Department of Homeland Security

Science and Technology Directorate

Budget Overview

Fiscal Year 2021

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
Research and Development	**Appropriation**	
Research, Development, and Innovation	PPA	
Border Security Thrust Area	R&D Project	Discretionary - Appropriation
Chemical, Biological, and Explosive Defense Thrust Area	R&D Project	Discretionary - Appropriation
Counter Terrorist Thrust Area	R&D Project	Discretionary - Appropriation
Cyber Security / Information Analysis Thrust Area	R&D Project	Discretionary - Appropriation
First Responder / Disaster Resilience Thrust Area	R&D Project	Discretionary - Appropriation
Innovative Research and Foundational Tools Thrust Area	R&D Project	Discretionary - Appropriation
University Programs	PPA	
Centers of Excellence	R&D Project	Discretionary - Appropriation
Minority Serving Institutions (MSI)	R&D Project	Discretionary - Appropriation

Science and Technology Directorate
Strategic Context

Component Overview

The strategic context presents the performance budget by tying together 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 programmatic view and a significant portion of the Level 1 PPAs represent what DHS refers to as our mission programs. A mission program is a group of activities acting together to accomplish a specific high-level outcome external to DHS and include operational processes, skills, technology, human capital, and other resources. 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 programs having publicly 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 Measure

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 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**
Target:	21	18	18	18	18	18
Result:	18	10	18	19	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 technology or knowledge products transitioned to customers for planned improvements in the Homeland Security Enterprise						
Description: This measure reflects the percent at which the Science and Technology Directorate (S&T) meets its planned fiscal year transitions of technology or knowledge products for research and development funded programs/projects. A successful transition is the ownership and/or operation of a technology or knowledge product by a customer within the Homeland Security Enterprise. Technology product is a piece of equipment, system, or component of a system, such as an algorithm to be embedded into a piece of software. Knowledge products may be assessments, standards, training, or documents for decision support. The transition of technology or knowledge products reflects the value that S&T provides in delivering solutions to secure key assets, enhance operational efficiencies and effectiveness, and enable the Department and first responders to do their jobs safer, better, and smarter.						
Fiscal Year:	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**
Target:	---	---	---	---	75%	75%
Result:	---	---	---	---	TBD	TBD

Management Measure

Measure: Percent of research, development, and innovation program milestones that are met, as established in the fiscal year's budget execution plan						
Description: This measure reflects the percent at which S&T meets its research, development, and innovation (RD&I) milestones planned for the fiscal year. A milestone is defined as a scheduled point or event in a project signifying the completion of a major deliverable or a phase of work. 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. Completing these milestones indicate satisfactory progress toward advancing technology within the Department and its stakeholders.						
Fiscal Year:	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**
Target:	---	---	---	75%	75%	75%
Result:	---	---	---	70%	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 Measure

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 plan goals. A milestone is defined as a scheduled point or event in a project signifying the completion of a major deliverable or a phase of work. The Office of University Programs (OUP) engages the academic community to conduct research and analysis, and provide education and training to enhance the Department's homeland security capabilities. OUP 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. The percent of milestones met reflects the programmatic and technical events, accomplishments, or intermediate goals in the life of projects and programs. These milestones indicate satisfactory progress toward achieving long-term S&T performance goals and Department-wide goals and objectives.						
Fiscal Year:	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**
Target:	75%	75%	75%	75%	75%	75%
Result:	92%	92%	78%	83%	TBD	TBD

Science and Technology Directorate
Budget Comparison and Adjustments
Appropriation and PPA Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Operations and Support	**$308,520**	**$314,864**	**$284,789**
Mission Support	$138,058	$143,632	$108,287
Laboratory Facilities	$121,952	$122,722	$123,030
Acquisition and Operations Analysis	$48,510	$48,510	$53,472
Procurement, Construction, and Improvements	**-**	**-**	**$18,927**
Laboratory Facilities	-	-	$18,927
Plum Island Closure and Sale	-	-	$18,927
Research and Development	**$511,265**	**$422,411**	**$340,013**
Research, Development, and Innovation	$470,765	$381,911	$318,267
Border Security Thrust Area	$118,637	$114,113	$89,533
Chemical, Biological, and Explosive Defense Thrust Area	$73,701	$67,032	$45,284
Counter Terrorist Thrust Area	$48,020	$44,515	$31,251
Cyber Security / Information Analysis Thrust Area	$71,301	$29,500	$24,091
First Responder / Disaster Resilience Thrust Area	$92,927	$71,515	$53,416
Innovative Research and Foundational Tools Thrust Area	$66,179	$55,236	$74,692
University Programs	$40,500	$40,500	$21,746
Centers of Excellence	$37,104	$37,104	$18,350
Minority Serving Institutions (MSI)	$3,396	$3,396	$3,396
Total	**$819,785**	**$737,275**	**$643,729**

Science and Technology Directorate
Comparison of Budget Authority and Request

Organization (Dollars in Thousands)	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Operations and Support	513	473	$308,520	507	499	$314,864	456	456	$284,789	(51)	(43)	($30,075)
Procurement, Construction, and Improvements	-	-	-	-	-	-	-	-	$18,927	-	-	$18,927
Research and Development	-	-	$511,265	-	-	$422,411	-	-	$340,013	-	-	($82,398)
Total	**513**	**473**	**$819,785**	**507**	**499**	**$737,275**	**456**	**456**	**$643,729**	**(51)**	**(43)**	**($93,546)**
Subtotal Discretionary - Appropriation	513	473	$819,785	507	499	$737,275	456	456	$643,729	(51)	(43)	($93,546)

*The FY 2019 enacted positions of 513 excludes 8 positions that will be transferred to U.S. Department of Agriculture by the end of FY 2019.

Component Budget Overview

The FY 2021 President's Budget includes $643.7M for the Science and Technology Directorate (S&T). This funding level represents a decrease of $93.5M from the FY 2020 Enacted Budget.

S&T's Research, Development, Test, and Evaluation (RDT&E) efforts are critical to maintaining threat awareness, delivering mitigation strategies, and creating novel technology and approaches for the Department of Homeland Security's (DHS) Components and partners in the homeland security enterprise (HSE). S&T's budget supports Component capability gap requirements and aligns with Administration and DHS priorities.

S&T focuses its resources on rapidly transitioning existing and new technology capabilities to operations in order to help the HSE respond more quickly to emerging threats. S&T leverages existing technologies to expedite the development of vital capabilities critical to mission operations. Advanced technologies, knowledge products, technical analyses, laboratories, and university-based research contributes to the effectiveness and efficiency of DHS operations and to the safety and interoperability of the first responder community.

Science and Technology Directorate
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	FY 2019	FY 2020	FY 2021
Enacted/Request	**$819,785**	**$737,275**	**$643,729**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$278,078	$269,555	$175,573
Rescissions to Current Year/Budget Year	($533)	($273)	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$1,097,330**	**$1,006,557**	**$819,302**
Collections – Reimbursable Resources	$73,600	$92,625	$79,325
Total Budget Resources	**$1,170,930**	**$1,099,182**	**$898,627**
Obligations (Actual/Estimates/Projections)	$787,340	$923,609	$720,982
Personnel: Positions and FTE			
Enacted/Request Positions	513	507	456
Enacted/Request FTE	473	499	456
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	431	507	456
FTE (Actual/Estimates/Projections)	431	499	456

*In the table above, the rescission line includes the administrative savings rescissions per the Consolidated Appropriation Act, 2019 (P.L. 116-6).

Science and Technology Directorate
Collections – Reimbursable Resources

Collections *(Dollars in Thousands)*		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Change		
		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Agriculture - Department of Agriculture	**Source**	-	-	$1,200	-	-	$3,600	-	-	$3,600	-	-	-
Operations and Support	Location	-	-	$700	-	-	$3,100	-	-	$3,100	-	-	-
Laboratory Facilities	Location	-	-	$700	-	-	$3,100	-	-	$3,100	-	-	-
Research and Development	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Research, Development, and Innovation	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Border Security Thrust Area	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Department of Defense - Department of Defense	**Source**	-	-	$12,550	-	-	$12,550	-	-	$6,000	-	-	($6,550)
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	-	-	$4,500	-	-	($6,550)
Research, Development, and Innovation	Location	-	-	$10,550	-	-	$10,550	-	-	$4,000	-	-	($6,550)
Border Security Thrust Area	Location	-	-	$10,550	-	-	$10,550	-	-	$4,000	-	-	($6,550)
University Programs	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-
Centers of Excellence	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	-	-	-
Border Security Thrust Area	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Department of Homeland Security - Department of Homeland Security	**Source**	-	-	$500	-	-	$500	-	-	$500	-	-	-
Operations and Support	Location	-	-	$500	-	-	$500	-	-	$500	-	-	-

Collections *(Dollars in Thousands)*		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Change		
		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
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	-	-	-
Department of Homeland Security - Federal Emergency Management Agency	**Source**	-	-	$2,950	-	-	$3,020	-	-	$2,770	-	-	($250)
Operations and Support	Location	-	-	$250	-	-	$320	-	-	$320	-	-	-
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	-	-	$2,450	-	-	($250)
Research, Development, and Innovation	Location	-	-	$2,700	-	-	$2,700	-	-	$2,450	-	-	($250)
Border Security Thrust Area	Location	-	-	$2,700	-	-	$2,700	-	-	$2,450	-	-	($250)
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	-	-	$4,545	-	-	$4,195	-	-	($350)
Operations and Support	Location	-	-	$1,150	-	-	$1,195	-	-	$1,195	-	-	-
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	-	-	$3,000	-	-	($350)
Research, Development, and Innovation	Location	-	-	$3,350	-	-	$3,350	-	-	$3,000	-	-	($350)
Border Security Thrust Area	Location	-	-	$3,350	-	-	$3,350	-	-	$3,000	-	-	($350)
Department of Homeland Security - U.S. Immigration and Customs Enforcement	**Source**	-	-	$150	-	-	$180	-	-	$180	-	-	-
Operations and Support	Location	-	-	-	-	-	$30	-	-	$30	-	-	-
Mission Support	Location	-	-	-	-	-	$30	-	-	$30	-	-	-

Collections		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Change		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Research and Development	Location	-	-	$150	-	-	$150	-	-	$150	-	-	-
Research, Development, and Innovation	Location	-	-	$150	-	-	$150	-	-	$150	-	-	-
Border Security Thrust Area	Location	-	-	$150	-	-	$150	-	-	$150	-	-	-
Department of Homeland Security - Citizenship and Immigration Services	**Source**	-	-	$1,050	-	-	$1,070	-	-	$1,070	-	-	-
Operations and Support	Location	-	-	$50	-	-	$70	-	-	$70	-	-	-
Mission Support	Location	-	-	-	-	-	$20	-	-	$20	-	-	-
Acquisition and Operations Analysis	Location	-	-	$50	-	-	$50	-	-	$50	-	-	-
Research and Development	Location	-	-	$1,000	-	-	$1,000	-	-	$1,000	-	-	-
Research, Development, and Innovation	Location	-	-	$1,000	-	-	$1,000	-	-	$1,000	-	-	-
Border Security Thrust Area	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	-	-	-
Border Security Thrust Area	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-
Department of Homeland Security - Countering Weapons of Mass Destruction	**Source**	-	-	$2,350	-	-	$2,400	-	-	$2,400	-	-	-
Operations and Support	Location	-	-	$1,250	-	-	$1,300	-	-	$1,300	-	-	-
Mission Support	Location	-	-	$300	-	-	$350	-	-	$350	-	-	-
Laboratory Facilities	Location	-	-	$50	-	-	$50	-	-	$50	-	-	-
Acquisition and Operations Analysis	Location	-	-	$900	-	-	$900	-	-	$900	-	-	-
Research and Development	Location	-	-	$1,100	-	-	$1,100	-	-	$1,100	-	-	-
Research, Development, and Innovation	Location	-	-	$1,100	-	-	$1,100	-	-	$1,100	-	-	-
Border Security Thrust Area	Location	-	-	$1,100	-	-	$1,100	-	-	$1,100	-	-	-
Department of Homeland Security - US Customs and Border Protection	**Source**	-	-	$600	-	-	$600	-	-	$600	-	-	-
Operations and Support	Location	-	-	$600	-	-	$600	-	-	$600	-	-	-

Collections		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Change		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
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	-	-	-
Border Security Thrust Area	Location	-	-	$800	-	-	$800	-	-	$800	-	-	-
Department of Justice - Federal Bureau of Investigation	**Source**	-	-	$26,750	-	-	$26,250	-	-	$26,250	-	-	-
Operations and Support	Location	-	-	$21,500	-	-	$21,000	-	-	$21,000	-	-	-
Laboratory Facilities	Location	-	-	$21,500	-	-	$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	-	-	-
Border Security Thrust Area	Location	-	-	$5,250	-	-	$5,250	-	-	$5,250	-	-	-
Department of Homeland Security - United States Coast Guard	**Source**	-	-	$2,750	-	-	$3,100	-	-	$1,950	-	-	($1,150)
Operations and Support	Location	-	-	$100	-	-	$450	-	-	$450	-	-	-
Mission Support	Location	-	-	-	-	-	$350	-	-	$350	-	-	-
Acquisition and Operations Analysis	Location	-	-	$100	-	-	$100	-	-	$100	-	-	-
Research and Development	Location	-	-	$2,650	-	-	$2,650	-	-	$1,500	-	-	($1,150)
Research, Development, and Innovation	Location	-	-	$2,650	-	-	$2,650	-	-	$1,500	-	-	($1,150)
Border Security Thrust Area	Location	-	-	$2,650	-	-	$2,650	-	-	$1,500	-	-	($1,150)
Department of Homeland Security - National Protection and Programs Directorate	**Source**	-	-	$1,450	-	-	$1,450	-	-	$1,450	-	-	-
Research and Development	Location	-	-	$1,450	-	-	$1,450	-	-	$1,450	-	-	-
Research, Development, and Innovation	Location	-	-	$1,450	-	-	$1,450	-	-	$1,450	-	-	-
Border Security Thrust Area	Location	-	-	$1,450	-	-	$1,450	-	-	$1,450	-	-	-

Collections		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Change		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Homeland Security - U.S. Customs and Border Protection	**Source**	-	-	$8,500	-	-	$25,000	-	-	$20,000	-	-	($5,000)
Research and Development	Location	-	-	$8,500	-	-	$25,000	-	-	$20,000	-	-	($5,000)
Research, Development, and Innovation	Location	-	-	$8,500	-	-	$25,000	-	-	$20,000	-	-	($5,000)
Border Security Thrust Area	Location	-	-	$8,500	-	-	$25,000	-	-	$20,000	-	-	($5,000)
Department of Homeland Security - CISA	**Source**	-	-	$950	-	-	$1,000	-	-	$1,000	-	-	-
Operations and Support	Location	-	-	$950	-	-	$1,000	-	-	$1,000	-	-	-
Mission Support	Location	-	-	-	-	-	$50	-	-	$50	-	-	-
Acquisition and Operations Analysis	Location	-	-	$950	-	-	$950	-	-	$950	-	-	-
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	-	-	-
Border Security Thrust Area	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	-	-	-
Canada	**Source**	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research and Development	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research, Development, and Innovation	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Border Security Thrust Area	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	-	-	-
Border Security Thrust Area	Location	-	-	$200	-	-	$200	-	-	$200	-	-	-

Collections *(Dollars in Thousands)*		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Change		
		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Netherlands	**Source**	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research and Development	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Research, Development, and Innovation	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Border Security Thrust Area	Location	-	-	$300	-	-	$300	-	-	$300	-	-	-
Total Collections		**-**	**-**	**$73,600**	**-**	**-**	**$92,625**	**-**	**-**	**$79,325**	**-**	**-**	**($13,300)**

Science and Technology Directorate
Personnel Compensation and Benefits
Pay Summary

Organization (Dollars in Thousands)	FY 2019 Enacted				FY 2020 Enacted				FY 2021 President's Budget				FY 2020 to FY 2021 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Operations and Support	513	473	$85,871	$180.59	507	499	$94,247	$183.49	456	456	$88,750	$188.67	(51)	(43)	($5,497)	$5.18
Total	**513**	**473**	**$85,871**	**$180.59**	**507**	**499**	**$94,247**	**$183.49**	**456**	**456**	**$88,750**	**$188.67**	**(51)**	**(43)**	**($5,497)**	**$5.18**
Discretionary - Appropriation	513	473	$85,871	$180.59	507	499	$94,247	$183.49	456	456	$88,750	$188.67	(51)	(43)	($5,497)	$5.18

* 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 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 - FY 2021 Change
11.1 Full-time Permanent	$59,620	$61,752	$58,059	($3,693)
11.3 Other than Full-Time Permanent	$5,352	$6,209	$5,516	($693)
11.5 Other Personnel Compensation	$1,330	$1,392	$1,853	$461
11.8 Special Personal Services Payments	-	$2,505	$2,540	$35
12.1 Civilian Personnel Benefits	$19,119	$22,211	$20,604	($1,607)
13.0 Benefits for Former Personnel	$450	$178	$178	-
Total - Personnel Compensation and Benefits	**$85,871**	**$94,247**	**$88,750**	**($5,497)**
Positions and FTE				
Positions - Civilian	513	507	456	(51)
FTE - Civilian	473	499	456	(43)

Science and Technology Directorate
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Operations and Support	$222,649	$220,617	$196,039	($24,578)
Procurement, Construction, and Improvements	-	-	$18,927	$18,927
Research and Development	$511,265	$422,411	$340,013	($82,398)
Total	**$733,914**	**$643,028**	**$554,979**	**($88,049)**
Discretionary - Appropriation	$733,914	$643,028	$554,979	($88,049)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
21.0 Travel and Transportation of Persons	$1,674	$1,674	$1,701	$27
22.0 Transportation of Things	$15	$15	$15	-
23.1 Rental Payments to GSA	$2,122	$2,122	$2,122	-
23.2 Rental Payments to Others	-	-	$200	$200
23.3 Communications, Utilities, and Misc. Charges	$84	$84	$184	$100
24.0 Printing and Reproduction	$135	$117	$117	-
25.1 Advisory and Assistance Services	$238,024	$206,913	$189,883	($17,030)
25.2 Other Services from Non-Federal Sources	$1,828	$1,626	$2,161	$535
25.3 Other Goods and Services from Federal Sources	$234,410	$190,572	$153,701	($36,871)
25.4 Operation and Maintenance of Facilities	$4,566	$4,291	$4,288	($3)
25.5 Research and Development Contracts	$189,898	$170,307	$141,377	($28,930)
25.6 Medical Care	$3	$3	$3	-
25.7 Operation and Maintenance of Equipment	$5,287	$6,935	$6,935	-
26.0 Supplies and Materials	$3,308	$3,308	$8,808	$5,500
31.0 Equipment	$9,620	$12,974	$18,193	$5,219
32.0 Land and Structures	$550	$550	$1,550	$1,000
41.0 Grants, Subsidies, and Contributions	$42,390	$41,537	$23,741	($17,796)
Total - Non Pay Object Classes	**$733,914**	**$643,028**	**$554,979**	**($88,049)**

Science and Technology Directorate
Supplemental Budget Justification Exhibits
Working Capital Fund

Appropriation and PPA *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Operations and Support	**$27,179**	**$28,163**	**-**
Mission Support	$27,179	$28,163	-
Total Working Capital Fund	**$27,179**	**$28,163**	**-**

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

Fiscal Year	Due Date	Reference/Citation	Requirement	Status
2020	01/18/2020	FY 2020 Appropriations P.L.116-93	Brief the committee NLT 30 days after enactment on the proposed allocation of RD&I funds by project and to subsequently update the Committee on any changes from the planned allocation.	Pending
2020	02/17/2020	H.Rept. 116-180 - Department of Homeland Security Appropriation Bill, 2020	S&T and CWMD to provide a joint report to the Committee, within 60 days of enactment on: 1) The status of developing and testing a successor bio-threat detection system, along with plans to complete development and field the new capability and 2) Describe planned changes to biodetection operations to improve upon the legacy program and how CWMD and S&T will coordinate their respective biodetection roles and activities.	Pending
2020	5/31/2020	H.Rept. 116-180 - Department of Homeland Security Appropriation Bill, 2020	The Committee remains concerned about the practice of spoofing by criminals to commit fraud using telephones. The Committee encourages the Department to continue to pursue the development of technologies to combat this practice and directs S&T to provide a briefing on its current efforts in this area, as well as on plans for future technological research and development.	Pending
2020	TBD	H.Rept. 116-180 - Department of Homeland Security Appropriation Bill, 2020	Notify the Committee of any plan or proposal to reduce funding for, diminish the role of, or eliminate COEs prior to taking any action to do so.	Pending
2020	05/31/2020	H.Rept. 116-180 - Department of Homeland Security Appropriation Bill, 2020	S&T to provide updates to the Committee on its activities at the site, including the need for any additional resources to support counter UAS efforts.	Pending
2020	01/18/2020	S.Rept. 116-125 - Department of Homeland Security Appropriation Bill, 2020	"NBACC Work For Others" (Funding received from FBI): Briefing within 30 days of enactment of this act and annually hereafter, on the process established to document, streamline and approve WFO projects to include the following performance metrics: number of projects and total revenue generated for each of the next 5 fiscal years."	Pending
2020	03/18/2020	S.Rept. 116-125 - Department of Homeland Security Appropriation Bill, 2020	SVIP: 180 day report on each grant awarded through the pilot and any commercialization or transition to practice resulted from the pilot.	Pending
2020	06/16/2020	S.Rept. 116-125 - Department of Homeland Security Appropriation Bill, 2020	Bi-national Cooperative Pilot: 180 day report on each grant awarded through the pilot and any commercialization or transition to practice resulted from the pilot.	Pending

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 2021 President's Budget
	Fiscal Year	Amount	Amount	Amount
Operations and Support	**N/A**	**N/A**	**N/A**	**$284,789**
Mission Support	N/A	N/A	N/A	$108,287
Laboratory Facilities	N/A	N/A	N/A	$123,030
Acquisition and Operations Analysis	N/A	N/A	N/A	$53,472
Procurement, Construction, and Improvements	**N/A**	**N/A**	**N/A**	**$18,927**
Plum Island Sale and Closure (PICS) Program	N/A	N/A	N/A	$18,927
Research and Development	**N/A**	**N/A**	**N/A**	**$340,013**
Research, Development and Innovation	N/A	N/A	N/A	$318,267
University Programs	N/A	N/A	N/A	$21,746
Total Direct Authorization/Appropriation	**N/A**	**N/A**	**N/A**	**$643,729**

Science and Technology Directorate
Proposed Legislative Language

Operations and Support

For necessary expenses of the Science and Technology Directorate for operations and support, including the purchase or lease of not to exceed 5 vehicles, [$314,864,000] *$284,789,433*, of which [$171,232,000] *$176,502,000* shall remain available until September 30, [2021] *2022*: Provided, That not to exceed $10,000 shall be for official reception and representation expenses.

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Language Provision	Explanation
…[$314,864,000] *$284,789,433*	Dollar change only. No substantial change proposed.
…[$171,232,000] *$176,502,000*	Dollar change only. No substantial change proposed.
…[2021] *2022*	Fiscal year change only. No substantial change proposed.

Procurement, Construction, and Improvements

For necessary expenses of the Science and Technology Directorate for Procurement, Construction, and Improvements, $18,927,000, to remain available until September 30, 2025.

Language Provision	Explanation
For necessary expenses of the Science and Technology Directorate for Procurement, Construction, and Improvements, $18,927,000, to remain available until September 30, 2025.	S&T does not currently have a Procurement, Construction, and Improvements appropriation, and this is a new request.

Research and Development

For necessary expenses of the Science and Technology Directorate for research and development, [$422,411,000**]** *$340,013,000*, to remain available until September 30, **[**2022**]** *2023*.

Language Provision	Explanation
…$422,411,000] *$340,013,000*	Dollar change only. No substantial change proposed.
[2022**]** *2023*	Fiscal year change only. No substantial change proposed.

Department of Homeland Security

Science and Technology Directorate

Operations and Support

Fiscal Year 2021

Congressional Justification

Table of Contents

Operations and Support

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization (Dollars in Thousands)	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Mission Support	372	342	$138,058	374	366	$143,632	323	323	$108,287	(51)	(43)	($35,345)
Laboratory Facilities	141	131	$121,952	133	133	$122,722	133	133	$123,030	-	-	$308
Acquisition and Operations Analysis	-	-	$48,510	-	-	$48,510	-	-	$53,472	-	-	$4,962
Total	**513**	**473**	**$308,520**	**507**	**499**	**$314,864**	**456**	**456**	**$284,789**	**(51)**	**(43)**	**($30,075)**
Subtotal Discretionary - Appropriation	513	473	$308,520	507	499	$314,864	456	456	$284,789	(51)	(43)	($30,075)

*FTE reported in this table differ in from MAX A-11 due to the MAX lock dates, FY20 should have been decreased by 8 FTE, and FY21 should have been increased by 19 FTE from MAX A-11 due to adjusted estimates based on FY enacted appropriations.

The Operations and Support (O&S) appropriation for the Science and Technology Directorate (S&T) provides funding to ensure delivery of advanced technology solutions to Department of Homeland Security (DHS) Components and first responders. This appropriation also supports Systems Engineering, Standards, and Test and Evaluation (T&E) to ensure that S&T and DHS Components develop effective technologies that work in the operational environment. This includes costs necessary for operations and support activities to advance S&T's mission, as well as salaries and benefits, and five laboratory facilities.

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, training and travel requirements, financial management, facility planning, maintenance, and other administrative functions. Offices supported under Mission Support include the Finance and Budget Division, Administration and Support Division (ASD), Privacy, Communications and Outreach, Office of the Under Secretary, Chief Scientist, Office of Strategy and Policy, Chief Information Office, and Compliance. Additionally, this appropriation finances the Office of General Counsel requirements including Intellectual Property (IP) and trademark rights for DHS and its Components.

Laboratory Facilities: The Laboratory Facilities PPA provides funding for the operations and maintenance of S&T's five 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 Department of Energy (DOE) national laboratories.

Acquisition and Operations Analysis: The Acquisition and Operations Analysis (AOA) 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 2019**	**FY 2020**	**FY 2021**
Enacted/Request	**$308,520**	**$314,864**	**$284,789**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$62,990	$45,548	$40,488
Rescissions to Current Year/Budget Year	($533)	($273)	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$370,977**	**$360,139**	**$325,277**
Collections – Reimbursable Resources	$31,800	$34,325	$34,325
Total Budget Resources	**$402,777**	**$394,464**	**$359,602**
Obligations (Actual/Estimates/Projections)	$326,006	$353,976	$320,333
Personnel: Positions and FTE			
Enacted/Request Positions	513	507	456
Enacted/Request FTE	473	499	456
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	431	507	456
FTE (Actual/Estimates/Projections)	431	499	456

*In the table above, the rescission line includes the administrative savings rescissions per the Consolidated Appropriation Act, 2019 (P.L. 116-6).

Operations and Support
Collections – Reimbursable Resources

Collections		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Agriculture - Department of Agriculture	Source	-	-	$700	-	-	$3,100	-	-	$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	-	-	$320	-	-	$320
Department of Homeland Security - Federal Law Enforcement Training Center	Source	-	-	-	-	-	$10	-	-	$10
Department of Homeland Security - Transportation Security Administration	Source	-	-	$1,150	-	-	$1,195	-	-	$1,195
Department of Homeland Security - U.S. Immigration and Customs Enforcement	Source	-	-	-	-	-	$30	-	-	$30
Department of Homeland Security - Citizenship and Immigration Services	Source	-	-	$50	-	-	$70	-	-	$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	-	-	$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	-	-	$21,500	-	-	$21,000	-	-	$21,000
Department of Homeland Security - United States Coast Guard	Source	-	-	$100	-	-	$450	-	-	$450
Department of Homeland Security - CISA	Source	-	-	$950	-	-	$1,000	-	-	$1,000
Department of State - Department of State	Source	-	-	$200	-	-	$200	-	-	$200
Library of Congress	Source	-	-	$500	-	-	$500	-	-	$500
Total Collections		**-**	**-**	**$31,800**	**-**	**-**	**$34,325**	**-**	**-**	**$34,325**

Operations and Support
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2019 Enacted	**513**	**473**	**$308,520**
FY 2020 Enacted	**507**	**499**	**$314,864**
FY 2021 Base Budget	**507**	**499**	**$314,864**
Transfer for WCF Offset for OGC Staffing from S&T/O&S/LF to OSEM/M&O	-	-	($29)
Transfer for WCF Offset for OGC Staffing from S&T/O&S/MS to OSEM/M&O	-	-	($130)
Transfer for WCF Removals from S&T/O&S/Mission Support to A&O/O&S	-	-	($703)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCFO	-	-	($13)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCHCO	-	-	($49)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCIO	-	-	($11,687)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCPO	-	-	($1)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCRSO	-	-	($9,242)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCSO	-	-	($1,338)
Total Transfers	**-**	**-**	**($23,192)**
2020 Pay Raise	-	-	$1,846
2021 Pay Raise	-	-	$459
FERS Agency Contribution	-	-	$748
Increased charges for FFMS from ICE	-	-	$60
Total, Pricing Increases	**-**	**-**	**$3,113**
FPS Fee Adjustment	-	-	($16)
Hiring Delays	-	-	($277)
Total, Pricing Decreases	**-**	**-**	**($293)**
Total Adjustments-to-Base	**-**	**-**	**($20,372)**
FY 2021 Current Services	**507**	**499**	**$294,492**
Awards Spending Increase	-	-	$611
Operations and Requirements Analysis	-	-	$4,000
SAFETY Act	-	-	$43
Technology Transition	-	-	$4,743
Total, Program Increases	**-**	**-**	**$9,397**
Administrative Support Services	-	-	($6,276)
Management Efficiency	(51)	(43)	($8,884)
Plum Island Animal Disease Center	-	-	($116)

Budget Formulation Activity *(Dollars in Thousands)*	**Positions**	**FTE**	**Amount**
Test and Evaluation	-	-	($3,824)
Total, Program Decreases	**(51)**	**(43)**	**($19,100)**
FY 2021 Request	**456**	**456**	**$284,789**
FY 2020 To FY 2021 Change	**(51)**	**(43)**	**($30,075)**

Operations and Support
Justification of Transfers

Transfers *(Dollars in Thousands)*	FY 2021 President's Budget		
	Positions	FTE	Amount
Transfer 1 - Transfer for WCF Offset for OGC Staffing from S&T/O&S/LF to OSEM/M&O	**-**	**-**	**($29)**
Laboratory Facilities	-	-	($29)
Transfer 2 - Transfer for WCF Offset for OGC Staffing from S&T/O&S/MS to OSEM/M&O	**-**	**-**	**($130)**
Mission Support	-	-	($130)
Transfer 3 - Transfer for WCF Removals from S&T/O&S/Mission Support to A&O/O&S	**-**	**-**	**($703)**
Mission Support	-	-	($703)
Transfer 4 - Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCFO	**-**	**-**	**($13)**
Mission Support	-	-	($13)
Transfer 5 - Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCHCO	**-**	**-**	**($49)**
Mission Support	-	-	($49)
Transfer 6 - Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCIO	**-**	**-**	**($11,687)**
Mission Support	-	-	($11,687)
Transfer 7 - Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCPO	**-**	**-**	**($1)**
Mission Support	-	-	($1)
Transfer 8 - Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCRSO	**-**	**-**	**($9,242)**
Mission Support	-	-	($9,242)
Transfer 9 - Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCSO	**-**	**-**	**($1,338)**
Mission Support	-	-	($1,338)
Total Transfers	**-**	**-**	**($23,192)**

Transfers 1-2 – Transfer for Working Capital Fund (WCF) Offset for OGC Staffing: This transfer represents costs associated with the removal of the General Services Administration (GSA) Rent, Research Library & Information Services, and National Capital Region Infrastructure Operations from the Office of General Council WCF base transfer. As with all WCF removals, this will not result in a loss of service for this activity.

Transfer 3-9 – Transfer for WCF Removals: These transfers represent costs associated with the removal of the following activities from the Working Capital Fund which is being eliminated as part of the FY 2021 Request: Interagency Council Funding, Human Capital Business System, e-Training, USAJOBS, Enterprise HR Integration, Human Resources Line of Business, Research Library & Information Services, e-Rulemaking, e-gov Benefits, Financial Management Line of Business, Geospatial Line of Business, Budget Formulation and Execution Line of Business, Mail Services, HSPD-12, CLAN, and Background Investigations.

Operations and Support
Justification of Pricing Changes

Pricing Changes *(Dollars in Thousands)*	FY 2021 President's Budget		
	Positions	FTE	Amount
Pricing Change 1 - 2020 Pay Raise	**-**	**-**	**$1,846**
Mission Support	-	-	$1,477
Laboratory Facilities	-	-	$369
Pricing Change 2 - 2021 Pay Raise	**-**	**-**	**$459**
Mission Support	-	-	$367
Laboratory Facilities	-	-	$92
Pricing Change 3 - FERS Agency Contribution	**-**	**-**	**$748**
Mission Support	-	-	$598
Laboratory Facilities	-	-	$150
Pricing Change 4 - FPS Fee Adjustment	**-**	**-**	**($16)**
Mission Support	-	-	($13)
Laboratory Facilities	-	-	($3)
Pricing Change 5 - Hiring Delays	**-**	**-**	**($277)**
Laboratory Facilities	-	-	($277)
Pricing Change 6 - Increased charges for FFMS from ICE	**-**	**-**	**$60**
Mission Support	-	-	$60
Total Pricing Changes	**-**	**-**	**$2,820**

Pricing Change 1 – 2020 Pay Raise: This pricing change reflects the costs to support the 2020 enacted 3.1% pay increase. This includes one quarter of funding for Calendar Year 2020 and three quarters to annualize the funding in Calendar Year 2021.

Pricing Change 2 – 2021 Pay Raise: This pricing change reflects the FY 2021 1.0% pay increase.

Pricing Change 3 - FERS Agency Contribution: Per OMB Circular A-11, agency Federal Employment Retirement System(FERS) contributions increased by 1.3% from 16.0% in FY 2020 to 17.3% in FY 2021. The agency contribution amount for Civil Service Retirement System did not change.

Pricing Change 4 – FPS Fee Adjustment: This pricing decrease is due to adjustments in the Federal Protective Service (FPS) basic security fees due to change in the basic security fee level and assessment model.

Pricing Change 5 – Hiring Delays: S&T will not immediately backfill attrited positions in the Laboratory Facilities PPA to mitigate salary costs.

Pricing Change 6 – Increased charges for FFMS from ICE: This pricing change will fund increased charges for the use and management of the Federal Financial Management System (FFMS), owned and managed by U.S. Immigration Customs Enforcement (ICE).

Operations and Support
Justification of Program Changes

Program Changes *(Dollars in Thousands)*	FY 2021 President's Budget		
	Positions	FTE	Amount
Program Change 1 - Administrative Support Services	**-**	**-**	**($6,276)**
Mission Support	-	-	($6,276)
Program Change 2 - Awards Spending Increase	**-**	**-**	**$611**
Mission Support	-	-	$489
Laboratory Facilities	-	-	$122
Program Change 3 - Management Efficiency	**(51)**	**(43)**	**($8,884)**
Mission Support	(51)	(43)	($8,884)
Program Change 4 - Operations and Requirements Analysis	**-**	**-**	**$4,000**
Acquisition and Operations Analysis	-	-	$4,000
Program Change 5 - Plum Island Animal Disease Center	**-**	**-**	**($116)**
Laboratory Facilities	-	-	($116)
Program Change 6 - Safety Act	**-**	**-**	**$43**
Acquisition and Operations Analysis	-	-	$43
Program Change 7 - Technology Transition	**-**	**-**	**$4,743**
Acquisition and Operations Analysis	-	-	$4,743
Program Change 8 - Test and Evaluation	**-**	**-**	**($3,824)**
Acquisition and Operations Analysis	-	-	($3,824)
Total Program Changes	**(51)**	**(43)**	**($9,703)**

Program Change 1 – Administrative Support Services

Description
The FY 2021 request includes a reduction of $6.3M to support services. The base for this program is $38.8M

Justification
This reduction will cut support contracts such as information technology, printer maintenance, inventory management, and other administrative support. S&T will reduce administrative services to focus resources on higher priority, mission support activities.

Performance
S&T will focus resources on programs with support service needs without impact to mission execution.

Program Change 2 – Awards Spending Increase

Description
The FY 2021 Request includes an increase of $0.6M for Awards Spending. The base for this program is $1.1M.

Justification
Consistent with this guidance, the FY 2021 Request increases awards spending to support strategic workforce development. On July 12, 2019, OMB issued Memorandum 19-24 Guidance on Awards for Employees and Agency Workforce Funding Plan. This Memorandum directs agencies to review and update their current awards spending plans in order to: 1) support the strategic use of awards and recognition throughout the year; 2) address workforce challenges and recognize high performing employees; and 3) recognize those employees with talent critical to mission achievement.

Performance
The FY 2021 Request supports the agency workforce planning requirements by providing a one percent increase for awards spending. The additional funding will help drive positive behavior by recognizing accomplishments of agency personnel, thereby fostering a culture of recognition and performance.

Program Change 3 – Management Efficiency:

Description
The FY 2021 request includes a management efficiency of decrease of $8.9M. This management efficiency directly corresponds to the reduction to Research and Development (R&D), and S&T plans to reduce positions associated with R&D reductions. The base for this program is 374 Positions, 366 FTE and $72.8M.

Justification
All salary and benefits for the S&T directorate, with the exception of Laboratory Facilities, reside in the Mission Support PPA. S&T plans to decrease positions by 51 based on project reductions to the R&D Appropriation, Research Development and Innovation PPA. S&T is estimating an $8.884M cost saving in FY 2021 with a reduction of 43 FTE.

Performance
S&T's mission is to deliver effective and innovative insight, methods and solutions for the critical needs of the HSE. The FTE reductions are directly associated with programs that are being eliminated or reduced and thereby will not affect S&T's performance. S&T's R&D work will continue to provide and support cutting-edge research to produce revolutionary changes in technologies, new capabilities and threat and risk assessments for the HSE.

Program Change 4 – Operations and Requirements Analysis:

Description
The FY 2021 Request includes an increase of $4.0M to S&T's System of Systems Operational Analytics (SoSOA) virtual environment initiative for collaborative operational analyses to enable complex, timely, mission-focused decisions across DHS and the HSE. The base for this program is 10 Positions, 10 FTE and $1.0M.

Justification
DHS missions are complex, combining disparate systems, data, organizations, and activities. The development of the SoSOA's virtual environment provides a shared informative analytic solution for DHS, Components and HSE. There are no efficiencies or economies of scales gained in purchasing shared tools, nor best practices or standard proven methodology shared across groups. This capability gap requirement was verified at a cross-department level in the recent Enterprise Analytics Capability Analysis Report (CAR) sponsored by the Department. A solution is not in place at S&T or at an enterprise level to fill this gap.

Performance
Increased funding expands the SoSOA virtual environment to maximize collaborative operational analyses supporting S&T and DHS-wide program, project, investment, and mission decisions. SoSOA supports decision makers by combining the right data, tools, and training to enhance analytic capabilities within DHS and the HSE.

Program Change 5 – Plum Island Animal Disease Center (PIADC):

Description
The FY 2021 Request includes a decrease of $0.1M to the PIADC. The base for this program is 34 Positions, 34 FTE and $52.4M.

Justification
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).

Performance
At the funding levels in the FY 2021 request PIADC will maintain levels of support provided in FY 2020 and will continue to serve as the Nation's premier defense against accidental or intentional introduction of transboundary animal diseases**.**

Program Change 6 – SAFETY Act:

Description
The FY 2021 Request includes an increase of $43,000 to the Support Anti-Terrorism by Fostering Effective Technologies (SAFETY) Act program to support an increased number of applications. The base for this program is 7 Positions, 7 FTE and $10.0M.

Justification
Increased funding for the SAFETY Act program enables S&T to meet some of the growing application demands and provide liability protection for qualified anti-terrorism technology developers. SAFETY Act work has increased by 15% per year due to a rise in applications from infrastructure protection and cybersecurity efforts. Demand for SAFETY Act work includes: professional sports league franchises and venue owners/operators; DHS and private sector initiatives to harden soft targets, particularly convention centers and public spaces; cybersecurity applications; energy sector applications for kinetic and cyber security measures; SAFETY Act Futures applications (e.g., autonomous vehicles, modern transit systems); and SAFETY Act Leader applications (e.g., enhanced security measures at commercial office buildings).

Performance
This proposed increase will encourage the industry leaders to develop anti-terrorism technologies, which contributes to preventing acts of terrorism and saving lives. The SAFETY Act is vital to ensuring the private sector continues to lean forward and aggressively improve the security of critical infrastructure in the United States.

Program Change 7 – Technology Transition Support:

Description
The FY 2021 Request includes an increase of $4.7M to S&T's Technology Transition Support program to fund the Integrated Domain Enterprise-Maritime (IDE-M) program. The base for this program is 10 Positions, 10 FTE and $8.5M.

Justification
The IDE-M program allows the transition of S&T developed enterprise operational information sharing technology that can be leveraged to improve Maritime Domain Awareness and enhance the ability for the United States Coast Guard and U.S. Customs and Border Protection's Air Marine Operations ability to detect, deter, interdict and investigate illegal maritime activity.

Performance
Funding IDE-M allows DHS to operationalize the capability as an enterprise service for the maritime domain and establishes a foundation for expansion to support multi-domain information sharing.

Program Change 8 – Test and Evaluation:

Description
The FY 2021 Request includes a decrease of $3.8M to S&T's Test and Evaluation program. The base for this program is 12 Positions, 12 FTE and $8.2M.

Justification
T&E critical functions will continue being performed 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.

Performance
This proposed reduction eliminates the First Responders Technologies System Assessment and Validation for Emergency Responders (SAVER) program as well as reducing Operational Test & Evaluation. This reduction will allow S&T to restructure its resources to best support requirements for S&T and the Components.

Operations and Support
Personnel Compensation and Benefits

Pay Summary

Organization (Dollars in Thousands)	FY 2019 Enacted				FY 2020 Enacted				FY 2021 President's Budget				FY 2020 to FY 2021 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Mission Support	372	342	$65,171	$189.68	374	366	$72,777	$192.24	323	323	$66,824	$199.29	(51)	(43)	($5,953)	$7.05
Laboratory Facilities	141	131	$20,700	$156.87	133	133	$21,470	$159.43	133	133	$21,926	$162.86	-	-	$456	$3.43
Total	**513**	**473**	**$85,871**	**$180.59**	**507**	**499**	**$94,247**	**$183.49**	**456**	**456**	**$88,750**	**$188.67**	**(51)**	**(43)**	**($5,497)**	**$5.18**
Discretionary - Appropriation	513	473	$85,871	$180.59	507	499	$94,247	$183.49	456	456	$88,750	$188.67	(51)	(43)	($5,497)	$5.18

* 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 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 - FY 2021 Change
11.1 Full-time Permanent	$59,620	$61,752	$58,059	($3,693)
11.3 Other than Full-Time Permanent	$5,352	$6,209	$5,516	($693)
11.5 Other Personnel Compensation	$1,330	$1,392	$1,853	$461
11.8 Special Personal Services Payments	-	$2,505	$2,540	$35
12.1 Civilian Personnel Benefits	$19,119	$22,211	$20,604	($1,607)
13.0 Benefits for Former Personnel	$450	$178	$178	-
Total - Personnel Compensation and Benefits	**$85,871**	**$94,247**	**$88,750**	**($5,497)**
Positions and FTE				
Positions - Civilian	513	507	456	(51)
FTE - Civilian	473	499	456	(43)

Operations and Support
Permanent Positions by Grade – Appropriation

Grades and Salary Range *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
Total, SES	25	25	25	-
GS-15	181	179	170	-9
GS-14	140	139	119	-20
GS-13	84	82	60	-22
GS-12	40	39	39	-
GS-11	7	7	7	-
GS-9	7	7	7	-
GS-8	1	1	1	-
GS-6	5	5	5	-
GS-5	1	1	1	-
Other Graded Positions	22	22	22	-
Total Permanent Positions	**513**	**507**	**456**	**-51**
Unfilled Positions EOY	99	-	-	-
Total Perm. Employment (Filled Positions) EOY	414	507	456	-51
Position Locations				
Headquarters	370	372	321	-51
U.S. Field	141	133	133	-
Foreign Field	2	2	2	-
Averages				
Average Personnel Costs, ES Positions	186,797	191,140	195,584	4,444
Average Personnel Costs, GS Positions	125,788	140,496	146,972	6,476
Average Grade, GS Positions	14	14	14	-

[1]The FY 2019 enacted positions exclude the 8 positions that transferred to U.S. Department of Agriculture at the end of FY 2019.

Operations and Support
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Mission Support	$72,887	$70,855	$41,463	($29,392)
Laboratory Facilities	$101,252	$101,252	$101,104	($148)
Acquisition and Operations Analysis	$48,510	$48,510	$53,472	$4,962
Total	**$222,649**	**$220,617**	**$196,039**	**($24,578)**
Discretionary - Appropriation	$222,649	$220,617	$196,039	($24,578)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
21.0 Travel and Transportation of Persons	$1,674	$1,674	$1,674	-
22.0 Transportation of Things	$15	$15	$15	-
23.1 Rental Payments to GSA	$2,122	$2,122	$2,122	-
23.3 Communications, Utilities, and Misc. Charges	$84	$84	$84	-
24.0 Printing and Reproduction	$135	$117	$117	-
25.1 Advisory and Assistance Services	$101,840	$96,810	$95,174	($1,636)
25.2 Other Services from Non-Federal Sources	$1,828	$1,626	$2,161	$535
25.3 Other Goods and Services from Federal Sources	$93,729	$91,997	$68,523	($23,474)
25.4 Operation and Maintenance of Facilities	$4,566	$4,291	$4,288	($3)
25.6 Medical Care	$3	$3	$3	-
25.7 Operation and Maintenance of Equipment	$5,287	$6,935	$6,935	-
26.0 Supplies and Materials	$3,308	$3,308	$3,308	-
31.0 Equipment	$7,008	$10,585	$10,585	-
32.0 Land and Structures	$550	$550	$550	-
41.0 Grants, Subsidies, and Contributions	$500	$500	$500	-
Total - Non Pay Object Classes	**$222,649**	**$220,617**	**$196,039**	**($24,578)**

Mission Support – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Mission Support	372	342	$138,058	374	366	$143,632	323	323	$108,287	(51)	(43)	($35,345)
Total	**372**	**342**	**$138,058**	**374**	**366**	**$143,632**	**323**	**323**	**$108,287**	**(51)**	**(43)**	**($35,345)**
Subtotal Discretionary - Appropriation	372	342	$138,058	374	366	$143,632	323	323	$108,287	(51)	(43)	($35,345)

*The FY 2019 enacted positions excludes the 8 positions that were transferred to U.S. Department of Agriculture at the end of FY 2019 .

PPA Level 1 Description

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 equivalents requested in FY 2021 will support S&T's 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 2019**	**FY 2020**	**FY 2021**
Enacted/Request	**$138,058**	**$143,632**	**$108,287**
Carryover and/or Recoveries (Actual/Estimates/Projections)	-	-	-
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$138,058**	**$143,632**	**$108,287**
Collections – Reimbursable Resources	$1,600	$2,225	$2,225
Total Budget Resources	**$139,658**	**$145,857**	**$110,512**
Obligations (Actual/Estimates/Projections)	$137,512	$145,857	$110,512
Personnel: Positions and FTE			
Enacted/Request Positions	372	374	323
Enacted/Request FTE	342	366	323
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	324	374	323
FTE (Actual/Estimates/Projections)	324	366	323

Mission Support – PPA
Collections – Reimbursable Resources

Collections		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget		
(Dollars in Thousands)		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	-	-	$70
Department of Homeland Security - Federal Law Enforcement Training Center	**Source**	-	-	-	-	-	$10	-	-	$10
Department of Homeland Security - Transportation Security Administration	**Source**	-	-	-	-	-	$45	-	-	$45
Department of Homeland Security - U.S. Immigration and Customs Enforcement	**Source**	-	-	-	-	-	$30	-	-	$30
Department of Homeland Security - Citizenship and Immigration Services	**Source**	-	-	-	-	-	$20	-	-	$20
Department of Homeland Security - Countering Weapons of Mass Destruction	**Source**	-	-	$300	-	-	$350	-	-	$350
Department of Homeland Security - US Customs and Border Protection	**Source**	-	-	$500	-	-	$500	-	-	$500
Department of Homeland Security - United States Coast Guard	**Source**	-	-	-	-	-	$350	-	-	$350
Department of Homeland Security - CISA	**Source**	-	-	-	-	-	$50	-	-	$50
Total Collections		**-**	**-**	**$1,600**	**-**	**-**	**$2,225**	**-**	**-**	**$2,225**

Mission Support – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2019 Enacted	**372**	**342**	**$138,058**
FY 2020 Enacted	**374**	**366**	**$143,632**
FY 2021 Base Budget	**374**	**366**	**$143,632**
Transfer for WCF Offset for OGC Staffing from S&T/O&S/MS to OSEM/M&O	-	-	($130)
Transfer for WCF Removals from S&T/O&S/Mission Support to A&O/O&S	-	-	($703)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCFO	-	-	($13)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCHCO	-	-	($49)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCIO	-	-	($11,687)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCPO	-	-	($1)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCRSO	-	-	($9,242)
Transfer for WCF Removals from S&T/O&S/Mission Support to MGMT/OCSO	-	-	($1,338)
Total Transfers	**-**	**-**	**($23,163)**
2020 Pay Raise	-	-	$1,477
2021 Pay Raise	-	-	$367
FERS Agency Contribution	-	-	$598
Increased charges for FFMS from ICE	-	-	$60
Total, Pricing Increases	**-**	**-**	**$2,502**
FPS Fee Adjustment	-	-	($13)
Total, Pricing Decreases	**-**	**-**	**($13)**
Total Adjustments-to-Base	**-**	**-**	**($20,674)**
FY 2021 Current Services	**374**	**366**	**$122,958**
Awards Spending Increase	-	-	$489
Total, Program Increases	**-**	**-**	**$489**
Administrative Support Services	-	-	($6,276)
Management Efficiency	(51)	(43)	($8,884)
Total, Program Decreases	**(51)**	**(43)**	**($15,160)**
FY 2021 Request	**323**	**323**	**$108,287**
FY 2020 To FY 2021 Change	**(51)**	**(43)**	**($35,345)**

Mission Support – PPA
Personnel Compensation and Benefits

Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted				FY 2020 Enacted				FY 2021 President's Budget				FY 2020 to FY 2021 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Mission Support	372	342	$65,171	$189.68	374	366	$72,777	$192.24	323	323	$66,824	$199.29	(51)	(43)	($5,953)	$7.05
Total	**372**	**342**	**$65,171**	**$189.68**	**374**	**366**	**$72,777**	**$192.24**	**323**	**323**	**$66,824**	**$199.29**	**(51)**	**(43)**	**($5,953)**	**$7.05**
Discretionary - Appropriation	372	342	$65,171	$189.68	374	366	$72,777	$192.24	323	323	$66,824	$199.29	(51)	(43)	($5,953)	$7.05

* 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 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 - FY 2021 Change
11.1 Full-time Permanent	$43,955	$45,842	$41,966	($3,876)
11.3 Other than Full-Time Permanent	$4,696	$5,538	$4,820	($718)
11.5 Other Personnel Compensation	$865	$920	$1,290	$370
11.8 Special Personal Services Payments	-	$2,417	$2,452	$35
12.1 Civilian Personnel Benefits	$15,355	$18,060	$16,296	($1,764)
13.0 Benefits for Former Personnel	$300	-	-	-
Total - Personnel Compensation and Benefits	**$65,171**	**$72,777**	**$66,824**	**($5,953)**
Positions and FTE				
Positions - Civilian	372	374	323	(51)
FTE - Civilian	342	366	323	(43)

Pay Cost Drivers

Pay Cost Drivers *(Dollars in Thousands)*	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate
Mission Support Personnel	342	$65,171	$189.68	366	$72,777	$192.24	323	$66,824	$199.29	(43)	($5,953)	$7.05
Total – Pay Cost Drivers	**342**	**$65,171**	**$189.68**	**366**	**$72,777**	**$192.24**	**323**	**$66,824**	**$199.29**	**(43)**	**($5,953)**	**$7.05**

*FY 2020 Enacted Amount is based on S&B associated with approved positions.

Explanation of Pay Cost Driver

Mission Support Personnel: S&Ts pay costs provide for the salaries and benefits of non-laboratory personnel supporting its mission. The decrease represents 51 unfunded positions in FY 2021.

Mission Support – PPA
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Mission Support	$72,887	$70,855	$41,463	($29,392)
Total	**$72,887**	**$70,855**	**$41,463**	**($29,392)**
Discretionary - Appropriation	$72,887	$70,855	$41,463	($29,392)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
21.0 Travel and Transportation of Persons	$615	$615	$615	-
23.1 Rental Payments to GSA	$22	$22	$22	-
24.0 Printing and Reproduction	$135	$117	$117	-
25.1 Advisory and Assistance Services	$29,480	$24,450	$17,968	($6,482)
25.2 Other Services from Non-Federal Sources	$782	$580	$1,115	$535
25.3 Other Goods and Services from Federal Sources	$31,859	$30,127	$6,682	($23,445)
25.4 Operation and Maintenance of Facilities	$550	$275	$275	-
25.6 Medical Care	$3	$3	$3	-
25.7 Operation and Maintenance of Equipment	$3,085	$4,733	$4,733	-
26.0 Supplies and Materials	$445	$445	$445	-
31.0 Equipment	$5,911	$9,488	$9,488	-
Total - Non Pay Object Classes	**$72,887**	**$70,855**	**$41,463**	**($29,392)**

Non Pay Cost Drivers

Non Pay Cost Drivers *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Contract Support Services	$29,480	$24,450	$17,968	($6,482)
Information Technology (IT) Equipment	$5,911	$9,488	$9,488	-
Rental Payments to GSA	$22	$22	$22	-
Working Capital Fund	$27,179	$28,163	-	($28,163)
Other Administrative and Support Costs	$10,295	$8,732	$13,985	$5,253
Total - Non Pay Cost Drivers	**$72,877**	**$70,855**	**$41,463**	**($29,392)**

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 decrease from FY 2020 is due to the realignment to match the actual cost category.

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.

Rental Payments to GSA: This covers costs for rental payment to GSA for the travel office located in Mississippi.

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. In FY 2021, there is an overall decrease of $28.2M due to the removal of the WCF Activities in DHS. These will transfer from S&T to the Management Directorate (MGMT)/OCFO, CHCO, OCIO, CRSO and OCSO. They will assume responsibility for providing these services DHS-wide.

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 printing services, legal services, consolidated subscriptions, government-wide mandated services, DHS crosscutting activities, and the DHS Freedom of Information Act (FOIA) system. The increase from FY 2020 is due to the net increase for shared services with the USM.

Laboratory Facilities – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Laboratory Facilities	141	131	$121,952	133	133	$122,722	133	133	$123,030	-	-	$308
Total	**141**	**131**	**$121,952**	**133**	**133**	**$122,722**	**133**	**133**	**$123,030**	**-**	**-**	**$308**
Subtotal Discretionary - Appropriation	141	131	$121,952	133	133	$122,722	133	133	$123,030	-	-	$308

PPA Level I Description

The Laboratory Facilities PPA provides funding to support operations, infrastructure 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), National Urban Security Transportation Laboratory (NUSTL), 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 (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 provides an enduring capability of subject matter expertise and dedicated technical infrastructure critical to the success in each of S&T's RD&I thrust areas.

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 laboratory and has completed the triennial Biological Select Agents and Toxins (BSAT) registration inspection.

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 the support and 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. All TSA threat detection systems are certified by TSL's Independent Test and Evaluation Division. TSL supports TSA as its primary customer, but also provides test and evaluation services to CBP, USCG, USSS, and other government organizations. TSL's main campus is located at the Federal Aviation Administration's William J. Hughes Technical Center in Atlantic City, NJ. A remote test facility located at Tyndall Air Force Base, FL, collects homemade explosive detection data supporting transportation security equipment developmental testing and certification testing, while another TSL capability at Redstone Arsenal in Huntsville, AL, conducts rapid assessment of detection system performance against emerging threats. Major operational costs include rent, operation support contracts, certification testing support, building maintenance, utilities, security, and information technology.

National Urban Security Transportation Laboratory:
NUSTL's capabilities in test and evaluation (T&E) and research and development (R&D) help first responders prepare, protect and respond to homeland security threats. NUSTL provides independent technology evaluations and assessments, thereby enabling informed acquisition and deployment decisions to ensure first responders have the best technologies available. NUSTL is a preferred and trusted resource for first responder agencies across all levels of the government and works with end-users to promote the successful deployment of both commercial and emerging technologies into field use for law enforcement, fire and other emergency response agencies. Staff experts work side-by-side with the Nation's first responders to effectively plan and execute tests, evaluations and assessments in operational scenarios, assist with the fielding of technologies, sponsor R&D, support the development of Concept of Operations and provide post-deployment advisory support. Major operational costs include rent for its laboratory facility, test and evaluation equipment purchase, maintenance and upgrades such as radiation detectors and radiation sources, contractor

support, information technology and security. S&T is continuously evaluating opportunities to mitigate costs to taxpayers, including the NUSTL location. The current NUSTL facility is located in Manhattan, New York due to the criticality of the partnership with the first responder community and access to urban test environments.

Chemical Security Analysis Center 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 Combat Capabilities Development Command Chemical Biological Center (CCDC CBC) 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 2019, CSAC completed and launched the Chemical Agent Reactions Database (CARD) v6.0 and v7.0 on the National Center for Medical Intelligence (NCMI), which hosts the CARD. CSAC developed aviation security models of wide body aircraft for TSA, collaborating with the UK and EU. CSAC developed a medical mitigation model for kinetic injuries in explosive attack scenarios. CSAC also completed a study to determine long-term health effects from acute, sub-lethal exposures to opioids, including fentanyl and synthetic analogs.

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 85% complete. United States Department of Agriculture (USDA) assumed full responsibility for ongoing operations planning and future operation of NBAF in FY 2019. S&T NBAF staff in Manhattan, KS also transferred to USDA in FY 2019.

Laboratory Facilities – PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2019**	**FY 2020**	**FY 2021**
Enacted/Request	**$121,952**	**$122,722**	**$123,030**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$47,062	$35,825	$27,701
Rescissions to Current Year/Budget Year	($470)	($273)	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$168,544**	**$158,274**	**$150,731**
Collections – Reimbursable Resources	$24,500	$26,400	$26,400
Total Budget Resources	**$193,044**	**$184,674**	**$177,131**
Obligations (Actual/Estimates/Projections)	$134,191	$156,973	$150,561
Personnel: Positions and FTE			
Enacted/Request Positions	141	133	133
Enacted/Request FTE	131	133	133
Onboard and Actual FTE; Includes Collections - Reimbursable Resources			
Onboard (Actual/Estimates/Projections)	107	133	133
FTE (Actual/Estimates/Projections)	107	133	133

Laboratory Facilities – PPA
Collections – Reimbursable Resources

Collections		FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget		
(Dollars in Thousands)		Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Department of Agriculture - Department of Agriculture	Source	-	-	$700	-	-	$3,100	-	-	$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	-	-	$50
Department of Justice - Federal Bureau of Investigation	Source	-	-	$21,500	-	-	$21,000	-	-	$21,000
Department of State - Department of State	Source	-	-	$200	-	-	$200	-	-	$200
Total Collections		**-**	**-**	**$24,500**	**-**	**-**	**$26,400**	**-**	**-**	**$26,400**

Laboratory Facilities – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2019 Enacted	**141**	**131**	**$121,952**
FY 2020 Enacted	**133**	**133**	**$122,722**
FY 2021 Base Budget	**133**	**133**	**$122,722**
Transfer for WCF Offset for OGC Staffing from S&T/O&S/LF to OSEM/M&O	-	-	($29)
Total Transfers	**-**	**-**	**($29)**
2020 Pay Raise	-	-	$369
2021 Pay Raise	-	-	$92
FERS Agency Contribution	-	-	$150
Total, Pricing Increases	**-**	**-**	**$611**
FPS Fee Adjustment	-	-	($3)
Hiring Delays	-	-	($277)
Total, Pricing Decreases	**-**	**-**	**($280)**
Total Adjustments-to-Base	**-**	**-**	**$302**
FY 2021 Current Services	**133**	**133**	**$123,024**
Awards Spending Increase	-	-	$122
Total, Program Increases	**-**	**-**	**$122**
Plum Island Animal Disease Center	-	-	($116)
Total, Program Decreases	**-**	**-**	**($116)**
FY 2021 Request	**133**	**133**	**$123,030**
FY 2020 To FY 2021 Change	**-**	**-**	**$308**

Laboratory Facilities – PPA
Personnel Compensation and Benefits

Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted				FY 2020 Enacted				FY 2021 President's Budget				FY 2020 to FY 2021 Total			
	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate	Pos.	FTE	Amount	Rate
Laboratory Facilities	141	131	$20,700	$156.87	133	133	$21,470	$159.43	133	133	$21,926	$162.86	-	-	$456	$3.43
Total	**141**	**131**	**$20,700**	**$156.87**	**133**	**133**	**$21,470**	**$159.43**	**133**	**133**	**$21,926**	**$162.86**	**-**	**-**	**$456**	**$3.43**
Discretionary - Appropriation	141	131	$20,700	$156.87	133	133	$21,470	$159.43	133	133	$21,926	$162.86	-	-	$456	$3.43

* 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 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 - FY 2021 Change
11.1 Full-time Permanent	$15,665	$15,910	$16,093	$183
11.3 Other than Full-Time Permanent	$656	$671	$696	$25
11.5 Other Personnel Compensation	$465	$472	$563	$91
11.8 Special Personal Services Payments	-	$88	$88	-
12.1 Civilian Personnel Benefits	$3,764	$4,151	$4,308	$157
13.0 Benefits for Former Personnel	$150	$178	$178	-
Total - Personnel Compensation and Benefits	**$20,700**	**$21,470**	**$21,926**	**$456**
Positions and FTE				
Positions - Civilian	141	133	133	-
FTE - Civilian	131	133	133	-

Pay Cost Drivers

Pay Cost Drivers *(Dollars in Thousands)*	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate	FTE	Amount	Rate
Laboratory Personnel	131	$20,700	$156.87	133	$21,470	$159.43	133	$21,926	$162.86	-	$456	$3.43
Total - Pay Cost Drivers	**131**	**$20,700**	**$156.87**	**133**	**$21,470**	**$159.43**	**133**	**$21,926**	**$162.86**	**-**	**$456**	**$3.43**

Explanation of Pay Cost Driver

Laboratory Personnel: S&T's pay costs provide for the salaries and benefits of laboratory personnel overseeing the operations, core capabilities, and maintenance requirements at S&T's laboratory facilities. The funding change from FY 2020 includes S&T's share of the Department's FERS contribution increase, Awards Increase and the FY 2021 one percent pay increase.

Laboratory Facilities – PPA
Non Pay Budget Exhibits
Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Laboratory Facilities	$101,252	$101,252	$101,104	($148)
Total	**$101,252**	**$101,252**	**$101,104**	**($148)**
Discretionary - Appropriation	$101,252	$101,252	$101,104	($148)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
21.0 Travel and Transportation of Persons	$516	$516	$516	-
22.0 Transportation of Things	$15	$15	$15	-
23.1 Rental Payments to GSA	$2,100	$2,100	$2,100	-
23.3 Communications, Utilities, and Misc. Charges	$84	$84	$84	-
25.1 Advisory and Assistance Services	$44,470	$44,470	$44,354	($116)
25.2 Other Services from Non-Federal Sources	$632	$632	$632	-
25.3 Other Goods and Services from Federal Sources	$44,873	$44,873	$44,844	($29)
25.4 Operation and Maintenance of Facilities	$4,016	$4,016	$4,013	($3)
25.7 Operation and Maintenance of Equipment	$322	$322	$322	-
26.0 Supplies and Materials	$2,863	$2,863	$2,863	-
31.0 Equipment	$811	$811	$811	-
32.0 Land and Structures	$550	$550	$550	-
Total - Non Pay Object Classes	**$101,252**	**$101,252**	**$101,104**	**($148)**

Non Pay Cost Drivers

Non Pay Cost Drivers *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Laboratory Contract Support	$44,470	$44,470	$44,354	($116)
Other Goods and Services from Federal Sources	$44,873	$44,873	$44,844	($29)
Laboratory Facilities Operations and Maintenance	$4,016	$4,016	$4,013	($3)
Laboratory Supplies and Materials	$2,863	$2,863	$2,863	-
Rental Payments to GSA	$2,100	$2,100	$2,100	-
Other Laboratory Costs	$2,930	$2,930	$2,930	-
Total – Non Pay Cost Drivers	**$101,252**	**$101,252**	**$101,104**	**($148)**

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.

Other Goods and Services from Federal Sources: Interagency agreements for contractual services for the purchase of goods and services for jointly funded projects. Examples include TSL's agreement with the Federal Aviation Administration (FAA) for the FAA to provide facility support services on a reimbursable basis for various activities, including utilities, building maintenance, emergency services, air shuttle services, and IT services. FPS provides security at PIADC.

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.

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

Rental Payments to GSA: This covers costs for rental payment to GSA for NUSTL.

Other Laboratory Costs: These costs include operations and maintenance of the laboratories' IT systems, payments to vendors, 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 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Acquisition and Operations Analysis	-	-	$48,510	-	-	$48,510	-	-	$53,472	-	-	$4,962
Total	**-**	**-**	**$48,510**	**-**	**-**	**$48,510**	**-**	**-**	**$53,472**	**-**	**-**	**$4,962**
Subtotal Discretionary - Appropriation	-	-	$48,510	-	-	$48,510	-	-	$53,472	-	-	$4,962

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 SAFETY Act program.

Operations and Requirements Analysis (ORA): Through the S&T-managed DHS Integrated Product Team (IPT) process and in coordination with the Department's Joint Requirement Council (JRC), S&T identifies common or similar operational R&D needs by DHS Components, and delivers operational analyses that support the pursuit of common technical solutions to increase DHS overall efficiency and effectiveness. ORA's management of the S&T IPT and First Responder Resource Group (FRRG) processes provides the mechanism to carry out these activities. The IPT and FRRG Processes occur annually, with ORA having responsibility to deliver the following: validated and coordinated list of DHS-wide R&D strategic priorities and capability gaps, and traceability of capability gaps to DHS missions and operations. ORA also is responsible for decomposing new capability gaps into actionable R&D requirements. Collectively, these outputs inform S&T leadership decision-making on near and long-term R&D planning and resource allocation. The outputs also enable S&T to successfully deliver impactful solutions to DHS Components and first responders that meets their mission needs and make their operations safer and more efficient and effective.

Federally Funded Research & Development Center (FFRDC) Program Management Office (PMO): The FFRDC PMO increases the strategic value and utilization by promoting the work performed by each FFRDC and providing solutions to the Department's most complex R&D issues. The PMO provides centralized oversight and support to the two FFRDCs, the Homeland Security Operational Analysis Center (HSOAC) and the Homeland Security Systems Engineering and Development Institute (HSSEDI). These FFRDCs work 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. The 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 to transform mission-level goals into strategies, operational requirements, and performance metrics. The HSSEDI utilizes its independent and objective perspective, extensive knowledge of the DHS mission space, and deep technical and systems engineering expertise to identify and solve critical technical problems and accelerate to operational use, the technology and systems necessary to secure the homeland.

System of Systems Operational Analytics (SoSOA): This effort supports the maturing of S&T's SoSOA and transforming it to an enterprise-level capability to increase the effectiveness and efficiency of DHS data analytics as a whole and enable the analysis of highly complex systems of interdependent components (system of systems) for Components, Headquarter Offices, and the Joint Requirements Council. The demand for a fully mature, enterprise-wide SoSOA capability is strong amongst the Homeland Security Enterprise, based on what SoSOA has been able to provide to date through various proofs-of-concept. SoSOA will provide Components an Enterprise-level capability with common analytic frameworks, tools, and training. Increasing the Departments analyses capability results in cost and time savings - freeing up operators and resources for mission-critical operations execution. Planned capabilities include:

- Assimilated visualization and analytic tools with fused data from disparate sources to improve reporting efficiency.
- Faster delivery of analyses to support decision making.
- Reduce costs for data-driven analysis by ensuring DHS Components leverage, share, reuse, and repurpose previously developed analyses.
- Enterprise analytic applications that include business analytics and visualization, statistical packages, modeling and simulation, and decision analysis tools, and a library of online SoSOA analytics training manuals for 2500 users.

Systems Engineering: 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 assists DHS Acquisition and R&D programs in implementing the DHS Systems Engineering Life Cycle, leads the DHS Systems Engineering Center of Excellence, and instructs the DHS Systems Engineering certification courses. S&T provides technical expertise to DHS Acquisition oversight offices including the Office of Program Accountability and Risk Management, Office of the Chief Information Officer, and the DHS Joint Requirements Council.

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, including utilization of our Office of National Laboratory capabilities, provides assistance and guidance to programs regarding Cyber Resilience T&E, First Responder Technology T&E, Scientific Test and Analysis Techniques, Reliability assessments, and effective mapping of government test facilities.

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. The program incentivizes the private sector to commit additional resources to significantly improve anti-terrorism preparedness and resilience. 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.

Standards: S&T performs the statutory functions of the Standards Executive for DHS and implements the Department's statutory responsibilities for the utilization of and participation in the development of consensus standards, facilitating the successful deployment of standards-enabled capabilities. This is conducted in six main functional areas executed across the Department : 1) providing advice and overseeing standardization and conformity assessment policy, 2) coordinating standards and conformity assessment activities, ensuring DHS component standards activities are harmonized and compatible with the mission, authority, and priorities of the Department, 3) training and educating DHS personnel on standards and conformity assessment, enabling them to effectively engage in the standards process, 4) integrating standards into DHS programs and activities, 5) providing technical resources, subject matter expertise and strategic vision and direction on standardization, and 6) supporting and funding critical standardization projects when existing standards are insufficient for the missions. These responsibilities are enabled through membership, participation, and leadership in, and coordination with multiple national and international standards development organizations and interagency groups. S&T provides technical standards, test methods, test kits and guidance to DHS Components and the homeland security enterprise. The DHS and homeland security enterprise equities are represented in over 1,000 new standards each year that deliver interoperable and counter-terrorism technologies and solutions to the Department, other Federal agencies, the first responder community and the private sector.

Office of the Chief Scientist: The Chief Scientist (CS) serves as a senior technology advisor and offers an analytic capability to the Under Secretary for Science and Technology (USST). 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 scans the technical horizon, and reviews and produces advanced scientifically sound analysis of emerging technologies focused on enhancing security and countering the constantly evolving threat environment.

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 the 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.

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 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.

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.

Integrated Domain Enterprise-Maritime (IDE-M): This program allows the transition of S&T developed enterprise operational information sharing technology that can be leveraged to improve Maritime Domain Awareness and enhance USCG's and CBP-AMO's ability to detect, deter, interdict and investigate illegal maritime activity. Funding allows DHS to operationalize the capability as an enterprise service for the maritime domain and establishes a foundation for expansion to support multi-domain information sharing.

Acquisitions and Operations Analysis – PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	**FY 2019**	**FY 2020**	**FY 2021**
Enacted/Request	**$48,510**	**$48,510**	**$53,472**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$15,928	$9,723	$12,787
Rescissions to Current Year/Budget Year	($63)	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$64,375**	**$58,233**	**$66,259**
Collections – Reimbursable Resources	$5,700	$5,700	$5,700
Total Budget Resources	**$70,075**	**$63,933**	**$71,959**
Obligations (Actual/Estimates/Projections)	$54,303	$51,146	$59,260
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 2019 Enacted			FY 2020 Enacted			FY 2021 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	-	-	$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 - CISA	Source	-	-	$950	-	-	$950	-	-	$950
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 2019 Enacted	**-**	**-**	**$48,510**
FY 2020 Enacted	**-**	**-**	**$48,510**
FY 2021 Base Budget	**-**	**-**	**$48,510**
FY 2021 Current Services	**-**	**-**	**$48,510**
Operations and Requirements Analysis	-	-	$4,000
SAFETY Act	-	-	$43
Technology Transition	-	-	$4,743
Total, Program Increases	**-**	**-**	**$8,786**
Test and Evaluation	-	-	($3,824)
Total, Program Decreases	**-**	**-**	**($3,824)**
FY 2021 Request	**-**	**-**	**$53,472**
FY 2020 To FY 2021 Change	**-**	**-**	**$4,962**

Acquisitions and Operations Analysis – PPA
Non Pay Budget Exhibits

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Acquisition and Operations Analysis	$48,510	$48,510	$53,472	$4,962
Total	**$48,510**	**$48,510**	**$53,472**	**$4,962**
Discretionary - Appropriation	$48,510	$48,510	$53,472	$4,962

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
21.0 Travel and Transportation of Persons	$543	$543	$543	-
25.1 Advisory and Assistance Services	$27,890	$27,890	$32,852	$4,962
25.2 Other Services from Non-Federal Sources	$414	$414	$414	-
25.3 Other Goods and Services from Federal Sources	$16,997	$16,997	$16,997	-
25.7 Operation and Maintenance of Equipment	$1,880	$1,880	$1,880	-
31.0 Equipment	$286	$286	$286	-
41.0 Grants, Subsidies, and Contributions	$500	$500	$500	-
Total - Non Pay Object Classes	**$48,510**	**$48,510**	**$53,472**	**$4,962**

Non Pay Cost Drivers

Non Pay Cost Drivers *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Contract Support Services	$27,890	$27,890	$32,852	$4,962
Other Goods and Services from Federal Sources	$16,997	$16,997	$16,997	-
Other Costs	$3,623	$3,623	$3,623	-
Total – Non Pay Cost Drivers	**$48,510**	**$48,510**	**$53,472**	**$4,962**

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 JRC. The increase from FY 2020 to FY 2021 is for the SoSOA which will enable S&T to develop the SoSOA virtual environment to allow collaborative operational analyses supporting S&T and DHS-wide program, project, investment and mission decisions. In addition, the increase is also for the IDE-M program, which allows DHS to operationalize the capability as an enterprise service for the maritime domain and establishes a foundation for expansion to support multi-domain information sharing.

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. Maintaining the funding level from FY 2020 to FY 2021 allows S&T to continue to identify major technical risks, provide recommendations to reduce those risks, support objective decision-making, and ensure that programs are technically sound through the Systems Engineering program.

Other Costs: Other Costs include operations and maintenance of the SAFETY Act Management System (SAMS), 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 Directorate

Procurement, Construction, and Improvements

Fiscal Year 2021
Congressional Justification

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Procurement, Construction, and Improvements

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Laboratory Facilities	-	-	$18,927	$18,927
Total	**-**	**-**	**$18,927**	**$18,927**
Discretionary - Appropriation	-	-	$18,927	$18,927

The Science and Technology Directorate's (S&T) Procurement, Construction, and Improvements (PC&I) appropriation supports requirements to ensure laboratory infrastructures remain aligned to S&T mission requirements. PC&I funding allows S&T to make essential investments in expansion, maintenance, modernization, or removal as necessitated to support requirements generated by Department of Homeland Security (DHS) Components. In addition, PC&I funding allows S&T the ability to invest in equipment and information technology to ensure that S&T laboratories maintain accreditation. Activities funded by this appropriation are categorized in one of the following areas:

- Procurement – the obtaining of one or more end items through purchase, transfer, exchange, or other means. The configuration of an end item required to meet the asset's intended use is part of procurement.
- Construction – the erection, installation, or assembly of materials (i.e., new facilities, improvements, vessels, and aircrafts); the addition, expansion, extension, alteration, conversion, or replacement of an existing facility; or the relocation of a facility from one installation to another.
- Improvement – the process of obtaining an increase in capability and/or capacity.

S&T performs cutting edge research, development, test, and evaluation (RDT&E) at its laboratories to maintain scientific capabilities in direct support of identified DHS and Homeland Security Enterprise (HSE) capability gaps.

Laboratory Facilities PPA: The Office of National Laboratories (ONL) oversees a coordinated network of five DHS laboratories that are vital to the national homeland security mission. This extensive network enables America's brightest scientists and engineers to apply their expertise and develop solutions that address our most dangerous threats and homeland security vulnerabilities. This PPA also supports the infrastructure upgrades, equipment purchase, and construction.

ONL oversees the planning, budgeting, management, and execution of S&T's laboratory infrastructure and construction activities. All real property activities sustain critical scientific and technical capabilities necessary to conduct RDT&E for S&T, DHS, and the HSE. These investments include:

1) The construction of new laboratories facilities to provide capabilities that do not currently exist,
2) Major renovations to extend the life or modify the capabilities of laboratory facilities, and

Closure activities to mitigate liabilities associated with infrastructure that no longer supports the mission.

Procurement, Construction, and Improvements
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	FY 2019	FY 2020	FY 2021
Enacted/Request	**-**	**-**	**$18,927**
Carryover and/or Recoveries (Actual/Estimates/Projections)	-	-	-
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**-**	**-**	**$18,927**
Collections – Reimbursable Resources	-	-	-
Total Budget Resources	**-**	**-**	**$18,927**
Obligations (Actual/Estimates/Projections)	-	-	$12,700
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)	-	-	-

Procurement, Construction, and Improvements
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2019 Enacted	**-**	**-**	**-**
FY 2020 Enacted	**-**	**-**	**-**
FY 2021 Base Budget	**-**	**-**	**-**
Plum Island Closure and Sale	-	-	$18,927
Total Investment Elements	**-**	**-**	**$18,927**
FY 2021 Request	**-**	**-**	**$18,927**
FY 2020 To FY 2021 Change	**-**	**-**	**$18,927**

Procurement, Construction, and Improvements
Non Pay Budget Exhibits

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
21.0 Travel and Transportation of Persons	-	-	$27	$27
23.2 Rental Payments to Others	-	-	$200	$200
23.3 Communications, Utilities, and Misc. Charges	-	-	$100	$100
25.1 Advisory and Assistance Services	-	-	$4,600	$4,600
25.5 Research and Development Contracts	-	-	$2,000	$2,000
26.0 Supplies and Materials	-	-	$5,500	$5,500
31.0 Equipment	-	-	$5,500	$5,500
32.0 Land and Structures	-	-	$1,000	$1,000
Total - Non Pay Object Classes	**-**	**-**	**$18,927**	**$18,927**

Procurement, Construction, and Improvements
Capital Investments Exhibits

Capital Investments

Investment *(Dollars in Thousands)*	Unique Item Identifier	Acquisition Level	Procurement/ Construction	IT/Non-IT	MAOL	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Plum Island Closure and Sale	-	3	Procurement	Non-IT	No	-	-	$18,927

Laboratory Facilities – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Plum Island Closure and Sale	-	-	$18,927	$18,927
Total	**-**	**-**	**$18,927**	**$18,927**
Discretionary - Appropriation	-	-	$18,927	$18,927

PPA Level I Description

The Laboratory Facilities PPA provides funding for S&T's laboratory infrastructure and construction activities, including major acquisitions. All real property activities support critical scientific and technical capabilities necessary to conduct RDT&E for DHS and the HSE.

This PPA is comprised of the following investment:

Plum Island Closure and Sale: The FY 2021 President's Budget supports the Plum Island Closure and Sale (PICS) program and activities required to close the Plum Island Animal Disease Center (PIADC) facility and prepare the island for sale. PICS activities include the following:

- biological decontamination of the laboratory facilities;
- completion of environmental regulatory compliance activities (e.g., remediation of remaining waste management areas);
- facility maintenance and closure activities;
- disposition of all records, personal property, real property, and information technology (IT) assets; and
- preservation of historic assets.

S&T is managing the PICS program as a Level III non-acquisition program. The PICS total cost is $150.0M, to be executed in coordination with PIADC operations, to achieve closure of the island by the end of FY 2026. Once the PICS program is completed, Plum Island will be closed and the island available for release from DHS to another entity.

Laboratory Facilities – PPA
Budget Authority and Obligations

Budget Authority *(Dollars in Thousands)*	FY 2019	FY 2020	FY 2021
Enacted/Request	**-**	**-**	**$18,927**
Carryover and/or Recoveries (Actual/Estimates/Projections)	-	-	-
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**-**	**-**	**$18,927**
Collections – Reimbursable Resources	-	-	-
Total Budget Resources	**-**	**-**	**$18,927**
Obligations (Actual/Estimates/Projections)	-	-	$12,700
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)	-	-	-

Laboratory Facilities – PPA
Summary of Budget Changes

Budget Formulation Activity *(Dollars in Thousands)*	Positions	FTE	Amount
FY 2019 Enacted	**-**	**-**	**-**
FY 2020 Enacted	**-**	**-**	**-**
FY 2021 Base Budget	**-**	**-**	**-**
Plum Island Closure and Sale	-	-	$18,927
Total Investment Elements	**-**	**-**	**$18,927**
FY 2021 Request	**-**	**-**	**$18,927**
FY 2020 To FY 2021 Change	**-**	**-**	**$18,927**

Laboratory Facilities – PPA
Non Pay Budget Exhibits
Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
21.0 Travel and Transportation of Persons	-	-	$27	$27
23.2 Rental Payments to Others	-	-	$200	$200
23.3 Communications, Utilities, and Misc. Charges	-	-	$100	$100
25.1 Advisory and Assistance Services	-	-	$4,600	$4,600
25.5 Research and Development Contracts	-	-	$2,000	$2,000
26.0 Supplies and Materials	-	-	$5,500	$5,500
31.0 Equipment	-	-	$5,500	$5,500
32.0 Land and Structures	-	-	$1,000	$1,000
Total - Non Pay Object Classes	**-**	**-**	**$18,927**	**$18,927**

Laboratory Facilities – PPA
Capital Investments Exhibits

Capital Investments

Investment *(Dollars in Thousands)*	Unique Item Identifier	Acquisition Level	Procurement/ Construction	IT/Non-IT	MAOL	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Plum Island Closure and Sale	-	3	Procurement	Non-IT	No	-	-	$18,927

Plum Island Closure and Sale – Investment
Itemized Procurements
End Items Purchases

Plum Island Closure and Sale
Procurement, Construction, and Improvements Funding

Investment *(Dollars in Thousands)*	Unique Item Identifier	Acquisition Level	Procurement/ Construction	IT/Non-IT	MAOL	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Plum Island Closure and Sale	-	3	Procurement	Non-IT	No	-	-	$18,927

Investment Description
The PICS program involves closure of the PIADC and public sale of all related property and assets, after its mission is fully transferred to the NBAF located in Manhattan, Kansas.

The scope of actions required to close the PIADC facility and prepare the island for sale include the following activities:
- biological decontamination of the laboratory facilities;
- completion of environmental regulatory compliance activities (e.g., remediation of remaining waste management areas);
- facility maintenance and closure activities;
- disposition of all records, personal property, real property, and information technology (IT) assets; and
- preservation of historic assets.

S&T is managing the PICS program as a Level III non-acquisition program (ADE-2A milestone achieved April 2019, enabling the transition from planning to execution). The program total cost is $150.0M, and is executed in coordination with PIADC operations, to achieve closure of the island by the end of FY 2026. Once the PICS program is completed, Plum Island will be considered closed.

In January 2009, DHS issued a Record of Decision (ROD) documenting its decision to construct the replacement for the aging PIADC – the NBAF in Manhattan, Kansas. DHS has the responsibility to close and convey Plum Island through the FY 2012 DHS Appropriations Act (P.L. 112-74). As the mission owner, S&T has the responsibility to manage the closure of Plum Island to prepare all its real and personal property assets for sale by the General Services Administration (GSA) on behalf of DHS.

The rate of completion of the various phases of the PICS program, as well as their congruity with the completion of the NBAF facility, is critical to the success and maintaining the cost estimate for this program. This funding will allow S&T the ability to execute key activities critical to maintaining the Program schedule for completion of PICS. In addition, the PICS will prepare the island for sale by FY 2026, substantially reducing future outlays of DHS funding to secure and maintain the PIADC facility after its science mission is complete. At present S&T funding related to

Plum Island operations is upwards of $50 million annually. Once the PICS program is completed this is estimated to fall to $10 million to sustain basic operations until sold.

The FY 2021 funding provides support for setup of an on-island Program Management Office to oversee the PICS program, execution of terminal decontamination and decommissioning of Building 102 (obsolete wastewater decontamination facility), continued planning/development of the approach for terminal decontamination and decommissioning of Building 101 (the large laboratory facility), reduction of the contaminated areas within Building 101, and remediation of remaining island Waste Management Areas as required by the New York State Department of Environmental Conservation.

The execution of the PICS program is reliant on the continued funding for operation and Federal staffing of PIADC beyond the transition of science programs to NBAF until the completion of the PICS program. The PICS program execution requires PIADC operations and staff to provide island logistics, utilities, security, and regulatory compliance in accordance with environmental and Select Agent requirements. A PICS Program Management Office (PMO) has been established to coordinate PICS planning activities with PIADC operations, regulators, DHS Management, and GSA.

End Items Breakdown *(Dollars in Thousands)*	**FY 2019 Enacted**		**FY 2020 Enacted**		**FY 2021 President's Budget**	
	Quantity	**Amount**	**Quantity**	**Amount**	**Quantity**	**Amount**
Program Management					N/A	$5,325
Regulatory Compliance					N/A	$434
Facilities					N/A	$13,127
Mission Closeout					N/A	$41

Department of Homeland Security

Science and Technology

Research and Development

Fiscal Year 2021
Congressional Justification

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Research and Development

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization (Dollars in Thousands)	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Research, Development, and Innovation	-	-	$470,765	-	-	$381,911	-	-	$318,267	-	-	($63,644)
University Programs	-	-	$40,500	-	-	$40,500	-	-	$21,746	-	-	($18,754)
Total	**-**	**-**	**$511,265**	**-**	**-**	**$422,411**	**-**	**-**	**$340,013**	**-**	**-**	**($82,398)**
Subtotal Discretionary - Appropriation	-	-	$511,265	-	-	$422,411	-	-	$340,013	-	-	($82,398)

The scope and diversity of the Department of Homeland Security's (DHS) missions require the Science and Technology Directorate (S&T) to address a wide range of programs supporting DHS Components' near-term needs for new operational capabilities, improved operational effectiveness, efficiency, and safety for the Homeland Security Enterprise (HSE). S&T has Research, Development, Test and Evaluation (RDT&E) responsibilities related to understanding and creating solutions for threats related to explosives, border security, cyber security, biological, chemical, and asymmetrical Dthreats. S&T's analytics and knowledge products also are equally important to supporting analysis of alternatives for 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. S&T's RDT&E efforts are prioritized to the homeland's highest threats. 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.

The S&T Research and Development (R&D) appropriation provides resources necessary to identify, explore, and demonstrate new technologies and capabilities that enable the DHS and its partners to prevent, protect against, respond to, and mitigate nuclear, chemical, radiological, and biological threats and incidents. R&D funds support Technology Readiness Levels (TRLs) 1-7:

Basic Research		Applied Research		Technology Development		Technology Demonstration	System Development
TRL-1	TRL-2	TRL-3	TRL-4	TRL-5		TRL-6	TRL-7
Basic Principles Observed/ Reported	Technology Concept/Application Formulated	Critical Function or Characteristic Proof of Concept	Validation in Lab Environment	Validation in Relevant Environment		System Prototypes in Relevant Environment	System Prototypes in Operational Environment

S&T has two programs, projects, and activities (PPAs) in its 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 RDT&E programs that balance risk, cost, impact, and time to delivery. S&T's research and development activities also include technology demonstrations, university and industry partnerships, technology transfer and commercialization.

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 2019	FY 2020	FY 2021
Enacted/Request	**$511,265**	**$422,411**	**$340,013**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$215,088	$224,007	$135,085
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$726,353**	**$646,418**	**$475,098**
Collections – Reimbursable Resources	$41,800	$58,300	$45,000
Total Budget Resources	**$768,153**	**$704,718**	**$520,098**
Obligations (Actual/Estimates/Projections)	$461,334	$569,633	$387,949
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 2019 Enacted	**-**	**-**	**$511,265**
FY 2020 Enacted	**-**	**-**	**$422,411**
FY 2021 Base Budget	**-**	**-**	**-**
Border Security Thrust	-	-	$89,533
Centers of Excellence	-	-	$18,350
Chemical, Biological and Explosive Defense Thrust	-	-	$45,284
Counterterrorist Thrust	-	-	$31,251
Cyber Security / Information Analysis Thrust	-	-	$24,091
First Responder / Disaster Resilience Thrust	-	-	$53,416
Innovative Research and Foundational Tools	-	-	$74,692
Minority Serving Institutions	-	-	$3,396
Total Research and Development Projects	**-**	**-**	**$340,013**
FY 2021 Request	**-**	**-**	**$340,013**
FY 2020 To FY 2021 Change	**-**	**-**	**($82,398)**

Research and Development
Non Pay Budget Exhibits

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Research, Development, and Innovation	$470,765	$381,911	$318,267	($63,644)
University Programs	$40,500	$40,500	$21,746	($18,754)
Total	**$511,265**	**$422,411**	**$340,013**	**($82,398)**
Discretionary - Appropriation	$511,265	$422,411	$340,013	($82,398)

Non-Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
25.1 Advisory and Assistance Services	$136,184	$110,103	$90,109	($19,994)
25.3 Other Goods and Services from Federal Sources	$140,681	$98,575	$85,178	($13,397)
25.5 Research and Development Contracts	$189,898	$170,307	$139,377	($30,930)
31.0 Equipment	$2,612	$2,389	$2,108	($281)
41.0 Grants, Subsidies, and Contributions	$41,890	$41,037	$23,241	($17,796)
Total - Non Pay Object Classes	**$511,265**	**$422,411**	**$340,013**	**($82,398)**

Research and Development Projects
Summary of Projects

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Border Security Thrust Area	$118,637	$114,113	$89,533
Chemical, Biological, and Explosive Defense Thrust Area	$73,701	$67,032	$45,284
Counter Terrorist Thrust Area	$48,020	$44,515	$31,251
Cyber Security / Information Analysis Thrust Area	$71,301	$29,500	$24,091
First Responder / Disaster Resilience Thrust Area	$92,927	$71,515	$53,416
Innovative Research and Foundational Tools Thrust Area	$66,179	$55,236	$74,692
Centers of Excellence	$37,104	$37,104	$18,350
Minority Serving Institutions (MSI)	$3,396	$3,396	$3,396

Research, Development, and Innovation – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization (Dollars in Thousands)	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Border Security Thrust Area	-	-	$118,637	-	-	$114,113	-	-	$89,533	-	-	($24,580)
Chemical, Biological, and Explosive Defense Thrust Area	-	-	$73,701	-	-	$67,032	-	-	$45,284	-	-	($21,748)
Counter Terrorist Thrust Area	-	-	$48,020	-	-	$44,515	-	-	$31,251	-	-	($13,264)
Cyber Security / Information Analysis Thrust Area	-	-	$71,301	-	-	$29,500	-	-	$24,091	-	-	($5,409)
First Responder / Disaster Resilience Thrust Area	-	-	$92,927	-	-	$71,515	-	-	$53,416	-	-	($18,099)
Innovative Research and Foundational Tools Thrust Area	-	-	$66,179	-	-	$55,236	-	-	$74,692	-	-	$19,456
Total	**-**	**-**	**$470,765**	**-**	**-**	**$381,911**	**-**	**-**	**$318,267**	**-**	**-**	**($63,644)**
Subtotal Discretionary - Appropriation	-	-	$470,765	-	-	$381,911	-	-	$318,267	-	-	($63,644)

PPA Level I Description

The RD&I PPA provides state of the-art technology and/or solutions to meet the needs of DHS's operational Components and the First Responder community. This PPA supports customer-focused and output-oriented RDT&E programs that balance risk, cost, impact, and time to delivery as well as technology demonstrations and transfer to DHS Components. It includes the following Thrust Areas:

Border Security: 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: Funds R&D in technologies and solutions in order to support the development of prevention and protective strategies and coordinated surveillance and detection to address CBE threats.

Counter Terrorist: Invests in technologies, methods, and procedures to counter terrorism.

Cyber Security / Information Analysis R&D: Conducts and supports RDT&E and the transition for advanced cybersecurity and information assurance technologies in order to secure the Nation's current and future cyber and critical infrastructures.

First Responder / Disaster Resilience: Invests in technologies and solutions, which reduce vulnerability to key leadership, critical infrastructure, and events from terrorist attacks and other hazards. It also increases the level of preparedness of State, local, regional, tribal, and territorial partners, as well as non-governmental organizations, private sector, and public, while improving the capabilities of DHS to lead in emergency management.

Innovative Research and Foundational Tools: Identifies gaps through analysis and requirements prioritization and focuses on identifying and analyzing potential solutions while 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 2019	FY 2020	FY 2021
Enacted/Request	**$470,765**	**$381,911**	**$318,267**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$200,063	$197,025	$112,313
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$670,828**	**$578,936**	**$430,580**
Collections – Reimbursable Resources	$41,300	$57,800	$44,500
Total Budget Resources	**$712,128**	**$636,736**	**$475,080**
Obligations (Actual/Estimates/Projections)	$432,801	$524,423	$356,310
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 2019 Enacted	**-**	**-**	**$470,765**
FY 2020 Enacted	**-**	**-**	**$381,911**
FY 2021 Base Budget	**-**	**-**	**-**
Border Security Thrust	-	-	$89,533
Chemical, Biological and Explosive Defense Thrust	-	-	$45,284
Counterterrorist Thrust	-	-	$31,251
Cyber Security / Information Analysis Thrust	-	-	$24,091
First Responder / Disaster Resilience Thrust	-	-	$53,416
Innovative Research and Foundational Tools	-	-	$74,692
Total Research and Development Projects	**-**	**-**	**$318,267**
FY 2021 Request	**-**	**-**	**$318,267**
FY 2020 To FY 2021 Change	**-**	**-**	**($63,644)**

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

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Border Security Thrust Area	$118,637	$114,113	$89,533	($24,580)
Chemical, Biological, and Explosive Defense Thrust Area	$73,701	$67,032	$45,284	($21,748)
Counter Terrorist Thrust Area	$48,020	$44,515	$31,251	($13,264)
Cyber Security / Information Analysis Thrust Area	$71,301	$29,500	$24,091	($5,409)
First Responder / Disaster Resilience Thrust Area	$92,927	$71,515	$53,416	($18,099)
Innovative Research and Foundational Tools Thrust Area	$66,179	$55,236	$74,692	$19,456
Total	**$470,765**	**$381,911**	**$318,267**	**($63,644)**
Discretionary - Appropriation	$470,765	$381,911	$318,267	($63,644)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
25.1 Advisory and Assistance Services	$136,184	$110,103	$90,109	($19,994)
25.3 Other Goods and Services from Federal Sources	$138,410	$96,304	$84,055	($12,249)
25.5 Research and Development Contracts	$188,918	$169,327	$138,892	($30,435)
31.0 Equipment	$2,586	$2,363	$2,095	($268)
41.0 Grants, Subsidies, and Contributions	$4,667	$3,814	$3,116	($698)
Total - Non Pay Object Classes	**$470,765**	**$381,911**	**$318,267**	**($63,644)**

Research and Development Projects
Summary of Projects

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Border Security Thrust Area	$118,637	$114,113	$89,533
Chemical, Biological, and Explosive Defense Thrust Area	$73,701	$67,032	$45,284
Counter Terrorist Thrust Area	$48,020	$44,515	$31,251
Cyber Security / Information Analysis Thrust Area	$71,301	$29,500	$24,091
First Responder / Disaster Resilience Thrust Area	$92,927	$71,515	$53,416
Innovative Research and Foundational Tools Thrust Area	$66,179	$55,236	$74,692

Border Security Thrust Area
Research and Development
Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Border Security Thrust Area	$118,637	$114,113	$89,533

BORDER SECURITY THRUST AREA: 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. The table that follows identifies initiatives and funding levels for FY 2021.

BORDER SECURITY THRUST AREA *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
Border Security Thrust Area Total		**$118,637**	**$114,113**	**$89,533**
Air Security		**$30,879**	**$28,850**	**$42,790**
	Air-Based Technologies	$12,879	$6,850	$6,850
	Counter UAS	$13,000	$13,000	$35,940
	Enabling UAS	$5,000	$9,000	-
Immigration Services		**-**	**$3,000**	**$3,000**
	Immigration-Based Technologies	-	$3,000	$3,000
Land Border Security		**$23,503**	**$15,008**	**$9,020**
	Border Situational Awareness (BSA)	$3,074	$1,079	$1,100
	Ground Based Technologies	$15,729	$11,429	$5,570
	Tunnel Detection and Surveillance	$4,700	$2,500	$2,350
Maritime Border Security		**$24,050**	**$24,050**	**$17,480**
	Port and Coastal Surveillance	$16,750	$16,750	$7,180
	Port and Waterway Resiliency	$1,000	$1,000	$1,000
	Remote Maritime Technologies	$6,300	$6,300	$9,300
POE Security and Trade		**$40,205**	**$43,205**	**$17,243**
	Air Cargo Screening	$9,000	$7,000	-

BORDER SECURITY THRUST AREA *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
	Opioid/Fentanyl Detection	$8,500	$8,500	$8,500
	People Screening	$5,850	$5,850	$3,543
	POE Forensics and Investigations	$8,399	$8,399	$2,000
	POE Scanning Technologies	$8,456	$13,456	$3,200

Air Security Program

This program develops and transitions technical capabilities that strengthen the security of our national airspace by advancing manned and unmanned aircraft technology and sensors to improve mission capability within the HSE.

Air-Based Technologies

- **Problem:** The convergence of Component baseline mission requirements, emerging asymmetric threats, evolving technologies, and critically strained resources makes it imperative for S&T to advance technologies that produce force-multiplying capabilities for operational elements of DHS and the Nation's first responders. This results in the HSE having to meet the following three enduring challenges:
  (1) Produce air-based Intelligence, Surveillance and Reconnaissance (ISR) technology solutions that enable mission space dominance.
  (2) Provide a focal point where the whole of the HSE can operationally evaluate emerging small Unmanned Aircraft System (sUAS) platforms and sensors.
  (3) Enable enhancements that improve command, control, communications, and computers of air-based platforms and sensors.

- **Solution:** The Air-Based Technology (ABT) program will: advance the development and transition of intelligence, surveillance and reconnaissance (ISR) sensor technology for applicable HSE operational scenarios. It will also address the challenge of managing the overwhelming and ever-changing landscape of sUAS technology and capabilities by enabling the dissemination of time critical and operationally relevant information from air based platforms; improving current operational assets in order to enable a measurable increase in operational flight hours or area of operation; and developing technology that advances a reduction in life cycle costs of manned or unmanned aircraft.

- **Justification:** The FY 2021 President's Budget provides $6.9M for this project, the same level as FY 2020 Enacted budget. This level of funding will be used to support the identification, testing and evaluation, and refinement of existing sUAS platforms and airborne sensors for deployment by DHS Components and nationwide first responders for enhanced detection, classification, and tracking of illicit activities, augmented emergency response capabilities, and improved resiliency and systems interoperability.

- **Impact:** ICE, CBP, USCG, and first responders at the local, county, and State levels will be able to cost-effectively invest in airborne sensors, sUAS platforms, and ground control equipment that meet mission needs. Based on the results of S&T's work, these stakeholders will be able to invest in systems that integrate into their ongoing operations and that are also acceptable to public opinion, privacy concerns, and safety issues.

Type of Research
Developmental/Applied

Technical Readiness Level
The targeted initial TRL for projects ranges from TRL-4 to TRL-7.

Transition Plans
- Provide resources to enable the development of ISR capability for use by CBP and USCG.
- Develop capability on second generation (GEN II) Vehicle and Dismount Exploitation Rader (VADER) technology for CBP Air and Marine Operations (AMO).
- Develop a hyperspectral capability for CBP AMO and USCG.
- Provide test and evaluation results and enable operational assessments for ICE and CBP U.S. Border Patrol (USBP) to determine best value of emerging sUAS capability.
- Publish project JUSTICE's demonstration, test and evaluation results, and associated analyses to DHS Components, first responder and emergency management service organizations.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Transitioned Mission Management System	FY 2018 Q4	FY 2019 Q3	7
Develop communication system that fits on a sUAS	FY 2018 Q2	FY 2019 Q4	5
Conducted First Responder Robotics System Test (FRROST)	FY 2019 Q1	FY 2019 Q4	6-7
Conducted Disaster Response/Public Safety UAS Exercises	FY 2019 Q1	FY 2019 Q4	6-7
FY 2020			
Initiate Project JUSTICE and establish a fully operational sUAS test facility	FY 2020 Q1	FY 2020 Q4	8
Perform 6 operational assessments of identified sUAS technology to improve HSE	FY 2020 Q2	FY 2020 Q4	6-8
Kickoff and Initiate ISR Projects: Vehicle and Dismount Exploitation Radar (VADER) GEN II and FLYSPEC.	FY 2020 Q1	FY 2020 Q4	6
FY 2021			
Evaluate LSTAR capability to enable Beyond Visual Line of Sight (BVLOS).	FY 2021 Q1	FY 2021 Q3	8

Research and Development Description	Plan Start Date	Planned Completion	TRL
Conduct Operational Tests for GEN II VADER technology.	FY 2021 Q2	FY 2021 Q2	6
Support testing and evaluation of sUAS platforms (fixed-wing, Vertical take-off and landing (VTOL) and hybrid) to enhance	FY 2021 Q1	FY 2021 Q3	6
Initiate transition of sUAS enabling technology to DHS Components and HSE customers for deployment.	FY 2021 Q2	FY 2021 Q4	6

Counter Unmanned Aircraft Systems (cUAS) / 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 operational Components have limited capabilities to detect, track, and classify UAS. With recent FAA reauthorization, four DHS authorized Components are working to develop the capability to mitigate the threat of nefarious UAS use. Each 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, S&T must ensure the development of capabilities that predict and characterize future UAS threats and guide/incubate advanced countermeasures.

  This project was formerly aligned under the Counter Terrorist Thrust area, but it has been realigned to the Border Security Thrust Area.

- **Solution:** The program will accomplish the following objectives:
  (1) Identify DHS Component operational requirements based on their specific mission sets;
  (2) Identify potential Commercial Off-the-Shelf (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 using 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.

- **Justification:** The FY 2021 President's Budget provides $35.9M for cUAS, an increase of $22.9M from the FY 2020 enacted budget. This level of funding will be used to identify and document DHS Components cUAS mission needs, evaluate cUAS technologies that address those needs, and integrate, test and deploy initial cUAS capabilities to Department prioritized critical assets, facilities and special events. Based on DHS Component requirements, approximately twenty cUAS kits will be integrated, tested and piloted.

- **Impact:** Upon successful completion of the project, S&T will have supported the development of well-defined and validated DHS Component cUAS requirements. Component acquisition strategies will be supported and based on S&T's knowledge of the state of the market, which is

obtained by periodical testing and evaluation of commercial-off-the-shelf (COTS) and government-off-the-shelf (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 will be developed and delivered to meet Component-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.

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 Urban cUAS Operational Prototype (UCOP) will be an enduring test and evaluation (T&E) capability for S&T in partnership with DHS Components. UCOP-validated technologies will transition as interim or permanent operational capabilities. The cUAS T&E effort will use a standardized and scalable test methodology, leveraging the work developed by Sandia National Laboratory's Physical Security Center of Excellence during the National Nuclear Security Administration Enterprise cUAS program. The transition deliverable will be thorough and will provide objective technical analysis in the form of an actionable final report.
- S&T will transition cUAS systems to DHS Components in order to protect identified high priority facilities.
- S&T will continue to evaluate and assess various COTS/GOTS cUAS capabilities in the Northern border environment.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Reviewed Future UAS Threat Capabilities Analysis at a Future Threat Workshop.	FY 2018 Q3	FY 2019 Q1	N/A
Delivered Unmanned Traffic Management Service Supplier security interface source code.	FY 2018 Q4	FY 2019 Q4	N/A
Executed UAS Traffic Management UCOP demonstration.	FY 2018 Q4	FY 2019 Q4	5
Initiated transition of Counter Small Unmanned Aerial Systems Advisory and Review (C-SMART) to Components.	FY 2018 Q4	FY 2019 Q4	5
Executed CUAS Simulation Exercise (SIMEX).	FY 2019 Q1	FY 2019 Q3	5
Drafted CUAS Capability Assessment Report (CAR) and submitted to Components for review.	FY 2019 Q1	FY 2019 Q3	N/A
Completed UCOP operational demonstration #3.	FY 2019 Q1	FY 2019 Q3	6
FY 2020			
Initiate implementation of CUAS systems to identified component "covered" facilities.	FY 2020 Q1	FY 2020 Q3	6
Initiate test and evaluation of CUAS systems on the Northern border.	FY 2020 Q1	FY 2020 Q3	6

Research and Development Description	Plan Start Date	Planned Completion	TRL
Reach Operational Capability for Urban Prototype Spiral 2.	FY 2020 Q1	FY 2020 Q4	7
Implement cUAS systems to covered facilities and the northern border.	FY 2018 Q4	FY 2020 Q3	7
University Drone Mitigation Challenge #1.	FY 2018 Q4	FY 2020 Q4	5-6
Transition cUAS Systems to protect component identified high priority facilities.	FY 2020 Q1	FY 2020 Q4	7
Evaluate and assess various COTS/GOTS CUAS capabilities in the northern border environment.	FY 2020 Q1	FY 2020 Q4	7
FY 2021			
Complete transition of UCOP Spiral 1 to TSA.	FY 2021 Q1	FY 2021 Q4	7
Complete transition of prototype CUAS capability to FPS.	FY 2021 Q1	FY 2021 Q4	7
University Drone Mitigation Challenge #2.	FY 2021 Q1	FY 2021 Q4	7

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 becomes increasingly integrated into the National Air Space, overcoming uncertainties in the limitations and legal requirements for their use, first responders will need information on what vehicles and sensor packages can 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) T&E 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
  (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.

- **Justification:** The FY 2021 President's Budget does not provide funding for this project, which is a decrease of $9.0M from FY 2020 Enacted.

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

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. S&T will directly involve first responder organizations in exercises to increase their knowledge and experience with UAS.

Project Schedule

Research & Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conduct First Responder Robotic Operations System Test (FRROST).	FY 2019 Q1	FY 2019 Q4	3
Conduct Disaster Response/Public Safety UAS Exercises.	FY 2019 Q1	FY 2019 Q4	3
FY 2020			
Perform operational assessment of identified sUAS Sensors.	FY 2020 Q1	FY 2020 Q4	3
Identification of training modules.	FY 2020 Q3	FY 2021 Q4	3
FY 2021			
N/A	N/A	N/A	N/A

Immigration Services Program

This program develops technologies for USCIS to meet their goals to (1) provide 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 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.

- **Justification:** The FY 2021 President's Budget provides $3.0M for this project, the same level as FY 2020 Enacted budget. This level of funding will be used to automate current immigration interview and documentation processes, which will enhance the efficiency and integrity of USCIS's execution of their statutory responsibilities.

- **Impact:** Automation of the current immigration interview and documentation processes will: (1) enhance USCIS's ability to process immigration benefit applications/petitions, (2) enhance their ability to identify fraudulent immigration applications/petitions, (3) reduce applicant backlogs, (4) improve USCIS staffing efficiency, and (5) improve customer throughput and satisfaction.

Type of Research

Developmental

Technical Readiness Level

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

Transition Plans

S&T plans to transition to USCIS the analyses, models, technology prototypes, and knowledge products in order to:

- Enhance the integrity of the immigration system;
- Support efficient adjudication of all applications and petitions for immigration benefits;
- Provide the ability to maintain the accuracy and integrity of immigration information; and,
- Ensure timely assistance to applicants, petitioners and beneficiaries.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
Conduct market research to identify areas of R&D investment to enhance the efficiency and integrity of USCIS's execution	FY 2020 Q1	FY 2020 Q3	N/A

Research and Development Description	Plan Start Date	Planned Completion	TRL
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.	FY 2020 Q2	FY 2020 Q4	N/A
FY 2021			
Based on results of market research, select area for R&D investment and intiate R&D project.	FY 2021 Q1	FY 2021 Q4	N/A
Develop Concept of Operations (CONOPS) and perform analysis to determine areas for potential automation of USCIS information systems.	FY 2021 Q1	FY 2021 Q4	N/A

Land Border Security Program

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 three 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.

- **Justification:** The FY 2021 President's Budget provides $1.1M for this project, an increase of $0.02M from the FY 2020 Enacted budget. This level of funding will be used in coordination with the Ground Based Technologies funding to develop, test, and evaluate technologies designed to enhance the detection, identification, classification, and tracking of illicit activity in remote areas of the U.S. land border and enhance communication and information sharing for HSE partners.

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

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

The 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. Simultaneously, S&T will also work with existing tactical technology programs to provide requirements, which will 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.

S&T will transition the capabilities to Components for operational use. Component sustainment 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 USBP (final operational capability).
- Border Security Operations Modeling, San Diego Detention Center to USBP (final operational capability).
- Team Awareness Kit (TAK) to ICE (initial operational capability).
- TAK to USBP (initial operational capability).
- TAK to CBP AMO (initial operational capability).
- TAK to U.S. Secret Service (USSS) (initial operational capability).
- TAK to USCG (initial operational capability).
- TAK to Federal Emergency Management Agency (FEMA) (initial operational capability).
- Border Data Explorer (BDE) to CBP (final operational capability).
- Targeting Analysis of Guides (TAG) to USBP (final operational capability).
- Course of Action (COA) Modeling and Simulation to USBP (initial operational capability).

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Initiated transition of selected Spiral 2 technologies into existing CBP system baseline, focused on improving tactical response.	FY 2019 Q1	FY 2019 Q3	7
Performed integration and developmental testing of selected Spiral 3 solutions; focused on improving strategic planning for	FY 2019 Q1	FY 2019 Q4	5-7

Research and Development Description	Plan Start Date	Planned Completion	TRL
CBP.			
FY 2020			
Conduct pilot of Spiral 3 of the BSA project focused on improving strategic planning for CBP.	FY 2020 Q1	FY 2020 Q2	5-7
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	6
FY 2021			
Complete transition of selected Spiral 3 solutions of the BSA project focused on improving strategic planning into existing CBP system baseline.	FY 2021 Q1	FY 2021 Q3	7
Closeout the Border Situational Awareness project and provide a final report on its performance.	FY 2021 Q2	FY 2021 Q4	7

Ground-Based Technologies

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

- **Justification:** The FY 2021 President's Budget provides $5.6M for this project, a decrease of $5.9M from the FY 2020 Enacted budget. This level of funding will be used to develop, test, and evaluate technologies designed to enhance the detection, identification, classification, and tracking of illicit activity in remote areas of the U.S. land border and enhance communication and information sharing for HSE partners.

- **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.

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 Land Automated Scene Understanding (LASU).
- Transition to DHS Components a handheld geospatial tool to provide access to situational awareness data and collaborate in real-time.
- Transition to DHS Components enhanced personal protection equipment and improved tools to more effectively execute their duties.
- Transition BACIS enterprise capabilities such as Tactical Chat, Friendly Forces, and sensor systems to operational Components.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Deployed, tested and assessed efficacy of prototype technologies for use in conjunction with the Border Wall.	FY 2019 Q1	FY 2019 Q4	6-7
Developed prototype and assessed ability to exchange tactical metadata to improve situational awareness.	FY 2019 Q1	FY 2019 Q4	5-6
Conducted verification testing for deployment of Android Team Awareness Kit (ATAK) as a federated enterprise service in accredited environment (Agent Situational Awareness Handheld).	FY 2019 Q1	FY 2019 Q3	7
Conducted market study of automated scene understanding technologies (LASU).	FY 2018 Q3	FY 2019 Q1	N/A
Evaluated Secure Audio/Video Rebroadcasting (SAVR) system in ICE HSI operational environment.	FY 2019 Q1	FY 2019 Q2	7
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	7
Transition ATAK as a federated enterprise service capability (Agent Situational Awareness Handheld).	FY 2020 Q1	FY 2020 Q3	7
Conduct "plugfest" of commercial "scene understanding" solutions on standards compliant CBP sensor data (LASU).	FY 2020 Q3	FY 2020 Q4	6
Perform a BACIS technology demonstration across one domain with two or more systems.	FY 2020 Q1	FY 2020 Q4	5-6
Develop test/demo plan for woodland and waterways ground sensors.	FY 2020 Q1	FY 2020 Q4	5-6
Conduct market study of Automated Ground Surveillance Vehicles (AGSV).	FY 2020 Q1	FY 2020 Q4	5
FY 2021			
Perform operational assessment of woodlands and waterways ground sensor technology prototype.	FY 2020 Q2	FY 2021 Q2	5-6

Research and Development Description	Plan Start Date	Planned Completion	TRL
Perform operational assessment of woodlands and waterways ground sensor technology.	FY 2021 Q1	FY 2021 Q4	6-7
Develop deployment concepts for Automated Ground Surveillance Vehicle (AGSV).	FY 2021 Q1	FY 2021 Q4	5
Transition guide used to define contractual requirements for sensors to output data in standards-based format which can be ingested by other CBP systems (LASU).	FY 2021 Q2	FY 2021 Q4	7
Transition BACIS enterprise information sharing capabilities such as Tactical Chat, Friendly Forces Tracks, and other track of interest / item of interest to Operational Components.	FY 2021 Q1	FY 2021 Q4	7
Conduct study to determine R&D for enhancing law enforcement telecommunication capabilities.	FY 2021 Q1	FY 2021 Q4	N/A

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:** This program is conducting market research, modeling and simulations, and operational experiments (OpEx) to enhance USBP's knowledge of the state of technology modalities to detect, exploit, and seal cross-border dug tunnels. The 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.

- **Justification:** The FY 2021 President's Budget provides $2.4M for this project, a decrease of $0.2M from the FY 2020 Enacted budget. This level of funding will be used to develop, test, and evaluate technologies designed to enhance capabilities to detect, surveil and remediate U.S. cross-border tunnels and enhance tunnel investigation and forensics capabilities.

- **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.

Type of Research
Developmental

Technical Readiness Level
TRL varies for specific portfolio projects between TRL-4 and TRL-5.

Transition Plans

- 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Performed analysis of tunnel detection technology that is commercially available or under development by other government agencies.	FY 2019 Q1	FY 2019 Q4	4-5
FY 2020			
Pilot/test tunnel detection technology that is commercially available or under development by other government agencies.	FY 2020 Q1	FY 2020 Q4	4-5
FY 2021			
Validate CONOPS for tunnel detection technology that is commercially available or under development by other government agencies.	FY 2021 Q1	FY 2021 Q4	N/A

Maritime Border Security Program

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, ICE, 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, CBP, and ICE 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.

- **Justification:** The FY 2021 President's Budget provides $7.2M for this project, a decrease of $9.6M from the FY 2020 Enacted budget. This level of funding will be used to facilitate the transition of the Integrate Maritime Domain Enterprise (IMDE) to a HQ information sharing program (current placeholder name Integrated Domain Enterprise – Maritime); to identify and acquire candidate sensors for Regional Maritime Surveillance Pilot to address persistent wide area maritime surveillance needs; to enhance capabilities to detect dark vessels in U.S. coastal waters; and to improve the effectiveness of USCG operations.

- **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.

Type of Research
Applied/Developmental

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

Transition Plans
- Deliver IDME to DHS HQ or DHS Component(s) a compliant reference segment architecture integration platform for agile information sharing and discovery.
- Deliver to CBP and USCG recommendations to use space-based imagery in support of Maritime Domain Awareness, including maritime surveillance operations.
- Deliver to operational Components Dark Vessel Detection track information from commercial and/or Government owned sensor systems.
- 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Transitioned selected Integrated Maritime Domain Enterprise (IMDE) and Coastal Surveillance System (CSS) prototype capability documentation to DHS Components and DHS OCIO for further development and integration into operations.	FY 2018 Q4	FY 2019 Q4	6
Completed Maritime Domain Awareness analysis of alternatives (AoA) against dark vessels in relevant areas of responsibilities.	FY 2018 Q4	FY 2019 Q4	5
Demonstrated ability of space-based technology concept to enhance Maritime Domain Awareness.	FY 2018 Q2	FY 2019 Q4	5-6
FY 2020			
Transition IMDE Enterprise framework to an accredited Cloud instantiation.	FY 2020 Q1	FY 2020 Q4	6
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	6-7
FY 2021			
Assess the use of Dark Vessel Detection track data feeds into Operational Component's system.	FY 2021 Q1	FY 2021 Q4	6

Research and Development Description	Plan Start Date	Planned Completion	TRL
Update IMDE accredited system and initiate preparations to formally establish a DHS IMDE Program of Record	FY 2021 Q1	FY 2021 Q4	7
Use the USCG-S&T Innovation Center to prototype a capability to improve the effectiveness of USCG operations.	FY 2021 Q1	FY 2021 Q4	5-6
Initiate DVD track data feed transition to Operational Components for operations and sustainment activities	FY 2021 Q1	FY 2021 Q4	7
Identify and begin acquiring candidate sensors to support a Regional Maritime Surveillance Pilot.	FY 2021 Q1	FY 2021 Q4	7

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.

- **Justification:** The FY 2021 President's Budget provides $1.0M for this project, the same level as FY 2020 Enacted budget. This level of funding will be used to transition Waterways Analysis and Management System (WAMS) into its operational environment and to continue research and development activities in support of solutions to DHS waterway management operational challenges.

- **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.

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). This knowledge and products will inform future USCG acquisition strategies.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed WAMS modules.	FY 2018 Q4	FY 2019 Q4	5
FY 2020			
Develop and assess WAMS modules.	FY 2019 Q1	FY 2020 Q4	4-5
Deliver WAMS modules to USCG.	FY 2019 Q3	FY 2020 Q4	5-6
FY 2021			
Initiate transition of WAMS to the USCG operational environment.	FY 2021 Q1	FY 2022 Q1	7
Research waterways management solutions.	FY 2021 Q1	FY 2022 Q4	5-6

Remote Maritime 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. This is necessary in order to identify those suspect vessels and to 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 for DHS to execute its mission.

- **Solution:** The program is performing R&D to leverage and integrate emerging space capabilities in order 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. The R&D will 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. S&T's R&D will repurpose existing analytic tools to provide analytics able to identify patterns of life, illicit behaviors and/or activities.

- **Justification:** The FY 2021 President's Budget provides $9.3M for this project, an increase of $3.0M from the FY 2020 Enacted budget. This level of funding will be used to complete and transition development of new data sources, which enables detection of "dark vessels" using emerging space-based capabilities and exploitation of previously untapped target signatures. Funding will leverage these new data sources to mature and transition analytics into existing component(s) systems for the detection of "dark vessels".

- **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.

Type of Research

Developmental

Technical Readiness Level

Project began at TRL-5 and completes at TRL-7.

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Perform multi-intelligence source demonstration of DHS DataHub analytics.	FY 2019 Q2	FY 2020 Q2	6
Conducted On-Orbit test and evaluation of space-based technologies to support Arctic missions.	FY 2019 Q1	FY 2019 Q3	6-7
FY 2020			
Deliver technical and cost analysis following On-Orbit T&E of space-based technologies to support Arctic missions.	FY 2020 Q1	FY 2020 Q2	6-7
Assess use of space-based capabilities to enhance Maritime Domain Awareness.	FY 2018 Q1	FY 2020 Q4	6-7
FY 2021			
Perform operational assessment of technology/techniques developed under the Adaptive Sensor Analytics Project.	FY 2020 Q3	FY 2021 Q3	6-7
Perform operational evaluation of DataHub analytics to detect and report dark vessels conducting specified illicit Living Marine Resources (LMR) activities.	FY 2021 Q1	FY 2021 Q3	7
Perform ground truth data collection to drive development and completion of TITANIC algorithms for automated detection and reporting of icebergs during the annual iceberg season, using data derived from commercial and intelligence community imagery systems, to be fed into International Ice Patrol (IIP) systems.	FY 2021 Q2	FY 2021 Q3	7

POE Security and Trade Program

This R&D develops technologies to ensure the integrity of cargo, goods, and people entering the United States while ensuring economic throughput for the U.S. economy. The program conducts technology foraging, technology readiness evaluations, and operational readiness assessments to inform DHS acquisition planning for more capable/lower cost systems in this area. The work performed will reduce the risk of terrorists and transnational criminal organizations from entering the United States through the POEs or from manipulating cargo as it conveys across various transit modes in the international supply chain.

Air Cargo Screening

- **Problem:** Air Cargo is one of three critical components of Aviation Security, along with Checked Baggage and Checkpoint Baggage. Public Law 110-52, mandates 100 percent screening of Air Cargo on passenger aircraft, including checked 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. Evolving threats pose a significant and continual threat to passenger safety through the Air Cargo conduit and, hence, adequate funding for the development of air screening technologies is critical.

- **Solution** In response to the Congressional mandate, TSA has instituted the Certified Cargo Screening Facility (CCSF) program, which is operated by private companies, in order to screen all Air Cargo utilizing TSA-approved screening equipment. Since private screening companies are low-margin facilities, screening equipment has to be affordable.

  The Air Cargo program supports TSA's CCSF program through a combination of short term, mid-term, and long-term strategies. These include (a) augmenting existing screening systems to support increased security in the short term, (b) developing low cost Computed Tomography (CT) systems for 3D imaging of skids and automated threat detection in the midterm, and (c) in the long term, developing technologies to screen dense cargo. The program seeks to achieve these goals to meet TSA capability gaps identified by close collaboration between TSA, S&T, original equipment manufacturers (OEMs) and Screening Companies.

- **Justification:** The FY 2021 President's Budget does not include funding for this project, which is a decrease of $7.0M from the FY 2020 Enacted budget.

- **Impact:** This research contributes to the strengthening of the Nation's air cargo security and aviation security infrastructure. With the exponential growth of e-commerce, Air Cargo security has a vital impact on both passenger safety and economic interests.

Type of Research
Developmental

Technical Readiness Level

- For low cost CT-like 3D imaging, the program began at TRL-3 and will end at TRL-6.
- For development of the high penetration cargo skid size screening capability Preliminary Design Review (PDR), the program began at TRL-3 and will end at TRL-6.

Transition Plans

When the CT and the high penetration air cargo skid scanners reach TRL-6 (successful developmental testing and evaluation at Transportation Security Laboratory (TSL)), the products would be available to TSA for certification testing. Upon 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Opacity and Complexity Assessment Software Tool (OCAST) was successfully tested at SeaTac (Seattle) airport in coordination with TSA and Alaska Airlines. Additional tests were conducted with Apollo Freight a private shipping company that screens almost 700 skids per day.	FY 2019 Q2	FY 2019 Q3	7
The low-cost Air Cargo system being developed by Astrophysics underwent a successful Critical Design Review.	FY 2019 Q2	FY 2019 Q2	5
Multiple projects in support of the Air Cargo program were initiated in cooperation with the TSL and COEs.	FY 2019 Q2	FY 2019 Q4	4
FY 2020			
Automatic Threat Recognition (ATR) software developed and integrated into 3D imaging systems from Integrated Defense and Security Solutions (IDSS) and Astrophysics.	FY 2019 Q2	FY 2020 Q3	5
Complete development of simulated cargo and threat concealment strategies (North Eastern University) to support ATR.	FY 2019 Q4	FY 2020 Q4	7
Demonstrate Nuclear Quadrupole Resonance Cargo screening system.	FY 2019 Q3	FY 2020 Q3	6
Continue joint development of Neutron generator explosive detection systems with BIM (Borders, Immigration and Maritime) and Transport Canada.	FY 2019 Q1	FY 2020 Q2	6
Conduct formal laboratory testing of low cost CT 3D imaging systems from IDSS and Astrophysics.	FY 2020 Q1	FY 2020 Q4	6
Complete investigation of limitations and possibilities of screening cargo skids for explosive vapor.	FY 2018 Q2	FY 2020 Q4	7
FY 2021			
N/A	N/A	N/A	N/A

Opioid/Fentanyl Detection

- **Problem:** The final report of the President's Commission on Combating Drug Addiction and the Opioid Crisis recognized challenges that limit DHS's ability to detect and interdict synthetic opioids, like fentanyl, that cross U.S. land, sea, and air borders, including international mail. The top challenges that DHS face include the following: the high volume of mail, trade, and travel; the ability of synthetic opioids to be smuggled in very small quantities; the low number of available automated detection systems and trained canines; and an inadequate infrastructure. CBP's Office of Field Operations (OFO) has identified a critical need for technologies to be able to detect opioids and fentanyl and disrupt the illicit opioid supply chain.

- **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 existing operational environments to allow for efficient screening and interdiction of opioids at ports of entry 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.

- **Justification:** The FY 2021 President's Budget provides $8.5M for this project, the same level as FY 2020 Enacted budget. This level of funding will be used to transition algorithms for narcotics anomaly detection on image-based systems and high throughput chemical detection technology for implementation in CBP operational environments. Funding also includes continued utilization of analytic capabilities to improve the understanding of supply chain logistics and intelligence to aid in targeting and investigation.

- **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 better enable CBP to 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.

Type of Research
Applied, Developmental

Technical Readiness Level
The program began at TRL-2 and will end at TRL-7.

Transition Plans

In close coordination with CBP and other stakeholders, a concept of operations and systems architecture for opioids and fentanyl detection at international mail facilities will be developed. 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 COTS/GOTS 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Delivered Technology Assessment Report.	FY 2018 Q4	FY 2019 Q1	2
Conducted opioid threat characterization studies.	FY 2019 Q1	FY 2019 Q4	N/A
Drafted test and evaluation master plan, including key system attributes and key performance parameters.	FY 2019 Q1	FY 2019 Q2	6-7
Conducted test and evaluation of existing technologies for opioid detection.	FY 2018 Q4	FY 2019 Q3	6-7
Executed open innovation prize competition for high-throughput non-intrusive screening technologies.	FY 2019 Q1	FY 2019 Q4	N/A
Solicited proposals for advanced development of opioids/fentanyl detection capabilities to close identified gaps.	FY 2019 Q1	FY 2019 Q2	N/A
Defined operational requirements.	FY 2019 Q1	FY 2019 Q4	N/A
Initiated rapid prototyping of high-throughput scanning and field-screening equipment.	FY 2019 Q3	FY 2019 Q4	6
Conducted systems engineering study (systems analysis) to develop system architecture to integrate proposed technologies into operational environment.	FY 2019 Q1	FY 2019 Q4	N/A
Developed proposed system architecture for opioids/fentanyl detection capability for CBP at POEs that will not unreasonably restrict flow of lawful commerce.	FY 2018 Q4	FY 2019 Q4	N/A
Awarded contracts with partner laboratories for independent test and evaluation to be completed in FY 2020.	FY 2019 Q3	FY 2019 Q4	6-7
FY 2020			
Develop advanced analytical tools to increase probability of detection.	FY 2019 Q1	FY 2020 Q2	4
Conduct analysis of analytical tools (e.g., anomaly detection) against “real” test set.	FY 2020 Q2	FY 2020 Q4	6-7
Evaluate performance of scanning technologies for opioid/narcotics anomaly detection.	FY 2020 Q2	FY 2020 Q4	6-7
Conduct test and evaluation of handheld illicit drug detection technologies for presumptive identification.	FY 2020 Q1	FY 2020 Q3	6-7
Develop transition and commercialization plans, as applicable, for technology solutions.	FY 2020 Q2	FY 2020 Q4	7
Initiate advanced development of down-selected prototype technologies.	FY 2020 Q3	FY 2020 Q4	6-7
Develop process models to enable Alternatives Analysis and recommendations for integrated systems-of-systems.	FY 2020 Q2	FY 2020 Q4	4
FY 2021			

Research and Development Description	Plan Start Date	Planned Completion	TRL
Develop opioid-related investigative, training, analytical, and other capabilities.	FY 2020 Q2	FY 2021 Q2	6-7
Initiate transition of narcotics anomaly detection algorithm for X-ray or CT systems.	FY 2020 Q4	FY 2021 Q1	7
Evaluate feasibility of rapid, non-contact trace narcotics detection in CBP operational environments.	FY 2020 Q3	FY 2021 Q3	6-7
Pilot technologies in operational facility to conduct operational data collection and assessments to determine additional R&D or operational readiness.	FY 2020 Q3	FY 2021 Q1	6-7
Define systems-of-systems architecture to inform non-materiel recommendations and configuration of technologies that increase overall throughput of mail inspection operations.	FY 2020 Q4	FY 2021 Q4	N/A
Deliver report on emerging, next generation detection technologies and methods to meet anticipated future requirements and needs.	FY 2020 Q3	FY 2021 Q3	2
Initiate transition of high-throughput chemical detection capability for mail operations to CBP.	FY 2021 Q4	FY 2021 Q4	6-7

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 to strengthen traveler vetting and scale operations to continue to facilitate lawful and legitimate travel.

- **Solution:** S&T will conduct technology foraging, technology readiness evaluations, and operational readiness assessments to inform DHS acquisition planning for more capable/lower cost technologies, including biometric recognition capabilities. This will strengthen traveler vetting and facilitate lawful and legitimate travel. S&T will also evaluate cost effectiveness of capabilities and technologies. This will ensure Components are able to effectively use available man power to scale operations for increasing traveler volume.

- **Justification:** The FY 2021 President's Budget provides $3.5M for this project, a $2.3M decrease from the FY 2020 Enacted budget. This level of funding will be used to identify, evaluate, and implement combinations of process and technology improvements (e.g. Flexible Facilitation, Biometric Collection Technology Refresh, and Facial Recognition Vetting capabilities) that enhance DHS's ability to biometrically verify and securely facilitate the movement of people through the Nation's air, land, and sea POEs.

- **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.

Type of Research
Applied, Developmental

Technical Readiness Level

The program began 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 in order to enable co-operative procurement through public-private partnerships. CBP-specific products include all operational explosives reports and business case documentation for follow-on CBP acquisition and/or sustainment, including Business Case Analysis and foundational acquisition documentation.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed 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	7
Developed Face and Multi-Biometric Recognition Deep Learning Technical Feasibility Report.	FY 2019 Q1	FY 2019 Q2	7
Developed CONOPS to enhance traveler identification validation and operations in support of CBP Flexible Facilitation.	FY 2019 Q1	FY 2019 Q3	N/A
Developed 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	N/A
FY 2020			
Develop assessment methods to evaluate integrated multi-biometrics collection and matching technologies to determine operational readiness or effectiveness for CBP traveler verification operations.	FY 2020 Q1	FY 2020 Q3	6
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.	FY 2020 Q1	FY 2020 Q4	6
Conduct Laboratory Evaluations and support CBP-led operational readiness evaluations of Face Recognition Technologies for Air and Land Pedestrian POEs.	FY 2020 Q2	FY 2020 Q4	7
FY 2021			
Develop and automate methods to measure and incrementally enhance CBP biometric traveler verification operations.	FY 2021 Q1	FY 2021 Q4	7
Develop technical specifications and standards for next-generation enhanced quality biometric collection capabilities.	FY 2021 Q1	FY 2021 Q3	7
Demonstrate complimentary capabilities of integrated multi-system technologies to improve real-time CBP operational awareness.	FY 2021 Q2	FY 2021 Q4	6

POE Forensics and Investigations

- **Problem:** CBP OFO 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:** S&T is working with CBP OFO to provide an advanced data analytics application to help in the mission of combatting transnational organized criminal organizations. This program enhances the ability of CBP OFO to share, query, and analyze law enforcement information/data, enabling law enforcement investigations.

- **Justification:** The FY 2021 President's Budget provides $2.0M for this project, a decrease of $6.4M from the FY 2020 Enacted budget. This level of funding will be used to develop R&D of advanced analytic software tools for state-of-the-art machine learning and pattern recognition. It will also support concept demonstrations of advanced analytics software.

- **Impact:** Impacts include (1) enhanced ability to investigate illegal activity and detection of illegal goods and (2) potential to save thousands of CBP labor hours.

Type of Research
Developmental

Technical Readiness Level
TRL-7

Transition Plans
In FY 2019, S&T transitioned Igloo system to ICE HSI. Igloo is a software tool that provides ICE the capability to analyze and correlate large data sets to identify illegal activity. Similarly, upon successful completion of the R&D work, S&T will transition new tools and capabilities to CBP for operational use. S&T is building on the success of Igloo and applying lessons learned while addressing CBP OFO's requirements.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
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	7
Expand Igloo mission capabilities to additional ICE HSI field offices.	FY 2019 Q1	FY 2019 Q4	7

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2020			
Perform operational assessment of Analytics technology/techniques for CBP.	FY 2020 Q1	FY 2020 Q4	7
FY 2021			
Develop software solutions for CBP OFO.	FY 2021 Q1	FY 2021 Q4	7

POE Scanning Technologies

- **Problem:** CBP's non-intrusive scanning systems are reaching the end of their service life and are exhibiting reduced performance as well as rising maintenance costs. Non-Intrusive Inspection (NII) systems technology needs to be refreshed in order to maintain parity with the threat. The volume of inbound goods and people passing through the POEs is projected to increase from year to year, while CBP manpower will not be increased proportionately. 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 systems in order to enhance their detection performance, extend their service life, and expand the range of detectable threats. This program is developing a new NII sources, detectors, and hardware for use in developing next generation NII scanning systems.

- **Justification:** The FY 2021 President's Budget provides $3.2M for this project, a decrease of $10.3M from the FY 2020 Enacted budget. This level of funding will be used to develop next generation NII sources and detectors, and hardware.

- **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.

Type of Research
Developmental Research

Technical Readiness Level
TRL-7

Transition Plans
Upon successful completion of the software/hardware upgrades, S&T will deliver a Common Viewer Workstation prototype to a POE. S&T will then deliver assessments of technologies and techniques to CBP to inform their acquisition process.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conducted POE demonstration of Common Viewer Workstation.	FY 2019 Q1	FY 2019 Q4	7
Conducted assessment of technology for improved NII performance.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Perform initial assessment of technology/techniques to improve performance of NII Detectors, Algorithms, and data collection.	FY 2020 Q1	FY 2020 Q4	7
Perform operational assessment of technology/techniques developed under the Improve Performance of NII Detectors and/or Sources project.	FY 2020 Q1	FY 2020 Q4	7
FY 2021			
Perform additional assessments of technology/techniques to improve performance of NII sources, Detectors and hardware.	FY 2021 Q1	FY 2021 Q4	7

Chemical, Biological, and Explosive (CBE) Defense Thrust Area
Research and Development

Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Chemical, Biological, and Explosive Defense Thrust Area	$73,701	$67,032	$45,284

CBE DEFENSE THRUST AREA: R&D investments support prevention and protective strategies as well as the coordinated surveillance and detection of 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.

CHEMICAL, BIOLOGICAL, AND EXPLOSIVE (CBE) DEFENSE THRUST AREA *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
CBE Defense Thrust Area Total		**$73,701**	**$67,032**	**$45,284**
Bioagent Detection		**$14,000**	**$5,000**	**$5,000**
	BioInformatics for BioDefense (BioFutures)	$3,000	-	-
	Biosurveillance Systems	$5,000	$5,000	$5,000
	Chem-Bio Integrated Product Team	$5,000	-	-
	Underground Transport Biodetection Test Bed	$1,000	-	-
Chemical Detection		**$3,099**	**$3,099**	**-**
	Multifunction Detectors	$3,099	$3,099	-
Explosives Detection		**$56,602**	**$58,933**	**$40,284**
	Checked Baggage Technology Development	$8,000	$7,309	$6,309
	Detection Canine Program	$12,269	$15,269	$4,820
	Next Generation Explosives Trace Detection	-	$8,200	$6,000
	Primary Screening for Carry-On Bags	$4,000	$5,458	$4,458
	Primary Screening for Passengers	$9,957	$6,000	$5,000
	Screening at Speed (SaS)	$8,000	$8,664	$8,664
	Secondary Screening Technology Development	$6,343	-	-
	Soft Target Crowded Places (ST-CP) Security	$7,000	$7,000	$4,000

	Training and Performance Optimization	$1,033	$1,033	$1,033

Bioagent Detection Program

This program conducts research, develops and identifies tools to enable rapid detection, and provides 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.

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**: S&T will 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. S&T will develop and host interactions between government, industry and academics to foster increased awareness and understanding.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **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. The program increases the awareness and understanding of synthetic biological threats across the HSE. This project focuses on preventing and minimizing the negative impact of synthetic biological risks by forecasting critical information about potential future threats at a time of rapid technological flux.

Type of Research
Development

Technical Readiness Level
N/A

Transition Plans

With prior year funds, S&T made technical reports and databases available to users across the HSE and to appropriate commercial customers via the Bio-Defense Knowledge Center Management System. S&T developed mechanisms of improved security at public and private institutions domestically and internationally.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed and deployed mechanisms of contact by which commercial gene synthesis companies may contact government to prevent malicious activity.	FY 2019 Q1	FY 2019 Q4	7
Expanded Sequences of Interest database as repository for engineering sequences developed by IARPA.	FY 2019 Q1	FY 2019 Q4	7
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Biosurveillance Systems

- **Problem:** Rapid response to biological incidents of national concern (e.g., a biological attack or disease outbreak) is critical to save lives, protect critical infrastructure, and safeguard 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 infectious agents in a public space is a critical challenge to multiple DHS Components and other Federal, State, local, tribal, and territorial (SLTT) customers, including the public health and first responder communities.

- **Solution:** S&T will develop cost-effective systems to rapidly collect and exploit information required for the rapid identification of biological incidents. This will enable decision makers to more quickly initiate protective measures. To shorten the time required to deliver a prototype system, the program aims to pursue parallel tracks in order to solve multiple aspects of the problem and to make use of existing COTS or GOTS solutions. The objectives include: 1) addressing timeliness to detect the release of a biological agent by developing novel sensor/trigger technologies, 2) identifying data and data streams to provide early warning situational awareness, 3) integrating analytical tools and applying advanced computational techniques to integrate and analyze real-time data and 4) enabling more real-time sharing of information across Federal agencies and SLTT officials.

- **Justification:** The FY 2021 President's Budget provides $5.0M for this project, the same level as FY 2020 Enacted. This level of funding will be used to test and evaluate systems for the collection and detection of biological aerosol threats as well as to continue the development and delivery of detection architectures that can rapidly improve the timeline for biological detection identification and response.

- **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 reducing casualties and the loss of life and mitigating adverse impacts to critical infrastructure, and the economy.

Type of Research
Applied, Developmental

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Deliver conceptual prototype architecture design based on stakeholder engagement for improved situational awareness (biosurveillance information and knowledge integration).	FY 2019 Q1	FY 2020 Q1	4
Deliver biodetection and biosurveillance systems architectures for DHS Components.	FY 2019 Q1	FY 2020 Q1	4
Technical pilot prototype planning and recommendations development.	FY 2019 Q1	FY 2020 Q1	4
Conduct test and evaluation of individual system prototype components in relevant environments.	FY 2019 Q1	FY 2020 Q1	4
Conduct systems analysis and develop plans to integrate component technologies into unified capabilities.	FY 2019 Q1	FY 2020 Q1	4

Research and Development Description	Plan Start Date	Planned Completion	TRL
Demonstrate utility of advanced analytic methods in biodetection and biosurveillance applications (e.g., reduce false alarms, identify anomalous data indicators).	FY 2019 Q1	FY 2020 Q1	4
FY 2020			
Continue to deliver biodetection and biosurveillance system architectures for DHS Components.	FY 2019 Q1	FY 2020 Q1	N/A
Continue to test and evaluation of prototype components in relevant environments.	FY 2019 Q1	FY 2020 Q1	6
Assess utility of advanced analytical methods in biodetection and biosurveillance applications (e.g., reduce false alarms, identify anomalous data indicators).	FY 2019 Q2	FY 2020 Q1	6
FY 2021			
Perform test and evaluation of systems for collection and detection of aerosolized biothreats.	FY 2020 Q1	FY 2021 Q4	6
Demonstrate advanced detection systems with Federal, State, and local end-users.	FY 2020 Q1	FY 2021 Q4	6
Deliver a national threat assessment taxonomy with a focus on DHS Components.	FY 2020 Q2	FY 2021 Q3	N/A
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.	FY 2020 Q4	FY 2021 Q4	4
Perform test and evaluation of prototype advanced detection systems.	FY 2020 Q2	FY 2021 Q2	4
Deliver biodetection and biosurveillance system architectures for DHS Components.	FY 2020 Q1	FY 2021 Q1	N/A

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. CB IPT Solutions has identified these six activities as the first gaps to address:
  - *Decision Support for Operational Decision Making:* delivers guidance to USCG for recovery from a wide-area biological event and returns ports and installations to an operational and mission-readiness status.
  - *Event Modeling:* Develops 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:* Delivers a software tool for use by FEMA city planners to estimate consequences of major biological agent events and inform preparedness planning.
  - *Field Detection Equipment:* Demonstrates a prototype, rapid nuclear magnetic resonance capability in order to detect liquid chemical agents, including precursors, at security checkpoints.

- *Executive Protection against Biological Agents:* Delivers 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:* Creates 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.

- **Solution:** The CB IPT 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.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include funding for this project.

- **Impact:** Utilizing prior year funds, this program will deliver solutions to high-priority gaps identified by DHS Components through the CB IPT process. The solutions provide increased capabilities that will 1) enhance Components' readiness to respond to, prepare for, and recover from hazardous biological, chemical, or radiological events (FEMA, USCG, USSS); 2) better inform targeting decisions for inspection and identification of potentially hazardous cargo at U.S. ports of entry (CBP); 3) support optimized placement of sensor technologies; 4) validate models that estimate public health and environmental impacts of an aerosolized biological threat; and 5) provide a new technology to screen for liquid chemical threats at airport checkpoints (TSA, CBP).

Type of Research
Applied, Developmental, and Demonstration.

Technical Readiness Level
TRL 3-7

Transition Plans
S&T has worked with Components to transition knowledge products, CONOPS, and operational control and maintenance of technologies developed through S&T's IPT process.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Executed test plan and identify best-of-breed respiratory systems for Component evaluation.	FY 2019 Q1	FY 2019 Q4	7

Research and Development Description	Plan Start Date	Planned Completion	TRL
Completed master test and evaluation plan execution for USCG powered air-purifying respirator (Gap 3).	FY 2019 Q1	FY 2019 Q3	7
Demonstrated 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	4
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

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. In FY 2016, S&T conducted a field test in the New York City subway that simulated a biological agent release. This field test confirmed dispersion model predictions that a contamination would be widespread and that a major public health crisis would occur.

- **Solution:** A permanent test bed in a major subway system enables 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. The Metropolitan Transportation Authority New York City Transit (MTA NYCT) continues to partner with DHS on implementing a test bed in the Nation's largest subway system. The testbed was initiated in FY 2019 and will conduct solution testing through FY 2022. In FY 2023, S&T will transition the testbed to NYC stakeholders. Outcomes are also anticipated to be transferrable to other large mass transit systems, with appropriate modifications.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **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 rapid situational awareness. The outcomes will be transferrable to other subway systems.

Type of Research

Developmental

Technical Readiness Level
TRL-5 through TRL-7

Transition Plans
S&T will provide technical reports and databases to users across the HSE and to appropriate commercial customers via the Bio-Defense Knowledge Center Management System.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Acquired technologies for test bed.	FY 2018 Q2	FY 2019 Q2	7
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Chemical Detection Program
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. S&T will 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.

- **Justification:** The FY 2021 President's Budget does not include new funding for this project, which is a decrease of $3.1M from FY 2020.

- **Impact:** Detection and interdiction of chemical hazards through rapid field-based assessments and optimized collection and integration of relevant data will shorten the timeline between event occurrence and response. This will reduce casualties and the loss of life, as well as mitigate adverse impacts to 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.

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, 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 in order 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 T&E of candidate systems and architectures in the relevant operational environments.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conduct market research of available (COTS/GOTS) laboratory and portable based chemical detection systems.	FY 2019 Q3	FY 2020 Q2	N/A
Complete assessment of detection systems against current chemical detection capability baseline and evaluation of risk.	FY 2019 Q2	FY 2020 Q3	N/A
Develop/improve modeling capability to analyze trade space for advanced chemical detection architectures (DHS Component focus).	FY 2019 Q2	FY 2020 Q3	N/A
Conduct horizon scanning (“Tech Watch”) for novel and emerging detection methodologies.	FY 2019 Q3	FY 2020 Q1	N/A
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	N/A
FY 2020			
Evaluate detection technologies in a laboratory setting.	FY 2020 Q1	FY 2020 Q2	6
Evaluation of detection technologies in an operational setting.	FY 2020 Q3	FY 2020 Q4	6

Research and Development Description	Plan Start Date	Planned Completion	TRL
Identify requirements and gaps in chemical and biological detection for a relevant Component.	FY 2020 Q1	FY 2020 Q2	N/A
Conduct a chemical and biological detection market survey and technology assessment.	FY 2020 Q1	FY 2020 Q3	N/A
FY 2021			
N/A	N/A	N/A	N/A

Explosives Detection Program

This program researches, develops, identifies, and validates 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.

Checked Baggage Technology Development Program

- **Problem:** TSA needs enhanced Explosives 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 detection rates, as well as reduced operating costs, due to decreased false alarm rates and improved throughput.

- **Solution:** In collaboration with TSA, S&T is developing and validating the next generation X-ray systems, including CT 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 technologies that will be migrated into next generation checked baggage screening equipment.

  The Checked Baggage Program has three specific focus areas:
  - Advanced X-ray Systems Development: Development and testing of system of full up 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.

- **Justification:** The FY 2021 President's Budget provides $6.3M for this project, a $1.0M decrease from the FY 2020 Enacted budget. This level of funding will be used to complete validation testing and to ensure transition and implementation of next generation EDS into TSA operations.

- **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 threats as well as with the pace of life for the traveling public. Future program capabilities will include the following:
  - An expanded library of explosives and explosives signatures that can be effectively detected.
  - Improved automated explosives detection and false alarm performance.
  - Enhanced and tested ability to detect priority non-explosive contraband materials.
  - Improved imaging tools for operator alarm resolution.
  - Improved system reliability, screening speed (throughput) and reduced cost of ownership compared with currently deployed EDS.

Type of Research

Developmental

Technical Readiness Level

The Checked Baggage Program will continue to initiate R&D through the targeted Broad Agency Announcements (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 EDS 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 (TSIF). Effectiveness of product will be proven to TSA. S&T will 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, or capabilities transfer, 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed new automated threat recognition algorithms applicable to the current TSA threat assessment and requirements.	FY 2018 Q4	FY 2019 Q4	2-7
Completed analysis and development 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	2-7
Demonstrated prototype detector for x-ray security screening.	FY 2018 Q4	FY 2019 Q4	2-7
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	N/A
Demonstration of system concept including a pre-preliminary design and benchmark or modeling data and data analysis report.	FY 2019 Q1	FY 2020 Q4	2-7
Demonstration of approved preliminary design through review with limited laboratory dataset and data analysis report.	FY 2019 Q1	FY 2020 Q4	2-7
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 2020 Q2	FY 2020 Q4	N/A
Perform independent readiness testing to determine detection, identification, and false alarm performance characteristics.	FY 2020 Q2	FY 2020 Q4	2-7
Complete trade study analysis of probability of detection, probability of false alarm.	FY 2020 Q2	FY 2020 Q4	2-7
Complete transition through document coordination evaluation sessions supported by interagency agreements and Technology Transfer Agreements.	FY 2020 Q3	FY 2020 Q4	2-7
FY 2021			
Demonstration of critical design review with expanded dataset including homemade explosives (HME) at a DHS-designated laboratory including data analysis.	FY 2020 Q4	FY 2021 Q1	4-6
Coordinate development with TSA's recapitalization plans ensuring smooth and timely technology insertion.	FY 2020 Q2	FY 2021 Q2	4-6
Complete transitions with delivery of prototypes to designated testing laboratories for certification readiness testing.	FY 2020 Q3	FY 2021 Q2	4-6
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.	FY 2020 Q4	FY 2021 Q3	4-6
Develop technology transition plans for qualifying prototypes, which may include the development of additional prototype models, though contracts or cooperative research and development, or capabilities transfer, agreements.	FY 2020 Q4	FY 2021 Q3	N/A
Delivery of test bed system with demonstrated minimum 10% Probability of Detection / Probability of False Alarm improvement.	FY 2020 Q4	FY 2021 Q3	7

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. The program has partnered with DHS partners, including TSA, and industry stakeholders to bring focus to the domestic detection canine supply challenge through FY 2021. The program established a breeding roadmap, which was endorsed by TSA. The program concept was validated by a Congressionally mandated Breeding Working Group comprised of S&T, TSA, academia and industry representatives. The working group validated a construct that integrates the 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.

- **Justification:** The FY 2021 President's Budget provides $4.8M for this project, a decrease of $10.4M from the FY 2020 Enacted budget. This level of funding will be used to execute ongoing 2020 research efforts into development of training tools that will ensure effective and efficient training of explosive detection canine teams. These tool include, but are not limited to, nonhazardous explosive training aids and training aids reflecting concealed devices. Ongoing research also includes conducting odor generalization studies to reduce training burdens, performing field assessments to validate operational strengths and limits of the mobile canine sensing platform, and continue a Congressionally-mandated pilot breeding consortium effort to improve the supply of domestic working dogs. Specific expanded focus areas initiated after program scope was detailed in FY 2018 / 2019 appropriation language may be curtailed or suspended at projected FY 2021 funding levels.

- **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 R&D office will support the expansion of domestic detection canine supply, but also the improved efficiency of production, which 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.

Type of Research
Developmental

Technical Readiness Level
The program began at TRL-5 and will end at TRL-7.

Transition Plans
- Training Aids:
  - Transferred Government owned design and manufacturing methodology to third party manufacturer.
  - Complete transfer of second non-hazardous, conventional base odor canine training aid through rigorous quality assurance testing.
  - Integrate into TSA canine training aid acquisition programs.
  - TSA to adopt S&T non-hazardous training aid "soak" design to mitigate challenge with human decoys.
- Operational Test and Evaluation (OT&E):
  - Inform TSA Passenger Screening Canine (PSC) Open Queues Concept 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 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Identified 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 Q4	7
Conducted 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	7

Research and Development Description	Plan Start Date	Planned Completion	TRL
Conducted qualitative assessment and analysis of law enforcement explosive detection canine teams in an operational environment through Regional Explosives Detection Dog Initiative (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	7
Conducted an initial study of canine phenotype criterion that provide the best predictors for selection of successful detection canines. Delivered 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	5
Established 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	7
FY 2020			
Deliver set of non-hazardous explosive canine training aids for conventional/powder-based explosives for proof of principle testing.	FY 2018 Q3	FY 2020 Q2	5
Initiate Phase 1 of Domestic Breeding Consortium Project to establish domestic canine supply.	FY 2019 Q3	FY 2020 Q4	5
Conduct Phase IV parametric study of PBIED detection canine use parameters for soft target/crowded place threats.	FY 2019 Q2	FY 2020 Q3	7
Deliver results of TSA canine operational Open Queue Concept (OQC) assessment testing.	FY 2019 Q1	FY 2020 Q2	7
Deliver analysis of phenotype study in support of Domestic Breeding Consortium Project.	FY 2019 Q3	FY 2020 Q3	6
FY 2021			
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 2021 Q1	6
Deliver study that validates training aid signatures, evaluates surrogate training aids to address current/emerging threats, and uses explosives generalization research to reduce operational costs.	FY 2020 Q1	FY 2021 Q2	5
Deliver study establishing best cognitive/behavioral predictors and traits for selection of successful detection canines; study will define quantitative measures for ideal explosives detection canines.	FY 2020 Q1	FY 2021 Q2	4

Next Generation Explosives Trace Detection (Next Gen ETD)

- **Problem:** Terrorists continue to evolve their tactics and threats, including HME. This leads to a continuous need for aviation and large event explosives screening worldwide. End-users of trace detection technology currently lack the tools to most effectively and efficiently conduct their work. To reduce the possibility of terrorist attacks in our homeland, better technology is needed to improve sampling. S&T must continue to assess the effectiveness of deployed technology and to improve tools/technology in order to increase the number of threats that can be detected.

- **Solution:** S&T is developing both near-term technology solutions for currently deployed equipment and mid-term solutions for the next generation of explosives trace detection (ETD). 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.

- **Justification:** The FY 2021 President's Budget provides $6.0M for this project, a decrease of $2.2M from the FY 2020 Enacted budget. This level of funding will be used to directly support TSA alarm resolution capability needs for identifying emerging threats, resolving alarms generated by primary screening methods, and reducing Transportation Security Officer (TSO) cognitive loads. In addition, the program leverages these capabilities to enhance explosive and chemical screening capabilities of DHS Components across the HSE.

- **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.

Type of Research

Applied; Developmental

Technical Readiness Level

TRL-4 through TRL-7

Transition Plans

Pending successful development of the ETD prototypes, the program will work with Components, such as TSA, to implement the next stage of development and testing, with the eventual goal of transitioning solutions into the acquisition process and then into operational use.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
Develop tools for assessing non-contact vapor and particle sampling prototypes.	FY 2020 Q1	FY 2020 Q2	4
Develop a review document on the Trace Vapor Generator for Explosives and Narcotics (TV-Gen) for the Trace explosives community.	FY 2020 Q1	FY 2020 Q2	N/A
Publish a Project Charter for the U.S. Vapor Working Group.	FY 2020 Q2	FY 2020 Q3	N/A
Produce a report on particle collection and analysis.	FY 2020 Q2	FY 2020 Q3	N/A
Complete technical assessment/development of Reagent Enhanced Swabs for currently employed ETD's platforms.	FY 2020 Q3	FY 2020 Q4	7
Demonstrate a prototype laser trace vaporization desorber with an existing ETD.	FY 2020 Q3	FY 2020 Q4	5

Research and Development Description	Plan Start Date	Planned Completion	TRL
Deliver enhanced trace sampling tools and methodologies to TSA.	FY 2020 Q1	FY 2020 Q2	6
Deliver feasibility study of Explosives Trace and Vapor Characterization methodologies to TSA.	FY 2020 Q3	FY 2020 Q4	N/A
FY 2021			
Transitioning knowledge of Reagent Enhanced Swabs manufacturing to ETD vendors.	FY 2020 Q3	FY 2021 Q1	7
Complete Integration Test and Evaluation of Next Gen ETDs and components.	FY 2021 Q1	FY 2021 Q2	7
Conduct assessment of non-contact sampling technologies.	FY 2021 Q2	FY 2021 Q3	N/A
Conduct assessment of optical trace detection technologies.	FY 2021 Q3	FY 2021 Q4	N/A

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 as new threats emerge, TSA's capabilities must meet the increased demand. The high false alarm rate during carry-on screening requires 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 (ATR) for explosives and other prohibited items. Technologies under development include 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.

- **Justification:** The FY 2021 President's Budget provides $4.5M for this project, a decrease of $1.0M from the FY 2020 Enacted budget. This level of funding will be used to support the current TSA initiative to deploy CT-based X-ray systems to the checkpoint and also to mature and transition complementary capabilities to meet more stringent TSA threat detection requirements. These efforts will focus on enhanced material discrimination, automatic prohibited items detection, and reducing unnecessary and intrusive bag searches.

- **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.

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 Integrated Product Teams (IPTs) and the DHS 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Demonstrated 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	4
Completed 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	5
Delivered 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	6
FY 2020			
Demonstrate a Stationary Gantry DT X-ray system capable of processing in excess of 400 bags per hour.	FY 2019 Q1	FY 2020 Q3	5
Submit a CT X-ray system for certification readiness testing that is capable of meeting TSA's Accessible Property Screening System standard including automatic prohibited items detection without passenger divestiture of liquids, gels, aerosols, powders, or electronics.	FY 20218 Q1	FY 2020 Q4	6
FY 2021			
Certify a system capable of meeting TSA APSS Level 1+ standards without removing liquids, aerosols, gels, powders, and electronics.	FY 2020 Q1	FY 2021 Q4	7
Demonstrate a CT X-ray system capable of adapting its detection algorithms through risk-based screening.	FY 2020 Q1	FY 2021 Q4	5

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 as 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.

- **Justification:** The FY 2021 President's Budget provides $5.0M for this project, a decrease of $1.0M from the FY 2020 Enacted budget. This level of funding will be used to mature and transition next-generation passenger screening systems and algorithms to replace TSA's aging fleet. These systems and algorithms will meet TSA's most stringent threat detection requirements while significantly reducing unnecessary pat-downs and respecting passenger privacy.

- **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.

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 IPT, and the DHS 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Delivered 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	6

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2020			
Submit for developmental test & evaluation 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 2020 Q3	6
Submit a shoe scanner for TSA T&E.	FY 2018 Q1	FY 2020 Q3	5
FY 2021			
Demonstrate AIT system with material discrimination technology to reduce divestiture.	FY 2019 Q1	FY 2021 Q2	5
Submit a high definition AIT system for TSA qualification.	FY 2020 Q4	FY 2021 Q4	7

Screening at Speed (SaS)

- **Problem:** TSA requires validated 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. This could eliminate the need for today's cumbersome restrictions that require removing electronic devices, liquids, aerosols, and gels from bags.

- **Justification:** The FY 2021 President's Budget provides $8.7M for this project, the same level as FY 2020 enacted budget. This level of funding will be used to mature and transition the SaS curb-to-gate architecture. This includes next-generation passenger and property screening systems that will meet TSA's most stringent threat detection requirements, enable rapid response to evolving threats, and improve the passenger experience through reduced pat-downs and bag searches.

- **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.

Type of Research
Applied; Developmental

Technical Readiness Level
The program began at 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. After the completion of Developmental Test and Evaluation (DT&E) at the TSL, systems will transition to TSA's acquisition process. Other Government customers may leverage the DT&E towards applications beyond the aviation environment. Screening device development spirals will be coordinated with TSA's recapitalization plans in order to ensure both a smooth and timely technology insertion. Furthermore, S&T will continue to engage industry through outreach events (Industry Days), BAA, Prize Competitions, and the Small Business Innovation Research (SBIR) program.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Demonstrated the use of a third-party threat algorithm on an S&T prototype AIT system using open standards.	FY 2018 Q1	FY 2019 Q2	4
Demonstrated wide-area video analytics using operational data from a curb-to-gate aviation security environment.	FY 2018 Q2	FY 2019 Q3	5
Received operational feedback analysis based on operational pilot of an airport risk assessment model.	FY 2018 Q1	FY 2019 Q4	6
Demonstrated an AIT system capable of screening passengers at a walking pace while scanning for aviation-size threats.	FY 2018 Q4	FY 2019 Q4	4
FY 2020			
Complete a critical design review for an engineering test unit that is capable of using additional physical X-ray signatures to discriminate between dangerous and benign materials.	FY 2019 Q4	FY 2020 Q4	6
Demonstrate a passenger screening system that can adapt its performance in real-time using risk-based screening.	FY 2018 Q3	FY 2020 Q4	6
FY 2021			
Demonstrate automated tracking algorithms that associate passengers and their divested items at an aviation checkpoint, to enable screening of items according to passenger risk profiles.	FY 2019 Q1	FY 2021 Q4	5
Demonstrate the latency and throughput improvements achieved by integration of optical interconnections to enable walk-by passenger screening systems.	FY 2020 Q1	FY 2021 Q1	6

Secondary Screening Technology Development

- **Problem:** The emergence of HME threats is a challenge for aviation security. The Secondary Screening Technology Development Program focuses on research, development, developmental T&E of the next generation of ETDs. This will enhance explosives 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 ability of ETDs 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 TSO training and training curriculum.

- **Solution:** To increase ETD detection capabilities, this S&T program will develop Next Generation ETDs with a 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 TSO explosives sampling proficiency.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **Impact:** With existing funding, the program will enhance the capabilities of currently deployed ETDs. The program will also 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/money and circumventing the need to retrain TSOs and other end-users. For mid- and long-term impact, S&T aims to develop ETDs with improved sampling and broader threat detection capabilities and to provide TSA and other DHS Components with more options for use in complex and diverse operational environments.

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, S&T is working to develop transition plans with these representatives. With regard to enhancing ETD capabilities, S&T is in the process of coordinating with the TSA to debrief them and transition two new capabilities: Advanced Itemizer DX ETD retrofit kit and reagent enhanced swabs.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conducted DT&E of portable ETD prototype with enhanced threat library.	FY 2018 Q4	FY 2019 Q2	7
DT&E of Portable Rapid Thermal Modulation Ion Mobility Spectrometer ETDs. This DT&E was 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	7
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Soft Target Crowded Places (ST-CP) Security

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

- **Solution:** S&T will provide an orthogonal, 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.

- **Justification:** The FY 2021 President's Budget provides $4.0M for this project, a decrease of $3.0M from the FY 2020 Enacted budget. This level of funding will be used to complete development and to transition applicable technologies that detect explosives threats to stakeholders. The funding will also support technology development that expand the threat space, which will enable stakeholders to better protect vulnerable soft target crowded venues.

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

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. 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 began early in 2019 with a goal to transition the Forensic Video Exploitation and Analysis (FOVEA) tool suite technology in 2020.
- Massachusetts Institute of Technology Lincoln Laboratory (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 S&T) to develop a portal-based millimeter wave system for detecting potential threat items entering large venues (i.e. stadiums) and schools.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed 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	5-7
Conducted DT&E of integrated IV/FOVEA tool suite within WMATA Security Operations Control Center (SOCC) to determine limits of detection performance in operational environment and impact to end-user.	FY 2018 Q4	FY 2019 Q1	5-7
Conducted DT&E of centimeter wave (cmW) Flat Panel Imaging Array Technology in lab environment.	FY 2019 Q1	FY 2019 Q1	5-7
Developed a Person Search capability within FOVEA tool suite and determine limits of detection performance in operational environment.	FY 2019 Q2	FY 2019 Q4	5-7
Conducted 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	5-7
FY 2020			
Conduct OT&E of FOVEA tool suite within TSA mass transit test bed with industry partners in preparation for transition.	FY 2019 Q2	FY 2020 Q2	5-7
Coordinate with S&T and MIT Technology Licensing Office (TLO) to transition the FOVEA tool suite to industry partner.	FY 2019 Q4	FY 2020 Q4	5-7
Conduct testing of Person Search capability within FOVEA tool suite in TSA mass transit test bed.	FY 2020 Q2	FY 2020 Q3	5-7

Research and Development Description	Plan Start Date	Planned Completion	TRL
Conduct Critical Design Review (CDR) of the integrated mmW Flat Panel Imaging Array.	FY 2020 Q2	FY 2020 Q3	5-7
Conduct DT&E of Person Borne Improvised Device (PBIED) integrated mmW Flat Panel Imaging Array in TSA mass transit test bed or a simulated operational environment.	FY 2020 Q2	FY 2020 Q4	5-7
FY 2021			
Conduct DT&E of Real-Time Threat Detection (RTTDA) algorithm in TSA mass transit test bed	FY 2021 Q1	FY 2021 Q1	5-7
Integration of component technologies into layered system with automated threat detection for proof of principle.	FY 2021 Q4	FY 2022 Q1	5-7

Training and Performance Optimization

- **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. DHS Officers, agents, and the Nation's first responders need improved training, including associated materials, methods, tools and technologies in order to more efficiently and effectively respond 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 in order 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.

- **Justification:** The FY 2021 President's Budget provides $1.0M for this project, the same as the FY 2020 Enacted budget. This level of funding will be used to develop, deliver, and transition modeling and simulation as well as advanced training technologies. Examples include augmented and virtual reality, as well as mission performance improvement technologies to the FLETC, DHS Training Academies, and DHS Component training offices.

- **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.

Type of Research
Applied

Technical Readiness Level
TRL-6 through TRL-7

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.
- Pat-down Accuracy Training Tool (PATT) mannequins to be transitioned to TSA to enhance TSO skills and advance training and curriculum at TSA Academy.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed a training interface that incorporates external triggers and presents the data graphically and interactively to instructors.	FY 2018 Q4	FY 2019 Q4	7
Conducted a post transition assessment of a recently transitioned technology (ScreenADAPT®, Sign Cutting, Web-Enabled ScreenADAPT®, Eye-Dentify, PATT).	FY 2018 Q4	FY 2019 Q4	N/A
Developed a training interface that incorporates performance and stress as an output.	FY 2018 Q3	FY 2019 Q4	7
Developed real-time wireless physiological classifier of stress that is validated and customized for first responders.	FY 2018 Q3	FY 2019 Q4	7
Designed an empirical evaluation of stress on learning for Stress Management and Assessment for Responder Training (SMART).	FY 2018 Q3	FY 2019 Q2	N/A
FY 2020			
Transition Eye-Dentify solution and conduct Project Tailoring Plan (PTP) assessment	FY 2019 Q4	FY 2020 Q4	7
Transition ARES as part of tracking package and conduct post transition assessment.	FY 2019 Q4	FY 2020 Q4	7
A sign cutting training module will be transitioned to USBP for enhancing tracking skills.	FY 2020 Q1	FY 2020 Q4	7
Eye-Dentify systems will be transitioned to CBP to enhance imposter detection and ID verifications skills.	FY 2020 Q1	FY 2020 Q4	7
FY 2021			
Create mobile application for USBP that sends geo-tagged tracking information to a team	FY 2020 Q4	FY 2021 Q4	6
Create a Web Enabled version of Eye-Dentify (impostor detection and ID validation capabilities) for CBP	FY 2020 Q4	FY 2021 Q4	7

Counter Terrorist Thrust Area
Research and Development
Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Counter Terrorist Thrust Area	$48,020	$44,515	$31,251

COUNTER TERRORIST THRUST AREA: 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 Chemical, Bioagent and Explosive (CBE) that terrorists may use to attack the Nation.

COUNTER TERRORIST THRUST AREA *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
Counter Terrorist Thrust Total		**$48,020**	**$44,515**	**$31,251**
Bioagent Threat Assessment		**$22,427**	**$21,427**	**$10,000**
	Bio-Defense Knowledge Center (BKC)	$4,000	$3,000	-
	Bio-Threat Characterization (BTC)	$18,427	$18,427	$10,000
Chemical Threat Assessment		**$4,393**	**$4,393**	**$4,393**
	Chemical Security Analysis Center (CSAC)	$4,393	$4,393	$4,393
Explosives Threat Assessment		**$18,700**	**$16,195**	**$15,358**
	Aircraft Vulnerability	$6,200	$3,695	$2,661
	HME Identification, Detection and Mitigation	$12,500	$12,500	$3,046
	Technology Explosives Assessment	-	-	$9,651
Hostile Behavior Predict and Detect		**$1,000**	**$1,000**	**$0**
	Actionable Indicators and Countermeasures	$1,000	$1,000	-
Identity Management		**$1,500**	**$1,500**	**$1,500**
	Digital Forensics	$1,500	$1,500	$1,500

Bioagent Threat Assessment Program

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.

- **Justification:** The FY 2021 President's Budget does not include new funding for this project, which is a $3.0M decrease from the FY 2020 Enacted budget.

- **Impact:** The BKC increases the awareness and understanding of biological threats across the HSE at multiple levels of classification. This work informs 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. This will enable the HSE to make informed decisions to prevent, prepare for, respond to, and recover from incidents involving these hazards.

Type of Research
Development

Technical Readiness Level
N/A

Transition Plans
S&T will provide technical reports and data analysis tools available to users across HSE via the Knowledge Management System at multiple classification levels.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Deliver two in-depth technical analyses of biothreat capability pathways to BKC stakeholders.	FY 2019 Q1	FY 2020 Q2	N/A
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	N/A
Expand the infrastructure developed for biological hazards to incorporate chemical and explosive hazards.	FY 2019 Q3	FY 2020 Q3	N/A
FY 2021			
N/A	N/A	N/A	N/A

Biological Threat Characterization (BTC)

- **Problem:** DHS Components and the biodefense community writ large lack critical data on certain characteristics of many biological threat agents, as well as the impact of technological advances on those characteristics. Improved data on these characteristics enables Components 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 in order 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) in order to ensure that the developed solutions mitigate hazards posed by biological threat agents.

- **Solution:** BTC activities provide knowledge products (technical reports) that are 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 in order 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).

- **Justification:** The FY 2021 President's Budget provides $10.0M for this project, a decrease of $8.4M compared to FY 2020 levels. The FY 2021 funding level will be used to enable a critical capability by executing characterization research at the NBACC, National Laboratories, and industry partners to fill critical knowledge gaps on biological hazards. This scientific data generated from this program is provided to various stakeholders across the HSE to inform an array of activities such as hazard modeling for operational planning, medical countermeasure development, policy development, etc. The FY 2021 Budget will greatly improve the preparedness of the United States Government (USG) for biodefense by supporting efforts to characterize traditional, emerging, enhanced, and advanced biological hazards to the Nation.

- **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.

Type of Research
Basic, Applied

Technical Readiness Level
TRL-3

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 reports 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. The BTC reports and knowledge products enable decision makers to appropriately prioritize biodefense spending on medical and non-medical countermeasure acquisition programs impacting billions of dollars of Government spending.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
BTC Projects execution.	FY 2019 Q1	FY 2019 Q4	3
BTC Projects next year planning.	FY 2019 Q3	FY 2019 Q4	3
BTC Yearly Project (portfolio) Review.	FY 2019 Q3	FY 2019 Q4	3
Completed NBACC Annual Plan execution.	FY 2018 Q4	FY 2019 Q2	3

Research and Development Description	Plan Start Date	Planned Completion	TRL
Developed 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.	FY 2019 Q1	FY 2019 Q4	3
Provided 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.	FY 2019 Q1	FY 2019 Q4	3
Produced and delivered four 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 2019 Q1	FY 2019 Q4	3
FY 2020			
Conduct BTC Projects execution, next year planning, and Year Project (portfolio) Review	FY 2020 Q1	FY 2020 Q4	3
Execute NBACC Annual Plan.	FY 2019 Q4	FY 2021 Q2	3
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.	FY 2020 Q1	FY 2020 Q4	3
FY 2021			
Based on priorities identified in collaboration with DHS Components, develop research studies to fill critical knowledge gaps on biological threat agents.	FY 2021 Q1	FY 2021 Q4	3
Transition at least four knowledge products resulting from biological threat agent studies to DHS Components and the biodefence community	FY 2021 Q1	FY 2021 Q4	3

Chemical Threat Characterization Program

This program researches and identifies current and potential chemical threats to better 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 identifies and develops countermeasures chemical, biological, radiological, and nuclear (CBRN) threats and develops comprehensive, research-based definable goals for such efforts. The need exists for a capability to identify and assess chemical threats and vulnerabilities in the U.S. and to 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.

- **Justification:** The FY 2021 President's Budget provides $4.4M for this project, the same level as FY 2020 Enacted. This level of funding will be used to enable a critical capability by providing chemical hazard analysis and threat characterization as well as chemical surveillance/ detection. CSAC provides 24/7 response and technical assistance to the HSE, modeling and simulation, characterization of current and emerging chemical threats, bulletins, threat scenario planning support to Federal and State agencies, and chemical threat knowledge tools that support the HSE. CSAC also provides rapid execution of high-priority and surge requirements.

- **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 CISA, USSS, CWMD, TSA, and I&A within DHS, as well as several interagency partners.

Type of Research

Developmental

Technical Readiness Level

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

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 the National Center for Medical Intelligence (NCMI) in order to launch the next iteration of the CARD.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed 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	N/A
Developed an updated Synthetic Opioid Data Repository for fentanyl and 200 synthetic analogs to serve as a vital resource to 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	N/A
Investigated, analyzed, and determined long term health effects from acute, sub-lethal exposures to opioids, including fentanyl and synthetic analogs.	FY 2019 Q1	FY 2019 Q4	N/A

Research and Development Description	Plan Start Date	Planned Completion	TRL
Completed and launched 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	7
Developed 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	N/A
Developed 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	N/A
FY 2020			
Complete and launch CARD v8.0.	FY 2020 Q1	FY 2020 Q4	7
Update Non Traditional Agent (NTA) Library to include advanced technical data matrices pertaining to fentanyl and synthetic opioid analogs on toxicology, medical countermeasures, physical properties, detection, decontamination, and personal protective equipment	FY 2020 Q1	FY 2020 Q4	N/A
Validate the CSAC-developed chemical source term tool and conduct studies to inform baseline vapor detection limits and optimal analytical targets.	FY 2020 Q2	FY 2020 Q4	N/A
Conduct scaled wind tunnel experiments to inform CISA Chemical Sector planning and preparation of outdoor experimentation.	FY 2020 Q2	FY 2020 Q4	N/A
Develop an enhanced outdoor model to handle multiple chemical releases	FY 2020 Q1	FY 2020 Q2	N/A
Develop and refine the Beta version of the HME 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	6
FY 2021			
Using the validated CSAC-developed chemical source term tool, conduct studies to design and evaluate new vapor detection strategies.	FY 2021 Q1	FY 2021 Q4	N/A
Develop an R&D roadmap for CISA Chemical Sector, in order to conduct a large scale chemical release experiment.	FY 2021 Q1	FY 2021 Q4	N/A

Explosives Threat Assessment Program

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 in air cargo, it is essential to first determine the effects that different explosive threats can cause to a variety of commercial aircraft. The vulnerability 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 explosives threat that would result in catastrophic aircraft loss. S&T continues to work to develop commercial aircraft blast mitigation technology that will provide protection to commercial aircraft. S&T is also developing emerging threats rapid response and assessment capability for commercial aircraft.

- **Justification:** The FY 2021 President's Budget provides $2.7M for this project, which reflects a decrease of $1.0M from the FY 2020 Enacted budget. This level of funding will be used to develop and report preliminary explosive vulnerability estimates and recommendations.

- **Impact:** Commercial aircraft vulnerability data collected under this project will be used by TSA to validate and refine explosives detection standards. TSA will ensure that EDS threat mass detection thresholds are sufficient to prevent introduction of explosive threats on board the aircraft that would otherwise result in catastrophic aircraft loss if detonated. 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.

Type of Research

Developmental

Technical Readiness Level

Completion of Threat Mitigation Unit (TMU) technology development was at TRL-7. Live fire test validated Modified Least Risk Bomb Location (M-LRBL) procedures at TRL-7.

Transition Plans

- Planned Demos and Deliverables/Transitions:
  - Conduct Blast testing of regular and large sizes of composite and aluminum aircraft panels.
  - Demonstration of M-LRBL procedures.
  - Deliver conventional aluminum aircraft explosive vulnerability testing
- Transition Products:
  - Deliver knowledge products to TSA to 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., validate M-LRBL procedures) to TSA.
  - Deliver updated Commercial Aircraft (aluminum fuselage structures) Explosive Vulnerability Analysis Tool (e.g.; BlastDam) to TSA.
  - Deliver explosive vulnerability estimates for wide body composite commercial aircraft to TSA.
  - Deliver recommendations on explosive equivalence (in reference to spherical C-4 baseline threat) approach for explosive damage and vulnerability of commercial aircraft to TSA.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Delivered to TSA an updated classified commercial aircraft vulnerability analysis report, incorporating narrow and wide-body aircraft (aluminum and composite-based aircraft structures) explosive vulnerability live fire test data collected from FY 2017 - present.	FY 2019 Q1	FY 2019 Q3	7
Completed live fire explosive validation testing of TSA specified M-LRBL and report results to TSA.	FY 2018 Q4	FY 2019 Q3	7
FY 2020			
Complete conventional (e.g., aluminum structures) airframe vulnerability testing and deliver updated vulnerability report to TSA.	FY 2020 Q1	FY 2020 Q4	7
Complete and deliver to TSA Commercial Aircraft (aluminum structures) Explosive Vulnerability Analysis Tool.	FY 2020 Q1	FY 2020 Q3	7
FY 2021			
Develop and report preliminary explosive vulnerability estimates for wide body composite composition structures commercial aircraft.	FY 2021 Q1	FY 2021 Q3	7
Develop and report preliminary commercial aircraft structural Damage Explosive Equivalence (in reference to spherical C4 baseline threat) recommendations.	FY 2021 Q1	FY 2021 Q4	7

Homemade Explosives Identification, Detection and Mitigation (HEID&M)

- **Problem**: The HME threat is persistent and continuously evolving. Detonation of a HME device presents an ongoing threat to the public and the homeland, in transportation as well as public places.

- **Solution:** The HEID&M project's primary mission is to mitigate against the effects of HME/Improvised Explosive Device (IED)-borne terrorist attacks. HEID&M leverages capabilities to advance the HMEID&M mission throughout its lifecycle, including:
  - Coordinating technical input from across the domestic and international community to inform standards, rulemaking, and harmonization activities.
  - Coordinating and conducting applied research, development, integration, and certification testing for the detection and mitigation of HME threats, including the management and utilization of laboratory capabilities.
  - Defining the needs and requirements for homemade explosive characterization to inform risk response and posture.
  - Performing explosive vulnerability assessments and developing testing tools and methods to inform future needs.
  - Supporting training requirements.

The project provides a path forward for HME threat solutions, concentrating on five focus areas: detection signatures and validated characterization; testing procedures for HME threat materials and devices in association with TSL managed facilities; training; risk response and assessment; and development of tools with the ability to preempt, detect, or mitigate HME threat impacts.

- **Justification:** The FY 2021 President's Budget provides $3.0M for this project, a decrease of $9.5M from the FY 2020 Enacted budget. This level of funding will be used to research and identify current and potential explosive threats to understand the risk posed to the United States, strengthen aviation security by bolstering the international aviation security system, and improve security processes and technologies.

- **Impact:** The HEID&M project 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. Additionally, the project 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 HEID&M project are technologies and knowledge products that protect national security and resiliency.

Type of Research

Developmental

Technical Readiness Level

The program began at TRL-6 and will end at TRL-7.

Transition Plans

- Deliver a comprehensive, multi-day HME Training course for TSA end-users.
- 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.
- 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.
- Provide precursor percentage data to CISA on Chemical Facility Anti-Terrorism Standards (CFATS) studies, in partnership with the FBI, informing the Global Initiative on precursor percentage regulations.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Initiated a baseline for OOI Red Team 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	FY 2019 Q1	FY 2019 Q4	6-7

Research and Development Description	Plan Start Date	Planned Completion	TRL
measures. This index testing measured the success of 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 2019 Q1	FY 2019 Q4	7
Delivered 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	7
Developed 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 Q3	7
FY 2020			
Deliver a comprehensive, multi-day Homemade Explosives Training course for TSA.	FY 2019 Q4	FY 2020 Q2	7
Transition chemical Region of Responsibility (ROR) to TSA.	FY 2020 Q1	FY 2020 Q3	7
Deliver first index testing baseline to TSA.	FY 2020 Q1	FY 2020 Q4	7
Deliver HExCAT consequence modeling to DHS Components.	FY 2019 Q4	FY 2020 Q4	7
Deliver report on lowering HME false alarms to the TSA.	FY 2020 Q1	FY 2020 Q4	7
Deliver small scale safety test results on 20 materials from the CFATS Chemicals of Interest.	FY 2020 Q1	FY 2020 Q4	7
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.	FY 2019 Q4	FY 2020 Q4	7
FY 2021			
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.	FY 2020 Q1	FY 2021 Q4	7
Provide precursor percentage data to CISA on CFATS studies, in partnership with the FBI, informing the Global Initiative on precursor percentage regulations.	FY 2020 Q1	FY 2021 Q4	7
Transition top 30 RORs from CONUS Detection Standards Analysis and revision methodology (DSARM) prioritized list to the TSA to improve security effectiveness and operational efficiency via selection and implementation against highest risk threats.	FY 2020 Q1	FY 2021 Q4	7
Transition Passenger Baggage Object Database (PBOD) HME Threat set to third party algorithm developers to improve security effectiveness via selection of alternate TSE, system automation, and/or process improvement.	FY 2020 Q1	FY 2021 Q4	7

Technology Explosives Assessment

- **Problem**: The TSL conducts T&E of all explosives and threat detection equipment utilized across the HSE, including systems installed at commercial airports. Explosive threats rapidly evolve, and emergent threats must be quickly and accurately characterized so that screening equipment can be upgraded to reliably detect these new threats. New more cost-effective screening equipment also must be validated

against both conventional and emerging threats.

- **Solution:** A network of laboratory capabilities are required to quickly and accurately characterize emerging threats and to develop cost-effective tools and T&E methods appropriate to analyze threats with modern screening technologies. TSL coordinates this capability through the management of core laboratories:
  - The W.J. Hughes Tech Center (NJ) characterizes explosive threats and develop test articles
  - The DHS-owned Tyndall Reactive Management Group (TRMG) facility on Tyndall AFB (FL) houses a collection of specialized data for HME
  - At the FBI TIEDS Center at Redstone Arsenal (AL), S&T performs rapid response transportation security equipment (TSE) assessments.

- **Justification:** The FY 2021 President's Budget provides $9.6M for this new project. This level of funding will be used to support the HME ID Detection & Mitigation strategic program by developing simulant validation methods for machine learning algorithms; developing drug detection methods and test articles; expanding scale up procedures for HME materials; developing new simulants for millimeter wave (MMW) and X-Ray Technologies; and developing testing methodologies and test articles for cargo skid screening systems.

- **Impact:** These capabilities enable quick, cost-effective, and accurate T&E of TSE in order to validate conformance with TSA requirements for existing and emerging threats. These capabilities also allow TSL to perform RDT&E that drives innovation and fosters the development of new technologies for the detection of emerging threats and other contraband (e.g. opioids).

Type of Research

Applied

Technical Readiness Level

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

Transition Plans

- The Technology Explosives Assessment capabilities do not, in general, produce products for external customers, but enables and facilitates the production of those products through applied research activities. The applied research customers, Developmental T&E and Independent T&E, work closely with staff to ensure the timely release of testing methods, standards, and quality control procedures necessary to support T&E.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
Develop simulant validation methods for machine learning algorithms.	FY 2021 Q1	FY 2021 Q4	5-7
Develop a drug detection methods and test articles.	FY 2021 Q1	FY 2021 Q4	5-7
Develop four new simulants for MMW and X-Ray technologies.	FY 2021 Q1	FY 2021 Q4	5-7
Develop testing methodologies and test articles for cargo skid screening systems.	FY 2021 Q1	FY 2021 Q4	5-7

Hostile Behavior Predict and Detect

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 in order to improve the effectiveness of violence prevention and intervention efforts implemented by FSLTT 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: 1) understanding individuals' motives both for engaging in, and disengaging from, violent extremism; 2) developing and supporting locally-tailored interventions with local partners; and, 3) evaluating the effectiveness of such interventions.

- **Justification:** The FY 2021 President's Budget does not provide funding for this project, a decrease of $1.0M from the FY 2020 Enacted budget.

- **Impact:** Through the FY 2019 and FY 2020 Enacted funding, new capabilities will be provided to 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 the 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.

Type of Research

Applied

Technical Readiness Level

TRL will vary between 2 and 7 for 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 will be adopted, piloted, and/or evaluated for impact and consequences, and then transferred to the Office of Targeted Violence and Terrorism Prevention (OTVTP).

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed a crowdsourcing app to identify available and appropriate violence prevention social services.	FY 2019 Q1	FY 2019 Q3	6
Conducted at least two qualitative data collection activities with prospective grantees.	FY 2019 Q1	FY 2019 Q4	5
Conducted 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	6
FY 2020			
N/A	N/A	N/A	N/A

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2021			
N/A	N/A	N/A	N/A

Identity Management Program

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 this number is 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 for the application of child exploitation, transnational crime, national security, organized crime and gang violence. It is imperative to improve the ability to identify perpetrators by providing research into 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 victims, and identify their perpetrators much faster. In addition, 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. This will be accomplished through the following activities:
  - Human Trafficking Systems Analysis & Technology Roadmap: Identifies technology gaps and provides recommendations for near-, mid-, and long-term development and implementation.
  - Matrix and Taxonomy- Human Trafficking*:* Maps government agencies and non-governmental organizations active in anti-trafficking efforts, including their relationships with each other. Identifies and matrixes 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: Convenes government agencies and law enforcement organizations from Australia, Canada, New Zealand, the United Kingdom, and the U.S. to exchange information, identify common priorities, and coordinate applied R&D efforts in countering child exploitation.
- Improving Child Exploitation Tip Prioritization and Utility: Enhances 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 Internet Service Providers (ISP)/Cloud Service Providers (ISP)/CSPs; and (2) identifying feedback that can be shared with ISPs/CSPs (e.g., information that led to law enforcement action) in order to encourage these entities to actively participate in the process by demonstrating return on investment.
- Child Exploitation Image Analysis Project: Designs, develops, tests, and integrates 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: Designs, develops, tests, and integrates new algorithms that characterize pictures taken from the same camera, thereby allowing forensic analysts to match still and video images. This better enables law enforcement officers to identify and locate victims and perpetrators. This work will also allow forensic analysts to cluster images from the same camera which will drastically reduce the amount of time necessary to locate victims and perpetrators.
- Language ID Tool: Develops, tests, and integrates 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.
- War Criminal Identification Project: Develops, tests, and integrates 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.

- **Justification:** The FY 2021 President's Budget provides $1.5M for this project, the same level as FY 2020 Enacted. This level of funding will be used to 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 ISPs/CSPs; and (2) identifying feedback that can be shared with ISPs/CSPs (e.g. information that led to law enforcement action) in order to encourage these entities to actively participate in the process by demonstrating return on investment.

- **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, thereby increasing an agent's effectiveness while drastically limiting the amount of time an agent must subject themselves to traumatizing material. This increases the number of children recognized and saved from a life of abuse. New capabilities will support more efficient and accurate analysis. This project improves the capability of Federal, State and local law enforcement.

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
- War Criminal Tool: TRL-5

Transition Plans

- Child Exploitation Image Analysis Project: Technology Transition Agreement was signed between S&T and the ICE Child Exploitation Investigations Unit (CEIU), who stress their need for these technologies and the operational ease in integrating new algorithms to their current forensic tool set for immediate operational use.
- Camera ID Project: Technology Transition Agreement was signed between S&T and the 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.
- Secure final Approval and signatures of Technical Annex for Digital Forensic Tool sharing by the U.S., Australia (AU), Canada (CA), New Zealand, and the United Kingdom.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed, tested, and operationalized 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 Q2	6
FY 2020			
Secure final Approval and signatures of Technical Annex for Digital Forensic Tool sharing by US, CA, UK and AU.	FY 2020 Q1	FY 2020 Q3	N/A
Test Camera ID algorithms as a disruptive technology to match digital imagery.	FY 2019 Q1	FY 2020 Q2	5
FY 2021			
Pursue Electronic Noise Frequency as a program if the science is mature.	FY 2020 Q2	FY 2021 Q4	4
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	FY 2019 Q4	FY 2021 Q4	6

Research and Development Description	Plan Start Date	Planned Completion	TRL
encourage these entities to actively participate in the process by demonstrating return on investment.			
Perform research using Camera ID algorithms on videos matching video to video, video to still and still to video digital imagery.	FY 2021 Q1	FY 2021 Q4	5
Transition machine learning language determination tools (developed by DARPA) capable of determining where language is spoken in a video sequences, what language is spoken and transcribing common languages to English text.	FY 2021 Q1	FY 2021 Q4	6

Cyber Security/Information Analysis R&D Thrust Area
Research and Development

Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Cyber Security / Information Analysis Thrust Area	$71,301	$29,500	$24,091

CYBER SECURITY / INFORMATION ANALYSIS R&D THRUST AREA: Conducts and supports RDT&E and the transition of advanced cybersecurity and information assurance technologies which secure the Nation's current and future cyber and critical infrastructures. These solutions include user identity and data privacy technologies, end system security, law enforcement forensic capabilities, secure protocols, and software assurance.

CYBER SECURITY / INFORMATION ANALYSIS THRUST AREA *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
Cyber Security / Information Analysis Thrust Total		**$71,301**	**$29,500**	**$24,091**
Information Analytics		**$5,000**	**-**	**$24,091**
	Decision Analytics	$5,000	-	-
	Cyber Data Analytics	-	-	$24,091
Network and System Security and Investigations		**$66,301**	**$29,500**	**-**
	Aviation Cyber Security	$4,758	$2,500	-
	CISA-Defined Requirements	$11,857	$5,000	-
	CISA Utility Protection Testbed	$3,000	-	-
	Cybersecurity for Law Enforcement	$5,100	$2,500	-
	Mobile Security	$16,860	$8,000	-
	Network System Security	$17,431	$8,500	-
	Software Assurance	$7,295	$3,000	-

Information Analytics Program

This program researches, analyzes, and develops technologies to strengthen interoperable communications and to improve effective information sharing at all levels of government.

Decision Analytics

- **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. Further, data analytics technologies, including computational, methodological, and systems components, rapidly evolve on six-month innovation cycles, thereby making it difficult to track solution options.

- **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 HSE. S&T has created the Data Analytics Engine (DA-E) and work center to assist 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-E works across disciplines to illuminate next generation problem sets and technologies (including social media and video analytics) to inform program planning, avoid technical obsolescence and prevent mission surprise.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **Impact:** DA-E helps analysts, operators, and agents across DHS increase mission effectiveness by better leveraging data for decision-making. DA-E provides S&T and DHS programs with coordinated information, subject matter expertise, mission studies, analysis of alternatives, experiments, prototypes, business methodologies, and transition planning to improve program efficiency, share best practices, and improve security and privacy protection across DHS analytics system investments.

Type of Research

Decision Analytics projects include elements of Basic, Applied, and Developmental research.

Technical Readiness Level

Decision Analytics projects range from TRL-2 through TRL-7.

Transition Plans

S&T will deliver targeted exploratory, developmental, and operational capabilities directly to the Component for operational use. Many deliverables will be transitioned through the commercial market place in the form of commercially supported open source products.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Demonstrate automated reporting tools on a DHS use case to improve efficiency in operations.	FY 2019 Q1	FY 2019 Q4	2-7
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Cyber Data Analytics

- **Problem:** Currently there is not a centralized source and capability for operational units (e.g., CISA National Cybersecurity and Communications Integration Center (NCCIC)) to query and correlate information related to cyber risk analysis, physical and infrastructure risk, and blended cyber-physical risk/threat. In order to close operational gaps, S&T must enhance the ability of operational units to correlate threat intelligence and risk data. This includes analysis of elements, increasing automated tools, and providing situational awareness in risk factors.

- **Solution:** This project supports the improvement of computational analytics and information sharing in order to improve homeland security cyber-physical security across government and the critical infrastructure sectors. This work is strategic in nature, with tactical capability milestones. The work is driven by a vision for next generation CISA architectures, computation, and decision-making capabilities, and establishes the foundation for future AI solutions. Initial activities will focus on maturing CISA data analytics efforts through the development of representative data sets, stand up of joint computational sandbox capabilities, assessment of emerging analytics tools, experimentation with a variety of analytics use cases, and establishment of strategic research capabilities for the development of secure multi-party computational capabilities. This will be accomplished through the following:
    - Information Marketplace for Policy and Analysis of Cyber-risk & Trust (IMPACT): Supports the global cyber-risk research community by coordinating and developing real-world data and information-sharing capabilities including tools, models and methodologies. To accelerate solutions around cyber-risk issues and infrastructure support, the IMPACT project coordinates data and information sharing between the government, critical infrastructure providers and the cybersecurity research and development community.

- Cyber Analytics Platform Capabilities: Develops and/or advances cyber analytic capabilities in three major areas: (1) automate, to the extent possible, what is currently a largely manual process of malware analysis; (2) improve Federal network protection through the development of an automated network data-centric threat discovery capability; and, (3) use data and analytics to gain information about adversaries to improve real-time network defense.
- Cyber Risk Economics (CYRIE): Improves the data-based decision-making of those who own, operate, protect, and regulate the Nation's vital data assets and critical infrastructure. CYRIE enables data and models to help organizations understand the specific cyber-risks they face, how to invest across the range of controls available to mitigate these risks, and how to quantify and understand the size and scope of actual harm when controls fail.

- **Justification:** The FY 2021 President's Budget provides $24.1M for this new project. This level of funding will be used to develop and deliver data analytics and machine learning technologies to enhance CISA Threat/Hunt capabilities and expand risk-consequence analysis from cyber-focus to blended cyber-physical environments within Federal networks and critical infrastructure.

- **Impact:** The project will provide improved operational utilization of large and complex data with modern data analytics techniques and enhanced tools and procedures. Enhanced risk analysis, consequence analysis, and threat intelligence data capabilities will improve incident response times and threat and mitigation correlation across Federal, State, and local governments and the private sector.

Type of Research
Applied and Developmental research.

Technical Readiness Level
Projects range from TRL-2 through TRL-7.

Transition Plans
S&T will deliver targeted exploratory, developmental, and operational capabilities directly to CISA for operational use.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			

Research and Development Description	Plan Start Date	Planned Completion	TRL
Conduct data audits of CISA data sets to characterize content, structure data elements, and prepare data sets for research and development technology assessments and evaluations.	FY 2021 Q1	FY 2021 Q2	2-7
Generate new and unique data feeds of various network actions such as malware network data, outage data, and DNS data for use by CISA and the cyber research community.	FY 2021 Q1	FY 2021 Q4	2-7
Deliver adversarial analysis of attacks with proof-of-concept for mitigation.	FY 2021 Q1	FY 2021 Q4	2-7
Deliver report on analysis of threat intelligence feeds.	FY 2021 Q1	FY 2021 Q3	2-7

Network and System Security and Investigations

This program produces the technologies needed to secure information and software that resides on the networks and systems that make up the Internet. It provides analytic tools for the law enforcement community to investigate crimes committed in cyberspace.

Aviation Cyber Security

- **Problem:** In today's global and interconnected economy, the safe movement of people and cargo across the open skies is a crucial factor in promoting free trade and advancing prosperity and freedom. Detecting, identifying, and defeating the array of cyber threats to the Global Air Domain is a national imperative. Unfortunately, when the current majority of aircraft were designed, decades ago, cyber security was not considered. Commercial aircraft flying today are extremely vulnerable to cyber-attacks.

- **Solution:** S&T will conduct the research to identify aircraft cyber vulnerabilities and develop mitigations to those vulnerabilities. The project will focus on identifying areas for strengthening cybersecurity within aircraft systems, but also create a robust assessment methodology and process that will be implemented to identify and eliminate threats to safe operation that emerge in the future.

- **Justification:** The FY 2021 President's Budget does not include any new funding for this project. This reflects a $2.5M decrease from the FY 2020 Enacted budget.

- **Impact:** The commercial aviation industry represents roughly five percent of the U.S. Gross Domestic Product (GDP). Disrupting U.S. commercial aviation industry interests would have a significant national economic impact.

Type of Research
Applied

Technical Readiness Level

TRLs-3 and 7

Transition Plans

As vulnerabilities are discovered and mitigations developed, the results and findings will be shared with the FAA to determine the level of risk and seriousness. If assessed as a "safety of flight" issue, the FAA, as the regulator, will take appropriate action. If deemed less than a "safety of flight" issue, then DHS will work with the industry partners to implement mitigation strategies, process, and procedures.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Execute Data Bus/Data Communication Link and General Avionic System following approved assessment plans.	FY 2019 Q3	FY 2020 Q3	3-7
FY 2020			
Conduct an analytical Cyber Tabletop Exercise with the broader community to inform potential use cases and priorities. This will provide documented insight into what areas to test, in accordance with National Institute of Standards and Technology (NIST) and DHS standards for cyber testing as well as the appropriateness of the test article and other testing mechanisms.	FY 2019 Q3	FY 2020 Q2	3-7
Execute Electronic Flight Bag Study following approved assessment plan	FY 2020 Q1	FY2020 Q3	3-7
Execute Maintenance Laptop and Data Loaders Study following approved assessment plan	FY 2020 Q2	FY 2020 Q3	3-7
Execute Flight Management System following approved assessment plan	FY 2020 Q2	FY 2020 Q3	3-7
Execute Navigation System following approved assessment plan	FY 2020 Q2	FY 2020 Q3	3-7
Execute Gear/Thrust Reverse System following approved assessment plan	FY 2020 Q2	FY 2020 Q3	3-7
FY 2021			
N/A	N/A	N/A	N/A

CISA-Defined Requirements

- **Problem:** Cyber threats are dynamic, and their attacks are asymmetric and difficult to predict. CISA's stakeholders and operational organizations need fast access to the latest advances in technology in order to ensure that they have the best tools to defend against threats. CISA needs novel technologies to address operational gaps and to provide its stakeholders and operational organizations with information about, early access to, or use of the latest cyber technology.

- **Solution:** S&T will partner with CISA and provide continued R&D support as CISA protects the Nation's cyber and critical infrastructure. This relationship will lead to the early adoption of R&D technologies by CISA operational stakeholders.

- **Justification:** The FY 2021 President's Budget does not include any new funding for this activity, which reflects a decrease of $5.0M from the FY 2020 Enacted.

- **Impact:** This project will allow CISA to remain abreast of the leading-edge cybersecurity defense capabilities as well as infrastructure protection activities. This will enable CISA to maintain preparedness and response to cyber, physical, and cyber physical attacks.

Type of Research
Applied and Developmental.

Technical Readiness Level
TRL varies between levels 2 and 7.

Transition Plans
Transition plans vary depending on the tools, technologies, research and methods produced under this project.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Researched technologies under development for situational awareness in various cyber environments.	FY2019 Q1	FY2019 Q4	2-7
Collected, refined, and updated cyber protection requirements and worked with DHS S&T to identify relevant technologies and projects that can meet CISA R&D requirements.	FY2019 Q1	FY2019 Q4	2-7
FY 2020			
Update CISA cyber security requirements to identify relevant technologies.	FY 2020 Q1	FY 2020 Q4	2-7
FY 2021			
N/A	N/A	N/A	N/A

CISA Utility Protection Testbed

- **Problem:** Due to the increasing sophistication of cybersecurity attacks, it is necessary to test new cybersecurity defenses and to research in a repeatable manner at a realistic scale in order to determine the best approach. Furthermore, such research and experimentation must be conducted in a secure environment to allow for testing against "live" threats, without endangering the larger Internet.

- **Solution:** S&T will develop the Defense Technology Experimental Research (DETER) Testbed, which provides a contained "virtual Internet" environment to conduct large scale, repeatable cybersecurity research experiments.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **Impact:** As the only freely available testbed of this scale, DETER improves attack mitigation and confinement strategies and the quality of new cybersecurity technologies as it is used by hundreds of organizations, including other government agencies, for test and evaluation purposes. Furthermore, DETER is also used as a tool for academia to enhance the educational experience of cybersecurity students, providing a realistic hands-on" experimentation platform for thousands of university students.

Type of Research
Applied

Technical Readiness Level
N/A

Transition Plans
The DETER Testbed project is a resource for the cybersecurity research community and does not currently have a plan to transition. Rather, it will exist as an enduring testing and experimentation resource for the entire cybersecurity R&D community to use.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Supported the development of cost efficient and operationally effective sensor technologies to support the Nation's public utility sectors	FY2019 Q1	FY2019 Q4	N/A
Identified potential utility sectors, which will clearly include electricity, natural gas, and water; public utilities could also include telephone, transportation, and broadband internet services (fixed line and mobile)	FY2019 Q1	FY2019 Q4	N/A
FY 2020			

Research and Development Description	Plan Start Date	Planned Completion	TRL
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Cybersecurity for Law Enforcement

- **Problem:** A significant barrier for law enforcement is keeping abreast of technology changes. New technology, both hardware and software, is released into the market at a very rapid pace and used in criminal and terrorist activity almost immediately.

- **Solution:** This project supports the development of new technologies, capabilities, and standards to assist law enforcement in cyber-crime investigations and the forensic analysis of technologies used in criminal activity. This will be accomplished through the following activities:
  - Anonymous Networks and Currencies: Criminals are increasingly exploiting the built-in privacy-enhancing protections for the legitimate use of anonymous networks and cryptocurrencies. S&T works with the law enforcement community to develop cost-effective solutions to complement and expand their abilities to investigate online criminal activity.
  - Cybersecurity Forensics: Almost all criminal investigations today include digital evidence. S&T works with the law enforcement community to gather requirements and to develop cost-effective solutions and capabilities. This supports quick acquisition and analysis of information from a wide variety of electronic devices including cell phones, GPS devices, tablets, and vehicle infotainment systems.

- **Justification:** The FY 2021 President's Budget does not provide funding for this project, which is a decrease of $2.5M from the FY 2020.

- **Impact:** These technologies, capabilities, and standards will reduce the amount of time needed to analyze technology used in illicit activity, reduce the cost of acquisition for law enforcement agencies whose budgets are stretched thin, and narrow the technology capability gap between criminals and law enforcement.

Type of Research
Developmental

Technical Readiness Level
TRL will vary between specific portfolio projects, 2-7.

Transition Plans

End-users and customers, including each of the DHS law enforcement components, test developed tools and technologies, and at times, the project provides limited hardware/software licenses to support transition. Otherwise, tools and technologies are transitioned into commercially available tools or integrated into law enforcement field deployment.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Published the Cyber Forensic Tool Test Reports (Knowledge Products) to the DHS public facing website, increasing the ability of the broader forensics community to determine the applicability of specific tools to their mission needs	FY2019 Q1	FY 2019 Q4	2-7
FY 2020			
Develop capability to monitor, identify, and track criminal usage of cryptocurrencies. This year's effort focuses on a specific currency of interest.	FY 2020 Q1	FY2020 Q4	2-7
Add law enforcement-specific features and modules to the open source digital forensics platform.	FY 2020 Q1	FY 2020 Q4	2-7
FY 2021			
N/A	N/A	N/A	N/A

Mobile Security

- **Problem:** The government's increasing reliance on mobile technology has made that technology an attractive and lucrative target for cyberattacks. The enhanced capabilities mobile technologies provide, the ubiquity and diversity of mobile applications and devices, and the typical use of the devices outside agencies' traditional network boundaries requires a security approach that differs substantially from the protections developed for desktop workstations. Further, security challenges exist across the complex mobile ecosystem, combined with mission need and cyber threats, presents security challenges and opportunities for additional study and mobile security R&D.

- **Solution**: To respond to the evolving threats and security challenges with mobile technologies, S&T will research and explore innovative technologies to meet the mission use cases and requirements. The Agency will develop secure, innovative, and mobile solutions to support the DHS and overall Federal government missions. Research and applied solutions will address multiple elements of the mobile ecosystem from mobile devices, software applications, and data to the underlying infrastructure of carrier networks, mobile operating system providers, and enterprise systems and infrastructure. This will be accomplished through the following initiatives:

- Mobile Device Security: Mobile technology has changed how people communicate, make daily decisions, and execute business transactions. However, the lack of security has prevented enterprise organizations from fully embracing mobile technology. The Mobile Device Security project is developing innovative security technologies to accelerate the secure adoption of mobility for mission use.
- Mobile Application Security (MAS): This project is developing innovative approaches to provide continuous automated assurance for security throughout a mobile application's lifecycle by monitoring commercial and Federal threat intelligence sources, correlating vulnerabilities across app stores, responsibly sharing threat information, and developing methods to provide actionable information to developers or security analyst to address threats and vulnerabilities.
- Secure & Resilient Mobile Network Infrastructure: The R&D project addresses security innovation for current and legacy protocol security challenges (e.g. Signaling System 7/Diameter, secure voice for Confidential Unclassified Information). S&T is seeking innovations to secure fifth generation telecommunications (e.g. network slicing, virtualization, and security monitoring). It is also developing innovative secure solutions for managing mobile network traffic for the HSE.
- Emergency Communications: An extension of mobile security, the Emergency Communications R&D project supports secure and resilient use of mobile communications for the public safety mission. In partnership with CISA, S&T will expand in the areas of public safety cybersecurity and operational framework, EC3 and media analysis framework, and more.

- **Justification:** The FY 2021 President's Budget does not include new funding for this project, a decrease of $8.0M from FY 2020 Enacted.

- **Impact:** Benefits from the Mobile Security R&D projects include higher assurance for mobile device integrity for operational use(s). Potential outcomes address the information and communications technology security chain challenges that exist today. If security is addressed early, the start for new applications and innovation in 5G will be hardened for enhanced Government use and Public Safety use.

Type of Research
Applied, and Developmental research.

Technical Readiness Level
Projects range from TRL-2 to TRL-7.

Transition Plans
S&T will deliver targeted exploratory, developmental, and operational capabilities directly to Components (i.e., CISA) for sustained operations.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Prototype Developed for MAS Program / Successful Demonstration.	FY 2019 Q1	FY 2020 Q2	6-7
Fully Demonstrated Pilots for Phishing Protection and Risk App Behavior for Mobile Threat Defense.	FY 2019 Q1	FY 2019 Q4	6-7
Awarded Small Business Innovation Research (SBIR) Phase II – Mobile & IoT Firmware Automated & Scalable Vulnerability Analysis - Phase I proof of concept successful, more than 140 Common Vulnerabilities and Exposures (CVEs) reported.	FY 2019 Q3	FY 2019 Q4	2-7
FY 2020			
SBIR award with Co-funding from DoD for Intelligent Waves (DHS portion is demonstration capabilities for pilot).	FY 2020 Q1	FY 2020 Q2	2-7
Information Sharing, Safeguarding, and Federated Identity, Credential and Access Management (ICAM) award	FY 2020 Q1	FY 2020 Q4	2-7
FY 2021			
N/A	N/A	N/A	N/A

Network System Security

- **Problem:** As the Internet continues to grow organically and exponentially, the protection of cyber infrastructure depends on the ability to identify critical Internet resources that are subject to attack and to develop robust metrics to determine the impact of cyber-attacks in a rapidly evolving environment. These resources include routing infrastructure, distributed denial of service defenses (DDoSD), and cloud-based systems.

- **Solution:** This program executes research in order to improve the multiple facets of network systems security. Effective network systems security needs to address multiple threats, provide a layered defensive approach, and include both hardware and software solutions. This will be accomplished through the following:
  - DDoSD: Distributed denial of service attacks are growing and frequently target critical infrastructure sectors and government agencies. The goal of the DDoSD project is to slow attack growth by promoting best practices and building technologies to mitigate new and current attack types. Through these strategies, critical infrastructure sectors and government agencies will have the ability to withstand one terabit per second attacks. This new level of defense will push the defender into the lead.
  - Security of Cloud-Based Systems: The Security of Cloud-based Systems project is developing technologies that will help mitigate the security implications of cloud computing, as well as leverage the dynamic nature of the cloud to provide enhanced defense for operational environments.

- Secure Protocols for the Routing Infrastructure: Routing infrastructure is one of the most critical components of the Internet, yet it is susceptible to spoofing and other attacks in which cyber criminals can redirect users to unsafe websites or pathways. The Secure Protocols for the Routing Infrastructure project's goal is to add security to the Internet's core routing protocol, namely Border Gateway Protocol (BGP), so communications follow the intended path between organizations.
- Application of Network Measurement Science: This project involves strengthening the certificate authority system, securing embedded systems and detecting network outages in real time.

- **Justification:** The FY 2021 President's Budget does not include funding for this project, which reflects a decrease of $8.5M from the FY 2020 Enacted budget.

- **Impact:** The development and application of capabilities will result in better predictions and defense against cyber-attacks on Federal Government installations and other critical infrastructure. This is accomplished at numerous points including DDoSD, routing infrastructure, and cloud-based systems.

Type of Research
Developmental

Technical Readiness Level
TRL will vary between specific portfolio projects

Transition Plans
The transition plan is multi-faceted with plans that are specific to each individual effort with final transitions to open source software, commercial licensing, and knowledge products. A variety of methods will be used to transition the tools, technologies, and methods produced under this project to include commercialization, transition to specific Federal Government organizations and both limited and open source licensing, depending on the product.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Telephony Denial of Service Defense (TDoS) focused on securing voice for 9-1-1 systems to develop a score for incoming calls and display the score into a visualization tool used in roughly 1/3 9-1-1 centers nationwide.	FY 2019 Q1	FY 2019 Q4	7
Developed voice authentication focused on contact center use. New patented technology incorporates both the device and voice characteristics.	FY 2019 Q1	FY 2019 Q3	4

Research and Development Description	Plan Start Date	Planned Completion	TRL
Developed consumer focused phone app to address robocalls	FY 2019 Q1	FY 2020 Q3	7
Developed new technology to identify and mitigate DDoS attacks. Low cost 100 gig capture capability developed. This is a follow-on to FY 2018 effort	FY 2019 Q1	FY 2019 Q4	6
Initial development to identify disruptive events on the internet with reporting	FY 2019 Q1	FY 2019 Q4	3
FY 2020			
Developed voice authentication focused on contact center use. New patented technology incorporates both the device and voice characteristics. – Follow-on.	FY 2020 Q1	FY 2020 Q4	7
Develop new technology to identify and mitigate DDoS attacks. Low cost 100 gig capture capability developed. Currently piloting in 3 ISP's on real traffic.	FY 2020 Q1	FY 2020 Q4	8
Enhance communication with the network operator community for increase compliance for the BCP38 standard	FY 2020 Q1	FY 2020 Q4	8
Enhance website for disruptive event notification	FY 2020 Q1	FY 2020 Q2	4
FY 2021			
N/A	N/A	N/A	N/A

Software Assurance

- **Problem:** There is a need to advance the science and technology for software quality assurance tools used to find defects in software. Modern software quality assurance tools generate too many false-positives and miss a good portion of actual defects in software.

- **Solution:** S&T will build and maintain a collaborative research environment to advance software quality assurance capabilities by offering 1) a collection of software quality assurance tools and assurance services for developers to test, evaluate and expose vulnerabilities in software and 2) provide software assurance tool developers an environment where they can test, calibrate, and improve the capability of their tools. The Agency will lead R&D efforts to modernize static analysis capabilities, improve synergies and integration with continuous delivery platforms, advance mobile application analysis, and proactive and automated threat analysis for application security. The project will also increase adoption of software assurance tools and best practices by increasing market transparency of software assurance tools, assessing tools against a common framework. S&T will accomplish this through the following activities:
  - Application Security Threat and Attack Modeling (ASTAM): ASTAM is a proactive analysis capability that monitors and actively protects systems and applications by identifying potential risks, security threats, and exposures to the system environment, and then developing appropriate countermeasures to prevent, or mitigate the effects of threats to the system environment by bringing together independent assessment activities to build better situational awareness regarding potential threats.
  - Static Tool Analysis Modernization Project (STAMP): The goal of STAMP is to modernize a list of candidate software analysis tools (open-source) to improve tool performance and coverage, to seamlessly integrate and support continuous integration and operational environments,

as well as provide stronger analysis of results by reducing false-positives and provide more visibility into false-negatives that often leave residual risks. STAMP should be designed to create new techniques that advance the state-of-the-art capabilities found in software analysis tools.

- Software Assurance Marketplace (SWAMP): Software has become an essential component of the Nation's critical infrastructure. Software capability and complexity has increased at a rate that exceeds our ability to keep pace with quality software. The SWAMP is S&T's response to address the growing concern. This project provides a broad range of software assurance services and capabilities to help improve the quality and security of software as well as improve the overall capabilities in software quality assurance tools. SWAMP helps to formalize software assurance in organizations and provides a collaborative research environment for tool developers and researchers to advance software assurance capabilities. This national-level resource will change the software assurance community for years to come.
- Software Quality Assurance: The growing reliance on software makes everyone vulnerable to cyberattacks. The complexity and size of software makes it difficult for software quality assurance tools to identify potential weaknesses that expose vulnerabilities in software. The project is working to create and improve the techniques and capabilities used in static, binary and dynamic analysis tools to help create a healthier and more secure software ecosystem.

- **Justification:** The FY 2021 President's Budget does not provide new funding for this project, and is a reduction of $3.0M from FY 2020 levels.

- **Impact:** Developed solutions will reduce the number of weaknesses found in software and minimize the software's attack surface by applying the principle of continuous assurance throughout the software development process. This will afford developers the opportunity to detect bugs and defects in their software early in the software development process. The result is a lower total cost of ownership to build and maintain software.

Type of Research

Applied, and Developmental research.

Technical Readiness Level

Projects range from TRL-2 to TRL-9.

Transition Plans

Deliver targeted exploratory, developmental, and operational capabilities directly to sustained Component operations (CISA).

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Develop and deliver initial prototype of software assurance tools comparison framework.	FY 2019 Q1	FY 2019 Q1	5
Deliver software application testing tools that will reduce the amount of time analysts spend on testing, including tools that map the attack surface of an application and track progress of application testing.	FY 2019 Q1	FY 2019 Q4	9
FY 2020			
Coordinate with the National Institute of Standards and Technology (NIST) to ensure sure that test cases, and associated datasets are incorporated into the Static Assurance Metrics and Tool Evaluation (SAMATE) program	FY 2020 Q1	FY 2020 Q4	5
Develop a comprehensive scoring framework to assess the performance of software quality assurance tools and deploy via web-based interface, helping improve market transparency and helping drive adoption.	FY 2020 Q1	FY 2020 Q4	8
FY 2021			
N/A	N/A	N/A	N/A

First Responder/Disaster Resiliense Thrust Area
Research and Development

Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
First Responder / Disaster Resilience Thrust Area	$92,927	$71,515	$53,416

FIRST RESPONDER / DISASTER RESILIENCE THRUST AREA: Work includes the reduction of vulnerability of critical infrastructure, key leadership, and events to terrorist attacks and other hazards; working with SLTT 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 SLTT 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.

FIRST RESPONDER / DISASTER RESILIENCE THRUST *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
First Responder / Disaster Resilience Thrust Total		**$92,927**	**$71,515**	**$53,416**
Bioagent Attack Resiliency		**$12,662**	**$3,000**	**$5,000**
	Bio-Forensics R&D	$5,682	-	-
	Compact Personal Protective Equipment	$2,000	-	$2,000
	Foreign Animal Disease Vaccine, Diagnostics & Countermeasures	$1,980	-	-
	USCG/EPA Wide Area/Vessel Decontamination Project	$3,000	$3,000	$3,000
Explosives and Rad/Nuc Attack Resiliency		**$5,000**	**$5,000**	**-**
	Explosives & Rad/Nuc Attack Resiliency	$5,000	$5,000	-
First Responder Capability		**$20,800**	**$16,000**	**$12,729**
	First Responder Technologies	$16,000	$9,500	$10,229
	Next Generation First Responder	$4,800	-	-
	Response and Defeat Operations Support (REDOPS)	-	$4,000	-
	Stakeholder Engagement and Requirements (First Responder Requirements Group & International)	-	$2,500	$2,500

FIRST RESPONDER / DISASTER RESILIENCE THRUST *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
Information Sharing, Analysis, and Interoperability		**$13,461**	**$15,700**	**$14,200**
	First Responders Emergency Response and Management Tools	$7,261	-	-
	Public Safety Communications	-	$7,700	$14,200
	Public Safety Wireless Communication	$6,200	$8,000	-
Natural Disaster Resiliency		**$41,004**	**$31,815**	**$21,487**
	CISA NCPS Cybersecurity Architecture Analysis	$3,500	-	-
	Counter Human Trafficking	-	$3,000	-
	Cyber for Critical Infrastructure	$3,650	$3,650	-
	Cyber Physical Systems	$6,165	$6,165	$7,817
	Disaster Recovery	-	-	$4,500
	Federal Systems Security	$8,000	$5,000	$2,184
	Flood	$10,000	$10,000	$6,986
	GPS Vulnerability Assessment in the Critical Infrastructure	$6,702	$4,000	-
	National Hurricane Technology	$1,000	-	-
	Regional Resilience Assessment Technology Modernization	$1,987	-	-

Bioagent Attack Resiliency Program

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.

Bio-Forensics R&D

- **Problem:** Bioforensics R&D is required in order to improve the ability to identify and to characterize source material collected from a bio-crime, which is necessary 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.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **Impact:** The Bioforensics R&D project leads national research efforts in microbial forensics and transitions analytical techniques to the National Bio-forensics Analysis Center (NBFAC) 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 to assign attribution and prevent or mitigate losses from future similar bio attacks.

Type of Research
Applied

Technical Readiness Level
The program began at TRL-4 and will end at TRL-6.

Transition Plans
This project provides NBFAC and law enforcement agencies with the required tools and methods needed in order to analyze bioagent samples involved in a biological terrorist attack or crime. This project also provides enhanced scientific data and analysis for legal admissibility into the U.S. courts.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Established capability to perform analysis of toxic biological molecules (protein toxins).	FY 2019 Q1	FY 2019 Q4	4-5
FY 2020			
Transition bioinformatics tools to support interpretation of metagenomics data in support of bioforensics investigations.	FY 2019 Q1	FY 2020 Q1	4-5
Deploy application to enable law enforcement for the identification of toxic plant materials.	FY 2019 Q1	FY 2020 Q1	5-6
FY 2021			
N/A	N/A	N/A	N/A

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 chemical, biological and radiological (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:** S&T is working to develop a compact, lightweight hooded escape respirator that can be rapidly deployed and provide respiratory protection against hazardous CBR substances. This device would enable the user to breathe in an oxygen-deficient situation and would 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.

- **Justification:** The FY 2021 President's Budget provides $2.0M for this project, an increase of $2.0M from the FY 2020 Enacted budget. This level of funding will be used to finalize performance requirements and advance escape respirator design to a fully-functional prototype.

- **Impact:** Improvements in PPE 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 pre-determined location to retrieve the PPE in the chaos of a rapidly unfolding event. The PPE will find use within the Federal, State, local, and tribal law enforcement and first responder communities.

Type of Research
Applied, Developmental

Technical Readiness Level
TRL 3-4

Transition Plans
S&T will provide hooded escape respirators developed with NIOSH-certification for use by DHS Components, First Responders and Law Enforcement Community members.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Selected winning prototype design/concept for compact escape hood respirator among Prize Competition finalists.	FY 2019 Q2	FY 2019 Q2	3
FY 2020			
Award advanced development contract to Prize Competition winner.	FY 2020 Q3	FY 2020 Q4	N/A
Hold kickoff meeting with Prize Competition winner.	FY 2020 Q4	FY 2020 Q4	N/A
FY 2021			
Complete preliminary design review.	FY 2021 Q3	FY 2021 Q3	3
Deliver advanced prototype.	FY 2021 Q1	FY 2021 Q4	4

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 utilizes the Plum Island Animal Disease Center (PIADC) to develop 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.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include funding for this project.

- **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.

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

Foreign Animal Disease Vaccines are targeted for transition to the Veterinary Vaccine Stockpile.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Development and Licensure of a wildlife vaccine for Epizootic Hemorrhagic Disease Virus.	FY 2018 Q3	FY 2019 Q2	6
FY 2020			
Establishment of a High Performance Computing Capability (data analytics and modeling) for Agricultural Biosecurity.	FY 2019 Q1	FY 2020 Q2	6
FY 2021			
N/A	N/A	N/A	N/A

USCG/EPA Wide Area/Vessel Decontamination Project

- **Problem:** A terrorist attack involving the release of an aerosolized biological agent, e.g. *Bacillus anthracis* (i.e. anthrax) 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, which include characterization, decontamination, waste management, and clearance, have to date only been proven effective and scalable for single building, 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, waste management procedures and clearance to inform response and recovery decisions.

- **Justification:** The FY 2021 President's Budget provides $3.0M for this project, the same level as FY 2020. This level of funding will be used to plan and execute a field demonstration of strategies and methods for recovery of USCG assets in a wide-area biological contamination event. The funding will include delivery of multiple decision support tools and web-based guidance and recommendations to inform recovery operations.

- **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 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 help to instill confidence in the safety of natural resources (e.g., drinking water).

Type of Research
Applied, Developmental

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Evaluate decontamination options for urban areas and USCG assets.	FY 2019 Q1	FY 2020 Q1	4
Complete laboratory evaluation of decontamination options for urban areas and USCG assets.	FY 2019 Q1	FY 2020 Q1	4
FY 2020			
Conduct field demonstration of sampling, decontamination and waste management methods and strategies for USCG small vessels.	FY 2020 Q1	FY 2020 Q2	7
Complete lab-based evaluation of wide-area sampling methods.	FY 2018 Q3	FY 2020 Q3	6
FY 2021			
Complete decontamination decision support tool for a wide area biological agent incident, incorporating field-tested methods for urban areas, vegetation, critical infrastructure and USCG assets.	FY 2020 Q1	FY 2021 Q4	6
Conduct wide area decontamination demonstration of USCG assets including vegetation and urban areas.	FY 2021 Q2	FY 2021 Q4	7

Explosives & Rad/Nuc Attack Resiliency

This program provides advanced planning, develops CONOPS, develops advanced materials, and funds exercises and training for responding to and recovering from a disaster employing explosives.

Explosives & Rad/Nuc Attack Resiliency

- **Problem:** The detonation of a Radiological Dispersal Device or Improvised Nuclear Device would be high consequence incidents and pose tremendous challenges to the first responder community and HSE.

- **Solution:** S&T will utilize the National Urban Security Technology Laboratory (NUSTL) to improve responder preparedness for the complexity of a radiological incident response and recovery operations. By working with partner agencies, Federal interagency working groups, and first responders, S&T will identify impactful opportunities that address technology and research needs in the areas of radiological response management, incident characterization, initial response capabilities, medical care/triage, casualty/evacuee care, impacted area stabilization/control, and site cleanup/decontamination.

- **Justification:** The FY 2021 President's Budget does not provide new funding for this project. This is a decrease of $5.0M from FY 2020.

- **Impact:** The project will result in improved radiological response capabilities at both the local and national level through strategic investment in projects focused on increasing agency preparedness, improving government understanding of impacts and risks, and finding technological solutions to radiological capability gaps and mission needs.

Type of Research
Basic, Applied, Developmental

Technical Readiness Level
TRL-5 through TRL-7

Transition Plans
S&T will utilize project partners to connect first responders with Federal agencies and specialized radiological assets that will assist them during a radiological response. Leverage existing radiological training and preparedness organizations to assist in distributing and integrating developed technology and knowledge products into State/Local radiological /nuclear preparedness and response activities:

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
In support of public safety and recovery decision making, expand capability of NARAC to develop urban dispersion modeling for DHS-IMAAC customers for additional radiological/nuclear hazards.	FY2020 Q1	FY2020 Q4	5-7
Develop and publish science-based planning guidance for the first 48 hours nuclear detonation response, outlining specific missions and tactics for first responder operations.	FY2020 Q1	FY2020 Q4	5-7
FY 2021			
N/A	N/A	N/A	N/A

First Responder Capability Program

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.

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:** S&T will 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. S&T focusing on the following solutions/technologies:
  - Emergency Vehicle to Emergency Vehicle Early Warning System: A notification system that provides other emergency vehicles with a warning that an active emergency vehicle is 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.
  - 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 Geo-Social 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.

- **Justification:** The FY 2021 President's Budget provides $10.2M for this project, an increase of $0.7M from the FY 2020 Enacted budget.

- **Impact:** These technologies 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.

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 manufacture and transition the technology to the commercial marketplace for the first responder community to purchase.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Began design for six new first responder technology awards.	FY 2019 Q3	FY 2019 Q3	N/A
Developed a prototype of First Responder Routing Logic Guide.	FY 2018 Q2	FY 2019 Q3	3-4
Developed a prototype of Integration of Public Data Feeds.	FY 2018 Q2	FY 2019 Q2	3-4
Transitioned the REDOPS Pan Aiming Device.	FY 2018 Q4	FY 2019 Q1	7
Transitioned EDGE School Environment.	FY 2018 Q4	FY 2019 Q1	7
Transition Rescue Hoist Protective Glove.	FY 2019 Q3	FY 2020 Q2	6
Transition Emergency Vehicle to Civilian Vehicle Early Warning System.	FY 2019 Q4	FY 2020 Q3	6
Transition Wildland Firefighter Respiratory Protection.	FY 2019 Q4	FY 2020 Q3	4
Transition Integration of Public Data Feeds.	FY 2019 Q3	FY 2020 Q2	5
Transition Respiratory Protection Equipment.	FY 2019 Q1	FY 2019 Q3	7

Research and Development Description	Plan Start Date	Planned Completion	TRL
Transition Multi Meter Wire Attack Kit.	FY 2019 Q4	FY 2020 Q3	7
FY 2020			
Award contracts for six new first responder technology development efforts.	FY 2020 Q1	FY 2020 Q2	N/A
Begin design for six new technology development efforts.	FY 2020 Q3	FY 2020 Q3	N/A
Develop prototypes for six new first responder technology development efforts.	FY 2020 Q4	FY 2020 Q4	3
Transition a minimum of two first responder technologies to the commercial market place.	FY 2020 Q1	FY 2020 Q4	7
Execute four REDOPS test bed assessments.	FY 2020 Q1	FY 2020 Q4	4-6
Validate and produce knowledge products for a minimum of four micro technologies.	FY 2020 Q1	FY 2020 Q4	N/A
Develop and test two REDOPS IED render safe technologies.	FY 2020 Q1	FY 2020 Q4	4-6
FY 2021			
Award contracts for six new first responder technology development efforts.	FY 2021 Q1	FY 2021 Q2	N/A
Begin design for six new technology development efforts.	FY 2021 Q3	FY 2021 Q3	N/A
Develop prototypes for 6 new first responder technology development efforts.	FY 2021 Q4	FY 2021 Q4	3-4
Transition four first responder technologies to the commercial market place.	FY 2021 Q1	FY 2021 Q4	N/A

Next Generation First Responder

- **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.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

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

Type of Research

Developmental

Technical Readiness Level

The program began at TRL 2 and end 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conducted 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	N/A
Conducted 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	N/A
Conducted 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	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Response and Defeat Operations Support (REDOPS)

- **Problem**: The response environment that our Nation's responders operate in on a day-to-day basis is constantly changing and requires and 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 particular, Public Safety Bomb Squads and Special Weapons and Tactics (SWAT) Teams are on the forefront of addressing emerging threats such as active shooter, complex coordinated attacks, and improvised explosive devices.

- **Solution**: S&T will support short, medium, and long-term focused efforts that ensure regular delivery of new capabilities to supported first responders. The Agency will identify user-developed innovations through direct and regular interaction with user community to identify user developed innovations that with additional development can be quickly transitioned. S&T will also identify high priority requirements and capability gaps, develop solutions, and conduct operational assessments of next generation technologies that address identified gaps, with a goal of rapidly developing and transitioning new capabilities. Furthermore, S&T will perform operational assessments of emerging technologies that assess new capabilities with immediate field applications and identify new research and development requirements. Finally, the Agency will develop IED disablement techniques through a combination of rigorous scientific testing and cutting-edge engineering practices. Specifically, S&T is focusing on the following:
  - Micro Research and Development: Identify user developed innovations that can quickly transition to community-wide use. Validate performance of the innovation and develop required designs and specification for immediate to operational use. Validate knowledge products with State and local agencies. Developed capabilities are transitioned in less than 12 months.
  - Operational Assessments and Response Experimentation: Perform user-driven operational assessments of emerging technologies with immediate field applications in order to identify capabilities and limitations of equipment and systems, new technology development requirements, and lessons learned/best practices in high threat operational responses. Knowledge products are transitioned within 12-18 months.
  - RAPID: Research and Prototyping for IED Defeat develops cutting edge counter-IED defeat capabilities with focused R&D on emerging threat devices. RAPID uses a hard science approach, both in the lab and in the field, to find the best possible methods for safety disabling bombs. Developed capabilities are transitioned to operational use within 12-24 months. RAPID is performed in partnership with the FBI Critical Incident Response Group who transitions all REDOPS technologies to the State and local community.
  - RAPTOR: Research and Prototyping for Tactical Operations applies the REDOPS model to the tactical community with focused operational assessments, response experimentation, and micro-R&D in direct support the FSLTT SWAT community.

- **Justification:** The FY 2021 President's Budget does not include new funding for this project, which is a decrease of $4.0M from FY 2020 levels.

- **Impact**: Developed solutions will strengthen the front-line public safety response capabilities to the highest priority threats and increase our ability to protect the homeland and respond to terrorist and criminal activities while saving lives and protecting property.

Type of Research
Projects include elements of Basic, Applied, and Developmental research.

Technical Readiness Level
Projects range from TRL-3 to TRL-7.

Transition Plans
The program partners with the National Bomb Squad Commanders Advisory Board, International Association of Bomb Technicians and Investigators, United States Bomb Technicians Association, National Tactical Officers Association, and the Department of Defense who are directly involved with the activities associated with this project from initiation to transition. In addition, the program partners with the FBI who serves as the National Program Manager for Counter IED activities and is responsible for the Hazardous Device School which trains all Public Safety Bomb Technicians within the United States. Products are evaluated and/or characterized before being transitioned directly into the Hazardous Device School and/or through the FBI's Law Enforcement Enterprise Portal. This ensures that applicable work products reach the bomb technician community.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
Award Contracts for six new first responder technology development efforts.	FY 2020 Q1	FY 2020 Q2	N/A
Begin design for six new technology development efforts.	FY 2020 Q3	FY 2020 Q3	3-7
Develop prototypes for 6 new first responder technology development efforts.	FY 2020 Q4	FY 2020 Q4	3-7
Transition four first responder technologies to the commercial market place.	FY 2020 Q1	FY 2020 Q4	3-7
Execute four REDOPS test bed assessments.	FY 2020 Q1	FY 2020 Q4	3-7
Validate and produce knowledge products for six REDOPS micro technology efforts.	FY 2020 Q1	FY 2020 Q4	3-7
Develop and test two REDOPS IED render safe technologies.	FY 2020 Q1	FY 2020 Q4	3-7
FY 2021			
N/A	N/A	N/A	N/A

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.

- **Justification:** The FY 2021 President's Budget provides $2.5M for this project, the same level as FY 2020 Enacted. This level of funding will be used to facilitate the planning and execution of the annual First Responder Resource Group meeting, where the Nation's first responder capability gaps are identified, prioritized and requirements are developed. 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 S&T on a yearly-basis to provide requirements for high priority technology development needs. Additionally, the gaps will be converted to R&D projects through the BAA process and finally the overarching strategic document that guides S&T's first responder R&D efforts will be and updated.

- **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 20 technologies to the commercial market place for first responder to purchase.

Type of Research

Applied

Technical Readiness Level

Most of the projects awarded through these activities start at a TRL- 4 and end at a TRL-- 7. There are exceptions where a project may start at a TRL-1. When this occurs, the projects still end at TRL-7. 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 encourages industry and other stakeholders to identify and develop solutions for first responders.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	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	N/A
FY 2021			
Execute one BAA solicitation and make six to ten new start R&D awards.	FY 2020 Q3	FY 2020 Q1	N/A
Refresh the Project Responder Strategic Direction Document	FY 2020 Q1	FY 2021 Q1	N/A
Hold one annual requirements gathering conference and identify 12 to 16 new technology requirements for DHS Components and our Nation's law enforcement, fire and emergency medical service first responder.	FY 2021 Q2	FY 2021 Q2	N/A
Refresh the Project Responder Strategic Direction Document	FY 2021 Q1	FY 2021 Q4	N/A

Information Sharing, Analysis, and Interoperability Program

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.

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 Specifically, S&T is focusing on the development of the following solutions:
  - *Vehicle Inspection for Early Warning (VIEW)*: Provides enhanced under vehicle scanning in support of CBP and FPS requirements for layered security and force protection.

- *School Age Trauma Training (SATT)*: Includes life safety training for mass casualty events in support of FEMA's Individual and Community Protection Divisions efforts to help citizens prepare for disasters.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **Impact:** This project will result in 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.

Type of Research
- *VIEW:* Applied
- *SATT:* Developmental

Technical Readiness Level
- *VIEW:* TRL-2
- *SATT:* TRL-2

Transition Plans
- *VIEW:* S&T 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:* S&T 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
VIEW – Designed 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	2
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 2020 Q2	2

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Public Safety Communications

- **Problem:** DHS Components need to have access to mission-critical communications solutions. While the introduction of broadband networks has allowed for an increased capability to share data and an alternative voice network, it has also resulted in a more complex environment where responders need to be ensured interoperability across networks. Moreover, the diversity of networks has resulted in complex spectrum sharing arrangements and a greater risk of interference. Finally, as the IoT has allowed for more information to be made available to responders, there is an increased need for analytics to ensure they do not become overwhelmed by data.

- **Solution:** Through the RDT&E of technologies, S&T will develop, tailor, and transition to operational use the mission-critical technologies that assist S&T's Component customers as they navigate across various networks and manage vast amounts of data. S&T will also identify and promote the development of standards-based solutions to ensure interoperability.

- **Justification:** The FY 2021 President's Budget provides $14.2M for this project, an increase of $6.5M from FY 2020 Enacted. This level of funding will be used to develop and deliver technology solutions, including knowledge products, to DHS Component as well as the broader first responder community in the area of communications and information sharing.

- **Impact:** This project provides a critical testing and evaluation capability for component customers to gain knowledge on mission critical communications technologies that provide efficient and effective use of networks and spectrum. This project will also examine how to parse through data and present only actionable, necessary data to the end user.

Type of Research
Developmental and Applied

Technical Readiness Level
TRL-3 through 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. Publicly 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
Test low-earth satellite comms IP protocols.	FY 2021 Q1	FY 2021 Q3	3-6
Design, plan, and execute Spectrum Interference Exercise in coordination with component customers.	FY 2021 Q1	FY 2021 Q4	7
Test FirstNet CORE interoperability between tier 1, 2, 3 service providers to evaluate body-worn devices.	FY 2021 Q1	FY 2021 Q1	5-6
Develop knowledge products for first responders to support public safety broadband implementation.	FY 2021 Q1	FY 2021 Q4	6
Conduct Inter RF Subsystem Interface (ISSI) and Console Subsystem Interface (CSSI) testing and report results	FY 2021 Q1	FY 2021 Q2	8

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:** S&T will conduct viable research as well as develop, test, and evaluate capabilities to ensure first responders are able to communicate regardless of the type of network. Specifically, S&T is focusing on the following capabilities:

    - 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: These systems are 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. Based on first responders' needs, the systems provide on-demand communication and computing capability.
- 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: Funding supports the development 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): AUDREY is a 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: S&T provides support to Federal, State, and local responders through participation in Shaken Fury 2019 Exercise. Activities will include technology demonstration, integration, and evaluation.

- **Justification:** The FY 2021 President's Budget does not include new funding for this project, which is a decrease of $8.0M from FY 2020.

- **Impact:** With prior year funding, 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.

Type of Research
Developmental and Applied

Technical Readiness Level
TRL levels vary across each sub-project within wireless communications. As a whole wireless communication 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed After Action Report from the Datacasting integration pilot with the Federal Law Enforcement Training Center in Glynco, Georgia.	FY 2019 Q1	FY 2019 Q4	4-7
Demonstrated datacasting utility with continued demonstrations/testing with public safety end users.	FY 2019 Q1	FY 2019 Q4	4-7
Integrated a Sensor Things API service infrastructure with Controller Core to support sensor discovery out in the field.	FY 2019 Q1	FY 2019 Q4	4-7
Developed automated speech recognition capability for first responders.	FY 2019 Q1	FY 2019 Q4	4-7
Completed Field Test automated speech recognition capability for first responders.	FY 2019 Q1	FY 2019 Q3	4-7
Provided Deployable System and AUDREY local and/or cloud integration and test.	FY 2019 Q3	FY 2019 Q3	4-7
Delivered unlicensed Spectrum Use Report Research into unlicensed deployments and feasibility of 1 watt Wi-Fi deployments.	FY 2019 Q3	FY 2019 Q4	4-7
Completed report on fog computing and applicability for PS vs. cloud or local deployments.	FY 2019 Q2	FY 2019 Q3	4-7
Completed report on effectiveness of Bluetooth / other methodologies as a PS protocol.	FY 2019 Q2	FY 2019 Q4	4-7
Created deployable analytics testing framework (hardware and software) for PS pilot.	FY 2019 Q4	FY 2019 Q4	4-7
FY 2020			
Conduct continued speech analytic systems evaluation event using the above datasets.	FY 2019 Q4	FY 2020 Q2	4-7
Develop a knowledge product for first responders to help inform video system design and procurement decisions.	FY 2020 Q1	FY 2020 Q3	4-7
Demonstrate datacasting utility with local first responder groups.	FY 2020 Q1	FY 2020 Q1	4-7
Develop advanced prototype for automated speech recognition capability for first responders.	FY 2020 Q1	FY 2020 Q3	4-7

Research and Development Description	Plan Start Date	Planned Completion	TRL
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	4-7
FY 2021			
N/A	N/A	N/A	N/A

Natural Disaster Resiliency Program

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.

CISA National Security Protection System (NCPS) Cybersecurity Architecture Analysis

- **Problem:** The Federal government relies on its IT infrastructure and the Internet to provide efficient and effective services to manage the growing amount of data needed to carry out its missions. This reliance makes the Federal IT infrastructure a high-priority target for sophisticated adversaries.
- **Solution:** S&T will partner with CISA and provide continued R&D in support of the NCPS. Specifically, S&T will conduct research for intrusion detection, analysis, and prevention.
- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.
- **Impact:** With previously enacted funding, this project will assist CISA in the R&D necessary to defend the Federal civilian government's IT infrastructure from cyber threats.

Type of Research
Developmental

Technical Readiness Level
TRL varies between 2 and 7.

Transition Plans

Transition plans vary depending on the tools, technologies, research and methods produced under this project.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Researched technologies under development for situational awareness in various cyber environments.	FY2019 Q1	FY2019 Q4	2-7
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Counter Human Trafficking

- **Problem:** There are an estimated 25 million human trafficking victims world-wide, comprising an industry worth more than $150.0B 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 DHS.

- **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 include mapping current trafficking efforts among Government, non-governmental organizations, and the private sector and detailed needs assessments through extensive involvement with operational stakeholders. Taken together, these efforts will form a detailed out-year research agenda. S&T will focus on the following activities to obtain this solution:
  - 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.

- **Justification:** The FY 2021 President's Budget does not include new funding for this project, a decrease of $3.0M from FY 2020.

- **Impact:** The 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.

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 efforts will inform the development of a human trafficking research strategy for FY 2020 and beyond that meets stakeholder needs.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
Operational Roadmap – Human Trafficking: Elicit needs and gaps from operational human trafficking stakeholders.	FY 2020 Q1	FY 2020 Q4	5
Matrix and Taxonomy – Human Trafficking: Identify indicators, signatures, pathways, and potential overlaps of several types of trafficking.	FY 2020 Q1	FY 2020 Q4	5
FY 2021			
N/A	N/A	N/A	N/A

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**: S&T will **d**evelop the technical basis and analytical tools needed to support cross-domain risk assessment and to identify standards of practice that support the expanded use of risk methodologies for cyber and physical systems, resource prioritization, and response planning. S&T will 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. This includes the development of the following:
  - Critical Infrastructure Design and Adaptive Resilient Systems (CIDARS): Examines 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): Develops 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: Facilitates research, development, T&E 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: Identifies and characterizes functional interactions among critical infrastructure sectors with a focus on key physical, social, and behavioral dependencies.
  - Risk Informed CISR Restoration: Focuses on the development of risk-informed, integrated resource allocation decision support for critical infrastructure restoration, renewal, and redesign.
  - Critical Infrastructure (CI) Supply Chain Analysis: Focuses on protecting our cyber infrastructure from unintended manipulation of hardware and software utilizing Scanning Electron Microscopy.

- **Justification:** The FY 2021 President's Budget does not provide new funding for this project, a decrease of $3.7M from FY 2020 Enacted.

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

Type of Research
Applied

Technical Readiness Level
The program began at TRL-2 and will end at TRL-6.

Transition Plans
S&T will provide tools, findings, reports, and methodologies that can 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
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	2-6
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	2-6
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	2-6
Collect, generate, validate, and publish existing, new, and synthetic data on critical infrastructure design and performance.	FY 2019 Q3	FY 2020 Q3	2-6
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	2-6
Develop draft federated models combining existing analytical tools at various levels of granularity.	FY 2020 Q1	FY 2020 Q4	2-6
Conduct a demonstration of novel watermarking and fingerprinting methods to verify integrated circuit integrity.	FY 2020 Q1	FY 2020 Q4	2-6
FY 2021			
N/A	N/A	N/A	N/A

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. Operators are increasingly seeing the potential of adding computational power and network connectivity to a wide range of devices. 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.

- **Solution:** The project will provide solutions that enable systems and defense-in-depth computer components that are trusted, hardened, and able to recover from large-scale failures. Project solutions align with government missions with highest value and highest risk to safety and security. This effort works to provide gap solutions as the spectrum of Industrial Control Systems (ICS), Cyber-Physical Systems (CPS), and the IoT continue to proliferate and become networked and a more complex attack surface. This includes efforts for risk, threat, and mitigation analysis capabilities in blended cyber, physical, and all-hazards scenarios. For example:
  - CPS/ICS/IoT: Risk assessments and analysis within the critical infrastructure today are often separate processes for cyber security in information technology and operational technology than other processes for physical security and processes for all-hazards events. The CPS/ICS/IoT effort works to enhance consequence and holistic risk assessment capabilities in context of overall blended and linked real-world, with mitigations/counter-measures appropriate to a blended outcome.
  - Vehicle Cyber Security*:* DHS has the largest fleet of civilian vehicles, a majority supporting law enforcement and homeland security missions. Current and future vehicles will increasingly utilize connected features and autonomous capabilities. This effort identifies cyber vulnerabilities in telematics, fleet management, connected components, and autonomous features, with development of mitigations in DHS law enforcement use cases.

- **Justification:** The FY 2021 President's Budget provides $7.8M for this project, an increase of $1.7M from the FY 2020 Enacted budget. This level of funding will be used to improve the cyber physical system security of the HSE through endeavors developing technologies to address vehicle cyber protection, building controls, and devices for our Federal law enforcement personnel.

- **Impact:** This project will provide capabilities for enhanced security in CPS/ICS/IoT practices and designs; enhance capabilities to detect, defend, and mitigate threats related to CPS/ICS/IoT; enable the exploration of recovery and reconstitution areas; and support the development of countermeasures that will fundamentally change the way CPS/ICS/IoT risk and security is deployed.

Type of Research
Developmental

Technical Readiness Level
The program began at TRL-4 and will end at TRL-7.

Transition Plan
S&T will deliver targeted exploratory, developmental, and operational capabilities directly to sustained component operations.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed and released final requirements and technical topic areas for CNPS.	FY 2019 Q1	FY 2019 Q4	N/A
Developed and published industry standards for secure over-the-air updates for automobiles.	FY 2019 Q1	FY 2019 Q4	N/A
Conducted and analyzed preliminary research and analysis in cyber-physical system areas of context-awareness, ambient intelligence, and autonomous environments.	FY 2019 Q1	FY 2019 Q4	N/A
Developed systems for real-time automotive firmware validation.	FY 2019 Q2	FY 2019 Q4	N/A
FY 2020			
Deliver targeted exploratory, developmental, and operational capabilities directly to sustained component operations.	FY 2020 Q1	FY 2020 Q4	N/A
Draft updated analysis and report in conjunction with DoT and GSA on cyber security risks and best practices in CPS fleet management and telematics.	FY 2020 Q1	FY 2020 Q3	N/A
Develop use cases with CISA and initiate projects to conduct applied research in blended cyber and physical (CPS/ICS/IoT) analysis and assessment capabilities.	FY 2020 Q1	FY 2020 Q4	N/A
Draft Aviation Security Report: Data Bus/Data Link Assessment.	FY 2020 Q1	FY 2020 Q3	N/A
FY 2021			
Conduct initial analysis of DHS cyber security risks in fixed-wing and rotary-wing mission uses, and supply-chain considerations in law enforcement/HSE air operations.	FY 2021 Q1	FY 2021 Q4	N/A
Deliver proof-of concept in conjunction with CISA to test and evaluate enhanced blended cyber and physical security analysis.	FY 2021 Q1	FY 2021 Q3	N/A
Develop initial analysis of cyber security risks to DHS law enforcement/HSE fleet vehicles and emerging autonomous capabilities. Include applied research project concepts to mitigate gaps and risks.	FY 2021 Q1	FY 2021 Q3	N/A

Disaster Recovery

- **Problem:** Natural disaster of all kinds are a leading cause of fatalities and economic loss in the United States. Recovery is the costliest and time-consuming phase of disaster management. Local communities need access to new and emerging technologies and innovations in order to streamline and to optimize disaster recovery operations and assistance programs. Communities need to speed up the process and reduce the time necessary to return to normal, to restore critical functions and community lifelines and for helping survivors get back to their daily lives.

- **Solution:** This project will develop new processes, products, and standards in order to improve operations and outcomes in FEMA, including promoting national preparedness and protective measures, preparing for catastrophic disasters, and reducing the complexity of FEMA. It will improve FEMA and State, local, and private sector capacities to recovery from disasters, return to normal, restore critical functions and community lifelines.

- **Justification:** The FY 2021 President's Budget provides $4.5M for this new project. The funds will be used to support R&D needs aligned to FEMA strategic plan objectives, including providing support for FEMA operational functions such as housing inspections and implementation of the FEMA Building Resilient Infrastructure and Community (BRIC) program, Disaster Recovery grant programs for Individual and Public assistance, and FEMA grant programs such as emergency management, firefighter assistance and safety, and hazard mitigation grants to reduce disaster recovery costs and losses.

- **Impact:** With support from S&T, FEMA will be able to: 1) speed up recovery aid to affected communities and assistance to survivors; 2) streamline individual and household assistance using new technology; 3) track and monitor rebuild and restoration functions through improved damage assessments for public assistance and mitigation programs, 4) reduce the complexity to communities and disaster survivors; 5) promote adaptive recovery; and 6) enable faster decision-making.

Type of Research
Applied, Developmental

Technical Readiness Level
TRL-3 to TRL-7

Transition Plans
The Disaster Recovery project is heavily integrated with S&T's FEMA Portfolio Manager, and its efforts are acknowledged and supported by FEMA's senior leadership. In support of successful transition, crucial conversations have already begun to ensure FEMA leadership and financial managers are aware of project development to enable the transition of S&T's technology solutions.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
Develop new methods and proofs of concept for automating claims and applicant processing to improve processing times with minimal error.	FY 2021 Q1	FY 2021 Q4	3-5
Develop new science, technology, and methods for improving accuracy and performance of hazard modeling and analytics through commercial services that would support key decision points.	FY 2021 Q2	FY 2021 Q4	3-5

Federal Systems Security

- **Problem:** A primary CISA mission is to improve cybersecurity for the Federal civilian government and other partners by facilitating the integration of various cybersecurity technologies, products, and services.

- **Solution:** This program executes research in order to improve the multiple facets of network systems security. Effective network systems security needs to address multiple threats, provide a layered defensive approach, and include both hardware and software solutions.

- **Justification:** The FY 2021 President's Budget provides $2.2M for this project, a decrease of $2.8M from the FY 2020 Enacted budget. This level of funding will be used to continue to support the Next Generation Cyber Infrastructure initiative. This project seeks to develop and deliver advanced sensing technologies, situation understanding, response, and recovery and network protections to agency, sector, and cross sector levels. This includes architecture, solutions, and techniques to reduce security vulnerabilities, improve information sharing, and increase response and recovery times in the critical infrastructure sectors. Additionally, the funding will support the Next Generation Cyber Infrastructure initiative in identifying dual-use technologies or approaches being used in the private financial sector for potential transition and application to fulfil a Component operational requirement.

- **Impact:** The development and application of capabilities to predict and defend against the effects of cyber-attacks on Federal government installations and other critical infrastructure. Enhances the capability of CISA National Cybersecurity Protection System (NCPS), Continuous Diagnostics and Mitigation (CDM), and Enhanced Cybersecurity Services (ECS) units to plan and adopt horizon capabilities with innovate solutions.

Type of Research
Applied, and Developmental research.

Technical Readiness Level
Projects range from TRL- 2 to TRL-7.

Transition Plans
S&T will deliver targeted exploratory, developmental, and operational capabilities directly to sustained Component operations (CISA).

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed and released final requirements and technical topic areas for Cyber Enabled Networked Physical Systems (CNPS).	FY 2019 Q1	FY 2019 Q4	3-6
Developed and published industry standards for secure over-the-air updates for automobiles.	FY 2019 Q1	FY 2019 Q4	3-6
Conducted and analyzed preliminary research and analysis in cyber-physical system areas of context-awareness, ambient intelligence, and autonomous environments.	FY 2019 Q1	FY 2019 Q4	3-6
Developed systems for real-time automotive firmware validation.	FY 2019 Q2	FY 2019 Q4	3-6
FY 2020			
Conduct one Exercise Simulation for each of the energy sector subsectors (Electric, Oil, and Gas).	FY 2020 Q2	FY 2020 Q4	N/A
Conduct testing and evaluation of two technology areas that address capability gaps for the FSS in a representational environment.	FY 2019 Q4	FY 2020 Q3	4
FY 2021			
Identify at least one dual-use technology or approach being used in the private financial sector for potential transition and application to fulfil a component operational requirement.	FY 2021 Q1	FY 2021 Q4	N/A

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. S&T 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.

  Specifically, S&T will develop the following:
  - 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*:* Utilize a cross-section of imaging technologies (e.g., aerial LiDAR, high-resolution satellite based synthetic aperture radar) and emerging technologies (e.g., UAS) 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 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.

- **Justification:** The FY 2021 President's Budget provides $7.0M for this project, a decrease of $3.0M from the FY 2020 Enacted budget. This level of funding will be used to fully transition completed R&D projects to FEMA and its external stakeholders including community pilots for high risk areas and assisting FEMA with updating related policy, doctrine, operations, and training plans.

- **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.

Type of Research

Applied

Technical Readiness Level

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

Transition Plans

The project will result in the development of charter and IPT to maintain close coordination with FEMA and to ensure the program's development aligns with operational requirements. S&T will also develop a transition agreement to transfer decision support tools to FEMA for deployment to Federal, State, local users and other stakeholders, including non-governmental agencies.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conducted Pilot demonstration of flood modeling technologies to provide structure level flood risk scores for community resilience.	FY 2019 Q1	FY 2019 Q2	4-6
Developed national guidelines for core information requirements to meet Flood Decision support requirements for first responders and emergency managers.	FY 2019 Q1	FY 2019 Q3	1-3
Developed 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	1-3
Transferred 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	6
FY 2020			
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	4-6
Extend ANSI national flood abatement standards for flood sealant and semi-permanent barrier products and smart flood.	FY 2020 Q1	FY 2020 Q4	1-3
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	1-3
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	1-3

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2021			
N/A	N/A	N/A	N/A

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. 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. Research will be done on possible complementary timing sources to supplement the timing from GPS to enable assured timing for critical infrastructure needs. Additionally, a conformance framework and reference architecture for resilient Position, Navigation, and Timing will be developed and transitioned.

- **Justification:** The FY 2021 President's Budget does not include funding for this project, a decrease of $4.0M from the FY 2020 Enacted.

- **Impact:** This project will identify GPS interference vulnerabilities (intentional and unintentional) and educate critical infrastructure owners and operators, thereby 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. It will also provide 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.

Type of Research
Developmental

Technical Readiness Level
TRL varies from levels 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, anti-spoofing algorithms).

Transition Plans

- Coordination with CISA National Risk Management Center to ensure communication and dissemination of GPS knowledge products to critical infrastructure sectors and owners/operators.
- Coordination with a standards development organization on the Resilient PNT Conformance Framework, which will lead to adoption of developed mitigation technology into existing equipment.
- Coordination with GSA to require compliance with the voluntary Resilient PNT Conformance Framework for placement of new PNT equipment into the GSA schedule.
- Transition of alternative PNT prototypes into critical infrastructure operational testing environments.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Completed draft conformance standard framework.	FY 2018 Q4	FY 2019 Q2	N/A
Characterized performance of multiple alternative PNT technologies.	FY 2019 Q1	FY 2019 Q3	N/A
Hosted one workshop for the industry conformance framework.	FY 2019 Q2	FY 2019 Q2	N/A
FY 2020			
Host follow-on open-air GPS test event for testing of mitigation technologies or revised equipment from manufacturers.	FY 2020 Q1	FY 2020 Q4	N/A
Test one alternative timing source prototype in a critical infrastructure operational environment.	FY 2020 Q4	FY 2020 Q4	7
Release first version of Resilient PNT Conformance Framework.	FY 2020 Q2	FY 2020 Q4	N/A
FY 2021			
N/A	N/A	N/A	N/A

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. The most significant challenges include understanding 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. However, 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 Administration (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.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **Impact:**
  - With previous year funding, S&T has modernized NHP technology, tools and methods that can be implemented in the decision support platform operationally called Web-Based HURREVAC. This will enhance the ability of the emergency management end users at the State and local level in managing local hurricane evacuations and response. These end users will 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.
  - 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.

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed 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	5
Enhanced 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	5
Held formal launch of HVX software to all 21 U.S. coastal states and territories.	FY 2019 Q4	FY 2019 Q4	5
FY 2020			
Add cyber sensing for power outages capability to HVX.	FY 2020 Q1	FY 2020 Q4	5
Optimize HVX for mobile devices.	FY 2020 Q1	FY 2020 Q2	5
Integrate mass-care meals and housing planner application.	FY 2020 Q2	FY 2020 Q3	5
Track and report on post-transition metrics.	FY 2020 Q2	FY 2020 Q4	5
FY 2021			
N/A	N/A	N/A	N/A

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.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include new funding for this project.

- **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.[1] If this program can reduce the future costs of disasters related to weather by 1 percent 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.

Type of Research
Applied

Technical Readiness Level
The program began at TRL-3 and will end at TRL-7.

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Transitioned technologies to operational use to increase community resilience.	FY 2019 Q2	FY 2019 Q4	7
Continued research resiliency projects with two additional stakeholders.	FY 2019 Q1	FY 2019 Q4	N/A
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	3-7
Develop regional resilience capability framework for assessing local capacity and measuring progress.	FY 2019 Q4	FY 2020 Q4	3-7
Pilot regional resilience framework in top 60 highest risk communities and with DHS partners.	FY 2020 Q3	FY 2020 Q3	3-7
Transition one or more technologies to operational use to increase community resilience.	FY 2020 Q1	FY 2020 Q4	7
FY 2021			
N/A	N/A	N/A	N/A

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

Innovative Research and Foundational Tools Thrust Area
Research and Development
Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Innovative Research and Foundational Tools Thrust Area	$66,179	$55,236	$74,692

INNOVATIVE RESEARCH AND FOUNDATIONAL TOOLS THRUST AREA: 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.

INNOVATIVE RESEARCH AND FOUNDATIONAL TOOLS THRUST AREA *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
Innovative Research and Foundational Tools Thrust Total		**$66,179**	**$55,236**	**$74,692**
Technology Centers		**$24,259**	**$22,614**	**$39,891**
	Advanced Computing Technology Centers	-	-	$12,126
	Biometrics and Identity Technology Center (BI-TC) (formerly Biometrics Technology Engine (BT-E) and Identity and Access Management Engine (IDAM-E))	$5,864	$4,500	-
	Data Analytics Technology Center (DA-TC) (formerly Data Analytics Engine (DA-E))	$10,267	$9,402	-
	Enduring Sciences Research Centers	-	-	$17,494
	Hazard Awareness and Characterization Technology Center (HAC-TC) (formerly Chemical and Biological Characterization Engine (CBC-E))	-	$1,145	-
	Innovative Systems Technology Centers	-	-	$10,271
	Modeling & Simulation Technology Center (MS-TC) (formerly Model & Simulation Engine (MS-E))	$1,876	$1,876	-
	Office for Interoperability and Compatibility Technology Center (OIC-TC) (formerly Communications & Networking (CN-E))	$2,752	$2,752	-
	Sensors and Platforms Technology Center (SP-TC) (formerly	$2,000	$1,939	-

INNOVATIVE RESEARCH AND FOUNDATIONAL TOOLS THRUST AREA *(Dollars in Thousands)*				
Program	**Project**	**FY 2019 Enacted**	**FY 2020 Enacted**	**FY 2021 President's Budget**
	Situational Awareness & Decision Support (SANDS-E))			
	Social Sciences Technology Center (SS-TC) (formerly Behavioral, Economic, and Social Science Engine (BESS-E))	$1,500	$1,000	-
Partnerships		**$37,170**	**$16,340**	**$21,274**
	Bi-National Cooperative Pilot	$2,000	$2,000	$2,000
	Commercialization Accelerator Program	$1,975	$1,900	$5,185
	Coordination, Engagement, and Outreach	-	-	$3,089
	Innovation Industry Collaboration and Outreach	$13,195	-	-
	Partnership Intermediary Agreements (PIA)	$7,000	$3,000	$1,000
	Partnership Mechanisms and Technology Transition	$3,000	$1,440	-
	Silicon Valley Innovation Program (SVIP)	$10,000	$8,000	$10,000
Foundational Tools		**$4,750**	**$16,282**	**$13,527**
	Aligning Departmental R&D to DHS Goals (Integrated Product Teams)	$2,000	$2,001	$2,001
	Technology Clearinghouse	$2,750	$2,750	$2,750
	Technology Scouting	-	$4,476	$4,796
	Technology Transition	-	$7,055	$3,980

Technology Centers Program

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.

The Technology Centers are grouped under three primary focus areas: Advanced Computing, Enduring Sciences, and Innovative Systems. S&T may establish or retire specific technology centers as the priorities and research needs of DHS evolve.

Advanced Computing Technology Centers

- **Problem:** DHS Components are generating more data for decision-making than can be handled, and we continue to face challenges with leveraging additional data sources to compute threats, impacts, risks, and situational awareness due to the exponential growth of data, particularly data associated with the IoT and social media. Further, we face a rapidly evolving digital environment, one in which advancements in quantum computing, immersive and augmented reality, artificial intelligence and machine learning are pushing the edge of innovation that enables us to explore new ways of training and protecting officers, detecting threats, and analyzing systems that were previously too complex or too dangerous to examine in the real world. However, this speed of innovation also makes it difficult to track and assess solution options for critical homeland security missions that are needed now.

- **Solution:** This project brings together a full complement of capabilities as S&T's resource and expertise in data sciences, computational methods, and modeling and simulation techniques. These centers invest in emerging innovations to experiment with and apply the strengths of artificial intelligence, machine learning, and scalable data analytics to homeland security systems and operations – including training applications that augment human perception and comprehension. The centers also provide access to the ecosystem of experts, tools, and applications that can be leveraged for new applications. The Advanced Computing Technology Centers work across disciplines to illuminate next-generation problem sets, technologies, and simulation environments to increase mission effectiveness. The centers conduct computationally- and data-intensive research in support of requirements generated by DHS customers. S&T is establishing the following:

- Data Analytics Technology Center (DA-TC): A capability to help analysts, operators, agents, and program managers across DHS increase mission effectiveness by better leveraging data for decision-making. DA-TC keeps pace with the rapidly evolving digital environment by experimenting with growing and next generation data sets and technologies, including social media, live streaming, real-time analytics, machine learning, artificial intelligence, edge computing, and cloud environments to inform program planning, avoid technical obsolescence, accelerate transition, and prevent mission surprise. DA-TC provides S&T and DHS programs with coordinated information and subject matter expertise relevant to data analytics to improve program efficiency, share best practices, and improve security and privacy protection across DHS system investments.
- Modeling and Simulation Technology Center (MS-TC): An enduring capability leveraged across multiple S&T and DHS programs, which have similar requirements and are often discarded after the completion of the program. To address this issue, the MS-TC coordinates Modeling and Simulation (M&S) activities and requirements across the Department through a Community of Interest; serves as a body of SMEs on the subject to assist DHS operators, program managers, and analysts in leveraging M&S tools; and conducts research into advancements in artificial intelligence, machine learning, and immersive reality to enhance simulation environments for training homeland security operators. The MS-TC enhances S&T's collaboration with interagency partners in the M&S domain and leverages best practices and impactful emerging M&S capabilities from across the government to ensure a coordinated approach for DHS efforts using modeling and simulation tools.
- Quantum Information Science Research Activity: Quantum Information Sciences (QIS) are priority elements of the Administration's "Industries of the Future" initiative. To accelerate the R&D in QIS technologies, the National Quantum Initiative Act was signed into law December 21, 2018, and calls for a federally coordinated effort in QIS. S&T is a member of the NSTC Subcommittee on QIS and co-chairs the End User Working Group (EUWG) to lead these coordination activities. To support these activities, S&T will establish a QIS community of interest within DHS that engages Components to promote an understanding of QIS technologies, identify potential mission areas where QIS technologies will provide significant impact, and develop a process, methodology and R&D roadmap to ensure Federal/industry/academic research communities are responsive to DHS and other agency technology needs. The EUWG activities also monitor, track, and examine the state of QIS technologies, including artificial intelligence applications, relative to the critical missions of the Department and identify potential areas where mature QIS technologies can be tested to demonstrate impact. To support these activities, S&T will partner with the Office of Science and Technology Policy (OSTP), NSTC, and other inter-agency partners (where feasible and appropriate) to support the national advancement of core QIS capabilities that meet needs of DHS. S&T will establish a QIS community of interest within DHS to that engages Components to promote an understanding the of QIS technologies, identify potential mission areas where QIS technologies will provide significant impact, and provide develop a process, methodology and R&D roadmap to ensure the Federal, industry, academic research communities is responsive to DHS and other agency technology needs.
- Artificial Intelligence and Machine Learning Research Activity: A priority element of the Administration's "Industries of the Future" initiative. The Department's initial examination of emerging technology threats to homeland security has also indicated that artificial intelligence and machine learning pose significant opportunities and threats to homeland security. This research activity will examine and characterize the state of artificial intelligence research relative to future homeland security mission applications. Research activities will focus on the development of core capabilities that enable trustworthy artificial intelligence to improve core automation capabilities that are secure,

private, and trusted for critical homeland security applications.

- **Justification:** The FY 2021 President's Budget provides $12.1M for this new project. This funding will be used to conduct technical assessments of emerging computing, analytic, modeling, and simulation capabilities for applicability and performance for DHS operational environments, including CISA cybersecurity applications, I&A analytics applications, and FLETC training applications. Specific emerging capabilities include artificial intelligence/machine learning, immersive simulation, secure multiparty computation and hybrid cloud computing.

- **Impact:** The Advanced Computing Technology Centers enables DHS to push beyond the state of the art and harness new technologies that both increase the productivity and effectiveness of the homeland security workforce and solve hard problems in more efficient ways. By investing in capabilities that empower data discovery, data curation, advanced cognition, and increased perception, homeland security end users and operators can spend more time looking at the right data and understanding the situation rather than looking for data and missing opportunities. In addition, these centers bring together communities of interest in relevant disciplines, which focuses a broad set of collaborative experts towards thinking about research solutions to homeland security challenges.

Type of Research

DA-TC, MS-TC, QIS, and AI projects include elements of Basic, Applied, and Developmental research.

Technical Readiness Level

DA-TC, MS-TC, QIS and AI projects range from TRL-2 to TRL-7.

Transition Plans

Data Analytics Technology Center (DA-TC):

- 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 emerging technology areas, DA-TC provides experimental results through technical reports and briefings that are relevant to homeland security mission. This transition of knowledge product provides inputs to S&T program planning as well as Component acquisition planning and ongoing operations.
- DA-TC also works directly with industry partners to provide expertise to help 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 and Simulation Technology Center (MS-TC):

- MS-TC will place subject matter experts at FLETC to integrate a simulation prototype into FLETC's future driver initiative.
- MS-TC continues to host the DHS M&S community of interest to share relevant best practices and impactful emerging M&S capabilities and tools. Reports and knowledge are shared via quarterly forum. By FY 2021, these reports will be posted in a government accessible knowledge repository for sharing across interagency partners.
- In emerging technology areas, such as the use of machine learning and immersive visualization for simulation environments relevant to homeland security missions, MS-TC provides experimental results through technical reports and briefings directly to S&T and DHS programs. This transition of knowledge product provides inputs to S&T program planning as well as component acquisition planning and ongoing operations.

QIS:

- QIS activities will build and share knowledge among a DHS community of interest that promotes an understanding of QIS technologies and identifies potential mission areas where QIS technologies will provide significant impact.
- The community of interest will develop a roadmap of QIS R&D activities that will be shared with the NSTC Subcommittee on QIS, End User Working Group (EUWG).

Artificial Intelligence:

- S&T works directly with AI/ML communities of interest to share knowledge and understanding of the state-of-the-art. This research activity will develop a report and technology roadmap that characterizes artificial intelligence and machine learning opportunities and risks to homeland security that will be shared within the communities of interest, DHS operational Components, and HSE partners. By FY 2021, this report will be posted in a government accessible knowledge repository for sharing across interagency partners.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
DA-TC: Develop two technical research reports summarizing evaluation results of emerging computational technologies to guide acquisitions across DHS Components and the broader Government.	FY 2020 Q3	FY 2021 Q4	5
DA-TC: Conduct two advanced data analytics pilots to inform component mission operations and expand DHS operational capabilities.	FY 2020 Q1	FY 2021 Q3	5
MS-TC: Develop simulation prototype for FLETC future driver initiative.	FY 2019 Q4	FY 2021 Q4	7

Research and Development Description	Plan Start Date	Planned Completion	TRL
MS-TC: Develop government accessible knowledge repository to house the M&S CoI Catalogue, as well as additional information and reports on best practices and impactful emerging M&S capabilities and tools.	FY 2020 Q2	FY 2021 Q4	7
QIS - Establish a DHS QIS community of interest that engages Components to promote an understanding of QIS technologies.	FY 2021 Q1	FY 2021 Q4	4
QIS – Conduct an assessment of emerging and commercially available QIS technologies, vendors, and mission applications within DHS,	FY 2021 Q1	FY 2021 Q4	4
QIS – Develop a roadmap of QIS R&D activities that communicates DHS QIS technology needs to Federal/industry/academic research communities.	FY 2021 Q1	FY 2021 Q4	4
QIS – Solicit fellowships and scholarships related to QIS and AI within DHS and in partnership with other Federal agencies	FY 2021 Q1	FY 2021 Q4	3-6
Artificial Intelligence and Machine Learning – Collaborate with inter-agency partners in the development of a joint research and development activity targeting the development of trustworthy AI.	FY 2021 Q1	FY 2021 Q4	3-6
Artificial Intelligence and Machine Learning – Develop a report and technology roadmap that characterizes artificial intelligence and machine learning opportunities and risks to homeland security	FY 2021 Q1	FY 2021 Q4	4

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.

- **Justification:** The FY 2021 President's Budget does not fund this as a separate project, which reflects decrease of $1.4M from the FY 2020 Enacted budget. This activity is funded FY 2021 as a sub-project within Innovative Systems Technology Centers instead.

- **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.

Type of Research
Applied and Developmental

Technical Readiness Level
TRL will vary between specific activities, can range between levels 2 and 7.

Transition Plans
S&T will develop a Technology and Process Assessment report for Biometrics Technology Refresh and deliver updated biometrics "body of knowledge". S&T will transition products to DHS and other Federal Agencies with specific applications for TSA, CBP, OBIM, and ICE. Identity activity results will 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
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	2-7
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	2-7
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	2-7
Provide Technical Subject Matter Expertise and technical reports to inform DHS review of biometric technology acquisition programs.	FY 2019 Q1	FY 2019 Q4	2-7
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	2-7
Develop candidate concepts of operational and evaluation criteria for traveler identity verification across CBP and TSA operations.	FY 2019 Q1	FY 2019 Q4	2-7
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	2-7
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	2-7
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	2-7
Enable CBP, TSA, ICE, or USCIS joint demonstration and operational evaluation of integrated multi-modal biometric capabilities.	FY 2020 Q2	FY 2020 Q4	2-7
Develop biometric and identity standards through International Standards Development Organizations to facilitate	FY 2019 Q2	FY 2020 Q4	2-7

Research and Development Description	Plan Start Date	Planned Completion	TRL
interoperability of DHS Component implementations.			

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 IoT 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.

- **Justification:** The FY 2021 President's Budget does not fund this as a separate project, and reflects a decrease of $10.4M from the FY 2020 Enacted budget. Instead, DA-TC has become a sub-project under the new Advanced Computing Sciences Technology Center.

- **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.

Type of Research
DA-TC projects include elements of Basic, Applied, and Developmental research.

Technical Readiness Level
DA-TC projects range from TRL-4 to TRL-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 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed 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.	FY 2019 Q1	FY 2019 Q4	4-7
Delivered 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.	FY 2019 Q1	FY 2019 Q4	4-7
Conducted 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 2019 Q1	FY 2019 Q4	4-7
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	4-7
Conduct two technology pilots to inform component mission operations and expand DHS operational capabilities.	FY 2020 Q1	FY 2020 Q4	4-7
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	4-7
FY 2021			
N/A	N/A	N/A	N/A

Enduring Sciences Research Centers

- **Problem:** Despite the immense cost of life and property associated with terrorism, challenges persist in our ability to prevent, detect, counter, and mitigate the effects of such actions. DHS Components are best positioned to identify their immediate operational needs; however, they and our partner agencies and communities, particularly those communities focused on the defense against terrorist actions and the use of chemical, biological, and explosive hazards often lack critical data and expertise necessary to formulate appropriate policy, operational, and system-level requirements as these hazards evolve. The drivers behind terrorist actions and the best methods of mitigating the risk of terrorism are not fully understood. Nor do DHS operational entities fully understand the ways in which new technologies will impact their ability to address such hazards, increasing the potential for failure when integrating solutions into operational use.

- **Solution:** As the threat of terrorist actions and the use of chemical, biological, and explosive hazards continues to evolve, the Enduring Sciences Research Centers are S&T's resource for maintaining awareness of and understanding the characteristics of current, emerging, and potential future threats. These centers provide a centralized function within S&T to coordinate critical expertise, provide access to knowledge products (i.e., technical reports) generated through rigorous laboratory experimentation, and identify and fill critical data gaps and insight on the properties of chemical, biological, and explosive threat agents and the hazards that they pose. These centers also form strategic insights into terrorism actions 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. The Enduring Sciences Research Centers directly inform DHS activities in preparing for, responding to, and mitigating the results of terrorist threats. The ongoing research will continue as threats and our need to understand them evolve.

- **Justification:** The FY 2021 President's Budget provides $17.5M for this new project. This level of funding will be used to:
  - Develop improved methods for characterizing explosives threats;
  - Develop and validate analytic methods for understanding the fundamental characteristics and properties of chemical and biological hazards; and,
  - Create new insights into the drivers behind terrorism and mass violence, as well as the effectiveness of terrorism prevention programs, to include best practices, demonstration experiments, and enhanced data collection activities that support understanding of the threat and best locations to surge prevention resources.

  This R&D project includes the following initiatives:
  - Hazard Awareness and Characterization Technology Center (HAC-TC): HAC-TC conducts basic and applied research to characterize prioritized and emerging chemical, biological, and explosives hazards and provides a centrally accessible repository for accessing the results of characterization efforts. HAC-TC directly coordinates activities with the following projects: Biological Threat Characterization (BTC), HME, BKC, NBACC, and the CSAC. Hazard characterization efforts 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.

- Social Science Technology Center (SS-TC): SS-TC serves as a research support function for S&T programs, DHS, and our SLTT partners. SS-TC conducts evidence-based research both in the transition of federally developed technologies and in terrorism prevention to (a) understand individuals' motives both for engaging in, and disengaging from, violent extremism; (b) develop and support locally-tailored interventions with State, local, tribal, territorial, and international partners; and (c) evaluate the effectiveness of such interventions. SS-TC 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. SS-TC also supports the Office of Terrorism Prevention Partnerships, Offices of the Principal Deputy Counterterrorism Coordinator, Policy, Civil Rights and Civil Liberties, and local terrorism prevention practitioners to provide subject matter expertise to assess the impacts of policies and programs developed to counter violent extremism.

  As the Department focuses on Targeted Violence and Terrorism Prevention (TVTP), Mass Attacks Against Soft Targets Prevention, Protection, and Mitigation efforts, SS-TC will increase additional research to inform policy, strategy, tactics, techniques, and procedures at the Department and local level. SS-TC provides independent, objective evaluation to characterize terrorism and violent extremism threats to ensure that stakeholders who perform, fund, oversee, select and direct prevention and protection activities can understand and predict their effects and effectiveness in a variety of settings based on evidence. This evaluation provides all potential stakeholders with detailed information about "what works, what doesn't, and what's promising" in the prevention of and protection from violence. Stakeholders have the ability to select prevention and protection activities with known effects, outcomes, and impacts. New technology integration and techniques will reduce the likelihood of mass violence and improve the ability to prevent and respond to mass violence and enable those that protect Americans from these attacks to do so more effectively.

  Additional technology centers may be established to support emerging and evolving priorities in DHS missions.

- **Impact:** The Enduring Sciences Research Centers establish and leverage innovative science-based capabilities to provide DHS and our partners with the expertise, research, 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. New solutions also support more efficient and accurate analysis of the threats posed by violent extremists and evidence-based terrorism preventions policies, programs, and interventions. The application of expertise, enduring research, and knowledge coordinated through the centers increases 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.

Type of Research

HAC-TC and SS-TC projects include activities of Basic, Applied, and Developmental research.

Technical Readiness Level

HAC-TC and SS-TC projects will range from TRL-3 to TRL-7.

Transition Plans

Hazard Awareness and Characterization Technology Center (HAC-TC):

- 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 Department of Defense through the 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.

Social Science Technology Center (SS-TC):

- SS-TC regularly delivers/transitions the knowledge and insight produced through various technical reports that are shared with DHS Components and HSE partners.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
HAC-TC: Complete characterization research on one chemical agent that will inform DHS's risk profile.	FY 2021 Q1	FY 2021 Q4	3-7
HAC-TC: Complete characterization research on one explosive agent that will inform DHS's risk profile.	FY 2021 Q1	FY 2021 Q4	3-7
HAC-TC: Deliver one technical report on on an agent or technology that will impact future biological threats.	FY 2021 Q1	FY 2021 Q4	3-7
HAC-TC: Deliver one technical report on an agent or technology that will impact future chemical threats.	FY 2021 Q1	FY 2021 Q4	3-7
SS-TC: Deliver technical research results that provides insights into the psychology that drives extremist behavior	FY 2021 Q1	FY 2021 Q4	3-7
SS-TC: Complete technical assessment of the effectiveness of terrorism prevention programs funded by State, local, and international partner organizations.	FY 2021 Q1	FY 2021 Q4	3-7
SS-TC: Establish the collection and sharing of independent, objective data related to individuals, events, and organizations participating in targeted violence in the U.S.	FY 2021 Q1	FY 2021 Q3	3-7
SS-TC: Establish formal, international information sharing for R&D supporting the prevention of Targeted Violence or Terrorism.	FY 2021 Q1	FY 2021 Q1	3-7
SS-TC: Convene international meeting researchers to develop "state of the science" report on targeted violence and terrorism prevention.	FY 2021 Q3	FY 2021 Q3	3-7
SS-TC: Deliver terrorism prevention and intervention Evaluation Plans for use across USG funded violence intervention	FY 2021 Q1	FY 2021 Q3	3-7

Research and Development Description	Plan Start Date	Planned Completion	TRL
programs.			

Hazard Awareness and Characterization Technology Center (HAC-TC)

- **Problem:** 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: BTC, HME, NBACC, CSAC, and 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. HAC-TC will support the following activities:
  - 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.

- **Justification:** The FY 2021 President's Budget does not include new funding project, which is a decrease of $1.1M from FY 2020 levels.

- **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.

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 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
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	N/A
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	N/A
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	N/A
Produce and transition at least three knowledge products on an agent or technology that will impact future explosive	FY 2020 Q1	FY 2020 Q4	N/A

Research and Development Description	Plan Start Date	Planned Completion	TRL
threats.			
Generate prioritization for basic research for the Biological Threat Characterization Project FY 2021 activities.	FY 2020 Q2	FY 2020 Q3	N/A
Generate prioritization for basic research for the Chemical Threat Characterization Project FY 2021 activities.	FY 2020 Q2	FY 2020 Q3	N/A
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	N/A
FY 2021			
N/A	N/A	N/A	N/A

Innovative Systems Technology Centers

- **Problem:** Technology can be a tool for increasing the efficiency and effectiveness of homeland security operations; it can enhance collaboration, speed decision making, and deliver the ability to do things that were once not possible. With the emergence of artificial intelligence and autonomy, private sector innovations around communication, sensors, and identity technologies are playing an increasingly significant role in securing the Homeland against dynamic threats. However, S&T lacks a coordinated approach to understand (a) how to harness these capabilities effectively, (b) securely use these capabilities in operational environments, and (c) protect against the misuse of these capabilities.

- **Solution:** The Innovative Systems Technology Centers are S&T's resource for understanding and harnessing next-generation and emerging innovations for cross-cutting mission capabilities. These centers focus on experimenting with and field testing innovative systems to identify technological maturity, operational uses, and vulnerabilities of these systems. Focus areas include intelligent sensors and autonomous systems; resilient communications equipment, data, and networks; and enhanced biometrics and identity capabilities.

- **Justification:** The FY 2021 President's Budget provides $10.3M for this new project. This funding will be used to experiment with and assess emerging telecommunications capabilities, such as beyond-5G broadband technology, for applications within DHS operational environments; evaluate sensors, control systems, and autonomous systems for applicable use within natural disaster and mass violence response situations; and assess innovative cutting-edge identity and biometric capabilities. Funding will support the following:
  - Office for Interoperability and Compatibility Technology Center (OIC-TC): Provides subject matter expertise and conducts research into next-generation communications; networks; and position, navigation, and timing capabilities. OIC-TC promotes R&D in the wireless communications and network ecosystem in order to experiment with and assess systems that deliver the interoperable, efficient, and resilient communication requirements of homeland security operators. This research impacts agency programs' ability to communicate mission-critical information as they carry out their daily tasks of saving lives and protecting properties.

- Sensors and Platforms Technology Center (SP-TC): Provides subject matter expertise and conducts research into next generation intelligent sensors, sensor platforms, and sensor integration architectures. SP-TC experiments with autonomous systems, innovative hazard sensors, and advanced emergency alert technologies to ensure operators have access to and can take advantage of emerging sensor capabilities.
- Biometrics and Identity Technology Center (BI-TC) Coordinates DHS technical biometric and identity competencies to provide world-class biometric and identity expertise, methods, tools, technologies, best practices, industry and international coordination, and operational insight to address the dynamic biometric needs of DHS and the HSE. DHS has a continued need for an expanded set of identity technologies that Component customers and S&T program managers can incorporate into their R&D projects. BI-TC provides a sustainable, common platform for driving biometric and identity technology standards, best practices, and innovation across DHS and its Components. This enables DHS Components to quickly establish technical competence using more capable and cost effective biometric and identity technologies and facilitate operational excellence. BI-TC accelerates effective integration of biometric and identity technologies into DHS programs and Component operations and works in a cross-cutting fashion to mitigate potential inefficiencies, further driving down costs and increasing operational impact.

Additional technology centers may be established to support emerging and evolving priorities in DHS missions.

- **Impact:** The Innovative Systems Technology Centers enable DHS Components as well as State, tribal, and local public safety to better take advantage of next generation and emerging innovations in communication, sensor, and identity technologies. These centers ensure that operators are able to effectively integrate technologies into use and that potential inefficiencies are mitigated.

Type of Research

OIC-TC, SP-TC, and BI-TC projects include elements of Basic, Applied, and Developmental research.

Technical Readiness Level

OIC-TC, SP-TC, and BI-TC projects range from TRL-3 to TRL-7.

Transition Plans

Research, experimentation, and field testing results are delivered in the form of knowledge products, including best practices, lessons learned, and technical reports. These are provided directly to S&T programs and DHS Components and end users.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
OIC-TC: Conduct First Responder Jamming Exercise with Federal, State, and local public safety partners.	FY 2021 Q1	FY 2021 Q4	7
OIC-TC: Deliver research results on applications of beyond-5G broadband capabilities for homeland security missions.	FY 2021 Q1	FY 2021 Q4	3
OIC-TC: Deliver experimentation results of methods for leveraging artificial intelligence to improve DHS users' access to available communications network and services, e.g., satellite, Wi-Fi, 5G, and mobile ad-hoc network.	FY 2021 Q1	FY 2021 Q4	5
SP-TC: Expand IoT Flood Sensors into commercialization markets.	FY 2019 Q3	FY 2021 Q2	7
SP-TC: Deliver research, prototype and evaluation of wildland fire detection, alert and notification sensors and control systems.	FY 2019 Q3	FY 2021 Q4	5
SP-TC: Deliver research on Autonomous Systems in the areas of soft targets, edge sensor computing and situational awareness.	FY 2019 Q3	FY 2021 Q4	3
SP-TC: Deliver research, prototype and evaluation of in-building control systems and sensor detection for air dispersion agents.	FY 2019 Q4	FY 2021 Q4	4/5
BI-TC: 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 2021 Q1	FY 2021 Q3	5
BI-TC: Enable joint CBP, TSA, ICE, or USCIS, or Critical Infrastructure Security Stakeholders to Operationally evaluate high-throughput biometric capabilities.	FY 2021 Q1	FY 2021 Q4	7
BI-TC: Develop a knowledge product and a capability to remotely verify the identity of DHS online service users with methods other than "knowledge-based Q&A," which is made ineffective by data breaches.	FY 2021 Q1	FY 2021 Q3	6
BI-TC: Facilitate collaborative industry and Federal agency test and evaluation activities at the Maryland Test Facility to assess innovative cutting-edge identity and biometric capabilities.	FY 2021 Q1	FY 2021 Q3	5
BI-TC: Provide Technical Subject Matter Expertise and technical reports to inform DHS review of biometric technology acquisition programs.	FY 2021 Q1	FY 2021 Q4	7
BI-TC: Contribute to digital identity and biometric technology standards and best practices in coordination with relevant entities (e.g. NIST) to enable DHS and US adoption and capabilities.	FY 2021 Q1	FY 2021 Q4	5

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 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.

- **Justification:** The FY 2021 President's Budget does not provide separate funding for this project. Instead, MS-TC has become a sub-project under the new Advanced Computing Sciences Technology Center.

- **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.

Type of Research
Applied and Developmental

Technical Readiness Level
TRL-2 through TRL-7

Transition Plans
S&T will complete and transition animal disease models to the Department of Agriculture. It will also complete the comprehensive integration of the M&S CoI catalog for use by S&T Program Managers and DHS Components.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
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	2-7
Develop AR/VR modeling capabilities in collaboration with the FLETC: virtualize a training site utilizing AR/VR technology.	FY 2018 Q1	FY 2019 Q4	2-7
FY 2020			
Deliver animal disease models to USDA.	FY 2018 Q4	FY 2020 Q1	2-7
Complete M&S CoI Catalogue integration.	FY 2019 Q1	FY 2020 Q4	2-7
FY 2021			
N/A	N/A	N/A	N/A

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.

- **Justification:** The FY 2021 President's Budget does not include separate funding for this project, a decrease of $2.8M compared to the FY 2020 Enacted budget. Instead, OIC-TC has become a sub-project under the new Innovative Systems Technology Center.

- **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.

Type of Research
Basic and Developmental

Technical Readiness Level
Ranges from TRL-3 to TRL-7

Transition Plans
S&T will deliver baseline research capabilities that align with S&T customer defined gaps and provide laboratory and field testing expertise and capabilities for technology solution evaluation.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Provisioned 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 DHS 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	7
NGFR Program's Spiral 3 Technology Integration and Experimentation – provided 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	7
Developed first iteration of video analytics R&D interoperability roadmap.	FY 2019 Q1	FY 2019 Q4	4
Evaluated public safety-oriented data against baseline performance measurements from year 1 speech analytic research.	FY 2019 Q1	FY 2019 Q4	5
Completed Application Service Load Testing Research into local application service hardware requirements.	FY 2019 Q1	FY 2019 Q3	3
Demonstrated BioSuit test bed with commercial sensor integration.	FY 2019 Q2	FY 2019 Q4	5
Researched into LTE-Unlicensed Band use for Public Safety.	FY 2019 Q3	FY 2019 Q4	5
FY 2020			
Conduct First Responder Jamming Exercise with Federal, State, and local public safety partners.	FY 2019 Q2	FY 2020 Q3	N/A
Incorporate hands-free, intelligent voice-based assistance to enable mobile users intuitive access and sharing of information.	FY 2020 Q1	FY 2020 Q2	6
Demonstrate wireless deployable capability to support localized wireless services with and without network backhaul.	FY 2020 Q1	FY 2020 Q2	7
Research edge-computing device to readily share data, e.g., body-worn camera video, physiological sensor and environmental sensor. Such solution 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	5
FY 2021			
N/A	N/A	N/A	N/A

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.

- **Justification:** The FY 2021 President's Budget does not provide separate funding for this project, a decrease of $2.0M compared to the FY 2020 Enacted budget. Instead, SP-TC has become a sub-project under the new Innovative Systems Technology Center.

- **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.

Type of Research
Applied and Developmental

Technical Readiness Level
TRL-2 to TRL-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)

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Prototyped IoT Intelligent Building Infrastructure sensors with stakeholder community.	FY 2018 Q3	FY 2019 Q4	2-7
Prototyped UAS platform and sensor payload for mass transit tunnel search and reconnaissance.	FY 2018 Q3	FY 2019 Q4	2-7
Tested and evaluated SCIRA with selected stakeholder community for practical implementation and cyber security protocols.	FY 2018 Q1	FY 2019 Q2	2-7

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2020			
Commercial transition of IoT Intelligent Building Infrastructure Sensors to stakeholders and commercial industry adoption.	FY 2019 Q1	FY 2020 Q2	2-7
FY 2021			
N/A	N/A	N/A	N/A

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.

- **Justification:** The FY 2021 President's Budget does not provide separate funding for this project. SS-TC has become a sub-project under the new Technology Centers - Enduring Sciences Research Center.

- **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.

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

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Deliver report identifying public perceptions surrounding first responder use of unmanned vehicles.	FY 2018 Q4	FY 2019 Q4	N/A
Conduct pilot study of ATAK training materials for USBP.	FY 2018 Q4	FY 2019 Q1	N/A
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	N/A
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	N/A
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	N/A
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	N/A
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	N/A
FY 2021			
N/A	N/A	N/A	N/A

Partnerships Program

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.

Bi-National Cooperative Pilot

- **Problem:** DHS shares many of the same technology requirements as its international partners and without collaboration, efforts to address these requirements could be duplicative.

- **Solution:** The Bi-National Industrial Research and Development (BIRD) Foundation promotes collaboration between U.S. and Israeli technology companies for joint product development for the HSE.

- **Justification:** The FY 2021 President's Budget provides $2.0M for this project, the same as the FY 2020 Enacted budget. This level of funding will be used to support a new call for proposals addressing homeland security priorities and to continue transitioning or commercializing the outcomes of previous BIRD cohorts.

- **Impact:** 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.

Type of Research
Developmental

Technical Readiness Level
TRLs will range from 6-7.

Transition Plans
S&T will identify activities associated with these efforts based on input from the international first responder community. In addition, the vendors supporting the activities will be partners from multiple international and will leverage a broader customer base which results in manufacturers being able to product the products more efficiently thus reducing the cost for the end user.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Expanded the technical topic areas within the Agreement between the U.S. and Israel from "NextGen First Responder Technologies" to the entire HSE mission.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Transition or commercialize outcomes of previous BIRD cohorts.	FY 2020 Q1	FY 2020 Q4	6-7
FY 2021			
Transition or commercialize outcomes of previous BIRD cohorts.	FY 2021 Q1	FY 2021 Q4	6-7
Release a new call for proposals addressing homeland security priority areas for technical development.	FY 2021 Q1	FY 2021 Q4	N/A

Commercialization Accelerator Program

- **Problem:** Only a small fraction of the research performed using Federal funding reaches the marketplace where it can have an impact and ensure the most meaningful return on investment. This is due to limited resources to identify the right technology, mature it for transition, evaluate it against user needs, and create partnerships with communities in the private sector that can facilitate commercialization.

- **Solution:** 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 increase market readiness of technologies and introduce them to operational users, development partners, and investors to accelerate commercialization through partnerships.

- **Justification:** The FY 2021 President's Budget provides $5.2M for this project, an increase of $3.3M from the FY 2020 Enacted budget. This level of funding will be used to analyze mission-relevant technology and innovation and develop licensing and marketing strategies that support commercialization of DHS-funded solutions.

- **Impact:** 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.

Type of Research
Developmental

Technical Readiness Level
TRLs will range from 6-7.

Transition Plans
Activities will be in support of S&T priority areas and will be commercialized for component customer adoption.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Identified mission relevant technologies and S&T funded intellectual property that have commercial potential.	FY 2019 Q1	FY 2019 Q4	6-7
Conducted 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 2019 Q1	FY 2019 Q4	6-7
FY 2020			

Research and Development Description	Plan Start Date	Planned Completion	TRL
Conduct technology and innovation analysis for DHS's high priority technological/capability requirements to inform commercial viability.	FY 2020 Q1	FY 2020 Q4	6-7
Develop plans to support commercialization of DHS-funded solutions including licensing, marketing and communication strategies with industry stakeholders.	FY 2020 Q1	FY 2020 Q4	6-7
FY 2021			
Conduct technology and innovation analysis for DHS's high priority technological/capability requirements to inform commercial viability.	FY 2021 Q1	FY 2021 Q4	6-7
Develop plans to support commercialization of DHS-funded solutions including licensing, marketing and communication strategies with industry stakeholders.	FY 2021 Q1	FY 2021 Q4	6-7

Coordination, Engagement and Outreach

- **Problem:** Traditional methods of engaging and contracting are not enough to ensure that S&T is reaching the broader groups of industry who are poised to deliver significant solutions to DHS customers in an appropriate, condensed timeline.
- **Solution:** S&T will initiate 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.
- **Justification:** The FY 2021 President's Budget provides $3.1M for this new project. The funds will be used to reach an ever-broader industry audience with DHS mission-relevant capabilities by facilitating additional events to educate stakeholders on the activities and technology needs of DHS Components.
- **Impact:** The program will ensure S&T is able to deliver the best technology solutions to DHS's end-users and operators building and sustaining relationships with industry and innovation communities.

Type of Research

Developmental

Technical Readiness Level

TRLs will range from 6-7.

Transition Plans

TBD - This will be determined and developed based on event observations and feedback.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Executed a series of 12 activities aligned to DHS priorities that provide an opportunity for industry to engage with S&T.	FY 2019 Q1	FY 2019 Q4	6-7
Facilitated the release of competitions and solicitations aligned to DHS Component missions.	FY 2019 Q1	FY 2019 Q4	6-7
FY 2020			
Facilitate 15 events to educate stakeholders on the activities of DHS Components, current technology capabilities, and technology needs.	FY 2020 Q1	FY 2020 Q4	6-7
Expand S&T's use of contracting actions to enhance the capabilities of the HSE.	FY 2020 Q1	FY 2020 Q4	6-7
FY 2021			
Facilitate 15 events to educate stakeholders on the activities of DHS Components, current technology capabilities, and technology needs.	FY 2021 Q1	FY 2021 Q4	6-7

Innovation Industry Collaboration and Outreach

- **Problem:** Traditional methods of engaging and contracting are not enough to ensure that S&T is reaching the broader groups of industry who are poised to deliver significant solutions to DHS customers in an appropriate, condensed timeline.
- **Solution:** S&T initiated 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.
- **Justification:** The FY 2021 President's Budget does not include funding for this project. Under S&T's revitalization, Innovation Industry Collaboration and Outreach efforts have been captured under the Coordination, Engagement and Outreach project.
- **Impact:** The program ensured S&T was able to deliver the best technology solutions to DHS's end-users and operators building and sustaining relationships with industry and innovation communities.

Type of Research

Developmental

Technical Readiness Level

TRLs will range from 6-7.

Transition Plans

TBD - This will be determined and developed based on event observations and feedback.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Executed a series of 12 activities aligned to DHS priorities that provide an opportunity for industry to engage with S&T.	FY 2019 Q1	FY 2019 Q4	6-7
Facilitated the release of competitions and solicitations aligned to DHS Component missions.	FY 2019 Q1	FY 2019 Q4	6-7
FY 2020			
N/A	N/A	N/A	N/A
FY 2021			
N/A	N/A	N/A	N/A

Partnership Intermediary Agreements (PIA)

- **Problem:** The transfer and commercialization of federally-funded technologies is frequently a time consuming and expensive undertaking especially when resources are constrained at Government agencies, including DHS.
- **Solution:** S&T will 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.
- **Justification:** The FY 2021 President's Budget provides $1.0M for this project, a decrease of $2.0M from the FY 2020 Enacted budget. This level of funding will be used to continue identifying DHS priority areas in which Partnership Intermediaries may engage external stakeholders to work with S&T in facilitating the transition of S&T-funded technologies.
- **Impact:** 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.

Type of Research

Developmental

Technical Readiness Level

TRLs will range from 6-7.

Transition Plans

The program will plan the transition of all relevant DHS technologies to DHS Components and the open market via commercialization.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Awarded DHS funded PIA in accordance with the DHS PIA Guide.	FY 2019 Q1	FY 2019 Q4	6-7
FY 2020			
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.	FY 2020 Q1	FY 2020 Q4	6-7
FY 2021			
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.	FY 2021 Q1	FY 2021 Q4	6-7

Partnership Mechanisms and Technology Transition

- **Problem:** To support the broad mission of DHS and keep pace with rapid changes in technology, S&T requires access to a wide range of innovative companies to include non-traditional Government partners. To encourage these innovative companies to engage with the Government requires creative approaches to communicate and invest with these non-traditional partners on specific problem sets.

- **Solution:** S&T provides a suite of capabilities to engage non-traditional partners (e.g., startups, incubators, accelerators, manufacturers, distributors) in the development and transition of technology solutions for homeland security. The EMERGE Accelerator Program, Prize Program, and Technology Transfer and Commercialization Program are specifically designed to engage and partner with industry to develop and transition innovative technologies. S&T continues to work with other Departments and agencies to identify successful approaches to engage the full range of performers.

- **Justification:** The FY 2021 President's Budget does not include funding for this project, which is a reduction of $1.4M.

- **Impact:** These programs broaden S&T's reach by working with a variety of industry partners to find commercial technology that is adaptable for use by the HSE. Influencing commercial technology supports S&T's goal to ensure transition of technology to end-users to close homeland security gaps. These capabilities allow S&T to leverage investments by other Government agencies and the private sector. In addition, access to these partner networks supports S&T technology scouting and transition efforts by increasing awareness of emerging technologies to inform S&T investments.

Type of Research
Applied

Technical Readiness Level
TRL will vary between specific portfolio projects.

Transition Plans
Transition Plans vary based on the specific problem statement and final results of the competition, accelerator, call, and/or work program.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conduct Prize Competition: USCG Research & Development Center Enhanced Person in the Water (ePIW) Detectability Challenge.	FY 2018 Q3	FY 2019 Q4	N/A
FY 2020			
Coordination, Engagement, and Outreach - Facilitate 15 events to educate stakeholders on the activities of DHS Components, current technology capabilities, and technology needs.	FY 2020 Q1	FY 2020 Q4	N/A
Coordination, Engagement, and Outreach - Expand S&T's use of contracting actions to enhance the capabilities of the HSE.	FY 2020 Q1	FY 2020 Q4	N/A
FY 2021			
N/A	N/A	N/A	N/A

Silicon Valley Innovation Program (SIVP)

- **Problem:** As the needs and technology gaps of DHS operational agencies and critical infrastructure partners continue to evolve, DHS needs to pursue multiple paths to innovative solutions for these needs. Lengthy procurement processes have created barriers for entry for innovative high-tech commercial small businesses thus limiting the Government's access to relevant and timely solutions to meet these evolving needs.

- **Solution:** The SVIP reaches out to innovation communities across the Nation and around the world to harness the commercial R&D ecosystem for government applications, co-invest in ideas, and accelerate transition-to-market. The SVIP also involves DHS operational Components, end users and HSE stakeholders throughout each project, thereby increasing the likelihood of successful transitions that meet operational needs.

- **Justification:** The FY 2021 President's Budget provides $10.0M for this project, an increase of $2.0M from the FY 2020 Enacted budget. This level of funding will be used to release solicitations in additional DHS-relevant topic areas and to continue transitioning research results to DHS Components or the commercial market.

- **Impact:** 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 also is drawing new companies that 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.

Type of Research
Developmental

Technical Readiness Level
Specific company solutions are expected to begin Phase I at a minimum TRL-3, and solutions that successfully progress through Phase IV should finish at a TRL-7.

Transition Plans
The program will plan the transition of all relevant DHS technologies to applicable DHS Components and commercialization.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Completed transition of two to four projects into Component operational acquisition cycles or commercial products (project/solution dependent).	FY 2019 Q1	FY 2019 Q4	6-7
FY 2020			
Release new solicitation calls in three to five specific areas covering broad DHS and critical infrastructure needs and requirements as identified through S&T requirement sourcing activities.	FY 2020 Q1	FY 2020 Q4	N/A
Transition completed projects into component operational acquisition cycles or commercial products (project/solution dependent).	FY 2020 Q1	FY 2020 Q4	6-7
FY 2021			
Release new solicitation calls in three to five specific areas covering broad DHS and critical infrastructure needs and	FY 2021 Q1	FY 2021 Q4	N/A

Research and Development Description	Plan Start Date	Planned Completion	TRL
requirements as identified through S&T requirement sourcing activities.			
Transition completed projects into component operational acquisition cycles or commercial products (project/solution dependent).	FY 2021 Q1	FY 2021 Q4	6-7

Foundational Tools Program

A critical part of S&T's mission as science advisor to the DHS Secretary and Department is to ensure that R&D receives the proper requirements analysis that will support homeland security operations. S&T is also responsible for identifying and prioritizing DHS-wide R&D capability gaps, minimizing or eliminating the duplication of efforts, as well as identifying 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 the information to Components and stakeholders in order 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 OpExs 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.

Aligning Departmental R&D with DHS Goals

- **Problem:** The R&D IPTs were established as the Department's primary collaboration mechanism for DHS-wide R&D needs. Since 2015, the IPT process has become the central process for identifying and prioritizing R&D capability gaps. 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:** S&T will establish the DHS IPT process and normalize the operations of all DHS IPTs as a mechanism to receive Components' R&D needs and priorities. The IPT will conduct analyses to support S&T prioritization of work and resource allocation.

- **Justification:** The FY 2021 President's Budget provides $2.0M for this project, the same level as FY 2020 Enacted budget. This level of funding will be used to advance the use of portfolio management and decision analytics. The IPT process will provide unprecedented transparency and traceability of S&T activities, from capability gap identification to end user operational application. The improved process ensures direct alignment of R&D resources to Component/Customer operational priorities and DHS strategic goals. By 2021, S&T will also align the IPT Process with the DHS Joint Requirements Council (JRC) Portfolio Team Process to improve prioritization and coordination of R&D with major acquisitions.

- **Impact:** S&T ensures that 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. The IPTs will also be the mechanism to capture information on other DHS R&D activities outside of S&T.

Type of Research
N/A

Technical Readiness Level
N/A

Transition Plans
N/A

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed 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.	FY 2019 Q1	FY 2019 Q3	N/A
Conducted the FY 2019-2020 IPT process to prioritize R&D capability gaps.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Integrate data analytics into the IPT Process to ascertain the technical feasibility of applying R&D to capability gaps.	FY 2020 Q1	FY 2020 Q4	N/A
Conduct the FY 2020-2021 IPT process to prioritize R&D capability gaps.	FY 2020 Q1	FY 2020 Q4	N/A
FY 2021			
Align the IPT and JRC Portfolio Team Process to ensure better coordination of R&D and acquisition resources for long-term capabilities development.	FY 2021 Q1	FY 2021 Q4	N/A
Conduct the FY 2021-2022 IPT process to prioritize R&D capability gaps.	FY 2021 Q1	FY 2021 Q4	N/A

Technology Clearinghouse

- **Problem:** S&T must maintain a collaboration space for DHS Components and the first responder and emergency preparedness and response communities. This is necessary in order to gather necessary information for its programs and to keep those communities informed about the technologies and knowledge products S&T is developing on their behalf. Additionally, DHS needs a single, intuitive knowledge sharing resource

to find, collect, curate and disseminate relevant information to partners, stakeholders and the private sector regarding homeland security technologies, innovative solutions, resources, and capabilities.

- **Solution:** The S&T Technology Clearinghouse provides collaboration opportunities among homeland security personnel, industry, academia, and other stakeholders and aids in the development of innovative technology solutions for homeland security. The S&T Technology Clearinghouse shares curated information and general resources that assist the industry and manufacturer community collaborate with DHS and the broader first responder community to protect the Homeland. This curated information defines authoritative homeland security requirements and gaps, research and development investment and business opportunities, licensing opportunities, operational testing and evaluation activities, standards development and other partnership initiatives. The Technology Clearinghouse is congressionally authorized in the Homeland Security Act of 2002.

- **Justification:** The FY 2021 President's Budget provides $2.8M for this project, same level as FY 2020 Enacted budget. Funds will be used to build on the existing public-facing Technology Clearinghouse to include a platform for secure sharing of For Official Use Only (FOUO) and Law Enforcement Sensitive (LES) content with DHS Components and the broader Homeland Security Community. The funding will also be used for Phase II of the Clearinghouse development in order to provide for two-way sharing of technology information (e.g. lessons learned, best practices, acquisition successes, etc.) among DHS Components, State, and local first responder organizations, and the broader Homeland Security Community.

- **Impact:** The S&T Technology Clearinghouse increases awareness of S&T's work, and it facilitates the flow of important information throughout DHS, the emergency response community, and the private sector innovation community. The Technology Clearinghouse facilitates the knowledge sharing of existing R&D expenditures and is a cost –effective communication tool that expands S&T's reach into stakeholder communities and enables DHS and the homeland security community to make better informed R&D, investment and purchasing decisions.

Type of Research
N/A

Technical Readiness Level
N/A

Transition Plans
N/A

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Expanded Technology Clearinghouse functions across broader S&T user base.	FY 2019 Q1	FY 2019 Q1	N/A
Conducted 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.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Expand content of public-facing instance of the Technology Clearinghouse to include relevant curated information from S&T's Office of Mission and Capability Support. Support broad S&T user-base beyond first responders in direct support of statutory requirements.	FY 2020 Q1	FY 2020 Q4	N/A
Provide an initial operational capability for a Technology Clearinghouse portal that will allow DHS Component access to Sensitive but Unclassified S&T information through use of their existing PIV credentials.	FY 2020 Q1	FY 2020 Q4	N/A
FY 2021			
Expand content of public-facing version of the Technology Clearinghouse to include relevant curated information from S&T's Office of Innovation and Collaboration.	FY 2021 Q1	FY 2021 Q4	N/A
Provide an initial operational capability for a Technology Clearinghouse portal that will allow State and local first responder/homeland security agency access to Sensitive but Unclassified S&T information through use of identity access management system	FY 2021 Q3	FY 2021 Q4	N/A

Technology Scouting

- **Problem:** S&T program managers and DHS Component customers need awareness of ongoing and/or completed capability solutions that could be acquired or adapted to meet operational mission needs. This is essential in order to avoid unnecessary, duplicative R&D. Detailed research and analysis of viable solution alternatives improves program planning and R&D decision-making, and it informs a customer's decision on the most appropriate existing, adaptable or new R&D solution(s). A centralized source of information on existing commercial or R&D solutions needs to be available to users to most effectively and efficiently satisfy existing technology capability gaps and to rapidly enhance homeland security.

- **Solution:** By conducting research on existing technologies and solutions that are available commercially, through another Federal agency or supported research organization, technology scouting provides input to assist in the make vs. buy decision; therefore, eliminating unnecessary R&D. Providing technology scouting services will support technology research, alternatives analysis, support and capability transition for inserting appropriate technology and knowledge products into DHS Components and the larger HSE.

- **Justification:** The FY 2021 President's Budget continues its request for $4.8M, the same as the FY 2020 Enacted level. This level of funding will be used to procure access to market analysts, technology databases, research services, and provide assessments of current state of the art and emerging technologies to DHS R&D and acquisition programs before and during program execution. Technology Scouting enables DHS program managers to make informed decisions regarding develop, modify, or buy decisions for technologies needed to fulfill identified capability gaps.

- **Impact:** 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 and eliminates unnecessary R&D expenditures.

Type of Research
N/A

Technical Readiness Level
N/A

Transition Plans
N/A

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Supported expansion of knowledge management database systems to increase scope of available technology options to solve Component technology requirements.	FY 2019 Q1	FY 2019 Q1	N/A
Built capacity to increase technology research and expand networks to maximize reuse of existing or adaptable technology solutions.	FY 2019 Q4	FY 2019 Q4	N/A
FY 2020			
Establish an S&T working group designed to enable awareness of TS activities and collect knowledge/input from S&T's SME networks to improve the quality and accuracy of deliverables. The Tech Scouting Working Group will meet quarterly.	FY 2020 Q1	FY 2020 Q4	N/A
FY 2021			
Create knowledge distribution channels to share completed tech scouting reports and research to greater audiences within the HSE.	FY 2021 Q2	FY 2021 Q4	N/A
Survey customers to document customer satisfaction and develop business process improvements to address feedback.	FY 2021 Q1	FY 2021 Q4	N/A

Technology Transition

- **Problem:** The transition of new technologies and capabilities to DHS Components and other end users is a challenge for all U.S. government agencies. The purpose of Technology Transition is to ensure, to the maximum extent practicable, that S&T transition planning and execution is integrated into S&T's research and development program management lifecycle process to increase the likelihood of adoption of solutions funded by DHS and developed for national homeland security purposes.

- **Solution:** S&T will provide transition support services and tools that will assist Program Managers (PMs) and S&T decision-makers in project planning and execution. These services focus on critical transition areas identified by S&T including selection and implementation of transition tools and strategies; identification, measurement, and mitigation of transition issues and risks; engagement and communication between the PM and the customer; and assurance that the user is ready and resourced to employ S&T-developed products.

- **Justification:** The FY 2021 President's Budget provides $3.9M for this project, a decrease of $3.1M from the FY 2020 Enacted budget. This level of funding will be used to provide R&D transition planning and advisory support to DHS Program Managers. Additionally, these professional and program support services will be used by S&T to track project transitions, collect and analyze post-transition data for the purpose of reporting on the impact of DHS sponsored Research and Development.

- **Impact:** Providing transition support services will expedite the transfer of technologies and knowledge to DHS and other government agencies; improve the probability of successful project outcomes; and provide a systematic approach to determine potential failure points associated with the transition so that resources can be quickly allocated to address issues or reallocated to priority projects (i.e., fail fast). Separately, S&T will track and report on DHS R&D transitions, and also focus on post-transition evaluations of all DHS R&D activities for three years in accordance with the *National Defense Authorization Act for FY 2017* (NDAA).

Type of Research
N/A

Technical Readiness Level
N/A

Transition Plans
N/A

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Developed Technology Transition Plan strategy and process in support of DHS Component Acquisition Executives and programs of record.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Provide Technology Transition guidance and planning tools for S&T R&D projects started in FY 2020.	FY 2020 Q1	FY 2020 Q4	N/A
FY 2021			
Establish DHS-wide Directive and Instruction on 2017 NDAA R&D tracking and reporting.	FY 2021 Q1	FY 2021 Q4	N/A

University Programs – PPA

Budget Comparison and Adjustments

Comparison of Budget Authority and Request

Organization (Dollars in Thousands)	FY 2019 Enacted			FY 2020 Enacted			FY 2021 President's Budget			FY 2020 to FY 2021 Total Changes		
	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount	Pos.	FTE	Amount
Centers of Excellence	-	-	$37,104	-	-	$37,104	-	-	$18,350	-	-	($18,754)
Minority Serving Institutions (MSI)	-	-	$3,396	-	-	$3,396	-	-	$3,396	-	-	-
Total	**-**	**-**	**$40,500**	**-**	**-**	**$40,500**	**-**	**-**	**$21,746**	**-**	**-**	**($18,754)**
Subtotal Discretionary - Appropriation	-	-	$40,500	-	-	$40,500	-	-	$21,746	-	-	($18,754)

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 includes the following programs:

Centers of Excellence: The 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 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 2019	FY 2020	FY 2021
Enacted/Request	**$40,500**	**$40,500**	**$21,746**
Carryover and/or Recoveries (Actual/Estimates/Projections)	$15,025	$26,982	$22,772
Rescissions to Current Year/Budget Year	-	-	-
Net Sequestered Resources	-	-	-
Reprogrammings/Transfers	-	-	-
Supplementals	-	-	-
Total Budget Authority	**$55,525**	**$67,482**	**$44,518**
Collections – Reimbursable Resources	$500	$500	$500
Total Budget Resources	**$56,025**	**$67,982**	**$45,018**
Obligations (Actual/Estimates/Projections)	$28,533	$45,210	$31,639
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 2019 Enacted	**-**	**-**	**$40,500**
FY 2020 Enacted	**-**	**-**	**$40,500**
FY 2021 Base Budget	**-**	**-**	**-**
Centers of Excellence	-	-	$18,350
Minority Serving Institutions	-	-	$3,396
Total Research and Development Projects	**-**	**-**	**$21,746**
FY 2021 Request	**-**	**-**	**$21,746**
FY 2020 To FY 2021 Change	**-**	**-**	**($18,754)**

University Programs – PPA
Non Pay Budget Exhibits

Non Pay Summary

Organization *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Total Changes
Centers of Excellence	$37,104	$37,104	$18,350	($18,754)
Minority Serving Institutions (MSI)	$3,396	$3,396	$3,396	-
Total	**$40,500**	**$40,500**	**$21,746**	**($18,754)**
Discretionary - Appropriation	$40,500	$40,500	$21,746	($18,754)

Non Pay by Object Class

Non-Pay Object Classes *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget	FY 2020 to FY 2021 Change
25.3 Other Goods and Services from Federal Sources	$2,271	$2,271	$1,123	($1,148)
25.5 Research and Development Contracts	$980	$980	$485	($495)
31.0 Equipment	$26	$26	$13	($13)
41.0 Grants, Subsidies, and Contributions	$37,223	$37,223	$20,125	($17,098)
Total - Non Pay Object Classes	**$40,500**	**$40,500**	**$21,746**	**($18,754)**

Research and Development Projects
Summary of Projects

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Centers of Excellence	$37,104	$37,104	$18,350
Minority Serving Institutions (MSI)	$3,396	$3,396	$3,396

Centers of Excellence
Research and Development
Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Centers of Excellence	$37,104	$37,104	$18,350

CENTERS OF EXCELLENCE: The DHS S&T Centers of Excellence (COEs) develop multidisciplinary, customer-driven, homeland security science and technology solutions and help train the next generation of homeland security experts. The COE network is an extended consortium of hundreds of universities conducting groundbreaking research to address homeland security challenges. Sponsored by the Office of University Programs, the COEs work closely with the homeland security community to develop customer-driven, innovative tools and technologies to solve real-world challenges. COE partners include academic institutions; industry; national laboratories; DHS operational components; S&T divisions; other Federal agencies; State, local, tribal, and territorial homeland security agencies; and first responders. These partners work in concert to develop critical technologies and analyses to secure the Nation.

Program	Project	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Centers of Excellence		**$37,104**	**$37,104**	**$18,350**
	Critical Infrastructure Resilience Institute (CIRI)	$3,711	$3,711	$3,670
	Arctic Domain Awareness Center (ADAC)	$3,711	$3,711	$3,670
	Criminal Investigations and Network Analysis (CINA)	$3,711	$3,711	$3,670
	Cross Border Threat Screening and Supply Chain Defense (CBTS)	$3,711	$3,711	$3,670
	Center for Accelerating Operational Efficiency (CAOE)	$3,710	$3,710	$3,670
	Awareness & Localization of Explosives-Related Threats (ALERT)	$3,710	$3,710	-
	Borders, Trade, and Immigration (BTI) Institution	$3,710	$3,710	-
	Coastal Resilience Center of Excellence (CRC)	$3,710	$3,710	-
	Security Technology Transition (STT/MBA)	$3,710	$3,710	-
	Terrorism Prevention Counterterrorism Research (TPCR)	$3,710	$3,710	-

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 compromised 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 explores the organizational, policy, business, and technical dimensions of critical infrastructure's dependence on cyber assets. CIRI examines 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 develops 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. The activities under this project include:
  - The Application of Critical Infrastructure Research in the Real-World: CIRI evaluates policy options and identifies, tests, and pilots technologies and non-material solutions to support effective decision-making in a collaborative risk management environment in real-world settings. Investigating areas from Cybersecurity assurance for Critical Infrastructure to EMP Risk Assessment and Mitigation Prioritization and Hybrid Quantum-Classical Reinforcement Learning, CIRI is leveraging existing publications, analyses, and verified and validated models to evaluate and select cross-sector issues that are amenable to real-world testing.
  - Understanding Resilient Critical Infrastructure Systems: Infrastructure systems are owned and operated by a variety of businesses and public entities, including municipal and other types of governments that vary in their knowledge of, and flexibility to manage catastrophic risk. To this end, CIRI is performing an Assessment and Measurement of Port Disruptions and will deliver a "proof-of-concept" framework that would allow port authorities to conduct contextually relevant threat-based assessments of port infrastructure.
  - The Business Case for Infrastructure Resiliency: Understanding how businesses that make up infrastructure systems make decisions before, during, and after a catastrophic event will assist in defining future policies, incentives, and programs. CIRI is analyzing government policies and regulations and the dynamics of risk insurance markets to determine their effects on the motivations and behavior of decision makers throughout the homeland security enterprise. By assisting with cybersecurity framework implementation, modeling and planning dynamic resiliency, and leveraging AI for Disaster Response, researchers are developing future options for policies, regulations, and market conditions that will properly incentivize decision makers to make timely and appropriate investments in infrastructure security and resilience.
  - The Future of Resilience: By researching cloud-based delivery of training related to cyber risk management processes, CIRI is improving risk-based cybersecurity postures within individual companies and government agencies.

- **Justification:** The FY 2021 President's Budget provides $3.7M for this project, $41 thousand below FY 2020 Enacted. This level of funding will be used to identify, execute, and deliver scientifically sound research that improves the resilience of the Nation's critical infrastructure, and to transition outputs from that research to the DHS Components, and the homeland security enterprise at large. Additionally, CIRI is responsible for developing and delivering educational and workforce development initiatives aimed at creating a workforce attuned to the requirements of infrastructure resilience and which is trained to implement resilience best practices and to pursue new avenues for improving critical infrastructure resilience. CIRI efforts support DHS initiatives to establish conditions for a more fundamentally secure and resilient cyber ecosystem that will enable effective cyber risk management.

- **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.

Type of Research

CIRI's research projects that range in technical risk and addresses enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

CIRI executes projects spanning TRLs. Primarily, CIRI conducts projects between TRL-2 through TRL-7, from initial concept development to system prototypes tested in the field.

Transition Plans

S&T program managers work with the CIRI to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. 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. 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. S&T 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.

Program managers work with the 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. 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Integrated, iteratively tested, and refined 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 2019 Q1	FY 2019 Q3	3
FY 2018 Annual Report review.	FY 2019 Q1	FY 2019 Q1	N/A
FY 2019 Workplan, development and submission.	FY 2019 Q2	FY 2019 Q2	N/A
FY 2019 Workplan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3	N/A
FY 2019 Annual Report development and submission.	FY 2019 Q4	FY 2019 Q4	N/A
FY 2020			
Conduct Biennial Review to evaluate CIRIs research portfolio at both theme and project levels for research quality, progress, and relevance to homeland security customer segment.	FY 2020 Q3	FY 2020 Q4	N/A
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.	FY 2020 Q1	FY 2020 Q4	4
FY 2021			
Integrate, iteratively test and refine software components to provide decision-making, information sharing, and data analytics tools enhancing business case and market incentives for increased investment in critical infrastructure security and resilience.	FY 2021 Q1	FY 2021 Q4	3
FY 2021 Conduct national scale cybersecurity workforce development initiatives, integrated and delivered in DHS/CIRI-developed software components, to provide cybersecurity education, training and reskilling, and to facilitate apprenticeships based on national standard.	FY 2021 Q1	FY 2021 Q4	5

Arctic Domain Awareness Center (ADAC)

ADAC 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 and other DHS Arctic missions. The activities under this project include:

- Maritime Risk, Threat Analysis, and Resilience Research: The DHS Components (e.g., USCG, CBP, FEMA, ICE) must define and assess threats, vulnerabilities and the consequences of terrorism, crime and natural disasters in the maritime domain to devise strategies to minimize these consequences. DHS must identify and select the most efficient and effective approaches to reduce risks to maritime environments, including ports, waterways, islands, the Arctic, coasts and coastal infrastructure. To do this, DHS needs to understand how to deter threats and crime, prepare for both human-caused and natural disasters, and develop effective approaches to increase U.S. resilience to maritime challenges. ADAC will focus on increasing USCG's knowledge of the impact of oil spills on the arctic environment and wildlife, including Arctic mussels and Arctic copepods, which will assist USCG first responders following an oil spill.
- Maritime Domain Awareness (MDA) Research: ADAC is working to expand MDA, which is the effective understanding of anything associated with the global maritime domain that could impact the United States' security, safety, economy, or environment. Growth of commercial activity in the maritime domain presents new security challenges, especially energy extraction-related growth. Increased and diversified utilization of maritime spaces will likely generate new security challenges and risks, and the potential for increased conflicts among maritime users, stakeholders, and interests. ADAC is currently providing USCG and mariners with information on ice conditions through an Arctic ice index and GIS platform to assist with operational decisions.
- Maritime Technology Research: Gaps in maritime security continue to evolve and maritime technology is one potential solution for addressing those gaps. ADAC is seeking innovative research and technologies to address maritime knowledge gaps that can be developed or adapted further to help, for example, first responders. ADAC is currently developing a specialized long-rang autonomous underwater vehicle to provide the USCG a capability to detect oil spills in remote and austere environment and support oil spill first responders.
- Integration of Science and Engineering with Maritime Security Governance and Policy Research: Technological developments can enhance the effectiveness of maritime security, commerce, environmental management and disaster preparedness. However, technology must be understood in the context of maritime policy, laws, and international relationships. Understanding the long-term geopolitical drivers and improving cooperation among stakeholders that share common interests will be crucial to reducing risks. ADAC seeks to advance physical, biological, and social science research to improve understanding of how technological change will affect policy and governance, as well as research to determine what policy and governance regimes will foster the growth of beneficial technologies in the maritime domain, e.g., improved communication among state and non-state actors.

- **Justification:** The FY 2021 President's Budget provides $3.7M for this project, $41 thousand below FY 2020 Enacted. This level of funding will be used to complete ADAC's research projects and transition activities. Project transition is vital to ensure that DHS operators are able to use ADAC's deliverables in support of their mission. Due to ADAC's exceptional performance, OUP plans to extend ADAC's period of performance by approximately 20 months with June 2021 as the new end date for ADAC's cooperative agreement. This funding will ensure that ADAC can continue its research portfolio in support of the USCG mission in the dynamic Arctic environment.

- **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.

Type of Research

ADAC's research ranges in technical risk and addresses enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

ADAC executes projects spanning TRLs. Primarily, ADAC conducts projects between TRL 2 through 7, from initial concept development to system prototypes tested in the field.

Transition Plans

S&T works with the ADAC to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. 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. 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. S&T 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.

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. 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Finalized a system prototype oil spill model for operation in the Arctic.	FY 2019 Q2	FY 2019 Q3	N/A
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1	N/A
FY 2019 Work plan, development and submission.	FY 2019 Q2	FY 2019 Q2	N/A
FY 2019 Work plan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3	N/A
FY 2019 Annual report development and submission.	FY 2019 Q4	FY 2019 Q4	N/A
FY 2020			
Transition an Arctic All-Hazards GIS platform tool to the government for sustainment.	FY 2020 Q1	FY 2020 Q2	7

Research and Development Description	Plan Start Date	Planned Completion	TRL
Transition an Arctic Vessel Monitoring tool.	FY 2020 Q1	FY 2020 Q3	3
Test and demonstrate a Long Range Autonomous Underwater Vehicle (LRAUV) in ice/extreme temperature conditions.	FY 2020 Q3	FY 2020 Q4	7
FY 2021			
Complete the design and fabrication of an additional sensor capability to LRAUV to create a multi-mission capability and manufacture an additional (second) LRAUV based upon a reduced cost design.	FY 2021 Q1	FY 2021 Q4	7
Create and optimize a forecast numeric Arctic ice condition index for Arctic waters.	FY 2021 Q1	FY 2021 Q4	7

Criminal Investigations and Network Analysis (CINA)

This Center conducts end user-focused research to enhance investigation strategies to address transnational criminal organizations activities and other homeland security-related crimes. This COE also provides 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 focuses on a major, cross-cutting DHS mission area, criminal law enforcement that the COEs have not yet addressed. While technological innovations promise continuing improvements in the quality of life for individuals around the globe, criminal organizations are capitalizing on these transformative advances to become more agile and expand their illicit activities. Sophisticated criminal networks can easily appear, disappear and reorganize in response to opportunities and authority gaps. These networks function as complex social structures across the cyber and physical spaces, and operate at a variety of scales, ranging from local to international.

- **Solution:** The overarching goal of the Center is 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. The activities under this project include:
  - Criminal Network Analysis: Focusing on equipping HSE stakeholders with a thorough understanding and knowledge of criminal activity, its evolution, and convergence, CINA researches the structure of organized gangs, illicit supply networks, and cartels; furthering the development of tools to monitor and disrupt these activities.
  - Dynamic Patterns of Criminal Activity: This initiative seeks to improve prediction and forecasting for HSE stakeholders through the development of cutting-edge methods, agent-based models, and game theory to forecast criminal actions, gang activities, and threats to the US. Studying the threats at the geographical, social, and cyber dimensions, the Center believes the Department can prevent, interdict, mitigate and deter homeland security threats or future losses.

- Forensics: With the intent on developing and deploying state-of-the-art forensic methods, tools, and technologies within the HSE community, the CINA Center leverages advancements in multimedia support, biometric characteristics and digital identifiers, allowing law enforcement officers to attribute malicious incidents with threat actors.
- Criminal Investigative Processes: Intent on improving HSE end user investigative processes used to detect, pursue and solve transnational criminal activity, the center is focusing on solving complex investigative process associated with human trafficking, cybercrimes and money laundering.

- **Justification:** The FY 2021 President's Budget provides $3.7M, $41 thousand below the FY 2020 level. This level of funding will be used to continue academic research focused on thwarting criminal networks and transnational crime by advancing tools available to law enforcement officers within the HSE and providing analysts and policy officials with insights into the networked structure of this illicit actors.

- **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.

Type of Research

CINA's research ranges in technical risk and addresses enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

CINA executes projects spanning TRLs.

Transition Plans

S&T works with CINA to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. 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. 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. S&T 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.

Program managers work with the 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. 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Reviewed the 2018 CINA Center of Excellence Annual Report.	FY 2019 Q1	FY 2019 Q1	N/A
Developed and submitted CINA COE Workplan for FY 2019.	FY 2019 Q2	FY 2019 Q2	N/A
Reviewed and Approved CINA COE Workplan for FY 2019.	FY 2019 Q3	FY 2019 Q3	N/A
Developed and submitted FY 2019 CINA COE Annual Report.	FY 2019 Q4	FY 2019 Q4	N/A
Awarded five scholarships for student internships or fellowships within DHS Components.	FY 2019 Q1	FY 2019 Q4	N/A
Identified a project with End-to-End potential and developed transition milestones with input from end users to be integrated into the work plan for FY 2019 execution.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Demonstrate an agent-based assessment model that predicts impacts from the disruption and dismantling of gangs/Transnational criminal Organizations have on American Communities to homeland security professionals.	FY 2018 Q3	FY 2020 Q2	3
Deliver publication on a human trafficking analytical model that analyzes data sources on indicators of human trafficking and validity of predictors that can be derived from the data sets.	FY 2019 Q3	FY 2020 Q2	2
Develop Application Programing Interface for digital media hashing prototype previously developed.	FY 2019 Q3	FY 2020 Q3	3
Incorporate Biennial Review results into the research work plan and strategic management plan	FY 2020 Q1	FY 2020 Q3	N/A
Review the 2019 CINA COE Annual Report.	FY 2020 Q1	FY 2020 Q1	N/A
Development and submission of CINA COE Workplan for FY 2020.	FY 2020 Q2	FY 2020 Q2	N/A
Review and approve CINA COE Workplan for FY 2020.	FY 2020 Q3	FY 2020 Q3	N/A
Development and submission of FY 2020 CINA COE Annual Report.	FY 2020 Q4	FY 2020 Q4	N/A
Conduct Biennial Review to evaluate CINA's research portfolio at both theme and project levels for research quality, progress and relevance to homeland security customer segments.	FY 2020 Q1	FY 2020 Q4	N/A
FY 2021			
Develop prototype synthetic criminal networks generator for interdiction testing.	FY 2019 Q4	FY 2021 Q3	3
Review the 2020 CINA COE Annual Report.	FY 2021 Q1	FY 2021 Q1	N/A
Development and submission of CINA COE Workplan for FY 2021.	FY 2021 Q2	FY 2021 Q2	N/A
Review and approve CINA COE Work plan for FY 2021.	FY 2021 Q3	FY 2021 Q3	N/A
Development and submission of FY 2021 CINA COE Annual Report.	FY 2021 Q4	FY 2021 Q4	N/A

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. The activities under this project include:
  - Detecting Biological Threats and Disruption to People and Global Supply Chains: Develop simplified, cost effective, interoperable, and broad-spectrum approaches to screen for biological threats. CBTS is analyzing the feasibility of using blockchain and/or other IoT technologies to capture and securely transmit information throughout the supply chain. Additionally, CBTS is developing a hand-held device that can identify infections in people before they develop symptoms, as well as differentiate between viral and bacterial pathogens in less than one hour.
  - Data Integration and Analytics: Improve decision analysis in the field by developing innovative tools, methodologies and processes to support DHS and its partners. Researchers are developing interoperable field-deployable software tools that integrate data from multiple data sources such as sensors, health records, import/exports, supply chains, private industry, and government partners to support decision makers.
  - Novel Operational Methods to Use Emerging Tools to Reduce Risk: Produce timely decision-making through meaningful data integration and representation from disparate sources via advanced Bayesian analysis applied to threat assessment outputs to inform future research, training and policy.
  - Time Critical Response Support: Research Early Warning and Workforce Protection against Highly Contagious Infectious Diseases will provide all levels of operators the guidance necessary to understand evolving global threats. This will help DHS respond to and support efforts to mitigate rapidly developing incidents.

- **Justification:** The FY 2021 President's Budget provides $3.7M for this project, $41 thousand below the FY 2020 level. The FY 2021 funding will be used to aid DHS in reducing risks posed by biological threats and hazards encountered at borders, ports of entry, and within the global supply chain. By researching the countering biological threats in supply chains, CBTS will assist DHS operations that protect the global supply chain and reduce the risk of exposing people and infrastructures to new and evolving biological threats.

- **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.

Type of Research

CBTS's research ranges in technical risk and addresses enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

CBTS executes projects spanning TRLs. Primarily, CBTS conducts projects between TRL-3.

Transition Plans

S&T works with CBTS to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. 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. 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. S&T 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.

Program managers work with the 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Launched COE program, including establishment of all sub-awards, Center management policies, project schedules, and data access agreements.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1	N/A
FY 2019 Work plan, development and submission.	FY 2019 Q2	FY 2019 Q2	N/A
FY 2019 Work plan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3	N/A
FY 2019 Annual report development and submission.	FY 2019 Q4	FY 2019 Q4	N/A

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2020			
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.	FY 2020 Q1	FY 2020 Q4	3
Workplan, development and submission.	FY 2020 Q2	FY 2020 Q3	N/A
Annual Report development and submission.	FY 2020 Q3	FY 2020 Q4	N/A
FY 2021			
Establish a portfolio of research projects to address the thematic areas of the COEs, including: 1) detecting biological threats and disruption to people and global supply chains – technologies, tools, and methods; 2) data integration and analytics; 3) novel operational methods to use emerging tools to reduce risk; 4) workforce development; 5) time critical reponse support.	FY 2021 Q1	FY 2021 Q4	N/A
Collaborate with the CBTS Board of Directors and create a portfolio of rubust projects that address the gaps and needs of the CBTS customers.	FY 2021 Q1	FY 2021 Q4	N/A

Center for Accelerating Operational Efficiency (CAOE)

This Center will conduct end user-focused research to enhance the application of analytic tools that support real-time decision making to address homeland security related threats and hazards. The Center will also provide education and professional development to improve data management and analysis, to facilitate operations research and systems analysis, to identify the economic impact of security threats and hazards, and to critically assess future risks posed to the DHS mission set.

- **Problem:** Our country's homeland security workforce each day faces complex challenges such us split-second decision making, wise allocation of scarce resources, accurately predicting consequences of natural and manmade disasters. In addition, the constantly changing information requirements make it difficult to provide dynamic and adaptable tools and processes to address these challenges.

- **Solution:** The overarching goal of the Center will be to develop tools and methods for all levels of the homeland security workforce (e.g. leaders, analysts and operators) to improve predictions in order to enhance preparation and response; to optimize screening and border operations for threat detection; and to inform prevention policy through risk and cost analysis. The activities under this project include:
  - Improving predictions to enhance preparation and response: CAOE's work in predictive analytics is advancing methodologies in terms of ability to provide analytic results faster and with more accuracy. Researchers are examining methods to analyze real-time streaming data to provide almost real-time solutions so that DHS operations can react quicker to changing situations. Research apply techniques to improve the accuracy of the predictions and build confidence in the results, whether it be in decision support tools or evaluation of the performance of artificial intelligence.

- Optimizing screening and border operations for threat detection: CAOE simulation and modeling advances understanding of the characteristics of homeland security threats and homeland security operations. CAOE researchers are using analytics to identify where and what type of infrastructure should be in place to counter specific threats along with enabling increased apprehensions at ports of entry, improved threat detection, and/or reduction in operating costs.
- Informing prevention policy through risk and cost analysis: CAOE's economic analysis and risk assessment capabilities are applied to DHS activities and mission areas, using "design science. Researchers are using both qualitative case-studies methods and quantitative psychometric/econometric approaches. The resulting design improvements touch areas across DHS, including acquisition and operations, cyber critical infrastructure, as well as the performance of TSOs.

- **Justification:** The FY 2021 President's Budget provides $3.7M for this project, which is $41 thousand below the FY 2020 Enacted budget. This level of funding will be used to advance research and also test the utility of specific project developments. For example, funding will support applying developed metrics that assess the usefulness of AI technologies when deploying processes that involve human AI teaming in the field. The Center will also deliver the proactive response toolkit to stakeholders to use and evaluate effectiveness.

- **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 homeland security professionals at all levels.

Type of Research

CAOE research ranges in technical risk and addresses enduring DHS mission areas. Portfolios are composed of early applied research to development efforts and initial deployment to the commercial sector. The balance of research depends upon the scientific domain, strategic needs, and the project progress.

Technical Readiness Level

CAOE executes projects spanning TRLs. Primarily, CAOE conducts projects between TRL-2 through TRL-4, from initial concept development to system prototypes tested in the field.

Transition Plans

S&T works with the CAOE to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. 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. 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. S&T 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.

Program managers work with the 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Identified an End-to-End project and develop milestones toward transition for operational use.	FY 2019 Q1	FY 2019 Q3	N/A
Developed a framework to standardize university-based research project data sharing, data use protocol and process to ensure that projects can deliver operational solutions while maximizing the use of non-sensitive data sources.	FY 2019 Q1	FY 2019 Q2	N/A
FY 2020			
FY 2019 Annual Report review.	FY 2020 Q1	FY 2020 Q1	N/A
Conduct Biennial Review and integrate results into the research work plan and strategic management plan.	FY 2020 Q1	FY 2020 Q2	N/A
Validate passenger arrival estimation and TSO scheduling methodologywith components at Phoenix Sky Harbor; demonstrate a 5% reduction in peak wait time through simulation.	FY 2020 Q1	FY 2020 Q4	4
Demonstrate testing methodology for measures of fairness in commercial off the shelf classifiers. This testing methodology will be applied to at least one AI technology to evaluate fairness.	FY 2020 Q3	FY 2020 Q4	3
CAOE will integrate the Simulation, Analytics and Modeling for Border Apprehension and Security (SAMBAS) into Border Patrol operations, as appropriate.	FY 2020 Q1	FY 2020 Q4	3
FY 2021			
FY 2020 Annual Report Review.	FY 2021 Q1	FY 2021 Q1	N/A
Provide proof of concept measures for human AI teaming to assess usefulness of AI technologies in the field. Qualitative survey results for the concept will be disseminated to two stakeholder groups or for at least two technologies and applications.	FY 2021 Q1	FY 2021 Q4	2/3
Demonstrate proactive response toolkit for emergency response to at least two stakeholder groups.	FY 2021 Q1	FY 2021 Q4	3

Awareness & Localization of Explosives-Related Threats (ALERT)

- **Problem:** DHS faces a myriad of complex threats and challenges in the execution of its duty to safeguard America and its people. In order to address the evolution of threats over time, the Department needs resources it can leverage to pursue long term research focused on these grand challenges and strengthens the creation of a capable workforce to enhance the homeland security.

- **Solution:** COEs are university-led consortia that work with industry, DHS Components, other government and homeland security agencies (Federal, State, and local), and first responders to develop critical technologies and analyses to secure the homeland. COEs also develop homeland security-related curricula and training.

- **Justification:** The FY 2021 President's Budget does not include funding for this project. As the current ALERT COE is scheduled to close by FY 2021. Office of University Programs (OUP) is planning for a replacement Center that best aligns with DHS mission needs and priorities per the approved S&T COE Topic Designation Process.

- **Impact:** COEs are university-led consortia with multiple partners from academia as well as potentially industrial partners. They bring a wealth of innovative thinking across a broad spectrum of technical fields. These consortia are able to respond to requests from the DHS Components to address needs and fill gaps in science and technology research needs.

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

N/A.

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
N/A	N/A	N/A	N/A
FY 2020			
Complete the planning and initiation of new Center.	FY 2020 Q1	FY 2020 Q4	N/A
FY 2021			
N/A	FY 2021 Q1	FY 2021 Q4	N/A

Borders, Trade, and Immigration (BTI) Institute

- **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. 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.

- **Justification:** As with the FY 2020 enacted budget, the FY 2021 President's Budget does not include funding for this project.

- **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.

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, this COEs conduct projects between TRL-2 through TRL-4.

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Reoriented BTI research program based on results of the Biennial Review held in FY 2018 Q3.	FY 2019 Q1	FY 2019 Q2	N/A
Initiated research to create a system to detect and match human subjects from a trail camera image.	FY 2019 Q1	FY 2019 Q4	4
FY 2018 Annual report review.	FY 2019 Q1	FY 2019 Q1	N/A
FY 2019 Work plan, development and submission.	FY 2019 Q2	FY 2019 Q2	N/A
FY 2019 Work plan approval and Project Initiation or continuation.	FY 2019 Q3	FY 2019 Q3	N/A
FY 2019 Annual report development and submission.	FY 2019 Q4	FY 2019 Q4	N/A
FY 2020			
Conduct research projects focused on legitimate trade and travel challenges and known knowledge gaps.	FY 2020 Q1	FY 2020 Q4	2
Improve the border crossing wait time measuring system and analyze emerging technologies to improve the system capabilities to provide accurate border crossing times for vehicles.	FY 2020 Q1	FY 2020 Q4	4
FY 2021			
N/A	N/A	N/A	N/A

Coastal Resilience Center of Excellence (CRC)

- **Problem:** Damage caused by floods and hurricanes poses a near-constant threat to lives and property. A lack of resilience to natural hazards at the individual and community level is contributing to the increasing public share of disaster response and recovery costs. As of October 8, 2019, a total of 10 weather and climate disaster events in 2019 are reported to have resulted in losses exceeding $1 billion each across the U.S.[2] Collectively, these events included three floods, five severe storms, and two tropical cyclones.[3] Consequently, these events have resulted in the deaths of 39 people and caused significantly adverse economic effects on the impacted coastal communities.[4] By comparison, the 1980–2018 annual average totaled 6.3 events (CPI-adjusted); the annual average for the most recent 5 years (2014–2018) is now 12.6 events.[5] The need for strengthening U.S. coastal resilience is greater than ever before.

- **Solution:** This Center conducts research and education to enhance the Nation's ability to safeguard people, infrastructure, and economies from natural hazards such as floods and hurricanes. It also considers the impact of future climate trends on coastal resilience. CRC's work directly addresses key challenges associated with growing coastal vulnerability and assists S&T, FEMA, USCG, NPPD and local communities in coordination with public and private sector partners. Coastal Infrastructure Resilience examines new methods to assess vulnerability and assist practitioners. Building Resilient Communities conducts research and education to help communities mitigate, recover, and adapt to natural hazard risks. Disaster Dynamics advances coastal storm surge and flood forecasting capabilities and communicates the results to improve coastal resilience through flood risk maps and other mechanisms.

- **Justification:** As with the FY 2020 enacted budget, the FY 2021 President's Budget does not include funding for this project.

- **Impact:** CRC's work produces tangible research and education results for use by DHS, other Federal agencies, State and local governments, and other relevant entities that help reduce the adverse impacts of coastal natural disasters on the Nation's citizens, infrastructure, and economy.

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. The current activities are at TRL-2.

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[2] National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) [2019] U.S. Billion-Dollar Weather and Climate Disasters. https://www.ncdc.noaa.gov/billions/

[3] NOAA NCEI. https://www.ncdc.noaa.gov/billions/

[4] NOAA NCEI. https://www.ncdc.noaa.gov/billions/

[5] NOAA NCEI. https://www.ncdc.noaa.gov/billions/

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Conduct Biennial Review to evaluate CRC's research portfolio at both theme and project levels for research quality, progress, and relevance to homeland security customer segment.	FY 2019 Q1	FY 2019 Q1	N/A
Complete a market research study to support the development of a self-sustaining business model for the ADCIRC Prediction System (APS) for storm surge and coastal flooding.	FY 2019 Q3	FY 2019 Q3	N/A
FY 2020			
FY 2019 Annual Report Development and Submission.	FY 2020 Q1	FY 2020 Q1	N/A
FY 2019 Annual Report Review.	FY 2020 Q2	FY 2020 Q2	N/A
Facilitate the securement of 20 internships for students within the HSE.	FY 2020 Q1	FY 2020 Q4	N/A
Partner with industry to develop a business model for the APS for storm surge and coastal flooding to transition innovations from CRC projects into stakeholder desired products and services.	FY 2020 Q1	FY 2020 Q4	2
FY 2021			
N/A	N/A	N/A	N/A

Security Technology Transition/MBA (STT/MBA)

- **Problem:** Technology development, transition, and procurement will always be a foundational element of DHS's strategy for keeping pace with current and emerging threats. The success of the Department's efforts in this is dependent not only on direct investments in research, development, and procurement, but is equally dependent upon a skilled workforce capable of moving the technologies into an operational setting.

- **Solution:** The Masters of Business Administration (MBA) STT COE pilot program is a non-traditional COE that will partner with an academic institution (e.g. top-ranked Business School) to develop a Masters of Business Administration with a concentration in Security Technology Transition. S&T investment in this space can be a "first of its kind" pilot program aimed to build a cross-DHS collaborative workforce with the capability and skillset needed to develop, acquire and implement operationally relevant technologies, understand and manage the process of transition, and avoid the pitfalls that have historically derailed critical technological or operational improvements.

- **Justification:** As with the FY 2020 enacted budget, the FY 2021 President's Budget does not include funding for this project.

- **Impact:** Through leadership development, the MBA STT COE will advance the DHS workforce with the ability to successfully manage R&D projects, tools, and technologies will provide an impact across all other DHS missions.

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

N/A

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Establish criteria for S&T to select students to participate in the MBA program.	FY 2019 Q1	FY 2019 Q1	N/A
Select COE Performer (U.S. Business School with an MBA Program)	FY 2019 Q4	FY 2019 Q4	N/A
FY 2020			
Select First and Second Cohorts from qualified DHS candidates (between 40-50 DHS employees)	FY 2020 Q1	FY 2020 Q3	N/A
First cohort to begin the MBA Program.	FY 2020 Q3	FY 2020 Q4	N/A
FY 2021			
N/A	N/A	N/A	N/A

Terrorism Prevention Counterterrorism Research (TPCR)

- **Problem:** In the past few years, the DHS IE has shifted their priorities and resources to focus on immediate counterterrorism operations. This has reduced the DHS IE's capability to develop, test, and implement innovative strategic methods to counter terrorism. DHS needs new technologies, protocols, and capabilities to support the IE's long-term strategic thinking and develop new approaches to terrorism prevention.

- **Solution:** The new Terrorism Prevention and Counterterrorism Research (TPCR) COE concept will harness universities to provide the DHS Intelligence Enterprise (IE) with analytic tools and strategic thinking. The TPCR COE will be designed to conduct a range of activities including basic and applied research, and education and training initiatives to support and enhance DHS analytic efforts to detect, deter, and prevent terrorism.

- **Justification:** As with the FY 2020 Enacted budget, the FY 2021 President's Budget does not include funding for this project.

- **Impact:** The TPCR COE has the potential to impact the entire DHS IE, the SLTT, and private and public partners by coordinating with the I&A Counterterrorism Mission Center. TPCR COE's involvement will include conducting a range of activities including basic and applied research, and education and training initiatives to support and enhance DHS analytic efforts that are not currently being done by other organizations in the space.

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

N/A

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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
Complete the planning and initiation of new TPCR Center.	FY 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Select a lead and partner (if applicable) university to host the new COE following internal, external, and on-site reviews of applicants.	FY 2020 Q1	FY 2020 Q3	N/A
Organize and conduct a COE kick-off workshop, engaging both components and researchers and creating a collaborative forum to inform the new COE's research program as well as identifying project champions.	FY 2020 Q3	FY 2020 Q4	N/A
FY 2021			
N/A	N/A	N/A	N/A

Minority Serving Institutions (MSI)
Research and Development

Technology Readiness Level Exhibit

Research and Development Project *(Dollars in Thousands)*	FY 2019 Enacted	FY 2020 Enacted	FY 2021 President's Budget
Minority Serving Institutions (MSI)	$3,396	$3,396	$3,396

Minority Serving Institutions

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 of 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.

- **Justification:** The FY 2021 President's Budget provides $3.4M for this project, the same level as FY 2020 Enacted budget. This level of funding will be used to enhance the HS-STEM academic research and education capabilities at MSIs across the U.S. effectively producing a diverse talent pool of scientist and engineers entering the homeland security enterprise.

- **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.

Type of Research

MSI program manages 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 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 TRL-7, from initial concept development to system prototypes tested in the field.

Transition Plans

S&T works with the MSIs to structure and position projects to align with customer needs, beginning from conception, through testing, and piloting in the field. 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. 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. S&T 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.

Program managers work with the 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. 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.

Project Schedule

Research and Development Description	Plan Start Date	Planned Completion	TRL
FY 2019			
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.	FY 2019 Q1	FY 2019 Q4	N/A
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 2019 Q1	FY 2019 Q4	N/A
FY 2020			
Award three to four Scientific Leadership Award grants to Minority Serving Institutions to help develop and strengthen homeland security related STEM curriculum. Provide students with scholarship funding to increase number of graduates in homeland security STEM fields. Develop pathways and increase number of two-year college students entering four-year degree programs.	FY 2020 Q1	FY 2020 Q2	N/A
Launch two high-level DHS research projects through non-traditional performers partnering with Minority Serving Institution Research and Development Consortium.	FY 2020 Q1	FY 2021 Q1	2
Collaborate with private-sector partner to establish a joint and robust internship program for undergraduate and graduate students interested in performing pioneering research projects for homeland security related.	FY 2020 Q2	FY 2020 Q4	N/A
Kickoff FY 2020 SRT internship program for Minority Serving Institution students and faculty members.	FY 2020 Q1	FY 2020 Q4	N/A

Research and Development Description	Plan Start Date	Planned Completion	TRL
Complete a 10-week SRT internship program to provide homeland security related research and mentoring experiences to faculty and students from MSIs at a DHS COE.	FY 2020 Q4	FY 2020 Q4	N/A
FY 2021			
Kickoff FY 2020 SRT internship program for Minority Serving Institution students and faculty members.	FY 2021 Q1	FY 2021 Q4	N/A
Launch pilot public-private internship program for undergraduate and graduate students to conduct DHS mission-relevant research with private industry partners.	FY 2021 Q1	FY 2021 Q4	N/A
Partner with two to three MSIs to launch DHS agency relevant research projects as an opportunity to draw innovative ideas from our diverse population and answer the challenges faced by DHS counterparts, the MSI Research and Development Consortium.	FY 2021 Q1	FY 2021 Q4	N/A
Launch two to three high-level DHS research projects in partnership with the Minority Serving Institution Research and Development Consortium.	FY 2021 Q1	FY 2022 Q1	2