Appendix F
Tables

F-1. Biological Effects of Nuclear Radiation

Note: Tables F-2 through F-6 are "Possible Militarily Significant Biological Agents or Diseases." Explanatory notes precede the tables.

F-2. Bacteria

F-3. Rickettsia

F-4. Chlamydia and Fungi

F-5. Viruses

F-6. Toxins

F-7. Biological Agent Employment Weather Factors

F-8. Chemical Agent Employment Weather Factors

F-9. Common Industrial Hazards

F-10. Major Differences between Biological and Chemical Defense

F-11. Equipment Electromagnetic Pulse Vulnerabilities

F-12. Conversion Factors

Explanatory Notes to Tables F-2 through F-6 Extracted from Development of a Trinational Biodefence Concept, International Task Force-23

1. Major militarily significant characteristics for biological warfare agents include a susceptible population, infectious or toxic properties, availability or adaptability to a scaled-up production, stability in handling and after dissemination, and suitability for aerosol dispersion. Limiting factors include biological properties, environmental factors and dissemination methods.

2. Biological agents can be classified as microorganisms and toxins:

a. Microorganisms. Human pathogens are defined as organisms that cause disease in man. These organisms can produce a wide range of pathology. While aerosolized BW agents constitute the primary military hazard, there may be other routes of entry, such as through the skin and ingestion. Pathogens include bacteria, rickettsia, chlamydia, fungi, and viruses.

Biological Agents	
√	Microorganisms
√	Toxins

- Bacteria. Single cell microorganisms capable of reproducing outside of a living host. If a pathogenic bacteria in sufficient quantities enters a victim, the microorganism multiplies and produces disease. Pathogenic bacteria can be found in almost any environment.
- Rickettsia. Bacteria that require a living host to reproduce. Most require an arthropod vector to spread from one host to another. They are smaller than most bacteria but larger than viruses.
- Chlamydia. Obligatory intercellular parasites incapable of generating their own energy source. Like viruses, they require living cells for multiplication.
- Fungi. Primitive plants which do not use photosynthesis, are capable of anaerobic growth, and draw nutrition from decaying vegetable matter. Most fungi form spores, and free-living forms are found in soil. The spore forms of fungi are operationally significant.
- Viruses. Viruses require a living host to reproduce. Viruses multiply by taking over a cell and causing it to produce more virus instead of cell components. As more and more cells are taken over the disease develops. Viruses are the smallest of the five types of microorganisms.

b. Toxins. Toxins are byproducts of microorganisms. These sources include microbes, snakes, insects, spiders, sea creatures, and plants. Most are relatively unstable in the presence of heat and other traumatic and environmental factors. They can be either lethal or highly incapacitating- some have far greater toxicity than the most deadly chemical warfare agents. The effects of toxins may closely resemble those of chemical warfare agents such as nerve, blister, vomiting, or choking agents. Toxins can be classified as neurotoxins or cytotoxins depending on their target systems. Neurotoxins interfere with nerve impulse

transmission. Cytotoxins cause cellular destruction or interfere with metabolic processes such as cell respiration or protein synthesis.

3. Dissemination. Biological agents may be disseminated as aerosols, liquid droplets or dry powders. To a certain extent, the state in which an agent normally exists determines its use, persistancy and physiological action. It also determines the type of system used for its dissemination. Live microorganisms usually grow in a moist environment. Therefore, these agents may be disseminated in a liquid medium as wet aerosols. However, the technology exists to store microbiological materials as a powder (usually by a freeze-drying process), suitable for dissemination. Dissemination of spores and certain toxins as dry powders is likely. Many toxins are water-soluble, and disseminaton could be as sprays or wet aerosols. In general, agents disseminated as dry powder will survive longer than those disseminated as wet aerosols.

4. Transmissibility. Some agents cause disease that is transmissible from man to man, either directly or through other vectors. However, other microorganisms are nontransmissible thus limiting their spread. Toxins are not transmissible.

5. Infectivity. The agent's ability to cause disease or incapacitation in a healthy person.

6. Incubation time. The human rate of reaction to pathogens and toxins varies widely. The time for maximum effects for pathogens occurs within 18 hours to 7 days, while rapid-acting toxins can incapacitate within minutes though effects usually occur within 1-24 hours.

7. Illness duration. The length of time the average person's bodily defenses require to overcome the disease.

8. Lethality. Expected percentage of fatalities in untreated personnel.

9. Persistency. Refers to the effective duration in the environment. It varies greatly between agents and depends on the agents' characteristics and the influence of weather and terrain. The duration does not generally relate to its physical properties. Some toxins are stable in the environment and are resistant to heat, hydrolysis, or vaporization, increasing their persistancy. Weather and terrain influences include solar (ultraviolet) radiation, relative humidity, windspeed, and temperature gradient. These are the most important weather factors in determining duration. Ultraviolet light affects most biological agents. However, encapsulation (either natural or man-made protective coverings) or possibly genetic engineering may protect some agents from sunlight and other destructive natural forces.

Table F-1
Biological Effects of Nuclear Radiation (1 of 3)
(STANAG 2083, Edition 5)

DOSE RANGE (cGy, FREE-IN-AIR)	INITIAL SYMPTOMS	PERFORMANCE MEASURE (MID RANGE FOR DOSE)	MEDICAL CARE/DISPOSITION
0-70	From 6-12 hrs: none to slight incidence of transient headache and nausea, vomiting in up to 5% of personnel in upper part of dose range.	Combat effective.	None; RTD
71-150	From 2-20 hrs: transient mild nausea and vomiting in 5-30% of personnel.	Combat effective.	None. RTD: no deaths anticipated.
151-300	From 2 hrs to 2 days: transient mild to moderate nausea and vomiting in 20-70%, mild to moderate fatigability and weakness in 25-60% of personnel.	DT: PD from 4 hrs until recovery. UT: PD from 6 hrs to 1 day, 6 weeks until recovery.	At 3-5 weeks: medical care for 10-50%. At low end of range, <5% deaths. At high end, death may occur in up to 10%; survivors RTD.
301-500	From 2 hrs to 3 days; transient moderate nausea and vomiting in 50-90%; moderate fatigability in 50-90% at high end of range.	DT: PD from 3 hrs until death or recovery. UT: PD from 4 hrs to 2 days and from 2 weeks until death or recovery.	At 2-5 weeks: medical care for 20-60%. At low end of range, <10% deaths. At high end, death may occur for more than 50%; survivors RTD.

Legend:
CI- Combat ineffective (<25% performance capable)
DT- Demanding task
PD- Performance degraded (25-75% performance)
UT- Undemanding task
RTD- Return to duty

Table F-1
Biological Effects of Nuclear Radiation (1 of 3)
(STANAG 2083, Edition 5)

DOSE RANGE (cGy, FREE-IN-AIR)	INITIAL SYMPTOMS	PERFORMANCE MEASURE (MID RANGE FOR DOSE)	MEDICAL CARE/DISPOSITION
501-800	Within first hr: moderate to severe nausea, vomiting, fatigability and weakness in 80-100% of personnel.	DT: PD from 1 hr to 3 weeks; CI from 3 weeks until death. UT: PD from 2 hrs to 2 days and from 7 days to 4 weeks; CI from 4 weeks until death.	At 10 days to 5 weeks: medical care for 50-100%. At low end of range, death may occur for more than 50% at 6 weeks. At high end, death may occur for 90% at 3-5 weeks.
801-3,000	Within first 3 minutes; severe nausea, vomiting, fatigability, weakness, dizziness and disorientation; moderate to severe fluid imbalance and headache.	DT: PD from 45 minutes to 3 hrs; CI from 3 hrs until death. UT: PD from 1-7 hrs; CI from 7 hrs to 1 day; PD from 1-4 days; CI from 4 days until death.	Medical care from 3 minutes until death. 1,000 cGy: 100% deaths at 2-3 weeks. 3,000 cGy: 100% deaths at 5-10 days.
3,001-8,000	Within the first 3 minutes: severe nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, headache and collapse.	DT: CI from 3-35 minutes; PD from 35-70 minutes; CI from 70 minutes until death. UT: CI from 3-20 minutes; PD from 20-80 minutes; CI from 80 min until death.	Medical care from 3 minutes until death. 4,500 cGy: 100% deaths at 2-3 days.
>8,000	Within the first 3 minutes: severe and prolonged nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, headache, and collapse.	DT and UT: CI from 3 minutes until death.	Medical care needed immediately. 8,000 cGy: 100% deaths at 1 day.

Legend:
CI- Combat ineffective (<25% performance capable)
DT- Demanding task
PD- Performance degraded (25-75% performance)
UT- Undemanding task
RTD- Return to duty

Table F-2
Possible Militarily Significant Biological Agents, Bacteria (1 of 2)

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INFECTIVITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
Inhalation Anthrax	Spores in aerosols .	No	Moderate	Few hours to 7 days ; most cases occur within 48 hrs of exposure.	3-5 days	Treated: presymptomatic rare Untreated: 100	Spores are very Stable, remaining viable for years in soil.
Brucellosis (undulant, Malta, or Mediterranean Fever)	1. Aerosol 2. Sabotage (food supply)	Rare	High	5-60 days (highly variable).	Weeks to years	Treated: rare Untreated: 3	Months in wet soil or carcasses.
Cholera	1. Sabotage (food and water supply) 2. Aerosol	Negligible except in conditions of poor hygiene.	Low	Few hours to 5 days, usually 2-3 days.	1 or more weeks	Treated: rare Untreated: 50	Unstable in aerosols and fresh water; stable for long periods in salt water.
Glanders	Aerosol	Rare	High	Days to years	Days to several weeks	Treated: rare Untreated: >90	2-3 weeks in decaying matter.
Melioidosis	Aerosol	No	High	2 days (several months/years may lapse between exposure and clinical disease).	4-10 days	Treated: rare Untreated: variable	Stable in soil and water.
Pneumonic Plague	Aerosol	High	High	1-7 days	1-6 days	Treated: rare Untreated: 100	Up to one year in soil, 270 days in bodies.
	Sabotage (food	High, caused by	Low	1-3 days	Week	Treated: <1	Up to 30 days in

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INFECTIVITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
Shigellosis	and water supply)	lapses in hygiene.				Untreated: 3-8	foods, 3 days in sea water .
Tularemia (Rabbit or Deer-Fly Fever)	Aerosol	No	High	1-14 days	2 or more weeks	Treated: <1 Untreated: 5-25	Months on moist soil or snow, in water, straw, grain dust or carcasses.
Typhiod Fever	1. Sabotage (food and water supply) 2. Aerosol	Negligible except in conditions of poor hygiene.	Low	3-60 days	Several weeks	Treated: <1 Untreated: 12	Weeks in water, ice, dust, dried sewage .

Source: FM 8-33 and Development of a Trinational Biodefence Concept .

Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.

2. For explanatory notes see page F-2.

Table F-3
Possible Militarily Significant Biological Agents, Rickettsia

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
Epidemic Louseborne Typhus	1. Aerosol 2. Infected vectors	No	7-14 days	Weeks to months	Treated: 2 Untreated: 30-70	Weeks in louse fecal material.
Query (Q)-Fever	1. Aerosol 2. Sabotage (food supply)	Rare	2-3 weeks	Weeks	Treated: <1 Untreated: rare	Months on wood and sand.
Rocky Mountain Spotted Fever	1. Aerosol 2. Infected vectors	No	3-14 days	2 weeks to months	Treated: 3-7 Untreated: 13-25	Unstable
Scrub Typhus	Aerosol	No	6-21 days	2-3 weeks	Treated: rare Untreated: 1-60	Unstable

Source: FM 8-33 and Development of a Trinational Biodefence Concept.
Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.
2. Listed rickettsia have high infectivity.
3. For explanatory notes see page F-2.

Table F-4
Possible Militarily Significant Biological Agents, Chlamydia and Fungi

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INFECTIVITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)	PERSISTENCE
CHLAMYDIA							
Psittacosis (Parrot Fever)	Aerosol	Rare	Moderate	1-4 weeks	Weeks	Treated: 1-2 Untreated: 10-40	20-30 days on surface.
FUNGI							
Coccidioidomycosis	Aerosol	No	High	1-4 weeks	Weeks to months	Low ; primary disease usually resolves spontaneously without therapy.	Months or years in soil.
Histoplasmosis	Aerosol	No	High	3-17 days	Weeks to months	Low in acute pulmonary form, severe progressive diseases are rare.	Months in soil, organic matter, and tap water.

Source: FM 8-33 and Development of a Trinational Biodefence Concept .
Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.
2. For explanatory notes see page F-2.

Table F-5
Possible Militarily Significant Biological Agents, Viruses (1 of 2)

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)
Chikungunya Fever	Aerosol	No	2-3 days	2 weeks	<1
Crimean-Congo Hemorrhagic Fever	Aerosol	Moderate	2-7 days	Days to weeks	10-50
Dengue Fever	Aerosol	No	2-5 days	Days to weeks	5-10
Eastern Equine Encephalitis	Aerosol	No	5-15 days	1-3 weeks; death 3-5 days from onset	80
Ebola Fever	Aerosol	Moderate	4-16 days	Death between 7-16 days	50-90
Hantaan (Korean Hemorrhagic Fever)	Aerosol	No	2-4 weeks	Days to weeks	<1-10
Influenza	Aerosol	High	1-3 days	Week	<1
Junin (Argentine Hemorrhagic Fever)	Aerosol	No	10-14 days	Weeks	5-30
Lassa Fever	Aerosol	Low to moderate	7-15 days	Weeks	10-50
Machupo (Bolivian Hemorrhagic Fever)	Aerosol	No	10-14 days	Weeks	5-30
Marburg	Aerosol	Moderate	3-9 days	Weeks; death between 7-16 days of onset.	50-90
Omsk Hemorrhagic Fever	1. Aerosol 2. Water	Negligible	3-7 days	7-10 days; prolonged convalescence.	.5-3
Rift Valley Fever	1. Aerosol	Low	1-6 days	2-5 days; prolonged	<1

DISEASE	DISSEMINATION	TRANSMISSIBILITY	INCUBATION TIME	ILLNESS DURATION	LETHALITY (%)
	2. Infected vector			convalescence.	
Russian Spring-Summer Encephalitis	1. Aerosol 2. Water	No	7-14 days	Days to months	<30
Smallpox	Aerosol	High	10-12 days	4 Weeks	25-50
Venezuelan Equine Encephalitis	1. Aerosol 2. Infected vectors	Low	1-6 days	Days to weeks	<1
Western Equine Encephalitis	Aerosol	No	1-20 days	Days to weeks	5-15
Yellow Fever	Aerosol	No	3-6 days	Weeks	20-50

Sources: FM 8-33 and Development of a Trinational Biodefence Concept.

Notes: 1. This table is not all-inclusive and does not imply weaponization or the ability to weaponize exists.

2. Listed viruses have high infectivity.

3. For explanatory notes see page F-2.