

Under the vaccine supply contract, AAHL is contracted by AHA to conduct potency and purity testing of any antigens to be supplied to Australia, in consultation with the manufacturer.

In the event that vaccine is ordered and delivered to Australia, AHA through its agent is responsible for the immediate collection and dispatch of a specified subsample of each batch to AAHL for quality testing.

Strain identification for optimum vaccination efficacy

While AAHL currently has a technical capability to undertake FMD virus strain identification, lack of experience working with FMD virus may mean that isolates will need to be sent to the reference laboratory in the United Kingdom (Pirbright) for definitive strain identification. It is essential that this be done as soon as possible after initial FMD virus isolation in an Australian outbreak. The United Kingdom Department for Environment, Food and Rural Affairs has indicated that identification of the particular strain and assessment of the protective effect of available vaccine antigens could take two days or longer.

It is possible that the outbreak strain of virus may have an 'r' value that is far enough from the field strain (<0.2) to make two vaccinations necessary for adequate protection. AAHL will provide appropriate advice after assessment of the protective effect of the vaccine against the field strain.

Appendix 6 Zoning

The infected area and FMD-free area definitions needed for disease control are different from those needed for credible international marketing. Both requirements must be accommodated. For example, for international marketing purposes, movement of product between infected and free zones must be restricted to meet export certification requirements, and so an RA that includes processing facilities may need to be defined. OIE requirements for FMD-free zones and FMD-infected zones are given in Articles 2.1.1.4 and 2.1.1.7 of the OIE Terrestrial Code (see Appendix 3).

Zoning workshop

An EXANDIS/Meat Research Corporation-funded workshop was held in October 1994 to establish Australia's position on zoning for FMD. The workshop was attended by representatives of the government (disease control), industry, and the meat marketing and live animal export sectors. All groups agreed that, in the event of an FMD outbreak, a whole state or territory should initially be declared as the CA, rather than Australia as an infected country. This was not because states were seen as the most environmentally or ecologically appropriate areas, but in order to have nonaffected states and territories recognised as FMD-free immediately to minimise trade disruption. Infected and free zones should then be determined on the basis of geography, trading and production systems, which can be readily defended to overseas countries, reducing as soon as possible to the smallest possible CA, based on whole shires and local government areas (subject to surveillance results and OIE Terrestrial Code requirements).

It is important to realise that the CA is a buffer between the RA and the rest of the country. It should be defined so that, if FMD escapes from the RA, disease spread will be minimised.

It was agreed that an *international assurance team* should be established during an outbreak to address international issues and liaison, and to work to have FMD-free zones accepted as being free. This team would:

- work in parallel with the teams handling disease-control activities;
- demonstrate freedom of nonaffected areas/states;
- make a case for continued export from nonaffected states, for example by amended certification and inspection systems;
- after the initial international declaration of infection based on an entire state, use pre-established surveillance systems to demonstrate zonal freedom to recipient countries; and
- make use of precedents (eg the European handling of the 1992 outbreak in Italy and the 1994 Greek outbreak).

It will be important to develop a system of surveillance for FMD-free zones.

The marketing strategy would be to direct fresh meat from the FMD-free zones onto the export markets. Meat from the FMD-infected zone would be directed onto

the domestic market, but may be subjected to interstate movement restrictions, depending on other states' FMD status.

The problem will be what to do with product. UHT milk can be moved anywhere within Australia or overseas, but meat and other products would be subject to specific OIE rules. Thoroughly cooked or canned meat could be moved anywhere within Australia, but Australia's canning capacity is limited. If fresh meat were moved from any RA or CA to an FMD-free zone, then the free zone would forfeit its status under OIE rules. Therefore, diversion of lost export product onto the domestic market will be subject to internal state/territory controls and be restricted to RAs and CAs.

Appendix 7 FMD survey — field activities operating procedures

In April 2002, the Veterinary Committee (now the Animal Health Committee) established a working group to examine field activities required for an FMD survey to provide evidence of freedom from disease for zoning purposes.

The working group established protocols to:

- determine suitable forms of permanent identification of sampled animals;
- document the standard procedure for clinical examination of sampled animals; and
- determine the volume of blood to be collected from each animal sampled.

Suitable forms of permanent identification of sampled animals

Rationale

Either 50 or 60 animals should be sampled per property, depending on whether Protocol A or Protocol B is used. Protocol A is a two-stage sampling procedure, while Protocol B uses a single stage. The protocols assume a test sensitivity of 95% and a specificity of 98%. The protocol used could vary between or within jurisdictions.

The number of animals to be sampled and clinically examined on each property will be supplied with the property information and job request form. The sampled animals will include cattle (dairy and beef), sheep, goats, deer and pigs. The properties containing these animals will vary in size, management and husbandry practices.

In some pastoral situations, it may not be possible to muster the animals for sampling. In such cases, it may be necessary to shoot animals for postmortem sampling and examination.

Where it would be difficult to recapture sampled animals at a later date, they should be held separately from the main herd or flock until the laboratory test results are received.

Need for individual identification

Retesting will be required if enough animals test positive for the herd to be declared suspect, or if samples are lost or damaged in transit. Test results may not be available until some days or weeks after sampling.

Where retesting is required, and if possible, the same animals should be sampled at the second sampling and inspection visit to enable a comparison of serum titres.

Based on these assumptions, sampled animals need to be individually identifiable.

Form of identification

Some animals will already be identified by brands, tattoos, earmarks, eartags or other devices, including NLIS devices. These identification methods relate to property and/or individual animal identification.

In addition to any such identification, all animals sampled will therefore be ear-tagged at the time of sampling. Tags should be of the same colour, be individually numbered, and have a word (such as 'SURVEY') stamped on them.

Standard procedure for clinical examination of sampled animals

Rationale

The examination of animals where a disease is not expected can be more difficult than where the presence of disease is more likely. In such cases, special care must be taken to conduct a thorough examination.

If facilities for restraining animals are not available on the property, sufficient equipment should be carried or be available to allow the restraint of the animals without undue stress (ie bull catcher, portable yards, darting).

Veterinarians examining animals for FMD should familiarise themselves by reading relevant material, including *Exotic Diseases of Animals: A Field Guide for Australian Veterinarians* (Geering et al 1995). All Australian veterinarians should have a copy of this book. Copies of suitable material will need to be made available to overseas staff.

Inspection of production records

An inspection of production records is an integral part of a herd assessment. This might include milk production in a dairy; weaning and growth rates in pig herds; weaning percentages or young stock losses in more extensively managed herds/flocks; or feed consumption in feedlots. Production records should be examined for every herd, and any change in production figures should be explained if possible.

Suitable production indices are:

- increased returns to service, abortion or neonatal deaths;
- reduced growth rates, decreased feed conversion efficiency;
- sudden drop in milk production; and
- unexplained deaths.

Clinical inspection

Clinical inspection should be carried out on all animals in the herd. This may involve a significant amount of time on properties such as pastoral leases and may require examination from motor vehicle or helicopter.

Clinical inspection is an assessment of the general health and mobility of animals to determine whether any animals are showing signs of FMD, and is carried out at a distance from the animals (but close enough to make sure that all animals are standing and walking). Animals that appear lame, drooling or otherwise unwell

should be restrained for a clinical examination. These animals may be additional to the prescribed number of clinical examinations to be carried out on a herd.

On very large pastoral properties, it may not be possible to inspect all animals. Nevertheless, animals from all parts of the property need to be inspected, and detailed records need to be kept of area inspections. The intensity of inspection should be determined by the SDCHQ.

Clinical examination

A clinical examination should be conducted on every animal that is sampled and tagged.

Clinical examination is a thorough veterinary health check of individual animals. The examination includes, but is not necessarily limited to, all the items described below. Many standard protocols exist for the conduct of clinical examinations, but it is the responsibility of the veterinarian to exercise good clinical judgment.

For animals that have been destroyed in order to collect blood samples, a thorough check of all the predilection sites for FMD lesions should be carried out, as described below. It should be noted on the sample record sheet that these animals have been destroyed.

Selection of animals for clinical examination

The number of animals to be sampled and clinically examined will be supplied with the property information and job request form. The animals should be chosen randomly from the herd. Guidelines for sample selection will be provided.

Collection of samples and clinical inspection where access is restricted

During the northern wet season, it may be impractical or impossible to muster animals from a given herd into yards. In such a situation, it may be necessary to examine, tag and collect blood samples from free-roaming animals that have been tranquillised by dart and are subsequently allowed to recover. Tranquillisation may be preferable to terminal sampling in cases where animals can recover, as they may need to be resampled in the event of positive reactions.

Management of unhealthy animals (target animals)

Any animals that appear to be unwell but are not suspected of having FMD on clinical inspection should also undergo a clinical examination and have a sample taken. This sampling is in addition to the normal sample numbers. Such animals are referred to as 'target' animals, and they should be identified as such on the recording sheet and on the blood tube next to the sample number, by means of the letter T.

Results should be recorded on the sample recording sheet, although this may be different for surveillance sampling in at-risk areas, where higher numbers are being sampled. Each state laboratory may have a different procedure.

Any sick animals should be recorded, and a diagnosis recorded if possible (eg lameness due to footrot).

Any animals suspected of infection with FMD should be reported immediately on 1800 675 888 or other suitable numbers (refer to pocket card).

Clinical examination — minimum requirements for FMD surveillance

Ensure that animals have had enough time to cool down if they have been recently mustered or sorted through yards/pens.

Assessment of general health

- *Mentation* — is the animal bright and alert?
- *Appetite* — is the animal eating or chewing cud?
- *Gait* — are there signs of lameness, reluctance to move or discomfort standing?
- *Rectal temperature* — is it in the normal range for the species being examined?

Animals in the early stages of infection will have neither obvious clinical signs nor antibodies, so a rise in temperature may be the only significant finding.

Physical examination

The following sites must be examined for FMD lesions:

- tongue
- lips
- gums
- dental pad
- rostral surface of muzzle and within the nostrils
- interdigital skin of the feet
- coronary bands
- bulbs of the heels
- teats and vulva in females.

Sampling/examination recording form (example only: not for use)

Herd code:					
Herd:			Veterinarian:		Date:
Page of					
Sample no.	**Species**	**ID**	**Clinical examination**	**Production**	**Comments**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Volume of blood to be collected from each animal sampled

Consideration

AAHL has advised that 1 mL of serum is required to run the relevant FMD surveillance tests (C ELISA or LP ELISA) and retain a sample for retesting.

Therefore, a minimum of 10 mL of blood is to be collected from each animal into a sterile plain blood tube, such as a Vacutainer.

Duplicate samples may be of benefit in some circumstances. However, the risks of such a procedure include transcription errors, the possible mislabelling of samples, and the risk of spoiling samples during separation, handling and storage. Rather, the risk of one or more individual samples spoiling could be overcome by collecting samples from more than the required minimum number of animals on a property.

Appendix 8 Vaccination equipment distributed with vaccine

1) *We are currently finalising arrangements with NJ Phillips for the supply of the equipment to be codistributed with the vaccine in an EAD event where vaccination is required*. The vaccine equipment identified for use in FMD vaccination has been tested by NJ Phillips against the vaccine adjuvant (a light mineral oil) to ensure compatibility. The two applicators identified are:

   A disposable, 3 ml fixed variable plastic applicator with feed tube which can be sterilised by boiling.

   A 50 ml repeat applicator (plastic) (1 ml increments) for use in small scale situations, sterilised by boiling.

   Additional material supplied with applicators:

   1. Draw-off and feed tubes, one for each bottle.
   2. Needles, two types.
   18G x ½ inch and 18G x 1 ½ inch.
   3. Spare parts for applicators.

2) Do not chemically sterilise any vaccination equipment as this will interfere or damage the FMD antigens in the vaccine. Any sterilisation of vaccine equipment should be by boiling for not less than 15 minutes.

Glossary

Animal byproducts	Products of animal origin that are not for consumption but are destined for industrial use (eg hides and skins, fur, wool, hair, feathers, hooves, bones, fertiliser).
Animal Health Committee	A committee comprising the CVOs of Australia and New Zealand, Australian state and territory CVOs, Animal Health Australia, and a CSIRO representative. The committee provides advice to PIMC on animal health matters, focusing on technical issues and regulatory policy (formerly called the Veterinary Committee). *See also* Primary Industries Ministerial Council (PIMC)
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture, Fisheries and Forestry — Australia who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. *See also* Chief veterinary officer
AUSVETPLAN	*Aus*tralian *Vet*erinary Emergency *Plan*. A series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.
Biological products	Reagents of biological origin (eg sera, hormones) for therapeutic use in the diagnosis or treatment of certain diseases.
Bos indicus cattle breeds	*See* Zebu
Bos taurus cattle breeds	European breeds of cattle, including friesian, hereford, jersey, shorthorn.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. *See also* Australian Chief Veterinary Officer
Compensation	The sum of money paid by government to an owner for stock that are destroyed and property that is compulsorily destroyed because of an emergency animal disease.

Consultative Committee on Emergency Animal Diseases (CCEAD)	A committee of state and territory CVOs, representatives of CSIRO Livestock Industries and the relevant industries, and chaired by the Australian CVO. CCEAD convenes and consults when there is an animal disease emergency due to the introduction of an emergency animal disease of livestock, or other serious epizootic of Australian origin.
Control area	A declared area in which the conditions applying are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an outbreak according to need). *See* Appendix 1 for further details
Corona (coronary band)	Band around the top of the hoof.
Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises	Premises that contain dangerous contact animals or other serious contacts. *See* Appendix 1 for further details
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. Types of declared areas include *restricted area, control area, infected premises, dangerous contact premises and suspect premises*. *See* Appendix 1 for further details
Decontamination	Includes all stages of cleaning and disinfection.
Depopulation	The removal of a host population from a particular area to control or prevent the spread of disease.
Destroy (animals)	To slaughter animals humanely.
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases — **1800 675 888**
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.

Disposal	Sanitary removal of animal carcases, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
ELISA	Enzyme-linked immunosorbent assay — a serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen–antibody binding occurs.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. *See also* Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include funding mechanisms, the use of appropriately trained personnel and existing standards such as AUSVETPLAN.
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. *See also* Emergency animal disease, Exotic animal disease
Enterprise	*See* Risk enterprise
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. *See also* Veterinary investigation
EXANDIS	A former Australian Government authority that provided for industry consultation and advice to the minister on disease preparedness.
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. *See also* Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	*See* Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
In-contact animals	Animals that have had close contact with infected animals, such as non-infected animals in the same group as infected animals.

Incubation period	The period that elapses between the introduction of the pathogen into the animal and the first clinical signs of the disease.
Index case	The first or original case of the disease to be diagnosed in a disease outbreak on the index property.
Index property	The property on which the first or original case (index case) in a disease outbreak is found to have occurred.
Infected premises	A defined area (which may be all or part of a property) in which an emergency disease exists, is believed to exist, or in which the infective agent of that emergency disease exists or is believed to exist. An infected premises is subject to quarantine served by notice and to eradication or control procedures. *See* Appendix 1 for further details
Laminitis	Inflammation of the sensitive laminae of the hoof.
Local disease control centre (LDCC)	An emergency operations centre responsible for the command and control of field operations in a defined area.
Monitoring	Routine collection of data for assessing the health status of a population. *See also* Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.
National management group (NMG)	A group established to direct and coordinate an animal disease emergency. NMGs may include the chief executive officers of the Australian Government and state or territory governments where the emergency occurs, industry representatives, the Australian CVO (and chief medical officer, if applicable) and the chairman of Animal Health Australia.
Native wildlife	*See* Wild animals
OIE Terrestrial Code	*OIE Terrestrial Animal Health Code.* Reviewed annually at the OIE meeting in May and published on the internet at: **http://www.oie.int/eng/normes/mcode/a_summry.htm** *See* Appendix 3 for further details
OIE Terrestrial Manual	*OIE Manual of Standards for Diagnostic Tests and Vaccines for Terrestrial Animals.* Describes standards for laboratory diagnostic tests and the production and control of biological products (principally vaccines). The current edition is published on the internet at: **http://www.oie.int/eng/normes/mmanual/a_summry.htm** *See* Appendix 3 for further details

Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Plume (virus)	A dense aerosol of virus particles capable of moving over large distances on air currents.
Polymerase chain reaction	A method of amplifying and analysing DNA sequences that can be used to detect the presence of virus DNA.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.
Primary Industries Ministerial Council (PIMC)	The council of Australian national, state and territory and New Zealand ministers of agriculture that sets Australian and New Zealand agricultural policy (formerly the Agriculture and Resource Management Council of Australia and New Zealand). *See also* Animal Health Committee
Quarantine	Legal restrictions imposed on a place or a tract of land by the serving of a notice limiting access or egress of specified animals, persons or things.
Restricted area	A relatively small declared area (compared to a control area) around an infected premises that is subject to intense surveillance and movement controls. *See* Appendix 1 for further details
Risk enterprise	A defined livestock or related enterprise, which is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold stores, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges, garbage depots.
Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. *See also* Specificity
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Seroconversion	Appearance in the blood serum of antibodies following vaccination or natural exposure to a disease agent.

Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Special quarantine area	Comprises the restricted and control areas.
Specificity	The proportion of truly negative units that are correctly identified as a negative by a test. *See also* Sensitivity
Stamping out	Disease eradication strategy based on the quarantine and slaughter of all susceptible animals that are infected or exposed to the disease.
State or territory disease control headquarters	The emergency operations centre that directs the disease control operations to be undertaken in that state or territory.
Surveillance	A systematic program of investigation designed to establish the presence, extent of, or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.
Susceptible animals	Animals that can be infected with a particular disease
Suspect animal	An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted. OR An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises	Temporary classification of premises containing suspect animals. After rapid resolution of the status of the suspect animal(s) contained on it, a suspect premises is reclassified either as an infected premises (and appropriate disease-control measures taken) or as free from disease. *See* Appendix 1 for further details
Swill, swill feeding	Food scraps of placental mammal origin that have not been obtained from approved slaughter facilities or treated by an approved process. Feeding swill to pigs is illegal in Australia
TCID50	Tissue culture infectious dose — a measure of virus concentration or dose. Serial dilutions of virus are added to susceptible cells in culture. The dilution of virus at which half of the cultures are infected is called the TCID50.
Tracing	The process of locating animals, persons or other items that may be implicated in the spread of disease, so that appropriate action can be taken.

Vaccination	Inoculation of healthy individuals with weakened or attenuated strains of disease-causing agents to provide protection from disease.
– swamp vaccination	Widespread vaccination of a large proportion of susceptible animals.
– ring vaccination	Vaccination of susceptible animals around a focus of infection to provide a buffer against the spread of disease.
Vaccine	Modified strains of disease-causing agents that, when inoculated, stimulate an immune response and provide protection from disease.
– adjuvant	A vaccine in which the vaccine virus is combined with an *adjuvant* (a substance known to increase the immunogenicity of the vaccine).
–attenuated	A vaccine prepared from infective or 'live' microbes that have lost their virulence but have retained their ability to induce protective immunity.
– gene deleted	An attenuated or inactivated vaccine in which genes for nonessential surface glycoproteins have been removed by genetic engineering. This provides a useful immunological marker for the vaccine virus compared to the wild virus.
– inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.
– recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A *biological* vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A *mechanical* vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Vesicular disease	Any disease in which intact, ruptured or healing blisters, papules or ulcers may be evident on skin or mucosal surfaces.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. *See also* Epidemiological investigation
Viraemia	The presence of viruses in the blood.
Virus infection associated (VIA) antibody	Antibody produced in response to infection with FMD virus. The antibody response is the same irrespective of the serotype of the virus.

Wild animals	
– native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
– feral animals	Domestic animals that have become wild (eg cats, horses, pigs).
– exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
Zebu (cattle)	Bovine animals *(Bos indicus*) with characteristic large hump over the shoulders. Widely distributed in India, China, eastern Africa, etc and used for cross-breeding in Africa and northern parts of Australia.
Zoning	The process of defining disease-free and infected areas in accord with OIE guidelines, based on geopolitical boundaries and surveillance, in order to facilitate trade.
Zoonosis	A disease of animals that can be transmitted to humans.

Abbreviations

AAHL	Australian Animal Health Laboratory
AHA	Animal Health Australia
ANEMIS	Animal Health Emergency Information System
AQIS	Australian Quarantine and Inspection Service
AUSVETPLAN	Australian Veterinary Emergency Plan
CA	control area
CCEAD	Consultative Committee on Emergency Animal Diseases
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DAFF	Department of Agriculture, Fisheries and Forestry (Australian Government)
DCP	dangerous contact premises
DIVA	differentiating infected from vaccinated animals
EAD	emergency animal disease
ELISA	enzyme-linked immunosorbent assay
EXANDIS	(former) Exotic Animal Diseases Preparedness Consultative Council
FMD	foot-and-mouth disease
GATT	General Agreement on Tariffs and Trade
HTST	high temperature – short time (pasteurisation)
IP	infected premises
IU	infectious unit
IVB	International Vaccine Bank
LDCC	local disease control centre
NMG	national management group

OIE	World Organisation for Animal Health (Office International des Epizooties)
PCR	polymerase chain reaction
RA	restricted area
RH	relative humidity
RT-PCR	reverse transcriptase PCR
SDCHQ	state or territory disease control headquarters
SP	suspect premises
TCID	tissue culture infective dose
UHT	ultra-high temperature
VIA	virus infection associated [antibody]
WTO	World Trade Organization

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