SECTION I - INFECTIOUS AGENT

NAME: Venezuelan equine encephalitis virus

SYNONYM OR CROSS REFERENCE: Venezuelan equine encephalomyelitis, VEEV, VEE, Venezuelan equine fever, arbovirus

CHARACTERISTICS: This spherical arbovirus belongs to the Togaviridae family and is an alphavirus. It is 70 nm in diameter and has an enveloped single stranded RNA genome. There are six subtypes of VEE viruses, although only varieties AB and C of subtype 1 are epizootic, while the other subtypes and varieties are enzootic.

SECTION II - HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: In humans, this virus usually causes mild to severe influenza-like symptoms, however 4-14% of cases develop neurological complications. Children and young adults are more likely to develop encephalitis caused as a result of infection; however, fatalities in humans are rare at about 1% of all reported cases. Usually, flu-like symptoms such as headache, myalgia, fatigue, vomiting, nausea, diarrhoea, pharyngitis and fever appear abruptly, 2 to 5 days after exposure to the virus. The VEE virus can also cause retro-orbital and occipital headaches as well as leucopenia and tachycardia. Symptoms of encephalitis, only appearing in a minority of cases, occur 4-10 days after exposure and include somnolence, convulsions, confusion, photophobia, and coma. Lethal human cases are usually caused by encephalitis as well as brain, lung and gastrointestinal bleeding. Long-term neurological damage can be caused by this virus and it can infect the foetus in pregnant women causing birth defects and stillbirths. Generally, the symptoms last between 3 and 8 days and can be biphasic, recurring 4 to 8 days after the initial symptoms.

EPIDEMIOLOGY: The epizootic and enzootic strains of the VEE virus range from northern Argentina to Florida and parts of the Rocky Mountains; however, it is most prevalent in northern South America. The virus was first observed in horses in 1935 after outbreaks in Columbia, Venezuela and Trinidad, and was isolated in 1938. In the 1960's, over 200,000 human cases and 100,000 equine deaths were reported in Colombia and smaller epidemics occurred in Venezuela and Mexico. Between 75,000 and 100,000 infections were reported in Venezuela and Colombia in 1995. The outbreaks usually occur after a season of heavy rains, due to increases in the mosquito population. Vaccinations of equines with the TC-83 vaccine and protection against mosquitoes (protective clothing, insecticides) are some of the proposed ways to reduce VEE outbreaks.

HOST RANGE: Horses and humans are the most common hosts; however, a variety of other animals have been shown to be susceptible to infection. These include mammals such as cats, dogs, cattle, goats, pigs, rodents, and birds.

INFECTIOUS DOSE: 1 viral infectious particle injected subcutaneously is enough to infect an individual with the VEE virus.

MODE OF TRANSMISSION: The VEE virus is most often transmitted by infected mosquito bites, although, it is also very contagious through aerosols. Subcutaneous injection, nasal instillation, and contact with broken skin or contaminated animal bedding are other ways to spread the virus, particularly in a laboratory setting.
**INCUBATION PERIOD:** The incubation period is usually about 2 to 6 days after exposure to the virus, but can be as short as 24 hours (8, 10).

**COMMUNICABILITY:** Instances of person-to-person transmission have not been reported for the VEE virus, although an infected individual can transmit the virus to mosquitoes (8). Generally, humans and equines become infected by mosquitoes of the *Psorophora* and *Ochlerotatus* genera. Equines can spread the virus to each other through aerosols and to mosquitoes via bites (11).

**SECTION III - DISSEMINATION**

**RESERVOIR:** There are two types of cycles involved in the VEE virus (1). The enzootic cycle is maintained by rodents and mosquitoes (11). The epizootic cycle implicates horses, mosquitoes and humans, although there is the potential for the virus to affect many other animal species (11). Horses are the amplifying host in the cycle and are necessary for a larger outbreak of VEE (4).

**ZOOONOSIS:** Capable of zoonosis. This virus is spread between horses and humans via mosquitoes (11).

**VECTORS:** The VEE virus is typically spread by mosquitoes, although certain types of ticks and mites can spread the virus as well (3). The *Culex* (*Melanoconion*) mosquito is normally responsible for the dispersal of the enzootic strain of the VEE virus (3, 9). *Ochlerotatus taeniorhynchus, Psorophora confinis, Psorophora columbiae, Ochleratus sollicitans, Mansonia titillans* and *Anophilis aquasalis* are some of the species of mosquitoes known to carry the epizootic varieties of the VEE virus (3, 5, 7).

**SECTION IV - STABILITY AND VIABILITY**

**DRUG SUSCEPTIBILITY:** No drug susceptibilities have been determined to date (5).

**SUSCEPTIBILITY TO DISINFECTANTS:** Like other enveloped viruses, the VEE virus is susceptible to disinfectants such as 1% sodium hypochlorite, 4% formaldehyde, 2% gluteraldehyde, 70% ethanol, 3-6% hydrogen peroxide, 2% and peracetic acid (2).

**PHYSICAL INACTIVATION:** Microbial inactivation is possible using moist or dry heat (12). Togaviruses can be inactivated by 15 minutes of heat at 65 °C (13).

**SURVIVAL OUTSIDE HOST:** The virus is stable in blood and exudates as well as in freeze dried materials (aerosols) (9, 14).

**SECTION V - FIRST AID / MEDICAL**

**SURVEILLANCE:** Monitor for symptoms. Confirm infection by isolating the virus from CSF of infected individuals with CNS complications and determine the antibody titre by serology tests such as SN, CF, and HI tests (5, 13, 16). A number of laboratory techniques are available for confirmation of arbovirus infections, including PCR, ELISA and serology as well as immunohistochemical (IHC) staining of tissue sections (15).

Note: All diagnostic methods are not necessarily available in all countries.

**FIRST AID/TREATMENT:** No specific treatment available. Supportive treatment may be given to alleviate symptoms (8).

**IMMUNIZATION:** The investigational formalin inactivated TC-83 vaccine is available and recommended for lab workers. This vaccine is quite effective in preventing infection by the epizootic strains of the VEE virus (2, 13). While the TC-83 vaccine is used in labs, there is no licensed vaccine available for the general population (2).

**PROPHYLAXIS:** None apart from avoidance of mosquito bites.
SECTION VI - LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: Several laboratory-acquired cases of the VEE virus have been reported. As of 2006, a total of 186 cases and 2 deaths were documented (16). Most of these incidents were related to egg culture techniques, suckling mice and aerosol exposure (9). A physical exam and a careful medical check-up are recommended after a laboratory accident involving VEE in order to avoid laboratory-acquired infections (16).

SOURCES/SPECIMENS: Arboviruses may be present in blood, cerebrospinal fluid, urine and exudates (14). The virus may be found in nasal, eye and mouth secretions of infected animals as well as in contaminated animal bedding (5, 14).

PRIMARY HAZARDS: The greatest risks when working with the VEE virus are exposure to infected aerosols, accidental subcutaneous inoculation, and contact with broken skin or contaminated animal bedding (14).

SPECIAL HAZARDS: The VEE virus is fairly stable in dried blood and exudates (14).

SECTION VII - EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk group 3 (17).

CONTAINMENT REQUIREMENTS: Containment Level 3 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures.

PROTECTIVE CLOTHING: Personnel entering the laboratory should remove street clothing and jewellery, and change into dedicated laboratory clothing and shoes, or don full coverage protective clothing (i.e., completely covering all street clothing). Additional protection may be worn over laboratory clothing when infectious materials are directly handled, such as solid-front gowns with tight fitting wrists, gloves, and respiratory protection. Eye protection must be used where there is a known or potential risk of exposure to splashes (18).

OTHER PRECAUTIONS: All activities with infectious material should be conducted in a biological safety cabinet (BSC) or other appropriate primary containment device in combination with personal protective equipment. Centrifugation of infected materials must be carried out in closed containers placed in sealed safety cups, or in rotors that are loaded or unloaded in a biological safety cabinet. The use of needles, syringes, and other sharp objects should be strictly limited. Open wounds, cuts, scratches, and grazes should be covered with waterproof dressings. Additional precautions should be considered with work involving animals or large scale activities (18).

SECTION VIII - HANDLING AND STORAGE

SPILLS: Allow aerosols to settle and while wearing protective clothing, gently cover spill with paper towels and apply appropriate disinfectants, starting at the perimeter and working towards the centre. Allow sufficient contact time before clean up (18).

DISPOSAL: Decontaminate all material used before disposal via incineration, and steam sterilization (18).

STORAGE: Store in sealed containers that are appropriately labelled inside the locked containment level 3 laboratory (18).

SECTION IX - REGULATORY AND OTHER INFORMATION

REGULATORY INFORMATION: The import, transport, and use of pathogens in Canada is regulated under many regulatory bodies, including the Public Health Agency of Canada, Health Canada, Canadian Food Inspection Agency, Environment Canada, and Transport Canada. Users are
responsible for ensuring they are compliant with all relevant acts, regulations, guidelines, and standards.

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PREPARED BY: Pathogen Regulation Directorate, Public Health Agency of Canada.

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