SECTION 3 - CHEMICAL AND BIOLOGICAL SYSTEMS TECHNOLOGY

SUMMARY

Overview (See Figure 3.0-1) This section addresses technologies for: Bioprocessing; Chemical Manufacturing; Chemical and Biological Defense Systems; Detection, Warning and Identification; Battlefield Environment; and Human Factors. The technology areas identified in the above box contain militarily critical technologies. The other technology areas do not currently include technologies that are militarily critical. The **Chemical and Biological Defense Systems** section includes technologies that are designed to protect forces when contamination cannot be avoided and provide prophylaxis and therapy from threat agents to any affected forces. These Chemical and Biological Defense Systems technologies also cover decontamination to ensure rapid force reconstitution. **Detection, Warning and Identification** technologies covered in this section can provide real-time capability to detect, identify, locate, and quantify chemical and biological threats. Sensors must be integrated with an information processing system to analyze the threat, identify potentially affected units, and pass on alarms and warnings to implement protective measures. Both detection and protection apply to personnel operating on the ground, at sea, in the air, and in shelters and large enclosures. Although many sensor and defense technologies have commercial applications, military requirements are much more stringent. Selected toxic chemicals and biological agents which are of concern for defense and detection are presented in tabular form (see Figures 3.0-3 and 3.0-4). Toxic chemicals are extracted from the Chemical Weapons Convention. Biological agents are extracted from the Australia Group list.

Rationale Although the development, production, acquisition, and retention of chemical and biological weapons is prohibited by the Chemical Weapons Convention (when it enters into force) and the Biological Weapons Convention, respectively, some countries will defer signing these treaties and others will probably abrogate their commitments, thus adding to the threat of proliferation. US forces must be able to detect toxic agents and avoid the threat or defend themselves against use of chemical and biological agents when avoidance is impossible. While technologies that are used to produce threat agents are not essential to US offensive superiority, their manufacture is important to maintain US superiority in countermeasures.

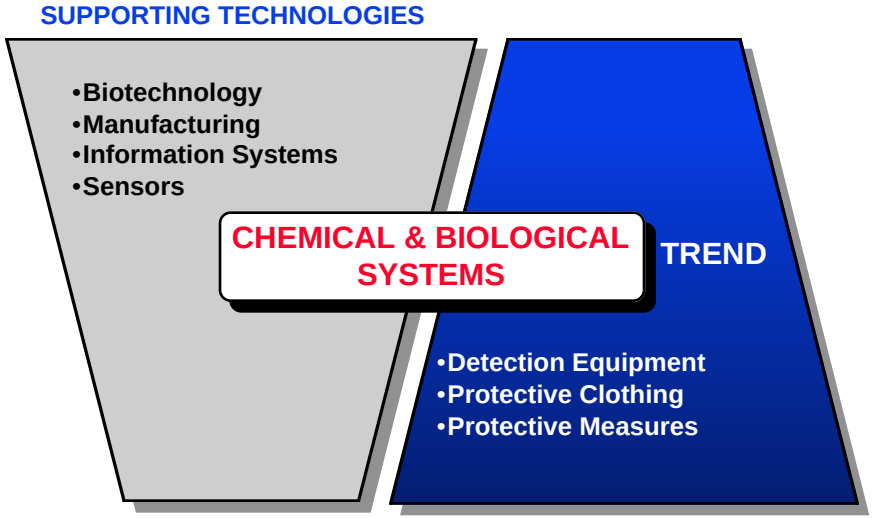

Figure 3.0-1. Chemical and Biological Systems Overview

Foreign Technology Assessment (See Figure 3.0-2) Many nations have the capability to use chemical agents in warfare. Approximately 25 are believed to have or recently have had some offensive chemical agent capability. As Third World countries develop their indigenous chemical industries, this number is likely to increase. Research in the detection and warning of the use of chemical agents and the means to protect against their use is extensive. Potential biological threat agents are available in many culture collections and research organizations worldwide. Biotechnical knowledge is primarily open source. Manufacturing facilities able to support a biological warfare program are as widespread as are the number of commercial facilities for the pharmaceutical, agriculture, and food industries. Nations that are most advanced in Chemical and Biological Defense Systems technologies include Canada, France, Germany, Israel, Japan, Russia, Sweden and the UK. The Netherlands and Switzerland join the above list as countries with significant capabilities in technologies associated with Detection, Warning and Identification.

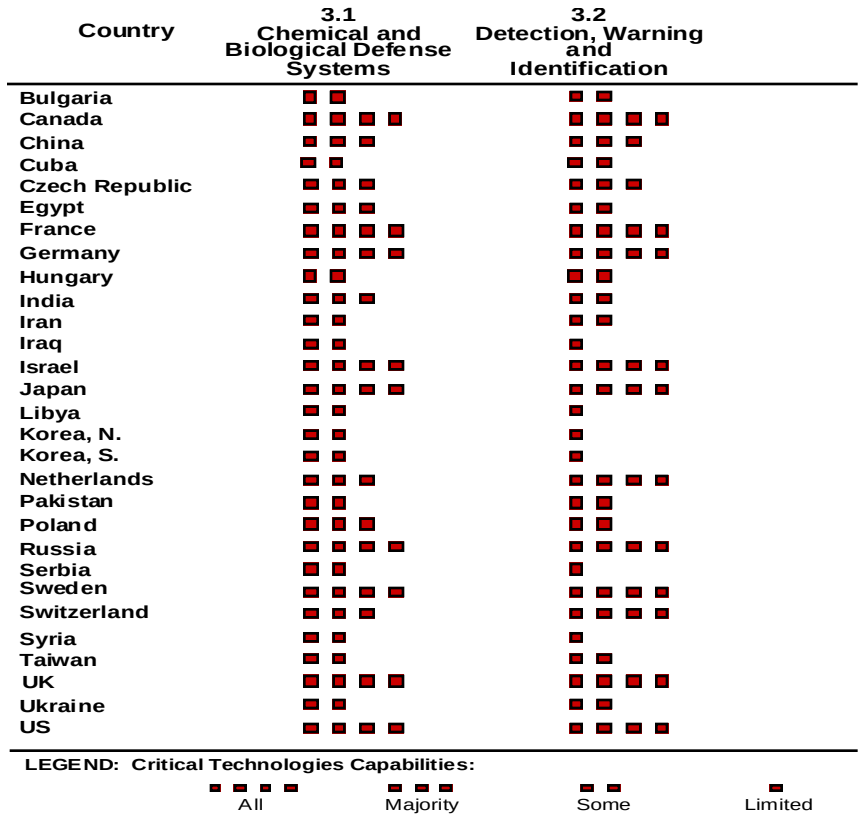

Figure 3.0-2. Chemical and Biological Systems FTA Summary

Figure 3.0-3. Australia Group Biological/Toxin Warfare Agents

Viruses	
V1.	Chikungunya virus
V2.	Congo-Crimean haemorrhagic fever virus
V3.	Dengue fever virus
V4.	Eastern equine encephalitis virus
V5.	Ebola virus
V6.	Hantaan virus
V7.	Junin virus
V8.	Lassa fever virus
V9.	Lymphocytic choriomeningitis virus
V10.	Machupo virus
V11.	Marburg virus
V12.	Monkey pox virus
V13.	Rift Valley fever virus
V14.	Tick-borne encephalitis virus (Russian Spring-Summer encephalitis virus)
V15.	Variola virus
V16.	Venezuelan equine encephalitis virus
V17.	Western equine encephalitis virus
V18.	White pox
V19.	Yellow fever virus
V20.	Japanese encephalitis virus

Rickettsiae	
R1.	Coxiella burnetti
R2.	Bartonella Quintana (Rochlimea quintana, Rickettsia quintana)
R3.	Rickettsia prowasecki
R4.	Rickettsia rickettsii

Bacteria	
B1.	Bacillus anthracis
B2.	Brucella abortus
B3.	Brucella melitensis
B4.	Brucella suis
B5.	Chlamydia psittaci
B6.	Clostridium botulinum
B7.	Francisella tularensis
B8.	Burkholderia mallei (pseudomonas mallei)
B9.	Burkholderia pseudomallei (pseudomonas pseudomallei)
B10.	Salmonella typhi
B11.	Shigella dysenteriae
B11.	Vibrio cholerae
B13.	Yersinia pestis

Genetically Modified Micro-organisms	
G1.	Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms in the core list.
G2.	Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences coding for any of the toxins in the core list, or their subunits.

Toxins	
T1.	Botulinum toxins
T2.	Clostridium perfringens toxins
T3.	Conotoxin
T4.	Ricin
T5.	Saxitoxin
T6.	Shiga toxin
T7.	Staphylococcus aureus toxins
T8.	Tetrodotoxin
T9.	Verotoxin
T10.	Microcystin (Cyanginosin)

Viruses (Warning List)	
WV1.	Kyasanur Forest virus
WV2.	Louping ill virus
WV3.	Murray Valley encephalitis virus
WV4.	Omsk haemorrhagic fever virus
WV5.	Oropouche virus
WV6.	Powassan virus
WV7.	Rocio virus
WV8.	St Louis encephalitis virus

Bacteria (Warning List)	
WB1.	Clostridium perfringens
WB2.	Clostridium tetani
WB3.	Enterohaemorrhagic Escherichia coli, serotype 0157 and other verotoxin producing serotypes
WB4.	Legionella pneumophila
WB5.	Yersinia pseudotuberculosis

Genetically Modified Micro-organisms

WG1.	Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms in the warning list.
WG2.	Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences coding for any of the toxins in the warning list, or their subunits.

Toxins (Warning List)

WT1.	Abrin
WT2.	Cholera toxin
WT3.	Tetanus toxin
WT4.	Trichothecene mycotoxins
WT5.	Modecin
WT6.	Volkensin
WT7.	Viscum Album Lectin 1 (Viscumin)

Animal Pathogens

Viruses:

AV1.	African swine fever virus
AV2.	Avian influenza virus
AV3.	Bluetongue virus
AV4.	Foot and mouth disease virus
AV5.	Goat pox virus
AV6.	Herpes virus (Aujeszky's disease)
AV7.	Hog cholera virus (synonym: Swine fever virus)
AV8.	Lyssa virus
AV9.	Newcastle disease virus
AV10.	Peste des petits ruminants virus
AV11.	Porcine enterovirus type 9 (synonym: swine vesicular disease virus)

Animal Pathogens (cont'd)

Viruses (cont'd):

AV12.	Rinderpest virus
AV13.	Sheep pox virus
AV14.	Teschen disease virus
AV15.	Vesicular stomatitis virus

Bacteria:

AB3.	Mycoplasma mycoides

Genetically Modified Micro-organisms:

AG1.	Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity and are derived from organisms in the list.

Plant Pathogens

Bacteria:

PB1.	Xanthomonas albilineans
PB2.	Xanthomonas campestris pv. citri

Fungi:

PF1.	Colletotrichum coffeanum var. virulans (Colletotrichum Kanawae)
PF2.	Cochliobolus miyabeanus (Helminthosporium oryzae)
PF3.	Microcyclus ulei (syn. Dothidella ulei)
PF4.	Puccinia graminis (syn. Puccinnia graminis f. sp. tritici)
PF5.	Puccinia striiformis (syn. Pucciniaglumarum)
PF6.	Pyricularia grisea/Pyricularia oryzae

Plant Pathogens (cont'd)

Genetically Modified Micro-organisms:

PG1.	Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity derived from the plant pathogens on the list.

Awareness Raising Guidelines

Bacteria:

PWB1.	Xanthomonas campestris pv. oryzae
PWB2.	Xylella fastidiosa

Fungi:

PWF1.	Deuterophoma tracheiphila (syn. Phoma tracheiphila)
PWF2.	Monilia rorei (syn. Moniliophthora rorei)

Viruses:

PWV1.	Banana bunchy top virus

Genetically Modified Micro-organisms:

PWG1.	Genetically modified micro-organisms or genetic elements that contain nucleic acid sequences associated with pathogenicity derived from the plant pathogens identified on the awareness raising list.

Figure 3.0.4 Selected Toxic Chemical Requiring Detection, Warning, Identification, and Defense*

Nerve Agents	(C.A.S. Number)**
O-Alkyl ($\leq C_{10}$, incl. cycloalkyl) alkyl	
(Me, Et, n-Pr or i-Pr)-phosphonofluoridates	
e.g. Sarin: O-Isopropyl methylphosphonofluoridate	(107-44-8)
Soman: O-Pinacolyl methylphosphonofluoridate	(96-64-0)
O-Alkyl ($\leq C_{10}$, incl. cycloalkyl) N,N-dialkyl	
(Me, Et, n-Pr or i-Pr) phosphoramidocyanidates	
e.g. Tabun: O-Ethyl N,N-dimethyl phosphoramidocyanidate	(77-81-6)
O-Alkyl (H or $\leq C_{10}$, incl. cycloalkyl) S-2-dialkyl	
(Me, Et, n-Pr or i-Pr)-aminoethyl alkyl	
(Me, Et, n-Pr or i-Pr) phosphonothiolates and corresponding alkylated or protonated salts	
e.g. VX: O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate	(50782-69-9)
Vesicants	
Sulfur mustards:	
2-Chloroethylchloromethylsulfide	(2625-76-5)
Mustard gas: Bis(2-chloroethyl)sulfide	(505-60-2)
Bis(2-chloroethylthio)methane	(63869-13-6)
Sesquimustard: 1,2-Bis(2-chloroethylthio)ethane	(3563-36-8)
1,3-Bis(2-chloroethylthio)-n-propane	(63905-10-2)
1,4-Bis(2-chloroethylthio)-n-butane	(142868-93-7)
1,5-Bis(2-chloroethylthio)-n-pentane	(142868-94-8)
Bis(2-chloroethylthiomethyl)ether	(63918-90-1)
O-Mustard: Bis(2-chloroethylthioethyl)ether	(63918-89-8)

Vesicants (cont)	
Lewisites:	
Lewisite 1: 2-Chlorovinyldichloroarsine	(541-25-3)
Lewisite 2: Bis(2-chlorovinyl)chloroarsine	(40334-69-8)
Lewisite 3: Tris(2-chlorovinyl)arsine	(40334-70-1)
Nitrogen mustards:	
HN1: Bis(2-chloroethyl)ethylamine	(538-07-8)
HN2: Bis(2-chloroethyl)methylamine	(51-75-2)
HN3: Tris(2-chloroethyl)amine	(555-77-1)
Toxins	
Saxitoxin	(35523-89-8)
Ricin (9009-86-3)	
Choking Agent	
Phosgene: Carbonyl dichloride	(75-44-5)
Blood Agents	
Cyanogen chloride	(506-77-4)
Hydrogen cyanide	(74-90-8)

* This list is representative and not all inclusive

** The C.A.S. number is the Chemical Abstract Service Registry Number, a unique number based on chemical structure

SECTION 3.1 CHEMICAL AND BIOLOGICAL DEFENSE SYSTEMS

Overview (See Figure 3.1-1) The US chemical and biological defense program includes contamination avoidance, individual and collective protection, and decontamination, all of which are addressed in this section. Contamination avoidance is based on sensors providing real-time detection and identification of toxic agents (see Section 3.2). The goal of individual and collective protection is to insulate US ground, air, and sea forces from CB agents using clothing ensembles and respirators for individuals and collective filtration systems for groups. Additional precautions can be taken for biological agents such as immunization prior to exposure and antidote treatments after exposure provided the threat agents can be identified. Military requirements for individual protection are much more stringent than those used in commercial applications. Manufacturers deal with known processes, inputs, and outputs. The military must be prepared to respond to unknown threats including new agents in unknown quantities anywhere, and at any time. Since many types of protective gear limit human performance, sometimes up to a 50% reduction in capabilities, more advanced efforts are aimed at accounting for these limitations and increasing the comfort/wear time and freedom of action. Decontamination technologies that ensure rapid and effective force reconstitution are also included. Modeling and simulation are used for hazard assessment, weapons effects, and the results of decontamination.

Rationale (See Table 3.1-1) Under a Global Reach concept, US forces must be prepared for conflict in a chemically or biologically toxic environment. Ground, air, and naval forces are possible subjects of attack as is the supporting civilian infrastructure. US forces must have the capability to survive an initial CB attack and to sustain mission operations with minimal casualties and degradation of equipment. Individual ensembles (suits and masks) are essential to provide protection against current and future threats. Properly designed masks are sufficient for B agent protection while full suits are required for protection against most C agents. Reducing the physical burden imposed by CB protective gear is imperative to maintain unit combat performance. Collective protection is critical in order to provide a protective environment for personnel operating in aircraft, armored vehicles, ships, shelters, command and control facilities, and other large-area enclosures. A contamination-free location for casualty care, prophylaxis and therapy, and rest and recuperation is also critical to sustain military operations. Environmentally acceptable decontamination technologies are important when toxic materials must be neutralized. A robust and effective defensive capability reduces the threat that offensive CB agents would be used.

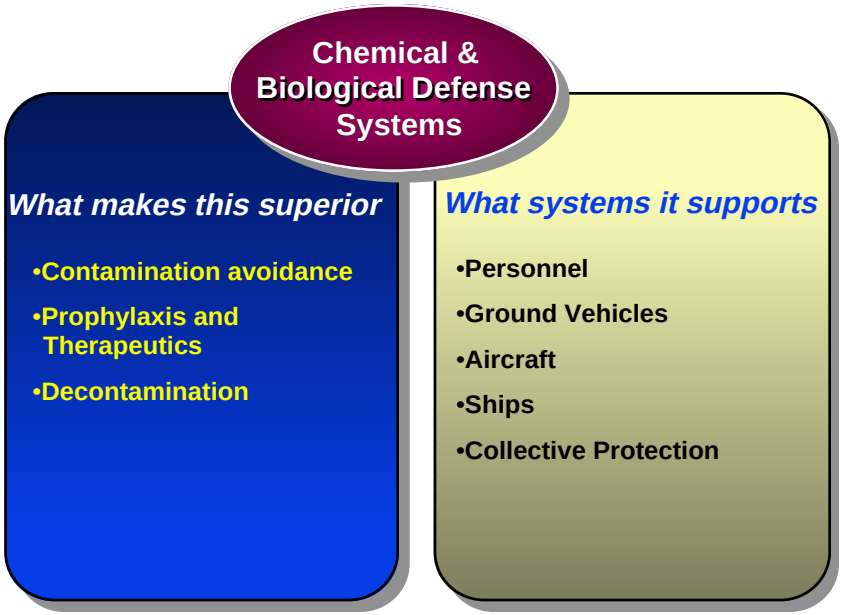

Figure 3.1-1. Chemical and Biological Defense Systems Overview

Foreign Technology Assessment (See Figure 3.0-2) Many countries produce protective gear, decontamination equipment, and medical counter-measures. Masks, including those for civilians, are the most common type of protective gear produced. There are at least 23 countries that produce protective masks either in government factories or at commercial locations. Many NATO, former Warsaw Pact countries, Middle East, and Asian countries also produce protective clothing. Presently, multiple countries are cooperating in the development of protective clothing, e.g., the Combat Suit 90 and the Saratoga System. Only a few countries manufacture aircraft respiratory equipment: Canada, Norway, Russia, and the UK. A number of countries have developed collective protective systems for shelters: Finland, France, Israel, Sweden, Switzerland, and the UK. In addition, Russia has fielded and maintains a substantial inventory of collective protection systems for a wide range of vehicles and shelters. European nations are developing wide area decontamination systems. Medical countermeasures are pursued worldwide.

Table 3.1-1. Chemical and Biological Defense Systems Militarily Critical Technology Parameters

TECHNOLOGY	MILITARILY CRITICAL PARAMETERS MINIMUM LEVEL TO ASSURE US SUPERIORITY	CRITICAL MATERIALS	UNIQUE TEST, PRODUCTION, AND INSPECTION EQUIPMENT	UNIQUE SOFTWARE AND PARAMETERS	EXPORT CONTROL REFERENCE
PRODUCTION AND DESIGN TECHNOLOGY FOR PROTECTIVE MASKS - BIOLOGICAL	Provide protection against aerosol particles in the 0.1 to 10 micrometer range	Butyl rubber, silicon rubber; plastics	Simulated agents; leakage testers; mannequin - face model for mask and suit design; particle-size analysis equipment	Software for generating facial contours	WA ML 7, 21, 22 WA Cat 1B, D, E USML X
PRODUCTION AND DESIGN TECHNOLOGY FOR PROTECTIVE MASKS - CHEMICAL	Provide protection for 24 hrs against 10,000 mg-min/m^3 challenge for toxic vapors, aerosols	Butyl rubber, Silicon rubber plastics Impregnated activated carbon (charcoal)	Simulated agents; Leakage testers; mannequin-face model for mask and suit design; particle-size analysis equipment	Software for generating facial contours	WA ML 7, 21, 22 WA Cat 1B, D, E USML X
PRODUCTION AND DESIGN TECHNOLOGY FOR PROTECTIVE CLOTHING - CHEMICAL	Provide protection for 24 hrs against 10 g/m^2 challenge by all liquid agents and 10,000 mg-min/m^3 for toxic vapors, aerosols	Charcoal activated cloth; semi-permeable membranes; polymers	Simulated agents; particle-size analysis equipment	None identified	WA ML 7, 21, 22 WA Cat 1B, D, E USML X
PRODUCTION AND DESIGN TECHNOLOGY FOR COLLECTIVE PROTECTION - BIOLOGICAL	Provide protection against aerosol particles in the 0.1 to 10 micrometer range	Teflon/Kevlar laminate for biological resistance, decontaminability and environmental durability	Simulated agents Particle size analysts equipment	None identified	WA ML 7, 21, 22 WA Cat 1B, D, E USML X
PRODUCTION AND DESIGN TECHNOLOGY FOR COLLECTIVE PROTECTION - CHEMICAL	Prevent > 99.9% of toxic agents from entering common areas	Impregnated carbon filters; polyethylene; fluoro-polymer/aramid laminate	Simulated agents	None identified	WA ML 7, 21, 22 WA Cat 1B, D, E USML X
DECONTAMINATION - BIOLOGICAL	Sieve or remove 0.1 to 10 micrometer particles	Filter system to remove 0.1 to 10 micrometer particles by sieve action	Simulated agents Particle size analysts equipment	None identified	WA ML 7, 21, 22 WA Cat 1B, D, E USML X
DECONTAMINATION - CHEMICAL	Remove > 99.9% of toxic material or neutralize it	AMBERGARD XE-555 resin; Super-Tropical Bleach (STB)	Simulated agents	None identified	WA ML 7, 21, 22 WA Cat 1B, D, E USML X

SECTION 3.2 DETECTION, WARNING, AND IDENTIFICATION

Overview (See Figure 3.2-1) Technologies used for detection, warning, and identification of toxic chemical and biological agents are included in this section. Detectors used at designated locations are called point detectors. Standoff detectors provide early, wide area warning of an attack. Detection technologies must be capable of sensing and mapping large areas of non-volatile liquid chemical agent contamination and to be able to rapidly discriminate and identify biological agents. For biological agents, detection and warning systems are based on physical or chemical properties of these agents. Identification systems use immunochemical or gene probe techniques or mass spectral analysis. No single sensor detects all chemical or biological agents of interest. Detectors for toxic agents must have a short response time with a low rate of false returns and meet appropriate size, weight, and power requirements. Detection equipment must be integrated with a command and control system to ensure an alarm is disseminated. This is essential for contamination avoidance. Other unknown factors include location, duration, and intensity of the agent, which are crucial parameters for command decisions. Current DoD emphasis is on multiagent sensors for biological detection and standoff CB detection. The technology focus is on detection, warning and identification across the spectrum of CB agents as well as on the integration of CB detectors into various platforms, individual clothing and the C^3I network. Identification is critical to medical response.

Rationale (See Table 3.2-1) The cornerstone of US CB defense efforts is early detection and warning to provide situational awareness and allow US forces to avoid the threat. Detection and identification of agents and prediction of future conditions provide information to military commanders and individuals. This information allows military commanders to initiate steps to avoid contamination or to ascertain the minimum appropriate protection required to continue operations with minimal degradation of performance and casualties.

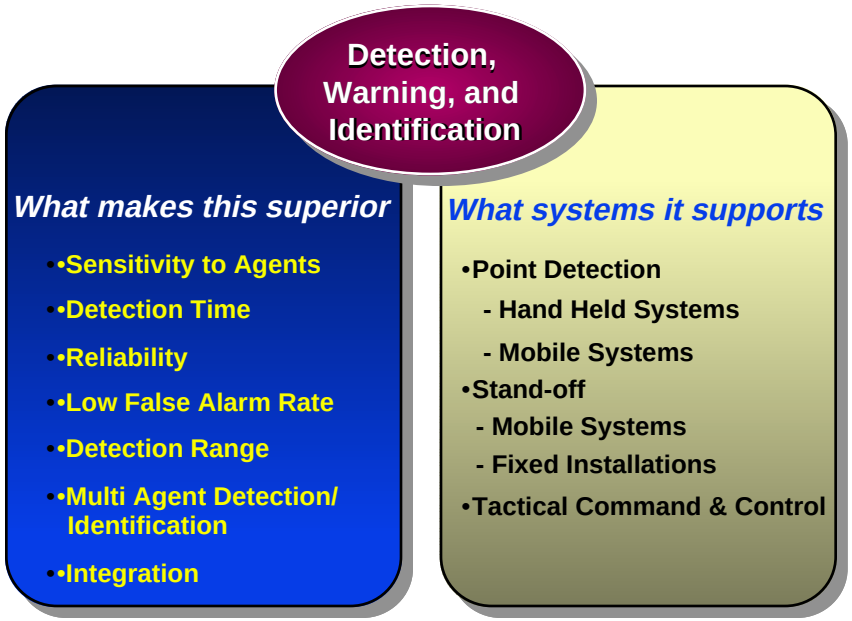

Figure 3.2-1. Detection, Warning, and Identification Overview

Foreign Technology Assessment (See Figure 3.0-2) A number of Western countries (Canada, France, Germany, UK) have significant capability in sensor technology. Russia and Israel also are well advanced in this field. At least 22 countries have some type of detector in their armed forces. The majority of detection, warning, and identification systems are for chemical agents; however, extensive efforts are underway to develop improved biological agent detectors.

Table 3.2-1. Detection, Warning, and Identification Militarily Critical Technology Parameters

TECHNOLOGY	MILITARILY CRITICAL PARAMETERS MINIMUM LEVEL TO ASSURE US SUPERIORITY	CRITICAL MATERIALS	UNIQUE TEST, PRODUCTION, AND INSPECTION EQUIPMENT	UNIQUE SOFTWARE AND PARAMETERS	EXPORT CONTROL REFERENCE
IMMUNO BASED - BIOLOGICAL	Capability of detecting 100 organisms of Australia Group agents.	Antibodies directed against Australia Group list agents	Antibody development	None identified	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
GENE BASED PROBE - BIOLOGICAL	Capability of detecting 100 organisms of Australia Group agents.	Polynucleolides complementary to Australia Group gene sequences; polymers	Gene sequence data	None identified	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
MOLECULAR RECOGNITION (E.G. ANTIGENS, ANTIBODIES, ENZYMES, NUCLEIC ACIDS, OLIGOMERS, LECTINS, WHOLE CELLS, RECEPTORS, ORGANELLES) - BIOLOGICAL	Capability of detecting 100 organisms of Australia Group agents. Can recognize weapons grade agent, by-products of its preparation or manufacturing signatures; does not recognize normally occurring environmental materials.	Antibodies directed against Australia Group list agents or polynucleotides complementary to Australia Group gene sequence	Coatings, films or fibers of biopolymers or chemical polymers that bind BW agents (binding K_d less than 1×10^{-8})	Molecular modeling databases (e.g. protein and DNA sequencing)	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
ION MOBILITY SPECTROMETRY (IMS) - BIOLOGICAL	Detecting several thousand organisms.	None identified	Database development; Ion source Spectroscope capable of concentrating and analyzing 1000 organisms	Spectrum recognition algorithms	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
ION MOBILITY SPECTROMETRY (IMS) - CHEMICAL	Capable of scanning samples of 10,000 daltons or less in 5 minutes or less.	None identified	Database development; Ion source	Spectrum recognition algorithms	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
MASS SPECTROMETRY - BIOLOGICAL	Capable of scanning samples of 10,000 daltons or less in 5 minutes or less.	None identified	Database development Portable, field rugged mass spectroscope	Spectrum recognition algorithms	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
MASS SPECTROMETRY - CHEMICAL	Capable of scanning samples of 10,000 daltons or less in 5 minutes or less.	None identified	Database development Portable, field ruggedized	Spectrum recognition algorithms	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E

(cont'd)

Table 3.2-1. Detection, Warning, and Identification Militarily Critical Technology Parameters (Cont'd)

TECHNOLOGY	MILITARILY CRITICAL PARAMETERS MINIMUM LEVEL TO ASSURE US SUPERIORITY	CRITICAL MATERIALS	UNIQUE TEST, PRODUCTION, AND INSPECTION EQUIPMENT	UNIQUE SOFTWARE AND PARAMETERS	EXPORT CONTROL REFERENCE
PASSIVE IR - CHEMICAL	Detects vapors at distances up to 5 km *(Nerve: 90 mg/m^2, blister: 500 mg/m^2 for L and 1500 mg/m^2 for HD).*	None identified	Database development	Spectrum and background recognition algorithms	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
TRANSDUCERS (E.G., OPTICAL, ELECTROCHEMICAL, ACOUSTIC, PIEZOELECTRIC, CALORIMETRIC, SURFACE ACOUSTIC WAVE (SAW); FIBER OPTIC WAVE GUIDE) - BIOLOGICAL, CHEMICAL	Converts recognition of agents to an optical or electrical signal. Low hysteresis. Optical/electronic component processing must be <1 second.	Antibodies and gene sequences for Australia Group list agents	Production equipment configured for the detection of biological agents	Spectrum recognition algorithms	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
SAMPLE COLLECTION (E.G. AIR, LIQUID, DUST, SOIL SAMPLING) - BIOLOGICAL	Collects and concentrates 1–10 micrometers particles into liquid medium.	None identified	Aerosol samplers able to collect less than or equal to 10 micrometers diameter particles into a liquid	None identified	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
SAMPLE COLLECTION (E.G. AIR, LIQUID, DUST, SOIL SAMPLING) - CHEMICAL	Collects and concentrates 1–10 micrometers particles into liquid medium.	None identified	Aerosol samplers able to collect less than or equal to 10 micrometers diameter particles into a liquid.	None identified	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
SAMPLE PROCESSING (E.G. CELL DISRUPTION, CONCENTRATION, PURIFICATION OR STABILIZATION) - BIOLOGICAL	Completion within 10 minutes.	None identified	Neg. pressure orifice devices for rupturing cell membranes or wall/retention of nucleic acids; impact collectors; ion trap mass spectrometers capable of scanning samples below 10,000 daltons in 5 minutes or less; pyrolyzers.	Spectrum recognition algorithm	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E
SAMPLE PROCESSING (E.G. CONCENTRATION) - CHEMICAL	Completion within 10 minutes.	None identified	Ion trap mass spectrometers capable of scanning samples from 40 to 1024 daltons in millisecs; pyrolyzers; chemical & enzyme detection kits.	Spectrum recognition algorithm	WA ML 7, 21 WA Cat 1A, D, E USML XIV CCL Cat 1A, D, E