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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2020 Air Force	<b>Date:</b> February 2019
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<b>Appropriation/Budget Activity</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force I BA 7: Operational Systems Development</i>	<b>R-1 Program Element (Number/Name)</b> PE 0101328F / ICBM Reentry Vehicles
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COST (\$ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
Total Program Element	-	0.000	14.167	75.571	0.000	75.571	112.959	74.868	81.905	101.000	Continuing	Continuing
674920: <i>IW1/Mk21A</i>	-	0.000	14.167	75.571	0.000	75.571	112.959	74.868	81.905	101.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

The Mk21A Reentry Vehicle (RV) program will design, develop, produce and deploy an integrated RV capable of delivering the W87-1 Warhead when released from the Ground Based Strategic Deterrent (GBSD) Intercontinental Ballistic Missile (ICBM). The Mk21A will provide needed performance and security enhancements over the Mk21 reentry vehicle to meet the upgraded requirements for the Department of Energy W87-1 warhead. The Mk21A will also meet the requirements laid out in the Ground Based Strategic Deterrent (GBSD) Capability Development Document (CDD) as directed by Air Force Global Strike Command.

The major activities in the Technology Maturation and Risk Reduction (TMRR) phase of the Mk21A RV program include: (1)Trade Studies; (2) Prototype designs; (3) Government systems engineering, analytics, and test capability development, (4) RV Risk Reduction, and (5) Weapon System (WS) Integration Risk Reduction. Reentry vehicle components include: high velocity nose tip, high impulse transducer, fuze, aero shell forward section, body section and rear cover, radio frequency subsystem with antennas, RV spin-up system, inflight disconnect cable and other electrical cables. The Mk21A program will include prime contractor development of applicable support equipment, data, flight test hardware, infrastructure, and training materials while examining and mitigating weapon system integration risks, and nuclear surety, hardness and certification and system vulnerability assessments.

This program element includes necessary civilian pay expenses required to manage, execute, and deliver Mk21A RV weapon system capability. The use of such program funds would be in addition to the civilian pay expenses budgeted in program element 0605833F.

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 2018 Air Force penalty total is \$14.373M. 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 7, Operational System Development because this budget activity includes development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year.

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B. Program Change Summary (\$ in Millions)		FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	
Previous President's Budget		0.000	18.412	75.571	0.000	75.571	
Current President's Budget		0.000	14.167	75.571	0.000	75.571	
Total Adjustments		0.000	-4.245	0.000	0.000	0.000	
• Congressional General Reductions		0.000	0.000				
• Congressional Directed Reductions		0.000	-4.245				
• 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	0.000	0.000	0.000	
Change Summary Explanation FY 2019 funds reflect a congressional reduction of \$4.245 million for "funding excess to need."							
C. Accomplishments/Planned Programs (\$ in Millions)					FY 2018	FY 2019	FY 2020
Title: Mk21A Technology Maturation Risk Reduction					0.000	14.167	75.571
Description: The objectives of TMRR for Mk21A are as follows: (1) Deliver one preliminary design and two prototypes for flight testing to inform National Nuclear Security Administration/ Department of Energy designs and further technology maturation (2) Incorporate a modular, open systems architecture (3) Implement Model Based System Engineering (MBSE) enabling the government to Own the Technical Baseline (OTTB) (4) Demonstrate performance of weapon system capabilities through prototyping, modeling, simulation, and testing (5) Conduct flight test of 2 prototype RVs in ICBM-like environment							
FY 2019 Plans: • Complete Milestone A • Award one TMRR contract • Initiate reentry vehicle preliminary design development • Develop ground and flight test plans for prototypes • Begin development of prototype test vehicles • Begin trade studies							
FY 2020 Plans: • Continue to mature reentry vehicle preliminary design							

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C. Accomplishments/Planned Programs (\$ in Millions)										FY 2018	FY 2019	FY 2020
• Continue to develop ground and flight test plans for prototypes • Continue development of prototype test vehicle • Complete trade studies												
FY 2019 to FY 2020 Increase/Decrease Statement: Increased cost due to vendor advancing from design work into prototyping efforts. The program will also be conducting a System Requirements Review (SRR), System Functional Review (SFR), preparing for a Preliminary Design Review (PDR), beginning nuclear certification, and starting initial flight test support in FY20.												
Accomplishments/Planned Programs Subtotals										0.000	14.167	75.571
D. Other Program Funding Summary (\$ in Millions)												
Line Item	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost	
• RDTE 04 0605230F/641025: Ground Based Strategic Deterrent	221.536	414.441	570.373	-	570.373	1,527.545	2,540.300	3,039.900	3,078.800	Continuing	Continuing	
• RDTE 05 0604933F/655082: Fuze Modernization	166.571	167.659	161.199	-	161.199	132.926	60.016	2.035	2.071	Continuing	Continuing	
• RDTE 04 060351F/641022: Dem/Val - RVAP	24.543	12.720	24.439	-	24.439	39.776	40.186	40.554	0.000	Continuing	Continuing	
Remarks												
E. Acquisition Strategy												
The Mk21A Reentry Vehicle (RV) program acquisition strategy is to deliver an integrated RV capable of delivering the W87-1 Warhead to target beginning in FY30. For the Technology Maturation and Risk Reduction (TMRR) phase, the Program Office will competitively award one cost plus fixed fee (CPFF) contract in FY19. This contract will be for 36 months with a 12 month option. The Air Force is responsible for developing, producing, and maintaining the Reentry Vehicle (RV). The National Nuclear Security Administration develops/modifies the nuclear weapon inside the RV, including the Weapon Electrical System (WES), which is the firing set that interfaces with the DoD fuze.												
The objectives of TMRR for Mk21A are as follows: (1) deliver one preliminary design and two prototypes; (2) incorporate a modular, open systems architecture; (3) implement Model Based System Engineering (MBSE) enabling the government to Own the Technical Baseline (OTTB); (4) demonstrate performance of weapon system capabilities through prototyping, modeling, simulation, and testing; (5) conduct test flight of two prototype RVs in ICBM-like environment.												
The TMRR phase will include a System Requirements Review (SRR), System Functional Review (SFR), Preliminary Design Review (PDR), and Prototype RV demonstrations. The contractor may elect to perform additional risk reduction testing on select components to further evolve the design during TMRR, in order to lower												

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<p>component integration risk during the Engineering and Manufacturing Development (EMD) phase. The reference design for the Mk21A includes use of Mk21 Mod 6 aeroshells. Because the Mod 6 vehicles were originally developed as test vehicles for the legacy Peacekeeper ICBM, they must be modified for use as war reserve. All RV subsystems must also be procured, including the High Impulse Transducer, Radio Frequency Subsystem, Antennas, Spin Generators, and cables.</p> <p>The TMRR contract will be a three year base contract plus a one year option potentially extending TMRR and test related activities through 3QFY23. After Milestone B approval, the EMD contract will be competitively awarded as early as 4QFY23.</p> <p><b>F. Performance Metrics</b></p> <p>Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.</p>		

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Air Force												Date: February 2019			
Appropriation/Budget Activity 3600 / 7						R-1 Program Element (Number/Name) PE 0101328F / ICBM Reentry Vehicles				Project (Number/Name) 674920 / IW1/Mk21A					
Product Development (\$ in Millions)				FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Mk21A TMRR Contractor	C/CPFF	TBD : TBD	-	-		6.083	Jun 2019	39.870	Nov 2019	-		39.870	Continuing	Continuing	-
Subtotal			-	-		6.083		39.870		-		39.870	Continuing	Continuing	N/A
Support (\$ in Millions)				FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Mk21A Integration Support	C/FP	BAE : Hill AFB, UT	-	-		3.137	Jan 2019	3.380	Oct 2019	-		3.380	Continuing	Continuing	-
Mk21A Fuze Trade Study	MIPR	Sandia National Lab : Albuquerque, NM	-	-		0.500	May 2019	2.500	Nov 2019	-		2.500	Continuing	Continuing	-
Mk21A TMRR Support	Various	Various : Various	-	-		0.373	Jan 2019	0.497	Nov 2019	-		0.497	Continuing	Continuing	-
Subtotal			-	-		4.010		6.377		-		6.377	Continuing	Continuing	N/A
Remarks															
• FY19 support requirements increase over FY19 PB reflect costs of the Own the Technical Baseline strategy.															
• FY19 Integration Support includes temporary increase in support of Source Selection.															
Test and Evaluation (\$ in Millions)				FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Mk21A Test & Evaluation Support	Various	Various : Various	-	-		0.900	Jan 2019	22.170	Nov 2019	-		22.170	Continuing	Continuing	-
Subtotal			-	-		0.900		22.170		-		22.170	Continuing	Continuing	N/A
Remarks															
• FY20 Test & Evaluation support includes developing ground test plans and flight test plans to support development of prototype test vehicles and provide detailed, reliable data to inform Engineering and Manufacturing Development.															

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Management Services (\$ in Millions)				FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Civilian Manpower	Various	US Gov Civilians : Hill AFB, UT	-	-		0.864	Jan 2019	5.040	Oct 2019	-		5.040	Continuing	Continuing	-
Mk21A PMA	C/Various	Various : Various	-	-		2.310	Jan 2019	2.114	Nov 2019	-		2.114	Continuing	Continuing	-
Subtotal			-	-		3.174		7.154		-		7.154	Continuing	Continuing	N/A
Remarks															
Civilian manpower increase supports ramp up of Program Office and Lead Project Officer (LPO) operations. Twenty five additional personnel will be added in FY20 (15 at the program office and 10 at the LPO).															
			Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals			-	-		14.167		75.571		-		75.571	Continuing	Continuing	N/A
Remarks															

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Exhibit R-4, RDT&E Schedule Profile: PB 2020 Air Force										Date: February 2019	
Appropriation/Budget Activity					R-1 Program Element (Number/Name)					Project (Number/Name)	
3600 / 7					PE 0101328F / ICBM Reentry Vehicles					674920 / IW1/Mk21A	

	FY 2018				FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Mk21A Reentry Vehicle (RV)																												
Milestone A (Apr 2019)																												
TMRR Phase																												
PDR (Jan 2021)																												
Milestone B (Jul 2023)																												
EMD Phase																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2020 Air Force			Date: February 2019
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
Mk21A Reentry Vehicle (RV)				
Milestone A (Apr 2019)	3	2019	3	2019
TMRR Phase	3	2019	3	2023
PDR (Jan 2021)	2	2021	2	2021
Milestone B (Jul 2023)	4	2023	4	2023
EMD Phase	4	2023	4	2024

**Note**  
• EMD Phase continues beyond FY2024 to FY2027