

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY
RDTE, Defense Wide BA 04

PE NUMBER AND TITLE
0603709D8Z - Joint Robotics Program

COST (\$ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
P709 Joint Ground Robotics Enterprise (JGRE) ACD&P	22.975	23.654	11.847	12.005	12.268	12.589	12.916

A. Mission Description and Budget Item Justification: (U) This Program Element (PE) was established in response to Congressional guidance to consolidate DoD robotic programs on unmanned ground systems and related robotic technologies in order to increase focus of the Services' robotic programs on operational requirements. Technologies in the PE support the continued development of technologies in Budget Activity 3 (PE 0603711D8Z) to continue technology transition and transformation for closing warfighter requirement capability gaps. The program ensures coordination between the Services and places emphasis on interoperability and commonality among unmanned ground systems. This PE continues the effort to overcome technology barriers in the thrust areas of unmanned ground system technologies to include Autonomous & Tactical Behaviors, Manipulation Technologies, Collaborative Operations, Interoperability, Man-portable Unmanned Ground System Technologies, and Technology Transition/Transformation. The purpose is to further the fielding of a family of affordable and effective mobile ground robotic systems; develop and transition technologies necessary to meet evolving user requirements, and serve as a catalyst for insertion of robotic systems and technologies into the force structure. This PE supports the need to integrate technologies into representative models or prototype systems in a high fidelity and realistic operating environment and expedite technology transition from the laboratory to operational use. Emphasis is on proving component and subsystem maturity prior to integration in major and complex systems and may involve risk reduction initiatives. Within this PE, funded projects will continue the delivery of responses to advanced technology needs directed at enhancing the warfighter's capabilities identified during concept development, operational assessments and field feedback of current unmanned systems.

All actions under this PE are within BA 4 and are identified with one project number.

<u>B. Program Change Summary</u>	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008)	22.978	11.860	11.867
Current BES/President's Budget (FY 2009)	22.975	23.654	11.847
Total Adjustments	-0.003	11.794	-0.020
Congressional Program Reductions			
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer			
Other	-0.003	11.794	-0.020

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C. Other Program Funding Summary Not applicable for this item.

D. Acquisition Strategy Not applicable for this item.

E. Performance Metrics:

FY	Strategic Goals Supported	Existing Baseline	Planned Performance Improvement / Requirement Goal	Actual Performance Improvement	Planned Performance Metric / Methods of Measurement	Actual Performance Metric / Methods of Measurement
08						

Comment: Metrics for the Joint Ground Robotics Enterprise (JGRE) funded Research, Development, Test & Evaluation (RDT&E) are articulated in individual project plans used to form the basis of funding justification and program assessment. These decisions are supported by the JGRE Technology Advisory Board (TAB). The TAB provides technology to capability matrix assessments to inform funding decisions, provide inputs to unmanned system (UMS) roadmaps and ensure technology transitions. In all document sets, project descriptions include task schedules with associated milestones, against which progress toward end goals can be measured. At the level of the performer, efforts are tracked using project technical and management milestones that have been appropriately defined and agreed upon in the project plans. At the enterprise level, the JGRE management structure and process tracks deliverables and examines the transition of technologies and ideas from the performer to DoD programs. The JGRE management structure and process includes a mid-year in progress review (IPR), annual funding justification and prioritization, technology assessments, a senior Military Council and a Senior Steering Group (SSG) overview. These DoD participant reviews include cost, schedule and technical progress assessment against the project milestones. Metric evaluations for the funded actions include, where appropriate, controlled trials, demonstrations, quasi-experimental evaluations, and direct/indirect analysis.

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COST (\$ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
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All actions under this PE are within BA 4 and are identified with one project number.

B. Accomplishments/Planned Program:

<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Autonomous & Tactical Behaviors	4.618	4.061	2.085

FY 2007 Accomplishments:

- * Experimentation and testing of next-generation platform stabilization systems (Perfect Horizon)
- * Began development of three different sizes (75, 150, and 300 lbs) of a linear actuator version of the Perfect Horizon for stabilization of larger payloads.
- * Initiated effort to develop a Computer Aided Fire Control system for robotic platforms to enhance accuracy and effectiveness of Less than Lethal weapons and reduce Operator workload associated with aiming, tracking and firing from a mobile platform.
- * Advanced convoy following operations in collaboration with the University of Florida
- * Developed JAUS software development kits to allow non-compliant hardware to more easily integrate into a JAUS complaint system.
- * Supporting Convoy following operations: Developed algorithm to determine the location of the lead vehicle relative to the follower based on the sensed infrared targets; Performed initial testing of system to evaluate the accuracy of the sensed lead vehicle location.

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- * Continued support to refine, maintain for and transition of documentation for Joint Architecture for Unmanned Systems (JAUS) to a Society of Automotive Engineers (SAE) standard.
- * Integrated JAUS into Simulation Systems for experimentation/validation.
- * Continued production of second-generation Automatically Deployable Communications Relays (ADCR) systems.

FY 2008, 2009 and 2010 Plans: Support the development of vehicle onboard intelligence and tactical behaviors to allow the fielding of advanced autonomous unmanned systems. Including integration and testing of specific tactical behaviors for fielded EOD robots. Baseline user identified mission scenarios to develop operational behaviors enabling unmanned operations within the conduct of mission tasks. Increase the warfighter's capability by transferring and developing technologies that will have an immediate impact on the autonomy and functional capabilities of current and future robotic systems. Enable transitioning of technologies appropriate for small robots from the technology transfer program to fielded systems. Plans include:

- * Autonomous Navigation for Small UGVs - Develop, test, and prototype navigation sensors and software designed specifically for small UGVs to enable autonomous navigation.
- * Automated Aircraft Refueling
- * Standoff Explosives Detection Using Hyperspectral Imaging
- * Mine Area Clearance Equipment - Automated guidance (navigation) and control technology
- * Autonomous Range Clearance - Demonstrate automated detection and clearance of unexploded submunition items
- * Robotic Route Clearance and Interrogation System Equipment
- * Chemical Biological Radiological & Nuclear (CBRN) Package for Unmanned Ground & Aerial Vehicles
- * Robotic Firefighting Technologies
- * Automatic Payload Deployment System (APDS) - UGV-mounted module to deploy payloads and a stand-alone networked sensor payload and conduct demonstrations and tests.
- * Human Presence Detection (HPD)
- * Continued development of the Joint Architecture for Unmanned Systems (JAUS)
- * Convoy Active Safety Technologies (CAST)
- * Joint Training and Experimentation Center (JTEC) Joint Robotics Program

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

(U) Manipulation Technologies

3.984

2.622

2.005

FY 2007 Accomplishments:

- * Conducted Military Utility Assessment on a Mobile Under Vehicle Inspection
- * Initiated Robotic Refueling capability for the Joint Strike Fighter.
- * Supported capability development via the Joint Architecture for Unmanned Systems (JAUS) development process.
- * Continued the Under Vehicle Mobile Inspection/Search Unmanned Ground Vehicle (Omni-Directional Inspection System (ODIS) platform design to include changes suggested from testing and user input in theater.
- * Continued support of field use and development purposes, procured off-the-shelf small robots for loan to government agencies, laboratories, and universities for the purpose of accelerating the spiral development process, more quickly improving future robotic platforms for the joint warfighter.
- * Supported limited objective experiments, feasibility demonstrations, and concept exploration projects.

FY 2008, 2009 and 2010 Plans: Incorporate existing technologies into systems representative to those in use, demonstrate ease of robotic manipulation, support the development of mobile

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manipulation, expedite the transition and integration of corresponding robotic technologies to enhance the current fielded systems with more functionalities, autonomy and state-of-the-art behavior with interface methods from the RTD&E environment. Plans include:

- * Integration of Access and Forced Entry Tools on Small UGV
- * Autonomous Navigation for Small UGVs
- * Developing and demonstrating meso-fluidic actuators: enabling technology in developing robotic manipulators with high level fidelity and dexterity.
- * Advanced EOD Robot System (AEODRS) Analysis of Alternatives
- * Advanced EOD Robot System Technology Development
- * Autonomous UAV Mission System (AUMS)
- * Joint Training and Experimentation Center (JTEC) Joint Robotics Program

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

(U) Collaborative Operations

3.782

4.212

2.035

FY 2007 Accomplishments:

- * Continued to refine, maintain and progress transition of documentation for Joint Architecture for Unmanned Systems (JAUS) to a Society of Automotive Engineers (SAE) standard.
- * Continued refinement of Joint Architecture for Unmanned Systems (JAUS) message sets and MOCU implementation for the Autonomous UAV Mission System (AUMS) refueling platform and Rotomotion UAV.
- * Initiated research to extend the dynamic discovery of JAUS, supporting UAV and UGV collaborations.
- * Algorithm development, implementation and testing for precision landing of the Rotomotion UAV utilizing a NovAtel Differential Global Positioning System (DGPS).
- * Initiated effort to integrate & fuse data from a variety of sensors, imagers, access control, robotic platforms and IFF systems to more effectively execute defensive battle space actions.
- * Continue integration of JAUS into Simulation Systems for experimentation/validation.
- * Continued efforts to determine and identify Mission Essential Modules to improve COTS system multi-mission capability.
- * Demonstrated and validated support for network-based systems.
- * Demonstrated ability to extend Non-Line-of-Sight operator control of UGVs up to 20 miles through use of a communications repeater integrated onto a UAV
- * Developed a Phase I user interface for UAV/UGV range extension operations that allow the operator to view optimal communications regions for uninterrupted telemetry and control
- * Convoy following operations: Designed infrared targets to be placed on the lead vehicle ; fabricated 1st target prototypes; Developed algorithm to determine the location of the lead vehicle relative to the follower based on the sensed infrared targets; Performed initial testing of system to evaluate the accuracy of the sensed lead vehicle location ; new target design initiated to improve tracking performance.
- * Procured and modified a commercially available vertical take off & landing (VTOL) UAV for JAUS compliant message set operation in support of the UAV and UGV mission collaboration program.

FY 2008, 2009 and 2010 Plans: Integrate communication, mission planning, interface technologies, and advanced intelligence capabilities to support collaborative operations between manned and unmanned systems. Develop and assess several strategies to enhance tele-operation of current UGVs and collaborative UAV teams. Included: Unmanned System Collaboration Demonstration. Collaborative and tactical behaviors include system conveying, teamed obstacle avoidance, area perception and relative position information sharing. Plans include:

- * Autonomous Range Clearance
- * Marsupial (SEGWAY) for APS and UXO

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* Continued development of the Joint Architecture for Unmanned Systems (JAUS)
 * Autonomous UAV Mission System (AUMS) - Develop and integrate Collaborative Technology Enablers essential to allow unmanned system collaboration.
 * Automatically Deployed Communications Relays (ADCR)
 * Joint Collaborative Technologies Experiment (JCTE)
 * Convoy Active Safety Technologies (CAST)
 * Joint Training and Experimentation Center (JTEC) Joint Robotics Program

<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Interoperability	3.585	4.930	2.628

FY 2007 Accomplishments:

* Demonstrated integrated capabilities in support of Force Protection Joint Experiments Integration Assessments (FPJEIA).
 * Continued to refine, maintain for and transition of documentation for Joint Architecture for Unmanned Systems (JAUS) to a Society of Automotive Engineers (SAE) standard.
 * Under the Automatically Deployable Communications Relays (ADCR) effort, continued testing on complete system.

FY 2008, 2009 and 2010 Plans: Promote and guide technology development to meet joint requirements and promote ground as well as air unmanned systems interoperability. Support the bridging of currently incompatible robots and controllers from various manufacturers, using different communications channels and hardware. Optimize best features of prior/ongoing research efforts into a maturing, standardized system that can be easily ported to robotic platforms used DoD-wide. Plans include:

* Continued development of the Joint Architecture for Unmanned Systems (JAUS)
 * Autonomous Control Development - Advanced Technologies Development to expand technologies required for unmanned systems to operate autonomously.
 * Universal UGV Platform - Inexpensive man-portable ground robotic platform, non-proprietary open architecture capable of accommodating a wide range of 3rd party payloads, interfaces, sensors, manipulators, etc.
 * Networked Robotic Communication Solutions
 * SUGV Range Extension (SRE)
 * Robotic Systems Technical & Operational Metrics Correlation
 * Covert Tracking Robots/Sensors
 * Autonomous Robotic Countermeasure (ARCS2)
 * Convoy Active Safety Technologies (CAST)
 * Joint Training and Experimentation Center (JTEC) Joint Robotics Program

<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Man-Portable Unmanned Ground System Technologies	3.172	3.063	1.845

FY 2007 Accomplishments:

* Continued Next Generation Explosive Ordnance Disposal Remote Control Vehicle (NGEODRCV) Level Development

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- * Continued the transition of technologies from the NGEODRCV Project.
- * Conducted Remote Ordnance Neutralization System (RONS) Continuous Improvement Program (CIP) Projects.
- * Continued EOD Cooperative Robotics Project.
- * Automatically Deployable Communications Relays (ADCR), continued support of Man-Portable Robotic System (MPRS).
- * Continued development, fielding and life cycle development of systems deployed for IED defeat missions.

FY 2008, 2009 and 2010 Plans: Increase the warfighter's capability by transferring and developing technologies that will have an immediate impact on the functional capabilities of man-portable robotic systems. Enable transition of technologies appropriate for small robots from the technology transfer program to fielded systems. Specific technologies include obstacle detection/obstacle avoidance (ODOA) and collaborative behaviors for small vehicles. Plans include:

- * Man-Portable ISR Robot - Develop a man-portable ground robot optimized for ISR applications.
- * Advanced Control Schemes for EOD Robotics
- * Automatically Deployable Communications Relays (ADCR)
- * Continued development of the Joint Architecture for Unmanned Systems (JAUS)
- * Autonomous Navigation for Small UGVs - Demonstrate an advanced obstacle detection suite for small UGVs.
- * Advanced EOD Robot System (AEODRS) Analysis of Alternatives
- * Advanced EOD Robot System Technology Development
- * Joint Training and Experimentation Center (JTEC) Joint Robotics Program

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

(U) Technology Transition/Transformation

3.834

4.766

1.249

FY 2007 Accomplishments:

- * Continued to support fielding and support of RCSS COTS systems to War on Terrorism forces.
- * Continued to provide support to determine and identify Mission Essential Modules to improve COTS system multi-mission capability.
- * Established baseline information on taxonomy of international ground robotics development thrusts and key performers
- * Experimentation and testing of next-generation platform stabilization systems (Perfect Horizon)
- * Continued refined optimization of Simultaneous Localization and Mapping (SLAM) capabilities for outdoor applications in GPS-denied areas.
- * Began development of three different sizes (75, 150, and 300 lbs) of a linear actuator version of the Perfect Horizon for stabilization of larger payloads.
- * Initiated technology transfer efforts as part of a joint experiment initiative leading to support of the Joint Force Protection Advanced Security System (JFPASS) JCTD.
- * Continued transition of technologies from the NGEODRCV Project
- * Refined, maintained for and began transition of documentation for Joint Architecture for Unmanned Systems (JAUS) to a Society of Automotive Engineers (SAE) standard.
- * Continued (Active Range Clearance) integrated experiment of ground and aerial platforms, continued development of automated ground targeting system and continued development of image feature extraction algorithms for UXO detection.

FY 2008, 2009 and 2010 Plans: Facilitate integration of and ensure the ultimate transfer or transformation of technologies to ongoing programs. Including a Technology Demonstration for Advanced EOD Robot System (AEODRS). Exploit the best features of past and on-going efforts while supporting the development of technologies that have low risk to transition. Technologies of interest include: Interface Technologies (Human Robot Interaction), Autonomous Operations (Information Fusion, Perception, and Navigation), Autonomous Technologies (Positioning), and Platform Technologies. Plans include:

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- * Legged Robotics - Improved robotic mobility, improved payload carrying capability for a dismounted squad, and increased survivability for the dismounted soldier.
- * Investigating advances in technology that focuses on the COCOM Homeland Defense Community - mission analysis and requirements investigation to identify technology gaps for future leverage of technology.
- * Continuing to pursue automatically deployed communications relays (ADCR) from unmanned ground vehicles.
- * Robotic Convoy Technologies - introduce robotic technologies into military land convoy operations and demonstrate methods of robotic convoy technologies.
- * Convoy Active Safety Technologies (CAST) - focus on development of a low-cost convoy solution for current force tactical wheeled vehicles with leverage of technologies developed under Robotic Follower (RF) ATO.
- * Automatic Sensor Deployment
- * Continued transition of the Joint Architecture for Unmanned Systems (JAUS)
- * Advanced EOD Robot System Technology Development - transition to program of record (POR)
- * Man-portable Robot Systems
- * Automated Aircraft Refueling
- * Autonomous Robotic Countermines (ARCS2)
- * Joint Collaborative Technologies Experiment (JCTE)
- * Integration of Access and Forced Entry Tools on Small UGV
- * Joint Training and Experimentation Center (JTEC) Joint Robotics Program

<u>C. Other Program Funding Summary</u>	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
PE 0603711D8Z (BA3) Joint Robotics/Autonomous Systems	7.700	11.256	14.202	14.626	14.825	15.019	15.231
PE 0604709D8Z (BA5) Joint Ground Robotics Enterprise (JGRE) SDD	6.004	2.911	5.725	5.212	4.245	3.242	3.111

Comment:

D. Acquisition Strategy The Joint Ground Robotics Enterprise (JGRE) utilizes several contracting and management strategies to achieve its objectives. JGR has established relationships with the several agencies to include the National Center for Defense Robotics (NCDR) and the Army's Rapid Equipping Force (REF) to support the rapid acquisition and evaluation of promising unmanned system technologies.

Funding is provided to Service lab partners and other developers to promote common technology solutions across platforms and Services.

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Beginning in FY08, JGRE will encourage the establishment of a robotics consortium to broaden the research and development of robotics technologies.

E. Major Performers Not applicable for this item.

OSD RDT&E COST ANALYSIS (R3)

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BUDGET ACTIVITY			PE NUMBER AND TITLE								PROJECT		
4 - Advanced Component Development and Prototypes (ACDP)			0603709D8Z - Joint Robotics Program								P709		
I. Product Development	Contract Method & Type	Performing Activity & Location	Total PYs Cost	FY 2007 Cost	FY 2007 Award Date	FY 2008 Cost	FY 2008 Award Date	FY 2009 Cost	FY 2009 Award Date	Cost To Complete	Total Cost	Target Value of Contract	
Joint Ground Robotics Enterprise Support				22975							22975		
Subtotal:				22975							22975		
II. Support Costs	Contract Method & Type	Performing Activity & Location	Total PYs Cost	FY 2007 Cost	FY 2007 Award Date	FY 2008 Cost	FY 2008 Award Date	FY 2009 Cost	FY 2009 Award Date	Cost To Complete	Total Cost	Target Value of Contract	
Joint Ground Robotics Enterprise Support					1-4Q	23654	1-4Q	11847	1-4Q		35501		
Subtotal:						23654		11847			35501		
III. Test And Evaluation	Contract Method & Type	Performing Activity & Location	Total PYs Cost	FY 2007 Cost	FY 2007 Award Date	FY 2008 Cost	FY 2008 Award Date	FY 2009 Cost	FY 2009 Award Date	Cost To Complete	Total Cost	Target Value of Contract	
Joint Ground Robotics Enterprise Support													
Subtotal:													
IV. Management Services	Contract Method & Type	Performing Activity & Location	Total PYs Cost	FY 2007 Cost	FY 2007 Award Date	FY 2008 Cost	FY 2008 Award Date	FY 2009 Cost	FY 2009 Award Date	Cost To Complete	Total Cost	Target Value of Contract	
Joint Ground Robotics Enterprise Support													

OSD RDT&E COST ANALYSIS (R3)							February 2008			
BUDGET ACTIVITY		PE NUMBER AND TITLE					PROJECT			
4 - Advanced Component Development and Prototypes (ACDP)		0603709D8Z - Joint Robotics Program					P709			
Subtotal:										
Project Total Cost:			22975		23654		11847		58476	

Schedule Profile (R4 Exhibit)

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BUDGET ACTIVITY
4 - Advanced Component Development and Prototypes (ACDP)

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0603709D8Z - Joint Robotics Program

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Event Name	FY 07				FY 08				FY 09				FY 10				FY 11				FY 12				FY 13			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Standoff Explosives Detection Using Hyperspectral Imaging Demonstration	Network Environment				0				0																			
(1) Standoff Explosives Detection Using Hyperspectral Imaging Demonstration									1																			
Joint Architecture for Unmanned Systems (JAUS) Transportation Specification, Joint Architecture for Unmanned Systems (JAUS) Information Modeling & Definition	JAUS Initiation																											
Joint Architecture for Unmanned Systems (JAUS) Experimentation	Experimentation																											
Autonomous UAV Mission System (AUMS)																												
(2) Autonomous UAV Mission System (AUMS) Joint Collaborative Technologies Experiment					2																							
Autonomous Navigation for Small UGVs					2				2																			
CBRN Biological Radiological & Nuclear (CBRN) Package for UGV					2																							
Robotic Tools for Entry Tools on Small UGVs					2																							
(3) MTRS PRM T&E	3																											
Automatic sensor deployment - ADCR					3																							

Schedule Profile (R4 Exhibit)

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BUDGET ACTIVITY
4 - Advanced Component Development and Prototypes (ACDP)

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Event Name	FY 07				FY 08				FY 09				FY 10				FY 11				FY 12				FY 13			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Robotics Extension (RE)				▲3																								
(4) Next Gen EOD RCV	▲4																											
(5) EOD Cooperative Robotics	▲5																											
(6) Advanced EOD Robot System (AEODRS) Analysis of Alternatives															▲6													
(7) Man-portable ISR Robot																												
Robotics Extension (RE)																												
Decontamination (JDAAD)																												

Schedule Detail (R4a Exhibit)

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4 - Advanced Component Development and Prototypes (ACDP)		0603709D8Z - Joint Robotics Program					P709	
<u>Schedule Detail</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	
Joint Architecture for Unmanned Systems (JAUS) Development	1Q - 4Q	1Q - 4Q						
Standoff Explosives Detection Using Hyperspectral Imaging		2Q - 4Q	1Q - 4Q					
Standoff Explosives Detection Using Hyperspectral Imaging Demonstration		4Q						
Joint Architecture for Unmanned Systems (JAUS) Transportation Specification	2Q - 4Q	1Q - 4Q						
Joint Architecture for Unmanned Systems (JAUS) Development			1Q					
Joint Architecture for Unmanned Systems (JAUS) Information Modeling & Definition	1Q - 4Q	1Q - 4Q						
Joint Architecture for Unmanned Systems (JAUS) Experimentation	1Q - 4Q	1Q - 4Q						
Autonomous UAV Mission System (AUMS)		2Q - 4Q						
Autonomous UAV Mission System (AUMS) Joint Collaborative Technologies Experiment		2Q						
Autonomous Navigation for Small UGVs		2Q - 4Q						
Autonomous Range Clearance		1Q - 4Q						
RONS CIP	1Q - 3Q							
Chemical Biological Radiological & Nuclear (CBRN) Package for UGV		2Q - 4Q						
EOD Cooperative Robotics	1Q - 4Q	1Q - 4Q						
Robotic Firefighting Technologies		1Q - 4Q	1Q					
Integration of Access and Forced Entry Tools on Small UGVs		1Q - 4Q	1Q - 4Q	1Q				
MTRS PRM T&E	1Q - 4Q	1Q - 4Q	1Q - 4Q					

Automatic sensor deployment - ADCR		1Q - 4Q	1Q - 4Q	1Q			
MTRS PSVM T&E							
Robotic Convoy Technologies		1Q - 4Q	1Q - 4Q	1Q			
SUGV Range Extension (SRE)		1Q - 4Q	1Q - 4Q	1Q			
MTRS AAP PROD DEC							
RONS CIP							
Next Gen EOD RCV	1Q - 4Q	1Q - 4Q					
EOD Cooperative Robotics	1Q - 4Q	1Q - 4Q					
Advanced EOD Robot System (AEODRS) Analysis of Alternatives			4Q				
Man-portable ISR Robot		4Q					
Covert Tracking Robots Sensors		4Q					
			4Q				
Advance Control Schemes for EOD Robots		2Q - 4Q					
Automated Aircraft Refueling		2Q - 4Q					
Battlefield Extraction - Assist Robot (BEAR)		4Q					
Convoy Active Safety Tech. (CAST)		2Q - 4Q					
Decon II - Joint Forward Area Automated Decontamination (JDAAD)		2Q - 4Q					