Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Chemical and Biological Defense Program

Date: February 2015

Appropriation/Budget Activity

R-1 Program Element (Number/Name)

0400: Research, Development, Test & Evaluation, Defense-Wide I BA 1: Basic PE 0601384BP I CHEMICAL/BIOLOGICAL DEFENSE (BASIC RESEARCH)

Research

COST (\$ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
Total Program Element	-	50.738	48.261	46.261	-	46.261	45.364	44.854	44.302	47.239	Continuing	Continuing
LF1: CHEMICAL/BIOLOGICAL DEFENSE - LIFE SCIENCES (BASIC RESEARCH)	-	34.623	31.727	28.588	-	28.588	29.744	28.606	28.215	31.043	Continuing	Continuing
PS1: CHEM/BIO DEFENSE - PHYSICAL SCIENCES (BASIC RESEARCH)	-	16.115	16.534	17.673	-	17.673	15.620	16.248	16.087	16.196	Continuing	Continuing

A. Mission Description and Budget Item Justification

Advances fundamental knowledge and promotes theoretical and experimental research in life and physical sciences.

The Projects within this BA reflect the research areas of Life Sciences(LF1) (e.g. microbiology, biochemistry, pathogenic mechanisms, cell and molecular biology, immunology, and information science) which focus on fundamental efforts to understand living systems' response to biological or chemical agents, to support detection, diagnostics, protection, and medical treatment.

The projects within in this BA also include efforts in Physical Sciences (PS1) (e.g. chemistry, physics, materials science, and environmental science) which focus on fundamental scientific phenomena. These support investigation of physical and chemical properties and interactions for enhanced functionalities important to detection. protection, and decontamination. BA1 also supports Science, Technology, Engineering, and Math (STEM) efforts through the National Research Council with Post-Doctorate research associate program, a two week summer camp for high school students and teachers, and Military Internships at West Point.

The projects in this PE are placed in BA1 because they are basic research efforts directed towards non-specific or non-unique military applications. Basic research technological breakthroughs support applied research (PE 0602384BP) activities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Chemical and Biological Defense Program

Appropriation/Budget Activity R-1 Program Element (Number/Name)

Date: February 2015

0400: Research, Development, Test & Evaluation, Defense-Wide I BA 1: Basic PE 0601384BP I CHEMICAL/BIOLOGICAL DEFENSE (BASIC RESEARCH)

Research

B. Program Change Summary (\$ in Millions)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	51.426	48.261	46.832	-	46.832
Current President's Budget	50.738	48.261	46.261	-	46.261
Total Adjustments	-0.688	-	-0.571	-	-0.571
 Congressional General Reductions 	-	-			
 Congressional Directed Reductions 	-	-			
 Congressional Rescissions 	-	-			
Congressional Adds	-	-			
 Congressional Directed Transfers 	-	-			
Reprogrammings	-	-			
SBIR/STTR Transfer	-0.688	-			
Other Adjustments	-	-	-0.571	-	-0.571

Change Summary Explanation

Funding: N/A

Schedule: N/A

Technical: N/A

Exhibit R-2A, RDT&E Project Justification: PB 2016 Chemical and Biological Defense Program									1	Date: Febr			
Appropriation/Budget Activity						am Elemen	t (Number/	Name)	Project (N	lumber/Name)			
0400 / 1					PE 060138	84BP <i>I CHE</i>	MICAL/BIO	LOGICAL	LF1 / CHE	-1 I CHEMICAL/BIOLOGICAL DEFENSE -			
	DEFENSE (BASIC RESEARCH) LIFE SCIENCES (BASIC RESEARC						RCH)						
COOT (ft in Milliana)	Prior			FY 2016	FY 2016	FY 2016					Cost To	Total	
COST (\$ in Millions)	Years	FY 2014	FY 2015	Base	oco	Total	FY 2017	FY 2018	FY 2019	FY 2020	Complete	Cost	
LF1: CHEMICAL/BIOLOGICAL DEFENSE - LIFE SCIENCES (BASIC RESEARCH)	-	34.623	31.727	28.588	-	28.588	29.744	28.606	28.215	31.043	Continuing	Continuir	

Focuses on fundamental efforts to understand living systems' response to biological or chemical agents, to support detection, protection, diagnostics, and medical treatment.

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2014	FY 2015	FY 2016
Title: 1) Life Sciences	34.623	31.279	28.588
Description: Focuses on fundamental efforts to understand living systems' response to biological or chemical agents, to support detection, protection, diagnostics, and medical treatment.			
FY 2014 Accomplishments:			
Developed understanding of pathogens, novel threats and host responses (including human and zoonotic) to prevent/minimize host injury. Investigated and evaluated systemic biological responses following exposure of living systems to CB agents. Improved understanding of how polymicrobial interactions interfere with bacterial activities (through investigation of genetic networks) to influence discovery of novel antagonists for medical countermeasures, thus influencing response to or course of disease. Explored materials in biotic/abiotic interface and biomimetics to enable design of robust synthetic enzymes. Explored nano- and nanostructured materials as approaches to the needs of chemical and biological countermeasures, including behavior in biological systems and how morphology relates to biological interaction and function.			
FY 2015 Plans: Continue efforts to understand pathogens, novel threats and host responses (including human and zoonotic) to prevent/minimize host injury. Continue to investigate and evaluate systemic biological responses following exposure of living systems to CB agents. Improve understanding of how polymicrobial interactions interfere with bacterial activities to influence discovery of novel antagonists for medical countermeasures, thus influencing response to or course of disease. Continue to explore computational infectious models that utilize experimental data to generate mathematical models of infection and immunity. Continue exploration of approaches to enable design of robust synthetic enzymes and proteins. Continue to explore micro-, nano- and nanostructured materials as approaches to the needs of chemical and biological countermeasures, including behavior in biological systems and how morphology relates to biological interaction and function. Continue exploring functional cellular and molecular systems and integration of functionality that may provide adaptive materials and/or autonomously functioning materials and capabilities for CB defense countermeasures that sense and transduce threats. Develop understanding and means to recognize the interaction of			

Exhibit R-2A, RDT&E Project Justif	ication: PR	2016 Chemi	ical and Riol	ngical Defens	se Program				Date: F	ebruary 2015	
Appropriation/Budget Activity 0400 / 1	ioation. i D	2010 0116111	cai and biolo	R-1 Pr PE 060	rogram Eler 01384BP / C	nent (Numb CHEMICAL/E CRESEARCI	BIOLOGICAL	. LF1/	ect (Number/Name) I CHEMICAL/BIOLOGICAL DEF SCIENCES (BASIC RESEARC		
B. Accomplishments/Planned Prog	rams (\$ in N	/lillions)							FY 2014	FY 2015	FY 2016
pathogens, toxicants, and novel threato explore the importance of bacterial as melioidosis. Initiate evaluation of bacterial pathogens. Investigate the	persistence role of Gene	and antibion	ic tolerance n and Duplic	in the establation in the	ishment of r	ecurring/chro	onic infection drug resistar	ns such			
Continue efforts to understand pathog host injury. Continue to investigate a agents. Improve understanding of honovel antagonists for medical counter and nano-structured materials as application by the importance of bacterial persistent melioidosis. Investigate the influence	nd evaluate sow polymicrolormeasures, the proaches to the polymer and antibioned an	systemic bion bial interaction interaction interaction interaction interaction by biological interaction in the needs of the biological interaction in the b	ological responsions interfere ing response chemical anateraction and in the esta	onses following with bacterie to or coursed biological of the function.	ng exposure al activities to of disease countermeas Continue co recurring/ch	e of living systo influence of Continue to sures, includensortium appropriationic infections.	stems to CB discovery of o explore nating behavior proach to expons such as	no- in			
melioloosis. Investigate the inilidence	e of glycosyla	ition pattern	s on biologic	stability and	pharmacolo	ogic characte	eristics.				
Title: 2) SBIR/STTR	e of glycosyla	ition pattern	s on biologic	stability and	pharmacolo	ogic characte	eristics.		-	0.448	-
Title: 2) SBIR/STTR FY 2015 Plans:		·	s on biologic	stability and	pharmacolo	ogic characte	eristics.		-	0.448	-
Title: 2) SBIR/STTR		·	s on biologic	•			rograms Su	btotals	34.623	0.448	28.58
Title: 2) SBIR/STTR FY 2015 Plans:	Innovative R	desearch.	FY 2016	•				btotals	34.623		
Title: 2) SBIR/STTR FY 2015 Plans: SBIR/STTR - FY15 - Small Business C. Other Program Funding Summa	Innovative R ry (\$ in Millio	desearch. ons) FY 2015	FY 2016 Base	Accon	nplishments FY 2016 Total	s/Planned P FY 2017	rograms Su FY 2018	FY 20°	l9 FY 202	31.727 Cost To Complete	Total Cos
Title: 2) SBIR/STTR FY 2015 Plans: SBIR/STTR - FY15 - Small Business C. Other Program Funding Summa Line Item CB2: CHEMICAL BIOLOGICAL	Innovative R	desearch.	FY 2016	Accon	nplishments	s/Planned P	rograms Su		l9 FY 202	31.727 Cost To	Total Cos
Title: 2) SBIR/STTR FY 2015 Plans: SBIR/STTR - FY15 - Small Business C. Other Program Funding Summa Line Item CB2: CHEMICAL BIOLOGICAL DEFENSE (APPLIED RESEARCH)	Innovative R ry (\$ in Million FY 2014 44.102	esearch. ons) FY 2015 54.061	FY 2016 Base 52.131	Accon	FY 2016 Total 52.131	FY 2017 54.321	rograms Su <u>FY 2018</u> 53.348	FY 20 ′ 47.02	19 FY 202 20 47.40	31.727 Cost To Complete Continuing	Total Cos Continuir
Title: 2) SBIR/STTR FY 2015 Plans: SBIR/STTR - FY15 - Small Business C. Other Program Funding Summar Line Item CB2: CHEMICAL BIOLOGICAL DEFENSE (APPLIED RESEARCH) TM2: TECHBASE MED	Innovative R ry (\$ in Millio	desearch. ons) FY 2015	FY 2016 Base 52.131 88.933	Accon	nplishments FY 2016 Total	s/Planned P FY 2017	rograms Su FY 2018	FY 20°	19 FY 202 20 47.40	31.727 Cost To Complete	Total Continuir
Title: 2) SBIR/STTR FY 2015 Plans: SBIR/STTR - FY15 - Small Business C. Other Program Funding Summa Line Item • CB2: CHEMICAL BIOLOGICAL DEFENSE (APPLIED RESEARCH) • TM2: TECHBASE MED DEFENSE (APPLIED RESEARCH) • CB3: CHEMICAL	Innovative R ry (\$ in Million FY 2014 44.102	esearch. ons) FY 2015 54.061	FY 2016 Base 52.131	Accon	FY 2016 Total 52.131	FY 2017 54.321	rograms Su <u>FY 2018</u> 53.348	FY 20 ′ 47.02	19 FY 202 20 47.40 33 85.79	31.727 Cost To Complete Continuing	Total Continuir
Title: 2) SBIR/STTR FY 2015 Plans: SBIR/STTR - FY15 - Small Business C. Other Program Funding Summa Line Item • CB2: CHEMICAL BIOLOGICAL DEFENSE (APPLIED RESEARCH) • TM2: TECHBASE MED DEFENSE (APPLIED RESEARCH)	Innovative R ry (\$ in Million FY 2014 44.102 85.828	esearch. ons) FY 2015 54.061 100.722	FY 2016 Base 52.131 88.933	Accon	FY 2016 Total 52.131 88.933	FY 2017 54.321 80.082	rograms Su <u>FY 2018</u> 53.348 82.046	FY 20 247.02	19 FY 202 20 47.40 33 85.79 77 15.69	31.727 Cost To Complete Continuing Continuing	Total Cos Continuin Continuin

PE 0601384BP: CHEMICAL/BIOLOGICAL DEFENSE (BASIC RESEA... Chemical and Biological Defense Program

Chemical and Biological Defense Program	Date: February 2015
R-1 Program Element (Number/Name) PE 0601384BP I CHEMICAL/BIOLOGICAL DEFENSE (BASIC RESEARCH)	Project (Number/Name) LF1 / CHEMICAL/BIOLOGICAL DEFENSE LIFE SCIENCES (BASIC RESEARCH)
	R-1 Program Element (Number/Name) PE 0601384BP I CHEMICAL/BIOLOGICAL

Exhibit R-2A, RDT&E Project Justification: PB 2016 Chemical and Biological Defense Program										Date: February 2015		
Appropriation/Budget Activity 0400 / 1 R-1 Program Eleme PE 0601384BP / CH DEFENSE (BASIC F						34BP <i>I CHE</i>	MICAL/BIO	•		M/BIO DEF	ne) ENSE - PH ESEARCH)	
COST (\$ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
PS1: CHEM/BIO DEFENSE - PHYSICAL SCIENCES (BASIC RESEARCH)	-	16.115	16.534	17.673	-	17.673	15.620	16.248	16.087	16.196	Continuing	Continuing

A. Mission Description and Budget Item Justification

B. Accomplishments/Planned Programs (\$ in Millions)

This project (PS1) advances fundamental scientific knowledge in physical science areas that include chemistry, physics, materials science, environmental sciences, and nanotechnology that could potentially lead to transformational CB defensive capabilities enhancing Warfighter performance and safety. Research results in physics, chemistry and materials sciences have potential application in point and standoff detection, as well as protection and decontamination. Surface and environmental sciences focus on the study of physical and chemical properties and phenomena of interactions, especially with regard to Non Traditional Agents (NTAs), that seek to improve capabilities such as detection, protection, and decontamination. Research in nanotechnology and nanoscale sciences, such as nanoelectromechanical systems, molecular motors, nano-mechanical resonance sensing, and nano-meter imaging, has potential application across CB capability areas to provide significant enhancement by, for example, decreasing detection response times, increasing medical countermeasure effectiveness against a wider array of threat agents, and providing currently unavailable modalities like detection imbedded in fabrics.

=	0	0.0	0.0
Title: 1) Physical Sciences	16.115	16.315	17.673
Description: Focuses on fundamental scientific phenomena including chemistry, physics, materials science, environmental science, and nanotechnology.			
FY 2014 Accomplishments: Continued exploring multifunctional material design and synthesis to identify dynamic materials that combine functionality and durability to improve CB protection by increasing protection factors and reducing physical burden. Designed and synthesized novel decontamination options that are broadly applicable to multiple chemicals or biologicals and are less harmful to equipment. Continued investigations into novel signatures and analytical methods, new separation approaches, and recognition elements to reduce logistical burden while increasing specificity to overcome limitations in current approaches to identifying and quantifying CB threats. Explored nano- and nanostructured materials as novel approaches to needs in chemical and biological countermeasures. Continued exploring integration of functionality that may provide adaptive materials and capabilities for CB defense countermeasures that sense, transduce, respond and mitigate threats.			
FY 2015 Plans: Continue exploring multifunctional material design and synthesis to identify dynamic materials that combine functionality and durability to improve CB protection by increasing protection factors and reducing physical burden. Design and synthesize novel decontamination options that are broadly applicable to multiple chemicals or biologicals and are less harmful to equipment.			

FY 2014

FY 2015

FY 2016

Exhibit R-2A, RDT&E Project Justif	ication: PB	2016 Chemi	cal and Biol	ogical Defen	se Program				Date: Fel	oruary 2015		
Appropriation/Budget Activity 0400 / 1		PE 0601384BP I CHEMICAL/BIOLOGICAL P							Project (Number/Name) PS1 <i>I CHEM/BIO DEFENSE - PHYSICA</i> SCIENCES (BASIC RESEARCH)			
B. Accomplishments/Planned Prog	rams (\$ in N	Millions)						I	Y 2014	FY 2015	FY 2016	
Continue investigations into novel signeduce logistical burden while increase CB threats. Continue exploration of rountermeasures. Continue explorin capabilities for CB defense countermimpact of ambient surface reactivity and understanding of chemical behavior in	sing specificinano- and na g materials a easures that and structure	ty to overcor anostructured and integration bind, cataly on performa	me limitation d materials a on of function ze, sense, trance of state	s in current as novel appoinality that malansduce, responding to the contract of the contract and contract an	approaches roaches to n ay provide a spond and/ond novel CB	to identifying eeds in cher daptive mate r mitigate the mitigating m	g and quantify mical and bio erials and reats. Investinaterials. De	ring logical igate				
FY 2016 Plans: Continue exploring multifunctional madurability to improve CB protection by decontamination options that are broadcontamination of micro-, nanocountermeasures. Continue exploring capabilities for CB defense countermediate of ambient surface reactivity and strudevelop understanding of chemical by	/ increasing adly applicate and nanosti g materials a easures that cture on perf	protection fable to multiple ructured mate and integration bind, cataly, formance of	ctors and re- e chemicals erials as no- on of function ze, respond state-of-the-	ducing physi or biological vel approach nality that mand/or mitigart and nove	cal burden. s and are ledes to needs ay provide a late threats. If CB mitigat	Design and ss harmful to in chemical daptive mate Continue to ing materials	synthesize no equipment. and biologica erials and investigate in	ovel al mpact				
Title: 2) SBIR/STTR		0 0111110111110	111, 00011 00 1	Titla material	intoractione	<u> </u>			-	0.219		
FY 2015 Plans: SBIR/STTR - FY15 - Small Business	Innovative R	Research.										
				Accon	nplishments	s/Planned P	rograms Su	btotals	16.115	16.534	17.673	
C. Other Program Funding Summa	ry (\$ in Milli	ons)										
	5 1/ 004 4	5)/ 00/5	FY 2016	FY 2016	FY 2016	5 \(004 5	5 1/ 00/0	5)/ 0040	5 1/ 0000	Cost To		
• CB2: CHEMICAL BIOLOGICAL	FY 2014 44.102	FY 2015 54.061	<u>Base</u> 52.131	<u>000</u>	<u>Total</u> 52.131	FY 2017 54.321	FY 2018 53.348	FY 2019 47.020		Complete Continuing		
• CB3: CHEMICAL BIOLOGICAL DEFENSE (ATD)	19.317	17.722	16.062	-	16.062	16.676	15.982	15.577	15.698	Continuing	Continuin	
Remarks												
D. Acquisition Strategy N/A												

PE 0601384BP: CHEMICAL/BIOLOGICAL DEFENSE (BASIC RESEA... Chemical and Biological Defense Program

Exhibit R-2A, RDT&E Project Justification: PB 2016 Chemical and Biological	Date: February 2015	
Appropriation/Budget Activity 0400 / 1	R-1 Program Element (Number/Name) PE 0601384BP I CHEMICAL/BIOLOGICAL DEFENSE (BASIC RESEARCH)	Project (Number/Name) PS1 I CHEM/BIO DEFENSE - PHYSICAL SCIENCES (BASIC RESEARCH)
E. Performance Metrics N/A		