Department of Homeland Security

Science and Technology Directorate

Budget Overview

Fiscal Year 2020

Congressional Justification

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Science and Technology Directorate

Appropriation Organization Structure

Organization Name	Level	Fund Type (* Includes Defense Funding)
Science and Technology Directorate	**Component**	
Operations and Support	**Appropriation**	
Mission Support	PPA	Discretionary - Appropriation
Laboratory Facilities	PPA	Discretionary - Appropriation
Acquisition and Operations Analysis	PPA	Discretionary - Appropriation
Procurement, Construction, and Improvements	**Appropriation**	
Laboratory Facilities	PPA	Discretionary - Appropriation
National Bio and Agro-Defense Facility (NBAF)	Investment,PPA Level II	Discretionary - Appropriation
Laboratory Facilities End Items	Investment,PPA Level II	Discretionary - Appropriation
Research and Development	**Appropriation**	
Research, Development and Innovation	PPA	Discretionary - Appropriation
University Programs	PPA	Discretionary - Appropriation

Science and Technology Directorate
Strategic Context
Component Overview

The strategic context presents the performance budget by tying together strategy, budget resource requests, programs, or PPAs, and performance measures that gauge the delivery of results to our stakeholders. The Common Appropriation Structure (CAS) allows DHS to integrate the strategic programmatic view with our budget view of resources. With this structure, a significant portion of the Level 1 PPAs represent what DHS refers to as our mission programs. Mission support programs are also an important subset of our Level 1 PPAs that provide products and/or services to mission programs. Mission support capabilities include research and development, intelligence, training, and information sharing. Mission support programs may be cross-cutting and support multiple mission programs. Mission support also includes enterprise leadership, management and/or business administration services and describes the capabilities and activities that support the day-to-day management and back office functions enabling the Department to operate efficiently and effectively. Performance measures associated with our programs are presented in two measure sets, strategic and management measures. Strategic measures communicate results delivered for our agency goals by programs and are considered our Government Performance and Results Act Modernization Act of 2010 (GPRAMA) measures. Additional management measures are displayed to provide a more thorough context of expected program performance for the Component related to its budgetary plans. Science and Technology's mission support program's publically reported measures are presented below. Measure tables that do not display previous year's results are because the measure did not exist at that time.

Acquisition and Operations Analysis: The Acquisition and Operations Analysis program provides expert assistance to entities across the homeland security enterprise to ensure that the transition, acquisition, and deployment of technologies, information, and procedures improve the efficiency and effectiveness of operational capabilities. This program assists in testing and evaluation, standards development, requirements analysis, systems engineering, and supporting technology transition.

Management Measures

Measure: Number of SAFETY Act "transition" (new, highly innovative) technologies awarded						
Description: In order to stay up to date with the continually changing nature of terrorism, the Office of SAFETY (Support Anti-Terrorism by Fostering Effective Technologies) Act Implementation (OSAI) will seek out those evolving technologies that can serve a homeland security mission and provide coverage to enable their transition into the commercial market, at a rate of 20 percent a year. A "transition" technology is defined as any technology that is awarded Developmental Testing and Evaluation (DTE) Designation, and those that can be considered new and innovative (i.e. a new technological application in the homeland security arena). OSAI is actively seeking out these technologies in an effort to address the ever-changing nature of terrorism. The SAFETY Act program is the only federal program that attempts to help industry transition these developmental technologies into the commercial marketplace.						
Fiscal Year:	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Target:	21	21	18	18	18	18
Result:	17	18	10	18	TBD	TBD

Measure: Percent of research, development, and innovation program milestones that are met, as established in the fiscal year's budget execution plan						
Description: The research, development, and innovation (RD&I) program refers to the Program, Project, and Activity (PPA) funding area for the Science and Technology Directorate (S&T) within the DHS Common Appropriations Structure. RD&I provides state-of-the-art technology and/or solutions to meet the needs of DHS Components and the first responder community. Prior to the budget execution of each fiscal year, S&T determines milestones to be met. This measure reflects the percent at which S&T meets its fiscal year budget milestones, which reflect the programmatic and technical events, accomplishments, or intermediate goals in the life of programs and projects funded under the RD&I PPA. Completing these milestones indicate satisfactory progress toward meeting the fiscal year budget execution plan and achieving long-term S&T and Department-wide performance goals and objectives.						
Fiscal Year:	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Target:	---	---	---	---	75%	75%
Result:	---	---	---	---	TBD	TBD

Research, Development, and Innovation: The Research, Development, and Innovation program provides state-of-the-art solutions to meet the needs of DHS Components and the first responder community. This includes customer-focused and output-oriented Research, Development, Test, and Evaluation (RDT&E) programs that balance risk, cost, impact, and time to delivery.

Strategic Measure

Measure: Percent of Apex technologies or knowledge products transitioned to customers for planned improvements in the Homeland Security Enterprise						
Description: This measure gauges the transition of high priority, and high value research and development projects known as Apex projects. Apex technologies and knowledge products are quickly delivered to improve homeland security operations. Apex products consist of cross-cutting, multi-disciplinary efforts which employ 3 to 5 year innovation cycles from project inception through operational testing.						
Fiscal Year:	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Target:	80%	80%	80%	80%	80%	80%
Result:	82%	100%	83%	67%	TBD	TBD

University Programs: University Programs supports critical homeland security-related research and education at U.S. colleges and universities to address high-priority DHS-related issues and to enhance homeland security capabilities over the long term. University Programs includes DHS Centers of Excellence and Minority Serving Institutions, creating a consortium of universities generating groundbreaking ideas for new technologies and critical knowledge for the homeland security enterprise.

Management Measures

Measure: Percent of university programs milestones that are met, as established in the fiscal year's budget execution plan						
Description: This measure reflects the percent of University Programs milestones that meet their fiscal year budget execution and five-year plan goals. University Programs works closely with its stakeholders to identify requirements, set goals for milestones and deliverables, discuss the status of projects, and plan for the allocation of resources.						
Fiscal Year:	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Target:	75%	75%	75%	75%	75%	75%
Result:	82%	92%	92%	78%	TBD	TBD

Science and Technology Directorate
Budget Comparison and Adjustments
Budget Comparison with FY 2019 Annualized CR

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 Annualized CR	FY 2019 President's Budget	FY 2020 President's Budget
Operations and Support	**$331,113**	**$331,113**	**$271,803**	**$278,954**
Mission Support	$134,752	$134,752	$118,732	$129,217
Laboratory Facilities	$150,116	$150,116	$110,519	$115,965
Acquisition and Operations Analysis	$46,245	$46,245	$42,552	$33,772
Research and Development	**$509,830**	**$509,830**	**$311,480**	**$303,163**
Research, Development and Innovation	$469,330	$469,330	$289,734	$281,417
University Programs	$40,500	$40,500	$21,746	$21,746
Total	**$840,943**	**$840,943**	**$583,283**	**$582,117**

Science and Technology Directorate
Comparison of Budget Authority and Request

Organization (Dollars in Thousands)	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Operations and Support	485	485	$331,113	431	431	$271,803	437	437	$278,954	6	6	$7,151
Research and Development	-	-	$509,830	-	-	$311,480	-	-	$303,163	-	-	($8,317)
Total	**485**	**485**	**$840,943**	**431**	**431**	**$583,283**	**437**	**437**	**$582,117**	**6**	**6**	**($1,166)**
Subtotal Discretionary - Appropriation	485	485	$840,943	431	431	$583,283	437	437	$582,117	6	6	($1,166)

*The FY17 Enactment included a permissive transfer of up to $2M from the Office of Health (OHA) to the Science and Technology Directorate R&D PPA for the purpose of advancing early detection capabilities related to a bioterrorism event. However, the funds were not transferred to S&T.

Component Budget Overview

The FY 2020 budget request includes $582.1M for the Science and Technology Directorate (S&T). This represents a decrease of $1.2M from the FY 2019 President's Budget.

The Department's research and development (R&D) efforts are critical to maintaining threat awareness, delivering mitigation strategies, and creating novel technology and approaches for Components and partners in homeland security. Within the available resources provided by the FY 2020 President's Budget, S&T has prioritized projects to align with Administration and Department priorities.

On October 1, 2018, S&T began a new approach to its R&D mission with a new organizational structure that will improve its ability to more rapidly transition technology capabilities into operations and enable S&T to respond quickly to emerging threats. The revitalized S&T structure set the foundation for S&T to be more agile and responsive, ready to move quickly in response to changes in the threat environment, and to make use of existing technologies that can be adapted and leveraged to expedite the development of vital capabilities.

S&T's focus is on efforts with a direct and demonstrable link to the efficiency, effectiveness, and safety of DHS's operational missions or to the safety and interoperability of the first responder community. Accordingly, the FY 2020 budget request includes an increase of $7.1M to restore funding for the Chemical Security Analysis Center (CSAC), and $2.7M for CSAC's operational budget, and personnel salaries. Also included is $4.4M for R&D in CSAC to enable DHS to have direct scientific and research advice during a chemical incident.

Science and Technology Directorate
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	FY 2018	FY 2019	FY 2020
Enacted/Request	**$840,943**	**$583,283**	**$582,117**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$280,878	$285,725	$224,093
Rescissions to Current Year/Budget Year	($10,000)	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$1,111,821**	**$869,008**	**$806,210**
Collections – Reimbursable Resources	$52,100	$52,100	$92,625
Total Budget Resources	**$1,163,921**	**$921,108**	**$898,835**
Obligations (Actual/Estimates/Projections)	$878,832	$695,812	$681,545
Personnel: Positions and FTE			
Enacted/Request Positions	485	431	437
Enacted/Request FTE	485	431	437
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	459	431	437
FTE (Actual/Estimates/Projections)	466	431	437

Science and Technology Directorate
Collections – Reimbursable Resources

Collections		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Change		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Agriculture - Department of Agriculture	**Source**	-	-	$1,200	-	-	$1,200	-	-	$3,600	-	-	$2,400
Operations and Support	Location	-	-	$700	-	-	$700	-	-	$3,100	-	-	$2,400
Laboratory Facilities	Location	-	-	$700	-	-	$700	-	-	$3,100	-	-	$2,400
Research and Development	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Research, Development and Innovation	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Department of Defense - Department of Defense	**Source**	-	-	$12,550	-	-	$12,550	-	-	$12,550	-	-	-
Operations and Support	Location	-	-	$1,500	-	-	$1,500	-	-	$1,500	-	-	-
Mission Support	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Laboratory Facilities	Location	-	-	$1,000	-	-	$1,000	-	-	$1,000	-	-	-
Research and Development	Location	-	-	$11,050	-	-	$11,050	-	-	$11,050	-	-	-
Research, Development and Innovation	Location	-	-	$10,550	-	-	$10,550	-	-	$10,550	-	-	-
University Programs	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Department of Energy - Department of Energy	**Source**	-	-	$700	-	-	$700	-	-	$700	-	-	-
Operations and Support	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Acquisition and Operations Analysis	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Research and Development	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Research, Development and Innovation	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Department of Homeland Security - Department of Homeland Security	**Source**	-	-	$500	-	-	$500	-	-	$500	-	-	-
Operations and Support	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Acquisition and Operations Analysis	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Department of Health and Human Services - Food and Drug Administration	**Source**	-	-	$300	-	-	$300	-	-	$300	-	-	-
Operations and Support	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Mission Support	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-

Collections		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Change		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Homeland Security - Federal Emergency Management Agency	**Source**	-	-	$2,950	-	-	$2,950	-	-	$3,020	-	-	$70
Operations and Support	Location	-	-	$250	-	-	$250	-	-	$320	-	-	$70
Mission Support	Location	-	-	-	-	-	-	-	-	$70	-	-	$70
Laboratory Facilities	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Acquisition and Operations Analysis	Location	-	-	$50	-	-	$50	-	-	$50	-	-	-
Research and Development	Location	-	-	$2,700	-	-	$2,700	-	-	$2,700	-	-	-
Research, Development and Innovation	Location	-	-	$2,700	-	-	$2,700	-	-	$2,700	-	-	-
Department of Homeland Security - Federal Law Enforcement Training Center	**Source**	-	-	-	-	-	-	-	-	$10	-	-	$10
Operations and Support	Location	-	-	-	-	-	-	-	-	$10	-	-	$10
Mission Support	Location	-	-	-	-	-	-	-	-	$10	-	-	$10
Department of Homeland Security - Transportation Security Administration	**Source**	-	-	$4,500	-	-	$4,500	-	-	$4,545	-	-	$45
Operations and Support	Location	-	-	$1,150	-	-	$1,150	-	-	$1,195	-	-	$45
Mission Support	Location	-	-	-	-	-	-	-	-	$45	-	-	$45
Laboratory Facilities	Location	-	-	$850	-	-	$850	-	-	$850	-	-	-
Acquisition and Operations Analysis	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research and Development	Location	-	-	$3,350	-	-	$3,350	-	-	$3,350	-	-	-
Research, Development and Innovation	Location	-	-	$3,350	-	-	$3,350	-	-	$3,350	-	-	-
Department of Homeland Security - U.S. Immigration and Customs Enforcement	**Source**	-	-	$150	-	-	$150	-	-	$180	-	-	$30
Operations and Support	Location	-	-	-	-	-	-	-	-	$30	-	-	$30
Mission Support	Location	-	-	-	-	-	-	-	-	$30	-	-	$30
Research and Development	Location	-	-	$150	-	-	$150	-	-	$150	-	-	-
Research, Development and Innovation	Location	-	-	$150	-	-	$150	-	-	$150	-	-	-
Department of Homeland Security - Citizenship and Immigration Services	**Source**	-	-	$1,050	-	-	$1,050	-	-	$1,070	-	-	$20
Operations and Support	Location	-	-	$50	-	-	$50	-	-	$70	-	-	$20
Mission Support	Location	-	-	-	-	-	-	-	-	$20	-	-	$20
Acquisition and Operations Analysis	Location	-	-	$50	-	-	$50	-	-	$50	-	-	-

Collections *(Dollars in Thousands)*		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Change		
		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Research and Development	Location	-	-	$1,000	-	-	$1,000	-	-	$1,000	-	-	-
Research, Development and Innovation	Location	-	-	$1,000	-	-	$1,000	-	-	$1,000	-	-	-
Department of Homeland Security - United States Secret Service	**Source**	-	-	$1,700	-	-	$1,700	-	-	$1,700	-	-	-
Operations and Support	Location	-	-	$1,500	-	-	$1,500	-	-	$1,500	-	-	-
Acquisition and Operations Analysis	Location	-	-	$1,500	-	-	$1,500	-	-	$1,500	-	-	-
Research and Development	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Research, Development and Innovation	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Department of Homeland Security - Countering Weapons of Mass Destruction	**Source**	-	-	-	-	-	$2,350	-	-	$2,400	-	-	$50
Operations and Support	Location	-	-	-	-	-	$1,250	-	-	$1,300	-	-	$50
Mission Support	Location	-	-	-	-	-	$300	-	-	$350	-	-	$50
Laboratory Facilities	Location	-	-	-	-	-	$50	-	-	$50	-	-	-
Acquisition and Operations Analysis	Location	-	-	-	-	-	$900	-	-	$900	-	-	-
Research and Development	Location	-	-	-	-	-	$1,100	-	-	$1,100	-	-	-
Research, Development and Innovation	Location	-	-	-	-	-	$1,100	-	-	$1,100	-	-	-
Department of Homeland Security - US Customs and Border Protection	**Source**	-	-	$600	-	-	$600	-	-	$600	-	-	-
Operations and Support	Location	-	-	$600	-	-	$600	-	-	$600	-	-	-
Mission Support	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Acquisition and Operations Analysis	Location	-	-	$100	-	-	$100	-	-	$100	-	-	-
Department of Homeland Security - US Immigration and Customs Enforcement	**Source**	-	-	$250	-	-	$250	-	-	$250	-	-	-
Operations and Support	Location	-	-	$250	-	-	$250	-	-	$250	-	-	-
Acquisition and Operations Analysis	Location	-	-	$250	-	-	$250	-	-	$250	-	-	-
Independent Agency - Intelligence Community Management Account	**Source**	-	-	$800	-	-	$800	-	-	$800	-	-	-
Research and Development	Location	-	-	$800	-	-	$800	-	-	$800	-	-	-
Research, Development and Innovation	Location	-	-	$800	-	-	$800	-	-	$800	-	-	-
Department of Justice - Federal Bureau of Investigation	**Source**	-	-	$5,250	-	-	$5,250	-	-	$26,250	-	-	$21,000
Operations and Support	Location	-	-	-	-	-	-	-	-	$21,000	-	-	$21,000

Collections		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Change		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Laboratory Facilities	Location	-	-	-	-	-	-	-	-	$21,000	-	-	$21,000
Research and Development	Location	-	-	$5,250	-	-	$5,250	-	-	$5,250	-	-	-
Research, Development and Innovation	Location	-	-	$5,250	-	-	$5,250	-	-	$5,250	-	-	-
Department of Homeland Security - United States Coast Guard	**Source**	-	-	$2,750	-	-	$2,750	-	-	$3,100	-	-	$350
Operations and Support	Location	-	-	$100	-	-	$100	-	-	$450	-	-	$350
Mission Support	Location	-	-	-	-	-	-	-	-	$350	-	-	$350
Acquisition and Operations Analysis	Location	-	-	$100	-	-	$100	-	-	$100	-	-	-
Research and Development	Location	-	-	$2,650	-	-	$2,650	-	-	$2,650	-	-	-
Research, Development and Innovation	Location	-	-	$2,650	-	-	$2,650	-	-	$2,650	-	-	-
Department of Homeland Security - National Protection and Programs Directorate	**Source**	-	-	$2,400	-	-	$2,400	-	-	$2,450	-	-	$50
Operations and Support	Location	-	-	$950	-	-	$950	-	-	$1,000	-	-	$50
Mission Support	Location	-	-	-	-	-	-	-	-	$50	-	-	$50
Acquisition and Operations Analysis	Location	-	-	$950	-	-	$950	-	-	$950	-	-	-
Research and Development	Location	-	-	$1,450	-	-	$1,450	-	-	$1,450	-	-	-
Research, Development and Innovation	Location	-	-	$1,450	-	-	$1,450	-	-	$1,450	-	-	-
Department of Homeland Security - U.S. Customs and Border Protection	**Source**	-	-	$8,500	-	-	$8,500	-	-	$25,000	-	-	$16,500
Research and Development	Location	-	-	$8,500	-	-	$8,500	-	-	$25,000	-	-	$16,500
Research, Development and Innovation	Location	-	-	$8,500	-	-	$8,500	-	-	$25,000	-	-	$16,500
Department of Homeland Security - Office of the Under Secretary for Management	**Source**	-	-	$2,100	-	-	$2,100	-	-	$2,100	-	-	-
Research and Development	Location	-	-	$2,100	-	-	$2,100	-	-	$2,100	-	-	-
Research, Development and Innovation	Location	-	-	$2,100	-	-	$2,100	-	-	$2,100	-	-	-
Department of State - Department of State	**Source**	-	-	$200	-	-	$200	-	-	$200	-	-	-
Operations and Support	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Laboratory Facilities	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Department of Homeland Security - Office of Health Affairs	**Source**	-	-	$500	-	-	-	-	-	-	-	-	-
Operations and Support	Location	-	-	$400	-	-	-	-	-	-	-	-	-

Collections		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Change		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Mission Support	Location	-	-	$300	-	-	-	-	-	-	-	-	-
Acquisition and Operations Analysis	Location	-	-	$100	-	-	-	-	-	-	-	-	-
Research and Development	Location	-	-	$100	-	-	-	-	-	-	-	-	-
Research, Development and Innovation	Location	-	-	$100	-	-	-	-	-	-	-	-	-
Department of Homeland Security - Domestic Nuclear Detection Office	**Source**	-	-	$1,850	-	-	-	-	-	-	-	-	-
Operations and Support	Location	-	-	$850	-	-	-	-	-	-	-	-	-
Laboratory Facilities	Location	-	-	$50	-	-	-	-	-	-	-	-	-
Acquisition and Operations Analysis	Location	-	-	$800	-	-	-	-	-	-	-	-	-
Research and Development	Location	-	-	$1,000	-	-	-	-	-	-	-	-	-
Research, Development and Innovation	Location	-	-	$1,000	-	-	-	-	-	-	-	-	-
Canada	**Source**	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research and Development	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research, Development and Innovation	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Library of Congress	**Source**	-	-	$500	-	-	$500	-	-	$500	-	-	-
Operations and Support	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Acquisition and Operations Analysis	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Sweden	**Source**	-	-	$200	-	-	$200	-	-	$200	-	-	-
Research and Development	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Research, Development and Innovation	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Netherlands	**Source**	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research and Development	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research, Development and Innovation	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Total Collections		-	-	**$52,100**	-	-	**$52,100**	-	-	**$92,625**	-	-	**$40,525**

Science and Technology Directorate
Personnel Compensation and Benefits
Pay Summary

Organization (Dollars in Thousands)	FY 2018 Enacted				FY 2019 President's Budget				FY 2020 President's Budget				FY 2019 to FY 2020 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Operations and Support	485	485	$84,530	$174.29	431	431	$75,499	$174.13	437	437	$79,827	$181.64	6	6	$4,328	$7.51
Total	**485**	**485**	**$84,530**	**$174.29**	**431**	**431**	**$75,499**	**$174.13**	**437**	**437**	**$79,827**	**$181.64**	**6**	**6**	**$4,328**	**$7.51**
Discretionary - Appropriation	485	485	$84,530	$174.29	431	431	$75,499	$174.13	437	437	$79,827	$181.64	6	6	$4,328	$7.51

* The FTE Rate calculation does not include Object Class 11.8-Special Personal Services Payments or 13.0-Benefits for Former Personnel.

Pay by Object Class

Pay Object Classes (Dollars in Thousands)	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 - FY 2020 Change
11.1 Full-time Permanent	$58,856	$51,766	$54,120	$2,354
11.3 Other than Full-Time Permanent	$5,512	$5,156	$5,262	$106
11.5 Other Personnel Compensation	$1,316	$1,106	$1,178	$72
12.1 Civilian Personnel Benefits	$18,846	$17,021	$18,817	$1,796
13.0 Benefits for Former Personnel	-	$450	$450	-
Total - Personnel Compensation and Benefits	**$84,530**	**$75,499**	**$79,827**	**$4,328**
Positions and FTE				
Positions - Civilian	485	431	437	6
FTE - Civilian	485	431	437	6

Science and Technology Directorate
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Operations and Support	$246,583	$196,304	$199,127	$2,823
Research and Development	$509,830	$311,480	$303,163	($8,317)
Total	**$756,413**	**$507,784**	**$502,290**	**($5,494)**
Discretionary - Appropriation	$756,413	$507,784	$502,290	($5,494)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$3,802	$2,781	$2,781	-
22.0 Transportation of Things	$49	$33	$33	-
23.2 Rental Payments to Others	$121	$75	$75	-
23.3 Communications, Utilities, and Misc. Charges	$117	$86	$86	-
25.1 Advisory and Assistance Services	$174,867	$126,242	$132,489	$6,247
25.2 Other Services from Non-Federal Sources	$4,695	$3,221	$3,519	$298
25.3 Other Goods and Services from Federal Sources	$354,473	$238,833	$226,790	($12,043)
25.4 Operation and Maintenance of Facilities	$5,660	$4,291	$4,991	$700
25.5 Research and Development Contracts	$152,163	$93,786	$85,824	($7,962)
25.6 Medical Care	$3	$3	$3	-
25.7 Operation and Maintenance of Equipment	$6,557	$5,400	$7,048	$1,648
26.0 Supplies and Materials	$5,281	$3,905	$3,905	-
31.0 Equipment	$10,737	$8,179	$11,756	$3,577
32.0 Land and Structures	$747	$550	$550	-
41.0 Grants, Subsidies, and Contributions	$37,141	$20,399	$20,399	-
94.0 Financial Transfers	-	-	$2,041	$2,041
Total - Non Pay Object Classes	**$756,413**	**$507,784**	**$502,290**	**($5,494)**

Science and Technology Directorate
Supplemental Budget Justification Exhibits
Working Capital Fund

Appropriation and PPA *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget
Operations and Support	**$27,176**	**$27,179**	**$28,163**
Mission Support	$27,176	$27,179	$28,163
Total Working Capital Fund	**$27,176**	**$27,179**	**$28,163**

Science and Technology Directorate
Status of Congressionally Requested Studies, Reports and Evaluations

Fiscal Year	Due Date	Reference/Citation	Requirement	Status
2018	6/21/2018	FY 2018 Appropriations P.L.115-141	Foreign Animal Disease Research Pilot Project	On Hold
2019	5/16/2019	FY 2019 Appropriations P.L.116-6	Report on Centers of Excellence (COEs)	In Process

Science and Technology Directorate
Authorized/Unauthorized Appropriations

Budget Activity *(Dollars in Thousands)*	Last year of Authorization	Authorized Level	Appropriation in Last Year of Authorization	FY 2020 President's Budget
	Fiscal Year	Amount	Amount	Amount
Operations and Support	**N/A**	**N/A**	**N/A**	**$278,954,000**
Mission Support	N/A	N/A	N/A	$129,217,000
Laboratory Facilities	N/A	N/A	N/A	$115,965,000
Acquisition and Operations Analysis	N/A	N/A	N/A	$33,772,000
Research and Development	**N/A**	**N/A**	**N/A**	**$303,163,000**
Research, Development and Innovation	N/A	N/A	N/A	$281,417,000
University Programs	N/A	N/A	N/A	$21,746,000
Total Direct Authorization/Appropriation	**N/A**	**N/A**	**N/A**	**$582,117,000**

Science and Technology Directorate
Proposed Legislative Language

Operations and Support

For necessary expenses of the Science and Technology Directorate for operations and support, [as authorized by title III of the Homeland Security Act of 2002 (6 U.S.C. 1818 et seq.), and]*including* the purchase or lease of not to exceed 5 vehicles, [$271,803,000**]***$278,954,000*, of which **[$**119,823,000**]***$149,737,000* shall remain available until September 30, [2020]*2021*: Provided, That not to exceed $7,650 shall be for official reception and representation expenses.

Language Provision	Explanation
…[as authorized by title III of the Homeland Security Act of 2002 (6 U.S.C. 1818 et seq.), and]	Deletion of authorizing language.
…[$271,803,000**]*278,954,000***	Dollar change only.
…[$153,071,000**]*149,737,000***	Dollar change only.
…[2020]***2021***	Updated period of availability. S&T requests to continue two-year funding for Acquisition and Operations Analysis (AOA) and Laboratory Facilities PPAs in the O&S appropriation. AOA supports the multi-year Research, Development, and Innovation PPA within the Research and Development appropriation. The activities such as test and evaluation, systems engineering, technology transition and international cooperative programs, support R&D projects and span multiple fiscal years. Reducing this PPA to one year would limit S&T's R&D programs ability to access these resources when needed, leading to potential delays in program execution. For example, this change could negatively impact test and evaluation of systems used for screening by TSA and CBP. In effort to support DHS operational components effectively for systems engineering, and test and evaluation it is vital that AOA is two year funding. Changing Laboratory Facilities PPA to one-year funds will result in cost increases and inefficiencies. This PPA pays for the operations and facility maintenance (similar to PC&I's all other activities costs) of S&T's aging laboratories. Facility maintenance can only be planned to a certain point, and many unforeseen costs arise as part of maintaining laboratory facilities and operations. Some of S&T's facilities are 40 to 50 years old, including TSL and PIADC, and require replacement of failing equipment. S&T's bio-safety laboratories, which include level 3 and 4 containment, often have costly repairs including water tank and pipe leakages in decontamination areas, and two year funding allows S&T to maintain contingency funding for these types of incidents. The funding requirements for S&T's laboratory facilities are unique due to the nature of the assets and their complex operational needs. Further S&T does not have PC&I funding, and it is critical that Laboratory Facilities PPA remains at two-year availability.

Research and Development

For necessary expenses of the Science and Technology Directorate for research and development, *including information technology equipment, maintenance, and operations*[as authorized by title III of the Homeland Security Act of 2002 (6 U.S.C. 181 et seq.), $311,480,000**]***$303,163,000,* to remain available until September 30, **[**2021**]***2022*.

Language Provision	Explanation
…*including information technology equipment, maintenance, and operations,*	Additional language allows for the use of R&D appropriations to support IT systems as many R&D projects involve an IT component, for example, data analytics.
…[as authorized by title III of the Homeland Security Act of 2002 (6 U.S.C. 181 et seq.),]	Deletion of authorizing language.
…[$311,480,000**]*$303,163,000***	Dollar change only.
[2021**]*2022***	Updated period of availability. S&T requests to continue three-year funding for the Research and Development appropriation. The nature of a R&D mission is to look at problems with uncertain outcomes through an innovative and fresh lens.

Department of Homeland Security

Science and Technology Directorate

Operations and Support

Fiscal Year 2020

Congressional Justification

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Operations and Support

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization (Dollars in Thousands)	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Mission Support	344	344	$134,752	324	324	$118,732	323	323	$129,217	(1)	(1)	$10,485
Laboratory Facilities	141	141	$150,116	107	107	$110,519	114	114	$115,965	7	7	$5,446
Acquisition and Operations Analysis	-	-	$46,245	-	-	$42,552	-	-	$33,772	-	-	($8,780)
Total	**485**	**485**	**$331,113**	**431**	**431**	**$271,803**	**437**	**437**	**$278,954**	**6**	**6**	**$7,151**
Subtotal Discretionary - Appropriation	485	485	$331,113	431	431	$271,803	437	437	$278,954	6	6	$7,151

Operations and Support (O&S) provides funding for effective and efficient management of the Science and Technology Directorate (S&T) activities to ensure delivery of advanced technology solutions to Department of Homeland Security (DHS) Components and first responders. This appropriation supports Systems Engineering, Standards, and Test and Evaluation (T&E) to ensure that S&T develops and Components procure technologies that work, and are delivered on time and on budget. This includes costs necessary for regular operations, salaries, facilities, mission support, headquarters management, and DHS Working Capital Fund (WCF) activities.

The O&S appropriation is broken out into the following Programs, Projects, and Activities (PPA):

Mission Support: The Mission Support PPA supports all S&T corporate-level functions enabling technical divisions to manage the Research, Development, Test, and Evaluation (RDT&E) programs and provides funding for salaries and benefits, WCF shared services costs, training and travel requirements, financial management, facility planning, maintenance, and other administrative functions. Divisions supported under Mission Support include the Finance and Budget Division, Administration and Support Division, Communications and Outreach, Office of the Under Secretary, Chief Information Officer, and Compliance. Additionally, the Office of General Counsel requirements including Intellectual Property (IP) on S&T's R&D projects as well as oversight of IP and trademark rights for DHS and its Components are supported by Mission Support.

Laboratory Facilities: The Laboratory Facilities PPA provides funding for the operations and maintenance of laboratory facilities and salaries and benefits expenses. These laboratory facilities provide the Nation with a coordinated, enduring core of productive science, technology and engineering laboratories, organizations and institutions, which provide the knowledge and technology required to secure our Homeland. Additionally, Laboratory Facilities facilitates the delivery of long-term capabilities vital to the homeland security mission through utilization of a coordinated network of S&T laboratories and the Department of Energy (DOE) national laboratories.

Acquisition and Operations Analysis: The Acquisition and Operations Analysis PPA provides resources that support expert assistance to entities across the Homeland Security Enterprise (HSE) to ensure that the transition, acquisition, and deployment of technologies, information, and procedures improve the efficiency and effectiveness of the operational capabilities across the HSE mission.

Operations and Support
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2018**	**FY 2019**	**FY 2020**
Enacted/Request	**$331,113**	**$271,803**	**$278,954**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$78,520	$73,781	$61,655
Rescissions to Current Year/Budget Year	($2,000)	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$407,633**	**$345,584**	**$340,609**
Collections – Reimbursable Resources	$10,300	$10,300	$34,325
Total Budget Resources	**$417,933**	**$355,884**	**$374,934**
Obligations (Actual/Estimates/Projections)	$344,788	$293,026	$310,580
Personnel: Positions and FTE			
Enacted/Request Positions	485	431	437
Enacted/Request FTE	485	431	437
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	459	431	437
FTE (Actual/Estimates/Projections)	466	431	437

Operations and Support
Collections – Reimbursable Resources

Collections		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Agriculture - Department of Agriculture	**Source**	-	-	$700	-	-	$700	-	-	$3,100
Department of Defense - Department of Defense	**Source**	-	-	$1,500	-	-	$1,500	-	-	$1,500
Department of Energy - Department of Energy	**Source**	-	-	$500	-	-	$500	-	-	$500
Department of Homeland Security - Department of Homeland Security	**Source**	-	-	$500	-	-	$500	-	-	$500
Department of Health and Human Services - Food and Drug Administration	**Source**	-	-	$300	-	-	$300	-	-	$300
Department of Homeland Security - Federal Emergency Management Agency	**Source**	-	-	$250	-	-	$250	-	-	$320
Department of Homeland Security - Federal Law Enforcement Training Center	**Source**	-	-	-	-	-	-	-	-	$10
Department of Homeland Security - Transportation Security Administration	**Source**	-	-	$1,150	-	-	$1,150	-	-	$1,195
Department of Homeland Security - U.S. Immigration and Customs Enforcement	**Source**	-	-	-	-	-	-	-	-	$30
Department of Homeland Security - Citizenship and Immigration Services	**Source**	-	-	$50	-	-	$50	-	-	$70
Department of Homeland Security - United States Secret Service	**Source**	-	-	$1,500	-	-	$1,500	-	-	$1,500
Department of Homeland Security - Countering Weapons of Mass Destruction	**Source**	-	-	-	-	-	$1,250	-	-	$1,300
Department of Homeland Security - US Customs and Border Protection	**Source**	-	-	$600	-	-	$600	-	-	$600
Department of Homeland Security - US Immigration and Customs Enforcement	**Source**	-	-	$250	-	-	$250	-	-	$250
Department of Justice - Federal Bureau of Investigation	**Source**	-	-	-	-	-	-	-	-	$21,000
Department of Homeland Security - United States Coast Guard	**Source**	-	-	$100	-	-	$100	-	-	$450
Department of Homeland Security - National Protection and Programs Directorate	**Source**	-	-	$950	-	-	$950	-	-	$1,000
Department of State - Department of State	**Source**	-	-	$200	-	-	$200	-	-	$200
Department of Homeland Security - Office of Health Affairs	**Source**	-	-	$400	-	-	-	-	-	-
Department of Homeland Security - Domestic Nuclear Detection Office	**Source**	-	-	$850	-	-	-	-	-	-
Library of Congress	**Source**	-	-	$500	-	-	$500	-	-	$500
Total Collections		**-**	**-**	**$10,300**	**-**	**-**	**$10,300**	**-**	**-**	**$34,325**

Operations and Support
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2018 Enacted	**485**	**485**	**$331,113**
FY 2019 President's Budget	**431**	**431**	**$271,803**
FY 2020 Base Budget	**431**	**431**	**$271,803**
Transfer to MGMT/CFO from S&T/Mission Support for CPIC	-	-	($314)
Transfer to MGMT/CFO from S&T/Mission Support for the Bankcard WCF Activity	-	-	($3)
Transfer to MGMT/CFO from S&T/Mission Support for the Integrated Audit	-	-	($53)
Transfer to MGMT/CFO from S&T/Mission Support for TIER	-	-	($105)
Transfer to MGMT/OCRSO from S&T/Mission Support for Regional Field Efficiencies	(1)	(1)	($225)
Transfer to MGMT/OCRSO from S&T/O&S for Regional Field Efficiencies	-	-	($11)
Transfer to S&T/Mission Support from MGMT/OCSO for Background Investigations	-	-	$657
Total Transfers	**(1)**	**(1)**	**($54)**
FERS Agency Contribution Increase	-	-	$1,259
Increase in Lab Operations	-	-	$2,457
Increased charges for FFMS from ICE	-	-	$341
National Capital Region Infrastructure Operations (NCRIO) Sustainment	-	-	$1,395
Total, Pricing Increases	**-**	**-**	**$5,452**
Efficiencies through Existing Technologies	-	-	($8,780)
Total, Pricing Decreases	**-**	**-**	**($8,780)**
Total Adjustments-to-Base	**(1)**	**(1)**	**($3,382)**
FY 2020 Current Services	**430**	**430**	**$268,421**
Restore Chemical Security Analysis Center (CSAC)	7	7	$2,737
Right Size Information Technology (IT) Investments	-	-	$7,796
Total, Program Increases	**7**	**7**	**$10,533**
FY 2020 Request	**437**	**437**	**$278,954**
FY 2019 To FY 2020 Change	**6**	**6**	**$7,151**

Operations and Support
Justification of Transfers

Transfers *(Dollars in Thousands)*	FY 2020 President's Budget		
	Positions	FTE	Amount
Transfer 1 - Transfer to MGMT/CFO from S&T/Mission Support for CPIC	**-**	**-**	**($314)**
Mission Support	-	-	($314)
Transfer 2 - Transfer to MGMT/CFO from S&T/Mission Support for TIER	**-**	**-**	**($105)**
Mission Support	-	-	($105)
Transfer 3 - Transfer to MGMT/CFO from S&T/Mission Support for the Bankcard WCF Activity	**-**	**-**	**($3)**
Mission Support	-	-	($3)
Transfer 4 - Transfer to MGMT/CFO from S&T/Mission Support for the Integrated Audit	**-**	**-**	**($53)**
Mission Support	-	-	($53)
Transfer 5 - Transfer to MGMT/OCRSO from S&T/Mission Support for Regional Field Efficiencies	**(1)**	**(1)**	**($225)**
Mission Support	(1)	(1)	($225)
Transfer 6 - Transfer to MGMT/OCRSO from S&T/O&S for Regional Field Efficiencies	**-**	**-**	**($11)**
Mission Support	-	-	($11)
Transfer 7 - Transfer to S&T/Mission Support from MGMT/OCSO for Background Investigations	**-**	**-**	**$657**
Mission Support	-	-	$657
Total Transfers	**(1)**	**(1)**	**($54)**

Transfer 1 – Transfer to MGMT/CFO from S&T/Mission Support for Bankcard Program: This transfer represents costs associated with the removal of the Bankcard program from the WCF. This will not result in a loss of service for this activity; MGMT will assume responsibility for providing this service DHS-wide.

Transfer 2 – Transfer to MGMT/CFO from S&T/Mission Support for CPIC: This transfer represents costs associated with the removal of the CPIC program from the WCF. This activity supports the preparation of decision packages for DHS investment review boards at key acquisition decision points and will not result in a loss of service as MGMT will assume responsibility for providing this service DHS-wide.

Transfer 3 – Transfer to MGMT/CFO from S&T/Mission Support for Integrated Audit: This transfer represents costs associated with the removal of the Integrated Audit program from the WCF. This will not result in a loss of service for this activity; MGMT/OCIO will assume responsibility for providing this service DHS-wide.

Transfer 4 – Transfer to MGMT/CFO from S&T/Mission Support for TIER: This transfer represents costs associated with the removal of TIER from the WCF. This activity funds the Department's application for creating automated financial statements and will not result in a loss of service for this activity; MGMT will assume responsibility for providing this service DHS-wide.

Transfer 5 – Transfer to MGMT/OCRSO from S&T/Mission Support for Regional Field Efficiencies: This transfer consolidates funds for this activity into MGMT/OCRSO to improve program management. This activity is currently funded by Components through Inter-Agency Agreement (IAAs).

Transfer 6 – Transfer to MGMT from S&T/Mission Support for Wind Farm Policy: This transfer permanently realigns one position/FTE to MGMT to manage the Wind Farm Policy function, previously supported by a Memorandum of Agreement between S&T and MGMT.

Transfer 7 – Transfer to S&T/Mission Support from MGMT/OCSO for Background Investigations: This transfer is for a new WCF activity to be managed by MGMT/OCSO for costs related to the initiation, scheduling, and adjudication of background investigations. This activity will improve services and increase customer savings.

Operations and Support
Justification of Pricing Changes

Pricing Changes *(Dollars in Thousands)*	FY 2020 President's Budget		
	Positions	FTE	Amount
Pricing Change 1 - Efficiencies through Existing Technologies	**-**	**-**	**($8,780)**
Acquisition and Operations Analysis	-	-	($8,780)
Pricing Change 2 - FERS Agency Contribution Increase	**-**	**-**	**$1,259**
Mission Support	-	-	$1,007
Laboratory Facilities	-	-	$252
Pricing Change 3 - Increase in Lab Operations	**-**	**-**	**$2,457**
Laboratory Facilities	-	-	$2,457
Pricing Change 4 - Increased charges for FFMS from ICE	**-**	**-**	**$341**
Mission Support	-	-	$341
Pricing Change 5 - National Capital Region Infrastructure Operations (NCRIO) Sustainment	**-**	**-**	**$1,395**
Mission Support	-	-	$1,395
Total Pricing Changes	**-**	**-**	**($3,328)**

Pricing Change 1 – Efficiencies through Existing Technologies: S&T's revitalization efforts will create a more agile and responsive environment, leading to efficiencies in the following areas: budget and financial management, program management, records management, process workflow tools, as well as S&T web based applications that meet customer needs. S&T is merging IT tools to support this new environment.

Pricing Change 2 – FERS Agency Contribution Increase: Per OMB Circular A-11, agency Federal Employment Retirement System (FERS) contributions increased. The regular FERS agency contribution increased by 2.3% from 13.7% in FY 2019 to 16.0% in FY 2020. The agency contribution amount for Civil Service Retirement System (CSRS) did not change.

Pricing Change 3 – Increase in Lab Operations: This pricing change is necessary to correctly fund the personnel for laboratory operations. There was an error in the FY 2019 pricing estimate per FTE, and this adjustment corrects that error accordingly.

Pricing Change 4 – Increased charges for FFMS from ICE: This pricing change reflects an increase in charges for the use and management of the Federal Financial Management System (FFMS), owned and managed by Immigration Customs Enforcement (ICE).

Pricing Change 5 – National Capital Region Infrastructure Operations (NCRIO) Sustainment: This pricing change reflects increases in the NCRIO program related to IT security, desk side support, and SharePoint services. These requirements are determined by the Working Capital Fund Governance Board.

Operations and Support
Justification of Program Changes

Program Changes *(Dollars in Thousands)*	FY 2020 President's Budget		
	Positions	FTE	Amount
Program Change 1 - Restore Chemical Security Analysis Center (CSAC)	**7**	**7**	**$2,737**
Laboratory Facilities	7	7	$2,737
Program Change 2 - Right Size Information Technology (IT) Investments	**-**	**-**	**$7,796**
Mission Support	-	-	$7,796
Total Program Changes	**7**	**7**	**$10,533**

Program Change 1 – Restore Chemical Security Analysis Center (CSAC):

Description
The FY 2020 President's Budget includes an increase of 7 positions, 7 FTE, and $2.7M to restore program funding for operations of the Chemical Security Analysis Center (CSAC) that was proposed for closure and ensure that the activities being performed by DHS Components continue.

Justification
Restoring funding for CSAC will enable DHS to restore its direct scientific and research advisory role during a chemical incident and support salary and benefit costs for CSAC personnel and costs incurred by Department of Defense (DoD) detailees supporting CSAC operations.

Performance
CSAC will continue directly supporting ongoing work with customers, including chemical multifunction detectors, analysis and response to chemical incidents, and development of mitigation strategies to protect the public. The capabilities at CSAC cannot be replicated at other facilities.

Program Change 2 – Right Size Information Technology (IT) Investments:

Description
The FY 2020 President's Budget includes an increase of $7.8M to right-size Information Technology (IT) investments. This program change will increase the IT Investments budget to $21.4M.

Justification

IT modernization is a top priority for this Administration, and S&T prioritized the rightsizing of its infrastructure costs to ensure the success of revitalization efforts. This includes prioritizing systems or data that are at risk, systems running on significantly outdated or unsupported technology, systems that are key to delivering public-facing citizen services and projects that could generate significant costs savings or cost avoidance in the near term. The FY 2020 request includes S&T activities to comply with DHS Enterprise level initiatives such as cloud, Windows 10, and Office 365 migration. Moreover, the FY 2020 request supports the DHS IT Asset Refresh Implementation Plan and Enterprise Information Systems (EIS) Agency Transition Plan.

Performance

Due to competing demands within the S&T for available funds, many IT assets exceed their useful life or reach end-of-life and have become inefficient in performing normal functions or out of warranty. Since the agency is on a sliding window of IT refresh, funding will ensure any delays in refresh cycles will not increase the number of outdated elements in the inventory. Increased funding will reduce security vulnerabilities, enhance system performance, and improve system availability. The FY 2020 request will also ensure there is no loss of productivity for users or staff to maintain the environment at an acceptable level and to continue cloud migration and development activities as required by DHS enterprise level plans and initiatives. S&T's laboratories and R&D program managers require robust infrastructure with flexibility, functionality, and security so they may execute their respective missions. Using flexible, secure, and efficient IT systems fosters peak performance of the S&T team.

Operations and Support
Personnel Compensation and Benefits

Pay Summary

Organization (Dollars in Thousands)	FY 2018 Enacted				FY 2019 President's Budget				FY 2020 President's Budget				FY 2019 to FY 2020 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Mission Support	344	344	$62,270	$181.02	324	324	$60,932	$187.14	323	323	$61,714	$190.14	(1)	(1)	$782	$3
Laboratory Facilities	141	141	$22,260	$157.87	107	107	$14,567	$134.74	114	114	$18,113	$157.57	7	7	$3,546	$22.83
Total	**485**	**485**	**$84,530**	**$174.29**	**431**	**431**	**$75,499**	**$174.13**	**437**	**437**	**$79,827**	**$181.64**	**6**	**6**	**$4,328**	**$7.51**
Discretionary - Appropriation	485	485	$84,530	$174.29	431	431	$75,499	$174.13	437	437	$79,827	$181.64	6	6	$4,328	$7.51

* The FTE Rate calculation does not include Object Class 11.8-Special Personal Services Payments or 13.0-Benefits for Former Personnel. This applies to all FTE rate calculations in this appropriation.

Pay by Object Class

Pay Object Classes (Dollars in Thousands)	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 - FY 2020 Change
11.1 Full-time Permanent	$58,856	$51,766	$54,120	$2,354
11.3 Other than Full-Time Permanent	$5,512	$5,156	$5,262	$106
11.5 Other Personnel Compensation	$1,316	$1,106	$1,178	$72
12.1 Civilian Personnel Benefits	$18,846	$17,021	$18,817	$1,796
13.0 Benefits for Former Personnel	-	$450	$450	-
Total - Personnel Compensation and Benefits	**$84,530**	**$75,499**	**$79,827**	**$4,328**
Positions and FTE				
Positions - Civilian	485	431	437	6
FTE - Civilian	485	431	437	6

Operations and Support
Permanent Positions by Grade – Appropriation

Grades and Salary Range *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
Total, SES	17	17	17	-
GS-15	159	147	150	3
GS-14	112	96	99	3
GS-13	74	60	60	-
GS-12	43	39	39	-
GS-11	16	15	15	-
GS-9	14	12	12	-
GS-7	2	2	2	-
GS-6	1	-	-	-
GS-5	4	3	3	-
Other Graded Positions	43	40	40	-
Total Permanent Positions	**485**	**431**	**437**	**6**
Unfilled Positions EOY	485	431	437	6
Position Locations				
Headquarters	336	323	322	-1
U.S. Field	148	107	114	7
Foreign Field	1	1	1	-
Averages				
Average Personnel Costs, ES Positions	184,260	185,964	185,964	-
Average Personnel Costs, GS Positions	124,713	124,796	124,796	-
Average Grade, GS Positions	14	14	14	-

Operations and Support
Non Pay Budget Exhibits

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Mission Support	$72,482	$57,800	$67,503	$9,703
Laboratory Facilities	$127,856	$95,952	$97,852	$1,900
Acquisition and Operations Analysis	$46,245	$42,552	$33,772	($8,780)
Total	**$246,583**	**$196,304**	**$199,127**	**$2,823**
Discretionary - Appropriation	$246,583	$196,304	$199,127	$2,823

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$1,989	$1,674	$1,674	-
22.0 Transportation of Things	$20	$15	$15	-
23.3 Communications, Utilities, and Misc. Charges	$114	$84	$84	-
25.1 Advisory and Assistance Services	$102,140	$81,570	$80,743	($827)
25.2 Other Services from Non-Federal Sources	$1,628	$1,328	$1,626	$298
25.3 Other Goods and Services from Federal Sources	$114,211	$90,686	$88,113	($2,573)
25.4 Operation and Maintenance of Facilities	$5,660	$4,291	$4,991	$700
25.6 Medical Care	$3	$3	$3	-
25.7 Operation and Maintenance of Equipment	$6,374	$5,287	$6,935	$1,648
26.0 Supplies and Materials	$4,314	$3,308	$3,308	-
31.0 Equipment	$8,840	$7,008	$10,585	$3,577
32.0 Land and Structures	$747	$550	$550	-
41.0 Grants, Subsidies, and Contributions	$543	$500	$500	-
Total - Non Pay Object Classes	**$246,583**	**$196,304**	**$199,127**	**$2,823**

Mission Support – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Mission Support	344	344	$134,752	324	324	$118,732	323	323	$129,217	(1)	(1)	$10,485
Total	**344**	**344**	**$134,752**	**324**	**324**	**$118,732**	**323**	**323**	**$129,217**	**(1)**	**(1)**	**$10,485**
Subtotal Discretionary - Appropriation	344	344	$134,752	324	324	$118,732	323	323	$129,217	(1)	(1)	$10,485

PPA Level 1 Description

Mission Support provides funding for all command and control functions for S&T. Serving as the administrative arm, Mission Support provides funding for financial management and procurement operations, information technology management and critical infrastructure support, human capital and personnel security, real estate and facilities management, internal and external mission and research centric communications, and compliance support and oversight. Mission Support also funds compliance assurance, export controls, legal intellectual property services for R&D projects, and oversight of intellectual property and trademark rights for all of DHS.

Additionally, the salaries and benefits and administration for non-laboratory personnel and offices with the important role of implementing RDT&E activities are supported by Mission Support resources.

The 323 full-time positions requested in FY 2020 will provide to S&T policy analysis, planning, financial management, and guidance formulation. These FTE also manage and oversee IP and trademark rights, conduct program management, execution, oversight, and analysis, as well as operations and maintenance support for all S&T research and development programs in the Research and Development Innovation, University Programs and AOA PPAs.

Mission Support – PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2018**	**FY 2019**	**FY 2020**
Enacted/Request	**$134,752**	**$118,732**	**$129,217**
Carryover and/or Recoveries (Actual/Estimates/Projections)	-	-	-
Rescissions to Current Year/Budget Year	($2,000)	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$132,752**	**$118,732**	**$129,217**
Collections – Reimbursable Resources	$1,600	$1,600	$2,225
Total Budget Resources	**$134,352**	**$120,332**	**$131,442**
Obligations (Actual/Estimates/Projections)	$134,988	$119,129	$130,343
Personnel: Positions and FTE			
Enacted/Request Positions	344	324	323
Enacted/Request FTE	344	324	323
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	327	324	323
FTE (Actual/Estimates/Projections)	334	324	323

Mission Support – PPA
Collections – Reimbursable Resources

Collections *(Dollars in Thousands)*		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget		
		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Defense - Department of Defense	**Source**	-	-	$500	-	-	$500	-	-	$500
Department of Health and Human Services - Food and Drug Administration	**Source**	-	-	$300	-	-	$300	-	-	$300
Department of Homeland Security - Federal Emergency Management Agency	**Source**	-	-	-	-	-	-	-	-	$70
Department of Homeland Security - Federal Law Enforcement Training Center	**Source**	-	-	-	-	-	-	-	-	$10
Department of Homeland Security - Transportation Security Administration	**Source**	-	-	-	-	-	-	-	-	$45
Department of Homeland Security - U.S. Immigration and Customs Enforcement	**Source**	-	-	-	-	-	-	-	-	$30
Department of Homeland Security - Citizenship and Immigration Services	**Source**	-	-	-	-	-	-	-	-	$20
Department of Homeland Security - Countering Weapons of Mass Destruction	**Source**	-	-	-	-	-	$300	-	-	$350
Department of Homeland Security - US Customs and Border Protection	**Source**	-	-	$500	-	-	$500	-	-	$500
Department of Homeland Security - United States Coast Guard	**Source**	-	-	-	-	-	-	-	-	$350
Department of Homeland Security - National Protection and Programs Directorate	**Source**	-	-	-	-	-	-	-	-	$50
Department of Homeland Security - Office of Health Affairs	**Source**	-	-	$300	-	-	-	-	-	-
Total Collections		-	-	**$1,600**	-	-	**$1,600**	-	-	**$2,225**

Mission Support – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2018 Enacted	**344**	**344**	**$134,752**
FY 2019 President's Budget	**324**	**324**	**$118,732**
FY 2020 Base Budget	**324**	**324**	**$118,732**
Transfer to MGMT/CFO from S&T/Mission Support for CPIC	-	-	($314)
Transfer to MGMT/CFO from S&T/Mission Support for the Bankcard WCF Activity	-	-	($3)
Transfer to MGMT/CFO from S&T/Mission Support for the Integrated Audit	-	-	($53)
Transfer to MGMT/CFO from S&T/Mission Support for TIER	-	-	($105)
Transfer to MGMT/OCRSO from S&T/Mission Support for Regional Field Efficiencies	(1)	(1)	($225)
Transfer to MGMT/OCRSO from S&T/O&S for Regional Field Efficiencies	-	-	($11)
Transfer to S&T/Mission Support from MGMT/OCSO for Background Investigations	-	-	$657
Total Transfers	**(1)**	**(1)**	**($54)**
FERS Agency Contribution Increase	-	-	$1,007
Increased charges for FFMS from ICE	-	-	$341
National Capital Region Infrastructure Operations (NCRIO) Sustainment	-	-	$1,395
Total, Pricing Increases	**-**	**-**	**$2,743**
Total Adjustments-to-Base	**(1)**	**(1)**	**$2,689**
FY 2020 Current Services	**323**	**323**	**$121,421**
Right Size Information Technology (IT) Investments	-	-	$7,796
Total, Program Increases	**-**	**-**	**$7,796**
FY 2020 Request	**323**	**323**	**$129,217**
FY 2019 To FY 2020 Change	**(1)**	**(1)**	**$10,485**

Mission Support – PPA
Personnel Compensation and Benefits

Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted				FY 2019 President's Budget				FY 2020 President's Budget				FY 2019 to FY 2020 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Mission Support	344	344	$62,270	$181.02	324	324	$60,932	$187.14	323	323	$61,714	$190.14	(1)	(1)	$782	$3
Total	**344**	**344**	**$62,270**	**$181.02**	**324**	**324**	**$60,932**	**$187.14**	**323**	**323**	**$61,714**	**$190.14**	**(1)**	**(1)**	**$782**	**$3**
Discretionary - Appropriation	344	344	$62,270	$181.02	324	324	$60,932	$187.14	323	323	$61,714	$190.14	(1)	(1)	$782	$3

* The FTE Rate calculation does not include Object Class 11.8-Special Personal Services Payments or 13.0-Benefits for Former Personnel.

Pay by Object Class

Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 - FY 2020 Change
11.1 Full-time Permanent	$41,894	$40,776	$40,623	($153)
11.3 Other than Full-Time Permanent	$4,807	$4,696	$4,696	-
11.5 Other Personnel Compensation	$819	$780	$780	-
12.1 Civilian Personnel Benefits	$14,750	$14,380	$15,315	$935
13.0 Benefits for Former Personnel	-	$300	$300	-
Total - Personnel Compensation and Benefits	**$62,270**	**$60,932**	**$61,714**	**$782**
Positions and FTE				
Positions - Civilian	344	324	323	(1)
FTE - Civilian	344	324	323	(1)

Pay Cost Drivers

Leading Cost Drivers *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate
Mission Support Personnel	344	$62,270	$181	324	$60,932	$187	323	61,712	$190	(1)	$780	$2.99
Total – Pay Cost Drivers	**344**	**$62,270**	**$181**	**324**	**$60,932**	**$187**	**323**	**$61,712**	**$190**	**(1)**	**$780**	**$2.99**

Explanation of Pay Cost Driver

Mission Support Personnel: S&T's pay costs provide for the salaries and benefits of non-laboratory personnel supporting its mission. The net increase is the overall effect of S&T's share of the Department's FERS contribution increase and a transfer of 1 FTE from S&T to the DHS Management Directorate that will oversee the Wind Farm Policy function.

Mission Support – PPA
Non Pay Budget Exhibits

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Mission Support	$72,482	$57,800	$67,503	$9,703
Total	**$72,482**	**$57,800**	**$67,503**	**$9,703**
Discretionary - Appropriation	$72,482	$57,800	$67,503	$9,703

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$698	$615	$615	-
25.1 Advisory and Assistance Services	$18,982	$15,168	$16,168	$1,000
25.2 Other Services from Non-Federal Sources	$320	$282	$580	$298
25.3 Other Goods and Services from Federal Sources	$40,340	$32,016	$35,196	$3,180
25.4 Operation and Maintenance of Facilities	$312	$275	$275	-
25.6 Medical Care	$3	$3	$3	-
25.7 Operation and Maintenance of Equipment	$3,894	$3,085	$4,733	$1,648
26.0 Supplies and Materials	$505	$445	$445	-
31.0 Equipment	$7,428	$5,911	$9,488	$3,577
Total - Non Pay Object Classes	**$72,482**	**$57,800**	**$67,503**	**$9,703**

Non Pay Cost Drivers

Leading Non Pay Cost Drivers *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Contract Support Services	$18,982	$15,168	$16,168	$1,000
Information Technology (IT) Equipment	$11,322	$8,996	$14,221	$5,225
Working Capital Fund	$27,176	$27,179	$28,163	$984
Other Administrative and Support Costs	$15,002	$6,457	$8,951	$2,494
Total Non Pay Cost Drivers	**$72,482**	**$57,800**	**$67,503**	**$9,703**

Explanation of Non Pay Cost Drivers

Contract Support Services: Cost in this category pay for contractor staff supporting the execution of headquarters functions including financial management, facility planning, maintenance, and other administrative functions. S&T uses a Business Office Support Services (BOSS) contract to provide administrative, technical and management support services that will enhance the organizational strengths of S&T's Administrative Support Division (ASD). The increase from FY 2019 is due to increased resources necessary to right-size S&T's IT investments.

Information Technology (IT) Equipment: Costs in this category include information technology hardware and custom and commercial off-the-shelf software. Additional costs include the purchase and maintenance of IT equipment, including hardware (e.g., laptops, monitors, printers, etc.) and software (e.g., Microsoft Office, McAfee, etc.) as well as upgrades of this equipment. The increase from FY 2019 is due to increased resources necessary to right-size S&T's IT investments.

Working Capital Fund: WCF provides shared services that the Components rely on to execute their missions, such as IT services, human resources, procurement operations, and financial systems. Funds provided in Mission Support also support DHS WCF services such as consolidated subscriptions, government-wide mandated services, and DHS crosscutting activities. In FY 2020, there is an overall increase of $1.0M due to increased activity costs, the transfers from S&T for WCF Activity Costs and the transfers to Under Secretary for Management (USM)/CRSO for Regional Field Efficiencies and to the USM/Office of the Chief Security Officer for Background Investigations.

Other Administrative and Support Costs: These costs include business operations functions that pay for office supplies, utilities, and other operational functions associated with the S&T's headquarters offices, including training and travel associated with senior management of S&T. Additionally, included here are the transfer of costs to DHS Management Offices who oversee these programs and provide services DHS-wide. These include but are not limited to background investigations, printing services, legal services, and the DHS Freedom of Information Act (FOIA) system.

Laboratory Facilities – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Laboratory Facilities	141	141	$150,116	107	107	$110,519	114	114	$115,965	7	7	$5,446
Total	**141**	**141**	**$150,116**	**107**	**107**	**$110,519**	**114**	**114**	**$115,965**	**7**	**7**	**$5,446**
Subtotal Discretionary - Appropriation	141	141	$150,116	107	107	$110,519	114	114	$115,965	7	7	$5,446

PPA Level I Description

The Laboratory Facilities PPA provides funding to support operations, core capabilities, maintenance, and personnel requirements at S&T's laboratory facilities. Laboratory Facilities is managed by the Office of National Laboratories (ONL) which oversees the continued operations of S&T's laboratory facilities to include the National Biodefense Analysis and Countermeasures Center (NBACC), Plum Island Animal Disease Center (PIADC), Transportation Security Laboratory (TSL), and Chemical Security Analysis Center (CSAC), to meet mission requirements while maintaining safe, secure, compliant, and efficient operations. ONL also manages the construction of the National Bio and Agro-Defense Facility (NBAF) and maintains capabilities vital to DHS and the national homeland security mission through a coordinated network of S&T laboratories and the Department of Energy (DOE) national laboratories. This network of laboratories houses some of the most advanced scientific expertise and capabilities in the world, enabling the homeland security enterprise to leverage, apply, and share knowledge that helps to inform policy, improve operations, and advance research in support of homeland security.

ONL is a crucial contributor to S&T's technology efforts and is a key resource in the new matrixed organization providing scientifically based RDT&E to deliver solutions. ONL significantly enhances S&T's tech scouting ability to bring in technical experts effectively to augment recommendations and offer capability insights and scientific knowledge to meet Component requirements.

The following Operations and Facilities are supported in this PPA:

National Biodefense Analysis and Countermeasures Center Operations: NBACC provides the capability to characterize current and future biological threats, assess their impacts, and inform the development of countermeasures and vaccines in response to events and identified threats. NBACC is part of the National Interagency Biodefense Campus (NIBC), NBACC also collaborates closely with the Federal Bureau of Investigation (FBI) and national security agencies. The unique missions of threat characterization and bioforensics enhance the Nation's overall biodefense capabilities.

NBACC examines opportunities for the cooperative use of existing capacity to perform R&D for other Federal agencies. S&T operates NBACC as a Federally Funded Research and Development Center (FFRDC), which plans, manages, and executes the NBACC research programs and operates the facility. Some of the major operational costs include safety, security, addressing and maintaining regulatory compliance, information technology and IT upgrades utility and garrison support costs, major facility and equipment upgrades, and energy renewal. NBACC is a certified and registered biosafety level (BSL) 2, 3, and 4 laboratories and has completed the triennial Biological Select Agents and Toxins (BSAT) registration inspection.

National Bio and Agro-Defense Facility Construction: S&T manages the construction of NBAF. NBAF will be a biocontainment laboratory for the study of diseases that threaten both, America's animal agricultural industry and public health. It will strengthen our Nation with critical capabilities to conduct research, develop vaccines and other countermeasures, and train veterinarians in preparedness and response against these diseases. NBAF will serve as a replacement for the PIADC facility. Construction funding was provided in prior appropriations. NBAF construction is 75% complete. USDA will assume full responsibility for ongoing operations planning and future operation of NBAF beginning in FY 2019. S&T NBAF staff in Manhattan, KS will transfer to USDA in FY 2019, as the funding for these positions will be provided to USDA.

Plum Island Animal Disease Center Operations: PIADC provides a host of high-impact, indispensable preparedness and response capabilities to include vaccine R&D, diagnostics, training, and bioforensics, it also has an interagency mission to protect U.S. agriculture from the threat of high-consequence foreign animal diseases such as foot and mouth disease (FMD). The biologic countermeasure development at PIADC supports S&T's agro-terrorism countermeasures program. Research at the facility occurs in biosafety level (BSL)-2, and BSL-3 agricultural laboratory spaces. S&T is responsible for the management, operations, and maintenance of the facility. The laboratory is a self-sustaining operation, with its own power plant, boiler plant, fuel storage, fire protection, waste disposal, security systems, and other critical infrastructures. S&T provides the only ferry transport to and from the island, and is responsible for operation and maintenance of the ferries, docks, and harbor. S&T also manages day-to-day operational support, including the operations workforce and emergency response capabilities (fire, rescue, emergency medical). Major operational costs at PIADC include bio safety, security, operations and maintenance contract, information technology and periodic upgrades to support regulatory requirements and equipment replacement to ensure safe facility operations. PIADC completed support of final transition of the newly developed FMD vaccine to manufacturing and safe storage of master seeds for availability in the potential outbreak of FMD.

Transportation Security Laboratory Operations: The TSL is responsible for researching, developing, testing, and evaluating technologies to detect and mitigate the threat of explosives and other weapons that may be used against our Nation's transportation systems and infrastructure. Constantly evolving threats to our Nation's transportation systems have spurred the need for rapid development of detection and mitigation technologies, requiring testing by the TSL prior to deployment. The TSL is located at the Federal Aviation Administration's William J. Hughes Technical Center in Atlantic City, NJ. Major operational costs include rent, operation support contracts, building maintenance, utilities, energy renewal projects/studies, security, and information technology. TSL develops procedures for a certification capability to verify/validate explosive simulants, awaits peer review for implementation and developed, tested, and documented the standard operating procedures for safely creating, analyzing, and testing marginally stable improvised explosives in quantities up to 100 grams.

Chemical Security Analysis Center Operations: The FY 2020 request includes an increase of $2.7M to restore program funding for the CSAC operations. CSAC is the Nation's only Federal studies, analysis, and knowledge management center for assessing the threat or hazard associated with an accidental or intentional large-scale chemical event or chemical terrorism event in the United States. CSAC is co-located at the DoD U.S. Army

Edgewood Chemical Biological Center (ECBC) at Aberdeen Proving Ground-Edgewood in Maryland. CSAC supports a variety of customers within DHS, the Federal Government, and the Homeland Security Enterprise, to include but not limited to S&T's Chemical and Biological work, DHS Components such as the Cybersecurity and Infrastructure Security Agency (CISA), the Office of CWMD, the United States Secret Service (USSS), the Transportation Security Administration (TSA), and other Federal agencies as well as the National Security Council. The CSAC provides science- and technology-based quality assured information capabilities for acquiring, storing, indexing, evaluating and making strategically available cheminformatic data, technical reports and other knowledge products across the chemical threat spectrum to support the unified effort to secure the Nation. Operational costs for this facility include rent, security, utilities, energy renewal projects/studies, and information technology. In FY 2018 CSAC, completed an aviation security study for TSA. The risk-based analysis involved multiple threats to narrow and wide body airframes. Additionally, CSAC completed and launched the CARD v5.0 on the National Center for Medical Intelligence (NCMI), which hosts the CARD.

Laboratory Facilities – PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2018**	**FY 2019**	**FY 2020**
Enacted/Request	**$150,116**	**$110,519**	**$115,965**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$58,749	$52,853	$41,593
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$208,865**	**$163,372**	**$157,558**
Collections – Reimbursable Resources	$3,000	$3,000	$26,400
Total Budget Resources	**$211,865**	**$166,372**	**$183,958**
Obligations (Actual/Estimates/Projections)	$159,012	$124,779	$137,968
Personnel: Positions and FTE			
Enacted/Request Positions	141	107	114
Enacted/Request FTE	141	107	114
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	132	107	114
FTE (Actual/Estimates/Projections)	132	107	114

Laboratory Facilities – PPA
Collections – Reimbursable Resources

Collections *(Dollars in Thousands)*		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget		
		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Agriculture - Department of Agriculture	**Source**	-	-	$700	-	-	$700	-	-	$3,100
Department of Defense - Department of Defense	**Source**	-	-	$1,000	-	-	$1,000	-	-	$1,000
Department of Homeland Security - Federal Emergency Management Agency	**Source**	-	-	$200	-	-	$200	-	-	$200
Department of Homeland Security - Transportation Security Administration	**Source**	-	-	$850	-	-	$850	-	-	$850
Department of Homeland Security - Countering Weapons of Mass Destruction	**Source**	-	-	-	-	-	$50	-	-	$50
Department of Justice - Federal Bureau of Investigation	**Source**	-	-	-	-	-	-	-	-	$21,000
Department of State - Department of State	**Source**	-	-	$200	-	-	$200	-	-	$200
Department of Homeland Security - Domestic Nuclear Detection Office	**Source**	-	-	$50	-	-	-	-	-	-
Total Collections		-	-	**$3,000**	-	-	**$3,000**	-	-	**$26,400**

Laboratory Facilities – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2018 Enacted	**141**	**141**	**$150,116**
FY 2019 President's Budget	**107**	**107**	**$110,519**
FY 2020 Base Budget	**107**	**107**	**$110,519**
FERS Agency Contribution Increase	-	-	$252
Increase in Lab Operations	-	-	$2,457
Total, Pricing Increases	**-**	**-**	**$2,709**
Total Adjustments-to-Base	**-**	**-**	**$2,709**
FY 2020 Current Services	**107**	**107**	**$113,228**
Restore Chemical Security Analysis Center (CSAC)	7	7	$2,737
Total, Program Increases	**7**	**7**	**$2,737**
FY 2020 Request	**114**	**114**	**$115,965**
FY 2019 To FY 2020 Change	**7**	**7**	**$5,446**

Laboratory Facilities – PPA
Personnel Compensation and Benefits

Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted				FY 2019 President's Budget				FY 2020 President's Budget				FY 2019 to FY 2020 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Laboratory Facilities	141	141	$22,260	$157.87	107	107	$14,567	$134.74	114	114	$18,113	$157.57	7	7	$3,546	$22.83
Total	**141**	**141**	**$22,260**	**$157.87**	**107**	**107**	**$14,567**	**$134.74**	**114**	**114**	**$18,113**	**$157.57**	**7**	**7**	**$3,546**	**$22.83**
Discretionary - Appropriation	141	141	$22,260	$157.87	107	107	$14,567	$134.74	114	114	$18,113	$157.57	7	7	$3,546	$22.83

* The FTE Rate calculation does not include Object Class 11.8-Special Personal Services Payments or 13.0-Benefits for Former Personnel.

Pay by Object Class

Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 - FY 2020 Change
11.1 Full-time Permanent	$16,962	$10,990	$13,497	$2,507
11.3 Other than Full-Time Permanent	$705	$460	$566	$106
11.5 Other Personnel Compensation	$497	$326	$398	$72
12.1 Civilian Personnel Benefits	$4,096	$2,641	$3,502	$861
13.0 Benefits for Former Personnel	-	$150	$150	-
Total - Personnel Compensation and Benefits	**$22,260**	**$14,567**	**$18,113**	**$3,546**
Positions and FTE				
Positions - Civilian	141	107	114	7
FTE - Civilian	141	107	114	7

Pay Cost Drivers

Leading Cost Drivers *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate
Laboratory Personnel	141	$22,260	$158	107	$14,567	$135	114	$18,113	$158	7	$3,546	$22.83
Total – Pay Cost Drivers	**141**	$22,260	$158	107	$14,567	$135	114	$18,113	$158	**7**	**$3,546**	**$22.83**

Explanation of Pay Cost Driver

Laboratory Personnel: Laboratory Personnel costs include salary and benefit resources to pay personnel overseeing the operations, core capabilities, and maintenance requirements at S&T's laboratory facilities. The change in FTE and funding from FY 2019 restores resources for continued operations at CSAC.

Laboratory Facilities – PPA
Non Pay Budget Exhibits

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Laboratory Facilities	$127,856	$95,952	$97,852	$1,900
Total	**$127,856**	**$95,952**	**$97,852**	**$1,900**
Discretionary - Appropriation	$127,856	$95,952	$97,852	$1,900

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$701	$516	$516	-
22.0 Transportation of Things	$20	$15	$15	-
23.3 Communications, Utilities, and Misc. Charges	$114	$84	$84	-
25.1 Advisory and Assistance Services	$59,322	$44,470	$44,470	-
25.2 Other Services from Non-Federal Sources	$858	$632	$632	-
25.3 Other Goods and Services from Federal Sources	$55,399	$41,673	$42,873	$1,200
25.4 Operation and Maintenance of Facilities	$5,348	$4,016	$4,716	$700
25.7 Operation and Maintenance of Equipment	$437	$322	$322	-
26.0 Supplies and Materials	$3,809	$2,863	$2,863	-
31.0 Equipment	$1,101	$811	$811	-
32.0 Land and Structures	$747	$550	$550	-
Total - Non Pay Object Classes	**$127,856**	**$95,952**	**$97,852**	**$1,900**

Non Pay Cost Drivers

Leading Non Pay Cost Drivers *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Laboratory Contract Support	$59,322	$44,470	$44,470	-
Other Goods and Services from Federal Sources	$55,399	$41,673	$42,873	$1,200
Laboratory Facilities	$5,348	$4,016	$4,716	$700
Laboratory Supplies and Materials	$3,809	$2,863	$2,863	-
Other Laboratory Costs	$3,978	$2,930	$2,930	-
Total – Non Pay Cost Drivers	**$127,856**	**$95,952**	**$97,852**	**$1,900**

Explanation of Non Pay Cost Drivers

Laboratory Contract Support: This covers costs for contract staff who support the execution of business functions including financial management, facility planning, engineering and technical services, and other administrative functions. S&T's PIADC relies heavily on contract support to maintain approximately 200,000 square feet including Biosafety-Level 2 (BSL-2), BSL-3, BSL-3 agriculture buildings and nine acres.

Other Goods and Services from Federal Sources: Interagency agreements for contractual services for the purchase of goods and services for jointly funded projects. S&T's TSL has an agreement with the Federal Aviation Administration (FAA) for the FAA to provide facility support services to TSL on a reimbursable basis for various activities, including utilities, building maintenance, emergency services, air shuttle services, and IT services. The Federal Protective Services (FPS) provides security at PIADC. The increased costs in FY 2020 are associated with detailees from the DoD who support CSAC.

Laboratory Facilities: These costs cover the upkeep of facilities to meet mission requirements while maintaining safe, secure, compliant, and efficient operations. In general, for laboratory facilities O&M includes: labor, management, supervision, equipment, software, firmware, and materials for all services required for the safe, reliable, effective, efficient, and compliant operations and maintenance under normal, abnormal, and emergency conditions. Also included are service contracts, routine repair of facilities and upkeep of land. PIADC must be maintained on a 24/7 basis. The increased costs in FY 2020 are associated with operating the CSAC facility.

Laboratory Supplies and Materials: These costs support business operations functions that pay for the purchase and maintenance of IT equipment, including hardware and software as well as upgrades of this equipment. This also includes office supplies and materials and costs associated with using and maintaining vehicles.

Other Laboratory Administrative and Support Costs: These costs include payments to vendors such as utilities at PIADC, fleet maintenance, training, supplies and other costs.

Acquisitions and Operations Analysis – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Acquisition and Operations Analysis	-	-	$46,245	-	-	$42,552	-	-	$33,772	-	-	($8,780)
Total	**-**	**-**	**$46,245**	**-**	**-**	**$42,552**	**-**	**-**	**$33,772**	**-**	**-**	**($8,780)**
Subtotal Discretionary - Appropriation	-	-	$46,245	-	-	$42,552	-	-	$33,772	-	-	($8,780)

PPA Level I Description

The Acquisition and Operations Analysis (AOA) PPA provides funding to support expert assistance, including systems engineering, to entities across the Homeland Security Enterprise (HSE) to ensure that the transition, acquisition, and deployment of technologies, information, and procedures improve the efficiency and effectiveness of the operational capabilities. This includes providing technological assessment of major acquisition programs in DHS to help ensure that technologies, concept of operations (CONOPS), and procedures meet operational requirements, technology analysis and technology review of analysis of alternatives at the beginning and throughout an acquisition program's life; standards to support the homeland security mission; and administration of the Support Anti-Terrorism by Fostering Effective Technologies (SAFETY) Act program.

Operations and Requirements Analysis (ORA): S&T reviews homeland security operations to identify ways to prioritize cross-DHS capability gaps, eliminate duplications and inefficiencies. By supporting the Department's Joint Requirement Council (JRC), S&T can identify common or similar operational needs by DHS Components and pursue common technical solutions that will increase DHS overall efficiency and effectiveness. ORA seeks a clear understanding of identified gaps in DHS operations and to refine these gaps into actionable Research & Development (R&D) requirements that will form the basis for S&T's work and resource allocation. ORA supports DHS capabilities and requirements analysis while enhancing the analytic capability and maturity of the Department through the development of System of Systems Operational Analytics (SoSOA) capability, a virtual common analytic environment)for collaborative operational analyses. In addition, S&T's ORA provides our Nation's first responders and DHS Components with a forum to identify, validate, relay and pursue their highest priority capability gaps needs for research and development. The requirements identified by S&T stakeholder engagement lead to the development of life saving technologies that make our Nation's first responders safer, more efficient and more effective.

Systems Engineering & Standards: S&T conducts Technical Assessments of DHS Acquisition and S&T R&D programs to identify major technical risks, provide recommendations to reduce those risks, support objective decision-making, and ensure that programs are technically sound. S&T also assists DHS Acquisitions and R&D programs in implementing systems engineering and engineering conformance into technical assessments and acquisition programs. S&T provides technical expertise to the DHS Joint Requirements Council to validate capability gaps, mission needs, and

operational requirements. Additionally, this program manages the statutory functions of the Standards Executive for DHS coordination and oversight responsibilities and participates in standards committees.

Test and Evaluation (T&E): T&E performs critical functions in support of delivering enhanced capabilities to Department of Homeland Security Operators to improve acquisition outcomes through comprehensive engagement in major acquisition programs and R&D efforts. T&E supports every major program on the Major Acquisition Oversight List (MAOL); providing input at each Acquisition Review Board; reviewing and providing comments on each program Operational Requirements Document; reviewing and approving the selection of Operational Test Agents, T&E Master Plans, and Operational Test Plans. T&E prepares and issues Letters of Assessment following each Operational Test, in support of initial and full production or deployment decisions that address operational effectiveness, operational suitability, and operational resilience. Test and Evaluation provides support to development and certification for members of the Test and Evaluation career field in the acquisition workforce. Test and Evaluation provides assistance and guidance to programs regarding Cyber Resilience T&E, Scientific Test and Analysis Techniques, Reliability assessments, and effective mapping of government test facilities.

Technology Scouting and Transition (TST): Technology transition activities involve integrating technology development efforts across S&T to develop the most cost-effective and timely solutions, and processes to meet customer requirements, including first responders. TST coordinates Component and S&T program plans to maximize opportunities for successful technology transition. TST also supports S&T strategic and tactical R&D investment decision-making by providing program managers with a better understanding of the state of technology, including new and emerging technology, market analysis, and private sector innovation landscape. Technology scouting shapes the way S&T discovers, monitors, and assesses new and emerging technologies critical to homeland security enterprise missions. Technology scouting provides the foundation for S&T program decisions and helps shape program priorities. Technology scouting program goals are to improve alternative options, increase speed of project execution, and reduce costs for projects.

Strategy and Policy: Strategy and Policy supports the identification of S&T strategic investment priorities by developing internal strategies and policy positions, and coordinating interactions with intra and interagency partners on the development of strategic plans and approaches. Strategy and Policy will also conduct reviews and assessments of S&T's R&D portfolio investments through the development of metrics and review criteria to consistently measure the impact of S&T's investments on homeland security missions. This program also supports the development of S&T policy and procedures through the Knowledge Management program.

Interagency Programs: This program addresses high-priority homeland security needs through facilitation and collaboration with cooperative science, technology, and RDT&E endeavors with other Federal agencies, academia, and private sector. This interagency function establishes trusted partnerships with government agencies to leverage their investments and other resources, acting as a force-multiplier for S&T programs and initiatives. It provides a key conduit for government agencies to capitalize on S&T innovation and leverages the capabilities and investments of external organizations to reduce duplication and identify unmet needs.

Office of the Chief Scientist: The Chief Scientist (CS) serves as a senior advisor and analytic capability to the Under Secretary for Science and Technology (USST). The office provides assessments of individual technologies and investments. The CS conducts technology reviews and delivers insights into the effectiveness of S&T's technology investments. These reviews present a picture of how well S&T's programs are filling capability

identified and validated gaps. The office reviews and produces advanced scientifically sound analysis of emerging technologies focused on enhancing security and countering the constantly evolving threat environment.

International Cooperative Programs Office (ICPO): ICPO develops understandings and agreements, identifies new international partnership opportunities to further the HSE mission, facilitates the planning and implementation of international cooperative activities for the HSE, and develops legal mechanisms to support international cooperative activities. The United States and its allies mutually benefit from the sharing of information and technological expertise to combat domestic and international threats and other high consequence events. ICPO engages in the above mentioned activities to coordinate RDT&E among partners, support the development and effective integration of technologies into operations, and make the best use of resources in order to minimize duplication and obtain more efficient and cost-effective results. The office maximizes cost savings, accelerate capability development and transition, and take advantage of emerging ideas and solutions, globally.

Federally Funded Research & Development Center (FFRDC) Program Management Office (PMO): The FFRDC PMO provides centralized oversight and support to the Homeland Security Operational Analysis Center (HSOAC) and the Homeland Security Systems Engineering and Development Institute (HSSEDI), two of DHS's FFRDCs. These FFRDCs are working in the interest of the public to ensure the highest levels of excellence by bringing together the expertise and point-of-view of government, industry, and academia. The close, but independent relationship between DHS and the FFRDC allows the FFRDCs to provide objective, independent research and analysis, free from conflicts of interest that result in actionable recommendations and candid advice rooted in the context of a long-term trusted relationship. HSOAC provides DHS with expertise, analytic rigor, and timely analysis to support operations, policy development, and decision-making for DHS and its partners across the HSE. HSSEDI utilizes its independent and objective perspective, extensive knowledge of the DHS mission space, and deep technical expertise to identify and solve critical technical problems and accelerate to operational use, the technology and systems necessary to secure the homeland.

Support Anti-Terrorism by Fostering Effective Technologies (SAFETY) Act: This program provides liability protections for claims resulting from an act of terrorism, and provides legal liability protection for providers of qualified anti-terrorism technologies. This program also creates pathways for S&T to work with industry and small businesses in a synchronized, strategic fashion to improve the pace and quality of solution development for the critical needs of the homeland security enterprise. In addition, the SAFETY Act Program actively supports DHS programs and initiatives (e.g., the National Infrastructure Protection Plan, TSA's Certified Cargo Screening Program, CBP's Customs-Trade Partnership Against Terrorism and other Federal anti-terrorism programs) by developing a streamlined procedure for providing SAFETY Act coverage known as Block Designations.

Acquisitions and Operations Analysis – PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2018**	**FY 2019**	**FY 2020**
Enacted/Request	**$46,245**	**$42,552**	**$33,772**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$19,771	$20,928	$20,062
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$66,016**	**$63,480**	**$53,834**
Collections – Reimbursable Resources	$5,700	$5,700	$5,700
Total Budget Resources	**$71,716**	**$69,180**	**$59,534**
Obligations (Actual/Estimates/Projections)	$50,788	$49,118	$42,269
Personnel: Positions and FTE			
Enacted/Request Positions	-	-	-
Enacted/Request FTE	-	-	-
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	-	-	-
FTE (Actual/Estimates/Projections)	-	-	-

Acquisitions and Operations Analysis – PPA
Collections – Reimbursable Resources

Collections		FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Energy - Department of Energy	**Source**	-	-	$500	-	-	$500	-	-	$500
Department of Homeland Security - Department of Homeland Security	**Source**	-	-	$500	-	-	$500	-	-	$500
Department of Homeland Security - Federal Emergency Management Agency	**Source**	-	-	$50	-	-	$50	-	-	$50
Department of Homeland Security - Transportation Security Administration	**Source**	-	-	$300	-	-	$300	-	-	$300
Department of Homeland Security - Citizenship and Immigration Services	**Source**	-	-	$50	-	-	$50	-	-	$50
Department of Homeland Security - United States Secret Service	**Source**	-	-	$1,500	-	-	$1,500	-	-	$1,500
Department of Homeland Security - Countering Weapons of Mass Destruction	**Source**	-	-	-	-	-	$900	-	-	$900
Department of Homeland Security - US Customs and Border Protection	**Source**	-	-	$100	-	-	$100	-	-	$100
Department of Homeland Security - US Immigration and Customs Enforcement	**Source**	-	-	$250	-	-	$250	-	-	$250
Department of Homeland Security - United States Coast Guard	**Source**	-	-	$100	-	-	$100	-	-	$100
Department of Homeland Security - National Protection and Programs Directorate	**Source**	-	-	$950	-	-	$950	-	-	$950
Department of Homeland Security - Office of Health Affairs	**Source**	-	-	$100	-	-	-	-	-	-
Department of Homeland Security - Domestic Nuclear Detection Office	**Source**	-	-	$800	-	-	-	-	-	-
Library of Congress	**Source**	-	-	$500	-	-	$500	-	-	$500
Total Collections		**-**	**-**	**$5,700**	**-**	**-**	**$5,700**	**-**	**-**	**$5,700**

Acquisitions and Operations Analysis – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2018 Enacted	**-**	**-**	**$46,245**
FY 2019 President's Budget	**-**	**-**	**$42,552**
FY 2020 Base Budget	**-**	**-**	**$42,552**
Efficiencies through Existing Technologies	-	-	($8,780)
Total, Pricing Decreases	**-**	**-**	**($8,780)**
Total Adjustments-to-Base	**-**	**-**	**($8,780)**
FY 2020 Current Services	**-**	**-**	**$33,772**
FY 2020 Request	**-**	**-**	**$33,772**
FY 2019 To FY 2020 Change	**-**	**-**	**($8,780)**

Acquisitions and Operations Analysis – PPA
Non Pay Budget Exhibits

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Acquisition and Operations Analysis	$46,245	$42,552	$33,772	($8,780)
Total	**$46,245**	**$42,552**	**$33,772**	**($8,780)**
Discretionary - Appropriation	$46,245	$42,552	$33,772	($8,780)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$590	$543	$543	-
25.1 Advisory and Assistance Services	$23,836	$21,932	$20,105	($1,827)
25.2 Other Services from Non-Federal Sources	$450	$414	$414	-
25.3 Other Goods and Services from Federal Sources	$18,472	$16,997	$10,044	($6,953)
25.7 Operation and Maintenance of Equipment	$2,043	$1,880	$1,880	-
31.0 Equipment	$311	$286	$286	-
41.0 Grants, Subsidies, and Contributions	$543	$500	$500	-
Total - Non Pay Object Classes	**$46,245**	**$42,552**	**$33,772**	**($8,780)**

Non Pay Cost Drivers

Leading Non Pay Cost Drivers *Dollars in Thousands*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Contract Support Services	$23,836	$21,932	$20,105	($1,827)
Other Goods and Services from Federal Sources	$18,472	$16,997	$10,044	($6,953)
Other Costs	$3,937	$3,623	$3,623	-
Total – Non Pay Cost Drivers	**$46,245**	**$42,552**	**$33,772**	**($8,780)**

Explanation of Non Pay Cost-Drivers

Contract Support Services: Costs include contract services for business operations including financial management, studies, analyses, and evaluations in support of information technology and R&D activities, as well as other administrative functions. S&T's AOA programs rely on contracting services to provide analyses, engineering, test expertise, and products for operational end users within DHS and Joint Requirements Council (JRC). The decrease in costs from FY 2019 to FY 2020 for these services will be achieved through efficiencies gained by utilizing existing information technology.

Other Goods and Services from Federal Sources: Interagency agreements for contractual services for the purchase of goods and services for jointly funded projects. For example, the SAFETY Act Office relies heavily on the Institute of Defense Analyses (IDA) to provide studies, analyses, test and evaluation support in determining whether to designate a particular technology as a Qualified Anti-Terrorism Technology. The decrease in costs from FY 2019 to FY 2020 is attributed to costs reductions through efficiencies gained by utilizing existing information technology.

Other Administrative and Support Costs: Costs include travel, conferences, and direct support of major acquisitions and systems essential to planning, R&D, or maintenance of the acquisition or system.

Department of Homeland Security

Science and Technology

Research and Development

Fiscal Year 2020
Congressional Justification

Table of Contents

Research and Development

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Research, Development and Innovation	-	-	$469,330	-	-	$289,734	-	-	$281,417	-	-	($8,317)
University Programs	-	-	$40,500	-	-	$21,746	-	-	$21,746	-	-	-
Total	**-**	**-**	**$509,830**	**-**	**-**	**$311,480**	**-**	**-**	**$303,163**	**-**	**-**	**($8,317)**
Subtotal Discretionary - Appropriation	-	-	$509,830	-	-	$311,480	-	-	$303,163	-	-	($8,317)

The extraordinary breadth and diversity of Department of Homeland Security's (DHS) missions requires the Science and Technology Directorate (S&T) to address a wide range of programs including DHS Components' near-term needs for new operational capabilities and improved operational effectiveness, efficiency, and safety for the Homeland Security Enterprise (HSE). S&T has responsibilities related to understanding and creating solutions for explosives, border security, cyber security, biological and chemical threats, and conducting the research and development (R&D) required to meet other Homeland Security needs. Equally important are S&T's contributions to Homeland Security in the form of analyses or "knowledge products." These include analyses of alternative technology options; risk and threat assessments; operational testing and evaluation of technologies proposed for acquisition; and detailed technical characterization of potential biological threat organisms for both human and agricultural biodefense. In addition, S&T's capacity to engage R&D activities worldwide is augmented by S&T's university-based Centers of Excellence (COEs) and 13 bilateral international agreements.

S&T has two programs, projects, and activities (PPAs) in the R&D appropriation:

Research, Development, and Innovation (RD&I): Provides state-of-the-art technology and/or solutions to meet the needs of DHS Components and the First Responder community. RD&I includes customer-focused and output-oriented Research, Development, Test and Evaluation (RDT&E) programs that balance risk, cost, impact, and time to delivery.

University Programs (UP): Supports critical Homeland Security-related research and education at U.S. colleges and universities to address high-priority DHS-related issues and to enhance Homeland Security capabilities over the long term. UP includes COEs and Minority Serving Institutions, a consortium of universities generating groundbreaking ideas for new technologies and critical knowledge for the HSE.

Research and Development
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2018**	**FY 2019**	**FY 2020**
Enacted/Request	**$509,830**	**$311,480**	**$303,163**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$202,358	$211,944	$162,438
Rescissions to Current Year/Budget Year	($8,000)	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$704,188**	**$523,424**	**$465,601**
Collections – Reimbursable Resources	$41,800	$41,800	$58,300
Total Budget Resources	**$745,988**	**$565,224**	**$523,901**
Obligations (Actual/Estimates/Projections)	$534,044	$402,786	$370,965
Personnel: Positions and FTE			
Enacted/Request Positions	-	-	-
Enacted/Request FTE	-	-	-
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	-	-	-
FTE (Actual/Estimates/Projections)	-	-	-

Research and Development
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	**Positions**	**FTE**	**Amount**
FY 2018 Enacted	**-**	**-**	**$509,830**
FY 2019 President's Budget	**-**	**-**	**$311,480**
FY 2020 Base Budget	**-**	**-**	**$311,480**
FY 2020 Current Services	**-**	**-**	**$311,480**
Border Security	-	-	$8,078
First Responder / Disaster Resilience R&D	-	-	$10,938
Innovative Research and Foundational Tools	-	-	$40,811
Total, Program Increases	**-**	**-**	**$59,827**
Apex	-	-	($42,584)
Chemical, Biological, and Explosives (CBE) Defense R&D	-	-	($6,466)
Counter Terrorist R&D	-	-	($19,094)
Total, Program Decreases	**-**	**-**	**($68,144)**
FY 2020 Request	**-**	**-**	**$303,163**
FY 2019 To FY 2020 Change	**-**	**-**	**($8,317)**

Research and Development
Justification of Program Changes

Program Changes *(Dollars in Thousands)*	FY 2020 President's Budget		
	Positions	**FTE**	**Amount**
Program Change 1 - Apex	**-**	**-**	**($42,584)**
Research, Development and Innovation	-	-	($42,584)
Program Change 2 - Border Security	**-**	**-**	**$8,078**
Research, Development and Innovation	-	-	$8,078
Program Change 3 - Chemical, Biological, and Explosives (CBE) Defense R&D	**-**	**-**	**($6,466)**
Research, Development and Innovation	-	-	($6,466)
Program Change 4 - Counter Terrorist R&D	**-**	**-**	**($19,094)**
Research, Development and Innovation	-	-	($19,094)
Program Change 5 - First Responder / Disaster Resilience R&D	**-**	**-**	**$10,938**
Research, Development and Innovation	-	-	$10,938
Program Change 6 - Innovative Research and Foundational Tools	**-**	**-**	**$40,811**
Research, Development and Innovation	-	-	$40,811
Total Program Changes	**-**	**-**	**($8,317)**

Program Change 1 – Apex

Description
The FY 2020 request includes a decrease of $42.6M from the Apex S&T Thrust area to remove this thrust area as a result of S&T revitalization efforts. The base for the Apex Thrust area is $42.6M.

Justification
As part of S&T's revitalization, there is a reduced emphasis on the Apex programs, but rather a renewed focus on all R&D programs and projects supporting the Department. The realignment ensures the necessary tools and capabilities are available to the R&D projects to facilitate technology scouting, project execution, and transition.

Performance
Removing this thrust area and realigning the R&D programs under this thrust will not impact the performance of the R&D programs themselves. All R&D programs previously under this thrust area are realigned to other thrust areas. The realignment of programs is necessary to maximize S&T's resources efficiently and effectively.

Program Change 2 – Border Security

Description
The FY 2020 request includes a net increase of $8.1M to the Border Security S&T Thrust area for the realignment of two projects from other thrust areas to the Border Security thrust, as well as realignment of funds to invest R&D for immigration services. The base for the Border Security Thrust area is $51.9M.

Justification
S&T will realign two projects to support the Administration's priority in border security: Border Situational Awareness (BSA) at $1.1M from the Apex Thrust; and Opioid/Fentanyl Detection at $7.0M from the Chemical, Biological, and Explosives (CBE) Defense R&D Thrust. BSA will no longer be emphasized as an Apex project, but rather as one of S&T's investments in border security R&D. The Opioid/Fentanyl Detection project is more suited to be aligned under the Border Security Thrust since the critical need identified is at land border Ports of Entry (POEs) and at facilities handling international mail and parcel shipments.

S&T will also realign funds to support the Administration's priority in immigration; this includes decreases of $2.3M from Ground Based Technologies project and $0.7M from Tunnel Detection and Surveillance project. The Immigration Based Technologies project at $3.0M seeks to make technology available to U.S. Citizenship and Immigration to enhance the efficiency and integrity of its immigration activities.

Performance
Realigning the two R&D projects to this Border Security thrust will maximize the efficiency and effectiveness of S&T's resources. Investing in R&D for immigration services is intended to improve the adjudication of applications and petitions for immigration benefits, strengthen and streamline the vetting process, and thereby reduce applicant backlog.

Program Change 3 – Chemical, Biological, and Explosives (CBE) Defense R&D

Description
The FY 2020 request includes a net decrease of $6.5M to the CBE Defense R&D S&T Thrust area due to the realignment of funds based on customer requirements, as well as the realignment of projects to and from other S&T Thrust areas. The base for the CBE Defense R&D Thrust area is $56.9M.

Justification
S&T is a service organization as much as it is focused on science and engineering. S&T is looking at each of its programs and projects to ensure DHS Component/customer alignment. Based on initial customer requirements, S&T redefined several Chemical/Biological programs. Consequently, S&T is decreasing funds for programs under the CBE Defense R&D Thrust area in order to fund customer requirements in other thrust areas.

S&T is also realigning two projects to maximize S&T's resources efficiently and effectively. Opioid/Fentanyl Detection at $7.0M will be realigned to the Border Security Thrust. Screening at Speed, which was previously under the Apex Thrust, will be realigned to this CBE Defense R&D Thrust.

Performance
S&T's focus is on efforts with a direct and demonstrable link to the efficiency, effectiveness, and safety of DHS's operational missions or to the safety and interoperability of the first responder community. The changes in funding for the CBE Defense R&D Thrust area will enable S&T to focus available resources on the projects most critical to needs of DHS operating components and first responders.

Program Change 4 – Counter Terrorist

Description
The FY 2020 request includes a net decrease of $19.1M in FY 2020 to the Counter Terrorist R&D S&T Thrust area for an increase of $4.4M to restore R&D funds for the Chemical Security Analysis Center (CSAC) as well as $23.5M decreases in an effort to consolidate similar programs or realign programs to more appropriate thrust areas as part of S&T's revitalization. The base for the Counter Terrorist R&D Thrust area is $77.0M.

Justification
The increase for CSAC provides R&D funds restored in the FY 2018 Enacted appropriation. The decrease in the Counter Terrorist R&D Thrust area accounts for the consolidation of the $5.1M Social Media Research program into the Data Analytics Technology Center (DA-TC) program, now aligned to the new thrust area – Innovative Research and Foundational Tools. Another decrease in this thrust area is the realignment of the $10.0M Silicon Valley Innovation Program (SVIP) to the new thrust area – Innovative Research and Foundational Tools.

Performance
R&D funding for CSAC restores DHS's ability to have direct scientific and research advice during a chemical incident. Restoring CSAC directly supports hazard analysis tools that support current and emerging needs of DHS Components and local communities.

The decrease in funding for the Counter Terrorist Thrust area will enable S&T to focus available resources on the projects most critical to the needs of DHS operating components and first responders. The realignment of funds to consolidate programs is necessary in order to maximize S&T's resources efficiently and effectively.

Program Change 5 – First Responder / Disaster Resilience R&D

Description
The FY 2020 request includes a net increase of $10.9M to the First Responder / Disaster Resilience R&D S&T Thrust area to fund programs based on customer requirements, to realign programs previously under the Apex Thrust area, and for the realignment of programs to the new thrust area – Innovative Research and Foundational Tools. The base for the First Responder / Disaster Resilience R&D Thrust area is $61.3M.

Justification
The increase in the First Responder / Disaster Resilience R&D Thrust area includes funds for programs requested by the Federal Emergency Management Agency (FEMA) to increase resiliency, preparedness, risk and mitigation in support of the FEMA Strategic Plan, such as Disaster

Recovery, National Hurricane Technology, and Regional Resilience Assessment. An increase in funds will also establish two programs: Research Supporting Public Safety Broadband Implementation and Counter Human Trafficking. Research Supporting Public Safety Broadband Implementation program will conduct RDT&E of technologies in the public safety broadband arena to support end user implementation. Counter Human Trafficking supports DHS and HSE missions by defining human trafficking nature, scope, victims, and criminals, to develop and evaluate mitigation strategies and practices, and in discovery, prevention, and enforcement for DHS Authorities in interagency and international settings.

Performance

The FY 2020 funding increase for this thrust will allow S&T to continue providing state-of-the-art technology and/or solutions to meet the needs of DHS Components and the First Responder community. This includes customer-focused and output-oriented RDT&E programs that balance risk, cost, impact, and time to delivery. S&T's focus is on efforts with a direct and demonstrable link to the efficiency, effectiveness, and safety of DHS's operational missions or to the safety and interoperability of the First Responder community. S&T technical innovation and products advance operational capabilities. R&D investments requested by FEMA allows DHS and FEMA to keep pace with the nation's evolving disaster risk, enable state and local capacity, and reduce fatalities and property losses. Public Safety Broadband Implementation program specifically supports First Responder technology integration for First Net. Funds for Counter Human Trafficking would: enable progress from lessons learned and best practices to evidence-based practice; scale nationally; reproduce beneficial results; and ensure cost effective and efficient effort.

Program Change 6 – Innovative Research and Foundational Tools

Description

The FY 2020 request includes $40.8M for the addition of the new Innovative Research and Foundational Tools thrust area. The base for this new thrust area is $0.0M.

Justification

S&T's new mission statement is to "Enable effective, efficient, and secure operations across all homeland security missions by applying scientific, engineering, analytic, and innovative approaches to deliver timely solutions and support departmental acquisitions." As part of S&T's revitalization, S&T aims to understand the high-priority, homeland security capability needs and gaps, and identify optimal approaches for providing solutions and knowledge that address those needs.

This new thrust now includes Technology Centers (formerly Apex Engines), initiatives that foster S&T's partnerships, and efforts to establish a solid foundation for S&T's R&D programs and projects. The Technology Centers are a renewed investment in unique, technical capabilities to support the DHS Components. This thrust also includes the consolidation of the Social Media Research program into the DA-TC program. The Social Media Research program focuses on leveraging open source and social media (OSSM) effectively by piloting commercial tools for DHS operational components to explain OSSM challenges in operational contexts. DA-TC serves DHS by applying leading-edge computational data analytics research and development techniques to enable user-focused, data-driven solutions.

Performance

R&D investments under this thrust area will enable gathering gaps through analysis and requirements prioritization. Focus will be on identifying and

analyzing potential solutions and working with customers to select the best approach to delivering solutions, including knowledge and advice.

The consolidation of programs is necessary in order to maximize S&T's resources efficiently and effectively. With an ever-increasing number of data-driven processes existing throughout government, DHS is increasingly relying on data analytics, open source social media analytics, and other computational methodologies to address DHS mission needs related to border security, immigration enforcement, and critical infrastructure protection. Additionally, DA-E supports DHS priorities by maintaining and operating a state-of-the-art data analytics facility that supports mission-relevant evaluations of emerging technologies, rapid experimentation, and strategic R&D efforts.

Research and Development
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Research, Development and Innovation	$469,330	$289,734	$281,417	($8,317)
University Programs	$40,500	$21,746	$21,746	-
Total	**$509,830**	**$311,480**	**$303,163**	**($8,317)**
Discretionary - Appropriation	$509,830	$311,480	$303,163	($8,317)

Non-Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$1,813	$1,107	$1,107	-
22.0 Transportation of Things	$29	$18	$18	-
23.2 Rental Payments to Others	$121	$75	$75	-
23.3 Communications, Utilities, and Misc. Charges	$3	$2	$2	-
25.1 Advisory and Assistance Services	$72,727	$44,672	$51,746	$7,074
25.2 Other Services from Non-Federal Sources	$3,067	$1,893	$1,893	-
25.3 Other Goods and Services from Federal Sources	$240,262	$148,147	$140,718	($7,429)
25.5 Research and Development Contracts	$152,163	$93,786	$85,824	($7,962)
25.7 Operation and Maintenance of Equipment	$183	$113	$113	-
26.0 Supplies and Materials	$967	$597	$597	-
31.0 Equipment	$1,897	$1,171	$1,171	-
41.0 Grants, Subsidies, and Contributions	$36,598	$19,899	$19,899	-
Total - Non Pay Object Classes	**$509,830**	**$311,480**	**$303,163**	**($8,317)**

Research, Development, and Innovation – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Research, Development and Innovation	-	-	$469,330	-	-	$289,734	-	-	$281,417	-	-	($8,317)
Total	**-**	**-**	**$469,330**	**-**	**-**	**$289,734**	**-**	**-**	**$281,417**	**-**	**-**	**($8,317)**
Subtotal Discretionary - Appropriation	-	-	$469,330	-	-	$289,734	-	-	$281,417	-	-	($8,317)

PPA Level I Description

Research, Development, and Innovation (RD&I) provides state-of-the-art technology and/or solutions to meet the needs of DHS's operational Components and the First Responder community. The PPA includes customer-focused and output-oriented RDT&E programs that balance risk, cost, impact, and time to delivery.

On October 1, 2018, S&T began a new approach to its R&D mission with a new organizational structure that will improve its ability to more rapidly transition technology capabilities into operations.The exhibit below reflects recent changes made as a result of S&T's Revitalization, and amounts for FY 2018 Enacted and FY 2019 President's Budget have been updated to reflect realignments.

RD&I Thrust Area Funding (*Dollars in Thousands*)	FY 2018 Enacted	FY 2018 Enacted / Post Revitalization	FY 2019 President's Budget	FY 2019 President's Budget / Post Revitalization	FY 2020 Request
APEX	$68,759	$0	$42,584	$0	$0
BORDER SECURITY	$75,779	$87,079	$51,854	$60,701	$59,933
CBE DEFENSE	$73,833	$75,833	$56,950	$57,641	$50,484
COUNTER TERRORIST	$85,020	$71,520	$77,051	$61,995	$57,957
CYBER SECURITY / INFORMATION ANALYSIS	$51,248	$51,248	$0	$0	$0
FIRST RESPONDER / DISASTER RESILIENCE	$114,691	$115,196	$61,294	$68,090	$72,232
INNOVATIVE RESEARCH AND FOUNDATIONAL TOOLS	$0	$68,454	$0	$41,306	$40,811
RD&I TOTAL	**$469,330**	**$469,330**	**$289,734**	**$289,734**	**$281,417**

Border Security: Border Security R&D invests in technologies and solutions to prevent the illicit movement and illegal entry or exit of people, weapons, dangerous goods, and contraband, and manage the risk posed by people and goods in transit.

Chemical, Biological, and Explosive (CBE) Defense: CBE Defense R&D invests in technologies and solutions to support prevention and protective strategies and coordinated surveillance and detection to address CBE threats.

Counter Terrorist: Counter Terrorist R&D invests in technologies, methods, and procedures to counter terrorism.

First Responder / Disaster Resilience: First Responder / Disaster Resilience R&D invests in technologies and solutions, which reduce vulnerability to key leadership, critical infrastructure, and events to terrorist attacks and other hazards. It also increases the level of preparedness of state, local, regional, tribal, and territorial partners, as well as nongovernmental organizations, the private sector, and the general public, while improving the capabilities of DHS to lead in emergency management.

Innovative Research and Foundational Tools: R&D investments in this thrust area idenitify gaps through analysis and requirements prioritization and focus on identifying and analyzing potential solutions and working with customers to select the best approach to delivering solutions, including knowledge and advice.

Research, Development, and Innovation -PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2018**	**FY 2019**	**FY 2020**
Enacted/Request	**$469,330**	**$289,734**	**$281,417**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$191,540	$192,434	$146,571
Rescissions to Current Year/Budget Year	($8,000)	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$652,870**	**$482,168**	**$427,988**
Collections – Reimbursable Resources	$41,300	$41,300	$57,800
Total Budget Resources	**$694,170**	**$523,468**	**$485,788**
Obligations (Actual/Estimates/Projections)	$501,736	$376,897	$347,335
Personnel: Positions and FTE			
Enacted/Request Positions	-	-	-
Enacted/Request FTE	-	-	-
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	-	-	-
FTE (Actual/Estimates/Projections)	-	-	-

Research, Development, and Innovation – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	**Positions**	**FTE**	**Amount**
FY 2018 Enacted	**-**	**-**	**$469,330**
FY 2019 President's Budget	**-**	**-**	**$289,734**
FY 2020 Base Budget	**-**	**-**	**$289,734**
FY 2020 Current Services	**-**	**-**	**$289,734**
Border Security	-	-	$8,078
First Responder / Disaster Resilience R&D	-	-	$10,938
Innovative Research and Foundational Tools	-	-	$40,811
Total, Program Increases	**-**	**-**	**$59,827**
Apex	-	-	($42,584)
Chemical, Biological, and Explosives (CBE) Defense R&D	-	-	($6,466)
Counter Terrorist R&D	-	-	($19,094)
Total, Program Decreases	**-**	**-**	**($68,144)**
FY 2020 Request	**-**	**-**	**$281,417**
FY 2019 To FY 2020 Change	**-**	**-**	**($8,317)**

Research, Development, and Innovation – PPA
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Research, Development and Innovation	$469,330	$289,734	$281,417	($8,317)
Total	**$469,330**	**$289,734**	**$281,417**	**($8,317)**
Discretionary - Appropriation	$469,330	$289,734	$281,417	($8,317)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$1,660	$1,025	$1,025	-
22.0 Transportation of Things	$29	$18	$18	-
23.2 Rental Payments to Others	$121	$75	$75	-
23.3 Communications, Utilities, and Misc. Charges	$3	$2	$2	-
25.1 Advisory and Assistance Services	$69,933	$43,172	$50,246	$7,074
25.2 Other Services from Non-Federal Sources	$3,065	$1,892	$1,892	-
25.3 Other Goods and Services from Federal Sources	$238,085	$146,978	$139,549	($7,429)
25.5 Research and Development Contracts	$150,301	$92,786	$84,824	($7,962)
25.7 Operation and Maintenance of Equipment	$183	$113	$113	-
26.0 Supplies and Materials	$967	$597	$597	-
31.0 Equipment	$1,897	$1,171	$1,171	-
41.0 Grants, Subsidies, and Contributions	$3,086	$1,905	$1,905	-
Total - Non Pay Object Classes	**$469,330**	**$289,734**	**$281,417**	**($8,317)**

Non Pay Cost Drivers

Leading Non Pay Cost-Drivers *Dollars in Thousands*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
Contract Support Services	$69,933	$43,172	$49,627	$6,455
Goods and Services from Federal Sources	$238,085	$146,978	$143,011	($3,967)
Research and Development Contracts	$150,301	$92,786	$90,667	($2,119)
Other Administrative Costs	$11,011	$6,798	$6,798	-
Total Non Pay Cost Drivers	**$469,330**	**$289,734**	**$290,103**	**369**

Explanation of Non Pay Cost Drivers

Contract Support Services: Costs include contract services for program and project management, studies, analyses, evaluations, and engineering in support of information technology and R&D activities. Additionally, S&T revitalization is driving costs in this category to support scientific and engineering excellence.

Goods and Services from Federal Sources: Costs include funding from other Federal Government accounts and interagency agreements for contractual services for the purchase of goods and services for jointly funded R&D projects. Additionally, S&T revitalization is driving costs in this category by consolidating projects and gaining efficiencies.

Research and Development Contracts: Costs include contracts for conduct of basic and applied research and development such as research in the areas of theoretical mathematics and basic medical, biological, physical, social, psychological, or other phenomena. Additionally, S&T revitalization is driving costs in this category by consolidating projects and gaining efficiencies.

Other Administrative Costs: These costs include travel, supplies, and equipment to support R&D contracts.

Research, Development, and Innovation-PPA
Research and Development
Technology Readiness Level Exhibit

BORDER SECURITY THRUST – DHS secures the borders, territorial waters, ports, terminals, waterways, and air, land, and sea transportation systems of the United States. S&T invests in border security research and development for technologies and solutions to prevent the illicit movement and illegal entry or exit of people, weapons, dangerous goods, and contraband, and manage the risk posed by people and goods in transit.

Immigration Services – FY 2018 Enacted: $0.0M. FY 2019 President's Budget: $0.0M. FY 2020 Request: $3.0M. This program develops technologies to enable the U.S. Citizenship and Immigration Services (USCIS) to meet their goals of (1) efficient adjudication of all applications and petitions for immigration benefits, (2) enhance the integrity of the legal immigration system, and (3) provide trusted and timely immigration, employment and identity information through a culture of efficiency and creativity.

Immigration Based Technologies

- **Problem**: USCIS has a need to introduce process and technology improvements to their adjudication of applications and petitions for immigration benefits, in order to strengthen and streamline the vetting process, thereby reducing the lengthy applicant backlog.

- **Solution**: This program enhances the ability of USCIS to efficiently adjudicate all applications and petitions for immigration benefits, take timely action on related ancillary applications and other assigned product lines, provide direct customer service, maintain the accuracy and integrity of immigration information, ensure the integrity of the immigration system and provide timely assistance to applicants, petitioners and beneficiaries. The program's goal is to make technology available to USCIS to enhance the efficiency and integrity of their immigration activities.

- **Impact:** Impacts include: (1) enhanced ability to process immigration benefit applications/petitions, (2) enhanced ability to identify fraudulent immigration applications/petitions, (3) reduced applicant backlog, (4) improved USCIS staffing efficiency, and (5) improved customer throughput and satisfaction.

FY 2019 Planned Key Milestone Events[1]

- Perform requirements analysis for technology to improve USCIS immigration services.

[1] While no funding was requested for this project in the FY 2019 President's Budget, FY 2019 activity for this program will be carried out by funding included in the FY 2019 appropriation.

FY 2020 Planned Key Milestone Events

- Conduct market research to identify areas of R&D investment to enhance the efficiency and integrity of USCIS's execution of their statutory responsibilities.
- Perform an analysis of alternatives of identified potential R&D investments to enhance the efficiency and integrity of the immigration system.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	-	$3,000
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
N/A		
FY 2019		
Perform requirements analysis for technology to improve USCIS immigration services.	FY 2019 Q2	FY 2019 Q4
FY 2020		
Conduct market research to identify areas of R&D investment to enhance the efficiency and integrity of USCIS's execution of their statutory responsibilities.	FY 2020 Q1	FY 2020 Q3
Perform an analysis of alternatives of identified potential R&D investments to enhance the efficiency and integrity of the immigration system.	FY 2020 Q2	FY 2020 Q4

Type of Research

Developmental

Technical Readiness Level

Technology Readiness Level (TRL) varies between specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

Transition to USCIS analyses, models, technology prototypes, and knowledge products to enable/enhance:

- the integrity of the immigration system
- the efficient adjudication of all applications and petitions for immigration benefits

- the ability to maintain the accuracy and integrity of immigration information
- timely assistance to applicants, petitioners and beneficiaries.

Cargo and Port of Entry (POE) Security – FY 2018 Enacted: $37.5M[2]. FY 2019 President's Budget: $15.0M. FY 2020 Request: $15.0M. This program develops technologies to ensure the integrity of cargo shipments (including sea, air, and land conveyances) and enhances the end-to-end security of the supply chain, from the manufacturer of goods to final delivery, while ensuring economic throughput for the U.S. economy. Program conducts technology foraging, technology readiness evaluations, and operational readiness assessments to inform DHS acquisition planning for more capable/lower cost biometric recognition capabilities to strengthen traveler vetting and facilitate lawful and legitimate travel. This work will reduce the risk of terrorists and transnational criminal organizations from entering the United States through the ports of entry or from manipulating cargo as it conveys across various transit modes in the international supply chain.

Opioid/Fentanyl Detection

- **Problem:** The final report of the President's Commission on Combating Drug Addiction and the Opioid Crisis recognized challenges that limit "Customs and Border Protection, United States Postal Service, and express consignment carriers' ability to detect and interdict" synthetic opioids, like fentanyl, including the high volume of mail, the ability of synthetic opioids to be shipped in very small quantities, low number of available automated detection systems and trained canines, and inadequate infrastructure. Customs and Border Protection (CBP) Office of Field Operations has identified a critical need for technologies to be able to detect opioids and fentanyls in small quantities at facilities handling international mail and parcel shipments.

- **Solution:** In coordination with CBP, S&T will develop a layered set of solutions, including both detection hardware and advanced analytics, which can be deployed rapidly within the existing operational environment to allow for efficient screening and interdiction of opioids at international mail and express consignment facilities at the speed of commerce. To enable agile and responsive support to CBP, S&T will pursue an iterative, integrated developmental approach and operational assessment. S&T will first make use of technologies, such as those used for explosives detection, and then, where technologies do not exist, employ rapid prototyping of systems to identify packages suspected of containing synthetic opioids. S&T will develop analytics to exploit available data (e.g., advanced electronic data, National Targeting Center, dark web commerce) to discover supply chain networks and augment decisions to screen certain packages. While mail and parcel shipments are the initial focus, resulting solutions may also be applicable to other environments such as air cargo processing and land border port of entry screening, among others.

[2] The FY 2018 Enacted total for Cargo and POE Security funds a project not funded in the proposed FY 2018 and FY 2019 President's Budgets ($16.1M Land Sea Cargo Screening).

- **Impact:** This program will deliver screening at speed capabilities that enable CBP to screen more packages per day (increase efficiency and reduce the manpower, time, and costs associated with the inspection process) and confidently detect the presence of synthetic opioids without exposing agents to the hazardous chemical. As a result, this program will likely increase the number of seizures/interdictions of illicit drugs, like synthetic opioids, thereby reducing the overall supply of drugs entering the United States and increasing the likelihood of successful identification of supply chain.

FY 2018 Key Milestone Events

- Obtained consensus from CBP (and/or Integrated Product Team (IPT) members) on initial set of concepts of operation and operational requirements for requested technologies.
- Delivered a report to DHS CBP and key stakeholders that characterizes the state-of-the-art for technology directly applicable to detection of opioids/fentanyls and the feasibility of implementing currently available technology.

FY 2019 Planned Key Milestone Events

- Develop proposed system architecture for opioids/fentanyls detection capability for CBP at POEs that will not unreasonably restrict flow of lawful commerce.
- Initiate rapid prototyping of high-throughput scanning and field-screening equipment.

FY 2020 Planned Key Milestone Events

- Develop transition and commercialization plans, as applicable, for technology solutions.
- Initiate advanced development of selected prototype technologies.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	-	-	$6,000	$7,000	$7,000
Obligations	-	-	$3,540	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Obtained consensus from CPB (and/or IPT members) on initial set of concepts of operation and operational requirements for requested technologies.	FY 2018 Q1	FY 2018 Q3
Delivered a report to DHS CBP and key stakeholders that characterizes the state-of-the-art for technology directly applicable to detection of opioids/fentanyls and the feasibility of implementing currently available technology.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Deliver Technology Assessment Report.	FY 2018 Q4	FY 2019 Q1
Conduct opioid threat characterization studies.	FY 2019 Q1	FY 2019 Q4
Draft test and evaluation master plan, including key system attributes and key performance parameters.	FY 2019 Q1	FY 2019 Q2
Conduct test and evaluation of existing technologies for opioid detection.	FY 2018 Q4	FY 2019 Q3
Execute open innovation prize competition for high-throughput non-intrusive screening technologies.	FY 2019 Q1	FY 2019 Q4
Develop advanced analytical tools to increase probability of detection.	FY 2019 Q1	FY 2020 Q2
Solicitation of proposals for advanced development of opioids/fentanyls detection capabilities to close identified gaps.	FY 2019 Q1	FY 2019 Q2
Define operational requirements.	FY 2019 Q1	FY 2019 Q4
Initiate rapid prototyping of high-throughput scanning and field-screening equipment.	FY 2019 Q3	FY 2019 Q4
Conduct systems engineering study (systems analysis) to develop system architecture to integrate proposed technologies into operational environment.	FY 2019 Q1	FY 2019 Q4
Develop proposed system architecture for opioids/fentanyls detection capability for CBP at POEs that will not unreasonably restrict flow of lawful commerce.	FY 2018 Q4	FY 2019 Q4
Award contracts with partner laboratories for independent test and evaluation to be completed in FY 2020.	FY 2019 Q3	FY 2019 Q4
FY 2020		
Deliver proposed system architecture for synthetic opioid detection capability for CBP at international mail facilities.	FY 2020 Q1	FY 2020 Q2
Conduct analysis of analytical tools (e.g., anomaly detection) against “real” test set.	FY 2020 Q1	FY 2020 Q4
Deliver prototype(s) of high-throughput scanning equipment for test and evaluation at partner laboratories.	FY 2020 Q1	FY 2020 Q4
Develop transition and commercialization plans, as applicable, for technology solutions.	FY 2020 Q2	FY 2020 Q4
Conduct advanced development of selected prototype technologies.	FY 2020 Q3	FY 2021 Q3
Perform limited operational evaluation of selected technologies.	FY 2020 Q3	FY 2020 Q4

Type of Research

Applied, Developmental

Technical Readiness Level

The program began at TRL 3 and will end at TRL 7.

Transition Plans

- A concept of operations and systems architecture for opioids and fentanyls detection at international mail facilities will be developed in close coordination with CBP and other critical stakeholders. From there, customized technology architectures, which may include thermal sensing, multispectral imaging, volatile organic compound detection and/or canine detection, suited to the individual operational environments and budgets will be developed utilizing commercial off the shelf/government off the shelf technology where available and investing in new technology development as necessary. S&T will execute in partnership with the primary customer, CBP OFO, and will support development of the key acquisition artifacts required upon delivery and transition of the final products.

Air Cargo Screening

- **Problem:** Air Cargo is a critical component of the Aviation Security Triad consisting of Air Cargo, Checked Baggage, and Checkpoint Baggage. Almost fifty percent of the contents in a passenger aircraft are Cargo and almost all U.S. commercial carrier passenger flights carry Air Cargo. Screening of Air Cargo is mandated by Public Law 110-52, which dictates 100% screening of air cargo on passenger aircraft and that it must be screened commensurate to the same level as checked baggage. In response to the Congressional mandate, the Transportation Security Administration (TSA) instituted the Certified Screening Facility program to screen all air cargo using TSA approved screening equipment. Since private screening companies are low margin facilities, screening equipment has to be affordable. Evolving threats pose a continual threat to passenger safety through the Air Cargo conduit.
- **Solution:** The Air Cargo program aims to (a) augment existing screening systems to support increased security in the short term, (b) develop low cost Computed Tomography (CT)-like systems, for 3D imaging of skids, and automated threat detection in the midterm, and (c) develop technologies to screen dense cargo using high penetration screening systems in the long term. The program seeks to achieve these goals in order to meet TSA capability gaps identified by close collaboration between TSA, S&T, original equipment manufacturers (OEMs) and Screening Companies.
- **Impact:** Air passenger safety remains uncompromised with the development of effective and affordable air cargo screening systems. Procurement of these systems by the Certified Cargo Screening Facilities enhances TSA's ability to maintain air cargo screening effectiveness and promptly address evolving air cargo threats.

FY 2018 Key Milestone Events

- Conducted critical design review on study to evaluate explosives trace detection vapor trace effectiveness, which was a review of the specific test design implementation and test procedure to be used to collect the study data for analysis.
- Conducted a preliminary design review for Opacity and Complexity Analysis Screening Tool (OCAST).

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- N/A

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$5,200	$7,476	$9,000	$0	$0
Obligations	$4,699	$6,609	$4,760	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conducted a preliminary design review on study to evaluate explosives trace detection vapor trace effectiveness, which was a review of the test design and methodology to be used including test articles.	FY 2018 Q1	FY 2018 Q1
Conducted critical design review on study to evaluate explosives trace detection vapor trace effectiveness, which was a review of the specific test design implementation and test procedure to be used to collect the study data for analysis.	FY 2018 Q2	FY 2018 Q2
Conducted a preliminary design review for Opacity and Complexity Analysis Screening Tool (OCAST).	FY 2018 Q1	FY 2018 Q1
Developed low cost CT-like 3D imaging PDR.	FY 2018 Q2	FY 2018 Q2
Developed Automated Operator Assist Tools, OCAST Critical Design Review.	FY 2018 Q1	FY 2018 Q4
Completed Critical Design Review of Vapor Detection of Explosives in Air Cargo.	FY 2018 Q2	FY 2018 Q2
FY 2019		
N/A		
FY 2020		
N/A		

Type of Research

Developmental

Technical Readiness Level

Low cost CT-like 3D imaging. This program began at TRL 3 and will end at TRL 6.
Develop high penetration cargo skid size screening capability Preliminary Design Review (PDR). This program began at TRL3 and will end at TRL 6.

Transition Plans

When the CT and the high penetration air cargo skid scanners reach TRL level 6 (successful developmental testing and evaluation at TSL) the products would be available to TSA for certification testing. On successful certification the TSA will place these products on the Air Cargo Screening Technology List (ACSTL). This will then allow the Certified Cargo Screening Facilities to procure and use these products.

People Screening

- **Problem:** Increases in international travel have strained CBP resources, resulting in increased wait times and delays for passengers to clear Federal Inspection Service (FIS) areas. CBP needs to introduce process and technology improvements to traveler inspection operations in order to strengthen traveler vetting and facilitate lawful and legitimate travel.

- **Solution:** Conduct technology foraging, technology readiness evaluations, and operational readiness assessments to inform DHS acquisition planning for more capable/lower cost biometric recognition capabilities to strengthen traveler vetting and facilitate lawful and legitimate travel. Evaluate accuracy and effectiveness of technologies for automatic monitoring of the flow of travelers throughout the FIS area.

- **Impact:** Impacts include (1) enhanced traveler identification validation, (2) enhanced operations by validating emerging biometric technologies for multiple CBP processes (e.g., Global Entry, FIS Entry), (3) informed DHS acquisition of secure, cost-effective technologies, (4) improved CBP staffing efficiency, and (5) improved traveler throughput and satisfaction.

FY 2018 Key Milestone Events

- Conducted operational readiness assessments of contact/non-contact fingerprint, face, and iris biometric recognition capabilities.
- Performed Rapid Usability Assessment of wearable systems to inform potential CBP Concepts of Operation and acquisition planning of emerging technologies to support more flexible and scalable traveler inspections (Pre-Clearance Technology).

FY 2019 Planned Key Milestone Events

- Develop next generation Face Recognition, Iris recognition, Fingerprint recognition collection device and matching algorithms operational readiness assessments final report for biometrics technology refresh.
- Develop Concept of Operations (CONOPS) to enhance traveler identification validation and operations in support of CBP Flexible Facilitation.

FY 2020 Planned Key Milestone Events

- Evaluate technical feasibility of repurposing commercially available Internet of Things (IoT) sensors, wearable technologies, and machine learning to improve operational measurement accuracy, precision, and reliability as well as officer situational awareness.
- Conduct Laboratory Evaluations and support CBP-led Operational readiness evaluations of Face Recognition Technologies for Air and Land Pedestrian Ports of Entry.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	$5,850	$5,850	$3,544	$3,543
Obligations	-	$4,855	$5,308	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conducted operational readiness assessments of contact/non-contact fingerprint, face, and iris biometric recognition capabilities.	FY 2017 Q4	FY 2018 Q3
Developed Global Entry Operational Readiness Assessment Report.	FY 2017 Q2	FY 2018 Q2
Developed Business Case Analysis Report for Counting and Measuring to support CBP acquisition planning.	FY 2018 Q2	FY 2018 Q4
Developed Enhanced Modified Egress Process Assessment Report to inform CBP acquisition decisions.	FY 2018 Q1	FY 2018 Q4
Performed Rapid Usability Assessment of wearable systems to inform potential CBP Concepts of Operation and acquisition planning of emerging technologies to support more flexible and scalable traveler inspections (Pre-Clearance Technology).	FY 2018 Q1	FY 2018 Q2
Delivered Technology Scouting Report on Mobile Device Geolocation for Land Border Entry/Exit.	FY 2017 Q2	FY 2018 Q1
Conducted facial recognition Operational Readiness Assessment.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Develop next generation Face Recognition, Iris recognition, Fingerprint recognition collection device and matching algorithms operational readiness assessments final report for biometrics technology refresh.	FY 2019 Q1	FY 2019 Q4
Develop an interface control document to enable airport, airlines, and DHS to share counting and measuring and traveler wayfinding data between parties.	FY 2019 Q1	FY 2019 Q4
Develop CONOPS to enhance traveler identification validation and operations in support of CBP Flexible Facilitation.	FY 2019 Q1	FY 2019 Q3
Develop Face and Multi-Biometric Recognition Deep Learning Technical Feasibility Report.	FY 2019 Q1	FY 2019 Q2
FY 2020		
Develop assessment methods to evaluate integrated multi-biometrics collection and matching technologies to determine operational readiness for CBP traveler verification operations.	FY 2020 Q1	FY 2020 Q3
Evaluate technical feasibility of repurposing commercially available IoT sensors, wearable technologies, and machine learning to improve operational measurement accuracy, precision, and reliability as well as officer situational awareness.	FY 2020 Q1	FY 2020 Q4
Conduct Laboratory Evaluations and support CBP-led Operational readiness evaluations of Face Recognition Technologies for Air and Land Pedestrian Ports of Entry.	FY 2020 Q2	FY 2020 Q4

Type of Research

Applied/Developmental

Technical Readiness Level

The program begins at TRL 3 and ends at TRL 7.

Transition Plans

- All analyses, models, technology prototypes, and knowledge products will be transitioned to CBP. Select work products may also be shared with airlines, airports, and other travel industry stakeholders to facilitate adoption and integration into aviation operations. Products include all operational assessment reports and business case documentation for follow-on CBP acquisition and/or sustainment to include Business Case Analysis and foundational acquisition documentation.

POE Forensics and Investigations

- **Problem:** CBP and Immigration and Customs Enforcement (ICE) has limited capabilities to collect and analyze available data to perform law enforcement investigations, limiting the ability to support the prosecution of illegal activity.

- **Solution:** This program enhances the ability of DHS components to share, query, and analyze law enforcement information/data, enabling law enforcement investigations (e.g., human trafficking, child exploitation, illegal immigration, movement of contraband). The program's goal is to make actionable law enforcement data available to ICE agents to enhance the investigation, interdiction and prosecution of illegal activity.

- **Impact:** Impacts include (1) enhanced ability to investigate illegal activity (e.g. human trafficking, child exploitation, illegal immigration, movement of contraband), (2) increased arrests and prosecution of individuals involved in illegal activity, and (3) save thousands of CBP/ICE labor hours.

FY 2018 Key Milestone Events

- Conducted requirements study to determine areas of R&D investment to enhance ICE's ability to track specific commodities through the global supply chain to support the investigation of illegal activity.
- Conducted requirements study to determine areas of R&D investment to enhance ICE's Law Enforcement investigation capability.

FY 2019 Planned Key Milestone Events

- Expand Igloo mission capabilities to additional ICE HSI Field Offices.
- Create Technology Roadmap and analyze alternative areas of R&D investment to enhance ICE's Law Enforcement (LE) investigation capability.

FY 2020 Planned Key Milestone Events

- Perform operational assessment of developed Igloo Analytics technology/techniques.
- Perform operational assessment of enabling technology/techniques developed to assist LE Investigations.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018[3]	FY 2019	FY 2020
Project Funding	-	-	$500	$2,000	$2,000
Obligations	-	-	$4,817	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Automated Igloo Data Ingestion and Management. Igloo is a software tool that provides ICE the capability to analyze and correlate large data sets to identify illegal activity.	FY 2018 Q1	FY 2018 Q4
Expanded Pollen database to include regions of interest to CBP.	FY 2018 Q1	FY 2018 Q4
Conducted requirements study to determine areas of R&D investment to enhance ICE's ability to track specific commodities through the global supply chain to support the investigation of illegal activity.	FY 2018 Q1	FY 2018 Q4
Conducted requirements study to determine areas of R&D investment to enhance ICE's Law Enforcement investigation capability.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Expand Igloo mission capabilities to additional ICE HSI Field Offices.	FY 2019 Q1	FY 2019 Q4
Create Technology Roadmap and analyze alternative areas of R&D investment to enhance ICE's Law Enforcement investigation capability.	FY 2018 Q4	FY 2019 Q2
FY 2020		
Perform operational assessment of developed Igloo Analytics technology/techniques.	FY 2020 Q1	FY 2020 Q4
Perform operational assessment of enabling technology/techniques developed to assist LE Investigations.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied/Developmental

Technical Readiness Level

TRL varies between specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

- Transitioned to CBP (1) an in-house capability for pollen sample collection, preparation, analysis, and storage, (2) a robust regional pollen database, and (3) compiled reference material on the geographic distribution of pollen.
- Transition Igloo to ICE. Transition to include Igloo software, User Guide and Interface Manual.

[3] Obligations exceed Project Funding level due to funding realignments during project execution.

- Transition to ICE tools/techniques to enhance their law enforcement investigation capability.

POE Based Technologies

- **Problem:** CBP's non-intrusive cargo scanning systems are reaching the end of their service life and are exhibiting reduced performance and rising maintenance costs. Non-Intrusive Inspection (NII) systems are using technology that needs to be refreshed to maintain parity with the threat. Moreover, the volume of inbound goods passing through the POEs is projected to increase from year to year while CBP manpower will not be increased proportionately. As such, new or improved technology and technical studies can be a force multiplier or enabler to help address these challenges.

- **Solution:** This program develops software and hardware upgrades for legacy cargo scanning units to enhance their detection performance, extend their service life, and expand the range of detectable threats. This program is developing a common workstation that interfaces with disparate NII systems along with a wireless communications infrastructure to support data sharing, workload load sharing, and rapid info exchange.

- **Impact:** Impacts include: (1) dramatic increase in interdiction rates without additional staffing, (2) increase in the speed of commerce (greater/faster throughput), and (3) improved resource loading providing a significant increase in efficiency.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- Conduct POE demonstration of Common Viewer Workstation.
- Conduct assessment of technology for improved NII performance.

FY 2020 Planned Key Milestone Events

- Perform operational assessment of technology/techniques developed under the Improve Performance of NII Detectors and/or Sources project.
- Identify and analyze alternative technologies to incorporate into the Through Wall / Floor Void Detection device.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	$2,453	$2,453
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
N/A		
FY 2019		
Conduct POE demonstration of Common Viewer Workstation.	FY 2019 Q1	FY 2019 Q4
Conduct assessment of technology for improved NII performance.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Perform operational assessment of technology/techniques developed under the Improve Performance of NII Detectors and/or Sources project.	FY 2020 Q1	FY 2020 Q4
Identify and analyze alternative technologies to incorporate into the Through Wall / Floor Void Detection device.	FY 2020 Q1	FY 2020 Q3

Type of Research

Developmental

Technical Readiness Level

TRL varies between specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

- Delivered to CBP an Automated Targeting System (ATS)-integrated cargo trend analysis and anomaly detection capability.
- Deliver Common Viewer Workstation prototype to a POE.
- Deliver Through the Wall/Floor Detection System prototype to CBP.

Land Border Security – FY 2018 Enacted: $33.1M. FY 2019 President's Budget: $29.7M. FY 2020 Request: $25.4M. This program develops and transitions technical capabilities that strengthen U.S. land border security by safeguarding lawful trade and travel and by helping to prevent goods and people from crossing the border illegally between the Ports of Entry (POEs).

Border Situational Awareness (BSA)

- **Problem:** CBP and partner law enforcement agencies (Federal, state, local, tribal, and international) need improved situational awareness to more effectively and efficiently deploy their resources to the areas of highest risk.

- **Solution:** The program will improve border situational awareness by establishing an enterprise capability to (1) access more data sources, (2) make available decision support tools to translate the data into actionable information and intelligence, and (3) share that actionable information and intelligence with partner law enforcement agencies. The solution will be rolled-out in 3 phases or "Spirals":
  - Spiral 1 - focused on establishing enterprise information sharing capabilities for CBP.
  - Spiral 2 - focused on improving tactical response capabilities for CBP.
  - Spiral 3 - focused on providing strategic planning capabilities for CBP.

- **Impact:** The BSA program will enable the HSE to achieve increased border situational awareness leading to increased border incursion detection, interdictions, and deterrence.

FY 2018 Key Milestone Events
- Performed integration and developmental testing of selected Spiral 2 solutions.
- Conducted pilot of Spiral 2 of the BSA project focused on improving tactical response for CBP.

FY 2019 Planned Key Milestone Events
- Initiate transition of selected Spiral 2 technologies into existing CBP system baseline, focused on improving tactical response.
- Perform integration and developmental testing of selected Spiral 3 solutions; focused on improving strategic planning for CBP.

FY 2020 Planned Key Milestone Events
- Conduct pilot of Spiral 3 of the BSA project focused on improving strategic planning for CBP.
- Initiate transition of selected Spiral 3 technologies into existing CBP system baseline, focused on improving strategic planning for CBP.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	$8,794	$9,279	$5,800	$2,347	$1,079
Obligations	$7,787	$8,496	$3,103	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Performed integration and developmental testing of selected Spiral 2 solutions.	FY 2017 Q3	FY 2018 Q2
Conducted pilot of Spiral 2 of the BSA project focused on improving tactical response for CBP.	FY 2018 Q3	FY 2018 Q4
FY 2019		
Initiate transition of selected Spiral 2 technologies into existing CBP system baseline, focused on improving tactical response.	FY 2019 Q1	FY 2019 Q3
Perform integration and developmental testing of selected Spiral 3 solutions; focused on improving strategic planning for CBP.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Conduct pilot of Spiral 3 of the BSA project focused on improving strategic planning for CBP.	FY 2020 Q1	FY 2020 Q2
Initiate transition of selected Spiral 3 technologies into existing CBP system baseline, focused on improving strategic planning for CBP.	FY 2020 Q3	FY 2020 Q4

Type of Research

Developmental

Technical Readiness Level

The program began TRL 5 in FY 2017 or higher (multiple technologies are being pursued) and will end at TRL 7 in FY 2021.

Transition Plans

- Transition strategy is to work with existing systems to pilot new technologies which are adopted into those system baselines following transition as part of existing planned "tech refresh" activities, while also working with existing tactical technology programs to provide requirements, which inform their existing planned acquisitions. Specifics activities to execute the transition strategy include:
  - Pilot integrated enterprise proof-of-concept situational awareness capabilities at select border locations.
  - Establish operational utility and prove cost/benefit of situational awareness capabilities.
  - Enhance situational awareness capabilities based on user-defined operational needs and field analysis.
  - Demonstrate enterprise level initial operating capability and transition to CBP.
  - Assist CBP in implementing enterprise level full operating capability.
- Transition to operational use successes have already been achieved during Spiral 1 (concluded in FY 2018) with additional (Spiral 2) transition on schedule for early FY 2020:
  - Capability Gap Analysis Process Webtool to United States Border Patrol (USBP) (initial operational capability)
  - Border Security Operations Modeling, San Diego Detention Center to USBP (initial operational capability)
  - Team Awareness Kit (TAK) to ICE (initial operational capability)
  - Team Awareness Kit (TAK) to USBP (initial operational capability)

- Team Awareness Kit (TAK) to CBP Air and Marine Operations (AMO) (initial operational capability)
- Team Awareness Kit (TAK) to United States Secret Service (USSS) (initial operational capability)
- Team Awareness Kit (TAK) to United States Coast Guard (USCG) (initial operational capability)

Air Based Technologies

- **Problem:** Airborne sensors, including unmanned aircraft systems (UAS) mounted sensors, have dramatically increased in capability in recent years and offer substantial opportunities to support the missions of the HSE in the domains of border protection, law enforcement, firefighting, emergency medical services, emergency management, and search and rescue. ICE, CBP, USCG and first responders need to understand the utility of state-of-the-art airborne sensors to improve domain awareness in both land and maritime scenarios.

- **Solution:** The program will perform R&D to enhance/enable the utilization of airborne sensors by the HSE to improve domain awareness in both land and maritime scenarios. The project is divided into three initiatives: (1) demonstration and evaluation of platforms and sensor packages against operational needs, (2) exercises to demonstrate and analyze the integration of airborne sensors/UAS into operational environments and (3) behavioral research into the public acceptability of UAS in relation to such issues as privacy protection and safety.

- **Impact:** ICE, CBP, USCG and first responders at the local, county and state levels will be able to invest cost-effectively in airborne sensors, UAS platforms and ground control equipment that meet mission needs. They will be able to invest in systems that integrate into their ongoing operations and are also acceptable to public opinion, privacy concerns and safety issues.

FY 2018 Key Milestone Events

- Built prototype Mission Management system.
- Conducted Robotic Aircraft Sensor Program event at the new DHS Common UAS Site.

FY 2019 Planned Key Milestone Events

- Transition Mission Management System.
- Conduct market research and assess technical feasibility of technologies for use in conjunction with CBP Air and Marine Operations's (AMO) Air Domain Awareness mission.

FY 2020 Planned Key Milestone Events

- Perform operational assessment of identified sUAS Sensors.
- Perform operational assessment of identified technology to improve CBP-AMO's Air Domain Awareness.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$1,468	$7,173	$6,879	$6,879	$6,850
Obligations	$325	$6,241	$6,118	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Built prototype Mission Management system.	FY 2017 Q3	FY 2018 Q1
Deployed/Demonstrated/Tested Mission Management System prototype.	FY 2018 Q1	FY 2018 Q4
Conducted Robotic Aircraft Sensor Program event at the new DHS Common UAS Site.	FY 2018 Q1	FY 2018 Q3
Conducted Requirements Analysis for CBP-AMO's Air Domain Awareness mission.	FY 2018 Q1	FY 2018 Q4
Developed and prioritized a list of test scenarios for the First Responder Mission at the FRROST Focus Group.	FY 2018 Q3	Ongoing
FY 2019		
Transition Mission Management System.	FY 2018 Q4	FY 2019 Q3
Develop communication system that fits on a sUAS.	FY 2018 Q2	FY 2019 Q4
Conduct market research and assess technical feasibility of technologies for use in conjunction with CBP-AMO's Air Domain Awareness mission.	FY 2019 Q1	FY 2019 Q4
Conduct Disaster Response/Public Safety UAS Exercises.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Perform operational assessment of identified sUAS Sensors.	FY 2020 Q1	FY 2020 Q4
Perform operational assessment of identified technology to improve CBP-AMO’s Air Domain Awareness.	FY 2020 Q2	FY 2020 Q4

Type of Research

Developmental/Applied

Technical Readiness Level

TRL varies for specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

- Deliver to CBP and USCG a Mission Management system including performance, procurement, and integration data; and communications capability on sUAS to enable/enhance the utilization of sUAS in border security operations.
- Deliver to CBP-AMO capabilities to enable and enhance AMO's Air Domain Awareness mission and inform CBP acquisition decisions.

Deliverables to include performance, procurement, and integration data.
- The project's demonstration, test and evaluation results and associated analyses will be made available to DHS components, first responder and emergency management service organizations at all levels.
- Directly involve components and first responder organizations in exercises to increase their knowledge and experience with UAS.

Ground Based Technologies

- **Problem:** DHS components lack or have limited capability to reliably and accurately detect, identify, classify, track, and interdict illegal activity on the land borders between the POEs.

- **Solution:** The program is partnering with CBP and ICE to identify, develop, and transition innovative technologies that can be leveraged to enhance land border security between the POEs and improve agent safety. Transitions will include providing the technical data and/or pilot systems necessary to allow the operational components to enter into acquisition programs to operationalize the capabilities.

- **Impact:** Impacts include: (1) enhanced domain awareness, (2) increased detection of illicit border activity, (3) additional data available to support CBP and ICE Homeland Security Investigations (HSI) intelligence and investigations, (4) increased interdiction of illicit border activity, (5) enhanced officer safety, and (6) enhanced effectiveness of field agents/officers while carrying out their duties.

FY 2018 Key Milestone Events
- Conducted market research and assess technical feasibility of technologies for use in conjunction with the Border Wall as part of Border Research in Instrumented Construction (BRIC) effort.
- Developed Android Team Awareness Kit (ATAK) as a federated enterprise service providing handheld information sharing between agents in the field greatly enhancing shared tactical situational awareness.

FY 2019 Planned Key Milestone Events
- Conduct market study of automated scene understanding technologiesland automated scene understanding (LASU).
- Conduct verification testing for deployment of ATAK as a federated enterprise service in accredited environment (Agent Situational Awareness Handheld).

FY 2020 Planned Key Milestone Events
- Conduct "plugfest" of commercial "scene understanding" solutions on standards compliant CBP sensor data (LASU).
- Transition ATAK as a federated enterprise service capability (Agent Situational Awareness Handheld).

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$7,261	$8,200	$15,700	$15,729	$13,429
Obligations	$6,599	$5,772	$6,966	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conducted Border Wall technology requirements analysis for BRIC effort.	FY 2017 Q4	FY 2018 Q1
Conducted market research and assess technical feasibility of technologies for use in conjunction with the Border Wall.	FY 2018 Q1	FY 2018 Q4
Install Northern Border Fiber Optic Distributed Sensing System Pilot.	FY 2018 Q1	FY 2019 Q4
Conducted a Design Review of method to capture and distribute video and audio to improve situational awareness.	FY 2018 Q1	FY 2018 Q2
Identified and analyzed alternative methods for capturing encrypted interactions between field agents/confidential informants and suspects.	FY 2018 Q1	FY 2018 Q4
Conducted Video Evidence Collection and Distribution requirements study for analysis of Covert Video Network.	FY 2018 Q1	FY 2018 Q2
Conduct multi-season Test and Evaluation for Tri-Axial Acoustic Sensor Units.	FY 2017 Q3	FY 2019 Q3
Developed ATAK as a federated enterprise service (Agent Situational Awareness Handheld).	FY 2018 Q1	FY 2018 Q3
Demonstrated Mobile Surveillance Capability ability to output data in standards based format, which is ingested by other CBP systems in an operational environment (LASU).	FY 2018 Q1	FY 2018 Q2
Demonstrated coastal surveillance sensors ability to output data in standards based format, which is ingested by other CBP systems in an operational environment (LASU).	FY 2018 Q1	FY 2018 Q4
Provided ability for CBP and USCG to restrict and enable individuals to view data based on user entitlements stored by DHS headquarters within Homeland Security Information Network (HSIN).	FY 2018 Q1	FY 2019 Q2
Developed a Secure Audio/Video Rebroadcasting (SAVR) system prototype to enable authorized users to access video and audio from existing surveillance systems, and rebroadcast for use by authorized users	FY 2017 Q3	FY 2018 Q4
Published Information System Design Document and Interface Control Documents (version 1) to enable third party development of enterprise operational information services and applications.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Deploy, test and assess efficacy of prototype technologies for use in conjunction with the Border Wall.	FY 2019 Q1	FY 2019 Q4
Plan and conduct BACIS domain agnostic test event.	FY 2019 Q1	FY 2019 Q4
Develop prototype and assess ability to exchange tactical metadata to improve situational awareness.	FY 2019 Q1	FY 2019 Q4
Conduct verification testing for deployment of ATAK as a federated enterprise service in accredited environment (Agent Situational Awareness Handheld)	FY 2019 Q1	FY 2019 Q3
Conduct market study of automated scene understanding technologies (LASU).	FY 2018 Q3	FY 2019 Q1
Develop woodlands and waterways ground sensor prototype capability.	FY 2019 Q1	FY 2019 Q4

Research and Development Description	Plan Start Date	Planned Completion
Evaluate SAVR system in ICE HSI operational environment.	FY 2019 Q1	FY 2019 Q2
FY 2020		
Perform operational assessment of technologies/techniques identified or developed under the Border Research in Instrumented Construction (BRIC) project.	FY 2020 Q3	FY 2020 Q4
Transition ATAK as a federated enterprise service capability (Agent Situational Awareness Handheld).	FY 2020 Q1	FY 2020 Q3
Perform operational assessment of woodlands and waterways ground sensor technology prototype.	FY 2020 Q2	FY 2021 Q2
Conduct "plugfest" of commercial "scene understanding" solutions on standards compliant CBP sensor data (LASU).	FY 2020 Q3	FY 2020 Q4
Integrate and demonstrate tactical information sharing and interoperability of DHS operational systems (BACIS).	FY 2020 Q1	FY 2020 Q4
Transition Secure Audio/Video Rebroadcasting (SAVR) system to ICE-HSI	FY 2019 Q3	FY 2020 Q2

Type of Research

Developmental

Technical Readiness Level

TRL varies for specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

- Transition Fiber-Optic Distributed Sensing to CBP to provide high probability of detection and enhance classification capability to discriminate between humans, animals, vehicles, and aircraft without the use of imagers.
- Transition Slash CameraPole technology to improve CBP's ability to detect and classify illegal border incursions.
- Transition Border Wall situational awareness capabilities to CBP.
- Transition sensor technology to CBP to improve the detection and tracking of illegal border activity.
- Transition analyses, technology prototypes, and knowledge products to ICE to support future request for proposals for enhancing their video surveillance capabilities.
- Transition to CBP the capability to translate data from surveillance sensors to facilitate target identification through automatic detection of possible illicit behavior (LASU).
- Transition to DHS operational Components a handheld geospatial tool to provide access to situational awareness data and collaborate in real-time.
- Transition to DHS operational Components enhanced personal protection equipment and improved tools to more effectively execute their duties.
- Transition SAVR system to ICE HSI.

Tunnel Detection and Surveillance

- **Problem:** CBP and ICE have a limited capability to (1) reliably detect cross-border tunnels, (2) investigate discovered tunnels without putting an agent in the tunnel and (3) perform forensic analysis of the discovered tunnel to support investigations and prosecutions.

- **Solution:** Program is conducting market research, modeling and simulations, and operational experiments (Op Ex) to enhance USBP's knowledge of the state of technology modalities to detect, exploit and seal cross-border dug tunnels. Program will conduct technology assessments to investigate the ability to detect tunnels under varying environmental conditions and collect and analyze samples from discovered tunnels to enable investigations/prosecutions.

- **Impact:** Impacts include: (1) technical risk reduction to future activities of CBP's Cross Border Tunnel Threat (CBTT) program of record, (2) increased ability to investigate/exploit discovered tunnels safely, (3) increased arrests and prosecution of individuals involved in the creation/use of tunnels, (4) reduction of hundreds of tons of drugs kept off U.S. streets, and (5) savings of thousands of CBP and ICE labor hours.

FY 2018 Key Milestone Events

- Planned field test and evaluation of tunnel robot technologies with ICE.

FY 2019 Planned Key Milestone Events

- Perform analysis of tunnel detection technology that is commercially available or under development by other government agencies.

FY 2020 Planned Key Milestone Events

- Pilot/test tunnel detection technology that is commercially available or under development by other government agencies.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$4,119	$4,300	$4,700	$4,700	$4,000
Obligations	$4,027	$3,256	$3,181	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Plan and field test operational prototype Tunnel Detection system with CBP.	FY 2018 Q1	FY 2018 Q4
Planned field test and evaluation of tunnel robot technologies with ICE.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Perform analysis of tunnel detection technology that is commercially available or under development by other government agencies.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Pilot/test tunnel detection technology that is commercially available or under development by other government agencies.	FY 2020 Q1	FY 2020 Q4

Type of Research

Developmental

Technical Readiness Level

TRL varies for specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

- Delivered to CBP a Sensor Performance Tool and Guidebook to inform which sensor types work best in the various border locations and the confidence level using each.
- Conducted developmental testing of a prototype of a new tunnel detection system.
- Deliver to CBP an analysis of tunnel detection technology that is commercially available or under development by other government agencies.
- Deliver to CBP test reports following the piloting/testing of tunnel detection technology that is commercially available or under development by other government agencies to inform CBP acquisitions.

Maritime Border Security – FY 2018 Enacted: $16.6M. FY 2019 President's Budget: $16.1M. FY 2020 Request: $16.6M. This program develops and transitions technical capabilities that enhance U.S. maritime border security by safeguarding lawful trade and travel and helps to prevent illegal use of the maritime environment to transport illicit goods or people.

Port and Coastal Surveillance

- **Problem:** USCG and CBP require enhanced operational capabilities to improve Maritime Domain Awareness and enhance their ability to detect, deter, interdict and investigate illegal maritime activity.

- **Solution:** The program is partnering with USCG and CBP to identify, develop and transition technology that can be leveraged to improve Maritime Domain Awareness and enhance their ability to detect, deter, interdict and investigate illegal maritime activity. Transitions will include providing the technical data necessary to allow the operational component to enter into an acquisition to operationalize the capability.

- **Impact:** Impacts include: (1) enhanced Maritime Domain Awareness, (2) increased detections of illicit activity, (3) increased interdictions of illicit activity, and (4) increased efficiency/effectiveness/safety of personnel and equipment involved in maritime interdiction operations.

FY 2018 Key Milestone Events

- Completed Integrated Maritime Domain Enterprise-Coastal Surveillance System (IMDE-CSS) Operational Demonstration.
- Assessed the impact of using commercial space-based imagery for maritime surveillance operations.

FY 2019 Planned Key Milestone Events

- Transition selected IMDE and CSS prototype capabilities to DHS Operational Components and DHS Office of the Chief Information Officer (OCIO) for further development and integration into operations.
- Demonstrate ability of space-based technology to enhance Maritime Domain Awareness.

FY 2020 Planned Key Milestone Events

- Complete IMDE-CSS Prototype transition into operations and sustainment in support of operational missions.
- Assess use of space-based capabilities to enhance Maritime Domain Awareness.

Overall Project Funding

(Dollars in Thousands)	**FY 2016[4]**	**FY 2017[5]**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	$6,866	$10,500	$8,750	$8,750	$9,279
Obligations	$6,889	$11,049	$6,078	-	-

[4] Obligations exceed Project Funding level due to funding realignments during project execution.
[5] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Completed IMDE-CSS Operational Demonstration.	FY 2018 Q1	FY 2018 Q4
Planned and executed IMDE-CSS Operational Assessment.	FY 2018 Q1	FY 2018 Q4
Assessed the impact of using commercial space based imagery for maritime surveillance operations.	FY 2018 Q1	FY 2018 Q4
Performed broad analysis of alternatives for Maritime Domain Awareness.	FY 2017 Q2	FY 2018 Q4
Performed Maritime Domain Awareness analysis of alternatives for Dark Vessel Detection.	FY 2018 Q1	FY 2018 Q4
Performed Great Lakes sensor survey of Federally-owned maritime sensors for Dark Vessel Detection.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Transition selected IMDE and CSS prototype capabilities to DHS Operational Components and DHS OCIO for further development and integration into operations.	FY 2018 Q4	FY 2019 Q4
Perform technical testing of select capabilities identified in the Maritime Domain Awareness analysis of alternatives against dark vessels in relevant areas of responsibilities.	FY 2018 Q4	FY 2019 Q4
Demonstrate ability of space-based technology concept to enhance Maritime Domain Awareness.	FY 2018 Q2	FY 2019 Q4
FY 2020		
Complete IMDE-CSS Prototype transition into operations and sustainment in support of operational missions.	FY 2020 Q1	FY 2020 Q4
Assess use of space-based capabilities to enhance Maritime Domain Awareness.	FY 2018 Q1	FY 2020 Q4
Perform operationally relevant testing and assessment of select capabilities identified in the Maritime Domain Awareness analysis of alternatives against dark vessels in relevant areas of responsibilities.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied/Developmental

Technical Readiness Level

TRL varies for specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

- IMDE – Deliver to DHS HQ or DHS Component(s) a compliant reference segment architecture integration platform for agile information sharing and discovery.
- CSS – Deliver to DHS Components a prototype coastal maritime sensor fusion system that enables cooperative maritime awareness of non-emitting vessels and the sharing of that time-critical, mission-useful sensor information between DHS Components including USCG and CBP and state, local and regional partners.

- Deliver to CBP and USCG recommendations to use space-based imagery in support of Maritime Domain Awareness, including maritime surveillance operations.
- Inform CBP and USCG acquisition strategies for the deployment of a dark vessel detection capability.
- Deliver to the USCG tools and techniques developed or assessed by the USCG-S&T Innovation Center that improve the effectiveness of USCG operations.

Remote Maritime Technologies (formerly Arctic Communications and Technologies)

- **Problem:** DHS lacks technologies in the Arctic and other remote maritime regions to enable effective execution of its law enforcement, regulatory and security missions. Effective execution of these missions requires effective intelligence, communications and analytics for these remote maritime regions. Existing Intelligence, Surveillance and Reconnaissance (ISR) capabilities do not provide for the time sensitive timelines required to execute most DHS missions in the maritime environment; existing ISR systems do not couple the detection and location of electronic emissions from "dark" vessels with imagery capabilities to identify those suspect vessels and disseminate collected information in real time. Additionally, analytics to detect and identify "dark" vessel activity lack necessary data to effectively perform analytics; new methods of generating data to identify maritime vessels, which operate "dark", or in manners which conceal their illicit operations are necessary.

- **Solution:** The program is performing R&D to: 1) leverage and integrate emerging space capabilities to detect electronic emissions from elicit activities, immediately cue imaging systems and provide real time relay of collected data to appropriate intelligence or operational centers for action; 2) develop new methods for generating data on dark vessels or vessels employing means of concealing their illicit activities; these data sources will leverage commercial and government-owned systems; and 3) repurpose existing analytic tools to provide analytics able to identify patterns of life, illicit behaviors and/or activities.

- **Impact:** Impacts include: 1) the ability to obtain near real time detection and identification of known or suspected illicit activities in the Arctic and other remote regions in timeframes that enable the conduct of time dominant operations; 2) improved ability to detect, identify and track dark vessels through the delivery of new data sources provided directly to DHS components; and 3) real time analytics performed at scale to identify dark vessels, patterns of life and illicit behaviors and/or activities.

FY 2018 Key Milestone Events

- Conducted limited Demonstration of Advanced Sensor Analytics Project.
- Performed analysis of alternatives for Arctic Communications.

FY 2019 Planned Key Milestone Events

- Perform evaluation of algorithms to detect dark vessels using commercial and intelligence community imagery systems.
- Conduct On-Orbit test and evaluation of space-based technologies to support Arctic missions.

FY 2020 Planned Key Milestone Events

- Perform operational assessment of dark vessel detection algorithms in the Arctic or other remote maritime environment(s).
- Deliver technical and cost analysis following On-Orbit Test and Evaluation (T&E) of space-based technologies to support Arctic missions.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017[6]	FY 2018[7]	FY 2019	FY 2020
Project Funding	-	$1,000	$6,800	$6,300	$6,300
Obligations	-	$2,758	$7,152	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conducted limited demonstration of Advanced Sensor Analytics Project.	FY 2017 Q2	FY 2018 Q3
Performed an Analysis of Alternatives for Arctic Communications.	FY 2017 Q4	FY 2018 Q4
FY 2019		
Perform multi-intelligence source demonstration of DHS DataHub analytics.	FY 2019 Q2	FY 2020 Q2
Perform evaluation of algorithms to detect dark vessels using commercial and intelligence community imagery systems.	FY 2019 Q1	FY 2019 Q4
Conduct On-Orbit test and evaluation of space-based technologies to support Arctic missions.	FY 2019 Q1	FY 2019 Q3
FY 2020		
Perform operational assessment of technology/techniques developed under the Adaptive Sensor Analytics Project.	FY 2020 Q3	FY 2021 Q3
Perform operational assessment of dark vessel detection algorithms in the Arctic or other remote maritime environment(s).	FY 2020 Q1	FY 2020 Q3
Deliver technical and cost analysis following On-Orbit T&E of space-based technologies to support Arctic missions.	FY 2020 Q1	FY 2020 Q2

Type of Research

Developmental

Technical Readiness Level

Began at TRL 6 and completes at TRL 7.

[6] Obligations exceed Project Funding level due to funding realignments during project execution.
[7] Obligations exceed Project Funding level due to funding realignments during project execution.

Transition Plans

- The program will inform a DHS acquisition strategy for the deployment of a remote maritime/Arctic Maritime Domain Awareness capability and communications capability.
- Analytic capabilities developed will transition to become enterprise systems.

Port and Waterway Resiliency

- **Problem:** The USCG has limited computer-based tools to efficiently and effectively conduct port or waterway health assessments, analyze the condition of ports or waterways after incidents or disasters, and develop risk-based approaches for mitigation, response and recovery.

- **Solution:** The program is developing and transitioning port and waterway resiliency analytical visualization tools, data, and technologies to provide USCG waterway managers with more effective and user-friendly capabilities to prepare for, mitigate, respond to, and recover from an incident or disaster affecting the Maritime Transportation System.

- **Impact:** Impacts include: (1) enhanced safety and economic security of maritime ports and waterways, (2) improved situational awareness and understanding of waterway criticality, and (3) enabled decision-making for more efficient/effective resource allocation to keep ports and waterways open.

FY 2018 Key Milestone Events

- Developed prototype computer-based analytical tool to provide USCG with a more effective capability to monitor Aids to Navigation (ATON).

FY 2019 Planned Key Milestone Events

- Develop Waterways Analysis and Management System (WAMS) modules.

FY 2020 Planned Key Milestone Events

- Develop and assess WAMS modules.
- Deliver WAMS modules to USCG.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	-	$1,000	$1,000	$1,000	$1,000
Obligations	-	$204	$911	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Developed prototype analytical tool to monitor ATON.	FY 2017 Q4	FY 2018 Q4
FY 2019		
Develop WAMS modules.	FY 2018 Q4	FY 2019 Q4
FY 2020		
Develop and assess WAMS modules.	FY 2019 Q1	FY 2020 Q4
Deliver WAMS modules to USCG.	FY 2019 Q3	FY 2020 Q4

Type of Research

Applied/Developmental

Technical Readiness Level

Began at TRL 4 and completes at TRL 7.

Transition Plans

- S&T plans to transition and integrate software into an existing program of record under the sponsorship of USCG Marine Transportation Systems Directorate (CG-5PW). Knowledge products will inform USCG acquisition strategies.

CHEMICAL, BIOLOGICAL, AND EXPLOSIVE (CBE) DEFENSE THRUST– S&T invests in R&D to support prevention and protective strategies and coordinated surveillance and detection to address CBE threats. R&D work includes prevention of terrorism, reduction of vulnerability of critical infrastructure from terrorist attacks and other hazards, and prevention of the illicit movement and illegal entry or exit of people, weapons, dangerous goods, and contraband by providing technology, methods, and procedures to detect CBE threats.

Bioagent Detection – FY 2018 Enacted: $21.5M[8]. FY 2019 President's Budget: $18.0M. FY 2020 Request: $5.0M. This program conducts research, develops and identifies tools to enable rapid detection, and provide advanced warning of attacks or releases of biological threat agents against the population and agriculture of the United States. It defines the intended use and application, develops the requirements, and executes the technology developmental efforts to support early detection and warning of potential bioagent threats to humans.

[8] The FY 2018 Enacted total for Bioagent Detection funds a project not funded in the FY 2018 and FY 2019 President's Budgets ($3.0M Bioassays).

Biosurveillance Systems

- **Problem:** Rapid response to a biological incident of national concern (e.g., a biological attack or disease outbreak) is critical to save lives, protect critical infrastructure, and safe guard the economy. In the event of biological incident, there is a dearth of capabilities for prompt detection, coordination, and rapid response actions amongst Federal, state, local governments and the private sector. The timely detection of, and confident response to, the release and/or exposure of biological threats and/or an infectious agents in a public space is a critical challenge to multiple DHS Components and other Federal, state, local, tribal, and territorial customers, including the public health and first responder communities.

- **Solution:** Develop cost-effective systems to rapidly collect and exploit information required for rapid identification of biological incidents; thereby, enabling decision makers to more quickly initiate protective measures. To shorten the time required to deliver a prototype system, and the program aims to pursue parallel tracks to solve multiple dimensions of the problem space and to make use of existing commercial-or government-off-the-shelf solutions. The objectives include developing: 1) addressing timeliness to detect the release of a biological agent by developing novel sensor/trigger technologies, 2) identifying data and early warning and situational awareness information and data streams to provide situational awareness, 3) integration analytical tools and apply advanced computational techniques to integrate and analyze real-time data and 4) enabling more real-time sharing and of information across federal agencies and SLTT.

- **Impact:** Detection and interdiction of biological incidents through rapid field-based assessment for threat agents and optimized collection and integration of relevant data will shorten the timeline between event occurrence and response; thereby, protecting the public, critical infrastructure, and the economy.

FY 2018 Key Milestone Events

- Delivered a report to DHS Component stakeholders that characterizes the state-of-the-art for technology directly applicable to field based biological assessment and collected input on the feasibility of implementing currently available technology.

FY 2019 Planned Key Milestone Events

- Deliver conceptual prototype architecture design based on stakeholder engagement for improved situational awareness (biosurveillance information and knowledge integration).
- Deliver biodetection and biosurveillance systems architectures for DHS Components.

FY 2020 Planned Key Milestone Events

- Deliver implementation protocol to include technical packages for transferring capabilities to additional jurisdictions and stakeholders.
- Deliver indoor aerosolized biological particle detection architectures, including sensors and field-based detection technologies, to test bed for test and evaluation in an operationally relevant environment.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017[9]	FY 2018	FY 2019	FY 2020
Project Funding	$10,000	$13,714	$13,522	$5,000	$5,000
Obligations	$8,808	$17,347	$12,178	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Characterized state of art of technologies for biological assessment and information sharing.	FY 2018 Q1	FY 2018 Q2
Stakeholder engagement: Identify stakeholder capabilities, needs, and requirements; form a working group for biological information and knowledge integration.	FY 2018 Q1	FY 2019 Q4
Delivered current "as-is" baseline national biodetection systems architectures.	FY 2018 Q1	FY 2018 Q4
Designed Conceptual Architecture for biosurveillance information and knowledge integration for local, state and Federal stakeholders.	FY 2018 Q4	FY 2019 Q4
Deliver prototype software architecture for improved situational awareness.	FY 2018 Q4	FY 2019 Q4
FY 2019		
Technical pilot prototype planning and recommendations development.	FY 2018 Q1	FY 2019 Q4
Conduct test and evaluation of individual system prototype components in relevant environments.	FY 2019 Q1	FY 2019 Q4
Conduct systems analysis and develop plans to integrate component technologies into unified capabilities.	FY 2019 Q1	FY 2019 Q4
Demonstrate utility of advanced analytic methods in biodetection and biosurveillance applications (e.g., reduce false alarms, identify anomalous data indicators).	FY 2019 Q2	FY 2019 Q4
FY 2020		
Demonstrate integrated biosurveillance capabilities with a customer.	FY 2020 Q1	FY 2020 Q4
Perform test and evaluation of prototype advanced laboratory-based detection systems.	FY 2020 Q1	FY 2020 Q4
Develop draft technical packages for implementation.	FY 2019 Q3	FY 2020 Q4
Deliver final biodetection and biosurveillance system architectures for DHS Components.	FY 2020 Q1	FY 2020 Q4
Deliver implementation protocol to include technical packages for transferring capabilities to additional jurisdictions and stakeholders.	FY 2019 Q3	FY 2020 Q4

Type of Research

Applied, Developmental

[9] Obligations exceed Project Funding level due to funding realignments during project execution.

Technical Readiness Level

The program began at TRL 3 and will end at TRL 6.

Transition Plans

- Systems architectures, concepts of operation, and implementation protocols for biodetection and biosurveillance systems will be developed for relevant DHS Components and other key stakeholders. These products will include customized, technology architectures suited to the individual operational environments. With new technology development, preference will be given to technologies that have commercial markets beyond Component needs to ensure the availability of an infrastructure to maintain and improve technologies as needed. To ensure successful development, integration, and ultimate transition of the deliverables under this program, individual system components and integrated system will immediately transition to the S&T-sponsored test bed(s) for robust advanced test and evaluation of performance and suitability in operational environments. Following testing in the S&T-sponsored test bed(s), the Biosurveillance Systems program will collaborate with DHS Components and other stakeholders to complete test and evaluation of candidate systems and architectures in the relevant operational environment.

Underground Transport Biodetection Test Bed

- **Problem:** Subway systems are attractive targets for potential acts of bioterrorism, particularly with aerosolized biological agents. Real-time detection of biological agents is currently not possible. An FY 2016 DHS S&T field test in the New York City subway that simulated a biological agent release confirmed dispersion model predictions that contamination would be widespread, and a major public health crisis would occur.

- **Solution:** A permanent test bed in a major subway system will enable the evaluation of emerging chemical and bio-detection technologies, detection architectures, and mitigation strategies to limit agent transport and public exposure to an aerosolized threat. Testing of rapid detection technologies and architectures, and mitigation countermeasures is necessary to establish performance in the harsh environment of a subway and suitability for operational deployment. The Metropolitan Transportation Authority New York City Transit will partner with DHS on implementing a test bed in the Nation's largest subway system.

- **Impact:** A test bed in the operational environment will enable an assessment of the readiness of commercial and emerging chemical and biodetection technologies, including effectiveness of and mitigation strategies and countermeasures, with the goal to minimize the impact and consequences of a bioterrorism event in the subway. The test bed will enable subway system authorities to make informed decisions on new technology acquisition and deployment to enhance public safety and situational awareness. The outcomes will be transferrable to other subway systems.

FY 2018 Key Milestone Events

- Developed initial test bed plan in collaboration with subway partner.

FY 2019 Planned Key Milestone Events

- Fabricate and validate test bed operational readiness.

FY 2020 Planned Key Milestone Events

- Expand test bed to a second subway station.
- Begin Year 1 of test bed operation and evaluation.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	$5,000	-
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Developed initial test bed plan in collaboration with subway partner.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Finalize test bed plan.	FY 2018 Q4	FY 2019 Q2
Acquire technologies for test bed.	FY 2018 Q2	FY 2019 Q2
Test bed fabrication and certification for first location.	FY 2019 Q2	FY 2019 Q3
FY 2020		
Initial recommendations for Advanced BioDefense Architectures and the R&D necessary to fill both detection and mitigation capability gaps.	FY 2019 Q4	FY 2020 Q1
Expand test bed to a second subway station.	FY 2020 Q2	FY 2020 Q4
Initiate evaluation of methods to mitigate spread of contamination.	FY 2020 Q3	FY 2020 Q4

Type of Research

Developmental; Demonstration

Technical Readiness Level

TRL 5-7

Transition Plans

- Make technical reports and databases available to users across the HSE and to appropriate commercial customers via the Bio-Defense Knowledge Center Management System.

BioInformatics for BioDefense

- **Problem**: Recent advancements in the field of life sciences, particularly synthetic biology, pose potential risks to the HSE. The tremendous rate of scientific advancement in the fields of synthetic biology and genetic engineering requires that the DHS community as well as the commercial gene synthesis community stay apprised about synthetic biology and ways it may be misused.

- **Solution**: Develop knowledge products and databases that inform decision-makers about the implications of synthetic biology. Active review of developing technologies, modeling of pathogen synthesis, and improving stakeholders understanding of the science will increase awareness as technologies and their policy and privacy implications evolve. Develop and host interactions between government, industry and academics to foster increased awareness and understanding.

- **Impact**: The BioInformatics for BioDefense program helps generate and develop requirements for the Hazard Awareness and Characterization Technology Center and for other biodefense efforts within the HSE. BioInformatics for BioDefense increases the awareness and understanding of synthetic biological threats across the HSE. This project increases the probability of preventing and minimizing the negative impact of synthetic biological risks at a time of rapid technological flux.

FY 2018 Key Milestone Events

- Developed system for ongoing monitoring and assessment of synthetic biology risks, based on risk spectrum developed by the Intelligence Advanced Research Projects Agency (IARPA).

FY 2019 Planned Key Milestone Events

- Expand contents of database of potentially concerning genetic sequences for use in risk-based analysis of potential threats. Transition database to IARPA, other government Departments/Agencies and select commercial companies.
- Coordinate with commercial gene synthesis companies and relevant Government departments and agencies to improve awareness and cooperation to prevent accidents or misuse in synthetic biology.

FY 2020 Planned Key Milestone Events

- Establish cooperative mechanisms for biodefense community to reduce risk in synthetic biology.
- Develop and define triggers to quantitatively analyze disruptive biotechnologies.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018 [10]	FY 2019	FY 2020
Project Funding	-	-	-	$3,000	-
Obligations	-	-	$400	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Developed system for ongoing monitoring and assessment of synthetic biology risks, based on risk spectrum developed by IARPA.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Develop and deploy mechanisms of contact by which commercial gene synthesis companies may contact government to prevent malicious activity.	FY 2019 Q1	FY 2019 Q4
Expand Sequences of Interest database as repository for engineering sequences developed by IARPA.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Establish cooperative mechanisms for biodefense community to reduce risk in synthetic biology.	FY 2020 Q1	FY 2020 Q4
Develop and define triggers to quantitatively analyze disruptive biotechnologies.	FY 2020 Q1	FY 2020 Q4

Type of Research

Development

Technical Readiness Level

N/A

Transition Plans

- Make technical reports and databases available to users across the HSE and to appropriate commercial customers via the Bio-Defense Knowledge Center Management System.

[10] Obligations exceed Project Funding level due to funding realignments during project execution.

Chemical and Biological Integrated Product Team (CB IPT) Solutions

- **Problem:** DHS Components have the mission to protect the nation from acts of terrorism, including attacks with chemical and biological agents. Each of the Components has a unique role in this mission and each has gaps in their current capabilities to prevent, protect, mitigate, respond to or recover from a chemical or biological agent attack. Operators in this mission space play a variety of roles and require detection, enhanced personal protection equipment, warning tools, modeling and predictive analytics capabilities.

- **Solution:** The CBIPT project will interface with DHS Components to develop detailed requirements and deliver technological solutions to fill capability gaps that impact diverse missions and operations in which chemical and biological agents may be encountered. Solutions will be provided based upon Component-driven requirements.

- **Impact:** This program will deliver solutions to high-priority gaps identified by DHS components through the CB IPT process. Increased capabilities through solutions delivered will enhance readiness to respond to, prepare for and recover from hazardous biological, chemical, or radiological events (FEMA, USCG, USSS), better inform targeting decisions for inspection and identification of potentially hazardous cargo at U.S. ports of entry (CBP), support optimized placement of sensor technologies (Countering Weapons of Mass Distruction-BioWatch), validate models that estimate public health and environmental impacts of an aerosolized biological threat, and provide a new technology to screen for liquid chemical threats at airport checkpoints (TSA, CBP).

Sub Projects

CB IPT Solutions has identified these eight activities as the first gaps to address:

- *Decision Support for Operational Decision Making:* This project delivers guidance to USCG for recovery from a wide-area biological event and returns ports and installations to an operational and mission-readiness status.
- *Compact Escape Hood:* This project will deliver improved respiratory protective equipment for use by security detail personnel to safely and rapidly extract U.S. Government officials from operational environments where a chemical, biological, or radiological (CBR) threat has been released.
- *Operational Decision Making:* This project supports a USCG Maritime Security Response Team requirement for a lightweight, powered-air purifying respirator (PAPR) system that facilitates optimal physical performance during high-threat missions where contaminated environments are likely to be encountered.
- *Event Modeling:* This project will deliver an integrated suite of dispersion models that can: 1) more accurately estimate impacted populations and areas in the event of a large-scale chemical or biological agent event, 2) optimize sensor placements, 3) inform decisions on medical countermeasure distribution and 4) estimate release locations.
- *Predictive Analysis:* This project will deliver a software tool for use by FEMA City Planners to estimate consequences of major biological agent events and inform preparedness planning.
- *Field Detection Equipment:* This project will demonstrate a prototype, rapid nuclear magnetic resonance capability to detect liquid chemical agents, including precursors, at security checkpoints.
- *Executive Protection against Biological Agents:* This project will deliver rapid, reliable, and accurate identification and confirmation of

biological threat agents using techniques that are comprehensively validated and will provide shorter analytical timelines, improved collection tools, and economical platforms.

- *Development and Maintenance of a Biological Repository:* This project will create a repository of biothreat agents and their near neighbors to supply repository materials necessary for assay development and maintaining operational proficiency for USSS biothreat screening.

FY 2018 Key Milestone Events

- Demonstrated initial prototype Nuclear Magnetic Resonance (NMR) capability to detect simulated high-threat chemical agents in 3-1-1 containers.

FY 2019 Planned Key Milestone Events

- Execute test plan and identify best-of-breed respiratory systems for Component evaluation.
- Develop prototype Next-Gen Sequencing methodology and platform to rapidly detect and characterize high consequence pathogens.

FY 2020 Planned Key Milestone Events

- Complete preparations for simulated outdoor release of biological agent in large urban setting.
- Conduct field test to evaluate sampling and decontamination techniques for a USCG vessel contaminated with a biological agent surrogate.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**	**FY 2018[11]**	**FY 2019**	**FY 2020**
Project Funding	-	-	$5,000	$5,000	-
Obligations	-	-	$5,612	-	-

[11] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Initiate GAP 1 Projects.	FY 2018 Q3	FY 2021 Q4
Initiate GAP 2 Projects.	FY 2018 Q2	FY 2019 Q2
Initiate GAP 3 Projects.	FY 2018 Q1	FY 2019 Q3
Initiate GAP 4 Projects.	FY 2018 Q1	FY 2020 Q2
Initiate GAP 5 Projects.	FY 2018 Q1	FY 2020 Q4
Initiate GAP 6 Projects.	FY 2017 Q4	FY 2020 Q3
Initiate GAP 7 Projects.	FY 2018 Q1	FY 2020 Q4
Initiate GAP 8 Projects.	FY 2018 Q1	FY 2020 Q4
FY 2019		
Complete development of sampling and decontamination methods and strategies for wide area recovery (Gap 1).	FY 2019 Q1	FY 2020 Q4
Down-select winning Prize Competition compact PPE prototype/concept for further development (Gap 2).	FY 2019 Q1	FY 2019 Q4
Complete master test and evaluation plan execution for USCG powered air-purifying respirator (Gap 3).	FY 2019 Q1	FY 2019 Q3
Verify dynamically integrated dispersion models functionality to support planned NYC field test (Gap 4).	FY 2019 Q2	FY 2020 Q4
Complete planning for large-scale simulated bioagent release (Gap 5).	FY 2019 Q1	FY 2020 Q4
Demonstrate proof-of-concept low field NMR capability suitable to screen for liquid chemical agent hazards in TSA 3-1-1 packaging (Gap 6).	FY 2019 Q1	FY 2019 Q4
Develop prototype Next-Gen Sequencing methodology and platform to rapidly detect and characterize high consequence pathogens.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Complete preparations for simulated outdoor release of biological agent in large urban setting.	FY 2020 Q1	FY 2020 Q4
Execute operational T&E with Component to identify best-of-breed respiratory system for procurement.	FY 2020 Q1	FY 2020 Q3
Validate dynamically-integrated airflow model in New York City field test.	FY 2020 Q1	FY 2020 Q4
Complete validation of next Next-Gen Sequencing methodology and platform to rapidly detect and characterize high consequence pathogens.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied, Development, and Demonstration.

Technical Readiness Level

TRL 3-7

Transition Plans

- Technology solutions and knowledge products, developed in accord with Component requirements, will transition to Component customers for acquisition programs or preparedness planning.

Chemical Detection – FY 2018 Enacted: $3.1M. FY 2019 President's Budget: $0.0M. FY 2020 Request: $0.0M. This program seeks to develop more reliable chemical detectors, which will promote their use and reduce vulnerabilities of the population and critical infrastructure in a wide array of operational applications.

Multifunction Detectors

- **Problem:** The timely detection of a chemical release in a public space is a critical challenge to multiple DHS components including CBP, USSS and USCG as well as within Federal, State, local, and tribal governments, including the law enforcement and first responder communities.

- **Solution:** There is a need to use risk to identify the gaps in current processes for chemical threat identification and response. Evaluate how sensor capability, sensor performance, data sharing capabilities, decision support platforms, modeling, integration of platforms, planning and training, response, and remediation can be utilized to impact those identified gaps.

- **Impact:** Detection and interdiction of chemical hazards through rapid field-based assessment and optimized collection and integration of relevant data will shorten the timeline between event occurrence and response; thereby, protecting the public, critical infrastructure, and the economy. This project identifies departmental gaps and develops cost-effective systems to enable decision makers to more quickly initiate protective measures and will address needs identified by components (e.g., CBP, USSS, USCG).

Sub Projects

- *Prioritize:* Identify current capabilities and gaps across the department at the component level. This includes understanding the current priority hazards and assessing the risk of chemical threats utilizing risk-based assessments and component-identified priorities.
- *Identify:* Develop road map and architecture to fill gaps and reduce risk. This roadmap will focus sensor development to detect priority threats using orthogonal technologies and will identify components stakeholders and leverage complementary needs in the department. Aligning with the Department of Defense (DOD) Combatting Terrorism Technical Support Office and their efforts to develop an online database containing feedback on field performance of CBRNE detector systems, test data on detector performance, and where or who can be contacted to receive a report depending on the data's sensitivity
- *Implement:* Evaluate chemical sensors and architectures for interdiction and early warning of a chemical threat to provide rapid, accurate identification of threat agents at the point of release. Work toward end-to-end detection to response capabilities that can be customized to meet community needs and budgets. Initiate programs to fill R&D needs that have been identified and cannot be filled with current commercial-off-the-shelf (COTS)/government-off-the-shelf (GOTS) solutions.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- Assessment of relevant chemical threat and requirements (DHS and components).
- Assessment and cross-walk of chemical risk (by component and target) to gaps and detector database to identify RDT&E pathways for reaching needed capability via commercial and government off the shelf solutions.

FY 2020 Planned Key Milestone Events

- Conceptual chemical detection systems architectures for relevant/identified DHS components.
- Establish proposed system architecture for field based chemical assessment capability for identified DHS component.
- Deliver national implementation protocol to include technical packages for transferring capabilities to relevant stakeholders.
- Deliver detection architectures, including sensors and field-based detection technologies, to test bed for test and evaluation in an operationally relevant environment.
- Initiate the development of sensors that detect multiple threats using orthogonal methodology that fill identified component gap.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	$3,099	-	-
Obligations	-	-	$603	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2019		
Conduct market research of available (COTS/GOTS) laboratory and portable based chemical detection systems.	FY 2019 Q3	FY 2020 Q1
Complete assessment of detection systems against current chemical detection capability baseline and evaluation of risk.	FY 2019 Q2	FY 2020 Q3
Develop/improve modeling capability to analyze trade space for advanced chemical detection architectures (DHS component focus).	FY 2019 Q2	FY 2020 Q3
Conduct horizon scanning ("Tech Watch") for novel and emerging detection methodologies.	FY 2019 Q3	FY 2020 Q1
Report for component stakeholders that characterizes the state-of-the-art for technology directly applicable to field-based chemical detection and collect input on the feasibility of implementing currently available technology.	FY 2019 Q3	FY 2020 Q4
FY 2020		
Chemical detection architecture for DHS component.	FY 2020 Q1	FY 2020 Q4
Deliver detection architecture to test bed.	FY 2020 Q1	FY 2020 Q4
Initiate the development of sensors that detect multiple threats using orthogonal methodology that fill identified component gap.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied; Developmental

Technical Readiness Level

The program began at TRL 3 and will end at TRL 6.

Transition Plans

A field-based chemical assessment concept of operations and systems architecture will be developed that includes all relevant DHS components (e.g., CBP, USSS, USCG) and other stakeholders. From there, customized technology architectures suited to the individual operational environments, which may include thermal sensing, multispectral imaging, and volatile organic compound detection and will be developed utilizing COTS technology where available and investing in new technology development when necessary. With new technology development, preference will be given to technologies that have commercial markets beyond component needs if at all possible, to ensure the availability of an infrastructure to maintain and improve technologies as needed. Following architecture development, gap identification and data base evaluation, the program will collaborate with DHS components and other stakeholders to complete test and evaluation of candidate systems and architectures in the relevant operational environments.

Explosives Detection – FY 2018 Enacted: $51.2M. FY 2019 President's Budget: $39.6M. FY 2020 Request: $45.5M. This program researches, develops, and/or identifies tools to detect and locate explosives intended to be used as terrorist weapons and strengthens aviation security by bolstering the international aviation security system, processes, and technologies, and by encouraging partnerships with industry. It defines concepts, requirements, and procedures for improved techniques for early detection and warning of potential explosive threats, including explosive threats to the Nation's transportation systems and large public gatherings.

Screening at Speed (SaS)

- **Problem:** TSA requires detection technologies that effectively and efficiently screen people for concealed explosive threats. Currently, as people move through checkpoints they must remove outerwear, footwear, belts and headwear, slowing the line and decreasing public acceptance. False alarms are frequent, causing inconvenient and intrusive pat-downs and searches. In addition, TSA requires detection technologies that effectively and efficiently screen carry-on bags and items for explosive threats. Present-day X-ray technologies require manual review and frequently stop the line for unnecessary alarms.

- **Solution:** SaS is developing technology that would enable the scanning of walking passengers, acquiring data through most garments and reliably detecting a wider range of prohibited items regardless of concealment. Future systems that record and analyze a richer array of data from each bag would provide greater security while limiting the number of invasive, time-consuming false alarms, all without the need for today's cumbersome restrictions that require removing electronic devices, liquids, aerosols, and gels from bags.

- **Impact:** The SaS Program will integrate screening tools with wide-area surveillance, credential authentication, risk-based screening, and other technologies to further reduce overall risk throughout an airport and potentially in other operational areas including soft targets. Improved detection probabilities and reduced false alarms will translate into fewer secondary inspections, lowering per-passenger costs for TSA, and reducing passenger inconvenience. A system-of-systems approach integrated using open architectures and capable of deploying a layered aviation security posture from curb-to-gate will reduce security risks and costs, and facilitate rapid, cost-effective system upgrades to continue countering evolving adversaries.

FY 2018 Key Milestone Events

- Using representative data, demonstrated algorithms to associate passengers and their belongings using video analytics. Passenger-baggage correlation is a required technology for risk-based screening in a single checkpoint lane.
- Completed testing and accepted report for a device capable of detecting trace explosive residue in a laboratory environment, at a standoff distance of 50 centimeters. The ability to detect explosive residues using non-contact technology may be used in the future in-line with carry-on screening systems to reduce false alarms, or as part of a curb-to-gate architecture to identify explosive residues at range.
- Transitioned a passenger screening algorithm to TSA, capable of processing inputs and detecting threats from any Digital Imaging and Communication for Security compliant passenger imaging system.

FY 2019 Planned Key Milestone Events

- Demonstrate the use of a third-party threat algorithm on an S&T prototype Advanced Imaging Technology (AIT) system using open standards.
- Demonstrate an AIT system capable of screening passengers at a walking pace while scanning for aviation-size threats.

FY 2020 Planned Key Milestone Events

- Submit for certification a system capable of automatic prohibited items detection without operator input.
- Demonstrate a passenger screening system that can adapt its performance in real-time using risk-based screening.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$4,000	$12,600	$8,000	$7,691	$8,664
Obligations	$3,607	$10,726	$6,568	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Using representative data, demonstrated algorithms to associate passengers and their belongings using video analytics. Passenger-baggage correlation is a required technology for risk-based screening in a single checkpoint lane.	FY 2017 Q2	FY 2018 Q3
Completed testing and accepted a test and evaluation report regarding a prototype capable of scanning for aviation-size threats, suitable for use if a passenger were in motion at a walking pace.	FY 2016 Q3	FY 2018 Q4
Completed testing and accepted report for a device capable of detecting trace explosive residue in a laboratory environment, at a standoff distance of 50 centimeters.	FY 2017 Q2	FY 2018 Q3
Transitioned a passenger screening algorithm to TSA, capable of processing inputs and detecting threats from any Digital Imaging and Communication for Security compliant passenger imaging system.	FY 2018 Q2	FY 2018 Q4
FY 2019		
Demonstrate the use of a third-party threat algorithm on an S&T prototype AIT system using open standards.	FY 2018 Q1	FY 2019 Q2
Demonstrate wide-area video analytics using operational data from a curb-to-gate aviation security environment.	FY 2018 Q2	FY 2019 Q3
Receive operational feedback analysis based on operational pilot of an airport risk assessment model.	FY 2018 Q1	FY 2019 Q4
Demonstrate an AIT system capable of screening passengers at a walking pace while scanning for aviation-size threats.	FY 2018 Q4	FY 2019 Q4
FY 2020		
Submit for certification a system capable of automatic prohibited items detection without operator input.	FY 2018 Q1	FY 2020 Q2
Submit for certification a third-party algorithm trained using synthetically generated data sets.	FY 2018 Q3	FY 2020 Q2
Demonstrate a passenger screening system that can adapt its performance in real-time using risk-based screening.	FY 2019 Q1	FY 2020 Q4

Type of Research
Applied; Developmental

Technical Readiness Level
The program began at Technology Readiness Level (TRL) 2 in FY 2016 and will end at TRL 7 in FY 2021.

Transition Plans
- S&T is working closely with TSA to refine a checkpoint architecture evolution plan.
- Systems developed by funded awardees will initially transition to TSA's Office of Acquisition Program Management, after the completion of Developmental Test and Evaluation (DT&E) at the TSL. Other Government customers may leverage this DT&E towards applications beyond the aviation environment.
- Screening device development spirals will be coordinated with TSA's recapitalization plans to ensure smooth and timely technology insertion.
- S&T will continue to engage industry through outreach events (Industry Days), Broad Agency Announcements, Prize Competitions and the Small Business Innovation Research (SBIR) program.

Detection Canine Program

- **Problem:** Nationwide, DHS and the HSE have over 16,000 detection canine teams that lack the benefit of having a specific Federal program focused on providing critical tools, techniques, and knowledge to improve operational proficiency as well as better understand, train, and utilize these detection canine teams. Over the last 20 years, the demand for elite detection canines has increased while domestic supply has not kept pace. This has resulted in an increased reliance on foreign sourcing of detection canines and a subsequent reduction in the quality of the canines being offered for sale. This program provides a critical Federal focal point of knowledge and expertise to identify/address performance gaps in basic canine operations and emerging threat detection, effective/efficient canine training, and supply, to improve the DHS and HSE canine teams' ability to better protect the Homeland.

- **Solution:** The Detection Canine program serves as a key federal focal point to address customer requirements by understanding emerging threat detection performance; analyzing how threat concealment effects detection; and providing scientifically rigorous/statistically significant R&D as trusted, independent broker. In 2018, the program partnered with DHS partners, including TSA, and DOD to bring focus to the domestic detection canine supply challenge. The program established a breeding roadmap, which was endorsed by TSA. The program concept will be developed in collaboration with academia, and will integrate best scientific practices in genetics, genomics, breeding, olfaction, behavior, training, and physiology and metrology. The program provides tools/knowledge including odor chemistry expertise, breakthrough laboratory analysis capabilities, specialized T&E experts, and canine operations and training expertise to improve operational proficiency of DHS and HSE canine teams.

- **Impact:** The nation relies on the performance of detection canine teams every day, and this program allows them to do their job more efficiently and effectively thereby improving mission performance. The creation of a dedicated focal area directed toward not only the expansion of domestic detection canine supply but the improved efficiency of production will substantially reduce dependence on foreign sources over time. The program establishes a RDT&E focal point for detection canines which otherwise would not exist. This provides DHS and the HSE with a resource to fill critical gaps in canine training and mission performance, improve detection canine proficiency to more efficiently/effectively train and perform in operational environments, respond to emerging threats, and address the growing threat of securing soft target venues and large public crowd events.

FY 2018 Key Milestone Events

- Completed Phase 1 of odor reduction proof of principle. Provide briefing and report to Director of TSA Canine Training Center (CTC) with study findings and recommendations. Findings will support specific recommendations to improve canine imprinting efficiencies and effectiveness.
- Completed Phase 2 parametric testing of Person-borne Improvised Explosive Device (PBIED) explosive detection canines in the operational environment. Phase 2 focused is on variations of explosive placements in bags and concealments on the body. The findings of this parametric testing were used as a baseline for the follow-on phases, and are informing changes to concepts of operations and risk mitigation based on detection performance.

FY 2019 Planned Key Milestone Events

- Conduct an initial study of canine phenomic criterion that provide the best predictors for selection of successful detection canines. Deliver findings of the comprehensive analysis, under a larger domestic canine breeding consortium concept, to augment behavioral evaluation by canine trainers, significantly improve selection success, and consequently reduce fiscal and manpower inefficiencies affiliated with canine failure.
- Conduct series of assessments for TSA on Passenger Screening Canine teams to determine more efficient and effective operational testing practices in conjunction with the checkpoint system, to determine best practices in deployment configurations, and to improve basic training effectiveness and efficiency.

FY 2020 Planned Key Milestone Events

- Initiate Generalization Study Phase 2 addressing base odors for emerging threats that will reduce maintenance training burden and improve operational proficiency, enhancing training effectiveness/efficiency.
- Publish final parametric study of detection canine use parameters for soft target/crowded place threats, and recommendations for domestic explosive detection canine from analysis of regional events.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$4,800	$5,269	$8,269	$4,408	$4,820
Obligations	$4,341	$4,756	$2,491	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Completed Phase I of Odor Reduction proof of principle.	FY 2017 Q1	FY 2018 Q1
Provided briefing and report to Director of TSA's CTC with study findings and recommendations. Findings support specific recommendations to improve canine imprinting efficiencies and effectiveness.	FY 2017 Q1	FY 2018 Q1
Finalized commercialization of second critical need non-hazardous peroxide based explosive canine training aid for use in the HSE.	FY 2018 Q1	FY 2018 Q4
Delivered qualitative analysis of the initial series of regional canine events. Analysis will inform a better understanding of operational readiness, identify gaps, and validate storage and handling challenges. Analysis will result in a report to state and local law enforcement agencies with explosive detection canines outlining recommendations for best practices improving training efficiency and effectiveness of the explosive detection canine teams.	FY 2018 Q1	FY 2018 Q4
Completed Phase 2 Parametric testing of PBIED explosive detection canines in the operational environment. Phase 2 focus is on variations of explosive placements in bags and concealments on the body. The findings of this phase of the parametric testing will be used as a baseline to build upon in future phases of test and evaluation. These findings have value to inform concepts of operations and risk mitigation based on probabilities of detection.	FY 2018 Q1	FY 2018 Q3
Conducted operational readiness assessment on the initial class of the TSA CTC's FY 2018 Passenger Screening Canine Training Course Pilot program. Assessment will inform the level of effectiveness of the pilot program.	FY 2018 Q1	FY 2018 Q4
Conducted four Regional Explosives Detection Dog Initiative (REDDI) events with state and local law enforcement agencies.	FY 2018 Q1	FY 2018 Q4
Developed proof of principle prototype of conventional base explosive material for non-hazardous/non-detonable detection canine training aid.	FY 2018 Q1	FY 2018 Q4
Completed Phase I of Odor Reduction proof of principle.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Identify potential areas for proficiency improvement by conducting an emerging threat assessment in operational settings with explosive detection canine teams from Capital Region Partners.	FY 2018 Q1	FY 2019 Q2
Conduct series of assessments for TSA on Passenger Screening Canine teams to determine more efficient and effective operational testing practices in conjunction with the checkpoint system, to determine best practices in deployment configurations, and to improve basic training effectiveness and efficiency.	FY 2019 Q1	FY 2019 Q4
Conduct qualitative assessment and analysis of law enforcement explosive detection canine teams in an operational environment through REDDI. Identify strength, weaknesses and trends that validate current S&T R&D program, improve future REDDI events, and inform the direction of investments going forward that address community HSE needs.	FY 2018 Q1	FY 2019 Q4
Conduct an initial study of canine phenotype criterion that provide the best predictors for selection of successful detection canines. Deliver findings of the comprehensive analysis, under a larger canine consortium concept, to augment behavioral evaluation by canine trainers and significantly improve selection success and consequently reduce fiscal and manpower inefficiencies affiliated with canine failure.	FY 2019 Q1	FY 2019 Q4
Establish a working group of private/public/academia partners to determine ways to support decentralized, non-Federal domestic canine breeding capacity to produce high quality explosives detection canines and modernize canine training standards.	FY 2019 Q2	FY 2019 Q4
Deliver set of non-hazardous explosive canine training aids for conventional/powder based explosives for proof of principle testing.	FY 2018 Q3	FY 2019 Q3
FY 2020		

Research and Development Description	Plan Start Date	Planned Completion
Initiate Phase 1 of Domestic Breeding Consortium Project in conjunction with TSA to establish domestic canine supply (Phase 1= 18 months).	FY 2019 Q3	FY 2020 Q4
Initiate Generalization Study Phase 2 addressing base odors for emerging threats that will reduce maintenance training burden and improve operational proficiency, enhancing training effectiveness/efficiency.	FY 2019 Q4	FY 2020 Q4
Publish final parametric study of PBIED detection canine use parameters for soft target/crowded place threats.	FY 2019 Q2	FY 2020 Q1
Deliver results of TSA canine operational readiness assessment testing.	FY 2020 Q3	FY 2021 Q1
Deliver analysis of phenotype and genotype study in support of Domestic Breeding Consortium Project.	FY 2019 Q3	FY 2020 Q2

Type of Research

Developmental; Demonstrations

Technical Readiness Level

The program began at TRL 5 and will end at TRL 7.

Transition Plans

- Training Aids:
  - Delivered canine training aids for TSA regional rollout for homemade explosives detection.
  - Transferred Government owned design and manufacturing methodology to third party manufacturer.
  - Complete commercialization of second non-hazardous peroxide based canine training aid through rigorous quality assurance testing.
  - Integrate into TSA canine training aid acquisition programs.
- Operational Test and Evaluation (OT&E):
  - Results are guiding operational deployment decisions by TSA and HSE.
  - Inform TSA Passenger Screening Canine testing to support Component updates to Detection Canine CONOPS.
  - Increased partner evaluation of first responder proficiency of canines using non-hazardous training aids.
  - Results inform U.S. and UK sharing for aviation threat vector.
  - Results from the REDDI inform the HSE with validation of capabilities and areas for further focus for both R&D and operational training.
- Detection Canine Domestic Breeding Consortium Project:
  - Publish findings of working group of private/public/academia partners to determine ways to support decentralized, non-Federal domestic canine breeding capacity to produce high-quality explosives detection canines and modernize canine training standards
  - Deliver PSC test results and recommendations for more efficient and effective operational testing practices in conjunction with the checkpoint system, including best practices in deployment configurations and basic training effectiveness and efficiency for the TSA PSC canine program.
  - Deliver analysis of phenotype and genotype study in support of Domestic Breeding Consortium Project
  - Expand domestic detection canine supply infrastructure for the HSE
  - Transition framework for increasing expanded domestic supply of detection canines

Checked Baggage Technology Development Program

- **Problem:** TSA needs enhanced Explosive Detection Systems (EDS) to detect the full array of potential improvised explosives threats and prohibited items in checked baggage. Modifying existing equipment to address these threats would result in greatly improved false alarm rates and an increase in operating costs.

- **Solution:** In collaboration with TSA, S&T is developing next generation X-ray systems that incorporate enhanced measurement techniques, novel detection algorithms, subsystem retrofits, newly developed components and new standalone systems. There is a focus on collaboration between different performers to develop innovative systems. The Checked Baggage program invests in high-performing enabling technologies that will be migrated into next generation checked baggage and checkpoint screening equipment.
  The Checked Baggage Program has three specific focus areas:
  - *Advanced X-ray Systems Development* – Development and testing of full up system engineering design models.
  - *Advanced Algorithms and System Integration* – Development/maturation of threat detection and false alarm reduction algorithms, integration into operational /prototype systems and demonstration of real time operation.
  - *Supporting Component Technology Development* – Development/maturation of system components and subsystems (such as X-ray Sources and Detectors) necessary to evolve laboratory and experimental prototypes into full up X-ray system designs able to meet the Advanced X-ray Systems requirements.

- **Impact:** These next generation X-ray systems are anticipated to provide TSA with enhanced threat detection capabilities, improved onscreen alarm resolution, improved and expanded detection, lower false alarm rates, and reduced lifecycle costs, allowing TSA to be more efficient and effective in keeping pace with new threat as well as with the pace of life for the traveling public. Future program capabilities will included the following:
  - An expanded library of explosives and explosives signatures that can be effectively detected
  - Improved automated explosives detection and false alarm performance
  - Improved imaging tools for operator alarm resolution
  - Improved system reliability, screening speed (throughput) and reduced cost of ownership compared with currently deployed EDS

FY 2018 Key Milestone Events

- Built and delivered functional x-ray pre-prototype system based on initial design, modeling and architecture.
- Finalized remaining Broad Agency Announcement (BAA)0 17-03 Awards for Advanced X-ray Systems Development. Transitioned knowledge products and engage in documented quarterly stakeholder exchange, in order to align with TSA acquisition.

FY 2019 Planned Key Milestone Events

- Complete two new automated threat recognition algorithms.
- Complete analysis and development for improvement of a currently TSA certified and deployed EDS system.

FY 2020 Planned Key Milestone Events

- System concept demonstration of system concept including a pre-preliminary design and benchmark or modeling data and data analysis report. The minimum improvement goal of probability of detection will be 10% and the minimum goal of reduction in false alarm rate will be 10%.
- Demonstration of approved preliminary design through review with limited laboratory dataset and data analysis report. The goal will be a minimum improvement of 10% in the probability of detection and a minimum goal of a reduction in false alarm rate will be 10%.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$11,069	$8,000	$8,000	$7,309	$7,309
Obligations	$10,056	$6,012	$5,674	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Transition standardized modular test kits and articles to DHS test centers (TSL) for evaluation and integration into DT&E and OT&E.	FY 2016 Q3	FY 2018 Q2
Built and delivered functional x-ray pre-prototype system based on initial design, modeling and architecture	FY 2017 Q4	FY 2018 Q3
Finalized Advanced x-ray Systems Development Remaining BAA 17-03 Awards. Transitioned knowledge products and engaged in documented quarterly stakeholder exchange, in order to align with TSA acquisition	FY 2015 Q3	FY 2018 Q2
Completed Long Range BAA (LRBAA) award for hybrid transmission x-ray scanner.	FY 2018 Q4	FY 2018 Q4
FY 2019		
Advanced X-ray Systems Development Phase II Awards – Monitor and manage remaining awards for BAA 17-03, Awards were phased in order to determine ability for prototype development at TRL 4 and progression to TRL 6-7 in the remaining 12-month follow on period.	FY 2018 Q3	FY 2019 Q4
Develop new automated threat recognition algorithms applicable to the current TSA threat assessment and requirements.	FY 2018 Q4	FY 2019 Q4
Develop for improvement of a currently TSA certified and deployed EDS system in support of TSA recapitalization acquisition in 2020.	FY 2018 Q2	FY 2019 Q4
Demonstrate prototype detector for x-ray security screening.	FY 2018 Q4	FY 2019 Q4
FY 2020		
Award New Advanced X-ray Material Discrimination contracts for BAA for TRL 3-5. This effort will develop basic level research in an effort to apply novel techniques and approaches to current capability gaps and to expand the detection library.	FY 2020 Q1	FY 2020 Q2
Demonstration of system concept including a pre-preliminary design and benchmark or modeling data and data analysis report.	FY 2019 Q1	FY 2020 Q4
Demonstration of approved preliminary design through review with limited laboratory dataset and data analysis report.	FY 2019 Q1	FY 2020 Q4
Initiate New Advanced X-ray Material Discrimination BAA for TRL 3-5. This effort will develop basic level research to apply novel techniques and approaches to current capability gaps and to expand the detection library.	FY 2019 Q2	FY 2020 Q2

Type of Research

Developmental

Technical Readiness Level

The Checked Baggage Program will continue to initiate R&D through the targeted BAA process at the basic level (TRL 2-4) in order to develop novel approaches for resolving current capability gaps. Base level efforts that show viability are transitioned to a follow-on BAA and undergo further development and testing at the TRL 5-7 range in preparation for transition to TSA for operational implementation.

Transition Plans

- Develop a fully functional and testable X-ray diffraction explosive detection system suitable for acquiring data at airports and government test facilities. Prototypes will be subject to independent certification readiness testing and preliminary operational evaluation at TSA's Transportation Systems Integration Facility. Effectiveness of product will be proven to TSA. Transition knowledge products upon delivery and coordinate direction of ongoing efforts.
- Perform independent readiness testing to determine detection, identification, and false alarm performance characteristics. Complete trade study analysis of probability of detection, probability of false alarm.
- Coordinate development with TSA's recapitalization plans ensuring smooth and timely technology insertion.
- Initiate transition of prototypes through knowledge products and acquisition alignment with TSA by completing designated testing regime to qualify prototype and present data analysis and results to relevant stakeholders.
- Develop technology transition plans for qualifying prototypes, which may include the development of additional prototype models, though contracts or Cooperative Research and Development Agreements.
- Complete transitions with delivery of prototypes to designated testing laboratories for certification readiness testing.
- Complete transition through document coordination evaluation sessions supported by interagency agreements and Technology Transfer Agreements.

Primary Screening for Passengers

- **Problem:** High false alarm rates and extensive divestiture requirements associated with passenger screening create significant bottlenecks at aviation checkpoints. Whenever passenger screening systems predict a potential threat, TSA staff engages in a secondary, manual screening process that increases operational costs and negatively impacts the experience of the traveling public. As the number of travelers increases every year and new threats emerge, TSA's capabilities must meet the increased demand. Additionally, currently qualified systems use proprietary architectures, which limits TSA's ability to engage a broader HSE to deploy improved capabilities.

- **Solution:** This Program develops people screening technologies that are safe, provide higher-resolution scans, and have better automated detection algorithms. These systems will substantially reduce the need for divestiture of shoes, headwear, outerwear, and small personal items. Novel approaches to solving these problems include a competition to develop improved algorithms for next-generation Advanced Imaging Technology (AIT) systems. New capabilities are under development for AIT systems include the ability to screen passengers with improved

imaging resolution to more efficiently detect challenging and emerging threats. New systems may also include the ability to screen passengers while they walk or while wearing bulky outerwear and shoes.

- **Impact:** When integrated with other advanced checkpoint technologies, these systems will provide faster, less invasive, and less costly screening of passengers. Limited divestiture will decrease passenger inconvenience and increase checkpoint throughput. Systems with material discrimination will confirm whether suspect items are potentially harmful or benign, reducing the rate of pat-downs and other intrusive security measures.

FY 2018 Key Milestone Events

- Accepted all final submissions in the Passenger Screening Algorithm Challenge; S&T received all Prize-eligible automated threat detection algorithms and completed formal evaluation and scoring against a new test data set before independent verification and validation.
- Formally initiated the development of the capability to run third-party automated threat recognition algorithms on an advanced imaging technology scanner using open architectures.

FY 2019 Planned Key Milestone Events

- Submit for certification a high-definition AIT portal for airport deployment that will be capable of automatically detecting threats at a higher TSA standard.
- Deliver system-specific Qualification Readiness Assistance and Qualification Readiness Testing reports on advanced systems such as Active Millimeter-Wave screening systems, AIT automated target recognition, and/or alternative checkpoint passenger screening technologies.

FY 2020 Planned Key Milestone Events

- Submit a high definition AIT system for TSA qualification.
- Submit a shoe scanner for TSA test and evaluation.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	$9,957	$9,957	$6,000	$6,000
Obligations	-	$8,173	$9,193	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Demonstrated alpha prototype for stand-off passenger screening with reduced divestiture of clothing. Completed at least two Preliminary Design Reviews for systems selected for development for high-throughput screening at TSA's highest tier security standards.	FY 2017 Q4	FY 2018 Q4
Accepted all final submissions in the Passenger Screening Algorithm Challenge; S&T received all Prize-eligible automated threat detection algorithms and completed formal evaluation and scoring against a new test data set before independent verification and validation.	FY 2018 Q1	FY 2018 Q2
Formally initiated the development of the capability to run third party automated threat recognition algorithms on an advanced imaging technology scanner using open architectures	FY 2017 Q3	FY 2018 Q1
FY 2019		
Submit for certification a high-definition AIT portal for airport deployment that will be capable of automatically detecting threats at a higher TSA standard.	FY 2018 Q1	FY 2019 Q4
Deliver system-specific Qualification Readiness Assistance and Qualification Readiness Testing reports on advanced systems such as Active Millimeter-Wave screening systems, AIT automated target recognition, and/or alternative checkpoint passenger screening technologies.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Submit a high definition AIT system for TSA qualification.	FY 2018 Q3	FY 2020 Q3
Submit a shoe scanner for TSA test and evaluation.	FY 2018 Q1	FY 2020 Q2

Type of Research

Applied; Developmental

Technical Readiness Level

The program began at TRL 3 and will end at TRL 7.

Transition Plans

- The Program team will continue working closely with customers, S&T's IPTs and Joint Requirements Council to ensure that system requirements comply with customer needs.
- Screening device development spirals will be coordinated with TSA's recapitalization plans ensuring smooth and timely technology insertion.

Primary Screening for Carry-On Baggage

- **Problem:** TSA's primary screening of carry-on bags and other personal items is slow, labor-intensive, and subject to significant operator performance variability. As the number of travelers increases every year and new threats emerge, TSA's capabilities must meet the increased demand. The high false alarm rate during carry-on screening requires Transportation Security Officers (TSOs) to scrutinize on-screen images with even greater vigilance, resulting in lower passenger throughput and greater TSO fatigue.

- **Solution:** This project develops modular, dynamically upgradable carry-on baggage screening technologies to improve detection capability and increase passenger throughput, while maintaining or improving life cycle costs. Specifically, this project will deliver carry-on baggage screening systems with Automated Target Recognition for explosives and other prohibited items. Technologies under development include Computed Tomography (CT) based X-ray systems augmented with enhanced material discrimination capabilities to screen more effectively while reducing the need for divestiture. New systems will be compatible with TSA standards and systems.

- **Impact:** This will provide the transition partner with technology that allows for greater throughput and higher security measures, while reducing operator burden. Improved technologies and algorithms would provide TSA the capability to detect prohibited items in 600 bags per hour, without divestiture of electronics, liquids, aerosols, powders, or gels.

FY 2018 Key Milestone Events

- Completed System Concept Review for a system with the capability to automatically identify prohibited items (guns, knives, etc.) using a checkpoint CT X-ray scanner.
- Completed testing and accepted a final report quantifying the feasibility of phase contrast imaging for detecting explosives and discriminating threats from innocuous items. Further developed, phase contrast imaging could augment primary screening systems for carry-on items to significantly reduce false alarm rates.

FY 2019 Planned Key Milestone Events

- Demonstrate X-ray techniques capable of enhanced material discrimination when used in a configuration suitable for screening aviation carry-on items.
- Complete a Critical Design Review of a system using algorithms that automatically identify prohibited items using a checkpoint CT X-ray system.

FY 2020 Planned Key Milestone Events

- Demonstrate a CT X-ray system capable of adapting its detection algorithms through risk-based screening.
- Submit a CT X-ray system for certification that is capable of meeting TSA's Accessible Property Screening Standard including automatic prohibited items detection without passenger divestiture of liquids, gels, aerosols, powders, or gels.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	$4,609	$4,609	$4,000	$5,458
Obligations	-	$3,651	$3,565	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Completed System Concept Review for a system with the capability to automatically identify prohibited items using a checkpoint CT X- ray scanner.	FY 2017 Q3	FY 2018 Q1
Completed testing and accepted a final report quantifying the feasibility of phase contrast imaging for detecting explosives and discriminating threats from innocuous items.	FY 2016 Q2	FY 2018 Q4
FY 2019		
Demonstrate X-ray techniques capable of enhanced material discrimination when used in a configuration suitable for screening aviation carry-on items.	FY 2018 Q4	FY 2019 Q4
Complete a Critical Design Review of a system using algorithms that automatically identify prohibited items using a checkpoint CT X- ray system.	FY 2019 Q1	FY 2019 Q4
Deliver system-specific Qualification Readiness Assistance and Qualification Readiness Testing reports on advanced systems such as CT X-ray systems and/or alternative checkpoint baggage screening technologies.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Demonstrate a CT X-ray system capable of adapting its detection algorithms through risk-based screening.	FY 2020 Q1	FY 2020 Q4
Submit a CT X-ray system for certification that is capable of meeting TSA's Accessible Property Screening Standard including automatic prohibited items detection without passenger divestiture of liquids, gels, aerosols, powders, or gels.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied; Developmental

Technical Readiness Level

The program began at TRL 3 to 5 and will end at TRL 7.

Transition Plans

- The Program team will continue working closely with customers, S&T's IPTs and Joint Requirements Council to ensure that system requirements comply with customer needs.
- Screening device development will be coordinated with TSA's recapitalization plans ensuring smooth and timely technology insertion.

Training and Performance Optimization (formerly Screening Training and Selection)

- **Problem:** The efficiency and effectiveness of first responders and those on the front lines of national security is directly related to the preparedness and robustness, capacity for recovery, and adaptability achieved in training. The nation's first responders need improved training, including associated materials, methods, tools and technologies in order to more efficient and effective when responding to local, national or international disasters or emergencies.

- **Solution:** S&T works with DHS Components and the first responder community to identify common capability gaps and operational needs that can be addressed through improved training methods, tools and technologies. These DHS end users and first responders require training that leverages the latest cutting edge training methods and innovative technologies to ensure their skills are flexible to respond under a variety of conditions, thereby making them more prepared and resilient, and increasing national security. Improved training in areas such as the underlying components of decision-making (e.g., perceptual skills, critical thinking, alternate option weighing) are critical, particularly when such critical decision-making is required under uncertainty within a time-constrained or hazardous environment. Improving training and optimizing the performance of first responders and those on the front lines of national security technologies will include maximizing human performance as well optimizing the integration of humans with the systems they use, whereby the collective synergy will be optimized to improve operational efficiency, effectiveness and overall national security.

- **Impact:** Providing DHS Enterprise end users and first responders with improved training methods, technologies and tools will result in operational performance increases in those individuals and an increase in national security. More effective and efficient training measurably improves performance and is directly correlated to increased preparedness, robustness, capacity for rapid recovery, and adaptability.

FY 2018 Key Milestone Events

- Developed prototype mannequins for Pat-down Accuracy Training Tool (PATT) - Male and PATT-Female.
- Transitioned a capability to the HSE to enhance efficiency, effectiveness and safety of first responders and those on the front lines of national security.

FY 2019 Planned Key Milestone Events

- Develop a training interface that incorporates external triggers and presents the data graphically and interactively to instructors.
- Conduct a post transition assessment of a recently transitioned technology (ScreenADAPT®, Signcutting, web-Enabled ScreenADAPT®, Eye-Dentify, PATT).

FY 2020 Planned Key Milestone Events

- Conduct training needs analyses for relevant identified technology gaps for training tools.
- Conduct post transition assessment of a recently transitioned technology (ScreenADAPT, web-Enabled ScreenADAPT, Eye-Dentify, PATT).

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$500	$1,033	$1,033	$1,033	$1,033
Obligations	$418	$930	$865	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Create static image functionality for ScreenADAPT®.	FY 2018 Q1	FY 2019 Q1
Create ID Validation functionality for Eye-dentify.	FY 2018 Q1	FY 2019 Q1
Expand Expert Tracker/Sign cutting training materials and methods to a stand-alone module for initial and recurrent training.	FY 2018 Q1	FY 2019 Q1
Conduct at least two data collection efforts focused on threat detection placement and pressure variants for Pat-down Accuracy Training Tool.	FY 2018 Q1	FY 2018 Q4
Conduct Training Effectiveness Evaluation for Pat-down Accuracy Training Tool.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Conduct Training Needs Analysis for Behavior Detection and Pre-Assault Indicator tasks.	FY 2018 Q2	FY 2019 Q2
Create ScreenADAPT Functionality for Behavior Detection and Pre-Assault Indicator tasks.	FY 2018 Q2	FY 2019 Q2
Conduct Training Effectiveness Evaluation of ScreenADAPT® for behavior detection.	FY 2018 Q2	FY 2019 Q4
Develop a training interface that incorporates performance and stress as an output.	FY 2018 Q3	FY 2019 Q4
Develop real-time wireless physiological classifier of stress that is validated and customized for first responders.	FY 2018 Q3	FY 2019 Q4
Design an empirical evaluation of stress on learning for SMART.	FY 2018 Q3	FY 2019 Q2
FY 2020		
Conduct front end analysis with DHS components to identify operational needs, conduct technology scouting and develop solutions.	FY 2019 Q2	FY 2020 Q2
Create mobile application for USBP that sends geo-tagged tracking information to a team.	FY 2019 Q2	FY 2020 Q2
Create a Web Enabled version of Eye-Dentify (impostor detection and ID validation capabilities) for CBP.	FY 2019 Q2	FY 2020 Q2

Type of Research

Applied

Technical Readiness Level

TRL 4

Transition Plans

- A sign cutting training module will be transitioned to USBP for enhancing tracking skills.
- Eye-dentify systems will be transitioned to CBP to enhance imposter detection and ID verifications skills.
- PATT mannequins to be transitioned to TSA to enhance TSO skills and advance training and curriculum at TSA Academy.

Secondary Screening Technology Development

- **Problem:** The emergence of homemade explosive threats is a challenge for aviation security. The Secondary Screening Technology Development Program focuses on research, development, developmental testing and evaluation of the next generation of explosive trace detectors (ETDs) to enhance explosive detection capabilities across the HSE, including DHS Components (TSA, CBP, USSS and USCG). DHS Components use ETDs as a screening tool for detection of explosives. The ETDs' ability to detect evolving explosive threats requires an expandable and upgradable explosive threat library. Current ETD libraries are difficult to expand due to technical limitations. Sampling efficiency of these ETDs is also limited by current CONOPS (mostly contact sampling) and by TSOs training and training curriculum.

- **Solution:** To increase ETD detection capabilities, the Secondary Screening Technology Development program develops Next Generation ETDs with more easily upgradable and expandable threat library that can selectively identify current and emerging explosives. New capabilities are sought with smaller, more portable ETDs while keeping costs as low as possible. Concurrently, the program seeks to increase ETD sensitivity by developing novel sampling technologies with higher collection efficiency and training tools to help increase TSOs explosives sampling proficiency.

- **Impact:** The program will enhance the capabilities of currently deployed ETDs and develop the next generation of ETDs with capabilities such as specific identification of explosive threats, upgradable threat libraries and advanced sampling methodologies, including contact and non-contact sampling. Short-term impact is to provide ETD operators with improved explosives detection capability while saving time and money and circumventing the need to retrain TSOs and other end-users. For mid- and long-term impact ETDs with improved sampling and broader threat detection capabilities, provide TSA and other DHS Components with more options for use in complex and diverse operational environments.

FY 2018 Key Milestone Events

- Transitioned critical design knowledge products and outcomes of an assessment of a non-contact sampling technology to the HSE. The non-contact sampling technology will be evaluated for the ability to enhance trace explosives sampling efficiency.
- DT&E of Triple Quad Mass Spectrometry Explosives Trace Detectors, conducted in collaboration with the TSL. The prototypes are tested and evaluated on their detection capabilities against conventional and homemade explosives. Special emphasis is placed on the Mass Spec engine's ability to confirm identities of conventional and homemade explosives.

FY 2019 Planned Key Milestone Events

- Conduct DT&E of portable ETD prototype with enhanced threat library.
- Conduct T&E of electrostatic-based swabs.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	$5,343	$6,343	$5,200	-
Obligations	-	$4,821	$5,658	-	-

Project Schedule

Research & Development Description	Plan Start Date	Planned Completion
FY 2018		
Critical Design Review (CDR) of an integrated Non-particle Vapor Sampler. This CDR focused on evaluating detailed design of the non-contact sampler including hardware and software, explosives detection performance, and systems tradeoffs and rationales. The CDR will focus on whether non-contact samplers can enhance explosives sampling efficiency and extend CONOPS for TSOs.	FY 2017 Q4	FY 2018 Q1
DT&E of Triple Quad MS ETDs. This DT&E was conducted in collaboration with the TSL. The prototypes are tested and evaluated on their detection capabilities against conventional and homemade explosives. Special emphasis is placed on the Mass Spec engine's ability to confirm identities of conventional and homemade explosives.	FY 2017 Q4	FY 2018 Q1
DT&E of Non-contact High Volume Vapor and Particle Sampler. This DT&E was conducted in collaboration with the TSL. The prototypes are tested and evaluated on their detection capabilities against conventional and homemade explosives and their throughput of screening passengers and carry-on bags at checkpoints.	FY 2017 Q4	FY 2018 Q3
FY 2019		
DT&E of Portable Rapid Thermal Modulation Ion Mobility Spectrometer ETDs. This DT&E will be conducted in collaboration with the TSL. In addition to being tested and evaluated on their detection capabilities against conventional and homemade explosives and selected illicit drugs, the prototypes have to conform to a small footprint, and discern analytes from common background substances. These requirements ensure portable ETDs meet the challenging demands of field applications.	FY 2018 Q4	FY 2019 Q2
DT&E of Advanced Near Field Sampling Methods using electrostatic swabs. This DT&E will be conducted in collaboration with the TSL. Electrostatic swabs and Near Field Sampling Methods will be tested and evaluated in comparison to current CONOPS of swab-based contact sampling. Special emphasis is placed on whether Near Field Sampling using electrostatic swabs are effective in harvesting a wide range of explosives.	FY 2018 Q4	FY 2019 Q1

Type of Research

Applied

Technical Readiness Level

The program began at TRL 3 and will end at TRL 7.

Transition Plans

- This program currently has representatives from TSA, USSS, CBP, and USCG reviewing developmental goals and progress of the ETD prototypes. Pending successful development of the ETD prototypes, the Secondary Screening Technology Development is working to develop Transition Plans with these representatives. With regard to enhancing ETD capabilities, the Program Manager is in the process of coordinating with the TSA Office of Requirements and Capabilities Analysis (ORCA) and TSA Office of Acquisition Program Management to debrief them and transition two new capabilities: Advanced Itemizer DX ETD retrofit kit and reagent enhanced swabs.

Next Generation Explosives Trace Detection (Next Gen ETD)

- **Problem:** This is a three-pronged problem involving security effectiveness, operational efficiency, and customer satisfaction. Terrorists continue to evolve their tactics and threats including Homemade Explosives leading to continuous needs for aviation and large event explosives screening worldwide. Currently, end-users of trace detection technology lack the tools to most effectively and efficiently conduct their work. Better technology to improve sampling and tools to assess the effectiveness of deployed technology, increase the number of threats that can be detected, thereby reducing the possibility of terrorist attacks in our homeland.

- **Solution:** This program directly addresses the needs. Activities include developing both near-term technology solutions for currently deployed equipment and mid-term solutions for the next generation of explosives trace detection. The program will focus on assessing and transitioning non-contact sampling methods, algorithm improvements for equipment, and developing handheld and/or modular technologies that can be used in next generation explosives detection systems. Tools and methods are also under development for the accurate assessment of technologies so they can be developed into equipment with realistic cost and performance characteristics.

- **Impact:** The program will increase security effectiveness to meet the evolving threat environment, provide TSOs and operators with equipment and tools to optimize their operations, keep false alarm rates low, and enhance customer satisfaction by screening at the pace of life while minimizing contact with passengers and reducing divestiture.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- Develop tools for assessing non-contact vapor and particle sampling prototypes.
- Complete Integration Test and Evaluation of Next Gen ETDs and components.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	-	$8,200
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
N/A		
FY 2019		
N/A		
FY 2020		
Develop tools for assessing non-contact vapor and particle sampling prototypes.	FY 2020 Q1	FY 2020 Q3
Complete Integration Test and Evaluation of Next Gen ETDs and components.	FY 2020 Q1	FY 2020 Q4
Demonstrate a prototype laser trace vaporization desorber with an existing COTS ETD.	FY 2020 Q3	FY 2020 Q4
Conduct technical assessments of ETD technologies in collaboration with TSA Innovation Task Force.	FY 2020 Q1	FY 2020 Q2
Deliver enhanced trace sampling tools and methodologies to TSA and New York Police Department.	FY 2020 Q1	FY 2020 Q2

Type of Research

Applied; Developmental

Technical Readiness Level

TRL 4-7

Transition Plans

- The Program currently has representatives from TSA, USSS, CBP, and USCG reviewing developmental goals and progress of the ETD prototypes. Pending successful development of the ETD prototypes, the Program works with components such as TSA for implementing the next stage of development. The Program also works with components to support operational testing to gather real-world testing data.
- TSA's Strategic Five-Year Technology Investment Plan for Aviation Security, 2017 called for the deployment of Next Gen ETDs in 2020 and the development of technologies and CONOPs that enhance passenger experiences during screening. Successful development of non-contact explosives trace sampling technologies has the potential for a higher return of investment by tapping into the TSA procurement cycle with a proven and matured technology.

Surface Transportation Explosive Threat Detection (STETD) Program

- **Problem:** Current security capabilities for screening people and baggage in surface transportation environments are extremely limited. The unique requirements of the surface transportation environment (an open system with no fixed checkpoints, extremely high throughput, and an unalterable existing infrastructure within which technologies for explosives detection must fit) dictate the need for a dedicated program to address vulnerabilities.

- **Solution:** Provide a layered and integrated capability to safely screen for potential threat items in unstructured crowds within soft-target venues and crowded spaces without impact to the speed of travel while maintaining individual privacy.

- **Impact:** Leave-Behind detection with surrounding circumstance assessment will allow security personnel to clear 30-50% of suspicious packages without necessitating an emergency response ($600K/year manpower savings per Washington Metro Area Transit Authority (WMATA)) and increase screening from 3% (current bag searches) to a goal of 95% of all passengers.

FY 2018 Key Milestone Events

- Conducted lab testing of prototype millimeter wave (mmW) Flat Panel Imaging Array to gauge effectiveness of preliminary integration of image exploitation algorithms for automatic target recognition (ATR). Millimeter wave images of potential threat items (including explosives and simulated) were captured and analyzed. The results of the testing will drive continued development of the envisioned operational form factor of the integrated array and ATR algorithm.
- Installed Forensic Video Exploitation & Analysis (FOVEA) tool suite in Massachusetts Bay Transit Authority Operations & Communications Center for extended pilot demonstration. Feedback from end-users will be incorporated into ongoing spiral development of the tool suite.

FY 2019 Planned Key Milestone Events

- Conduct DT&E of integrated Intelligent Video /Forensic Video Exploitation & Analysis (IV/FOVEA) tool suite within WMATA Security and Operations Control Center (SOCC) to determine limits of detection performance in operational environment and impact to end-user.
- Conduct DT&E of centimeter wave (cmW) Flat Panel Imaging Array Technology in lab environment.

FY 2020 Planned Key Milestone Events

- Transition FOVEA tool suite to industry partner.
- Conduct DT&E of Person Borne Improvised Explosive Device (PBIED) integrated mmW Flat Panel Imaging Array in TSA ORCA Mass Transit Test Bed (MTTB) or a simulated operational environment.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	$3,000	$5,000	$4,000	$4,000
Obligations	-	$2,744	$4,566	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conducted lab testing of prototype mmW imager to gauge effectiveness of preliminary integration of image exploitation algorithms for automatic target recognition.	FY 2018 Q1	FY 2018 Q4
Conducted DT&E of mmW Flat Panel Imaging Array technology in simulated operational environment to determine limits of detection performance in operational environment and impact to end-user.	FY 2018 Q1	FY 2018 Q1
Integrated IV algorithm into FOVEA tool suite demonstrating automated detection and end-user cueing.	FY 2018 Q1	FY 2018 Q2
Installed FOVEA tool suite in Massachusetts Bay Transit Authority Operations & Communications Center for pilot demonstration.	FY 2018 Q2	FY 2018 Q3
Conducted simulation and analysis of layered sensing configurations for layered architecture prototyping effort to optimize sensor placement and system performance.	FY 2018 Q2	FY 2018 Q4
FY 2019		
Develop additional image exploitation algorithm data products (bag overlay and size threshold) and integrate with prototype mmW Flat Panel Imaging Array to scan the traveling public and their belongings without slowing the speed of travel.	FY 2018 Q2	FY 2019 Q3
Conduct DT&E of integrated IV/FOVEA tool suite within WMATA SOCC to determine limits of detection performance in operational environment and impact to end-user.	FY 2018 Q4	FY 2019 Q1
Conduct DT&E of centimeter wave (cmW) Flat Panel Imaging Array Technology in lab environment.	FY 2019 Q1	FY 2019 Q1
Conduct OT&E of FOVEA tool suite within TSA ORCA mass transit test bed with industry partners in preparation for transition.	FY 2019 Q2	FY 2019 Q4
Develop a Person Search capability within FOVEA tool suite and determine limits of detection performance in operational environment.	FY 2019 Q2	FY 2019 Q4
Conduct Preliminary Design Review (PDR) of the integrated mmW Flat panel Imaging Array leveraging the design of the prototype mmW array.	FY 2019 Q2	FY 2019 Q2
FY 2020		
Transition FOVEA tool suite to industry partner.	FY 2019 Q4	FY 2020 Q2
Conduct testing of Person Search capability within FOVEA tool suite in TSA Mass Transit Test Bed.	FY 2020 Q1	FY 2020 Q3
Conduct Critical Design Review (CDR) of the integrated mmW Flat Panel Imaging Array.	FY 2020 Q2	FY 2020 Q2
Conduct DT&E of PBIED integrated mmW Flat Panel Imaging Array in TSA ORCA Mass Transit Test Bed or a simulated operational environment.	FY 2020 Q2	FY 2020 Q4

Type of Research
Developmental

Technical Readiness Level
Project begins at TRL 5 and ends at TRL 7.

Transition Plans
- DT&E and OT&E will be conducted with surface transportation end-users within TSA ORCA Mass Transit Test Beds. When technologies reach appropriate maturity, they will be transitioned to an industry partner for commercialization. Once in the marketplace, the technology can be added to the approved grant list for purchase by surface transportation authorities.
- Discussions with potential industry partners will begin early in CY 2019 with a goal to transition the FOVEA tool suite technology in early CY 2020.
- MIT/LL has entered into a technology transition agreement with Liberty Defense Technologies (LDT). LDT has obtained the license to an MIT/LL patent (based on the mmW Flat Panel Imaging Array technology under development for DHS S&T) to develop a portal-based millimeter wave system for detecting potential threat items entering large venues (i.e. stadiums) and schools.

COUNTER TERRORIST THRUST – S&T invests in the R&D technologies, methods, and procedures to counter terrorists. Efforts include R&D to identify individuals or groups that intend to conduct terrorist attacks and/or illicitly move weapons, dangerous goods, and contraband. It also includes providing threat assessments of the high-consequence attack methods such as CBE that terrorists may use to attack the Nation.

Bioagent Threat Assessment – FY 2018 Enacted: $23.4M. FY 2019 President's Budget: $16.4M. FY 2020 Request: $16.4M. This program addresses biological knowledge gaps and develops defensive strategies to counter potential threats. It also supports a full spectrum of knowledge products (e.g., reports/studies) to better inform policy makers on the attributes, risks, and consequences associated with the intentional release of a biological agent.

Biodefense Knowledge Center (BKC)

- **Problem:** Customers from across the HSE need technical information, analysis, knowledge, and access to expertise to help them make decisions that involve biological sciences and biological threats. Customers' information and decision needs vary considerably across DHS Components, multiple Federal, state, and local agencies. Advances in biotechnology that are inherently dual-use, including genetic engineering, genome engineering, synthetic biology, and the expanding Do-it-Yourself (DIY) Biology community, will require DHS and the entire HSE to combat an ever evolving problem. The hazards that DHS and the HSE may need to respond to tomorrow are not known, unique solutions may need to be developed, and likely involve an agile community of government and industry entities - many of whom have asked for government leadership and guidance.

- **Solution:** With expertise in biological agent science, genomics, dual-use biology, intelligence, and risk/threat assessment, the BKC is an enduring center of scientific excellence and information about biological sciences and threats. Its knowledge products bridge science, technology, intelligence, health threats, and law enforcement. It provides customer requested biothreat and bioscience assessments as well as in-depth analyses of biodefense issues and biotechnologies. Its knowledge management system houses classified and unclassified data and analyses, technical or analytical reports written by the BKC and other biodefense sources, and is available 24/7 for community use. BKC activities will be executed in coordination with the Hazard Awareness and Characterization Technology Center starting in FY 2019 and will be integrated into a combined Knowledge Repository for chemical, biological, and explosive hazards starting in FY 2020.

- **Impact:** The BKC increases the awareness and understanding of biological threats across the HSE at multiple levels of classification to inform policy, CONOPS, RDT&E, technology acquisitions, and development and acquisition of medical countermeasures. By integrating the BKC into a combined Knowledge Repository for chemical, biological, and explosive hazards, the HSE will have access to the technical information and analysis through a single portal to make informed decisions to prevent, prepare for, respond to, and recover from incidents involving these hazards.

FY 2018 Key Milestone Events

- Deployed pathogen genomic alignment toolset and metadata analysis capability for the DHS Sequences of Interest database.
- Completed two national security sensitive, in-depth technical analyses of biothreat vulnerability pathways for biodefense community.

FY 2019 Planned Key Milestone Events

- Deploy a metagenomic analysis capability within the Biodefense Knowledge Management System infrastructure for stakeholders to analyze potential genomic security risks.
- Deliver two in-depth technical analyses of biothreat capability pathways to BKC stakeholders.

FY 2020 Planned Key Milestone Events

- Transition at least three knowledge products on an agent or technology that will impact current, emerging, or future biological hazards.
- Expand the infrastructure developed for biological hazards to incorporate chemical and explosive hazards.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**[12]	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	$3,000	$3,000	$5,000	$3,000	$3,000
Obligations	$5,391	$2,583	$3,382	-	-

[12] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Brief the biodefense community on vulnerabilities related to an important emerging biothreat topic.	FY 2018 Q1	FY 2018 Q4
Update scientific and sensitive holdings in the Biodefense Knowledge Management System for the biodefense community.	FY 2018 Q1	FY 2018 Q4
Identify and host threat-specific genomic databases and metagenomic analysis tools relevant to understanding and preventing biothreats in the genomic age.	FY 2018 Q1	FY 2018 Q4
Maintain analytical support to the Chem-Bio Defense Division, as well as stakeholder requests for technical reach back support.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Deploy a metagenomic analysis capability within the Biodefense Knowledge Management System infrastructure for stakeholders to analyze potential genomic security risks.	FY 2019 Q1	FY 2019 Q4
Deliver two in-depth technical analyses of biothreat capability pathways to BKC stakeholders.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Transition at least three knowledge products on an agent or technology that will impact current, emerging, or future biological hazards.	FY 2020 Q3	FY 2020 Q4
Expand the infrastructure developed for biological hazards to incorporate chemical and explosive hazards.	FY 2019 Q3	FY 2020 Q3

Type of Research

Development

Technical Readiness Level

N/A

Transition Plans

- Provide technical reports and data analysis tools available to users across HSE via the Knowledge Management System at multiple classification levels.

Biological Threat Characterization (BTC)

- **Problem:** DHS components, and the biodefense community writ large, lack critical data on certain characteristics of many biological threat agents, and the impact of technological advances on those characteristics. Improved data on these characteristics enables to confidently predict the consequences or risk of a biological attack involving a given agent on the United States. In turn, these analyses allow decision makers to effectively prioritize biodefense investments to prevent, prepare for, respond to, and recover from such an event. Further, this data is needed to define performance requirements for defensive countermeasures (e.g., detectors, personal protective equipment, and operational protocols) to ensure that the developed solutions mitigate hazards posed by biological threat agents.

- **Solution:** BTC activities provide knowledge products (technical reports) generated through rigorous laboratory experimentation providing critical data and insight on the properties of biological threat agents and the hazards that they pose. Knowledge products are made available to DHS Components and the U.S. biodefense community to support operational elements for use in planning for and responding to natural and intentional disease outbreaks. BTC activities are executed in coordination and collaboration with the Hazard Awareness and Characterization Technology Center (HAC-TC) and the National Biodefense Analysis and Countermeasure Center (NBACC).

- **Impact:** BTC activities establish and leverage innovative science-based capabilities to provide DHS with data and knowledge products which improve pre-event planning, event-specific operational response, and strategic biodefense preparedness decisions. BTC transitions the knowledge products and capabilities required for effective preparedness and response to current and future biological threats.

FY 2018 Key Milestone Events

- Developed projects and experiments to address additional traditional biological threat-related knowledge gap requirements identified by stakeholders to provide actionable information to support informed policy and decision-making before, during, and in response to a biological incident.
- Addressed at least three critical knowledge gaps on the production, dissemination, persistence, and virulence of Tier 1 biological threat agents to inform the BTRA program, as well as, other government stakeholders responsible for biodefense preparedness and response.
- Produced and delivered three knowledge products addressing high priority knowledge gaps along the attack pathway (i.e., agent acquisition, production and processing, storage stability, dissemination, persistence, and infection/intoxication, disease and treatment in appropriate models) for biological agents to inform and improve DHS and national consequence and risk assessment efforts DHS and HSE biodefense strategy and policy development.

FY 2019 Planned Key Milestone Events

- Develop projects and experiments to address biological threat-related knowledge gap requirements identified by stakeholders to provide actionable information to support informed policy and decision-making before, during, and in response to a biological incident.
- Provide flexible and agile BTC capabilities for the execution of national security priority initiatives in support of DHS and the HSE that address traditional biological threat-related knowledge gap requirements identified by stakeholders to provide actionable information and data.
- Produce and deliver at least three knowledge products that address additional critical knowledge gaps on the production, formulation,

dissemination, persistence, and virulence of Tier 1 biological threat agents to inform and improve DHS and national consequence and risk assessment efforts, DHS and HSE biodefense strategy and policy development.

FY 2020 Planned Key Milestone Events

- Develop projects and experiments to address biological threat-related knowledge gap requirements based on priorities identified by stakeholders to provide actionable information to support informed policy and decision-making before, during, and in response to a biological incident.
- Provide flexible and agile BTC capabilities for the execution of national security priority initiatives in support of collaboration with DHS and the HSE that address traditional biological threat-related knowledge gap requirements identified by stakeholders to provide actionable information and data.
- Produce and deliver at least three knowledge products that address additional critical knowledge gaps on the production, formulation, dissemination, persistence, and virulence of Tier 1 biological threat agents to inform and improve DHS and national consequence and risk assessment efforts, DHS and HSE biodefense strategy and policy development.

Overall Project Funding

(Dollars in Thousands)	FY 2016[13]	FY 2017[14]	FY 2018	FY 2019	FY 2020
Project Funding	$18,400	$18,634	$18,427	$13,369	$13,369
Obligations	$26,063	$22,980	$16,686	-	-

[13] Obligations exceed Project Funding level due to funding realignments during project execution.
[14] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
BTC Projects review final reports.	FY 2017 Q4	FY 2018 Q1
NBACC Annual Plan execution.	FY 2017 Q4	FY 2018 Q2
NBACC Final Reports.	FY 2018 Q2	FY 2018 Q3
BTC Projects execution.	FY 2018 Q1	FY 2018 Q4
BTC Projects next year planning.	FY 2018 Q3	FY 2018 Q4
BTC Projects review final reports.	FY 2018 Q4	FY 2019 Q1
BTC Yearly Project (portfolio) Review.	FY 2018 Q3	FY 2018 Q4
FY 2019		
BTC Projects execution.	FY 2019 Q1	FY 2019 Q4
BTC Projects next year planning.	FY 2019 Q3	FY 2019 Q4
BTC Projects review final reports.	FY 2019 Q4	FY 2020 Q1
BTC Yearly Project (portfolio) Review.	FY 2019 Q3	FY 2019 Q4
NBACC Annual Plan execution.	FY 2018 Q4	FY 2019 Q2
FY 2020		
BTC Projects execution.	FY 2020 Q1	FY 2020 Q4
BTC Projects next year planning.	FY 2020 Q3	FY 2020 Q4
BTC Yearly Project (portfolio) Review.	FY 2020 Q3	FY 2020 Q4
NBACC Annual Plan execution.	FY 2019 Q4	FY 2020 Q2

Type of Research

Basic, Applied

Technical Readiness Level

N/A: Enduring capability that results in continuing delivery of foundational knowledge (i.e., data, technical, and analytical reports) to inform need and technical requirements for other technology development efforts.

Transition Plans

BTC regularly delivers/transitions the knowledge and insight produced by laboratory studies through reports delivered to the DHS/S&T Hazard Awareness & Characterization Technology Center. These are shared with the HSE, including the Intelligence Community and the DOD through the Biodefense Knowledge Center's Biodefense Knowledge Management System and other information portals. BTC reports and knowledge products

provide the essential technical foundation for confidence in both DHS and national consequence and risk assessments, enabling policymakers to establish technically informed and sound policy, and supporting decision makers to appropriately prioritize biodefense spending on medical and non-medical countermeasure acquisition programs impacting billions of dollars of Government spending.

Chemical Threat Characterization – FY 2018 Enacted: $4.4M. FY 2019 President's Budget: $0.0M. FY 2020 Request: $4.4M. This program researches and identifies current and potential chemical threats to understand the risk posed to the United States by their illicit use. This program encompasses risk-based, chemical threat agent characterization programs, domestic defense strategic planning, and analytical technologies, strategies, and procedures.

Chemical Security Analysis Center (CSAC)

- **Problem:** DHS has a mandate to "… Identify and develop countermeasures to [chemical, biological, radiological, and nuclear] CBRN threats … develop comprehensive, research-based definable goals for such efforts …" Thus, the need exists for a capability to identify and assess chemical threats and vulnerabilities in the United States and develop the best responses to potential chemical hazards. Included is a single centralized repository of chemical threat information (hazard and characterization data) for analysis of the nation's vulnerabilities to chemical events to serve key customers.

- **Solution:** CSAC provides chemical hazard analysis and threat characterization as well as chemical surveillance and detection. CSAC develops science-and technology-based quality assured information capabilities for acquiring, storing, indexing, evaluating and making strategically available cheminformatic data, technical reports and other knowledge products. Products include, the chemical agent reactions database (CARD); the interagency Non Traditional Agent Library; unclassified daily and classified weekly reports addressing current and emerging chemical and chemical-related threats to critical infrastructure; citizens, food, and water, and 24/7 Technical Assistance.

- **Impact:** CSAC is the nation's only Federal studies, analysis, and knowledge management center for assessing the threat or hazard associated with an accidental or intentional large-scale chemical event or chemical terrorism event in the United States. CSAC serves key customers such as the Cybersecurity and Infrastructure Security Agency (CISA), USSS, Countering Weapons of Mass Destruction(CWMD), TSA, and the Office of Intelligence and Analysis (I&A) within DHS, as well as several Interagency partners.

FY 2018 Key Milestone Events

- Completed an aviation security study for the Transportation Security Administration. The risk-based analysis involved multiple threats to narrow and wide body airframes.
- Completed and launched the CARD v5.0 on the National Center for Medical Intelligence (NCMI), which hosts the CARD.

FY 2019 Planned Key Milestone Events

- Complete a comprehensive market survey and technology assessment to determine chemical detection solutions for improving CBP capabilities to screen for, and interdict synthetic opioids in packages at the nation's International Mail Facilities.
- Develop an opioid detection R&D roadmap to guide S&T investments in developable technology solutions to screen for, detect, and identify fentanyl and other synthetic opioids being trafficked into the U.S. through the international mail.

FY 2020 Planned Key Milestone Events

- Conduct the S&T Synthetic Opioid Detection At Speed (SODAS) Research and Development program, providing the lead technical support and oversite for the rapid prototype development of novel opioid detection technologies for CBP to conduct non-intrusive inspection of international mail.
- Develop updated Synthetic Opioid Data Repository for fentanyl and 200 synthetic analogs to include advanced technical data matrices on toxicology, medical countermeasures, physical properties, detection, decontamination, and personal protective equipment.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017[15]**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	$6,300	$5,593	$4,393	-	$4,393
Obligations	$6,142	$6,400	$3,877	-	-

[15] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Tailored Assessment for TSA on multiple threats to narrow and wide body airframes.	FY 2018 Q1	FY 2018 Q3
Completed and launched the CARD v5.0, on the NCMI, which hosts the CARD.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Perform a Market Survey for SODAS in support of CBP.	FY 2018 Q4	FY 2019 Q4
Develop an opioid detection R&D Roadmap to guide S&T investments in developable technology solutions to screen for, detect, and identify fentanyl and other synthetic opioids being trafficked into the U.S. through the international mail.	FY 2019 Q1	FY 2019 Q4
Develop an updated Synthetic Opioid Data Repository for fentanyl and 200 synthetic analogs to serve as a vital resource to DHS S&T and the Interagency community combatting the opioid crisis. Essential data includes opioid potency, toxicity, median lethal doses, physical properties, analytical data, medical treatment efficacy, supply chain availability, and interdiction metrics and trends.	FY 2019 Q1	FY 2019 Q4
Investigate, analyze, and determine long term health effects from acute, sub-lethal exposures to opioids, including fentanyl and synthetic analogs.	FY 2019 Q1	FY 2019 Q4
Complete and launch the Chemical Agent Reactions Database v7.0, with new threat chemicals from S&T mission critical areas, including synthetic opioids and gas forming reactions , and complete a system unit test on current release architecture.	FY 2019 Q1	FY 2019 Q4
Develop enhanced models of chemical attack scenarios on soft targets using toxic industrial chemicals, which incorporates experimental reaction kinetics, toxicity and mitigation data into models to assess impact sensitivity.	FY 2019 Q1	FY 2019 Q4
Develop a medical mitigation model for kinetic injuries in explosive attack scenarios, and develop and integrate a stock and flow model with previously developed consequence assessment models.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Complete and launch CARD v6.0.	FY 2020 Q1	FY 2020 Q4
Conduct the S&T SODAS Research and Development program, providing the lead technical support and oversite for the rapid prototype development of novel opioid detection technologies for CBP to conduct non-intrusive inspection of international mail.	FY 2020 Q1	FY 2020 Q4
Develop updated Synthetic Opioid Data Repository for fentanyl and 200 synthetic analogs to include advanced technical data matrices on toxicology, medical countermeasures, physical properties, detection, decontamination, and personal protective equipment.	FY 2020 Q1	FY 2020 Q4
Develop and execute the SODAS's master Test & Evaluation plan to systematically conduct performance assessments of opioid detection technologies developed for CBP to screen international mail for fentanyl and synthetic analogs. Additionally provide support to CBP to assess the operational utility and impact of all technology solutions developed and support the transition of those capabilities.	FY 2020 Q1	FY 2020 Q4
Develop a toxic chemical Risk Prioritization Matrix tool that uses constructed algorithms to identify and prioritize key data gaps based on parameter sensitivity and data quality confidences.	FY 2020 Q1	FY 2020 Q4
Develop and refine the Beta version of the Homeland Explosives Consequence and Threat Tool 1.0, utilizing enhanced distributions for key performance parameters and Medical Response sensitivity studies based on new and ongoing Public Health initiatives.	FY 2020 Q1	FY 2020 Q4

Type of Research

CSAC is the nation's only Federal studies, analysis, and knowledge management center for assessing the threat and hazard associated with an accidental or intentional large-scale chemical event or chemical terrorism event in the United States. CSAC produces knowledge products based on its core capabilities – chemical hazard awareness and chemical hazard characterization – developed over 12 years. The current version of the CARD is TRL 9. Development of the next iteration of the CARD will start at TRL 5 and end at TRL 9 when it is launched.

Technical Readiness Level

The program began at TRL 5 and will end at TRL 9.

Transition Plans

CSAC knowledge products (e.g., chemical-related tailored assessments) will be in accordance with the requirements (scope, content, timeline) of the stakeholder requesting the product. CSAC will maintain its relationship with NCMI in order to launch the next iteration of the CARD.

Explosives Threat Assessment – FY 2018 Enacted: $18.2M. FY 2019 President's Budget: $18.2M. FY 2020 Request: $15.7M. This program researches and identifies current and potential explosive threats to understand the risk posed to the United States, strengthens aviation security by bolstering the international aviation security system, improves security processes and technologies, and encourages partnerships with industry. It encompasses risk-based threat characterization, attribution, strategic planning, prediction of magnitude of explosive disasters, and analytical technologies, strategies, and procedures.

Aircraft Vulnerability

- **Problem:** To determine the explosives that screening technologies need to detect, whether on passengers, in checked bags or air cargo, it is essential to first determine the effects that different explosive threats can cause to a variety of commercial aircraft. Vulnerability of the great variety of commercial aircraft types to the broad range of conventional and emerging improvised explosive device threat configurations is not thoroughly understood and/or characterized. This includes the blast effects vulnerability of new composite aircraft structures currently entering the civil transport fleet

- **Solution:** S&T is working to identify the minimum size of the explosive threat that would result in catastrophic aircraft loss and develop commercial aircraft blast mitigation technology that will provide protection to commercial aircraft.

- **Impact:** Commercial aircraft vulnerability data collected under this project will be used by TSA to validate and refine explosives detection standards for checkpoints, checked baggage, and air cargo. TSA will ensure that EDS threat mass detection thresholds are sufficient to prevent introduction of explosive threats onboard the aircraft that would otherwise result in catastrophic aircraft loss if detonated during operational flight. Blast mitigation efforts provide a means to reduce the vulnerability of commercial aircraft to internal explosive threats and form a basis for countermeasures that can be leveraged for non-aviation use by other DHS Components. Project efforts also support test and analysis that provide timely and pertinent information on commercial aircraft vulnerability to emerging terrorist-based explosive threats.

FY 2018 Key Milestone Events

- Conducted preliminary (unpressurized and pressurized) explosive vulnerability testing on narrow body commercial aircraft test asset and delivered report to TSA.
- Conducted testing to evaluate aircraft cabin pressurization effects on curved/complex composite panel designs subjected to internal blast loads and reported results to TSA.

FY 2019 Planned Key Milestone Events

- Deliver to TSA an updated classified commercial aircraft vulnerability analysis summary report, incorporating narrow and wide-body aircraft (aluminum and composite-based aircraft fuselage structures) explosive vulnerability live fire test data collected from FY 2017 - present.
- Complete live fire explosive validation testing of TSA specified Modified Least Risk Bomb Location Procedures (M-LRBL) and report results to TSA.

FY 2020 Planned Key Milestone Events

- Complete conventional (e.g., aluminum structures) airframe vulnerability testing and deliver updated vulnerability report to TSA.
- Complete and deliver to TSA Commercial Aircraft (aluminum structures) Explosive Vulnerability Analysis Tool.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$1,750	$2,550	$5,700	$6,200	$3,695
Obligations	$1,544	$2,302	$5,371	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conducted preliminary (unpressurized and pressurized) explosive vulnerability testing on narrow body commercial aircraft test asset and delivered report to TSA.	FY 2017 Q4	FY 2018 Q3
Conducted testing to evaluate aircraft cabin pressurization effects on curved/complex composite panel designs subjected to internal blast loads and reported results to TSA.	FY 2017 Q4	FY 2018 Q4
Conducted and documented (test plans and test reports) preliminary narrow body aircraft live fire explosive vulnerability testing (i.e. multiple tests with both pressurized and unpressurized conditions).	FY 2017 Q4	FY 2018 Q3
Conducted/completed live fire explosive vulnerability tests (multiple tests) on composite-construction commercial aircraft fuselage panels incorporating aircraft fuselage pressure differential.	FY 2017 Q4	FY 2018 Q4
Delivered DHS-SharePoint resident update (e.g.; incorporating user feedback and test reports/data updates) Explosive Test Database to TSA user community (TSA Explosive Specialists).	FY 2018 Q1	FY 2018 Q3
FY 2019		
Deliver updated (incorporating aluminum and composite aircraft structures explosive vulnerability test results) classified wide and narrow body commercial aircraft explosive vulnerability analysis report to TSA.	FY 2019 Q1	FY 2019 Q3
Complete live fire explosive validation testing of TSA specified M-LRBL and report results to TSA.	FY 2018 Q4	FY 2019 Q4
FY 2020		
Complete conventional (e.g., aluminum structures) airframe vulnerability testing and deliver updated vulnerability report to TSA	FY 2020 Q1	FY 2020 Q4
Complete and deliver to TSA Commercial Aircraft (aluminum structures) Explosive Vulnerability Analysis Tool.	FY 2020 Q1	FY 2020 Q4

Type of Research

Developmental

Technical Readiness Level

Completion of Threat Mitigation Unit (TMU) technology development at TRL 7.
Live fire test validated M-LRBL procedures at TRL 7.

Transition Plans

- Planned Demos and Deliverables/Transitions
  - Deliverable of preliminary blast testing of composite aircraft panels.
  - Demo – Explosive testing of explosive TMU.
  - Deliverable of multiple (2) full-scale TMU's (and associated TMU design package) to DHS Component customer for operational testing.
  - Demo – Modified Least Risk Bomb Location Procedures.
  - Deliverable of composite aircraft design blast testing and modeling report.

- Transition Products
  - Deliver knowledge products to TSA customer (e.g., Office of Security Operations Explosives Operations Branch OSO-EOB and Requirements and Capabilities Analysis-RCA) that support requirements development, risk assessment and policy decisions (e.g., setting minimum detection requirements).
  - Deliver technology and methodologies for blast mitigation protection of commercial aircraft (e.g., Least Risk Bomb Location Procedures).
  - Prototype explosive TMU finalized design and full-scale prototype(s) for DHS Component customer operational pilot.
  - Deliver updated Commercial Aircraft (aluminum fuselage structures) Explosive Vulnerability Analysis Tool (e.g.; BlastDam).

Homemade Explosives Characterization (HME)

- **Problem:** The HME Program's primary mission is to mitigate against the effects of HME/Improvized Explosive Device (IED) borne terrorist attacks.

- **Solution:** The Program provides a path forward for HME threat solutions, concentrating on detection signatures as well as validated characterization and testing procedures for HME threat materials and devices. The HME Program provides solutions to a wide array of HME threat areas. The HME Program provides solutions to a wide array of HME threat areas. The development of tools with the ability to preempt, detect, or mitigate HME threats impacts and increases national resiliency and is a measure of the program's success. Starting in FY 2019, the Program will be working with TSA to track metrics of success through checkpoint index testing.

- **Impact:** The HME Program is affecting future operations. HME Program results have allowed TSA to develop and field more effective transportation security equipment, provide better training to front line personnel, and validate and monitor continuing and emerging threats. In addition, The program provides and transitions products that are essential to the mission of several other key DHS Components including CISA, USSS, and CBP. The tools, modeling and risk mitigation projects undertaken by the HME Program are front line products that protect national security and resiliency.

FY 2018 Key Milestone Events

- Transitioned software training package for X-ray image recognition to the DHS customer.
- Completed testing on a large scale Vehicle Borne Improvised Explosive Device test at S&T's Tyndall Reactive Materials Group laboratory in Panama City, Florida.

FY 2019 Planned Key Milestone Events

- Initiate a baseline for red teaming practices and TSA capabilities across various security systems to measure performance enhancements over time as training, system enhancements and TTPs work to strengthen security measures. This index testing will measure the success of DHS S&T and TSA investments.
- Deliver threat library data set to TSA for the Passenger Baggage Object Database, an extensible repository of images and metadata related to aviation security inspection modalities that can be provided as a common standard data set for third party developers of automated threat recognition algorithms.

FY 2020 Planned Key Milestone Events

- The HME Regions of Responsibility (RORs) transitioned in FY 2018 will be deployed at the checkpoint.
- Transition chemical RORs to TSA RCA.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	$8,750	$8,550	$12,500	$12,000	$12,000
Obligations	$7,963	$7,711	$10,392	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Completed and delivered certification guidelines to a Certified Blast Protection Professional qualificationto to a Certified Blast Protection Professional qualification	FY 2016 Q2	FY 2018 Q3
Transitioned software training package for X-ray image recognition to DHS customer.	FY 2016 Q4	FY 2018 Q2
Delivered complete literature review on Chemical Facility Anti-Terrorism Standards Chemicals of Interest. This review will be critical in informing sequential tasks in support of CISA upcoming Notice for Proposed Rule Making	FY 2017 Q4	FY 2018 Q2
Deliver explosive characterization and equivalency information to TSA for updating their detection standards	FY 2015 Q4	FY 2018 Q4
Delivered two DTRA/SCC-WMD hosted VAPO classroom training courses and product transitions to six major Federal, State and Local government end users	FY 2016 Q3	FY 2018 Q4
Conducted explosive material characterization studies against the DSARM threat list and incorporated the study's results into the TSA detection standards.	FY 2018 Q1	FY 2018 Q4
Developed and transitioned explosive characterization training products to TSA Intelligence Operations for use in classroom exercises	FY 2018 Q1	FY 2018 Q4
Completed development and delivered a PED application prototype for enhanced checkpoint screening	FY 2017 Q4	FY 2018 Q4
FY 2019		
Deliver threat library data set to TSA for the Passenger Baggage Object Database, an extensible repository of images and metadata related to aviation security inspection modalities that can be provided as a common standard data set for third party developers of automated threat recognition algorithms.	FY 2019 Q1	FY 2019 Q4
Deliver characterization data on five additional HME formulations by the Israel Security Agency. This data will aid the HME Program to deliver data to the TSA and vendors for algorithm development, certification of equipment and ultimately impact Checkpoint and Checked Bag capabilities at the airport.	FY 2019 Q2	FY 2019 Q4
Deliver precursor percentage data to CFATS from Federal Bureau of Investigation studies and hold first meeting on Global Initiative on precursor percentage regulations.	FY 2016 Q1	FY 2019 Q2
Develop a C-4 Equivalency and data upload for the Scenario and Target Relevant Explosive Equivalency Tool, a software tool which calculates scenario-appropriate explosive equivalence for a wide variety of explosive materials for improving the TSA detection standards and vulnerability assessments.	FY 2018 Q3	FY 2019 Q2
Conduct an explosives simulant validation and verification methodology for x-ray signatures to enable the completion of a pilot study.	FY 2016 Q1	FY 2019 Q2
FY 2020		
HME RORs for APSS 6.2 are transitioned to the checkpoint.	FY 2020 Q1	FY 2020 Q4
Deliver first index testing baseline to TSA OOI.	FY 2020 Q2	FY 2020 Q4
Deliver HExCAT consequence modeling to DHS Components.	FY 2019 Q4	FY 2020 Q4
Deliver report on lowering HME false alarms to the TSA.	FY 2020 Q1	FY 2020 Q4
Deliver small scale safety test results on 20 materials from the Chemical Facility Anti-Terrorism Standards Chemicals of Interest.	FY 2020 Q1	FY 2020 Q4
Initiate simulant validation results to the TSA and other Stakeholders.	FY 2020 Q1	FY 2020 Q4

Type of Research
Applied

Technical Readiness Level
The program began at TRL 6 and will end at TRL 7.

Transition Plans
- Provide a comprehensive multi day Red Team Training course to both the Federal Protective Service and TSA Red Team Members, Red Team trainers, and index yearly testing results.
- Delivered Homemade Explosives Training course for TSA-Office of Security Operations.
- Transfer a law enforcement version of VAPO to the DHS Federal Protective Service and the Philadelphia Police Department after providing these end users with DTRA/SCC- WMD hosted VAPO classroom training courses to enable them to effectively use the tool.
- Provide study results to support TSA Freight and Rail Security Policy and Industry Partners. This will enable the development of more effective transportation infrastructure risk mitigation plans and Government supported voluntary self-regulation considerations.
- Deliver test data and videos to TSA Special Operations Division's Red Team in support of TSA's Congressional mandate to perform access control testing.
- Deliver a decision support tool prototype to the TSA which will provide enhanced detection capabilities complementary to X-ray imaging offering additional screening measures for Passenger's PEDs such as laptop computers in their carry-on bags at checkpoints.
- Transition and implement guidelines for a Certified Blast Protection Professional consisting of a credentialing model framework and best-practice knowledge, skills, and abilities for architectural and engineering professionals engaged in characterizing or mitigating the hazardous effects of explosives to the National Institute for Certification in Engineering Technologies.
- Deliver a standard energetic film aimed to minimize the variability in major factors to support inter and intra laboratory comparison of homemade explosives sensitivity data as well as identification of system changes or malfunctions improving the safety posture of the entire explosives safety testing community.
- Develop and transition a C-4 Equivalency and data upload for the Scenario and Target Relevant Explosive Equivalency Tool. This tool will improve the TSA detection standards and their vulnerability assessments.
- Provide precursor percentage data to CFATS studies, in partnership with the FBI to CISA to inform the Global Initiative on precursor percentage regulations.

Hostile Behavior Predict and Detect – FY 2018 Enacted: $24.0M. FY 2019 President's Budget: $22.0M. FY 2020 Request: $20.0M. This program leverages social and behavioral science research, data, and theory to understand the determinants and timing of group conversions to terrorism and the intent to engage in violence. Knowledge from this program informs analytical, operational, and policy concerns related to terrorists and terrorist activities. This program also develops and builds the capability to noninvasively detect suspicious behavior that indicates the intent to cause harm.

Actionable Indicators and Countermeasures

- **Problem:** Despite the immense cost of life and property associated with terrorism, challenges persist in our ability to prevent the threat of terrorism. The drivers behind violent extremism and the best methods of mitigating the risk of terrorism are not fully understood. Analyses of extremist violence are currently based on case studies as well as empirical, quantitative data (developed by S&T), but the effectiveness of terrorism prevention (TP) programs are often not clear.

- **Solution:** S&T conducts evidence-based research to meet the policy, operational and public needs to improve the effectiveness of violence prevention and intervention efforts implemented by federal, state, local, tribal, territorial and non-governmental stakeholders. This includes independent evaluation research, innovative capability development, and data analysis and development. Three strategic insights inform and motivate S&T's role in supporting U.S. government efforts to prevent terrorism: (a) understanding individuals' motives both for engaging in, and disengaging from, violent extremism; (b) developing and supporting locally-tailored interventions with local partners; and (c) evaluating the effectiveness of such interventions.

- **Impact:** New capabilities will support more efficient and accurate analysis of the threats posed by violent extremists and evidence-based TP policies, programs, and interventions. This project improves the capability of the I&A DHS Fusion Center analysts and Federal, state, and local law enforcement to identify indicators that individuals and groups are moving toward extremist violence. It will also support the Office of Terrorism Prevention Partnerships (OTPP), Offices of the Principal Deputy Counterterrorism Coordinator, Policy, Civil Rights and Civil Liberties, and local TP practitioners in assessing the impacts of policies and programs developed to counter violent extremism. S&T directly supports the Department's terrorism prevention mission, conducting applied research to deliver new capabilities and evaluate the impacts of programs and policies to build the evidence base of what works.

FY 2018 Key Milestone Events

- Developed a data and literature library on government TP policies, programs, and operational activities to establish an operational roadmap.
- Developed a catalog of common metrics used by evaluators of local extremist violence prevention and intervention programs internationally.

FY 2019 Planned Key Milestone Events

- Conduct at least two qualitative data collection activities with prospective grantees.
- Conduct program evaluations of OTPP funded terrorism prevention programs for three grantees. Deliver results on scalability and sustainability to DHS and practitioners.

FY 2020 Planned Key Milestone Events

- N/A

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$2,500	$1,000	$1,000	$1,000	-
Obligations	$1,762	$891	$585	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Deliver International Expert Engagement Final Report	FY 2017 Q2	FY 2018 Q1
Deliver Impact Evaluation in Los Angeles and Boston.	FY 2017 Q1	FY 2018 Q2
Transition common metrics used for evaluation by the international community to researchers and community stakeholders.	FY 2017 Q3	FY 2018 Q2
Deliver metrics and evaluation of Community Awareness Briefings to OTTP.	FY 2017 Q3	FY 2018 Q3
Conduct a process evaluation for hotline protocols.	FY 2018 Q1	FY 2018 Q4
Finalize data and literature library for TP.	FY 2016 Q1	FY 2018 Q1
FY 2019		
Deliver an evaluation of hotline protocols.	FY 2019 Q1	FY 2019 Q2
Develop a crowdsourcing app to identify available and appropriate violence prevention social services.	FY 2019 Q1	FY 2019 Q3
Conduct at least two qualitative data collection activities with prospective grantees.	FY 2019 Q1	FY 2019 Q4
Catalog how individual risk and need assessments are currently used in terrorism prevention.	FY 2019 Q1	FY 2019 Q4
Produce two systematic evidence reviews to determine the efficacy of programs, policy, techniques, and procedures for the prevention of terrorism with U.S. Department of Justice (USDOJ)/NIJ, Australia, Canada, New Zealand, and the United Kingdom.	FY 2019 Q1	FY 2019 Q4
Conduct program evaluations of OTPP funded terrorism prevention programs for three grantees. Deliver results on scalability and sustainability to DHS and practitioners.	FY 2019 Q1	FY 2019 Q4

Type of Research

Applied

Technical Readiness Level

TRL will vary between specific portfolio projects.

Transition Plans

- Tools such as databases will be maintained by the researchers who create them for the public good.
- Tools and techniques that are developed for local use are adopted, piloted, evaluated for impact and consequences, and transferred.

Counter Unmanned Aviation Systems / Non-Traditional Aviation Technologies (NTAT) and Autonomous Systems (AS)

- **Problem:** Recent technology advances have resulted in a flood of inexpensive and easily obtainable small UAS for multiple uses. DHS is responsible for the protection of critical infrastructure and assets against UAS nefarious use. Currently, DHS operating components have limited capabilities to detect, track, and classify UAS. With the recent authorization, DHS components are working on developing the capability to mitigate the threat of nefarious UAS use. DHS Component's differing missions and environments require different solutions. As such, there is no "one size fits all" solution. Furthermore, given the rapid proliferation of highly capable UAS in the market and their ever increasing capabilities, DHS S&T must ensure the development of capabilities that predict and characterize future UAS threats and guide/incubate advanced countermeasures.

- **Solution:** The program will: (1) identify DHS Component operational requirements based on their specific mission sets; (2) identify potential COTS solutions that might meet Component operational requirements; (3) modify/tailor/adapt COTS and other mature technologies to address urgent needs that cannot be met by COTS; (4) conduct rapid test and evaluation of these adaptation/modifications in support of Component acquisitions; (5) determine the direction of UAS technology advancement in the far term to inform RD&I efforts to counter these improvements; (6) leverage industry and schools of higher education in the creation of novel technical methods to defeat UAS through the use of challenge events; and (7) pursue technologies that can exploit the nascent Unmanned Traffic Management system to help determine friend vs. foe UAS in the national airspace.

- **Impact:** Well defined and validated DHS Component Counter-UAS (CUAS) requirements. Component acquisition strategies are well advised based on S&T's knowledge of the state of the market, which is obtained by periodical testing and evaluation of COTS and GOTS CUAS systems. Most suitable COTS, GOTS and mature CUAS technologies are recommended for operational evaluation and/or extended user evaluation. Urgent needs that cannot be met by COTS are addressed and solutions developed and delivered to meet Components specific requirements. The planning of security postures for National Special Security Events and other high priority events are well advised by S&T, especially regarding the CUAS sensor layout.

FY 2018 Key Milestone Events

- Upgraded Counter UAS Capability Advisory & Review Toolkit (CSMART) with geospatial information system extensions and virtual reality capabilities to improve accuracy and ease of use.
- Delivered an Initial Operational Capability (IOC) for the Urban CUAS Operational Prototype (UCOP) platform.

FY 2019 Planned Key Milestone Events

- Execute UAS Traffic Management UCOP demonstration.
- Initiate transition of CSMART to component.

FY 2020 Planned Key Milestone Events

- Initiate implementation of CUAS systems to identified component "covered" facilities.
- Initiate implementation of CUAS systems on the northern border.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$20,000	$19,386	$19,000	$19,000	$11,000
Obligations	$19,168	$17,576	$15,525	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Upgrade CSMART for geospatial and virtual reality.	FY 2018 Q1	FY 2018 Q3
Developed and Delivered upgraded capability for a DHS Component.	FY 2018 Q2	FY 2018 Q3
Achieve IOC for the UCOP platform.	FY 2018 Q2	FY 2018 Q4
Completed Phase 2 of Technical Assessment of Counter Unmanned Aerial Systems Technologies in Cities (TACTIC).	FY 2018 Q1	FY 2018 Q1
Establish the CUAS Sub-IPT.	FY 2018 Q1	FY 2018 Q2
Completed the National Capital Region CUAS Interoperability Simulation Experiment.	FY 2018 Q2	FY 2018 Q2
FY 2019		
Begin development of additional upgrades of UCOP platform.	FY 2019 Q1	FY 2020 Q4
Review of Future UAS Threat Capabilities Analysis at a Future Threat Workshop.	FY 2018 Q3	FY 2019 Q1
Delivery of Unmanned Traffic Management Service Supplier security interface source code.	FY 2018 Q4	FY 2019 Q4
Execute UAS Traffic Management UCOP demonstration.	FY 2018 Q4	FY 2019 Q4
Initiate transition of CSMART to component.	FY 2018 Q4	FY 2019 Q4
FY 2020		
Reach Operational Capability for Urban Prototype Spiral 2.	FY 2020 Q1	FY 2020 Q4
Implement CUAS systems to covered facilities and the northern border.	FY 2018 Q4	FY 2020 Q3
Drone Mitigation Challenge.	FY 2018 Q4	FY 2020 Q1

Type of Research

Developmental and applied, depending on specific efforts.

Technical Readiness Level

TRL varies for specific portfolio projects between TRL-5 and TRL-7.

Transition Plans

- The UCOP will be an enduring T&E capability for S&T in partnership with the as well as other DHS components with CUAS equities. UCOP validated technologies will transition as interim or permanent operational capabilities for USSS and other components. The CUAS T&E Effort will use a standardized and scalable test methodology leveraging the work developed by SNLs Physical Security Center of Excellence during the National Nuclear Security Administration Enterprise CUAS (E-CUAS) program. The transition deliverable will be thorough, objective technical analysis in the form of an actionable final report.
- The C-SMART Tool will transition and be used to support operational missions and acquisition decisions by DHS, DOJ/FBI and state and local law enforcement.
- Transition CUAS Systems to protect component identified high priority facilities.
- Transition CUAS Systems installed on the northern border.

Enabling UAS Technologies

- **Problem:** UAS have increased in capability dramatically in recent years and offer substantial opportunities to support the missions of all first response domains: law enforcement, firefighting, emergency medical services, emergency management, hazardous materials (HAZMAT), search and rescue and corrections. As UAS become increasingly integrated into the National Air Space, overcoming uncertainties in the limitations and legal requirements for their use, first responders need information on what vehicles and sensor packages meet their mission requirements, standard operating procedures for their use and guidance for integrating them into the entirety of their first response missions.

- **Solution:** The project is divided into three initiatives: (1) testing and evaluation of platforms and sensor packages against the operational needs of first responders' field operations, (2) exercises to demonstrate and analyze the integration of UAS into the larger first response environment and (3) behavioral research into the public acceptability of UAS use by first responders in relation to such issues as privacy protection and public fears of accidents or property damage.

- **Impact:** With support from S&T, first responders at the local, county and state levels will be able to invest cost-effectively in UAS platforms, sensors and ground control equipment that meet mission needs. The immediate impact to public safety and DHS is that it will: a) increase the safe use of sUAS at disasters such as hurricanes, earthquakes and industrial accidents through understanding what support tools and protocols should be recommended or required; b) create training modules on human performance and the use of support tools and protocols to be incorporated into sUAS training for public safety.

FY 2018 Key Milestone Events

- Identified and refined testing requirements from the first responder community at the first Focus Group convened for the First Responder Robotics System Test (FRROST) program.
- Developed and prioritized a list of test scenarios for the first responder mission at the FRROST Focus Group.

FY 2019 Planned Key Milestone Events

- Conduct FRROST operational tests on UAS systems supporting Monitoring and Surveillance operations and, if possible, Tactical Operations.
- Conduct Disaster Response/Public Safety UAS Exercises.

FY 2020 Planned Key Milestone Events

- Perform operational assessment of identified SUAS Sensors.
- Identification of training modules to be evaluated and refined.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	$4,000	$2,000	$9,000
Obligations	-	-	$761	-	-

Project Schedule

Research & Development Description	Plan Start Date	Planned Completion
FY 2018		
Identified and refined testing requirements for FRROST.	FY 2018 Q2	FY 2018 Q3
Developed and prioritized a list of test scenarios for the First Responder Mission at the FRROST Focus Group.	FY 2018 Q3	Ongoing
FY 2019		
Conduct FRROST.	FY 2019 Q1	FY 2019 Q4
Conduct Disaster Response/Public Safety UAS Exercises.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Perform operational assessment of identified SUAS Sensors.	FY 2020 Q1	FY 2020 Q4
Identification of training modules.	FY 2020 Q3	FY 2021 Q4

Type of Research
Applied

Technical Readiness Level
TRL 3, but may vary depending on specific efforts.

Transition Plans
- The project's test and evaluation results and associated analyses will be made available to first responder and emergency management service organizations at all levels.
- Directly involve first responder organizations in exercises to increase their knowledge and experience with UAS.

Identity Management Program – FY 2018 Enacted: $1.5M. FY 2019 President's Budget: $1.5M. FY 2020 Request: $1.5M. This program researches and develops biometrics-based technologies, procedures, CONOPS, and information to identify known terrorists and criminals and prevent their movement into and out of the United States through effective, interoperable multi-biometrics in diverse areas, including border crossings, ports of entry, and visa application sites.

Digital Forensics

- **Problem:** Child sexual and physical exploitation is exploding online, and law enforcement officials need new tools to combat it. At any given time, there are more than 300 darknet boards with more than 500,000 members with the sole purpose of facilitating the exchange of child exploitation material. There are over 220 million child exploitation images in the current database. Each week over 900,000 images are seized in new child exploitation cases and growing exponentially with only 6,000 law enforcement personnel available to fight child exploitation, agents are overwhelmed and outnumbered by perpetrators. New digital forensic technologies are becoming available and need to be transitioned into law enforcement forensic tools. It is also imperative to improve the ability to identify perpetrators by providing research into the social and behavioral factors that can be used to identify human traffickers and perpetrators of child exploitation.

- **Solution:** This program will design, develop, test and integrate new innovative technologies that will give law enforcement agents the ability to sift through massive amounts of digital data much quicker than their current manual process and therefore locate crime scenes, identify and rescue the children, and identify their perpetrators much faster. In addition, DHS S&T will conduct evidence-based research to meet the policy, operational and public needs to improve the effectiveness of understanding how to identify human traffickers and perpetrators of child exploitation on and off line.

- **Impact:** This program will provide agents with the ability to dramatically speed up the process of initial triage and the subsequent necessary forensic deep dive analysis of seized child exploitation digital imagery, increasing an agent's effectiveness while drastically limiting the amount of time an agent must subject themselves to traumatizing material, thus increasing the number of children recognized and therefore saved from a life of abuse. New capabilities will support more efficient and accurate analysis. This project improves the capability of ICE.

Sub Projects

- *Human Trafficking Systems Analysis & Technology Roadmap:* Through stakeholder engagement, identify technology gaps and provide recommendations for near, mid-, and long-term development and implementation.
- *Matrix and Taxonomy- Human Trafficking:* Map government agencies and non-governmental organizations active in anti-trafficking efforts, including their relationships with each other. Identify and matrix characteristics of several types of trafficking to begin to identify indicators, signatures, pathways, and potential overlaps.
- *Facilitation and Outcomes Analysis of the 5RD Workshop to Combat Child Exploitation:* Convene government agencies and law enforcement organizations from Australia, Canada, New Zealand, the United Kingdom, and the United States to exchange information, identify common priorities, and coordinate applied R&D efforts in countering child exploitation.
- *Improving Child Exploitation Tip Prioritization and Utility:* Enhance the child exploitation reporting process by: (1) working with subject matter experts to develop a reporting template that meets the needs of law enforcement and CSPs/ISPs (2) identifying feedback that can be shared with ISPs/CSPs, e.g., information that led to law enforcement action, to encourage these entities to actively participate in the process by demonstrating return on investment.
- *Child Exploitation Image Analysis Project:* Design, develop, test and integrate new face, text and object detection and recognition algorithms that will allow agents to sift through massive amounts of data much faster and efficiently than their current manual process.
- *Camera ID Project:* Design, develop, test and integrate new algorithms that characterize a camera's sensor pattern noise (like finger prints for each individual camera) allowing forensic analysts to match still and video images from the same camera thus giving law enforcement officers the ability to identify and locate victims and perpetrators when the illicit material does not include faces but other non-illicit material from the same camera does. This work will also allow forensic analysts to cluster images from the same camera based on the sensor noise pattern (unique signature/fingerprint) which will drastically reduce the amount of time necessary to locate victims and perpetrators.
- *Language ID Tool:* Develop, test and integrate language ID into current forensic tools. This new capability will allow forensic analysts to quickly determine what sections of video digital imagery contains voice and what language is spoken.
- *Auto Categorization Tool:* Develop, test, and operationalize a matrix categorization framework for an automated categorization tool that will assist international agents in sharing seized images and videos. The tool will automatically categorize media in United States, United Kingdom, Canada, New Zealand, and Australia to relieve agents from having to re-categorize when media is received from foreign partners.
- *War Criminal Identification Project:* Develop, test, and integrate algorithms into the Human Rights Violators & War Criminal Unit forensic tools at ICE-HSI. The goal of these tools is to assist agents in identifying war criminals and victims in images and videos where agents currently have little access to facial recognition technology.

FY 2018 Key Milestone Events

- Developed a software development kit, application programming interface, and data interchange format in preparation for a full system integration of sensor pattern noise algorithms for Camera ID (uses complementary metal–oxide–semiconductor anomalies to identify pictures taken from the same camera).
- Performed operational test pilot of operationalized IARPA Janus face recognition algorithms.

FY 2019 Planned Key Milestone Events

- Develop and test machine learning (training) capability for the IARPA Janus face recognition algorithms.
- Develop sensor pattern noise algorithms to scale searching 200 million digital images.

FY 2020 Planned Key Milestone Events

- Transition trainable face recognition algorithms into ICE-HSI digital forensic tool.
- Test sensor pattern noise algorithms using the camera's imprint as a disruptive technology to match digital imagery when Extensible Image File (EXIF) data (e.g., make, model, serial number) is missing.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017[16]	FY 2018	FY 2019	FY 2020
Project Funding	-	-	$1,500	$1,500	$1,500
Obligations	-	$682	$1,272	-	-

[16] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Complete testing and piloting face detection and recognition algorithms. Integrate, test and pilot new sensor pattern noise algorithms within current forensic tool that will give law enforcement agents the ability to sift through massive amounts of data much quicker than their current manual process and therefore locate victims and perpetrators much faster.	FY 2018	FY 2019
Human Trafficking Systems Analysis & Technology Roadmap: Through stakeholder engagement, identify technology gaps and provide recommendations for near, mid-, and long-term development and implementation.	FY 2018	FY 2019
Matrix and Taxonomy- Human Trafficking: Map government agencies and non-governmental organizations active in anti-trafficking efforts, including their relationships with each other. Identify and matrix characteristics of several types of trafficking to begin to identify indicators, signatures, pathways, and potential overlaps.	FY 2018	FY 2019
Facilitation and Analysis of the 5RD Workshop to Combat Child Exploitation: Convene government agencies and law enforcement organizations from Australia, Canada, New Zealand, the United Kingdom, and the United States to exchange information, identify common priorities, and coordinate applied research and development (R&D) efforts in countering child exploitation.	FY 2018	FY 2019
FY 2019		
Complete development of sensor pattern noise algorithms to scale to searching 200 million digital images in order to fully aide forensic law enforcement officials against human trafficking and child exploitation. Scaling algorithms to search this massive amount of data will require additional research and development to complete and verify operational effectiveness.	FY 2018 Q4	FY 2019 Q3
Improving Child Exploitation Tip Prioritization and Utility: Enhance the child exploitation reporting process by: (1) working with subject matter experts to develop a reporting template that meets the needs of law enforcement and CSPs/ISPs (2) identifying feedback that can be shared with ISPs/CSPs, e.g. information that led to law enforcement action, to encourage these entities to actively participate in the process by demonstrating return on investment.	FY 2018 Q4	FY 2020 Q2
Form an international, collaborative R&D working group and framework focused on Countering Child Exploitation with the 5RD partners with the goals of identify operational gaps and solutions, increase information sharing, and pool resources among parties.	FY 2018 Q4	FY 2020 Q4
Develop, test, and operationalize a matrix categorization framework for an automated categorization tool that will assist international agents in sharing seized images and videos. The tool will automatically categorize media in United States, United Kingdom, Canada, New Zealand, and Australia to relieve agents from having to re-categorize when media is received from foreign partners.	FY 2019 Q1	FY 2019 Q4
Develop the ability to scrape the dark web for child exploitation imagery to include human trafficking, sex abuse and child war criminals. Isolate faces from this imagery and format it for ingestion by the DHS IDENT database for use by DHS operational Components (and other trusted government agencies) who routinely screen people.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Pursue Electronic Noise Frequency as a program if the science is mature.	FY 2020 Q2	FY 2021 Q4
Transition trainable face recognition algorithms into ICE-HSI digital forensic tool.	FY 2020 Q1	FY 2020 Q4
Test sensor pattern noise algorithms using the camera's Complementary metal–oxide–semiconductor imprint as a disruptive technology to match digital imagery when EXIF data (make, model, serial number) is missing.	FY 2019 Q1	FY 2020 Q2

Type of Research

Applied

Technical Readiness Level

TRL will vary between specific portfolio projects.
Child Exploitation Image Analysis Project: TRL 6
Camera ID Project: TRL 5
Language ID Project: TRL 6
Auto-Categorization Tool: TRL 4
War Criminal Tool: TRL 5

Transition Plans

- *Child Exploitation Image Analysis Project:* Technology Transition Agreement signed between S&T and ICE Child Exploitation Investigations Unit (CEIU) who stress their need for these technologies and operational ease in integrating new algorithms to their current forensic tool set for immediate operational use.
- *Camera ID Project:* Technology Transition Agreement signed between S&T and ICE CEIU who stress their need for these technologies and operational ease in integrating new algorithms to their current forensic tool set for immediate operational use.
- *Language ID Project:* ICE HSI will integrate this technology using the existing signed Technology Transition Agreement
- *Auto-Categorization Tool:* ICE HSI will integrate this technology using the existing signed Technology Transition Agreement
- *War Criminal Tool:* Human Rights Violators & War Criminals Unit at ICE HSI will integrate tools into their existing forensics tools.

FIRST RESPONDER / DISASTER RESILIENCE THRUST – Work includes reduction of vulnerability of critical infrastructure, key leadership, and events to terrorist attacks and other hazards; working with state, local, tribal, and territorial governments to secure their information systems; working with local and regional partners to identify hazards, assess vulnerabilities, and develop strategies to manage risks associated with all hazards; increasing the level of preparedness of state, local, regional, tribal, and territorial partners, as well as nongovernmental organizations, the private sector, and the general public; advancing and improving disaster emergency and interoperable communications capabilities; and, improving the capabilities of DHS to lead in emergency management.

Bioagent Attack Resiliency – FY 2018 Enacted: $26.2M. FY 2019 President's Budget: $5.0M. FY 2020 Request: $5.0M. This program provides advanced planning; develops CONOPS; develops and provides capabilities to support forensics, laboratory response, personnel protection, and decontamination; and utilizes exercises and training for responding to and recovering from a biological disaster.

USCG/EPA Wide Area/Vessel Decontamination Project

- **Problem:** A terrorist attack involving the release of an aerosolized biological agent, e.g. Bacillus anthracis spores, in a major metropolitan area, often located along a coastal region or inner waterway, will require field-tested methods to rapidly restore vital services and critical infrastructure necessary to serve and help protect the public. USCG operations, assets, and facilities would be adversely impacted by wide-area biological agent contamination. Methods and strategies for recovery from biological agent contamination – which include characterization, decontamination, waste management – have to date only been proven effective and scalable for indoor locations. Field-tested methods for recovery of outdoor areas and key DHS Component assets are needed to minimize the impact on DHS missions to serve and protect the public.

- **Solution:** Develop and field test methods for rapid characterization of a wide-area biological agent event, decontamination techniques, and waste management procedures that would address fate and transport, including natural weathering, to inform response and remediation decisions.

- **Impact:** Effective and efficient methods for rapid recovery of large metropolitan regions, coastal areas, and critical government assets following a wide-area biological contamination event will have been demonstrated. The USCG will benefit by rapid return-to-service of vessels, rotary wing assets and port facilities to enable continuity of mission responsibilities to protect and defend the coastal regions and waterways of the homeland. More broadly, the field-tested methods will enable faster re-occupation by the public of populated areas and instill confidence in the safety of natural resources (e.g., drinking water).

FY 2018 Key Milestone Events

- Initiated Wide-area Decontamination project.

FY 2019 Planned Key Milestone Events

- Conduct field demonstration of sampling, decontamination and waste management methods and strategies for USCG small vessels.
- Complete laboratory evaluation of decontamination options for urban areas and USCG assets.

FY 2020 Planned Key Milestone Events

- Complete decontamination decision support tool for a wide area biological agent incident, incorporating developed methods for urban areas, vegetation, critical infrastructure and USCG assets.
- Complete waste management decision support tool for a wide area biological agent incident, including pre-incident waste management planning.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	$3,000	$3,000	$3,000
Obligations	-	-	$2,402	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Initiated Wide-area Decontamination project.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Evaluate decontamination options for urban areas and USCG assets.	FY 2019 Q1	FY 2019 Q4
Conduct field demonstration of sampling, decontamination and waste management methods and strategies for USCG small vessels.	FY 2019 Q1	FY 2019 Q4
Complete laboratory evaluation of decontamination options for urban areas and USCG assets.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Develop wide area sampling methods for outdoor matrices and USCG, vehicles and vessels.	FY 2018 Q3	FY 2020 Q2
Evaluate fate/transport/weathering of spores on various surfaces to inform mitigation and sampling strategies.	FY 2018 Q3	FY 2020 Q2
Plan and execute demonstration of sampling, decontamination and waste management techniques for bacterial spores on USCG vessel.	FY 2019 Q1	FY 2020 Q1
Complete decontamination decision support tool for a wide area biological agent incident, incorporating developed methods for urban areas, vegetation, critical infrastructure and USCG assets.	FY 2020 Q1	FY 2020 Q4
Complete waste management decision support tool for a wide area biological agent incident, including pre-incident waste management planning.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied, Development, and Demonstration

Technical Readiness Level

TRL 4 & 6-7

Transition Plans

- Technology solutions and knowledge products, developed in accord with component requirements, will be transitioned to USCG and the Environmental Protection Agency for acquisition programs or preparedness planning.

Compact Personal Protective Equipment (CPPE)

- **Problem:** Law Enforcement VIP Protective Personnel lack an enhanced ability to discreetly carry Personal Protective Equipment (PPE) for the protection and safe extraction of senior leadership and other designated persons from a full range of operational environments where a hazardous CBR substance has been released. The lack of this enhanced ability can prolong exposure to a respiratory threat due to the inaccessibility of PPE in an emergency situation.

- **Solution:** A compact, lightweight 'hooded escape respirator' that can be rapidly deployed and provide respiratory protection against hazardous CBR substances, enable the user to breathe in an oxygen-deficient situation, and provide for visual acuity and oral communications. The escape hood must be certified by the National Institute for Occupational Safety and Health (NIOSH) as protective against CBR contaminants. These escape hoods are designed for use only in emergency situations for rapid egress from CBR-containing environments of individuals under the protection of First Responders and Law Enforcement.

- **Impact:** Improvements in Protective Personnel technology will enable more compact, readily accessible, equipment suitable for tactical emergency response operations in a contaminated environment. Personnel charged with protection of VIPs will be better able to discreetly carry the full ensemble of equipment in support of their mission without a need in a time-critical situation to return to a designated location to retrieve the PPE. The PPE will find use within the tribal, local, state, Federal law enforcement and First Responder communities.

FY 2018 Key Milestone Events

- Selected performer to develop and execute Prize Competition for compact emergency escape hood.

FY 2019 Planned Key Milestone Events

- Down-select winning prototype design among Prize Competition finalists.

FY 2020 Planned Key Milestone Events

- Award advanced development contract to Prize Competition winner.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	-	-	$2,000	$2,000	$2,000
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Selected performer(s) to design and execute Prize Competition for design of compact hooded escape respirator.	FY 2018 Q2	FY 2018 Q4
FY 2019		
Select winning prototype design/concept for compact escape hood respirator.	FY 2019 Q2	FY 2019 Q2
FY 2020		
Award advanced development contract to Prize Competition winner.	FY 2020 Q2	FY 2020 Q4
Complete preliminary and critical design reviews; develop test and evaluation master plan.	FY 2021 Q2	FY 2022 Q2

Type of Research

Applied, Demonstration and Development

Technical Readiness Level

TRL 3-4 & 6-7

Transition Plans

- Hooded escape respirators developed with NIOSH-certification for use by DHS Component, First Responders and Law Enforcement Community members.

Bio-Forensics R&D

- **Problem:** Bioforensics research and development is required to improve the ability to identify and characterize source material collected from a bio-crime in order to pursue legal prosecution against the responsible party (or parties). This research provides law enforcement investigators such as FBI and USSS with critical tools that provide investigative leads for attribution.

- **Solution:** This project develops advanced forensic capabilities to determine the source and production method of biological threat agents (BTAs) collected from crime scenes. Specifically, the project develops protocols for characterization and identification of BTAs, and utilizes a robust sample management, molecular signatures, and physical/chemical analysis research program. Bioforensics R&D is currently focused on establishing a methods-based approach to BTA characterization, which does not depend on prior knowledge of the organism and can detect novel and/or emerging organisms. Establishment of this approach includes development of orthogonal approaches to agent characterization initiation of an effort to build a national sequence database for whole genome comparison and development of computational algorithms for data analysis.

- **Impact:** The Bioforensics R&D project leads national research efforts in microbial forensics and transitions analytical techniques to the National Bio-forensics Analysis Center and other government stakeholders. The Bioforensics R&D project will support intelligence assessments, preparedness planning, response, emerging threat characterization, bioforensic analyses, and evidence associated with biocrime incidents.

FY 2018 Key Milestone Events

- Filled gaps in infectious organism biology and publish results to support legal admissibility of analytical results into court.
- Transitioned methods for ricin and abrin mass-spec-based identification and characterization to forensics investigations

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- N/A

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$6,500	$5,682	$5,682	-	-
Obligations	$3,114	$1,912	$5,056	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Developed analytical standards for whole genome sequencing.	FY 2018 Q1	FY 2018 Q4
Filled gaps in infectious organism biology and publish results to support legal admissibility of analytical results into court.	FY 2018 Q1	FY 2018 Q4
Developed methods that support definitive bioforensics identification and characterization for emerging, enhanced, chimeric, engineered and purely synthetic threat agents to forensics investigations.	FY 2018 Q1	FY 2018 Q4
Filled gaps in infectious organism biology and publish results to support legal admissibility of analytical results into court.	FY 2018 Q1	FY 2018 Q4
Developed methods that support definitive bioforensics identification and characterization for emerging, enhanced, chimeric, engineered, and purely synthetic threat agents to law enforcement.	FY 2018 Q1	FY 2018 Q4
Developed metagenomics and host based capabilities to support bioforensic casework.	FY 2018 Q1	FY 2018 Q4
Populated comparative genomics databases with emerging agent data.	FY 2018 Q1	FY 2018 Q4
Transitioned methods for ricin and abrin mass-spec-based identification and characterization to forensics investigations.	FY 2018 Q1	FY 2018 Q4
FY 2019		
N/A		
FY 2020		
N/A		

Type of Research

Applied

Technical Readiness Level

The program began at TRL 4 and will end at TRL 6.

Transition Plans

- N/A

Foreign Animal Disease Vaccine, Diagnostics & Countermeasures

- **Problem:** The United States is at risk for outbreaks of high-priority foreign animal diseases that would cause major economic disruption to the agriculture sector critical infrastructure resulting in billions of dollars of losses to U.S. livestock producers and the U.S. government. These diseases include Foot-and-Mouth Disease, Classical Swine Fever and African Swine Fever which may be introduced to the U.S. through natural, accidental, or deliberate means.

- **Solution:** This project provides new, next-generation vaccines and other countermeasures to government and industry stakeholders to ensure that United States Department of Agriculture (USDA) and other first responders in the animal agriculture community, have the countermeasures needed to effectively identify, respond and recover from foreign animal disease outbreaks. In addition to investing in novel technologies to rapidly respond to and recover from these threats, this project works with commercial animal health industry partners to ensure completion of U.S. regulatory requirements (master-seed, pre-licensing serials, clinical trials) for high-priority countermeasures so that they are readily available in an outbreak situation.

- **Impact:** This project strengthens the defense of the U.S. agricultural infrastructure by ensuring that USDA and other first responders in the animal agriculture community, have effective countermeasures needed to respond to foreign animal disease outbreaks. Efforts to develop multi-serotype countermeasures are underway to provide faster and more comprehensive protection to limit the spread and size of an outbreak. Data from this project will support the regulatory licensing and/or availability of new countermeasures in the event of a high-consequence outbreak in the United States.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- N/A

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$13,800	$15,496	$15,496	-	-
Obligations	$4,402	$1,637	$9,263	-	-

Project Schedule

N/A

Type of Research

Applied

Technical Readiness Level

This project funds the development of multiple vaccines, diagnostic assays, and molecular tools for new and more effective vaccines and diagnostics, the vast majority of which start at TRL 3 and end at TRL 7.

Transition Plans

- N/A

First Responder Capability – FY 2018 Enacted: $21.0M. FY 2019 President's Budget: $19.5M. FY 2020 Request: $17.5M. This program develops technologies, information, procedures, and CONOPS to aid first responders, emergency managers, and incident commanders as they respond to hazardous situations. It assists emergency response communities to establish requirements and tests technologies and assesses them for usability to help make the technologies available across all first responder communities.

Next Generation First Responder Program

- **Problem:** First responders rely primarily on disparate voice radio communications, limited network connectivity for data and video, and PPE with insufficient threat protection – each of which offers little or no access to available or advanced sensor technologies.

- **Solution:** The Next Generation First Responder (NGFR) program is developing a scalable and modular system that includes an enhanced duty uniform, personal protective equipment, wearable computing and sensing technology, and robust voice and data communication networks. In collaboration with Model & Simulation Engine, Communications & Networking, and Situational Awareness and Decision Support, NGFR will harness the best existing and emerging technologies and integrate them in a well-defined and standards-based open architecture.

- **Impact:** NGFR's cutting-edge technologies accelerate decision-making and improve response to better safeguard lives and property before, during, and after incidents.

FY 2018 Key Milestone Events

- Conducted a PlugFest with industry vendors relevant to at least one portion of the NGFR system architecture (e.g., wearables).
- Published recommendations to better prepare public safety agencies to counter electronic threats, using the analysis from the 2017 First Responder Electronic Jamming Exercise.

FY 2019 Planned Key Milestone Events

- Conduct a Technology Integration Demonstration event (Spiral 4), incorporating additional technologies and functionality from the Spiral 3 and PlugFest events, including environmental and physiological monitoring augmented intelligence-enabled data synthesis, and personal protective equipment.
- Transition, commercialize, or make available through open source platforms at least three technologies (e.g., analyses, models, technology prototypes and/or knowledge products).

FY 2020 Planned Key Milestone Events

- N/A

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$4,542	$4,546	$5,000	$4,546	-
Obligations	$3,971	$4,069	$3,498	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conduct a PlugFest with industry vendors relevant to at least one portion of the NGFR system architecture (e.g., wearables).	FY 2018 Q1	FY 2018 Q2
Develop working draft of the NGFR Interface Control Document to raise industry awareness of the standards, data formats and interfaces NGFR devises are using.	FY 2018 Q3	FY 2018 Q3
Publish recommendations to better prepare public safety agencies to counter electronic threats, using the analysis from the 2017 First Responder Electronic Jamming Exercise.	FY 2018 Q2	FY 2018 Q4
FY 2019		
Conduct a Technology Integration Demonstration event (Spiral 4), incorporating additional technologies and functionality from the Spiral 3 and PlugFest events, including environmental and physiological monitoring augmented intelligence-enabled data synthesis, and personal protective equipment.	FY 2019 Q1	FY 2019 Q4
Complete evaluation of stress on learning.	FY 2019 Q1	FY 2019 Q1
Conduct an operation exercise (Spiral 3) with state and local partners to assess integration of specifically identified open architecture technologies for first responders.	FY 2018 Q3	FY 2019 Q1
Conduct an experiment to assess how the Assistant for Understanding Data through Reasoning, Extraction, and sYnthesis (AUDREY) artificial intelligence and data analytics capabilities can enhance paramedic decision-making and help improve patient outcomes.	FY 2019 Q1	FY 2019 Q3
Transition, commercialize, or make available through open source platforms at least three technologies (e.g., analyses, models, technology prototypes and/or knowledge products).	FY 2019 Q2	FY 2019 Q4
FY 2020		
N/A		

Type of Research

Developmental

Technical Readiness Level

The program begins at TRL 2 and ends at TRL 6.

Transition Plans

- S&T has initiated a portfolio approach to integration of capabilities for the NGFR program. All initiatives are assessed against an architectural system framework to determine functional and operational requirements that are then integrated into the NGFR spiral demonstrations. All analyses, models, prototypes, and knowledge products must demonstrate an interoperable approach, allowing a services-based approach using open standards that allows industry to propose enhanced products to integrate with the NGFR capabilities.
- NGFR technologies will be considered for inclusion on the FEMA Approved Equipment List for DHS state and local grant funding.
- NGFR's commitment to a modular design, interoperability, open source standards, and continual engagement with industry will facilitate transition. Technologies developed under the NGFR program are required to interface or integrate using open standards, which will allow responder organizations to incrementally acquire new NGFR capabilities while extending the life of legacy systems.
- In addition, NGFR technologies can "plug-and-play" with commercial technologies that are not typically considered part of the first responder market (i.e., health sensors for athletes), increasing dual use for secondary markets and allowing first responder organizations to custom-build the suite of NGFR-compatible technologies that mission requirements and resource constraints.
- The NGFR program will collaborate with industry and identify key partners to test interoperability of commercially available sensors and communications equipment with the NGFR system in concert with NGFR spiral demonstrations.

First Responder Technologies

- **Problem:** The response environment that our nation's first responders operate in on a day to day basis is constantly changing and requires an ongoing evaluation of needs, required capabilities, and potential investments and/or innovations, to allow them to conduct their missions more safely, effectively, and efficiently. In addition, commercializing technology that fully meet these challenges is typically a lengthy process. Developing near term innovative technologies that address high priority capability gaps identified by Federal, state, local, and tribal first responders is critical to ensure their safety, performance, and well-being.

- **Solution:** Identify high priority needs, develop prototype solutions, and conduct operational field assessments of next generation technologies to address gaps, with the goal of rapidly developing (12 to 18 months) and transitioning (an additional 12 months) technologies that meet at least 80 percent of the operational requirement.

- **Impact:** This will strengthen the response community's ability to protect the homeland, respond to disasters, and save lives through the increased availability and reliability of technology for first responders.

Sub Projects

- *Emergency Vehicle to Emergency Vehicle Early Warning System:* A notification system that provides other emergency vehicles warning of an active emergency vehicle traveling within their proximity.
- *Rescue Hoist Protective Glove:* A proposed new glove made of advanced materials or replaceable/attachments that assists with increasing the duration of gloves used in rescue hoisting operations.
- *First Responder Routing Logic Guide:* Emergency responder routing system that informs responders of upcoming road and traffic conditions and can suggest alternate routes to safely navigate their vehicles.
- *Integration of Public Data Feeds:* A platform that provides first responders with a single stream of eyewitness, social media, and open source data and shared information feeds.
- *Response and Defeat Operations Support (REDOPS):* Establishes a systems analysis approach involving explosives countermeasures experts from all levels of government and direct RDT&E of technologies needed by state and local bomb squads.
- *Multimeter Wire Attack Kit:* A tool that combines the functions of a multimeter with a wire attack kit into one device in order to conduct electronic diagnostics of detonator wires and switches.
- *POINTER:* Provides a solution for position tracking in harsh indoor environments by using magnetoquasistatic fields instead of propagating radio waves.
- *Enhanced Dynamic Geococial Environment (EDGE):* Provides a cost-effective capability for a large number of geographically dispersed First Responders to train simultaneously, repeatedly, and frequently in an experiential and realistic manner.
- *Respiratory Protection:* Develop a low profile tactical self-contained breathing apparatus to allow for working in confined spaces, tunnels, and similar access denied environments while providing high quality breathing air.

FY 2018 Key Milestone Events

- Made contract awards for the development of 6 technologies that address the high priority needs identified by first responders.
- Transitioned the EDGE School Environment and the Smoke Particulant Resistant Turnout Gear.
- Transitioned six RAPID products and two REDOPS Micro products to U.S. Bomb Squads.

FY 2019 Planned Key Milestone Events

- Transition four first responder technologies.
- Transition the REDOPS Pan Aiming Device.

FY 2020 Planned Key Milestone Events

- Transition the Rescue Hoist Protective Glove.
- Transition the Wildland Fire Respiratory Protection Device.

Overall Project Funding

(Dollars in Thousands)	FY 2016[17]	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$14,300	$15,000	$16,000	$15,000	$15,000
Obligations	$16,298	$12,830	$8,237	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Make contract awards for six new technology development efforts.	FY 2018 Q1	FY 2018 Q2
Began design of a Prototype Rescue Hoist Protective Glove.	FY 2018 Q3	FY 2018 Q3
Begin design of Emergency Vehicle to Civilian Vehicle Early Warning System.	FY 2018 Q4	FY 2018 Q4
Began design of Wildland Fire Respiratory Protection.	FY 2018 Q3	FY 2018 Q3
Begin design of Emergency Vehicle to Emergency Vehicle Early Warning System.	FY 2018 Q4	FY 2018 Q4
Began design of First Responder Routing Logic Guide.	FY 2018 Q2	FY 2018 Q2
Began design of Integration of Public Data Feeds.	FY 2018 Q3	FY 2018 Q3
Began Design of Multi Meter Wire Attack Kit.	FY 2018 Q2	FY 2018 Q2
Perform OFA and Transition of the Body Warn Camera project.	FY 2018 Q2	FY 2018 Q4
Transitioned Automated Driver and Responder Alert System project.	FY 2018 Q3	FY 2019 Q2
Transitioned the POINTER project.	FY 2018 Q4	FY 2019 Q4
Transition Smoke Resistant Turnout Gear.	FY 2018 Q1	FY 2018 Q1
Transition Base Ensemble Duty Uniform.	FY 2018 Q2	FY 2018 Q4
Transition ReVet Render Safe Pan tool.	FY 2018 Q3	FY 2018 Q4
Transition Pan Aiming Device Tool.	FY 2018 Q4	FY 2019 Q1
Transition EDGE School Environment.	FY 2018 Q4	FY 2019 Q1
Develop a prototype of Rescue Hoist Protective Glove.	FY 2018 Q3	FY 2019 Q2
Develop a prototype of Emergency Vehicle to Civilian Vehicle Early Warning System.	FY 2018 Q4	FY 2019 Q4
Develop a prototype of First Responder Routing Logic Guide.	FY 2018 Q2	FY 2019 Q3
Develop a prototype of Integration of Public Data Feeds.	FY 2018 Q2	FY 2019 Q2
Develop a prototype of Wildland Fire Respiratory Protection.	FY 2018 Q3	FY 2019 Q4
Develop a prototype of Multi Meter Wire Attack Kit.	FY 2018 Q3	FY 2019 Q3

[17] Obligations exceed Project Funding level due to funding realignments during project execution.

Research and Development Description	Plan Start Date	Planned Completion
FY 2019		
Award contracts for six new first responder technologies.	FY 2019 Q1	FY 2019 Q2
Begin design for six new first responder technology awards.	FY 2019 Q3	FY 2019 Q3
Develop prototypes for six new first responder technologies.	FY 2019 Q4	FY 2020 Q4
Transition Rescue Hoist Protective Glove.	FY 2019 Q3	FY 2020 Q2
Transition Emergency Vehicle to Civilian Vehicle Early Warning System.	FY 2019 Q4	FY 2020 Q3
Transition Wildland Firefighter Respiratory Protection.	FY 2019 Q4	FY 2020 Q3
Transition Integration of Public Data Feeds.	FY 2019 Q3	FY 2020 Q2
Transition First Responder Routing Logic Guide.	FY 2019 Q4	FY 2020 Q3
Transition Respiratory Protection Equipment.	FY 2019 Q1	FY 2019 Q3
Transition Multi Meter Wire Attack Kit.	FY 2019 Q4	FY 2020 Q3
FY 2020		
Award contracts for six new first responder technology development efforts.	FY 2020 Q1	FY 2020 Q2
Begin design for six new technology development efforts.	FY 2020 Q3	FY 2020 Q3
Develop prototypes for 6 new first responder technology development efforts.	FY 2020 Q4	FY 2020 Q4
Transition four first responder technologies to the commercial market place.	FY 2020 Q1	FY 2020 Q4
Execute four REDOPS test bed assessments.	FY 2020 Q1	FY 2020 Q4
Validate and produce knowledge products for six REDOPS micro technology efforts.	FY 2020 Q1	FY 2020 Q4
Develop and test two REDOPS IED render safe technologies.	FY 2020 Q1	FY 2020 Q4

Type of Research

Developmental

Technical Readiness Level

The program plans begin at TRL 3 and end at TRL 7.

Transition Plans

- The program's main stakeholders are Federal, state, local, tribal, and territorial first responders who do not generally make bulk group purchases or enter into technology transition agreements, due to the uncertain nature of funding availability. Therefore, S&T works with the vendor at the onset of a project to develop a commercialization plan that requires the vendor to invest its own funds to transition the technology to the first responder community.

Stakeholder Engagement and Requirements (First Responders Resource Group and International)

- **Problem:** First responders have limited avenues to relay their highest priority requirements for R&D that can save their life and improve their safety, efficiency and effectiveness.

- **Solution:** S&T will provide our nation's first responders and DHS Components with a forum, including international partners, to relay and pursue their highest priority capability gaps for research and development.

- **Impact:** The requirements identified by the Stakeholder Engagement and Requirements Group lead to the development of life saving technologies that make our nation's first responders safer, more efficient and more effective. To date, the group has successfully transitioned 18 technologies to the commercial market place for first responder to purchase.

Sub Projects

- *First Responders Resource Group* - The First Responder Resource Group consists of 150 federal, state and local first responders (fire, law enforcement, emergency medical service) from around the country who meet with DHS S&T on a yearly basis to provide requirements for high priority technology development needs.
- *International Collaborative Programs* - Collaborative effort with international partners focused on defining and discussing common, high priority capability gaps in an effort to enhance and expand the development of affordable, innovative technology for first responders worldwide.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- Hold one annual requirements gathering conference and identify 8 to 12 new technology requirements for DHS components and our nation's law enforcement, fire and emergency medical service first responders.
- Collect national capability gaps from the International Forum to Advance First Responder Innovation (IFAFRI) member countries and synthesize them to provide an overarching common global capability gaps list.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	-	$2,500
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
N/A		
FY 2019		
N/A		
FY 2020		
Hold one annual requirements gathering conference and identify 8 to 12 new technology requirements for DHS components and our nation's law enforcement, fire and emergency medical service first responders.	FY 2020 Q1	FY 2020 Q3
Execute one BAA solicitation and make six to ten new start R&D awards.	FY 2020 Q3	FY 2020 Q1
Update the current IFAFRI first responder market analysis, to include five additional countries and provide up-to-date information on the 13 existing IFAFRI countries.	FY 2020 Q1	FY 2020 Q4
Collect national capability gaps from IFAFRI member countries and synthesize them to provide an overarching common global capability gaps list.	FY 2020 Q1	FY 2020 Q4
Characterize markets and identify technology solutions relevant to the IFAFRI's aforementioned Common Global Capability Gaps List, to garner interest from researchers, industry and academia to develop affordable, innovative technology solutions addressing the various capability gaps for first responders.	FY 2020 Q1	FY 2020 Q4
Develop common global capability gaps that will provide a technical overview of the global first responder need from an operational and functional perspective and direct researchers who may be interested in pursuing development of a solution.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied

Technical Readiness Level

Most of the projects awarded through these activities start at a TRL level 4 and end at a TRL level 9. There are exceptions where a project may start at a TRL level 1. When this occurs, the projects still gets delivered at a TRL 9. The period of performance for most activities is 12 to 18 months.

Transition Plans

- Each performer is required to deliver a transition plan as part of the contractual agreement that gets put in place. The transition plan gets delivered before the period of performance ends.
- Identification of common global capability gaps to encourage industry and other stakeholders to identify and develop solutions for first responders.

Information Sharing, Analysis, and Interoperability – FY 2018 Enacted: $13.5M. FY 2019 President's Budget: $11.9M. FY 2020 Request: $21.9M. This program creates an integrated information sharing architecture and links that architecture to interagency efforts to prevent terrorism while protecting privacy, civil rights, and civil liberties.

Public Safety Alerts, Warning and Notifications

- **Problem:** The HSE needs to be able to quickly generate and receive meaningful Alerts, Warnings and Notifications (AWN) messages regarding potential, impending, or ongoing threats. The advent of the IoT sensors applied to Smart Cities is expanding the potential availability of real time alerting. In addition, Social Media use for public safety and communications as part of AWN through the Wireless Emergency Alerting (WEA) protocols is a challenge for timely, accurate and consistent public safety awareness and action.

- **Solution:** The AWN initiative will advance the WEA Research, Development, Testing and Evaluation (RDT&E) Program initiatives to identify, develop and adopt common alerting protocols and open data exchange standards. This effort will assess the current the Common Alerting Protocol (CAP) standard to determine gaps and the resulting solutions to meet those needs. Social Media as an emerging technology for AWN will require best practices and procedures that can be used within the Integrated Public Alerting Warning System (IPAWS) protocols and standards.

- **Impact:** The AWN initiative will define a set of information needs and functional data exchange requirements which will allow federal agencies to better share accurate and actionable information, ultimately helping to save lives, protect property and ensure continuity of government. The results of these initiatives will be tools, practices and guidance for the informed use of AWN and social media for public safety and will provide improved messaging protocols, standards, and public understanding of AWN and WEA messaging.

Sub Projects

- *AWN / CAP Landscape Assessment (Alerting Lane)* – An in-depth analysis of the CAP alerting standard to assess its future applicability to future technology developments; and identification of ways to generate an alert from a sensor to be disseminated through the WEA system to the public.
- *Social Media Tool Development and Enhancement for Open Source Availability (Social Media Lane)* – Development of best practice models for implementing social media programs and digital volunteers in public safety communications planning and development; and implementing those models in an open source technology to enhance public safety use of social media in public communications and alerting.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- *Alerting Lane* – Based on the FY 2019 deliverables and milestones, create a final knowledge product and assessment report about the alerting landscape with actionable recommendations for increasing alerting interoperability across public safety disciplines.
- *Social Media Lane* – Create iterative improvements to the Social Media Lane application, pilot with stakeholders, and transition application to component partners.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	-	$500
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
N/A		
FY 2019		
N/A		
FY 2020		
Alerting Lane – Research specific actions that will enhance alerting interoperability across public safety disciplines	FY 2020 Q1	FY 2020 Q4
Social Media Lane – Complete beta testing of the application, and transition the final market ready version.	FY 2020 Q1	FY 2020 Q4

Type of Research

- *Alerting Lane* – Developmental
- *Social Media Lane* – Developmental and Applied

Technical Readiness Level

- *Alerting Lane* – TRL 3
- *Social Media Lane* – TRL 3

Transition Plans

- *Alerting Lane* – Transition Plan for the Alerting Lane is the transfer of the Alerting knowledge products to the Office of Emergency Communications (OEC)-SAFECOM as a SAFECOM reference document, and a module for the Technical Assistance program to states and local jurisdictions.
- *Social Media Lane* – Transition Plan for Social Media Lane is to transfer hosting and control of the application to FEMA's National Preparedness Directorate, National Training and Education Division.

Communications Architecture Network Interoperability (CANI)

- **Problem:** A common communications architecture remains a challenge to obtain network interoperability, especially for on-body communications and sensor integration. Networks are capable of handling more data; however, this increase and the creation of a multi-network environments creates additional interoperability challenges.

- **Solution:** CANI will provide the framework for a standards-based reference architecture to build the components necessary for communications and sensor interoperability for an on-body 'SmartHub'. The initiative will focus upon the integration of communications applications and sensors embedded into on-body architecture framework for the first responder community.

- **Impact:** The effort will focus on the applied use and demonstration of communications and sensors for on-body SmartHub. The result will be vetted capabilities for adoption by first responder community and commercialization by industry vendors

Sub Projects

- *SmartHub Engineering Design and Technical Guidance* – NGFR "on body" smart hub-DHS provisional patent (sensor and voice communications hub) architectural design for interoperable commercial devices.
- *SmartHub prototype and commercialization* – Prototype and evaluate commercial smart hub interoperable devices.

FY 2018 Key Milestone Events

- Designed communications architecture for open standards based integration.
- Developed SmartHub Engineering Design and Technical Guidance.

FY 2019 Planned Key Milestone Events

- Prototype interoperable Communication Hub for on-body sensor integration.

FY 2020 Planned Key Milestone Events

- Test and evaluate SmartHub industry products for commercialization, transition and adoption.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	-	$1,000
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Designed communications architecture for open standards based integration.	FY 2016 Q4	FY 2018 Q2
Developed SmartHub Engineering Design and Technical Guidance.	FY 2016 Q4	FY 2018 Q2
FY 2019		
Prototype interoperable Communication Hub for on-body sensor integration.	FY 2019 Q1	FY 2019 Q1
FY 2020		
Test and evaluate SmartHub industry products for commercialization, transition and adoption.	FY 2019 Q2	FY 2020 Q3

Type of Research

Developmental / Applied

Technical Readiness Level

TRL 3-7

Transition Plans

Commercialization with selected industry partners and transition to first responder community based in part by operational test and evaluation during design and development phased tasks.

First Responders Emergency Response and Management Tools

- **Problem:** DHS Components and first responders often lack timely access to the situational awareness information and tools they need to operate safely and enhance their ability to save lives and protect property. Whether they are unaware of available information, lack access to environmental sensors, or because their systems are not interoperable, decisions are not made in the most effective and timely manner.

- **Solution:** In collaboration with DHS Components, first responder stakeholders at national, state and local levels and commercial industry partners, this project will develop and transition to operational use the situational awareness technologies required to deliver requirements driven incident information. These research initiatives will provide the standard operating procedures, implementation guidance, product integration technologies, sensors, and services necessary to conduct effective and efficient response and recovery efforts.

- **Impact:** Increased safety of U.S. citizens and first responders, more effective incident response and recovery leading to fewer lives lost, decreased property damages, and increased national resilience from incidents of all types and scales. By working with commercial industry partners and transition partners, these initiatives will expand commercial industry markets with new IoT sensor solutions.

Sub Projects

- *Vehicle Inspection for Early Warning (VIEW)*: enhanced under vehicle scanning in support of CBP and Federal Protective Service (FPS) requirements for layered security and force protection.
- *School Age Trauma Training (SATT)*: life safety training for mass casualty events in support of FEMA's Individual and Community Protection Divisions efforts to help citizens prepare for disasters.

FY 2018 Key Milestone Events

- Developed and deployed 300 low-cost IoT Flood Sensors with three small businesses and perform test and evaluation with state/local government stakeholders for adoption and industry commercialization.
- Designed, integrated and commercialized Smart City and IoT Intelligent Building Infrastructure platforms (Unmanned Aerial Systems, EXIT signs and smoke alarms) with sensors (Wi-Fi detectors, 360 degree imaging and thermal) for search and detection.

FY 2019 Planned Key Milestone Events

- *VIEW*: Develop and field test prototype designs (Alpha and Beta) of in-place and mobile optical scanning units and demonstrate those requirements conforming solutions to CBP and FPS customers.
- *SATT*: Develop production-ready content and curriculum based upon demonstrations, research, and community results to be delivered in self-taught and instructor led environments.

FY 2020 Planned Key Milestone Events

- *VIEW:* Develop version of enhancements of the VIEW capability and deploy with CBP and FPS Components for operational Test and Evaluation.
- *SATT:* Deliver SATT training to school institutions and communities of interest and develop a self-sustaining mechanism to maintain and expand the training capability into high schools and age appropriate stakeholder communities.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017[18]	FY 2018	FY 2019	FY 2020
Project Funding	$4,000	$4,206	$7,261	$6,211	$8,229
Obligations	$3,581	$5,956	$4,232	-	-

[18] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Develop and deploy 300 low-cost IoT Flood Sensors with three small businesses and perform test and evaluation with state/local government stakeholders for adoption and industry commercialization.	FY 2018 Q1	FY 2018 Q4
Design, integrate and commercialize Smart City & IoT Intelligent Building Infrastructure platforms (Unmanned Aerial Systems, EXIT signs and smoke alarms) with sensors (Wi-Fi detectors, 360 degree imaging and thermal) for search and detection.	FY 2018 Q1	FY 2018 Q4
Initiate/originate an AWN message from a sensor (environment) into the FEMA IPAWS Test and Development Lab	FY 2018 Q1	FY 2018 Q4
FY 2019		
VIEW – Design an enhanced prototype of a vehicle undercarriage imagining translator to detect modifications to manufacturing specifications to detect explosives, smuggled goods and other anomalies.	FY 2019 Q1	FY 2019 Q3
SATT Design and develop an initial draft training curriculum and delivery capability for a citizen centric training to control bleeding from an injury from accidents or terrorist activities. Develop school-age appropriate training, materials, public service announcements and expand availability via state and local academic institutions and not-for-profit organizations. Develop online accessible mechanisms for content and curriculum delivery. Develop a business and implementation plan for the program.	FY 2019 Q3	FY 2019 Q4
FY 2020		
VIEW – Develop version with enhancements of the VIEW capabilities and deploy with CBP and FPS Components for OT&E.	FY 2019 Q4	FY 2020 Q4
SATT – Deliver SATT training to school institutions and communities of interest and develop a self-sustaining mechanism to maintain and expand the training capability into high schools and age appropriate stakeholder communities. Develop enhancements to the content and curriculum, learned through program deployment.	FY 2019 Q4	FY 2020 Q4

Type of Research

- *VIEW:* Applied
- *SATT:* Developmental

Technical Readiness Level

- *VIEW:* TRL 2
- *SATT:* TRL 2

Transition Plans

- *VIEW* – will work with small business innovators to design, develop and commercialize a product-2-market strategy as part of the Cooperative Agreement solicitation. DHS Components, including CBP and FPS are the primary stakeholders; however, state and local authorities and critical infrastructure industry partners are also market segments for commercialization.
- *SATT* – will work with the FEMA's Individual and Community Protection Division to design, develop, and deliver the SATT training to a self-sustaining Grantee as part of the cooperative agreement requirements.

Interoperability and Compatibility Standards

- **Problem:** The proliferation of new technologies makes it difficult for first responders to securely communicate with each other during emergencies. In addition, equipment manufacturers often use different technical approaches that leave their products incompatible.

- **Solution:** Identify and accelerate the development and adoption of standards essential to ensure that new technologies are interoperable. Establish testing and evaluation practices that promote the use of compliance documentation so DHS Components and first responder agencies can make informed decisions new technologies. Provide commercial industry guidance for open standards compliance to advance product development and market value through standards compliance.

- **Impact:** These new and strengthened standards will help first responders to make the right choices about new technologies so that their equipment will be interoperable and able to migrate successfully; including: the new nationwide public safety broadband network (e.g. $7 billion national investment); secure access to FirstNet (e.g., $40 billion national investment); SmartHub communications and IoT sensor configurations (e.g., part of Smart City national investments at state and local levels).

Sub Projects

- *Smart City Interoperable Reference Architecture (SCIRA):* Design guidance for state, local, city, and public safety interoperable architectures.
- *National Information Exchange Model (NIEM):* Federal data exchange standard that will be applied to public safety emergency operations data exchange.
- *IoT Cyber Security:* "Identity of things" for system control and data access to secure deployable and fixed sensors.
- *Project 25 Compliance Assessment Program (P25 CAP):* Ensures that P25 communications equipment declared by the supplier is P25 compliant, and tested against the standards with publicly published results.

FY 2018 Key Milestone Events

- Conducted Smart City Architecture Landscape assessment.

FY 2019 Planned Key Milestone Events

- *SCIRA:* Transition Architecture Deployment Guidance and deliver final SCIRA documentation including guidance implementation.
- *P25 CAP:* Stand up an accredited DHS recognized laboratory to conduct Inter RF Sub system Interface (ISSI)/Console Sub system Interface (CSSI) testing.

FY 2020 Planned Key Milestone Events

- *IoT Cyber Security:* Design IoT cyber security guidance for operational use of sensor suites.
- *P25 CAP:* Post ISSI/CSSI test results on the P25 CAP website.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	$1,505	-	-	$1,500
Obligations	-	$1,360	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conduct Smart City Architecture Landscape Assessment.	FY 2018 Q1	FY 2018 Q3
Draft Architecture design and development.	FY 2018 Q2	FY 2018 Q4
FY 2019		
Develop Architecture Deployment Guidance.	FY 2018 Q3	FY 2019 Q3
Perform pilot/tabletop exercise demonstrating interoperability with different agencies using existing Emergency Data eXchange Language.	FY 2018 Q4	FY 2019 Q1
Conduct Inter RF Sub system Interface (ISSI)/ Console Sub system Interface (CSSI) testing.	FY 2019 Q1	FY 2019 Q2
Conduct at least three ISSI/CSSI pilot tests.	FY 2019 Q1	FY 2019 Q3
Identify key P25 standards that need to be updated.	FY 2019 Q1	FY 2019 Q2
FY 2020		
Post ISSI/CSSI test results on the P25 CAP website.	FY 2020 Q1	FY 2020 Q2
Develop approach to update outstanding P25 standards activities.	FY 2020 Q1	FY 2020 Q2
Design IoT cyber security guidance for operational use of sensor suites.	FY 2019 Q4	FY 2020 Q4

Type of Research

Developmental / Applied

Technical Readiness Level

TRL 3-7

Transition Plans

- *SCIRA* – Transition to standards body (Open Geospatial Consortium) and commercial industry Smart City investment community for design build of interoperable IoT sensor networks.
- *IoT Cyber Security* – Incorporate into DHS grant language for IoT sensors and DHS Components for contract language.
- *NIEM* – has a broad interagency working group and PMO to facilitate adoption. NIEM IEPDs are placed in a common repository for open access.

Public Safety Wireless Communications

- **Problem:** Technologies capable of bridging disparate but essential communications systems are not currently available, making it difficult for first responders to communicate with each other during emergencies.

- **Solution:** Conduct viable research, develop, test, and evaluate capabilities to ensure first responders are able to communicate regardless of the type of network.

- **Impact:** This project provides a critical testing and evaluation capability for first responders to gain knowledge on how communication devices work on broadband networks and determine how the systems will meet user needs. This project brings together public safety practitioners, Federal partners, manufacturers, and representatives of standards making bodies to improve the way in which video and other technologies serve the public safety community.

Sub Projects

- *Datacasting* – Performs technical and operational evaluations of datacasting as a telecommunications capability in support of public safety. Datacasting is using existing broadcast television signals to deliver encrypted, targeted public safety video and data.
- *Video Quality in Public Safety* – Develops assessment tools and guidance documents that enable first responder agencies to purchase and deploy appropriate video technology to meet their operational needs.
- *Video Analytics* – Develops a public safety video analytics Community of Interest, develops R&D, Standards, and Collaboration priorities and strategy, as well as develops initial research in content-based video quality measurement.
- *Demo Network - Deployables* – Examines ways in which first responders could access and communicate critical information using deployable networks during incidents that arise in areas that are not served or are under-served by the fixed Nationwide Public Safety Broadband Network or alternative access networks, such as commercial carriers or public Wi-Fi.
- *Wearable Alert and Monitoring System* – Composed of wearable devices called sensor nodes that connect to IoT sensors, as well as controller software that works with both local and remote artificial intelligence agents in the cloud to provide on demand communication and computing based on first responders' needs.
- *Personal Area Network/ Wearable IoT Sensors* – This project will assess the current state of standards for wireless sensors and to identify areas where the standards can be modified or enhanced to support public safety agendas. Additionally, this project will seek to drive or develop standards which will allow an open architecture for wireless sensors.

- *Speech Analytic Technology* – This project is intended to develop a speech analytics technology performance assessment methodology using suitable public safety relevant test data, and to measure current speech analytic systems capabilities in the context of public safety applications.
- *Automatic Speech Recognition* – This project will gather user requirements and develop a user profile for speech recognition technologies. Further, this project will examine the state of technology across industry and identify remaining gaps.
- *Assistant for Understanding Data through Reasoning, Extraction, and sYnthesis (AUDREY)* – Human-like reasoning system that performs data fusion and provides tailored situational awareness information to responders by connecting with sensors on responders' personal protective equipment.
- *Central U.S. Earthquake Consortium Support* – Provide support to Federal, state, and local responders through participation in Shaken Fury 2019 Exercise. Activities will include technology demonstration, integration, and evaluation.

FY 2018 Key Milestone Events

- Conducted field demonstrations for one wireless broadband technology demonstrator solutions.
- Conducted tabletop exercise for two wireless broadband technology demonstrator solutions.

FY 2019 Planned Key Milestone Events

- Develop After Action Report from the Datacasting integration pilot with FLETC.
- Provide deployable system and AUDREY local and/or cloud integration and test.

FY 2020 Planned Key Milestone Events

- Develop a knowledge product for first responders to help inform video system design and procurement decisions.
- Develop advanced prototype for automated speech recognition capability for first responders.

Overall Project Funding

(Dollars in Thousands)	FY 2016[19]	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$4,000	$4,206	$6,200	$5,700	$5,700
Obligations	$4,021	$3,827	$4,594	-	-

[19] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conduct field demonstrations for one wireless broadband technology demonstrator solutions.	FY 2018 Q1	FY 2018 Q4
Conduct tabletop exercise for two wireless broadband technology demonstrator solutions.	FY 2018 Q1	FY 2018 Q4
Publish results in professional conference proceedings and journals.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Demonstrate datacasting utility with continued demonstrations/testing with public safety end users.	FY 2019 Q1	FY 2019 Q4
Integrate a Sensor Things API service infrastructure with Controller Core to support sensor discovery out in the field.	FY 2019 Q1	FY 2019 Q4
Develop automated speech recognition capability for first responders.	FY 2019 Q1	FY 2019 Q4
Field Test automated speech recognition capability for first responders.	FY 2019 Q1	FY 2019 Q3
Provide Deployable System and AUDREY local and/or cloud integration and test.	FY 2019 Q3	FY 2019 Q3
Unlicensed Spectrum Use Report Research into unlicensed deployments and feasibility of 1 watt Wi-Fi deployments.	FY 2019 Q3	FY 2019 Q4
Report on fog computing and applicability for PS vs. cloud or local deployments.	FY 2019 Q2	FY 2019 Q3
Report on effectiveness of Bluetooth / other methodologies as a PS protocol.	FY 2019 Q2	FY 2019 Q4
Interoperability Framework architecture design document published.	FY 2019 Q3	FY 2019 Q4
Creation of deployable analytics testing framework (hardware and software) for PS pilot.	FY 2019 Q4	FY 2019 Q4
FY 2020		
Conduct continued speech analytic systems evaluation event using the above datasets.	FY 2019 Q4	FY 2020 Q2
Develop a knowledge product for first responders to help inform video system design and procurement decisions.	FY 2020 Q1	FY 2020 Q3
Demonstrate datacasting utility with local first responder groups.	FY 2020 Q1	FY 2020 Q1
Develop advanced prototype for automated speech recognition capability for first responders.	FY 2020 Q1	FY 2020 Q3
Enhanced local Audrey in Wireless Alert Monitoring System automatically takes over if network connectivity is lost. Implement support for TensorFlow and neural networks.	FY 2020 Q1	FY 2020 Q3

Type of Research

Developmental and Applied

Technical Readiness Level

TRL levels vary across each sub-project within wireless communications. As a whole wireless communications includes efforts that begin as early as TRL 4 and will be carried through to TRL 7.

Transition Plans

- In addition to aiding first responders through publishing of test results, this project will also develop knowledge products to better inform stakeholders about the state of the art technologies.
- Memoranda of Understanding, Memoranda of Agreements, and other agreements are established with local, state, and Federal first responder agencies to allow for testing and evaluation of technology prototypes through demonstrations and pilot.
- When technology solutions are not available this project will develop technology solutions based on user requirements to address capability gaps.

Research Supporting Public Safety Broadband Implementation

- **Problem:** Public safety has access to a dedicated broadband network for the first time. This network promises to provide enhanced video and data capabilities. There will undoubtedly be a transition period where public safety will continue to rely on their land mobile radio network for voice communication while taking advantage of the broadband network for data communications. This new IP-based broadband network will also introduce a variety of security vulnerabilities for public safety. The IoT technology arena has a multitude of competing data standards which may add complexity and interoperability issues to the environment.

- **Solution:** This program will conduct RDT&E of technologies in the public safety broadband arena to support end user implementation. The program will transition user driven technologies as well as knowledge products (e.g., lessons learned, best practices, pilot reports, and test evaluations).

- **Impact:** Today public safety primarily uses land mobile radios for voice communications and commercial cellular networks for data communications. With the creation of a public safety broadband network, public safety will transition to the broadband network for its data needs and perhaps even voice in the future. The implementation of this broadband network into existing CONOPS will be critical to its success.

Sub Projects

- *Public Safety Broadband Network Integration (PSBN) (features, services, applications and technologies)* - RDT&E of broadband technology solutions through pilots with local, state, and federal public safety agencies in operational environments
- *Artificial intelligence /Artificial General Intelligence Integration* - Integration of machine learning technologies with existing networks and associated capabilities to address public safety's most pressing needs.
- *Data analytics and location-based services Technology Integration* – Integration of data analytics including location based services technologies with existing networks and associated capabilities to address public safety's most pressing needs
- *Communications Center of Excellence* – Consortium of federal partners identifying and addressing shared emergency communications challenges to leverage each department's domain expertise.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- Integrate artificial general intelligence into a location to be determined by Program Manager during planning stage to assist call takers and dispatchers.
- Identify potential technology solutions in data analytics for further T&E through operational test pilots, in coordination with Department of Commerce National Institute of Standards and Technology (NIST).

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	-	$5,000
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2020		
Working with the NIST Public Safety Communications Research Office, FirstNet, and AT&T, test, evaluate, and demonstrate new features, services, applications and technologies that can be integrated into the PSBN.	FY 2020 Q1	FY 2020 Q4
Integrate artificial general intelligence into PSBN at a location to be determined to assist call takers and dispatchers. Develop test plan for integration pilot.	FY 2020 Q1	FY 2020 Q4
Conduct laboratory testing for integration pilot.	FY 2020 Q1	FY 2020 Q2
Conduct technology environmental scan for possible technology adaption.	FY 2020 Q2	FY 2020 Q2
Develop a CONOPs and program model to establish a first-ever Public Safety Communications Center of Excellence.	FY 2020 Q1	FY 2020 Q2

Type of Research

Developmental

Technical Readiness Level

Sub projects will vary in TRL levels; however, they will range from TRL 3 to TRL 8.

Transition Plans

- This effort will transition technology solutions to customers after rigorous laboratory, field, and operational testing. Solutions will be standards

based, non-proprietary in nature to allow plug and play adaptability for first responders. Forward leaning first responder agencies will be identified to serve as early adopters and evangelists for the technology solutions.
- Knowledge product development (e.g., lessons learned, best practices, pilot reports, and test evaluations) will also be a key component of transition. Publically available knowledge products can be disseminated more broadly and have great reach with end users. These knowledge products can also serve to promote best practices and help agencies learn from those who have come before them.

Natural Disaster Resiliency – FY 2018 Enacted: $45.6M[20]. FY 2019 President's Budget: $31.6M. FY 2020 Request: $27.8M. This program develops and provides advanced planning, CONOPS, disaster management tools, and training aids for responding to and recovering from a large-scale natural disaster. This includes providing assistance to the private sector to design greater resilience for critical infrastructure and providing DHS with more robust tools for disaster response, disaster logistics, individual and public assistance programs, and national continuity programs.

Next Generation Cyber Infrastructure

- **Problem:** Hacking of the cyber fabric underlying our nation's critical infrastructure is a threat to U.S. national security. Known penetration of critical infrastructure sectors networks by sophisticated adversaries combined with existing fragilities in the core of the sectors present a clear and growing risk to our economic and national security.

- **Solution:** S&T partners with the Financial Services Sector (FSS) to develop and deliver advanced sensing technologies, situational understanding, response, and recovery and network protections to institutional, sector, and cross sector levels. S&T is also conducting research and development activities for sector specific cyber exercise capability designed to make critical infrastructures more resilient to cyber-attacks.

- **Impact:** With S&T's assistance, the critical infrastructure sectors will reduce security vulnerabilities, improve information sharing, and increase response and recovery times. This program will also result in the delivery of simulation-supported cyber exercises to the desktops of critical infrastructure owners.

FY 2018 Key Milestone Events
- Completed Technology Forage list and made go/no go decision for test & evaluation of technologies in two project areas.
- Conducted Testing and Evaluation of selected technologies.

FY 2019 Planned Key Milestone Events
- Revalidate Financial Sector Requirements and conduct test & evaluation of technologies in two additional project areas to address cyber gaps in sector.

[20] The FY 2018 Enacted total for Natural Disaster Resiliency funds a project not funded in the FY 2018 and FY 2019 President's Budgets ($1.3M Critical Infrastructure Supply Chain Interdependencies).

- Transition proven prototype technologies, all analyses, models and knowledge products, to FSS Institutions. Transition efforts will correspond to, and coincide with the two project / technology topic areas identified in the Technology Foraging phase each year.

FY 2020 Planned Key Milestone Events

- Conduct testing & evaluation of three technology areas that address capability gaps for the FSS in a representational environment.
- Conduct one financial simulation for each of the energy sector subsectors (Electric, Oil, and Gas).

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$10,039	$10,000	$14,000	$5,000	$5,000
Obligations	$9,657	$3,439	$6,417	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Conducted market survey to determine evolving high priority threat areas for the FSS to inform additional technical areas to address.	FY 2018 Q2	FY 2018 Q2
Partnered with the SVIP to solicit the startup community to address high priority threat areas identified in market survey.	FY 2018 Q2	FY 2018 Q4
FY 2019		
Transition analyses, models, technology prototypes, and knowledge products related to prior year Test and Evaluation activities to FSS.	FY 2018 Q1	FY 2019 Q1
Complete Technology Forage list and make go/no go decision for test & evaluation of technologies in three additional project areas.	FY 2019 Q1	FY 2019 Q4
Conduct physical simulation exercise for the electric subsector.	FY 2019 Q2	FY 2019 Q3
Conduct physical simulation exercise for the oil subsector.	FY 2018 Q3	FY 2019 Q4
Conduct physical simulation exercise for the gas subsector.	FY 2018 Q3	FY 2019 Q4
FY 2020		
Conduct testing & evaluation of three technology areas that address capability gaps for the FSS in a representational environment.	FY 2019 Q2	FY 2020 Q3
Conduct testing & evaluation of two technology areas that address capability gaps for the FSS in an operational environment.	FY 2019 Q4	FY 2020 Q4
Conduct financial simulation exercise for the electric subsector.	FY 2020 Q2	FY 2020 Q3
Conduct financial simulation exercise for the oil subsector.	FY 2020 Q3	FY 2020 Q4
Conduct financial simulation exercise for the gas subsector.	FY 2020 Q3	FY 2020 Q4

Type of Research
Developmental

Technical Readiness Level
The program will have varying TRL entry and exit points depending on the solution pursued for a specific Tech Foraging area. For less matured areas, the program began at TRL 3 and will end at TRL 6. For more matured areas, the program began at TRL 6 and will end at TRL 7.

Transition Plans
- All analyses, models, technology prototypes, and knowledge products will transition to FSS institutions, commercialized or made available through open source during the course of the project. Products may include, but are not limited to:
  - Sensor capabilities to verify the presence or absence of attacker modifications to network infrastructure.
  - Real Time Intrusion prevention capability using non signature based technologies.
  - Behavior modeling tools to detect potential violations of system security policy by an authorized user, identify anomalous behavior within a network in real time using probabilistic modeling and traffic analysis, and detect patterns of pending data exfiltration.
  - Sensor correlation tools and tools to reduce the amount of data that requires analysis.
  - Tools to measure logical and physical internet topologies and measure the effectiveness of routing in order to determine the problem.

Cyber Physical Systems (formerly Cyber Physical Security)

- **Problem:** Cyber Physical Systems (CPS) have enabled dramatic increases in productivity and efficiency in sector operations, resulting in their widespread proliferation in the Nation's Critical Infrastructure. Advances in networking, computing, sensing, and control systems have enabled a broad range of new applications. Device manufactures and operators are increasingly seeing the potential of adding computational power and network connectivity to a wide range of devices, known as the IoT. As the IoT continues to expand, the need to be able to quickly integrate IoT devices and sensors into legacy enterprise systems and networks is becoming critical. Securing these devices is necessary to ensure safe operational use while minimizing the risks and vulnerabilities. Increasing reliance on automated cyber systems creates the potential for unintentional design and implementation errors as well as intentional cyber-attacks. This requires a combination of industry innovation, fundamental science, and crucially cross-cutting applied research.

- **Solution:** S&T has a principal goal of identifying and investing in technological solutions that can be transitioned to industry and DHS operational components to provide capability and mission improvements. Within the CPS mission space, S&T's goal is to coordinate and invest in solutions that enable systems that are trusted, hardened, and able to recover from large-scale failures. Project solutions align with government missions and present the highest risk to safety and security. S&T will directly fund efforts that target challenging problems faced by specific or multiple sectors that emphasize technology transition of usable products. DHS recognizes that different sectors are at varying stages and engages individual sectors based on industry and component requirements and S&T's assessment of where its investment can have the greatest impact.

- **Impact:** S&T investments in CPS, in conjunction with other Federal agencies and Industry efforts, will marshal applied R&D initiatives to achieve: enhanced security in CPS practices and designs; enhance capabilities to detect, defend, and mitigate threats related to CPS; explore recovery and reconstitution areas; and explore the development of countermeasures that will fundamentally change the way CPS risk and security is considered today. DHS intends to anticipate and combat evolving CPS threats in near-term applications as well as over the long-term.

Sub Projects

- *Cyber Physical Systems Security* – This project is looking at the systems which are often a source of competitive advantage in today's innovation economy, but also increase cyber security risks and attack surfaces. The consequences of unintentional faults or malicious attacks could have severe impact on human lives and the environment.
- *Cyber-Enabled Networked Physical Systems (CNPS)* - CPS and IoT are designed with computation and communication, including machine-to-machine communication capabilities. This has resulted in new cyber security challenges and the risks only increase as CPS/IoT systems are scaled and designed to work in autonomous situations. This applied research will address issues in security, trust, context-awareness, ambient intelligence, and reliability issues.

FY 2018 Key Milestone Events

- Developed systems for securely delivering firmware updates for CPS, including automobiles.
- Developed a system for securely updating the electronic control unit in automobiles and implement the system in two or more Tier-1 automotive suppliers.

FY 2019 Planned Key Milestone Events

- Develop and release final requirements and technical topic areas for CNPS.
- Develop and publish industry standards for secure over-the-air updates for automobiles.

FY 2020 Planned Key Milestone Events

- Demonstrate proof of concept capabilities in at least two technology areas to address CNPS operational gaps, within law enforcement vehicle/fleet cyber security.
- Demonstrate proof of concept capabilities in at least one technology area to address CNPS operational gaps, within building controls and automation.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$7,750	$6,165	$6,165	$4,167	$4,167
Obligations	$7,058	$5,558	$3,174	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Academic and industry team provided draft best practices for building control security.	FY 2017 Q2	FY 2018 Q2
Develop pre-competitive research consortium with key sectors of the automotive industry. Consortium has established relationships with the target number of domestic OEM/partners. Initiated efforts to establish a relationship with an international OEM, specifically from the European auto industry.	FY 2018 Q1	FY 2018 Q4
Developed systems for securely delivering firmware updates for cyber physical systems, including automobiles.	FY 2018 Q1	FY 2018 Q3
Developed a system for securely updating the electronic control unit in automobiles and implement the system in two or more Tier-1 automotive suppliers.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Develop and release final requirements and technical topic areas for CNPS.	FY 2019 Q1	FY 2019 Q4
Conduct and analyze preliminary research and analysis in cyber-physical system areas of context-awareness, ambient intelligence, and autonomous environments.	FY 2019 Q1	FY 2019 Q4
Develop systems for real-time automotive firmware validation.	FY 2019 Q2	FY 2019 Q4
Support workforce development efforts in automotive cyber security (Cyber Auto Challenge).	FY 2019 Q1	FY 2019 Q3
FY 2020		
Demonstrate proof of concept capabilities in at least two technology areas to address CNPS operational gaps, within law enforcement vehicle/fleet cyber security.	FY 2020 Q1	FY 2020 Q4
Demonstrate proof of concept capabilities in at least one technology area to address CNPS operational gaps, within building controls and automation.	FY 2020 Q4	FY 2020 Q4
Define and develop projects in the automotive industry consortium.	FY 2020 Q1	FY 2020 Q4

Type of Research

Developmental

Technical Readiness Level

The program began at TRL 4 and will end at TRL 7.

Transition Plans

- Solutions will be developed that are practical and ready to be deployed at full operating capability.
- Beta testing and evaluation opportunities will be investigated and determined early on and agreements will be made with partners for such opportunities.
- Due to the nature of the program focus, outcomes are applicable to a wide number of government and private sector agencies.

GPS Vulnerability Assessment in the Critical Infrastructure

- **Problem:** U.S. critical infrastructure is dependent on the Global Positioning System (GPS) for many applications to maintain operations. In addition to the use of GPS for position and navigation, timing is an essential element for many critical infrastructures such as the electric grid, telecommunications, transportation, emergency services. Timing is typically derived and maintained in these networks through GPS receivers and as the threats to GPS from jamming and spoofing continue to grow, so do the vulnerabilities within our critical infrastructure. Initial testing by S&T showed that the GPS receivers used within critical infrastructure do not always behave as desired, further increasing the vulnerability.

- **Solution:** This assessment will conduct comprehensive testing on GPS receivers used within the critical infrastructure networks against various jamming and spoofing threats. The project will also engage with the receiver manufacturers and others to begin developing and fielding mitigations at low cost to the critical infrastructure owner and operators. Additionally, research will be done on possible complementary timing sources to supplement the timing from GPS to enable assured timing for critical infrastructure needs.

- **Impact:** This project will identify GPS interference vulnerabilities (intentional and unintentional) and educate critical infrastructure owners and operators enabling them to take action to mitigate and protect against these threats. With the engagement of the receiver manufacturers, identified issues can be addressed and implemented on new receivers prior to being placed on the market as well as the possibility of software or firmware upgrades to protect legacy equipment within the critical infrastructure. Additionally, alternate mitigations developed by the project will enable a layered approach to ensure robust Position Navigation and Timing (PNT) solutions to meet critical infrastructure needs.

Sub Projects

- *Commercial GPS Receiver Performance Characterization:* Test commonly used GPS receivers in critical infrastructure to identify their performance characteristics and vulnerabilities.
- *Integration and Validation of Alternative Position and Timing via Iridium:* Integrate and validate Satellite Time and Location over Iridium NEXT ("STL") prototypes based on the DHS S&T PNT reference architecture. This activity will ensure that STL meets critical infrastructure PNT needs across a wide geographic area of the United States and will also provide prototype devices that can be further tested in operational environments by DHS S&T partner agencies.
- *Multi-Global Navigation Satellite System (GNSS) Issues and Evaluation of PNT Mitigation Technologies:* Understand the implications of using multi-GNSS enabled receivers on critical infrastructure.
- *System-Level Timing Vulnerability Testing for Critical Infrastructure:* Perform system-level testing to understand the impact of timing disruptions on critical infrastructure.
- *Impact Analysis of Power Grid Timing Service Disruptions*: Perform an impact analysis of timing service disruptions (both jamming and spoofing) on power grids through modeling and simulation and validation through hardware-in-the-loop simulation.
- *Timing Manipulation Detection Capabilities:* Develop capabilities to detect GPS timing signal interference that can be easily integrated into critical infrastructure and/or utilizes existing critical infrastructure assets, sensors, or networks.
- *Adaptable Timing Manipulation Detection via Diverse Time Sources:* Develop a timing manipulation detection capability by utilizing sensor fusion of a diverse ensemble of time sources and applying statistical models to monitor and detect anomalous timing errors.

- *Promontory Timing System:* Develop alternative timing system that can maintain a stable and accurate time reference in the presence of GPS disruptions by utilizing available signals of opportunity.
- *Test and Evaluation of Alternative Position, Navigation and Timing Technologies:* Conduct testing of alternative PNT technologies to characterize their performance in multiple simulated scenarios and environments.
- *Conformance Program for Assured Timing in Critical Infrastructure:* In coordination with industry input, develop and transition a conformance program for assured timing equipment for critical infrastructure.
- *Networked GPS Spoofing Detection for Power Systems*: Develop capabilities that can detect the following types of GPS spoofing attacks: Meaconing, Measurement spoofing, and Data spoofing.

FY 2018 Key Milestone Events

- Project Initiation completed: System-Level Timing Vulnerability Testing for Critical Infrastructure Timing.
- Project Initiation completed: Timing Manipulation Detection Capabilities and Promontory Timing System.

FY 2019 Planned Key Milestone Events

- Host follow-on open-air GPS test event for testing of mitigation technologies or revised equipment from manufacturers.
- Characterize performance of multiple alternative PNT technologies.

FY 2020 Planned Key Milestone Events

- Test one alternative timing source prototype in a critical infrastructure operational environment.
- Release first version of Resilient PNT Compliance Specification.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$1,000	$6,702	$6,702	$10,830	$4,000
Obligations	$878	$6,161	$5,420	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Completed Project Initiation: System-Level Timing Vulnerability Testing for Critical Infrastructure.	FY 2017 Q2	FY 2018 Q1
Completed Project Initiation: Assured Timing Detection Methods for Critical Infrastructure.	FY 2017 Q2	FY 2018 Q2
Completed Project Initiation: Promontory Timing System.	FY 2017 Q3	FY 2018 Q2
Released memorandum for April 2019 GPS Week Number Rollover.	FY 2018 Q3	FY 2019 Q2
FY 2019		
Host annual open-air GPS test event for industry.	FY 2019 Q1	FY 2019 Q4
Complete draft conformance standard framework.	FY 2018 Q4	FY 2019 Q2
Characterize performance of multiple alternative PNT technologies.	FY 2019 Q1	FY 2019 Q3
Host at least one workshop for the industry conformance framework.	FY 2019 Q2	FY 2019 Q2
FY 2020		
Test one alternative timing source prototype in a critical infrastructure operational environment.	FY 2020 Q1	FY 2020 Q4
Release first version of Resilient PNT Compliance Specification.	FY 2020 Q1	FY 2020 Q4

Type of Research

Developmental

Technical Readiness Level

TRL varies 4-7. Current GPS-PNT user equipment are commercial and in use. New designs and/or other mitigation solutions for jamming/spoofing risks may vary (e.g., user equipment, antennas).

Transition Plans

- Partnership and coordination with CISA National Risk Management Center for communication and dissemination of GPS knowledge products to critical infrastructure Sectors and owners/operators. Development of a voluntary compliance standards framework for transition of developed mitigation technology into existing equipment. Coordination with GSA to require compliance with the voluntary standards framework for placement of new PNT equipment into the GSA schedule.

National Hurricane Technology

- **Problem:** FEMA's National Hurricane Program's (NHP) current hurricane evacuation planning relies upon legacy systems that require too many resources, time and leaves too much uncertainty to maximize timely and actionable results. The most significant challenges are to understand the potential impacts of storm surge, winds, and inland flooding as well as the level of uncertainty of these forecasts as storms approach. Planning

and training often use different sets of tools that cause challenges in translating plans and training into action during real life events. Training is only available to around 250 individuals annually due to limitations in class size, available funding, and instructors, while the system has over 20,000 users that could all benefit from improved access to training. Once evacuation decisions are made, the challenge becomes alerting the public who often are not aware that they are in a hazard zone or what they should do. After an event, the process of understanding lessons-learned requires a lengthy and cumbersome review process that faces significant issues in gathering accurate and timely critical data.

- **Solution:** S&T is working across multiple agencies including FEMA; U.S. Army Corps of Engineers (USACE); U.S. Geological Survey (USGS); National Oceanic and Atmospheric Adminstration (NOAA), the National Hurricane Center, and emergency management stakeholders in state, local and tribal communities to create an integrated decision support platform that meets the needs of the entire hurricane response community.

- **Impact:** Modernized NHP technology, tools and methods implemented in the decision support platform operationally called Web-Based HURREVAC will enhance the ability of the emergency management end users at the state and local level in managing local hurricane evacuations and response to be better prepared in emergency management planning and decision making and more efficient and effective in the event of an emergency. Successful transition of HVX allows FEMA to eliminate legacy systems and integrated training will enable the delivery of training to all users at reduced cost. Improvements in evacuation alerting, resource planning and inland flooding products will improve evacuation effectiveness and automated post-storm assessment capture and reporting will reduce paperwork and increase the timeliness of these critical reports. Web-based HURREVAC will provide an anywhere, anytime, any device, mobile decision support platform for emergency managers during hurricanes. This web-based system offers embedded training and integrated storm simulation capabilities for training and sharpening the decision-making skills of both new and experienced emergency managers using realistic and customized scenarios. Unlike legacy systems, the new platform is built for sustainability and future enhancements through the use of open standards and software with intuitive and flexible interfaces to tailor analytical tools and training to meet individual user needs. The new capabilities provide innovative visualizations of hurricane data and information for evacuation planning and decision making to help managers avoid unnecessary and costly "over" evacuations, and save lives by preventing "under" evacuations.

FY 2018 Key Milestone Events

- Integrated inland flooding impact products based on Hurricane Matthew/Hurricane Harvey experiences.
- Transitioned HVX software to FEMA/USACE selected industry O&M provider.

FY 2019 Planned Key Milestone Events

- Develop comprehensive hurricane evacuation planning training for emergency managers, covering all of FEMA's L-324 content and providing that content online, to all system users, year round.
- Launch Web-based HURREVAC as FEMA's Operational Hurricane Decision Support Platform.

FY 2020 Planned Key Milestone Events

- Add cyber sensing for power outages capability to HVX.
- Optimize capabilities for mobile devices.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$1,000	$1,000	$1,000	$1,000	$1,000
Obligations	$917	$880	$835	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Create prototype post-storm assessment capability products.	FY 2018 Q2	FY 2018 Q4
Integrate evacuation alert pilot application (I-PAWS and current research).	FY 2018 Q1	FY 2018 Q4
Develop inland flooding impact capability.	FY 2018 Q2	FY 2018 Q4
HVX transition assistance.	FY 2018 Q1	FY 2018 Q4
Develop a graphical user interface that will allow emergency managers (EMs) to easily add new questions to existing scenarios and build new training modules.	FY 2018 Q1	FY 2018 Q4
Integrate Transportation Analysis Capability.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Develop comprehensive hurricane evacuation planning training for emergency managers, covering all of FEMA's L-324 content and providing that content online, to all system users, year round.	FY 2019 Q1	FY 2019 Q4
Enhance inland flood risk analysis capability.	FY 2019 Q1	FY 2019 Q4
Develop capability to incorporate decision timelines from State/Local operational response plans for various evacuation scenarios into timeline graphics.	FY 2019 Q1	FY 2019 Q4
Enhance storm simulator functionality to ensure that users can create specific fully customizable storms and develop random storms to drive innovative training, and establish a capability for EM's to practice critical decision making.	FY 2019 Q1	FY 2019 Q4
Develop the capability to ingest and provide alerts from real-time traffic data.	FY 2019 Q1	FY 2019 Q4
Integrate IPAWS compatible functionality for public alerting.	FY 2019 Q1	FY 2019 Q4
Track and report on post-transition metrics.	FY 2019 Q4	FY 2020 Q4
Hold formal launch of HVX software to all 21 U.S. coastal states and territories.	FY 2019 Q4	FY 2019 Q4
FY 2020		
Add cyber sensing for power outages capability to HVX.	FY 2020 Q1	FY 2020 Q4
Optimize HVX for mobile devices.	FY 2020 Q1	FY 2020 Q2
Integrate mass-care meals and housing planner application.	FY 2020 Q2	FY 2020 Q3
Track and report on post-transition metrics.	FY 2020 Q2	FY 2020 Q4

Type of Research
Applied research.

Technical Readiness Level
TRL 5

Transition Plans
FEMA issued a Request for Proposal (RFP) for transition and operations and maintenance of S&T's HVX and awarded the O&M in October 2017. Additional features will be transitioned based on this same contracting mechanism.

Regional Resilience Assessment Technology Modernization

- **Problem:** The United States is increasingly affected by disasters of all types - natural, technological and man-made. Existing science and technologies available at the Federal, state and community levels are not adequate to meet the challenges of assessing the multiple risks and hazards of disasters effectively and efficiently. This negatively affects the ability of organizations to spend mitigation funds effectively to reduce risks, and to respond and recover from disasters of all types. New science and technology is required to fully meet the goals of PPD-21, which defines resilience "as the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions." Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.

- **Solution:** S&T works with key stakeholders at Federal, state and local levels to understand and prioritize gaps in science and technology needed to increase resiliency at all levels of government. S&T will coordinate with the research community, industry and other practitioners to identify, develop, test and transition to operational use new tools to increase resiliency. S&T will leverage existing research partnerships with FEMA for flood resiliency and modernization of hurricane technologies and other relevant programs.

- **Impact:** Severe weather events over the past 20 years, including floods and hurricanes, now cause over $50B per year in damages in the United States.[21] If this program can reduce the future costs of disasters related to weather by 1% due to improved resiliency, the impact will be over $500M in annual benefits. In addition, Federal, state and local organizations will have improved tools to guide mitigation investments, and manage response and recovery operations, resulting in improved community and national resiliency.

FY 2018 Key Milestone Events
- Developed research plan.
- Initiated three resiliency research program with key stakeholders.

FY 2019 Planned Key Milestone Events
- Transition one or more technologies to operational use to increase community resilience.
- Continue research resiliency projects with two additional stakeholders.

[21] NOAA National Centers for Environmental Information, Billion-Dollar Weather and Climate Disasters: Summary Stats, September 2018

FY 2020 Planned Key Milestone Events

- Complete a design study on National Resilience Investment Opportunity Zones for optimizing whole-community investment in pre- and post-disaster resilience and mitigation.
- Develop regional resilience capability framework for assessing local capacity and measuring progress.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018[22]	FY 2019	FY 2020
Project Funding	-	$620	$1,986	$1,986	$1,986
Obligations	-	$12	$2,779	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Develop and coordinate research plan with stakeholders.	FY 2018 Q1	FY 2018 Q2
Initiate and complete three resiliency research programs with key stakeholders.	FY 2018 Q3	FY 2019 Q3
FY 2019		
Transition one or more technologies to operational use to increase community resilience.	FY 2019 Q2	FY 2019 Q4
Continue research resiliency projects with two additional stakeholders.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Complete a design study on National Resilience Investment Opportunity Zones for optimizing whole-community investment in pre- and post- disaster resilience and mitigation.	FY 2019 Q2	FY 2020 Q2
Develop regional resilience capability framework for assessing local capacity and measuring progress.	FY 2019 Q4	FY 2020 Q4
Pilot regional resilience framework in top 60 highest risk communities and with DHS partners.	FY 2020 Q3	FY 2020 Q3
Transition one or more technologies to operational use to increase community resilience.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied

Technical Readiness Level

The program began at TRL 3 and will end at TRL 7.

[22] Obligations exceed Project Funding level due to funding realignments during project execution.

Transition Plans

- Transition will be accomplished through collaboration with key partners. Initially, it is envisioned that tools developed from this activity will be adopted incrementally by Federal, state, and local organizations to replace and update existing infrastructure used to plan mitigation programs and respond to and recover from disasters.

Flood

- **Problem:** Flooding of all kinds are a leading cause of fatalities and economic losses in the United States from natural disasters. Communities need new and emerging technologies to increase their resilience to flood disasters and provide flood predictive analytic tools to the FEMA and to state and local governments to reduce future flood fatalities and economic damages.

- **Solution:** This program will develop new processes, products (sensors, data sets, analytic tools, imagery) and standards to improve operations and outcomes in FEMA (including the Flood Insurance and Mitigation Administration, flood assistance programs and dam safety programs), other Federal agencies and the insurance industry. It is developing low-cost, network-connected flood sensors to improve regional and local flood prediction; new machine learning algorithms to detect buildings and other structures in hi-resolution satellite imagery, which will in turn create a national structures inventory to improve flood insurance risk evaluations and underwriting; and a variety of standards and specifications to support individual and community investments in flood-proofing products. These innovations will assist Federal, state, local, tribal, territorial and other stakeholder groups in making planning, disaster response and recovery, and investment decisions related to floods.

- **Impact:** With support from S&T, FEMA will be able to: 1) leverage existing data sources to create multi-dimensional representations of community functions using an integrated system-of-systems approach; 2) enhance whole community collaboration around disaster risk reduction; 3) identify indicators of community resilience and opportunities to introduce advanced technology solutions; 4) empower communities with decision support capabilities to enable both pre-event scenario-based risk planning and adaptive recovery in the post-event environment; and 5) enable faster decision-making.

Sub Projects

- *New flood sensors and alerting:* Develop and test an integrated flood warning system incorporating inexpensive, deployable flood sensors; information integration and modeling software; and an automated smartphone-based, geo-targeted alert system. Create flood alert models, tuned to local terrain; that can provide longer lead-times and more accurate geo-targeting. Investigate the potential of adapting these technologies to dam/levee integrity monitoring.
- *Smarter remote sensing and situational awareness:* While considering the practicality of development, utilize a cross-section of imaging technologies (e.g., aerial LiDAR, high-resolution satellite based synthetic aperture radar) and emerging technologies (e.g., unmanned aerial systems) to improve the image base, exploit historical satellite imagery, and exploit emerging digital elevation modeling technologies to improve the definition and accuracy of flood hazard areas, including flood hazards in areas not included in FEMA Special Flood Hazard Areas (SFHAs).
- *New products from high performance computing and artificial intelligence:* Apply computer learning technologies and facial recognition algorithms to the development of a national inventory of structures database for flood-prone areas, especially for identified FEMA Special Flood

Hazard Areas; SFHAs, including type of structure, elevation, tax assessment, ownership and other relevant data. Work with private sector companies to investigate the feasibility of transitioning the national structures inventory to become a commercial product that supports flood and other disaster insurance underwriting.

- *Realigned economic incentives and risk analysis:* Support more cost-effective investment decisions improving the resiliency of residential properties, business continuity and public/private infrastructure resilience by improving the mitigation decision-making tools available, including integrated analytics such as Kentucky's Community Hazard Assessment and Mitigation Planning System tool, and the use of low cost historical satellite imagery to identify flood prone areas outside of those mapped to date by FEMA.
- *Enhance community resilience:* Promote faster and more complete recovery from flood disasters by identifying quantitative indicators of resilience that have practical use in guiding and mitigating investment decisions and by developing SOPs, planning methodologies and quantitative methods to integrate resilience analysis into local and state flood planning, response and mitigation activities.
- *Improve flood data quality and access:* Provide decision-makers with access to the data they need and when they need it through developing a roadmap of the best available flood decision data for all data categories. As well as, developing new types of flood sensors that are cheap enough to be widely distributed and easily moved, developing technologies to create, maintain and share elevation and structure footprint data, and developing new technical methods for filling decision data gaps.
- *Improve predictive models and analytical services:* Provide decision-makers with access to better models for all phases of flood management. Review all available flood models and forecasting tools with multiple uses and users in mind; create flood alert models, tuned to local terrain, that can provide longer lead-times and more accurate geo-targeting; provide better coverage of inland and flash flooding, accounting for increased impervious surfaces and the availability of fine-grained elevation data from new technology and expand the coverage of models to better forecast the aftermath of floods.

FY 2018 Key Milestone Events

- Demonstrated the technical capability to issue geo-targeted flood alerts.
- Completed evaluation of the private flood insurance market and ways to close the flood insurance gap in the U.S.

FY 2019 Planned Key Milestone Events

- Transfer scientific methods for automated building detection to industry and conduct demonstration pilot of structure-level data utility service that supports FEMA, emergency managers, floodplain managers, insurers, and other stakeholders.
- Complete testing of low-cost, networked flood sensors in six locations around the country.

FY 2020 Planned Key Milestone Events

- Develop Flood Resilience planning methodology and tools to track readiness levels and monitor investment outcomes.
- Extend and update American National Standards Institute (ANSI) national flood abatement standards for flood sealant and semi-permanent barrier products and smart flood sensors.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$5,000	$5,000	$5,755	$5,000	$5,000
Obligations	$4,544	$3,665	$4,197	$140	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Made a determination on the feasibility of near real-time monitoring of dam/levee integrity using low cost sensors.	FY 2018 Q4	FY 2018 Q4
Successfully tested automated building footprint detection scientific methods with FEMA for use by disaster response, recovery, mitigation, and the National Flood Insurance Program.	FY 2017 Q3	FY 2018 Q4
Completed evaluation of the private flood insurance market and ways to close the flood insurance gap in the U.S.	FY 2018 Q1	FY 2018 Q4
Completed an economic-benefit analysis of a new data product for historically observed flood extents from 1984-2017 (33yrs) of LandSat data in eight (8) communities for optimizing mitigation investments and targeting areas for flood insurance expansion.	FY 2018 Q1	FY 2018 Q4
Demonstrated technical feasibility to issue geo-targeted flood alerts.	FY 2017 Q2	FY 2018 Q1
FY 2019		
Conduct Pilot demonstration of flood modeling technologies to provide structure level flood risk scores for community resilience.	FY 2019 Q1	FY 2019 Q2
Conduct Pilot demonstration of remote sensing technologies to provide wide area rapid damage assessments to help streamline disaster assistance and restore community services.	FY 2019 Q1	FY 2019 Q4
Develop national guidelines for core information requirements to meet Flood Decision support requirements for first responders and emergency managers	FY 2019 Q1	FY 2019 Q3
Develop best practices for low cost IoT flood sensors for storm water management.	FY 2019 Q1	FY 2019 Q4
Develop best practices for low cost IoT sensors for dam/levee safety monitoring.	FY 2019 Q1	FY 2019 Q4
Develop draft standards for ANSI national flood abatement standards for flood sealant and semi-permanent barrier products and smart flood sensors.	FY 2019 Q1	FY 2019 Q4
Develop criteria for national standards for assessment, monitoring, and reporting of state and municipally-owned dams in collaboration with the National Dam Safety Program.	FY 2019 Q1	FY 2019 Q2
Transfer scientific methods for automated building detection to industry and conduct demonstration pilot of structure-level data utility service that supports FEMA, emergency managers, floodplain managers, insurers, and other stakeholders.	FY 2019 Q1	FY 2019 Q4
Conduct demonstration pilot using low costs sensors and criteria for a National standard for dam assessment, monitoring, and reporting in coordination with the National Dam Safety Program.	FY 2019 Q1	FY 2019 Q4
Complete the Observed Flood Extent inventory of previously flooded lands for the remainder of the continental United States and transition to FEMA for future O&M.	FY 2019 Q1	FY 2019 Q4
FY 2020		

Research and Development Description	Plan Start Date	Planned Completion
Develop enhancements to the Decision Support System for Water Infrastructure Security (DSS-WISE) web-enabled dam breach modeling and simulation service in coordination with the National Dam Safety Program.	FY 2019 Q1	FY 2020 Q3
Develop a Flood Resilience planning methodology and tools to track readiness levels and monitor investment outcomes.	FY 2019 Q3	FY 2020 Q4
Extend ANSI national flood abatement standards for flood sealant and semi-permanent barrier products and smart flood.	FY 2020 Q1	FY 2020 Q4
Facilitate final update ANSI national flood abatement standards for flood sealant and semi-permanent barrier products and smart flood sensors.	FY 2020 Q1	FY 2020 Q4
Facilitate, in coordination with the National Dam Safety Program, new guidelines for a National standard for dam assessment monitoring and reporting.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied

Technical Readiness Level

This program begins at TRL 2 and ends at TRL 6.

Transition Plans

- Development of charter and IPT to maintain close coordination with FEMA and to ensure the program's development aligns with operational requirements.
- Development of transition agreement to transfer decision support tools to FEMA for deployment to Federal, state, local users and other stakeholders, including non-governmental agencies.

Counter Human Trafficking

- **Problem:** Worldwide there are an estimated 25 million victims of human trafficking, comprising an industry worth more than $150 billion in illegal profits. Given the scale, evolving nature, and complexity of human trafficking, combatting the problem poses a significant challenge, particularly for those on the front lines, including the Department of Homeland Security.

- **Solution:** Through evidence-based research, S&T will provide operational stakeholders with actionable information and strategies to more effectively perform their duties. Two foundational efforts (mapping current trafficking efforts among Government, non-governmental organizations, and the private sector and detailed needs assessments through extensive involvement with operational stakeholders) will, taken together, form a detailed out-year research agenda.

- **Impact:** The DHS S&T Human Trafficking program will be designed to advance operationally-relevant, end-user focused applied social and behavioral science research that will enable decision makers, inform policy makers, and assist operational partners in mitigating the human and monetary costs of human trafficking.

Sub Projects

- *Operational Roadmap – Human Trafficking:* Identify human trafficking stakeholder needs and requirements to assist in building a research portfolio that is useful to end-users.
- *Human Trafficking Systems Analysis & Technology Roadmap:* In coordination with Digital Forensics, this sub project will identify technology gaps and provide recommendations for near, mid-, and long-term development and implementation.
- *Matrix and Taxonomy – Human Trafficking:* Map government agencies and non-governmental organizations active in anti-trafficking efforts, including their relationships with each other. Identify and matrix characteristics of several types of trafficking to begin to identify indicators, signatures, pathways, and potential overlaps.

FY 2018 Key Milestone Events

- N/A

FY 2019 Planned Key Milestone Events

- N/A

FY 2020 Planned Key Milestone Events

- *Operational Roadmap – Human Trafficking:* Elicit needs and gaps from operational human trafficking stakeholders.
- *Matrix and Taxonomy – Human Trafficking:* Identify indicators, signatures, pathways, and potential overlaps of several types of trafficking.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	-	-	$3,000
Obligations	-	-	-	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
N/A		
FY 2019		
N/A		
FY 2020		
Operational Roadmap – Human Trafficking: Elicit needs and gaps from operational human trafficking stakeholders.	FY 2020 Q1	FY 2020 Q4
Matrix and Taxonomy- Human Trafficking: Identify indicators, signatures, pathways, and potential overlaps of several types of trafficking.	FY 2020 Q1	FY 2020 Q4

Type of Research

Applied; Developmental

Technical Readiness Level

TRL 5

Transition Plans

- The reports, findings, and interactive web tool will be shared with other organizations, including the DHS Blue Campaign, DHS Office for Trade Policy, Interagency Working Group on Forced Labor, and the Senior Policy Operating Group Research & Data Committee among others. Importantly, the findings of these two efforts will inform the development of a human trafficking research strategy for FY 2020 and beyond that meets stakeholder needs.

Cyber for Critical Infrastructure

- **Problem:** Critical infrastructure systems are vital to our national security and economy vitality. This infrastructure has become increasingly global, complex, and susceptible to disruptions. Increased connectivity across critical infrastructure sectors creates vulnerability and opportunities which cannot be addressed in isolation. DHS needs enhanced awareness of potential disruptions and the ability to design in flexibility and resilience to mitigate the effects of such disruptions. Current risk assessment and management approaches often do not incorporate all of the relevant linkages, such as sector interdependencies and cybersecurity (including cyber-physical) risk factors. As a result, formulation of risk-informed designs that can incorporate resilience remains a challenge.

- **Solution:** Develop the technical basis and analytical tools needed to support cross-domain risk assessment and identify standards of practice to support the expanded use of risk methodologies for cyber and physical systems, resource prioritization and response planning. Work with CISA, the National Infrastructure Protection Plan sector partnership structure, and international partners to build on existing risk assessment tools and platforms to incorporate cross-sector interdependencies.

- **Impact:** Economic vitality is dependent on complex infrastructure systems. The efficiency & reliability of the systems are important elements of competitiveness. Enhancing effectiveness & ease of adoption of risk assessment tools across critical infrastructure enables collective security & resilience more broadly. Solutions must reflect interdependencies of supply chains & cross-domain risk exposure to effectively/efficiently make CI more robust & able to withstand, absorb, recover & adapt to ensure essential functionality.

Sub Projects

- *Critical Infrastructure Design and Adaptive Resilient Systems (CIDARS)* – The CIDARS project is examining innovative approaches to plan and design adaptive performance into critical infrastructure systems. The goal is to create common capabilities and quantitative approaches that facilitate the development and implementation of integrated solutions that will enable secure and resilient service provisioning.
- *Cyber Resilient Energy Delivery Consortium (CREDC)* – The consortium is developing solutions through R&D, education and industry engagement. CREDC will generate research, evaluate the results and deploy solutions in the marketplace. The project's foci include cyber protection technologies; cyber monitoring, metrics, and event detection; risk assessment of Energy Delivery Systems technology; data analytics for cyber event detection; resilient Energy Delivery Systems architectures and networks; and identifying the impact of disruptive technologies such as the IoT and cloud computing on Energy Delivery Systems resiliency.
- *Cybersecurity for Oil & Gas Systems* – This project facilitates research, development, testing and evaluation procedures to improve cybersecurity in petroleum industry digital control systems. The project undertakes collaborative R&D projects to improve the level of cyber security in critical systems of interest to the oil and natural gas sector. The objective is to promote the interests of the sector while maintaining impartiality, the independence of the participants and vendor neutrality.
- *Critical Infrastructure Security and Resilience (CISR) Characterization* – This project identifies and characterizes functional interactions among critical infrastructure sectors with a focus on key physical, social, and behavioral dependencies.
- *Risk Informed CISR Restoration* – This project focuses on the development of risk-informed, integrated resource allocation decision support for critical infrastructure restoration, renewal, and redesign.
- *Critical Infrastructure Supply Chain Analysis* – This project focuses on protecting our cyber infrastructure from unintended manipulation of hardware and software utilizing Scanning Electron Microscopy.

FY 2018 Key Milestone Events

- Finalized and released final report of a study on vulnerabilities on Safety Instrumented Systems and basic Process Control Systems.
- Selected and developed specifications for the testing and evaluation procedures of a new project.

FY 2019 Planned Key Milestone Events

- Initial prototype design for a customized microcontroller and IC as a controlled experimental unit in support of hardware vulnerability analysis using scanning electron microscopy.

FY 2020 Planned Key Milestone Events

- Demo scale project of sector interdependencies at the community, industry, regional, and national levels, that identifies the key physical, operational, economic, social, and behavioral relationships.
- Conduct a demonstration of novel watermarking and fingerprinting methods to verify integrated circuit integrity.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	$8,650	$3,650	$3,650
Obligations	-	-	$4,821	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Finalize and release final report of a study on vulnerabilities on Safety Instrumented Systems and basic Process Control Systems.	FY 2018 Q1	FY 2018 Q4
Select and develop specifications for the testing and evaluation procedures of a new project.	FY 2018 Q1	FY 2018 Q3
Identify and prioritize draft gaps in the existing data and model set based on synthetic data preliminary award findings.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Initial prototype design for a customized microcontroller and IC as a controlled experimental unit in support of hardware vulnerability analysis using scanning electron microscopy.	FY 2019 Q2	FY 2019 Q4
FY 2020		
Identify and characterize how the evolving demand for infrastructure services and new technologies can be incorporated into new designs for more resilient interdependent critical infrastructure systems.	FY 2019 Q2	FY 2020 Q2
Develop data to support infrastructure design, performance, and operation to identify predictive models and decision making for normalization, taxonomies, and repository requirements to support public and private efforts.	FY 2019 Q3	FY 2020 Q3
Collect, generate, validate, and publish existing, new, and synthetic data on critical infrastructure design and performance.	FY 2019 Q3	FY 2020 Q3
Demo scale project of sector interdependencies at the community, industry, regional, and national levels, that identifies the key physical, operational, economic, social, and behavioral relationships.	FY 2020 Q1	FY 2020 Q4
Develop draft federated models combining existing analytical tools at various levels of granularity.	FY 2020 Q1	FY 2020 Q4
Conduct a demonstration of novel watermarking and fingerprinting methods to verify integrated circuit integrity.	FY 2020 Q1	FY 2020 Q4

Type of Research
Applied

Technical Readiness Level
The program began at TRL 2 and will end at TRL 6.

Transition Plans
- Tools, findings, reports, and methodologies will be shared with other organizations, such as CISA, the NIST, the National Science Foundation sector, and international partners, to improve the formulation of risk-informed designs for critical infrastructure that can incorporate resilience and improve DHS's awareness of potential disruptions.

INNOVATIVE RESEARCH AND FOUNDATIONAL TOOLS THRUST – S&T aims to understand the high-priority, homeland security capability needs and gaps, and identify optimal approaches for providing solutions and knowledge that address those needs. R&D investments enable gathering gaps through analysis and requirements prioritization with focus on identifying and analyzing potential solutions and working with customers to select the best approach to delivering solutions, including knowledge and advice.

Technology Centers – FY 2018 Enacted: $25.7M. FY 2019 President's Budget: $20.1M. FY 2020 Request: $24.6M. The Technology Centers conduct enduring, foundational, basic and applied research activities into cross-cutting scientific, engineering, and technological areas to (1) ensure advancements in science and technology are harnessed for cutting edge solutions to operational challenges, and (2) ensure technical SME capabilities are available to S&T and the Department for decision making. The Technology Centers are the source within S&T for scientific, engineering, and technology expertise and solutions to widespread challenges across DHS mission spaces. The funding for Technology Centers is applied towards broad outcomes that fundamentally change or provide a unique capability to address the Department's recognized gaps, needs, and emerging threats, to include:
- Maintaining S&T's technical baseline competency and awareness of the state-of-the-art/art-of-the-possible in key science, engineering, and technology areas.
- Advancing the state of science and technology where needed to address operational gap areas common to multiple missions/multiple portfolios.
- Exploring emerging technology areas and their potential threat and/or application to current and future DHS missions.
- Providing cross cutting solutions against challenging and persistent DHS mission needs and Component requirements.
- Delivering rapid-response expertise to urgent needs.

Data Analytics Technology Center (DA-TC) (formerly Data Analytics Engine (DA-E) and Social Media Research)

- **Problem:** Leveraging data sources to compute threats, impacts, risks, decision support, and situational awareness continues to become increasingly challenging due to the exponential growth of data, particularly data associated with the Internet-of-Things and social media analytics. Further, data analytics technologies (such as artificial intelligence and machine learning), including computational, methodological and

systems components, rapidly evolve on six-month innovation cycles making it difficult to track and assess solution options relative to critical missions of the Department.

- **Solution:** Keeping pace with growing data sets and rapidly evolving solutions requires an agile core technical service that can quickly diagnose privacy, security, computation, and analytics for the missions of S&T, DHS, and the HSE. The DA-TC assists in problem definition and solutions development for DHS programs using relevant data sets, analytic methodology, technologies and systems in collaboration with subject matter experts from Government, industry and academia. Further, DA-TC works across disciplines to illuminate next generation problem sets and technologies (including social media, live streaming, real-time analytics, machine learning and artificial intelligence) to inform program planning, avoid technical obsolescence, accelerate transition, and prevent mission surprise.

- **Impact:** DA-TC helps analysts, operators, agents, and program managers across DHS increase mission effectiveness by better leveraging data for decision-making. DA-TC provides S&T and DHS programs with coordinated information, subject matter expertise, mission studies, analysis of alternatives, experiments, prototypes, business methodologies, technical capabilities, analytics methodologies and transition planning to improve program efficiency, share best practices, and improve security and privacy protection across DHS analytics system investments.

FY 2018 Key Milestone Events

- Conducted experiments and delivered reports and recommendations regarding the use of automated image, video, and speech analytics to meet DHS mission needs for immigration and border security as well as other DHS missions.
- Developed and transitioned a framework for approaching Real Time Analytics for Multi-Latency Multi-Party Metro Scale Networks (RAMMMNets) problem sets to improve the focus and impact of research efforts on homeland security mission priorities including Smart Cities.
- Delivered an analysis of advanced analytic applications such as graph processing capabilities to ICE that demonstrate significant mission impact for national security investigations and that is also relevant to other DHS mission areas including nuclear threat detection and critical infrastructure protection.

FY 2019 Planned Key Milestone Events

- Develop an advanced concept prototype, experiments and technical reports to help DHS discern data, analytics and computational architecture requirements for next generation mission and operations analytic systems.
- Deliver two technical reports based upon laboratory analysis and experimentation with advanced analytics and computation technologies that pose significant homeland security threats and/or offer significant mission opportunities to improve enterprise knowledge and appropriately support acquisition decision making for components and HSE.
- Conduct research to develop new capabilities for leveraging open source and social media content to support DHS missions such as countering terrorism and the distribution of illegal opioids.

FY 2020 Planned Key Milestone Events

- Develop two knowledge products based on emerging technology evaluations that guide acquisitions across DHS components and the broader Government.
- Conduct two technology pilots to inform component mission operations and expand DHS operational capabilities.
- Conduct open source and social media capabilities testing with DHS operational stakeholders to evaluate performance and impact on mission.

Overall Project Funding[23]

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$6,750	$7,500	$8,711	$10,267	$10,402
Obligations	$3,911	$5,888	$7,203	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Delivered and transitioned a report on image, video, and speech analytic experiments to improve open source and social media analytics for DHS missions.	FY 2018 Q1	FY 2018 Q4
Delivered and transitioned a framework for approaching RAMMMNets problem sets for research.	FY 2018 Q1	FY 2018 Q4
Delivered an analysis of advanced analytic applications such as graph processing capabilities to ICE, CBP, and CWMD that demonstrate significant mission impact for national security, including nuclear threat detection and critical infrastructure protection; customs fraud; adversarial activity; and counter-proliferation.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Deliver technical reports that provide components and members of HSE with specific technical information regarding technology threats and opportunities related to advanced data analytics and computation environment.	FY 2019 Q1	FY 2019 Q4
Deliver technical reports, briefings, and demonstrations to components and members of HSE that form the basis for operational strategy and acquisitions to achieve next generation data, analytics and computational capabilities.	FY 2019 Q1	FY 2019 Q4
Conduct experiments to develop new capabilities for leveraging open source and social media content to support DHS missions such as countering terrorism and the distribution of illegal opioids.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Develop two knowledge products based on emerging technology evaluations that guide acquisitions across DHS components and the broader Government.	FY 2020 Q1	FY 2020 Q4
Conduct two technology pilots to inform component mission operations and expand DHS operational capabilities.	FY 2020 Q1	FY 2020 Q4
Conduct open source and social media capabilities testing with operational Component stakeholders to evaluate performance and impact on mission.	FY 2020 Q1	FY 2020 Q4

[23] Overall Project Funding for DA-TC is a combination of funding from former DA-E and Social Media Research.

Type of Research

DA-TC projects include elements of Basic, Applied, and Developmental research.

Technical Readiness Level

DA-TC projects range from TRL 2 to 7.

Transition Plans

- DA-TC continues to advise the DHS Social Media Working Group, led by DHS Policy, which includes the Office of the Chief Financial Officer, Office of Privacy, and Office of Civil Rights and Civil Liberties. Social Media and Open Source data sources, methodologies and tool development are examined during operational test pilots with end users. The pilots are supported by the respective DHS Component leadership who hosts S&T staff onsite to conduct the testing. DA-TC works closely with oversight organizations to address issues before pilots begin to facilitate future transition, and transitions technology development products once they are proven in the Component's operational environment.
- In other technology areas, DA-TC provides experimental results that are provided through technical reports and briefings that are relevant to homeland security mission. This transition of knowledge product provides inputs to DHS S&T program planning as well as component acquisition planning and ongoing operations.
- DA-TC also works directly with industry partners to facilitate transition of new technical analytics capabilities directly to Components through the private sector. This method of transition is direct to the component through industry, and can be completed using competitive procurement actions.
- As a respected member of the data analytics research community, DA-TC regularly collaborates with industry, government and academic partners to ensure that the technical interests of homeland security are included in joint planning activities and external research efforts. This leverage improves the efficiency of DHS research investments and enables leverage of cross government efforts.

Modeling & Simulation Technology Center (MS-TC) (formerly Model & Simulation Engine (MS-E))

- **Problem:** Prior to the MS-TC being formed, there was not a centralized organization within DHS to coordinate Modeling & Simulation (M&S) activities or to serve as a Subject Matter Expert (SME) on the subject. M&S is an analytical capability used across multiple S&T projects and programs, which have similar elements and requirements, and they are often discarded after the completion of the project. As a result, there is an opportunity to coordinate M&S across these programs and to leverage capabilities and best practices from interagency partners such as the DOD Defense Modeling and Simulation Coordination Office (DMSCO).

- **Solution:** By creating the MS-TC, S&T has established a highly-capable M&S team of SMEs, with significant inter- and intra-agency coordination linkage. MS-TC provides a centralized repository and single-manager M&S Coordination function for mission-based models as well as modeling and simulation tools that will be available for use to S&T program managers. This allows M&S analytical capabilities and best practices to be coordinated across programs.

- **Impact:** The MS-TC increases the efficiency of DHS Component operators, eliminates duplication and saves resources. The MS-TC enhances S&T's collaboration with DOD and other agency partners in the M&S domain, and leverages best practices to ensure a coordinated M&S approach for S&T's programs and other Component efforts. This coordinated approach assists mission critical programs by providing emergent and impactful M&S capabilities leveraged from across the Government to ensure the safety of frontline agents and citizens.

FY 2018 Key Milestone Events

- Established Counter Small Unmanned Aerial Systems Advisory and Review Toolkit (C-SMART) 2.0 capabilities for the Program Executive Office for Unmanned Aerial Systems (PEO UAS). C-SMART 2.0 provides significant enhancements to 1.0 features, such as incorporating RF propagation modeling to increase fidelity of UAS and C-UAS simulations.
- Expanded NGFR immersive simulation technologies to include incident command training for fire, police, and unified command activities. This capability will allow joint tactics, techniques, and procedure (TTP) development, and enhancement of incident command training delivered to HSE stakeholders.

FY 2019 Planned Key Milestone Events

- Establish a DHS M&S Community of Interest (CoI) in coordination with DHS Component and inter-agency partners. This effort leverages enterprise information sharing tools, such as SharePoint, to maintain a collaborative environment for CoI members.
- Develop and transition an augmented reality (AR)/virtual reality (VR) modeling capabilities to enhance operational capability available for S&T Programs (such as Next Gen First Responder) and at FLETC.

FY 2020 Planned Key Milestone Events

- Deliver animal disease models to United States Department of Agriculture.
- Complete M&S CoI Catalogue integration.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**[24]	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	$1,696	$1,500	$3,876	$1,876	1,876
Obligations	$1,657	$1,911	$1,783	-	-

[24] Obligations exceed Project Funding level due to funding realignments during project execution.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Established Counter Small Unmanned Aerial Systems Advisory and Review Toolkit 2.0 capabilities for the PEO UAS. C- SMART 2.0 provides significant enhancements to 1.0 features, such as incorporating RF propagation modeling to increase fidelity of UAS and C-UAS simulations.	FY 2017 Q4	FY 2018 Q4
Expanded NGFR immersive simulation technologies to include incident command training for fire, police, and unified command activities. This capability will allow joint TTP development, and enhancement of incident command training delivered to HSE stakeholders.	FY 2017 Q2	FY 2018 Q3
Finalized co-development of DHS M&S Catalog in coordination with DMSCO using EMBR tools, and populate catalog with comprehensive list of S&T M&S capabilities.	FY 2017 Q3	FY 2018 Q3
FY 2019		
Establish DHS M&S CoI in coordination with DHS Component and inter-agency partners. Leverage enterprise information sharing tools, such as SharePoint, to maintain a collaborative environment for CoI members.	FY 2018 Q1	FY 2019 Q4
Develop AR/VR modeling capabilities in collaboration with the FLETC: virtualize a training site utilizing AR/VR technology.	FY 2018 Q1	FY 2019 Q4
FY 2020		
Deliver animal disease models to United States Department of Agriculture.	FY 2018 Q4	FY 2020 Q1
Complete M&S CoI Catalogue integration.	FY 2019 Q1	FY 2020 Q4

Type of Research

Applied and Developmental

Technical Readiness Level

TRL 2-7

Transition Plans

- Complete and transition animal disease models to the Department of Agriculture.
- Complete the comprehensive integration of the M&S CoI catalog for use by S&T Program Managers and DHS Components.

Social Sciences Technology Center (SS-TC) (formerly Behavioral, Economic, and Social Science Engine (BESS-E))

- **Problem**: Government-developed technologies risk failure in transition due an insufficient understanding of the ways in which new solutions will impact customers' missions before, during, and after implementation.

- **Solution:** SS-TC helps S&T's programs bridge the transition gap by providing independent and objective support prior to and during technology transition. Using social science methodologies such as focus groups, interviews, quantitative and qualitative data analyses, organizational assessments, logic models, and metrics development and evaluations, SS-TC helps S&T programs anticipate and mitigate potential barriers to adoption.

- **Impact:** SS-TC increases the likelihood of successful technology transition by providing programs with actionable recommendations based on measures of short and long-term success in process, impacts, outcomes, and unintended consequences of technology implementation.

FY 2018 Key Milestone Events

- Provided a knowledge product to FEMA with recommendations to decrease uninsured flood losses.
- Delivered a framework, based on data collections that enhances and streamlines the USBP's Capability Gap Analysis Process.

FY 2019 Planned Key Milestone Events

- Deliver a report identifying public perceptions surrounding first responder use of unmanned vehicles for several different use cases to DHS S&T's PEO UAS. This information can be shared with local first responder organizations.
- Deliver a report on input and feedback from Transportation Security Officers and staff from TSA's Office of Security Operations regarding the design and human systems integration considerations for integrating the shoe scanner into the current passenger checkpoint.

FY 2020 Planned Key Milestone Events

- Deliver case studies of six border communities consisting of a literature review, stakeholder interviews, focus groups, collection and aggregation of extant data, and an analysis and summary of all case study data. The case studies will provide insights into how each of these communities has changed over time, indicating how border security measures may have influenced life in the community.
- Deliver a communications toolkit to first responders focused on how to manage risk perception and public acceptance of first responder use of UAS.

Overall Project Funding

(Dollars in Thousands)	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Project Funding	$1,479	$1,500	$1,500	$1,500	$1,000
Obligations	$1,022	$1,377	$849	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Developed and field a survey in three Virginia counties to ascertain the reasons why residents do/not acquire flood insurance.	FY 2018 Q2	FY 2018 Q3
Developed a research plan to assess the effectiveness of emergency communications in making a listener take the recommended action	FY 2018 Q1	FY 2018 Q1
Delivered report containing data analysis and recommendations for more efficient planning of future exercises (JamX 17).	FY 2018 Q1	FY 2018 Q1
Delivered recommendations for enhancing and streamlining the USBP's Capability Gap Analysis Process.	FY 2018 Q2	FY 2018 Q3
Developed and implement evaluation of newly developed ATAK training process and materials.	FY 2018 Q2	FY 2018 Q4
Developed protocols and conduct data collection on the types of footwear worn by airline passengers.	FY 2018 Q2	FY 2018 Q3
Identified stakeholder and passenger perceptions on the use and integration of a millimeter-wave footwear scanner in the passenger screening process.	FY 2018 Q2	FY 2018 Q3
FY 2019		
Deliver report identifying public perceptions surrounding first responder use of unmanned vehicles.	FY 2018 Q4	FY 2019 Q4
Conduct pilot study of ATAK training materials for USBP.	FY 2018 Q4	FY 2019 Q1
Deliver report identifying potential facilitators and barriers to technology acceptance to New York Police Department for the technologies used in the Critical Incident Management Technical Assessment Exercise.	FY 2017 Q2	FY 2019 Q1
Deliver a report detailing the types of footwear worn by airline passengers and passenger perceptions of millimeter-wave footwear scanners for use in the screening process.	FY 2018 Q2	FY 2019 Q2
Deliver a report on input and feedback from TSOs regarding the design and human systems integration considerations for integrating the shoe scanner into the current passenger checkpoint.	FY 2018 Q2	FY 2019 Q2
FY 2020		
Deliver case studies of six border communities consisting of a literature review, stakeholder interviews, focus groups, collection and aggregation of extant data, and an analysis and summary of all case study data. The case studies will provide insights into how each of these communities has changed over time, indicating how border security measures may have influenced life in the community.	FY 2019 Q1	FY 2020 Q1
Deliver a communications toolkit to first responders focused on how to manage risk perception and public acceptance of first responder use of ASs.	FY 2019 Q1	FY 2020 Q1

Type of Research

Applied

Technical Readiness Level

N/A – SS-TC develops and provides knowledge products tailored to individual program needs.

Transition Plans

- SS-TC serves as a research support function for S&T programs. The research aids in the transition of federally developed technologies and contributes to increased effectiveness of S&T customers' missions.

Office for Interoperability and Compatibility Technology Center (OIC-TC) (formerly Communications & Networking Engine (CN-E))

- **Problem**: During an emergency, public safety personnel frequently are unable to communicate with one another. Factors such as the non-interoperable radio equipment, insufficient radio bandwidth allocation, intentional interference and jamming, and outdated equipment all contribute to this problem. The OIC-TC seeks to promote R&D in wireless communications solutions to deliver an interoperable, efficient, and resilient communication ecosystem to vastly improve the first responder's communications capabilities.

- **Solution**: The OIC-TC is focusing its efforts to provide subject matter expertise and enduring research in communications and network capabilities as well as position, navigation, and timing. It is legislatively mandated to establish a comprehensive research, development, testing, and evaluation program for improving interoperable emergency communications. Its research will result in the development of technology solutions, as appropriate, as well as development of knowledge products including best practices and lessons learned.

- **Impact**: OIC-TC will help DHS operational components as well as state, tribal, and local public safety achieve a greater level of communications interoperability. This will dramatically impact agency programs' ability to communicate mission-critical information as they carry out their daily tasks of saving lives and protecting properties.

FY 2018 Key Milestone Events

- Conducted Phase 1 of the Speech Analytic project: Documented the performance of existing voice recognition technology in First Responder operational environments and develop requirements for improved performance as needed.

FY 2019 Planned Key Milestone Events

- Develop first iteration of video analytics R&D interoperability roadmap.
- Conduct Phase 2 of the Speech Analytic project: Develop the Speech recognition and analytic project to implement mobile application on user device (e.g., smartphone). Document the performance of the improved voice recognition technologies at an S&T technology experimentation event.

FY 2020 Planned Key Milestone Events

- Demonstrate wireless deployables capability to support localized wireless services with and without network backhaul.
- Research edge-computing device to readily share Artificial Intelligence (AI)-infused data, e.g., body-worn camera video, physiological sensor and environmental sensor. Such device shall provide intelligent fusion of wearable sensor data and share alerts with localized user if disconnected from network as well as networked users using available connections.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$2,274	$2,300	$2,752	$2,752	$2,752
Obligations	$2,600	$2,111	0	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Documented the technology demonstration outcome from the Phase 1 of the Speech Analytic project at a proof-of-concept event.	FY 2018 Q1	FY 2018 Q3
FY 2019		
Provision a deployable communication network system, allowing first responders to access the dedicated public safety spectrum, to participate in a public safety field exercise or an actual Component operational event and document the outcome as well as the technology's impact to the way information sharing is carried out by the end users.	FY 2018 Q2	FY 2019 Q2
NGFR Program's Spiral 3 Technology Integration and Experimentation – provide the communications and networking technologies funded by OIC-TC and other S&T projects to assist public safety first responders to exchange voice, data and video information to improve responders' situational awareness and to further foster the IoT sensor data communications.	FY 2019 Q1	FY 2019 Q3
Develop first iteration of video analytics R&D interoperability roadmap.	FY 2019 Q1	FY 2019 Q4
Evaluate public safety oriented data against baseline performance measurements from year 1 speech analytic research.	FY 2019 Q1	FY 2019 Q4
Application Service Load Testing Research into local application service hardware requirements.	FY 2019 Q1	FY 2019 Q3
Demonstrate BioSuit test bed with commercial sensor integration.	FY 2019 Q2	FY 2019 Q4
Research into LTE-Unlicensed Band use for Public Safety.	FY 2019 Q3	FY 2019 Q4
FY 2020		
Conduct First Responder Jamming Exercise with Federal, state, and local public safety partners.	FY 2019 Q2	FY 2020 Q3
Incorporate hands-free, intelligent voice-based assistance to enable mobile users intuitive access and sharing of information.	FY 2020 Q1	FY 2020 Q2
Demonstrate wireless deployables capability to support localized wireless services with and without network backhaul.	FY 2020 Q1	FY 2020 Q2
Research edge-computing device to readily share AI-infused data, e.g., body-worn camera video, physiological sensor and environmental sensor. Such device shall provide intelligent fusion of wearable sensor data and share alerts with localized user if disconnected from network as well as networked users using available connections.	FY 2020 Q3	FY 2020 Q4

Type of Research

Basic and Developmental

Technical Readiness Level

TRL 3 to 6

Transition Plans

- Deliver baseline research capabilities that align with S&T customer defined gaps.
- Provide laboratory and field testing expertise and capabilities for technology solution evaluation.

Sensors and Platforms Technology Center (SP-TC) (formerly Situational Awareness and Decision Support Engine (SANDS-E))

- **Problem:** DHS components require assured, secure access to essential elements of information, visualization tools and shared situational awareness that enhance their operational effectiveness. In order for data, applications and devices to be compatible and interoperable, they require open standards and exchange, integrated architectures that commercial industry can develop and stakeholders can adopt and scale.

- **Solution:** The SP-TC provides S&T programs with the most efficient and effective assured, secure Identity Credential and Access Management guidance and procedures, shared situational awareness, interoperable architecture and networking solutions, IoT sensors integration with Smart Cities, and advanced wireless emergency alert technology and communications.

- **Impact:** The SP-TC ensures that S&T programs and DHS Components can exchange critical information and data across all mediums and on any platform, and that the most critical and relevant information will be rapidly accessible to the right decision makers to achieve improved situational awareness in operational environments and meet defined requirements.

FY 2018 Key Milestone Events

- Developed prototype Flood Decision Support Tool: Prototype (Alpha) sensors were deployed in the summer of 2018 across five State, County and City government stakeholders for operational Test & Evaluation. Beta Sensors enhancement expected spring 2019.
- Assessed IoT sensors, standards, and physical prototypes for interoperable situational awareness. Landscape technology assessment resulted in the award of 13 commercial businesses contracts for the prototype development of in-door building sensors, autonomous unmanned aerial platforms, and a SmartHub on-body communications capability for First Responders.

FY 2019 Planned Key Milestone Events

- Prototype UAS platform and sensor payload for mass transit tunnel search and reconnaissance and develop prototype in-building detection sensor.
- Test and evaluate SCIRA with selected stakeholder community for practical implementation and cyber security protocols.

FY 2020 Planned Key Milestone Events

- Commercial transition of IoT Flood Sensors to state and local government floodplain management authorities.
- Commercial transition of IoT Intelligent Building Infrastructure Sensors (e.g. Smoke Alarms and Exit Signs) to stakeholders and commercial industry adoption.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$2,751	$2,300	$2,000	$1,939	$1,939
Obligations	$2,443	$2,101	$374	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Developed SCIRA with commercial industry partners and standards development organization leadership.	FY 2017 Q4	FY 2018 Q3
Sensor Architecture Framework Environment – delivered Next Generation First Responder SmartHub (e.g. IoT sensors and Communications) framework for industry adoption.	FY 2017 Q2	FY 2018 Q2
Build out, test and recommend Identity Credential and Access Management Trust Framework capability solution(s) for Public Safety & Communications stakeholders (SAFECOM and FirstNet) in support of NGFR.	FY 2018 Q1	FY 2018 Q4
Expanded RFI Tool functionality for mobile, secure and disconnected communications for CBP field agents.	FY 2017 Q1	FY 2018 Q1
FY 2019		
Prototype IoT Intelligent Building Infrastructure sensors with stakeholder community.	FY 2018 Q3	FY 2019 Q4
Prototype UAS platform and sensor payload for mass transit tunnel search and reconnaissance.	FY 2018 Q3	FY 2019 Q4
Test and evaluate SCIRA with selected stakeholder community for practical implementation and cyber security protocols.	FY 2018 Q1	FY 2019 Q2
FY 2020		
Perform operational test & evaluation of IoT Flood Sensors with State/local stakeholders for commercialization	FY 2018 Q4	FY 2020 Q2
Expand IoT Flood Sensors into commercialization markets.	FY 2019 Q3	FY 2020 Q3
Commercial transition of IoT Intelligent Building Infrastructure Sensors (e.g. Smoke Alarms and Exit Signs) to stakeholders and commercial industry adoption.	FY 2019 Q1	FY 2020 Q2

Type of Research

Applied and Developmental

Technical Readiness Level

TRL 2 to 7

Transition Plans

- IoT Flood Sensors inclusion in FEMA Mitigation Grant language for State disaster mitigation grants.
- IoT In-Building sensors for CISA-FPS and commercial industry (Insurance, Real Estate markets)

Biometrics and Identity Technology Center (BI-TC) (formerly Biometrics Technology Engine (BT-E) and Identity and Access Management Engine (IDAM-E))

- **Problem:** Biometric and identity technologies are playing an increasingly significant role in securing the Homeland against dynamic threats, yet S&T lacks a coordinated approach to identify, coordinate, and deploy interoperable capabilities, solutions and innovations across DHS operational Components and missions. In addition, S&T programs have identified requirements associated with identity and access management capabilities, including controlled access of secure data and system user identification tools for approved users who have an operational "need to know." DHS has a continued need for an expanded set of Identity capabilities that component customers and S&T program managers can incorporate into their R&D projects.

- **Solution:** BI-TC will provide a sustainable, common platform for driving biometric and identity technology standards, best practices, and innovation across DHS and its Components. This will enable DHS components to quickly establish technical competence using more capable and cost effective biometric and identity technologies and facilitate operational excellence. BI-TC will coordinate DHS technical biometric and identity competencies to provide world-class biometric and identity expertise, methods, tools, technology, best practices, industry and international coordination, and operational insight to address the dynamic biometric needs of DHS and the HSE.

- **Impact:** BI-TC will accelerate effective integration of biometric and identity technologies into DHS programs and Component operations, and work in a cross-cutting fashion to mitigate potential inefficiencies, further driving down costs and increasing operational impact.

FY 2018 Key Milestone Events
- Compiled and analyzed S&T portfolio of biometric programs, to include working groups, capabilities, use cases, and customers.
- Executed test and evaluation activities at the Maryland Test Facility in collaboration with HSE stakeholders to assess innovative technologies.
- Developed a tool, technology, or knowledge product that improves the anti-spoofing capabilities of wearables and in-ground and above ground sensor platforms that support the mission requirements of emergency responders as well as border situational awareness and defense.

FY 2019 Planned Key Milestone Events
- Co-lead multi-agency biometrics challenge competition for biometric fingerprint, face or iris recognition collection technologies.
- Develop tools to inform and improve biometric and identity facilitation of trusted travelers enrolled in CBP Global Entry program.

FY 2020 Planned Key Milestone Events
- In coordination with the NIST, contribute to the enhancement of biometric technologies, standards, and best practices and drive adoption of biometric standards across the HSE.
- Develop biometric and identity standards through International Standards Development Organizations to facilitate interoperability of DHS Component implementations.

Overall Project Funding[25]

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$2,100	$2,100	$4,364	$1,721	$1,408
Obligations	$1,927	$1,728	$3,808	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Compiled and analyzed S&T portfolio of biometric programs to include: working groups, capabilities, use cases, and customers.	FY 2018 Q1	FY 2018 Q4
Executed test and evaluation activities at the Maryland Test Facility in collaboration with HSE stakeholders to assess innovative technologies.	FY 2018 Q1	FY 2018 Q4
Developed a tool, technology, or knowledge product that improves the anti-spoofing capabilities of wearables and in-ground and above ground sensor platforms that support the mission requirements of emergency responders as well as border situational awareness and defense.	FY 2018 Q1	FY 2018 Q4
FY 2019		
Maintain and expand an accessible biometric "body of knowledge" for the HSE with regard to non-contact fingerprint; face and iris recognition while moving; and speaker and DNA recognition.	FY 2019 Q1	FY 2019 Q4
Facilitate multi-agency test and evaluation activities at the Maryland Test Facility in collaboration with HSE stakeholders to assess innovative contact and non-contact fingerprint recognition technologies.	FY 2019 Q1	FY 2019 Q4
Contribute to the enhancement of biometric technologies, standards, and best practices in coordination with relevant entities (e.g. NIST), and drive adoption of biometric standards across the HSE.	FY 2019 Q2	FY 2019 Q4
Provide Technical Subject Matter Expertise and technical reports to inform DHS review of biometric technology acquisition programs.	FY 2019 Q1	FY 2019 Q4
Develop tools to inform and improve biometric and identity facilitation of trusted travelers enrolled in CBP Global Entry program.	FY 2019 Q1	FY 2019 Q3
Develop candidate concepts of operational and evaluation criteria for traveler identity verification across CBP and TSA operations.	FY 2019 Q1	FY 2019 Q4
FY 2020		
Maintain and expand an accessible biometric "body of knowledge" for the HSE with regard to non-contact fingerprint; face and iris recognition while moving; and speaker and DNA recognition.	FY 2020 Q1	FY 2020 Q4
Facilitate multi-agency test and evaluation activities at the Maryland Test Facility in collaboration with HSE stakeholders to assess innovative multi-biometric recognition on the move technologies.	FY 2020 Q1	FY 2020 Q3
Contribute to the enhancement of biometric technologies, standards, and best practices in coordination with relevant entities (e.g. NIST), and drive adoption of biometric standards across the HSE.	FY 2020 Q2	FY 2020 Q4
Enable CBP, TSA, ICE, or USCIS joint demonstration and operational evaluation of integrated multi-modal biometric capabilities.	FY 2020 Q2	FY 2020 Q4
Develop biometric and identity standards through International Standards Development Organizations to facilitate interoperability of DHS Component implementations.	FY 2019 Q2	FY 2020 Q4

[25] Overall Project Funding for BI-TC is a combination of funding from former BT-E and IDAM-E.

Type of Research
Applied and Developmental

Technical Readiness Level
TRL will vary between specific activities

Transition Plans
- Develop Technology and Process Assessment report for Biometrics Technology Refresh and deliver updated biometrics "body of knowledge". Transition: products to DHS and other Federal Agencies with specific applications for TSA, CBP, OBIM, and ICE.
- Identity activity results consist of a mixture of open source releases of technology and knowledge products, commercial capability development, as well as direct transitions to S&T Programs and DHS Components.

Hazard Awareness and Characterization Technology Center (HAC-TC) (formerly Chemical and Biological Characterization Engine (CBC-E))

- **Problem:** DHS S&T is responsible for conducting RDT&E for technological solutions to support DHS component operations. While DHS components are best positioned to identify their immediate operational needs, they and the chemical, biological, and explosive defense community writ large often lack critical data and expertise necessary to formulate appropriate lower-level system performance requirements. The combination of expertise, knowledge, and capability to anticipate knowledge requirements is neither resident in all of the required program offices, and is not available as a centralized resource in S&T.

- **Solution:** Establishing the HAC-TC provides a centralized function within S&T to provide and coordinate critical expertise, access to knowledge products (i.e., technical reports) generated through rigorous laboratory experimentation, and capabilities to identify and fill critical data and insight on the properties of chemical, biological, and explosive threat agents and the hazards that they pose. The HAC-TC directly coordinates activities with the following projects: Biological Threat Characterization (BTC), Homemade Explosive Characterization (HME), National Biodefense Analysis and Countermeasure Center (NBACC), Chemical Security and Analysis Center (CSAC) and BioKnowledge Center (BKC). Characterization efforts will ensure the interagency community has a defensible threat prioritization methodology and core research characterization capability in order to define the physical, chemical and detection properties of threats.

- **Impact:** The HAC-TC program establishes and leverages innovative science-based capabilities to provide the DHS and others with the expertise, data and knowledge necessary to implement best-practices and appropriate understanding of functional requirements for solutions to current and emerging chemical, biological, and explosive hazards produced by S&T to address customer requirements. The application of expertise and knowledge coordinated through the HAC-TC will increase the efficiency of DHS by enabling development of more effective solutions based on consistent and defensible recommendations, such as developing and fielding more effective transportation security equipment, providing better training to front line personnel, and validating and monitoring continuing and emerging threats.

Sub Projects

- *Hazard Awareness:* Identify chemical, biological, and explosive hazards to inform requirement development, hazard prioritization, CONOPS, response operations, and policy.
- *Hazard Characterization:* Conduct foundational research, including development and validation of required analytic methods on the fundamental properties of chemical, biological, and explosive hazards in order to support hazard awareness, and the development of strategies to prevent, prepare for, respond to and recover from incidents involving their use.
- *Hazard Knowledge Repository:* Collect and provide access to users from DHS and across the HSE to data and knowledge products developed by or for DHS/S&T regarding chemical, biological, and explosive hazards.

FY 2018 Key Milestone Events

- Developed a proposal for the CBC-E to provide S&T with centralized subject matter expertise to coordinate and expand upon S&T's chemical and biological competencies to provide world-class methods, tools, technology, best practices, industry outreach, and operational insight to address the dynamic chemical and biological needs of DHS mission components and the HSE.
- Developed a charter for the CBC-E to be reviewed and approved by S&T leadership to set the scope and initiate the execution of the engine.

FY 2019 Planned Key Milestone Events

- Develop priorities for the capabilities and basic research portfolio for Project Year 4 of the National Biological Threat Characterization Center.
- Develop at least three tailored technical assessments for informing programs and performance requirements.

FY 2020 Planned Key Milestone Events

- Develop priorities for the capabilities and basic research portfolio for Project Year 5 of the National Biological Threat Characterization Center.
- Produce at least three knowledge products on an agent or technology that will impact current, emerging, or future biological hazards.
- Produce and transition at least three knowledge products on an agent or technology that will impact current, emerging, or future chemical hazards.

Overall Project Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	-	$2,500	-	$5,243
Obligations	-	-	$2,238	-	-

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
Developed a proposal for the CBC-E to provide S&T with centralized subject matter expertise to coordinate and expand upon S&T's chemical and biological competencies to provide world-class methods, tools, technology, best practices, industry outreach, and operational insight to address the dynamic chemical and biological needs of DHS mission components and the HSE.	FY 2018 Q2	FY 2018 Q3
Developed a charter for the CBC-E to be reviewed and approved by S&T leadership to set the scope and initiate the execution of the engine.	FY 2018 Q3	FY 2018 Q4
FY 2019		
Generate prioritization for basic research for Project Year 4 of the National Biological Threat Characterization Center.	FY 2019 Q1	FY 2019 Q1
Initiated development of a library of tens of thousands of threat bag checkpoint CT images from multiple vendor platforms for a Passenger Baggage Object Database	FY 2017 Q2	FY 2019 Q2
Develop at least three tailored technical assessments for informing programs and performance requirements.	FY 2019 Q1	FY 2019 Q4
Characterize at least 10 explosive threat materials based on the prioritized explosive threat list, including detection signatures, characterization studies of explosives, and quality control efforts supporting S&T and interagency testing services.	FY 2016 Q1	FY 2019 Q4
Generate prioritization for basic research for the Biological Threat Characterization Project FY 2020 activities	FY 2019 Q2	FY 2019 Q3
Generate prioritization for basic research for the Chemical Threat Characterization Project FY 2020 activities.	FY 2019 Q2	FY 2019 Q3
FY 2020		
Produce and transition at least three knowledge products on an agent or technology that will impact current, emerging, or future biological hazards.	FY 2020 Q1	FY 2020 Q4
Produce and transition at least three knowledge products on an agent or technology that will impact current, emerging, or future chemical hazards.	FY 2020 Q1	FY 2020 Q4
Develop a last point of departure based data set on an interagency vetted analysis and rating methodology for improvised explosive threats.	FY 2019 Q1	FY 2020 Q4
Produce and transition at least three knowledge products on an agent or technology that will impact future explosive threats.	FY 2020 Q1	FY 2020 Q4
Generate prioritization for basic research for the Biological Threat Characterization Project FY 2021 activities.	FY 2020 Q2	FY 2020 Q3
Generate prioritization for basic research for the Chemical Threat Characterization Project FY 2021 activities.	FY 2020 Q2	FY 2020 Q3
Characterize at least 10 explosive threat materials based on the prioritized explosive threat list (DSARM threat list and emergent threats), including detection signatures, characterization studies of explosives, and quality control efforts supporting S&T and interagency testing services.	FY 2020 Q2	FY 2020 Q3

Type of Research

Basic, Applied

Technical Readiness Level

N/A: Enduring capability that results in continuing delivery of Knowledge Products.

Transition Plans

- HAC-TC regularly delivers/transitions the knowledge and insight produced through various products that are shared with DHS's components and the HSE, including the Intelligence Community and the DOD through the DHS S&T Hazard Awareness and Characterization Knowledge Repository and other information portals. These reports and knowledge products provide the essential technical foundation for confidence in both DHS and national consequence and risk assessments, enabling policymakers to establish technically informed and sound policy, and enabling decision makers to appropriately prioritize spending on medical and non-medical countermeasure acquisition programs to mitigate chemical, biological, and explosive hazards impacting billions of dollars of Government spending.
- Explosive Threat Characterization will transition the Detection Standards Analysis and Revision Methodology, which will result in standard explosive threat prioritization.
- Explosive Threat Characterization will transition results to support at least 10 material characterization studies against the prioritized threat list and rapid responses, including detection signatures, characterization studies of explosives effects, and quality control efforts supporting S&T and interagency testing services.
- Deliver explosives characterization data to include safety information, data to assist explosive detection technologies, explosive properties and threat validation documentation to the Interagency Homemade Explosives Working Group.
- Deliver chemical analysis and mitigation results to the TSA and FAA.

***Partnerships – FY 2018 Enacted: $36.5M. FY 2019 President's Budget: $13.5M. FY 2020 Request: $11.4M*:** S&T Partnerships build and sustain relationships with industry to advance the development and delivery of innovative technology solutions to homeland security operators. Funding supports two primary focus areas of innovative technology development and solution delivery.

S&T Partnerships

- **Problem:** Over the past several decades, private sector investment in R&D has far outpaced that of the Federal Government, resulting in significant commercial technology advancements. These advantages can be leveraged to address homeland security challenges, but connecting end-users with the industry solutions to meet requirements is difficult for Component customers.

- **Solution:** S&T Partnerships offers various tools and programs to fund or support private sector innovation and helps deliver solutions to end users by accelerating commercialization and technology transfer.

- **Impact:** By engaging the private sector, S&T Partnerships forges connections with technology developers and operational end users, enabling joint R&D and energizing a diverse group of research communities to address homeland security challenges.

Initiatives

- *Coordination, Engagement, and Outreach (formerly Private Sector Outreach and Engagement):* Focused on identifying and managing strategic partnerships with industry and communicating and promoting these efforts to internal and external stakeholders. This will be accomplished through a series of platforms including online and in-person events around the country designed to engage a range of community stakeholders on homeland security missions, technology, and innovative solutions.
- *Silicon Valley Innovation Program (SVIP):* The SVIP aims to provide novel solutions for component and HSE requirements that can be used in operations in as little as 12-24 months. The program is also drawing new companies into interactions with and work in support of the Government who may not have previously engaged with the Government. Bringing in new companies increases avenues by which DHS and its partners can obtain and leverage innovative technology and solutions.
- *Partnerships Intermediary Agreements:* This program will increase the likelihood of success in the conduct of cooperative activities of with small business firms and academic institutions, including by supporting technology transfer and commercialization of S&T-funded solutions and mission relevant technologies. The program will enable S&T to identify qualified Partnership Intermediary organizations and engage with them to advance S&T efforts in increasing awareness, adoption, and utilization of S&T funded technology by government and industry stakeholders.
- *Bi-National Cooperative Pilot:* International research agreements leverage technical resources and expertise and share costs for technology research, development and assessment and contributes to building a global homeland security industrial base, and, most importantly, help generate cutting-edge technologies in support of first responders and the larger homeland security mission. The Bi-National Industrial Research and Development (BIRD) Foundation promotes collaboration between U.S. and Israeli technology companies for joint product development for first responders.
- *Commercialization Accelerator Program:* The program will support S&T in delivering innovative technology solutions to DHS customers by focusing on accelerating the commercialization process and addressing roadblocks to transition of federally-funded R&D. The program will enable S&T to leverage relevant existing technologies, including those funded and developed by others, to ensure a pipeline of ready to transition solutions for DHS customers at a fraction of the time and cost.

FY 2018 Key Milestone Events

Coordination, Engagement, and Outreach

- Executed quarterly industry outreach videos to convey to non-traditional partners S&T's key priorities and available mechanisms for partnering with S&T.
- Developed a comprehensive set of partners for the inaugural Science and Technology Exercise Partnership Showcase (STEPS) consisting of DHS Component partners, other federal government agencies, state, local, tribal and territorial stakeholders, and private industry.

Silicon Valley Innovation Program

- Released four new solicitation topics across two to three verticals covering broad DHS and critical infrastructure needs such as aviation security, seamless travel and cyber security.
- Conducted 12 outreach events (e.g., Industry Days, Speaking Engagements, Webinars, etc.) in U.S. and internationally based innovation communities.

Partnerships Intermediary Agreements

- Posted public notification regarding DHS's statement of need from qualifying organizations for technology transfer and commercialization program support in accordance with the DHS Guide on Partnership Intermediary Agreements.

Bi-National Cooperative Pilot

- N/A

Commercialization Accelerator Program

- N/A

FY 2019 Planned Key Milestone Events

Coordination, Engagement, and Outreach

- Execute a series of 12 activities aligned to DHS priorities that provide an opportunity for industry to engage with S&T.
- Facilitate the release of competitions and solicitations aligned to DHS component missions.

Silicon Valley Innovation Program

- Release three to five new solicitation topic areas across two to three verticals covering broad DHS and critical infrastructure needs, including IoT Security, Blockchain, trade and cyber security.
- Complete transition of two to four projects into Component operational acquisition cycles or commercial products (project/solution dependent).

Partnerships Intermediary Agreements

- Award DHS funded Partnership Intermediary Agreement in accordance with the DHS PIA Guide.

Bi-National Cooperative Pilot

- Expand the technical topic area within the Agreement between the U.S. and Israel from "NextGen First Responder Technologies" to the entire HSE mission.
- Increase awareness of commercialization pathways for previous BIRD[26] First Responder Program cohorts.

Commercialization Accelerator Program

- Identify mission relevant technologies and S&T funded intellectual property that have commercial potential.
- Conduct engagement with industry stakeholders and the investment community via webinars, workshops, or at trade shows to broker and/or accelerate commercialization partnerships for DHS-funded technologies.

FY 2020 Planned Key Milestone Events

Coordination, Engagement, and Outreach

- Continue to facilitate 20 events to educate stakeholders on the activities of DHS components, current technology capabilities, and technology needs.
- Expand S&T's use of contracting actions to enhance the capabilities of the HSE.

[26] BIRD is an acronym for Israel-U.S. Binational Industrial Research and Development. The BIRD Foundation's mission is to stimulate, promote and support industrial R&D of mutual benefit to the U.S. and Israel.

Silicon Valley Innovation Program

- Release new solicitation calls in three to five specific areas covering broad DHS and critical infrastructure needs and requirements as identified through DHS S&T requirement sourcing activities.
- Transition completed projects into component operational acquisition cycles or commercial products (project/solution dependent).

Partnerships Intermediary Agreements

- Identify high priority technological areas/capability requirements for S&T for which PIAs can identify external stakeholders interested in licensing S&T technologies or partnering with S&T.

Bi-National Cooperative Pilot

- Transition or commercialize outcomes of previous BIRD cohorts.

Commercialization Accelerator Program

- Conduct technology and innovation analysis for DHS's high priority technological/capability requirements to inform commercial viability.
- Develop technology transition plans to support commercialization of DHS-funded solutions including licensing, marketing and communication strategies with industry stakeholders.

Overall Funding[27]

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$3,500	$5,100	$36,500	$13,500	$11,440
Obligations	$8,313	$3,828	$3,434	-	-

***Foundational Tools – FY 2018 Enacted: $6.3M. FY 2019 President's Budget: $7.8M. FY 2020 Request: $4.8M*:** S&T is the primary science advisor to the DHS Secretary and the Department that includes all aspects of research and development. A critical part of this mission is to ensure the R&D receives the proper requirements analysis that will support homeland security operations to identify and prioritize DHS-wide R&D capability gaps, minimize or eliminate the duplication of efforts, as well as identify cost effective solutions for Component operations and process inefficiencies. S&T also utilizes its scientific, technical, and mission expertise to conduct technology scouting analysis and transfer to Components and stakeholders to support the identification, development, and transition of solutions to high priority capability needs and gaps. In support of these activities, S&T aims to expand the associated functions of Operational Experimentations (OpEx) and the Technology Clearinghouse to serve as centralized demonstrations of potential technology options and a common knowledge management and communication portal for homeland security technology requirements and solutions.

[27] Overall Funding for Partnerships is a combination of funding from former Private Sector Outreach and Engagement, SVIP, Partnership Intermediary Agreements, Bi-National Cooperative Pilot, and Commercialization Accelerator Program.

Operations and Requirements Analysis (ORA)

- **Problem:** S&T receives various requests from DHS Components for R&D work. With a limited budget, S&T needs to understand the relative priority of each of these requests and their significance to the Component's mission and the overall Department's strategic goals.

- **Solution:** Establish and operate the S&T Integrated Product Team (IPT) and the Senior Research Council (SRC) as mechanisms to achieve validation and prioritization of Components' R&D needs. Conduct analyses to support the IPT & SRC decision making.

- **Impact:** ORA ensures that S&T R&D efforts address validated and prioritized Component operational gaps. This will in turn enable S&T to successfully deliver effective and impactful solutions that meet Components needs to help them fulfill their missions.

Initiatives

- *Aligning Departmental R&D with DHS Goals and Components' Needs via the Integrated Product Team (IPT) and the Senior Research Council (SRC):* The R&D IPTs were established as the Department's primary collaboration mechanism for DHS-wide R&D coordination. Since 2015, the IPTs have become the central process for identifying and prioritizing R&D technological capability gaps. By developing advanced data methodologies and standards, IPTs are shifting the R&D culture within DHS by providing a reproducible mechanism that results in a list of high priority R&D gaps. These priority gaps ensure that S&T R&D is strongly aligned to DHS goals. As a consequence, IPTs have moved DHS from a Component-dependent R&D profile to a more agile enterprise that is based on R&D needs and sound investment strategies with close monitoring of budget activities. By 2020, S&T will also seek the establishment of the SRC to further prioritize across the IPTs.

FY 2018 Key Milestone Events

Aligning Departmental R&D with DHS Goals:

- Automated IPT processes for eliminating duplication and identifying R&D gaps solutions by implementing additional data analytics that resulted in increased efficiencies. Developed a DHS-wide R&D plan based on the data gathered via the IPT process.

FY 2019 Planned Key Milestone Events

Aligning Departmental R&D with DHS Goals:

- Develop a platform that will incorporate Predictive Analytics (based on current data analytics capabilities) into the IPT Process in order to improve overall effectiveness and efficiency of the IPT Process.
- Conduct the IPT FY 2019-2020 process to prioritize R&D capability gaps.

FY 2020 Planned Key Milestone Events

Aligning Departmental R&D with DHS Goals:

- Integrate data analytics into the SRC process.
- Conduct the IPT and SRC FY 2020-2021 process to prioritize R&D capability gaps.

Overall Funding

(Dollars in Thousands)	FY 2016[28]	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	-	$2,000	$2,000	$5,000	$2,001
Obligations	$2,000	0	$1,050	-	-

Technology Scouting and Transition

- **Problem:** S&T program managers need a market awareness of ongoing and/or completed capability solutions that could be acquired or adapted to meet operational mission needs without starting unnecessary R&D efforts. The commercialization market and operations and maintenance for S&T developed capabilities is a critical but presently minimal path to transition that is not well understood and has been challenging to breach.

- **Solution:** Providing a centralized approach to technology research, analysis of alternatives, OpEx, validation, acquisition support and capability transition and infusion into the DHS components.

- **Impact:** Planning will be able to effectively move to the front end of a project to ensure that all alternatives are considered eliminating needless spending on R&D and the product or technology is given to the end user or marketplace. This would assist in responding to DHS Component needs minimize duplication of efforts, improve decision making, and enhance mission delivery.

Initiatives

- *Technology Clearinghouse:* The Technology Clearinghouse increases the HSE awareness and use of S&T's research, products and services. Tech Clearinghouse facilitates the flow of important information throughout the homeland security community, and enables S&T to design and manage projects that truly meet HSC mission. It is an innovative cost-effective, multi-faceted knowledge management and communications effort.
- *Technology Scouting:* Technology Scouting is a core strategic capability to drive discovery and aim to reduce duplication in R&D investments by leveraging existing investments made by outside entities. Leveraging these existing capabilities allows faster development and increases partnership opportunities and resources to assist in the development of current or future homeland security systems and needs.
- *Operational Exercises (OpEx):* With the long-term goal of integrating OpEx into the established DHS Demonstration/Validation Test & Evaluation acquisition process, these demonstrations provide Components with decision quality data to support acquisition of technology products to increase mission capabilities.
- *Technology Transition:* Technology Transition provides a centralized approach to transitioning knowledge products, capabilities, and technologies to DHS Components. Transition includes direct delivery of new products to Component acquisition programs of record and new technologies to the commercial market place for procurement by both DHS users and the national first responder community.

[28] Obligations exceed Project Funding level due to funding realignments during project execution.

FY 2018 Key Milestone Events

Technology Scouting

- Completed 50 technology scouting reports, research summaries and technology briefs for DHS Components and the First Responder Community.

Technology Clearinghouse

- Produced project-based videos targeted to the first responder community, and published them on scitech.dhs.gov/first-responders to inform them of progress and status and/or how to engage with S&T.
- Developed and expanded S&T's presence on current and future social media pages (i.e., Facebook, Twitter, YouTube, Instagram, etc.) to increase traffic to First Responder content on scitech.dhs.gov/first-responders and provide information tailored for the first responder community.

FY 2019 Planned Key Milestone Events

Technology Scouting

- Support expansion of knowledge management database systems to increase scope of available technology options to solve Component technology requirements.
- Build capacity to increase technology research and expand networks to maximize reuse of existing or adaptable technology solutions.

Technology Clearinghouse

- Expand Technology Clearinghouse functions across broader S&T user base
- Update the First Responder Communities of Practice collaboration site with relevant content, and promote the site, its communities, and features to stakeholders to facilitate usage of the site.
- Conduct outreach to the first responder community by interacting with professional homeland security, public safety, responder, and criminal justice associations such as the Interagency Board (IAB), National Public Safety Telecommunications Council (NPSTC), International Association of Chiefs of Police (IACP), International Association of Fire Chiefs (IAFC), Association of Public-Safety Communications Officials (APCO), International Association of Emergency Managers (IAEM), etc.

Operational Exercises (OpEx)

- Integrate OpEx process into DHS Demonstration/Validation Test & Evaluation acquisition process.

Technology Transition

- Deliver annual DHS Technology Transition Report to Congress required by the *National Defense Authorization Act for Fiscal Year 2017*.
- Develop Technology Transition Plan strategy and process in support of DHS Component Acquisition Executives and programs of record.

FY 2020 Planned Key Milestone Events

Technology Scouting

- Expand research capabilities to perform both tech scouting and forecasting for new and innovative technology requirements identified by Components and the First Responder Community.
- Develop and test a pilot to provide a user-friendly process to enable Components to perform preliminary scouting of available technologies to meet their emergent mission needs.

Technology Clearinghouse

- Support broad S&T user-base beyond first responders in direct support of statutory requirements.

- Update scitech.dhs.gov/first-responders with relevant content, including internal and external information on first responder related projects/programs and increase usage by first responders via marketing.
- Develop and expand S&T's presence on current and future social media pages (i.e., Facebook, Twitter, YouTube, Instagram, etc.) to increase traffic to First Responder content on scitech.dhs.gov/first-responders, and provide information tailored for the first responder community.

Operational Exercises(OpEx)

- Formal integration of OpEx into DHS Acquisition policy.

Technology Transition

- Deliver updated NDAA report on DHS Technology Transition.
- Implement Technology Transition Planning process to all DHS Components.

Overall Funding

(Dollars in Thousands)	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Project Funding	$4,000	$4,250	$4,250	$2,750	$2,750
Obligations	$3,834	$3,813	$3,588	-	-

University Programs - PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2018 Enacted			FY 2019 President's Budget			FY 2020 President's Budget			FY 2019 to FY 2020 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
University Programs	-	-	$40,500	-	-	$21,746	-	-	$21,746	-	-	-
Total	**-**	**-**	**$40,500**	**-**	**-**	**$21,746**	**-**	**-**	**$21,746**	**-**	**-**	**-**
Subtotal Discretionary - Appropriation	-	-	$40,500	-	-	$21,746	-	-	$21,746	-	-	-

PPA Level I Description

University Programs (UP) supports homeland security-related research and education at U.S. colleges and universities to address high-priority DHS-related issues and to enhance homeland security capabilities over the long term. This PPA includes programs that bring together scientists, mathematicians, and engineers from many academic disciplines and institutions. These researchers are investigating research questions important to DHS, as well as developing new technologies and approaches to solve complex and challenging homeland security problems.

UP is executed by the Office of University Programs (OUP) and includes the following programs:

Centers of Excellence: The Centers of Excellence (COE) program focuses on building homeland security expertise in the academic community, creating strategic partnerships among universities, commercial interests, and public agencies, and developing a new science and engineering workforce dedicated to homeland security. COE program priorities are developed by DHS operational Components, based on their long term mission needs.

Minority Serving Institutions: This program enhances the capabilities of Minority Serving Institutions (MSIs) to develop homeland security-related science, technology, engineering, and mathematics research and curricula, and prepare MSI students for successful homeland security careers.

University Programs – PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2018**	**FY 2019**	**FY 2020**
Enacted/Request	**$40,500**	**$21,746**	**$21,746**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$10,818	$19,510	$15,867
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$51,318**	**$41,256**	**$37,613**
Collections – Reimbursable Resources	$500	$500	$500
Total Budget Resources	**$51,818**	**$41,756**	**$38,113**
Obligations (Actual/Estimates/Projections)	$32,308	$25,889	$23,630
Personnel: Positions and FTE			
Enacted/Request Positions	-	-	-
Enacted/Request FTE	-	-	-
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	-	-	-
FTE (Actual/Estimates/Projections)	-	-	-

University Programs – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2018 Enacted	**-**	**-**	**$40,500**
FY 2019 President's Budget	**-**	**-**	**$21,746**
FY 2020 Base Budget	**-**	**-**	**$21,746**
FY 2020 Current Services	**-**	**-**	**$21,746**
FY 2020 Request	**-**	**-**	**$21,746**
FY 2019 To FY 2020 Change	**-**	**-**	**-**

University Programs – PPA
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Total Changes
University Programs	$40,500	$21,746	$21,746	-
Total	**$40,500**	**$21,746**	**$21,746**	**-**
Discretionary - Appropriation	$40,500	$21,746	$21,746	-

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2018 Enacted	FY 2019 President's Budget	FY 2020 President's Budget	FY 2019 to FY 2020 Change
21.0 Travel and Transportation of Persons	$153	$82	$82	-
25.1 Advisory and Assistance Services	$2,794	$1,500	$1,500	-
25.2 Other Services from Non-Federal Sources	$2	$1	$1	-
25.3 Other Goods and Services from Federal Sources	$2,177	$1,169	$1,169	-
25.5 Research and Development Contracts	$1,862	$1,000	$1,000	-
41.0 Grants, Subsidies, and Contributions	$33,512	$17,994	$17,994	-
Total - Non Pay Object Classes	**$40,500**	**$21,746**	**$21,746**	**-**

Non Pay Cost Drivers

Leading Non Pay Cost-Drivers *Dollars in Thousands*	**FY 2018 Enacted**	**FY 2019 President's Budget**	**FY 2020 President's Budget**	**FY 2019 to FY 2020 Total Changes**
Contract Support Services	$2,794	$1,500	$1,500	-
Financial Assistance	$33,512	$17,994	$17,994	-
Other	$4,194	$2,252	$2,252	-
Total – Non Pay Cost Drivers	**$40,500**	**$21,746**	**$21,746**	**-**

Explanation of Non Pay Cost Drivers

Contract Support Services: Costs include contract services for program and project management, studies, analyses, evaluations, and engineering in support of information technology and R&D activities with the COEs.

Financial Assistance: Grants, Subsidies and Contributions are the financial assistance funding that invests in the Centers of Excellence.

Other: Research and Development Contracts are the direct cost of conducting research and development associated with COEs, and Travel.

University Programs – PPA
Research and Development
Technology Readiness Level Exhibit

Centers of Excellence – FY 2018 Enacted: $37.1M. FY 2019 President's Budget: $18.4M. FY 2020 Request: $18.4M.

Critical Infrastructure Resilience Institute (CIRI)

This Center conducts research and education to enhance the resiliency of the Nation's critical infrastructures, and the businesses and public entities that own and operate them. This research will provide a better understanding of risk management of catastrophic disruptions to infrastructure operations focusing on the dynamic interface between cyber and physical systems.

- **Problem:** Federal and state governments and the private sector need industries and regional economies working again as soon as possible after catastrophic events, particularly in locales that also host critical infrastructure systems and industries. Therefore, DHS must understand the complex public and private sector linkages that comprise an infrastructure system and community, and how the severe stress of catastrophic events impacts them. Infrastructure systems are increasingly reliant upon cyber physical systems. Those systems may become comprised as a result of cyber-attacks. Infrastructure owners and operators need to understand how organizational risk and operational readiness is affected by cyber risks.

- **Solution:** CIRI will explore the organizational, policy, business, and technical dimensions of critical infrastructure's dependence on cyber assets. CIRI will examine how computer hardware and software both contribute to and threaten resiliency and how industry makes decisions about cyber assets which contribute to resilience. The Center will develop business cases for preparing for and mitigating the effects of catastrophic incidents with an emphasis on how computer hardware and software contribute to and threaten resiliency.

- **Impact:** The Center's work will result in data-rich quantitative analyses, technologies, and other tools that assist DHS and the critical infrastructure industry in understanding threats and vulnerabilities, risk management strategies, and costs and trade-offs of risk management decisions.

FY 2018 Key Milestone Events

- Conducted Biennial Review to evaluate CIRI's research portfolio at both theme and project levels for research quality, progress, and interest of homeland security customer segments, and implement recommendations to adjust portfolio investment by Q3.
- Integrated research outputs into three concentrations supporting the refinement of projects in: next generation risk assessment approaches, approaches to understand the mitigation of risks posed by cyber-attacks to manufacturing, and the role that market-based incentives can play in stimulating private sector resilience investment.

FY 2019 Planned Key Milestone Events

- Integrate, iteratively test, and refine prototype software components linking cyber-attack prediction and data sets to infrastructure models and risk assessment methods to support contextual based decision making that enhances the resilience of cyber physical systems.

FY 2020 Planned Key Milestone Events

- Conduct Biennial Review to evaluate CIRI's research portfolio at both theme and project levels for research quality, progress, and relevance to homeland security customer segment.
- Conduct operational experimentations to assess performance of data analytics tools and cyber risk identification and mitigation approaches in providing value to suppliers and infrastructure owners and operator.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
FY 2017 Annual report review.	FY 2018 Q1	FY 2018 Q1
FY 2018 Work plan, development and submission.	FY 2018 Q2	FY 2018 Q2
FY 2018 Work plan approval and Project Initiation or continuation.	FY 2018 Q3	FY 2018 Q3
FY 2018 Annual report development and submission.	FY 2018 Q4	FY 2018 Q4
FY 2019		
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1
FY 2019 Work plan, development and submission.	FY 2019 Q2	FY 2019 Q2
FY 2019 Work plan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3
FY 2019 Annual report development and submission.	FY 2019 Q4	FY 2019 Q4
FY 2020		
FY 2019 Annual report review.	FY 2020 Q1	FY 2020 Q1
FY 2020 Work plan, development and submission.	FY 2020 Q2	FY 2020 Q2
FY 2020 Work plan approval and Project Initiation or continuation.	FY 2020 Q3	FY 2020 Q3
FY 2020 Annual report development and submission.	FY 2020 Q4	FY 2020 Q4

Type of Research

COEs manage research projects that range in technical risk and address variations enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment of to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

The COEs execute projects spanning TRLs. Primarily, COEs conduct projects between TRL 2 through 6, from initial concept development to system prototypes tested in the field.

Transition Plans

OUP Program Managers work with the COEs to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. OUP technology development activities sync with the scientific and program management milestones appropriate for each project. These efforts differ depending upon the research gap being addressed, but involve partnerships with technology providers, data owners, commercialization entities, DHS Components, and other public sector agencies. OUP's management methods are designed to reduce the technical and programmatic risks of new technologies to the point where industry and other Federal customers are willing to invest in technology commercialization or move towards direct acquisition. OUP manages planned, formal technical and strategic annual and biennial reviews to assess individual project performance against key performance parameters. These reviews readjust overall research portfolio investments to respond to market forces and customer demand.

OUP Program Managers work with S&T's Office of General Counsel, the General Counsel of the performing institution(s), and COE Technology Commercialization Offices to support legal, privacy, market, and technology transfer elements of each project. DHS encourages COEs work with their technology transfer offices to attract investments, address legal concerns, and leverage university infrastructures to execute the plans necessary to enable long-term sustainment of technologies.

Arctic Domain Awareness Center (ADAC)

This Center develops and transitions technology solutions, innovative products, and educational programs to improve situational awareness and crisis response capabilities related to emerging challenges posed by the dynamic Arctic environment.

- **Problem:** The lack of Arctic domain knowledge inhibits situational awareness in the Arctic for the USCG and DHS security and response missions. Imagery, data, and communications, and scientific understanding of the operating environment are insufficient to develop reliable operational responses to mission needs.

- **Solution:** ADAC conducts relevant research and development that benefits USCG operations, with particular emphasis on mission areas of high consequence: vessel intrusion, threats to navigation, search and rescue, humanitarian assistance, and disaster response. Results serve USCG, other DHS Arctic missions.

- **Impact:** ADAC's impact will affect future operations by advancing knowledge in Arctic Domain Awareness research areas that improve USCG's Arctic operator coordination, control, and decision making.

FY 2018 Key Milestone Events

- Reoriented ADAC Research Program based on the results of the Biennial Review.
- Conducted a Request for Proposal competition seeking research to address maritime technology challenges in the Arctic.

FY 2019 Planned Key Milestone Events

- Test and demonstrate a Long Range Autonomous Underwater Vehicle in the Arctic.
- Finalize a system prototype oil spill model for operation in the Arctic.

FY 2020 Planned Key Milestone Events

- Transition an Arctic All-Hazards geographic information systems (GIS) platform took to the government for sustainment.
- Transition an Arctic Vessel Monitoring tool.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
FY 2017 Annual report review.	FY 2018 Q1	FY 2018 Q1
FY 2018 Work plan, development and submission.	FY 2018 Q2	FY 2018 Q2
FY 2018 Work plan approval and Project Initiation or continuation.	FY 2018 Q3	FY 2018 Q3
FY 2018 Annual report development and submission.	FY 2018 Q4	FY 2018 Q4
FY 2019		
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1
FY 2019 Work plan, development and submission.	FY 2019 Q2	FY 2019 Q2
FY 2019 Work plan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3
FY 2019 Annual report development and submission.	FY 2019 Q4	FY 2019 Q4
FY 2020		
FY 2019 Annual report review.	FY 2020 Q1	FY 2020 Q1
FY 2020 Work plan, development and submission.	FY 2020 Q2	FY 2020 Q2
FY 2020 Work plan approval and Project Initiation or continuation.	FY 2020 Q3	FY 2020 Q3
FY 2020 Annual report development and submission.	FY 2020 Q4	FY 2020 Q4

Type of Research

COEs manage research projects that range in technical risk and address variations enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment of to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

The COEs execute projects spanning TRLs. Primarily, COEs conduct projects between TRL 2 through 6, from initial concept development to system prototypes tested in the field.

Transition Plans

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Borders, Trade, and Immigration (BTI) Institute

BTI conducts research and provides education to enhance the Nation's ability to secure its borders and facilitate legitimate trade and travel. It also conducts research to help CBP, ICE, and USCIS effectively enforce immigration and customs laws; promoting awareness and understanding of citizenship; and ensuring the integrity of the U.S. immigration system.

- **Problem:** Transnational challenges associated with border security and immigration require innovations in technology-based tools and techniques for border management, trade facilitation, targeting, and enforcement. R&D is necessary to determine the principal global transnational and national influences and factors that impact border, trade, security, and immigration activities.

- **Solution:** BTI delivers technology solutions, data-informed policies, and trans-disciplinary education to address the Nation's challenges as they relate to border control, customs, trade and travel facilitation, security, and enforcement.

- **Impact:** BTI impacts include improving the operational effectiveness of border management processes at ports of entry, identifying opportunities to counter weapons of mass destruction (WMDs) proliferation through export control enforcement, and improving biometric video and imagery capabilities that identify people in operational environments.

FY 2018 Key Milestone Events

- Issued report to address impact of the ongoing Export Control Reform Initiative on U.S. Government efforts to enforce export controls in support of counters the proliferation of WMDs.
- Conducted Biennial Review to evaluate BTI's research portfolio at both theme and project levels for research quality, good progress, and committed HSE customers.

FY 2019 Planned Key Milestone Events

- Reorient BTI research program based on results of the Biennial Review held in FY 2018.
- Initiate research to create a system to detect and match human subjects from a trail camera image.

FY 2020 Planned Key Milestone Events

- Conduct research projects focused on legitimate trade and travel challenges and known knowledge gaps.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
FY 2017 Annual report review.	FY 2018 Q1	FY 2018 Q1
FY 2018 Work plan, development and submission.	FY 2018 Q2	FY 2018 Q2
FY 2018 Work plan approval and Project Initiation or continuation.	FY 2018 Q3	FY 2018 Q3
FY 2018 Annual report development and submission.	FY 2018 Q4	FY 2018 Q4
FY 2019		
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1
FY 2019 Work plan, development and submission.	FY 2019 Q2	FY 2019 Q2
FY 2019 Work plan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3
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FY 2020		
FY 2019 Annual report review.	FY 2020 Q1	FY 2020 Q1
FY 2020 Work plan, development and submission.	FY 2020 Q2	FY 2020 Q2
FY 2020 Work plan approval and Project Initiation or continuation.	FY 2020 Q3	FY 2020 Q3
FY 2020 Annual report development and submission.	FY 2020 Q4	FY 2020 Q4

Type of Research

COEs manage research projects that range in technical risk and address variations enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment of to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

The COEs execute projects spanning TRLs. Primarily, COEs conduct projects between TRL 2 through 6, from initial concept development to system prototypes tested in the field.

Transition Plans

OUP Program Managers work with the COEs to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. OUP technology development activities sync with the scientific and program management milestones appropriate for each project. These efforts differ depending upon the research gap being addressed, but involve partnerships with technology providers, data owners, commercialization entities, DHS Components, and other public sector agencies. OUP's management methods are designed to reduce the technical and programmatic risks of new technologies to the point where industry and other Federal customers are willing to invest in technology commercialization or move towards direct acquisition. OUP manages planned, formal technical and strategic annual and biennial reviews to assess individual project performance against key performance parameters. These reviews readjust overall research portfolio investments to respond to market forces and customer demand.

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Criminal Investigations and Network Analysis (CINA)

This Center will conduct end user-focused research to enhance investigation strategies to address transnational criminal organizations activities and other homeland security-related crimes. This COE will also provide education and professional development to improve the cost-effectiveness of criminal investigations, prosecution, prediction, and prevention.

- **Problem:** Trans-national criminal organizations are committing heinous crimes in both physical and cyber space. This COE will focus on a major, cross-cutting DHS mission area, criminal law enforcement that the COEs have not yet addressed. DHS's Quadrennial Homeland Security Review (QHSR) contains the goals of Preventing Terrorism and Enhancing Security, Securing and Managing Our Borders, Enforcing and Administering Immigration Laws, and Securing Cyberspace.

- **Solution:** The overarching goal of the Center will be to develop tools and methods for agents, officers, and investigators to better coordinate investigative strategies with on-the-ground and cybersecurity activities to predict, thwart, and prosecute crime.
- **Impact:** Research outcomes will include analytical tools, technologies, and knowledge products for the workforce. The Center will produce new capabilities, test them in operational settings, and make validated solutions available and useful to law enforcement agencies at all levels.

FY 2018 Key Milestone Events

- CINA finalized its research agenda and thrust areas through a series of workshops attended by lead institution personnel, OUP officials, and the corresponding Board of Directors.

FY 2019 Planned Key Milestone Events

- Identify a project with End-to-End potential and develop transition milestones with input from end users to be integrated into the work plan for FY 2019 execution.
- Award five scholarships for student internships or fellowships within DHS Components.

FY 2020 Planned Key Milestone Events

- Incorporate Biennial Review results into the research work plan and strategic management plan.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
FY 2017 Annual report review.	FY 2018 Q1	FY 2018 Q1
FY 2018 Work plan, development and submission.	FY 2018 Q2	FY 2018 Q2
FY 2018 Work plan approval and Project Initiation or continuation.	FY 2018 Q3	FY 2018 Q3
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FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1
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Type of Research

COEs manage research projects that range in technical risk and address variations enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment of to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

The COEs execute projects spanning TRLs. Primarily, COEs conduct projects between TRL 2 through 6, from initial concept development to system prototypes tested in the field.

Transition Plans

OUP Program Managers work with the COEs to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. OUP technology development activities sync with the scientific and program management milestones appropriate for each project. These efforts differ depending upon the research gap being addressed, but involve partnerships with technology providers, data owners, commercialization entities, DHS Components, and other public sector agencies. OUP's management methods are designed to reduce the technical and programmatic risks of new technologies to the point where industry and other Federal customers are willing to invest in technology commercialization or move towards direct acquisition. OUP manages planned, formal technical and strategic annual and biennial reviews to assess individual project performance against key performance parameters. These reviews readjust overall research portfolio investments to respond to market forces and customer demand.

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Cross Border Threat Screening and Supply Chain Defense (CBTS)

This Center focuses on researching and developing solutions, protocols, and capabilities to support the identification of potential biological threats and/or hazards within the DHS operational environment that could disrupt critical infrastructure supply chains and the supporting operational activities conducted at ports of entry, land borders, and other critical nodes within the supply chain.

- **Problem:** Certain technological fields such as biology, bioengineering, and supply chain analytics are rapidly evolving. New biological threats and hazards have the potential to significantly affect the health and well-being of people, animals, and plants, and to subsequently affect the Nation's economy and critical infrastructure. DHS needs to ability to better understand current and emerging biological threats that are faced at POEs and land borders and that may affect critical infrastructure supply chains.

- **Solution:** Potential approaches include the utilization of innovative technologies (e.g., screening physical cargo and passengers and data analysis to identify potential conditions that warrant greater scrutiny), optimized operational procedures, and a skilled workforce trained in latest methods to identify and respond to biological threats and their corresponding impact on health and the economy.

- **Impact:** This Center will strengthen the DHS operational workforce, protect people, animals, and agriculture, and help to defend against threats to the global supply chain that, if comprised, would cause harm to public health and the economy.

FY 2018 Key Milestone Events

- Completed three-tier competition process for the proposed Center, evaluating the scientific merit and relevance of proposed projects to support DHS's biological defense areas of responsibility.
- Analyzed review finding and developed all documentation required to select performer for new Cross-Border Threats topic area. Presented to DHS S&T leadership proposed recommendation for issuing the Center award.

FY 2019 Planned Key Milestone Events

- Launch COE program, including establishment of all subawards, Center management policies, project schedules, and data access agreements.
- Initiate research projects to develop solutions, protocols, and capabilities to support DHS operations that detect, assess, and respond to known and unknown biological threats and hazards that could adversely impact the Nation's people, agriculture, and economy.

FY 2020 Planned Key Milestone Events

- Complete an assessment of vulnerabilities and uncertainties in the supply chain space as it pertains to biological threats. The assessment results will identify recommendations and guidelines to establish priorities to inform the Center's research portfolio, workforce development, policy and operational gaps; estimate risk and financial impact; and increase resiliency.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
FY 2017 Annual report review.	FY 2018 Q1	FY 2018 Q1
FY 2018 Work plan, development and submission.	FY 2018 Q2	FY 2018 Q2
FY 2018 Work plan approval and Project Initiation or continuation.	FY 2018 Q3	FY 2018 Q3
FY 2018 Annual report development and submission.	FY 2018 Q4	FY 2018 Q4
FY 2019		
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1
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FY 2019 Annual report review.	FY 2020 Q1	FY 2020 Q1
FY 2020 Work plan, development and submission.	FY 2020 Q2	FY 2020 Q2
FY 2020 Work plan approval and Project Initiation or continuation.	FY 2020 Q3	FY 2020 Q3
FY 2020 Annual report development and submission.	FY 2020 Q4	FY 2020 Q4

Type of Research

COEs manage research projects that range in technical risk and address variations enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment of to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

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Transition Plans

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commercialization or move towards direct acquisition. OUP manages planned, formal technical and strategic annual and biennial reviews to assess individual project performance against key performance parameters. These reviews readjust overall research portfolio investments to respond to market forces and customer demand.

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Minority Serving Institutions (MSI) – FY 2018 Enacted: $3.4M. FY 2019 President's Budget: $3.4M. FY 2020 Request: $3.4M.

This program enhances the capabilities of Minority Serving Institutions (MSI) to develop homeland security-related science, technology, engineering, and mathematics research and curricula, and prepare MSI students for successful homeland security careers. Current MSI programs, including the Scientific Leadership Award (SLA) program and the Summer Research Team (SRT) program, are developing course content and training in areas critical to homeland security while they also build enduring partnerships with COEs. With small investments, S&T expects to realize significant returns in the development the next generation of scientists and engineers focused on homeland security.

- **Problem:** Federal security agencies need diverse, well-qualified analysts and technologists to enter the homeland security science and engineering workforce.

- **Solution:** MSIs will design innovative high school-science, technology, engineering, and math (HS-STEM) curricula; support academic enhancements; provide student internships and other experiential learning opportunities; and support DHS-relevant research projects or initiatives with significant involvement of early career faculty and in coordination with DHS COEs.

- **Impact:** MSI students will enter HS-STEM related careers or obtain admission to graduate school to continue HS-STEM related research, increasing diversity and representation within the future homeland security science and engineering workforce.

FY 2018 Key Milestone Events

- Awarded MSI grants to colleges and universities at or above funding levels report in the prior fiscal year's MSI report to the Office of Civil Rights Executive Order Summary Report.
- Provided award management activities for 10 SLA awardees and 16 SRT awardees that enable S&T and Components to access scientific expertise at academic MSI institutions and their partners.

FY 2019 Planned Key Milestone Events

- Make three to six MSI SLA awards available through an open competitive process with a focus on priority research needs across emergency management, border security, cybersecurity, counterterrorism, countering weapons of mass destruction, forensics, robotics for detection/response,

and data analytics.

- Complete a 10-week SRT program for MSIs that provides experience for teams consisting of a faculty member and up to two students to perform research at a DHS COE that aligns with the agency's mission.

FY 2020 Planned Key Milestone Events

- Hold a goal-setting workshop for the COEs and MSIs to streamline engagement collaboration and transition of students and research results.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion
FY 2018		
FY 2017 Annual report review.	FY 2018 Q1	FY 2018 Q1
FY 2018 Work plan, development and submission.	FY 2018 Q2	FY 2018 Q2
FY 2018 Work plan approval and Project Initiation or continuation.	FY 2018 Q3	FY 2018 Q3
FY 2018 Annual report development and submission.	FY 2018 Q4	FY 2018 Q4
FY 2019		
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1
FY 2019 Work plan, development and submission.	FY 2019 Q2	FY 2019 Q2
FY 2019 Work plan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3
FY 2019 Annual report development and submission.	FY 2019 Q4	FY 2019 Q4
FY 2020		
FY 2019 Annual report review.	FY 2020 Q1	FY 2020 Q1
FY 2020 Work plan, development and submission.	FY 2020 Q2	FY 2020 Q2
FY 2020 Work plan approval and Project Initiation or continuation.	FY 2020 Q3	FY 2020 Q3
FY 2020 Annual report development and submission.	FY 2020 Q4	FY 2020 Q4

Type of Research

MSIs manage research projects that range in technical risk and address variations enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment of to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

The MSIs execute projects spanning TRLs. Primarily, MSIs conduct projects between TRL 2 through 6, from initial concept development to system prototypes tested in the field.

Transition Plans

OUP Program Managers work with the MSIs to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. OUP technology development activities sync with the scientific and program management milestones appropriate for each project. These efforts differ depending upon the research gap being addressed, but involve partnerships with technology providers, data owners, commercialization entities, DHS Components, and other public sector agencies. OUP's management methods are designed to reduce the technical and programmatic risks of new technologies to the point where industry and other Federal customers are willing to invest in technology commercialization or move towards direct acquisition. OUP manages planned, formal technical and strategic annual and biennial reviews to assess individual project performance against key performance parameters. These reviews readjust overall research portfolio investments to respond to market forces and customer demand.

OUP Program Managers work with S&T's Office of General Counsel, the General Counsel of the performing institution(s), and MSI Technology Commercialization Offices to support legal, privacy, market, and technology transfer elements of each project. DHS encourages MSIs work with their technology transfer offices to attract investments, address legal concerns, and leverage university infrastructures to execute the plans necessary to enable long-term sustainment of technologies.