Chemical/Biological Defense

CB.06 Advanced Lightweight Chemical Protection

Objectives. Develop and demonstrate materials for a new generation of lightweight chemical/biological (CB) protective clothing ensembles based on selectively permeable membrane technology that will eliminate or reduce the use of carbon in CB clothing. The resulting advanced material system will be 30% lighter in weight than the battle dress overgarment material system, allow selective permeation of moisture while preventing the passage of common vesicant agents, provide protection against penetration by toxic agents in aerosolized form, and provide at least the current level of protection against toxic vapors and liquids. The ultimate objective will be to demonstrate a CB protective garment that replaces the standard duty uniform.

Payoffs. This DTO will reduce the logistics burden as a result of improved launderability, lighter weight, and reduced volume (less bulky); and significantly improve performance while in a mission-oriented protective posture as a result of significantly reduced thermal stress and bulk of uniform. Ultimately, incorporation of CB protection into standard duty uniform will provide continuous protection. This DTO supports Land Warrior, Air Warrior, Mounted Warrior, Joint Service Lightweight Integrated Suit Technology (JSLIST) P^3I, Advanced Development Clothing and Equipment, and Engineering Development Clothing and Equipment. In FY99, this DTO demonstrated material durability. Advanced membranes with lightweight shell fabrics and novel closure systems were integrated into a lightweight CB duty uniform concept. The CB duty uniform is launderable, 30% lighter in weight, and less bulky than the JSLIST duty uniform/overgarment system, with equivalent durability, reduced logistics burden, and lower cost.

Challenges. The key technical challenge is the development of selectively permeable membranes suitable for all battlefield applications. Closure concepts and material that provide maximum protection must also be improved.

Milestones/Metrics.

FY2000: Fabricate and demonstrate a lightweight CB duty uniform that is 30% lighter with the same or better protection.

Customer POC	Service/Agency POC	USD(A&T) POC
CPT Jon CARROLL, USA USAIC	Dr. Gary RESNICK SBCCOM/TPCBD	Dr. Robert FOSTER ODUSD(S&T)

CB.06 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	CB2	0.6	0.0	0.0	0.0	0.0	0.0
	DTO Total	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CB.07 Laser Standoff Chemical Detection Technology

Objectives. Provide a standoff laser integrated chemical and bioaerosol detection capability for protection of fixed sites, reconnaissance, and other battlefield applications.

Payoffs. Demonstrate capabilities in field testing with sufficient laser power and detector sensitivity to detect agents at a distance of 20 km (a 400% increase from the FY96 baseline), evaluate sensitivity for "dusty" chemical agent detection, and enhance protection at fixed sites against CB agents. This DTO supports Joint Service Chemical Warning and Identification LIDAR Detector, Joint Service Nuclear/Biological/Chemical (NBC) Reconnaissance System, and Airbase and Shipboard Chemical and Biological Defense. In FY99, a brassboard build for a multipurpose detector was initiated.

Challenges. Demonstration of the existing laser standoff chemical detector (LSCD) in all joint service scenarios requires expansion of current azimuth and elevation scanning limits (low risk) and enhanced information display (low risk). Minimization of system response time will require upgrading to a real-time algorithm or display (low-to-moderate risk). Maximization of system ranges will require upgrading to a larger telescope (low risk) and higher-energy, tunable CO_2 laser (moderate risk). Although a laser having the exact specifications for this application has not yet been developed, recent experiments indicate that there are at least three viable laser architectures suitable for development. The feasibility of adding improved mustard detection capabilities depends on developing and demonstrating 8-µm laser technology (high risk). The feasibility of adding dusty agent detection capabilities requires the characterization of optical properties of such particles (low-to-moderate risk) and modeling of LIDAR performance (low risk). In addition, substantiation of the theoretical analysis on dusty agent detection capabilities depends on the generation and testing of an appropriate simulant (moderate risk).

Milestones/Metrics.

FY2000: Demonstrate brassboard capabilities in field testing with sufficient laser power and detector sensitivity to detect chemical and biological agents at a distance of 20 km (a 400% increase from the FY96 baseline); evaluate sensitivity for dusty chemical agent detection.

Customer POC	Service/Agency POC	USD(A&T) POC
LTC Mike LANPHERE, USA JSIG	Dr. Gary RESNICK SBCCOM/TPCBD	Dr. Robert FOSTER ODUSD(S&T)
COL Stephen V. REEVES, USA NBC Defense Systems		

CB.07 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603384BP	CB3	5.4	0.0	0.0	0.0	0.0	0.0
	DTO Total	**5.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CB.08 Advanced Adsorbents for Protection Applications

Objectives. Develop advanced adsorbent bed compositions (e.g., layered adsorbents) to enhance the chemical agent filtration capabilities of current single-pass filters as well as regenerative filtration systems under development.

Payoffs. Advanced adsorbent bed compositions for use in nuclear/biological/chemical (NBC) filters will result in smaller, lighter-weight filtration systems with reduced logistical requirements, improved protection against toxic industrial materials (TIMs), and reduced combustibility. Smaller, lighter-weight filters are especially desirable to address respirator needs for (1) improved face seal (less filter weight improves mask-to-face bond), and (2) improved weapons sighting (reduced filter size improves man-to-weapon interface). Development of noncombustible adsorbent beds is desirable to eliminate the possibility of a filter fire in the event of overheating resulting from malfunctioning of system components. In FY99, adsorbent materials and combinations of materials exhibiting the desired properties and performance were prepared. An agent sorption assessment was initiated.

Challenges. For single-pass filters, adsorbent beds that improve kinetics of agent removal are needed to address the goal of smaller, lighter-weight filters. For regenerable filters, adsorbent beds that readily release adsorbed agent during the purge cycle are needed to minimize size and energy requirements. The identification of noncombustible adsorbents with high levels of agent removal at all humidity conditions has proven to be an especially difficult challenge. Adsorbent bed compositions need to address recent drafted requirement documents for NBC protection systems (e.g., JSGPM, JTCOPS), including capability for protection against TIMs, which is not adequately provided by current NBC filters.

Milestones/Metrics.

FY2000: Adsorption equilibrium correlation to be developed so that predictions of equilibria are available for formulation of adsorbent bed compositions. Identify additional bed formulations to address competitive adsorptive effects of water adsorption and retention of high-vapor-pressure agents/TIMs for regenerative applications. Optimize the performance to minimize water adsorption and maximize adsorption capacity for high-vapor-pressure agents/TIMs.

FY2001: Select the best adsorbent bed composition for protective mask applications against agents/TIMs.

FY2002: Select the best adsorbent bed composition for single-pass collective protection applications against agents/TIMs.

FY2003: Select the best adsorbent bed composition for regenerative filtration applications against agents/TIMs. Conduct qualification testing to verify the performance expected in host filter systems against agents/TIMs.

Customer POC	Service/Agency POC	USD(A&T) POC
Mr. Roger LABATAILLE PEO/GSI	Dr. Gary RESNICK SBCCOM/TPCBD	Dr. Robert FOSTER ODUSD(S&T)
COL Stephen V. REEVES, USA NBC Defense Systems		

CB.08 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	CB2	0.9	1.1	1.2	1.1	0.0	0.0
	DTO Total	**0.9**	**1.1**	**1.2**	**1.1**	**0.0**	**0.0**

CB.09 Enzymatic Decontamination

Objectives. Develop and demonstrate a new generation of enzyme-based decontaminants that are nontoxic, noncorrosive, environmentally safe, and lightweight (freeze-dried concentrate).

Payoffs. Enzyme-based systems have the potential to reduce the logistical burden by 50- to 100-fold. High-activity G-agent enzymes have been identified, characterized, and demonstrated to be effective in NATO-sponsored agent trials. Several V-agent enzymes and H-agent reactive polymers have been identified, but their activity will need to be improved. Enzyme-based materials may also have applications in some nonaqueous systems (sorbent, sensitive equipment decontamination). In FY99, enzymes for V- and H-agents were evaluated. Reactive polymers and other materials for enhanced H-agent hydrolysis/oxidation and compatibility with nerve agent enzymes were also evaluated.

Challenges. The major technical challenge is to identify appropriate enzymes and enzyme-compatible chemicals that are (1) reactive with all nerve and blister agents; (2) genetically engineered for large-scale production; and (3) nontoxic, noncorrosive, and environmentally safe.

Milestones/Metrics.

FY2000: Select the best candidate V- and H-agent enzymes and use molecular biology techniques to facilitate their production. Optimize use of reactive materials for H-agent hydrolysis/oxidation in enzyme-based decontaminants.

FY2001: Produce sufficient V- and H-agent enzymes and reactive materials to optimize their use in foams, detergent solutions, or other types of dispersion systems.

FY2002: Demonstrate the efficacy and stability of enzyme/chemical decontamination systems for G-, H-, and V-type agents in foams, detergent solutions, or other types of dispersions systems.

Customer POC	Service/Agency POC	USD(A&T) POC
COL Leonard A. IZZO, USA USACS	Dr. Gary RESNICK SBCCOM/TPCBD	Dr. Robert FOSTER ODUSD(S&T)
LTC Mike LANPHERE, USA JSIG		

CB.09 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	CB2	0.8	0.8	0.9	0.0	0.0	0.0
	DTO Total	**0.8**	**0.8**	**0.9**	**0.0**	**0.0**	**0.0**

CB.19 Chemical Imaging Sensor

Objectives. Demonstrate a lightweight, wide-area, passive standoff imaging detection system capable of rapidly detecting chemical agent vapors for the purpose of contamination avoidance, reconnaissance, and facilities evaluation. The final system will operate at 360 Hz with a 256 x 256 focal plane array (FPA), and is scheduled for transition to development in FY03. This DTO will focus on development of ultra-high-speed interferometers, integration of off-the-shelf FPAs, and development of a signal processing algorithm.

Payoffs. The chemical imaging sensor (CIS) will allow rapid evaluation of large areas for chemical warfare (CW) contamination, and provide detailed information as to the position of a CW agent cloud. Current single-pixel designs have an extremely limited field of view (typically 26 m at a distance of 1 km). In addition, they cannot scan at sufficient speeds for proposed high-speed applications (i.e., tactical helicopter, high-speed aircraft, and hemispherical scanning applications). The CIS will be capable of operating at fields of view at least 250 times greater than current systems. In addition, scan speeds will be increased by almost two orders of magnitude for extremely high-speed applications. The potential deployments include fixed sites, ground vehicles, unmanned aerial vehicles, helicopters, high and low aircraft, and even low-Earth-orbit configurations. In FY99, real-time operation at 30 Hz was demonstrated.

Challenges. Proposed deployment of the CIS includes many ground and airborne scenarios that require high-speed operation. Speeds of at least 360 scans per second are required in many airborne operations in order not to "blur" the data. A significant effort is required to run an imaging spectrometer at these high speeds. The proposed spectrometer will contain (at the least) a low-density array of 9 to 16 pixels with higher density arrays being incorporated as they become available. The most significant current challenges are signal processing hardware and software, high-density FPA development, and high-speed interferometry. Commercially available interferometers typically operate at a few scans per second, with ten being a typical number. A CIS operating at 360 Hz with a 256 x 256 FPA will require about 1 TFLOP of computing power. Extrapolating current speed increases of high-speed computers into future signal processing hardware that can handle the CIS is expected to be available commercially in about 5 years.

Milestones/Metrics.

FY2000: Demonstrate 16-pixel spectrometer at 100 Hz (offline processing of data).

FY2001: Demonstrate real-time operation at 100 Hz.

FY2002: Demonstrate 16-pixel spectrometer at 360 Hz.

Customer POC	Service/Agency POC	USD(A&T) POC
LTC Mike LANPHERE, USA JSIG	Dr. Gary RESNICK SBCCOM/TPCBD	Dr. Robert FOSTER ODUSD(S&T)
COL Stephen V. REEVES, USA NBC Defense Systems		

CB.19 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	CB2	2.1	2.2	2.4	0.0	0.0	0.0
	DTO Total	**2.1**	**2.2**	**2.4**	**0.0**	**0.0**	**0.0**

CB.20 Biological Sample Preparation System for Biological Identification

Objectives. Develop and demonstrate by 2001 an advanced Biological Sample Preparation System (BSPS) for incorporation with leading-edge biological identification technologies. The advanced BSPS will be compatible with an array of agents of biological origin (ABO) identification approaches under development for next-generation field biodetection systems, and represents an essential enabling technology for the success of these systems. The final product of this effort is intended to transition to Joint Biological Point Detection System Block II.

Payoffs. When incorporated with advanced biological identification technologies, the technology being developed will expand the scope of detectable and identifiable ABOs, shorten the time required for sample analysis, ensure that a maximum and properly prepared sample load is analyzed, and reduce the associated logistics burden as well as overall footprint. The development of these technologies, along with concurrent advances in biological identification systems, will permit more rapid and reliable response at a lower overall implementation investment to biological threats on the battlefield, as well as in applications related to domestic preparedness, intelligence gathering, and treaty verification issues. In FY99, methodologies to reduce time for disruption of spores and viral particles to 20 min at sensitivities corresponding to one agent-containing particle per liter air, as measured using DNA detection on gene probe sensors and protein biomarkers in mass spectrometry, were demonstrated.

Challenges. Specific ABO identification platforms requiring the development of this technology include gene probe sensors, which provide highly specific and sensitive detection; and biological mass spectrometry, which provides broad spectrum coverage. Major technical challenges include the removal of environmental/biological materials that may diminish performance of these platforms, rapid preconcentration of samples, rapid and efficient extraction of nucleic materials or proteins, automation of the entire sample treatment process to permit fully unattended operation, and the development and incorporation of microscale (MEMS-level) components where possible while maintaining overall sensitivity and response time.

Milestones/Metrics.

FY2000: Demonstrate a fully automated, 2-ft^3 BSPS concept coupled with a gene probe sensor and the next-generation biomass spectrometer for bio-aerosol analysis.

FY2001: Incorporate microscale approaches to reduce size of BSPS by 35% while maintaining overall sensitivity on both platforms against eight bacterial and viral materials. Demonstrate reduction of sample preparation time to 15 min.

Customer POC	Service/Agency POC	USD(A&T) POC
LTC Mike LANPHERE, USA JSIG	Dr. Gary RESNICK SBCCOM/TPCBD	Dr. Robert FOSTER ODUSD(S&T)

CB.20 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	CB2	3.3	2.8	0.0	0.0	0.0	0.0
	DTO Total	**3.3**	**2.8**	**0.0**	**0.0**	**0.0**	**0.0**

CB.22 Medical Countermeasures for Vesicant Agents

Objectives. Demonstrate a safe and effective pharmacological countermeasure to prevent or decrease the severity of injuries caused by vesicant chemical agents, focusing principally on sulfur mustard. Several pharmacologically distinct classes of compounds have been identified and assessed, each of which interferes at a different point in the multistep chain of biological events triggered by sulfur mustard. These classes, which have been shown to have efficacy in one or more cellular or animal models, include intracellular calcium modulators, protease inhibitors, and various anti-inflammatory drugs. The various technological alternatives will ultimately be competed against one another with respect to safety and efficacy to determine an optimal approach (or combination of approaches) for transition to advanced development.

Payoffs. Vesicant chemical agents, such as sulfur mustard, are a significant threat to U.S. forces. There are no specific medical counteragents for blister agents. Medical management of the injuries these agents inflict presently depends on immediate decontamination followed by conventional treatment of the resulting blisters or burns, rather than on specifically designated pretreatment/treatment. This work will yield a vesicant agent countermeasure that will substantially reduce the number of casualties or degree of injury among exposed soldiers, with consequent reductions in the medical logistic burden. Effective countermeasures to vesicant chemical agents would deter their use and enhance capabilities of U.S. forces to sustain operational tempo.

Challenges. Major technical challenges include developing effective pretreatments completely devoid of side effects, developing suitable animal models, and extrapolating efficacy test results from animals to man.

Milestones/Metrics.

FY2000: Identify candidate medical countermeasures that reduce both morbidity and healing time by 50% following vesicant exposure. Demonstrate safety and efficacy of this countermeasure sufficient to transition to advanced technology development (concept exploration phase).

Customer POC	Service/Agency POC	USD(A&T) POC
COL Robert DEADERICK, USA AMEDD/C&S	COL Gennady PLATOFF, USA USA/MRMC	Dr. Robert FOSTER ODUSD(S&T)
COL Ernest TAKAFUJI, USA OSD/HA		

CB.22 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	TC2	3.4	0.0	0.0	0.0	0.0	0.0
0603384BP	TC3	5.5	0.0	0.0	0.0	0.0	0.0
	DTO Total	**8.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CB.23 Medical Countermeasures for Staphylococcal Enterotoxin B

Objectives. Develop medical countermeasures against the biological warfare (BW) threat of staphylococcal enterotoxin B (SEB) toxin. Recombinant vaccine technology will be exploited to provide an effective candidate that may be safer and more affordable to manufacture than traditional toxoid vaccines.

Payoffs. SEB is a validated BW threat of high priority. It is an incapacitating and potentially lethal biological toxin that can be delivered by either aerosol or oral routes to a target population. This easily produced bacterial toxin can be a serious problem on the battlefield, causing sepsis (blood poisoning) and shock. Deliberate exposure of troops to SEB delivered as a BW agent would significantly reduce mission effectiveness. The development of a vaccine against SEB reduces this threat for the warfighter, deters its use as a BW agent, and enhances strategic mobility.

Challenges. Major technical challenges include developing appropriate model systems for investigational purposes, determining expression vectors for recombinant products, and retaining antigenicity without superantigen properties in a vaccine candidate.

Milestones/Metrics.

FY2000: Transition to advanced development (program definition and risk reduction) a second-generation (recombinant) SEB vaccine that protects 80% of immunized personnel against both a lethal and an incapacitating aerosol challenge of SEB.

Customer POC	Service/Agency POC	USD(A&T) POC
COL Robert DEADERICK, USA AMEDD/C&S	COL Gennady PLATOFF, USA USA/MRMC	Dr. Robert FOSTER ODUSD(S&T)
COL Ernest TAKAFUJI, USA OSD/HA		

CB.23 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603384BP	TB3	1.9	0.0	0.0	0.0	0.0	0.0
	DTO Total	**1.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CB.24 Medical Countermeasures for Encephalitis Viruses

Objectives. Develop medical countermeasures against the biological warfare (BW) threat of the equine encephalitis viruses. Recombinant vaccine technology will be exploited to provide effective vaccine candidates.

Payoffs. Equine encephalitis viruses are a group of viruses that cause disorientation, convulsions, paralysis, and death. They are important BW threats because of aerosol infectivity and relative stability. Clinical illness associated with Venezuelan, Eastern, and Western equine encephalitides (VEE, EEE, and WEE, respectively) includes headache, fever, chills, nausea, vomiting, mental confusion, sleepiness, and sometimes seizures and other neurological signs and symptoms. Mosquito vectors normally transmit these alphaviruses to birds, horses, and humans; however, alphaviruses are very stable when freeze-dried and have the potential to be used as a biological weapon. Safe and effective vaccines are needed to protect warfighters. Current vaccines for alphaviruses causing encephalitis are inadequate. Improved vaccines would decrease the threat of BW and enhance strategic mobility. Under this DTO, vaccine candidates for EEE and WEE analogous to a VEE vaccine have been constructed.

Challenges. Major technical challenges include development of appropriate model systems for investigational purposes, and determining expression vectors for recombinant products.

Milestones/Metrics.

FY2000: Complete construction of analogous EEE and VEE IIIA vaccine constructs. Complete assessment of VEE IE, VEE IIIA, EEE, and WEE in small animal models.

FY2001: Complete safety and efficacy testing of VEE IE, VEE IIIA, EEE, and WEE in nonhuman primate models. Complete potency and stability studies on all vaccine candidates. Complete definition of surrogate protection markers.

FY2002: Complete formulation and vaccine interference studies. Transition VEE multivalent vaccine (VEE IA/B, VEE IE, VEE IIIA)

FY2003: Transition combined VEE/EEE/WEE vaccine.

Customer POC	Service/Agency POC	USD(A&T) POC
COL Robert DEADERICK, USA AMEDD/C&S	COL Gennady PLATOFF, USA USA/MRMC	Dr. Robert FOSTER ODUSD(S&T)
COL Ernest TAKAFUJI, USA OSD/HA		

CB.24 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	TB2	0.5	0.7	0.2	0.2	0.0	0.0
0603384BP	TB3	0.6	0.6	0.8	0.8	0.0	0.0
	DTO Total	**1.1**	**1.3**	**1.0**	**1.0**	**0.0**	**0.0**

CB.25 Multiagent Vaccines for Biological Threat Agents

Objectives. Produce a vaccine or vaccine delivery approach that could be used to concurrently immunize an individual against a range of biological warfare (BW) threats. Bioengineered and recombinant vaccine technologies (naked DNA vaccines or replicon vaccines) will be exploited to achieve multivalent vaccines that are directed against multiple agents, yet use the same basic construct for all of the agents.

Payoffs. Vaccines currently being developed for biological threat agents are univalent with respect to the threat itself (e.g., separate vaccines against agents such as anthrax, plague, botulinum toxins, variola virus). Multiagent vaccines to be demonstrated through this DTO would be analogous to such commercial vaccines as the combined diphtheria-pertussis-tetanus vaccine and the measles-mumps-rubella vaccine. The possibility of achieving protective immunity against multiple BW threat agents with a much reduced requirement for the number of vaccines or immunization schedules means greater flexibility and fewer time constraints in fielding a force protected against the threats. Other potential benefits include decreased cost of production, greater range of potential vaccine production facilities, and possibly faster licensure of vaccines. Due to the nature of some of the threat agents and lack of commercial viability for such a combined product, there is no other commercial or foreign source through which to procure such products. In FY99, animal models were developed for evaluating single and potential combined vaccines.

Challenges. Major technical challenges include development of appropriate model systems for investigational purposes; and evaluation of immunogenicity, efficacy, and possible interference effects of a multiagent vaccine candidate.

Milestones/Metrics.

FY2000: Select most promising approach and identify final agents to be incorporated into the combined product; begin evaluation of immunogenicity for combined products and examine for possible interference effects.

FY2001: Test efficacy of combined products both individually and in combined products.

FY2002: Complete preclinical data package for FDA; submit package for transition to advanced development (program definition and risk reduction phase).

Customer POC	Service/Agency POC	USD(A&T) POC
COL Robert DEADERICK, USA AMEDD/C&S	CDR Shaun B. JONES, USN DARPA/DSO	Dr. Robert FOSTER ODUSD(S&T)
COL Ernest TAKAFUJI, USA OSD/HA	COL Gennady PLATOFF, USA USA/MRMC	

CB.25 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602383E	BW–01	1.0	1.0	1.0	0.0	0.0	0.0
0602384BP	TB2	1.0	0.5	0.3	0.0	0.0	0.0
0603384BP	TB3	0.9	1.5	1.7	0.0	0.0	0.0
	DTO Total	**2.9**	**3.0**	**3.0**	**0.0**	**0.0**	**0.0**

CB.26 Common Diagnostic Systems for Biological Threats and Endemic Infectious Diseases

Objectives. Develop state-of-the-art technologies (platforms/devices) capable of diagnosing infectious disease and biological warfare (BW) agents in clinical specimens. The devices will be used by preventive medicine personnel for disease surveillance and monitoring, and by medical laboratory personnel for the diagnosis of disease due to natural and BW threat agents. Efforts will focus on an immunologically based membrane device to rapidly detect host immune responses to etiologic agents or the antigens or products of the agents themselves, and on miniaturized polymerase chain reaction technology for detection and identification of nucleic acids of natural infectious disease and BW agents.

Payoffs. The ability to quickly identify exposure to specific BW and infectious disease agents and rapidly treat warfighters is critical to maintaining the strength of the force and to giving commanders the ability to provide specific protective measures to yet unexposed warfighters. The technologies to be provided will benefit all elements of health care from forward-based to CONUS-based fixed medical facilities, and will allow medical diagnosis of biological threat agents and endemic infectious diseases much farther forward on the battlefield than is currently possible. Many BW agent-induced illnesses have early symptoms that are flu-like and indistinguishable from each other and other less harmful pathogens. The ability to detect infection immediately after exposure would be extremely helpful in determining whether a BW attack has occurred and how many warfighters were exposed and in need of treatment. Early diagnosis is key to providing effective therapy. An effective broad diagnostic capability is important in locating the correct therapeutics and getting them moved in-theater in a timely manner. Collaborations with industrial/biotechnology entities, government, and academic centers of excellence will be developed to leverage continuing advances in biotechnology and industry. In FY99 an immunologically based membrane platform was transitioned to advanced development (program definition and risk reduction phase.) The immunologically based membrane platform requires no special instrumentation and is capable of (1) the rapid detection of specific host immune responses to a broad range of etiologic agents, or (2) the detection of the antigens or products of these agents in clinical specimens with 100% specificity and 97% sensitivity for each agent.

Challenges. Requisite technologies require adaptation for clinical use and for detection of specific infectious disease or BW agents. Challenges include development of appropriate antibodies, elimination of interference from substances contained in clinical samples, and selection of appropriate nucleic acid probes. There are a large number of actual and potential biological threat agents. The diagnostic system must be able to distinguish these diverse pathogens both from each other and from those common natural infections that may begin with similar signs and symptoms. Current diagnostic systems also require manual sample collection and preparation, which is labor intensive and time consuming, especially when large numbers of clinical samples must be collected in the field.

Milestones/Metrics.

FY2002: Transition to advanced development a handheld device capable of detecting and identifying nucleic acids of a broad range of natural infectious disease and BW agents in clinical specimens with 100% specificity and 97% sensitivity for each agent. Refine diagnostic technologies as applied directly to the diagnostic tests and devices, emphasizing specific genetic targets as derived from genomic sequencing. Define and characterize immunological and nucleic acid-based diagnostic platform methodologies. Validate immunologically based diagnostic assays for specific BW agents.

Customer POC	Service/Agency POC	USD(A&T) POC
COL Robert DEADERICK, USA AMEDD/C&S	COL Charles H. Jr. HOKE, USA USA/MRMC	Dr. Robert FOSTER ODUSD(S&T)
COL Ernest TAKAFUJI, USA OSD/HA	Dr. Steven S. MORSE DARPA/DSO	
	COL Gennady PLATOFF, USA USA/MRMC	

CB.26 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602383E	BW–01	2.0	1.0	0.0	0.0	0.0	0.0
0602384BP	TB2	0.6	0.6	0.6	0.0	0.0	0.0
0603384BP	TB3	1.0	1.0	1.0	0.0	0.0	0.0
	DTO Total	**3.6**	**2.6**	**1.6**	**0.0**	**0.0**	**0.0**

CB.27 Therapeutics Based on Common Mechanisms of Pathogenesis

Objectives. Develop a suite of medical countermeasures against broad classes of biological pathogens (bacterial, viral, bioengineered, etc.) that share common mechanisms of pathogenesis.

Payoffs. Effective pathogen countermeasures may not eliminate the threat of biological warfare by a determined adversary, but they can provide a significant disincentive to its use. Program success will provide vaccine and therapeutic countermeasures that will reduce the threat of biological warfare and its operational impact through the development of new broad-spectrum antivirals and antibacterials. These will be particularly important for new emerging and bioengineered threats for which we have no current countermeasures.

Challenges. The large number of actual and potential threats include hitherto unknown pathogens and virulence strategies. A particular concern is the exploitation of modern genetic engineering by adversaries to develop "super pathogens" or to disguise agents. This emerging capability puts an even greater stress on our ability to detect and combat the medical consequences of exposure and infection. In addition, the operational environment constitutes one of generalized immunosuppression, further increasing both the risk from biological threats and the need for robust immune defenses.

Milestones/Metrics.

FY2000: Identify broad-spectrum strategies with potential for immunomodulatory activity against multiple pathogens. Identify virulent mechanisms shared by multiple pathogens.

FY2001: Develop novel therapeutics targeting the common pathways of pathogenesis.

FY2002: Demonstrate efficacy of candidate therapeutics in laboratory and animal models.

FY2003: Develop testing and evaluation architectures for operational force protection efficacy.

Customer POC	Service/Agency POC	USD(A&T) POC
COL Robert DEADERICK, USA AMEDD/C&S	Dr. Michael GOLDBLATT DARPA/DSO	Dr. Robert FOSTER ODUSD(S&T)
COL Ernest TAKAFUJI, USA OSD/HA	CDR Shaun B. JONES, USN DARPA/DSO	Dr. Anna JOHNSON–WINEGAR DATSD(CBD)
	COL Gennedy PLATOFF, USA ACC/HQ USA/MRMC	

CB.27 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602383E	BW–01	14.0	12.0	9.0	5.0	0.0	0.0
	DTO Total	**14.0**	**12.0**	**9.0**	**5.0**	**0.0**	**0.0**

CB.28 Chemical Agent Prophylaxes II

Objectives. As a follow-on to the completed DTO CB.21, continue development (Phase 0) of a prophylactic that can detoxify nerve agents at a sufficient rate to protect the warfighter from exposure to up to five median lethal doses (5LD50) of nerve agents. The prophylactic substance should be nontoxic, produce no adverse side effects, have no adverse effect on performance, be easy to administer, and have a long in vivo half-life.

Payoffs. Nerve agents are a validated threat to U.S. forces. In comparison to currently fielded nerve agent countermeasures, achievement of this technology objective would provide a capability for extended protection against a wide spectrum of nerve agents without causing side effects, behavioral effects, or the need for extensive postexposure therapy. Improved prophylaxis for chemical warfare agents deters their use by the enemy and increases the capability of U.S. and allied forces to sustain operational tempo and provide full-dimension protection. The successful application of this technology could reduce the reliance on mission-oriented protective posture gear by the warfighter.

Challenges. Major technical challenges include developing effective prophylactics devoid of side effects, developing circulating scavengers with extended half-lives, developing suitable animal models for these studies, producing sufficient material for safety and efficacy studies, and extrapolating efficacy test results from animals to man.

Milestones/Metrics.

FY2000: Develop in vivo transgenic animal models for use as testbeds for evaluating scavengers. Expand the evaluation of human protein catalytic scavengers to include enzymes and human butyrylcholinesterase. Initiate development of an animal model capable of producing large quantities of recombinant enzyme scavenger. Identify several delivery platforms for bioscavenger genetic material for exploration of administration of bioscavengers via gene therapy.

FY2001: Expand physiologically based pharmacokinetic (PK) models for use as PK studies of candidate scavengers with/without agent present. Complete the evaluation of human protein catalytic scavengers. Examine human protein scavengers for human safety. Determine the 3D x-ray crystallographic structure of human CaE and PON–1. Determine through discussions with the FDA the type(s) of data required for submission with an Investigational New Drug application for a human recombinant catalytic protein.

FY2002: Complete development/validation of a transgenic animal model capable of producing sufficient amounts of recombinant enzyme scavenger material for clinical trials. Determine safety and efficacy of scavenger candidates in two animal species. Complete testing of various vector/gene combinations to validate in an animal model the concept of gene therapy for delivery of bioscavengers. Convene Milestone I in-process review to approve transition of candidate(s) scavengers to Phase I of development. Transition to a chemical warfare agent prophylactic that will protect the warfighter for a period greater than 8 hr against exposure to 5LD50s of nerve agent.

Customer POC	Service/Agency POC	USD(A&T) POC
COL Ernest TAKAFUJI, USA OSD/HA	COL Gennady PLATOFF, USA USAMRMC	Dr. Robert FOSTER ODUSD(S&T)
COL Helen S. TIERNAN, USA USAMEDD/C&S		

CB.28 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602384BP	TC2	1.3	1.2	1.0	0.0	0.0	0.0
0603384BP	TC3	0.6	0.7	1.0	0.0	0.0	0.0
	DTO Total	**1.9**	**1.9**	**2.0**	**0.0**	**0.0**	**0.0**

CB.29 Reactive Topical Skin Protectant

Objectives. Increase the protection offered by the existing topical skin protectant (TSP) by incorporating a reactive compound that will detoxify nerve and blister agents. This reactive substance must be compatible with the TSP and not irritate the skin.

Payoffs. Vesicant and nerve agents are significant threats to U.S. forces. While prophylaxes and treatment compounds are available for nerve agents, no specific countermeasures have been developed for vesicants such as sulfur mustard (HD). Reactive TSPs (RTSPs) would either augment the protection afforded by the protective overgarments or, ideally, redefine and reduce the circumstances requiring mission-oriented protective posture levels. The rapid action of vesicating agents such as HD and lewisite suggests that a pre-exposure skin protection system offers the best opportunity to prevent the serious consequences from percutaneous exposure to these agents. This approach also reduces the risks from exposure to nerve agents. Improved prophylaxes for chemical warfare agents deters their use by the enemy and increases the capability of U.S. and allied forces to sustain operational tempo.

Challenges. Major technical challenges include identifying catalytic reactive moieties, developing suitable evaluation models, and extrapolating efficacy test results from animals to man.

Milestones/Metrics.

FY2000: Initiate formulation studies of mixtures of reactive compound and TSP. Begin downselection process

FY2001: Demonstrate the efficacy of reactive TSP formulation candidate(s) using two animal species.

FY2002: Complete formulation studies. Perform acute eye and skin irritation safety evaluations. Demonstrate efficacy of RTSP formulation against estimated battlefield levels of nerve and blister agent as liquids or vapors. Select best formulation candidate(s) for transition to development. Convene in-process review (Milestone I) to consider transition of RTSP formulation to Phase 1 (Program Definition and Risk Reduction). Transition RTSP formulation capable of protecting against anticipated battlefield levels of nerve or blister agents with no adverse side effects.

Customer POC	Service/Agency POC	USD(A&T) POC
COL Ernest TAKAFUJI, USA OSD/HA	COL Gennady PLATOFF, USA USAMRMC	Dr. Robert FOSTER ODUSD(S&T)
COL Helen S. TIERNAN, USA USAMEDD/C&S		

CB.29 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603384BP	TC3	0.4	0.4	0.4	0.0	0.0	0.0
	DTO Total	**0.4**	**0.4**	**0.4**	**0.0**	**0.0**	**0.0**