

## Chapter 26

### BIOSAFETY

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## Appendix B. Pathogen and Toxin Lists

### B.1 Introduction and Scope

Pathogens and toxins are discussed in detail in Work Process B.3.d, *Pathogenic Agents and Toxins*, of this manual. This appendix lists the following biological agents and toxins presented in Work Process B.3.d:

- Human etiologic agents (pathogens) from Appendix B of the *NIH Guidelines*
- Select agents and toxins from the National Select Agent Registry (NSAR)
- Plant pathogens previously identified by U.S. Department of Agriculture (USDA)

These lists are provided for convenience in this manual, but may not reflect the actual regulatory list or applicable agents or materials. Regulatory sources, standards, and Web links noted in this appendix and Work Process B.3.d should be consulted to confirm applicable agents or toxins.

### B.2 *NIH Guidelines* Human Etiologic Agents

This section provides a list of human pathogens and their Risk Group (RG) 2, RG3, and RG4 designations as excerpted from Appendix B, Classification of Human Etiologic Agents on the Basis of Hazard, of the *NIH Guidelines*, amendment effective November 6, 2013.

#### B.2.1 Risk Group 1 Agents

RG1 agents are not associated with disease in healthy adult humans. Examples of RG1 agents include asporogenic *Bacillus subtilis* or *Bacillus licheniformis* (see *NIH Guidelines*, Appendix C-IV-A, *Bacillus subtilis* or *Bacillus licheniformis* Host-Vector Systems, Exceptions); adeno-associated virus (AAV, all serotypes); and recombinant or synthetic AAV constructs, in which the transgene does not encode either a potentially tumorigenic gene product or a toxin molecule and which are produced in the absence of a helper virus. A strain of *Escherichia coli* (see *NIH Guidelines*, Appendix C-II-A, *Escherichia coli* K-12 Host Vector Systems, Exceptions) is an RG1 agent if it (a) does not possess a complete lipopolysaccharide (i.e., lacks the O antigen) and (b) does not carry any active virulence factors (e.g., toxins) or colonization factors and does not carry any genes encoding these factors.

Those agents not listed in RGs 2, 3, and 4 are not automatically or implicitly classified in RG1; a risk assessment must be conducted based on the known and potential properties of the unlisted agents and their relationship to the listed agents.

#### B.2.2 Risk Group 2 Agents

RG2 agents are associated with human disease that is rarely serious and for which preventive or therapeutic interventions are *often* available.

### **Risk Group 2 Bacterial Agents, Including Chlamydia**

- *Acinetobacter baumannii* (formerly *Acinetobacter calcoaceticus*)
- *Actinobacillus*
- *Actinomyces pyogenes* (formerly *Corynebacterium pyogenes*)
- *Aeromonas hydrophila*
- *Amycolata autotrophica*
- *Archanobacterium haemolyticum* (formerly *Corynebacterium haemolyticum*)
- *Arizona hinshawii*: all serotypes
- *Bacillus anthracis*
- *Bartonella henselae*, *B. quintana*, *B. vinsonii*
- *Bordetella* including *B. pertussis*
- *Borrelia recurrentis*, *B. burgdorferi*
- *Burkholderia* (formerly *Pseudomonas* species) (except those listed in *NIH Guidelines*, Appendix B-III-A (RG3))
- *Campylobacter coli*, *C. fetus*, *C. jejuni*
- *Chlamydia psittaci*, *C. trachomatis*, *C. pneumoniae*
- *Clostridium botulinum*, *C. chauvoei*, *C. haemolyticum*, *C. histolyticum*, *C. novyi*, *C. septicum*, *C. tetani*
- *Coxiella burnetii*, specifically the Phase II, Nine Mile strain, plaque purified, clone 4
- *Corynebacterium diphtheriae*, *C. pseudotuberculosis*, *C. renale*
- *Dermatophilus congolensis*
- *Edwardsiella tarda*
- *Erysipelothrix rhusiopathiae*
- *Escherichia coli*: all enteropathogenic, enterotoxigenic, enteroinvasive and strains bearing K1 antigen, including *E. coli* O157:H7
- \**Francisella tularensis*, specifically \**F. tularensis* subspecies *novicida* (aka *F. novicida*), strain Utah 112; \**F. tularensis* subspecies *holarctica* LVS; \**F. tularensis* biovar *tularensis* strain ATCC 6223 (aka strain B38). \*For research involving high concentrations, BL3 practices should be considered.
- *Haemophilus ducreyi*, *H. influenzae*
- *Helicobacter pylori*
- *Klebsiella*: all species except *K. oxytoca* (RG1)
- *Legionella*, including *L. pneumophila*
- *Leptospira interrogans*: all serotypes
- *Listeria*
- *Moraxella*
- *Mycobacterium* (except those listed in Appendix B-III-A [RG3]), including *M. avium* complex, *M. asiaticum*, *M. bovis* BCG vaccine strain, *M. chelonae*, *M. fortuitum*, *M. kansasii*, *M. leprae*, *M. malmoense*, *M. marinum*, *M. paratuberculosis*, *M. scrofulaceum*, *M. simiae*, *M. szulgai*, *M. ulcerans*, *M. xenopi*
- *Mycoplasma*, except *M. mycoides* and *M. agalactiae*, which are restricted animal pathogens
- *Neisseria gonorrhoeae*, *N. meningitidis*
- *Nocardia asteroides*, *N. brasiliensis*, *N. otitidiscaviarum*, *N. Transvalensis*
- *Pseudomonas aeruginosa*
- *Rhodococcus equi*
- *Salmonella*, including *S. arizonae*, *S. cholerasuis*, *S. enteritidis*, *S. gallinarum-pullorum*, *S. meleagridis*, *S. paratyphi*, A, B, C, *S. typhi*, *S. typhimurium*
- *Shigella*, including *S. boydii*, *S. dysenteriae*, type 1, *S. flexneri*, *S. sonnei*

- *Sphaerophorus necrophorus*
- *Staphylococcus aureus*
- *Streptobacillus moniliformis*
- *Streptococcus*, including *S. pneumoniae*, *S. pyogenes*
- *Treponema pallidum*, *T. carateum*
- *Vibrio cholerae*, *V. parahemolyticus*, *V. vulnificus*
- *Yersinia enterocolitica*
- *Yersinia pestis*, specifically  $pgm^{(-)}$  strains (lacking the 102 kb pigmentation locus) and  $lcr^{(-)}$  strains (lacking the LCR plasmid)

### **Risk Group 2 Fungal Agents**

- *Blastomyces dermatitidis*
- *Cladosporium bantianum*, *C. (Xylohypha) trichoides*
- *Cryptococcus neoformans*
- *Dactylaria galopava (Ochroconis gallopavum)*
- *Epidermophyton*
- *Exophiala (Wangiella) dermatitidis*
- *Fonsecaea pedrosoi*
- *Microsporium*
- *Paracoccidioides braziliensis*
- *Penicillium marneffeii*
- *Sporothrix schenckii*
- *Trichophyton*

### **Risk Group 2 Parasitic Agents**

- *Ancylostoma* human hookworms, including *A. duodenale*, *A. ceylanicum*
- *Ascaris*, including *Ascaris lumbricoides suum*
- *Babesia*, including *B. divergens*, *B. microti*
- *Brugia* filaria worms, including *B. malayi*, *B. timori*
- *Coccidia*
- *Cryptosporidium*, including *C. parvum*
- *Cysticercus cellulosae* (hydatid cyst, larva of *T. solium*)
- *Echinococcus*, including *E. granulosus*, *E. multilocularis*, *E. vogeli*
- *Entamoeba histolytica*
- *Enterobius*
- *Fasciola*, including *F. gigantica*, *F. hepatica*
- *Giardia*, including *G. lamblia*
- *Heterophyes*
- *Hymenolepis*, including *H. diminuta*, *H. nana*
- *Isospora*
- *Leishmania*, including *L. braziliensis*, *L. donovani*, *L. ethiopia*, *L. major*, *L. mexicana*, *L. peruviana*, *L. tropica*
- *Loa loa* filaria worms
- *Microsporidium*
- *Naegleria fowleri*
- *Necator* human hookworms, including *N. americanus*
- *Onchocerca* filaria worms, including *O. volvulus*
- *Plasmodium*, including simian species, *P. cynomologi*, *P. falciparum*, *P. malariae*, *P. ovale*, *P. vivax*
- *Sarcocystis*, including *S. sui hominis*

- *Schistosoma*, including *S. haematobium*, *S. intercalatum*, *S. japonicum*, *S. mansoni*, *S. mekongi*
- *Strongyloides*, including *S. stercoralis*
- *Taenia solium*
- *Toxocara*, including *T. canis*
- *Toxoplasma*, including *T. gondii*
- *Trichinella spiralis*
- *Trypanosoma*, including *T. brucei brucei*, *T. brucei gambiense*, *T. brucei rhodesiense*, *T. cruzi*
- *Wuchereria bancrofti* filaria worms

## Risk Group 2 Viruses

- Adenoviruses, human: All types
- Alphaviruses (Togaviruses), group A Arboviruses:
  - Chikungunya vaccine strain 181/25
  - Eastern equine encephalomyelitis virus
  - Venezuelan equine encephalomyelitis vaccine strain TC-83
  - Western equine encephalomyelitis virus
- Arenaviruses:
  - Junin virus candid #1 vaccine strain
  - Lymphocytic choriomeningitis virus (non-neurotropic strains)
  - Tacaribe virus complex
  - Other viruses as listed in [BMBL](#)
- *Bunyaviruses*:
  - Bunyamwera virus
  - Rift Valley fever virus vaccine strain MP-12
  - Other viruses as listed in [BMBL](#)
- Calciviruses
- Coronaviruses
- Flaviviruses, Group B Arboviruses:
  - Dengue virus, serotypes 1, 2, 3, and 4
  - Japanese encephalitis virus strain SA 14-14-2
  - Yellow fever virus vaccine strain 17D
  - Other viruses as listed in [BMBL](#)
- Hepatitis A, B, C, D, and E viruses
- Herpesviruses, except *Herpesvirus simiae* (monkey B virus) (see Appendix B-IV-D, Risk Group 4 (RG4) – Viral Agents):
  - Cytomegalovirus
  - Epstein Barr virus
  - *Herpes simplex*, types 1 and 2
  - *Herpes zoster*
  - Human herpesvirus, types 6 and 7
- Orthomyxoviruses:
  - Influenza viruses, types A, B, and C
  - Tick-borne orthomyxoviruses
- Papilloma viruses: All human papilloma viruses
- Paramyxoviruses:
  - Newcastle disease virus
  - Measles virus
  - Mumps virus
  - Parainfluenza viruses, types 1, 2, 3, and 4
  - Respiratory syncytial virus

- Parvoviruses: Human parvovirus (B19)
- Picornaviruses:
  - Coxsackie viruses, types A and B
  - Echoviruses, all types
  - Polioviruses, all types, wild and attenuated
  - Rhinoviruses, all types
- Poxviruses: All types except monkeypox virus (see Appendix B-III-D, *Risk Group 3 (RG3)—Viruses and Prions*) and restricted poxviruses including Alastrim, Smallpox, and Whitepox (see [BMBL](#) Section V-L)
- Reoviruses: All types including Coltivirus, human Rotavirus, and Orbivirus (Colorado tick fever virus)
- Rhabdoviruses:
  - Rabies virus, all strains
  - Vesicular stomatitis virus non exotic strains: VSV-Indiana 1 serotype strains (e.g., Glasgow, Mudd-Summers, Orsay, San Juan) and VSV-New Jersey serotype strains (e.g., Ogden, Hazelhurst)
- Rubivirus (Togaviruses), Rubella virus

### B.2.3 Risk Group 3 Agents

RG3 agents are associated with serious or lethal human disease for which preventive or therapeutic interventions *may be* available.

#### Risk Group 3 Bacterial Agents Including Rickettsia

- *Bartonella*
- *Brucella* including *B. abortus*, *B. canis*, *B. suis*
- *Burkholderia (Pseudomonas) mallei*, *B. pseudomallei*
- *Coxiella burnetii* (except the Phase II, Nine Mile strain listed in *NIH Guidelines Appendix B-II-A, Risk Group 2 (RG2) - Bacterial Agents Including Chlamydia*)
- *Francisella tularensis* (except those strains listed in *NIH Guidelines Appendix B-II-A, Risk Group 2 (RG2) - Bacterial Agents Including Chlamydia*)
- *Mycobacterium bovis* (except BCG strain, see *NIH Guidelines Appendix B-II-A, Risk Group 2 (RG2) - Bacterial Agents Including Chlamydia*), *M. tuberculosis*
- *Pasteurella multocida* type B: "Buffalo" and other virulent strains
- *Rickettsia akari*, *R. australis*, *R. canada*, *R. conorii*, *R. prowazekii*, *R. rickettsii*, *R. siberica*, *R. tsutsugamushi*, *R. typhi* (*R. mooseri*)
- *Yersinia pestis* (except those strains listed in *NIH Guidelines Appendix B-II-A, Risk Group 2 (RG2) - Bacterial Agents Including Chlamydia*)

#### Risk Group 3 Fungal Agents

- *Coccidioides immitis* (sporulating cultures, contaminated soil)
- *Histoplasma capsulatum*, *H. capsulatum* var. *duboisii*

#### Risk Group 3 Parasitic Agents

None

#### Risk Group 3 Viruses and Prions

- Alphaviruses (Togaviruses), Group A Arboviruses:
  - Chikungunya virus (except the vaccine strain 181/25 listed in *NIH Guidelines Appendix B-II-D Risk Group 2 (RG2) – Viruses*)
  - Semliki Forest virus
  - St. Louis encephalitis virus
  - Venezuelan equine encephalomyelitis virus (except the vaccine strain TC-83, see Appendix B-II-D (RG2))
  - Other viruses as listed in **BMBL**
- Arenaviruses:
  - Flexal
  - Lymphocytic choriomeningitis virus (LCM) (neurotropic strains)
- Bunyaviruses:
  - Hantaviruses, including Hantaan virus
  - Rift Valley fever virus
- Coronaviruses, SARS-associated coronavirus (SARS-CoV)
- Flaviviruses (togaviruses), group B arboviruses:
  - Japanese encephalitis virus (except those strains listed in *NIH Guidelines Appendix B-II-D Risk Group 2 (RG2) - Viruses*)
  - West Nile virus (WNV)
  - Yellow fever virus
  - Other viruses as listed in **BMBL**
- Middle East Respiratory Syndrome coronavirus (MERS-CoV)
- Orthomyxoviruses: Influenza viruses 1918–1919 H1N1 (1918 H1N1), human H2N2 (1957–1968), and highly pathogenic avian influenza H5N1 strains within the Goose/Guangdong/96-like H5 lineage (HPAI H5N1)
- Poxviruses: Monkeypox virus
- Prions: Transmissible spongiform encephalopathy (TME) agents (Creutzfeldt-Jacob disease and kuru agents) (see **BMBL**, for containment instruction)
- Retroviruses:
  - Human immunodeficiency virus (HIV) types 1 and 2
  - Human T cell lymphotropic virus (HTLV) types 1 and 2
  - Simian immunodeficiency virus (SIV)
- Rhabdoviruses: Vesicular stomatitis virus (except those strains listed in *NIH Guidelines Appendix B-II-D Risk Group 2 (RG2) - Viruses*)

## B.2.4 Risk Group 4 Agents

RG4 agents are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are *not usually* available.

### Risk Group 4 Bacterial Agents

None

### Risk Group 4 Fungal Agents

None

### Risk Group 4 Parasitic Agents

None

### Risk Group 4 Viral Agents

- Arenaviruses:

- Guaranito virus
- Lassa virus
- Junin virus (except the candid #1 vaccine strain listed in [Appendix B-II-D Risk Group2 \(RG2\) – Viruses](#))
- Machupo virus
- Sabia
- Bunyaviruses (Nairovirus): Crimean-Congo hemorrhagic fever virus
- Filoviruses:
  - Ebola virus
  - Marburg virus
- Flaviruses (Togaviruses), Group B Arboviruses: Tick-borne encephalitis virus complex including Absetterov, Central European encephalitis, Hanzalova, Hypr, Kumlinge, Kyasanur Forest disease, Omsk hemorrhagic fever, and Russian spring-summer encephalitis viruses
- Herpesviruses (alpha): Herpesvirus simiae (Herpes B or Monkey B virus)
- Paramyxoviruses: Equine morbillivirus (Hendra virus)
- Hemorrhagic fever agents and viruses as yet undefined

## **B.2.5 Animal Viral Etiologic Agents in Common Use**

The following list of animal etiologic agents is appended to the list of human etiologic agents. None of these agents are associated with disease in healthy adult humans; however, they are commonly used in laboratory experimental work. A containment level appropriate for RG1 human agents is recommended for their use. For agents that are infectious to human cells, e.g., amphotropic and xenotropic strains of murine leukemia virus, a containment level appropriate for RG2 human agents is recommended.

- Baculoviruses
- Herpesviruses:
  - Herpesvirus ateles
  - Herpesvirus saimiri
  - Marek's disease virus
  - Murine cytomegalovirus
- Papilloma viruses:
  - Bovine papilloma virus
  - Shope papilloma virus
- Polyoma viruses:
  - Polyoma virus
  - Simian virus 40 (SV40)
- Retroviruses:
  - Avian leukosis virus
  - Avian sarcoma virus
  - Bovine leukemia virus
  - Feline leukemia virus
  - Feline sarcoma virus
  - Gibbon leukemia virus
  - Mason-Pfizer monkey virus
  - Mouse mammary tumor virus
  - Murine leukemia virus
  - Murine sarcoma virus
  - Rat leukemia virus

## B.2.6 Murine Retroviral Vectors

Murine retroviral vectors to be used for human transfer experiments (less than 10 liters) that contain less than 50% of their respective parental viral genome and that have been demonstrated to be free of detectable replication-competent retrovirus can be maintained, handled, and administered under Biosafety Level (BL) 1 containment.

## B.3 Select Agents and Toxins

Table B-1 provides the list of select agents and toxins on the **National Select Agent Registry (NSAR)** established by the Department of Health and Human Services (HHS) Centers for Disease Control and Prevention (CDC) and United States Department of Agriculture (USDA). The most recent online list may be found at <http://www.selectagents.gov/index.html>. Listed select agents and toxins are categorized as follows:



- Agents and toxins that cause disease in humans are listed by HHS CDC as:
  - HHS select agents and toxins that affect humans
  - Overlap select agents and toxins that affect both (or overlap with) humans and animals
- Agents and toxins that cause disease in agricultural animals or plants are listed by USDA as:
  - Overlap select agents and toxins that affect humans and animals
  - USDA select agents and toxins that affect animals
  - USDA Plant Protection and Quarantine (PPQ) select agents and toxins that affect plants

<b>Table B-1. National Select Agent Registry of Select Agents and Toxins</b>	
<b>HHS and USDA Select Agents and Toxins</b> 7 CFR Part 331, 9 CFR Part 121, and 42 CFR Part 73	
<p><b>HHS Select Agents and Toxins</b></p> <ul style="list-style-type: none"> <li>• Abrin</li> <li>• Botulinum neurotoxins*</li> <li>• Botulinum neurotoxin producing species of <i>Clostridium</i>*</li> <li>• Conotoxins (Short, paralytic alpha conotoxins containing the following amino acid sequence X<sub>1</sub>CCX<sub>2</sub>PACGX<sub>3</sub>X<sub>4</sub>X<sub>5</sub>X<sub>6</sub>CX<sub>7</sub>)</li> <li>• <i>Coxiella burnetii</i></li> <li>• Crimean-Congo hemorrhagic fever virus</li> <li>• Diacetoxyscirpenol</li> <li>• Eastern Equine Encephalitis virus</li> </ul>	<p><b>Overlap Select Agents and Toxins</b></p> <ul style="list-style-type: none"> <li>• <i>Bacillus anthracis</i>*</li> <li>• <i>Bacillus anthracis</i> Pasteur strain</li> <li>• <i>Brucella abortus</i></li> <li>• <i>Brucella melitensis</i></li> <li>• <i>Brucella suis</i></li> <li>• <i>Burkholderia mallei</i>* (formerly <i>Pseudomonas mallei</i>)</li> <li>• <i>Burkholderia pseudomallei</i>* (formerly <i>Pseudomonas pseudomallei</i>)</li> <li>• Hendra virus</li> <li>• Nipah virus</li> <li>• Rift Valley fever virus</li> </ul>



**Table B-1. National Select Agent Registry of Select Agents and Toxins**

**HHS and USDA Select Agents and Toxins  
7 CFR Part 331, 9 CFR Part 121, and 42 CFR Part 73**

<ul style="list-style-type: none"> <li>• Ebola virus*</li> <li>• <i>Francisella tularensis</i>*</li> <li>• Lassa fever virus</li> <li>• Lujo virus</li> <li>• Marburg virus*</li> <li>• Monkeypox virus</li> <li>• Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments (Reconstructed 1918 Influenza virus)</li> <li>• Ricin</li> <li>• <i>Rickettsia prowazekii</i></li> <li>• SARS-associated coronavirus (SAARS-CoV)</li> <li>• Saxitoxin</li> <li>• South American hemorrhagic fever viruses (Chapare, Guanarito, Junin, Machupo, Sabia)</li> <li>• Staphylococcal enterotoxins A, B, C, D, E subtypes</li> <li>• T-2 toxin</li> <li>• Tetrodotoxin</li> <li>• Tick-borne encephalitis complex (flavi) viruses (Far Eastern subtype, Siberian subtype, Kyasanur Forest disease virus, Omsk hemorrhagic fever virus)</li> <li>• Variola major virus (Smallpox virus)*</li> <li>• Variola minor virus (Alastrim)*</li> <li>• <i>Yersinia pestis</i>*</li> </ul>	<ul style="list-style-type: none"> <li>• Venezuelan equine encephalitis virus</li> </ul> <p><b>USDA Select Agents and Toxins</b></p> <ul style="list-style-type: none"> <li>• African horse sickness virus</li> <li>• African swine fever virus</li> <li>• Avian influenza virus</li> <li>• Classical swine fever virus</li> <li>• Foot-and-mouth disease virus*</li> <li>• Goat pox virus</li> <li>• Lumpy skin disease virus</li> <li>• <i>Mycoplasma capricolum</i></li> <li>• <i>Mycoplasma mycoides</i></li> <li>• Newcastle disease virus <sup>1</sup></li> <li>• Peste des petits ruminants virus</li> <li>• Rinderpest virus*</li> <li>• Sheep pox virus</li> <li>• Swine vesicular disease virus</li> </ul> <p><b>USDA Plant Protection and Quarantine (PPQ) Select Agents and Toxins</b></p> <ul style="list-style-type: none"> <li>• <i>Peronosclerospora philippinensis</i> (<i>Peronosclerospora sacchari</i>)</li> <li>• <i>Phoma glycinicola</i> (formerly <i>Pyrenochaeta glycines</i>)</li> <li>• <i>Ralstonia solanacearum</i></li> <li>• <i>Rathayibacter toxicus</i></li> <li>• <i>Sclerophthora rayssiae</i></li> <li>• <i>Synchytrium endobioticum</i></li> <li>• <i>Xanthomonas oryzae</i></li> </ul>
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Source: NSAR list updated 10/5/2012

\* Denotes Tier 1 Agent

<sup>1</sup> A virulent Newcastle disease virus (avian paramyxovirus serotype 1) has an intracerebral pathogenicity index in day-old chicks (*Gallus gallus*) of 0.7 or greater or has an amino acid sequence at the fusion (F) protein cleavage site that is consistent with virulent strains of Newcastle disease virus. A failure to detect a cleavage site that is consistent with virulent strains does not confirm the absence of a virulent virus.

Table B-2 provides additional information, permissible toxin amounts, and synonyms for biological toxins listed on the NSAR of select agents and toxins. A permissible toxin amount is

the maximum quantity of biological toxin that can be under the control of a principal investigator at any time without regulation under CDC or USDA.

**Table B-2. Additional Information for National Select Agent Registry Toxins**

Name (Permissible Toxin Amount)	Synonyms/Types (Strains)/ Key Words	CAS Numbers	Description
Abrin (100 mg)	Abrina, Abrin B, Abrin C, Abrin D, Abrin reconstituted (A+B mix), Abrin agglutinin, Toxalbumin	<b>1393-62-0</b> (Abrin) <b>53597-23-2</b> (Abrin A) <b>53597-24-3</b> (Abrin C)	A powerful phytotoxin present in the seeds of <i>Abrus precatorius</i> (common names include precatory bean, rosemary pea, and jequirity).
Botulinum neurotoxin (0.5 mg)	Botulinum neurotoxin, Types A, B, C, C1, C2, D, E, F, and G (seven serotypes with a few subtypes). <i>Clostridium botulinum</i> toxin, botulinum toxin, botulinus toxin, botulin toxin	<b>93384-43-1</b> (Type A)	Produced by the soil bacterium <i>Clostridium botulinum</i> under anaerobic conditions. The most potent toxin known but is heat labile and neutralized by specific antibodies.
Conotoxins (100 mg)	Only short, paralytic alpha conotoxins containing the amino acidsequence X <sub>1</sub> CCX <sub>2</sub> PACGX <sub>3</sub> X <sub>4</sub> X <sub>5</sub> X <sub>6</sub> CX <sub>7</sub> are HHS select toxins. The specific conotoxins listed below may or may not meet NSAR’s more-specific 10/5/12 definition of conotoxins: Conotoxins GI, GIA, GII, GIV, GIIIA, GIIIB, GIIIC, GIVA, GVIB, GVIC, Im1, MI,MVIIA,MVIIIB, MVIIC,MVIIv, MVIIDSIA, SVIB (plus more). <i>Conus geographus</i> venom, <i>Conus magus</i> venom, <i>Conus straiatus</i> venom	<b>81133-24-6</b> (IV) <b>76862-65-2</b> (GI) <b>156467-85-5</b> (Im 1) <b>106375-28-4</b> (GVIA) <b>107452-89-1</b> (MVIIA) <b>147794-23-8</b> (MVIIC) <b>150433-82-2</b> (SVIB) The above CAS numbers may or may not meet NSAR’s more specific 10/5/12 definition of conotoxins.	Small peptide venoms produced by cone shells (Conidia) and marine snails (carnivorous gastropod “cone” mollusks). Venoms vary between species. Act on neuronal communications but each (alpha-mu- and omega-conotoxins) target a different aspect of the process.
Diacetoxyscirpenol (1,000 mg)	Diacetoxyscirpenol; Anguidin; Auguidine; Insariotoxin; DAS; 4,15-Diacetoxyscirpen-3-OL; Scirpenetriol 4,15-diacetate; 4 beta, 15-diacetoxy-3-alpha-hydroxy-12, 13-epoxytrichotech-9-ene	<b>2270-40-8</b> <b>4297-61-4</b> (3-A-acetyldiacetoxyscirpenol).	Trichothecene compound toxins (mycotoxins) produced by various fungus <i>Fusarium</i> , which grow on barley, corn, rye, wheat, etc.
Ricin (100 mg)	Ricinotoxin, Ricinus toxin, Ricin A, Ricin B, Ricin C, Ricin D, Ricin Toxin-Con A, Concanvalin A, Ricin nitrogen, Ricine, Ricin	<b>9009-86-3</b> (Ricin), <b>63099-95-6</b> <b>9040-12-4</b> (Ricin D) <b>72514-84-</b>	A powerful phytotoxin present in the seeds of the castor bean oil

**Table B-2. Additional Information for National Select Agent Registry Toxins**

Name (Permissible Toxin Amount)	Synonyms/Types (Strains)/ Key Words	CAS Numbers	Description
	total hydrolysate, Ricinus lectin, <i>Ricinusagglutinin</i>	<b>2</b> (Ricin D ananine chain) <b>66419-04-03</b> (Ricin D iso-leucine chain reduced)	plant ( <i>Ricinus communis</i> ).
Saxitoxin (100 mg)	Mytilotoxin; Saxitoxin hydrate; Saxitoxin hydrochloride; Saxitoxin dihydrochloride; STX dihydrochloride; neo-Saxitoxin (neo-STX); Saxitoxin p-bromo benzenesulfonate; <i>Mytilus californianus</i> poison/toxin; <i>Saxidomas giganteus</i> poison/ toxin; <i>Gonyaulax catenella</i> poison/ toxin; Saxitonin diacetate salt	<b>35523-89-8</b> <b>35554-08-6</b> <b>80450-05-01</b> <b>64296-20-4</b> (neo-STX from dinoflagellates) <b>220355-66-8</b> (Saxitoxin doacetate salt)	Toxin produced by marine dinoflagellates and cyanobacteria and accumulate in organisms such as mussels ( <i>Mytilus</i> ), and clams ( <i>Saxidomas</i> ).
Staphylococcal enterotoxin (5.0 mg)	Staphylococcus enterotoxins subtypes A,B,C, D, E are HHS select toxins. Enterotoxin F is the Toxic Shock Syndrome "Toxin-1" and is not a HHS select toxin.	<b>11100-45-1</b> (Enterotoxin B)	Toxin produced by a strain of <i>Staphylococcus aureus</i> . Acts on receptors in gut.
Tetrodotoxin (100 mg)	Fugu poison; fugtoxin; Anhydroepitetrodotoxin; Deoxytetrodotoxin; 4-Deoxytetrodotoxin; Deoxytetrotoxin; Diatelylanhydrotetrodotoxin; Diacetate 4,9-anhydrotetrodotoxin; Ethoxytetrodotoxin; Maculotoxin; Ethyl tetrodotoxin; 4-Deoxy tetrodotoxin; Spheroidine; Tarichatoxin; 4-amino-4-deoxy, 4,9-Anhydrotetrodotoxin; 8,8-Diacetate 4,9-anhydrotetrodotoxin; tetrodotoxin citrate; TTX; (4-alpha)-4-amino-4-deoxy-tetrodotoxin	<b>4368-28-9</b> (tetrodotoxin) <b>13072-89-4</b> (4,9-anhydrotetrodotoxin) <b>13285-84-2</b> (8,8-diacetate 4,9-anhydro tetrodotoxin) <b>7724-38-1</b> ([4 alpha]-4-amino-4-deoxy-tetrodotoxin) <b>7724-41-6</b> (4-deoxy-tetrodotoxin) <b>18660-81-6</b> (Tetrodotoxin citrate salt) <b>7724-39-2</b> (O <sup>4</sup> - methyl tetrodotoxin) <b>7724-40-5</b> (O <sup>5</sup> -ethyl tetrodotoxin)	Highly lethal neurotoxin present in numerous species of puffer fish ( <i>Tetraodontoidea</i> ) and newts ( <i>Tarika</i> ).
T-2 Toxin (1000 mg)	Toxin T-2; T-2 mycotoxin; T-2 hemisuccinate; T-2 tetraol; T-2 Toxin d3; T-2 Triol; 2,4,5-T-2 ethylhexyl ester; 2,4,5-T-2 methylpropyl ester; Insariotoxin; 12,13-tricothecene; Fusariotoxine T-2; Scirpenol	<b>21259-20-1</b> (T-2 Toxin) <b>34114-99-3</b> (T-2 tetraol) <b>120467-83-6</b> (T-2 Toxind3) <b>34114-98-2</b> (T-2 triol) <b>1928-47-8</b> (2,4,5-T2 ethylhexyl ester)	Tricothecene compound toxins (mycotoxins) produced by various species of fungus <i>Fusarium</i> , which grows on

**Table B-2. Additional Information for National Select Agent Registry Toxins**

Name (Permissible Toxin Amount)	Synonyms/Types (Strains)/ Key Words	CAS Numbers	Description
		<b>4938-72-1</b> (2,4,5-T-2-methylpropyl ester)	barley, corn, rye, and wheat.

Source: LBNL EHS Division (July 2003), revised to reflect changes to NSAR effective 10/5/2012

## B.4 Plant Pathogens

This appendix of the *Biosafety Manual* provides lists of bacterial, fungal, and viral plant pathogens that may be used to identify agents that might be considered plant pathogens. Current USDA Web sites and the USDA permit process may also be used to determine whether the USDA considers agents in specific locations (e.g., California) to be plant pathogens.

### B.4.1 Plant Pathogen Bacteria (by Scientific Name)

*Agrobacterium radiobacter*, *Agrobacterium rubi*, *Agrobacterium tumefaciens*, *Agrobacterium vitis*, *Burkholderia andropogonis*, *Burkholderia caryophylli*, *Burkholderia cepacia*, *Burkholderia cichorii*, *Burkholderia corrugata*, *Burkholderia gladioli* pv. *gladioli*, *Clavibacter michiganensis* subsp. *insidiosus*, *Clavibacter michiganensis* subsp. *michiganensis*, *Clavibacter michiganensis* subsp. *sepedonicus*, *Curtobacterium flaccumfaciens* pv. *flaccumfaciens*, *Erwinia amylovora*, *Erwinia carotovora* subsp. *atroseptica*, *Erwinia carotovora* subsp. *carotovora*, *Erwinia chrysanthemi*, *Erwinia chrysanthemi* pv. *chrysanthemi*, *Erwinia chrysanthemi* pv. *dieffenbachiae*, *Erwinia chrysanthemi* pv. *zeae*, *Erwinia tracheiphila*, *Pantoea stewartii* subsp. *stewartii*, *Pseudomonas syringae* pv. *apii*, *Pseudomonas syringae* pv. *atofaciens*, *Pseudomonas syringae* pv. *coronafaciens*, *Pseudomonas syringae* pv. *glycinea*, *Pseudomonas syringae* pv. *lachrymans*, *Pseudomonas syringae* pv. *mori*, *Pseudomonas syringae* pv. *papulans*, *Pseudomonas syringae* pv. *phaseolicola*, *Pseudomonas syringae* pv. *pisi*, *Pseudomonas syringae* pv. *syringae*, *Pseudomonas syringae* pv. *tabaci*, *Pseudomonas syringae* pv. *tomato1*, *Ralstonia solanacearum*2, *Rhodococcus fascians*, *Spiroplasma citri*, *Streptomyces scabies*, *Xanthomonas campestris* pv. *armoraciae*, *Xanthomonas campestris* pv. *campestris*, *Xanthomonas campestris* pv. *carotae*, *Xanthomonas campestris* pv. *cucurbitae*, *Xanthomonas campestris* pv. *hederae*, *Xanthomonas campestris* pv. *juglandis*, *Xanthomonas campestris* pv. *papavericola*, *Xanthomonas campestris* pv. *pelargonii*, *Xanthomonas campestris* pv. *pruni*, *Xanthomonas campestris* pv. *raphani*, *Xanthomonas campestris* pv. *vitians*, *Xanthomonas campestris* pv. *zinniae*, *Xanthomonas fragariae*, *Xanthomonas phaseoli* pv. *alfalfae*, *Xanthomonas phaseoli* pv. *begoniae*, *Xanthomonas phaseoli* pv. *glycines*, *Xanthomonas phaseoli* pv. *phaseoli*, *Xanthomonas translucens* pv. *translucens*, *Xanthomonas vesicatoria*.

### B.4.2 Plant Pathogen Fungi (by Scientific Name)

#### CHYTRIDIOMYCETES

*Physoderma maydis*

## **OOMYCETES**

*Albugo candida*, *Peronospora sojae*, *Peronospora trifoliorum*, *Peronospora viticola*, *Phytophthora cactorum*, *Phytophthora capsici*, *Phytophthora cinnamomi*, *Phytophthora citricola*, *Phytophthora fragariae*, *Phytophthora infestans*, *Phytophthora megasperma*, *Phytophthora megasperma* f.sp. *medicaginis*, *Phytophthora rubi* s.sp. *fragariae*, *Phytophthora sojae*, *Plasmodiophora brassicae*, *Pythium aphanidermatum*, *Pythium arrhenomanes*, *Pythium graminicola*, *Pythium irregulare*, *Pythium ultimum*, *Sclerophthora macrospora*.

## **ASCOMYCETES**

*Apiosporina morbosa* (black knot), *Botryosphaeria obtusa*, *Botryosphaeria ribis* (*B. dothidea*, *B. berengeriana*), *Claviceps purpurea*, *Cymadothea trifolii* (sooty blotch), *Diaporthe phaseolorum*, *Gaeumannomyces graminis*, *Gibberella zeae*, *Glomerella cingulata*, *Leptosphaerulina trifolii*, *Monilinia fructicola* (*Sclerotinia fructicola*), *Nectria cinnabarina*, *Ophiostoma ulmi* (*Ceratocystis ulmi*), *Pseudopeziza medicaginis*, *Pseudopeziza trifolii*, *Sclerotinia sclerotiorum* (*Whetzelinia sclerotiorum*), *Sclerotinia trifoliorum*, *Valsa ambiens*, *Venturia inaequalis* (apple scab), *Xylaria polymorpha*.

## **Powdery Mildews**

*Erysiphe graminis*, *Microsphaera vaccinii* (on *Ericaceae*), *Podosphaera clandestina* (on *Rosaceae*), *Sphaerotheca Asteraceae*, *Cucurbitaceae*, *Scrophulariaceae*), *Sphaerotheca macularis* (on hops and strawberry), *Unicinula viticola*.

## **Coelomycetes**

*Colletotrichum acutatum*, *Colletotrichum coccodes*, *Colletotrichum destructivum*, *Colletotrichum fragariae*, *Colletotrichum gloeosporioides*, *Colletotrichum graminicola*, *Colletotrichum trifolii*, *Macrophomina phaseolina* (*Macrophoma phaseolina*, *M. phaseoli*, *Botryodiplodia phaseoli*), *Phoma medicaginis*, *Phomopsis juniperovora*, *Phomopsis sojae*, *Phomopsis viticola*, *Septoria rubi*, *Septoria tritici*, *Sphaeropsis sapinea* (*Diplodia pinea*), *Stagonospora nodorum* (*Septoria nodorum*), *Stenocarpelia maydis* (*Diplodia zeae*, *D. zeae-maydis*).

## **Hyphomycetes**

*Alternaria alternata*, *Alternaria solani*, *Bipolaris maydis* (*Heminthosporium maydis*, *Drechslera maydis*), *Bipolaris sorokiniana* (*Helminthosporium sorokiniana*, *Drechslera sorokiniana*), *Bipolaris victoriae* (*Helminthosporium victoriae*, *Drechslera victoriae*), *Botrytis cinerea*.

*Cercospora medicaginis*, *Cercospora zeae-maydis*, *Cladosporium herbarum*, *Drechslera avenae* (on oats, other grasses), *Drechslera graminea* (on barley, other grasses), *Drechslera poae* (on grasses), *Drechslera teres* (on barley, other grasses), *Drechslera tritici-repentis* (on cereals, other grasses), *Exserohilum turcicum* (*Helminthosporium turcicum*, *Bipolaris turcicum*), *Fusarium acuminatum*, *Fusarium avenaceum*, *Fusarium culmorum*, *Fusarium equiseti*, *Fusarium graminearum*, *Fusarium moniliforme*, *Fusarium oxysporum*, *Fusarium oxysporum*, *Fusarium roseum*, *Fusarium solani*, *Penicillium expansum*, *Rhynchosporium secalis*, *Thielaviopsis basicola*, *Verticillium albo-atrum*, *Verticillium dahliae*.

## **HEMIASCOMYCETES**

*Taphrina caerulescens* (leaf blister on oak, *Ostrya*, *Rhus*), *Taphrina communis* (plum pocket on Prunus), *Taphrina deformans* (peach leaf curl).

## **BASIDIOMYCETES**

### **Wood Rotters and Root-Collar Rotters**

*Armillaria mellea*, *Ceratobasidium cerealea*, *Daedaleopsis confragosa* (*Daedalea confragosa*), *Ganoderma applanatum* (*Fomes applanatus*), *Ganoderma lucidum*, *Hirschioporus pargamenus* (*Trichaptum bififormis*, *Polyporus pargamenus*), *Laetiporus sulphureus* (*Polyporus sulphureus*), *Phellinus gilii*, *Phellinus robiniae*, *Schizophyllum commune*, *Stereum ostrea*, *Trametes versicolor* (*Polyporus versicolor*, *Coriolus versicolor*).

### **Rusts**

*Gymnosporangium clavipes* (cedar-quince rust), *Gymnosporangium globosum* (cedar-hawthorn rust), *Gymnosporangium juniperi-virginianae* (cedar-apple rust), *Puccinia coronata* (on Rhamnaceae, Eleganaceae/Poaceae), *Puccinia graminis* (on Berberis/Poaceae), *Puccinia recondita* (on Ranunculaceae/Poaceae), *Pucciniastrum americanum* (late leaf rust on raspberry).

### **Smuts**

*Tilletia caries* (*Tilletia tritici*), *Tilletia laevis* (*Tilletia foetida*), *Ustilago avenae*, *Ustilago hordei*, *Ustilago tritici*, *Ustilago zaeae*.

### **Other Basidiomycetes**

*Rhizoctonia solani* (*Thanatephorus cucumeris*), *Sclerotium rolfsii*.

## **B.4.3 Plant Pathogen Viruses (Regulated by the State of California)**

*Alfalfa mosaic*, *barley yellow dwarf*, *bean common mosaic*, *bean yellow mosaic*, *beet curly top*, *beet mosaic*, *cactus virus X*, *camellia yellow mottle*, *carnation mottle*, *cauliflower mosaic*, *chrysanthemum mosaic*, *chrysanthemum virus B*, *cucumber mosaic*, *cymbidium mosaic*, *dasheen mosaic*, *fig mosaic*, *impatiens necrotic spot*, *lettuce big vein*, *lettuce mosaic*, *lily symptomless*, *maize dwarf mosaic*, *odontoglossum ringspot*, *papaya ringspot*, *pepper mottle*, *plum line pattern*, *potato leafroll*, *potato virus S*, *potato virus X*, *potato virus Y*, *prune dwarf*, *prunus necrotic ringspot*, *squash mosaic*, *sugarcane mosaic*, *tobacco etch*, *tomato mosaic*, *tomato spotted wilt*, *turnip mosaic*, *watermelon mosaic virus 2*, *zucchini yellow mosaic*.