

UNCLASSIFIED

**Department of Defense
Fiscal Year (FY) 2023 Budget Estimates**

April 2022



Air Force

Justification Book Volume 1 of 4

Research, Development, Test & Evaluation, Air Force

Vol-1

UNCLASSIFIED

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Volume 1 Table of Contents

Introduction and Explanation of Contents.....Volume 1 - iii

Comptroller Exhibit R-1..... Volume 1 - v

Master Program Element Table of Contents (by Budget Activity then Line Item Number)..... Volume 1 - liii

Master Program Element Table of Contents (Alphabetically by Program Element Title)..... Volume 1 - lxxi

Program Element Table of Contents (by Budget Activity then Line Item Number)..... Volume 1 - lxxxvii

Program Element Table of Contents (Alphabetically by Program Element Title).....Volume 1 - xci

Supplemental Document.....Volume 1 - xciii

Acronyms..... Volume 1 - ci

Exhibit R-2s..... Volume 1 - 1

UNCLASSIFIED

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Fiscal Year (FY) 2023 Budget Estimates RDT&E Descriptive Summaries Budget Activities April 2022

INTRODUCTION AND EXPLANATION OF CONTENTS

GENERAL

- This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY 2023 President's Budget (PB).
 - All exhibits in this document have been assembled in accordance with DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5.
 - Other comments on exhibit contents in this document:
 - Exhibits R-2/2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY 2022 RDT&E program with the exception of classified program elements. The format and contents of this document are in accordance to the guidelines and requirements of the Congressional committees in so far as possible.
 - The "Other Program Funding Summary portion of the R-2 includes, in addition to RDTE& funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.

UNCLASSIFIED

UNCLASSIFIED

CLASSIFICATION

- All exhibits contained in Volumes I, II, and III are unclassified. Classified exhibits are not included in the submission due to the level of security classification and necessity of special security clearances.

Exhibit footnotes for FY 2020 actuals and FY 2021 Enacted:

a. **Fiscal Year (FY) 2023 Overseas Operations Costs funding accounted for in the Base budget include:**

- Operation INHERENT RESOLVE (OIR) \$0 thousands.
- European Deterrence Initiative (EDI) \$0 thousands.
- Other theater requirements and related missions \$1,065 thousands.

UNCLASSIFIED

UNCLASSIFIED

Department of Defense
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Summary Recap of Budget Activities -----	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022	FY 2022	FY 2022	FY 2022
			Division B P.L.117-43 Enactment*	Division B P.L.117-70 Enactment**	Division A P.L. 117-86 Enactment***	Division N P.L. 117-103 Enactment****
Basic Research	496,255	540,706				
Applied Research	1,794,038	1,872,076				
Advanced Technology Development	929,477	1,207,122				
Advanced Component Development & Prototypes	8,528,913	11,293,813				47,500
System Development & Demonstration	5,904,910	5,692,659				
Management Support	4,072,703	3,508,829				
Operational Systems Development	24,647,644	28,920,584				
Software and Digital Technology Pilot Programs	155,067	154,529				
Total Research, Development, Test & Evaluation	46,529,007	53,190,318				47,500

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of Defense
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Summary Recap of Budget Activities -----	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request
Basic Research		540,706	546,517
Applied Research		1,872,076	1,549,524
Advanced Technology Development		1,207,122	1,391,486
Advanced Component Development & Prototypes	47,500	11,341,313	10,937,696
System Development & Demonstration		5,692,659	11,774,613
Management Support		3,508,829	3,458,471
Operational Systems Development		28,920,584	29,193,876
Software and Digital Technology Pilot Programs		154,529	1,101,490
Total Research, Development, Test & Evaluation	47,500	53,237,818	59,953,673

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of Defense
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****
Summary Recap of FYDP Programs						
Strategic Forces	897,413	1,157,141				
General Purpose Forces	3,542,013	4,578,366				
Intelligence and Communications	1,143,506	1,142,450				47,500
Mobility Forces	886,208	825,887				
Research and Development	14,431,656	16,605,652				
Central Supply and Maintenance	122,916	155,648				
Training Medical and Other	7,012	17,944				
Administration and Associated Activities	68,180	89,612				
Support of Other Nations	3,592	2,420				
Space	6,979,949	7,040,836				
Classified Programs	18,446,562	21,574,362				
Total Research, Development, Test & Evaluation	46,529,007	53,190,318				47,500

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of Defense
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request
	-----	-----	-----
Summary Recap of FYDP Programs -----			
Strategic Forces		1,157,141	1,217,682
General Purpose Forces		4,578,366	4,818,319
Intelligence and Communications	47,500	1,189,950	1,509,185
Mobility Forces		825,887	765,678
Research and Development		16,605,652	18,433,261
Central Supply and Maintenance		155,648	66,133
Training Medical and Other		17,944	27,538
Administration and Associated Activities		89,612	29,823
Support of Other Nations		2,420	2,593
Space		7,040,836	10,869,462
Classified Programs		21,574,362	22,213,999
Total Research, Development, Test & Evaluation	47,500	53,237,818	59,953,673

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****
Summary Recap of Budget Activities -----						
Basic Research	496,255	540,706				
Applied Research	1,579,544	1,585,571				
Advanced Technology Development	929,477	968,538				
Advanced Component Development & Prototypes	7,193,095	9,695,253				47,500
System Development & Demonstration	2,266,274	2,524,849				
Management Support	3,534,738	3,037,687				
Operational Systems Development	20,022,756	23,240,309				
Software and Digital Technology Pilot Programs						
Total Research, Development, Test & Evaluation	36,022,139	41,592,913				47,500

R-123BPB: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Summary Recap of Budget Activities -----	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request
Basic Research		540,706	546,517
Applied Research		1,585,571	1,305,787
Advanced Technology Development		968,538	827,271
Advanced Component Development & Prototypes	47,500	9,742,753	7,945,238
System Development & Demonstration		2,524,849	6,438,954
Management Support		3,037,687	3,033,528
Operational Systems Development		23,240,309	23,090,569
Software and Digital Technology Pilot Programs			946,437
Total Research, Development, Test & Evaluation	47,500	41,640,413	44,134,301

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****
Summary Recap of Budget Activities -----						
Summary Recap of FYDP Programs -----						
Strategic Forces	897,413	1,157,141				
General Purpose Forces	3,542,013	4,578,366				
Intelligence and Communications	1,143,506	1,142,450				47,500
Mobility Forces	886,208	825,887				
Research and Development	14,431,656	16,605,652				
Central Supply and Maintenance	122,916	155,648				
Training Medical and Other	7,012	17,944				
Administration and Associated Activities	68,180	89,612				
Support of Other Nations	3,592	2,420				
Space	9,974	6,740				
Classified Programs	14,909,669	17,011,053				
Total Research, Development, Test & Evaluation	36,022,139	41,592,913				47,500

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request
Summary Recap of Budget Activities -----			
Summary Recap of FYDP Programs -----			
Strategic Forces		1,157,141	1,217,682
General Purpose Forces		4,578,366	4,818,319
Intelligence and Communications	47,500	1,189,950	1,509,185
Mobility Forces		825,887	765,678
Research and Development		16,605,652	18,432,445
Central Supply and Maintenance		155,648	66,133
Training Medical and Other		17,944	27,538
Administration and Associated Activities		89,612	29,823
Support of Other Nations		2,420	2,593
Space		6,740	24,264
Classified Programs		17,011,053	17,240,641
Total Research, Development, Test & Evaluation	47,500	41,640,413	44,134,301

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
1	0601102F	Defense Research Sciences	01	303,718	353,303					U
2	0601103F	University Research Initiatives	01	178,083	187,403					U
3	0601108F	High Energy Laser Research Initiatives	01	14,454						U
		Basic Research		496,255	540,706					
4	0602020F	Future AF Capabilities Applied Research	02	73,226	79,901					U
5	0602102F	Materials	02	228,115	220,960					U
6	0602201F	Aerospace Vehicle Technologies	02	148,576	183,032					U
7	0602202F	Human Effectiveness Applied Research	02	127,160	156,863					U
8	0602203F	Aerospace Propulsion	02	190,732	190,683					U
9	0602204F	Aerospace Sensors	02	221,779	255,918					U
10	0602212F	Defense Laboratories R&D Projects (10 U.S.C, Sec 2358)	02	106,964						U
11	0602298F	Science and Technology Management - Major Headquarters Activities	02	8,910	8,891					U
12	0602602F	Conventional Munitions	02	118,541	151,757					U
13	0602605F	Directed Energy Technology	02	122,816	116,456					U
14	0602788F	Dominant Information Sciences and Methods	02	205,839	221,110					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
1	0601102F	Defense Research Sciences	01		353,303	375,325	U
2	0601103F	University Research Initiatives	01		187,403	171,192	U
3	0601108F	High Energy Laser Research Initiatives	01				U
		Basic Research			540,706	546,517	
4	0602020F	Future AF Capabilities Applied Research	02		79,901	88,672	U
5	0602102F	Materials	02		220,960	134,795	U
6	0602201F	Aerospace Vehicle Technologies	02		183,032	159,453	U
7	0602202F	Human Effectiveness Applied Research	02		156,863	135,771	U
8	0602203F	Aerospace Propulsion	02		190,683	172,861	U
9	0602204F	Aerospace Sensors	02		255,918	192,733	U
10	0602212F	Defense Laboratories R&D Projects (10 U.S.C, Sec 2358)	02				U
11	0602298F	Science and Technology Management - Major Headquarters Activities	02		8,891	8,856	U
12	0602602F	Conventional Munitions	02		151,757	137,303	U
13	0602605F	Directed Energy Technology	02		116,456	109,302	U
14	0602788F	Dominant Information Sciences and Methods	02		221,110	166,041	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line	Program Element	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S
---	-----	----	---	-----	-----	-----	-----	-----	-----	---
15	0602890F	High Energy Laser Research	02	26,886						U
		Applied Research		1,579,544	1,585,571					
16	0603032F	Future AF Integrated Technology Demos	03	135,940	112,643					U
17	0603112F	Advanced Materials for Weapon Systems	03	57,221	63,378					U
18	0603199F	Sustainment Science and Technology (S&T)	03	15,631	19,112					U
19	0603203F	Advanced Aerospace Sensors	03	33,162	53,750					U
20	0603211F	Aerospace Technology Dev/Demo	03	34,321	105,486					U
21	0603216F	Aerospace Propulsion and Power Technology	03	159,354	110,273					U
22	0603270F	Electronic Combat Technology	03	33,804	44,938					U
23	0603273F	Science & Technology for Nuclear Re-entry Systems	03							U
24	0603401F	Advanced Spacecraft Technology	03	63,088						U
25	0603444F	Maui Space Surveillance System (MSSS)	03	11,486						U
26	0603456F	Human Effectiveness Advanced Technology Development	03	29,412	23,459					U
27	0603601F	Conventional Weapons Technology	03	124,025	155,306					U
28	0603605F	Advanced Weapons Technology	03	29,094	31,855					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
15	0602890F	High Energy Laser Research	02				U
		Applied Research			1,585,571	1,305,787	
16	0603032F	Future AF Integrated Technology Demos	03		112,643	152,559	U
17	0603112F	Advanced Materials for Weapon Systems	03		63,378	29,116	U
18	0603199F	Sustainment Science and Technology (S&T)	03		19,112	10,695	U
19	0603203F	Advanced Aerospace Sensors	03		53,750	36,997	U
20	0603211F	Aerospace Technology Dev/Demo	03		105,486	54,727	U
21	0603216F	Aerospace Propulsion and Power Technology	03		110,273	64,254	U
22	0603270F	Electronic Combat Technology	03		44,938	33,380	U
23	0603273F	Science & Technology for Nuclear Re-entry Systems	03			39,431	U
24	0603401F	Advanced Spacecraft Technology	03				U
25	0603444F	Maui Space Surveillance System (MSSS)	03				U
26	0603456F	Human Effectiveness Advanced Technology Development	03		23,459	20,652	U
27	0603601F	Conventional Weapons Technology	03		155,306	187,374	U
28	0603605F	Advanced Weapons Technology	03		31,855	98,503	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
29	0603680F	Manufacturing Technology Program	03	143,334	176,200					U
30	0603788F	Battlespace Knowledge Development and Demonstration	03	59,605	72,138					U
		Advanced Technology Development		929,477	968,538					
31	0603036F	Modular Advanced Missile	04							U
32	0603260F	Intelligence Advanced Development	04	4,312	5,795					U
33	0603742F	Combat Identification Technology	04	25,824	21,939					U
34	0603790F	NATO Research and Development	04	3,506	4,114					U
35	0603851F	Intercontinental Ballistic Missile - Dem/Val	04	34,755	76,621					U
36	0604001F	NC3 Advanced Concepts	04		6,900					U
37	0604002F	Air Force Weather Services Research	04	2,151	3,855					U
38	0604003F	Advanced Battle Management System (ABMS)	04	152,691	268,849					U
39	0604004F	Advanced Engine Development	04	642,581	583,712					U
40	0604006F	Dept of the Air Force Tech Architecture	04		25,138					U
41	0604015F	Long Range Strike - Bomber	04	2,744,473	2,872,624					U
42	0604032F	Directed Energy Prototyping	04	19,023	15,820					U
43	0604033F	Hypersonics Prototyping	04	374,426	318,687					U

R-123BBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
29	0603680F	Manufacturing Technology Program	03		176,200	47,759	U
30	0603788F	Battlespace Knowledge Development and Demonstration	03		72,138	51,824	U
Advanced Technology Development					968,538	827,271	
31	0603036F	Modular Advanced Missile	04			125,688	U
32	0603260F	Intelligence Advanced Development	04		5,795	6,101	U
33	0603742F	Combat Identification Technology	04		21,939	17,318	U
34	0603790F	NATO Research and Development	04		4,114	4,295	U
35	0603851F	Intercontinental Ballistic Missile - Dem/Val	04		76,621	46,432	U
36	0604001F	NC3 Advanced Concepts	04		6,900	5,098	U
37	0604002F	Air Force Weather Services Research	04		3,855		U
38	0604003F	Advanced Battle Management System (ABMS)	04		268,849	231,408	U
39	0604004F	Advanced Engine Development	04		583,712	353,658	U
40	0604006F	Dept of the Air Force Tech Architecture	04		25,138	66,615	U
41	0604015F	Long Range Strike - Bomber	04		2,872,624	3,253,584	U
42	0604032F	Directed Energy Prototyping	04		15,820	4,269	U
43	0604033F	Hypersonics Prototyping	04		318,687	431,868	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022	FY 2022	FY 2022	FY 2022	FY 2022
						Division B Division C P.L.117-43 Enactment*	Division B P.L.117-70 Enactment**	Division A P.L. 117-86 Enactment***	Division N P.L. 117-103 Enactment****	S e c
44	0604183F	Hypersonics Prototyping - Hypersonic Attack Cruise Missile (HACM)	04		190,116					U
45	0604201F	PNT Resiliency, Mods, and Improvements	04		39,742					U
46	0604257F	Advanced Technology and Sensors	04	25,901	23,745					U
47	0604288F	Survivable Airborne Operations Center	04	50,038	95,788					U
48	0604317F	Technology Transfer	04	16,823	56,768					U
49	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	53,026	12,886					U
50	0604414F	Cyber Resiliency of Weapon Systems-ACS	04	67,616	71,229					U
51	0604668F	Joint Transportation Management System (JTMS)	04							U
52	0604776F	Deployment & Distribution Enterprise R&D	04	25,474	40,103					U
53	0604858F	Tech Transition Program	04	297,254	359,045					U
54	0604860F	Operational Energy and Installation Resilience	04		104,000					U
55	0605230F	Ground Based Strategic Deterrent	04	1,397,485	2,553,541					U
56	0207110F	Next Generation Air Dominance	04	869,740	1,524,667					U
57	0207179F	Autonomous Collaborative Platforms	04							U

R-123BBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
44	0604183F	Hypersonics Prototyping - Hypersonic Attack Cruise Missile (HACM)	04		190,116	144,891	U
45	0604201F	PNT Resiliency, Mods, and Improvements	04		39,742	12,010	U
46	0604257F	Advanced Technology and Sensors	04		23,745	13,311	U
47	0604288F	Survivable Airborne Operations Center	04		95,788	203,213	U
48	0604317F	Technology Transfer	04		56,768	16,759	U
49	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04		12,886	106,826	U
50	0604414F	Cyber Resiliency of Weapon Systems-ACS	04		71,229	44,526	U
51	0604668F	Joint Transportation Management System (JTMS)	04			51,758	U
52	0604776F	Deployment & Distribution Enterprise R&D	04		40,103	27,586	U
53	0604858F	Tech Transition Program	04		359,045	649,545	U
54	0604860F	Operational Energy and Installation Resilience	04		104,000		U
55	0605230F	Ground Based Strategic Deterrent	04		2,553,541		U
56	0207110F	Next Generation Air Dominance	04		1,524,667	1,657,733	U
57	0207179F	Autonomous Collaborative Platforms	04			51,747	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
58	0207420F	Combat Identification	04							U
59	0207455F	Three Dimensional Long-Range Radar (3DELRR)	04	18,862						U
60	0207522F	Airbase Air Defense Systems (ABADS)	04	8,451	10,905					U
61	0208030F	War Reserve Materiel - Ammunition	04		3,943					U
62	0208099F	Unified Platform (UP)	04	5,869						U
63	0304369F	Cyber Capabilities Support Office (CCSO)	04	19,964						U
64	0305236F	Common Data Link Executive Agent (CDL EA)	04	39,221	43,881					U
65	0305601F	Mission Partner Environments	04	10,991	16,420					U
66	0306250F	Cyber Operations Technology Support	04	226,073	242,499				38,900	U
67	0306415F	Enabled Cyber Activities	04	10,166	16,578				8,600	U
68	0401310F	C-32 Executive Transport Recapitalization	04	6,151						U
69	0708051F	Rapid Sustainment Modernization (RSM)	04	34,693	65,000					U
70	0808737F	CVV Integrated Prevention	04							U
71	0901410F	Contracting Information Technology System	04	5,555	20,343					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
58	0207420F	Combat Identification	04			1,866	U
59	0207455F	Three Dimensional Long-Range Radar (3DELRR)	04			14,490	U
60	0207522F	Airbase Air Defense Systems (ABADS)	04		10,905	52,498	U
61	0208030F	War Reserve Materiel - Ammunition	04		3,943	10,288	U
62	0208099F	Unified Platform (UP)	04				U
63	0304369F	Cyber Capabilities Support Office (CCSO)	04				U
64	0305236F	Common Data Link Executive Agent (CDL EA)	04		43,881	37,460	U
65	0305601F	Mission Partner Environments	04		16,420	17,378	U
66	0306250F	Cyber Operations Technology Support	04	38,900	281,399	234,576	U
67	0306415F	Enabled Cyber Activities	04	8,600	25,178	16,728	U
68	0401310F	C-32 Executive Transport Recapitalization	04				U
69	0708051F	Rapid Sustainment Modernization (RSM)	04		65,000		U
70	0808737F	CVV Integrated Prevention	04			9,315	U
71	0901410F	Contracting Information Technology System	04		20,343	14,050	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c e c e
72	1206415F	U.S. Space Command Research and Development Support	04							U
		Advanced Component Development & Prototypes		7,193,095	9,695,253				47,500	
73	0604200F	Future Advanced Weapon Analysis & Programs	05	22,478	18,499					U
74	0604201F	PNT Resiliency, Mods, and Improvements	05	37,409	163,520					U
75	0604222F	Nuclear Weapons Support	05	24,502	30,050					U
76	0604270F	Electronic Warfare Development	05	2,017	7,110					U
77	0604281F	Tactical Data Networks Enterprise	05	111,125	159,836					U
78	0604287F	Physical Security Equipment	05	5,979	8,469					U
79	0604602F	Armament/Ordnance Development	05	20,199	9,047					U
80	0604604F	Submunitions	05	3,085	2,954					U
81	0604617F	Agile Combat Support	05	18,398	27,938					U
82	0604618F	Joint Direct Attack Munition	05	6,555						U
83	0604706F	Life Support Systems	05	27,748	25,437					U
84	0604735F	Combat Training Ranges	05	23,054	23,980					U
85	0604800F	F-35 - EMD	05	5,214						U
86	0604932F	Long Range Standoff Weapon	05	373,499	599,042					U
87	0604933F	ICBM Fuze Modernization	05	151,158	129,709					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
72	1206415F	U.S. Space Command Research and Development Support	04			10,350	U
		Advanced Component Development & Prototypes		47,500	9,742,753	7,945,238	
73	0604200F	Future Advanced Weapon Analysis & Programs	05		18,499	9,879	U
74	0604201F	PNT Resiliency, Mods, and Improvements	05		163,520	176,824	U
75	0604222F	Nuclear Weapons Support	05		30,050	64,425	U
76	0604270F	Electronic Warfare Development	05		7,110	2,222	U
77	0604281F	Tactical Data Networks Enterprise	05		159,836	133,117	U
78	0604287F	Physical Security Equipment	05		8,469	8,493	U
79	0604602F	Armament/Ordnance Development	05		9,047	5,279	U
80	0604604F	Submunitions	05		2,954	3,273	U
81	0604617F	Agile Combat Support	05		27,938	14,252	U
82	0604618F	Joint Direct Attack Munition	05				U
83	0604706F	Life Support Systems	05		25,437	47,442	U
84	0604735F	Combat Training Ranges	05		23,980	91,284	U
85	0604800F	F-35 - EMD	05				U
86	0604932F	Long Range Standoff Weapon	05		599,042	928,850	U
87	0604933F	ICBM Fuze Modernization	05		129,709	98,376	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c e c e
88	0605030F	Joint Tactical Network Center (JTNC)	05							U
89	0605056F	Open Architecture Management	05	29,709	37,109					U
90	0605223F	Advanced Pilot Training	05	216,765	188,898					U
91	0605229F	HH-60W	05	32,196	62,255					U
92	0605238F	Ground Based Strategic Deterrent EMD	05							U
93	0101125F	Nuclear Weapons Modernization	05	9,595						U
94	0207171F	F-15 EPAWSS	05	165,691	112,012					U
95	0207279F	Isolated Personnel Survivability and Recovery	05							U
96	0207328F	Stand In Attack Weapon	05	145,858	166,570					U
97	0207701F	Full Combat Mission Training	05	9,060	12,064					U
98	0303267F	Auctioned Spectrum Relocation Fund	05	36,154						U
99	0303667F	Citizen Broadband Radio System	05	2,306						U
100	0303767F	AMBIT - Pre-Auctioned SRF	05	5,270						U
101	0305176F	Combat Survivor Evader Locator	05	935						U
102	0401221F	KC-46A Tanker Squadrons	05	35,818	66,758					U
103	0401319F	VC-25B	05	720,155	655,665					U
104	0701212F	Automated Test Systems	05	12,418	15,445					U

R-123BBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
88	0605030F	Joint Tactical Network Center (JTNC)	05			2,222	U
89	0605056F	Open Architecture Management	05		37,109	38,222	U
90	0605223F	Advanced Pilot Training	05		188,898	37,121	U
91	0605229F	HH-60W	05		62,255	58,974	U
92	0605238F	Ground Based Strategic Deterrent EMD	05			3,614,290	U
93	0101125F	Nuclear Weapons Modernization	05				U
94	0207171F	F-15 EPAWSS	05		112,012	67,956	U
95	0207279F	Isolated Personnel Survivability and Recovery	05			27,881	U
96	0207328F	Stand In Attack Weapon	05		166,570	283,152	U
97	0207701F	Full Combat Mission Training	05		12,064	3,028	U
98	0303267F	Auctioned Spectrum Relocation Fund	05				U
99	0303667F	Citizen Broadband Radio System	05				U
100	0303767F	AMBIT - Pre-Auctioned SRF	05				U
101	0305176F	Combat Survivor Evader Locator	05				U
102	0401221F	KC-46A Tanker Squadrons	05		66,758	197,510	U
103	0401319F	VC-25B	05		655,665	492,932	U
104	0701212F	Automated Test Systems	05		15,445	16,664	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c e c
105	0804772F	Training Developments	05	4,471	2,482					U
106	0901299F	AF A1 Systems	05	7,453						U
107	1206442F	Next Generation OPIR	05							U
		System Development & Demonstration		2,266,274	2,524,849					
108	0604256F	Threat Simulator Development	06	56,987	46,909					U
109	0604759F	Major T&E Investment	06	207,103	130,766					U
110	0605101F	RAND Project Air Force	06	35,195	36,017					U
111	0605502F	Small Business Innovation Research	06	662,308						U
112	0605712F	Initial Operational Test & Evaluation	06	10,407	12,582					U
113	0605807F	Test and Evaluation Support	06	770,149	811,032					U
114	0605826F	Acq Workforce- Global Power	06	264,371						U
115	0605827F	Acq Workforce- Global Vig & Combat Sys	06	263,868	267,919					U
116	0605828F	Acq Workforce- Global Reach	06	164,440	429,659					U
117	0605829F	Acq Workforce- Cyber, Network, & Bus Sys	06	251,517	439,571					U
118	0605830F	Acq Workforce- Global Battle Mgmt	06	173,987						U
119	0605831F	Acq Workforce- Capability Integration	06	227,357	263,014					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
---	-----	----	---	-----	-----	-----	-
105	0804772F	Training Developments	05		2,482	15,138	U
106	0901299F	AF A1 Systems	05				U
107	1206442F	Next Generation OPIR	05			148	U
	System Development & Demonstration			-----	-----	-----	
					2,524,849	6,438,954	
108	0604256F	Threat Simulator Development	06		46,909	21,067	U
109	0604759F	Major T&E Investment	06		130,766	44,714	U
110	0605101F	RAND Project Air Force	06		36,017	37,921	U
111	0605502F	Small Business Innovation Research	06			86	U
112	0605712F	Initial Operational Test & Evaluation	06		12,582	13,926	U
113	0605807F	Test and Evaluation Support	06		811,032	826,854	U
114	0605826F	Acq Workforce- Global Power	06				U
115	0605827F	Acq Workforce- Global Vig & Combat Sys	06		267,919	255,995	U
116	0605828F	Acq Workforce- Global Reach	06		429,659	457,589	U
117	0605829F	Acq Workforce- Cyber, Network, & Bus Sys	06		439,571	459,223	U
118	0605830F	Acq Workforce- Global Battle Mgmt	06			3,696	U
119	0605831F	Acq Workforce- Capability Integration	06		263,014	229,610	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022	FY 2022	FY 2022	FY 2022	S
						Division B Division C P.L.117-43 Enactment*	Division B P.L.117-70 Enactment**	Division A P.L. 117-86 Enactment***	Division N P.L. 117-103 Enactment**** c	
120	0605832F	Acq Workforce- Advanced Prgm Technology	06	53,577	62,755					U
121	0605833F	Acq Workforce- Nuclear Systems	06	174,318	227,425					U
122	0605898F	Management HQ - R&D	06	5,424	5,537					U
123	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	60,856	70,788					U
124	0605978F	Facilities Sustainment - Test and Evaluation Support	06	29,826	30,057					U
125	0606017F	Requirements Analysis and Maturation	06	66,233	90,799					U
126	0606398F	Management HQ - T&E	06	6,929	6,163					U
127	0303166F	Support to Information Operations (IO) Capabilities	06		537					U
128	0303255F	Command, Control, Communication, and Computers (C4) - STRATCOM	06	21,525	35,340					U
129	0308602F	ENTEPRISE INFORMATION SERVICES (EIS)	06	9,561	26,720					U
130	0702806F	Acquisition and Management Support	06	12,943	37,211					U
131	0804731F	General Skill Training	06	1,260	1,506					U
132	0804772F	Training Developments	06		2,957					U
133	0909999F	Financing for Cancelled Account Adjustments	06	1,005						U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
---	-----	----	---	-----	-----	-----	-
120	0605832F	Acq Workforce- Advanced Prgm Technology	06		62,755	92,648	U
121	0605833F	Acq Workforce- Nuclear Systems	06		227,425	241,226	U
122	0605898F	Management HQ - R&D	06		5,537	4,347	U
123	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06		70,788	77,820	U
124	0605978F	Facilities Sustainment - Test and Evaluation Support	06		30,057	31,561	U
125	0606017F	Requirements Analysis and Maturation	06		90,799	101,844	U
126	0606398F	Management HQ - T&E	06		6,163	6,285	U
127	0303166F	Support to Information Operations (IO) Capabilities	06		537	556	U
128	0303255F	Command, Control, Communication, and Computers (C4) - STRATCOM	06		35,340	15,559	U
129	0308602F	ENTEPRISE INFORMATION SERVICES (EIS)	06		26,720	83,231	U
130	0702806F	Acquisition and Management Support	06		37,211	24,306	U
131	0804731F	General Skill Training	06		1,506	871	U
132	0804772F	Training Developments	06		2,957		U
133	0909999F	Financing for Cancelled Account Adjustments	06				U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line	Program Element	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c e c
134	1001004F	International Activities	06	3,592	2,420					U
135	1206864F	Space Test Program (STP)	06		3					U
		Management Support		3,534,738	3,037,687					
136	0604233F	Specialized Undergraduate Flight Training	07	13,438	8,589					U
137	0604445F	Wide Area Surveillance	07		2,760					U
138	0604617F	Agile Combat Support	07							U
139	0604776F	Deployment & Distribution Enterprise R&D	07	479						U
140	0604840F	F-35 C2D2	07	684,931	1,105,404					U
141	0605018F	AF Integrated Personnel and Pay System (AF-IPPS)	07	29,526	22,010					U
142	0605024F	Anti-Tamper Technology Executive Agency	07	46,785	51,492					U
143	0605117F	Foreign Materiel Acquisition and Exploitation	07	68,962	71,391					U
144	0605278F	HC/MC-130 Recap RDT&E	07	15,552	46,796					U
145	0606018F	NC3 Integration	07	30,521	26,532					U
146	0606942F	Assessments and Evaluations Cyber Vulnerabilities	07	2,885						U
147	0101113F	B-52 Squadrons	07	453,605	646,811					U

R-123BBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
---	-----	----	---	-----	-----	-----	-
134	1001004F	International Activities	06		2,420	2,593	U
135	1206864F	Space Test Program (STP)	06		3		U
		Management Support					
					3,037,687	3,033,528	
136	0604233F	Specialized Undergraduate Flight Training	07		8,589	18,037	U
137	0604445F	Wide Area Surveillance	07		2,760		U
138	0604617F	Agile Combat Support	07			8,199	U
139	0604776F	Deployment & Distribution Enterprise R&D	07			156	U
140	0604840F	F-35 C2D2	07		1,105,404	1,014,708	U
141	0605018F	AF Integrated Personnel and Pay System (AF-IPPS)	07		22,010	37,901	U
142	0605024F	Anti-Tamper Technology Executive Agency	07		51,492	50,066	U
143	0605117F	Foreign Materiel Acquisition and Exploitation	07		71,391	80,338	U
144	0605278F	HC/MC-130 Recap RDT&E	07		46,796	47,994	U
145	0606018F	NC3 Integration	07		26,532	23,559	U
146	0606942F	Assessments and Evaluations Cyber Vulnerabilities	07				U
147	0101113F	B-52 Squadrons	07		646,811	770,313	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
148	0101122F	Air-Launched Cruise Missile (ALCM)	07	1,377	453					U
149	0101126F	B-1B Squadrons	07	15,276	39,127					U
150	0101127F	B-2 Squadrons	07	147,390	131,647					U
151	0101213F	Minuteman Squadrons	07	63,535	113,622					U
152	0101316F	Worldwide Joint Strategic Communications	07	30,124	15,202					U
153	0101324F	Integrated Strategic Planning & Analysis Network	07	23,420	29,564					U
154	0101328F	ICBM Reentry Vehicles	07	108,625	96,313					U
156	0102110F	UH-1N Replacement Program	07	34,524	16,132					U
157	0102326F	Region/Sector Operation Control Center Modernization Program	07	9,846	771					U
158	0102412F	North Warning System (NWS)	07	96	99					U
159	0102417F	Over-the-Horizon Backscatter Radar	07		67,400					U
160	0202834F	Vehicles and Support Equipment General	- 07		5,889					U
161	0205219F	MQ-9 UAV	07	103,245	79,121					U
162	0205671F	Joint Counter RCIED Electronic Warfare	07	4,080	3,111					U
163	0207040F	Multi-Platform Electronic Warfare Equipment	07		36,607					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
148	0101122F	Air-Launched Cruise Missile (ALCM)	07		453	571	U
149	0101126F	B-1B Squadrons	07		39,127	13,144	U
150	0101127F	B-2 Squadrons	07		131,647	111,990	U
151	0101213F	Minuteman Squadrons	07		113,622	69,650	U
152	0101316F	Worldwide Joint Strategic Communications	07		15,202	22,725	U
153	0101324F	Integrated Strategic Planning & Analysis Network	07		29,564	3,180	U
154	0101328F	ICBM Reentry Vehicles	07		96,313	118,616	U
156	0102110F	UH-1N Replacement Program	07		16,132	17,922	U
157	0102326F	Region/Sector Operation Control Center Modernization Program	07		771	451	U
158	0102412F	North Warning System (NWS)	07		99	76,910	U
159	0102417F	Over-the-Horizon Backscatter Radar	07		67,400	12,210	U
160	0202834F	Vehicles and Support Equipment - General	07		5,889	14,483	U
161	0205219F	MQ-9 UAV	07		79,121	98,499	U
162	0205671F	Joint Counter RCIED Electronic Warfare	07		3,111	1,747	U
163	0207040F	Multi-Platform Electronic Warfare Equipment	07		36,607	23,195	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022	FY 2022	FY 2022	FY 2022	S
						Division B Division C P.L.117-43 Enactment*	Division B P.L.117-70 Enactment**	Division A P.L. 117-86 Enactment***	Division N Division S P.L. 117-103 Enactment**** c	
164	0207131F	A-10 Squadrons	07	24,274	34,224					U
165	0207133F	F-16 Squadrons	07	197,641	225,573					U
166	0207134F	F-15E Squadrons	07	230,299	239,616					U
167	0207136F	Manned Destructive Suppression	07	14,462	15,855					U
168	0207138F	F-22A Squadrons	07	642,138	647,296					U
169	0207142F	F-35 Squadrons	07	104,264	69,365					U
170	0207146F	F-15EX	07	79,866	107,126					U
171	0207161F	Tactical AIM Missiles	07	18,779	32,974					U
172	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	50,074	51,288					U
173	0207227F	Combat Rescue - Pararescue	07	668	852					U
174	0207247F	AF TENCAP	07	21,605	23,685					U
175	0207249F	Precision Attack Systems Procurement	07	8,983	12,083					U
176	0207253F	Compass Call	07	15,228	91,266					U
177	0207268F	Aircraft Engine Component Improvement Program	07	121,206	115,715					U
178	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	63,712	117,325					U
179	0207327F	Small Diameter Bomb (SDB)	07	20,010	32,109					U

R-123BBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
164	0207131F	A-10 Squadrons	07		34,224	72,393	U
165	0207133F	F-16 Squadrons	07		225,573	244,696	U
166	0207134F	F-15E Squadrons	07		239,616	213,272	U
167	0207136F	Manned Destructive Suppression	07		15,855	16,695	U
168	0207138F	F-22A Squadrons	07		647,296	559,709	U
169	0207142F	F-35 Squadrons	07		69,365	70,730	U
170	0207146F	F-15EX	07		107,126	83,830	U
171	0207161F	Tactical AIM Missiles	07		32,974	34,536	U
172	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07		51,288	52,704	U
173	0207227F	Combat Rescue - Pararescue	07		852	863	U
174	0207247F	AF TENCAP	07		23,685	23,309	U
175	0207249F	Precision Attack Systems Procurement	07		12,083	12,722	U
176	0207253F	Compass Call	07		91,266	49,054	U
177	0207268F	Aircraft Engine Component Improvement Program	07		115,715	116,087	U
178	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07		117,325	117,198	U
179	0207327F	Small Diameter Bomb (SDB)	07		32,109	27,713	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
180	0207410F	Air & Space Operations Center (AOC)	07	50,133	90,027					U
181	0207412F	Control and Reporting Center (CRC)	07	15,514	9,875					U
182	0207417F	Airborne Warning and Control System (AWACS)	07	108,779	167,014					U
183	0207418F	AFSPECWAR - TACP	07	497	4,598					U
185	0207431F	Combat Air Intelligence System Activities	07	16,534	17,863					U
186	0207438F	Theater Battle Management (TBM) C4I	07	7,660	7,905					U
187	0207439F	Electronic Warfare Integrated Reprogramming (EWIR)	07		15,000					U
188	0207444F	Tactical Air Control Party-Mod	07	12,589	13,081					U
189	0207452F	DCAPES	07	14,135	4,305					U
190	0207521F	Air Force Calibration Programs	07	1,966	1,984					U
191	0207522F	Airbase Air Defense Systems (ABADS)	07		7,392					U
192	0207573F	National Technical Nuclear Forensics	07	380	1,971					U
193	0207590F	Seek Eagle	07	29,572	30,539					U
194	0207601F	USAF Modeling and Simulation	07	17,023	17,110					U
195	0207605F	Wargaming and Simulation Centers	07	6,113	7,535					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
---	-----	----	---	-----	-----	-----	-
180	0207410F	Air & Space Operations Center (AOC)	07		90,027		U
181	0207412F	Control and Reporting Center (CRC)	07		9,875	6,615	U
182	0207417F	Airborne Warning and Control System (AWACS)	07		167,014	239,658	U
183	0207418F	AFSPECWAR - TACP	07		4,598	5,982	U
185	0207431F	Combat Air Intelligence System Activities	07		17,863	23,504	U
186	0207438F	Theater Battle Management (TBM) C4I	07		7,905	5,851	U
187	0207439F	Electronic Warfare Integrated Reprogramming (EWIR)	07		15,000	15,990	U
188	0207444F	Tactical Air Control Party-Mod	07		13,081	10,315	U
189	0207452F	DCAPES	07		4,305	8,049	U
190	0207521F	Air Force Calibration Programs	07		1,984	2,123	U
191	0207522F	Airbase Air Defense Systems (ABADS)	07		7,392		U
192	0207573F	National Technical Nuclear Forensics	07		1,971	2,039	U
193	0207590F	Seek Eagle	07		30,539	32,853	U
194	0207601F	USAF Modeling and Simulation	07		17,110	19,341	U
195	0207605F	Wargaming and Simulation Centers	07		7,535	7,004	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c e c
196	0207610F	Battlefield Abn Comm Node (BACN)	07	5,450	32,008					U
197	0207697F	Distributed Training and Exercises	07	3,260	4,007					U
198	0208006F	Mission Planning Systems	07	80,193	96,057					U
199	0208007F	Tactical Deception	07		14,338					U
200	0208064F	OPERATIONAL HQ - CYBER	07	5,323	2,115					U
201	0208087F	Distributed Cyber Warfare Operations	07	65,402	72,487					U
202	0208088F	AF Defensive Cyberspace Operations	07	29,255	18,449					U
203	0208097F	Joint Cyber Command and Control (JCC2)	07	35,060	79,079					U
204	0208099F	Unified Platform (UP)	07	91,886	91,893					U
208	0208288F	Intel Data Applications	07	1,224	493					U
209	0301025F	GeoBase	07		2,782					U
210	0301112F	Nuclear Planning and Execution System (NPES)	07	31,576	15,120					U
211	0301113F	Cyber Security Intelligence Support	07		5,224					U
218	0301401F	Air Force Space and Cyber Non-Traditional ISR for Battlespace Awareness	07	1,404	2,463					U
219	0302015F	E-4B National Airborne Operations Center (NAOC)	07	3,940	26,331					U

R-123BBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
196	0207610F	Battlefield Abn Comm Node (BACN)	07		32,008		U
197	0207697F	Distributed Training and Exercises	07		4,007	4,628	U
198	0208006F	Mission Planning Systems	07		96,057	99,214	U
199	0208007F	Tactical Deception	07		14,338	17,074	U
200	0208064F	OPERATIONAL HQ - CYBER	07		2,115	2,347	U
201	0208087F	Distributed Cyber Warfare Operations	07		72,487	76,592	U
202	0208088F	AF Defensive Cyberspace Operations	07		18,449	8,367	U
203	0208097F	Joint Cyber Command and Control (JCC2)	07		79,079	80,740	U
204	0208099F	Unified Platform (UP)	07		91,893	107,548	U
208	0208288F	Intel Data Applications	07		493	1,065	U
209	0301025F	GeoBase	07		2,782	2,928	U
210	0301112F	Nuclear Planning and Execution System (NPES)	07		15,120		U
211	0301113F	Cyber Security Intelligence Support	07		5,224	8,972	U
218	0301401F	Air Force Space and Cyber Non-Traditional ISR for Battlespace Awareness	07		2,463	3,069	U
219	0302015F	E-4B National Airborne Operations Center (NAOC)	07		26,331	25,701	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line	Program Element	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c e c e
220	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	38,298	58,165					U
221	0303140F	Information Systems Security Program	07	9,592	8,032					U
222	0303142F	Global Force Management - Data Initiative	07	1,294	452					U
223	0303248F	All Domain Common Platform	07		64,000					U
224	0303260F	Joint Military Deception Initiative	07							U
226	0304260F	Airborne SIGINT Enterprise	07	117,859	93,546					U
227	0304310F	Commercial Economic Analysis	07	3,887	3,770					U
230	0305015F	C2 Air Operations Suite - C2 Info Services	07							U
231	0305020F	CCMD Intelligence Information Technology	07	1,646	1,663					U
232	0305022F	ISR Modernization & Automation Dvmt (IMAD)	07	19,230	15,888					U
233	0305099F	Global Air Traffic Management (GATM)	07	4,133	4,672					U
234	0305103F	Cyber Security Initiative	07	368	290					U
235	0305111F	Weather Service	07	34,618	39,228					U
236	0305114F	Air Traffic Control, Approach, and Landing System (ATCAL)	07	5,729	15,749					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
---	-----	----	---	-----	-----	-----	-
220	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07		58,165	41,171	U
221	0303140F	Information Systems Security Program	07		8,032	70,582	U
222	0303142F	Global Force Management - Data Initiative	07		452		U
223	0303248F	All Domain Common Platform	07		64,000		U
224	0303260F	Joint Military Deception Initiative	07			2,588	U
226	0304260F	Airborne SIGINT Enterprise	07		93,546	108,528	U
227	0304310F	Commercial Economic Analysis	07		3,770	4,542	U
230	0305015F	C2 Air Operations Suite - C2 Info Services	07			8,097	U
231	0305020F	CCMD Intelligence Information Technology	07		1,663	1,751	U
232	0305022F	ISR Modernization & Automation Dvmt (IMAD)	07		15,888	13,138	U
233	0305099F	Global Air Traffic Management (GATM)	07		4,672	4,895	U
234	0305103F	Cyber Security Initiative	07		290	91	U
235	0305111F	Weather Service	07		39,228	11,716	U
236	0305114F	Air Traffic Control, Approach, and Landing System (ATCAL)	07		15,749	8,511	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c
237	0305116F	Aerial Targets	07	438	1,528					U
240	0305128F	Security and Investigative Activities	07	415	223					U
241	0305146F	Defense Joint Counterintelligence Activities	07	4,881	8,733					U
243	0305179F	Integrated Broadcast Service (IBS)	07	8,848	21,335					U
244	0305202F	Dragon U-2	07	36,593	35,846					U
245	0305206F	Airborne Reconnaissance Systems	07	133,247	108,291					U
246	0305207F	Manned Reconnaissance Systems	07	14,679	14,799					U
247	0305208F	Distributed Common Ground/Surface Systems	07	14,126	24,568					U
248	0305220F	RQ-4 UAV	07	163,278	83,124					U
249	0305221F	Network-Centric Collaborative Targeting	07	15,022	17,224					U
250	0305238F	NATO AGS	07	36,664	19,473					U
251	0305240F	Support to DCGS Enterprise	07	33,486	40,421					U
252	0305600F	International Intelligence Technology and Architectures	07	13,603	14,473					U
253	0305881F	Rapid Cyber Acquisition	07	4,098	4,326					U
254	0305984F	Personnel Recovery Command & Ctrl (PRC2)	07	2,122	2,567					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
---	-----	----	---	-----	-----	-----	c
237	0305116F	Aerial Targets	07		1,528	1,365	U
240	0305128F	Security and Investigative Activities	07		223	223	U
241	0305146F	Defense Joint Counterintelligence Activities	07		8,733	8,328	U
243	0305179F	Integrated Broadcast Service (IBS)	07		21,335	22,123	U
244	0305202F	Dragon U-2	07		35,846	20,170	U
245	0305206F	Airborne Reconnaissance Systems	07		108,291	55,048	U
246	0305207F	Manned Reconnaissance Systems	07		14,799	14,590	U
247	0305208F	Distributed Common Ground/Surface Systems	07		24,568	26,901	U
248	0305220F	RQ-4 UAV	07		83,124	68,801	U
249	0305221F	Network-Centric Collaborative Targeting	07		17,224	17,564	U
250	0305238F	NATO AGS	07		19,473	826	U
251	0305240F	Support to DCGS Enterprise	07		40,421	28,774	U
252	0305600F	International Intelligence Technology and Architectures	07		14,473	15,036	U
253	0305881F	Rapid Cyber Acquisition	07		4,326	3,739	U
254	0305984F	Personnel Recovery Command & Ctrl (PRC2)	07		2,567	2,702	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line	Program Element	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B Division C P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****	S e c e c
255	0307577F	Intelligence Mission Data (IMD)	07	6,266	6,169					U
256	0401115F	C-130 Airlift Squadron	07	48,698	12,552					U
257	0401119F	C-5 Airlift Squadrons (IF)	07	22,742	17,507					U
258	0401130F	C-17 Aircraft (IF)	07	11,653	16,360					U
259	0401132F	C-130J Program	07	6,179	24,112					U
260	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	4,949	5,540					U
261	0401218F	KC-135s	07	4,583	3,564					U
262	0401318F	CV-22	07	17,823	17,189					U
263	0408011F	Special Tactics / Combat Control	07	7,457	6,640					U
264	0708055F	Maintenance, Repair & Overhaul System	07	20,422	26,921					U
265	0708610F	Logistics Information Technology (LOGIT)	07	32,122	11,071					U
266	0708611F	Support Systems Development	07	10,318						U
267	0804743F	Other Flight Training	07	1,281	5,999					U
268	0808716F	Other Personnel Activities	07		5,000					U
269	0901202F	Joint Personnel Recovery Agency	07	2,019	1,841					U
270	0901218F	Civilian Compensation Program	07	3,093	3,560					U
271	0901220F	Personnel Administration	07	1,536	3,368					U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
---	-----	----	---	-----	-----	-----	c
255	0307577F	Intelligence Mission Data (IMD)	07		6,169	6,332	U
256	0401115F	C-130 Airlift Squadron	07		12,552	407	U
257	0401119F	C-5 Airlift Squadrons (IF)	07		17,507	6,100	U
258	0401130F	C-17 Aircraft (IF)	07		16,360	25,387	U
259	0401132F	C-130J Program	07		24,112	11,060	U
260	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07		5,540	2,909	U
261	0401218F	KC-135s	07		3,564	12,955	U
262	0401318F	CV-22	07		17,189	10,121	U
263	0408011F	Special Tactics / Combat Control	07		6,640	6,297	U
264	0708055F	Maintenance, Repair & Overhaul System	07		26,921	19,892	U
265	0708610F	Logistics Information Technology (LOGIT)	07		11,071	5,271	U
266	0708611F	Support Systems Development	07				U
267	0804743F	Other Flight Training	07		5,999	2,214	U
268	0808716F	Other Personnel Activities	07		5,000		U
269	0901202F	Joint Personnel Recovery Agency	07		1,841	2,164	U
270	0901218F	Civilian Compensation Program	07		3,560	4,098	U
271	0901220F	Personnel Administration	07		3,368	3,191	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022	FY 2022	FY 2022	FY 2022	S e c e
						Division B Division C P.L.117-43 Enactment*	Division B P.L.117-70 Enactment**	Division A P.L. 117-86 Enactment***	Division N P.L. 117-103 Enactment****	
272	0901226F	Air Force Studies and Analysis Agency	07	1,151	1,248					U
273	0901538F	Financial Management Information Systems Development	07	6,740	4,852					U
274	0901554F	Defense Enterprise Acntng and Mgt Sys (DEAMS)	07	39,628	54,400					U
275	1201921F	Service Support to STRATCOM - Space Activities	07	991						U
276	1202140F	Service Support to SPACECOM Activities	07	8,983	6,737					U
9999	9999999999	Classified Programs		14,909,669	17,011,053					U
		Operational Systems Development		20,022,756	23,240,309					
278	0608158F	Strategic Mission Planning and Execution System - Software Pilot Program	08							U
279	0608410F	Air & Space Operations Center (AOC) - Software Pilot Program	08							U
280	0608920F	Defense Enterprise Accounting and Management System (DEAMS) - Software Pilot Pro	08							U
281	0208087F	Distributed Cyber Warfare Operations	08							U
282	0308605F	Air Force Defensive Cyber Systems (AFDCS) - Software Pilot Program	08							U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request	Se
--	-----	----	---	-----	-----	-----	-
272	0901226F	Air Force Studies and Analysis Agency	07		1,248	899	U
273	0901538F	Financial Management Information Systems Development	07		4,852	5,421	U
274	0901554F	Defense Enterprise Acntng and Mgt Sys (DEAMS)	07		54,400		U
275	1201921F	Service Support to STRATCOM - Space Activities	07				U
276	1202140F	Service Support to SPACECOM Activities	07		6,737	13,766	U
9999	9999999999	Classified Programs			17,011,053	17,240,641	U
		Operational Systems Development			23,240,309	23,090,569	
278	0608158F	Strategic Mission Planning and Execution System - Software Pilot Program	08			100,167	U
279	0608410F	Air & Space Operations Center (AOC) - Software Pilot Program	08			177,827	U
280	0608920F	Defense Enterprise Accounting and Management System (DEAMS) - Software Pilot Pro	08			136,202	U
281	0208087F	Distributed Cyber Warfare Operations	08			37,346	U
282	0308605F	Air Force Defensive Cyber Systems (AFDCS) - Software Pilot Program	08			240,926	U

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022	FY 2022	FY 2022	FY 2022	FY 2022	S e c
						Division B Division C P.L.117-43 Enactment*	Division B P.L.117-70 Enactment**	Division A P.L. 117-86 Enactment***	Division N P.L. 117-103 Enactment****		
283	0308606F	All Domain Common Platform (ADCP) - Software Pilot Program	08								U
284	0308607F	Air Force Weather Programs - Software Pilot Program	08								U
285	0308608F	Electronic Warfare Integrated Reprogramming (EWIR) - Software Pilot Program	08								U
		Software and Digital Technology Pilot Progr		-----	-----	-----	-----	-----	-----	-----	
		Total Research, Development, Test & Eval, AF		36,022,139	41,592,913					47,500	

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52
 *Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).
 **Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).
 ***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).
 ****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

Appropriation: 3600F Research, Development, Test & Eval, AF

Line	Program Element No Number	Item -----	Act ---	FY 2022 Total Supplemental Enactment -----	FY 2022 Total Enactment -----	FY 2023 Request -----	S e c -
283	0308606F	All Domain Common Platform (ADCP) - Software Pilot Program	08			190,112	U
284	0308607F	Air Force Weather Programs - Software Pilot Program	08			58,063	U
285	0308608F	Electronic Warfare Integrated Reprogramming (EWIR) - Software Pilot Program	08			5,794	U
		Software and Digital Technology Pilot Progr				946,437	
Total Research, Development, Test & Eval, AF				47,500	41,640,413	44,134,301	

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

	FY 2021 (Base + OCO)	FY 2022 Less Supplementals Enactment	FY 2022 Division B P.L.117-43 Enactment*	FY 2022 Division B P.L.117-70 Enactment**	FY 2022 Division A P.L. 117-86 Enactment***	FY 2022 Division N P.L. 117-103 Enactment****
Summary Recap of Budget Activities -----						
Applied Research	214,494	286,505				
Advanced Technology Development		238,584				
Advanced Component Development & Prototypes	1,335,818	1,598,560				
System Development & Demonstration	3,638,636	3,167,810				
Management Support	537,965	471,142				
Operational System Development	4,624,888	5,680,275				
Software & Digital Technology Pilot Programs	155,067	154,529				
Total Research, Development, Test & Evaluation	10,506,868	11,597,405				
Summary Recap of FYDP Programs -----						
Research and Development						
Space	6,969,975	7,034,096				
Classified Programs	3,536,893	4,563,309				
Total Research, Development, Test & Evaluation	10,506,868	11,597,405				

R-123BPB: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

*Includes enacted funding pursuant to the Extending Government Funding and Delivering Emergency Assistance Act (Public Law 117-43).

**Includes enacted funding pursuant to the Further Extending Government Funding Act (Public Law 117-70).

***Includes enacted funding pursuant to the Further Additional Extending Government Funding Act (Public Law 117-86).

****Includes enacted funding pursuant to the Ukraine Supplemental Appropriations Act (Public Law 117-103).

UNCLASSIFIED

Department of the Air Force
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

25 Mar 2022

	FY 2022 Total Supplemental Enactment	FY 2022 Total Enactment	FY 2023 Request
Summary Recap of Budget Activities -----			
Applied Research		286,505	243,737
Advanced Technology Development		238,584	564,215
Advanced Component Development & Prototypes		1,598,560	2,992,458
System Development & Demonstration		3,167,810	5,335,659
Management Support		471,142	424,943
Operational System Development		5,680,275	6,103,307
Software & Digital Technology Pilot Programs		154,529	155,053
Total Research, Development, Test & Evaluation		11,597,405	15,819,372
Summary Recap of FYDP Programs -----			
Research and Development			816
Space		7,034,096	10,845,198
Classified Programs		4,563,309	4,973,358
Total Research, Development, Test & Evaluation		11,597,405	15,819,372

R-123PBP: FY 2023 President's Budget (Total Base Published Version), as of March 25, 2022 at 15:49:52

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Master Program Element Table of Contents (by Budget Activity then Line Item Number)

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
1	01	0601102F	Defense Research Sciences.....	Volume 1 - 1
2	01	0601103F	University Research Initiatives.....	Volume 1 - 17
3	01	0601108F	High Energy Laser Research Initiatives.....	Volume 1 - 23

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
4	02	0602020F	Future AF Capabilities Applied Research.....	Volume 1 - 27
5	02	0602102F	Materials.....	Volume 1 - 31
6	02	0602201F	Aerospace Vehicle Technologies.....	Volume 1 - 49
7	02	0602202F	Human Effectiveness Applied Research.....	Volume 1 - 77
8	02	0602203F	Aerospace Propulsion.....	Volume 1 - 95
9	02	0602204F	Aerospace Sensors.....	Volume 1 - 123
10	02	0602212F	Defense Laboratories R&D Projects (10 U.S.C, Sec 2358).....	Volume 1 - 149

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
11	02	0602298F	Science and Technology Management - Major Headquarters Activities.....	Volume 1 - 151
12	02	0602602F	Conventional Munitions.....	Volume 1 - 153
13	02	0602605F	Directed Energy Technology.....	Volume 1 - 163
14	02	0602788F	Dominant Information Sciences and Methods.....	Volume 1 - 173
15	02	0602890F	High Energy Laser Research.....	Volume 1 - 191

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
16	03	0603032F	Future AF Integrated Technology Demos.....	Volume 1 - 195
17	03	0603112F	Advanced Materials for Weapon Systems.....	Volume 1 - 203
18	03	0603199F	Sustainment Science and Technology (S&T).....	Volume 1 - 219
19	03	0603203F	Advanced Aerospace Sensors.....	Volume 1 - 225
20	03	0603211F	Aerospace Technology Dev/Demo.....	Volume 1 - 235
21	03	0603216F	Aerospace Propulsion and Power Technology.....	Volume 1 - 247
22	03	0603270F	Electronic Combat Technology.....	Volume 1 - 271
23	03	0603273F	Science & Technology for Nuclear Re-entry Systems.....	Volume 1 - 289

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
24	03	0603401F	Advanced Spacecraft Technology.....	Volume 1 - 291
25	03	0603444F	Maui Space Surveillance System (MSSS).....	Volume 1 - 297
26	03	0603456F	Human Effectiveness Advanced Technology Development.....	Volume 1 - 299
27	03	0603601F	Conventional Weapons Technology.....	Volume 1 - 315
28	03	0603605F	Advanced Weapons Technology.....	Volume 1 - 325
29	03	0603680F	Manufacturing Technology Program.....	Volume 1 - 331
30	03	0603788F	Battlespace Knowledge Development and Demonstration.....	Volume 1 - 341

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
31	04	0603036F	Armament Demonstration and Validation.....	Volume 2 - 1
32	04	0603260F	Intelligence Advanced Development.....	Volume 2 - 9
33	04	0603742F	Combat Identification Technology.....	Volume 2 - 23
34	04	0603790F	NATO Research and Development.....	Volume 2 - 49
35	04	0603851F	Intercontinental Ballistic Missile - Dem/Val.....	Volume 2 - 57
36	04	0604001F	NC3 Advanced Concepts.....	Volume 2 - 83

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
37	04	0604002F	Air Force Weather Services Research.....	Volume 2 - 89
38	04	0604003F	Advanced Battle Management System (ABMS).....	Volume 2 - 97
39	04	0604004F	Advanced Engine Development.....	Volume 2 - 111
40	04	0604006F	Dept of the Air Force Tech Architecture.....	Volume 2 - 119
41	04	0604015F	Long Range Strike - Bomber.....	Volume 2 - 131
42	04	0604032F	Directed Energy Prototyping.....	Volume 2 - 137
43	04	0604033F	Hypersonics Prototyping.....	Volume 2 - 145
44	04	0604183F	Hypersonics Prototyping - Hypersonic Attack Cruise Missile (HACM).....	Volume 2 - 161
45	04	0604201F	PNT Resiliency, Mods, and Improvements.....	Volume 2 - 169
46	04	0604257F	Advanced Technology and Sensors.....	Volume 2 - 177
47	04	0604288F	Survivable Airborne Operations Center.....	Volume 2 - 191
48	04	0604317F	Technology Transfer.....	Volume 2 - 199
49	04	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program.....	Volume 2 - 219
50	04	0604414F	Cyber Resiliency of Weapon Systems-ACS.....	Volume 2 - 227
51	04	0604668F	Joint Transportation Management System (JTMS).....	Volume 2 - 249
52	04	0604776F	Deployment & Distribution Enterprise R&D.....	Volume 2 - 255
53	04	0604858F	Tech Transition Program.....	Volume 2 - 289
54	04	0604860F	Operational Energy and Installation Resilience.....	Volume 2 - 333

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
55	04	0605230F	Ground Based Strategic Deterrent.....	Volume 2 - 343
56	04	0207110F	Next Generation Air Dominance.....	Volume 2 - 357
57	04	0207179F	Autonomous Collaborative Platforms.....	Volume 2 - 365
59	04	0207455F	Three Dimensional Long-Range Radar (3DELRR).....	Volume 2 - 371
60	04	0207522F	Airbase Air Defense Systems (ABADS).....	Volume 2 - 381
61	04	0208030F	War Reserve Materiel - Ammunition.....	Volume 2 - 389
62	04	0208099F	Unified Platform (UP).....	Volume 2 - 397
63	04	0304369F	Cyber Capabilities Support Office (CCSO).....	Volume 2 - 411
64	04	0305236F	Common Data Link Executive Agent (CDL EA).....	Volume 2 - 419
65	04	0305601F	Mission Partner Environments.....	Volume 2 - 433
66	04	0306250F	Cyber Operations Technology Support.....	Volume 2 - 439
67	04	0306415F	Enabled Cyber Activities.....	Volume 2 - 449
68	04	0401310F	C-32 Executive Transport Recapitalization.....	Volume 2 - 455
69	04	0708051F	Rapid Sustainment Modernization (RSM).....	Volume 2 - 461
70	04	0808737F	CVV Integrated Prevention.....	Volume 2 - 467
71	04	0901410F	Contracting Information Technology System.....	Volume 2 - 477
72	04	1206415F	U.S. Space Command Research and Development Support.....	Volume 2 - 487

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
73	05	0604200F	Future Advanced Weapon Analysis & Programs.....	Volume 2 - 493
74	05	0604201F	PNT Resiliency, Mods, and Improvements.....	Volume 2 - 503
75	05	0604222F	Nuclear Weapons Support.....	Volume 2 - 513
76	05	0604270F	Electronic Warfare Development.....	Volume 2 - 535
77	05	0604281F	Tactical Data Networks Enterprise.....	Volume 2 - 543
78	05	0604287F	Physical Security Equipment.....	Volume 2 - 563
79	05	0604602F	Armament/Ordnance Development.....	Volume 2 - 571
80	05	0604604F	Submunitions.....	Volume 2 - 593
81	05	0604617F	Agile Combat Support.....	Volume 2 - 601
82	05	0604618F	Joint Direct Attack Munition.....	Volume 2 - 619
83	05	0604706F	Life Support Systems.....	Volume 2 - 625
84	05	0604735F	Combat Training Ranges.....	Volume 2 - 635
85	05	0604800F	F-35 - EMD.....	Volume 2 - 649
86	05	0604932F	Long Range Standoff Weapon.....	Volume 2 - 659
87	05	0604933F	ICBM Fuze Modernization.....	Volume 2 - 669
88	05	0605030F	Joint Tactical Network Center (JTNC).....	Volume 2 - 679

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
88	05	0605031F	Joint Tactical Network (JTN).....	Volume 2 - 687
89	05	0605056F	Open Architecture Management.....	Volume 2 - 689
90	05	0605223F	Advanced Pilot Training.....	Volume 2 - 697
91	05	0605229F	HH-60W.....	Volume 2 - 705
92	05	0605238F	Ground Based Strategic Deterrent EMD.....	Volume 2 - 715
93	05	0101125F	Nuclear Weapons Modernization.....	Volume 2 - 733
94	05	0207171F	F-15 EPAWSS.....	Volume 2 - 741
95	05	0207279F	Isolated Personnel Survivability and Recovery.....	Volume 2 - 749
96	05	0207328F	Stand In Attack Weapon.....	Volume 2 - 755
97	05	0207701F	Full Combat Mission Training.....	Volume 2 - 765
99	05	0303667F	Citizen Broadband Radio System.....	Volume 2 - 777
100	05	0303767F	AMBIT - Pre-Auctioned SRF.....	Volume 2 - 783
101	05	0305176F	Combat Survivor Evader Locator.....	Volume 2 - 789
101	05	1203176F	Combat Survivor Evader Locator.....	Volume 2 - 791
102	05	0401221F	KC-46A Tanker Squadrons.....	Volume 2 - 793
103	05	0401319F	VC-25B.....	Volume 2 - 817
104	05	0701212F	Automated Test Systems.....	Volume 2 - 825
105	05	0804772F	Training Developments.....	Volume 2 - 833

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
106	05	0901299F	AF A1 Systems.....	Volume 2 - 843
107	05	1206442F	Next Generation OPIR.....	Volume 2 - 849

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
108	06	0604256F	Threat Simulator Development.....	Volume 3 - 1
109	06	0604759F	Major T&E Investment.....	Volume 3 - 11
110	06	0605101F	RAND Project Air Force.....	Volume 3 - 19
111	06	0605502F	Small Business Innovation Research.....	Volume 3 - 23
112	06	0605712F	Initial Operational Test & Evaluation.....	Volume 3 - 27
113	06	0605807F	Test and Evaluation Support.....	Volume 3 - 33
114	06	0605826F	Acq Workforce- Global Power.....	Volume 3 - 41
115	06	0605827F	Acq Workforce- Global Vig & Combat Sys.....	Volume 3 - 45
116	06	0605828F	Acq Workforce- Global Reach.....	Volume 3 - 51
117	06	0605829F	Acq Workforce- Cyber, Network, & Bus Sys.....	Volume 3 - 59
118	06	0605830F	Acq Workforce- Global Battle Mgmt.....	Volume 3 - 67

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
119	06	0605831F	Acq Workforce- Capability Integration.....	Volume 3 - 71
120	06	0605832F	Acq Workforce- Advanced Prgm Technology.....	Volume 3 - 79
121	06	0605833F	Acq Workforce- Nuclear Systems.....	Volume 3 - 85
122	06	0605898F	Management HQ - R&D.....	Volume 3 - 93
123	06	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support.....	Volume 3 - 99
124	06	0605978F	Facilities Sustainment - Test and Evaluation Support.....	Volume 3 - 103
125	06	0606017F	Requirements Analysis and Maturation.....	Volume 3 - 107
126	06	0606398F	Management HQ - T&E.....	Volume 3 - 117
127	06	0303166F	Support to Information Operations (IO) Capabilities.....	Volume 3 - 119
128	06	0303255F	Command, Control, Communication, and Computers (C4) - STRATCOM.....	Volume 3 - 123
129	06	0308602F	ENTEPRISE INFORMATION SERVICES (EIS).....	Volume 3 - 129
130	06	0702806F	Acquisition and Management Support.....	Volume 3 - 133
131	06	0804731F	General Skill Training.....	Volume 3 - 141
132	06	0804772F	Training Developments.....	Volume 3 - 143
133	06	0909999F	Financing for Cancelled Account Adjustments.....	Volume 3 - 145
134	06	1001004F	International Activities.....	Volume 3 - 147
135	06	1206864F	Space Test Program (STP).....	Volume 3 - 153

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
136	07	0604233F	Specialized Undergraduate Flight Training.....	Volume 3 - 157
137	07	0604445F	Wide Area Surveillance.....	Volume 3 - 181
138	07	0604617F	Agile Combat Support.....	Volume 3 - 189
139	07	0604776F	Deployment & Distribution Enterprise R&D.....	Volume 3 - 197
140	07	0604840F	F-35 C2D2.....	Volume 3 - 203
141	07	0605018F	AF Integrated Personnel and Pay System (AF-IPPS).....	Volume 3 - 289
142	07	0605024F	Anti-Tamper Technology Executive Agency.....	Volume 3 - 301
143	07	0605117F	Foreign Materiel Acquisition and Exploitation.....	Volume 3 - 309
144	07	0605278F	HC/MC-130 Recap RDT&E.....	Volume 3 - 317
145	07	0606018F	NC3 Integration.....	Volume 3 - 333
146	07	0606942F	Assessments and Evaluations Cyber Vulnerabilities.....	Volume 3 - 341
147	07	0101113F	B-52 Squadrons.....	Volume 3 - 347
148	07	0101122F	Air-Launched Cruise Missile (ALCM).....	Volume 3 - 419
149	07	0101126F	B-1B Squadrons.....	Volume 3 - 425
150	07	0101127F	B-2 Squadrons.....	Volume 3 - 437
151	07	0101213F	Minuteman Squadrons.....	Volume 3 - 457

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
152	07	0101316F	Worldwide Joint Strategic Communications.....	Volume 3 - 487
153	07	0101324F	Integrated Strategic Planning & Analysis Network.....	Volume 3 - 497
154	07	0101328F	ICBM Reentry Vehicles.....	Volume 3 - 505
156	07	0102110F	UH-1N Replacement Program.....	Volume 3 - 517
157	07	0102326F	Region/Sector Operation Control Center Modernization Program.....	Volume 3 - 533
158	07	0102412F	North Warning System (NWS).....	Volume 3 - 541
159	07	0102417F	Over-the-Horizon Backscatter Radar.....	Volume 3 - 547
160	07	0202834F	Vehicles and Support Equipment - General.....	Volume 3 - 557
161	07	0205219F	MQ-9 UAV.....	Volume 3 - 565
162	07	0205671F	Joint Counter RCIED Electronic Warfare.....	Volume 3 - 595
163	07	0207040F	Multi-Platform Electronic Warfare Equipment.....	Volume 3 - 601
164	07	0207131F	A-10 Squadrons.....	Volume 3 - 609
165	07	0207133F	F-16 Squadrons.....	Volume 3 - 621
166	07	0207134F	F-15E Squadrons.....	Volume 3 - 637
167	07	0207136F	Manned Destructive Suppression.....	Volume 3 - 651
168	07	0207138F	F-22A Squadrons.....	Volume 3 - 659
169	07	0207142F	F-35 Squadrons.....	Volume 3 - 681
170	07	0207146F	F-15EX.....	Volume 3 - 707

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
171	07	0207161F	Tactical AIM Missiles.....	Volume 3 - 713
172	07	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM).....	Volume 3 - 721
173	07	0207227F	Combat Rescue - Pararescue.....	Volume 3 - 731
174	07	0207247F	AF TENCAP.....	Volume 3 - 737
175	07	0207249F	Precision Attack Systems Procurement.....	Volume 3 - 747
176	07	0207253F	Compass Call.....	Volume 3 - 753
177	07	0207268F	Aircraft Engine Component Improvement Program.....	Volume 3 - 761
178	07	0207325F	Joint Air-to-Surface Standoff Missile (JASSM).....	Volume 3 - 779
179	07	0207327F	Small Diameter Bomb (SDB).....	Volume 3 - 789
180	07	0207410F	Air & Space Operations Center (AOC).....	Volume 3 - 799
181	07	0207412F	Control and Reporting Center (CRC).....	Volume 3 - 809
182	07	0207417F	Airborne Warning and Control System (AWACS).....	Volume 3 - 817
183	07	0207418F	AFSPECWAR - TACP.....	Volume 3 - 831
185	07	0207431F	Combat Air Intelligence System Activities.....	Volume 3 - 837
186	07	0207438F	Theater Battle Management (TBM) C4I.....	Volume 3 - 851
187	07	0207439F	Electronic Warfare Integrated Reprogramming (EWIR).....	Volume 3 - 857
188	07	0207444F	Tactical Air Control Party-Mod.....	Volume 3 - 865
189	07	0207452F	DCAPES.....	Volume 3 - 879

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
190	07	0207521F	Air Force Calibration Programs.....	Volume 3 - 889
191	07	0207522F	Airbase Air Defense Systems (ABADS).....	Volume 3 - 895
192	07	0207573F	National Technical Nuclear Forensics.....	Volume 3 - 903
193	07	0207590F	Seek Eagle.....	Volume 3 - 909
194	07	0207601F	USAF Modeling and Simulation.....	Volume 3 - 919
195	07	0207605F	Wargaming and Simulation Centers.....	Volume 3 - 935
196	07	0207610F	Battlefield Abn Comm Node (BACN).....	Volume 3 - 945
197	07	0207697F	Distributed Training and Exercises.....	Volume 3 - 953
198	07	0208006F	Mission Planning Systems.....	Volume 3 - 963
199	07	0208007F	Tactical Deception.....	Volume 3 - 985
200	07	0208064F	OPERATIONAL HQ - CYBER.....	Volume 3 - 991
201	07	0208087F	Distributed Cyber Warfare Operations.....	Volume 3 - 997
202	07	0208088F	AF Defensive Cyberspace Operations.....	Volume 3 - 1025
203	07	0208097F	Joint Cyber Command and Control (JCC2).....	Volume 3 - 1055
204	07	0208099F	Unified Platform (UP).....	Volume 3 - 1063
208	07	0208288F	Intel Data Applications.....	Volume 3 - 1071
209	07	0301025F	GeoBase.....	Volume 3 - 1077
210	07	0301112F	Nuclear Planning and Execution System (NPES).....	Volume 3 - 1083

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
211	07	0301113F	Cyber Security Intelligence Support.....	Volume 3 - 1097
218	07	0301401F	Air Force Space and Cyber Non-Traditional ISR for Battlespace Awareness.....	Volume 3 - 1103
219	07	0302015F	E-4B National Airborne Operations Center (NAOC).....	Volume 3 - 1109
220	07	0303131F	Minimum Essential Emergency Communications Network (MEECN).....	Volume 3 - 1119
221	07	0303140F	Information Systems Security Program.....	Volume 3 - 1139
222	07	0303142F	Global Force Management - Data Initiative.....	Volume 3 - 1151
223	07	0303248F	All Domain Common Platform.....	Volume 3 - 1159
224	07	0303260F	Joint Military Deception Initiative.....	Volume 3 - 1167
226	07	0304260F	Airborne SIGINT Enterprise.....	Volume 3 - 1173
227	07	0304310F	Commercial Economic Analysis.....	Volume 3 - 1197
230	07	0305015F	C2 Air Operations Suite - C2 Info Services.....	Volume 3 - 1203
231	07	0305020F	CCMD Intelligence Information Technology.....	Volume 3 - 1211
232	07	0305022F	ISR Modernization & Automation Dvmt (IMAD).....	Volume 3 - 1219
233	07	0305099F	Global Air Traffic Management (GATM).....	Volume 3 - 1231
234	07	0305103F	Cyber Security Initiative.....	Volume 3 - 1241
235	07	0305111F	Weather Service.....	Volume 3 - 1247
236	07	0305114F	Air Traffic Control, Approach, and Landing System (ATCAL).....	Volume 3 - 1259
237	07	0305116F	Aerial Targets.....	Volume 3 - 1271

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
240	07	0305128F	Security and Investigative Activities.....	Volume 3 - 1281
241	07	0305146F	Defense Joint Counterintelligence Activities.....	Volume 3 - 1287
243	07	0305179F	Integrated Broadcast Service (IBS).....	Volume 3 - 1293
244	07	0305202F	Dragon U-2.....	Volume 3 - 1303
245	07	0305206F	Airborne Reconnaissance Systems.....	Volume 3 - 1311
246	07	0305207F	Manned Reconnaissance Systems.....	Volume 3 - 1353
247	07	0305208F	Distributed Common Ground/Surface Systems.....	Volume 3 - 1361
248	07	0305220F	RQ-4 UAV.....	Volume 3 - 1373
249	07	0305221F	Network-Centric Collaborative Targeting.....	Volume 3 - 1383
250	07	0305238F	NATO AGS.....	Volume 3 - 1389
251	07	0305240F	Support to DCGS Enterprise.....	Volume 3 - 1397
252	07	0305600F	International Intelligence Technology and Architectures.....	Volume 3 - 1409
253	07	0305881F	Rapid Cyber Acquisition.....	Volume 3 - 1415
254	07	0305984F	Personnel Recovery Command & Ctrl (PRC2).....	Volume 3 - 1423
255	07	0307577F	Intelligence Mission Data (IMD).....	Volume 3 - 1431
256	07	0401115F	C-130 Airlift Squadron.....	Volume 3 - 1437
257	07	0401119F	C-5 Airlift Squadrons (IF).....	Volume 3 - 1451
258	07	0401130F	C-17 Aircraft (IF).....	Volume 3 - 1459

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
259	07	0401132F	C-130J Program.....	Volume 3 - 1467
260	07	0401134F	Large Aircraft IR Countermeasures (LAIRCM).....	Volume 3 - 1485
261	07	0401218F	KC-135s.....	Volume 3 - 1493
262	07	0401318F	CV-22.....	Volume 3 - 1503
263	07	0408011F	Special Tactics / Combat Control.....	Volume 3 - 1513
264	07	0708055F	Maintenance, Repair & Overhaul System.....	Volume 3 - 1523
265	07	0708610F	Logistics Information Technology (LOGIT).....	Volume 3 - 1533
266	07	0708611F	Support Systems Development.....	Volume 3 - 1549
267	07	0804743F	Other Flight Training.....	Volume 3 - 1555
268	07	0808716F	Other Personnel Activities.....	Volume 3 - 1563
269	07	0901202F	Joint Personnel Recovery Agency.....	Volume 3 - 1569
270	07	0901218F	Civilian Compensation Program.....	Volume 3 - 1577
271	07	0901220F	Personnel Administration.....	Volume 3 - 1583
272	07	0901226F	Air Force Studies and Analysis Agency.....	Volume 3 - 1595
273	07	0901538F	Financial Management Information Systems Development.....	Volume 3 - 1601
274	07	0901554F	Defense Enterprise Acntng and Mgt Sys (DEAMS).....	Volume 3 - 1617
275	07	1201921F	Service Support to STRATCOM - Space Activities.....	Volume 3 - 1637
276	07	1202140F	Service Support to SPACECOM Activities.....	Volume 3 - 1649

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
278	08	0608158F	Strategic Mission Planning and Execution System - Software Pilot Program.....	Volume 4 - 1
279	08	0608410F	Air & Space Operations Center (AOC) - Software Pilot Program.....	Volume 4 - 13
280	08	0608920F	Defense Enterprise Accounting and Management System (DEAMS) - Software Pilot Pro	Volume 4 - 23
281	08	0208087F	Distributed Cyber Warfare Operations.....	Volume 4 - 33
282	08	0308605F	Air Force Defensive Cyber Systems (AFDCS) - Software Pilot Program.....	Volume 4 - 39
283	08	0308606F	All Domain Common Platform (ADCP) - Software Pilot Program.....	Volume 4 - 61
284	08	0308607F	Air Force Weather Programs - Software Pilot Program.....	Volume 4 - 69
285	08	0308608F	Electronic Warfare Integrated Reprogramming (EWIR) - Software Pilot Program.....	Volume 4 - 77

UNCLASSIFIED

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Master Program Element Table of Contents (Alphabetically by Program Element Title)

Program Element Title	Program Element Number	Line #	BA	Page
A-10 Squadrons	0207131F	164	07.....	Volume 3 - 609
AF A1 Systems	0901299F	106	05.....	Volume 2 - 843
AF Defensive Cyberspace Operations	0208088F	202	07.....	Volume 3 - 1025
AF Integrated Personnel and Pay System (AF-IPPS)	0605018F	141	07.....	Volume 3 - 289
AF TENCAP	0207247F	174	07.....	Volume 3 - 737
AFSPECWAR - TACP	0207418F	183	07.....	Volume 3 - 831
AMBIT - Pre-Auctioned SRF	0303767F	100	05.....	Volume 2 - 783
Acq Workforce- Advanced Prgm Technology	0605832F	120	06.....	Volume 3 - 79
Acq Workforce- Capability Integration	0605831F	119	06.....	Volume 3 - 71
Acq Workforce- Cyber, Network, & Bus Sys	0605829F	117	06.....	Volume 3 - 59
Acq Workforce- Global Battle Mgmt	0605830F	118	06.....	Volume 3 - 67
Acq Workforce- Global Power	0605826F	114	06.....	Volume 3 - 41
Acq Workforce- Global Reach	0605828F	116	06.....	Volume 3 - 51
Acq Workforce- Global Vig & Combat Sys	0605827F	115	06.....	Volume 3 - 45
Acq Workforce- Nuclear Systems	0605833F	121	06.....	Volume 3 - 85
Acquisition and Management Support	0702806F	130	06.....	Volume 3 - 133
Advanced Aerospace Sensors	0603203F	19	03.....	Volume 1 - 225

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Advanced Battle Management System (ABMS)	0604003F	38	04.....	Volume 2 - 97
Advanced Engine Development	0604004F	39	04.....	Volume 2 - 111
Advanced Materials for Weapon Systems	0603112F	17	03.....	Volume 1 - 203
Advanced Medium Range Air-to-Air Missile (AMRAAM)	0207163F	172	07.....	Volume 3 - 721
Advanced Pilot Training	0605223F	90	05.....	Volume 2 - 697
Advanced Spacecraft Technology	0603401F	24	03.....	Volume 1 - 291
Advanced Technology and Sensors	0604257F	46	04.....	Volume 2 - 177
Advanced Weapons Technology	0603605F	28	03.....	Volume 1 - 325
Aerial Targets	0305116F	237	07.....	Volume 3 - 1271
Aerospace Propulsion	0602203F	8	02.....	Volume 1 - 95
Aerospace Propulsion and Power Technology	0603216F	21	03.....	Volume 1 - 247
Aerospace Sensors	0602204F	9	02.....	Volume 1 - 123
Aerospace Technology Dev/Demo	0603211F	20	03.....	Volume 1 - 235
Aerospace Vehicle Technologies	0602201F	6	02.....	Volume 1 - 49
Agile Combat Support	0604617F	81	05.....	Volume 2 - 601
Agile Combat Support	0604617F	138	07.....	Volume 3 - 189
Air & Space Operations Center (AOC)	0207410F	180	07.....	Volume 3 - 799
Air & Space Operations Center (AOC) - Software Pilot Program	0608410F	279	08.....	Volume 4 - 13
Air Force Calibration Programs	0207521F	190	07.....	Volume 3 - 889

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Air Force Defensive Cyber Systems (AFDCS) - Software Pilot Program	0308605F	282	08.....	Volume 4 - 39
Air Force Space and Cyber Non-Traditional ISR for Battlespace Awareness	0301401F	218	07.....	Volume 3 - 1103
Air Force Studies and Analysis Agency	0901226F	272	07.....	Volume 3 - 1595
Air Force Weather Programs - Software Pilot Program	0308607F	284	08.....	Volume 4 - 69
Air Force Weather Services Research	0604002F	37	04.....	Volume 2 - 89
Air Traffic Control, Approach, and Landing System (ATCALs)	0305114F	236	07.....	Volume 3 - 1259
Air-Launched Cruise Missile (ALCM)	0101122F	148	07.....	Volume 3 - 419
Airbase Air Defense Systems (ABADS)	0207522F	60	04.....	Volume 2 - 381
Airbase Air Defense Systems (ABADS)	0207522F	191	07.....	Volume 3 - 895
Airborne Reconnaissance Systems	0305206F	245	07.....	Volume 3 - 1311
Airborne SIGINT Enterprise	0304260F	226	07.....	Volume 3 - 1173
Airborne Warning and Control System (AWACS)	0207417F	182	07.....	Volume 3 - 817
Aircraft Engine Component Improvement Program	0207268F	177	07.....	Volume 3 - 761
All Domain Common Platform	0303248F	223	07.....	Volume 3 - 1159
All Domain Common Platform (ADCP) - Software Pilot Program	0308606F	283	08.....	Volume 4 - 61
Anti-Tamper Technology Executive Agency	0605024F	142	07.....	Volume 3 - 301
Armament Demonstration and Validation	0603036F	31	04.....	Volume 2 - 1
Armament/Ordnance Development	0604602F	79	05.....	Volume 2 - 571
Assessments and Evaluations Cyber Vulnerabilities	0606942F	146	07.....	Volume 3 - 341

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Automated Test Systems	0701212F	104	05.....	Volume 2 - 825
Autonomous Collaborative Platforms	0207179F	57	04.....	Volume 2 - 365
B-1B Squadrons	0101126F	149	07.....	Volume 3 - 425
B-2 Squadrons	0101127F	150	07.....	Volume 3 - 437
B-52 Squadrons	0101113F	147	07.....	Volume 3 - 347
Battlefield Abn Comm Node (BACN)	0207610F	196	07.....	Volume 3 - 945
Battlespace Knowledge Development and Demonstration	0603788F	30	03.....	Volume 1 - 341
C-130 Airlift Squadron	0401115F	256	07.....	Volume 3 - 1437
C-130J Program	0401132F	259	07.....	Volume 3 - 1467
C-17 Aircraft (IF)	0401130F	258	07.....	Volume 3 - 1459
C-32 Executive Transport Recapitalization	0401310F	68	04.....	Volume 2 - 455
C-5 Airlift Squadrons (IF)	0401119F	257	07.....	Volume 3 - 1451
C2 Air Operations Suite - C2 Info Services	0305015F	230	07.....	Volume 3 - 1203
CCMD Intelligence Information Technology	0305020F	231	07.....	Volume 3 - 1211
CV-22	0401318F	262	07.....	Volume 3 - 1503
CVV Integrated Prevention	0808737F	70	04.....	Volume 2 - 467
Citizen Broadband Radio System	0303667F	99	05.....	Volume 2 - 777
Civilian Compensation Program	0901218F	270	07.....	Volume 3 - 1577
Combat Air Intelligence System Activities	0207431F	185	07.....	Volume 3 - 837

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Combat Identification Technology	0603742F	33	04.....	Volume 2 - 23
Combat Rescue - Pararescue	0207227F	173	07.....	Volume 3 - 731
Combat Survivor Evader Locator	0305176F	101	05.....	Volume 2 - 789
Combat Survivor Evader Locator	1203176F	101	05.....	Volume 2 - 791
Combat Training Ranges	0604735F	84	05.....	Volume 2 - 635
Command, Control, Communication, and Computers (C4) - STRATCOM	0303255F	128	06.....	Volume 3 - 123
Commercial Economic Analysis	0304310F	227	07.....	Volume 3 - 1197
Common Data Link Executive Agent (CDL EA)	0305236F	64	04.....	Volume 2 - 419
Compass Call	0207253F	176	07.....	Volume 3 - 753
Contracting Information Technology System	0901410F	71	04.....	Volume 2 - 477
Control and Reporting Center (CRC)	0207412F	181	07.....	Volume 3 - 809
Conventional Munitions	0602602F	12	02.....	Volume 1 - 153
Conventional Weapons Technology	0603601F	27	03.....	Volume 1 - 315
Cyber Capabilities Support Office (CCSO)	0304369F	63	04.....	Volume 2 - 411
Cyber Operations Technology Support	0306250F	66	04.....	Volume 2 - 439
Cyber Resiliency of Weapon Systems-ACS	0604414F	50	04.....	Volume 2 - 227
Cyber Security Initiative	0305103F	234	07.....	Volume 3 - 1241
Cyber Security Intelligence Support	0301113F	211	07.....	Volume 3 - 1097
DCAPES	0207452F	189	07.....	Volume 3 - 879

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Defense Enterprise Accounting and Management System (DEAMS) - Software Pilot Pro	0608920F	280	08.....	Volume 4 - 23
Defense Enterprise Acntng and Mgt Sys (DEAMS)	0901554F	274	07.....	Volume 3 - 1617
Defense Joint Counterintelligence Activities	0305146F	241	07.....	Volume 3 - 1287
Defense Laboratories R&D Projects (10 U.S.C, Sec 2358)	0602212F	10	02.....	Volume 1 - 149
Defense Research Sciences	0601102F	1	01.....	Volume 1 - 1
Deployment & Distribution Enterprise R&D	0604776F	52	04.....	Volume 2 - 255
Deployment & Distribution Enterprise R&D	0604776F	139	07.....	Volume 3 - 197
Dept of the Air Force Tech Architecture	0604006F	40	04.....	Volume 2 - 119
Directed Energy Prototyping	0604032F	42	04.....	Volume 2 - 137
Directed Energy Technology	0602605F	13	02.....	Volume 1 - 163
Distributed Common Ground/Surface Systems	0305208F	247	07.....	Volume 3 - 1361
Distributed Cyber Warfare Operations	0208087F	201	07.....	Volume 3 - 997
Distributed Cyber Warfare Operations	0208087F	281	08.....	Volume 4 - 33
Distributed Training and Exercises	0207697F	197	07.....	Volume 3 - 953
Dominant Information Sciences and Methods	0602788F	14	02.....	Volume 1 - 173
Dragon U-2	0305202F	244	07.....	Volume 3 - 1303
E-4B National Airborne Operations Center (NAOC)	0302015F	219	07.....	Volume 3 - 1109
ENTEPRISE INFORMATION SERVICES (EIS)	0308602F	129	06.....	Volume 3 - 129
Electronic Combat Technology	0603270F	22	03.....	Volume 1 - 271

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Electronic Warfare Development	0604270F	76	05.....	Volume 2 - 535
Electronic Warfare Integrated Reprogramming (EWIR)	0207439F	187	07.....	Volume 3 - 857
Electronic Warfare Integrated Reprogramming (EWIR) - Software Pilot Program	0308608F	285	08.....	Volume 4 - 77
Enabled Cyber Activities	0306415F	67	04.....	Volume 2 - 449
F-15 EPAWSS	0207171F	94	05.....	Volume 2 - 741
F-15E Squadrons	0207134F	166	07.....	Volume 3 - 637
F-15EX	0207146F	170	07.....	Volume 3 - 707
F-16 Squadrons	0207133F	165	07.....	Volume 3 - 621
F-22A Squadrons	0207138F	168	07.....	Volume 3 - 659
F-35 - EMD	0604800F	85	05.....	Volume 2 - 649
F-35 C2D2	0604840F	140	07.....	Volume 3 - 203
F-35 Squadrons	0207142F	169	07.....	Volume 3 - 681
Facilities Restoration and Modernization - Test and Evaluation Support	0605976F	123	06.....	Volume 3 - 99
Facilities Sustainment - Test and Evaluation Support	0605978F	124	06.....	Volume 3 - 103
Financial Management Information Systems Development	0901538F	273	07.....	Volume 3 - 1601
Financing for Cancelled Account Adjustments	0909999F	133	06.....	Volume 3 - 145
Foreign Materiel Acquisition and Exploitation	0605117F	143	07.....	Volume 3 - 309
Full Combat Mission Training	0207701F	97	05.....	Volume 2 - 765
Future AF Capabilities Applied Research	0602020F	4	02.....	Volume 1 - 27

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Future AF Integrated Technology Demos	0603032F	16	03.....	Volume 1 - 195
Future Advanced Weapon Analysis & Programs	0604200F	73	05.....	Volume 2 - 493
General Skill Training	0804731F	131	06.....	Volume 3 - 141
GeoBase	0301025F	209	07.....	Volume 3 - 1077
Global Air Traffic Management (GATM)	0305099F	233	07.....	Volume 3 - 1231
Global Force Management - Data Initiative	0303142F	222	07.....	Volume 3 - 1151
Ground Based Strategic Deterrent	0605230F	55	04.....	Volume 2 - 343
Ground Based Strategic Deterrent EMD	0605238F	92	05.....	Volume 2 - 715
HC/MC-130 Recap RDT&E	0605278F	144	07.....	Volume 3 - 317
HH-60W	0605229F	91	05.....	Volume 2 - 705
Hard and Deeply Buried Target Defeat System (HDBTDS) Program	0604327F	49	04.....	Volume 2 - 219
High Energy Laser Research	0602890F	15	02.....	Volume 1 - 191
High Energy Laser Research Initiatives	0601108F	3	01.....	Volume 1 - 23
Human Effectiveness Advanced Technology Development	0603456F	26	03.....	Volume 1 - 299
Human Effectiveness Applied Research	0602202F	7	02.....	Volume 1 - 77
Hypersonics Prototyping	0604033F	43	04.....	Volume 2 - 145
Hypersonics Prototyping - Hypersonic Attack Cruise Missile (HACM)	0604183F	44	04.....	Volume 2 - 161
ICBM Fuze Modernization	0604933F	87	05.....	Volume 2 - 669
ICBM Reentry Vehicles	0101328F	154	07.....	Volume 3 - 505

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
ISR Modernization & Automation Dvmt (IMAD)	0305022F	232	07.....	Volume 3 - 1219
Information Systems Security Program	0303140F	221	07.....	Volume 3 - 1139
Initial Operational Test & Evaluation	0605712F	112	06.....	Volume 3 - 27
Integrated Broadcast Service (IBS)	0305179F	243	07.....	Volume 3 - 1293
Integrated Strategic Planning & Analysis Network	0101324F	153	07.....	Volume 3 - 497
Intel Data Applications	0208288F	208	07.....	Volume 3 - 1071
Intelligence Advanced Development	0603260F	32	04.....	Volume 2 - 9
Intelligence Mission Data (IMD)	0307577F	255	07.....	Volume 3 - 1431
Intercontinental Ballistic Missile - Dem/Val	0603851F	35	04.....	Volume 2 - 57
International Activities	1001004F	134	06.....	Volume 3 - 147
International Intelligence Technology and Architectures	0305600F	252	07.....	Volume 3 - 1409
Isolated Personnel Survivability and Recovery	0207279F	95	05.....	Volume 2 - 749
Joint Air-to-Surface Standoff Missile (JASSM)	0207325F	178	07.....	Volume 3 - 779
Joint Counter RCIED Electronic Warfare	0205671F	162	07.....	Volume 3 - 595
Joint Cyber Command and Control (JCC2)	0208097F	203	07.....	Volume 3 - 1055
Joint Direct Attack Munition	0604618F	82	05.....	Volume 2 - 619
Joint Military Deception Initiative	0303260F	224	07.....	Volume 3 - 1167
Joint Personnel Recovery Agency	0901202F	269	07.....	Volume 3 - 1569
Joint Tactical Network (JTN)	0605031F	88	05.....	Volume 2 - 687

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Joint Tactical Network Center (JTNC)	0605030F	88	05.....	Volume 2 - 679
Joint Transportation Management System (JTMS)	0604668F	51	04.....	Volume 2 - 249
KC-135s	0401218F	261	07.....	Volume 3 - 1493
KC-46A Tanker Squadrons	0401221F	102	05.....	Volume 2 - 793
Large Aircraft IR Countermeasures (LAIRCM)	0401134F	260	07.....	Volume 3 - 1485
Life Support Systems	0604706F	83	05.....	Volume 2 - 625
Logistics Information Technology (LOGIT)	0708610F	265	07.....	Volume 3 - 1533
Long Range Standoff Weapon	0604932F	86	05.....	Volume 2 - 659
Long Range Strike - Bomber	0604015F	41	04.....	Volume 2 - 131
MQ-9 UAV	0205219F	161	07.....	Volume 3 - 565
Maintenance, Repair & Overhaul System	0708055F	264	07.....	Volume 3 - 1523
Major T&E Investment	0604759F	109	06.....	Volume 3 - 11
Management HQ - R&D	0605898F	122	06.....	Volume 3 - 93
Management HQ - T&E	0606398F	126	06.....	Volume 3 - 117
Manned Destructive Suppression	0207136F	167	07.....	Volume 3 - 651
Manned Reconnaissance Systems	0305207F	246	07.....	Volume 3 - 1353
Manufacturing Technology Program	0603680F	29	03.....	Volume 1 - 331
Materials	0602102F	5	02.....	Volume 1 - 31
Maui Space Surveillance System (MSSS)	0603444F	25	03.....	Volume 1 - 297

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Minimum Essential Emergency Communications Network (MEECN)	0303131F	220	07.....	Volume 3 - 1119
Minuteman Squadrons	0101213F	151	07.....	Volume 3 - 457
Mission Partner Environments	0305601F	65	04.....	Volume 2 - 433
Mission Planning Systems	0208006F	198	07.....	Volume 3 - 963
Multi-Platform Electronic Warfare Equipment	0207040F	163	07.....	Volume 3 - 601
NATO AGS	0305238F	250	07.....	Volume 3 - 1389
NATO Research and Development	0603790F	34	04.....	Volume 2 - 49
NC3 Advanced Concepts	0604001F	36	04.....	Volume 2 - 83
NC3 Integration	0606018F	145	07.....	Volume 3 - 333
National Technical Nuclear Forensics	0207573F	192	07.....	Volume 3 - 903
Network-Centric Collaborative Targeting	0305221F	249	07.....	Volume 3 - 1383
Next Generation Air Dominance	0207110F	56	04.....	Volume 2 - 357
Next Generation OPIR	1206442F	107	05.....	Volume 2 - 849
North Warning System (NWS)	0102412F	158	07.....	Volume 3 - 541
Nuclear Planning and Execution System (NPES)	0301112F	210	07.....	Volume 3 - 1083
Nuclear Weapons Modernization	0101125F	93	05.....	Volume 2 - 733
Nuclear Weapons Support	0604222F	75	05.....	Volume 2 - 513
OPERATIONAL HQ - CYBER	0208064F	200	07.....	Volume 3 - 991
Open Architecture Management	0605056F	89	05.....	Volume 2 - 689

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Operational Energy and Installation Resilience	0604860F	54	04.....	Volume 2 - 333
Other Flight Training	0804743F	267	07.....	Volume 3 - 1555
Other Personnel Activities	0808716F	268	07.....	Volume 3 - 1563
Over-the-Horizon Backscatter Radar	0102417F	159	07.....	Volume 3 - 547
PNT Resiliency, Mods, and Improvements	0604201F	45	04.....	Volume 2 - 169
PNT Resiliency, Mods, and Improvements	0604201F	74	05.....	Volume 2 - 503
Personnel Administration	0901220F	271	07.....	Volume 3 - 1583
Personnel Recovery Command & Ctrl (PRC2)	0305984F	254	07.....	Volume 3 - 1423
Physical Security Equipment	0604287F	78	05.....	Volume 2 - 563
Precision Attack Systems Procurement	0207249F	175	07.....	Volume 3 - 747
RAND Project Air Force	0605101F	110	06.....	Volume 3 - 19
RQ-4 UAV	0305220F	248	07.....	Volume 3 - 1373
Rapid Cyber Acquisition	0305881F	253	07.....	Volume 3 - 1415
Rapid Sustainment Modernization (RSM)	0708051F	69	04.....	Volume 2 - 461
Region/Sector Operation Control Center Modernization Program	0102326F	157	07.....	Volume 3 - 533
Requirements Analysis and Maturation	0606017F	125	06.....	Volume 3 - 107
Science & Technology for Nuclear Re-entry Systems	0603273F	23	03.....	Volume 1 - 289
Science and Technology Management - Major Headquarters Activities	0602298F	11	02.....	Volume 1 - 151
Security and Investigative Activities	0305128F	240	07.....	Volume 3 - 1281

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Seek Eagle	0207590F	193	07.....	Volume 3 - 909
Service Support to SPACECOM Activities	1202140F	276	07.....	Volume 3 - 1649
Service Support to STRATCOM - Space Activities	1201921F	275	07.....	Volume 3 - 1637
Small Business Innovation Research	0605502F	111	06.....	Volume 3 - 23
Small Diameter Bomb (SDB)	0207327F	179	07.....	Volume 3 - 789
Space Test Program (STP)	1206864F	135	06.....	Volume 3 - 153
Special Tactics / Combat Control	0408011F	263	07.....	Volume 3 - 1513
Specialized Undergraduate Flight Training	0604233F	136	07.....	Volume 3 - 157
Stand In Attack Weapon	0207328F	96	05.....	Volume 2 - 755
Strategic Mission Planning and Execution System - Software Pilot Program	0608158F	278	08.....	Volume 4 - 1
Submunitions	0604604F	80	05.....	Volume 2 - 593
Support Systems Development	0708611F	266	07.....	Volume 3 - 1549
Support to DCGS Enterprise	0305240F	251	07.....	Volume 3 - 1397
Support to Information Operations (IO) Capabilities	0303166F	127	06.....	Volume 3 - 119
Survivable Airborne Operations Center	0604288F	47	04.....	Volume 2 - 191
Sustainment Science and Technology (S&T)	0603199F	18	03.....	Volume 1 - 219
Tactical AIM Missiles	0207161F	171	07.....	Volume 3 - 713
Tactical Air Control Party-Mod	0207444F	188	07.....	Volume 3 - 865
Tactical Data Networks Enterprise	0604281F	77	05.....	Volume 2 - 543

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Tactical Deception	0208007F	199	07.....	Volume 3 - 985
Tech Transition Program	0604858F	53	04.....	Volume 2 - 289
Technology Transfer	0604317F	48	04.....	Volume 2 - 199
Test and Evaluation Support	0605807F	113	06.....	Volume 3 - 33
Theater Battle Management (TBM) C4I	0207438F	186	07.....	Volume 3 - 851
Threat Simulator Development	0604256F	108	06.....	Volume 3 - 1
Three Dimensional Long-Range Radar (3DELRR)	0207455F	59	04.....	Volume 2 - 371
Training Developments	0804772F	105	05.....	Volume 2 - 833
Training Developments	0804772F	132	06.....	Volume 3 - 143
U.S. Space Command Research and Development Support	1206415F	72	04.....	Volume 2 - 487
UH-1N Replacement Program	0102110F	156	07.....	Volume 3 - 517
USAF Modeling and Simulation	0207601F	194	07.....	Volume 3 - 919
Unified Platform (UP)	0208099F	62	04.....	Volume 2 - 397
Unified Platform (UP)	0208099F	204	07.....	Volume 3 - 1063
University Research Initiatives	0601103F	2	01.....	Volume 1 - 17
VC-25B	0401319F	103	05.....	Volume 2 - 817
Vehicles and Support Equipment - General	0202834F	160	07.....	Volume 3 - 557
War Reserve Materiel - Ammunition	0208030F	61	04.....	Volume 2 - 389
Wargaming and Simulation Centers	0207605F	195	07.....	Volume 3 - 935

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Weather Service	0305111F	235	07.....	Volume 3 - 1247
Wide Area Surveillance	0604445F	137	07.....	Volume 3 - 181
Worldwide Joint Strategic Communications	0101316F	152	07.....	Volume 3 - 487

UNCLASSIFIED

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Table of Contents (by Budget Activity then Line Item Number)

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
1	01	0601102F	Defense Research Sciences.....	Volume 1 - 1
2	01	0601103F	University Research Initiatives.....	Volume 1 - 17
3	01	0601108F	High Energy Laser Research Initiatives.....	Volume 1 - 23

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
4	02	0602020F	Future AF Capabilities Applied Research.....	Volume 1 - 27
5	02	0602102F	Materials.....	Volume 1 - 31
6	02	0602201F	Aerospace Vehicle Technologies.....	Volume 1 - 49
7	02	0602202F	Human Effectiveness Applied Research.....	Volume 1 - 77
8	02	0602203F	Aerospace Propulsion.....	Volume 1 - 95
9	02	0602204F	Aerospace Sensors.....	Volume 1 - 123
10	02	0602212F	Defense Laboratories R&D Projects (10 U.S.C, Sec 2358).....	Volume 1 - 149

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
11	02	0602298F	Science and Technology Management - Major Headquarters Activities.....	Volume 1 - 151
12	02	0602602F	Conventional Munitions.....	Volume 1 - 153
13	02	0602605F	Directed Energy Technology.....	Volume 1 - 163
14	02	0602788F	Dominant Information Sciences and Methods.....	Volume 1 - 173
15	02	0602890F	High Energy Laser Research.....	Volume 1 - 191

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
16	03	0603032F	Future AF Integrated Technology Demos.....	Volume 1 - 195
17	03	0603112F	Advanced Materials for Weapon Systems.....	Volume 1 - 203
18	03	0603199F	Sustainment Science and Technology (S&T).....	Volume 1 - 219
19	03	0603203F	Advanced Aerospace Sensors.....	Volume 1 - 225
20	03	0603211F	Aerospace Technology Dev/Demo.....	Volume 1 - 235
21	03	0603216F	Aerospace Propulsion and Power Technology.....	Volume 1 - 247
22	03	0603270F	Electronic Combat Technology.....	Volume 1 - 271
23	03	0603273F	Science & Technology for Nuclear Re-entry Systems.....	Volume 1 - 289

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line #	Budget Activity	Program Element Number	Program Element Title	Page
24	03	0603401F	Advanced Spacecraft Technology.....	Volume 1 - 291
25	03	0603444F	Maui Space Surveillance System (MSSS).....	Volume 1 - 297
26	03	0603456F	Human Effectiveness Advanced Technology Development.....	Volume 1 - 299
27	03	0603601F	Conventional Weapons Technology.....	Volume 1 - 315
28	03	0603605F	Advanced Weapons Technology.....	Volume 1 - 325
29	03	0603680F	Manufacturing Technology Program.....	Volume 1 - 331
30	03	0603788F	Battlespace Knowledge Development and Demonstration.....	Volume 1 - 341

UNCLASSIFIED

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Table of Contents (Alphabetically by Program Element Title)

Program Element Title	Program Element Number	Line #	BA	Page
Advanced Aerospace Sensors	0603203F	19	03.....	Volume 1 - 225
Advanced Materials for Weapon Systems	0603112F	17	03.....	Volume 1 - 203
Advanced Spacecraft Technology	0603401F	24	03.....	Volume 1 - 291
Advanced Weapons Technology	0603605F	28	03.....	Volume 1 - 325
Aerospace Propulsion	0602203F	8	02.....	Volume 1 - 95
Aerospace Propulsion and Power Technology	0603216F	21	03.....	Volume 1 - 247
Aerospace Sensors	0602204F	9	02.....	Volume 1 - 123
Aerospace Technology Dev/Demo	0603211F	20	03.....	Volume 1 - 235
Aerospace Vehicle Technologies	0602201F	6	02.....	Volume 1 - 49
Battlespace Knowledge Development and Demonstration	0603788F	30	03.....	Volume 1 - 341
Conventional Munitions	0602602F	12	02.....	Volume 1 - 153
Conventional Weapons Technology	0603601F	27	03.....	Volume 1 - 315
Defense Laboratories R&D Projects (10 U.S.C, Sec 2358)	0602212F	10	02.....	Volume 1 - 149
Defense Research Sciences	0601102F	1	01.....	Volume 1 - 1
Directed Energy Technology	0602605F	13	02.....	Volume 1 - 163
Dominant Information Sciences and Methods	0602788F	14	02.....	Volume 1 - 173
Electronic Combat Technology	0603270F	22	03.....	Volume 1 - 271

UNCLASSIFIED

UNCLASSIFIED

Air Force • Budget Estimates FY 2023 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Future AF Capabilities Applied Research	0602020F	4	02.....	Volume 1 - 27
Future AF Integrated Technology Demos	0603032F	16	03.....	Volume 1 - 195
High Energy Laser Research	0602890F	15	02.....	Volume 1 - 191
High Energy Laser Research Initiatives	0601108F	3	01.....	Volume 1 - 23
Human Effectiveness Advanced Technology Development	0603456F	26	03.....	Volume 1 - 299
Human Effectiveness Applied Research	0602202F	7	02.....	Volume 1 - 77
Manufacturing Technology Program	0603680F	29	03.....	Volume 1 - 331
Materials	0602102F	5	02.....	Volume 1 - 31
Maui Space Surveillance System (MSSS)	0603444F	25	03.....	Volume 1 - 297
Science & Technology for Nuclear Re-entry Systems	0603273F	23	03.....	Volume 1 - 289
Science and Technology Management - Major Headquarters Activities	0602298F	11	02.....	Volume 1 - 151
Sustainment Science and Technology (S&T)	0603199F	18	03.....	Volume 1 - 219
University Research Initiatives	0601103F	2	01.....	Volume 1 - 17

UNCLASSIFIED

Department of the Air Force
TOTAL CIVILIAN PERSONNEL COSTS
FY 2023 Enactment President's Budget
(FY 2021)

	a Begin Strength	b End Strength	c FTES	d Basic Comp	e Overtime Pay	f Holiday Pay	g Other O.C.11	h Total Variables
Direct Funded Personnel (includes OC 13)	19,660	17,831	19,354	2,800,044			4,174	4,174
D1. US Direct Hire (USDH)								
D1a. Senior Executive Schedule	19,658	17,829	19,352	2,799,720			4,174	4,174
D1b. General Schedule	13	13	13	2,005			45	45
D1c. Special Schedule	16,310	14,787	16,049	2,580,411			4,129	4,129
D1d. Wage System								
D1e. Highly Qualified Experts	3,335	3,029	3,290	217,304				
D1f. Other								
D2. Direct Hire Program Foreign Nationals (DHFN)								
D3. Total Direct Hire	19,658	17,829	19,352	2,799,720			4,174	4,174
D4. Indirect Hire Foreign Nationals (IHFN)	2	2	2	324				
Subtotal - Direct Funded (excludes OC 13)	19,660	17,831	19,354	2,800,044			4,174	4,174
D5. Other Object Class 13 Benefits								
D5a. USDH - Benefits for Former Employees								
D5b. DHFN - Benefits for Former Employees								
D5c. Voluntary Separation Incentive Pay (VSIP)								
D5d. Foreign National Separation Liability Accrual								
Reimbursable Funded Personnel (includes OC 13)	4,026	4,141	2,449	351,805				
R1. US Direct Hire (USDH)								
R1a. Senior Executive Schedule	4,026	4,141	2,449	351,805				
R1b. General Schedule								
R1c. Special Schedule	4,026	4,141	2,449	351,805				
R1d. Wage System								
R1e. Highly Qualified Experts								
R1f. Other								
R2. Direct Hire Program Foreign Nationals (DHFN)								
R3. Total Direct Hire	4,026	4,141	2,449	351,805				
R4. Indirect Hire Foreign Nationals (IHFN)								
Subtotal - Reimbursable Funded (excludes OC 13)	4,026	4,141	2,449	351,805				
R5. Other Object Class 13 Benefits								
R5a. USDH - Benefits for Former Employees								
R5b. DHFN - Benefits for Former Employees								
R5c. Voluntary Separation Incentive Pay (VSIP)								
R5d. Foreign National Separation Liability Accrual								

Department of the Air Force
TOTAL CIVILIAN PERSONNEL COSTS
FY 2023 Enactment President's Budget
(FY 2021)

	a	b	c	d	e	f	g	h
	Begin Strength	End Strength	FTEs	Basic Comp	Overtime Pay	Holiday Pay	Other O.C.11	Total Variables
Total Funded Personnel (includes OC 13)	23,686	21,972	21,803	3,151,849			4,174	4,174
T1. US Direct Hire (USDH)								
T1a. Senior Executive Schedule	23,684	21,970	21,801	3,151,525			4,174	4,174
T1b. General Schedule	13	13	13	2,005			45	45
T1c. Special Schedule	20,336	18,928	18,498	2,932,216			4,129	4,129
T1d. Wage System								
T1e. Highly Qualified Experts	3,335	3,029	3,290	217,304				
T1f. Other								
T2. Direct Hire Program Foreign Nationals (DHFN)								
T3. Total Direct Hire	23,684	21,970	21,801	3,151,525			4,174	4,174
T4. Indirect Hire Foreign Nationals (IHFN)	2	2	2	324				
Subtotal - Total Funded (excludes OC 13)	23,686	21,972	21,803	3,151,849			4,174	4,174
T5. Other Object Class 13 Benefits								
T5a. USDH - Benefits for Former Employees								
T5b. DHFN - Benefits for Former Employees								
T5c. Voluntary Separation Incentive Pay (VSIP)								
T5d. Foreign National Separation Liability Accrual								

Department of the Air Force
TOTAL CIVILIAN PERSONNEL COSTS
FY 2023 Enactment President's Budget
(FY 2022)

	a Begin Strength	b End Strength	c FTEs	d Basic Comp	e Overtime Pay	f Holiday Pay	g Other O.C.11	h Total Variables
Direct Funded Personnel (includes OC 13)	17,831	18,218	18,325	1,930,128	6,499	1,915	53,152	61,566
D1. US Direct Hire (USDH)								
D1a. Senior Executive Schedule	17,829	18,216	18,323	1,929,916	6,499	1,915	53,152	61,566
D1b. General Schedule	13	13	13	2,005			45	45
D1c. Special Schedule	14,787	15,110	15,172	1,701,929	1,988	1,216	39,891	43,095
D1d. Wage System								
D1e. Highly Qualified Experts	3,029	3,093	3,138	225,882	4,511	699	13,216	18,426
D1f. Other								
D2. Direct Hire Program Foreign Nationals (DHFN)								
D3. Total Direct Hire	17,829	18,216	18,323	1,929,816	6,499	1,915	53,152	61,566
D4. Indirect Hire Foreign Nationals (IHFN)	2	2	2	312				
Subtotal - Direct Funded (excludes OC 13)	17,831	18,218	18,325	1,930,128	6,499	1,915	53,152	61,566
D5. Other Object Class 13 Benefits								
D5a. USDH - Benefits for Former Employees								
D5b. DHFN - Benefits for Former Employees								
D5c. Voluntary Separation Incentive Pay (VSIP)								
D5d. Foreign National Separation Liability Accrual								
Reimbursable Funded Personnel (includes OC 13)	4,141	4,153	4,096	352,124	406	248	8,152	8,806
R1. US Direct Hire (USDH)								
R1a. Senior Executive Schedule	4,141	4,153	4,096	352,124	406	248	8,152	8,806
R1b. General Schedule								
R1c. Special Schedule	4,141	4,153	4,096	352,124	406	248	8,152	8,806
R1d. Wage System								
R1e. Highly Qualified Experts								
R1f. Other								
R2. Direct Hire Program Foreign Nationals (DHFN)								
R3. Total Direct Hire	4,141	4,153	4,096	352,124	406	248	8,152	8,806
R4. Indirect Hire Foreign Nationals (IHFN)								
Subtotal - Reimbursable Funded (excludes OC 13)	4,141	4,153	4,096	352,124	406	248	8,152	8,806
R5. Other Object Class 13 Benefits								
R5a. USDH - Benefits for Former Employees								
R5b. DHFN - Benefits for Former Employees								
R5c. Voluntary Separation Incentive Pay (VSIP)								
R5d. Foreign National Separation Liability Accrual								

Department of the Air Force
 TOTAL CIVILIAN PERSONNEL COSTS
 FY 2023 Enactment President's Budget
 (FY 2022)

	a Begin Strength	b End Strength	c FTEs	d Basic Comp	e Overtime Pay	f Holiday Pay	g Other O.C.11	h Total Variables
Total Funded Personnel (includes OC 13)	21,972	22,371	22,421	2,282,252	6,905	2,163	61,304	70,372
T1. US Direct Hire (USDH)								
T1a. Senior Executive Schedule	21,970	22,369	22,419	2,281,940	6,905	2,163	61,304	70,372
T1b. General Schedule	13	13	13	2,005			45	45
T1c. Special Schedule	18,928	19,263	19,268	2,054,053	2,394	1,464	48,043	51,901
T1d. Wage System								
T1e. Highly Qualified Experts	3,029	3,093	3,138	225,882	4,511	699	13,216	18,426
T1f. Other								
T2. Direct Hire Program Foreign Nationals (DHFN)								
T3. Total Direct Hire	21,970	22,369	22,419	2,281,940	6,905	2,163	61,304	70,372
T4. Indirect Hire Foreign Nationals (IHFN)	2	2	2	312				
Subtotal - Total Funded (excludes OC 13)	21,972	22,371	22,421	2,282,252	6,905	2,163	61,304	70,372
T5. Other Object Class 13 Benefits								
T5a. USDH - Benefits for Former Employees								
T5b. DHFN - Benefits for Former Employees								
T5c. Voluntary Separation Incentive Pay (VSIP)								
T5d. Foreign National Separation Liability Accrual								

Department of the Air Force
TOTAL CIVILIAN PERSONNEL COSTS
FY 2023 Enactment President's Budget
(FY 2023)

	a Begin Strength	b End Strength	c FTEs	d Basic Comp	e Overtime Pay	f Holiday Pay	g Other O.C.11	h Total Variables
Direct Funded Personnel (includes OC 13)	18,218	19,087	18,944	2,572,425	6,505	1,916	53,186	61,607
D1. US Direct Hire (USDH)								
D1a. Senior Executive Schedule	18,216	19,085	18,942	2,572,107	6,505	1,916	53,186	61,607
D1b. General Schedule	13	13	13	2,005			45	45
D1c. Special Schedule	15,110	15,816	15,673	2,344,011	1,989	1,217	39,925	43,131
D1d. Wage System								
D1e. Highly Qualified Experts	3,093	3,256	3,256	226,091	4,516	699	13,216	18,431
D1f. Other								
D2. Direct Hire Program Foreign Nationals (DHFN)								
D3. Total Direct Hire	18,216	19,085	18,942	2,572,107	6,505	1,916	53,186	61,607
D4. Indirect Hire Foreign Nationals (IHFN)	2	2	2	318				
Subtotal - Direct Funded (excludes OC 13)	18,218	19,087	18,944	2,572,425	6,505	1,916	53,186	61,607
D5. Other Object Class 13 Benefits								
D5a. USDH - Benefits for Former Employees								
D5b. DHFN - Benefits for Former Employees								
D5c. Voluntary Separation Incentive Pay (VSIP)								
D5d. Foreign National Separation Liability Accrual								
Reimbursable Funded Personnel (includes OC 13)	4,153	4,091	4,091	532,000	475	290	9,532	10,297
R1. US Direct Hire (USDH)								
R1a. Senior Executive Schedule	4,153	4,091	4,091	532,000	475	290	9,532	10,297
R1b. General Schedule								
R1c. Special Schedule	4,153	4,091	4,091	532,000	475	290	9,532	10,297
R1d. Wage System								
R1e. Highly Qualified Experts								
R1f. Other								
R2. Direct Hire Program Foreign Nationals (DHFN)								
R3. Total Direct Hire	4,153	4,091	4,091	532,000	475	290	9,532	10,297
R4. Indirect Hire Foreign Nationals (IHFN)								
Subtotal - Reimbursable Funded (excludes OC 13)	4,153	4,091	4,091	532,000	475	290	9,532	10,297
R5. Other Object Class 13 Benefits								
R5a. USDH - Benefits for Former Employees								
R5b. DHFN - Benefits for Former Employees								
R5c. Voluntary Separation Incentive Pay (VSIP)								
R5d. Foreign National Separation Liability Accrual								

Department of the Air Force
 TOTAL CIVILIAN PERSONNEL COSTS
 FY 2023 Enactment President's Budget
 (FY 2023)

	a	b	c	d	e	f	g	h
	Begin Strength	End Strength	FTEs	Basic Comp	Overtime Pay	Holiday Pay	Other O.C.11	Total Variables
Total Funded Personnel (includes OC 13)	22,371	23,178	23,035	3,104,425	6,980	2,206	62,718	71,904
T1. US Direct Hire (USDH)								
T1a. Senior Executive Schedule	22,369	23,176	23,033	3,104,107	6,980	2,206	62,718	71,904
T1b. General Schedule	13	13	13	2,005			45	45
T1c. Special Schedule	19,263	19,907	19,764	2,876,011	2,464	1,507	49,457	53,428
T1d. Wage System								
T1e. Highly Qualified Experts	3,093	3,256	3,256	226,091	4,516	699	13,216	18,431
T1f. Other								
T2. Direct Hire Program Foreign Nationals (DHFN)								
T3. Total Direct Hire	22,369	23,176	23,033	3,104,107	6,980	2,206	62,718	71,904
T4. Indirect Hire Foreign Nationals (IHFN)	2	2	2	318				
Subtotal - Total Funded (excludes OC 13)	22,371	23,178	23,035	3,104,425	6,980	2,206	62,718	71,904
T5. Other Object Class 13 Benefits								
T5a. USDH - Benefits for Former Employees								
T5b. DHFN - Benefits for Former Employees								
T5c. Voluntary Separation Incentive Pay (VSIP)								
T5d. Foreign National Separation Liability Accrual								

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

ACRONYMS

GENERAL ACRONYMS

A&AS	- Advisory & Assistance Services
ABIDES	- Automated Budget Interactive Data Environment System
ACAT	- Acquisition Category
ACTD	- Advanced Concept Technology Demonstration
AGM	- Air-to-Ground Missile
AIM	- Air Intercept Missile
AIS	- Avionics Intermediate Shop
ACMI	- Aircraft Combat Maneuvering Instrumentation
AMRAAM	- Advanced Medium-Range Air-to-Air Missile
APPN	- Appropriation
ATD	- Advanced Technology Development
BA	- Budget Activity
BES	- Budget Estimate Submission
BY	- Budget Year
C3	- Command, Control, and Communication System
CFE	- Contractor Furnished Equipment
CONOPS	- Concept of Operation
CONUS	- Continental United States
CPMS	- Comprehensive Power Management System
CPT	- Cockpit Procedures Trainer
CRA	- Continuing Resolution Authority
CTS	- Countermeasures Test Set
CY	- Current Year
ECCM	- Electronic Counter Counter-Measures
ECM	- Electronic Counter Measures
ECO	- Engineering Change Orders
EOQ	- Economic Order Quantity
ECP	- Engineering Change Proposal
EPA	- Economic Price Adjustment
EW	- Electronic Warfare
EWAISP	- Electronic Warfare Avionics Integration Support Facility
FLIR	- Forward Looking Infra Red

UNCLASSIFIED

UNCLASSIFIED

FOT&E	- Follow-on Test and Evaluation
FOC	- Fully Operational Capability
FLTS	- Flight Line Test Set
FPIF	- Fixed Price Incentive Firm
FPIS	- Fixed Price Incentive Fee, Successive Targets
FY	- Fiscal Year
GANS	- Global Access Navigation & Safety
GATM	- Global Air Traffic Management
GFE	- Government Furnished Equipment
GFP	- Government Furnished Property
GPS	- Global Positioning System
GSE	- Ground Support Equipment
ICS	- Interim Contractor Support
IOC	- Initial Operating Capability
IT	- Information Technology
JUON	- Joint Urgent Operational Need
MAIS	- Major Automated Information System Program
MDAP	- Major Defense Acquisition Program
METS	- Mobile Electronic Test Stations
MYP	- Multiyear Procurement
NAVWAR	- Navigation Warfare
NMC Rate	- Not Mission Capable Rate
OCO	- Overseas Contingency Operations
OT&E	- Operational Test and Evaluation
OWRM	- Other War Reserve Material
PAGEL	- Priced Aerospace Ground Equipment List
PB	- President's Budget
PBR	- Program Budget Review
PMA	- Program Management Administration
PMC	- Procurement Method Code
PNO	- Acquisition Program Number (MDAP Codes)
PR	- Purchase Request
PRCP	- Program Resource Collection Process
PTT	- Part Task Trainer
PY	- Prior Year
R&M	- Reliability and Maintainability

UNCLASSIFIED

UNCLASSIFIED

RAA	- Rapid Acquisition Authority
RDT&E	- Research, Development, Test and Evaluation
RWR	- Radar Warning Receiver
ROM	- Rough Order of Magnitude
SS	- Sole Source
SOF	- Special Operation Force
TAF	- Tactical Air Force
TCAS	- Traffic Collision Alert and Avoidance System
TEWS	- Tactical Electronic Warfare System
TISS	- TEWS Intermediate Support System
TOA	- Total Obligation Authority
WCF	- Working Capital Fund
WRM	- War Reserve Material
WST	- Weapon System Trainer
UAV	- Unmanned Aerial Vehicle
XML	- Extensible Markup Language

BASE / ORGANIZATIONAL ACRONYMS

ACC	- Air Combat Command
AETC	- Air Education & Training Command
AFCAO	- Air Force Computer Acquisition Office
AFCESA	- Air Force Civil Engineering Support Agency
AFCIC	- AF Communications & Information Center
AFCSC	- Air Force Cryptologic Service Center
AFESC	- Air Force Engineering Services Center
AFGWC	- Air Force Global Weather Central
AFIT	- Air Force Institute of Technology
AFLCMC	- Air Force Life Cycle Management Center
AFMC	- Air Force Materiel Command
AFMETCAL	- Air Force Metrology and Calibration Office
AFMLO	- Air Force Medical Logistics Office
AFOSI	- Air Force Office of Special Investigation
AFOTEC	- Air Force Operational Test & Evaluation Center
AFPC	- Air Force Personnel Center
AFPSL	- AF Primary Standards Lab

UNCLASSIFIED

UNCLASSIFIED

AFR	- Air Force Reserve
AFSOC	- AF Special Operations Command
AFSPC	- Air Force Space Command
AIA	- Air Intelligence Agency
ALC	- Air Logistics Center
AMC	- Air Mobility Command
ANG	- Air National Guard
ASC	- Aeronautical Systems Center
AETC	- Air Education Training Command
AU	- Air University
AWS	- Air Weather Service
CIA	- Central Intelligence Agency
DGSC	- Defense General Support Center
DLA	- Defense Logistics Center
DOE	- Department of Energy
DPSC	- Defense Personnel Support Center
DSCC	- Defense Supply Center, Columbus
DTIC	- Defense Technical Information Center
ER	- Eastern Range
ESC	- Electronic Systems Center
FAA	- Federal Aviation Agency
FBI	- Federal Bureau of Investigation
GSA	- General Services Administration
JCS	- Joint Chiefs of Staff
NATO	- North Atlantic Treaty Organization
OSD	- Office of the Secretary of Defense
PACAF	- Pacific Air Forces
USAF	- United States Air Force
USAFA	- United States Air Force Academy
USAFE	- United States Air Force Europe
USCENTCOM	- United States Central Command
USEUCOM	- United States European Command
USMC	- United States Marine Corps
USSTRATCOM	- United States Strategic Command
WP AFB	- Wright-Patterson AFB, OH

UNCLASSIFIED

UNCLASSIFIED

CONTRACT METHOD / TYPE ACRONYMS

C	- Competitive
BA	- Basic Agreement
BOA	- Basic Ordering Agreement
BPA	- Blanket Purchasing Agreement
CS	- Cost Sharing
IDDQ	- Indefinite Delivery, Definite Quantity
IDIQ	- Indefinite Delivery, Indefinite Quantity
IDRT	- Indefinite Delivery, Requirements
Letter	- Letter
LH	- Labor-hour
MIPR	- Military Interdepartmental Purchase Request
MIPR-C	- Military Interdepartmental Purchase Request - Competitive
MIPR-OPT	- Military Interdepartmental Purchase Request - Option
MIPR-OTH	- Military Interdepartmental Purchase Request - Other
MIPR-SS	- Military Interdepartmental Purchase Request - Sole Source
OPT	- Option
OTH	- Other
PO	- Project Order
REQN	- Requisition
SS	- Sole Source
T&M	- Time and Materials
UCA	- Undefined Contract Action
WP	- Work Project

CONTRACTED BY ACRONYMS

11 WING	- 11th Support Wing, Washington, DC
ACC	- Air Combat Command, Langley AFB, VA
AEDC	- Arnold Engineering Development Center, Arnold AFB, TN
AAC	- Air Armament Center, Eglin AFB, FL
AEDC	- Arnold Engineering Development Center, Arnold AFB, TN
AETC	- Air Education and Training Command, Randolph AFB, TX
AFCIC	- Air Force Communications and Information Center, Washington, DC
AFCESA	- Air Force Civil Engineering Support Agency, Tyndall AFB, FL
AFFTC	- Air Force Flight Test Center, Edwards AFB, CA

UNCLASSIFIED

UNCLASSIFIED

AFLCMC	- Air Force Life Cycle Management Center, Wright-Patterson AFB, OH
AFMC	- Air Force Materiel Command, Wright-Patterson AFB, OH
AFMETCAL	- Air Force Metrology and Calibration Office, Heath, Ohio
AFMLO	- Air Force Medical Logistics Office, Ft Detrick, MD
AIA	- Air Intelligence Agency, Kelly AFB, TX
AMC	- Air Mobility Command, Scott AFB, IL
ASC	- Aeronautical Systems Center, Wright-Patterson AFB, OH & Eglin AFB, FL
AFWA	- Air Force Weather Agency, Offutt AFB, NE
DGSC	- Defense General Support Center, Richmond, VA
DPSC	- Defense Personnel Support Center, Philadelphia, PA
ER	- Eastern Range, Patrick SFB, FL
ESC	- Electronic Systems Center, Hanscom AFB, MA
HSC	- Human Services Center, Brook AFB, TX
OC-ALC	- Oklahoma City Air Logistics Center, Tinker AFB, OK
OO-ALC	- Ogden Air Logistics Center, Hill AFB, UT
SMC	- Space & Missile Systems Center, Los Angeles AFB, CA
US STRATCOM	- US Strategic Command, Offutt AFB, NE
WACC	- Washington Area Contracting Center, Washington DC
WR	- Western Range, Vandenberg SFB, CA
WR-ALC	- Warner-Robins Air Logistics Center, Robins AFB, GA
AFSPC	- Air Force Space Command, Peterson AFB, CO
HQ ANG	- Headquarters, Air National Guard, Washington, DC
USAFE	- United States Air Force Europe, Ramstein AB, GE
USAFA	- United States Air Force Academy, Colorado Springs, CO

IDENTIFICATION CODES

Code "A"	- Line items of material which have been approved for Air Force service use.
Code "B"	- Line items of material that have not been approved for Service use
OBAN	- Operating Budget Account Number, 2-digit code for unit allocated funds

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force / BA 1: Basic Research</i>	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>
---	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	303.718	353.303	375.325	0.000	375.325	376.916	345.580	351.805	335.237	Continuing	Continuing
613001: <i>Physics and Electronics</i>	-	86.991	95.387	110.359	0.000	110.359	115.022	111.959	114.323	108.962	Continuing	Continuing
613002: <i>Aerospace, Chemical and Material Sciences</i>	-	91.572	100.415	115.618	0.000	115.618	110.021	100.357	102.480	105.076	Continuing	Continuing
613003: <i>Mathematics, Information and Life Sciences</i>	-	86.399	96.060	111.035	0.000	111.035	112.699	103.862	104.981	90.514	Continuing	Continuing
613004: <i>Education and Outreach</i>	-	38.756	61.441	38.313	0.000	38.313	39.174	29.402	30.021	30.685	Continuing	Continuing

A. Mission Description and Budget Item Justification

Defense Research Sciences consists of extramural research activities in academia and industry along with in-house research performed in the Air Force Research Laboratory. This program supports basic broad-based scientific and engineering research in areas critical to Department of the Air Force weapon, sensor, and support systems. All research areas are subject to long-range planning and technical review by both DAF and tri-Service scientific planning groups. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 0602298F, and 1206601SF.

Funds in this program element may be used to investigate specified science advancements in air, space and/or cyber domains.

This program is in Budget Activity 1, Basic Research because this budget activity includes scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force</i> / BA 1: <i>Basic Research</i>	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>
--	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	324.755	328.303	0.000	0.000	0.000
Current President's Budget	303.718	353.303	375.325	0.000	375.325
Total Adjustments	-21.037	25.000	375.325	0.000	375.325
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	25.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.101	0.000			
• SBIR/STTR Transfer	-8.322	0.000			
• Other Adjustments	-12.614	0.000	375.325	0.000	375.325

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 613004: *Education and Outreach*

Congressional Add: *Program Increase - defense research sciences*

Congressional Add: *Program increase: Basic Research*

Congressional Add Subtotals for Project: 613004

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	9.743	-
	0.000	25.000
Congressional Add Subtotals for Project: 613004	9.743	25.000
Congressional Add Totals for all Projects	9.743	25.000

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 1					R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>				Project (Number/Name) 613001 / <i>Physics and Electronics</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
613001: <i>Physics and Electronics</i>	-	86.991	95.387	110.359	0.000	110.359	115.022	111.959	114.323	108.962	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Physics and Electronics Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Department of the Air Force. Research stresses high-risk, high-reward, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Major areas being investigated in this project are complex electronics and fundamental quantum processes; plasma physics and high energy density non-equilibrium processes; and lasers and optics, electromagnetics, communication, and signal processing. While the following specific sub-areas are the focus of the project, there is interest in exploring novel ideas that may bridge these major efforts as well as those in the other projects within this program.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Complex Electronics and Fundamental Quantum Processes</p> <p>Description: Scientific focus areas are atomic and molecular physics, photonics, quantum electronic solids, gigahertz-terahertz electronics and material, semiconductor and electromagnetic materials, and optoelectronics.</p> <p>FY 2022 Plans: Explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, metamaterials, cathodes, dielectric and magnetic materials, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photonic systems, quantum dots and defects in solids, and ultracold atoms and molecules.</p> <p>FY 2023 Plans: Continue to explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, metamaterials, cathodes, dielectric and magnetic materials, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photonic systems, quantum dots and defects in solids, and ultracold atoms and molecules.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$5.989 million. Funding increased due to added emphasis in Complex Electronics and Fundamental Quantum Processes research.</p>	34.796	38.155	44.144
<p>Title: Plasma Physics and High Energy Density Non-Equilibrium Processes</p> <p>Description: Scientific focus areas are plasma, electro-energetic physics and space sciences.</p> <p>FY 2022 Plans:</p>	17.398	19.077	23.175

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613001 / <i>Physics and Electronics</i>
--	--	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma discharges, radio frequency propagation, radio frequency-plasma interaction, and high-power, beam-driven microwave devices.</p> <p>FY 2023 Plans: Continue to explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma discharges, radio frequency propagation, radio frequency-plasma interaction, and high-power, beam-driven microwave devices.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$4.168 million. Funding increased due to added emphasis in Plasma Physics and High Energy Density Non-Equilibrium Processes research.</p>			
<p>Title: Lasers and Optics, Electromagnetics, Communication and Signal Processing</p> <p>Description: Scientific focus areas are physical mathematics and applied analysis, novel computational methods, electromagnetics and wave propagation in complex media, ultra-fast dynamics, for revolutionary approaches to remote sensing and imaging physics, and surveillance and navigation, including both air and the space environment from near Earth to cis-lunar trajectories.</p> <p>FY 2022 Plans: Explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Investigate aspects of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals as well as calculating astrodynamical spacecraft orbits.</p> <p>FY 2023 Plans: Continue to explore all aspects of producing and receiving electromagnetic and electro-optical signals, as well as their propagation through complex media, including adaptive optics and optical imaging. Continue to investigate aspects of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals as well as calculating astrodynamical spacecraft orbits.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	34.797	38.155	43.040

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613001 / <i>Physics and Electronics</i>
--	--	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$4.885 million. Funding increased due to added emphasis in Lasers and Optics, Electromagnetics, Communication and Signal Processing research.			
Accomplishments/Planned Programs Subtotals	86.991	95.387	110.359

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 1					R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>				Project (Number/Name) 613002 / <i>Aerospace, Chemical and Material Sciences</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
613002: <i>Aerospace, Chemical and Material Sciences</i>	-	91.572	100.415	115.618	0.000	115.618	110.021	100.357	102.480	105.076	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Aerospace, Chemical, and Materials Sciences Project seeks to enable revolutionary advances and expand the fundamental knowledge supporting technologies critical to the future of the Department of the Air Force. Research stresses high-risk, high-reward, game-changing capability breakthroughs essential for future leaps in warfighter system performance, functionality, reliability, and survivability while simultaneously reducing component and system power, size, mass, and life cycle costs. Research topics include: aero-structure interactions and control; energy, power, and propulsion; complex materials and structures; and cross-disciplinary research reflecting the highly integrated nature of future weapon systems.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Aero-Structure Interactions and Control</p> <p>Description: Scientific focus areas are high temperature aerospace materials, non-equilibrium aerothermodynamics and chemistry, unsteady, compressible flow turbulence, multiscale fluid-material interactions, and flow control.</p> <p>FY 2022 Plans: Investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Department of the Air Force systems. Explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, high-performance structures, and thermodynamics.</p> <p>FY 2023 Plans: Continue to investigate the characterization, modeling, and exploitation of interactions between the unsteady aerodynamic flow field and the dynamic air vehicle structure to enable enhanced performance in next generation Department of the Air Force systems. Continue to explore the synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, high-performance structures, and thermodynamics.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$4.560 million. Funding increased due to added emphasis in Aero-Structure Interactions and Control research.</p>	27.472	30.125	34.685
<p>Title: Energy, Power, and Propulsion</p> <p>Description: Scientific focus areas are thermal control, theoretical chemistry, molecular dynamics, power and propulsion, and combustion and diagnostics.</p>	27.471	30.125	35.842

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613002 / <i>Aerospace, Chemical and Material Sciences</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> Exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hydrodynamics, structural dynamics, and multi-fidelity simulations. Investigate processes associated with the generation, storage, and utilization of energy, specifically for Department of the Air Force systems including developing novel energetic materials as well as understanding optimizing and controlling combustion processes.</p> <p><i>FY 2023 Plans:</i> Continue to exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hydrodynamics, structural dynamics, and multi-fidelity simulations. Continue to investigate processes associated with the generation, storage, and utilization of energy, specifically for Department of the Air Force systems including developing novel energetic materials as well as understanding optimizing and controlling combustion processes.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$5.717 million. Funding increased due to added emphasis in Energy, Power and Propulsion research.</p>			
<p><i>Title:</i> Complex Materials and Structures</p> <p><i>Description:</i> Scientific focus areas are design, manufacturing, and dynamics and control of multifunctional materials and microsystems, multi-scale mechanics, diagnostics and prognosis, and physico-chemistry of novel organic materials.</p> <p><i>FY 2022 Plans:</i> Investigate multifunctional materials and structures composed of different classes of materials, both organic and inorganic, that can adapt to environmental constraints or mission requirements. Explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the mesoscale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility.</p> <p><i>FY 2023 Plans:</i> Continue to investigate multifunctional materials and structures composed of different classes of materials, both organic and inorganic, that can adapt to environmental constraints or mission requirements. Continue to explore complex materials, microsystems, and structures that incorporate hierarchical design and functionality from the nano-scale through the mesoscale, ultimately leading to controlled, well-understood material or structural behavior capable of dynamic functionality and/or performance characteristics to enhance mission versatility.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i></p>	36.629	40.165	45.091

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613002 / <i>Aerospace, Chemical and Material Sciences</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$4.926 million. Funding increased due to added emphasis in Complex Materials and Structures research.			
Accomplishments/Planned Programs Subtotals	91.572	100.415	115.618

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 1					R-1 Program Element (Number/Name) PE 0601102F / Defense Research Sciences				Project (Number/Name) 613003 / Mathematics, Information and Life Sciences			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
613003: <i>Mathematics, Information and Life Sciences</i>	-	86.399	96.060	111.035	0.000	111.035	112.699	103.862	104.981	90.514	Continuing	Continuing

A. Mission Description and Budget Item Justification

Basic research in the Mathematics, Information Sciences, and Life Sciences Project seeks to expand fundamental knowledge and enable revolutionary advances and supporting technologies critical to the future of the Department of the Air Force. Major areas being investigated in this project are data fusion, machine learning and artificial intelligence, information and complex networks, cyber-security, autonomous decision making, dynamical systems, optimization and control, and natural materials and systems. While the following are specific sub-areas within this project, there is a continuing interest to explore novel ideas to bridge disciplines within this program.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Information and Complex Networks</p> <p>Description: Scientific focus areas are information operations and security, data and information fusion, advanced computing, artificial intelligence and complex networks.</p> <p>FY 2022 Plans: Design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems, including hardware and software interactions. Investigate traditional aspects of information assurance with an emphasis on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Analyze, optimize and design multi-scale networks with resilient features against noise and corruption from difficult environments and adversarial operations, using rigorous mathematical models of information exchange, physical operations, and human-machine interactions. Develop new computing approaches and algorithms for network-of-network information processing at the speed of warfare and new mathematical approaches for predictive, multi-scale and multi-physics simulations of Department of the Air Force systems and systems-of-systems in realistic environments.</p> <p>FY 2023 Plans: Continue to design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems, including hardware and software interactions. Investigate traditional aspects of information assurance with an emphasis on the underlying mathematics of secure-by-design architectures of networked communications and neural information processing. Analyze, optimize and design multi-scale networks with resilient features against noise and corruption from difficult environments and adversarial operations, using rigorous mathematical models of information exchange, physical operations, and human-machine interactions. Develop new computing approaches and algorithms for network-of-network</p>	21.600	24.015	27.759

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613003 / <i>Mathematics, Information and Life Sciences</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>information processing at the speed of warfare and new mathematical approaches for predictive, multi-scale and multi-physics simulations of Department of the Air Force systems and systems-of-systems in realistic environments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$3.744 million. Funding increased due to added emphasis in Information and Complex Networks research.</p>				
<p>Title: Decision Making</p> <p>Description: Scientific focus areas are mathematical modeling of cognition and decision making, development and testing of advanced representations and processes for higher-level artificial intelligence, trust between humans and autonomous agents, mixed human-machine decision making, and computational social science for asymmetric threat detection and predictive large-scale influence.</p> <p>FY 2022 Plans: Investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision-making to achieve accurate real-time integration of human expertise and knowledge into a machine-based battlespace network. Develop new mathematical models for information capture; object, scene and relation identification; and multi-level reasoning and meta-learning. Advance the critical knowledge base in modeling of individual and group cognitive processing and decision making, and construct advanced methodologies for predictive, verifiable simulations of large-scale socio-cultural and human-machine hybrid networks.</p> <p>FY 2023 Plans: Continue to investigate new mathematical laws, scientific principles, and robust algorithms that underlie intelligent, mixed human-machine decision-making to achieve accurate real-time integration of human expertise and knowledge into a machine-based battlespace network. Continue to develop new mathematical models for information capture; object, scene and relation identification; and multi-level reasoning and meta-learning. Continue to advance the critical knowledge base in modeling of individual and group cognitive processing and decision making, and construct advanced methodologies for predictive, verifiable simulations of large-scale socio-cultural and human-machine hybrid networks.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$2.995 million. Funding increased due to added emphasis in Decision Making research.</p>		17.280	19.212	22.207
<p>Title: Dynamical Systems, Optimization, and Control</p> <p>Description: Scientific focus areas are computer models of dynamical data and communication networks, data-fusion, dynamics and control theory for multi-scale and complex networks, and mathematics of distributed optimization in uncertain, variable,</p>		21.600	24.015	28.869

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613003 / <i>Mathematics, Information and Life Sciences</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>continuous and discrete networked systems. Includes the development of advanced computing architectures for solving optimization and data-fusion problems in real time and by embedded processors in autonomous or semi-autonomous platforms.</p> <p>FY 2022 Plans: Develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Develop novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments.</p> <p>FY 2023 Plans: Continue to develop new scientific concepts supported by rigorous analysis for advancing the science of autonomy and promoting the understanding necessary to analyze and design complex multi-scale systems as well as provide guaranteed levels of performance. Continue to develop novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$4.854 million. Funding increased due to added emphasis in Dynamical Systems, Optimization, and Control research.</p>				
<p>Title: Natural Materials and Systems</p> <p>Description: Scientific focus areas are natural materials and nature inspired systems, human performance and biosystems, cognitive neuroscience and biophysics.</p> <p>FY 2022 Plans: Investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems are built, assembled and organized, and functioning to accomplish their objectives. Develop fundamental understanding of bio-chemical mechanisms and control procedures for the production and manufacture of natural materials, and develop reverse-engineering approaches to optimize the bio-chemical functionality. Develop approaches to adapt, blend and mimic existing natural sensory systems and neural systems of varying complexity, to add existing capabilities to these organisms and design in-silico replicas with similar or advanced capabilities.</p> <p>FY 2023 Plans: Continue to investigate multi-disciplinary approaches for studying, using, mimicking, synthesizing and adapting to the ways natural systems are built, assembled and organized, and functioning to accomplish their objectives. Continue to develop fundamental understanding of bio-chemical mechanisms and control procedures for the production and manufacture of natural materials, and develop reverse-engineering approaches to optimize the bio-chemical functionality. Continue to develop approaches to adapt,</p>		25.919	28.818	32.200

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613003 / <i>Mathematics, Information and Life Sciences</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
blend and mimic existing natural sensory systems and neural systems of varying complexity, to add existing capabilities to these organisms and design in-silico replicas with similar or advanced capabilities.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$3.382 million. Funding increased due to added emphasis in Natural Materials and Systems research.			
Accomplishments/Planned Programs Subtotals	86.399	96.060	111.035

C. Other Program Funding Summary (\$ in Millions) N/A
Remarks
D. Acquisition Strategy Not Applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 1					R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>				Project (Number/Name) 613004 / <i>Education and Outreach</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
613004: <i>Education and Outreach</i>	-	38.756	61.441	38.313	0.000	38.313	39.174	29.402	30.021	30.685	Continuing	Continuing

A. Mission Description and Budget Item Justification

The major efforts in the Science and Technology (S&T) Education and Outreach Project are to facilitate interactions between the international and domestic research communities and Department of the Air Force (DAF) researchers, and to support and develop scientists and engineers with an awareness of DAF basic research priorities. These professional interactions and collaborations benefit the DAF by increasing awareness of DAF basic research priorities in the research community as a whole, and attracting talented scientists and engineers to address DAF needs. International interactions facilitate future interoperability of coalition systems and foster relationships with future coalition partners. This project also seeks to enhance interactions with Historically Black Colleges and Universities, Hispanic serving institutions, and other minority institutions.

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

	FY 2021	FY 2022	FY 2023
Title: Outreach to International S&T Community	10.155	12.754	13.410
Description: Foster international S&T cooperation by supporting direct interchanges with a broad range of key international researchers and communities. Identify and leverage international scientific advances when appropriate.			
FY 2022 Plans: Leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explore current foreign investments and influence world-class scientific research on specific topics of interest to the Department of the Air Force. Pursue access to technical information on foreign research capabilities within our interests. Support international visits by scientists and high-level DoD science and technology delegations, and provide primary interface to coordinate international science and technology participation among DoD organizations.			
FY 2023 Plans: Continue to leverage international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Continue to explore current foreign investments and influence world-class scientific research on specific topics of interest to the Department of the Air Force. Continue to pursue access to technical information on foreign research capabilities within our interests. Continue to support international visits by scientists and high-level DoD science and technology delegations, and provide primary interface to coordinate international science and technology participation among DoD organizations.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.656 million. Funding increased due to added emphasis in Outreach to International Research Community.			
Title: Outreach to U.S. S&T Workforce	18.858	23.687	24.903

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613004 / <i>Education and Outreach</i>
--	--	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Strengthen science, mathematics, and engineering research and infrastructure in the U.S., thereby strengthening current and future Department of the Air Force S&T capabilities.</p> <p>FY 2022 Plans: Identify, recruit, and increase opportunities for new investigators to participate in critical Department of the Air Force research. Support science, mathematics, and engineering research including Historically Black Colleges and Universities, Hispanic-Serving Institutions, and other minority institutions. Support science activities that encourage elementary/middle/high school youths to develop an interest in and pursue higher education and employment in the science, mathematics, and engineering fields.</p> <p>FY 2023 Plans: Continue to identify, recruit, and increase opportunities for new investigators to participate in critical Department of the Air Force research. Continue to support science, mathematics, and engineering research including Historically Black Colleges and Universities, Hispanic-Serving Institutions, and other minority institutions. Continue to support science activities that encourage elementary/middle/high school youths to develop an interest in and pursue higher education and employment in the science, mathematics, and engineering fields.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.216 million. Funding increased due to added emphasis in Outreach to United States S&T Workforce.</p>			
Accomplishments/Planned Programs Subtotals	29.013	36.441	38.313

	FY 2021	FY 2022
Congressional Add: Program Increase - defense research sciences	9.743	-
FY 2021 Accomplishments: Conduct Congressionally directed effort		
Congressional Add: Program increase: Basic Research	0.000	25.000
FY 2021 Accomplishments: Not Applicable		
FY 2022 Plans: Conducted Congressionally directed effort		
Congressional Adds Subtotals	9.743	25.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / <i>Defense Research Sciences</i>	Project (Number/Name) 613004 / <i>Education and Outreach</i>
--	--	--

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 1: Basic Research</i>	R-1 Program Element (Number/Name) PE 0601103F / <i>University Research Initiatives</i>
---	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	178.083	187.403	171.192	0.000	171.192	173.509	147.513	124.889	132.547	Continuing	Continuing
615094: <i>University Research Initiatives</i>	-	178.083	187.403	171.192	0.000	171.192	173.509	147.513	124.889	132.547	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program supports defense-related basic research in a wide range of scientific and engineering disciplines relevant to maintaining U.S. military technology superiority. Research topics include, but are not limited to, transformational and high priority technologies such as nanotechnology, sensor networks, artificial intelligence and information fusion, smart materials and structures, quantum materials and processes for sensing, communication and computing, efficient energy and power conversion, and high-energy materials for propulsion and control. The program also enhances and promotes the education of U.S. scientists and engineers in disciplines critical to maintaining, advancing, and enabling future U.S. defense technologies. For example, the National Defense Science and Engineering Graduate program awards fellowships to train U.S. citizens in science and engineering disciplines of military importance under a joint tri-Service and Office of the Assistant Secretary of Defense for Research and Engineering competitive scholarship program. Finally, this program assists universities in establishing superior instrumentation capabilities needed to improve the quality of defense-related research and education. A fundamental component of this program is the recognition that future technologies and technology exploitations require highly coordinated and concerted multi- and inter-disciplinary efforts. Efforts in this program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

Funds in this program element may be used to investigate specified science advancements in air, space and/or cyber domains.

This program is in Budget Activity 1, Basic Research because this budget activity includes scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 1: Basic Research</i>	R-1 Program Element (Number/Name) PE 0601103F / <i>University Research Initiatives</i>
---	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	196.502	162.403	0.000	0.000	0.000
Current President's Budget	178.083	187.403	171.192	0.000	171.192
Total Adjustments	-18.419	25.000	171.192	0.000	171.192
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	25.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-10.674	0.000			
• SBIR/STTR Transfer	-1.271	0.000			
• Other Adjustments	-6.474	0.000	171.192	0.000	171.192

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 615094: *University Research Initiatives*

Congressional Add: *Program increase - university research initiatives*

Congressional Add: *Program increase - solar block research*

Congressional Add: *Program increase - hypersonic supply chain research*

Congressional Add: *Program increase - gigahertz - terahertz electronics and material research*

Congressional Add: *Program increase: Defense university research instrumentation program*

Congressional Add Subtotals for Project: 615094

Congressional Add Totals for all Projects

	FY 2021	FY 2022
Congressional Add: <i>Program increase - university research initiatives</i>	14.456	-
Congressional Add: <i>Program increase - solar block research</i>	4.818	-
Congressional Add: <i>Program increase - hypersonic supply chain research</i>	4.818	-
Congressional Add: <i>Program increase - gigahertz - terahertz electronics and material research</i>	9.637	-
Congressional Add: <i>Program increase: Defense university research instrumentation program</i>	0.000	25.000
Congressional Add Subtotals for Project: 615094	33.729	25.000
Congressional Add Totals for all Projects	33.729	25.000

Change Summary Explanation

Decrease in FY 2021 reflects adjustments and reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY 2023 cannot be made in a relevant manner.

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Title: Multidisciplinary University Research Initiative	79.218	89.322	92.444

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 1: Basic Research</i>		R-1 Program Element (Number/Name) PE 0601103F / <i>University Research Initiatives</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Description: Promote fundamental, multi- and interdisciplinary science and engineering research projects involving multiple principal investigators.</p> <p>FY 2022 Plans: Fund competitive research grants at U.S. universities that focus on significantly expanding the basic knowledge of Department of the Air Force-relevant science and technology areas, not normally achievable in smaller funded, single investigator awards. Support and recognize superior academic researchers in the early stages of their careers through the Presidential Early Career Award for Scientists and Engineers program. Fund existing multi-year awards of multi-disciplinary programs.</p> <p>FY 2023 Plans: Enhance the program and continue funding competitive research grants at U.S. universities that focus on significantly expanding the basic knowledge of Department of the Air Force-relevant science and technology areas, not normally achievable in smaller funded, single investigator awards. Continue to support and recognize superior academic researchers in the early stages of their careers through the Presidential Early Career Award for Scientists and Engineers program. Continue funding of existing multi-year awards of multi-disciplinary programs.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$3.122 million. Funding increased due to added emphasis in Multidisciplinary University Research Initiative research.</p>				
<p>Title: Science and Engineering Education</p> <p>Description: Support post-graduate, graduate, and undergraduate education in science and engineering disciplines at U.S. universities.</p> <p>FY 2022 Plans: Award highly competitive National Defense Science and Engineering Graduate fellowships. Support competitive awards for graduate and undergraduate research experiences, including those established under the Awards to Stimulate and Support Undergraduate Research Experiences program. Fund awards initiated under prior year DoD programs.</p> <p>FY 2023 Plans: Enhance the program and continue to award highly competitive National Defense Science and Engineering Graduate fellowships. Continue to support competitive awards for graduate and undergraduate research experiences, including those established under the Awards to Stimulate and Support Undergraduate Research Experiences program. Continue funding for awards initiated under prior year DoD programs.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		50.412	56.841	61.629

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force</i> / BA 1: <i>Basic Research</i>	R-1 Program Element (Number/Name) PE 0601103F / <i>University Research Initiatives</i>
--	--

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$4.788 million. Funding increased due to added emphasis in Science and Engineering Education.			
Title: Research Instrumentation	14.724	16.240	17.119
Description: Enhance scientific and engineering research through advanced education infrastructure and instrumentation at U.S. universities.			
FY 2022 Plans: Award grants on a competitive basis under the Defense University Research Instrumentation Program to U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities.			
FY 2023 Plans: Enhance the program and continue to award grants on a competitive basis under the Defense University Research Instrumentation Program to U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by 0.879 million. Funding increased due to added emphasis in Research Instrumentation.			
Accomplishments/Planned Programs Subtotals	144.354	162.403	171.192

	FY 2021	FY 2022
Congressional Add: Program increase - university research initiatives	14.456	-
FY 2021 Accomplishments: Conducted Congressionally directed effort		
Congressional Add: Program increase - solar block research	4.818	-
FY 2021 Accomplishments: Conducted Congressionally directed effort.		
Congressional Add: Program increase - hypersonic supply chain research	4.818	-
FY 2021 Accomplishments: Conducted Congressionally directed effort		
Congressional Add: Program increase - gigahertz - terahertz electronics and material research	9.637	-
FY 2021 Accomplishments: Conducted Congressionally directed effort		
Congressional Add: Program increase: Defense university research instrumentation program	0.000	25.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 1: Basic Research</i>	R-1 Program Element (Number/Name) PE 0601103F / <i>University Research Initiatives</i>
---	--

	FY 2021	FY 2022
FY 2021 Accomplishments: Not Applicable		
FY 2022 Plans: Conducted Congressionally directed effort		
Congressional Adds Subtotals	33.729	25.000

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not Applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 1: Basic Research</i>					R-1 Program Element (Number/Name) PE 0601108F / <i>High Energy Laser Research Initiatives</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	14.454	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
615097: <i>Joint Directed Energy Basic Research</i>	-	14.454	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program funded basic research aimed at developing fundamental scientific knowledge to support future Department of Defense Directed Energy Weapon systems through the Joint Directed Energy Transition Office. This program funded multi-disciplinary research institutes to conduct research on laser, laser beam control and high power microwave technologies. In addition, this program supported educational grants to stimulate student interest in directed energy and encourage graduate research in topics related to high energy lasers and high power microwaves. These educational grants were used for educational tools, scholarships, and summer intern employees in military laboratories. Efforts in this program were coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

For FY 2022 this effort moved to OSD PE 601108D8Z.

This program is in Budget Activity 1, Basic Research because this budget activity includes scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	15.057	0.000	0.000	0.000	0.000
Current President's Budget	14.454	0.000	0.000	0.000	0.000
Total Adjustments	-0.603	0.000	0.000	0.000	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.603	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	0.000	0.000	0.000

Change Summary Explanation

NA

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 1: Basic Research</i>		R-1 Program Element (Number/Name) PE 0601108F / <i>High Energy Laser Research Initiatives</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Title: Directed Energy Sources and Devices</p> <p>Description: Improve the fundamental understanding and modeling of high energy laser and high power microwave sources and devices.</p> <p>FY 2022 Plans: FY 2022 effort is moving to OSD PE 601108D8Z.</p> <p>FY 2023 Plans: Not Applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not Applicable</p>		6.307	0.000	0.000
<p>Title: Directed Energy Propagation Technologies</p> <p>Description: Improve the fundamental understanding and modeling of beam control technologies as they relate to high energy laser applications and high power microwaves. Conduct research in atmospheric characterization, metrology, control systems, algorithms, waveguides, antennas and beam control component technology.</p> <p>FY 2022 Plans: FY 2022 effort is moving to OSD PE 601108D8Z.</p> <p>FY 2023 Plans: Not Applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no increase or decrease. This is zeroed out.</p>		6.897	0.000	0.000
<p>Title: Directed Energy Education</p> <p>Description: Fund educational grants to stimulate student interest in directed energy.</p> <p>FY 2022 Plans: FY 2022 effort is moving to OSD PE 601108D8Z.</p> <p>FY 2023 Plans: Not Applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		1.250	0.000	0.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 1: Basic Research</i>	R-1 Program Element (Number/Name) PE 0601108F / <i>High Energy Laser Research Initiatives</i>
---	---

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Not Applicable			
Accomplishments/Planned Programs Subtotals	14.454	0.000	0.000

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not Applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602020F / <i>Future AF Capabilities Applied Research</i>
---	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	73.226	79.901	88.672	0.000	88.672	88.852	88.840	90.976	93.198	Continuing	Continuing
620200: <i>Enterprise Transformational Appld Research</i>	-	73.226	79.901	88.672	0.000	88.672	88.852	88.840	90.976	93.198	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops cross-enterprise transformational applied research efforts to accelerate the "pipeline" of technology-enabled capability candidates focused on the five strategic capabilities outlined in the Air Force 2030 Science and Technology (S&T) Strategy: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality. The Air Force Research Laboratory (AFRL) will plan and manage these funds at the enterprise level to achieve the intent of the Strategy.

These activities are managed by the Air Force Research Laboratory Chief Technologist located at Wright Patterson Air Force Base, Ohio, at the Enterprise level, and executed across the various AFRL Technology Directorate locations.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, and 0602298F.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	79.854	79.901	0.000	0.000	0.000
Current President's Budget	73.226	79.901	88.672	0.000	88.672
Total Adjustments	-6.628	0.000	88.672	0.000	88.672
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	-4.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-2.628	0.000			
• Other Adjustments	0.000	0.000	88.672	0.000	88.672

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602020F / <i>Future AF Capabilities Applied Research</i>
---	--

Change Summary Explanation

FY 2021 reduction (\$4.000 million) Congressional Directed Transfer for Section 219.

FY 2021 reduction (\$2.628 million) SBIR/STTR Transfer.

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Transformational Capability Incubator</p> <p>Description: Integrates cross-enterprise multi-directorate transformational applied research efforts to accelerate the "pipeline" of technology-enabled capability candidates pursuing the five strategic capabilities outlined in the Air Force Science and Technology Strategy. The Air Force Research Laboratory will plan and manage these research activities at the enterprise level with decentralized execution to achieve the intent of the Strategy.</p> <p>FY 2022 Plans: Continue to develop future candidate technology programs which result from the scanning and ideation activities from the previous year. The current technology programs include: Air Force Explore (now called Explore), Seedlings for Disruptive Capabilities, WARTECH capability demonstrations, and novel business processes all intent on implementing the Department of the Air Force Science and Technology 2030 Strategy with applied research. Technology studies and demonstrations include integrated base defense, space integration, airships for logistics, low cost multipurpose unmanned aircraft, and predictive tracking for commercial satellites. Advance the development of disruptive seedling technologies such as integrated compact Electro-Optic/Infra-Red sensing, autonomous runway and airfield augmentation, digital arrays for airborne battle management systems, printed composites for attritable and rapidly deployable aircraft, and articulated nose technology for missiles. Continue to explore transformational research analytic technologies to enable validated positions and provide a solid foundation to predict future outcomes, as well as looking for more seedlings to feed the capability pipeline. Continue to advance future workforce development programs and broadening partnerships to deepen and expand the scientific and technology enterprise.</p> <p>FY 2023 Plans: Continue to develop future candidate technology programs which result from the scanning and ideation activities from the previous year, while maturing the programs already in progress from the previous year. The current technology programs include: Explore, Seedlings for Disruptive Capabilities, WARTECH capability demonstrations, and novel business processes. Capability demonstrations and close out will occur for FY22 Explore projects with potential new technology studies and demonstrations in areas of fog and edge computing, cement replacement material, and potential WARTECH topics that require technology maturation and studies, as well as, seedling technologies such as next generation targeted electromagnetics, In-Band lethality against seeker threats, Magnetic and star tracking for extended range navigation, and photonic integrated circuits for improved space-based position and timing. Continue to explore transformational research analytic technologies to enable</p>	73.226	79.901	88.672

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602020F / <i>Future AF Capabilities Applied Research</i>
---	--

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
validated positions and provide a solid foundation to predict future outcomes, as well as looking for more seedlings to feed the transformational capability pipeline. Continue to advance future workforce development programs and broadening partnerships to deepen and expand the scientific and technology enterprise.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$8.771 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.			
Accomplishments/Planned Programs Subtotals	73.226	79.901	88.672

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	228.115	220.960	134.795	0.000	134.795	135.031	139.922	134.785	138.457	Continuing	Continuing
624347: <i>Materials for Structures, Propulsion, and Subsystems</i>	-	109.001	104.876	52.794	0.000	52.794	51.077	54.207	55.514	56.879	Continuing	Continuing
624348: <i>Materials for Electronics, Optics, and Survivability</i>	-	60.873	55.699	37.279	0.000	37.279	38.119	38.850	36.771	37.694	Continuing	Continuing
624349: <i>Materials Technology for Sustainment</i>	-	58.241	60.385	44.722	0.000	44.722	45.835	46.865	42.500	43.884	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops advanced materials, processing, and inspection technologies to reduce life cycle costs and improve performance, sustainability, availability, affordability, supportability, reliability, and survivability of current and future Department of the Air Force systems and operations. The program has three projects that develop: structural, propulsion, and sub-systems materials and processes technologies; electronic, optical, and survivability materials and processes technologies; and sustainment materials, processes technologies, and advanced non-destructive inspection methodologies. Efforts in the program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication. This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities.

Funds in this PE may be used to investigate specified technology advancements in air, space and/or cyber domains.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>
---	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	237.847	113.460	0.000	0.000	0.000
Current President's Budget	228.115	220.960	134.795	0.000	134.795
Total Adjustments	-9.732	107.500	134.795	0.000	134.795
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	107.500			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-4.101	0.000			
• Other Adjustments	-5.631	0.000	134.795	0.000	134.795

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 624347: *Materials for Structures, Propulsion, and Subsystems*

Congressional Add: *Program increase - Certification of advanced composites*

Congressional Add: *Program Increase - High Performance Materials*

Congressional Add: *Program increase - classified additive manufacturing*

Congressional Add: *Program increase - ceramic matrix composites*

Congressional Add: *Program increase - thermal protection for hypersonic vehicles*

Congressional Add: *Program increase - born qualified additive manufacturing*

Congressional Add: *Program increase - high and ultra-high temperature ceramic-matrix composites for hypersonics*

Congressional Add: *Program increase - additive manufacturing of alloys*

Congressional Add: *Program increase - high energy synchotron x-ray research*

Congressional Add: *Program increase - maturation of carbon-carbon thermal protection systems*

Congressional Add Subtotals for Project: 624347

Project: 624348: *Materials for Electronics, Optics, and Survivability*

Congressional Add: *Program Increase - Technology for Broadband Operation*

Congressional Add: *Program Increase - Deployable passive cooling*

Congressional Add: *Program Increase - Human monitoring capabilities*

	FY 2021	FY 2022
	14.741	0.000
	7.862	0.000
	19.655	0.000
	9.827	0.000
	9.827	10.000
	0.000	20.000
	0.000	10.000
	0.000	10.000
	0.000	8.500
	0.000	5.000
	61.912	63.500
	9.827	0.000
	4.913	5.000
	9.336	0.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>
---	--

Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: <i>Program increase - nano-bio technologies for aeromedical and en route care</i>	0.000	10.000
Congressional Add: <i>Program increase - photonic radio frequency CM</i>	0.000	10.000
Congressional Add Subtotals for Project: 624348	24.076	25.000
Project: 624349: <i>Materials Technology for Sustainment</i>		
Congressional Add: <i>Program Increase - Coating Technologies</i>	9.827	0.000
Congressional Add: <i>Program increase - digital maintenance advisor demonstration for F-16</i>	0.000	5.000
Congressional Add: <i>Program increase - failure prediction in material models</i>	0.000	5.000
Congressional Add: <i>Program increase - stealth aircraft coatings research</i>	0.000	4.000
Congressional Add: <i>Program increase - coating technologies to reduce lifecycle costs</i>	0.000	5.000
Congressional Add Subtotals for Project: 624349	9.827	19.000
Congressional Add Totals for all Projects	95.815	107.500

Change Summary Explanation

Decrease in FY 2021 reflects adjustments to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>				Project (Number/Name) 624347 / <i>Materials for Structures, Propulsion, and Subsystems</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624347: <i>Materials for Structures, Propulsion, and Subsystems</i>	-	109.001	104.876	52.794	0.000	52.794	51.077	54.207	55.514	56.879	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops the materials and processing technology base for aircraft, spacecraft, launch systems, and missiles to improve affordability, maintainability, and performance of current and future Department of the Air Force systems. A family of affordable lightweight materials is being developed, including metals, polymers, ceramics, metallic and nonmetallic composites, and hybrid materials to provide upgraded capabilities for existing aircraft, missile, and propulsion systems to meet the future system requirements. The project develops high-temperature turbine engine materials that will enable engine designs to improve turbine engine thrust-to-weight ratio, specific fuel consumption and affordability. Advanced high temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet aerospace and missile requirements. Alternative or replacement materials are being developed to maintain the performance of fielded operational systems. The project concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

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

	FY 2021	FY 2022	FY 2023
Title: Ceramics and Composites	24.806	23.584	29.562
Description: Develop ceramic, polymer, polymer and ceramic matrix composites, and hybrid materials technologies for performance and supportability improvement in propulsion systems and high temperature aerospace structures.			
FY 2022 Plans: Continue to validate, demonstrate and mature new advanced processing methods, coating technologies, and behavioral life prediction concepts for current and future higher capability polymer and ceramic matrix composites. Continue in-depth analyses and assessment of severe environment durability of advanced composite systems via mechanical testing. Continue validating, developing, and testing the new ceramic and polymer matrix composite materials and processes with higher temperature capability for next generation propulsion systems and aerospace structures. Continue to advance and integrate the computational material science infrastructure for composite materials in tools to model, characterize, and accelerate the development and certification of advanced composite materials. Continue to verify and validate damage progression models on increasingly complex polymer matrix composite structural applications. Continue developing and validating newer testing and assessment methods on composite damage progression models for application in an engineering environment. Continue to develop and validate advanced materials to meet evolving requirements for structural hardening. Initiate development and refine modeling tools to link processing to performance of organic/polymer matrix composites and expand damage mechanics models to increasingly complex composite materials.			
FY 2023 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624347 / <i>Materials for Structures, Propulsion, and Subsystems</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue to validate, demonstrate and mature new advanced processing methods, coating technologies, and behavioral life prediction concepts for current and future higher capability polymer and ceramic matrix composites. Continue in-depth analyses and assessment of severe environment durability of advanced composite systems via mechanical testing. Continue validating, developing, and testing the new ceramic and polymer matrix composite materials and processes with higher temperature capability for next generation propulsion systems and aerospace structures. Continue to advance and integrate the computational material science infrastructure for composite materials in tools to model, characterize, and accelerate the development and certification of advanced composite materials. Continue to verify and validate damage progression models on increasingly complex polymer matrix composite structural applications. Continue developing and validating newer testing and assessment methods on composite damage progression models for application in an engineering environment. Continue to develop and validate advanced materials to meet evolving requirements for structural hardening. Continue development and refinement modeling tools to link processing to performance of organic/polymer matrix composites and expand damage mechanics models to increasingly complex composite materials.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$5.978 million. Funding increased due to increased emphasis on affordable composites.</p>			
<p>Title: Metals</p> <p>Description: Develop lightweight and high temperature metallics, life prediction technologies, and metals processing technologies for increased affordability, durability, and reliability of Department of the Air Force systems.</p> <p>FY 2022 Plans: Continue to validate, demonstrate and implement advanced computation methods to support faster material development and characterization modeling. Continue to analyze relationships between microstructure, processing, properties, and performance of affordable metallic and high performance gradient metallic materials. Continue to validate integrated material/manufacturing and component analysis for life management and development of affordable structural metals and low cost processes. Continue to advance reliable affordable metallic structural components through computational methods. Continue to validate the value of integrated analytical tools in the optimization of design and certification of additively manufactured metallic components. Continue development of novel capabilities via metallic additive manufacturing to be used as an alternative process when applicable. Continue to develop and refine processing methods and affordable metals for low cost, attritable propulsion systems. Continue development of enhanced life management practices to incorporate effects of engineered residual stress. Continue research on application of advanced data science, artificial intelligence and machine learning on materials science problems. Continue research on engine life prediction.</p> <p>FY 2023 Plans:</p>	14.934	14.077	15.463

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624347 / <i>Materials for Structures, Propulsion, and Subsystems</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue to validate, demonstrate and implement advanced computation methods to support faster material development and characterization modeling. Continue to analyze relationships between microstructure, processing, properties, and performance of affordable metallic and high performance gradient metallic materials. Continue to validate integrated material/manufacturing and component analysis for life management and development of affordable structural metals and low cost processes. Continue to advance reliable affordable metallic structural components through computational methods. Continue to validate the value of integrated analytical tools in the optimization of design and certification of additively manufactured metallic components. Continue development of novel capabilities via metallic additive manufacturing to be used as an alternative process when applicable. Continue to develop and refine processing methods and affordable metals for low cost, attritable propulsion systems. Continue research on application of advanced data science, artificial intelligence and machine learning on materials science problems. Continue research on engine life prediction. Completed development of enhanced life management practices to incorporate effects of engineered residual stress.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.386 million. Funding increased due to increased emphasis on novel capabilities via metallic additive manufacturing.</p>			
<p>Title: Thermal Protection Materials</p> <p>Description: Develop and evaluate lightweight, active, adaptive, multifunctional, high temperature, and durable material systems for extreme environments and hypersonic applications.</p> <p>FY 2022 Plans: Continue to validate and mature processing methods for fabricating materials required for expendable hypersonic applications. Continue to validate, develop and refine unique experimental techniques to assess mechanical properties and time-dependent behavior. Continue to validate and demonstrate material properties and performance to meet design needs for control surfaces, leading edges, aeroshells, and apertures. Further the development of computational models to assess environmental degradation of materials in a hypersonic environment.</p> <p>FY 2023 Plans: Continue to validate and mature processing methods for fabricating materials required for expendable hypersonic applications. Continue to validate, develop and refine unique experimental techniques to assess mechanical properties and time-dependent behavior. Continue to validate and demonstrate material properties and performance to meet design needs for control surfaces, leading edges, aeroshells, and apertures. Continue development of computational models to assess environmental degradation of materials in a hypersonic environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	4.593	3.715	4.657

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624347 / <i>Materials for Structures, Propulsion, and Subsystems</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$0.942 million. Funding increased due to increased emphasis in hypersonic materials and processes.				
<p>Title: Pervasive and Affordable Metals Technologies</p> <p>Description: Develop and demonstrate affordable, novel high temperature powder processing materials/structures and additive metals technology concepts to enable future defense capabilities, air vehicle propulsion, and computational prediction models.</p> <p>FY 2022 Plans: Technical work in this effort completed in FY 2021.</p> <p>FY 2023 Plans: Initiate demonstration of affordable metallic turbine engine disks made via powder processing technologies through high temperature, aggressive environment testing. Initiate development of low cost, complex shape metallic components made through additive manufacturing for advanced weapon system component prototypes. Initiate development of computational methodologies that incorporate impact of surface residual stress on the ability to extend life and lower life cycle cost of air vehicle propulsion system components.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$3.112 million. Funding increased due to the re-initiation of this effort in FY 2023.</p>		2.756	0.000	3.112
Accomplishments/Planned Programs Subtotals		47.089	41.376	52.794
		FY 2021	FY 2022	
Congressional Add: Program increase - Certification of advanced composites		14.741	0.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.				
FY 2022 Plans: Not applicable				
Congressional Add: Program Increase - High Performance Materials		7.862	0.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.				
FY 2022 Plans: Not applicable				
Congressional Add: Program increase - classified additive manufacturing		19.655	0.000	

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624347 / <i>Materials for Structures, Propulsion, and Subsystems</i>	
		FY 2021	FY 2022
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - ceramic matrix composites		9.827	0.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - thermal protection for hypersonic vehicles		9.827	10.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - born qualified additive manufacturing		0.000	20.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - high and ultra-high temperature ceramic-matrix composites for hypersonics		0.000	10.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - additive manufacturing of alloys		0.000	10.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - high energy synchrotron x-ray research		0.000	8.500
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - maturation of carbon-carbon thermal protection systems		0.000	5.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624347 / <i>Materials for Structures, Propulsion, and Subsystems</i>
--	--	--

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	61.912	63.500

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>				Project (Number/Name) 624348 / <i>Materials for Electronics, Optics, and Survivability</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624348: <i>Materials for Electronics, Optics, and Survivability</i>	-	60.873	55.699	37.279	0.000	37.279	38.119	38.850	36.771	37.694	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops materials technologies for the Department of the Air Force's Intelligence, Surveillance, and Reconnaissance (ISR), situational awareness, and low-observable systems and subsystems for aerospace platforms and munitions. This includes sensors for microwave, short, mid, and long-wave infrared (SWIR, MWIR, LWIR) detection and countermeasures devices used for targeting, electronic warfare, and active aircraft protection. Electronic and optical materials are being developed to enable surveillance and situational awareness with faster operating speeds, greater tunability, higher power output, improved thermal management (including higher operating temperatures), greater sensitivity, and extended dynamic range. Materials for protection of aircrews, sensors, and aerospace structures from laser and high-power microwave directed energy threats are also developed. New materials are being developed to counter the most prominent laser threats and to respond to emerging and agile threat wavelengths without impairing mission effectiveness. The project develops novel materials for electromagnetic interactions with matter for electromagnetic pulse, high power microwave, and lightning strike protection. The project develops nanostructured and biological materials for aerospace structures, munitions, aerospace vehicle subsystems, and personnel.

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

	FY 2021	FY 2022	FY 2023
Title: Infrared Detector and Electromagnetic Device Materials	11.147	9.516	11.557
Description: Develop infrared (IR) detector and electro-magnetic device materials and processes technologies for performance, affordability, and operational capability of surveillance, tracking, targeting, and situational awareness systems for the Department of the Air Force.			
FY 2022 Plans: Continue advanced development, demonstration and validation of materials and processes for control and detection of electromagnetic radiation for Intelligence, Surveillance and Reconnaissance (ISR) technologies. Further the development, testing, and assessment of materials for use in high resolution imaging by electromagnetic radiation. Continue advanced demonstration of nanoscale materials, metamaterials, and models for use in producing detectors. Continue to utilize all aspects of computational materials science to improve performance prediction and reliability models, as well as analyzing quantum materials for aerospace applications. Continue specific development and demonstration of short wave infrared detector and hyper-spectral long wave infrared materials. Continue to verify and validate materials and processes for integration of radio frequency and optical signals as well as concepts for novel optical devices and components. Continue development of photonics for aerospace applications,			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624348 / <i>Materials for Electronics, Optics, and Survivability</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>and demonstrate nanostructured materials for components to enable agile radio frequency capability. Continue development of techniques using quantum materials and processes.</p> <p>FY 2023 Plans: Continue advanced development, demonstration and validation of materials and processes for control and detection of electromagnetic radiation for Intelligence, Surveillance and Reconnaissance (ISR) technologies. Further the development, testing, and assessment of materials for use in high resolution imaging by electromagnetic radiation. Continue advanced demonstration of nanoscale materials, metamaterials, and models for use in producing detectors. Continue to utilize all aspects of computational materials science to improve performance prediction and reliability models, as well as analyzing quantum materials for aerospace applications. Continue specific development and demonstration of short wave infrared detector and hyper-spectral long wave infrared materials. Continue to verify and validate materials and processes for integration of radio frequency and optical signals as well as concepts for novel optical devices and components. Continue development of photonics for aerospace applications, and demonstrate nanostructured materials for components to enable agile radio frequency capability. Continue development of techniques using quantum materials and processes. Initiate development of software defined imaging receivers.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$2.041 million. Funding increased due to increased emphasis on low-cost sensor materials for Intelligence, Surveillance, and Reconnaissance (ISR).</p>			
<p>Title: Directed Energy Hardened Materials</p> <p>Description: Develop and demonstrate technologies to enhance the safety, survivability, and mission effectiveness of personnel, sensors, viewing systems, and related Department of the Air Force assets.</p> <p>FY 2022 Plans: Continue to analyze, validate and demonstrate the comprehensive generated data of materials and technologies to protect against directed energy threats. Continue to develop and demonstrate advanced optical limiter materials for damage protection, enhanced hybrid materials for advanced applications, and continue to assess the response of new materials for high-energy laser interactions. Continue developing novel approaches for integration of multimodal hardening into structures and devices. Continue to assess data, validate repeatability and utilize computational materials science to enhance multi-scale modeling for design of robust, reliable integrated protection. Continue development of proven selected advanced materials technologies to protect against nuclear flash blindness.</p> <p>FY 2023 Plans: Continue to analyze, validate and demonstrate the comprehensive generated data of materials and technologies to protect against directed energy threats. Continue to develop and demonstrate advanced optical limiter materials for damage protection, enhanced hybrid materials for advanced applications, and continue to assess the response of new materials for high-energy laser</p>	12.807	9.210	11.184

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624348 / <i>Materials for Electronics, Optics, and Survivability</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>interactions. Continue developing novel approaches for integration of multimodal hardening into structures and devices. Continue to assess data, validate repeatability and utilize computational materials science to enhance multi-scale modeling for design of robust, reliable integrated protection. Continue development of proven selected advanced materials technologies to protect against nuclear flash blindness.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.974 million. Funding increased due to increased emphasis on integrated directed energy protection systems.</p>				
<p>Title: Laser Source Materials</p> <p>Description: Develop materials to enable higher performance high power laser sources (quasi-Continuous Wave to Continuous Wave) with emphasis on laser output in the mid-InfraRed spectral region (2-5 microns).</p> <p>FY 2022 Plans: Continue to demonstrate and validate materials and process technologies to control and generate directed electromagnetic energy for survivability and other applications. Further demonstrate and model materials processes for controlling laser beam direction and focus with optical components, and materials for frequency conversion, high power optical isolators, mid-wave infrared laser sources and high power microwave sources for directed energy sources.</p> <p>FY 2023 Plans: Continue to demonstrate and validate materials and process technologies to control and generate directed electromagnetic energy for survivability and other applications. Further demonstrate and model materials processes for controlling laser beam direction and focus with optical components, and materials for frequency conversion, high power optical isolators, mid-wave infrared laser sources and high power microwave sources for directed energy sources.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.263 million. Funding increased due increased emphasis on high power optical isolators.</p>		1.327	1.228	1.491
<p>Title: Nanostructured and Biological Materials</p> <p>Description: Develop enabling and foundational biotechnologies for guidance and control, rapid tagging, tracking and identification of targets, bio-integrated electronics and sensing for the Department of the Air Force applications.</p> <p>FY 2022 Plans: Continue to validate and verify engineering, scientific and processing methods for nano and biological materials to address unique requirements for the Department of the Air Force human-machine integration and electronic components. Continue to explore</p>		11.516	10.745	13.047

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624348 / <i>Materials for Electronics, Optics, and Survivability</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>biotechnology to assess the impact of microbes and fungi on Department of the Air Force systems. Continue to study more robust and reliable materials and processes to optimize components for compact, flexible, stretchable multi-functional devices, and validate materials and process for functional additive manufacturing of electronic components. Continue to demonstrate methods to assess reliability and field resiliency of nano and biological materials and processes. Continue to support the Flexible Hybrid Electronics Institutes for Manufacturing Innovation and the NanoBio Manufacturing Consortium for collaborative teaming. Initiate agile materials for basing, infrastructure and expeditionary operations.</p> <p>FY 2023 Plans: Continue to validate and verify engineering, scientific and processing methods for nano and biological materials to address unique requirements for the Department of the Air Force human-machine integration and electronic components. Continue to explore biotechnology to assess the impact of microbes and fungi on Department of the Air Force systems. Continue to study more robust and reliable materials and processes to optimize components for compact, flexible, stretchable multi-functional devices, and validate materials and process for functional additive manufacturing of electronic components. Continue to demonstrate methods to assess reliability and field resiliency of nano and biological materials and processes. Continue to support the Flexible Hybrid Electronics Institutes for Manufacturing Innovation and the NanoBio Manufacturing Consortium for collaborative teaming. Continue development of agile materials for basing, infrastructure and expeditionary operations.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$2.302 million. Increased funding due to increased emphasis on materials and processes to enable human-machine teaming.</p>			
Accomplishments/Planned Programs Subtotals	36.797	30.699	37.279

	FY 2021	FY 2022
Congressional Add: Program Increase - Technology for Broadband Operation	9.827	0.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts.		
FY 2022 Plans: Not Applicable		
Congressional Add: Program Increase - Deployable passive cooling	4.913	5.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Add: Program Increase - Human monitoring capabilities	9.336	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624348 / <i>Materials for Electronics, Optics, and Survivability</i>

	FY 2021	FY 2022
FY 2021 Accomplishments: Conduct Congressionally directed efforts.		
FY 2022 Plans: Not Applicable		
Congressional Add: Program increase - nano-bio technologies for aeromedical and en route care	0.000	10.000
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Add: Program increase - photonic radio frequency CM	0.000	10.000
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	24.076	25.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>				Project (Number/Name) 624349 / <i>Materials Technology for Sustainment</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624349: <i>Materials Technology for Sustainment</i>	-	58.241	60.385	44.722	0.000	44.722	45.835	46.865	42.500	43.884	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops materials and processing technologies to support operational Department of the Air Force mission areas by providing the ability to inspect the quality of delivered systems, transition more reliable and maintainable materials, establish a capability to detect and characterize performance threatening defects, characterize materials processes and properties necessary for materials transition, and provide quick reaction support and failure analysis to the operational commands and repair centers. Repair techniques and nondestructive inspection/evaluation (NDI/E) methods are developed that are needed for metallic and non-metallic structures, coatings, corrosion control processes, and to support integration of composite structures for aerospace systems. Various NDI/E methods are essential to ensure optimum quality in the design and production of aircraft, propulsion, and missile systems. These NDI/E methods are also essential to monitor and detect the onset of any service initiated damage and/or deterioration due to aging of operational systems.

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

	FY 2021	FY 2022	FY 2023
Title: Material State Awareness	16.896	14.482	15.653
Description: Develop Materials State Awareness technologies to identify and characterize materials and/or damage regardless of scale for managing the health of fielded structures, propulsion systems, and low-observable materials/structures, plus enabling advanced materials qualification for Department of the Air Force systems.			
FY 2022 Plans: Continue to validate and demonstrate non-destructive evaluation modeling capabilities and use these competencies to drive improvements in capability to detect, characterize and quantify damage in realistic aerospace structures and engine components. Continue to analyze approaches to address the variability inherent in aerospace systems and materials to quantify the impact of that variability on nondestructive inspection capability and reliability. Continue to validate advanced sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Continue development and validation of damage state awareness approaches and methodologies for use on aerospace structures and engine components. Continue to improve methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of specialty materials that enables/ensures more affordable coatings assessment. Validate tools to improve characterization and failure modes of specialty multilayer coatings. Continue to develop automation and robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization.			
FY 2023 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624349 / <i>Materials Technology for Sustainment</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue to validate and demonstrate non-destructive evaluation modeling capabilities and use these competencies to drive improvements in capability to detect, characterize and quantify damage in realistic aerospace structures and engine components. Continue to analyze approaches to address the variability inherent in aerospace systems and materials to quantify the impact of that variability on nondestructive inspection capability and reliability. Continue to validate advanced sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Continue to improve methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of specialty materials that enables/ensures more affordable coatings assessment. Continue to validate tools to improve characterization and failure modes of specialty multilayer coatings. Continue to develop automation and robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization. Initiate development of miniaturized nondestructive evaluation/inspection capabilities.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.171 million. Increased funding due to increased emphasis on automation capabilities.</p>			
<p>Title: Production and Repair Technologies</p> <p>Description: Develop support capabilities, information, and processes to resolve problems with materials in the production and repair of systems components and structures for the Department of the Air Force.</p> <p>FY 2022 Plans: Continue to develop and communicate to the field best practices to ensure repeatability of advanced materials and processes technology to repair and extend the life of Department of the Air Force systems. Further refine through demonstration the understanding of material durability and repair limits for emerging Department of the Air Force systems. Continue to advance the analysis and development of improved life cycle prediction test methods and techniques to understand effects of service environments, corrosion, residual stresses, and material processes on structural and functional materials. Continue to improve the service life of advanced materials, processes and designs for improved repair and maintainability and life cycle cost of outer mold line coatings, access panel treatments, and multifunctional systems. Continue to further advance specialty material affordability technologies and processes to reduce maintenance costs of specialty materials.</p> <p>FY 2023 Plans: Continue to develop and communicate to the field best practices to ensure repeatability of advanced materials and processes technology to repair and extend the life of Department of the Air Force systems. Further refine through demonstration the understanding of material durability and repair limits for emerging Department of the Air Force systems. Continue to advance the analysis and development of improved life cycle prediction test methods and techniques to understand effects of service environments, corrosion, residual stresses, and material processes on structural and functional materials. Continue to improve the</p>	12.551	10.759	11.628

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624349 / <i>Materials Technology for Sustainment</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>service life of advanced materials, processes and designs for improved repair and maintainability and life cycle cost of outer mold line coatings, access panel treatments, and multifunctional systems. Continue to further advance specialty material affordability technologies and processes to reduce maintenance costs of specialty materials.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.869 million. Increased funding is a result of increased emphasis on specialty material affordability.</p>				
<p>Title: Failure Analysis Technologies</p> <p>Description: Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis for the Department of the Air Force.</p> <p>FY 2022 Plans: Continue to perform and increase efficiency of quick response failure analyses and materials investigations. Further the development and investigate improved analysis techniques to determine and prevent root cause materials failure/degradation. Continue to develop and provide advanced materials and processing solutions to ensure warfighter systems availability and safety of flight. Continue to refine development of functional materials failure analysis capabilities. Continue to analyze and validate advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Continue to transition advanced test and characterization methods for analyzing electrical and structural failures of emerging materials. Continue development of new, more durable materials and protection for high power wiring technologies, and advanced materials.</p> <p>FY 2023 Plans: Continue to perform and increase efficiency of quick response failure analyses and materials investigations. Further the development and investigate improved analysis techniques to determine and prevent root cause materials failure/degradation. Continue to develop and provide advanced materials and processing solutions to ensure warfighter systems availability and safety of flight. Continue to refine development of functional materials failure analysis capabilities. Continue to analyze and validate advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Continue to transition advanced test and characterization methods for analyzing electrical and structural failures of emerging materials. Continue development of new, more durable materials and protection for high power wiring technologies, and advanced materials.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.297 million. Increased funding is a result of increased emphasis on functional materials failure analysis.</p>		18.967	16.144	17.441
Accomplishments/Planned Programs Subtotals		48.414	41.385	44.722

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / <i>Materials</i>	Project (Number/Name) 624349 / <i>Materials Technology for Sustainment</i>	
		FY 2021	FY 2022
Congressional Add: Program Increase - Coating Technologies		9.827	0.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not Applicable			
Congressional Add: Program increase - digital maintenance advisor demonstration for F-16		0.000	5.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - failure prediction in material models		0.000	5.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - stealth aircraft coatings research		0.000	4.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - coating technologies to reduce lifecycle costs		0.000	5.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Adds Subtotals		9.827	19.000
C. Other Program Funding Summary (\$ in Millions)			
N/A			
Remarks			
D. Acquisition Strategy			
Not Applicable.			

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	148.576	183.032	159.453	0.000	159.453	163.842	166.249	169.389	173.108	Continuing	Continuing
622401: <i>Structures</i>	-	65.940	71.546	70.320	0.000	70.320	71.485	72.634	74.181	75.829	Continuing	Continuing
622403: <i>Flight Controls and Pilot-Vehicle Interface</i>	-	11.674	39.790	39.422	0.000	39.422	40.320	40.837	41.704	42.611	Continuing	Continuing
622404: <i>Aeromechanics and Integration</i>	-	7.451	29.941	9.745	0.000	9.745	9.947	10.156	10.374	10.592	Continuing	Continuing
622405: <i>High Speed Systems Technology</i>	-	35.457	38.103	36.432	0.000	36.432	38.474	38.943	39.771	40.642	Continuing	Continuing
622406: <i>Aerospace Power & Flight Control Technology</i>	-	25.130	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
623066: <i>Turbine Engine Technology</i>	-	2.924	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
625172: <i>NUCLEAR SYSTEM TECHNOLOGY</i>	-	0.000	3.652	3.534	0.000	3.534	3.616	3.679	3.359	3.434	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace vehicle technologies in the primary areas of high speed systems, flight control technologies, aeromechanics, structure systems and nuclear system technology. The effort has five current projects, each focusing on a technology area critical to the Department of the Air Force. The High Speed Systems Technology project develops component level vehicle technologies for expendable and reusable high speed/hypersonic aerospace systems. The Flight Controls and Pilot-Vehicle Interface project develops technologies that enable maximum affordable capability from manned, remotely-piloted and autonomous aerospace vehicles. The Aeromechanics and Integration project designs advanced aerodynamic vehicle configurations that are developed and analyzed through simulations, experiments, and multi-disciplinary analyses. It also develops design techniques, incorporating vehicle, inter-vehicle, and intra-vehicle control systems. The Structures project develops and exploits new materials, and fabrication processes. The Nuclear System Technology project provides science and technology to preserve nuclear deterrence for future generations.

Funds in this program element may be used to investigate specified technology advancements in air, space and/or cyber domains.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602203F, 0602202F, 0602204F, 0602602F, 0602605F, 0602788F, 0602298F, and 1206601SF.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>
---	---

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	164.426	163.032	0.000	0.000	0.000
Current President's Budget	148.576	183.032	159.453	0.000	159.453
Total Adjustments	-15.850	20.000	159.453	0.000	159.453
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	20.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-4.883	0.000			
• SBIR/STTR Transfer	-4.868	0.000			
• Other Adjustments	-6.099	0.000	159.453	0.000	159.453

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 622401: Structures

Congressional Add: *Program increase - Educational partnership agreement for secure UAV technologies*

Congressional Add: *Program increase - Collaborative hypersonic demonstration*

Congressional Add Subtotals for Project: 622401

Project: 622405: High Speed Systems Technology

Congressional Add: *Program increase - secure UAV technologies*

Congressional Add: *Program increase - modeling and testing of high temperature aero vehicle*

Congressional Add: *Program increase - hypersonic research and education*

Congressional Add Subtotals for Project: 622405

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	0.000	10.000
	0.000	10.000
	0.000	20.000
	9.703	-
	3.881	-
	2.340	-
	15.924	-
	15.924	20.000

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity
3600: *Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research*

R-1 Program Element (Number/Name)
PE 0602201F / *Aerospace Vehicle Technologies*

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies	Project (Number/Name) 622401 / Structures
--	--	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622401: Structures	-	65.940	71.546	70.320	0.000	70.320	71.485	72.634	74.181	75.829	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new concepts and design techniques. New structural concepts include low cost design and fabrication techniques, incorporating subsystem hardware items and adaptive mechanisms into the aerospace structures and/or skin of the platform.

In FY 2023, Next Generation Aerodynamic Technologies and Aircraft Integration Technologies efforts will transfer from Program 0602201F, Aerospace Vehicle Technologies, Project 622404, Aeromechanics and Integration, to this Project 622401, Structures, in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Title: Aircraft Service Life Technologies</p> <p>Description: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring technologies.</p> <p>FY 2022 Plans: Continue lifing methods for durability and damage tolerance of aging structures on legacy fleet aircraft. Initiate digital engineering systems analysis on a low cost attritable unmanned aircraft system.</p> <p>FY 2023 Base Plans: Complete lifing methods for durability and damage tolerance of aging structures on legacy fleet aircraft. Complete digital engineering systems analysis on a low cost attritable unmanned aircraft system.</p> <p>FY 2023 OCO Plans: Not Applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$16.619 million. Funding decrease due to reduced emphasis on aircraft-service-life enhancement technologies for legacy fleet aircraft.</p>	23.825	18.615	1.996	0.000	1.996
<p>Title: Vehicle Design Technologies</p>	21.664	16.937	18.137	0.000	18.137

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622401 / <i>Structures</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Description: Develop methodologies to reduce the cost and time involved from design to full-scale testing of structural concepts and aerospace systems.</p> <p>FY 2022 Plans: Continue the development of advanced high fidelity aircraft design analysis tools. Continue the development of integrating cost, mission effectiveness, and affordable manufacturing methods into aircraft design analysis tools. Continue new design techniques to quantify and trade risk impacts against performance in aircraft designs. Continue the development of new design methods that link vehicle system requirements to mission operation performance.</p> <p>FY 2023 Base Plans: Continue the development of advanced high fidelity aircraft design analysis tools. Complete the development of integrating cost, mission effectiveness, and affordable manufacturing methods into aircraft design analysis tools. Complete new design techniques to quantify and trade risk impacts against performance in aircraft designs. Continue the development of new design methods that link vehicle system requirements to mission operation performance. Initiate the integration of model-based system engineering methodology with risk-aware aircraft design methods</p> <p>FY 2023 OCO Plans: Not Applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$1.2 million. Funding increase due to an increased emphasis on vehicle design Technologies for future platforms to include autonomous collaborative platforms.</p>					
<p>Title: Structural Concepts</p> <p>Description: Develop design methods, processes, and lightweight, adaptive, and multifunctional structural concepts to capitalize on new materials, multi-role considerations, and technology integration into aircraft systems.</p> <p>FY 2022 Plans: Continue development of innovative structural design methods to dramatically reduce weight and complexity of aircraft structures. Continue development of fail-safe technologies for bonded unitized composite structures applicable to Mobility aircraft. Continue validation of impact damage analysis and methods for advanced fail-safe</p>	20.451	15.994	24.938	0.000	24.938

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies	Project (Number/Name) 622401 / Structures

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>composite structures applicable to Mobility aircraft. Initiate new low cost design and manufacturing structural concepts for attritable vehicles.</p> <p>FY 2023 Base Plans: Continue development of innovative structural design methods to dramatically reduce weight and complexity of aircraft structures. Complete development of fail-safe technologies for bonded unitized composite structures applicable to next generation aircraft. Continue validation of impact damage analysis and methods for advanced fail-safe composite structures applicable to next generation aircraft. Continue new low cost design and manufacturing structural concepts for attritable vehicles. Initiate development of low-cost agile manufacturing concepts for structures in support of the development of a next variant of a low cost unmanned aerospace system.</p> <p>FY 2023 OCO Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$8.944 million. Funding increase due to an increased emphasis on advanced structural concepts for future platforms to include autonomous collaborative platforms.</p>					
<p>Title: Next Generation Aerodynamic Technologies</p> <p>Description: Develop and assess technologies for the next generation of multi-role large aircraft.</p> <p>FY 2022 Plans: In FY2022, this effort is performed in Program 0602201F, Aerospace Vehicle Technologies, Project 622404, Aeromechanics and Integration.</p> <p>FY 2023 Base Plans: Complete the design of a small, pod-mounted tactical air refueling boom for future Mobility applications. Continue the development of advanced high fidelity aerodynamic analysis tools for aircraft conceptual design. Continue assessment of innovative next generation vehicle concepts.</p> <p>FY 2023 OCO Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	0.000	8.075	0.000	8.075

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force			Date: April 2022			
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies	Project (Number/Name) 622401 / Structures				
B. Accomplishments/Planned Programs (\$ in Millions)						
	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	
FY2023 increased compared to FY2022 by \$8.075 million. Funding increase is due to transfer from Program 0602201F, Aerospace Vehicle Technologies, Project 622404, Aeromechanics and Integration and an increased emphasis on development of component technologies for next generation systems.						
Title: Aircraft Integration Technologies						
Description: Develop enabling technologies to allow efficient and effective integration of propulsion, weapons, and subsystems into current and future air vehicles.						
FY 2022 Plans: In FY2022, this effort is performed in Program 0602201F, Aerospace Vehicle Technologies, Project 622404, Aeromechanics and Integration.						
FY 2023 Base Plans: Complete development of advanced kinetic and directed energy weapons integration technologies for Air Superiority 2030. Continue integrated full flow path demonstration of a medium bypass embedded engine for next generation mobility. Complete the design and analysis methods to allow rapid certification of stores separation for new small weapons on tactical aircraft. Continue development of hybrid electric distributed propulsion vehicle integration designs for next generation vehicle concepts. Initiate development of novel kinetic weapons integration technologies for enhanced weapon payload in attritable platforms.						
FY 2023 OCO Plans: Not applicable						
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$17.174 million. Funding increase is due to transfer from Program 0602201F, Aerospace Vehicle Technologies, Project 622404, Aeromechanics and Integration and increased emphasis on weapon and propulsion integration technologies for next generation systems.						
Accomplishments/Planned Programs Subtotals		65.940	51.546	70.320	0.000	70.320
	FY 2021	FY 2022				
Congressional Add: Program increase - Educational partnership agreement for secure UAV technologies	0.000	10.000				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622401 / <i>Structures</i>
--	---	--

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Add: Program increase - Collaborative hypersonic demonstration	0.000	10.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts. This effort will be executed in Program 0602201F, Aerospace Vehicle Technologies, Project 622405, High Speed Systems Technology.		
Congressional Adds Subtotals	0.000	20.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>				Project (Number/Name) 622403 / <i>Flight Controls and Pilot-Vehicle Interface</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622403: <i>Flight Controls and Pilot-Vehicle Interface</i>	-	11.674	39.790	39.422	0.000	39.422	40.320	40.837	41.704	42.611	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops technologies that enable maximum affordable capability from manned, remotely-piloted, and autonomous aerospace vehicles. Advanced control, automation, and autonomy technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in full-scale, surrogate, and virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous or remotely piloted air vehicles, hypersonic aircraft, and extended-life legacy aircraft.

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Title: Advanced Flight Controls Technologies</p> <p>Description: Develop technologies for advanced control-enabled capabilities, including flight controls, components, integrated vehicle management systems, and software and system certification techniques for both manned/unmanned and remotely piloted aircraft.</p> <p>FY 2022 Plans: Continue the development of trusted autonomy approach, integrating certification processes and autonomy development. Continue the development, demonstration, and assessment of autonomy capabilities under adverse and contested environments.</p> <p>FY 2023 Base Plans: Continue the development of a trusted autonomy approach, integrating certification processes and autonomy development. Complete the development, demonstration, and assessment of autonomy capabilities under adverse and contested environments. Initiate the development, demonstration and assessment of autonomy capabilities for dynamic tasking in complex environments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.194 million. Funding increase due to increased emphasis on advanced flight controls technologies to enable future capabilities including autonomous collaboration.</p>	2.675	9.168	9.362	-	9.362
<p>Title: Manned and Unmanned Teaming Technologies</p> <p>Description: Develop technology for flight control systems that will permit safe interoperability between manned and remotely piloted aircraft and effective teaming in adverse and contested environments.</p>	6.952	23.569	22.858	-	22.858

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622403 / <i>Flight Controls and Pilot-Vehicle Interface</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p><i>FY 2022 Plans:</i> Continue development, demonstration, and assessment of advanced control automation techniques. Continue the development of autonomous behaviors for safe, effective manned-unmanned teams. Continue the development of tactical autonomy for manned-unmanned teams in contested, dynamic mission environments. Initiate the development of mission management autonomy for manned-unmanned teams.</p> <p><i>FY 2023 Base Plans:</i> Complete development, demonstration, and assessment of advanced control automation techniques. Complete the development of autonomous behaviors for safe, effective manned-unmanned teams. Continue the development of tactical autonomy for manned-unmanned teams in contested, dynamic mission environments. Continue the development of mission management autonomy for manned-unmanned teams. Initiate development, demonstration and assessment of autonomous behaviors to address mission capability gaps.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY2023 decreased compared to FY2022 by \$0.711 million. Funding decrease due to a decreased emphasis in development of autonomous behaviors to address mission capability gaps.</p>					
<p><i>Title:</i> Flight Controls Technologies Modeling and Simulation</p> <p><i>Description:</i> Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles.</p> <p><i>FY 2022 Plans:</i> Continue modeling and simulation efforts to evaluate emerging autonomous and robust flight control technologies and concepts, as well as assess mission level performance of integrated aerospace systems. Continue analyses of manned-unmanned teams in adversarial mission environments. Continue trade studies of vehicle concepts for strike, mobility and reconnaissance. Continue manned-unmanned teaming evaluations including rapid development of new capabilities. Continue analyses of capability concepts for future advanced development programs.</p> <p><i>FY 2023 Base Plans:</i> Complete modeling and simulation efforts to evaluate emerging autonomous and robust flight control technologies and concepts, as well as assess mission level performance of integrated aerospace systems. Complete analyses of manned-unmanned teams in adversarial mission environments. Continue trade studies of vehicle concepts for strike, mobility and reconnaissance. Continue manned-unmanned teaming evaluations</p>	2.047	7.053	7.202	-	7.202

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622403 / <i>Flight Controls and Pilot-Vehicle Interface</i>

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
including rapid development of new capabilities. Continue analyses of capability concepts for future advanced development programs. Initiate modeling and simulation efforts to assess emerging aerospace technologies and concepts in complex and dynamic battlespace environments. Initiate digital engineering efforts to create a continuum from military utility and cost effectiveness analysis to investment planning to technology development to technology transition.					
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY2023 increased compared to FY2022 by \$0.149 million. Funding increase due to increased emphasis on modeling and simulation, digital engineering, and tool development to inform future Aerospace Systems Science and Technology (S&T) investments.					
Accomplishments/Planned Programs Subtotals	11.674	39.790	39.422	-	39.422

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies				Project (Number/Name) 622404 / Aeromechanics and Integration			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622404: Aeromechanics and Integration	-	7.451	29.941	9.745	0.000	9.745	9.947	10.156	10.374	10.592	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops aerodynamic configurations of a broad range of revolutionary, affordable aerospace vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction and integrates and demonstrates multi-disciplinary advances in airframe, propulsion, weapon, and air vehicle control integration.

In FY2023, Next Generation Aerodynamic Technologies and Aircraft Integration Technologies efforts will transfer to Program 0602201F, Aerospace Vehicle Technologies, Project 622401, Structures, in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Aerodynamic Systems Technologies	1.669	6.740	9.745	-	9.745
Description: Develop aerodynamic assessment prediction methods centered on expanding the design capabilities of future air vehicles.					
FY 2022 Plans: Complete development and assessment of low cost attritable unmanned air vehicle concepts. Complete an assessment of design options to allow runway independence for low cost attritable unmanned air vehicle concepts. Continue design assessments of distributed propulsion concepts for next generation Mobility. Continue the assessment and development of incorporating active flow control techniques into advanced design to enable new aircraft configurations.					
FY 2023 Base Plans: Continue design assessments of distributed propulsion concepts for next generation aircraft. Continue the assessment and development of incorporating active flow control techniques into advanced design to enable new aircraft configurations. Initiate design assessments of long-endurance unmanned platforms. Initiate the development of prediction methods which include air vehicle stability and control requirements.					
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$3.005 million. Funding increase due to an increased emphasis on air vehicle range enhancement and runway independence.					
Title: Next Generation Aerodynamic Technologies	1.847	7.445	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies	Project (Number/Name) 622404 / Aeromechanics and Integration

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Description: Develop and assess technologies for the next generation of multi-role large aircraft.</p> <p>FY 2022 Plans: Complete next generation tanker maturation and assess promising configurations in high and low speed wind tunnels. Continue the design of a small, pod-mounted tactical air refueling boom for future Mobility applications. Continue the development of advanced high fidelity aerodynamic analysis tools for aircraft conceptual design. Initiate assessment of innovative next generation vehicle concepts.</p> <p>FY 2023 Base Plans: In FY2023, this effort will transfer to Program 0602201F, Aerospace Vehicle Technologies, Project 622401, Structures, in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$7.445 million. Funding decrease is due to transfer to Program 0602201F, Aerospace Vehicle Technologies, Project 622401, Structures.</p>					
<p>Title: Aircraft Integration Technologies</p> <p>Description: Develop enabling technologies to allow efficient and effective integration of propulsion, weapons, and subsystems into current and future air vehicles.</p> <p>FY 2022 Plans: Continue development of advanced kinetic and directed energy weapons integration technologies for Air Superiority 2030. Continue integrated full flow path demonstration of a medium bypass embedded engine for next generation mobility and completing the full flow path demonstration design. Continue design and analysis methods to allow rapid certification of stores separation for new small weapons on tactical aircraft. Initiate development of hybrid electric distributed propulsion vehicle integration designs for next generation vehicle concepts.</p> <p>FY 2023 Base Plans: In FY2023, this effort will transfer to Program 0602201F, Aerospace Vehicle Technologies, Project 622401, Structures, in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	3.935	15.756	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies	Project (Number/Name) 622404 / Aeromechanics and Integration

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
FY2023 decreased compared to FY2022 by \$15.756 million. Funding decrease is due to transfer to Program 0602201F, Aerospace Vehicle Technologies, Project 622401, Structures.					
Accomplishments/Planned Programs Subtotals	7.451	29.941	9.745	-	9.745

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>				Project (Number/Name) 622405 / <i>High Speed Systems Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622405: <i>High Speed Systems Technology</i>	-	35.457	38.103	36.432	0.000	36.432	38.474	38.943	39.771	40.642	Continuing	Continuing

A. Mission Description and Budget Item Justification

This effort investigates, analyzes, and develops high speed/hypersonic aerospace vehicle technologies. Advanced high temperature structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analyses. Advanced flight control technologies are developed and simulated for hypersonic vehicles. These technologies will enable future high speed weapons and platforms; intelligence, surveillance, and reconnaissance systems; and space access vehicles.

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: High Speed Systems Technology	11.355	22.123	21.153	-	21.153
Description: Develop design analysis methods and technologies for high speed systems at extreme flight conditions.					
FY 2022 Plans: Continue to mature critical technologies for high speed/ hypersonic flight with primary emphasis on longer range flight and heavier payloads. Continue maturation of innovative structural concepts, analytical methods, service life predictions, airframe/engine integration, and thermal management techniques for structures. Complete development of design and analysis techniques and tools as well as experimental approaches to enable enhanced high-speed air induction system starting, operability, and performance for propulsion integration concepts over a wide range of flight conditions. Continue development of high speed system concepts that provide revolutionary capabilities including affordable expendable systems and robust reusable systems. Continue investigation of aeromechanic technologies to reduce drag and enable robust stability and control at all flight conditions. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through ground and flight testing. Complete assessment of engagement, mission, and campaign-levels of effectiveness for promising high speed systems and refine concept designs to incorporate needed capabilities.					
FY 2023 Base Plans: Continue critical technology maturation for high speed/ hypersonic systems with primary emphasis on longer range flight and heavier payloads. Continue maturation of innovative aerospace structural concepts, analytical methods, service life predictions, airframe/engine integration, fluid/thermal/structural interactions and thermal					

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622405 / <i>High Speed Systems Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>management techniques. Continue development of high speed system concepts, including flight research concepts, to provide revolutionary capabilities for affordable expendable systems and robust reusable systems. Complete investigation of aeromechanic technologies to reduce drag and enable robust stability and control at all flight conditions. Continue efforts to characterize high-speed structural phenomena, develop and validate fundamental high-speed component technologies through computational analysis, ground, and flight testing.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$0.970 million. Funding decrease due to decreased emphasis on high speed system structures.</p>					
<p>Title: High Speed Vehicle Aeromechanics and Integration</p> <p>Description: Develop new and improved components, concepts, and designs for sustained flight of high-speed/hypersonic expendable and re-useable vehicles. Conduct analyses of high speed/hypersonic vehicles to enable revolutionary capabilities.</p> <p>FY 2022 Plans: Continue to mature critical technologies for high speed/hypersonic flight with primary emphasis on longer range flight, heavier payloads, and high speed deployment. Continue development of design and analysis techniques and tools as well as experimental approaches to enhance high-speed engine inlet performance over a wide range of flight conditions. Continue development of high speed system concepts that provide revolutionary capabilities. Continue investigation of aeromechanic technologies to reduce drag, evaluate uncertainty, improve instrumentation accuracy, enable payload deployment, and achieve robust stability & control at all flight conditions. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through ground and flight testing. Continue assessment of engagement, mission, and campaign level effectiveness for promising high speed system concepts and refine concept designs to incorporate needed capabilities. Complete assessment of campaign level benefits of preferred high speed weapon alternatives.</p> <p>FY 2023 Base Plans: Continue to mature critical technologies for high speed/hypersonic flight with primary emphasis on longer range and heavier payloads, with secondary emphasis on reusable systems. Continue development of multi-disciplinary design and analysis techniques and tools. Complete development of experimental approaches to enhance high-speed engine inlet performance over a wide range of flight conditions. Continue development of high speed system concepts that provide revolutionary capabilities through configuration research. Continue</p>	8.178	15.980	15.279	-	15.279

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622405 / <i>High Speed Systems Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
investigation of aeromechanic technologies to reduce drag, evaluate uncertainty, improve instrumentation accuracy, include safe multi-body physics, and achieve robust stability & control at all flight conditions. Continue efforts to characterize high-speed aeromechanics phenomena and develop and validate fundamental high-speed component technologies through computational analysis, ground, and flight testing. Complete assessment of engagement, mission, and campaign level effectiveness for promising high speed system concepts and refine concept designs to incorporate needed capabilities.					
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY2023 decreased compared to FY2022 by \$0.701 million. Funding decrease due to decreased emphasis on high speed vehicle technologies.					
Accomplishments/Planned Programs Subtotals	19.533	38.103	36.432	-	36.432

	FY 2021	FY 2022
<i>Congressional Add:</i> Program increase - secure UAV technologies	9.703	-
<i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts		
<i>Congressional Add:</i> Program increase - modeling and testing of high temperature aero vehicle	3.881	-
<i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts.		
<i>Congressional Add:</i> Program increase - hypersonic research and education	2.340	-
<i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	15.924	-

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>			Project (Number/Name) 622406 / <i>Aerospace Power & Flight Control Technology</i>				
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622406: <i>Aerospace Power & Flight Control Technology</i>	-	25.130	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops integrated electrical and thermal management components, controls and systems for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, affordability, and supportability of aircraft and flight line equipment. Research is conducted in energy storage and hybrid power system technologies to enable special purpose applications. Electrical power and thermal management technologies enable future military megawatt level power and thermal management needs. Controls and system integration technologies ensure the interoperability of aircraft, power, thermal, engine and other systems and subsystems. This project supports development of electrical power and thermal management components, controls and systems suitable for applications to legacy and future aircraft platforms including strike and mobility concepts. Lightweight power systems suitable for other aerospace applications are also developed. This project develops technologies that enable maximum affordable capability from manned, remotely-piloted and autonomous aerospace vehicles. Advanced control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous or remotely piloted air vehicles, hypersonic aircraft, and extended-life legacy aircraft.

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: High Power System Technologies	10.337	0.000	0.000	-	0.000
Description: Develop integrated system architecture, controls, and component technologies to provide for the large amounts of electrical power needed, and concurrent thermal mitigation required, by current and future manned and unmanned systems.					
FY 2022 Plans: Not applicable.					
FY 2023 Base Plans: Not applicable.					
FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable.					
Title: Advanced Flight Control Technologies	3.391	0.000	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622406 / <i>Aerospace Power & Flight Control Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>Description: Develop technologies for advanced control-enabled capabilities, including flight controls, components, integrated vehicle management systems and software and system certification techniques for both manned/unmanned and remotely piloted aircraft.</p> <p>FY 2022 Plans: Not applicable</p> <p>FY 2023 Base Plans: Not applicable.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable.</p>					
<p>Title: Manned and Unmanned Teaming Technologies</p> <p>Description: Develop technology for flight control systems that will permit safe interoperability between manned and remotely piloted aircraft and effective teaming in adverse and contested environments.</p> <p>FY 2022 Plans: Not applicable.</p> <p>FY 2023 Base Plans: Not applicable.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable.</p>	8.809	0.000	0.000	-	0.000
<p>Title: Flight Controls Technologies Modeling and Simulation</p> <p>Description: Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles.</p> <p>FY 2022 Plans: Not applicable.</p> <p>FY 2023 Base Plans: Not applicable.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	2.593	0.000	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 622406 / <i>Aerospace Power & Flight Control Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Not applicable.					
Accomplishments/Planned Programs Subtotals	25.130	0.000	0.000	-	0.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>				Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
623066: <i>Turbine Engine Technology</i>	-	2.924	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops technology to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental areas of emphasis are fans and compressors, high temperature combustors, turbines, internal flow systems, controls, augmentor and exhaust systems, integrated power and thermal management systems, engine inlet integration, mechanical systems, adaptive cycle technologies, and structural design. The project investigates advanced propulsion, power, and thermal management system for subsonic, supersonic, or hypersonic vision systems for the 2025-2035 timeframe to: Develop and demonstrate propulsion technologies for subsonic expendable and attritable air platforms; develop and validate targeted life component design, materials, and modeling tools for all engine classes; develop advanced turbine engine technologies to enable significantly increased range and dash speed; investigate durability, efficiency, and specific power with reduced cost of ownership for reusable engines; develop pervasive, hydrocarbon fueled pressure gain propulsion technologies that offer increased efficiency, reduced propulsion system volume/weight, and truly disruptive vehicle performance to the warfighter; evaluate lubricants, mechanical systems, and combustion concepts for advanced turbine engines, pressure gain propulsion, and combined cycle engines; analysis for an adaptive cycle engine architecture that provides both optimized performance and fuel efficiency for widely varying mission needs.

This project supports joint Department of Defense, agency, and industry efforts to focus turbine propulsion technology on national needs. The project plan is relevant across capability areas for global responsive air superiority, strike, tactical and global mobility, responsive space lift, and persistent intelligence, surveillance, and reconnaissance (ISR).

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Turbofan/Turbojet Engine Technologies	1.287	0.000	0.000	-	0.000
Description: Develop core turbofan/turbojet engine components (i.e., fans, nozzles, compressors, combustors, and turbines and mechanical systems) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports.					
FY 2022 Plans: Continue development of improved aerodynamic design tools and analysis methods to extend engine operability and efficiency. Continue developing physics-based bearing life model based on bearing alloy fatigue and microstructural investigations, including bearing life factors for advanced bearing materials. Continue incorporating fatigue life, fault evolution, and parametric heat generation of advanced material systems into the models. Continue development of oil-free bearing technology for Unmanned Air Systems. Continue the					

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>development and demonstration of propulsion technologies for subsonic expendable and attritable air platforms, small and medium scale propulsion technologies, and evaluate lubricants, mechanical systems, bearing technology and combustion concepts for advanced turbine engines. Continue the development of fundamental knowledge of bearing material rolling contact fatigue failure mechanisms and lubricant interactions through microstructural investigations and failure analysis.</p> <p>FY 2023 Base Plans: Not applicable.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: No increase or decrease.</p>					
<p>Title: Turboshaft/Turboprop and Small Turbofan Engine Technologies</p> <p>Description: Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.</p> <p>FY 2022 Plans: Continue to demonstrate advanced component designs in rig testing. Continue to utilize validation data to develop improved test protocol for small engine augmentor designs. Continue development and validation of modeling and simulation tools for the design and analysis of turbine components with mission-tailored aero-performance and highly efficient cooling geometries. Continue the new innovative architectures, critical technologies, exploration of targeted life applications for small missile and remotely piloted aircraft applications; evaluate critical technologies that will increase range, performance, durability, electrical power and thermal capacity of these systems. Continue the exploration of new small engine technologies that can operate in high speed applications; Evaluate risk reduction technologies to increase usage time of systems. Continue demonstrating advanced component designs and modeling tools in rig and engine testing. Continue to utilize validation data to develop improved test protocol for small engine designs. Continue development and validation of modeling and simulation tools for the design and analysis of engine components with new manufacturing processes. Continue the exploration of advanced integrated engine controls with potential for synergistic airframe system level benefits. Continue exploration of new small and medium size engine technologies for increased fuel efficiency, propulsive capability, power and thermal management, and reduced life cycle cost. Continue identification of new architectures and critical technologies for integrated power and thermal systems. Continue identification of requirements and develop models for simulation of highly integrated systems. Continue exploring interactions and effects of compressor and turbine components on the combustor and combustor</p>	0.234	0.000	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>materials to reduce engine weight and increase efficiency. Continue using advanced diagnostics tools to develop high-quality datasets for use by academia and industry for model development and verification. Continue the determination of necessary reference performance and operability combustion systems and metrics to decrease the cost of certifying new and alternative fuels in weapon systems. Continue to support development of advanced computational fluid dynamics (CFD) models to reduce combustor and augmentor design costs. Continue development of computations, modeling and simulation, and research experimentation of advanced combustion concepts including pressure gain combustion components and system level architectures. Continue to explore advanced combustion and flameholding concepts working towards improved understanding at relevant operating conditions such as sub-atmospheric (less than 1 atmosphere) and high pressure (greater than 10 atmospheres); this includes fundamental combustion modeling and fluid-dynamic phenomena on high speed systems and rocket propulsion and advanced turbine engine applications, identifying modeling and simulation concepts/approaches to address combustion chemistry and physics and light/matter interactions, for high speed systems exploring turbulent combustion modeling in advanced configurations, exploring advanced combustion including pressure gain propulsion as it relates to new applications and architectures. Continue the development and demonstration of new tools and use of new designs and materials to improve efficiency, power under quiet operations. Continue investigation to identify and assess disruptive propulsion/power concepts and evaluate concepts. Continue development of new technologies for unmanned aircraft system propulsion/power systems for improved understanding at relevant operating conditions.</p> <p>FY 2023 Base Plans: Not applicable.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: No increase or decrease.</p>					
<p>Title: Diagnostic Technologies</p> <p>Description: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies.</p> <p>FY 2022 Plans: Continue supporting computational fluid dynamics combustion modeling by providing, insights for interpreting experimental results using existing Modeling & Simulation methodologies and applying recently developed high-speed, spatially resolved laser diagnostics to our representative, single- element combustion experiments in order to demonstrate and deliver measurements of key combustion species and flow properties under high</p>	0.000	0.000	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>pressure conditions. Continue development of diagnostic tools/methods for robust measurement capability in engine test cells and full annular ground test environments including reacting and non-reacting spray experiments for liquid fuel spray model development and employment of Nonintrusive optical diagnostics that will be used to obtain accurate, spatially/temporally resolved data. This provides the local flow field data required for comparisons to results of numerical simulations. Continue the development of improved numerical methods and turbulent combustion models to guide design and development of experimental components and systems utilizing existing Modeling & Simulation methodologies.</p> <p>FY 2023 Base Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: No increase or decrease.</p>					
<p>Title: Revolutionary Propulsion Technology</p> <p>Description: Develop, test, and evaluate revolutionary propulsion concepts for gas turbine, pressure gain propulsion, and combined cycle engines for missiles, manned and unmanned systems.</p> <p>FY 2022 Plans: Continue identification of control technology elements applicable to integrated propulsion/power/thermal solutions. Continue evaluation of power and thermal modeling of advanced architectures into aircraft system level multidisciplinary analysis and optimization tools: explore new control methods for integrated propulsion, power and thermal management; continue evaluation of integration of advanced augmentors and ramburners; continue exploration of new expendable and attritable architectures. Continue the development and evaluation of advanced, integrated propulsion technologies for supersonic expendable, attritable, and reusable strike and Intelligence, Surveillance, and Reconnaissance (ISR) systems. Continue studies for exploration of advanced propulsion technologies. Continue exploration and evaluation of innovative architectures for affordable & efficient air-launched propulsion capability from Mach 3 to Mach 5+, and turbine based combined cycle propulsion capability to Mach 5+.</p> <p>FY 2023 Base Plans: Not applicable.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	0.789	0.000	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies	Project (Number/Name) 623066 / Turbine Engine Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
No increase or decrease.					
<p>Title: Missile and Unmanned Aerial System (UAS) Engine Technologies</p> <p>Description: Develop limited life engine components for missile and Unmanned Aerial System (UAS) applications, including long-range subsonic, supersonic and hypersonic vehicles.</p> <p>FY 2022 Plans: Continue identification of control technology elements applicable to integrated propulsion/power/thermal solutions. Continue evaluation of power and thermal modeling of advanced architectures into aircraft system level multidisciplinary analysis and optimization tools: explore new control methods for integrated propulsion, power and thermal management; continue evaluation of integration of advanced augmentors and ramburners; continue exploration of new expendable and attritable architectures. Continue the development and evaluation of advanced, integrated propulsion technologies for supersonic expendable, attritable, and reusable strike and Intelligence, Surveillance, and Reconnaissance (ISR) systems. Continue exploration of new engine concepts for missile and unmanned systems.</p> <p>FY 2023 Base Plans: Not applicable.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: No increase or decrease.</p>	0.614	0.000	0.000	-	0.000
<p>Title: Lubricant Technologies</p> <p>Description: Develop, test, and qualify advanced turbine engine lubricants. Generate and maintain military specifications for aviation engine lubricants.</p> <p>FY 2022 Plans: Continue developing innovative fluids by; defining target requirements for new polyol ester oils, conducts Research & Development for new/enhanced turbine engine oils for legacy & emerging engines, qualifies new & updated engine oil products for legacy & emerging engines. Continue the development of lubricant modeling through characterization of heat generation, lubrication system cooling effectiveness, failure progression of bearing materials under relevant engine conditions, and overall system performance of advanced bearing concepts for model validation. Continue supporting the warfighter on field-related mechanical system issues. Continue performance validation study of advanced bearing designs/materials, lubricant & lubrication system components via full-scale high-fidelity laboratory parametric testing at representative engine operating</p>	0.000	0.000	0.000	-	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
conditions. Continue the generation of the fatigue life database & assess fatigue growth characteristics of state of the art baseline, emerging, & advanced engine rolling element bearing materials thru sub-scale experimental investigations. <i>FY 2023 Base Plans:</i> Not applicable. <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> No increase or decrease.					
Accomplishments/Planned Programs Subtotals	2.924	0.000	0.000	-	0.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602201F / <i>Aerospace Vehicle Technologies</i>				Project (Number/Name) 625172 / <i>NUCLEAR SYSTEM TECHNOLOGY</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
625172: <i>NUCLEAR SYSTEM TECHNOLOGY</i>	-	0.000	3.652	3.534	0.000	3.534	3.616	3.679	3.359	3.434	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides sustaining S&T to preserve nuclear deterrence for future generations, develops complimentary projects to inform future systems, establishing inter-agency partnerships for Modeling & Simulation (M&S) and test platforms, and coordinates with existing programs for next generation strategic systems development and test platforms.

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

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Nuclear Technologies	0.000	3.652	3.534	-	3.534
Description: Develop nuclear-related technologies to support National requirements for nuclear deterrence operations including environmental modeling and simulation on re-entry systems.					
FY 2022 Plans: Continue to test new algorithms on high performance computing capabilities with special focus on automation of seismic event discrimination and characterization, improving earth structure models, and developing analysis methods for emerging detection technologies. Continue to exercise earth models in use in high-performance computing modeling and simulation codes for operational expert analysis of difficult-to-discriminate earthquakes and explosions. Continue to test specific algorithms for application of big data heuristics to more quickly characterize seismic events. Continue to further develop new statistical approaches to the behavior of discriminants for local and regional seismic events. Initiate refinement of distributed acoustic sensing methodology to provide a new detection solution for seismic explosion monitoring.					
FY 2023 Base Plans: Continue to develop and test new algorithms using high performance capabilities which focus on automation of seismic event discrimination and characterization. Continue to develop earth models and statistical approaches to advance the ground-based seismic nuclear monitoring mission through improving anomaly detection, attribution and protection. Continue to further develop new statistical approaches to the behavior of discriminants for local and regional seismic events. Initiate enhanced seismic monitoring with distributed acoustic sensing with machine learning data analysis approaches. Continue development of end-to-end modeling suite for re-entry systems by incorporating additional flight physics databases and solvers and adding more user/analysis tools. Continue aerothermal model validation and development through various testing					

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / Aerospace Vehicle Technologies	Project (Number/Name) 625172 / NUCLEAR SYSTEM TECHNOLOGY
--	--	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
mechanisms. Initiate analysis of strategic command, control, and communications to identify space-layer technologies of interest.					
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$0.118 million. Justification for this decrease is described in plans above.					
Accomplishments/Planned Programs Subtotals	0.000	3.652	3.534	-	3.534

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
Not applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>
---	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	127.160	156.863	135.771	0.000	135.771	118.402	115.918	118.441	121.176	Continuing	Continuing
621123: <i>Learning and Operational Readiness</i>	0.000	22.361	18.591	21.164	0.000	21.164	21.492	21.704	22.164	22.647	Continuing	Continuing
625328: <i>Human Dynamics Evaluation</i>	0.000	40.124	84.405	28.668	0.000	28.668	26.417	22.117	22.648	23.301	Continuing	Continuing
625329: <i>Sensory Evaluation and Decision Science</i>	0.000	37.547	35.783	40.148	0.000	40.148	40.764	41.719	42.606	43.530	Continuing	Continuing
627757: <i>Bioeffects</i>	0.000	27.128	18.084	45.791	0.000	45.791	29.729	30.378	31.023	31.698	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program conducts applied research in the area of airmen training, airmen performance sustainment, bioeffects, and understanding and shaping adversarial behavior. The Learning and Operational Readiness project conducts research to increase the agility of training for readiness while advancing learning and performance assessment science and practice. The Biosciences Performance project conducts research to discover, demonstrate, and transition capabilities which optimize and safe-guard Airman physical and cognitive performance allowing for the maximum potential of the multi-domain Airman. The Sensory Evaluation and Decision Science project conducts research to discover, develop, and transition advanced interface technology, decision aiding tools, and situationally-adaptive augmentation methods to seamlessly integrate Airmen and intelligent machines into maximally collaborative warfighting teams. The Bioeffects project conducts novel and operational exposure bioeffects research, exposure effects analysis and national/international exposure standards for the Air Force to enable, sustain, and enhance Airman performance and protection during deployment of directed energy systems.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, and 0602298F.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>
---	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	133.877	136.273	0.000	0.000	0.000
Current President's Budget	127.160	156.863	135.771	0.000	135.771
Total Adjustments	-6.717	20.590	135.771	0.000	135.771
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	20.590			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-2.108	0.000			
• Other Adjustments	-4.609	0.000	135.771	0.000	135.771

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 625328: *Human Dynamics Evaluation*

Congressional Add: *Warfighter Physiology Program*

Congressional Add: *Human Motion Assessment*

Congressional Add: *Pilot Hypoxia Detection and Notification*

Congressional Add: *F-35 Helmet Mounted Display System Tech Refresh and Weight Reduction*

Congressional Add: *Special Tactics Support Assessment*

Congressional Add Subtotals for Project: 625328

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	4.817	0.000
	3.853	0.000
	9.538	7.000
	0.000	9.590
	0.000	4.000
	18.208	20.590
	18.208	20.590

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 621123 / <i>Learning and Operational Readiness</i>
--	---	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
621123: <i>Learning and Operational Readiness</i>	0.000	22.361	18.591	21.164	0.000	21.164	21.492	21.704	22.164	22.647	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project advances research to measure, accelerate, and expand the cognitive skills necessary to improve airmen training and mission performance. The emphasis is on developing technology to enable a more lethal force by delivering revolutionary training and readiness capabilities at the speed of operations. Research is conducted in two focus areas: personalized learning and cognitive modeling. Personalized learning focuses on exploratory application of adaptive proficiency technologies and interactive task learning capabilities to provide more effective, efficient learning that improves mission readiness. Cognitive modeling advances computational and mathematical methods to represent human information processing to facilitate the development of models capable of operating as intelligent teammates, adversaries, or coaches, and cognitive performance prediction systems.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Personalized Learning</p> <p>Description: Research enhances distributed mission operations (DMO) and live-virtual-constructive (LVC) environments through the creation and exploratory application of adaptive proficiency technologies and interactive task learning capabilities, to provide more effective, efficient learning that improves mission readiness.</p> <p>In FY 2021, this effort changed names from Continuous Learning to Personalized Learning.</p> <p>FY 2022 Plans: Initiate research to evaluate new integrated human and machine personalized learning capabilities in mission-relevant laboratory, testbed, and field environments. Continue development of novel methods for adaptive, multi-objective optimization of instruction, as well as the development of quantitative measures to estimate uncertainty in proficiency measurement and prediction. In collaboration with Cognitive Modeling effort within this project and Multisensory Perception and Communication effort within the Sensory Evaluation and Decision Science Project, initiate research on the integration of multi-modal data to support improved inference, understanding, and decision-making in team-based performance environments.</p> <p>FY 2023 Plans: Continue research to evaluate integrated human and machine personalized learning capabilities in mission-relevant laboratory, testbed, and field environments. Evaluate adaptive, multi-objective optimization methods in constrained instructional settings. Incorporate uncertainty in proficiency measurement and prediction in laboratory assessments. Initiate research to evaluate the impact of training fidelity related to augmented, virtual, mixed, and extended reality on readiness. Explore methods and</p>	13.416	11.155	12.698

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 621123 / <i>Learning and Operational Readiness</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
standards for assessing transfer of skill for just in time, novel mission training requirements for a peer fight in deployed and austere environments. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.543 million. Funding increase due to added emphasis in personalized learning, and multi-objective instruction and interactive task learning.				
Title: Cognitive Modeling Description: Research explores application of mathematical and computational modeling to understand the human mind and factors that will enhance or degrade cognitive performance. Simulations of training in mission-relevant environments (e.g., flight simulators, multi-domain operations) will optimize learning strategies during training to increase/accelerate mission readiness. FY 2022 Plans: Initiate research to track performance by profiling cognitive performance during task execution. Identify mechanisms to predict performance impacts of fatigue countermeasures. Demonstrate technology to track and predict individual fatigue. Continue integration of physiological and cognitive models to predict performance under chemical exposure. Evaluate models that identify and resolve knowledge gaps resulting from learning from text-based instructions. Initiate research on language adaptation in team-based communication in collaboration with Personalized Learning effort within this project and Multisensory Perception and Communication effort within the Sensory Evaluation and Decision Science Project. FY 2023 Plans: Demonstrate laboratory capability to profile workload and cognitive performance in real time. Evaluate real-time, personalized tracking of fatigue in operationally relevant environments, including impacts of countermeasures. Apply integrated physiology-cognitive models to oxygen deprivation and chemical air contaminants. Demonstrate automated knowledge and skill learning through verbal instruction with knowledge gap resolution in a laboratory-based artificial learning system. Mature mechanisms for adaptation in communication within human-machine teams. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.030 million. Funding increase due to added emphasis in high-cognitive-fidelity models for predictive cognitive performance.		8.945	7.436	8.466
Accomplishments/Planned Programs Subtotals		22.361	18.591	21.164
C. Other Program Funding Summary (\$ in Millions) N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / Human Effectiveness Applied Research	Project (Number/Name) 621123 / Learning and Operational Readiness

C. Other Program Funding Summary (\$ in Millions)

Remarks

None

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / Human Effectiveness Applied Research	Project (Number/Name) 625328 / Human Dynamics Evaluation
--	--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
625328: <i>Human Dynamics Evaluation</i>	0.000	40.124	84.405	28.668	0.000	28.668	26.417	22.117	22.648	23.301	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts bioengineering and biotechnology research to optimize, safe-guard, and restore the performance of the multi-domain Airman and warfighter in all environments. Research is focused in the areas of 1) cognitive and physiological performance technologies to sustain, augment, and recover operator performance; 2) biotechnology for performance--research in systems biology, synthetic biology, and risk assessment; 3) performance sensing and assessment--technologies to sense and forecast operator state based on physiological, molecular, and environmental signatures related to mission performance; and 4) performance impact of space and flight--elucidate how air and space environments affect processes of life and the ability to maintain homeostasis and develop countermeasures and solutions to sustain, enhance, and restore operator performance.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Performance Sensing and Assessment</p> <p>Description: Develop technologies to sense and forecast operator state based on physiological, molecular, and environmental signatures related to Airman and warfighter performance. Develop solutions optimized for real-time, minimally-invasive, and autonomous sensing and assessing capabilities to enhance and protect the Airman and the warfighter across the spectrum of operational environments.</p> <p>In FY 2023, this effort changed names from Molecular Sensing and Physiology to Performance Sensing and Assessment.</p> <p>FY 2022 Plans: Mature Biological Recognition Elements (BRE) development pipeline and optimize for BRE transition to sensor platforms. Develop and test different sensor options (electrochemical, field effect transistors, etc.) for biomarker and Volatile Organic Compounds (VOCs) detection in different operational environments. Incorporate sensor modalities into wearable and injectable sensors. Integration of biological system and their components in sensing platforms. Design, test and evaluate solutions for air quality assessment (sampling, analysis and models). Finalize investigation into Onboard Oxygen Generating System oxygen and flow performance decrements during highly dynamic operating conditions. Conduct Onboard Oxygen Generating System (OBOGS) chemical containment research to assess quality of OBOGS breathing gas under realistic operating conditions. Develop Onboard Oxygen Generating System performance monitor for predicting failure. In FY 2021 and prior years, the OBOGS research is performed under Project 625328/Human Dynamics Evaluation, Aircrew Biodynamics and Protection sub-project.</p> <p>FY 2023 Plans:</p>	5.479	15.953	7.167

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 625328 / <i>Human Dynamics Evaluation</i>

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

	FY 2021	FY 2022	FY 2023
<p>Develop rapid Biological Recognition Element (BRE) selection and optimization strategies. Develop electrochemical and Field Effect Transistors (FET)-based biomarker sensing platforms, including synthetic biology developed components. Optimize sensor form factor for deployment with focus on platform miniaturization. Develop wearable and implantable/biodegradable sensors for continuous biomarker monitoring. Develop platforms to deliver augmentation strategies in an autonomous fashion. Evaluate commercial, off-the-shelf molecular-based sensing technologies for Air Force and Space Force applications. In FY 2023, the research performance of On-board Oxygen Generation System (OBOGS) and implications on human physiology for current and next-generation aircraft is being performed under the Project 625328/Performance Impact of Air and Space sub-project.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$8.786 million. Funding decrease due to a reduced emphasis in physiological, molecular, and environmental signatures related to the warfighter's performance.</p>			
<p>Title: Biotechnology for Performance</p> <p>Description: Conduct research in systems biology, synthetic biology, and physiologic risk assessment research to focus on the underlying mechanisms contributing to individual performance in various operational environments through the integration of genomics, proteomics, metabolomics, and epigenetics. Conduct research to utilize multi-omics technologies to determine the risk associated with exposure to toxic compounds and materials. Resulting research will generate biomarker candidates for sensing personalized predictions of response to stressors and novel interventions to optimize, safeguard, and restore Airman and warfighter performance.</p> <p>In FY 2023, this effort changed names from Systems Biology for Performance to Biotechnology for Performance.</p> <p>FY 2022 Plans: Explore mechanistically inspired synthetic biology and other performance enhancing technologies to include engineering the microbiome. Generate mechanistic understanding of the effects of stress factors from which to generate biomarkers. Develop advanced physical and in silico models and simulations to predict individualized performance.</p> <p>FY 2023 Plans: Develop a microfluidic "brain-on-a-chip" platform simulating the dynamic environment and physiologic conditions of brain cells/ tissue to include blood brain barrier oxygen dynamics. Utilize advanced bio-data analytics and bioinformatics processing to analyze baseline multi-omics data collected on large scale research cohort--identify relevant biomarkers, mechanisms of action, and intervention strategies to provide predictive performance assessment algorithms for physical and cognitive augmentation. Identify nasal microbiome strain suitable for peptide delivery to improve stress resilience.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	5.479	15.954	7.167

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 625328 / <i>Human Dynamics Evaluation</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 decreased compared to FY 2022 by \$8.787 million. Funding decrease due to a reduced emphasis in systems biology, synthetic biology, and physiologic risk assessment research.				
<p>Title: Cognitive and Physiological Performance</p> <p>Description: Develop technologies in cognitive neuroscience and physical performance to sustain, augment, and recover operator performance and determine performance attributes/metrics for optimal career field alignment. Includes research focused on developing and validating physiological and behavioral assessments of current and predicted cognitive state combined with personalized cognitive performance enhancement techniques and technologies to augment operator performance.</p> <p>In FY 2023, this effort changed names from Cognitive Neuroscience to Cognitive and Physiological Performance.</p> <p>FY 2022 Plans: Continue research to elucidate the neural mechanisms of neuromodulation and stress on cognitive performance in animal models. Conduct studies of peripheral nerve stimulation effects on various aspects of cognition including learning, attention, and multitasking. Explore methods of addressing physiologic variability between days, people, tasks, and time to improve the accuracy of cognitive state assessments. Perform research to develop methods of assessing fatigue state via physiology, and compare the effects of cognitive interventions on performance during sleep deprivation. Continue development of a novel Brain Machine Interface (BMI) technology to accelerate training for Air Force personnel, such as pilots.</p> <p>FY 2023 Plans: Conduct evaluation of Brain Machine Interface (BMI) devices optimized for extended reality (XR) applications or alternate Air Force relevant application. Conduct research to determine feasibility to send interpretable information directly to the brain. Conduct longitudinal study evaluating passive sensing technologies for cognitive state assessment. Transition artifact correction algorithms necessary for accurate cognitive state assessment to advanced development projects. Update real-time analytics testbed with additional capabilities and utilize for cognitive probing validation and replication experiments. Finalize research detailing differences between effects of transcranial direct current stimulation (tDCS) and transcutaneous vagal nerve stimulation (tVNS) on brain physiology and structure. Initiate neuromodulation paradigms for cognitive enhancement across Air Force career fields (i.e., piloting; intelligence, surveillance, and reconnaissance (ISR); cyber operations; special operations).</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$8.787 million. Funding decrease due to a reduced emphasis in predictive and personalized cognitive performance enhancement techniques.</p>		5.479	15.954	7.167
Title: Performance Impact of Air and Space		5.479	15.954	7.167

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 625328 / <i>Human Dynamics Evaluation</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Description: Conduct research investigating Airman and warfighter performance degradation resulting from exposure to air and space environments, and seek to understand the fundamental mechanisms driving environmental and operational risks. Develop technologies to mitigate or eliminate the root physiologic causes of these degradations and to ultimately optimize Airman and warfighter performance resulting in the capability to fly faster, higher, and longer than our adversaries.</p> <p>In FY 2023, this effort changed names from Aircrew Biodynamics and Protection to Performance Impact of Air and Space.</p> <p>FY 2022 Plans: Conduct research to develop and validate lumbar and neck injury criteria. Continue development of computational modeling to predict and assess acute and chronic injury to full aircrew. Conduct research to ascertain injury mechanisms of chronic neck and back pain to aircraft mission durations and vibration effects. Continue research on evaluation of structural integrity of medical transport devices.</p> <p>In FY 2022, the Onboard Oxygen Generating System (OBOGS) research will be performed under Project 625328, effort Human Dynamics Evaluation.</p> <p>FY 2023 Plans: Conduct research to develop next generation onboard oxygen generation system (OBOGS) technologies. Conduct research to characterize aircrew kinematics, and etiology related to acute and chronic back/neck pain and musculoskeletal injuries. Develop mitigation strategies such as physical conditioning, system design improvements, and interventional strategies to repair post-sortie injury from high-G exposures. Develop human digital engineering algorithms and models for fighter and bomber aircraft system design and human factors analysis applications. In FY 2023, Onboard Oxygen Generating System (OBOGS) research moved from the Project 625328, effort Performance Sensing and Assessment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$8.787 million. Funding decrease due to a reduced emphasis in efforts focused on understanding the root physiologic, environmental, and operational degradations.</p>				
Accomplishments/Planned Programs Subtotals		21.916	63.815	28.668
		FY 2021	FY 2022	
Congressional Add: Warfighter Physiology Program		4.817	0.000	

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 625328 / <i>Human Dynamics Evaluation</i>	
		FY 2021	FY 2022
FY 2021 Accomplishments: Conduct Congressionally directed efforts			
FY 2022 Plans: Not applicable			
Congressional Add: Human Motion Assessment		3.853	0.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts			
FY 2022 Plans: Not applicable			
Congressional Add: Pilot Hypoxia Detection and Notification		9.538	7.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts			
FY 2022 Plans: Not applicable			
Congressional Add: F-35 Helmet Mounted Display System Tech Refresh and Weight Reduction		0.000	9.590
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts			
Congressional Add: Special Tactics Support Assessment		0.000	4.000
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts			
Congressional Adds Subtotals		18.208	20.590
C. Other Program Funding Summary (\$ in Millions)			
N/A			
Remarks			
D. Acquisition Strategy			
Not applicable			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>				Project (Number/Name) 625329 / <i>Sensory Evaluation and Decision Science</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
625329: <i>Sensory Evaluation and Decision Science</i>	0.000	37.547	35.783	40.148	0.000	40.148	40.764	41.719	42.606	43.530	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts research to discover, develop, and transition advanced interface technology, decision aiding tools, and situationally-adaptive augmentation methods to seamlessly integrate Airmen and intelligent machines into maximally collaborative warfighting teams. Advanced technologies will enhance how Airmen fight via improved team interactions and adaptive information throughput. Airman-Machine interaction design is critical for achieving mission success and maintaining meaningful human control in highly complex, uncertain, and rapidly evolving environments.

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

	FY 2021	FY 2022	FY 2023
Title: Collaborative Interfaces and Teaming	10.138	9.661	10.840
Description: Research new Human-Machine Teaming (HMT) technologies and concepts (e.g., information portrayal, control devices, decision aiding algorithms and adaptive agents) for effective human-machine interaction and teamwork.			
FY 2022 Plans: Develop and test multiple interface designs for teaming solutions based on research on swift trust development, and effective teaming methods between human operators in a Joint All Domain Command and Control (JADC2) context; develop a multi-domain playbook for JADC2 operators; conduct research and experimentation focused on human-machine-teaming (HMT) and collaborative interface design among mixed human-human and human-machine teams; conduct research on trust development within mixed human-synthetic agent teams; conduct research on human implications of machine learning and run-time assurance technologies; conduct research focused on development of software architectures and platforms to enable HMT for pilot-vehicle interfaces, Unmanned Aerial System (UAS) teaming, base defense, and air battle management.			
FY 2023 Plans: Develop and validate the effects of multiple interface designs for teaming solutions based on research on swift trust development and effective teaming methods between human operators in a Joint All Domain Command and Control (JADC2) context; expand a multi-domain playbook for JADC2 operators to include Air, Space and Cyber effects; conduct research and experimentation focused on human-machine-teaming (HMT) and collaborative interface design among mixed human-human and human-machine teams in applied and simulated domains; conduct research on trust development within mixed human-synthetic agent teams; conduct research on human implications of machine learning and run-time assurance technologies; conduct research focused on development of software architectures and platforms to enable human-machine-teaming (HMT) for pilot-vehicle interfaces in operationally relevant scenarios, Unmanned Aerial System teaming, base defense, and air battle management; apply research			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 625329 / <i>Sensory Evaluation and Decision Science</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
methodologies to conduct operator-centric field evaluations of fielded automation/autonomy systems; synthesize guidelines for engendering trust in human-human and human-machine teams. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.179 million. Funding increase due to added emphasis in areas such as Human-Machine Teaming technologies, and collaborative interface designs in applied and simulated domains.				
Title: Multisensory Perceptions and Communication Description: Multisensory Perception and Communication focuses on identifying and exploiting the underlying sensory and cognitive mechanisms mediating human perception and communication in order to inform the development of multimodal interfaces and speech/language technologies. Research will examine sensory processing, multisensory integration, and human communication processes in simple and complex environments to identify the barriers to effective information transmission and inform the development of technologies to overcome, or exploit, those barriers in order to enhance Airmen performance. FY 2022 Plans: Conduct research examining impact of communication interruption on task performance and refine a prototype real-time interruption system for human-machine communication; evaluate impact of communication management technologies used in real-world operations; develop laboratory and web-based toolkit and tablet-based applications for studying communication and perception for use in remote and in-house experimentation; generate and test model of perception of real-world sounds in complex environments for developing tools supporting perceptual disruption; establish new testbed for neurophysiological studies of multisensory perception and multimodal display research; conduct research on multimodal contribution to automatic speech recognition and machine translation; develop new algorithms for real-time speech synthesis for speech displays; conduct experiments on speech perception in complex environments to improve operational communication; develop program for research in visual and auditory attention monitoring to inform advanced multimodal interfaces; measure, model, and simulate operational acoustic environments for use in training and interface research and development; address requests for direct support from operational community. FY 2023 Plans: Conduct behavioral research on team communication; collect operationally-relevant speech databases; develop new models of dialogue processes; build and integrate algorithms from these models into an existing communication interface for identifying intelligent interruption capability; identify characteristics of effective/ineffective communication to inform prototype miscommunication identification system; evaluate these capabilities in operationally-relevant testbeds. Build and evaluate new communication management technologies and explore new domain-specific features and form factors; test in operational exercises with military and civilian operational communities. Evaluate Augmented and Virtual reality (AR/VR) capabilities for providing information through additional perceptual channels (visual, haptic/tactile along with speech communications); for		14.268	13.597	15.256

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 625329 / <i>Sensory Evaluation and Decision Science</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>distributed, collaborative tasks, supporting multi-capable airmen. Develop multimodal symbologies and evaluate, with subject matter experts from flight community and Special Forces, in simulation and real-world operating environments with appropriate environmental/task complexity. Collect behavioral and neurophysiological data, use to refine real-time model of attention and processing capacity, integrate into operational testbeds to evaluate as driver for adaptive interfaces. Evaluate new technologies focused on perceptual and communication disruption in field tests. Continue to address requests for direct support from operational community.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.659 million. Funding increase due to added emphasis in areas such as cognitive mechanisms mediating human perception and communication, and evaluation of Augmented and Virtual reality capabilities for training and collaborative tasks.</p>			
<p>Title: System Analytics</p> <p>Description: System Analytics studies the macro-cognition of the Airman using computational tools to accomplish mission objectives, encompassing interactions between operators, analytics, and environment. The goal of this research area is to describe, assess, and design for effective integration of analytics into mission systems.</p> <p>FY 2022 Plans: Advance development of theory-driven, evidence-based approaches to integrate new analytics (including decision aids, algorithms, automation, autonomy, and artificial intelligence/machine learning technologies) into human-machine systems in complex operational environments. Lines of effort will emphasize maturation and transition of research in systems analytics assessment, dynamic wide area discovery and exploitation, meaning making in the information environment, applied operational analytics, joint integrated Intelligence, Surveillance, and Reconnaissance (ISR), and human language technology. Efforts will include increased investment in evaluation of conversational artificial intelligence, exploitation of publicly available information, and explain-ability and ISR applications of topological data analytics.</p> <p>FY 2023 Plans: Focus on the goal of accelerating design and assessment of mission relevant, Airman-centric data analytics capabilities at speed and scale. Research activities are aligned under two enduring Lines of Effort (LOEs). The Analytic-enabled Cognition LOE seeks to quantify the impact of analytics on thinking and reasoning in order to tailor capabilities to the context-specific cognitive requirements of Airmen. The Sense-making at Scale LOE seeks to design analytics to enhance sense-making and mitigate data overload in order to enable Airmen to rapidly extract meaning from complex, uncertain, multi-dimensional data sources. Planned areas of increased investment include cognitive and physiological performance assessment, development of analytics for insider threat identification, and decision support for joint all domain mission planning and execution. Areas of decreased investment</p>	13.141	12.525	14.052

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 625329 / <i>Sensory Evaluation and Decision Science</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
and transition to 6.3 will encompass single-INT analytics studies, data visualization for wide area monitoring, and technologies for intelligence requirement management.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$1.527 million. Funding increase due to an added emphasis in areas such as the analytics on thinking and reasoning in order to tailor capabilities to cognitive requirements of Airmen, and computational tools to accomplish mission objectives.			
Accomplishments/Planned Programs Subtotals	37.547	35.783	40.148

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602202F / Human Effectiveness Applied Research				Project (Number/Name) 627757 / Bioeffects			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
627757: Bioeffects	0.000	27.128	18.084	45.791	0.000	45.791	29.729	30.378	31.023	31.698	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts applied research on the effects of human exposure to electromagnetic energy (direct current to radio frequency to optical, scalable directed energy weapons, and non-lethal weapons). This research addresses fundamental physical principles, as well as the biophysical interaction between directed energy and the individual or groups of individuals. Research is divided into two core focus areas: novel directed energy bioeffects and mechanisms and directed energy modeling, simulation, and analysis. The research enhances combat survivability and systems effectiveness through technologies that enable deployed forces to counter optical threats and exploit optical systems for offensive applications. In addition, basic biological investigations into the mechanisms associated with high peak power and high average power radio frequency exposure allow for the exploitation of directed energy systems for offensive capabilities while protecting the warfighter from adversarial use of radio frequency technologies. The novel directed energy bioeffects mechanisms research examines the physical, physiological, and neural interactions of electromagnetic energy with tissues to understand dose-response effects as well as reveal the means to cause or prevent a specific effect. The directed energy modeling, simulation, and analysis research is focused on new software components that represent and optimize concepts of directed energy system employment from the Airman standpoint. These components are matured for future transition and application for engagement-to-mission level simulations in which directed energy weapons are employed.

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

	FY 2021	FY 2022	FY 2023
Title: Novel Directed Energy Bioeffects and Mechanisms	9.495	6.329	16.027
<p>Description: Conduct laboratory experiments to provide fundamental knowledge of mechanisms of interaction of directed energy with molecules, cells, tissues, organs, and whole organisms in support of military directed energy systems. Conduct laboratory experiments to understand the mechanistic and behavioral effects of novel weapon incidents to the Airman and to understand the effects of protection strategies on Airman performance.</p> <p>FY 2022 Plans: Continue multiple parameterization, validation and verification experimental studies which examine high peak power microwave, high energy laser, and other emerging directed energy weapon concepts in order to assure valid modeling of real-world concerns. Initiate studies to further understanding of superthreshold effects on critical tissues including dynamic tissue characteristics under superthreshold insult. Develop methodologies to validate representation of directed energy vision effects within the Modeling and Simulation environment. Collect data that leads to more refined exposure limits for militarily relevant environments. Examine postulated second-order effects for their impact on military missions. Examine mechanisms emerging from subcellular and cellular level response to radio frequency and optical radiation. Participate in activities that further development of directed energy bioeffects policy and standards to maximize safe use of the technology.</p> <p>FY 2023 Plans:</p>			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 627757 / <i>Bioeffects</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Continue collection and transition of data from multiple parameterization, validation and verification experimental studies to candidate products that support high peak power microwave, high energy laser, and other emerging directed energy weapon concepts in order to assure valid modeling of real-world concerns. Continue studies to further the understanding of suprathreshold effects on critical tissues including dynamic tissue characteristics under suprathreshold insult. Develop methodologies to represent human vulnerabilities and vision effects within the modeling and simulation environment. Examine mechanisms emerging from subcellular and cellular level response to radio frequency and optical radiation. Perform research that underpins enhanced assessment of operational exposures to battlefield directed energy environments. Provide research data and expertise to activities that further the development of directed energy policy and exposure standards to maximize interoperability and safe use of technology.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$9.698 million. Funding increase due to added emphasis in novel and experimental directed energy efforts to better understand dynamic tissue characteristics that support high peak power microwave, high energy laser, and other emerging directed energy weapon concepts.</p>				
<p>Title: Directed Energy Bioeffects Modeling, Simulation and Analysis</p> <p>Description: Conduct physics-level modeling and simulations to represent and optimize directed energy bioeffects to include direct, scalable, and collateral effects.</p> <p>FY 2022 Plans: Expand content of component level models to support future transitions of digital human representations to tactical wargaming and models. Translate new data from relevant biological experiments to establish engineering to mission-level models supporting severity of outcome in system risk assessments. Initiate new approaches for utilizing high performance computing for better characterizing uncertainty in quantitative models for bioeffects analysis. Extend advanced multi physics models to contain accurate representations of newly-discovered or postulated mechanisms of directed energy biological activity.</p> <p>FY 2023 Plans: Advance dose-response models to include probability of injury as a function of depth within the skin. Mature approaches for utilizing high performance computing to quantify the uncertainty within multi-physics bioeffect simulations of directed energy engagement. Extend prototype approaches for surrogating physics-level simulations through machine learning applications. Develop advanced three-dimensional digital anatomical models for use within physics-level software, and leverage these models against empirical datasets for advanced validation purposes.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		17.633	11.755	29.764

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / <i>Human Effectiveness Applied Research</i>	Project (Number/Name) 627757 / <i>Bioeffects</i>
--	---	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$18.009 million. Funding increase due to added emphasis in directed energy bioeffects modeling, simulation and analysis efforts, and efforts such as supporting severity of outcome in system risk assessments.			
Accomplishments/Planned Programs Subtotals	27.128	18.084	45.791

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>
---	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	190.732	190.683	172.861	0.000	172.861	174.787	176.980	180.725	184.647	Continuing	Continuing
623012: <i>Advanced Propulsion Technology</i>	-	8.338	17.679	17.358	0.000	17.358	17.674	18.021	18.402	18.802	Continuing	Continuing
623048: <i>Combustion and Mechanical Systems</i>	-	3.481	11.345	4.659	0.000	4.659	4.756	4.858	4.961	5.065	Continuing	Continuing
623066: <i>Turbine Engine Technology</i>	-	58.252	68.350	68.146	0.000	68.146	69.777	70.973	72.441	74.018	Continuing	Continuing
623145: <i>Aerospace Power Technology</i>	-	49.630	42.557	38.199	0.000	38.199	36.856	37.563	38.358	39.188	Continuing	Continuing
624847: <i>Rocket Propulsion Technology</i>	-	64.736	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
625171: <i>Missile Rocket Propulsion</i>	-	0.000	42.114	36.039	0.000	36.039	37.067	36.754	37.566	38.381	Continuing	Continuing
625330: <i>Aerospace Fuel Technology</i>	-	6.295	8.638	8.460	0.000	8.460	8.657	8.811	8.997	9.193	Continuing	Continuing

A. Mission Description and Budget Item Justification

This effort develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The effort has six current projects, each focusing on a technology area critical to the Department of the Air Force. The Advanced Propulsion Technology project develops high-speed air breathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies. The Combustion and Mechanical Systems project develops engine mechanical system technologies: bearings, seals, drives, and lubricants as well as combustion components, concepts, and technologies for legacy and advanced turbine engines. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems and develops component technologies for ultra-high pressure ratio, substantially improved durability, and adaptive cycle engine architecture to provide optimized performance, fuel efficiency, and life for widely varying mission needs. The Aerospace Power Technology project develops electrical power and thermal control technologies for military applications that remove operational limitations and enable advanced vehicle designs and high-power mission systems. The Missile Rocket Propulsion project develops advances in rocket propulsion technologies for tactical missiles and the sustainment of strategic systems. The Aerospace Fuel Technology project evaluates fuels and related technologies for legacy and advanced turbine engines, scramjets, rotating detonation engines and combined-cycle engines. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>
---	---

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602204F, 0602602F, 0602605F, 0602788F, 0602298F, and 1206601SF.

Funds in this program element may be used to investigate specified technology advancements in air, space and/or cyber domains.

All transfers detailed below are administrative realignments due to the stand up of the United States Space Force, and not new starts. This work will continue to be executed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Wright Patterson Air Force Base, OH, Edwards Air Force Base, CA, or Arnold Air Force Base, TN.

In FY 2022, the work and funding associated with space technology research in Program 0602203F, Aerospace Propulsion, Project 624847, Rocket Propulsion Technology, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, Program 1206601SF, Project 624847, Rocket Propulsion Technology, due to the creation of a new Appropriation for Space Force.

In FY 2022, the work and funding associated with missile rocket propulsion technologies in Program 0602203F, Aerospace Propulsion are transferred from Project 624847, Rocket Propulsion Technology to Project 625171, Missile Rocket Propulsion Technology due to the creation of a new Appropriation for Space Force.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	201.048	174.683	0.000	0.000	0.000
Current President's Budget	190.732	190.683	172.861	0.000	172.861
Total Adjustments	-10.316	16.000	172.861	0.000	172.861
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	16.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	2.391	0.000			
• SBIR/STTR Transfer	-4.837	0.000			
• Other Adjustments	-7.870	0.000	172.861	0.000	172.861

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 623066: *Turbine Engine Technology*

FY 2021	FY 2022

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>
---	---

Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: <i>Program Increase - Modular open system architecture for turbine engine technology</i>	0.000	6.000
Congressional Add Subtotals for Project: 623066	0.000	6.000
Project: 623145: Aerospace Power Technology		
Congressional Add: <i>Emergency power and cooling thermal management growth</i>	0.000	5.000
Congressional Add Subtotals for Project: 623145	0.000	5.000
Project: 624847: Rocket Propulsion Technology		
Congressional Add: <i>Program increase - small business research for rocket technology</i>	2.415	-
Congressional Add Subtotals for Project: 624847	2.415	-
Project: 625171: Missile Rocket Propulsion		
Congressional Add: <i>Program increase - Small business research for rocket technology</i>	0.000	5.000
Congressional Add Subtotals for Project: 625171	0.000	5.000
Congressional Add Totals for all Projects	2.415	16.000

Change Summary Explanation

Decrease in FY 2021 reflects Cong Adds Realignment to appropriate program and reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY2022 President's Budget submittal did not reflect FY2023 through FY2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602203F / Aerospace Propulsion				Project (Number/Name) 623012 / Advanced Propulsion Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
623012: <i>Advanced Propulsion Technology</i>	-	8.338	17.679	17.358	0.000	17.358	17.674	18.021	18.402	18.802	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops combined/advanced cycle air breathing high-speed and hypersonic propulsion technologies to provide revolutionary propulsion options for the Air Force. These new engine technologies will enable future high-speed/hypersonic weapons and aircraft concepts. The primary focus is on hydrocarbon-fueled engines capable of operating over a broad range of flight Mach numbers. Efforts include modeling, simulations, and proof of concept demonstrations of critical components; advanced component development; and ground-based demonstrations.

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

	FY 2021	FY 2022	FY 2023
Title: Hypersonic Scramjet Technologies	8.338	17.679	17.358
Description: Develop robust hydrocarbon fueled scramjet engine components and technologies to improve performance, operability, durability, and scalability for future platforms.			
FY 2022 Plans: Continue development and demonstration of advanced engine components to improve scramjet operating margin, operating time, and to refine scramjet scaling laws for expendable and reusable applications. Continue development of low internal drag flame stabilization devices, instrumentation, endothermic fuels, and flight test engine components. Continue propulsion studies and design efforts required for the development and demonstration of an engine flight test that expands the flight environment of current high speed propulsion systems.			
FY 2023 Plans: Continue development and demonstration of advanced, high speed engine components to improve operating margin, operating time and scaling laws for expendable and reusable applications. Continue development of low internal drag flame stabilization devices, instrumentation, endothermic fuels, and flight test engine components. Initiate development of design and analysis techniques and tools as well as experimental approaches to enable enhanced high-speed air induction system starting, operability, and performance for propulsion integration concepts over a wide range of flight conditions. Continue propulsion studies and design efforts required for the development and demonstration of an engine flight test that expands the flight environment of current high speed propulsion systems.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$0.321 million. Funding decrease due to decreased emphasis on high speed propulsion technologies.			
Accomplishments/Planned Programs Subtotals	8.338	17.679	17.358

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / Aerospace Propulsion	Project (Number/Name) 623012 / Advanced Propulsion Technology

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>				Project (Number/Name) 623048 / <i>Combustion and Mechanical Systems</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
623048: <i>Combustion and Mechanical Systems</i>	-	3.481	11.345	4.659	0.000	4.659	4.756	4.858	4.961	5.065	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project evaluates lubricants, mechanical systems, and combustion concepts for advanced turbine engines, rotating detonation engines, and combined cycle engines. This project also develops technologies to increase turbine engine operational reliability, durability, mission flexibility, maintainability, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include: missiles, aircraft, and re-usable high-speed vehicles. Analytical and experimental areas of emphasis include: lubricants, bearings, mechanical systems diagnostics, mechanical systems prognostics, rotor dynamics, oil-less engine technology, optical diagnostics, fundamental combustion, detonations, combustors, and afterburners. Lubricants for these engines must be thermally stable, cost-effective, and operate over a broad range of conditions. Advanced combustion concepts must be cost-effective, durable, and reduce pollutant emissions. A portion of this project supports evaluation of technologies for future conceptual cycles. This project develops component technologies for future conceptual engine cycles and architectures that provide both optimized performance and fuel efficiency for widely varying mission needs.

In FY2023, Combustion Technologies, Diagnostic Technologies, and Bearing Technologies efforts in this Project will transfer to Program 0602203F, Aerospace Propulsion, Project 623066, Turbine Engine Technology, in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.

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

	FY 2021	FY 2022	FY 2023
Title: Combustion Technologies	1.438	4.687	0.000
Description: Develop, test, and evaluate revolutionary combustion and propulsion concepts for gas turbine, pulse detonation, and combined cycle engines for missiles, manned and unmanned systems.			
FY 2022 Plans:			
Continue exploring interactions and effects of compressor and turbine components on the combustor and combustor materials to reduce engine weight and increase efficiency. Continue using advanced diagnostics tools to develop high-quality datasets for use by academia and industry for model development and verification. Continue the determination of necessary reference performance and operability combustion systems and metrics to decrease the cost of certifying new and alternative fuels in weapon systems. Continue to support development of advanced computational fluid dynamics (CFD) models to reduce combustor and augmentor design costs. Continue development of computations, modeling and simulation, and research experimentation of advanced combustion concepts including pressure gain combustion components and system level architectures. Continue to explore advanced combustion and flameholding concepts working towards improved understanding at relevant operating conditions such as sub-atmospheric (less than 1 atmosphere) and high pressure (greater than 10 atmospheres); this includes fundamental combustion modeling and fluid-dynamic phenomena on high speed systems and rocket propulsion and advanced turbine engine applications, identifying modeling and simulation concepts/approaches to address combustion chemistry and			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623048 / <i>Combustion and Mechanical Systems</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>physics and light/matter interactions, for high speed systems exploring turbulent combustion modeling in advanced configurations, exploring advanced combustion including pressure gain propulsion as it relates to new applications and architectures. Continue the development and demonstration of new tools and use of new designs and materials to improve efficiency, power under quiet operations. Continue investigation to identify and assess disruptive propulsion/power concepts and evaluate concepts. Continue development of new technologies for unmanned aircraft system propulsion/power systems for improved understanding at relevant operating conditions.</p> <p>FY 2023 Plans: In FY2023, this effort will transfer to Program 0602203F, Aerospace Propulsion, Project 623066, Turbine Engine Technology in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$4.687 million. Funding decrease is due to transfer to Program 0602203F, Aerospace Propulsion, Project 623066, Turbine Engine Technology.</p>				
<p>Title: Diagnostic Technologies</p> <p>Description: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies.</p> <p>FY 2022 Plans: Continue supporting computational fluid dynamics combustion modeling by providing, insights for interpreting experimental results using existing Modeling & Simulation methodologies and applying recently developed high-speed, spatially resolved laser diagnostics to our representative, single- element combustion experiments in order to demonstrate and deliver measurements of key combustion species and flow properties under high pressure conditions. Continue development of diagnostic tools/ methods for robust measurement capability in engine test cells and full annular ground test environments including reacting and nonreacting spray experiments for liquid fuel spray model development and employment of Nonintrusive optical diagnostics that will be used to obtain accurate, spatially/temporally resolved data. This provides the local flow field data required for comparisons to results of numerical simulations. Continue the development of improved numerical methods and turbulent combustion models to guide design and development of experimental components and systems utilizing existing Modeling & Simulation methodologies.</p> <p>FY 2023 Plans: In FY2023, this effort will transfer to Program 0602203F, Aerospace Propulsion, Project 623066, Turbine Engine Technology in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		0.247	0.805	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623048 / <i>Combustion and Mechanical Systems</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY2023 decreased compared to FY2022 by \$0.805 million. Funding decrease is due to transfer to Program 0602203F, Aerospace Propulsion, Project 623066, Turbine Engine Technology.				
<p>Title: Lubricant Technologies</p> <p>Description: Develop, test, and qualify advanced turbine engine lubricants. Generate and maintain military specifications for aviation engine lubricants.</p> <p>FY 2022 Plans: Continue developing innovative fluids by; defining target requirements for new polyol ester oils, conducts Research & Development for new/enhanced turbine engine oils for legacy & emerging engines, qualifies new & updated engine oil products for legacy & emerging engines. Continue the development of lubricant modeling through characterization of heat generation, lubrication system cooling effectiveness, failure progression of bearing materials under relevant engine conditions, and overall system performance of advanced bearing concepts for model validation. Continue supporting the warfighter on field-related mechanical system issues. Continue performance validation study of advanced bearing designs/materials, lubricant & lubrication system components via full-scale high-fidelity laboratory parametric testing at representative engine operating conditions. Continue the generation of the fatigue life database & assess fatigue growth characteristics of state of the art baseline, emerging, & advanced engine rolling element bearing materials thru sub-scale experimental investigations</p> <p>FY 2023 Plans: Continue developing innovative fluids by; defining target requirements for new polyol ester oils, conduct Research & Development for new/enhanced turbine engine oils for legacy & emerging engines, qualify new & updated engine oil products for legacy & emerging engines. Continue the development of lubricant modeling through characterization of heat generation, lubrication system cooling effectiveness, failure progression of bearing materials under relevant engine conditions, and overall system performance of advanced bearing concepts for model validation. Continue supporting the warfighter on field-related mechanical system issues. Continue performance validation study of lubricant & lubrication system components via full-scale high-fidelity laboratory parametric testing at representative engine operating conditions. Complete the generation of the fatigue life database & assess fatigue growth characteristics of state of the art baseline, emerging, & advanced engine rolling element bearing materials thru sub-scale experimental investigations Initiate development of applied rotor dynamics models for design.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$1.873 million. Funding increase due to increased emphasis in turbine engine lubricants for next generation systems to include autonomous collaborative platforms.</p>		0.855	2.786	4.659
Title: Bearing Technologies		0.941	3.067	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623048 / <i>Combustion and Mechanical Systems</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-scale turbine engine applications.</p> <p>FY 2022 Plans: Continue developing physics-based bearing life model based on bearing alloy fatigue and microstructural investigations, including bearing life factors for advanced bearing materials. Continue incorporating fatigue life, fault evolution, and parametric heat generation of advanced material systems into the models. Continue development of oil-free bearing technology for Unmanned Air Systems. Continue the development and demonstration of propulsion technologies for subsonic expendable and attritable air platforms, small and medium scale propulsion technologies, and evaluate lubricants, mechanical systems, bearing technology and combustion concepts for advanced turbine engines. Continue the development of fundamental knowledge of bearing material rolling contact fatigue failure mechanisms and lubricant interactions through microstructural investigations and failure analysis.</p> <p>FY 2023 Plans: In FY2023, this effort will transfer to Program 0602203F, Aerospace Propulsion, Project 623066, Turbine Engine Technology in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$3.067 million. Funding decrease is due to transfer to Program 0602203F, Aerospace Propulsion, Project 623066, Turbine Engine Technology.</p>			
Accomplishments/Planned Programs Subtotals	3.481	11.345	4.659

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602203F / Aerospace Propulsion				Project (Number/Name) 623066 / Turbine Engine Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
623066: <i>Turbine Engine Technology</i>	-	58.252	68.350	68.146	0.000	68.146	69.777	70.973	72.441	74.018	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops technology to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental areas of emphasis are fans and compressors, high temperature combustors, turbines, internal flow systems, controls, augmentor and exhaust systems, integrated power and thermal management systems, engine inlet integration, mechanical systems, conceptual cycle technologies, and structural design. This project develops component technology for an adaptive cycle engine architecture that provides both optimized performance and fuel efficiency for widely varying mission needs. This project supports joint Department of Defense, agency, and industry efforts to focus turbine propulsion technology on national needs. The project plan is relevant across capability areas for global responsive strike, tactical and global mobility, responsive space lift, and persistent intelligence, surveillance, and reconnaissance (ISR).

In FY2023, Combustion Technologies, Diagnostic Technologies, and Bearing Technologies efforts will transfer from PE 0602203F, Aerospace Propulsion, Project 623048, Combustion and Mechanical Systems, to this Project 623066 Turbine Engine Technology, in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.

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

	FY 2021	FY 2022	FY 2023
Title: Turbofan/Turbojet Engine Core Technologies	25.703	27.461	23.761
Description: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports.			
FY 2022 Plans: Continue development of improved aerodynamic design tools and analysis methods to extend engine operability and efficiency.			
FY 2023 Plans: Continue development of improved aerodynamic design tools and analysis methods to extend engine operability and efficiency. Initiate transonic fan distortion tolerance and transfer study to enable design-for-integration and reliable assessment for embedded engines. Initiate high lift /high work turbine study to reduce turbine stage /blade count.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$3.700 million. Funding decreased due to decreased emphasis on turbofan/turbine engine core technologies for large scale turbine engines.			
Title: Turboshaft/Turboprop and Small Turbofan Engine Technologies	4.457	4.793	4.896

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

Description: Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.

FY 2022 Plans:

Continue to demonstrate advanced component designs in rig testing. Continue to utilize validation data to develop improved test protocol for small engine augmentor designs. Continue development and validation of modeling and simulation tools for the design and analysis of turbine components with mission-tailored aero-performance and highly efficient cooling geometries. Continue the new innovative architectures, critical technologies, exploration of targeted life applications for small missile and remotely piloted aircraft applications; evaluate critical technologies that will increase range, performance, durability, electrical power and thermal capacity of these systems. Continue the exploration of new small engine technologies that can operate in high speed applications; evaluate risk reduction technologies to increase usage time of systems. Continue demonstrating advanced component designs and modeling tools in rig and engine testing. Continue to utilize validation data to develop improved test protocol for small engine designs. Continue development and validation of modeling and simulation tools for the design and analysis of engine components with new manufacturing processes. Continue the exploration of advanced integrated engine controls with potential for synergistic airframe system level benefits. Continue exploration of new small and medium size engine technologies for increased fuel efficiency, propulsive capability, power and thermal management, and reduced life cycle cost. Continue identification of new architectures and critical technologies for integrated power and thermal systems. Continue identification of requirements and develop models for simulation of highly integrated systems.

FY 2023 Plans:

Complete current demonstration phase of advanced component designs in rig testing. Complete validation of data to develop improved test protocol for small engine augmentor designs. Complete development and validation phase of modeling and simulation tools for the design and analysis of turbine components with mission-tailored aero-performance and highly efficient cooling geometries. Complete application evaluation in new innovative architectures, critical technologies, exploration of targeted life applications for small missile and remotely piloted aircraft applications; evaluate critical technologies that will increase range, performance, durability, electrical power and thermal capacity of these systems. Continue the exploration of new small engine technologies that can operate in high speed applications; evaluate risk reduction technologies to increase usage time of systems. Complete demonstrating advanced component designs and modeling tools in rig and engine testing. Continue to utilize validation data to develop improved test protocol for small engine designs. Complete development and validation of modeling and simulation tools for the design and analysis of engine components with new manufacturing processes. Complete the exploration of advanced integrated engine controls with potential for synergistic airframe system level benefits. Continue exploration of new small and medium size engine technologies for increased fuel efficiency, propulsive capability, power and thermal management, and

FY 2021	FY 2022	FY 2023

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>reduced life cycle cost. Continue identification of new architectures and critical technologies for integrated power and thermal systems. Continue identification of requirements and develop models for simulation of highly integrated systems.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.103 million. Funding increase due to increased emphasis on turboshaft/turboprop and small turbofan engine technologies for small scale turbine engines.</p>				
<p>Title: Revolutionary Propulsion Technology</p> <p>Description: Develop, test, and evaluate revolutionary propulsion concepts for gas turbine, pressure gain propulsion, and combined cycle engines for missiles, manned and unmanned systems.</p> <p>FY 2022 Plans: Continue identification of control technology elements applicable to integrated propulsion/power/thermal solutions. Continue evaluation of power and thermal modeling of advanced architectures into aircraft system level multidisciplinary analysis and optimization tools: explore new control methods for integrated propulsion, power and thermal management; continue evaluation of integration of advanced augmentors and ramburners; continue exploration of new expendable and attritable architectures. Continue the development and evaluation of advanced, integrated propulsion technologies for supersonic expendable, attritable, and reusable strike and Intelligence, Surveillance, and Reconnaissance (ISR) systems. Continue studies for exploration of advanced propulsion technologies. Continue exploration and evaluation of innovative architectures for affordable & efficient airlaunched propulsion capability from Mach 3 to Mach 5+, and turbine based combined cycle propulsion capability to Mach 5+.</p> <p>FY 2023 Plans: Continue identification of control technology elements applicable to integrated propulsion/power/thermal solutions. Complete evaluation of power and thermal modeling of advanced architectures into aircraft system level multidisciplinary analysis and optimization tools. Continue evaluation of integration of advanced augmentors and ramburners. Continue exploration of new expendable and attritable architectures. Continue the development and evaluation of advanced, integrated propulsion technologies for supersonic expendable, attritable, and reusable strike and Intelligence, Surveillance, and Reconnaissance (ISR) systems. Continue studies for exploration of advanced propulsion technologies. Complete exploration and evaluation of innovative architectures for affordable & efficient airlaunched propulsion capability from Mach 3 to Mach 5+, and turbine based combined cycle propulsion capability to Mach 5+.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.364 million. Funding increase due to increased emphasis on revolutionary propulsion technology to include rotating detonation engines.</p>		15.746	16.861	17.225
<p>Title: Missile and Unmanned Aerial Systems (UAS) Engine Technologies</p>		12.346	13.235	13.521

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

Description: Develop limited life engine components for missile and Unmanned Aerial System (UAS) applications, including longrange subsonic, supersonic and hypersonic vehicles.

FY 2022 Plans:

Continue identification of control technology elements applicable to integrated propulsion/power/thermal solutions. Continue evaluation of power and thermal modeling of advanced architectures into aircraft system level multidisciplinary analysis and optimization tools: explore new control methods for integrated propulsion, power and thermal management; continue evaluation of integration of advanced augmentors and ramburners; continue exploration of new expendable and attritable architectures. Continue the development and evaluation of advanced, integrated propulsion technologies for supersonic expendable, attritable, and reusable strike and Intelligence, Surveillance, and Reconnaissance (ISR) systems. Continue exploration of new engine concepts for missile and unmanned systems.

FY 2023 Plans:

Complete identification of control technology elements applicable to integrated propulsion/power/thermal solutions. Continue evaluation of power and thermal modeling of advanced architectures into aircraft system level multidisciplinary analysis and optimization tools: explore new control methods for integrated propulsion, power and thermal management; Complete evaluation of integration of advanced augmentors and ramburners; continue exploration of new expendable and attritable architectures. Complete the development and evaluation of advanced, integrated propulsion technologies for supersonic expendable, attritable, and reusable strike and Intelligence, Surveillance, and Reconnaissance (ISR) systems. Continue exploration of new engine concepts for missile and unmanned systems. Initiate lifetime demonstration of limited life engine components.

FY 2022 to FY 2023 Increase/Decrease Statement:

FY2023 increased compared to FY2022 by \$0.286 million. Funding increase due to increased emphasis on engine technologies for missiles and unmanned aerial systems to include hypersonic vehicles.

Title: Combustion Technologies

Description: Develop, test, and evaluate revolutionary combustion and propulsion concepts for gas turbine, pulse detonation, and combined cycle engines for missiles, manned and unmanned systems.

FY 2022 Plans:

In FY2022, this effort is performed in PE 0602203F, Aerospace Propulsion, Project 623048, Combustion and Mechanical Systems.

FY 2023 Plans:

Continue exploring interactions and effects of compressor and turbine components on the combustor and combustor materials to increase efficiency and improve altitude ignition & operability. Complete use of advanced diagnostics tools to develop high-

	-	0.000	4.788

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>quality datasets for use by academia and industry for model development and verification. Complete research in the determination of necessary reference performance and operability combustion systems and metrics to decrease the cost of certifying new and alternative fuels in weapon systems. Complete support of development of advanced computational fluid dynamics (CFD) models to reduce combustor and augmentor design costs. Continue development of computations, modeling and simulation, and research experimentation of advanced combustion concepts including pressure gain combustion components and system level architectures. Complete planned exploration of advanced combustion and flameholding concepts working towards improved understanding at relevant operating conditions such as sub-atmospheric (less than 1 atmosphere) and high pressure (greater than 10 atmospheres); this includes fundamental combustion modeling and fluid-dynamic phenomena on high speed systems and rocket propulsion and advanced turbine engine applications, identifying modeling and simulation concepts/approaches to address combustion chemistry and physics and light/matter interactions, for high speed systems exploring turbulent combustion modeling in advanced configurations, exploring advanced combustion including pressure gain propulsion as it relates to new applications and architectures. Continue the development and demonstration of new design, modeling and simulation and testing methods to improve efficiency and operability. Continue investigation to identify and assess disruptive propulsion/power concepts and evaluate concepts. Continue development of new technologies for unmanned aircraft system propulsion/power systems for improved understanding at relevant operating conditions. Initiate exploration of applied high speed combustion and combustor design. Initiate exploration of rotating detonation engines for next generation combustion systems. Initiate the development of improved numerical methods and combustion models to guide design and applied development of combustion components and systems.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$4.788 million. Funding increase is due to transfer from PE 0602203F Aerospace Propulsion, Project 623048, Combustion and Mechanical Systems and increased emphasis in combustion technology for next generation systems to include high speed systems.</p>			
<p>Title: Diagnostic Technologies</p> <p>Description: Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies.</p> <p>FY 2022 Plans: In FY2022, this effort is performed in PE 0602203F, Aerospace Propulsion, Project 623048, Combustion and Mechanical Systems.</p> <p>FY 2023 Plans: Complete support to current phase in computational fluid dynamics combustion modeling by providing insights for interpreting experimental results using existing Modeling & Simulation methodologies and applying recently developed high-speed, spatially resolved laser diagnostics to our representative, single- element combustion experiments in order to demonstrate and deliver</p>	-	0.000	0.822

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / Aerospace Propulsion	Project (Number/Name) 623066 / Turbine Engine Technology
--	--	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>measurements of key combustion species and flow properties under high pressure conditions. Continue development of diagnostic tools/ methods for robust measurement capability in engine test cells and full annular ground test environments including reacting and nonreacting spray experiments for liquid fuel spray model development and employment of Nonintrusive optical diagnostics that will be used to obtain accurate, spatially/temporally resolved data. Initiate the application of optical diagnostic to challenging engine environments including detonations, high pressures, and multiphase. Complete the development of improved numerical methods and turbulent combustion models to guide design and development of experimental components and systems utilizing existing Modeling & Simulation methodologies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.822M. Funding increase is due to transfer from PE 0602203F Aerospace Propulsion, Project 623048, Combustion and Mechanical Systems.</p>			
<p>Title: Bearing Technologies</p> <p>Description: Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-scale turbine engine applications.</p> <p>FY 2022 Plans: In FY2022, this effort is performed in PE 0602203F, Aerospace Propulsion, Project 623048, Combustion and Mechanical Systems.</p> <p>FY 2023 Plans: Continue developing physics-based bearing life model based on bearing alloy fatigue and microstructural investigations, including bearing life factors for advanced bearing materials. Continue incorporating fatigue life, fault evolution, and parametric heat generation of advanced material systems into the models. Continue development of oil-free bearing technology for Unmanned Air Systems. Continue the development and demonstration of propulsion technologies for subsonic expendable and attritable air platforms, small and medium scale propulsion technologies, and evaluate lubricants, mechanical systems, bearing technology and combustion concepts for advanced turbine engines. Continue the development of fundamental knowledge of bearing material rolling contact fatigue failure mechanisms and lubricant interactions through microstructural investigations and failure analysis.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$3.133M. Funding increase is due to transfer from PE 0602203F Aerospace Propulsion, Project 623048, Combustion and Mechanical Systems.</p>	-	0.000	3.133
Accomplishments/Planned Programs Subtotals	58.252	62.350	68.146

Congressional Add: Program Increase - Modular open system architecture for turbine engine technology	FY 2021	FY 2022
	0.000	6.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623066 / <i>Turbine Engine Technology</i>
--	---	---

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	0.000	6.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>				Project (Number/Name) 623145 / <i>Aerospace Power Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
623145: <i>Aerospace Power Technology</i>	-	49.630	42.557	38.199	0.000	38.199	36.856	37.563	38.358	39.188	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops integrated electrical and thermal management components, controls and systems for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, affordability, and supportability of aircraft and flight line equipment. Research is conducted in energy storage and hybrid power system technologies to enable special purpose applications. Electrical power and thermal management technologies enable future military power and thermal needs. Controls and system integration technologies ensure the interoperability of aircraft, power, thermal, engine and other systems and subsystems. This project supports development of electrical power and thermal management components, controls and systems suitable for applications to legacy and future aircraft platforms including strike and mobility concepts. Lightweight power systems suitable for other aerospace applications are also developed.

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

	FY 2021	FY 2022	FY 2023
Title: High Power System Technologies	49.630	37.557	38.199
Description: Develop integrated system architecture, controls, and component technologies to provide for the large amounts of electrical power needed, and concurrent thermal mitigation required, by current and future manned and unmanned systems.			
FY 2022 Plans: Continue development of system and component electrical power, electro-mechanical, and thermal technologies for high-power applications. Complete development of hybrid approaches to power generation, storage, and application as well as thermal management. Continue testing of subsystems hardware in conjunction with continued platform level tip-to-tail modeling and simulation for energy optimization. Continue development of advanced, safe energy storage, power distribution, and management systems to include Silicon Carbide applications and batteries and fan tip generator development. Complete power and thermal development toward demonstration of tactical aircraft high-power payload capability to include +/-270 Volts Direct Current (VDC) power generation and storage. Continue analysis and development of adaptive power and thermal control systems for highpower aircraft to include open system integration and test. Continue weapon system contractor support for platform integration of advanced power and thermal system architectures. Continue medium-scale propulsion, power and thermal system studies and development to include innovative, integrated hybrid architectures.			
FY 2023 Plans: Continue development of system and component electrical power, electro-mechanical, and thermal technologies for high-power applications. Continue testing of subsystems hardware in conjunction with continued platform level tip-to-tail modeling and simulation for energy optimization. Complete development of advanced, safe energy storage, power distribution, and management systems to include Silicon Carbide applications and batteries and fan tip generator development. Complete analysis and development of adaptive power and thermal control systems for high-power aircraft to include open system integration and			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 623145 / <i>Aerospace Power Technology</i>
--	---	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
test. Complete weapon system contractor support for platform integration of advanced power and thermal system architectures. Continue medium-scale propulsion, power and thermal system studies and development to include innovative, integrated hybrid architectures. Initiate development of advanced power and thermal capabilities for future hypersonic aircraft. Initiate development of adaptive, affordable power and thermal technologies for emerging medium-scale platforms and mission capabilities.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY2023 increased compared to FY2022 by \$0.642 million. Funding increase due to increased emphasis in technology for high power systems for next generation systems to include autonomous collaborative platforms.			
Accomplishments/Planned Programs Subtotals	49.630	37.557	38.199

	FY 2021	FY 2022
<i>Congressional Add:</i> Emergency power and cooling thermal management growth	0.000	5.000
<i>FY 2021 Accomplishments:</i> Not applicable.		
<i>FY 2022 Plans:</i> Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	0.000	5.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602203F / Aerospace Propulsion				Project (Number/Name) 624847 / Rocket Propulsion Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624847: Rocket Propulsion Technology	-	64.736	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops rocket propulsion technologies for space access, space maneuver, the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, aging and surveillance efforts), and tactical missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, technology for sustainment of strategic systems, and innovative space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of these systems. Develop technologies to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense (DoD). Technologies under this project enable capabilities of interest to both DoD and National Aeronautics and Space Administration (NASA). Tasks include: modeling and simulation; proof of concept tests of critical components; advanced component development; and ground-based tests. Aging and surveillance tasks could reduce lifetime prediction uncertainties for individual motors by 50%, enabling motor replacement for cause. All thrusts are part of the Rocket Propulsion 21 (RP21) collaboration and are reviewed by a DoD level steering committee yearly for relevance to DoD missions and progress towards RP21 Goals.

In FY 2022, the work and funding associated with space technology research in Program 0602203F, Aerospace Propulsion, Project 624847, Rocket Propulsion Technology, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, Program 1206601SF, Project 624847, Rocket Propulsion Technology, due to the creation of a new Appropriation for Space Force.

In FY 2022, the work and funding associated with missile rocket propulsion technologies in Program 0602203F, Aerospace Propulsion are transferred from Project 624847, Rocket Propulsion Technology to Project 625171, Missile Rocket Propulsion Technology due to the creation of a new Appropriation for Space Force.

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

	FY 2021	FY 2022	FY 2023
Title: Fuel Technologies	12.561	0.000	0.000
Description: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellants, and monopropellants to increase space launch payload capability and refine new synthesis methods.			
FY 2022 Plans: In FY2022, work and funding associated with fuel technologies in Project 624847, Rocket Propulsion Technology, are transferred to Project 625171, Missile Rocket Technology, due to the creation of a new Appropriation for Space Force.			
FY 2023 Plans: Not applicable			
FY 2022 to FY 2023 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 624847 / <i>Rocket Propulsion Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Not applicable				
<p>Title: Liquid Engine Combustion Technologies</p> <p>Description: Develop advanced liquid engine combustion technology for improved performance, while preserving chamber lifetime and reliability needs for engine uses in heavy lift space vehicles.</p> <p>FY 2022 Plans: In FY2022, the work and funding associated with liquid engine combustion technologies in Project 624847, Rocket Propulsion Technology, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, PE 1206601SF, Project 624847, Rocket Propulsion Technology, due to the creation of a new Appropriation for Space Force.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>		11.186	0.000	0.000
<p>Title: Advanced Liquid Engine Technologies</p> <p>Description: Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles.</p> <p>FY 2022 Plans: In FY2022, the work and funding associated with advanced liquid engine technology in Project 624847, Rocket Propulsion Technology, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, PE 1206601SF, Project 624847, Rocket Propulsion Technology, due to the creation of a new Appropriation for Space Force.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>		4.952	0.000	0.000
<p>Title: On-Orbit Propulsion Technologies</p> <p>Description: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for station-keeping, repositioning, and orbit transfer for satellites and satellite constellations.</p> <p>FY 2022 Plans:</p>		7.631	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 624847 / <i>Rocket Propulsion Technology</i>
--	---	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>In FY2022, the work and funding associated with on-orbit propulsion technologies in Project 624847, Rocket Propulsion Technology, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, PE 1206601SF, Project 624847, Rocket Propulsion Technology, due to the creation of a new Appropriation for Space Force.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>			
<p>Title: Ballistic and Tactical Propulsion Technologies</p> <p>Description: Develop missile propulsion technologies and aging & surveillance technologies for ballistic and tactical missiles.</p> <p>FY 2022 Plans: In FY2022 the work and funding associated with ballistic and tactical propulsion technologies in Project 624847, Rocket Propulsion Technology, are transferred to Project 625171, Missile Rocket Technology, due to the creation of a new Appropriation for Space Force.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>	25.991	0.000	0.000
Accomplishments/Planned Programs Subtotals	62.321	0.000	0.000

	FY 2021	FY 2022
Congressional Add: Program increase - small business research for rocket technology	2.415	-
FY 2021 Accomplishments: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	2.415	-

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602203F / Aerospace Propulsion				Project (Number/Name) 625171 / Missile Rocket Propulsion			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
625171: <i>Missile Rocket Propulsion</i>	-	0.000	42.114	36.039	0.000	36.039	37.067	36.754	37.566	38.381	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops rocket propulsion technologies for the sustainment of strategic systems (including solid boost/missile propulsion, post boost control, aging and surveillance efforts), and tactical missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, and technology for sustainment of strategic systems. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of these systems. Develop technologies to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense (DoD). Tasks include: modeling and simulation; proof of concept tests of critical components; advanced component development; and ground-based tests. Aging and surveillance tasks could reduce lifetime prediction uncertainties for individual motors by 50%, enabling motor replacement for cause. All efforts are part of the Rocket Propulsion of the 21st Century (RP21) collaboration and are reviewed by a DoD level steering committee yearly for relevance to DoD missions and progress towards RP21 Goals.

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

	FY 2021	FY 2022	FY 2023
Title: Fuel Technologies	0.000	12.146	10.565
Description: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellants, and monopropellants to increase space launch payload capability and refine new synthesis methods.			
FY 2022 Plans: Complete development of solid rocket propellant binder systems for use across operationally relevant conditions. Continue to devise, synthesize, scale-up, and characterize novel energetic ingredients for monopropellants, fuels, and oxidizers, for use across the span of space and missile applications including tactical, strategic, and in-space thrust and attitude control. Continue to formulate, scale-up, and evaluate formulations of solid and liquid rocket propellants, including green monopropellants. Continue to identify, evaluate, and adapt 21st century automated formulation and production techniques to enable more rapid and agile munitions production arrangements. Continue research in high- temperature resins, insulators, and composite case fabrication techniques to enable high performance rocket motor cases.			
FY 2023 Plans: Continue to devise, synthesize, scale-up, and characterize novel energetic ingredients for monopropellants, fuels, and oxidizers, for use across the span of space and missile applications including tactical, strategic, and in-space thrust and attitude control. Continue to formulate, scale-up, and evaluate formulations of solid and liquid rocket propellants, including green monopropellants. Continue to identify, evaluate, and adapt 21st century automated formulation and production techniques to enable more rapid			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 625171 / <i>Missile Rocket Propulsion</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
and agile munitions production arrangements. Continue research in high- temperature resins, insulators, and composite case fabrication techniques to enable high performance rocket motor cases.				
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$1.581 million. Funding decreased due to decreased emphasis in fuel technologies for strategic solid rocket propulsion.				
Title: Ballistic and Tactical Propulsion Technologies		0.000	24.968	25.474
Description: Develop missile propulsion technologies and aging and surveillance technologies for ballistic and tactical missiles.				
FY 2022 Plans: Continue to apply next generation of chemical and mechanical aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, to user needs and unique challenges. Complete development of advanced sensor, non-destructive evaluation, modeling and supporting technology development efforts to detect and explain phenomena further improve data acquisition and reduce uncertainty in tactical, hypersonic, and ballistic missile solid rocket motor service life predictions. Complete long-term validation of tools through long-term aging and testing of sub-scale motors. Continue to develop advanced tactical propulsion and concepts. Complete propellant development efforts including long-life and other novel propellant systems. Continue development, evaluation, verification, and validation of next generation of updated, physics-based modeling, simulation, and analysis tools for rapid and agile missile propulsion design, analysis, and production to include designs for 21st century material processing techniques and hardware. Continue to support advanced component technologies for missile propulsion applications for strategic and strike systems helping to ensure their long-term sustainment. Initiate automated solid rocket motor production techniques and equipment to enable more rapid and agile munitions production and logistic support.				
FY 2023 Plans: Continue to apply next generation of chemical and mechanical aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, to user needs and unique challenges. Continue to develop advanced tactical propulsion hardware and concepts. Continue development, evaluation, verification, and validation of next generation of physics-based modeling, simulation, and analysis (MS&A) tools for rapid and agile missile propulsion design, analysis, and production to include designs for 21st century material processing techniques and hardware. Continue to support advanced component technologies for missile propulsion applications for strategic and strike systems helping to ensure their long-term sustainment. Continue automated solid rocket motor production techniques and components to enable more rapid and agile munitions production and logistic support.				
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.506 million. Funding increase due to increased emphasis on ballistic and tactical propulsion technologies to include automated solid rocket motor production techniques.				
Accomplishments/Planned Programs Subtotals		0.000	37.114	36.039

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 625171 / <i>Missile Rocket Propulsion</i>
--	---	---

	FY 2021	FY 2022
Congressional Add: Program increase - Small business research for rocket technology	0.000	5.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	0.000	5.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>				Project (Number/Name) 625330 / <i>Aerospace Fuel Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
625330: <i>Aerospace Fuel Technology</i>	-	6.295	8.638	8.460	0.000	8.460	8.657	8.811	8.997	9.193	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project evaluates fuels for legacy and advanced turbine engines, scramjets, detonation, and combined cycle engines. This project also considers fuel related concepts that can increase turbine engine operational reliability, durability, mission flexibility, energy efficiency, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, sustained high-speed vehicles, hypersonic, and responsive space launch. Analytical and experimental areas of emphasis include evaluations of fuel properties and characteristics of traditional fuels and alternative fuels developed from unconventional sources, specialty fuels, and components development used in integrated thermal and energy management systems including high heat sink fuel capability, fuels logistics and associated vulnerabilities, and combustion diagnostics and engine emissions measurements.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Alternative Fuels</p> <p>Description: Investigate novel sustainable aviation fuels for engines, missiles, aircraft, sustained high-speed vehicles, hypersonic, and responsive space launch applications. Conduct evaluations and perform technical assessments of alternative fuels developed from unconventional sources for use in legacy and advanced aerospace systems. Support development of alternative fuel specification for commercial jet fuels with Federal Aviation Agency.</p> <p>FY 2022 Plans: Initiate investigation and development of novel sustainable aviation fuels and technologies for potential propulsion performance enhancement.</p> <p>FY 2023 Plans: Continue investigation and development of novel sustainable and alternative aviation fuels and technologies for potential propulsion performance and logistical enhancements.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.016 million. Funding increase due to increased emphasis on alternative fuels.</p>	0.598	0.636	0.652
<p>Title: Integrated Thermal and Energy Management</p> <p>Description: Develop advanced and specialty fuels, components, associated technologies, and conduct performance assessments of advanced integrated thermal and energy management systems for engines, missiles, aircraft, sustained high-speed vehicles, hypersonic, and responsive space launch. Evaluate stability and performance of advanced and specialty fuels.</p> <p>FY 2022 Plans:</p>	1.911	2.728	2.796

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 625330 / <i>Aerospace Fuel Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue the development and evaluation of novel additives, catalysts, and fuel composition and fuel system approaches enable new hypersonic applications. Continue model development for integrated thermal and energy management that include designs and evaluation of vehicle fuel systems, and prototype sensors to monitor the fuel chemistry that produces coke deposits and characterization of system-level impacts from thermally-stressed fuel. Continue evaluation of fuel reaction models that enable high temperature systems for evaluating endothermic fuels. Continue investigation of fuel heat sink approaches for thermal management of advanced engines and other systems that evaluate integrated power and thermal management approaches. Continued the development of fuel models for system design and evaluation of fuel system. Continue development of sensors and analysis techniques for monitoring fuel chemistry that causes deposits. Continue characterization system-level impacts of emerging aviation technologies. Continue studies using fuel as a thermal management fluid to meet Air Force requirements. Continue investigation of fuel heat exchangers including additive manufactured units and their reaction to fuels. Continue developing integrated test rigs to tests these approaches and assess efficiency of these approaches.</p> <p>FY 2023 Plans: Continue the development and evaluation of novel fuel additives, catalysts, compositions, and system approaches enabling new hypersonic applications and expanding into other advance concepts and system-level impacts of emerging aviation technologies. Continue development of fuel related integrated thermal and energy management technologies including models for designs and evaluation of vehicle fuel systems, methods to monitor the fuel coking and other chemistry, and characterization methods for system-level impacts from thermally-stressed fuel, as well as expanding use as a thermal management fluid. Continue prototype sensors to monitor the fuel chemistry that produces coke deposits and characterization of system-level impacts from thermally-stressed fuel. Continue evaluation of fuel reaction models that enable high temperature systems for evaluating advanced fuels including endothermic fuels. Continue investigation of fuel heat sink approaches for thermal management of advanced engines and other systems that evaluate integrated power and thermal management approaches to include heat exchangers. Continue development of fuel models for system design and evaluation of fuel system. Continue development of sensors and analysis techniques for monitoring fuel chemistry that causes deposits. Complete characterization system-level impacts of emerging aviation technologies. Complete studies using fuel as a thermal management fluid to meet Air Force requirements. Complete investigation of fuel heat exchangers as an independent investigation including additive manufactured units and their reaction to fuels. Continue developing integrated test rigs to tests these approaches and assess their efficiency.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.068 million. Funding increase due to increased emphasis on integrated thermal and energy management.</p>			
<p>Title: Fuel Logistics and Sustainment</p> <p>Description: Study and evaluate low-cost approaches to reduce fuel logistics footprint to reduce cost. Study fuel logistics vulnerabilities and develop detection and mitigation technologies. Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Department of the Air Force.</p>	1.914	2.728	2.796

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 625330 / <i>Aerospace Fuel Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

FY 2022 Plans:
Continue supporting fuel sustainment issues as needed, to understand problems and work to find solutions. Continue development of compositional analysis that can be verified across services and leverages a database of specification and extended compositional information to advance data visualization and analytics. Continue approaches to be able to: capture fuel stability limiters to minimize logistics vulnerabilities; develop detection and mitigations for fuel biocontamination to support logistics readiness; and develop fuel sensing technologies with coordination and collaboration across the government. Continue thermal stability studies, models (such as chemistry, fuel system, and hybrid) developments, and technologies (such as additives, deoxygenation, and platform thermal stability sensors) developments for traditional, specialty, and sustainable aviation fuels under simulated operational domain conditions to ensure readiness across the Air Force's operational domains. Continue to analyze and develop fuels, fuel blends, and catalyst formulations that provide endothermic cooling capacity for hypersonic applications. Continue study of fuels and models for next generation vehicles.

FY 2023 Plans:
Continue support of fuel sustainment issues as needed, to understand current needs and problems as well as work to find solutions. Continue development of fuel compositional analyses methods that are verifiable across services and leverages a database of specification and extended compositional information to advance data visualization and analytics. Continue method developments to capture fuel stability limiters to minimize logistics vulnerabilities; develop detection and mitigations for fuel biocontamination to support logistics readiness; and develop fuel-sensing technologies with coordination and collaboration across the government. Continue thermal stability studies (such as chemistry, fuel system, and hybrid developments), and technologies (such as additives, deoxygenation, and platform thermal stability sensors); and models and technologies developments for traditional, specialty, and sustainable aviation fuels under simulated current and future operational domain conditions to ensure Air Force's readiness. Continue to analyze and develop fuels, fuel blends, catalyst formulations, accessories, and models for operational requirement of hypersonic application and extending into other next generation applications and vehicles. Complete study of fuels and models for next generation vehicles.

FY 2022 to FY 2023 Increase/Decrease Statement:
FY2023 increased compared to FY2022 by \$0.068 million. Funding increase due to increased emphasis on logistics and sustainment for fuel.

Title: Combustion Emissions and Performance	1.872	2.546	2.216
Description: Develop and test applied emissions diagnostic techniques for air breathing propulsion systems. Evaluate aviation fuel for combustion and emissions characteristics and fuel composition performance impacts. Identify and develop approaches to improve system performance and emissions across different fuels and types.			
FY 2022 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / <i>Aerospace Propulsion</i>	Project (Number/Name) 625330 / <i>Aerospace Fuel Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue development of augmentor combustor/simulator to determine fuel effects on augmentor operability under realistic conditions. Initiate studies of impact on combustor performance and emissions based on fuel chemistry (traditional, specialty, and sustainable aviation fuels), and fuel entrance temperature well above historic use levels, and other operational impacts, such as high altitude. Initiate development of low temperature catalyst augmented combustion technologies.</p> <p><i>FY 2023 Plans:</i> Complete development of augmentor combustor/simulator to determine fuel effects on augmentor operability under realistic conditions. Continue studies of impact on combustor performance and emissions based on fuel chemistry (traditional, specialty, and sustainable aviation fuels), and fuel entrance temperature well above historic use levels, and other operational impacts, such as high altitude. Continue development of low temperature catalyst augmented combustion technologies.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY2023 decreased compared to FY2022 by \$0.330 million. Funding decreased due to decreased emphasis on combustion emissions and performance.</p>			
Accomplishments/Planned Programs Subtotals	6.295	8.638	8.460

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>
---	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	221.779	255.918	192.733	0.000	192.733	197.998	201.322	195.226	192.094	Continuing	Continuing
622002: <i>Electronic Component Technology</i>	-	55.230	91.176	41.159	0.000	41.159	42.510	43.587	34.150	27.518	Continuing	Continuing
622003: <i>EO Sensors & Countermeasures Tech</i>	-	34.638	24.725	28.120	0.000	28.120	28.768	28.787	29.396	30.036	Continuing	Continuing
622005: <i>Cyber Technology</i>	-	16.625	6.934	8.466	0.000	8.466	9.215	9.514	9.713	9.925	Continuing	Continuing
624920: <i>Electronic Warfare Technology</i>	-	44.749	45.347	45.410	0.000	45.410	46.085	46.803	47.796	48.835	Continuing	Continuing
626095: <i>Sensor Fusion Technology</i>	-	35.716	35.984	33.577	0.000	33.577	34.323	35.234	35.979	36.763	Continuing	Continuing
627622: <i>RF Sensors and Countermeasures Tech</i>	-	34.821	51.752	36.001	0.000	36.001	37.097	37.397	38.192	39.017	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing anytime, anywhere surveillance, reconnaissance, precision targeting, and electronic warfare (EW) capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical (EO) and infrared (IR) aerospace sensor technologies for a variety of offensive and defensive uses; 3) radio frequency antennas and associated electronics for airborne and space surveillance, together with active and passive electro-optical/infrared sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; 5) technology for affordable, trusted, and reliable, all-weather surveillance, reconnaissance, and precision strike radio frequency sensors and electronic combat systems; and 6) technologies that aid in the development of agile and resilient mission systems. This program has been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

Funds in this program element may be used to investigate specified technology advancements in air, space and/or cyber domains.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>
---	--

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	232.876	193.514	0.000	0.000	0.000
Current President's Budget	221.779	255.918	192.733	0.000	192.733
Total Adjustments	-11.097	62.404	192.733	0.000	192.733
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	57.000			
• Congressional Directed Transfers	0.000	5.404			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-2.645	0.000			
• Other Adjustments	-8.452	0.000	192.733	0.000	192.733

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 622002: *Electronic Component Technology*

- Congressional Add: *Program increase - exploitation detection for flexible combat avionics*
- Congressional Add: *Program increase: enhanced security sensors to detect threats in near and far field emissions*
- Congressional Add: *Program increase: hardware-based oversight system for microelectronics endpoints*
- Congressional Add: *Program increase: low cost sensors for UAVs*
- Congressional Add: *Program increase: Zero-trust environment for semiconductor technology*
- Congressional Add: *Program increase: Extreme wideband RF sensor*

Congressional Add Subtotals for Project: 622002

Project: 622003: *EO Sensors & Countermeasures Tech*

- Congressional Add: *Low cost sensors for small unmanned vehicles*
- Congressional Add: *Additive manufacturing for electronics*

Congressional Add Subtotals for Project: 622003

Project: 622005: *Cyber Technology*

	FY 2021	FY 2022
	4.943	5.000
	0.000	5.000
	0.000	6.000
	0.000	5.000
	0.000	10.000
	0.000	19.000
Congressional Add Subtotals for Project: 622002	4.943	50.000
	4.943	0.000
	5.931	0.000
Congressional Add Subtotals for Project: 622003	10.874	0.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>
---	--

Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: <i>Cyber assurance and assessment of electronic hardware systems</i>	5.931	0.000
Congressional Add Subtotals for Project: 622005	5.931	0.000
Project: 626095: <i>Sensor Fusion Technology</i>		
Congressional Add: <i>Program increase: Reliability of combat cloud communications systems</i>	0.000	7.000
Congressional Add Subtotals for Project: 626095	0.000	7.000
Congressional Add Totals for all Projects	21.748	57.000

Change Summary Explanation

Decrease in FY 2021 reflects adjustments to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>				Project (Number/Name) 622002 / <i>Electronic Component Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622002: <i>Electronic Component Technology</i>	-	55.230	91.176	41.159	0.000	41.159	42.510	43.587	34.150	27.518	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on electronics and optoelectronics technologies that generate, control, receive, and process electromagnetic spectrum for aerospace sensor and electronic warfare (EW) applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance, electronic warfare, battlespace access, and precision engagement capabilities. The technologies developed include exploratory electronic and optoelectronic devices, components, microsystems and subsystems.

This project also assesses designs, develops, fabricates, and demonstrates the associated technologies for integrating combinations of these component technologies. The project demonstrates significantly smaller size, lower weight, lower cost, lower power dissipation, higher reliability, trustworthiness and improved performance. The device and subsystem technology developments under this project are military unique; they are based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, communications, electronic warfare, positioning, navigation, timing, and smart weapons.

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

	FY 2021	FY 2022	FY 2023
Title: Sensor Subsystems	9.055	7.912	7.475
Description: Develop, analyze, demonstrate, and perform engineering trade studies for technologies for compact, affordable, multi-function subsystems for aerospace sensors.			
FY 2022 Plans: Complete low cost electro-optical/infrared sensor subsystem development. Continue research into autonomous low size, weight and power sensor processing. Continue research into digital at every element technology for multifunction microwave and millimeter wave arrays. Initiate development of low size weight and power wideband multifunction RF sensor subsystem suitable for Group 4 unmanned aircraft system operation.			
FY 2023 Plans: Continue research into autonomous low size, weight and power sensor processing. Continue research into digital at every element technology for multifunction microwave and millimeter wave arrays. Continue development of low size weight and power wideband multifunction radio frequency sensor subsystem suitable for Group 4 unmanned aircraft system operation. Initiate millimeter wave digital array demonstrations. Initiate wideband phased array emulation utilizing digital beamforming demonstrator.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.437 million. Justification for this decrease is described in plans above.			
Title: Electronic Devices	8.765	6.793	6.762

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 622002 / <i>Electronic Component Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Assess, research, develop, demonstrate and transition revolutionary and evolutionary electronic devices and their associate technologies.</p> <p>FY 2022 Plans: Complete advanced wide band-gap model development for multi-use applications. Complete initial demonstration of novel wide-band gap switch integration with millimeter-wave transistor development. Continue development of integrated chip-level radio frequency device and power conversion modeling. Continue development of wide bandgap device and power conversion integration technologies. Initiate prototype demonstration of high efficiency microwave power modules with integrated high speed power conversion switching.</p> <p>FY 2023 Plans: Complete initial demonstration of wide bandgap device and power conversion integration. Continue development of integrated chip-level radio frequency device and power conversion modeling. Continue development of wide bandgap device and power conversion integration technologies. Continue demonstration of high efficiency microwave power modules with integrated high speed power conversion switching. Initiate next generation predictive analysis using higher order harmonics. Initiate wide bandgap W-band device and circuit optimization. Initiate evaluation of next generation wide bandgap radio frequency materials.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.031 million. Justification for this decrease is described in plans above.</p>			
<p>Title: Electro-Optical/Infrared (EO/IR) Components</p> <p>Description: Research, develop, demonstrate and transition electro-optical/infrared (EO/IR) components for next generation intelligence, surveillance, reconnaissance (ISR) and countermeasures.</p> <p>FY 2022 Plans: Complete advanced avalanche photo-diode based focal plane array development. Continue photonic and quantum substructure technology development. Continue research into non-linear devices for tunability and power scaling. Initiate development of high power, narrow line width lasers sources for advanced sensing and countermeasure applications.</p> <p>FY 2023 Plans: Continue photonic and quantum substructure technology development. Continue research into non-linear devices for tunability and power scaling. Continue development of high power, narrow line width lasers sources for advanced sensing and countermeasure applications. Initiate laser component packaging for laser detection and ranging.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.319 million. Justification for this decrease is described in plans above.</p>	8.925	6.969	7.288
<p>Title: Trusted Electronics for Intelligence, Surveillance, Reconnaissance and Avionics Mission Systems</p>	15.553	7.946	8.886

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 622002 / <i>Electronic Component Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Investigate and develop designs of trusted electronic and optoelectronic systems when integrating commercially available solutions with emerging government-off-the-shelf advanced technologies. Areas of development include: multi-function radio frequency and electro-optical subsystems, advanced electronic and optoelectronic materials, on-board sensor processing, high-frequency power modules, electro-optical/infrared sources, electro-optical/infrared detectors, beam control and waveguides, and trusted and reliable electronics.</p> <p>FY 2022 Plans: Mature trust in design and trust in fabrication. Continue studies of modeling and simulation capability to improve predictive capability of mission assurance for highly integrated microsystems, devices, and materials. Advance development of prototype trustworthiness assessment capability. Continue reliability assessments of advanced heterogeneously integrated microsystems. Continue the development of processes and techniques for trust through design. Continue verification and validation of security techniques and methodologies for integrated circuit designs.</p> <p>FY 2023 Plans: Complete initial investigation of trust in design and trust in fabrication methodologies. Complete studies of modeling and simulation capability to improve predictive capability of mission assurance for highly integrated microsystems, devices, and materials. Complete the initial development of processes and techniques for trust through design. Continue development of prototype trustworthiness assessment capability. Continue reliability assessments of advanced heterogeneously integrated microsystems. Continue verification and validation of security techniques and methodologies for integrated circuit designs. Initiate disaggregated multi chip System in Package demonstration using fine pitch for assurance.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.940 million. Justification for this increase is described in plans above.</p>			
<p>Title: Advanced Highly Integrated Microsystems for Intelligence, Surveillance, Reconnaissance and Electronic Warfare</p> <p>Description: Perform research and development of electronic and photonic circuit and microsystem technologies focused on miniaturization, power reduction, reconfigurability and reduced cost.</p> <p>FY 2022 Plans: Complete development of photonically enabled electronic intelligence subsystem. Complete development of photonic antenna remoting concept. Complete development of integrated and adaptable transceiver microsystems. Continue development of next generation reconfigurable transceiver prototype. Continue development of microsystem integration solutions that integrate advanced components and thermal management technologies for cost, size, weight and power constrained microwave and millimeter wave applications. Initiate development of chip-scale photonic/electronic wideband transceiver components.</p> <p>FY 2023 Plans:</p>	7.989	6.492	6.218

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 622002 / <i>Electronic Component Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue development of next generation reconfigurable transceiver prototype. Continue development of microsystem integration solutions that integrate advanced components and thermal management technologies for cost, size, weight and power constrained microwave and millimeter wave applications. Continue development of chip-scale photonic/electronic wideband transceiver components. Initiate development of high-Q passive components for heterogeneous integration. Initiate identification of application areas and development of heterogeneous integration concepts.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.274 million. Justification for this decrease is described in plans above.</p>			
<p>Title: Microelectronics & Embedded System Assurance</p> <p>Description: Investigate and develop microelectronics security technologies to impede unwanted technology transfer and enable timely adoption of commercial and government-off-the-shelf microelectronic technologies that enable revolutionary capabilities for the Air Force.</p> <p>FY 2022 Plans: Investigate trust technologies and techniques in sensors and sensor systems to deter reverse engineering and exploitation of critical hardware and software technology and impede unwanted technology transfer, alteration of system capability, and prevent the development of countermeasures to our systems.</p> <p>FY 2023 Plans: Complete investigation of trust technologies and techniques in sensors and sensor systems. Continue development of techniques to deter reverse engineering and exploitation of critical program information. Initiate advanced exploitation tool development to assess modern threat capability.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.534 million. Justification for this decrease is described in plans above.</p>	0.000	5.064	4.530
Accomplishments/Planned Programs Subtotals	50.287	41.176	41.159

	FY 2021	FY 2022
Congressional Add: Program increase - exploitation detection for flexible combat avionics	4.943	5.000
FY 2021 Accomplishments: Conducted Congressional directed efforts		
FY 2022 Plans: Conduct Congressional directed efforts		
Congressional Add: Program increase: enhanced security sensors to detect threats in near and far field emissions	0.000	5.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 622002 / <i>Electronic Component Technology</i>
--	--	---

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressional directed efforts		
Congressional Add: Program increase: hardware-based oversight system for microelectronics endpoints	0.000	6.000
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressional directed efforts		
Congressional Add: Program increase: low cost sensors for UAVs	0.000	5.000
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressional directed efforts		
Congressional Add: Program increase: Zero-trust environment for semiconductor technology	0.000	10.000
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressional directed efforts		
Congressional Add: Program increase: Extreme wideband RF sensor	0.000	19.000
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressional directed efforts		
Congressional Adds Subtotals	4.943	50.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>				Project (Number/Name) 622003 / <i>EO Sensors & Countermeasures Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622003: <i>EO Sensors & Countermeasures Tech</i>	-	34.638	24.725	28.120	0.000	28.120	28.768	28.787	29.396	30.036	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project determines the technical feasibility of advanced electro-optical aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared portion of the spectrum. Related efforts include improvements in avionics integration, digital processing, analysis tools, and sensor architectures. One of the project's goals is to improve electro-optical and related technologies for the detection, tracking, and identification of non-cooperative and difficult targets, such as those obscured by camouflage or acquired at great range. This project also develops the passive and active imaging sensors and algorithms needed to enable precision targeting in severe weather. These technologies are critical to future aerospace surveillance and targeting. Other project goals include advanced electro-optical threat warning and countermeasures.

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

	FY 2021	FY 2022	FY 2023
Title: Passive Electro-Optical/Infrared Sensing in Contested Environments	12.291	12.411	13.765
Description: Develop innovative passive optical sensing technology to support surveillance and reconnaissance in contested environments. Develop high performance focal planes, aperture technologies, sensing architectures, and imaging techniques capable of long range target detection and characterization for intelligence, surveillance, reconnaissance and air-to-air sensing.			
FY 2022 Plans: Conduct flight test evaluation of the staring infrared search and track system against military relevant targets. Complete flight testing of compact, low-cost, low volume, real-time hyperspectral sensor for atritable platforms in preparation for operational demonstration. Continue development of low-earth orbit sensing systems for critical Air Force needs, including event-based sensors and passive interferometry.			
FY 2023 Plans: Continue refinement of advanced processing algorithms for hyperspectral imaging. Conduct demonstration of low-cost, compact hyperspectral imaging sensor with on-board, near real time processing software that utilizes advanced processing algorithms under development. Perform testing of new multi-spectral cameras and filters that allow more compact designs. Continue development of low-earth orbit sensing systems for critical Air Force needs, including event-based sensors and passive interferometry. Perform a field demonstration and evaluation of an event based/neuromorphic sensing system. Finalize development of large format, long wave infrared detector array for infrared search and track in preparation for future testing.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 622003 / <i>EO Sensors & Countermeasures Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$1.354 million. Increase is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors.			
<p>Title: Laser Radar Sensing in Contested Environments</p> <p>Description: Develop innovative laser sensing technology for non-cooperative identification of airborne and ground-based targets in contested environments. Develop optical spectrum transmitters, detectors and agile aperture technologies capable of sensing multiple target characteristics for robust non-cooperative target identification.</p> <p>FY 2022 Plans: Continue refinement/improvement of laser radar model to improve performance predictions of ability to meet operational demands. Collect additional data from an airborne laser vibrometry system to feed artificial intelligence algorithms for positive target identification. Build small-scale demonstration to show feasibility of new small size, weight and power digital holography system. Complete evaluation of new detector technology for coherent laser radar. Conduct feasibility analysis for space base laser radar concept.</p> <p>FY 2023 Plans: Refine design of multi-mode laser radar system for attritable platforms. Using data collected from other airborne laser radar programs, benchmark performance of modeling and simulation software. Complete initial development of processing software for multi-mode laser radar collecting vibration and synthetic aperture data. Investigate feasibility of multi-static laser radar concepts. After demonstration of a large aperture laser radar for high-resolution imaging needs, continue refinement of designs to improve performance while working with customers to investigate transition potential of existing designs.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$2.041 million. Increase is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors.</p>	11.473	12.314	14.355
Accomplishments/Planned Programs Subtotals	23.764	24.725	28.120

	FY 2021	FY 2022
Congressional Add: Low cost sensors for small unmanned vehicles	4.943	0.000
FY 2021 Accomplishments: Conduct congressional directed efforts		
FY 2022 Plans: Not applicable		
Congressional Add: Additive manufacturing for electronics	5.931	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 622003 / <i>EO Sensors & Countermeasures Tech</i>
--	--	---

	FY 2021	FY 2022
FY 2021 Accomplishments: Conduct Congressional directed efforts		
FY 2022 Plans: Not applicable		
Congressional Adds Subtotals	10.874	0.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>				Project (Number/Name) 622005 / <i>Cyber Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622005: <i>Cyber Technology</i>	-	16.625	6.934	8.466	0.000	8.466	9.215	9.514	9.713	9.925	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on technologies for enabling agile and resilient Air Force mission systems. This project improves our understanding of cyber vulnerabilities of mission systems by investigating the fundamental nature of those vulnerabilities including: how they come about, how they can be discovered, how they can be quantified and categorized, how they can be exploited, and how they can be removed or mitigated to secure the system. This project develops adaptable and resilient hardware/software for real-time avionics cyber-attack pattern recognition and develop a protection system with the capability for autonomous learning, adaptation, and self-protection. This project investigates open architecture concepts and technologies to deliver capability flexibility to Air Force mission systems. These technologies are matured via integrated capability demonstrations.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Vulnerability Mitigation</p> <p>Description: Apply knowledge from computer vulnerability discovery and computer security to investigate capabilities for identifying and mitigating vulnerabilities in United States mission systems resulting from software and/or hardware deficiencies. Develop automated and cost effective processes, techniques and technologies to assist in the identification of potential vulnerabilities.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 622005, Cyber Technology, Flexible and Secure Avionics effort.</p> <p>FY 2023 Plans: Not applicable</p>	4.324	0.000	0.000
<p>Title: Flexible and Secure Avionics</p> <p>Description: Develop avionics protection tools and capabilities to enable manned and unmanned aircraft, avionics, and related support equipment to automatically adapt to and withstand cyber attacks. Research and develop tools, methodologies and architecture guidelines that enable the design of avionics systems with sense, learn and adapt capabilities. Support test, maintenance, and acquisition communities with cyber subject matter expertise and techniques through consultation and technical interchange. Support other Services with cyber resiliency capabilities for air, ground and sea platforms and develop Open Mission Systems architectures incorporating cyber protections and resilience technologies.</p> <p>FY 2022 Plans: Perform flight test and demonstrations in operationally relevant capabilities for malware detection, diagnostics, and attack inferencing for mission systems. Continue research and develop real-time response mechanisms for cyber-attacks and software, firmware, and hardware diversity techniques to enable resilient cyber defense systems. Mature laboratory demonstrations</p>	6.370	6.934	8.466

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / Aerospace Sensors	Project (Number/Name) 622005 / Cyber Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>of automated test generation tools to expose malware embedded within mission critical software and firmware. Continue to investigate protection methodologies and open system architecture standards and approaches to improve agility and resiliency of legacy and next-generation mission systems architectures. Perform laboratory and flight demonstrations on flight worthy hardware. Share expertise with other Services and Test, Maintenance, and Acquisition communities.</p> <p>In FY 2022 this effort was renamed from Agile Mission Systems Protections to Flexible and Secure Avionics.</p> <p>FY 2023 Plans: Continue investigation and development of techniques to enable resilient cyber protections for avionics systems. Continue laboratory and flight demonstrations on flight worthy hardware. Share expertise with other Services and Test, Maintenance, and Acquisition communities. Initiate investigating protection technologies applied to open system architectures to enable resilience in next-generation mission systems and facilitate agility in mission system capability. Initiate development of advanced modular architecture for agile avionics.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.532 million. Increase is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors.</p>			
Accomplishments/Planned Programs Subtotals	10.694	6.934	8.466

	FY 2021	FY 2022
Congressional Add: Cyber assurance and assessment of electronic hardware systems	5.931	0.000
FY 2021 Accomplishments: Conduct Congressional directed efforts		
FY 2022 Plans: Not applicable		
Congressional Adds Subtotals	5.931	0.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>				Project (Number/Name) 624920 / <i>Electronic Warfare Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624920: <i>Electronic Warfare Technology</i>	-	44.749	45.347	45.410	0.000	45.410	46.085	46.803	47.796	48.835	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable, all weather radio frequency countermeasure concepts for aerospace applications covering the range of radio frequency sensors including communications, navigation, intelligence, surveillance and reconnaissance (ISR), and radar, both active and passive, across the air, land, sea, space and cyber domains. It develops and evaluates technology for electronic warfare, integrated radar and electronic warfare systems, and electro-optical/infrared seeker defeat. This project develops the radio frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. The project also explores technologies to maintain a military advantage in positioning, navigation and timing integrity, accuracy, and resiliency as well as on aircraft mission assurance - the protection of airborne platforms, manned and unmanned, in contested environments. The ultimate goal of the project is to ensure unrestricted access to the airspace and the electromagnetic spectrum in contested and congested environments.

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

	FY 2021	FY 2022	FY 2023
Title: Positioning, Navigation and Timing in Contested/Denied Environments	12.446	14.415	13.778
Description: Develop resilient position, navigation and timing sensors. Explore position, navigation and timing solutions to enable novel distributed radio frequency sensing and countermeasure techniques. Develop technology base to provide solutions addressing navigation and timing threats.			
FY 2022 Plans: Continue the exploration of position, navigation and timing alternatives to satellite navigation, such as RF signals of opportunity, magnetic, and vision aiding of inertial navigation systems. Prototype technologies to support airborne precise time, frequency, velocity and position as well as transfer between platforms to enable coherent sensing (intelligence, surveillance, reconnaissance) and effects (electromagnetic warfare). Demonstrate prototype trust techniques to enable military use of foreign satellite navigation signals. Develop software defined antenna electronics to complement software defined navigation receiver efforts, and explore advanced algorithms for software defined navigation. Begin to develop the requirements for a prototype communications receiver to provide a connected solution for time, frequency, velocity and position data transfer.			
FY 2023 Plans: Continue research and prototype demonstrations of integrated position, navigation and timing alternatives to satellite navigation, such as radio frequency signals of opportunity, magnetic, and vision aiding of inertial navigation systems. Demonstrate technologies to support airborne precise time, frequency, velocity and position as well as transfer between platforms to enable coherent sensing (intelligence, surveillance, reconnaissance) and effects (electromagnetic warfare). Continue to develop and demonstrate prototype trust techniques to enable military use of foreign satellite navigation signals. Continue to develop software defined antenna electronics to complement software defined navigation receiver efforts, and explore advanced algorithms for			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 624920 / <i>Electronic Warfare Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
software defined navigation. Mature the requirements for a prototype communications receiver to provide a connected solution for time, frequency, velocity and position data transfer. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.637 million. Justification for this decrease is described in plans above.				
Title: Radio Frequency Electronic Warfare Technologies Description: This project develops the radio frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. This project develops techniques and technologies to detect and counter the communications links and sensors of threat integrated air defense systems and hostile command and control networks. FY 2022 Plans: Continue research to develop electronic warfare technologies that can reason about threat capabilities and intentions and the electromagnetic environment to synthesize an optimized response in a time frame to support aircraft survivability against adaptive and agile threats. Continue the demonstration of robust modeling, simulation, and assessment capability to determine the efficiency versus effectiveness of emerging electronic support and electronic attack technologies, in complex electromagnetic spectrum background environments with hardware in the loop. Continue to develop and demonstrate distributed electronic warfare techniques to defeat integrated air defense systems. Continue integration of electro-optical and radio frequency engagement model development and experimentation to develop strategies to counter multispectrum threats to airborne platforms. FY 2023 Plans: Continue research to develop electromagnetic warfare technologies that operate in a contested electromagnetic environment to reason about complex threat capabilities/intentions. Technologies must understand the electromagnetic environment to synthesize an optimized response in a time frame to support aircraft survivability against adaptive and agile threats. Continue integration of electro-optical and radio frequency engagement model development and experimentation to develop strategies to counter multi-spectral threats to airborne platforms. Expand robust modeling, simulation, and assessment capability to include multi-spectral components to determine the efficiency versus effectiveness of emerging electronic support and electronic attack technologies. Continue to enhance hardware in the loop assessment capabilities to keep pace with complex electromagnetic spectrum background environments and emerging threats. Continue to develop and demonstrate distributed electronic warfare techniques to defeat integrated air defense systems. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$3.909 million. Increase is due to realignment of personnel between this effort and the Electro-Optical/Infrared Threat Warning and Countermeasures Technologies effort.		22.759	20.741	24.650
Title: Electro-Optical/Infrared Threat Warning and Countermeasures Technologies		9.544	10.191	6.982

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 624920 / <i>Electronic Warfare Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Develop electro-optical/infrared sensor countermeasure technologies. Explore novel concepts to enable electro-optical/infrared threat seeker exploitation and surrogate modeling. Conduct fundamental research in countermeasures to defeat electro-optical/infrared threat seekers. Conduct fundamental research on integrated electro-optical/infrared threat warning systems.</p> <p>FY 2022 Plans: Continue threat characterization and development of countermeasures techniques to defeat emerging advanced electro-optical/infrared guided threats to airborne platforms. Continue the development of advanced threat surrogates and conduct infrared countermeasure testing at test ranges. Continue to investigate long-range missile warning and laser warning technology concepts. Continue development of an advanced framework for modeling and simulation and hardware in the loop assessment with scene generation of engagements and techniques to defeat electro-optical and infrared guided threats to airborne platforms. Validate results using data collected in live fire tests.</p> <p>FY 2023 Plans: Continue threat characterization and development of countermeasures techniques to defeat emerging advanced electro-optical/infrared guided threats to airborne platforms. Continue to investigate long-range missile warning and develop laser warning technology concepts to improve aircraft and aircrew survivability. Continue development of advanced threat surrogates and conduct infrared countermeasure testing at test ranges. Continue development of an advanced framework for modeling and simulation and hardware in the loop assessment with scene generation of engagements and techniques to defeat electro-optical and infrared guided threats to airborne platforms. Continue to validate results using data collected in live fire tests. Continue development of electro-optical/infrared models and scenes to transition to multi-spectral threat assessment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$3.209 million. Decrease is due to realignment of personnel between this effort and the Radio Frequency Electronic Warfare Technologies effort.</p>			
Accomplishments/Planned Programs Subtotals	44.749	45.347	45.410

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>				Project (Number/Name) 626095 / <i>Sensor Fusion Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
626095: <i>Sensor Fusion Technology</i>	-	35.716	35.984	33.577	0.000	33.577	34.323	35.234	35.979	36.763	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops foundational and applied technologies required for closed-loop autonomous sensing employing multiple information domains, diverse sensor phenomena, and multiple platform types to provide intelligence, surveillance, and reconnaissance; target recognition; situational awareness and battlespace visualization; fire control; and battle damage assessment capabilities against a wide variety of air and ground based targets engaged in multitudes of behaviors in a broad range of operational environments. This project conducts exploratory and applied investigations to determine technology feasibility and estimate operational capability constraints associated with missions in future contested and highly contested operating environments, using cooperative and non-cooperative sensing sources. This project develops techniques to automate multi-sensor exploitation and information processing which leverage data fusion, adaptive signal processing, sensor and platform orchestration, leveraging artificial intelligence / machine learning research communities. This project develops concepts and algorithms for efficient processing at the edge, parallel processing, distributed processing, and high-performance computing in sensor data processing and synthetic data generation.

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

	FY 2021	FY 2022	FY 2023
Title: Battlespace Awareness Sensing Fusion	14.450	11.738	15.883
<p>Description: Continue to develop novel techniques for behavioral and physical knowledge generation from multiple sensors, intelligence sources, domains (Air, Space, Cyber) and sources to include algorithm development, assessment, and experiments across multiple distributed, homogeneous and heterogeneous sensors and platforms. This effort will focus on technology areas of data association, entity detect/track/identification, information fusion, training with limited data, and data/performance modeling. The application of machine learning techniques to address technical challenges in contested environments is a particular emphasis.</p> <p>FY 2022 Plans: Continue to generate knowledge through fusion of multiple spatial and temporal sensors to provide solutions for contested environments wherein data is extremely limited. Continue to apply deep and machine learning techniques to the detection/tracking/targeting and recognition of stationary and moving objects and systems, and for pattern of life understanding in a broad set of sensing operating conditions. Advance the development in decision/feature and/or signal-level fusion capabilities that will be applied to new multi-sensor exploitation for autonomy efforts to include demonstration of four-dimensional change detection for intelligence, surveillance and reconnaissance applications. Continue to investigate fusion of hard and soft information sources for military relevant applications. Design and evaluate neural network training techniques, to include blended measured-synthetic training, for deep and machine learning classifiers to produce timely and autonomous intelligence, surveillance and reconnaissance, enhanced situational awareness and improved battlespace awareness with decision timelines inside the adversary's observe, orient, decide, act loop.</p>			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / Aerospace Sensors	Project (Number/Name) 626095 / Sensor Fusion Technology
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

In FY 2022 this effort was renamed from Synthesis for Understanding to Battlespace Awareness Sensing Fusion.

FY 2023 Plans:
Continue to generate knowledge through fusion of multiple spatial and temporal sensors, improving the state of the art in fusion exploitation. Continue to provide solutions for contested environments wherein data is extremely limited. Continue to apply deep and machine learning techniques to the detection/ tracking/targeting, recognition of stationary and moving objects and ground-based systems, pattern of life understanding, applying advanced information understanding tools and emerging techniques, over a broad set of sensing operating conditions. Start research applying techniques learned in air/space to ground application, applying those techniques, where applicable to the air/space to air problem. Continue to investigate fusion of hard and soft information sources for military relevant applications. Continue to invest in integration capabilities which reduce the time between development and demonstration such as a development, secure, operations and algorithm containerization.

FY 2022 to FY 2023 Increase/Decrease Statement:
FY 2023 increased compared to FY 2022 by \$4.145 million. Increase is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors and realignment of funding from Project 626095, Sensor Fusion Technology, Multi-Domain Sensing Effects and Analysis effort.

Title: Multi-Domain Sensing Effects and Analysis	7.763	6.046	3.436
---	-------	-------	-------

Description: This effort will focus on two primary areas: (1) Multi domain sensing and effects mission analysis and (2) performance understanding and assessments. It will develop methodologies and modeling, simulation, and analysis tools to enable multi domain analysis and technology development, informing other efforts and projects across the directorate. Investments in modeling, simulation and analysis represent current and next generation sensing platforms to include air, space, and cyber to include fusion of information, battlespace understanding, and the ability to simulate sensor and platform performance at the mission level, engagement level, and physics level, to understand performance and trade space amongst these domains.

FY 2022 Plans:
Develop new autonomy performance evaluation techniques adapted to specific artificial intelligence and machine learning challenges. Continue to perform empirical performance estimation for intelligence, surveillance, and reconnaissance automated sensing exploitation of military-critical targets with limited training data. Continue to mature sensor data as-a-service research environment by extending into classified networks and pursuing integration with other data science and research cloud environments further enabling sensing autonomy developers and warfighting analysts. Develop defense applications for new data tagging and automated availability architecture; assist transitions of this capability service-wide and to intelligence community partners. Transition test and evaluation harness software to department-wide performance analysis community; continue to standardize test metrics and performance understanding.

FY 2023 Plans:

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 626095 / <i>Sensor Fusion Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue development of autonomy performance evaluation techniques adapted to specific artificial intelligence and machine learning challenges. Continue to perform empirical performance estimation for intelligence, surveillance, and reconnaissance automated sensing exploitation of military-critical targets with limited training data. Employ data as-a-service research environment by extending from unclassified to classified networks, leveraging research cloud environments, further enabling sensing autonomy developers and warfighting analysts. Transition to defense applications the ability to perform new data tagging and automated data availability architecture to a service-wide application along with our intelligence community partners. Continue the transition of test and evaluation harness software to department-wide performance analysis community, leveraging standardize test metrics and performance measurement understanding.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.610 million. Funding decrease is a result of realignment of funding to Project 626095, Sensor Fusion Technology, Battlespace Awareness Sensing Fusion effort.</p>			
<p>Title: Knowledge and Execution Management</p> <p>Description: Develop, evaluate, and demonstrate models for sensing and for adversary behavior that support anticipatory asset tasking, characterization of latencies and related uncertainties, and joint inference and control. Develop multisource sensing techniques to include sensor and platform optimization and control, providing environment characterization consistent with the needs of automated and autonomous systems. This research and development investment allows for the automation of closed-loop intelligence, surveillance and reconnaissance.</p> <p>FY 2022 Plans: Improve and integrate onboard mission resource management techniques for distributed sensing/effects capabilities via open autonomy architectures and continue experimentation via simulation, live, and blended sim/live testing (multiple aircraft & sensors). Continue improving representational and computational efficiency of on-board reasoning about ground targets and target groupings, and target behaviors. Continue development of foundational knowledge management algorithms for situation awareness incorporating interacting ground targets, environments, and operationally representative contingencies. Embrace new forms of reasoning and continue to evolve forms of representations and combined representations and reasoning approaches like self-querying synergistic knowledge graph / machine learning world models, more diverse state representations in reinforcement learning, and spiking neural network reinforcement learning.</p> <p>In FY 2022 this effort was renamed from Multisource Knowledge Representation and Management to Knowledge and Execution Management.</p> <p>FY 2023 Plans: Continue to improve and integrate onboard mission resource management techniques for distributed sensing/effects capabilities via open autonomy architectures and continue experimentation. Continue to accomplish performance understanding through</p>	13.503	6.900	11.216

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 626095 / <i>Sensor Fusion Technology</i>
--	--	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

<p>simulation, demonstration, and blended sim/live testing (multiple aircraft & sensors). Continue improving representational and computational efficiency of on-board reasoning about ground targets and target groupings, and target behaviors. Start new research in foundational knowledge of emerging management algorithms for battlespace awareness incorporating interacting air/ground targets, air/air targets, environments, and operationally representative contingencies. Continue the development of emerging algorithms to perform information reasoning and continue to evolve forms of representations and combined representations and reasoning approaches such as self-querying synergistic knowledge graph / machine learning world models, more diverse state representations in reinforcement learning, and spiking neural network reinforcement learning.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$4.316 million. Increase is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors and realignment of funding from Project 626095, Sensor Fusion Technology, Cyber Physical Sensing effort.</p>			
---	--	--	--

<p>Title: Cyber Physical Sensing</p> <p>Description: Cyber Physical Sensing is the opportunity to exploit the internet of things and other non-traditional intelligence, surveillance and reconnaissance sensing systems in a way other than what they were designed to do. This additional source of information closes the gap between current intelligence, surveillance and reconnaissance collection capabilities and the vision of all intelligence, surveillance and reconnaissance, all the time. This technology investment looks at the sensing opportunities which exist at the point where physics meets the cyber domain. This effort focuses on the proliferated sensing devices, extracting information from multi-intelligence sensors and translating that information into detection, tracking and identification by use of multi-intelligence fusion. This effort leverages processing at-the-edge and distributed processing, exploited using new-generation machine learning, artificial intelligence and deep learning techniques.</p> <p>FY 2022 Plans: Master real-world sensing physics between the adversary and devices uniquely available via the cyber domain. Develop and instrument empirical, multi domain research facilities to collect, demonstrate, and access cyber physical sensing in mission-relevant context. Research, develop, and transition processing and exploitation techniques with edge and core flexibilities on proliferated and distributed cyber physical platforms. Advance deployed warfighters tactics, techniques, and procedures through the use of exploited cyber physical modalities. Create unsolvable dilemmas for our adversaries by persistent, omniscient sensing of their physical state through cyber means.</p> <p>FY 2023 Plans: Research new non-traditional intelligence, surveillance and reconnaissance collection opportunities, associate new opportunities to intelligence, surveillance and reconnaissance collection capabilities, and invest appropriately in research and development of techniques to improve collection, processing, and dissemination of information, allowing for automation and autonomy in intelligence, surveillance and reconnaissance. Continue research and development in edge to core/cloud information processing</p>	0.000	4.300	3.042
--	-------	-------	-------

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 626095 / <i>Sensor Fusion Technology</i>
--	--	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
and how these capabilities can best be utilized to get within the adversaries observe, orient, decide, act loop. Start research in new novel techniques to exploit unforeseen information from these non-traditional ISR information sources. Continue research which advances tactics, techniques and procedures by way of new exploitation techniques of cyber physical modalities.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$1.258 million. Funding decrease is a result of realignment of funding to Project 626095, Sensor Fusion Technology, Knowledge and Execution Management effort.			
Accomplishments/Planned Programs Subtotals	35.716	28.984	33.577

	FY 2021	FY 2022
<i>Congressional Add:</i> Program increase: Reliability of combat cloud communications systems	0.000	7.000
<i>FY 2021 Accomplishments:</i> Not applicable		
<i>FY 2022 Plans:</i> Conduct Congressional directed efforts		
Congressional Adds Subtotals	0.000	7.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>				Project (Number/Name) 627622 / <i>RF Sensors and Countermeasures Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
627622: <i>RF Sensors and Countermeasures Tech</i>	-	34.821	51.752	36.001	0.000	36.001	37.097	37.397	38.192	39.017	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable all weather radio frequency sensing and countermeasure concepts for aerospace applications covering the range of radio frequency sensors including communications, navigation, intelligence, surveillance and reconnaissance (ISR), and radar, both active and passive, across the air, land, sea, space and cyber domains. This project also develops and evaluates technology for intelligence, surveillance and reconnaissance sensors, fire control radars, electronic warfare, integrated radar and electronic warfare systems, and offensive information operations systems. It emphasizes the detection and tracking of surface and airborne targets with radio frequency signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple radio frequency phenomenologies, multi-dimensional adaptive processing, advanced waveforms and knowledge-aided processing techniques. This project also develops concepts to counter threats to our aerospace systems. It develops and evaluates technology for electronic warfare, integrated radar and electronic warfare systems, and electro-optical/infrared seeker defeat. This project develops the radio frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. The project also explores technologies to maintain a military advantage in positioning, navigation and timing integrity, accuracy, and resiliency.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Radio Frequency Sensor Technologies</p> <p>Description: Conduct applied research and development for the advancement of passive and active radio frequency sensors; including phenomenology, modeling and simulation, algorithm development, and experimentation. Plan, execute, and maintain state-of-the-art radio frequency sensor research and development facilities. Conduct research on sensing, learning, and adapting to enable the countering of emerging adaptive, agile radio frequency threats.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 627622, RF Sensors and Countermeasure Tech, Passive Radio Frequency Sensing effort and Distributed Radio Frequency Sensing effort.</p> <p>FY 2023 Plans: Not applicable</p>	11.935	0.000	0.000
<p>Title: Multiband Multifunction Radio Frequency Sensing</p> <p>Description: Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks.</p> <p>FY 2022 Plans:</p>	11.022	20.272	14.295

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 627622 / <i>RF Sensors and Countermeasures Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Complete demonstration of electronic support measure/airborne moving target indicator/ground moving target indicator modes in ultra high frequency to S-band ground demonstrator. Continue advanced mode development for multi-beam digital arrays, implementing more complex modes and advanced waveforms. Continue investigation of advanced digital signal processing techniques to demonstrate mode-switching and multi-function capability. Initiate mode development for 2-18 GHz airborne digital array. Perform laboratory demonstration of millimeter wave digital beamforming array for command and control functionality. Continue demonstration of additive manufacturing techniques and use of COTS components to fabricate low-cost, wide bandwidth, scalable, and conformal phased array antennas for integration on unmanned sensing platforms such as the Low Cost Attributable Aircraft Technology XQ-58A experimental platform. Complete study of alternative digital backend technologies. Complete performance assessment of wideband digital arrays embedded on platforms. Initiate full wave analysis of sensor performance on large platforms.</p> <p>In FY 2022 this effort was renamed from Multi-Band/Multi-Beam Technologies to Multiband Multifunction Radio Frequency Sensing.</p> <p>FY 2023 Plans: Demonstrate integrated electronic support measure/airborne moving target indicator/ground moving target indicator modes for passive multi-mode radar using ultra high frequency to S-band digital array demonstrator. Continue advanced mode development for multi-beam and multi-function digital arrays, implementing more complex modes and advanced waveforms with applications for Advanced Early Warning radar. Begin transition of ground-based modes to airborne digital array demonstrator. Continue integration of additively manufactured antennas and radar backend components to demonstrate low-cost, wide bandwidth, scalable, and conformal phased array antennas for unmanned sensing platforms. Perform bi-static flight data collection using low cost digital beamforming receiver. Continue development of techniques for analysis of complex active electronically scanned arrays on large platforms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$5.977 million. Decrease is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors.</p>			
<p>Title: Sensor Resource Management</p> <p>Description: Develop technology to enable optimization of sensor resources in contested environments on own-ship and multi-ship in manned, unmanned and manned/unmanned teaming concepts.</p> <p>FY 2022 Plans:</p>	11.864	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 627622 / <i>RF Sensors and Countermeasures Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Starting in FY 2022, this work is performed under Project 627622, RF Sensors and Countermeasure Tech, Passive Radio Frequency Sensing effort and Distributed Radio Frequency Sensing effort.				
FY 2023 Plans: Not applicable				
Title: Passive Radio Frequency Sensing		0.000	11.554	9.081
Description: Develop a system that performs traditional radar sensing modes through passive means. The research plan is designed to continue the development of the subsystems which make up the passive radar and to follow a spiral development path that involves the integration and testing of various technology instantiations to produce alternate versions of a full passive multi-mode system. Includes the development of low size-weight-and-power radio frequency signal detection and geolocation payloads for small unmanned air systems and the integration of advanced receiver subsystems to meet a particular need of the Air Force. Explore combat identification technologies, modeling and simulation enhancements, and technologies supporting passive radar, electronic support, and signals intelligence.				
FY 2022 Plans: Continue development of low cost, size, weight and power direction finding payloads and geolocation techniques. Continue integration onto attritable unmanned air systems to improve radio frequency situational awareness for advanced battle management system applications. Initiate development of advanced processing techniques for onboard signal characterization, geolocation/track, and signals pattern-of-life analysis. Continue integration of bi- and multi-static radar clutter models into high fidelity radar system models for evaluation of advanced passive radar performance in complex environments. Continue analysis of bi-static target/ground scattering phenomenology to improve combat identification of ground targets from bi-static/multi-static radar systems. Continue analysis of bi-static high resolution radar data in conjunction with advanced automated target recognition algorithms to demonstrate improved timeliness for combat identification of complex targets from bi-static radar systems.				
FY 2023 Plans: Continue development of small low cost direction finding payloads and advanced processing techniques for onboard signal characterization, geolocation/track, and signals pattern-of-life analysis. Demonstrate distributed multi-ship geolocation aboard small unmanned aircraft systems. Continue development of enhanced radio frequency modeling and simulation tools for evaluation of passive radar performance in complex environments. Complete integration of bi- and multi-static radar clutter models into modeling and simulation tools. Continue to integrate high fidelity modeling and simulation with mission level modeling to demonstrate operational utility of passive radar concepts. Continue analysis of bi-static target/ground scattering phenomenology and bi-static high resolution radar data in conjunction with advanced automated target recognition algorithms to demonstrate				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 627622 / <i>RF Sensors and Countermeasures Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
improved accuracy and timeliness for combat identification of complex targets. Initiate investigation of advanced processing techniques to enhance passive radar performance. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.473 million. Decrease is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors.				
Title: Distributed Radio Frequency Sensing Description: Develop innovative, timely, and affordable target detection, tracking, and characterization (namely imaging/identification) capabilities that leverage two or more spatially-distributed receivers and transmitters that use cooperative radio frequency transmitters (illuminators), namely those radio frequency sources that have a common objective to the receiver systems being used. FY 2022 Plans: Continue development of robust multi-static transmit waveforms and receive processing chains for operationally relevant multi-static ground moving target indicator systems. Continue development of clutter mitigation techniques for multi-channel distributed sensor systems to detect slow-moving targets in denied environments. Continue advancement of multi-static synthetic aperture radar algorithms to improve operation in complex environments. Complete study of imaging alternatives for low signal-to-noise environments. Initiate assessments of multi-static synthetic aperture radar algorithms to support combat identification and automatic target recognition requirements on tactical timelines. Initiate implementation and demonstration of multi-static synthetic aperture radar algorithms on low cost, size, weight and power platforms. Continue data collection and analysis to assess performance of distributed radar systems for ground moving target indicator and synthetic aperture radar modes. FY 2023 Plans: Continue development of robust non-traditional multi-static transmit waveforms and receive processing chains for operationally relevant multi-static ground moving target indicator systems. Initiate investigation of platform constraints and implementation of near real-time processing. Define requirements for capstone flight experiment demonstrating multi-static detection and tracking of ground targets. Continue enhancements of multi-static synthetic aperture radar algorithms to support combat identification and automatic target recognition requirements on tactical timelines. Continue implementation and demonstration of multi-static synthetic aperture radar algorithms on cost and size constrained platforms. Begin to develop/mature distributed 3-dimensional imaging algorithms that are scalable to a multi-domain approach. Continue data collection and analysis to assess performance of distributed radar systems for ground moving target indicator and synthetic aperture radar. Continue to explore multi- and cross-domain applications. FY 2022 to FY 2023 Increase/Decrease Statement:		0.000	19.926	12.625

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / <i>Aerospace Sensors</i>	Project (Number/Name) 627622 / <i>RF Sensors and Countermeasures Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 decreased compared to FY 2022 by \$7.301 million. Decrease is the result of rebalancing organizational support costs among the projects in PE 0602204F, Aerospace Sensors.			
Accomplishments/Planned Programs Subtotals	34.821	51.752	36.001

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602212F / <i>Defense Laboratories R&D Projects (10 U.S.C, Sec 2358)</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	106.964	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
622030: <i>Defense Lab R&D Projects</i>	-	106.964	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Implementation of 10 U.S.C. Section 2363, amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B), to fund: innovative basic and applied research conducted at the defense laboratory and supports military missions; development programs supporting the transition of technologies developed by the defense laboratory into operational use; workforce development activities improving the capacity of the defense laboratory to recruit and retain personnel with necessary scientific and engineering expertise that support military missions; and the repair or minor military construction of the laboratory infrastructure and equipment.

The Air Force is dependent on technological advances in response to emerging threats and to maintain a competitive advantage. Air Force has a comprehensive and deliberative planning process to identify and fund research that is expected to have the greatest benefit to the Air Force and the warfighter. 10 U.S.C. Section 2363 provides the Commander of the Air Force Research Laboratory (AFRL), in consultation with the Air Force Science and Technology (S&T) Executive, a degree of flexibility to rapidly exploit scientific breakthroughs or respond to emerging threats, to include developing a skilled workforce and necessary infrastructure. This flexibility increases the rate of innovation and accelerates the development and fielding of needed military capabilities to address current and future problems.

The Air Force has established PE 0602212F, where the 10 U.S.C. Section 2363 funds are internally reprogrammed to this program element in the year of execution after receipt of the appropriation. This allows increased transparency to Congress on 10 U.S.C. Section 2363 funding and additional execution flexibility for 10 U.S.C. Section 2363 activities to cross all technology areas.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602212F I Defense Laboratories R&D Projects (10 U.S.C, Sec 2358)
--	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	0.000	0.000	0.000	0.000
Current President's Budget	106.964	0.000	0.000	0.000	0.000
Total Adjustments	106.964	0.000	0.000	0.000	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	106.964	0.000	0.000	0.000	0.000

Change Summary Explanation

Increase in FY 2021 in Other Adjustments is due to realignment of funds to PE 0602212F to support Research and Development Projects, 10 U.S.C. Section 2358, as amended by 10 U.S.C. 2805(d)(1)(B) and 10 U.S.C. Section 2363.

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Title: Defense Laboratories R&D Projects - Air Force Research Laboratory	106.964	-	-
Description: Implementation of 10 U.S.C. Section 2363, amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B), to fund: innovative basic and applied research conducted at the Air Force Research Laboratory (AFRL) and supports military missions; development programs supporting the transition of technologies developed by AFRL into operational use; workforce development activities improving the capacity of AFRL to recruit and retain personnel with necessary scientific and engineering expertise that support military missions; and the repair or minor military construction of the laboratory infrastructure and equipment.			
Accomplishments/Planned Programs Subtotals	106.964	-	-

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602298F / <i>Science and Technology Management - Major Headquarters Activities</i>
---	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	8.910	8.891	8.856	0.000	8.856	9.040	9.234	9.432	9.630	Continuing	Continuing
622520: <i>Science and Technology Management - Major HQ</i>	-	8.910	8.891	8.856	0.000	8.856	9.040	9.234	9.432	9.630	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force Research Laboratory (AFRL) is a global technical enterprise, boasting some of the best and brightest leaders in the world. It provides revolutionary, relevant, and responsive science and technology (S&T) to the Warfighter. AFRL's mission is to lead the discovery, development, and integration of affordable warfighting technologies for the global air, space, and cyberspace force.

This program element includes necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, and 1206601SF.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	8.910	8.891	0.000	0.000	0.000
Current President's Budget	8.910	8.891	8.856	0.000	8.856
Total Adjustments	0.000	0.000	8.856	0.000	8.856
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	8.856	0.000	8.856

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602298F / <i>Science and Technology Management - Major Headquarters Activities</i>	Project (Number/Name) 622520 / <i>Science and Technology Management - Major HQ</i>
--	--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622520: <i>Science and Technology Management - Major HQ</i>	-	8.910	8.891	8.856	0.000	8.856	9.040	9.234	9.432	9.630	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force Research Laboratory (AFRL) is a global technical enterprise, boasting some of the best and brightest leaders in the world. It provides revolutionary, relevant, and responsive science and technology (S&T) to the Warfighter. AFRL's mission is to lead the discovery, development, and integration of affordable warfighting technologies for the global air, space, and cyberspace force.

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

	FY 2021	FY 2022	FY 2023
Title: AFRL - Major Headquarters Activities	8.910	8.891	8.856
Description: Provide professional government civilian workforce in support of all AFRL programs and activities.			
FY 2022 Plans: Continue to provide professional government civilian workforce in support of all AFRL programs and activities.			
FY 2023 Plans: FY 2023 funding decreased compared to FY 2022 by \$0.035 million. Funding decrease due to civilian pay reprice adjustments.			
FY 2022 to FY 2023 Increase/Decrease Statement: The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY 2023 cannot be made in a relevant manner.			
Accomplishments/Planned Programs Subtotals	8.910	8.891	8.856

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>
---	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	118.541	151.757	137.303	0.000	137.303	140.602	142.749	140.399	143.572	Continuing	Continuing
622068: <i>Advanced Guidance Technology</i>	-	66.041	101.070	75.017	0.000	75.017	76.797	78.045	79.700	81.440	Continuing	Continuing
622502: <i>Ordnance Technology</i>	-	52.500	50.687	62.286	0.000	62.286	63.805	64.704	60.699	62.132	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program investigates, develops, and establishes the technical feasibility and military utility of guidance and ordnance technologies for conventional munitions. The effort supports core technical competencies of munitions aerodynamics, guidance, navigation, and control; terminal seeker sciences; fuze technology; energetic materials; damage mechanisms; and munition systems effects. Technologies and associated models and simulation assets to be developed include seekers that provide high-confidence target discrimination and classification with precise target location and robust terminal tracking; navigation technologies that do not rely upon the Global Positioning System (GPS); blast, fragmentation, penetrating, low-collateral-damage, and multi-mission warheads; collaborative, synchronized fuzing; and high-performance and insensitive explosives.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of such program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602605F, 0602788F, 0602298F, and 0602020F.

Funds in this PE may be used to investigate specified technology advancements in air, space and/or cyber domains.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>
---	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	127.193	151.757	0.000	0.000	0.000
Current President's Budget	118.541	151.757	137.303	0.000	137.303
Total Adjustments	-8.652	0.000	137.303	0.000	137.303
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.003	0.000			
• SBIR/STTR Transfer	-3.352	0.000			
• Other Adjustments	-5.297	0.000	137.303	0.000	137.303

Change Summary Explanation

Decrease in FY 2021 reflects adjustments and reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY 2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>				Project (Number/Name) 622068 / <i>Advanced Guidance Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622068: <i>Advanced Guidance Technology</i>	-	66.041	101.070	75.017	0.000	75.017	76.797	78.045	79.700	81.440	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional munitions guidance technologies to establish technical feasibility and military utility of innovative munition seekers, weapon aerodynamics, navigation and control, and guidance subsystem integration/simulation. Project payoffs include adverse-weather, Global Positioning System (GPS)-degraded and Global Positioning System-denied, networked, and autonomous precision munition guidance capability; increased number of kills per sortie; increased aerospace vehicle survivability; improved weapon reliability and affordability; and improved weapon survivability and effectiveness.

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

<p>Title: Seeker Technologies</p> <p>Description: Develops seeker technologies for munitions to provide high-confidence target discrimination and classification, precise target location, and robust terminal tracking.</p> <p>FY 2022 Plans: Continue to emphasize technology development of multi-function sensors, rapid data compression for targeting, bio-inspired information processing and data fusion, and low-power computation. Continue to develop technologies that simplify, increase flexibility, and reduce the cost of advanced seeker concepts. Continue to develop algorithmic approaches integrating weapons into the kill chain to enable distributive, flexible seeker targeting with or without an operator in the loop. Continue development and testing of innovative engagements for fifth generation aircraft and beyond. Continue materials research efforts on radomes and apertures to improve transmission and optical performance while increasing protection from operational environments including directed energy and rain. Continue to explore incorporation of open architecture principles to reduce cost and enable technology refresh within seeker sub-systems. Continue to explore specific techniques for seeker cost reduction with performance improvement such as sparse sensing and compressive sensing. Continue research on integrated processing techniques to enable networked systems. Continue multi-function radio frequency technique development to enable coherent multi-weapon operation. Continue to develop Open Seeker Architecture with extended view and continue integration into weapon mission computer to enable cooperative weapon operation. Continue open seeker architecture integration into the weapon open system architecture and evaluate the impact with respect to cyber vulnerability. Continue to develop and demonstrate coherent collaborative radio frequency seeker operation.</p> <p>FY 2023 Plans: Continue to emphasize technology development of multi-function sensors, rapid data compression for targeting, bio-inspired information processing and data fusion, and low-power computation. Continue to develop technologies that simplify, increase flexibility, and reduce the cost of advanced seeker concepts. Continue to develop algorithmic approaches integrating weapons</p>	FY 2021	FY 2022	FY 2023
	11.465	23.921	14.421

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>	Project (Number/Name) 622068 / <i>Advanced Guidance Technology</i>
--	---	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

<p>into the kill chain to enable distributive, flexible seeker targeting with or without an operator in the loop. Continue development and testing of innovative engagements for fifth generation aircraft and beyond. Continue development of weapon radomes and apertures to improve transmission and optical performance while increasing protection from operational environments including directed energy and rain. Continue to explore incorporation of open architecture principles to reduce cost and enable technology refresh within seeker sub-systems. Continue to explore specific techniques for seeker cost reduction with performance improvement such as sparse sensing and compressive sensing. Continue research on integrated processing techniques to enable networked systems. Continue multi-function radio frequency technique development to enable coherent multi-weapon operation. Continue to develop weapon open system architecture with extended view and integration into weapon mission computer to enable cooperative weapon operation. Continue open seeker architecture integration into the weapon open system architecture and evaluate the impact with respect to cyber vulnerability. Continue to develop and demonstrate coherent collaborative radio frequency seeker operation.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$9.500 million. Funding decreased due to higher Air Force priorities.</p>			
---	--	--	--

Title: Aerodynamics, Navigation, and Control Technologies	32.616	41.770	34.217
--	--------	--------	--------

Description: Develops weapon aerodynamic control, navigation, and networking technologies for munitions to provide precise, agile flight, networked effects, and immunity to countermeasures.

FY 2022 Plans:
Continue novel position, navigation and timing technology development for global positioning system denied environments with intent to insert into demonstration programs. Continue to investigate cooperative, autonomous, and collaborative weapon behaviors to develop robust algorithms and swarming playbooks. Continue experiments demonstrating precision navigation, emphasizing cruise missile, form-factored optics and tracker for celestial aided navigation at supersonic cruise missile speeds and trajectory. Continue flight testing of articulating head missile at supersonic speeds at full scale. Completed flight demonstration of heterogeneous collaborative capability which integrated kinetic swarm plays with electronic attack swarm plays. Initiate new phase of kinetic and electronic attack swarm plays incorporating cyber domain, electric warfare, and kinetic effects. Continue flight demonstration of network aided navigation autonomy playbook. Continue flight demonstration of high-speed, high-performance weaponized quadrotor in a complex environment in support of autonomy tactics development and maturation. Complete machine learning of visual servos. Initiate machine learning to develop tactics for multi-weapon engagements.

FY 2023 Plans:
Continue novel position, navigation and timing technology development for global positioning system denied environments with intent to insert into demonstration programs. Continue to investigate cooperative, autonomous, and collaborative weapon behaviors to develop robust algorithms and swarming playbooks. Continue experiments demonstrating precision navigation, emphasizing cruise missile, form-factored optics and tracker for celestial aided navigation at supersonic cruise missile speeds

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>	Project (Number/Name) 622068 / <i>Advanced Guidance Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>and trajectory. Continue flight testing of articulating head missile at supersonic speeds at full scale to include analysis of range extension through airframe morphing and articulation. Continue kinetic and electronic attack swarm plays incorporating cyber domain, electric warfare, and kinetic effects. Continue flight demonstration of network aided navigation autonomy playbook. Continue flight demonstration of high-speed, high-performance weaponized quadrotor in a complex environment in support of autonomy tactics development and maturation. Continue machine learning to develop tactics for multi-weapon engagements. Initiate synthetic aperture radar based alternative-navigation technology investigation. Initiate post-weapon deployment data analytics to improve guidance, navigation, and controls models and autonomy tactics.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$7.553 million. Funding decreased due to higher Air Force priorities.</p>			
<p>Title: Guidance Technologies</p> <p>Description: Develops guidance subsystem integration and evaluation technologies to provide open and closed-loop ground testing, flight test risk reduction, and digital simulation of novel concepts.</p> <p>FY 2022 Plans: Continue low-cost cruise missile demonstration of critical behaviors for distributed, cooperative, collaborative strategies and other advanced guidance capabilities. Continue to improve constructive and virtual analysis tools for design, development, and analysis of advanced low-cost cruise missile concepts in representative environments. Continue engagement level analysis on hypersonic and air-to-air weapon concepts providing design, performance, and trade space analysis to the program offices. Continue to improve simulation technologies evaluating innovative air-to-air and air-to-surface engagements to include guidance and control evaluation. Continue to add additional targets and improved terrain resolution to radar, millimeter wave, infrared, and ultraviolet signature generation capability for testing algorithms in real-time software and hardware in-the-loop environments. Continue development of hypersonic hardware-in-the-loop simulation technology, including thermal environment, aerodynamic control uncertainty, seeker modeling, and navigation sensor effectiveness. Complete simulator upgrades to accommodate resolution requirements for navigation quality synthetic aperture radar target and background modeling. Continue development of infrared light emitting diode target simulator technology to create higher frame rate and higher resolution target simulator technology. Continue providing weapon oriented multi-security level, cross-domain distributed modeling and simulation support using distributed connectivity between Eglin Air Force Base facilities and other geographic locations. Continue development of 6-degrees of freedom and scene generation modules for the extended modeling and simulation community using Air Force Simulator. Continue hardware-in-the-loop activities in support of international cooperative research efforts.</p> <p>FY 2023 Plans: Continue development of cruise missile behaviors for distributed, cooperative, collaborative strategies and other advanced guidance capabilities. Continue to improve constructive and virtual analysis tools for design, development, and analysis of advanced missile concepts in representative environments. Continue engagement level analysis on high-speed and air-to-</p>	21.960	35.379	26.379

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>	Project (Number/Name) 622068 / <i>Advanced Guidance Technology</i>
--	---	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>air weapon concepts providing design, performance, and trade space analysis to the program offices. Continue to improve simulation technologies evaluating innovative air-to-air and air-to-surface engagements to include guidance and control evaluation. Continue to add additional targets and improved terrain resolution to radar, millimeter wave, infrared, and ultraviolet signature generation capability for testing algorithms in real-time software and hardware in-the-loop environments. Continue development of high-speed hardware-in-the-loop simulation technology, including thermal environment, aerodynamic control uncertainty, seeker modeling, and navigation sensor effectiveness. Continue development of infrared light emitting diode target simulator technology to create higher frame rate and higher resolution target simulator technology. Continue providing weapon oriented multi-security level, cross-domain distributed modeling and simulation support using distributed connectivity between Eglin Air Force Base facilities and other geographic locations. Continue development of 6-degrees of freedom and scene generation modules for the extended modeling and simulation community using Air Force Simulator. Continue hardware-in-the-loop activities in support of international cooperative research efforts. Initiate exploration of guidance technologies for potential United States Space Force applications.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$9.000 million. Funding decreased due to higher Air Force priorities.</p>			
Accomplishments/Planned Programs Subtotals	66.041	101.070	75.017

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>				Project (Number/Name) 622502 / <i>Ordnance Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
622502: <i>Ordnance Technology</i>	-	52.500	50.687	62.286	0.000	62.286	63.805	64.704	60.699	62.132	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility for advanced explosives, fuzes, warheads, sub-munitions, and weapon airframes, carriage, and dispensing. The project also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses target vulnerability. The payoffs include improved storage capability and transportation safety of fully assembled weapons, improved warhead and fuze effectiveness, improved sub-munitions dispensing, low-cost airframe/subsystem components and structures, and reduced aerospace vehicle and weapon drag.

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

	FY 2021	FY 2022	FY 2023
Title: Energetic Materials Technology	4.833	4.721	6.620
Description: Investigates and develops energetic materials and technology that safely and securely optimize survivability, cost, and weapon lethality for munitions.			
FY 2022 Plans: Continue to advance and develop selected energetic materials to increase energy density over traditional explosives while enhancing damage mechanisms and lethality for mass and volume-constrained applications. Continue to build and implement experimental techniques/capabilities to quantify dynamic and mechanical properties as well as survivability of energetic materials in extreme temperature and vibrational environments. Continue to develop tools and analysis techniques to further the understanding of energy partitioning in order to optimize lethality against a broad spectrum of targets. Complete liner technologies formulation and test to improve Insensitive Munitions performance. Continue to mature additive manufacturing techniques to increase the design space for kinetic weapon lethality. Continue formulation of novel explosive fill to satisfy severe environmental constraints. Continue development of large scale nano-energetic material fabrication.			
FY 2023 Plans: Continue to advance and develop selected energetic materials to increase energy density over traditional explosives while enhancing damage mechanisms and lethality for mass and volume-constrained applications. Continue to build and implement experimental techniques/capabilities to quantify dynamic and mechanical properties as well as survivability of energetic materials in extreme temperature and vibrational environments. Continue to develop tools and analysis techniques to further the understanding of energy partitioning in order to optimize lethality against a broad spectrum of targets. Continue to mature additive manufacturing techniques to increase the design space for kinetic weapon lethality. Continue formulation of novel explosive fill to satisfy severe environmental constraints. Continue development of large scale nano-energetic material fabrication.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>	Project (Number/Name) 622502 / <i>Ordnance Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$1.899 million. Funding increased due to increased emphasis on improving energy density and lethality of energetic materials.				
<p>Title: Fuze Technologies</p> <p>Description: Investigate and develop fuzing technology for weapons to ensure reliable and optimal function to maximize weapon lethality for all engagement scenarios.</p> <p>FY 2022 Plans: Continue to develop testing capabilities for munitions penetration scenarios and increase modeling and simulation capabilities to reduce research and development costs and timelines. Continue to develop and demonstrate alternative packaging technology for survivable fuze electronic components. Continue to investigate the reliability and survivability of electronic components to predict and measure fuze performance during munition penetration at high-impact speeds. Continue research to facilitate tailored lethal effects and enable optimum fuzing solutions across the spectrum of weapon and target interactions. Continue research for distributed and multi-point fuzing concepts. Continue implementing additive manufacturing techniques to increase fuze reliability. Continue fuze explosive interfaces analysis for robust definition of explosive train reliability and performance. Continue fuze endgame, active imaging for target detection and aim point selection.</p> <p>FY 2023 Plans: Completed development of testing capabilities for munitions penetration scenarios and increase modeling and simulation capabilities to reduce research and development costs and timelines. Continue to develop and demonstrate alternative packaging technology for survivable fuze electronic components. Continue to investigate the reliability and survivability of electronic components to predict and measure fuze performance during munition penetration at high-impact speeds. Continue research to facilitate tailored lethal effects and enable optimum fuzing solutions across the spectrum of weapon and target interactions. Continue research for distributed and multi-point fuzing concepts. Continue implementing additive manufacturing techniques to increase fuze reliability. Continue fuze explosive interfaces analysis for robust definition of explosive train reliability and performance. Continue fuze endgame, active imaging for target detection and aim point selection.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.700 million. Funding increased due to increase emphasis on fuzing at high-speeds for improved survivability and reliability.</p>		5.977	5.779	6.479
<p>Title: Warhead Technologies</p> <p>Description: Investigate and develop innovative warhead kill mechanisms for weapons that maximize weapon lethality for all engagement scenarios.</p> <p>FY 2022 Plans:</p>		8.691	8.225	14.225

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>	Project (Number/Name) 622502 / <i>Ordnance Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

<p>Continue to mature small, multi-output warhead technologies for soft-surface targets, to include limited penetration capability of hardened structures. Continue to evolve test capabilities to enhance quantification of the mechanical response under high-rate, high-pressure loading conditions for use in high-fidelity modeling and simulation tools, to include materials used in additive manufacturing processes. Continue to develop additive manufacturing techniques and produce optimized sub-scale articles for test. Continue to demonstrate technologies for effective and survivable high-speed penetration into hard targets. Continue to develop warhead concepts for the air targets in near-peer engagement scenarios. Continue to research and develop cumulative damage mechanisms taking advantage of distributed blast, as well as shock wave and reactive particle interactions. Continue integration of warhead research with related activities planned for the advanced/integrated ordnance sub-systems research capability. Continue the development of topological optimization in support of additive manufacturing. Continue studies of composite-based warheads for penetrator/perforator applications.</p> <p>FY 2023 Plans: Continue to mature small, multi-output warhead technologies for soft-surface targets, to include limited penetration capability of hardened structures. Continue to evolve test capabilities to enhance quantification of the mechanical response under high-rate, high-pressure loading conditions for use in high-fidelity modeling and simulation tools, to include materials used in additive manufacturing processes. Continue to develop additive manufacturing techniques and produce optimized sub-scale articles for test. Continue to demonstrate technologies for effective and survivable high-speed penetration. Continue to develop warhead concepts for the air targets in peer engagement scenarios. Continue to research and develop cumulative damage mechanisms taking advantage of distributed blast, as well as shock wave and reactive particle interactions. Continue subsystem warhead technology integration. Continue the development of topological optimization in support of additive manufacturing. Complete studies of composite-based warheads for penetrator/perforator applications.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$6.000 million. Funding increased due to additional emphasis in warhead technologies for high speed and hypersonic applications.</p>			
---	--	--	--

<p>Title: Ordnance Technologies</p> <p>Description: Investigate and develop ordnance sub-system (energetics, fuzes and war-heads) and integrated system concepts using both high-fidelity and fast-running engineering level Modeling and Simulation tools.</p> <p>FY 2022 Plans: Continue to develop validated mesoscale modeling and simulation tools for computational physics sciences. Continue to develop engineering-level simulation architecture capability to enable weapon sub-system and system-level technology assessments. Continue to implement cost-effective and rapid transition warhead technologies for inventory penetrators. Continue modeling and simulation efforts exploring the ordnance technology trade space for low-cost, long-range munition concepts. Continue to develop predictive techniques for munition effectiveness tools used in concept development and assessment as well as studies involving</p>			
--	--	--	--

	32.999	31.962	34.962
--	--------	--------	--------

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / <i>Conventional Munitions</i>	Project (Number/Name) 622502 / <i>Ordnance Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>analysis of alternatives. Continue to develop test capability and data collection for modeling and simulation tools to characterize lethality, survivability, and performance of sub-systems and integrated ordnance systems. Continue the development of ordnance test and evaluation capabilities that include thermal and vibration management for hypersonic and high-speed flight.</p> <p><i>FY 2023 Plans:</i> Continue to develop validated mesoscale modeling and simulation tools for computational physics sciences. Continue to develop engineering-level simulation architecture capability to enable weapon sub-system and system-level technology assessments. Continue to implement cost-effective and rapid transition warhead technologies for inventory weapons. Continue modeling and simulation efforts exploring the ordnance technology trade space for low-cost, long-range munition concepts. Continue to develop predictive techniques for munition effectiveness tools used in concept development and assessment as well as studies involving analysis of alternatives. Continue to develop test capability and data collection for modeling and simulation tools to characterize lethality, survivability, and performance of sub-systems and integrated ordnance systems. Continue the development of ordnance test and evaluation capabilities that include thermal and vibration management for hypersonic and high-speed flight. Initiate investigation of machine learning technologies for ordnance. Initiate and explore connection of ordnance modeling and simulation and lethality tools to the broader digital engineering ecosystem. Initiate exploration of ordnance technologies for potential United States Space Force applications.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$3.000 million. Funding increased due to additional emphasis in modeling and simulation and physical test infrastructure needs for hypersonic and digital transformation applications.</p>			
Accomplishments/Planned Programs Subtotals	52.500	50.687	62.286

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>
---	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	122.816	116.456	109.302	0.000	109.302	112.221	114.681	117.236	119.837	Continuing	Continuing
624866: <i>Lasers & Imaging Technology</i>	-	92.746	0.000	25.305	0.000	25.305	25.925	26.369	26.952	27.518	Continuing	Continuing
624867: <i>Advanced Weapons & Survivability Technology</i>	-	30.070	51.185	60.896	0.000	60.896	62.286	64.766	65.954	67.576	Continuing	Continuing
625173: <i>Laser Technology</i>	-	0.000	65.271	23.101	0.000	23.101	24.010	23.546	24.330	24.743	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program covers research in Directed Energy (DE) technologies, primarily High Energy Lasers (HEL); including devices, subcomponents, and novel materials; optical beam control; laser system integration; target laser lethality/vulnerability assessments; and high power microwaves (HPM). Laser research includes moderate to high power laser devices that are applicable to a wide range of applications, optical technologies to propagate laser beams through the atmosphere, and integration of these technologies into demonstration packages. High power microwaves research examines technologies for applications such as counter-electronics and non-lethal weapons. This program conducts research into other novel Directed Energy applications; conducts Directed Energy vulnerability/lethality assessments; develops protection technologies versus Directed Energy; conducts research into other advanced non-conventional/innovative weapons; develops and uses tools to compare solutions to determine the most effective and efficient Directed Energy technologies to meet Air Force needs; coordinates efforts through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602788F, 1206601SF, and 0602298F.

Funds in this PE may be used to investigate specified technology advancements in air, space and/or cyber domains.

As directed in the FY 2018 NDAA, Sec 825, amendment to PL 114-92 FY 2016 NDAA, Sec 828 Penalty for Cost Overruns, the FY 2019 Air Force penalty total is \$50.0M. The calculated percentage reduction to each research, development, test and evaluation and procurement account will be allocated proportionally from all programs, projects, or activities under such account.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>
---	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	130.375	121.869	0.000	0.000	0.000
Current President's Budget	122.816	116.456	109.302	0.000	109.302
Total Adjustments	-7.559	-5.413	109.302	0.000	109.302
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	-5.413			
• Reprogrammings	-0.001	0.000			
• SBIR/STTR Transfer	-2.434	0.000			
• Other Adjustments	-5.124	0.000	109.302	0.000	109.302

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 624866: *Lasers & Imaging Technology*

Congressional Add: *DE Center of Excellence*

	FY 2021	FY 2022
	2.453	-
Congressional Add Subtotals for Project: 624866	2.453	-
Congressional Add Totals for all Projects	2.453	-

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

Decrease in FY 2022 reflects Air Force's Request to transfer \$5.413M to Space Force RDT&E Line 1 for Civilian Pay.

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>				Project (Number/Name) 624866 / <i>Lasers & Imaging Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624866: <i>Lasers & Imaging Technology</i>	-	92.746	0.000	25.305	0.000	25.305	25.925	26.369	26.952	27.518	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project explores the technical feasibility of moderate to high power lasers, including beam control, for applications such as aircraft protection, force protection, and precision engagement from the Department of the Air Force platforms. This project investigates the effects of laser weapons on a wide range of systems and components as well as producing, modifying, validating and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue. Additionally, this project conducts research supporting ground-based optical space situational awareness.

In FY 2022, A portion of PE 0602605F, the optical space domain awareness and satellite vulnerability efforts of PE 0602605F, Directed Energy Technology, Project 624866, Lasers & Imaging Technology, was transferred to Appropriation 3620, Research, Development, Test & Evaluation, Space Force, PE 1206601SF, Space Technology, Project 624866, Lasers & Imaging Technology from Appropriation 3600, Budget Activity 2 due to the creation of a new Appropriation for Space Force. In addition the funds associated with High Energy Laser Technologies and Directed Energy Assessments were moved to PE 0602605F, Project 625173.

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

	FY 2021	FY 2022	FY 2023
Title: High Energy Laser Technologies and Directed Energy Assessments	63.652	0.000	25.305
Description: This effort explores the technical feasibility of moderate to high power lasers, including beam control, for applications such as aircraft protection, force protection, and precision engagement from the Department of the Air Force platforms. This project investigates the effects of laser weapons on a wide range of systems and components as well as producing, modifying, validating and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue.			
FY 2022 Plans: For FY 2022, this effort moved to BA2, Program 060205F, Directed Energy Technology, Project 625173, Laser Technology. Funds moved as a result of the creation of the Space Force.			
FY 2023 Plans: For FY 2023, this effort moved to BA2, Program 060205F, Directed Energy Technology, Project 625173, Laser Technology. Funds are supposed to be moved as a result of the creation of the Space Force.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY22 increased from zero in FY22 to 25.305M in FY23 are intended to support Laser Technology (BPAC 625173). The combined value of BPACs 625173 and 624866 is a decrease from FY22 of \$16.865M which reflects the activities supporting the Space Force and the increased emphasis on High Power Microwave effectors.			
Title: Optical Space Situational Awareness and Satellite Vulnerability	26.641	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>	Project (Number/Name) 624866 / <i>Lasers & Imaging Technology</i>
--	---	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

Description: Develop advanced, long-range, electro-optical technologies that enable ground-based optical Space Domain Awareness (SDA) and quantum-based optical communications. Develop and use technologies to understand the vulnerability of blue satellite systems and components to lasers. Operate the Starfire Optical Range (SOR) to conduct research meeting internal and customer requirements.

FY 2022 Plans:
This research activity is transferring to United States Space Force Program Element C6601SF.

Continue to mature daylight detection of satellites allowing custody through daytime hours when satellites cannot normally be detected by ground-based optical systems. Continue to mature component technologies for 24/7 real-time optical imaging of near-earth and geosynchronous objects enabling characterization on tactical timelines. Continue investigation through modeling and simulation the susceptibility of satellite components to laser threats to inform practical designs for protection equipment and for tactically-rapid course-of-action decision-making enabling protection methods. Continue research & development of laser-enabled space domain awareness (SDA) focused on full-dark imaging using laser illumination. Continue development of laser-enabled options for both ranging to and imaging of geosynchronous satellites from apertures smaller than 3 meters. Continue development of long-range secure optical communications technologies leveraging quantum science for free space lasercom channels. Continue project to apply machine-learning to automatically identify geosynchronous-orbit objects more accurately and rapidly than current "hard-wired" algorithms can. Continue to maintain the Starfire Optical Range (SOR) facilities and experimental equipment in a mission-ready state.

FY 2023 Plans:
Non Applicable. BPAC moved to USSF PE 1206601SF

FY 2022 to FY 2023 Increase/Decrease Statement:
Non Applicable. BPAC moved to USSF PE 1206601SF

Accomplishments/Planned Programs Subtotals	90.293	0.000	25.305
---	--------	-------	--------

	FY 2021	FY 2022
Congressional Add: DE Center of Excellence	2.453	-
FY 2021 Accomplishments: Perform directed work under congressional add		
Congressional Adds Subtotals	2.453	-

C. Other Program Funding Summary (\$ in Millions)
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>	Project (Number/Name) 624866 / <i>Lasers & Imaging Technology</i>

C. Other Program Funding Summary (\$ in Millions)

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>				Project (Number/Name) 624867 / <i>Advanced Weapons & Survivability Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
624867: <i>Advanced Weapons & Survivability Technology</i>	-	30.070	51.185	60.896	0.000	60.896	62.286	64.766	65.954	67.576	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project explores the use of High Power Microwave and other unconventional/innovative weapon concepts to support applications such as non-lethal counter personnel and electronic warfare including disruption, degradation, and damage of electronic infrastructure on the Department of the Air Force platforms. This research includes weapon technology that can provide covert effects and/or no collateral or human damage. The project also investigates the effects of potential adversary High Power Microwave weapons and how to mitigate those effects on US assets, as well as producing and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue. This project includes but is not limited to high power microwaves, plasmas, particle beams, and millimeter waves.

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

	FY 2021	FY 2022	FY 2023
Title: High Power Microwave and Unconventional Weapon Technologies	12.237	19.641	23.522
Description: Investigate technologies for High Power Microwave and unconventional weapon components. Investigate High Power Microwave and other unconventional weapon concepts using innovative technologies. Investigate advanced technologies that support force protection tactical applications, including non-kinetic/non-lethal counter-electronics applications.			
FY 2022 Plans: Develop system engineering plan to develop an ultra-short pulsed laser system. Initiate research and development to integrate High Power Microwave technology into an airborne platform for the next generation Air Force airborne High Power Microwave technology demonstration. Continue to develop and test high power microwave components for ground and aerial high power microwave demonstrators. Continue to develop and test smaller, higher power, source technology for the next generation Department of the Air Force high power microwave demonstration. Continue to support the modeling, simulation, and analysis (MS&A) tools that have been transitioned to the broader modeling, simulation, and analysis community.			
FY 2023 Plans: Conduct effects testing and propagation experiments to define the performance requirements to develop an ultra-short pulsed laser system. Continue to design and develop High Power Microwave technology that will be integrated into an airborne platform for the next generation Department of the Air Force airborne High Power Microwave technology demonstration. Continue to develop and test high power microwave components for ground and aerial high power microwave demonstrators.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>	Project (Number/Name) 624867 / <i>Advanced Weapons & Survivability Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
4) Integrate smaller, higher power, source technology with all support components to enable the next generation Department of the Air Force high power microwave demonstration. Support the modeling, simulation, and analysis (MS&A) tools that have been transitioned to the broader modeling, simulation, and analysis community. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased by \$3.881M compared to FY 2022. Justification for this increase is described in the plans above.				
Title: High Power Microwave Effects Description: Assess the effects/lethality of High Power Microwave technologies. Develop and apply sophisticated models to enhance the development of High Power Microwave and related technology. Develop tools and perform assessments which allow comparisons among Directed Energy concepts and tradeoffs between Directed Energy and non-Directed Energy solutions. FY 2022 Plans: Complete validation of software applications that are hosted in the directed energy High Performance Computing Software Applications Institute for a broad spectrum directed energy sources. Continue to populate data base of high power sources. Continue to assess military utility of high power microwave weapon technology that is integrated into various platforms for multiple target engagements using end-to-end modeling. Continue to assess synergistic weapon concepts that merge kinetic energy and non-kinetic weapon capabilities into one weapon system. Complete validation of the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community. FY 2023 Plans: Support software applications that are hosted in the directed energy High Performance Computing Software Applications Institute for a broad spectrum directed energy sources. Continue to populate data base of high power sources. Complete military utility assessment of high power microwave weapon technology that is integrated into various platforms for multiple target engagements using end-to-end modeling. Continue to assess synergistic weapon concepts that merge kinetic energy and non-kinetic weapon capabilities into one weapon system. Support the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community. Continue to assess military utility of high power microwave weapon technology that is integrated into various platforms for multiple target engagements using end-to-end modeling. Complete validation of the modeling, simulation, and analysis tools that have been transitioned to the broader modeling, simulation, and analysis community FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased by \$5.830M compared to FY 2022. Justification for this increase is described in the plans above.		17.833	31.544	37.374
Accomplishments/Planned Programs Subtotals		30.070	51.185	60.896

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>	Project (Number/Name) 624867 / <i>Advanced Weapons & Survivability Technology</i>

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>				Project (Number/Name) 625173 / <i>Laser Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
625173: <i>Laser Technology</i>	-	0.000	65.271	23.101	0.000	23.101	24.010	23.546	24.330	24.743	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project explores the technical feasibility of moderate to high power lasers, including beam control, for applications such as aircraft protection, force protection, and precision engagement from the Department of the Air Force platforms. This project investigates the effects of laser weapons on a wide range of systems and components as well as producing, modifying, validating and applying Directed Energy and non-Directed Energy concept development and assessment tools to determine which technology solutions to pursue.

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

	FY 2021	FY 2022	FY 2023
Title: Laser Technology	0.000	65.271	23.101
Description: Develop and demonstrate High Energy Laser device technologies for the Department of the Air Force applications. Develop and demonstrate laser beam control technologies including atmospheric propagation and pointing and tracking. Perform laser system level modeling and simulation validated by laser effects and vulnerability testing. Develop tools and perform assessments which allow comparisons among concepts and tradeoffs between Directed Energy and non-Directed Energy solutions. Integrate optical beam control technologies with laser device technologies and demonstrate the combined technologies. Develop and use modeling, testing and diagnostic technologies to better understand the vulnerability of adversary weapon systems to High Energy Lasers.			
FY 2022 Plans: Continue to incorporate physics-based modeling tools to establish a predictive physics-based End-to-End model that covers all elements of laser weapon systems (LWS)-photon "birth to death". In FY 2022, the End-to-End model will incorporate a high fidelity surrogate model for laser systems & damage effects. In FY 2022, continue to develop novel high energy laser technologies including power scaling of monolithic fiber amplifiers and advancing individual fiber components of the system to increase overall performance. In FY 2022, transition data package on 8kW single all-fiber amplifier (bandwidth 50-100GHz) to other DoD services. Continue development of fiber optic amplifiers that are more resistant to nonlinear effects. Continue advanced modeling to evaluate fiber designs, manufacturing maturity efforts for microstructure and nano-doped glass fibers. In FY 2022, complete effort for micro-structure fiber development to overcome the nonlinearities that occur when power scaling fibers to the multi-kW level. Continue to develop laser vulnerability models for high-priority emerging threat systems. Begin testing of novel beam-control components in relative atmospheric and turbulence environments. Demonstrate high reflectivity coating for High Brightness LWIR Quantum Cascade Lasers in order to provide prototype devices			
FY 2023 Plans: Continue development and validation of the predictive physics-based End-to-End model that covers all elements of laser weapon systems (LWS)-photon "birth to death". Complete testing of the effects of a 2um wavelength laser on targets of interest and make			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / <i>Directed Energy Technology</i>	Project (Number/Name) 625173 / <i>Laser Technology</i>
--	---	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>decision on path for improving compactness and power. Demonstrate 100 W average power for Beacon Illuminating Laser used for target acquisition. Continue development of fiber optic amplifiers that are more resistant to nonlinear effects. Continue to develop laser vulnerability models for high-priority emerging threat systems. Complete fiber optic gyro to enable next generation optical Inertial Reference Unit (IRU). Continue to transition the models to the Department of Defense and Industry Modeling, Simulation and Analysis community. Conduct table top exercises and focused wargames to develop concepts of employment for directed energy weapons in representative scenarios and vignettes.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased by \$42.170M due to transfer of funds in FY 2022 to BPAC 624866 and Space Force. This value is not representative of the full PB23 investment in High Energy Laser Technology.</p>			
Accomplishments/Planned Programs Subtotals	0.000	65.271	23.101

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
Non Applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	205.839	221.110	166.041	0.000	166.041	170.096	173.414	177.096	180.937	Continuing	Continuing
625315: <i>C4I Dominance Technology</i>	-	118.165	145.030	82.282	0.000	82.282	84.330	85.803	87.624	89.537	Continuing	Continuing
625319: <i>Cyberspace Dominance Technology</i>	-	71.636	52.234	59.282	0.000	59.282	60.769	62.074	63.390	64.760	Continuing	Continuing
620MMS: <i>Research Site Support</i>	-	16.038	23.846	24.477	0.000	24.477	24.997	25.537	26.082	26.640	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops enterprise-centric information technology for the Department of the Air Force. Advances in enterprise-centric information technologies are required to increase warfighter readiness and effectiveness by providing the right information, at the right time, in the right format, anytime, anywhere in the world. The C4I Dominance Technology project provides the technologies for (a) secure, self-configuring, self-healing, seamless networks; (b) timely delivery of information to tactical assets; (c) scaling, robustness, and collaboration features required of the Department of the Air Force net-centric information management environment; and (d) real-time effective portrayal of complex data sets. This project also provides a network-centric, collaborative intelligence analysis capability that enables the fusion of multi-intelligence and sensor sources to provide timely situational awareness, understanding, and anticipation of the threats in the battlespace; and the advanced, novel exploitation technologies needed to intercept, collect, locate, and process both covert and overt raw data from intelligence and sensor sources. The Cyberspace Dominance Technology project provides technologies to deliver a full range of options in cyberspace on par with air and space dominance in each of the areas of cyber-attack, cyber defense, and cyber support to achieve the strategic capability of cyber dominance. This project also provides technology that ensures Department of Air Force ability to (a) access, maintain presence on, and deliver effects to adversary systems; (b) detect, defend, and respond to attacks on friendly computer systems and provide forensic analysis concerning those attack attempts; (c) bring game-changing computing power to the warfighter and disruptive computing power at the tactical edge and for federated grid services; and (d) provide cyber situational awareness to Department of the Air Force Commanders. The Research Site Support project provides the Rome Research Site infrastructure at Rome, New York and provides for the continued operations of all Rome Research Site properties, buildings, and services necessary for the research mission. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

Funds in this program element may be used to investigate specified technology advancements in air, space and/or cyber domains.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>
---	--

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	215.275	169.110	0.000	0.000	0.000
Current President's Budget	205.839	221.110	166.041	0.000	166.041
Total Adjustments	-9.436	52.000	166.041	0.000	166.041
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	52.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.012	0.000			
• SBIR/STTR Transfer	-2.289	0.000			
• Other Adjustments	-7.135	0.000	166.041	0.000	166.041

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 625315: C4I Dominance Technology

Congressional Add: *Program Increase- Quantum Cryptography*

Congressional Add: *Program Increase- Quantum Network Testbed*

Congressional Add: *Program Increase- Quantum Information Science Innovation Center*

Congressional Add: *Program Increase - Quantum Network Testbed*

Congressional Add: *Program Increase - Photonic Quantum Computing*

Congressional Add: *Program Increase - Quantum Internet Battlefield*

Congressional Add: *Program Increase - Ion Trap Quantum Computing*

Congressional Add Subtotals for Project: 625315

Project: 625319: Cyberspace Dominance Technology

Congressional Add: *Program Increase- Trusted UAS Traffic Management and c-SUAS Testbed*

Congressional Add Subtotals for Project: 625319

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	6.925	0.000
	9.393	0.000
	9.893	0.000
	0.000	10.000
	0.000	25.000
	0.000	7.000
	0.000	10.000
	26.211	52.000
	9.893	0.000
	9.893	0.000
	36.104	52.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	
<u>Change Summary Explanation</u> Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B) The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY 2023 cannot be made in a relevant manner.		

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>
--	--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To	Total
											Complete	Cost
625315: <i>C4I Dominance Technology</i>	-	118.165	145.030	82.282	0.000	82.282	84.330	85.803	87.624	89.537	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Department of the Air Force requires advanced technologies which support the Department of the Air Force five core missions and enable the Department of the Air Force to achieve Global Vigilance, Global Reach, and Global Power in support of national security objectives. The technologies developed under this project enable the National Defense Strategy and Department of the Air Force future operating concepts which require operational agility (the ability to rapidly generate—and shift among—multiple solutions for a given challenge), creating combinations of air, space, and cyberspace capabilities to achieve desired effects in the battlespace.

This project provides the technologies for secure, self-configuring, self-healing, seamless networks; advanced communications processors; anti-jam and low probability of intercept communications techniques; agile and dynamic policy-based network management capabilities; and modular, programmable, low-cost software radios. In addition, it develops both the technology base for ultra-wide bandwidth and multi-channeled communications networks (both air and space based) on and between platforms.

This project provides the technologies which enable the ability to globally share, discover, and access information across organizational, functional, and coalition boundaries and between and among domains, the timely delivery of information to tactical assets, the tailoring and prioritization of information based on mission needs and importance, and the scaling, robustness, and collaboration features required of the Department of the Air Force net-centric information management environment.

This project advances technologies enabling the effective execution of military objectives that will vastly improve the ability to support the commander and staff's ability to command all viable options to achieve desired effects across the full spectrum of operations (air, space, and cyberspace) at all levels of war (strategic, operational, and tactical) and during all phases of conflict. This project provides technologies for anticipatory decision support; course of action development, planning, scheduling, and assessment; and the real-time effective portrayal of complex data sets.

This project improves and automates the capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. This project provides not only a network-centric, collaborative intelligence analysis capability that enables the fusion of multi-intelligence and sensor sources to provide timely situational awareness, understanding, and anticipation of the threats in the battlespace, but also the advanced, novel exploitation technologies needed to intercept, collect, locate, and process both covert and overt raw data from intelligence and sensor sources.

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

	FY 2021	FY 2022	FY 2023
Title: Assured Communications & Networks	24.992	25.462	18.925
Description: Develop communications, networking, and signal processing technologies with improved survivability and capacity to provide secure, adaptive, covert, anti-jam, and assured global battlespace connectivity tailored to anti-access and area-denial			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>environments and contested operations. Includes the research and development to advance existing nuclear capable forces to ensure command, control, and connectivity for the President without constraints.</p> <p>FY 2022 Plans: Continue the research and development of technologies for robust, adaptive, and mission aware airborne networks. Maintain the research and development of large-scale hardware-in-the-loop verification of developed directional networking protocols. Advance the research and development of propagation models. Initiate the development of a network stack suitable for high-bandwidth terahertz links. Launch the development, verification, and validation of advanced, airborne high-frequency antenna/ionospheric structure. Initiate the development, verification, and test of advanced waveforms. Establish the development, verification, and test of software-defined radio prototypes. Continue development of enhanced assurance and filtration offloading. Extend the development of advanced, airborne high-frequency antenna/ionospheric structures. Continue to develop, verify, and validate software-defined radio prototypes.</p> <p>FY 2023 Plans: Continue the research and development of technologies for robust, adaptive, and mission aware airborne networks. Continue the research and development of large-scale hardware-in-the-loop verification of developed directional networking protocols. Decrease the research and development of propagation models. Decrease the development of a network stack suitable for high-bandwidth terahertz links. Decrease the development, verification, and validation of advanced, airborne high-frequency antenna/ionospheric structure. Decrease the development of an airborne mesh networking capability that utilizes adaptive and responsive antennas for a dynamic and reliable high capacity mesh network suitable for communications in contested environments. Continue the development, verification, and test of advanced waveforms. Continue the development, verification, and test of software-defined radio prototypes. Continue development of enhanced assurance and filtration offloading. Continue to develop, verify, and validate software-defined radio prototypes. Develop capabilities that incorporated communications network connectivity into information extraction tools.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$6.537 million due to higher Department priorities.</p>				
<p>Title: Data to Decisions</p> <p>Description: Investigate and develop technologies for decision quality information dissemination services via publish, subscribe, and query across the Global Information Grid to enterprise and tactical assets and coalition partners.</p> <p>FY 2022 Plans: Continue the research and development of data analytics and strategic indications and warnings technologies (including large data alignment, indexing and search on textual data, large-scale and disparate data sources, both structured and unstructured</p>		14.210	15.199	14.186

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>

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

data, and employment of various ontologies and machine learning techniques). Maintain the development of a user customizable entity, event, and relation text extraction capability with automatic performance estimates of the user-customized extractors on new documents and mission areas. Initiate research and development of a Request for Information (RFI) dialog system that can help answer Requests for Information (RFI) for single service applications across 10 essential Intelligence enterprise identified RFIs. Develop a Multi-Int Intelligence, Surveillance, and Reconnaissance ontology connecting Air Force analytics, Application Programming Interfaces, and services. Research and develop an initial integrated threat detection system based on vetted events from PAI fused and corroborated with ISR sources. Continue the research and development of autonomous, heterogeneous, distributed multi-sensor management and upstream data fusion for improved target detection, tracking and classification. Sustain the development of counter Small Unmanned Air systems (C-SUAS) detection and identification, via acoustics, and algorithm work.

FY 2023 Plans:

Continue the research and development of data analytics and strategic indications and warnings technologies (including large data alignment, indexing and search on textual data, large-scale and disparate data sources, both structured and unstructured data, and employment of various ontologies and machine learning techniques). Decrease the development of Conversational Artificial Intelligence (CAI) capabilities to deliver conversational agents capable of answering complex analytical questions. Decrease the development of a user customizable entity, event, and relation text extraction capability with automatic performance estimates of the user-customized extractors on new documents and mission areas. Decrease research and development of a Request for Information (RFI) dialog system that can help answer Requests for Information (RFI) for single service applications across 10 essential Intelligence enterprise identified RFIs. Continue the development of a Multi-Int Intelligence, Surveillance, and Reconnaissance ontology connecting Air Force analytics, Application Programming Interfaces, and services. Continue research and development of an integrated threat detection system based on vetted events from PAI fused and corroborated with ISR sources. Continue the research and development of autonomous, heterogeneous, distributed multi-sensor management and upstream data fusion for improved target detection, tracking and classification. Decrease the development of counter Small Unmanned Air systems (C-SUAS) detection and identification, via acoustics, and algorithm work. Initiate the development of new methods that exploit traditional and non-traditional data to categorize and predict engagement scenarios of coordinated, non-cooperative targets, and that assess the threats based on situation-driven adversary capabilities. Continue to develop capabilities to automate emitter corridor extraction and mode tagging to deploy capabilities onboard the collection platform. Initiate research to add new data sources to identify signatures corresponding to different categories of multi-satellite actions. Research methods that allow for change detection and pattern recognition. Initiate research to seek correlations between non-traditional data source signatures and multi-satellite actions.

FY 2022 to FY 2023 Increase/Decrease Statement:

FY 2021	FY 2022	FY 2023

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 decreased compared to FY 2022 by \$1.013 million due to higher Department priorities.				
<p>Title: Processing Technologies</p> <p>Description: Develop automatic and dynamically reconfigurable, scalable, affordable distributed peta-flop processing technologies for real-time global information systems.</p> <p>Starting in FY 2021, the remaining non-cyber work that was performed under Project 625319, Cyberspace Dominance Technology, in the Processing Technologies effort within this PE will now be performed within this effort.</p> <p>FY 2022 Plans: Advance the application of novel neuromorphic systems for robust machine learning. Continue to advance research and development of the neuromorphic processor and validate capabilities for dynamic learning on mobile and power-constrained platforms. Initiate the development of a prototype integrated with existing embedded high performance computing systems. Commence the development and delivery of a Neuromorphic High-Performance-Computing (Brain-in-the-Box).</p> <p>FY 2023 Plans: Continue to advance the application of novel neuromorphic systems for robust machine learning. Continue to advance research and development of the neuromorphic processor and validate capabilities for dynamic learning on mobile and power-constrained platforms. Decrease the development of a prototype integrated with existing embedded high performance computing systems. Continue the development and delivery of a Neuromorphic High-Performance-Computing (Brain-in-the-Box).</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.202 million. Justification for the decrease is described in the plans above.</p>		6.481	7.463	7.261
<p>Title: Multi-Domain Command & Control (MDC2)</p> <p>Description: Develop advanced monitoring, planning, and assessment technologies enabling aerospace commanders to develop effects-based campaigns. Investigate, analyze, and develop technologies for planning, execution, and automatic rapid reconfiguration of distributed intelligent and integrated command and control information systems to achieve the commander's intent throughout varying crisis levels.</p> <p>FY 2022 Plans: Continue research for applying machine learning techniques to enhance and optimize space operations. Advance research and development to refine the mathematical framework and provide a method for evaluating and presenting multi-domain courses of action to maximize operational effects for decisive advantage. Maintain the development of tools, technology, and a framework</p>		18.782	19.731	17.892

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>for execution management of operational center process workflows and applications. Sustain the research and development of a novel composable planning paradigm to overcome the serial and time-intensive nature of existing planning techniques.</p> <p>FY 2023 Plans: Decrease research for applying machine learning techniques to enhance and optimize multi domain operations (including space). Increase research and development to refine the mathematical framework and provide a method for evaluating and presenting multi-domain courses of action to maximize operational effects for decisive advantage. Decrease the development of tools, technology, and a framework for execution management of operational center process workflows and applications. Sustain the research and development of a novel composable planning paradigm to overcome the serial and time-intensive nature of existing planning techniques.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$1.839 million due to higher Department priorities.</p>			
<p>Title: Artificial Intelligence/Autonomy/Machine Learning</p> <p>Description: Perform research and development (R&D) to harness the speed and scale of computers and machines to address problems of complexity.</p> <p>FY 2022 Plans: Advance the research and development of machine learning approaches for supporting and performing operations in complex adversarial environments. Maintain the research to understand operational needs of machine learning algorithms and systems with the multi-domain command and control connect. Continue to research the application of Interactive Learning techniques to the auto-planning problem and develop an IL based planning capability to augment existing auto-planning tools. Sustain the research and development of machine learning approaches for supporting and performing operations in complex adversarial environments.</p> <p>FY 2023 Plans: Advance the research and development of machine learning approaches for supporting and performing operations in complex adversarial environments. Maintain the research to understand operational needs of machine learning algorithms and systems with the multi-domain command and control connect. Decrease research into the application of Interactive Learning techniques to the auto-planning problem and development of an IL based planning capability to augment existing auto-planning tools. Decrease the research and development of machine learning approaches for supporting and performing operations in complex adversarial environments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	15.700	16.699	15.580

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 decreased compared to FY 2022 by \$1.119 million due to higher Department priorities.				
<p>Title: Nuclear C3 Modernization</p> <p>Description: Perform research and development (R&D) to advance existing nuclear capable forces to ensure command, control, and connectivity for the President without constraints.</p> <p>FY 2022 Plans: Starting in FY 2022, this work will be performed in PE 0602788F, Dominant Information Sciences and Methods, Project 625315, C4I Dominance Technology, Assured Communications & Networks effort.</p> <p>FY 2023 Plans: Starting in FY 2022, this work will be performed in PE 0602788F, Dominant Information Sciences and Methods, Project 625315, C4I Dominance Technology, Assured Communications & Networks effort.</p>		4.099	0.000	0.000
<p>Title: Quantum Information Science</p> <p>Description: Perform research and development (R&D) that will utilize quantum physics for the storage, transmission, manipulation, computing, or measurement of information in ways that offer advantages to classical capabilities.</p> <p>FY 2022 Plans: Continue research and development in the area of supreme and quantum computing information sciences. Maintain development of further reducing SWaP of network node demonstrations. Initiate demonstration of quantum information processing on a single chip by using developed quantum photonics processor with photon sources.</p> <p>FY 2023 Plans: Continue research and development in the area of supreme and quantum computing information sciences. Advance development of further reducing SWaP of network node demonstrations. Continue demonstration of quantum information processing on a single chip by using developed quantum photonics processor with photon sources.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.038 million. Justification for the decrease is described in the plans above.</p>		7.690	8.476	8.438
<p>Title: Future AF Capabilities Applied Research</p> <p>Description: Investigate, design, and develop science and technologies supporting future Department of the Air Force capabilities to provide compelling advantage to the warfighter. To the greatest extent practical, research efforts will utilize modeling and simulation and cross-discipline systems integration (For example: air and space vehicles, avionics, propulsion, materials, human</p>		0.000	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
performance, cybersecurity, command, control, communications, computer and intelligence, sensors, electronic warfare, and conventional/unconventional weapons). The National Defense Strategy and the Department of the Air Force Science and Technology 2030 Strategy will inform investments over the FYDP. FY 2022 Plans: Not applicable. FY 2023 Plans: Not applicable			
Accomplishments/Planned Programs Subtotals	91.954	93.030	82.282

	FY 2021	FY 2022
Congressional Add: Program Increase- Quantum Cryptography FY 2021 Accomplishments: Conduct congressionally directed efforts. FY 2022 Plans: Not applicable.	6.925	0.000
Congressional Add: Program Increase- Quantum Network Testbed FY 2021 Accomplishments: Conduct congressionally directed efforts. FY 2022 Plans: Not applicable.	9.393	0.000
Congressional Add: Program Increase- Quantum Information Science Innovation Center FY 2021 Accomplishments: Conduct congressionally directed efforts. FY 2022 Plans: Not applicable.	9.893	0.000
Congressional Add: Program Increase - Quantum Network Testbed FY 2021 Accomplishments: Not applicable. FY 2022 Plans: Conduct congressionally directed efforts.	0.000	10.000
Congressional Add: Program Increase - Photonic Quantum Computing	0.000	25.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625315 / <i>C4I Dominance Technology</i>

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct congressionally directed efforts.		
Congressional Add: Program Increase - Quantum Internet Battlefield	0.000	7.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct congressionally directed efforts.		
Congressional Add: Program Increase - Ion Trap Quantum Computing	0.000	10.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct congressionally directed efforts.		
Congressional Adds Subtotals	26.211	52.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>				Project (Number/Name) 625319 / <i>Cyberspace Dominance Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
625319: <i>Cyberspace Dominance Technology</i>	-	71.636	52.234	59.282	0.000	59.282	60.769	62.074	63.390	64.760	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Department of the Air Force requires technologies to deliver a full range of options in cyberspace on par with air and space dominance in each of the areas of cyber-attack, cyber defense, and cyber support to achieve the strategic capability of cyber dominance. The Department of the Air Force requires the development of superior, intelligent, on-demand computing to enable information superiority to include advances in secure information sharing across domains and boundaries as well as technologies that successfully deter any adversary from attacking computer systems anytime, anywhere by ensuring the Department of the Air Force's ability to: access, maintain presence on, and deliver effects to adversary systems; detect, defend, and respond to attacks on friendly computer systems and provide forensic analysis concerning those attack attempts; and provide cyber situational awareness to Department of the Air Force Commanders. In addition, the Department of the Air Force requires technology development that produces computing architectures with greater capacity and sophistication for addressing constrained, dynamic mission objectives; game-changing computing power to the warfighter, disruptive computing power at the tactical edge and for federated grid services; and interactive and real-time computing improving the usability of high-performance computing to the Department of the Air Force. It includes technologies in computational sciences and engineering, computer architectures and software intensive systems.

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

	FY 2021	FY 2022	FY 2023
Title: Cyber Defense Technologies	20.358	32.225	29.279
Description: Develop cyber defense and supporting technologies to detect, defend, and respond to attacks on computer systems as well as provide forensic concerning attacks.			
FY 2022 Plans:			
Continue research in the area of autonomous integrated cyber operations. Advance applied research in the area of biologically resilient cyber technologies. Extend research into mission-specific block-chain capabilities, and the alignment of cyber resilient services and dynamic management tailored towards unmanned aerial systems. Maintain the development of radical architectural and infrastructural changes from computational diversity, to deliver a quantifiable improvement to cybersecurity. Continue to sustain research and validation of a cyber-hardened (robust, secure) processor for embedded weapon systems. Continue to maintain applied research to create trusted and resilient embedded systems that are capable of identifying, localizing, and automatically repairing previously unknown and/or unintended vulnerabilities. Sustain development of software using evolutionary approaches to make embedded systems tolerant to unexpected and unforeseen situations. Continue to investigate research concepts and capabilities for cyber survivability techniques and algorithms for counter-unmanned aerial systems. Extend development of a counter-unmanned aerial systems open architecture to enable interoperability. Maintain evolution of autonomous machine learning functions. Continue the validation and demonstration of automated workflows into defensive cyber operations systems. Sustain development of a model-assisted concolic firmware exploration and threat models based on device			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625319 / <i>Cyberspace Dominance Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>behavior. Conduct large scale device analysis and demonstration on AF-relevant system. Create a capability to model, intercept, and synchronize the state of all embedded devices connected on a single bus.</p> <p>FY 2023 Plans: Continue research in the area of autonomous integrated cyber operations. Decrease applied research in the area of biologically resilient cyber technologies. Continue research into mission-specific block-chain capabilities, and the alignment of cyber resilient services and dynamic management tailored towards unmanned aerial systems. Maintain the development of radical architectural and infrastructural changes from computational diversity, to deliver a quantifiable improvement to cybersecurity. Decrease research and validation of a cyber-hardened (robust, secure) processor for embedded weapon systems. Decrease applied research to create trusted and resilient embedded systems that are capable of identifying, localizing, and automatically repairing previously unknown and/or unintended vulnerabilities. Sustain development of software using evolutionary approaches to make embedded systems tolerant to unexpected and unforeseen situations. Decrease research effort to discover concepts and capabilities for cyber survivability techniques and algorithms for counter-unmanned aerial systems. Decrease development of a counter-unmanned aerial systems open architecture to enable interoperability. Maintain evolution of autonomous machine learning functions. Decrease the validation and demonstration of automated workflows into defensive cyber operations systems. Sustain development of a model-assisted concolic firmware exploration and threat models based on device behavior. Conduct large scale device analysis and demonstration on AF-relevant system. Create a capability to model, intercept, and synchronize the state of all embedded devices connected on a single bus. Develop a physics-based and topologically-based model of an intra-connected and inter-connected electric power grid and communications network. Research and develop the design, implementation, and evaluation of a proof-of-concept prototype to enable secure and efficient outsourcing of relational queries and Machine Learning training. Research the inference to untrusted clouds with cost-based optimization options, under Multiparty Computation (MPC) protocols with different threat models, guarantees, and physical deployments (i.e., Local Area Network, Wide Area Networks, Blockchain, or mixed) settings.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.946 million due to higher Department priorities.</p>			
<p>Title: Cyber Offense Technologies</p> <p>Description: Develop offensive cyber operations technologies to access, maintain presence on, and deliver effects to adversary systems.</p> <p>FY 2022 Plans: Sustain research and development of new, leading-edge technologies that are game changing and employ dominant power for cyber offensive operations. Continue to increase research and development in capabilities for multi-function, non-kinetic cyber effects against adversarial systems. Continue to demonstrate ground-based and airborne delivery of disrupt, deny, degrade,</p>	19.012	20.009	30.003

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625319 / <i>Cyberspace Dominance Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>destroy, or deceive effects that are both cyber and physical/kinetic. Maintain the advancement of research in systems to perform blind data discovery associated with the Internet of Things. Advance the identification of items of interest associated with the Internet of Things. Extend research for specific items of interest within the Internet of Things. Complete the Mission tool framework and automated vulnerability discovery framework.</p> <p>FY 2023 Plans: Increase research and development of new, leading-edge technologies that are game changing and employ dominant power for cyber offensive operations and information warfare to change the future fight. Increase research and development in capabilities for multi-function, non-kinetic cyber effects against adversarial systems. Continue to demonstrate ground-based and airborne delivery of disrupt, deny, degrade, destroy, or deceive effects that are both cyber and physical/kinetic. Increase the advancement of research in systems to perform blind data discovery associated with the Internet of Things. Increase research and development for the identification of items of interest associated with the Internet of Things. Increase research for specific items of interest within the Internet of Things.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$9.994 million due to implementation of AF S&T 2030 for Speed and Reach of Disruption & Lethality for cyber offensive and information warfare kinetic cyber effects against adversarial systems, performing blind data discovery associated with the Internet of Things (IoT), identification of items of interest associated with the IoT, and increase in research for specific items of interest within the IoT.</p>				
<p>Title: Advanced Architectural Technologies</p> <p>Description: Develop the architectural mechanisms that form the basis for predictable software and high assurance systems.</p> <p>FY 2022 Plans: Starting in FY 2022, this work will be performed within this PE, under Project 625319, Cyberspace Dominance Technology, in the Cyber Defense Technologies effort.</p> <p>FY 2023 Plans: Not applicable</p>		8.624	0.000	0.000
<p>Title: Processing Technologies</p> <p>Description: Develop automatic and dynamically reconfigurable, scalable, affordable distributed peta-flop processing technologies for real-time global information systems.</p> <p>FY 2022 Plans:</p>		0.000	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625319 / <i>Cyberspace Dominance Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Not applicable				
FY 2023 Plans: Not applicable				
Title: Survivability Technologies Description: Develop methods and technologies for controlled operation of information systems during attacks and fault conditions, minimizing vulnerabilities of cyber attacks, and guaranteeing the accuracy and correctness of data and codes. FY 2022 Plans: Starting in FY 2022, this work will be performed within this PE, under Project 625319, Cyberspace Dominance Technology, in the Cyber Defense Technologies effort. FY 2023 Plans: Not applicable		3.989	0.000	0.000
Title: Cross-Domain Technologies Description: Develop secure cross-domain discovery services for access to services outside the existing domain. Develop the tools to allow collaboration of workflows required by the Air Force net-centric information management system. FY 2022 Plans: Much of the technology covered under this effort has matured to the level of advanced technology. Starting in FY 2022, the remaining work will be performed within this PE, under Project 625315, C4I Dominance Technologies, in the Assured Communications & Networks effort. FY 2023 Plans: Not applicable		6.012	0.000	0.000
Title: Cyber Technologies for Spectrum Warfare Description: Develop technologies combining electronic warfare, signals intelligence, communications, and cyber technologies that provide synergistic access, exploitation and effects across air and cyber domains in congested and contested environments. FY 2022 Plans: Starting in FY 2022, this work will be performed within this PE, under Project 625319, Cyberspace Dominance Technology, in the Cyber Offense Technologies effort. FY 2023 Plans:		3.748	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 625319 / <i>Cyberspace Dominance Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Not applicable				
Accomplishments/Planned Programs Subtotals		61.743	52.234	59.282
		FY 2021	FY 2022	
Congressional Add: Program Increase- Trusted UAS Traffic Management and c-SUAS Testbed		9.893	0.000	
FY 2021 Accomplishments: Conduct congressionally directed efforts.				
FY 2022 Plans: Not applicable.				
Congressional Adds Subtotals		9.893	0.000	
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
Not applicable				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 2					R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>				Project (Number/Name) 62OMMS / <i>Research Site Support</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
62OMMS: <i>Research Site Support</i>	-	16.038	23.846	24.477	0.000	24.477	24.997	25.537	26.082	26.640	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force Research Laboratory Information Directorate leads the discovery, development and implementation of information science and technology to drive transformation within the Department of the Air Force and across the Department of Defense. The focus of the work is to provide the warfighter with the required technology-based capabilities to defend the Nation by unleashing the power of innovative information science and technology to anticipate, find, fix, track, target, engage, and assess anything, anytime, anywhere. Since the site is a single-purpose location which is not located on a military installation, the Information Directorate has unique requirements for supporting its science and technology mission. As the host unit, the directorate is responsible to provide the Rome Research Site infrastructure at Rome, New York and provide for the continued operations of all Rome Research Site properties, buildings, and services necessary for the research mission. Operations include: logistics and communication services, utilities, maintenance of facilities and structures, safety and security of the workforce and visiting researchers, and ensures compliance with the laws, regulations, and directives that pertain to site operations. These services are host unit responsibilities and are necessary to provide a safe and effective environment for the Research Site's workforce and mission.

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

	FY 2021	FY 2022	FY 2023
Title: Rome Research Infrastructure	16.038	23.846	24.477
Description: Provide the necessary services and support including, but not limited to: fire inspections, refuse collection, water, electricity, steam, heat, custodial, and grounds maintenance services to the Research Site. Provide the necessary support for the maintenance and repair of Research Site facilities (buildings and other structures), vehicle and equipment lease and security/safety inspections and services as necessary for compliance and safety/security of personnel and research assets. Provide the Research Site with long haul communications (using the Government Services Administration set of Networx contracts for Continental United States), trunk connectivity and wireless communications.			
FY 2022 Plans:			
Continue to provide civilian payroll and non-pay costs for installation operations in support of the Rome Research Site property and all onsite personnel. Continue to provide facilities, facility operations, facility sustainment, support equipment, contracts, and associated costs to plan, manage and execute the following functions: fire prevention, disaster preparedness, plant operation and purchase of commodity, refuse collection, pavement clearance of snow and ice, grounds maintenance including landscaping, real property special inspections, pest control, and custodial services. Continue to provide Real Property Management and Engineering Services, including: (1) Facility Management and Administration and (2) Installation Engineering Services. Facility Management includes public works management costs, contract management, material procurement, facility data management, furnishings management costs, and real estate management. Installation Engineering Services includes annual inspection of facilities, master planning, overhead of planning and design, overhead of construction management, and non Site Recovery			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / <i>Dominant Information Sciences and Methods</i>	Project (Number/Name) 62OMMS / <i>Research Site Support</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Management service calls. Continue to provide basic installation communication services, including long haul trunk and telecommunications services. Continue to provide site vehicle lease for logistics, security, and mission support under the Government Services Administration.</p> <p>FY 2023 Plans: Continue to provide civilian payroll and non-pay costs for installation operations in support of the Rome Research Site property and all onsite personnel. Continue to provide facilities, facility operations, facility sustainment, support equipment, contracts, and associated costs to plan, manage and execute the following functions: fire prevention, disaster preparedness, plant operation and purchase of commodity, refuse collection, pavement clearance of snow and ice, grounds maintenance including landscaping, real property special inspections, pest control, and custodial services. Continue to provide Real Property Management and Engineering Services, including: (1) Facility Management and Administration and (2) Installation Engineering Services. Facility Management includes public works management costs, contract management, material procurement, facility data management, furnishings management costs, and real estate management. Installation Engineering Services includes annual inspection of facilities, master planning, overhead of planning and design, overhead of construction management, and non Site Recovery Management service calls. Continue to provide basic installation communication services, including long haul trunk and telecommunications services. Continue to provide site vehicle lease for logistics, security, and mission support under the Government Services Administration.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.631 million. Justification for the increase is described in the plans above.</p>				
Accomplishments/Planned Programs Subtotals		16.038	23.846	24.477
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
Not applicable				

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602890F / <i>High Energy Laser Research</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	26.886	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
625096: <i>High Energy Laser Research</i>	-	26.886	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program funded Department of Defense Directed Energy applied research through the Joint Directed Energy Transition Office. This program was part of an overall Department of Defense Directed Energy Science and Technology program. Directed Energy weapon systems have many potential advantages including speed of-light delivery, low collateral damage, significant magazine depth, low incremental cost per kill. Directed Energy Weapon Systems have the potential to perform a wide variety of military missions including high value asset and base protection, precision strike and platform self-protection versus a wide variety of missile, rocket, artillery, mortar and air platforms. Efforts under this program were generally chosen for their potential to have an impact on multiple Directed Energy Weapon systems and multiple Service missions while complementing Service/Agency efforts that are directed at specific Service needs. A broad range of technologies were addressed in key areas such as laser sources, microwave sources, laser beam control, antennas, waveguides, modeling and simulation, and lethality mechanisms. This program provided the enabling technology necessary to demonstrate advanced concepts for high power microwave sources, antennas and waveguides for mission areas not considered to date. The high power microwave lethality, hardware and software improvements and modeling and simulation advances provided by this program are essential to expand and build upon current architectures. This program supported the Senior Official as required. Efforts in this program were coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

For FY 2022 this devolved PE was transferred back to OSD under BA2 Program 62890D8Z. This move was at the request of OSD so that they may better integrate with current OSD Directed Energy efforts and participate in OSD budget processes.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602890F I High Energy Laser Research
--	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	29.155	0.000	0.000	0.000	0.000
Current President's Budget	26.886	0.000	0.000	0.000	0.000
Total Adjustments	-2.269	0.000	0.000	0.000	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	-4.920	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	4.920	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	-2.269	0.000	0.000	0.000	0.000

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 625096: High Energy Laser Research

Congressional Add: Program increase - Directed energy fiber lasers

	FY 2021	FY 2022
Congressional Add Subtotals for Project: 625096	2.651	0.000
Congressional Add Totals for all Projects	2.651	0.000

Change Summary Explanation

Not Applicable

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

	FY 2021	FY 2022	FY 2023
Title: Directed Energy Technologies	4.242	0.000	0.000
Description: Mature technologies that will provide system level performance commensurate with fieldable directed energy devices.			
FY 2022 Plans: For FY 2022 this effort is moving to OSD PE 62890D8Z			
FY 2023 Plans: Not Applicable			
FY 2022 to FY 2023 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>		R-1 Program Element (Number/Name) PE 0602890F / <i>High Energy Laser Research</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Not Applicable				
<p>Title: Advanced Directed Energy Technologies</p> <p>Description: Investigate new technologies that have revolutionary potential for high energy lasers and high power microwaves.</p> <p>FY 2022 Plans: For FY 22 this effort is moving to OSD PE 62890D8Z</p> <p>Not applicable.</p> <p>FY 2023 Plans: Not Applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not Applicable</p>		3.451	0.000	0.000
<p>Title: Directed Energy Propagation Technologies</p> <p>Description: Develop technology to support high performance beam control systems and integrated demonstrations.</p> <p>FY 2022 Plans: For FY 22 this effort is moving to OSD PE 62890D8Z</p> <p>FY 2023 Plans: Not Applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not Applicable</p>		12.011	0.000	0.000
<p>Title: Directed Energy Lethality Research</p> <p>Description: Conduct directed energy vulnerability experiments on materials, components, and targets. Develop a lethality database, and integrate into a systems-level architecture plan and lethality models.</p> <p>FY 2022 Plans: For FY 22 this effort is moving to OSD PE 62890D8Z</p> <p>FY 2023 Plans:</p>		2.282	0.000	0.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602890F / <i>High Energy Laser Research</i>
---	---

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Not Applicable			
FY 2022 to FY 2023 Increase/Decrease Statement: Not Applicable			
Title: Directed Energy Modeling Description: Maintain and evaluate high-fidelity engineering models for high energy laser and high power microwave system scenario evaluation and incorporation into the directed energy toolkit. Provide atmospheric propagation and directed energy system modeling for mission-level war-gaming activities. FY 2022 Plans: For FY 22 this effort is moving to OSD PE 62890D8Z FY 2023 Plans: Not Applicable FY 2022 to FY 2023 Increase/Decrease Statement: Not Applicable	2.249	0.000	0.000
Accomplishments/Planned Programs Subtotals	24.235	0.000	0.000

	FY 2021	FY 2022
Congressional Add: Program increase - Directed energy fiber lasers	2.651	0.000
FY 2021 Accomplishments: Conduct Congressional directed efforts.		
FY 2022 Plans: Not applicable		
Congressional Adds Subtotals	2.651	0.000

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603032F / <i>Future AF Integrated Technology Demos</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	135.940	112.643	152.559	0.000	152.559	56.819	44.779	35.236	30.711	Continuing	Continuing
630320: <i>Air Force Vanguard</i> s	-	135.940	112.643	152.559	0.000	152.559	56.819	44.779	35.236	30.711	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Program develops and delivers transformational operational capabilities through advanced technology solutions which focus on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

Department of the Air Force Vanguard programs are focused, priority initiatives with enterprise commitment which incorporate multidisciplinary solutions to advance and accelerate emerging Science and Technology driven capabilities and warfighting concepts. High risk by design, Vanguard's seek to answer specific questions to inform future acquisition programs and identify gaps where additional research is still needed.

The DAF Technology Executive Officer partners with Air Force Futures (A5/7), USSF (CTIO, USSF/S5B), and the Deputy Assistant Secretary (Science, Technology and Engineering) to identify and to recommend emerging technologies as Vanguard Prospect investments through a deliberate, multidisciplinary and multifunctional process. The Future Transformational Capabilities major thrust enables the Department of the Air Force to respond rapidly to these emerging Science and Technology investment opportunities within the budget cycle and launch future Vanguard Program candidates closely aligned to validated DAF future force needs. The subsequent process to commission new Vanguard Programs is co-chaired by the Under Secretary of the Air Force, Vice Chief of Staff of the Air Force, and Vice Chief of Space Operations.

The current Air Force Vanguard programs are Skyborg, Golden Horde, Navigation Technology Satellite 3 (NTS-3), and Rocket Cargo. Skyborg will integrate artificial intelligence into autonomous unmanned air vehicles to enable future manned-unmanned teaming. Golden Horde will transition the demonstrated networked collaborative autonomous weapon core capability into a digital ecosystem for additional advancement. NTS-3 will demonstrate technologies and tactics involving space, control, and user equipment for advanced satellite navigation, in order to provide robust and resilient, agile augmentation to the GPS system. Rocket Cargo will demonstrate new trajectories and ways to fly large rockets, the ability to land rockets at austere locations, and design & test an ejectable pod for air drop.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603032F I Future AF Integrated Technology Demos
---	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	147.350	131.643	0.000	0.000	0.000
Current President's Budget	135.940	112.643	152.559	0.000	152.559
Total Adjustments	-11.410	-19.000	152.559	0.000	152.559
• Congressional General Reductions	0.000	-19.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	-6.305	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-5.105	0.000			
• Other Adjustments	0.000	0.000	152.559	0.000	152.559

Change Summary Explanation

FY 2021 reduction (\$6.305 million) Congressional Directed Transfer for Section 219.

FY 2021 reduction (\$5.105 million) SBIR/STTR Transfer.

FY 2022 reduction (\$19.000 million) Congressional Directed Reduction for Rocket Cargo-program growth.

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

Title: Future Transformational Capabilities	9.200	9.063	32.432
Description: Identify game-changing transformational Science and Technology investment opportunities through the WARfighter-TECHnologist (WARTECH) process. The WARTECH process brings together technologists and DAF requirement officials to assess the best intersection of technology readiness and DAF future force design priorities. Select programs will be designated Vanguards indicating enterprise-level priority and a transition partner endorses the program. Future Transformational Capability funds will be used to kick-start newly designated Vanguard programs to accelerate capability development and transition and respond to emerging technology opportunities within the budget cycle.			
FY 2022 Plans: Kick-start one or more of the six WARTECH topics and initiate Transformational Component Vanguard program(s) identified through the FY21-22 WARTECH process and approved by DAF. Perform modeling, simulation, and analyses used to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.			
FY 2023 Plans:			

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>		R-1 Program Element (Number/Name) PE 0603032F / <i>Future AF Integrated Technology Demos</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Continue investments that address DAF priorities such as achieving operationally optimized command and control, achieving target engagement at scale, and defining optimized resilient basing, sustainment, and communications. Investments will leverage Artificial Intelligence and gaming technologies to accelerate DAF capability to create theatre-scale operational plans within hours; demonstrate a capability for high speed delivery of area effects; enable multi-domain sense-making at the tactical edge; and create an effective, layered defense of air bases. Complete the WARTECH 3.0 process to investigate several DAF prioritized topics and initiate timely launch of several Transformational Component Vanguard Prospect programs. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 Funding increased compared to FY 2022 by \$23.369 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>				
<p>Title: Navigation Technology Satellite 3 (NTS-3)</p> <p>Description: Develop and demonstrate advanced space-based navigation system technologies to provide resilient navigation support in contested environments. The demonstration includes a space-based test vehicle, ground based enterprise command and control, and agile software defined receivers for the user.</p> <p>FY 2022 Plans: Complete development of advanced space-based navigation technology demonstration. Complete Ground Control System software and hardware, and integrate in New Mexico and Colorado ground control sites. Complete final software defined receiver hardware and release final user equipment software, and conduct end-to-end system functional test and space signal validation. Complete final system integration, test, and launch. Complete spacecraft final integration, environmental testing, and functional tests, and ship to launch site for anticipated launch. Complete system End-to-End Integration and Test. Initiate entire system checkout, once on-orbit, to prepare for experimentation with potential for follow-on residual operations led by a non-Air Force Research Laboratory organization.</p> <p>FY 2023 Plans: Complete experimental operations training and rehearsals. Complete all experiment plans and finalize experimental procedures and 1-year on-orbit experiment schedule. Complete final user equipment software release and deploy all receivers to CONUS sites to support experimental data collection. Deliver certifications of flight readiness and ship fully integrated and tested spacecraft to launch site, and support launch activities. Once on-orbit, initiate contact the spacecraft and perform initial system checkout period, maneuver to intended experimental orbit, and conduct first six months of experimentation. Prepare for transition to follow-on residual operations led by a non-Air Force Research Laboratory organization in mid-FY24.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		47.294	16.110	10.735

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603032F / <i>Future AF Integrated Technology Demos</i>
--	--

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>FY 2023 decreased compared to FY 2022 by \$5.375 million. Funding decreased due to completing test & spacecraft integration and ground control system deployment to mission operations control site, and transitioning to final integrated system tests, experimental operations rehearsals, and launch integration.</p> <p>Title: Skyborg</p> <p>Description: Skyborg is an autonomous, attritable vehicle architecture suite which will enable the Air Force to posture, produce and sustain multi-mission sorties at sufficient tempo to thwart adversary attempts at quick, decisive action in contested and highly contested environments. Skyborg is organized into three main lines of effort (LOEs). LOE 1 develops, demonstrates, and prototypes the Autonomy Core System (ACS) consisting of Skyborg autonomy architecture and software, enabling machine-machine and manned-unmanned teaming, while also ensuring openness, modularity, and expandability of the Skyborg autonomy mission systems suite. The ACS LOE also develops, demonstrates, and prototypes the hardware components and Open Architecture standards needed to allow modular sensor, communication, and other payload integration into the Skyborg autonomy and vehicle architectures in systems integration laboratories and platforms. LOE 2 (Low-cost vehicles) develops, demonstrates, and prototypes new low cost attritable vehicle concepts and technologies for expeditionary mass generation including sortie generation employment concepts. LOE 3 (Operational Experimentation) conducts analysis and experimentation on concepts of operations and concepts of employment for attritable, autonomous, unmanned systems and assesses the openness, and modular capabilities / sensors integration for autonomous, attritable, aircraft and mission systems.</p> <p>FY 2022 Plans: Continue development and demonstration of Skyborg Autonomy Core System hardware and software open architecture and components. Continue maturation and transition of human-machine interfaces, human systems interfaces and live, virtual & constructive technologies for command and control of autonomous systems. Continue demonstration and transition of government open architectures for autonomous unmanned systems. Continue demonstration and transition of a DevSecOps pipeline for the Skyborg Autonomy Core system software architecture. Complete development and demonstration of technologies for situational awareness, advanced autonomous behaviors, and survivability for unmanned systems. Complete demonstration of teaming concepts and technologies among cooperative human-machine teams in networked simulation environments. Continue integration, demonstration and transition of a digital engineering enterprise autonomous low-cost weapon system model and system integration laboratory.</p> <p>FY 2023 Plans: Complete development, demonstration, and transition of Skyborg Autonomy Core System hardware and software open architecture and components. Complete maturation and transition of human systems interfaces for autonomous systems. Complete demonstration and transition of government open architectures for autonomous unmanned systems. Complete demonstration and transition of a DevSecOps pipeline for the Skyborg Autonomy Core system software architecture. Complete creation and start-up of a digital integration facility including a system integration laboratory, digital engineering modeling,</p>	45.127	58.570	46.680

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>		R-1 Program Element (Number/Name) PE 0603032F <i>I Future AF Integrated Technology Demos</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
simulation and analysis laboratory and hardware/software-in-the-loop test facility for transition of Skyborg technology to program customers.				
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 funding decreased compared to FY 2022 by \$11.89 million. Funding decreased due to planned program requirements and completing the demonstration of teaming concepts and technologies among cooperative human-machine teams in networked simulation environments.				
Title: Golden Horde		34.319	0.000	18.812
Description: Integrate networked collaborative technologies into selected inventory weapon systems. Technologies can include new payloads, weapon datalinks/radios, and autonomous behaviors that are bounded by operator-defined mission rules of engagement. Supports the integration of Air Force weapons into the Joint All-Domain Command/Control network. Develop new standard software and hardware architecture environment to accelerate change for new weapon systems. This environment will integrate new concept designs via simulations, virtual and live testing, and operational analysis, experiments and war games to show the value of collaborative weapons in increasing combat power across the spectrum of conflict. Work with Weapons Program Executive Officer to define requirements for future weapons and Concept of Operations.				
FY 2022 Plans: Vanguard effort will complete efforts in FY 2022 through final demonstrations of networked collaborative technologies via simulations, testing, operational analysis, experiments and war-games. Complete work with operational users to define Concepts of Operation (CONOPs) in future force structures and future employment scenarios.				
FY 2023 Plans: Continue development of the multi-tier digital weapon ecosystem, consisting of a high fidelity, government owned, open architected, live, virtual, and constructive development pipeline for Networked Collaborative and Autonomous (NCA) technology and tactics. Complete the Software Integration and Simulation Laboratory. Complete the hardware-in-the-loop environment. Continue conducting yearly challenges where both traditional and non-traditional suppliers can compete new NCA weapon technology using Government reference architectures to accelerate delivery and verification of new weapon technology. Continue building the repository of industry NCA weapon technology and containerized NCA algorithms/software to have off-the-shelf solutions for new weapon development programs. Initiate demonstration of UAS surrogate capability to conduct high fidelity live-constructive testing of NCA technology with a mix of live and simulated vehicles. Prepare to transition the ecosystem to potential users/partners.				
FY 2022 to FY 2023 Increase/Decrease Statement:				

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603032F / <i>Future AF Integrated Technology Demos</i>
--	--

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>FY 2023 funding increased compared to FY 2022 by 18.812 million. Funding increased due to a planned re-phase of activities caused by a directed revector of the program and initiation of demonstration of UAS surrogate capability to conduct high fidelity live-constructive testing of NCA technology with a mix of live and simulated vehicles.</p>			
<p>Title: Rocket Cargo</p> <p>Description: The Department of the Air Force (DAF) seeks to leverage the current multi-billion dollar commercial investment to develop the largest rockets ever, and with full reusability to develop and test the capability to leverage a commercial rocket to deliver DAF cargo anywhere on the Earth in less than one hour, with a 100-ton capacity. The DAF is not investing in the commercial rocket development, but rather investing in the Science & Technology needed to interface the capability with DoD logistics needs, and extend the commercial capability to DoD-unique missions. Provides a new, faster and cheaper solution to the existing TRANSCOM Strategic Airlift mission. Enables AFSOC to perform current Rapid-Response Missions at lower cost, and meet a one-hour response requirement. Rocket Cargo uses modeling, simulation, and analysis to conduct operational analysis, verify military utility, performance, and operational cost. S&T will include novel "loadmaster" designs to quickly load/unload a rocket, rapid launch capabilities from unusual sites, characterization of potential landing surfaces and approaches to rapidly improve those surfaces, adversary detectability, new novel trajectories, and an S&T investigation of the potential ability to air drop a payload after reentry. This is not a rocket engine or launch vehicle development program. It is an S&T effort to leverage the commercial development into a novel new DoD capability.</p> <p>FY 2022 Plans: Mature effort in leveraging commercial space launch to create military capability in Rocket-based Cargo delivery. Complete S&T testing leveraging the current commercial prototype testing. Perform site measurements needed to integrate the capability onto DoD missions including plume-surface physics and toxicity, loads, detectability, and acoustics. Also, complete initial AFRL wind tunnel testing to assess novel trajectories needed for air-drop capability, and high-speed separation physics. Under contract and CRADA, partner with Commercial to test and demonstrate an initial one-way transport capability to an austere site. Seek to perform an early end-to-end test to fully identify the technical challenges. In addition, complete Industry outreach for loadmaster concepts including novel container designs, load/unload concepts, and testing the compatibility of AF cargo with rocket launch and space environments. Issue solicitation and award contracts.</p> <p>FY 2023 Plans: Leveraging the commercial development, initiate the first-ever deorbit and land with a large payload thereby testing the full stress on the thermal protection system, in-flight trajectory control, and landing leg strength. Initiate validation of Computational-fluid-dynamic (CFD) models using wind tunnels and commercially-leverage flight test that will enable the first in-depth S&T of high-speed separation options where the ejected payload is released in the anti-velocity direction. Complete assessment of the rocket vulnerability and detectability using leveraged field-test campaigns. Complete plume toxicity, acoustic and pad-material degradation experiments across a wider range of test parameters afforded by the commercial development, and update the AF</p>	0.000	28.900	43.900

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603032F / <i>Future AF Integrated Technology Demos</i>
--	--

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
CFD models accordingly. Initiate field research, in partnership with NASA, to investigate the plume interactions with a variety of materials expected for landing on Earth. Initiate efforts to design/test off-load apparatus optimized for the AF logistics mission set.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 funding decreased compared to FY 2022 by \$4.0 million. Funding decreased due to completion of S&T testing leveraging the current commercial prototype testing and testing to assess novel trajectories needed for air-drop capability, and high-speed separation physics			
Accomplishments/Planned Programs Subtotals	135.940	112.643	152.559

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	57.221	63.378	29.116	0.000	29.116	34.883	35.753	36.351	37.160	Continuing	Continuing
632100: <i>Laser Hardened Materials</i>	-	0.000	16.083	12.646	0.000	12.646	15.921	16.557	16.602	16.972	Continuing	Continuing
633153: <i>Non-Destructive Inspection Development</i>	-	0.000	4.436	4.806	0.000	4.806	8.811	8.931	9.163	9.366	Continuing	Continuing
633946: <i>Materials Transition</i>	-	57.221	42.859	11.664	0.000	11.664	10.151	10.265	10.586	10.822	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates advanced materials and process technologies to satisfy Department of the Air Force requirements in areas such as survivability, readiness, affordability, and new processes and materials. These projects ensure the Department of the Air Force weapon systems are ready and able when needed.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>
--	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	60.059	31.905	0.000	0.000	0.000
Current President's Budget	57.221	63.378	29.116	0.000	29.116
Total Adjustments	-2.838	31.473	29.116	0.000	29.116
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	-0.327			
• Congressional Adds	0.000	31.800			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-1.431	0.000			
• Other Adjustments	-1.407	0.000	29.116	0.000	29.116

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 632100: *Laser Hardened Materials*

Congressional Add: *Program increase - laser protective eyewear*

Congressional Add Subtotals for Project: 632100

Project: 633153: *Non-Destructive Inspection Development*

Congressional Add: *Artificial intelligence enhanced life cycle management*

Congressional Add Subtotals for Project: 633153

Project: 633946: *Materials Transition*

Congressional Add: *Program increase - Metals Affordability Research*

Congressional Add: *Program Increase - Composites technology*

Congressional Add: *Additive manufacturing for aerospace components*

Congressional Add: *Advanced ballistic eyewear*

Congressional Add: *Program increase - polymer printing technology for additive manufacturing*

Congressional Add: *Program increase - certification for advanced materials*

Congressional Add Subtotals for Project: 633946

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	0.000	1.800
	0.000	1.800
	0.000	0.000
	0.000	0.000
	9.762	10.000
	5.857	0.000
	4.881	0.000
	3.904	0.000
	0.000	5.000
	0.000	15.000
	24.404	30.000
	24.404	31.800

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force Date: April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>
--	--

Change Summary Explanation

Decrease in FY 2021 reflects adjustments to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>				Project (Number/Name) 632100 / <i>Laser Hardened Materials</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
632100: <i>Laser Hardened Materials</i>	-	0.000	16.083	12.646	0.000	12.646	15.921	16.557	16.602	16.972	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced materials technologies that enhance protection for Department of the Air Force personnel to ensure safety and to enable them to perform required missions in threat environments. Advanced materials technologies also enhance protection for Department of the Air Force sensors and systems to ensure safety, survivability, and operability in threat environments.

This project includes the initiation and development of programs addressing Department of the Air Force capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to Department of the Air Force design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Aerospace Systems Protection	0.000	8.224	6.620
Description: Develop and demonstrate materials technologies that enhance hardening for sensors, avionics, and components to increase survivability and mission effectiveness of Department of the Air Force systems.			
FY 2022 Plans: Continue to validate and assess the demonstrated results and transition the use of protection technologies for future sensor designs and strategies to mitigate directed energy damage for visual/near, short-wave, and mid-wave infrared detectors. Continue transitioning new technologies and integrate the developments into light, operator friendly survivable electro-optic sensors that provide full spectrum protection for missile warning. Continue analyzing the high-performance properties of damage limiting semiconductor materials designed to harden electro-optic imaging sensors. Continue to transition developed laser countermeasures for survivability of dynamic electro-optic/infrared imagers. Continue to advance the employment and integration of evolved computational materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings development for use in sensor hardening. Transition and continue technology development and maturation to develop defensive capability for air systems airframe and anti-access munitions hardening assessments and solutions. Continue development of materials for survivable next generation aircraft sensor systems.			
FY 2023 Plans: Continue to validate and assess the demonstrated results and transition the use of protection technologies for future sensor designs and strategies to mitigate directed energy damage for visual/near, short-wave, and mid-wave infrared detectors.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 632100 / <i>Laser Hardened Materials</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue transitioning new technologies and integrate the developments into light, operator friendly survivable electro-optic sensors that provide full spectrum protection for missile warning. Continue analyzing the high-performance properties of damage limiting semiconductor materials designed to harden electro-optic imaging sensors. Continue to transition developed laser countermeasures for survivability of dynamic electro-optic/infrared imagers. Continue to advance the employment and integration of evolved computational materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings development for use in sensor hardening. Continue development of materials for survivable next generation aircraft sensor systems. Completed technology development and maturation of anti-access munitions hardening.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 funding decreased compared to FY 2022 by \$1.604 million. Funding decrease is due to decreased emphasis on structural hardening.</p>			
<p>Title: Aircrew Protection</p> <p>Description: Develop and demonstrate materials technologies that enhance protection for Department of the Air Force personnel to ensure safety and to enable crews to perform required missions in a threat environment.</p> <p>FY 2022 Plans: Continue to develop, validate, demonstrate, and transition laser protection materials and technologies for personnel protection. Continue to validate and develop light-weight helmet-mounted sensor hardening materials focusing on next-generation nighttime specialized sensors. Continue to advance transition efforts and development of visor based aircrew protection materials with agile protection. Continue to evaluate and assess new materials and advances in characterization and demonstration of eye protection technologies using computational materials science tools. Continue to transition, validate, mature, and test improvements to functionality and performance of personnel protection technologies in expected operational conditions. Continue development and testing of materials technologies to protect against nuclear flash blindness.</p> <p>FY 2023 Plans: Continue to develop, validate, demonstrate, and transition laser protection materials and technologies for personnel protection. Continue to validate and develop light-weight helmet-mounted sensor hardening materials focusing on next-generation nighttime specialized sensors. Continue to advance transition efforts and development of visor based aircrew protection materials with agile protection. Continue to evaluate and assess new materials and advances in characterization and demonstration of eye protection technologies using computational materials science tools. Continue to transition, validate, mature, and test improvements to functionality and performance of personnel protection technologies in expected operational conditions. Continue development and testing of materials technologies to protect against nuclear flash blindness.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	0.000	6.059	4.782

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 632100 / <i>Laser Hardened Materials</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 decreased compared to FY 2022 by \$1.277 million. Funding decreased due to decreased emphasis on aircrew protection.				
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through advanced materials technologies for hardening avionics, sensors, and components and increasing personnel protection. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: N/A. This effort is starting in FY 2023.</p> <p>FY 2023 Plans: Continue investments leveraging Artificial Intelligence and gaming technologies to accelerate Department of the Air Force capability to create theatre-scale operational plans within hours. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.244 million. Funding is increased due to to scaling investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>		-	0.000	1.244
Accomplishments/Planned Programs Subtotals		0.000	14.283	12.646
		FY 2021	FY 2022	
Congressional Add: Program increase - laser protective eyewear		0.000	1.800	
FY 2021 Accomplishments: Not applicable				
FY 2022 Plans: Conduct Congressionally directed efforts.				
Congressional Adds Subtotals		0.000	1.800	

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 632100 / <i>Laser Hardened Materials</i>

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>				Project (Number/Name) 633153 / <i>Non-Destructive Inspection Development</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
633153: <i>Non-Destructive Inspection Development</i>	-	0.000	4.436	4.806	0.000	4.806	8.811	8.931	9.163	9.366	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced nondestructive inspection and evaluation technologies to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. Nondestructive inspection and evaluation capabilities greatly influence and/or limit many design, manufacturing, and maintenance practices. This project provides technology to satisfy Department of the Air Force requirements to extend the lifetime of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels. Equally important is assuring manufacturing quality, integrity, and safety requirements are built in.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Special Material Inspection Technologies	0.000	0.751	0.895
Description: Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability.			
FY 2022 Plans: Continue the transition process to depots and flight lines for improved methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage to special materials that enables/ensures more affordable coatings assessment. Continue to validate tools to improve characterization and failure modes of specialty multilayer coatings. Continue to develop automation for robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization.			
FY 2023 Plans: Continue the transition process to depots and flight lines for improved methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage to special materials that enables/ensures more affordable coatings assessment. Continue to validate tools to improve characterization and failure modes of specialty multilayer coatings.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 633153 / <i>Non-Destructive Inspection Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Continue to develop automation for robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.144 million. Funding increased due to increased emphasis on automation of specialty materials inspection technologies.				
Title: Advanced System Monitoring Technologies Description: Develop and demonstrate advanced systems status monitoring technologies to provide on-board and embedded sensing to gain continuous awareness of the state of key subsystems. FY 2022 Plans: Continue to demonstrate advanced analytical methods to more accurately assess the location, and register spatial location, of damage detected using nondestructive inspection data and results. Develop augmented reality technologies to improve the process of performing non-destructive evaluation tasks, acquiring and archiving data and reporting results, and enabling improved inspector guidance and visualization. Continue development and transition of novel approaches to collect, analyze, transport, archive, and use digital nondestructive inspection data and information. Continue enhanced methods for compiling, reporting, collecting and rapidly analyzing digital nondestructive testing and evaluation data necessary for improved damage detection and characterization. Demonstrate and transition technologies to locate damage to composite structures without coating removal and to inspect composite structures with complex geometry. Continue the transition and integration of computational materials science tools with provide data necessary for life prediction methods to enable risk-based life management. FY 2023 Plans: Continue to demonstrate advanced analytical methods to more accurately assess the location, and register spatial location, of damage detected using nondestructive inspection data and results. Develop augmented reality technologies to improve the process of performing non-destructive evaluation tasks, acquiring and archiving data and reporting results, and enabling improved inspector guidance and visualization. Continue development and transition of novel approaches to collect, analyze, transport, archive, and use digital nondestructive inspection data and information. Continue enhanced methods for compiling, reporting, collecting and rapidly analyzing digital nondestructive testing and evaluation data necessary for improved damage detection and characterization. Demonstrate and transition technologies to locate damage to composite structures without coating removal and to inspect composite structures with complex geometry. Continue the transition and integration of computational materials science tools with provide data necessary for life prediction methods to enable risk-based life management. FY 2022 to FY 2023 Increase/Decrease Statement:		0.000	2.212	2.638

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 633153 / <i>Non-Destructive Inspection Development</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022
FY 2023 increased compared to FY 2022 by \$0.426 million. Increased funding due to increased emphasis on augmented reality technologies.			
Title: Transformational Technology Development		0.000	1.473
Description: Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through developments in nondestructive inspection and evaluation technologies to monitor performance integrity and detect failures before they affect they system. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.			1.273
FY 2022 Plans: Fund the follow-on efforts for Transformational Technology Development projects selected in prior FYs. Select Transformational Technology Development efforts starting in FY 22 that support the National Defense Strategy and Department of the Air Force priorities.			
FY 2023 Plans: Continue nondestructive inspection and evaluation technology efforts for development and demonstration of the capability for high speed delivery of area effects. Initiate projects selected from the WARTECH 3.0 process that investigate Department of the Air Force prioritized topics and initiate timely launch of Transformational Component Vanguard Prospect programs. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.200 million. Funding is decreased due to scaling investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.			
Accomplishments/Planned Programs Subtotals		0.000	4.436
		FY 2021	FY 2022
Congressional Add: Artificial intelligence enhanced life cycle management		0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 633153 / <i>Non-Destructive Inspection Development</i>
--	--	--

	FY 2021	FY 2022
<i>FY 2021 Accomplishments:</i> Not applicable		
<i>FY 2022 Plans:</i> Not applicable		
Congressional Adds Subtotals	0.000	0.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>				Project (Number/Name) 633946 / <i>Materials Transition</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
633946: <i>Materials Transition</i>	-	57.221	42.859	11.664	0.000	11.664	10.151	10.265	10.586	10.822	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced materials and processing technologies for fielded and planned Department of the Air Force weapon, airframe, and propulsion applications. Advanced materials and processes that have matured beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. This design and scale-up data improves the overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Air Vehicle Materials Technologies	18.048	10.999	9.830
Description: Develop and demonstrate materials and processes technologies for air vehicle and subsystems to enhance lift, propulsion, Low Observable (LO) performance, power generation management, survivability, and affordability of air vehicles.			
FY 2022 Plans: Continue development of technologies for organic engine lifing analysis for enhanced engine component risk management capability. Continue development and characterization for transitioning materials to protect infrared apertures on next generation hardened assets. Continue to validate and verify results of microstructure sensitive lifing methodologies that lower life cycle cost and advance performance characteristics of airframe and engine components in order to initiate development of next generation modeling tools that incorporate residual stress effects on component life. Continue development and characterization of materials for application in nuclear systems and protected infra-red apertures for next-generation hardened assets.			
FY 2023 Plans: Continue development of technologies for organic engine lifing analysis for enhanced engine component risk management capability. Continue development and characterization for transitioning materials to protect infrared apertures on next generation hardened assets. Continue to validate and verify results of microstructure sensitive lifing methodologies that lower life cycle cost and advance performance characteristics of airframe and engine components in order to initiate development of next generation			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 633946 / <i>Materials Transition</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>modeling tools that incorporate residual stress effects on component life. Continue development and characterization of materials for application in nuclear systems and protected infra-red apertures for next-generation hardened assets.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$1.169 million. Funding decreased due to decreased emphasis on air vehicles materials technology.</p>				
<p>Title: High Temperature Material Technologies</p> <p>Description: Develop and demonstrate affordable, novel high temperature materials/structures and thermal management concepts to enable future defense capabilities for the Department of the Air Force global strike concepts.</p> <p>FY 2022 Plans: Work in this effort completed in FY 2021.</p> <p>FY 2023 Plans: Work in this effort completed in FY 2021.</p>		14.769	0.000	0.000
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through characterization and data evaluation of advanced materials in potential operational environment in order to improve affordability. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Fund the follow-on efforts for Transformational Technology Development projects selected in prior FYs. Select Transformational Technology Development efforts starting in FY 22 that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2023 Plans:</p>		0.000	1.860	1.834

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 633946 / <i>Materials Transition</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Continue advanced materials and processing technology efforts for development and demonstration of a capability for high speed delivery of area effects. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$0.026 million. Funding is decreased due to scaling investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.			
Accomplishments/Planned Programs Subtotals	32.817	12.859	11.664

	FY 2021	FY 2022
<i>Congressional Add:</i> Program increase - Metals Affordability Research <i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts. <i>FY 2022 Plans:</i> Conduct Congressionally directed efforts.	9.762	10.000
<i>Congressional Add:</i> Program Increase - Composites technology <i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts. <i>FY 2022 Plans:</i> Not applicable	5.857	0.000
<i>Congressional Add:</i> Additive manufacturing for aerospace components <i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts. <i>FY 2022 Plans:</i> Not applicable	4.881	0.000
<i>Congressional Add:</i> Advanced ballistic eyewear <i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts. These efforts will be executed in project 632100 of this program. <i>FY 2022 Plans:</i> Not applicable	3.904	0.000
<i>Congressional Add:</i> Program increase - polymer printing technology for additive manufacturing <i>FY 2021 Accomplishments:</i> Not applicable <i>FY 2022 Plans:</i> Conduct Congressionally directed efforts.	0.000	5.000
<i>Congressional Add:</i> Program increase - certification for advanced materials	0.000	15.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / <i>Advanced Materials for Weapon Systems</i>	Project (Number/Name) 633946 / <i>Materials Transition</i>
--	--	--

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	24.404	30.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603199F / <i>Sustainment Science and Technology (S&T)</i>
--	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	15.631	19.112	10.695	0.000	10.695	11.368	13.694	14.480	15.051	Continuing	Continuing
635351: <i>Technology Sustainment</i>	-	15.631	19.112	10.695	0.000	10.695	11.368	13.694	14.480	15.051	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This program develops and demonstrates mature Air Force Research Laboratory (AFRL) sustainment technologies such as: materials, corrosion, maintenance/repair techniques, state awareness/non-destructive inspection, health management, life prediction, low observable materials and processes, composite materials and logistics for transition into fielded Department of the Air Force systems to reduce life cycle sustainment costs and increase readiness. Technologies matured and demonstrated impact affordability and availability of fielded aerospace weapon systems by reducing sustainment costs, extending service life, and maintaining mission readiness and capability. This program develops and demonstrates maintenance, life cycle management, and system/fleet decision making technologies that can be implemented to address operational sustainment issues and could influence future system sustainability decisions via risk reduction to support inclusion into new systems. Studies are conducted to analyze processes and methodologies for application of technologies to address sustainment issues across the force, identifying cross cutting applications for fielded systems, and opportunities for building in sustainability into future applications. This program also develops and demonstrates affordable advanced composites for aircraft structures of fielded and emerging systems. This includes studies, analysis, and tests for application of composites to address sustainment and affordability issues across the force. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603199F I Sustainment Science and Technology (S&T)
---	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	16.902	21.057	0.000	0.000	0.000
Current President's Budget	15.631	19.112	10.695	0.000	10.695
Total Adjustments	-1.271	-1.945	10.695	0.000	10.695
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	-1.945			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-1.271	0.000			
• Other Adjustments	0.000	0.000	10.695	0.000	10.695

Change Summary Explanation

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

Title: System Health Management/Assessment Technologies	5.096	0.000	0.000
Description: Develop, demonstrate, and transition state awareness/system health management technologies. Conduct studies and analyses to design sustainability into future Department of the Air Force applications. The short-term tasks in this area are selected based on warfighter needs identified via a semi-annual, competitive process.			
FY 2022 Plans: Technical work on this effort completed in FY 2021.			
FY 2023 Plans: Technical work on this effort completed in FY 2021.			
FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable			
Title: Prevention/Enhanced Maintainability Technologies	5.442	5.854	5.544
Description: Develop, demonstrate, and transition maintenance and sustainment technologies to improve component design, maintenance, replacement, and concepts for performance improvement and reduced maintenance burden for the Department			

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>		R-1 Program Element (Number/Name) PE 0603199F / <i>Sustainment Science and Technology (S&T)</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
of the Air Force. Short term tasks in this effort are selected based on warfighter needs identified via a semi-annual, competitive process.				
FY 2022 Plans: Continue rapid repair and materials development for aircraft battle damage repair of advanced fighter aircraft. Continue advanced canopy technology development. Continue total body nondestructive evaluation system for outer mold line inspection of advanced fighter aircraft. Continue development of materials and processes to reduce maintenance burden on low observable systems. Continue efforts to demonstrate high reliability of repair and maintenance technologies to increase service time between maintenance actions. Continue to develop, demonstrate, and transition maintenance and sustainment technologies to improve component design, maintenance, repair, replacement, and concepts for maintainer training, extending part life, and reduced maintenance burden spanning Department of the Air Force mission areas of Air, Space, and Cyber. Continue to develop abrasion resistance coating to protect composite material substrates for low observable systems. Continue to develop a flexible crack-blunting primer. Initiate other new efforts based on competitive selection processes in FY 2021.				
FY 2023 Plans: Continue rapid repair and materials development for aircraft battle damage repair of advanced fighter aircraft. Continue advanced canopy technology development. Continue total body nondestructive evaluation system for outer mold line inspection of advanced fighter aircraft. Continue development of materials and processes to reduce maintenance burden on low observable systems. Continue efforts to demonstrate high reliability of repair and maintenance technologies to increase service time between maintenance actions. Continue to develop, demonstrate, and transition maintenance and sustainment technologies to improve component design, maintenance, repair, replacement, and concepts for maintainer training, extending part life, and reduced maintenance burden spanning Department of the Air Force mission areas of Air, Space, and Cyber. Continue development abrasion resistance coating to protect composite material substrates for low observable systems. Completed development of a flexible crack-blunting primer.				
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.310 million. Funding decreased due to plans described above.				
Title: Management/Improved Reliability Technologies		5.093	5.477	5.118
Description: Develop, demonstrate, and transition technologies to improve existing and new components, fleet management/ decision-making tools, and supply chain/sustainment infrastructure to decrease downtime and costs, and increase reliability. The short-term tasks in this effort are selected based on warfighter needs identified via a semi-annual, competitive process.				
FY 2022 Plans:				

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>		R-1 Program Element (Number/Name) PE 0603199F / <i>Sustainment Science and Technology (S&T)</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Continue system development to provide prognostic capabilities for avionics components and analysis techniques to extend engine component service life. Continue efforts to develop system fleet management decision-making tools, maintenance/repair database technologies and techniques, and supply chain/infrastructure approaches to reduce sustainment costs. These efforts span Department of the Air Force mission areas of Air, Space, and Cyber. Initiate new efforts based on competitive selection processes in FY 2021.</p> <p>FY 2023 Plans: Continue system development to provide prognostic capabilities for avionics components and analysis techniques to extend engine component service life. Continue efforts to develop system fleet management decision-making tools, maintenance/repair database technologies and techniques, and supply chain/infrastructure approaches to reduce sustainment costs. These efforts span Department of the Air Force mission areas of Air, Space, and Cyber. Continue efforts based on competitive selection processes in FY 2021.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.359 million. Funding decreased due to the plans described above.</p>				
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation is to provide funding to start new and continue Transformational Technology Developments. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to: materials, corrosion, maintenance/repair techniques, state awareness/non-destructive inspection, health management, life prediction, low observable materials and processes, composite materials and logistics technologies that affect mission availability. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Fund the follow-on efforts for projects started in FY 2021. Select Transformational Technology Development efforts that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2023 Plans:</p>		0.000	7.781	0.033

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603199F / <i>Sustainment Science and Technology (S&T)</i>
--	---

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Continue to fund the follow-on efforts for Transformational Technology Development projects selected in prior FYs (eg composites for emerging hypersonic systems). Select Transformational Technology Development efforts for following FY that support the National Defense Strategy and Department of the Air Force priorities.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$7.748 million. Funding is decreased due to scaling investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.			
Accomplishments/Planned Programs Subtotals	15.631	19.112	10.695

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>
--	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	33.162	53.750	36.997	0.000	36.997	42.398	45.552	50.754	51.882	Continuing	Continuing
63665A: <i>Advanced Aerospace Sensors Technology</i>	-	33.162	19.664	16.204	0.000	16.204	18.651	21.248	23.790	24.319	Continuing	Continuing
6369DF: <i>Target Attack and Recognition Technology</i>	-	0.000	34.086	20.793	0.000	20.793	23.747	24.304	26.964	27.563	Continuing	Continuing

A. Mission Description and Budget Item Justification

The program develops and demonstrates advanced technologies for electro-optical sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. It also develops and demonstrates radio frequency (RF) and electro-optical (EO) sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. This program develops the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. This program has been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>
--	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	35.274	44.730	0.000	0.000	0.000
Current President's Budget	33.162	53.750	36.997	0.000	36.997
Total Adjustments	-2.112	9.020	36.997	0.000	36.997
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	-1.014			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	9.300			
• Congressional Directed Transfers	0.000	0.734			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.698	0.000			
• Other Adjustments	-1.414	0.000	36.997	0.000	36.997

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 6369DF: *Target Attack and Recognition Technology*

Congressional Add: *Program increase: software verification and validation for autonomous sensors*

Congressional Add Subtotals for Project: 6369DF

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	0.000	9.300
	0.000	9.300
	0.000	9.300

Change Summary Explanation

Decrease in FY 2021 reflects adjustments to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>				Project (Number/Name) 63665A / <i>Advanced Aerospace Sensors Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
63665A: <i>Advanced Aerospace Sensors Technology</i>	-	33.162	19.664	16.204	0.000	16.204	18.651	21.248	23.790	24.319	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project area develops and demonstrates aerospace sensor and processing technologies for intelligence, surveillance, reconnaissance, target, and attack radar applications in both manned and unmanned platforms, including electro-optical sensors and electronic counter-countermeasures for radars. It provides aerospace platforms with the capability to precisely detect, track, and target both airborne (conventional and low radar cross-section) and ground-based, high-value, time-critical targets in adverse clutter and jamming environments. Project activities include developing multi-function radio-frequency systems including radar and electronic warfare technology and the position and timing information to enable distributed sensing. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Persistent Sensing in Contested Environment Technologies</p> <p>Description: Develop active radio frequency sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced radio frequency architectures for open and reconfigurable systems. Enable persistent intelligence, surveillance and reconnaissance over wide areas, and detect advanced air and ground targets.</p> <p>FY 2022 Plans: Not applicable</p> <p>FY 2023 Plans: Not applicable</p>	2.903	0.000	0.000
<p>Title: Passive/Multi-Mode Sensing</p> <p>Description: Develop advanced techniques and prototype passive radio frequency sensors to intercept, collect, locate and track enemy radio frequency sensor systems for intelligence, surveillance and reconnaissance of air and ground targets.</p> <p>FY 2022 Plans:</p>	5.777	6.817	7.816

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>	Project (Number/Name) 63665A / <i>Advanced Aerospace Sensors Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Continue development and ground demonstrations of illumination selection manager to address more complex signal environments and implementation in open architectures. Complete platform level modeling to evaluate key parameters for passive multi-mode radar performance. Continue mission level modeling to evaluate passive multi-mode system effectiveness for relevant scenarios. Continue implementation of electronic support, passive radar and illumination selection manager subsystems in advanced digital antenna architectures. Initiate implementation of illumination selection manager into sensor resource manager. Complete systems engineering study to identify subsystem enhancements for airborne passive multi-mode. Begin integration of illumination selection manager and/or passive multi-mode radar on existing airborne platforms. Initiate planning for airborne passive multi-mode demonstration.</p> <p>FY 2023 Plans: Complete development of core illumination selection manager algorithms that operate in complex signal environments. Continue mission level modeling to evaluate system effectiveness for relevant operational scenarios. Complete implementation of electronic support, passive radar and ISM subsystems in advanced wideband digital active electronically scanned arrays. Perform a ground-based integrated demonstration incorporating a state-of-the-art digital active electronically scanned arrays. Complete implementation of illumination selection manager into sensor resource manager, demonstrating that illumination selection manager subsystem interfaces are compliant with open architectures. Continue integration of illumination selection manager and/or passive multi-mode radar on existing airborne platforms. Continue planning for follow-on airborne demonstration.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.999 million. Justification for this increase is described in plans above.</p>				
<p>Title: Long Range Sensing Technologies</p> <p>Description: Develop radio frequency sensor technology to detect, locate, and identify air and ground targets at long ranges, including those that are low-observable, or use deception or camouflage.</p> <p>FY 2022 Plans: Not applicable</p> <p>FY 2023 Plans: Not applicable</p>		2.785	0.000	0.000
<p>Title: Triple Raven Advanced Technology Demonstration</p> <p>Description: Advance, demonstrate, and transition innovative imaging and non-imaging optical sensing technologies for surveillance and reconnaissance of airborne and ground-based objects of interest in an anti-access/area denial environment. This effort includes the development of systems, subsystems, and components necessary to yield new capabilities.</p>		7.942	7.776	6.081

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>	Project (Number/Name) 63665A / <i>Advanced Aerospace Sensors Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> Continue design and development of complete surveillance demonstration system. Complete development of laser radar transmitter, receiver, and integrate with passive imaging systems and control system. Conduct lab testing of entire system. Prepare for long-range ground demonstration of system at government test range.</p> <p><i>FY 2023 Plans:</i> Complete development of turbulence mitigation algorithms. Finalize assembly of the entire passive and active electro-optical sensor system. Conduct long range mountain-to-ground demonstration of the system at a Government test range. Demonstrate performance of system during airborne data collections and ability of the system to meet program office data collection needs.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$1.695 million. Funding decrease is a result of the Triple Raven Advanced Technology Demonstration effort ending in FY 2023.</p>			
<p><i>Title:</i> Transformational Technology Development</p> <p><i>Description:</i> Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through electro-optical and radio frequency sensing capabilities and algorithms. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p><i>FY 2022 Plans:</i> Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p><i>FY 2023 Plans:</i> Continue to develop and enable multi-domain sense-making at the tactical edge. Continue to develop radio frequency (RF) and electro-optical (EO) sensing capability to detecting, locating, and targeting airborne, fixed, and time critical mobile ground targets. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized</p>	0.000	5.071	2.307

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>	Project (Number/Name) 63665A / <i>Advanced Aerospace Sensors Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.764 million. Funding decreased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p> <p>Title: Multidomain Analytic Development - Evolution</p> <p>Description: Develop enabling capabilities and technical know-how required for Department of the Air Force multi-domain command and control within highly contested environments through closed-loop central and decentralized sensing for battle management, automated onboard systems that use complex reasoning for situational awareness (SA) leading "intelligent" response, executive reasoning for selectable re-planners that provide task allocation. Use of shared models with both onboard reasoners and mission simulation and evaluation. Built with government-owned scalable closed-loop algorithms.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 6369DF, Target Attack and Recognition Technology, Multidomain Analytic Development - Evolution effort.</p> <p>FY 2023 Plans: Not applicable</p>		13.755	0.000	0.000
Accomplishments/Planned Programs Subtotals		33.162	19.664	16.204
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
Not applicable				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>				Project (Number/Name) 6369DF / <i>Target Attack and Recognition Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
6369DF: <i>Target Attack and Recognition Technology</i>	-	0.000	34.086	20.793	0.000	20.793	23.747	24.304	26.964	27.563	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project area develops and demonstrates advanced technologies for closed-loop, multi-domain, multi-intelligence sources, multi-platform, multi-sensor automation and autonomy, providing capabilities in battle management, fire control, battlespace awareness and visualization, predictive analytics, target recognition, sensor and information fusion, and sensor / platform asset tasking. This project also conducts advanced investigations to determine solution credibility, in terms of underlying technology and in terms of consistency with future Air Force missions within highly contested environments. This project includes robust techniques to support intelligence, surveillance, and reconnaissance and targeting missions within adverse weather conditions and against adversaries employing deceptive techniques. This project includes development of software-intensive solutions suitable for cloud-based integration and for development/operations-like operational environments. This project develops technology for effective management of online and offline information sources incorporating both constrained and cooperative sensing. This project has been realigned to better reflect technical areas being emphasized such as autonomy, multi-domain and multi-sensor information processing, leverage of machine learning developments and enterprise-level modeling, simulation and analysis.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Multidomain Analytic Development - Evolution	0.000	17.133	14.920
<p>Description: Develop enabling capabilities and technical know-how required for Department of the Air Force multi-domain command and control within highly contested environments through closed-loop central and decentralized sensing for battle management, automated onboard systems that use complex reasoning for situational awareness (SA) leading "intelligent" response, executive reasoning for selectable re-planners that provide task allocation. Use of shared models with both onboard reasoners and mission simulation and evaluation. Built with government-owned scalable closed-loop algorithms.</p> <p>FY 2022 Plans: Continue development of a prototype capability supporting the generation, evaluation, modification, and fielding of activity models for real-time use in automatically characterizing adversary behavior. Continue to demonstrate that activity modeling is a portable process, applicable to indications and warnings against a broad range of adversary activity. Continue integration of new component capabilities aimed at augmenting existing Department of the Air Force capability by developing processes used to</p>			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>	Project (Number/Name) 6369DF / <i>Target Attack and Recognition Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>generate adversary activity models and using those models to automatically generate indications and warnings alerts. Continue to integrate all components in an open-architecture testbed running on a cloud based environment.</p> <p>FY 2023 Plans: Continue the integration and demonstration of onboard and off-board intelligence, surveillance and reconnaissance algorithms to build a dominating intelligence, surveillance and reconnaissance capability against our adversaries. Continue the model, simulate and test new algorithm advancements for detection, identification, tracking, fusion, battle space awareness, predictive and prescriptive analytics, reasoning over an adversaries actions, collection, and execution of sensing and platform resources. Continue integration of new component capabilities aimed at augmenting existing Department of the Air Force capability by developing processes used to generate adversary activity models and using those models to automatically generate indications and warnings alerts. Continue to integrate all components in an open-architecture testbed running on a cloud-based environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by 2.213 million. Decrease is a result of reduced emphasis on simulating and testing advanced techniques.</p>				
<p>Title: Resilient & Agile Mission Systems Architecture</p> <p>Description: This project performs advanced development and demonstration of methods, technologies, and tools to enable resilience and protect mission systems against threats. This involves open and adaptable architectures for rapid integration and agile systems, cyber protections and resilience technologies to protect against threats. It integrates research efforts in electronic and cyber warfare to demonstrate novel operational capabilities through laboratory, field, and flight tests and experimentation. The goal is to reduce risk for rapid transition of novel operational capabilities into Air Force mission systems.</p> <p>FY 2022 Plans: Evolve and mature open architecture standards. Initiate development of advanced networking, processing, advanced computing paradigms, and cybersecurity technologies for next-generation avionics mission system capabilities. Apply agile software technologies and digital engineering techniques for rapid and affordable development, integration, and prototype capability demonstrations.</p> <p>FY 2023 Plans: Continue investigations to evolve and mature open architecture standards. Continue development of advanced networking, processing, advanced computing paradigms, and cybersecurity technologies for next-generation avionics mission system capabilities. Apply agile software technologies and digital engineering techniques for rapid and affordable development,</p>		0.000	4.185	3.500

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>	Project (Number/Name) 6369DF / <i>Target Attack and Recognition Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
integration, and prototype capability demonstrations. Initiate development of Reference Architecture Implementation for resilient mission systems.				
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.685 million. Justification for this decrease is described in plans above.				
Title: Transformational Technology Development		0.000	3.468	2.373
Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through multi-sensor automation and autonomy, battlespace awareness and visualization, predictive analytics, target recognition, sensor and information fusion, and sensor/platform asset tasking. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.				
FY 2022 Plans: Select new Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.				
FY 2023 Plans: Continue to develop and enable multi-domain sense-making at the tactical edge. Continue to develop capabilities to provide real-time battle management, fire control, battlespace awareness and visualization, predictive analytics, target recognition, sensor and information fusion, and sensor/platform asset tasking. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.				
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$1.095 million. Funding decreased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.				
Accomplishments/Planned Programs Subtotals		0.000	24.786	20.793

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / <i>Advanced Aerospace Sensors</i>	Project (Number/Name) 6369DF / <i>Target Attack and Recognition Technology</i>
--	---	--

	FY 2021	FY 2022
Congressional Add: Program increase: software verification and validation for autonomous sensors	0.000	9.300
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressional directed efforts		
Congressional Adds Subtotals	0.000	9.300

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603211F / <i>Aerospace Technology Dev/Demo</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	34.321	105.486	54.727	0.000	54.727	63.167	96.213	105.074	105.654	Continuing	Continuing
634094: <i>Next Gen Platform Dev/Demo</i>	-	0.000	17.288	14.748	0.000	14.748	6.576	6.697	6.834	6.987	0.000	59.130
634920: <i>Flight Vehicle Tech Integration</i>	-	34.321	71.788	15.851	0.000	15.851	16.442	29.253	32.369	26.023	Continuing	Continuing
634926: <i>High Speed Systems Integ & Demo</i>	-	0.000	11.058	7.080	0.000	7.080	13.580	35.797	36.603	37.416	Continuing	Continuing
634927: <i>Flight Systems Control</i>	-	0.000	5.352	17.048	0.000	17.048	26.569	24.466	29.268	35.228	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program supports Department of Defense (DoD) priorities for demonstrations in hypersonics and manned/unmanned systems, respectively. This effort integrates and demonstrates advanced flight vehicle technologies that improve the performance and supportability of existing and future aerospace vehicles. System level integration brings together aerospace vehicle technologies along with avionics, propulsion, and weapon systems for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational aircraft. Additionally, this effort supports the nuclear enterprise and nuclear deterrence through advanced component and technology demonstrations. Projects in this program have been coordinated through the DoD Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 0602298F, and 1206601SF.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603211F I Aerospace Technology Dev/Demo
---	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	62.117	70.486	0.000	0.000	0.000
Current President's Budget	34.321	105.486	54.727	0.000	54.727
Total Adjustments	-27.796	35.000	54.727	0.000	54.727
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	35.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-24.138	0.000			
• SBIR/STTR Transfer	-2.169	0.000			
• Other Adjustments	-1.489	0.000	54.727	0.000	54.727

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 634920: *Flight Vehicle Tech Integration*

Congressional Add: *Program increase - Heavy fuel engine hybrid electric ducted fan advanced propulsion*

Congressional Add: *Program increase - Small unit autonomous UAS resupply*

Congressional Add Subtotals for Project: 634920

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	0.000	15.000
	0.000	20.000
	0.000	35.000
	0.000	35.000

Change Summary Explanation

Decrease in FY 2021 reflects Cong Adds Realignment to appropriate program and reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY2022 President's Budget submittal did not reflect FY2023 through FY2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603211F / Aerospace Technology Dev /Demo				Project (Number/Name) 634094 / Next Gen Platform Dev/Demo			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634094: Next Gen Platform Dev/Demo	-	0.000	17.288	14.748	0.000	14.748	6.576	6.697	6.834	6.987	0.000	59.130
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project demonstrates advanced nuclear-related components and technologies in support of the nuclear enterprise and nuclear deterrence operations missions. Next Gen Platform Development/Demonstration efforts are accomplished through development, integration, testing, and evaluation of various technologies to include fuzes, aeroshells, inertial guidance, and nuclear-specific communications for demonstration in near-realistic operational environments.

This Project and associated efforts will continue to be executed by the Air Force Research Laboratory Space Vehicles Technology Directorate located in Kirtland Air Force Base, New Mexico.

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

	FY 2021	FY 2022	FY 2023
Title: Advanced Nuclear Components	0.000	17.288	14.748
Description: Develop next-generation solid state, radiation-hardened strategic advance inertial system components for hostile environment.			
FY 2022 Plans: Complete gravity gradiometer testbed design. Complete design and development of second gyroscope prototype and execute environment testing; initiate nesting work with prototype. Continue design of first inertial measurement unit engineering design unit and design of radiation hardened electronics module. Continue to mature modeling, simulation, and test/validation procedures for inertial sensor systems in relevant strategic environments.			
FY 2023 Plans: Continue iterative development of inertial measurement unit (IMU) prototypes, including nested sensor configuration of gyroscope and accelerometer technologies, and environmental testing. Continue development of radiation hardened electronics supporting nested sensor design. Continue to mature covariance analysis through test data inputs from sensor/system testing.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.540 million. Funding decreased due to completion of design and development of the second gyroscope prototype.			
Accomplishments/Planned Programs Subtotals	0.000	17.288	14.748

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / <i>Aerospace Technology Dev /Demo</i>	Project (Number/Name) 634094 / <i>Next Gen Platform Dev/Demo</i>

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603211F / Aerospace Technology Dev /Demo				Project (Number/Name) 634920 / Flight Vehicle Tech Integration			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634920: <i>Flight Vehicle Tech Integration</i>	-	34.321	71.788	15.851	0.000	15.851	16.442	29.253	32.369	26.023	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project demonstrates advanced aerospace vehicle technologies. Aerospace Vehicle Technology Integration efforts are accomplished through integration of various technologies to include avionics, advanced propulsion, and weapon systems for demonstration in near-realistic operational environments. Advanced Aerospace Structures Technologies are demonstrated to enhance the capability of current and future aerospace vehicles.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Aerospace Vehicle Technology Integration	16.160	36.788	13.821
Description: Develop, simulate, and demonstrate integrated technologies to improve the performance of aerospace platform capabilities.			
FY 2022 Plans: Complete the flight demonstration of a low cost unmanned aerospace systems capable of interoperations with different unmanned aerospace systems assets. Continue next variant of a low cost unmanned aerospace system.			
FY 2023 Plans: Continue development and initiate flight test of a next variant of a low cost unmanned aerospace system. Initiate the development of a forward weapons employment derivative of a low cost unmanned aerospace system.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY22 by \$22.967 million. Funding decreased due to higher AF priorities and shift in emphasis from S&T integration of legacy platforms to autonomous collaborative platforms.			
Title: Advanced Aerospace Structure Technologies	18.161	0.000	0.000
Description: Develop and demonstrate affordable, lightweight, adaptive, and multifunctional structural concepts integrated into aerospace systems.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / Aerospace Technology Dev /Demo	Project (Number/Name) 634920 / Flight Vehicle Tech Integration	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022
FY 2022 Plans: Not applicable.			
FY 2023 Plans: Not applicable.			
Title: Transformational Technology Development		0.000	0.000
Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through integration techniques for technologies including avionics, advanced propulsion, and weapon systems. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.			2.030
FY 2022 Plans: This effort is starting in FY23.			
FY 2023 Plans: Continue to develop and demonstrate a capability for high speed delivery of area effects. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$2.03 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.			
Accomplishments/Planned Programs Subtotals		34.321	36.788
		FY 2021	FY 2022
Congressional Add: Program increase - Heavy fuel engine hybrid electric ducted fan advanced propulsion		0.000	15.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / <i>Aerospace Technology Dev /Demo</i>	Project (Number/Name) 634920 / <i>Flight Vehicle Tech Integration</i>
--	---	---

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Add: Program increase - Small unit autonomous UAS resupply	0.000	20.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	0.000	35.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603211F / <i>Aerospace Technology Dev /Demo</i>				Project (Number/Name) 634926 / <i>High Speed Systems Integ & Demo</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634926: <i>High Speed Systems Integ & Demo</i>	-	0.000	11.058	7.080	0.000	7.080	13.580	35.797	36.603	37.416	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops, integrates and demonstrates, via simulations, ground, and flight tests, advanced flight vehicle technologies that improve the performance and supportability of future high speed/hypersonic vehicles. System level integration brings together air vehicle technologies with avionics, propulsion, warheads and other aerospace subsystems for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational systems.

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

	FY 2021	FY 2022	FY 2023
Title: High Speed/Hypersonic Vehicle Technologies	0.000	11.058	7.080
Description: Develop, simulate, and demonstrate integrated vehicle technologies to enable and improve the performance of future high-speed and hypersonic systems.			
FY 2022 Plans: Continue Multi-Mission Cruiser technology maturation activities to expand performance capabilities of high speed systems.			
FY 2023 Plans: Continue Multi-Mission Cruiser technology maturation activities to expand performance capabilities of high speed systems. Initiate robust digital engineering framework, model-based systems engineering, and multi-level modeling, simulation & analysis (MS&A) for accelerated, focused technology development.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$3.978 million. Funding decreased due to decreased emphasis on high speed vehicle technologies.			
Accomplishments/Planned Programs Subtotals	0.000	11.058	7.080

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / <i>Aerospace Technology Dev /Demo</i>	Project (Number/Name) 634926 / <i>High Speed Systems Integ & Demo</i>

D. Acquisition Strategy
Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / Aerospace Technology Dev /Demo	Project (Number/Name) 634927 / Flight Systems Control
--	--	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634927: <i>Flight Systems Control</i>	-	0.000	5.352	17.048	0.000	17.048	26.569	24.466	29.268	35.228	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This program integrates and demonstrates advanced control technologies that improve the performance, reliability, safety, and survivability of existing and future, manned and unmanned, aerospace systems. Enhanced capabilities are enabled by control, automation, and system level integration of subsystems and systems such as propulsion, airframes, avionics, power & thermal management, weapons, communications, and operator interfaces. Modeling and simulation, integration, and technology demonstrations in a near-operational environment reduce the risk and time required to transition technologies into existing and future aerospace systems.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Autonomous Systems Control	0.000	5.352	6.626
Description: Develop, simulate, and demonstrate advanced automation and control-enabled capabilities for manned or unmanned aerospace platforms. Develop, simulate, and demonstrate autonomous flight controls for safe flight and cooperative operations between manned and remotely piloted air platforms.			
FY 2022 Plans: Continue development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Continue research to incorporate autonomous and safe airspace interoperability for manned and remotely piloted aircraft systems, airborne control of teams of unmanned aircraft, and unmanned sense and avoid technologies for ground and air operations to the autonomy spiral demonstrations. Complete development of technologies to reduce risk for transition of collision avoidance technologies to 4th and 5th-gen aircraft. Complete development of foundational autonomy for unmanned systems and spiral demonstrations of capability, including safe airspace interoperability			
FY 2023 Plans: Complete development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Continue research to incorporate autonomous and safe airspace interoperability for manned and remotely piloted aircraft systems, airborne control of teams of unmanned aircraft, and unmanned sense and avoid technologies for ground and air operations to the autonomy spiral demonstrations.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / <i>Aerospace Technology Dev /Demo</i>	Project (Number/Name) 634927 / <i>Flight Systems Control</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY2023 increased compared to FY2022 by \$1.274 million. Funding increased to enable autonomous collaboration capability, increased emphasis on autonomy development and demonstration for rapid transition.				
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through advanced control technologies to improve manned and unmanned aerospace systems, modeling and simulation, and integration. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: This effort is starting in FY23.</p> <p>FY 2023 Plans: Continue investments leveraging Artificial Intelligence and gaming technologies to accelerate Department of the Air Force capability to create theatre-scale operational plans within hours. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$10.422 million. Due to database/systems issues, \$8.507 million was erroneously moved from Program 0603216F, Aerospace Propulsion & Power Technology, Project 633035, Aerospace Power Technology under the High Power Aircraft Subsystem Technologies effort. The funding in this effort should have increased by \$1.915 million in FY2023 compared to FY2022. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy. A technical adjustment will be submitted to correct this error.</p>		0.000	0.000	10.422
Accomplishments/Planned Programs Subtotals		0.000	5.352	17.048
C. Other Program Funding Summary (\$ in Millions)				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / Aerospace Technology Dev /Demo	Project (Number/Name) 634927 / Flight Systems Control

C. Other Program Funding Summary (\$ in Millions)

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603216F / Aerospace Propulsion and Power Technology
---	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	159.354	110.273	64.254	0.000	64.254	85.665	104.409	107.943	110.344	Continuing	Continuing
633035: Aerospace Power Technology	-	43.536	38.216	12.049	0.000	12.049	12.753	14.132	15.618	15.966	Continuing	Continuing
634093: Missile Rocket Propulsion Integ & Demo	-	0.000	22.612	3.192	0.000	3.192	8.899	9.250	9.480	9.690	Continuing	Continuing
634921: Aircraft Propulsion Subsystems Int	-	0.000	11.610	31.576	0.000	31.576	40.800	44.589	45.590	46.605	Continuing	Continuing
634922: Space & Missile Rocket Propulsion	-	75.666	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
635098: Advanced Aerospace Propulsion	-	0.000	17.019	17.437	0.000	17.437	23.213	36.438	37.255	38.083	Continuing	Continuing
63681B: Advanced Turbine Engine Gas Generator	-	40.152	20.816	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced-cycle, rocket, and space propulsion as well as electrical power, thermal management, and fuels. The program has five current projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapon systems. The Aerospace Power Technology project develops and demonstrates adaptive power and thermal management components, controls, and systems for high-power payloads and aircraft as part of energy-optimized aircraft development. The Aircraft Propulsion Subsystems Integration project develops demonstrator engines by integrating the engine cores demonstrated in the Advanced Turbine Engine Gas Generator project with low-pressure components. The Advanced Aerospace Propulsion project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based). The Advanced Turbine Engine Gas Generator project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. The Missile Rocket Propulsion project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques.

All transfers detailed below are administrative realignments due to the stand up of the United States Space Force, and not new starts. This work will continue to be executed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Wright Patterson Air Force Base, OH, Edwards Air Force Base, CA, or Arnold Air Force Base, TN.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>
--	--

In FY 2022, the work and funding associated with advanced space technology demonstrations in Program 0603216F, Aerospace Propulsion, Project 634922, Space & Missile Rocket Propulsion, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, Program 1206616SF, Space Advanced Technology Development/Demo, Project 634922, Space & Missile Rocket Propulsion, due to the creation of a new Appropriation for Space Force.

In FY 2022, the work and funding associated with missile rocket propulsion technologies in Program 0603216F, Aerospace Propulsion, are transferred from Project 634922, Space & Missile Rocket Propulsion, to Project 634093, Missile Rocket Propulsion Integ & Demo due to the creation of a new Appropriation for Space Force.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 0602298F, and 1206601SF.

Projects in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	144.229	75.273	0.000	0.000	0.000
Current President's Budget	159.354	110.273	64.254	0.000	64.254
Total Adjustments	15.125	35.000	64.254	0.000	64.254
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	35.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	24.178	0.000			
• SBIR/STTR Transfer	-4.753	0.000			
• Other Adjustments	-4.300	0.000	64.254	0.000	64.254

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603216F I Aerospace Propulsion and Power Technology
---	---

Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: 633035: Aerospace Power Technology		
Congressional Add: Program increase - Silicon carbide research	9.670	10.000
Congressional Add: Program increase - low spool generator capabilities	4.835	-
Congressional Add: Program increase - advanced battery technology for directed energy	4.851	-
Congressional Add: Program increase - Domestic manufacturing of solid state power controllers	0.000	10.000
Congressional Add Subtotals for Project: 633035	19.356	20.000
Project: 634093: Missile Rocket Propulsion Integ & Demo		
Congressional Add: Program increase - Hypersonic liquid rocket propulsion	0.000	10.000
Congressional Add: Program increase - Altitude chamber infrastructure upgrades	0.000	5.000
Congressional Add Subtotals for Project: 634093	0.000	15.000
Project: 634922: Space & Missile Rocket Propulsion		
Congressional Add: Program increase - chemical apogee engines	0.000	-
Congressional Add: Program increase - upper stage engine maturation	0.000	-
Congressional Add: Program increase - space propulsion technologies	0.000	-
Congressional Add: Program increase - multi-mode propulsion	4.835	-
Congressional Add: Program increase - upper stage engine technology	19.341	-
Congressional Add Subtotals for Project: 634922	24.176	-
Project: 63681B: Advanced Turbine Engine Gas Generator		
Congressional Add: Program increase - small turbine engines for long range weapons	16.440	-
Congressional Add Subtotals for Project: 63681B	16.440	-
Congressional Add Totals for all Projects	59.972	35.000

Change Summary Explanation

Increase in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity	R-1 Program Element (Number/Name)
3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>

The FY2022 President's Budget submittal did not reflect FY2023 through FY2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 633035 / <i>Aerospace Power Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
633035: <i>Aerospace Power Technology</i>	-	43.536	38.216	12.049	0.000	12.049	12.753	14.132	15.618	15.966	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates system and subsystem integration to include adaptive architectures, actuation, electrical power, thermal management, and distribution for aerospace applications. This project develops and demonstrates the components, controls and systems required to satisfy the operational needs of current and future aircraft and enables the use of future high-power payloads. This technology enhances reliability and survivability, and reduces vulnerability, weight, and life cycle costs of air platforms. The electrical power system components developed are projected to provide a two-fold to five-fold improvement in aircraft reliability and maintainability, and a reduction in power system weight. This project is integrated into energy optimized aircraft efforts and power and thermal programs.

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

	FY 2021	FY 2022	FY 2023
Title: High Power Aircraft Subsystem Technologies	24.180	18.216	9.755
Description: Develop and demonstrate integrated architecture, controls and components for power generation, conditioning, and distribution; energy storage components; and thermal management and subsystem technologies for integration into high power aircraft.			
FY 2022 Plans: Continue development and demonstration of system and component electrical power, electro-mechanical, and thermal technologies for high-power aircraft. Continue the development of hybrid-cycle power and thermal management system. Continue development of advanced power generation and distribution system. Continue development and demonstration of integrated, adaptive megawatt- class tactical aircraft power and thermal capability. Continue development and demonstration of megawatt class architecture, controls and integration. Continue development and demonstration of robust electrical power systems for megawatt applications. Continue development and demonstration of thermal management systems for megawatt applications.			
FY 2023 Plans: Complete development and demonstration of system and component electrical power, electro-mechanical, and thermal technologies for high-power aircraft. Complete the development of hybrid-cycle power and thermal management system. Complete development of advanced power generation and distribution system. Continue development and demonstration of integrated, adaptive megawatt- class tactical aircraft power and thermal capability. Continue development and demonstration of megawatt class architecture, controls and integration. Complete development and demonstration of robust electrical power			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 633035 / <i>Aerospace Power Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>systems for megawatt applications. Complete development and demonstration of thermal management systems for megawatt applications.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$8.461 million. Due to database/systems issues, \$8.507 million was erroneously moved to Program 0603211F, Aerospace Technology Dev/ Demo, Project 634927, Flight Systems Control under the Transformational Technology Development effort. The funding in this effort should have increased by \$0.046 million in FY2023 compared to FY2022 due to increased emphasis on power and thermal management technologies related to autonomous systems. A technical adjustment will be submitted to correct this error.</p>			
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through engine core and low spool component technologies. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: This effort is starting in FY2023.</p> <p>FY 2023 Plans: Continue to develop and demonstrate a capability for high speed delivery of area effects. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$2.294 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>	0.000	0.000	2.294
Accomplishments/Planned Programs Subtotals	24.180	18.216	12.049

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 633035 / <i>Aerospace Power Technology</i>
--	--	--

	FY 2021	FY 2022
Congressional Add: Program increase - Silicon carbide research <i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts. <i>FY 2022 Plans:</i> Conduct Congressionally directed efforts.	9.670	10.000
Congressional Add: Program increase - low spool generator capabilities <i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts.	4.835	-
Congressional Add: Program increase - advanced battery technology for directed energy <i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts.	4.851	-
Congressional Add: Program increase - Domestic manufacturing of solid state power controllers <i>FY 2021 Accomplishments:</i> Not applicable. <i>FY 2022 Plans:</i> Conduct Congressionally directed efforts.	0.000	10.000
Congressional Adds Subtotals	19.356	20.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 634093 / <i>Missile Rocket Propulsion Integ & Demo</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634093: <i>Missile Rocket Propulsion Integ & Demo</i>	-	0.000	22.612	3.192	0.000	3.192	8.899	9.250	9.480	9.690	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops technologies for the sustainment of strategic systems (including solid rocket motor boosters and missile propulsion, post boost control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion technologies and high-energy propellants. Aging and surveillance thrusts for solid rocket motors could reduce lifetime prediction uncertainties for individual motors by fifty percent, enabling motor replacement for cause. The efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense (DoD). The efforts in this project are part of the Rocket Propulsion of the 21st Century (RP21) program. The efforts in this project are reviewed by a DoD level steering committee annually for relevance to DoD missions and achievement of technical goals defined by the RP21 program.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Ballistic Missile Technologies	0.000	7.612	2.032
Description: Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles.			
FY 2022 Plans: Continue development and test of solid rocket motors relevant to defense needs such as large air-launched boosters for high speed weapon application. Continue to design and develop modeling and simulation tools that more fully describe the physical processes that occur during manufacture and/or operation, and that reduce predictive uncertainty in design and analysis. Initiate development of advanced components and manufacturing processes for solid rocket motors including inert components, energetic components, and automated assembly operations.			
FY 2023 Plans: Continue development and test of solid rocket motors relevant to defense needs such as large air-launched boosters for high speed weapon application. Continue to design and develop modeling and simulation tools that more fully describe the physical processes that occur during manufacture and/or operation, and that reduce predictive uncertainty in design and analysis. Continue			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634093 / <i>Missile Rocket Propulsion Integ & Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
development of advanced manufacturing processes for solid rocket motors including inert components, energetic components, fabrication systems and automated assembly operations. FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decrease compared to FY2022 by \$5.580 million. Funding decreased due to decreased emphasis in strategic solid rocket propulsion technologies and higher AF priorities.				
Title: Transformational Technology Development Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through sustainment technologies for solid rocket motor boosters and post boost control. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made. FY 2022 Plans: This effort is starting in FY23. FY 2023 Plans: Continue to develop and demonstrate a capability for high speed delivery of area effects. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.160 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.		0.000	0.000	1.160
Accomplishments/Planned Programs Subtotals		0.000	7.612	3.192
		FY 2021	FY 2022	
Congressional Add: Program increase - Hypersonic liquid rocket propulsion		0.000	10.000	

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634093 / <i>Missile Rocket Propulsion Integ & Demo</i>
--	--	--

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Add: Program increase - Altitude chamber infrastructure upgrades	0.000	5.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	0.000	15.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 634921 / <i>Aircraft Propulsion Subsystems Int</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634921: <i>Aircraft Propulsion Subsystems Int</i>	-	0.000	11.610	31.576	0.000	31.576	40.800	44.589	45.590	46.605	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The Aircraft Propulsion Subsystems Integration (APSI) project includes demonstrator engines for manned systems and efficient small-scale propulsion for remotely piloted aircraft and cruise missile applications. The demonstrator engines integrate the core (high- pressure spool) technology developed under a joint multi-agency and aerospace industry project with the engine (low-pressure spool) technology such as fans, turbines, engine controls, mechanical systems, exhaust nozzles, and augmentors. Additionally, this project includes activities to improve propulsion safety and readiness. This project also focuses on integration of inlets, nozzles, engine-to-airframe compatibility, and power and thermal management subsystems technologies. The APSI project provides aircraft with potential for longer range and higher cruise speeds with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost, and improved survivability, resulting in increased mission effectiveness. Technologies developed are applicable to sustained high-speed vehicles and responsive space launch. The Aircraft Propulsion Subsystems Integration project is focused on improving propulsion capabilities while at the same time reducing the cost of ownership. Anticipated technology advances include turbine engine improvements providing approximately twice the range for a sustained supersonic combat aircraft, doubling the time on station with ten times the power output for surveillance aircraft and propulsion for a high speed supersonic missile with double the range for time sensitive targets. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, high power extraction, integrated thermal management, and durability for widely varying mission needs.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

In FY2023, Core Engine Technologies, High Pressure Ratio Core Engine Technologies, and Adaptive Turbine Engine Core Technology efforts transferred from Program 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, Advanced Turbine Engine Gas Generator in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.

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

	FY 2021	FY 2022	FY 2023
Title: Missile/Remotely Piloted Aircraft Engine Performance	0.000	6.878	12.560
Description: Design, fabricate, and test component technologies for limited-life engines to improve the performance, durability, and affordability of missile and remotely piloted aircraft engines.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634921 / <i>Aircraft Propulsion Subsystems Int</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> Continue next innovative architecture, critical technologies and component designs for efficient small engines. Continue operational benefits analysis for missile and unmanned aerial vehicle (UAV) systems. Initiate development of pervasive, hydrocarbon pressure gained propulsion fueled technologies.</p> <p><i>FY 2023 Plans:</i> Continue next innovative architecture, critical technologies and component designs for efficient small engines. Continue operational benefits analysis for missile and unmanned aerial vehicle (UAV) systems. Continue development of pervasive, hydrocarbon pressure gained propulsion fueled technologies. Initiate advanced development in rotating detonation engine technologies to advance powered munitions.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY2023 increase compared to FY2022 by \$5.682 million. Funding increased due to increased emphasis in advancing development in rotating detonation engine technologies to advance powered munitions.</p>			
<p><i>Title:</i> Adaptive Turbine Engine Technologies</p> <p><i>Description:</i> Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies.</p> <p><i>FY 2022 Plans:</i> Continue analyzing and evaluating conceptual design of adaptive engine technology and continue technology rig tests to decrease risk in core technology testing. Initiate maturation and integration of key technology through component and rig testing.</p> <p><i>FY 2023 Plans:</i> Complete analysis and evaluation conceptual design of adaptive engine technology and complete technology rig tests to decrease risk in core technology testing. Complete maturation and integration of key technology through component and rig testing. Emphasis moving to Missile/Remotely Piloted Aircraft Engine Performance effort.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> No increase/decrease in FY2023 compared to FY2022.</p>	0.000	4.732	4.732
<p><i>Title:</i> Core Engine Technologies</p> <p><i>Description:</i> Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan and for turbojet engines.</p> <p><i>FY 2022 Plans:</i></p>	0.000	0.000	9.067

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634921 / <i>Aircraft Propulsion Subsystems Int</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>In FY2022, this effort is performed in Program 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, Advanced Turbine Engine Gas Generator.</p> <p>FY 2023 Plans: Continue core tests for medium scale engines maturing key technologies. Continue risk reduction component tests for medium-scale engine advanced fan and core. Initiate advanced propulsion air frame integration experiments to enable embedded propulsion systems.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$9.067 million. Funding increase is due to transfer from Program 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, Advanced Turbine Engine Gas Generator and increased emphasis in design/validation in medium scale core engine technologies.</p>			
<p>Title: High Pressure Ratio Core Engine Technologies</p> <p>Description: Design, fabricate, and demonstrate high overall pressure ratio engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines.</p> <p>FY 2022 Plans: In FY2022, this effort is performed in Program 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, Advanced Turbine Engine Gas Generator.</p> <p>FY 2023 Plans: Continue assessing innovative architecture, critical technologies and component designs for efficient, small engines. Continue assembly of advanced concept additive manufacturing heat exchanger for small core engines. Continue fabrication of recuperator for demonstration of increased core efficiency in small core engines. Continue to work and mature medium scale core technologies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$1.478 million. Funding increase is due to transfer from Program 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, Advanced Turbine Engine Gas Generator and increased emphasis in design/validation in medium scale core engine technologies.</p>	0.000	0.000	1.478
<p>Title: Adaptive Turbine Engine Core Technologies</p> <p>Description: Design, fabricate, and demonstrate adaptive turbine engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines.</p> <p>FY 2022 Plans:</p>	0.000	0.000	0.149

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634921 / <i>Aircraft Propulsion Subsystems Int</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>In FY2022, this effort is performed in Program 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, Advanced Turbine Engine Gas Generator.</p> <p>FY 2023 Plans: Complete component tests of advanced variable turbine and innovative compression rear block designed to accept flow variations caused by variable turbine operation. Emphasis moving to in Core Engine Technologies effort.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 increased compared to FY2022 by \$0.149 million. Funding increase is due to transfer from Program 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, Advanced Turbine Engine Gas Generator and increased emphasis in design/validation in medium scale core engine technologies.</p>			
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through engine core and low spool component technologies. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: This effort is starting in FY2023.</p> <p>FY 2023 Plans: Continue to develop and demonstrate a capability for high speed delivery of area effects. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$3.590 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>	0.000	0.000	3.590
Accomplishments/Planned Programs Subtotals	0.000	11.610	31.576

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / Aerospace Propulsion and P ower Technology	Project (Number/Name) 634921 / Aircraft Propulsion Subsystems Int

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 634922 / <i>Space & Missile Rocket Propulsion</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634922: <i>Space & Missile Rocket Propulsion</i>	-	75.666	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbo-machinery and components, and low-cost space launch propulsion technologies. Additionally, this project develops technologies for the sustainment of strategic systems (including solid rocket motor boosters and missile propulsion, post boost control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion technologies, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances in this project could improve the performance of expendable payload capabilities by approximately twenty to fifty percent and reduce launch, operations, and support costs by approximately thirty percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Aging and surveillance thrusts for solid rocket motors could reduce lifetime prediction uncertainties for individual motors by fifty percent, enabling motor replacement for cause. The efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense (DoD) and National Aeronautics and Space Administration (NASA). The efforts in this project are part of the Rocket Propulsion 21st Century (RP21) program. The efforts in this project are reviewed by a DoD level steering committee annually for relevance to DoD missions and achievement of technical goals defined by the RP21 program.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

In FY2022, the work and funding associated with space demonstrations in Project 634922, Space & Missile Rocket Propulsion, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, PE 1206616SF, Project 634922, Space & Missile Rocket Propulsion, due to the creation of a new Appropriation for Space Force.

In FY2022, the work and funding associated with missile technology demonstrations in Project 634922, Space & Missile Rocket Propulsion, are transferred to Project 634093, Missile Rocket Propulsion Integ & Demo, due to the creation of a new Appropriation for Space Force.

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

	FY 2021	FY 2022	FY 2023
Title: Liquid Rocket Propulsion Technologies	26.574	0.000	0.000
Description: Develop liquid rocket propulsion technology for current and future space launch vehicles.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634922 / <i>Space & Missile Rocket Propulsion</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> In FY2022, the work and funding associated with space demonstrations in Project 634922, Space & Missile Rocket Propulsion, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, PE 1206616SF, Project 634922, Space & Missile Rocket Propulsion, due to the creation of a new Appropriation for Space Force.</p> <p><i>FY 2023 Plans:</i> Not applicable.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> There is no increase or decrease.</p>			
<p><i>Title:</i> On-Orbit Propulsion Technologies</p> <p><i>Description:</i> Develop solar electric, electric, and monopropellant propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite maneuvering.</p> <p><i>FY 2022 Plans:</i> In FY2022, the work and funding associated with space demonstrations in Project 634922, Space & Missile Rocket Propulsion, are transferred to Appropriation 3620F, Research, Development, Test & Evaluation, Space Force, PE 1206616SF, Project 634922, Space & Missile Rocket Propulsion, due to the creation of a new Appropriation for Space Force.</p> <p><i>FY 2023 Plans:</i> Not applicable.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> There is no increase or decrease.</p>	20.021	0.000	0.000
<p><i>Title:</i> Ballistic Missile Technologies</p> <p><i>Description:</i> Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles.</p> <p><i>FY 2022 Plans:</i> In FY2022, the work and funding associated with missile technology demonstrations in Project 634922, Space & Missile Rocket Propulsion, are transferred to Project 634093, Missile Rocket Propulsion Integ & Demo, due to the creation of a new Appropriation for Space Force.</p> <p><i>FY 2023 Plans:</i> Not applicable.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i></p>	4.895	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634922 / <i>Space & Missile Rocket Propulsion</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
There is no increase or decrease.			
Title: Strategic System Motor Surveillance	0.000	0.000	0.000
Description: Develop and demonstrate aging and surveillance technologies for strategic systems to reduce lifetime prediction uncertainty for individual motors, enabling motor replacement for cause.			
FY 2022 Plans: Not applicable.			
FY 2023 Plans: Not applicable.			
FY 2022 to FY 2023 Increase/Decrease Statement: There is no increase or decrease.			
Accomplishments/Planned Programs Subtotals	51.490	0.000	0.000

	FY 2021	FY 2022
Congressional Add: Program increase - chemical apogee engines	0.000	-
FY 2021 Accomplishments: Not applicable.		
Congressional Add: Program increase - upper stage engine maturation	0.000	-
FY 2021 Accomplishments: Not applicable.		
Congressional Add: Program increase - space propulsion technologies	0.000	-
FY 2021 Accomplishments: Not applicable.		
Congressional Add: Program increase - multi-mode propulsion	4.835	-
FY 2021 Accomplishments: Conduct Congressionally directed efforts.		
Congressional Add: Program increase - upper stage engine technology	19.341	-
FY 2021 Accomplishments: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	24.176	-

C. Other Program Funding Summary (\$ in Millions)
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / Aerospace Propulsion and Power Technology	Project (Number/Name) 634922 / Space & Missile Rocket Propulsion

C. Other Program Funding Summary (\$ in Millions)

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 635098 / <i>Advanced Aerospace Propulsion</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
635098: <i>Advanced Aerospace Propulsion</i>	-	0.000	17.019	17.437	0.000	17.437	23.213	36.438	37.255	38.083	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates, via ground and flight tests, the scramjet propulsion cycle to a technology readiness level appropriate for full integration with other engine cycles (including turbine and rocket-based) to provide the Air Force with transformational military capabilities. The primary focus is on the hydrocarbon-fueled, scramjet engine. Multi-cycle engines will provide the propulsion systems for possible application to support aircraft and weapon platforms. Efforts include: scramjet flow-path optimization to enable operation over the widest possible range of Mach numbers; active combustion control to assure continuous positive thrust (even during mode transition); robust flame-holding to maintain stability through flow distortions; and maximized volume-to-surface area to minimize the thermal load imposed by the high-speed engine. Thermal management plays a vital role in scramjet and combined cycle engines, including considerations for protecting low speed propulsion systems (e.g., turbine engines) during hypersonic flight.

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

	FY 2021	FY 2022	FY 2023
Title: Scramjet Technologies	0.000	17.019	17.437
Description: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation.			
FY 2022 Plans: Continue development of scramjet technologies to enhance operability including robust operation during maneuvers and extended operating time. Continue development and demonstration of tactically-relevant, long range, high speed strike scramjet engine designs, technologies, and components including ground and flight demonstrations needed for potential follow-on acquisition program. Continue propulsion technology maturation activities for Multi-Mission Cruiser concept to expand performance capabilities of high speed systems.			
FY 2023 Plans: Continue development and integration of larger scale scramjet component technologies to enhance operability including robust operation during maneuvers and extended operating time. Continue development and demonstration of tactically-relevant, high speed strike scramjet engine designs, technologies, and components including ground and flight demonstrations needed for potential follow-on acquisition program. Continue propulsion technology maturation activities for multi-mission cruiser concept to expand performance capabilities of high speed systems.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 635098 / <i>Advanced Aerospace Propulsion</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY2023 increased compared to FY2022 by \$0.418 million. Funding increase due to increased emphasis on high speed propulsion technology.			
Accomplishments/Planned Programs Subtotals	0.000	17.019	17.437

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 63681B / <i>Advanced Turbine Engine Gas Generator</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
63681B: <i>Advanced Turbine Engine Gas Generator</i>	-	40.152	20.816	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The objective is to provide continuous evolution of technologies into an advanced gas generator in which the performance, cost, durability, repairability, and maintainability can be assessed in a realistic engine environment. The gas generator, or core, is the basic building block of the engine and nominally consists of a compressor, a combustor, a high-pressure turbine, mechanical systems, and core subsystems. Experimental core engine demonstration validates engineering design tools and enhances rapid, low-risk transition of key engine technologies into engineering development, where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, ships, and responsive space launch. Component technologies are demonstrated in a core (sub-engine). This project also assesses the impact of low spool components such as; inlet systems, fans, low pressure turbines, exhaust systems, and system level technologies such as; integrated power generators and thermal management systems on core engine performance, and durability in ground demonstrations of engine cores. The core performances of this project are validated on demonstrator engines in the Aircraft Propulsion Subsystem Integration Project of this program. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

In FY2023, Core Engine Technologies, High Pressure Ratio Core Engine Technologies, and Adaptive Turbine Engine Core Technologies efforts will transfer to Program 0603216F, Aerospace Propulsion and Power Technology, Project 634921, Aircraft Propulsion Subsystems Integration in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.

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

	FY 2021	FY 2022	FY 2023
Title: Core Engine Technologies	9.980	8.761	0.000
Description: Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan and for turbojet engines.			
FY 2022 Plans: Continue core tests for medium scale engines maturing key technologies. Initiate risk reduction component tests for medium-scale engine advanced fan and core.			
FY 2023 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 63681B / <i>Advanced Turbine Engine Gas Generator</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>In FY2023, this effort will transfer to Program 0603216F, Aerospace Propulsion & Power Technology, Project 634921, Aircraft Propulsion Subsystems Integration in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$8.761 million. Funding decrease is due to transfer to Program 0603216F, Aerospace Propulsion & Power Technology, Project 634921, Aircraft Propulsion Subsystems Integration.</p>				
<p>Title: High Pressure Ratio Core Engine Technologies</p> <p>Description: Design, fabricate, and demonstrate high overall pressure ratio engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines.</p> <p>FY 2022 Plans: Continue assessing innovative architecture, critical technologies and component designs for efficient, small engines. Continue assembly of advanced concept additive manufacturing heat exchanger for small core engines. Continue fabrication of recuperator for demonstration of increased core efficiency in small core engines. Continue to work and mature medium scale core technologies.</p> <p>FY 2023 Plans: In FY2023, this effort will transfer to Program 0603216F, Aerospace Propulsion & Power Technology, Project 634921, Aircraft Propulsion Subsystems Integration in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY2023 decreased compared to FY2022 by \$3.295 million. Funding decrease is due to transfer to Program 0603216F, Aerospace Propulsion & Power Technology, Project 634921, Aircraft Propulsion Subsystems Integration.</p>		3.754	3.295	0.000
<p>Title: Adaptive Turbine Engine Core Technologies</p> <p>Description: Design, fabricate, and demonstrate adaptive turbine engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines.</p> <p>FY 2022 Plans: Continue component tests of advanced variable turbine and innovative compression rear block designed to accept flow variations caused by variable turbine operation.</p> <p>FY 2023 Plans:</p>		9.978	8.760	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 63681B / <i>Advanced Turbine Engine Gas Generator</i>
--	--	---

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
In FY2023, this effort will transfer to Program 0603216F, Aerospace Propulsion & Power Technology, Project 634921, Aircraft Propulsion Subsystems Integration in order to effectively and efficiently align resources to Aerospace Systems Core Technical Competencies.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY2023 decreased compared to FY2022 by \$8.760 million. Funding decrease is due to transfer to Program 0603216F, Aerospace Propulsion & Power Technology, Project 634921, Aircraft Propulsion Subsystems Integration.			
Accomplishments/Planned Programs Subtotals	23.712	20.816	0.000

	FY 2021	FY 2022
<i>Congressional Add:</i> Program increase - small turbine engines for long range weapons	16.440	-
<i>FY 2021 Accomplishments:</i> Conduct Congressionally directed efforts		
Congressional Adds Subtotals	16.440	-

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>
--	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	33.804	44.938	33.380	0.000	33.380	39.964	45.206	57.038	58.305	Continuing	Continuing
633720: <i>EW Quick Reaction Capabilities</i>	-	0.000	27.967	17.877	0.000	17.877	20.443	23.351	34.654	35.424	Continuing	Continuing
63431G: <i>RF Warning & Countermeasures Tech</i>	-	29.142	9.119	8.926	0.000	8.926	12.034	12.268	12.543	12.821	Continuing	Continuing
634335: <i>Cyber Concepts</i>	-	0.000	4.147	3.725	0.000	3.725	4.098	4.689	4.835	4.942	Continuing	Continuing
63691X: <i>EO/IR Warning & Countermeasures Tech</i>	-	4.662	3.705	2.852	0.000	2.852	3.389	4.898	5.006	5.118	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to support Air Force electronic combat warfighting capabilities. The program focuses on developing components, subsystems, and technologies with potential aerospace, special operations, and airlift electronic combat applications. It develops and demonstrates technologies for integrating electronic combat sensors and systems into a fused and seamless whole. It integrates and focuses research efforts in electronic warfare and cyber warfare to rapidly demonstrate a capability for rapid fielding. It develops and demonstrates technologies for navigation and timing in radio frequency (RF) contested and denied environments. It develops and demonstrates advanced technologies for radio frequency electronic combat suites and advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. It also develops and demonstrates technologies that will enable mission systems to be more resilient, agile, autonomous, and be able to operate in multiple domains. This program has been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>
--	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	35.841	46.591	0.000	0.000	0.000
Current President's Budget	33.804	44.938	33.380	0.000	33.380
Total Adjustments	-2.037	-1.653	33.380	0.000	33.380
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	-1.653			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.023	0.000			
• SBIR/STTR Transfer	-0.578	0.000			
• Other Adjustments	-1.436	0.000	33.380	0.000	33.380

Change Summary Explanation

Decrease in FY 2021 reflects adjustments and reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>			Project (Number/Name) 633720 / <i>EW Quick Reaction Capabilities</i>				
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
633720: <i>EW Quick Reaction Capabilities</i>	-	0.000	27.967	17.877	0.000	17.877	20.443	23.351	34.654	35.424	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project establishes a capability to rapidly assess, develop and demonstrate new electronic warfare concepts, techniques, and capabilities as well as the required position navigation and timing (PNT) technologies and capabilities in the context of systemic electronic warfare (EW) effects (electronic warfare threat interactions) in a congested/contested electromagnetic spectrum, system-of-systems (SoS) environment of the future. It develops disruptive electronic warfare and countermeasures concepts specifically selected for high-impact, game-changing effects; evaluates them in high fidelity virtual and hardware evaluation settings; and demonstrates them in an operationally relevant environment. It establishes and maintains an all-source, physics-based, threat-to-countermeasures electronic warfare systems engineering methodology. It develops a core analytic function, supported by simulation-based wargaming and interactive engineering modeling capabilities to evaluate advanced countermeasures concepts.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Radio Frequency Electronic Warfare	0.000	3.476	3.432
Description: Develop electronic warfare focused knowledge databases, engineering models, mission simulations, analysis tools and assessment environments which enable the development of multi-domain electronic warfare technologies. The primary focus is on emulating complex battlespace radio frequency environments, electronic attack effects against emerging, networked weapon systems, and assessing flexible, software-defined electronic warfare systems with non-deterministic performance (for example, utilizing cognitive algorithms).			
FY 2022 Plans: Mature fidelity of simulations of advanced electronic warfare systems to emulate the complex radio frequency threats and signals environment. Continue implementation of advanced digital signal synthesis to better represent complex emitters operating in complex environments containing sophisticated background emitters. Continue the development and demonstration efforts to prove the concepts for full spectrum countermeasures capabilities. Continue expansion of software-in-the-loop and hardware-in-the-loop environments to assess closed-loop system performance.			
FY 2023 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 633720 / <i>EW Quick Reaction Capabilities</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Continue the implementation of emerging electromagnetic attack and support capabilities into open architectures to support electromagnetic spectrum operations. Continue to conduct technology demonstrations to support transition into Air Force platforms and electromagnetic spectrum operations units. Use agile software defined process to demonstrate the capability to rapidly respond to new and unexpected complex emitters in realistic radio frequency environments. Continue expansion and maturation of modeling, simulation and laboratory assessment environments commensurate with technologies being researched, developed and tested including cognitive and autonomous electronic warfare technologies for multi-spectral treats in a complex electromagnetic environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.044 million. Justification for this decrease is described in plans above.</p>				
<p>Title: Resilient Positioning, Navigation and Timing</p> <p>Description: Develop and transition robust Global Navigation Satellite System capabilities; resilient complementary position, navigation and timing techniques; precise position, navigation and timing technologies for distributed sensing/effects; position, navigation and timing technology to provide position, navigation and timing electronic warfare situational awareness and training; and position, navigation and timing architectures to enable resiliency against the rapidly evolving threat. Efforts will include prototypes and relevant Open Architecture standards where applicable to enable timely technology transition.</p> <p>FY 2022 Plans: Develop and demonstrate multi-ship geolocation of sources interfering with navigational satellite signals. Develop and demonstrate a transcoder that converts modernized Global Positioning System military signals into military signals useable by legacy Department of Defense Global Positioning System receivers. Continue software defined radio technology efforts to authenticate signals from foreign satellite navigation systems. Continue to define and refine navigational open architecture standards to permit integration of alternative/complementary position, navigation and timing approaches into future DoD systems including the resilient embedded Global Positioning System-inertial government reference architecture.</p> <p>In FY 2022 this effort renamed from Position, Navigation and Timing for Contested/Denied Environments to Resilient Positioning, Navigation and Timing.</p> <p>FY 2023 Plans: Continue to prototype and transition technologies for geolocation of sources interfering with navigational satellite signals. Continue to develop and demonstrate a transcoder that converts modernized Global Positioning System military signals into military signals useable by legacy Department of Defense GPS receivers. Continue software defined radio technology efforts to authenticate signals from foreign satellite navigation systems. Further develop, demonstrate, and promulgate navigational open</p>		0.000	14.947	10.098

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 633720 / <i>EW Quick Reaction Capabilities</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>architecture standards to permit integration of alternative/complementary position, navigation and timing approaches into future Department of Defense systems, such as the resilient embedded Global Positioning System-inertial program of record.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$4.849 million. Funding decrease is a result of Department of the Air Force reprogramming.</p>				
<p>Title: Electro-Optical/Infrared Warfare Demonstrator</p> <p>Description: Develop next generation countermeasure techniques to address the complete range of multispectral (for example, dual band infrared) threats including advanced techniques versus advanced man portable air defense system and air-to-air threats with multimode capabilities. Develop capabilities for situational awareness and countermeasure to integrated air defense systems and associated multispectral threats.</p> <p>FY 2022 Plans: Develop a low cost, integrated missile and laser warning capability to identify, geo-locate, and counter, using both laser and expendable countermeasure response techniques, advanced laser and EO/IR guided missile threats to aircrews. Continue to apply analysis from field test to develop requirements for proactive detection and situation awareness for multiple Air Force platforms. Continue to iterate and refresh techniques for in-house at range data collection capabilities. Continue efforts to develop multispectrum electro-optical/radio frequency countermeasures and insert capabilities into existing and developing engagement modeling and simulation tools.</p> <p>In FY 2022 this effort renamed from Electro-Optical/Infrared Threat Warning and Countermeasures to Electro-Optical/Infrared Warfare Demonstrator.</p> <p>FY 2023 Plans: Continue assessment of developed low cost, integrated missile and laser warning capability to identify, geo-locate, and counter, using both laser and expendable countermeasure response techniques, advanced laser and electro-optical/infrared guided missile threats to aircrews. Continue to iterate and refresh techniques for in-house at range data collection capabilities. Apply analysis from field test to develop requirements for proactive detection and situation awareness for multiple Department of the Air Force platforms. Continue efforts to develop multi-spectral electro-optical/radio frequency countermeasures and insert capabilities into existing and developing engagement modeling and simulation tools.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.871 million. Justification for this increase is described in plans above.</p>		0.000	3.476	4.347
<p>Title: Transformational Technology Development</p>		0.000	6.068	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 633720 / <i>EW Quick Reaction Capabilities</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through new electronic warfare concepts, techniques and capabilities as well as new positioning, navigation and timing technologies and capabilities. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$6.068 million. Funding decrease is a result of Department of the Air Force reprogramming.</p>			
Accomplishments/Planned Programs Subtotals	0.000	27.967	17.877

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>				Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
63431G: <i>RF Warning & Countermeasures Tech</i>	-	29.142	9.119	8.926	0.000	8.926	12.034	12.268	12.543	12.821	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced technologies for radio frequency electronic combat suites, including the required navigation technologies and capabilities, to enhance the survivability of aerospace vehicles and to provide crew situational awareness. The research addresses technologies for missile/threat warning, radio frequency receivers, electronic combat pre-processors, advanced sorting/pre-processing algorithms, and expert software for applications on existing and future electronic combat systems. The research also focuses on the development and demonstration of subsystems and components for generating on-board/off-board radio frequency countermeasure techniques. This includes the development of electronic countermeasures techniques, as well as advanced electronic countermeasures technologies such as antennas, power amplifiers, and preamplifiers.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Radio Frequency Electronic Warfare Demonstrator	5.710	8.575	7.896
Description: Develop aerospace platform jamming concepts, technologies and techniques to counter advanced radio frequency threats associated with current and future aerospace weapon systems. Provide position, navigation and system resilience via open architecture solutions.			
FY 2022 Plans: Continue the implementation of emerging electronic attack and electronic support capabilities into open architectures. Continue to conduct technology demonstrations to support transition into Air Force platforms. Use agile software defined process to demonstrate the capability to rapidly respond to new and unexpected complex emitters in realistic radio frequency environments. Continue expansion and maturation of modeling, simulation and laboratory assessment environments commensurate with technologies being researched, developed and tested including cognitive and autonomous electronic warfare technologies.			
In FY 2022 this effort was renamed from Electronic Attack to Radio Frequency Electronic Warfare Demonstrator.			
FY 2023 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Continue the implementation of emerging electromagnetic attack and support capabilities into open architectures to support electromagnetic spectrum operations. Continue to conduct technology demonstrations to support transition into Air Force platforms and electromagnetic spectrum operations units. Use agile software defined process to demonstrate the capability to rapidly respond to new and unexpected complex emitters in realistic radio frequency environments. Continue expansion and maturation of modeling, simulation and laboratory assessment environments commensurate with technologies being researched, developed and tested including cognitive and autonomous electronic warfare technologies for multi-spectral treats in a complex electromagnetic environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.679 million. Justification for this decrease is described in plans above.</p>			
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through development and demonstration of advanced technologies for radio frequency electronic combat suites. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p>FY 2023 Plans: Continue to develop and enable multi-domain sense-making at the tactical edge. Continue to develop and demonstrate advanced technologies for radio frequency electronic combat capabilities. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	0.000	0.544	1.030

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$0.486 million. Justification for this increase is described in plans above.				
<p>Title: Radio Frequency Electronic Warfare</p> <p>Description: Develop electronic warfare focused knowledge databases, engineering models, mission simulations, analysis tools and assessment environments which enable the development of multi-domain electronic warfare technologies. The primary focus is on emulating complex battlespace radio frequency environments, electronic attack effects against emerging, networked weapon systems, and assessing flexible, software-defined electronic warfare systems with non-deterministic performance (for example, utilizing cognitive algorithms).</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 633720, EW Quick Reaction Capabilities, Radio Frequency Electronic Warfare effort and Transformational Technology Development effort.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>		4.800	0.000	0.000
<p>Title: Position, Navigation and Timing for Contested/Denied Environments</p> <p>Description: Develop and transition robust Global Navigation Satellite System capabilities; resilient complementary position, navigation and timing techniques; precise position, navigation and timing technologies for distributed sensing/effects; position, navigation and timing technology to provide position, navigation and timing electronic warfare situational awareness and training; and position, navigation and timing architectures to enable resiliency against the rapidly evolving threat. Efforts will include prototypes and relevant Open Architecture standards where applicable to enable timely technology transition.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 633720, EW Quick Reaction Capabilities, Resilient Positioning, Navigation and Timing effort.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>		8.899	0.000	0.000
<p>Title: Electro-Optical/Infrared Threat Warning and Countermeasures</p>		5.034	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Develop next generation countermeasure techniques to address the complete range of multispectral (for example, dual band infrared) threats including advanced techniques versus advanced man portable air defense system and air-to-air threats with multimode capabilities. Develop capabilities for situational awareness and countermeasure to integrated air defense systems and associated multispectral threats.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 633720, EW Quick Reaction Capabilities, Electro-Optical/Infrared Warfare Demonstrator effort and Transformational Technology Development effort.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>			
<p>Title: Avionics Cyber Vulnerabilities</p> <p>Description: Develop and demonstrate methods, techniques, and technical tools to enable, assist, and improve the vulnerability discovery processes. Use developed tools and techniques to assess avionics boxes, systems, busses, and components. Investigate techniques to mitigate discovered vulnerabilities. Develop and demonstrate mitigation and protection technologies on future concept platforms for adaptability and resilience.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 634335, Cyber Concepts, Resilient and Agile Mission Systems Architecture effort and Transformational Technology Development effort.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>	1.500	0.000	0.000
<p>Title: Avionics Cyber Protections</p> <p>Description: Develop and demonstrate advanced automated analysis tools and protection techniques to prevent exploitation of cyber susceptibilities in avionics systems. This strategy would include discovery and mitigation of likely attack vectors, remediation of susceptibilities, and safeguards to assure the integrity of embedded software.</p> <p>FY 2022 Plans:</p>	3.199	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Starting in FY 2022, this work is performed under Project 634335, Cyber Concepts, Resilient and Agile Mission Systems Architecture effort and Transformational Technology Development effort. <i>FY 2023 Plans:</i> Not applicable <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Not applicable			
Accomplishments/Planned Programs Subtotals	29.142	9.119	8.926

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 634335 / <i>Cyber Concepts</i>
--	---	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
634335: <i>Cyber Concepts</i>	-	0.000	4.147	3.725	0.000	3.725	4.098	4.689	4.835	4.942	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates methods to discover cyber susceptibilities, assess avionics systems, formulate mitigation strategies, and investigate use of tools and technologies to automate this process. It is designed to apply developed vulnerability discovery, vulnerability mitigation, and cyber protection technology to avionics systems and components and embedded systems. This involves technologies for trusted sensors and trusted systems that deter exploitation of our critical hardware and software. This project aims to develop cyber resilience and protect systems through adaptation of the system to the threat. It demonstrates these technologies in open and adaptable architectures for system integration in field demonstrations and proves out the technologies through rapid integration of sensors and architectures for technology transition. It integrates research efforts in electronic and cyber warfare to rapidly demonstrate a capability for rapid fielding.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Resilient and Agile Mission Systems Architecture	0.000	3.260	3.021
Description: This effort performs advanced development and demonstration of methods, technologies, and tools to enable resilience and protect mission systems against threats. This involves open and adaptable architectures for rapid integration and agile systems, cyber protections and resilience technologies to protect against threats. It integrates research efforts in electronic and cyber warfare to demonstrate novel operational capabilities through laboratory, field, and flight tests and experimentation. The goal is to reduce risk for rapid transition of novel operational capabilities into Department of the Air Force mission systems.			
FY 2022 Plans: Continue ongoing investigations to evolve and mature open architecture standards. Initiate development of advanced networking, processing, advanced computing paradigms, and cybersecurity technologies for next-generation avionics mission system capabilities. Apply agile software technologies and digital engineering techniques for rapid and affordable development, integration, and prototype capability demonstrations.			
FY 2023 Plans: Continue investigations to evolve and mature open architecture standards. Continue development of advanced networking, processing, advanced computing paradigms, and cybersecurity technologies for next-generation avionics mission system capabilities. Apply agile software technologies and digital engineering techniques for rapid and affordable development,			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 634335 / <i>Cyber Concepts</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
integration, and prototype capability demonstrations. Initiate development of Reference Architecture Implementation for resilient mission systems. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.239 million. Justification for this decrease is described in plans above.				
Title: Transformational Technology Development Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through vulnerability discovery, vulnerability mitigation, and cyber protection technology to avionics systems and components and embedded systems. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made. FY 2022 Plans: Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities. FY 2023 Plans: Continue to develop and enable multi-domain sense-making at the tactical edge. Continue to develop technologies to automate cyber vulnerabilities detection. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.183 million. Justification for this decrease is described in plans above.		0.000	0.887	0.704
Accomplishments/Planned Programs Subtotals		0.000	4.147	3.725
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 634335 / <i>Cyber Concepts</i>

D. Acquisition Strategy
Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>				Project (Number/Name) 63691X / <i>EO/IR Warning & Countermeasures Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
63691X: <i>EO/IR Warning & Countermeasures Tech</i>	-	4.662	3.705	2.852	0.000	2.852	3.389	4.898	5.006	5.118	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical/infrared and laser threats to aerospace platforms. Develops off-board (decoys and expendables) and on-board countermeasure technologies for aircraft self-protection to provide robust, affordable solutions for protection against infrared missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and electro-optical/infrared tracking systems used to direct electro-optical/infrared and radar-guided missiles.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Advanced Electro-Optical/Infrared Warning and Countermeasure Technologies	4.662	2.791	2.243
Description: Analyze the vulnerabilities of current infrared missile systems and future imaging infrared sensors. Develop advanced countermeasure system techniques to exploit vulnerabilities for use against infrared and electro-optical guided missile threats. Develop advanced optical and infrared sensor systems for airborne and space situational awareness and threat warning.			
FY 2022 Plans: Continue to mature the process for threat characterization and countermeasures development and field testing of new advanced threats to include laser jam codes and techniques. Mature the incorporation of air to air threat radio frequency data links into validated engagement models and examine the combination of the infrared models with equivalent radio frequency models into the overarching Advanced Framework for Simulation, Integration and Modeling software environment to address multispectrum threats. Continue effectiveness assessment of laser and missile warning technologies and techniques for a variety of Air Force platforms.			
FY 2023 Plans: Continue to mature the process for threat characterization and countermeasures development and field testing of new advanced threats to include laser jam codes and techniques. Continue effectiveness assessment of laser and missile warning technologies and techniques for a variety of Air Force platforms. Continue to provide electro-optical/infrared models to be combine with radio			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63691X / <i>EO/IR Warning & Countermeasures Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
frequency models to further enhance the overarching Advanced Framework for Simulation, Integration and Modeling software environment to address multi-spectral threats. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.548 million. Justification for this decrease is described in plans above.				
Title: Transformational Technology Development Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through development and demonstration of advanced warning and countermeasure technologies required to negate electro-optical/infrared and laser threats to aerospace platforms. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made. FY 2022 Plans: Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities. FY 2023 Plans: Continue to develop and enable multi-domain sense-making at the tactical edge. Continue to develop advanced warning and countermeasure technologies. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.305 million. Justification for this decrease is described in plans above.		0.000	0.914	0.609
Accomplishments/Planned Programs Subtotals		4.662	3.705	2.852
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63691X / <i>EO/IR Warning & Countermeasures Tech</i>

D. Acquisition Strategy
Not applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603273F / <i>Science & Technology for Nuclear Re-entry Systems</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	0.000	0.000	39.431	0.000	39.431	70.162	87.945	118.933	155.791	Continuing	Continuing
634094: <i>Next Gen Platform Dev/Demo</i>	-	0.000	0.000	39.431	0.000	39.431	70.162	87.945	118.933	155.791	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This program supports Department of Defense (DOD) priorities for enduring nuclear science and technology (S&T) for re-entry systems. This effort will provide advanced technology development that will effectively address evolving threats and maintain operational effectiveness while also aligning with the highest level guidance for nuclear forces. This effort will contribute to preserving the viability of the nuclear deterrent in a cost-effective manner by reducing technical and programmatic risk associated with execution of the overall nuclear modernization program. These ends will be reached by developing technologies to inform future system requirements, establishing interagency partnerships for re-entry system test platform development, and coordinating with existing programs for next generation strategic system development. This program enhances and enables technology developed under the Next Gen Platform Dev/Demo Effort currently being executed under program element 0603211F, Aerospace Technology Dev/Demo, Project 634094.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 0602298F, and 1206601SF.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	0.000	0.000	0.000	0.000
Current President's Budget	0.000	0.000	39.431	0.000	39.431
Total Adjustments	0.000	0.000	39.431	0.000	39.431
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	39.431	0.000	39.431

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>		R-1 Program Element (Number/Name) PE 0603273F / <i>Science & Technology for Nuclear Re-entry Systems</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Title: Re-entry System Technologies</p> <p>Description: Develop next generation hardware, software and material technologies for flight representative testing and environments for re-entry systems.</p> <p>FY 2022 Plans: Not applicable</p> <p>FY 2023 Plans: Initiate development of advanced aeroshell technologies to maintain a viable deterrent for the foreseeable future through enhanced resiliency and survivability. Initiate development of advanced fuzing solutions that are able to maintain operational effectiveness against emerging targeting challenges and develop alternative safety and surety features required for nuclear systems. Initiate development of strategic-grade, radiation-hardened guidance, navigation and control solutions for advanced systems. Initiate establishment of requisite testing infrastructure to enable nuclear re-entry S&T development activities and to evaluate component technologies in relevant environments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$39.431 million. Funding increased due to the stand-up of joint, enduring science and technology for nuclear re-entry systems across the DOD.</p>		-	0.000	39.431
Accomplishments/Planned Programs Subtotals		-	0.000	39.431
D. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
E. Acquisition Strategy				
Not applicable				

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force</i> / BA 3: <i>Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603401F / <i>Advanced Spacecraft Technology</i>
---	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	63.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
632181: <i>Spacecraft Payloads</i>	-	6.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
633834: <i>Integrated Space Technology Demonstrations</i>	-	56.588	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft vehicles, and space systems survivability. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Efforts in this program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary (\$ in Millions)	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	87.608	0.000	0.000	0.000	0.000
Current President's Budget	63.088	0.000	0.000	0.000	0.000
Total Adjustments	-24.520	0.000	0.000	0.000	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-19.341	0.000			
• SBIR/STTR Transfer	-2.888	0.000			
• Other Adjustments	-2.291	0.000	0.000	0.000	0.000

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 632181: *Spacecraft Payloads*

Congressional Add: *Congressional Add: Program increase - ground-based interferometry*

Congressional Add Subtotals for Project: 632181

Project: 633834: *Integrated Space Technology Demonstrations*

	<u>FY 2021</u>	<u>FY 2022</u>
	6.500	-
	6.500	-

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603401F / <i>Advanced Spacecraft Technology</i>
--	---

Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: <i>Congressional Add: Program increase - modular satellite power systems</i>	3.868	-
Congressional Add Subtotals for Project: 633834	3.868	-
Congressional Add Totals for all Projects	10.368	-

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / <i>Advanced Spacecraft Technology</i>	Project (Number/Name) 632181 / <i>Spacecraft Payloads</i>
--	---	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
632181: <i>Spacecraft Payloads</i>	-	6.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, satellite control hardware, and software for advanced satellite surveillance operations. Future improved space-qualifiable electronics and software for data and signal processing will be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (for example, radiation-hardening) commercial data and signal processor technologies for use in Air Force space systems. For mid-term applications, this project merges advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century Department of Defense satellites. In the long-term, this project area focuses on developing low-cost, easily modifiable software and hardware architectures for fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

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

	FY 2021	FY 2022
Congressional Add: Congressional Add: Program increase - ground-based interferometry	6.500	-
FY 2021 Accomplishments: Conduct Congressionally directed effort. This effort will be executed in PE 0603401F, Advanced Spacecraft Technology, Project 633834, Integrated Space Technology Demonstrations.		
Congressional Adds Subtotals	6.500	-

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603401F / <i>Advanced Spacecraft Technology</i>				Project (Number/Name) 633834 / <i>Integrated Space Technology Demonstrations</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
633834: <i>Integrated Space Technology Demonstrations</i>	-	56.588	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project is a series of advanced technology demonstrations designed to address mission needs by applying emerging technologies from the Air Force Research Laboratory, other United States government laboratories, and industry. These technologies are integrated into system-level demonstrations that are used to test, evaluate, and validate the technologies in a relevant environment.

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

	FY 2021	FY 2022	FY 2023
Title: Integrated Satellite Demonstrations	52.720	0.000	0.000
Description: Develop satellite technologies for integrated, robust, and flexible satellite demonstrations building on previous work and leveraging investments by other organizations.			
FY 2022 Plans: In FY 2022, PE 0603401F, Advanced Spacecraft Technology, Project 633834, Integrated Space Technology Demonstrations efforts were transferred to Appropriation 3620, Research, Development, Test & Evaluation, Space Force, PE 1206616SF, Space Advanced Technology Development/Demo, Project 633834, Integrated Space Technology Demonstrations, from Appropriation 3600, Budget Activity (BA) 03 due to the creation of a new Appropriation for Space Force.			
FY 2023 Plans: Not applicable			
FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable			
Accomplishments/Planned Programs Subtotals	52.720	0.000	0.000
	FY 2021	FY 2022	
Congressional Add: Congressional Add: Program increase - modular satellite power systems	3.868	-	
FY 2021 Accomplishments: Conduct Congressionally directed effort.			
Congressional Adds Subtotals	3.868	-	

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / <i>Advanced Spacecraft Technology</i>	Project (Number/Name) 633834 / <i>Integrated Space Technology Demonstrations</i>

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603444F / <i>Maui Space Surveillance System (MSSS)</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	11.486	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	Continuing	Continuing
634868: <i>Maui Space Surveillance System</i>	-	11.486	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note
not applicable

A. Mission Description and Budget Item Justification

This program funded ground-based optical space situational awareness (SSA) technology development and demonstration at the Maui Space Surveillance System (MSSS) in Hawaii, as well as the operation and upgrade of the facility. Efforts in this program were coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary (\$ in Millions)	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	12.068	0.000	0.000	0.000	0.000
Current President's Budget	11.486	0.000	0.000	0.000	0.000
Total Adjustments	-0.582	0.000	0.000	0.000	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.484	0.000			
• Other Adjustments	-0.098	0.000	0.000	0.000	0.000

Change Summary Explanation

Not applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603444F / <i>Maui Space Surveillance System (MSSS)</i>
--	--

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Title: Operate and Upgrade Maui Space Surveillance System</p> <p>Description: Operate and upgrade the Maui Space Surveillance System to support development, demonstration, and integration of ground-based optical space situational awareness technologies.</p> <p>FY 2022 Plans: In FY 2022, work formerly performed under this effort was transferred to Appropriation 3620, Research, Development, Test & Evaluation, Space Force, PE 1206616SF, USSF S&T 6.3, Project 634868, Maui Space Surveillance System, from Appropriation 3620, Budget Activity (BA) 03 due to the creation of a new Appropriation for Space Force.</p> <p>FY 2023 Plans: Not applicable</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Not applicable</p>	11.486	0.000	0.000
Accomplishments/Planned Programs Subtotals	11.486	0.000	0.000

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

Not Applicable

E. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	29.412	23.459	20.652	0.000	20.652	26.461	33.537	28.876	29.629	Continuing	Continuing
635323: <i>Directed Energy Bioeffects Parameters</i>	-	0.000	5.607	5.724	0.000	5.724	9.813	10.632	10.841	11.168	Continuing	Continuing
635324: <i>Human Dynamics and Terrain Demonstration</i>	-	10.284	5.651	3.630	0.000	3.630	4.633	9.010	4.297	4.417	Continuing	Continuing
635325: <i>Mission Effective Performance</i>	-	19.128	6.722	5.435	0.000	5.435	7.366	9.256	9.160	9.364	Continuing	Continuing
635327: <i>Warfighter Interfaces</i>	-	0.000	5.479	5.863	0.000	5.863	4.649	4.639	4.578	4.680	Continuing	Continuing

Note

This program, BA 3, PE 0603456F, project 635324, Human Performance Augmentation and Development, is a new start.

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to enhance Airman performance and effectiveness in the aerospace force. State-of-the-science advances are made in warfighter training, warfighter system interfaces, directed energy bioeffects, deployment and sustainment of warfighters in extreme environments, and understanding and shaping adversarial behavior. The Directed Energy Bioeffects Parameters project develops, demonstrates, and transitions technologies to predict, evaluate, and mitigate the effects of directed energy on personnel and mission performance, and exploits the offensive capabilities of directed energy systems. The Human Dynamics and Terrain Demonstration develops, demonstrates, and transitions technologies to sustain airman performance in adverse operational and/or training environments, monitor and mitigate in-flight unexplained physiological events, and prevent human performance related mishaps through real-time monitoring and mitigation—particularly through highly automated or autonomous systems. The Mission Effective Performance project develops, demonstrates, and transitions advanced training, simulation, mission rehearsal, and other performance-aiding methods and technologies to enhance warfighter readiness. The Warfighter Interfaces project develops, demonstrates, and transitions technologies to revolutionize the way airmen synergistically use Air Force systems, including autonomous machines and adaptive teams of airmen and machines. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>
--	--

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	31.667	24.589	0.000	0.000	0.000
Current President's Budget	29.412	23.459	20.652	0.000	20.652
Total Adjustments	-2.255	-1.130	20.652	0.000	20.652
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	-1.130			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.986	0.000			
• Other Adjustments	-1.269	0.000	20.652	0.000	20.652

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>				Project (Number/Name) 635323 / <i>Directed Energy Bioeffects Parameters</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
635323: <i>Directed Energy Bioeffects Parameters</i>	-	0.000	5.607	5.724	0.000	5.724	9.813	10.632	10.841	11.168	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions technologies to predict, evaluate, and mitigate the effects of directed energy on personnel and mission performance, and exploits the offensive capabilities of directed energy systems. This project develops the human components of the guidelines for testing, deployment, and protection from high-power microwave and high-energy laser systems and uses this information to enhance the effectiveness of these weapon systems in air, space, and cyber operations. This project develops tools and plug-ins that enhance mission and engagement models, provide predictive risk analysis for deployment of Directed Energy systems, and analyzes systems for use in the Department of Defense. This project develops tools and analysis techniques to model and demonstrate the use of fielded protection on Airman performance, and informs developers of design specifications to optimize design of novel weapon systems.

This project includes the initiation and development of programs addressing Department of the Air Force capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to Department of Air Force design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Transformational Technology Development	0.000	0.958	1.462
Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through the development of new tools and plug-ins that enhance mission and engagement models, and provide predictive risk analysis for deployment of directed energy systems. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.			
FY 2022 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635323 / <i>Directed Energy Bioeffects Parameters</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Fund the follow-on efforts for Transformational Technology Development projects selected in prior FYs. Select Transformational Technology Development efforts starting in FY 2022 that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2023 Plans: Continue investments leveraging Artificial Intelligence and gaming technologies to accelerate Department of the Air Force capability to create theatre-scale operational plans within hours. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.504 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>			
<p>Title: Directed Energy Bioeffects</p> <p>Description: This project combined two efforts into a single effort to better align the directed energy modeling simulation and analysis supporting both radio-frequency and laser bioeffects advanced demonstration. Develop and demonstrate modeling capabilities to assess collateral hazards from high power directed energy laser and radio frequency systems, including the use of probabilistic risk assessment techniques and analysis of system level effects on the Airman. Develop and demonstrate optical protective technologies for aircrew and ground personnel to provide protection against directed energy threats.</p> <p>FY 2022 Plans: Provide hazard analysis for directed energy systems under development for Department of Defense. Continue maturation of high peak power assessment models and tools to address real world concerns. Provide human response analysis to use of nuclear flash-blindness protection technologies and the impact on mission performance. Continue integration of radio frequency hazard, optical (laser) radiation hazard, and vision analysis and tools into Advanced Framework for Simulation, Integration and Modeling (AFSIM) architecture and the Endgame Framework architecture for future transitions in Joint weaponing and targeteering tool suites and to support formal studies and analyses. Continue development of Integrated Vision Modeling libraries to inform display design and advanced protection technologies.</p> <p>FY 2023 Plans: FY 2023 Plans: Continue to provide hazard analysis for directed energy systems under development for the Department of Defense. Continue maturation of high peak power radio frequency and laser assessment models and tools to address real world concerns. Analyze operational & mission performance impacts of ocular personnel protection equipment. Continue integration of radio frequency and optical radiation hazards and vision analysis into engagement-level modeling, simulation, and analysis tools</p>	0.000	4.649	4.262

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635323 / <i>Directed Energy Bioeffects Parameters</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
for future transitions in mission-level tool suites to support formal studies and analyses. Continue development of integrated vision modeling libraries to inform display design and advanced protection technologies.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$0.387 million. Funding decrease due to reduced emphasis on Directed Energy Bioeffects efforts.			
Accomplishments/Planned Programs Subtotals	0.000	5.607	5.724

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>				Project (Number/Name) 635324 / <i>Human Dynamics and Terrain Demonstration</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
635324: <i>Human Dynamics and Terrain Demonstration</i>	-	10.284	5.651	3.630	0.000	3.630	4.633	9.010	4.297	4.417	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This program, BA 3, PE 0603456F, project 635324, Human Performance Augmentation and Development, is a new start.

A. Mission Description and Budget Item Justification

Project objective is to develop, demonstrate, and transition products that provide Airman-integrated capabilities to sustain, enhance, and augment airmen physical and cognitive performance under challenging and adverse operational and training mission environments. Integrate technical advances in molecular and synthetic biology, multi-omics, cognitive performance optimization, brain-machine interface, and application of non-invasive physiological and cognitive performance monitoring devices. Develop solutions to sense, assess, and mitigate impacts to airmen performance degradation including, but not limited to, unexplained physiological events (UPE), fatigue, injury, stressors (environmental, occupational, personal), and cognitive overload. Develop technologies to enhance and accelerate individual physical and cognitive ability to rapidly learn and acquire new mission skills and maintain proficiency of acquired skills. Develop technologies providing commanders real time status monitoring and assessment of individual's mission ready status and intervention protocols to accelerate restoral to combat readiness.

This project includes the initiation and development of programs addressing Department of Air Force capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to Department of Air Force design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Transformational Technology Development	0.000	1.232	1.317
Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through unexplained physiological events (UPE), fatigue, injury, stressors (environmental, occupational, personal), and cognitive overload. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635324 / <i>Human Dynamics and Terrain Demonstration</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> Fund the follow-on efforts for Transformational Technology Development projects selected in prior FYs. Select Transformational Technology Development efforts starting in FY 2022 that support the National Defense Strategy and Department of the Air Force priorities.</p> <p><i>FY 2023 Plans:</i> Continue investments leveraging Artificial Intelligence and gaming technologies to accelerate Department of the Air Force capability to create theatre-scale operational plans within hours. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$0.085 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>			
<p><i>Title:</i> Sensing and Assessment</p> <p><i>Description:</i> Develop advanced prototype systems integrating biological, physiological, neural, environmental, and behavioral sensing capabilities with validated analytics and assessments to sustain and enhance Airman performance. Resulting products fall within three operational mission environments: (1) maintenance, (2) special operations/dismount forces, and aircrew (cockpit). Emphasis is on maturing and transitioning wearable and platform integrated technologies that provide operator mission-specific performance sustainment and enhancement.</p> <p><i>FY 2022 Plans:</i> Continue to develop, validate, and demonstrate the Integrated Cockpit Sensing technology. Start demonstration effort of a fatigue management system that incorporates self-contained sensing capabilities with validated models of cognitive performance under fatigue to guide targeted intervention. Begin integration of component sensors, models, and intervention protocols/methods into an advanced prototype fatigue management system. Develop models for use in wargaming simulations to assess impact of fatigue on operation effectiveness efficacy of fatigue management technologies. Demonstrates mobile decision-support technologies and software solutions improving situation awareness and enhancing communication effectiveness for dismounted operators. Demonstrate technologies enabling remote monitoring of airman physical and cognitive state. Demonstrate wearable interfaces lessening cognitive demands and increasing sensor interoperability.</p> <p><i>FY 2023 Plans:</i> Complete development of the Integrated Cockpit Sensing prototype, conduct operational flight demonstration of the Integrated Cockpit Sensing prototype, and transition Integrated Cockpit Sensing prototype and corresponding data package to transition</p>	10.284	4.419	1.291

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635324 / <i>Human Dynamics and Terrain Demonstration</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>partner. Complete prototype development of the baseline Hypothermia Prevention System and conduct operational demonstration of the Hypothermia Prevention System prototype. Foster and maintain a rapid prototype capability to support activities relating to early learning prototyping, product development, and quick turn customer needs.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$3.128 million. Funding decrease due to a reduced emphasis in sensing and assessment efforts, such as capabilities with validated analytics and assessments to sustain and enhance Airman performance.</p>				
<p>Title: Human Performance Augmentation and Development</p> <p>Description: Develop and demonstrate advanced prototype products that provide Air and Space-integrated capabilities to enhance and enable Airman and warfighter performance under fatigue and other cognitive and physiological stressors beyond current human norms.</p> <p>FY 2022 Plans: Not applicable</p> <p>FY 2023 Plans: Initiate advanced product development effort to develop a fatigue management system prototype incorporating integrated sensing capabilities with validated models of cognitive performance under fatigue to guide targeted intervention. Begin planning for start of advanced product effort to develop a biochemical sensor platform utilizing interstitial fluid sensing technologies to analyze operator biomarkers indicative of operational and mission stressors.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$1.022 million. Funding increase due to a added emphasis in a new thrust area for human fatigue, cognitive, and physiological stressors efforts.</p>		0.000	0.000	1.022
Accomplishments/Planned Programs Subtotals		10.284	5.651	3.630
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
Not applicable				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>				Project (Number/Name) 635325 / <i>Mission Effective Performance</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
635325: <i>Mission Effective Performance</i>	-	19.128	6.722	5.435	0.000	5.435	7.366	9.256	9.160	9.364	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and transitions advanced training, simulation, mission rehearsal, and other performance-aiding methods and technologies to enhance warfighter readiness. This project also develops advanced methods and technologies to enable interactive Live-Virtual-Constructive virtual environments for performance-aiding methods and technologies. Focus areas include integrated high-fidelity weapon systems training technologies for air, space, and cyber; tailored immersive simulation environments for airmen at the tactical and operational levels; and incorporation of performance assessment and feedback tools. These methods and technologies facilitate the development of mission-essential competencies.

This project includes the initiation and development of programs addressing Department of Air Force capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to Department of Air Force design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Transformational Technology Development	0.000	1.643	1.412
Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through advanced training, simulation, mission rehearsal, and other performance-aiding methods and technologies to enhance warfighter readiness. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.			
FY 2022 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635325 / <i>Mission Effective Performance</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Fund the follow-on efforts for Transformational Technology Development projects selected in prior FYs. Select Transformational Technology Development efforts starting in FY 2022 that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2023 Plans: Continue to develop and enable multi-domain sense-making at the tactical edge. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$0.231 million. Funding decreased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>			
<p>Title: Readiness</p> <p>Description: Develop and demonstrate secure, persistent, and standardized live, virtual, and constructive training enterprise. Utilize modeling capabilities for technology demonstration efforts focused on developing software-based tools for training that would replace human instructors.</p> <p>FY 2022 Plans: Continue transition of readiness and proficiency tracking tools into tactical operations. Continue development and evaluation of technologies to permit routine tracking of mission performance and readiness across virtual and live training environments. Complete data specifications for encrypted data retrieval from operational aircraft and instrumented ranges and conduct field demonstrations of seamless, integrated readiness tracking. Begin alignment of augmented and virtual reality training with readiness and proficiency tracking tools. Begin field testing of software agent models inside Government and Commercial training and rehearsal systems and on instrumented ranges.</p> <p>FY 2023 Plans: Complete proficiency tracking and reporting in Program of Record Mission Training Centers for the F-16, F-15E and Airborne Warning and Control System (AWACS) Block 40/45. Using encrypted data specifications begin migration and integration of those data into an operational readiness data lake with user-specified data extraction and reporting formats. Continue integration of readiness measurement tools in all current training and readiness environments, to include augmented and virtual reality, part-task and full fidelity simulators, and operational range infrastructure. Continue fielding and conduct evaluations of higher fidelity software agent models integrated with live and virtual systems and their impact on the quality of training and exercise for a peer fight. Begin work to integrate technologies to support multi-capable airmen with just-in-time-training and readiness support in deployed and austere mission contexts and locations. Begin work to connect developed data lake and proficiency infrastructure</p>	19.128	5.079	4.023

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635325 / <i>Mission Effective Performance</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
with operational event-based tracking and reporting systems. Begin systematic evaluations of proficiency-based live, virtual, and constructive (LVC) on operational readiness and more optimal mixes of live and virtual training and exercise.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 decreased compared to FY 2022 by \$1.056 million. Funding decrease due to reduced emphasis in efforts such as live and virtual training and exercise, and integration of readiness measurement tools in all current training and readiness environments.			
Accomplishments/Planned Programs Subtotals	19.128	6.722	5.435

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>				Project (Number/Name) 635327 / <i>Warfighter Interfaces</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
635327: <i>Warfighter Interfaces</i>	-	0.000	5.479	5.863	0.000	5.863	4.649	4.639	4.578	4.680	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops, demonstrates, and readies the transition of technologies to revolutionize the way airmen optimize the capabilities of Air Force systems, including autonomous machines and adaptive teams of Airmen and machines. Improvements in the presentation of operational information to the community of users, from the system operator to the commander, must be developed in step with advancements in the acquisition, storage, and retrieval of information. This project provides the advances in understanding of human cognitive abilities, as well as the utilization of human interfaces, multisensory fusion, high-resolution image displays, and three-dimensional audio to customize communications and enhance shared understanding across a diverse user community in air, space, and cyber for maximum situational awareness.

This project includes the initiation and development of programs addressing Department of Air Force capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to Department of Air Force design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Transformational Technology Development	0.000	0.685	1.021
<p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through autonomous machines and adaptive teams of Airmen and machines. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Fund the follow-on efforts for Transformational Technology Development projects selected in prior FYs. Select Transformational Technology Development efforts starting in FY 2022 that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2023 Plans:</p>			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635327 / <i>Warfighter Interfaces</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Continue investments leveraging Artificial Intelligence and gaming technologies to accelerate Department of the Air Force capability to create theatre-scale operational plans within hours. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.336 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>				
<p>Title: Airman Machine Interfaces</p> <p>Description: Description: Develops advanced, situationally-adaptive and scalable interface technology and decision aiding tools for more rapid and accurate battlefield awareness, decision making and maximized collaborative, distributed human-machine team performance. This is accomplished through integrated solutions that manage Airman and Guardian cognitive workload in complex, distributed, and degraded environments.</p> <p>FY 2022 Plans: Prepare for transition of advanced command and control technologies for operators in multiple domains operating in both the air and ground. Develop and demonstrate manned-unmanned teaming interfaces with intents and concepts embedded within the strategic, operational and tactical environments. Continue development of collaborative interfaces for cognitive workload reduction. Establish online repositories for open and interoperable software development. Prototype operational human-machine interfaces via dismounted/mounted hardware. Develop and transition interface technologies to satisfy user requirements by controlling the tactical airspace inhabited by small unmanned aerial systems.</p> <p>FY 2023 Plans: Continue to transition advanced command and control (C2) technologies for operators in multiple domains, as well as enabling Air Battle Management System capabilities for distributed C2. Continue to build library of user interfaces for manned-unmanned teaming in order to meet demands of strategic, operational and tactical environments. Continue development of collaborative interfaces, leveraging intelligent agents, for cognitive workload reduction. Transition open and interoperable software to Air Battle Management System-supported platforms. Transition interface technologies for base defense and protection of the tactical airspace from small unmanned aerial systems. Develop wearable communication management platform prototype for mission recording and intelligibility enhancement. Automate mission planning and debrief for assets with unique capabilities and enhance with intelligent agent aided decision making.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		0.000	1.678	1.694

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635327 / <i>Warfighter Interfaces</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$0.016 million. Funding increase due to added emphasis in airman-machine interface efforts.				
<p>Title: Analytic Tools</p> <p>Description: Develop, demonstrate, and transition software and hardware tools that help Conventional Department of Defense, Special Operations, and Intelligence customers to rapidly identify, analyze, shape, and operationalize all types of information without succumbing to "analysis paralysis." In addition to delivering stand-alone tools, supports other Air Force Research Laboratory Technical Directorates. Build human-centric solutions to: triage data-at-scale, automate mundane processes, optimize workflow, identify obscured patterns, mitigate cognitive overload, expedite logical decision-making, quantify performance metrics, accelerate human interpretation of information, and autonomously cue humans in real and simulated environments. These tools mitigate the scale and complexity imposed by Great Power Competition in Joint All Domain Operations environments.</p> <p>FY 2022 Plans: Perform integration and transition of speech-to-text technologies with military intelligence systems. Enhance electronic, air, and air defense order of battle visualization, analysis, and dissemination to multiple theaters of operation. Enhance threat detection, decision making, and intelligence, surveillance and reconnaissance planning and collection decision aides. Prepare for Department of the Air Force certification and transition of technology solutions to strategic partners. Conduct research to speed up access to the relevance of auto-detections of vital data. Timeliness of detection will continue to improve warfighter decision making. Research and document detections via several methods of automation and deliver concepts of operation (CONOPS) and tactics, techniques and procedures (TTPs) for tactical use of national exploitation systems, with characterizations of denied weapons systems. Perform evaluations of automation methods for new systems, not typically used for algorithm detections.</p> <p>FY 2023 Plans: Build upon existing, in-house Live-Virtual-Constructive simulation architecture to address training deficiencies across the United States Air Force. Automate the following: post-training grading in single simulator environment, real-time feedback in single simulator environment, proactive cueing in single simulator environment, real-time feedback and proactive cueing in multi-simulator, team environment. Expand upon existing, in-house Live-Virtual-Constructive simulation architecture to include the Space, Cyber, and/or Maritime domains to support the emerging focus on the Great Power Competition, and Joint All Domain Operations environment. Productize a suite of customized software developed to operationalize existing, in-house Live-Virtual-Constructive architecture. Evolve new and/or existing Artificial Intelligence/Machine Learning analytic tools from "canned" frameworks to explainable architectures and interfaces that leverage the psychology of human trust.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		0.000	3.116	3.148

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / <i>Human Effectiveness Advanced Technology Development</i>	Project (Number/Name) 635327 / <i>Warfighter Interfaces</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$0.032 million. Funding increase due to reduced emphasis in Artificial Intelligence/ Machine Learning analytic tools, and live-virtual-constructive efforts.			
Accomplishments/Planned Programs Subtotals	0.000	5.479	5.863

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	124.025	155.306	187.374	0.000	187.374	226.278	245.965	250.584	256.136	Continuing	Continuing
63670A: <i>Weapon Technology Development</i>	-	0.000	55.278	56.569	0.000	56.569	63.909	83.630	80.657	82.497	Continuing	Continuing
63670B: <i>Weapon Concept Development</i>	-	124.025	100.028	130.805	0.000	130.805	162.369	162.335	169.927	173.639	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates advanced ordnance and guidance technologies for conventional weapons. The effort focuses on conventional ordnance component technologies such as warheads, fuzes, and explosives, as well as munition guidance component technologies such as navigation and control systems and seekers. Technologies to be developed, demonstrated, and integrated into system concepts will address blast, fragmentation, penetration, low collateral damage, variable depth/location fuzing, precise guidance, and high-performance and insensitive explosives. Efforts in this project have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of such program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602605F, 0602788F, 0602298F, and 0602020F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>
--	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	133.900	157.423	0.000	0.000	0.000
Current President's Budget	124.025	155.306	187.374	0.000	187.374
Total Adjustments	-9.875	-2.117	187.374	0.000	187.374
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	-2.117			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-4.509	0.000			
• Other Adjustments	-5.366	0.000	187.374	0.000	187.374

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

FY 2021 and 2022: Congressional directed realignment due to reversal of program element restructure. The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY 2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>				Project (Number/Name) 63670A / <i>Weapon Technology Development</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
63670A: <i>Weapon Technology Development</i>	-	0.000	55.278	56.569	0.000	56.569	63.909	83.630	80.657	82.497	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops, matures, assesses, and demonstrates advanced/innovative ordnance and guidance component and subsystem technologies for conventional weapons. The project focuses on maturation of advanced explosives, fuzes, warheads, sub-munitions, and weapon airframes, carriage and dispensing; as well as innovative munition seekers, weapon aerodynamics, navigation and control, and guidance subsystem integration/simulation.

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

	FY 2021	FY 2022	FY 2023
Title: Ordnance Technologies	0.000	27.082	27.728
Description: Develop and demonstrate integrated ordnance technologies to improve conventional munitions. Specific technical areas of focus include energetic materials, fuze technology, warhead sciences, and modeling and simulation tools.			
FY 2022 Plans: Continue to demonstrate distributed, embedded fuzing concepts for close-controlled strike, area attack, and penetration applications such as layer counting at high-speed, including assessing long-term safety, survivability, and functionality. Continue development of ordnance technologies to allow tailored lethality by controlling weapon fragmentation. Continue to mature ordnance technologies for rapid transition into high-speed strike weapon concepts, collecting complex arena test data for implementation into lethality modeling and simulation tools. Continue to develop test capabilities and high-fidelity analysis tools to generate more accurate, faster-running weaponeering data. Continue to develop ordnance technologies/methodologies for high-speed impact and functional defeat. Continue research into armament systems for Special Operations applications. Continue to conduct lethality analyses for weapons and improve lethality and survivability tools at the meso-scale and micro-scale. Continue to mature research on distributed, collaborative and cooperative effects munition technologies. Continue the development of high-fidelity test capabilities and analysis tools to evaluate ordnance technologies in relevant environments. Continue incorporation of previously developed material models and improve/advance additional joint kinetic/directed energy common target models. Continue synthesis and incorporation of warhead models for progressive collapse, multiple point initiation, secondary debris and other models.			
FY 2023 Plans: Continue to demonstrate advanced distributed, embedded fuzing concepts, including assessing long-term safety, survivability, and functionality. Continue advanced development of ordnance technologies to allow tailored lethality by controlling weapon fragmentation. Continue to mature advanced ordnance technologies for rapid transition into high-speed strike weapon concepts,			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>	Project (Number/Name) 63670A / <i>Weapon Technology Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>collecting complex arena test data for implementation into lethality modeling and simulation tools. Continue to develop test capabilities and high-fidelity analysis tools to quickly generate more accurate weaponing data. Continue to develop advanced ordnance technologies for high-speed impact. Continue to develop advanced ordnance technologies/methodologies for functional defeat. Continue research into armament systems for Special Operations applications. Continue to conduct lethality analyses for weapons and lethality/survivability tools at the meso/micro-scale. Complete research on distributed, collaborative and cooperative effects munition technologies. Continue the development of high-fidelity test capabilities and analysis tools to evaluate ordnance technologies in relevant environments. Continue incorporation of previously developed material models and improve/advance additional joint kinetic/directed energy common target models. Continue synthesis and incorporation of warhead models for progressive collapse, multiple point initiation, secondary debris and other models.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$0.646 million. Justification for increase is described in the plans above.</p>			
<p>Title: Guidance Technologies</p> <p>Description: Develop guidance technologies to improve the precision, controlled lethality, and flexibility of conventional munitions. Specific technical areas include precision navigation and terminal seekers.</p> <p>FY 2022 Plans: Continue integration of hardware-in-the-loop, software-in-the-loop, and other modeling and simulation technologies for the demonstration of open architecture, high-speed, networked, collaborative and autonomous, and modular munition concepts. Continue the design and development of seeker sub-system prototypes for platform self-defense. Continue development of advanced, high-resolution infrared scene projectors, distributed simulation concepts, software-defined radio frequency test chamber, scene generation, mission, engagement, campaign level simulations, and panoramic infrared dome technologies. Continue to develop technologies for precision navigation of weapons in Global Positioning System-denied scenarios. Continue to mature and integrate advanced carriage and release concepts and sub-systems. Continue providing multi-security level, cross-domain distributed modeling and simulation support for munition research using distributed connectivity between Eglin Air Force Base facilities and other geographic locations. Continue integrating lethality models into guidance and control simulations to enhance weapon integrated performance. Continue development of sensor test technologies to enable verification of autonomous munition concepts. Continue integrating higher fidelity constructive analysis tools with engagement and mission level modeling and simulation. Initiate miniature munition technology integration for ground launch demonstration.</p> <p>FY 2023 Plans: Continue integration of hardware-in-the-loop, software-in-the-loop, and other modeling and simulation technologies for the demonstration of open architecture, high-speed, networked, collaborative and autonomous, and modular munition concepts. Continue the design, development, and evaluation of seeker sub-system prototypes for platform self-defense. Continue</p>	0.000	28.196	28.841

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>	Project (Number/Name) 63670A / <i>Weapon Technology Development</i>

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

	FY 2021	FY 2022	FY 2023
development of advanced, high-resolution infrared scene projectors, distributed simulation concepts, software-defined radio frequency test chamber, scene generation, mission, engagement, campaign level simulations, and panoramic infrared dome technologies. Continue to develop technologies for precision navigation of weapons in Global Positioning System-denied scenarios. Continue to mature and integrate advanced carriage and release concepts and sub-systems. Continue improving multi-security level, cross-domain distributed modeling and simulation for munition research using distributed connectivity between Eglin Air Force Base facilities and other geographic locations. Continue integrating higher-fidelity lethality models into guidance and control simulations to enhance weapon integrated performance. Complete development of sensor test technologies to enable verification of autonomous munition concepts. Continue integrating higher fidelity constructive analysis tools with engagement and mission level modeling and simulation. Continue miniature munition technology integration for ground launch demonstration. Initiate design and development of a weapons digital ecosystem that enables digital engineering and the use of high-fidelity digital twinning across the weapons lifecycle.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$0.645 million. Justification for increase is described in the plans above.			
Accomplishments/Planned Programs Subtotals	0.000	55.278	56.569

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>				Project (Number/Name) 63670B / <i>Weapon Concept Development</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
63670B: <i>Weapon Concept Development</i>	-	124.025	100.028	130.805	0.000	130.805	162.369	162.335	169.927	173.639	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops, refines, integrates, demonstrates, and assesses ordnance and guidance technologies to reduce risk for potential conventional weapons acquisitions. The project concentrates in two effort areas, Air-to-Air Concept Development and Air-to-Ground Concept Development. The project focuses on risk reduction of advanced explosives, fuzes, warheads, sub-munitions, and weapon airframes, carriage and dispensing; as well as innovative munition seekers, weapon aerodynamics, navigation and control, and guidance subsystem integration/simulation.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Air-to-Air Concept Development	60.030	43.790	42.284
Description: Mature, integrate, and demonstrate air-to-air weapon components and systems to include ordnance, guidance, and carriage and release technologies to demonstrate war-fighter capability.			
FY 2022 Plans: Continue developing the technology trade space to enable air-to-air weapons with robust capability in the future threat environment, including technologies for efficient propulsion, high lethality, efficient flight, high agility, miniaturization, as well as cost and risk reduction for both offensive and defensive purposes. Continue to develop and test prototype propulsion systems with flexibility to enable more adaptable next generation air-to-air weapons. Continue to conduct lethality studies to enable design of small form factor warheads lethal against the 2030 plus target set. Transition advanced target models to other AF and DoD offices. Continue to develop preliminary design of air-to-air weapon concepts for sixth generation platforms. Continue to document missile flight dynamics trade space. Continue to conduct wind-tunnel experiments to characterize airframes and validate aerodynamic codes leading to development of highly maneuverable and efficient missiles to counter advanced targets, and improve persistence and survivability of future platforms. Continue to conduct ground and arena tests of advanced weapons experimental carriages for sixth generation weapon concept and prepare for flight worthiness testing. Continue to mature simulation architectures to assess the trade and synergies between kinetic and directed energy weapons. Continue to perform experiments with small warheads to obtain data for lethality analysis to validate and improve designs. Continue to plan			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>	Project (Number/Name) 63670B / <i>Weapon Concept Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>and execute integrated sub-system experiments. Initiate miniature munition ground launch demonstration. Initiate modeling, simulation, analysis, and digital engineering in support of air-to-air advanced weapon technologies.</p> <p>FY 2023 Plans: Continue developing the technology trade space to enable air-to-air weapons with robust capability in the future threat environment, including technologies for efficient propulsion, high lethality, efficient flight, high agility, miniaturization, as well as cost and risk reduction for both offensive and defensive purposes. Continue to develop and test prototype propulsion systems with flexibility to enable more adaptable next generation air-to-air weapons. Continue to conduct lethality analysis to enable design of small form factor warheads lethal against the 2030 plus target set. Continue to transition advanced target models to other AF and DoD offices. Continue to develop preliminary design of air-to-air weapon concepts for sixth generation platforms. Continue to document missile flight dynamics trade space. Continue to conduct wind-tunnel experiments to characterize airframes and validate aerodynamic codes leading to development of highly maneuverable and efficient missiles to counter advanced targets, and improve persistence and survivability of future platforms. Continue to conduct ground and arena tests of advanced weapons experimental carriages for sixth generation weapon concept and prepare for flight worthiness testing. Complete simulation architectures to assess the trade and synergies between kinetic and directed energy weapons. Continue to perform experiments with small warheads to obtain data for lethality analysis to validate and improve designs. Continue to plan and execute integrated sub-system experiments. Continue miniature munition ground launch demonstration. Continue modeling, simulation, analysis, and digital engineering in support of air-to-air advanced weapon technologies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$1.506 million. Funding decreased due to higher Air Force priorities for investigating transformational technologies.</p>			
<p>Title: Air-to-Ground Concept Development</p> <p>Description: Mature, integrate, and demonstrate air-to-ground weapon components and systems (ordnance, guidance, and carriage and release technologies) to demonstrate war-fighter capability.</p> <p>FY 2022 Plans: Continue expanded integration of collaborative weapon technology onto additional weapon systems. Complete exploring the algorithms and software defined radios for networked, collaborative, and autonomous weapon effects. Continue planning efforts for technology risk reduction including demonstration and flight testing for weapons concepts responsive to the future threat environment (including hypersonic and cooperative/collaborative concepts). Continue to mature simulation architectures to assess the trades and synergies between kinetic and directed energy weapons. Continue to develop kinetic/non-kinetic payloads,</p>	63.995	47.768	45.765

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>	Project (Number/Name) 63670B / <i>Weapon Concept Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>seeker, and fuze technology for hypersonic applications. Initiate modeling, simulation, analysis, and digital engineering in support of air-to-ground advanced weapon technologies.</p> <p>FY 2023 Plans: Complete integration of collaborative weapon technology onto additional weapon systems. Continue planning efforts for technology risk reduction including demonstration and flight testing for weapons concepts responsive to the future threat environment (including hypersonic and high-speed concepts). Complete simulation architectures to assess the trades and synergies between kinetic and directed energy weapons. Continue to develop kinetic/non-kinetic payloads, seeker, and fuze technology for hypersonic applications. Continue modeling, simulation, analysis, and digital engineering in support of air-to-ground advanced weapon technologies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.003 million. Funding decreased due to higher Air Force priorities for investigating transformational technologies.</p>			
<p>Title: Transformational Component</p> <p>Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through ordnance and guidance technologies. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Initiate transformational efforts to address weapons capability gaps.</p> <p>FY 2023 Plans: Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p>	0.000	8.470	42.756

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603601F / <i>Conventional Weapons Technology</i>	Project (Number/Name) 63670B / <i>Weapon Concept Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Continue to develop and demonstrate a capability for high speed delivery of area effects. Continue to develop and enable multi-domain sense-making at the tactical edge			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> FY 2023 increased compared to FY 2022 by \$34.286 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.			
Accomplishments/Planned Programs Subtotals	124.025	100.028	130.805

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603605F / <i>Advanced Weapons Technology</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	29.094	31.855	98.503	0.000	98.503	114.373	65.545	45.668	46.578	Continuing	Continuing
633151: <i>High Power Solid State Laser Technology</i>	-	29.094	23.171	40.815	0.000	40.815	45.813	45.056	24.695	25.139	Continuing	Continuing
633152: <i>High Power Microwave Development and Integration</i>	-	0.000	8.684	57.688	0.000	57.688	68.560	20.489	20.973	21.439	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program provides for the development, integration, demonstration, and detailed assessment of directed energy (DE) weapon technologies for potential application on Air Force platforms. These include high energy laser (HEL), high power microwaves (HPM), and other unconventional weapon generation and transmission technologies, which can support a wide range of Air Force applications. The program develops a corresponding susceptibility, vulnerability, and lethality database for directed energy weapons. Efforts in this program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

As directed in the FY 2018 NDAA, Sec 825, amendment to PL 114-92 FY 2016 NDAA, Sec 828 Penalty for Cost Overruns, the FY 2019 Air Force penalty total is 50.0M. The calculated percentage reduction to each research, development, test and evaluation and pro

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603605F / <i>Advanced Weapons Technology</i>
--	--

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	31.388	28.258	0.000	0.000	0.000
Current President's Budget	29.094	31.855	98.503	0.000	98.503
Total Adjustments	-2.294	3.597	98.503	0.000	98.503
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	-1.403			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	5.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.003	0.000			
• SBIR/STTR Transfer	-1.034	0.000			
• Other Adjustments	-1.257	0.000	98.503	0.000	98.503

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603605F / <i>Advanced Weapons Technology</i>				Project (Number/Name) 633151 / <i>High Power Solid State Laser Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
633151: <i>High Power Solid State Laser Technology</i>	-	29.094	23.171	40.815	0.000	40.815	45.813	45.056	24.695	25.139	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project provides for the development, integration, demonstration, and detailed technical assessment of high energy laser devices, advanced imaging and beam control technologies needed for applications such as force protection, force application, precision engagement, and aircraft self-protection. Laser system concept assessments to include vulnerability assessments and target effect testing are performed.

This project includes the initiation and development of programs addressing Department of the Air Force capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: High Energy Laser/Beam Control	29.094	22.418	40.815
Description: Develop and demonstrate advanced beam control technologies, integrated laser systems, and aircraft self-protection laser technologies. Demonstrate beam control components integrated with high energy lasers for the Department of the Air Force utility.			
FY 2022 Plans: Continue SHiELD (Self-Protect High Energy Laser Demonstrator) system development and integration for technical demonstration. Continue planning for flight testing.			
FY 2023 Plans: In keeping with 2-star summit decision in 2019 to address integrated base defense priority, continue to develop the SHiELD demonstration to address counter-cruise missile defense. Complete system integration of the SHiELD laser pod. Conduct SHiELD ground test.			
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased by 18.397M compared to FY 2022 due to the Air Force's increased emphasis on Directed Energy Technology.			
Title: Transformational Technology Development	0.000	0.753	0.000
Description: Continually funded effort. This funding allocation will start new and continue Transformational Technology Developments. The Transformational Technology Development program will select new projects, in alignment with mission			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603605F / <i>Advanced Weapons Technology</i>	Project (Number/Name) 633151 / <i>High Power Solid State Laser Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to development and demonstration of new high energy laser devices, advanced imaging and beam control technologies, as well as assessments to enable new laser system concept development. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Select Transformational Technology Development efforts as new starts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p>FY 2023 Plans: Fund the follow-on efforts for projects started in FY 2022. Select Transformational Technology Development efforts as new starts in FY 2023 that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Budget decreased from \$0.753M in FY 2022 to zero (\$0.00) in FY 2023 because no funding was reallocated from Thrust 1 in FY 2023 for the Transformational Component.</p>				
Accomplishments/Planned Programs Subtotals		29.094	23.171	40.815
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
Not Applicable				
D. Acquisition Strategy				
Not Applicable				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603605F / <i>Advanced Weapons Technology</i>				Project (Number/Name) 633152 / <i>High Power Microwave Development and Integration</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
633152: <i>High Power Microwave Development and Integration</i>	-	0.000	8.684	57.688	0.000	57.688	68.560	20.489	20.973	21.439	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates high power microwave and other unconventional electromagnetic field generation and transmission technologies that can be integrated into future weapon systems to support a wide range of the Department of the Air Force missions such as air base defense or the damage/destruction of an adversary's electronic infrastructure. It also provides inputs to the susceptibility, vulnerability, and lethality databases used across the Department of Defense to understand thresholds for scalable effects of directed energy weapons.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: High Power Microwave Technologies	0.000	3.826	52.474
Description: Develop and evaluate high power microwave and other unconventional weapon technologies for various platforms, including aerial, for applications such as counter-electronics. Develop and evaluate high power microwave technologies for non-kinetic and counter-electronic weapon applications.			
FY 2022 Plans: Initiate high power microwave payload integration into an advanced, reusable, aerial platform. Continue to characterize, model, test and evaluate current and projected blue Directed Energy weapons against relevant red assets. Conduct the joint static technology demonstration of a compact High Power Microwave weapon with the Navy. Design next generation High Power Microwave sources.			
FY 2023 Plans: Continue high power microwave payload integration into an advanced, reusable, aerial platform. Continue to characterize, model, test and evaluate current and projected blue Directed Energy weapons against relevant red assets. Develop next generation High Power Microwave sources.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603605F / <i>Advanced Weapons Technology</i>	Project (Number/Name) 633152 / <i>High Power Microwave Development and Integration</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 increased by \$48.648M compared to FY 2022 due to the Air Force's increased emphasis on Directed Energy Technology.				
Title: Transformational Technology Development		0.000	4.858	5.214
Description: Continually funded effort. This funding allocation will start new and continue Transformational Technology Developments. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to development and demonstration of new high power microwave sources, transmission technologies, and applications, to include non-kinetic and counter-electronic. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.				
FY 2022 Plans: Fund the follow-on efforts for projects started in FY 2021. Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of the Air Force priorities				
FY 2023 Plans: Fund the follow-on efforts for projects started in FY 2022. Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of the Air Force priorities.				
FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased by \$0.456M compared to FY 2022 due to increased emphasis on Transformational Component efforts.				
Accomplishments/Planned Programs Subtotals		0.000	8.684	57.688
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
Not Applicable				
D. Acquisition Strategy				
Not Applicable				

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603680F / <i>Manufacturing Technology Program</i>
--	---

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	143.334	176.200	47.759	0.000	47.759	43.332	43.907	44.503	44.975	Continuing	Continuing
635280: <i>Manufacturing Technologies</i>	-	143.334	176.200	47.759	0.000	47.759	43.332	43.907	44.503	44.975	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This program executes technical efforts to develop and maintain an affordable and reliable industrial base and manufacturing capability responsive to Department of the Air Force warfighter needs. The program develops and improves manufacturing technologies and processes to reduce transition risk, enable cost reduction, improve component and system quality, increase readiness and affordable mission availability, enhance industrial capability and promote transformation through the industrial base. Value stream modifications and manufacturing throughput improvements are implemented to shorten weapon system cycle times during design, development, production and sustainment. Cost savings are realized through early engagement with stakeholders to promote producible designs, ensuring the industrial base will be ready to manufacture at the needed quantities. Manufacturing technologies objectives are conducted through industrial partnerships that enable targeted investment of manufacturing technologies and reduce risk in the industrial supply chain for existing weapon system upgrades and new warfighter systems. Efforts in the program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603680F / <i>Manufacturing Technology Program</i>
--	---

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	138.748	45.259	0.000	0.000	0.000
Current President's Budget	143.334	176.200	47.759	0.000	47.759
Total Adjustments	4.586	130.941	47.759	0.000	47.759
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	-1.810			
• Congressional Adds	0.000	132.751			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	9.663	0.000			
• SBIR/STTR Transfer	-3.461	0.000			
• Other Adjustments	-1.616	0.000	47.759	0.000	47.759

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 635280: *Manufacturing Technologies*

- Congressional Add: *Program increase - F-35 Battery Technology*
- Congressional Add: *Program Increase - Modeling Technology for Small Turbine Engines*
- Congressional Add: *Program increase - Low cost manufacturing methods for hypersonic vehicle components*
- Congressional Add: *Program increase - Technologies to repair fastener holes*
- Congressional Add: *Program increase - Manufacturing technology for reverse engineering*
- Congressional Add: *Program increase - Hybrid manufacturing for rapid tooling and repair*
- Congressional Add: *Program increase - cost reduction for aerospace composite structures*
- Congressional Add: *Program increase - flexible thermal protection systems for hypersonics*
- Congressional Add: *Program increase - alternative domestic rubber production*
- Congressional Add: *Program increase - large scale additive manufacturing for hypersonics*
- Congressional Add: *Program increase - manufacturing readiness for hypersonic propulsion systems*
- Congressional Add: *Program increase - thermoplastic material systems*
- Congressional Add: *Program increase - automated fiber placement for composite structures*
- Congressional Add: *Program increase - hypersonic manufacturing capability and supply*
- Congressional Add: *Program increase - massive area additive manufacturing*

	FY 2021	FY 2022
	9.361	0.000
	6.825	0.000
	7.800	0.000
	4.875	5.000
	4.875	5.000
	4.875	10.000
	9.751	0.000
	9.751	10.000
	4.875	0.000
	5.850	0.000
	9.751	0.000
	6.825	4.751
	4.875	5.000
	5.850	0.000
	9.663	10.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603680F I Manufacturing Technology Program
---	--

Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: Program increase - academic-industry partnerships for advanced materials and manufacturing processes	0.000	6.000
Congressional Add: Program increase - adaptive modeling for low-cost titanium	0.000	5.000
Congressional Add: Program increase - beryllium additive manufacturing	0.000	3.000
Congressional Add: Program increase - component 30 online demonstration	0.000	10.000
Congressional Add: Program increase - MRO advanced process technology development	0.000	10.000
Congressional Add: Program increase - sustainment and modernization research and development	0.000	10.000
Congressional Add: Program increase - virtual augmented mixed reality readiness	0.000	8.000
Congressional Add: Program increase - affordable manufacture of resistive films	0.000	10.000
Congressional Add: Program increase - rapid large format metal additive manufacturing to optimize scramjet production	0.000	5.000
Congressional Add: Program increase - universal robotic controller	0.000	6.000
Congressional Add: Program increase - hypersonics supply chain research	0.000	10.000
Congressional Add Subtotals for Project: 635280	105.802	132.751
Congressional Add Totals for all Projects	105.802	132.751

Change Summary Explanation

Increase in FY 2021 reflects adjustments and reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY2023 cannot be made in a relevant manner.

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Title: Affordable Mission Availability	10.241	13.578	14.328
Description: Develop and transition pervasive manufacturing technologies for affordable mission availability of Department of the Air Force components and systems.			
FY 2022 Plans: Continue to advance high demand specialized manufacturing technologies to develop cost effective conventional production, overhaul, and specialty material repair technologies to enable affordable sustainment of aircraft systems. Continue to develop			

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>		R-1 Program Element (Number/Name) PE 0603680F / <i>Manufacturing Technology Program</i>		
C. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>cost-effective manufacturing and repair processes to meet specific needs of Programs of Record and depots. Continue to develop manufacturing methods to meet the needs of the next generation hypersonic platforms. Continue to develop and demonstrate the manufacturability of materials, processes and devices for command and control communication technologies, intelligence, surveillance and reconnaissance systems, and RF, digital and power management components. Initiate manufacturing repair technologies for turbine engine components.</p> <p>FY 2023 Plans: Continue to advance high demand specialized manufacturing technologies to develop cost effective conventional production, overhaul, and specialty material repair technologies to enable affordable sustainment of aircraft systems. Continue to develop cost-effective manufacturing and repair processes to meet specific needs of Programs of Record and depots. Continue to develop manufacturing methods to meet the needs of the next generation hypersonic platforms. Continue to develop and demonstrate the manufacturability of materials, processes and devices for command and control communication technologies, intelligence, surveillance and reconnaissance systems, and RF, digital and power management components. Continue manufacturing repair technologies for turbine engine components. Initiate manufacturing technologies for high temperature sensors and windows.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 funding increased compared to FY 2022 by \$0.750 million. Funding increased due to increased emphasis on manufacturing technologies and repair processes to meet specific needs of Programs of Record and depots.</p>				
<p>Title: Advanced Manufacturing Technologies</p> <p>Description: Develop and transition affordable advanced manufacturing for Department of the Air Force fielded and future platforms.</p> <p>FY 2022 Plans: Continue to enable and promote advanced manufacturing processes, techniques, and equipment availability for reducing materiel acquisition, maintenance and repair costs. Continue to develop and demonstrate intelligent robotics and digital engineering concepts into manufacturing processes. Continue to develop, demonstrate and evaluate additively manufactured aerospace components and subcomponents. Continue to develop and demonstrate technologies enabling factory of the future, digital supply chain management, industrial internet of things to provide improvements in production, delivery and support of warfighter capabilities.</p> <p>FY 2023 Plans: Continue to enable and promote advanced manufacturing processes, techniques, and equipment availability for reducing materiel acquisition, maintenance and repair costs. Continue to develop and demonstrate intelligent robotics and digital engineering concepts into manufacturing processes. Continue to develop, demonstrate and evaluate additively manufactured aerospace components and subcomponents. Continue to develop and demonstrate technologies enabling factory of the future, digital</p>		27.291	22.630	23.880

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603680F <i>I Manufacturing Technology Program</i>
--	---

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
supply chain management, industrial internet of things to provide improvements in production, delivery and support of warfighter capabilities. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 funding increased compared to FY 2022 by \$1.250 million. Funding increased due to increased emphasis on advanced manufacturing processes and techniques for reducing total cost of systems			
Title: Manufacturing for Transformational Technologies Description: Develop and transition manufacturing technologies that enable advanced technology solutions that will shape the future force across the air, space and cyberspace domains. FY 2022 Plans: Refine development of high demand manufacturing technologies including low cost and attritable systems, thermal protection materials for high temperature applications and other manufacturing technologies geared toward realizing the future force and to provide a cost-imposing strategy against adversarial forces. FY 2023 Plans: Continue development of high demand manufacturing technologies including low cost and attritable systems, thermal protection materials for high temperature applications and other manufacturing technologies geared toward realizing the future force and to provide a cost-imposing strategy against adversarial forces. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 funding increased compared to FY 2022 by \$2.310 million. Funding increased due to scaling investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.	0.000	7.241	9.551
Accomplishments/Planned Programs Subtotals	37.532	43.449	47.759

	FY 2021	FY 2022
Congressional Add: Program increase - F-35 Battery Technology	9.361	0.000
FY 2021 Accomplishments: Conduct Congressionally directed efforts.		
FY 2022 Plans: Not applicable		
Congressional Add: Program Increase - Modeling Technology for Small Turbine Engines	6.825	0.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity	R-1 Program Element (Number/Name)		
3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	PE 0603680F I Manufacturing Technology Program		
	FY 2021	FY 2022	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - Low cost manufacturing methods for hypersonic vehicle components	7.800	0.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - Technologies to repair fastener holes	4.875	5.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - Manufacturing technology for reverse engineering	4.875	5.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - Hybrid manufacturing for rapid tooling and repair	4.875	10.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - cost reduction for aerospace composite structures	9.751	0.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - flexible thermal protection systems for hypersonics	9.751	10.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - alternative domestic rubber production	4.875	0.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - large scale additive manufacturing for hypersonics	5.850	0.000	

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity	R-1 Program Element (Number/Name)		
3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	PE 0603680F I Manufacturing Technology Program		
	FY 2021	FY 2022	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - manufacturing readiness for hypersonic propulsion systems	9.751	0.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - thermoplastic material systems	6.825	4.751	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - automated fiber placement for composite structures	4.875	5.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - hypersonic manufacturing capability and supply	5.850	0.000	
FY 2021 Accomplishments: Conduct Congressionally directed efforts.			
FY 2022 Plans: Not applicable			
Congressional Add: Program increase - massive area additive manufacturing	9.663	10.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - academic-industry partnerships for advanced materials and manufacturing processes	0.000	6.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - adaptive modeling for low-cost titanium	0.000	5.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - beryllium additive manufacturing	0.000	3.000	

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force		Date: April 2022	
Appropriation/Budget Activity	R-1 Program Element (Number/Name)		
3600: Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)	PE 0603680F I Manufacturing Technology Program		
	FY 2021	FY 2022	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - component 30 online demonstration	0.000	10.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - MRO advanced process technology development	0.000	10.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - sustainment and modernization research and development	0.000	10.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - virtual augmented mixed reality readiness	0.000	8.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - affordable manufacture of resistive films	0.000	10.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - rapid large format metal additive manufacturing to optimize scramjet production	0.000	5.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - universal robotic controller	0.000	6.000	
FY 2021 Accomplishments: Not applicable			
FY 2022 Plans: Conduct Congressionally directed efforts.			
Congressional Add: Program increase - hypersonics supply chain research	0.000	10.000	

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
--	-------------------------

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603680F / <i>Manufacturing Technology Program</i>
--	---

	FY 2021	FY 2022
FY 2021 Accomplishments: Not applicable		
FY 2022 Plans: Conduct Congressionally directed efforts.		
Congressional Adds Subtotals	105.802	132.751

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	59.605	72.138	51.824	0.000	51.824	59.213	60.916	59.429	60.831	Continuing	Continuing
635321: <i>C4I Battlespace Dev and Demo</i>	-	41.909	49.166	32.301	0.000	32.301	38.429	40.215	35.643	36.516	Continuing	Continuing
635329: <i>Cyber Battlespace Dev & Demo</i>	-	17.696	22.972	19.523	0.000	19.523	20.784	20.701	23.786	24.315	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates Air Force enterprise-centric information technologies for the warfighter. The C4I Battlespace Dev and Demo project provides technology enabling the Air Force (a) to monitor, assess, plan, and execute missions rapidly across the full spectrum of operations at all levels of war and during all phases of conflict; (b) to field advanced, secure, net-enabled architectures and communications/network technologies in support of persistent, global, and survivable kinetic and non-kinetic military operations; (c) to process and exploit data and information from a variety of sources and domains to create a common operating picture of the battlespace; and (d) to provide the decision maker and staff with seamless access to tailored information within a mobile, dynamic, and scalable, globally distributed Air Operations Center, as well as among other producers, consumers, and managers of information relevant to other particular Communities of Interest (COI). The Cyber Battlespace Dev & Demo project develops the ability to deliver cyber-attack capabilities (access, stealth, persistence, intelligence, and weapons delivery), cyber defense capabilities (attack detection, attack attribution, and response automation) and cyber support capabilities (situation awareness and war gaming). This project will also develop (a) a science and engineering capability demonstrating new models of computation; (b) novel approaches for high performance, interactive, net-centric, distributed and embedded computing systems; and (c) the technological tools enabling affordable, large-scale, and complex software-intensive systems.

The National Defense Strategy and Air Force Future Operating Concept established science and technology challenges to enable operational agility (the ability to rapidly generate and shift among multiple solutions for a given challenge) as a way to adapt swiftly to any situation or enemy action. Operational agility will require flexibility (manifested as multi-domain operations), speed (manifested as superior decision speed), coordination (manifested as dynamic command and control), balance (manifested as presenting a balanced capability mix), and strength (manifested as performance-optimized teams). In order to enable operational agility, this program will begin to shape future research and development (R&D) to focus on technologies in support of operational agility through multi-domain command and control (MDC2) capabilities.

This program has been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>
--	--

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	63.106	56.772	0.000	0.000	0.000
Current President's Budget	59.605	72.138	51.824	0.000	51.824
Total Adjustments	-3.501	15.366	51.824	0.000	51.824
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	-2.824			
• Congressional Adds	0.000	18.190			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-1.572	0.000			
• Other Adjustments	-1.929	0.000	51.824	0.000	51.824

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 635321: C4I Battlespace Dev and Demo

Congressional Add: *Program Increase- Assured Communication and Networks*

Congressional Add: *Program Increase- Command and Control Capability Development*

Congressional Add: *Program Increase - Assured Communication and Networks*

Congressional Add: *Project Increase - Command and Control Capability Development and Deployment*

Congressional Add Subtotals for Project: 635321

	FY 2021	FY 2022
	9.751	0.000
	4.875	0.000
	0.000	10.000
	0.000	5.000
	14.626	15.000
	0.000	0.000
	0.000	0.000

Project: 635329: Cyber Battlespace Dev & Demo

Congressional Add: *Program Increase- assured communication and networks*

Congressional Add: *Program Increase- command and control capability development*

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>
--	--

Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2021	FY 2022
Congressional Add: <i>Project Increase - Development of Cybersecurity Methodologies</i>	0.000	2.990
Congressional Add: <i>Project Increase - Skydome Trusted Smart-X Experimentation Environment</i>	0.000	0.200
Congressional Add Subtotals for Project: 635329	0.000	3.190
Congressional Add Totals for all Projects	14.626	18.190

Change Summary Explanation

Decrease in FY 2021 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2363, an amendment to PL 110-417, 10 U.S.C. Section 2358 and 10 U.S.C. 2805(d)(1)(B).

The FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY 2023 cannot be made in a relevant manner.

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>				Project (Number/Name) 635321 / <i>C4I Battlespace Dev and Demo</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
635321: <i>C4I Battlespace Dev and Demo</i>	-	41.909	49.166	32.301	0.000	32.301	38.429	40.215	35.643	36.516	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The National Defense Strategy and Air Force Future Operating Concept established science and technology challenges to enable operational agility (the ability to rapidly generate and shift among multiple solutions for a given challenge) as a way to adapt swiftly to any situation or enemy action. In order to enable multi-domain operations, this project will begin to shape future research and development to focus on technologies in support of multi-domain command and control.

In order to achieve operational agility, the Air Force must be able (a) to monitor, assess, plan, and execute missions rapidly across the full spectrum of operations at all levels of war and during all phases of conflict; (b) to field advanced, secure, net-enabled architectures and communications/network technologies in support of persistent, global, and survivable kinetic and non-kinetic military operations; (c) to process and exploit data and information from a variety of sources and domains to create a common operating picture of the battlespace; and (d) to provide the decision maker and staff with seamless access to tailored information within a mobile, dynamic, and scalable, globally distributed Air Operations Center, as well as among other producers, consumers, and managers of information relevant to other particular Communities of Interest (COI).

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.”

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

	FY 2021	FY 2022	FY 2023
Title: Transformational Technology Development	0.000	8.042	8.583
Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through advances in enterprise-centric information technologies, offensive and defensive cyber operations capabilities, advanced command and control capabilities, and collection, management, analysis, and exploitation of complex data. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635321 / <i>C4I Battlespace Dev and Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Fund the follow-on efforts for projects started in FY 2021. Select Transformational Technology Development efforts that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2023 Plans: Continue investments leveraging Artificial Intelligence and gaming technologies to accelerate Department of the Air Force capability to create theatre-scale operational plans within hours. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 Funding increased compared to FY 2022 by \$0.541 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>				
<p>Title: Multi-Domain Command and Control</p> <p>Description: Perform research and development (R&D) that will advance existing, or discover new, command and control capabilities to support multi-domain operations (MDO) for air, space, cyberspace, land, sea, and undersea.</p> <p>FY 2022 Plans: Continue demonstration of communication, information management, and replication capabilities for intra base distribution of one C2 operational echelon function. Continue to execute experiments, based on operational scenarios, which incorporate process management execution into the extensible Space command and control framework, and which integrate disparate data and applications, providing a pedigree for proposed tasking options to decision makers. Continue to develop software capabilities that employ cyber, directed energy, and electronic warfare weaponry. Continue to provide on-the-fly valuable quantitative evaluations of cyber assets to cyber operators, enabling them to present viable cyber options to commanders in multi-domain settings. Continue development of tools, technology, and framework for execution management of operational center process workflows and applications.</p> <p>FY 2023 Plans: Continue demonstration of communication, information management, and replication capabilities for intra base distribution of one C2 operational echelon function. Continue to execute experiments, based on operational scenarios, which incorporate process management execution into the extensible Space command and control framework, and which integrate disparate data and</p>		6.537	6.975	10.214

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635321 / <i>C4I Battlespace Dev and Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>applications, providing a pedigree for proposed tasking options to decision makers. Continue development of tools, technology, and framework for execution management of operational center process workflows and applications.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 increased compared to FY 2022 by \$3.239 million due to implementation of AF S&T 2030 addressing Rapid, Effective Decision Making and Complexity, Unpredictability, and Mass.</p>				
<p>Title: Nuclear C3 Modernization</p> <p>Description: Develop and demonstrate the advancement of existing nuclear capable forces to ensure command, control, and connectivity for the President without constraints.</p> <p>FY 2022 Plans: Starting in FY 2022, this work will be performed in PE 0603788F, Battlespace Knowledge, Development, and Demonstration, Project 635321, C4I Battlespace Dev and Demo, Assured Communications & Networks effort.</p> <p>FY 2023 Plans: Starting in FY 2022, this work will be performed in PE 0603788F, Battlespace Knowledge, Development, and Demonstration, Project 635321, C4I Battlespace Dev and Demo, Assured Communications & Networks effort.</p>		2.945	0.000	0.000
<p>Title: Artificial Intelligence/Autonomy/Machine Learning</p> <p>Description: Develop and demonstrate to harness the speed and scale of computers and machines to address problems of complexity.</p> <p>FY 2022 Plans: Decrease development of robust artificial intelligence/machine learning (AI/ML) for targeted transition capabilities. Decrease development to operationalize and implement state of the art learning models. Continue to integrate within the AI/ML framework to develop, evaluate, and deploy custom solutions meeting operational requirements & needs. Decrease development of secure diode for cross-domain embedded solution. Implementation and testing of neuromorphic-based algorithms for processing and exploitation of multiple data feeds.</p> <p>FY 2023 Plans: Decrease development of robust artificial intelligence/machine learning (AI/ML) for targeted transition capabilities. Decrease development to operationalize and implement state of the art learning models. Continue to integrate within the StreamlinedML framework. Decrease development of secure diode for cross-domain embedded solution. Implementation and testing of neuromorphic-based algorithms for processing and exploitation of multiple data feeds.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		2.234	3.274	1.729

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635321 / <i>C4I Battlespace Dev and Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 decreased compared to FY 2022 by \$1.545 million due to higher Department priorities.				
<p>Title: Data to Decisions</p> <p>Description: Develop and demonstrate the collection, management, analysis, and exploitation of complex data for availability to Air Force and other stakeholders.</p> <p>FY 2022 Plans: Continue development and demonstration of intelligence analysis capabilities from multiple intelligence sources for both near-real time and post mission. Continue research and development in data analytics and strategic indications and warnings. Continue to perform service-based capability development. Conduct a demonstration of additional government fusion techniques applied to combined commercial/commodity hardware and existing military hardware within a trusted wrapper. Conduct an integrated demonstration of data flow into intelligence production environment. Continue to advance the prototype to deliver multi-INT exploitation on-board and in real-time.</p> <p>FY 2023 Plans: Continue development and demonstration of intelligence analysis capabilities from multiple intelligence sources for both near-real time and post mission. Continue research and development in data analytics and strategic indications and warnings for the air and space domains. Continue to perform service-based capability development. Decrease investments to advance the prototype to deliver multi-INT exploitation on-board and in real-time.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.597 million due to higher Department priorities.</p>		4.180	3.809	1.212
<p>Title: Game Changing Computing Power</p> <p>Description: Develop and demonstrate computer architectures with greater capacity and sophistication to enable game-changing computing power to the warfighter anywhere, anytime.</p> <p>FY 2022 Plans: Demonstrating secure, on-board, simultaneous processing of multi-INT data to correlate and identify surface targets.</p> <p>FY 2023 Plans: Continue to demonstrate secure, on-board, simultaneous processing of multi-INT data to correlate and identify surface targets. Integrate and test to utilize pod for additional data sources.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		3.086	3.099	2.235

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force	Date: April 2022
---	-------------------------

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635321 / <i>C4I Battlespace Dev and Demo</i>
--	--	--

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
---	----------------	----------------	----------------

FY 2023 decreased compared to FY 2022 by \$0.864 million due to higher Department priorities.

Title: Assured Communications & Networks	8.301	8.967	8.328
---	-------	-------	-------

Description: Develop and demonstrate secure and reliable communications to ensure the delivery of timely, reliable, and actionable information to warfighters and systems.

FY 2022 Plans:

Continue development and demonstration for rapid waveform development of multi-mission software defined radio frequency capability. Continue wideband high frequency waveform development and testing. Continue ionospheric research, propagation modeling and simulation. Continue beacon data collection on both the V and W frequency bands along with waveform development and simulation. Develop robust mesh networking capability with both Line-of-Sight and Beyond Line-of-Sight communication links. Continue to add SATCOM links to multi-spectral capability. Continue to demonstrate a protected, single security domain commercial off-the-shelf (COTS) device hosting user and asset tracking, machine learning architecture provisioning and innovative aerial port (AMC) solutions for mobile situational awareness (SA) and decision making. Continue to enhance communication link availability prediction for better Command, Control, and Communications (C3) planning and simulation.

FY 2023 Plans:

Continue development and demonstration for rapid waveform development of multi-mission software defined radio frequency capability. Advance development of wideband high frequency waveform development and testing. Continue to enhance communication link availability prediction for better Command, Control, and Communications (C3) planning and simulation. Continue to demonstrate a protected, single security domain commercial off-the-shelf (COTS) device hosting user and asset tracking, machine learning architecture provisioning and innovative aerial port (AMC) solutions for mobile situational awareness (SA) and decision making.

FY 2022 to FY 2023 Increase/Decrease Statement:

FY 2023 decreased compared to FY 2022 by \$0.639 million. Justification for the decrease is described in the plans above.

Accomplishments/Planned Programs Subtotals	27.283	34.166	32.301
---	--------	--------	--------

	FY 2021	FY 2022
Congressional Add: Program Increase- Assured Communication and Networks	9.751	0.000
FY 2021 Accomplishments: Conduct congressionally directed effort.		
FY 2022 Plans: Not applicable.		
Congressional Add: Program Increase- Command and Control Capability Development	4.875	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force **Date:** April 2022

Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635321 / <i>C4I Battlespace Dev and Demo</i>
--	--	--

	FY 2021	FY 2022
FY 2021 Accomplishments: Conduct congressionally directed effort.		
FY 2022 Plans: Not applicable.		
Congressional Add: Program Increase - Assured Communication and Networks	0.000	10.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct congressionally directed effort.		
Congressional Add: Project Increase - Command and Control Capability Development and Deployment	0.000	5.000
FY 2021 Accomplishments: Not applicable.		
FY 2022 Plans: Conduct congressionally directed effort.		
Congressional Adds Subtotals	14.626	15.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force										Date: April 2022		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>				Project (Number/Name) 635329 / <i>Cyber Battlespace Dev & Demo</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
635329: <i>Cyber Battlespace Dev & Demo</i>	-	17.696	22.972	19.523	0.000	19.523	20.784	20.701	23.786	24.315	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Air Force requires the ability to deliver sovereign options in cyberspace through the development and integration of cyber-attack, cyber defense, and cyber support technologies for a strategic capability of cyber dominance. This project develops the ability to deliver cyber-attack capabilities (access, stealth, persistence, intelligence, and weapons delivery), cyber defense capabilities (attack detection, attack attribution, and response automation) and cyber support capabilities (situation awareness and war gaming). This project will also develop 1) a science and engineering capability demonstrating new models of computation, 2) novel approaches for high performance, interactive, net-centric, distributed and embedded computing systems, and 3) the technological tools enabling affordable, large-scale, and complex software-intensive systems.

The National Defense Strategy and Air Force Future Operating Concept established science and technology challenges to enable operational agility (the ability to rapidly generate and shift among multiple solutions for a given challenge) as a way to adapt swiftly to any situation or enemy action. In order to enable multi-domain operations, this project will begin to shape future research and development to focus on cyber technologies in support of multi-domain command and control.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2021	FY 2022	FY 2023
Title: Transformational Technology Development	0.000	3.251	4.322
Description: Continually funded effort. This funding allocation will initiate new and continue existing Transformational Technology Development efforts. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming, Battlespace Awareness, Integrated Base Defense, and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to technologies to enhance survivability, operability and performance of personnel, sensors, and structures in a threat environment through advances in enterprise-centric information technologies, offensive and defensive cyber operations capabilities, advanced command and control capabilities, and collection, management, analysis, and exploitation of complex data. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635329 / <i>Cyber Battlespace Dev & Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2022 Plans: Fund the follow-on efforts for projects started in FY 2021. Select Transformational Technology Development efforts that support the National Defense Strategy and Department of the Air Force priorities.</p> <p>FY 2023 Plans: Continue to develop and enable multi-domain sense-making at the tactical edge. Initiate projects selected from the annual WARTECH process that investigate Department of the Air Force prioritized topics. Continue to perform modeling, simulation, and analyses to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 Funding increased compared to FY 2022 by \$1.071 million. Funding increased to scale investment toward the Department of the Air Force target outlined in the Air Force 2030 Science and Technology (S&T) Strategy.</p>				
<p>Title: Cyber Defense Technologies</p> <p>Description: Develop and demonstrate defensive cyber operations capabilities in a series of experimental technology demonstrations.</p> <p>FY 2022 Plans: Continue development of software capabilities and concept of operations for active guidance and automated processes addressing cyber defense. Continue to demonstrate automated cyber survivability using integrated cyber technologies within the operational system laboratory in the context of risk management framework requirements. Continue development of an advanced secure processor hardware capability. Develop processor-agnostic sub-system for golden-image storage, verification, and re-flashing. Continue development and integration of polyglot file identification filters to mitigate data exfiltration risks. Continue to sustain development of a modularized filter store to maximize filter re-usability and increase the agility of cross-domain solutions to support new file types. Continue development and demonstration of Air, Space, Cyber tasking order interoperability and ingestion by IKE Cyber system. Demonstrate additional government fusion techniques applied to combined commercial/commodity hardware and existing military hardware within a trusted wrapper. Demonstrate data flow into the intelligence production environment.</p> <p>FY 2023 Plans: Decrease development of software capabilities and concept of operations for active guidance and automated processes addressing cyber defense. Decrease demonstration of automated cyber survivability using integrated cyber technologies within</p>		0.000	7.416	4.647

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635329 / <i>Cyber Battlespace Dev & Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
the operational system laboratory in the context of risk management framework requirements. Continue development of an advanced secure processor hardware capability. Continue development, demonstration, and integration of the IKE Cyber system. FY 2022 to FY 2023 Increase/Decrease Statement: FY 2023 decreased compared to FY 2022 by \$2.769 million due to higher Department priorities.				
Title: Cyber Offense Technologies Description: Develop and demonstrate offensive cyber operations capabilities in a series of experimental technology demonstrations. FY 2022 Plans: Continue the development of a counter small unmanned aerial system open architecture specification to enable interoperability between disparate protection systems. Develop a base-threat awareness toolkit. Develop a framework for quickly adapting new features to allow for increased efficiency in updating cyber offense capabilities. Continue development of processor-agnostic sub-system for golden-image storage, verification, and re-flashing. Continue to integrate and transition multiple Air Force Research Laboratory and Air Force Lifecycle Management Center counter small unmanned aerial system capabilities. Continue the development of a capability to enable the warfighter access into congested environments as directed by warfighter requirements. Continue development of cellular testbed with 5G and Internet of Things representative technologies. Demonstrate an initial SIGINT hardware prototype. FY 2023 Plans: Advance research towards development of non-kinetic cyber effects against high-impact, critical targets within areas of responsibility (AORs) or of interest to enable stand-off power projection options that enable cyber-only and coordinated cyber-kinetic target prosecution. Increase development in signal identification capabilities in adverse environments addressing advanced communications signals and networks. Decrease investments for the development of a counter small unmanned aerial system open architecture specification to enable interoperability between disparate protection systems. Develop a base-threat awareness toolkit. Decrease development of processor-agnostic sub-system for golden-image storage, verification, and re-flashing. Decrease to integrate and transition multiple Air Force Research Laboratory and Air Force Lifecycle Management Center counter small unmanned aerial system capabilities. Decrease investments for the development of a capability to enable the warfighter access into congested environments as directed by warfighter requirements. Decrease investments for the development of cellular testbed with 5G and Internet of Things representative technologies. Demonstrate an initial SIGINT hardware prototype. FY 2022 to FY 2023 Increase/Decrease Statement:		0.000	9.115	10.554

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635329 / <i>Cyber Battlespace Dev & Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
FY 2023 increased compared to FY 2022 by \$1.438 million due to implementation of AF S&T 2030 for Speed and Reach of Disruption & Lethality for cyber offensive and information warfare offensive to change the future fight.				
Title: Resiliency Description: Integrate and demonstrate a resilient and self-generating information enterprise that dynamically recognizes, characterizes, and understands novel cyber attacks, and then reconfigures and self-optimizes itself to resist new attacks. FY 2022 Plans: Starting in FY 2022, this work will be performed within this PE, under Project 635329, Cyber Battlespace Dev & Demo, in the Cyber Defense Technologies effort. FY 2023 Plans: Not applicable		7.485	0.000	0.000
Title: Game Changing Computing Power Description: Develop and demonstrate computer architectures with greater capacity and sophistication to enable game-changing computing power to the warfighter anywhere, anytime. FY 2022 Plans: Not Applicable FY 2023 Plans: Not applicable		0.000	0.000	0.000
Title: Autonomous, Multi-level Access and Transfer Description: Develop autonomous, secure information access and sharing capabilities required by the Air Force net-centric information enterprise. FY 2022 Plans: Starting in FY 2022, this work will be performed within this PE, under Project 635329, Cyber Battlespace Dev & Demo, in the Cyber Defense Technologies effort. FY 2023 Plans: Not applicable		1.042	0.000	0.000
Title: Cyber Power Projection		9.169	0.000	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635329 / <i>Cyber Battlespace Dev & Demo</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: Develop and demonstrate offensive cyber capabilities in contested environments through a series of experiments and exercises.</p> <p>FY 2022 Plans: Starting in FY 2022, this work will be performed within this PE, under Project 635329, Cyber Battlespace Dev & Demo, in the Cyber Offense Technologies effort.</p> <p>FY 2023 Plans: Not applicable</p>			
Accomplishments/Planned Programs Subtotals	17.696	19.782	19.523

	FY 2021	FY 2022
<p>Congressional Add: Program Increase- assured communication and networks</p> <p>FY 2021 Accomplishments: Conduct congressionally directed efforts. To be executed from Project 635321, C4I Battlespace Dev and Demo.</p> <p>FY 2022 Plans: Not applicable.</p>	0.000	0.000
<p>Congressional Add: Program Increase- command and control capability development</p> <p>FY 2021 Accomplishments: Conduct congressionally directed efforts. To be executed from Project 635321, C4I Battlespace Dev and Demo.</p> <p>FY 2022 Plans: Not applicable.</p>	0.000	0.000
<p>Congressional Add: Project Increase - Development of Cybersecurity Methodologies</p> <p>FY 2021 Accomplishments: Not applicable.</p> <p>FY 2022 Plans: Conduct congressionally directed effort.</p>	0.000	2.990
<p>Congressional Add: Project Increase - Skydome Trusted Smart-X Experimentation Environment</p> <p>FY 2021 Accomplishments: Not applicable.</p> <p>FY 2022 Plans: Conduct congressionally directed effort.</p>	0.000	0.200
Congressional Adds Subtotals	0.000	3.190

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / <i>Battlespace Knowledge Development and Demonstration</i>	Project (Number/Name) 635329 / <i>Cyber Battlespace Dev & Demo</i>

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

UNCLASSIFIED

THIS PAGE INTENTIONALLY LEFT BLANK

UNCLASSIFIED