Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force												Date: February 2019
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 7: *Operational Systems Development*					R-1 Program Element (Number/Name) PE 0401119F / *C-5 Airlift Squadrons (IF)*							
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	-	11.433	25.071	10.223	0.000	10.223	36.288	22.634	0.672	0.000	0.000	106.321
671307: *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*	-	0.000	0.000	10.223	0.000	10.223	36.288	22.634	0.672	0.000	0.000	69.817
675358: *C-5 Mission Computer-Mission Sys Equip-Weather Radar*	-	4.797	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.797
675359: *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ATM)*	-	6.636	25.071	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	31.707

Note

This program, BA 7, PE 0401119F, project 671307, C-5 Replace Multi-Functional Controls and Displays (C-5), is a new start.

A. Mission Description and Budget Item Justification

The C-5M operates across the entire range of military operations. It is the only aircraft capable of carrying 100% of certified air-transportable cargo and includes a dedicated passenger compartment enabling commanders to have troops and their equipment arrive in an area of operation simultaneously when national security concerns demand fast force closure. C-5M missions include strategic airlift of cargo and passengers as well as emergency aeromedical evacuation (AE). The aircraft must perform these missions throughout the worldwide air traffic control environment with the proper equipment to operate in FAA/ICAO controlled airspace. Additionally, C-5M aircraft must operate at night, in adverse weather conditions, and in Chemical, Biological, Radiological, Nuclear (excluding electromagnetic pulse in accordance with Joint Requirements Oversights Council (JROC) approved/validated the C-5 RERP ORD 14 Aug 01, see Appendix B, Ref YY, page 11, para 4.3.1), and High Explosive (CBRNE) environments.

C-5M communication, navigation, surveillance/air traffic management (CNS/ATM) program is a comprehensive effort to ensure appropriate CNS/ATM system design architectures are developed and equipment is installed on the C-5M to allow aircraft operation in accordance with civil airspace access mandates for both the US national airspace system (NAS) and international civil airspace. Also, the program will add equipment to meet outstanding National Security Agency mandates for encryption of voice communications. The C-5M CNS/ATM program ensures system standardization and interoperability with other DoD systems to the maximum extent possible and directly supports airworthiness certification of the C-5M. CNS/ATM requirements include, but are not limited to, capabilities such as automatic dependence surveillance-broadcast out (ADS-B Out), identification friend or foe (IFF) mode 5, satellite communication equipment replacement, and beyond line-of-sight voice radio replacement. It is anticipated equipment will be predominately commercial off-the-shelf or non-developmental items.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: February 2019
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 7: *Operational Systems Development*	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*

The C-5M core mission computer (CMC)/weather radar (WxR) program is a comprehensive sustainment modification to mitigate the obsolescence of the current CMC and WxR. This effort centers around modifying the current mission computer to obtain sufficient capacity/capability to support integration of new system capabilities with margin for growth by upgrading module cards and correcting any mission essential deficiencies identified during development. Also, the effort includes replacement of the weather radar with a commercial off-the-shelf weather radar. Mission systems equipment includes, but is not limited to, a redesign of the C-5M lavatory system. Examples of other mission systems equipment include troop seats, crew entry door and ladder, and interior trim.

C-5M Replace Multi-function Controls and Displays (RMCD) program helps to maintain aircraft availability and increased situational awareness though a new Multi Function Display Unit (MFDU)replace the current 20+ year MFDU design; current equipment is experiencing severe diminishing manufacturing source (DMS) issues. Additionally, a charging solution for the Electronic Flight Bag (EFB) will provide complementary situational awareness for operational mission support. The current generation of displays and controls supporting services used on the C-5M will no longer be repairable beginning in 2022 for MFDU. Without this modification, the C-5M will be unable to support the National Defense Strategy, AF Strategic Master Plan, Geographical Combatant Command Operational Plans.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver C-5M weapon system capability. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0605826F, 0605827F, 0605828F, 0605829F, 0605830F, 0605831F, 0605832F, 0605898F and 605833F.

Available funds will be used for program management administration, studies and analysis, risk reduction efforts, Advisory and Assistance Services, change orders, and other government costs such as travel, directorate support, government furnished equipment (GFE), and over and above costs. Funding may also be used to address Diminishing Manufacturing Sources (DMS) through studies and analysis, bridge buys, life-of-type buys, etc.

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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force					Date: February 2019
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 7: *Operational Systems Development*		R-1 Program Element (Number/Name) PE 0401119F / *C-5 Airlift Squadrons (IF)*			
B. Program Change Summary ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**
Previous President's Budget	22.758	25.071	0.000	0.000	0.000
Current President's Budget	11.433	25.071	10.223	0.000	10.223
Total Adjustments	-11.325	0.000	10.223	0.000	10.223
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	-11.000	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	-0.323	0.000			
• Other Adjustments	-0.002	0.000	10.223	0.000	10.223

Change Summary Explanation

FY 2018 funds includes Other Adjustment for -$.002 million for a C-5 AMP Upward Adjustment for an invoice against cancelled year funding.

FY 2019 funds include $0.051 million withhold pending final determination of Penalty for Cost Overruns in accordance with PL 114-92 as amended by PL 115 -91 section 825(a).

FY 2020 funds include $10.223 million for RMCD New Start Program.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force			Date: February 2019
Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 0401119F / *C-5 Airlift Squadrons (IF)*	Project (Number/Name) 671307 / *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*	

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
671307: *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*	-	0.000	0.000	10.223	0.000	10.223	36.288	22.634	0.672	0.000	0.000	69.817
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This program, BA 7, PE 0401119F, project 671307, C-5 Replace Multi-Functional Controls and Displays (C-5), is a new start.

A. Mission Description and Budget Item Justification

C-5M Replace multi-function controls and display (RMCD) program is a comprehensive effort to ensure appropriate RMCD Line Replaceable Units (LRU) are developed and installed on the C-5M allowing aircraft operation in accordance with civil airspace access mandates for both US national airspace system (NAS) and international civil airspace. The C-5M RMCD program ensures system standardization and interoperability with other DoD systems to the maximum extent possible and directly supports airworthiness certification. The purpose of the program is to identify a suitable charging solution for Electronic Flight Bag (EFB), and replacement/alternatives to the existing multi-function control display unit (MCDU) and multi-function display unit (MFDU) LRUs while maintaining existing interfaces to legacy equipment and providing for future growth opportunities. Operational Flight Programs (OFP) updates/aggregation are required to support the latest aircraft display technologies and will be designed to ensure seamless integration into the platform. Aircraft wiring will be replaced/upgraded as required. Use of mixed displays (current and new) is not permissible due to human factors considerations. It is anticipated equipment will be predominately commercial off-the-shelf or non-developmental items.

The RMCD program is a comprehensive sustainment modification to mitigate the obsolescence of the current control and display units. This effort centers around modifying the current display units to obtain sufficient capacity/capability to support integration of new system capabilities with margin for growth by upgrading displays and correcting any mission essential deficiencies identified during development, including addition of a charging solution for EFB. This modification may include software non-recurring engineering (NRE), data, cyber security, testing, installation, spares, systems integration lab (SIL), Interim Contractor Support (ICS), program support, etc.

The modification helps to maintain aircraft availability as the new multifunctional controls and displays replaces the current controls and displays, which are experiencing severe diminishing manufacturing source (DMS) issues. Failure to upgrade the displays to support aircraft availability will create a significant operational impact to the support of Geographic Combatant Command (GCCs) and maintaining U.S. National objectives. Further, Diminishing Manufacturing Source (DMS) issues will be resolved to support continued operations through studies and analysis, risk reduction efforts, bridge buys, life-of-type buys, development, and redesign efforts.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver C-5M weapon system capability. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0605826F, 0605827F, 0605828F, 0605829F, 0605830F, 0605831F, 0605832F, 0605833F and 0605898F.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 671307 / *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*

Available funds may be used for program management administration, studies and analysis, risk reduction efforts, Advisory and Assistance Services, change orders, and other government costs such as travel, directorate support, government furnished equipment (GFE), and over and above costs. Funding may also be used to address Diminishing Manufacturing Sources (DMS) through studies and analysis, bridge buys, life-of-type buys, etc.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: C-5M Replace Multi-Functional Controls and Displays	-	0.000	10.223
Description: Replace Multifunctional Controls and Displays replacement will enable the C-5M to achieve wartime mission requirements by maintaining fleet availability (mission capable rate) and program management administration (PMA). ***FY 2019 Plans:*** Not an active program in FY19 ***FY 2020 Plans:*** $10.223 million is New Start in FY20 Award EMD Contract for hardware and software design, development, integration, data management, systems engineering, program management, and spares. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** New Start in FY20			
Accomplishments/Planned Programs Subtotals	-	0.000	10.223

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

The Acquisition Strategy (AS) for the RMCD has not been determined/approved as of January 2019. The Program Office anticipates completion of Early Strategy & Issues Session (ESIS) by February 2019, with the Acquisition Strategy Plan (ASP) completion by April 2019. The strategy is to procure the display units,integrate and test those components, and install on two (2) EMD aircraft.

Program Office anticipates that the contract type will be that of Cost Plus Incentive Fee (CPIF) with some Firm Fixed Price (FFP) elements.

Program office will consider the use commercial components.
The MCDU may require Non-Recurring Engineering (NRE).
The MFDU may require Sole Source (SS) to Lockheed, who holds the Data Rights.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 671307 / *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*

E. Performance Metrics

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.

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 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 671307 / *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
RMCD hardware/software design, development, integration, data management, technical data rights, systems engineering, program management, and spares	SS/CPAF	TBD : Marietta, GA	-	-		-		8.771	Apr 2020	-		8.771	Continuing	Continuing	52.649
		Subtotal	-	-		-		8.771		-		8.771	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Other Govt Test and SIL	Various	TBD : TBD	-	-		-		-		-		-	0.000	0.000	-
		Subtotal	-	-		-		-		-		-	0.000	0.000	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Other Govt	PO	AFLCMC/WLS : WPAFB, OH	-	-		-		1.452		-		1.452	Continuing	Continuing	-
		Subtotal	-	-		-		1.452		-		1.452	Continuing	Continuing	N/A

	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	-	-		0.000		10.223		-		10.223	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 671307 / *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*

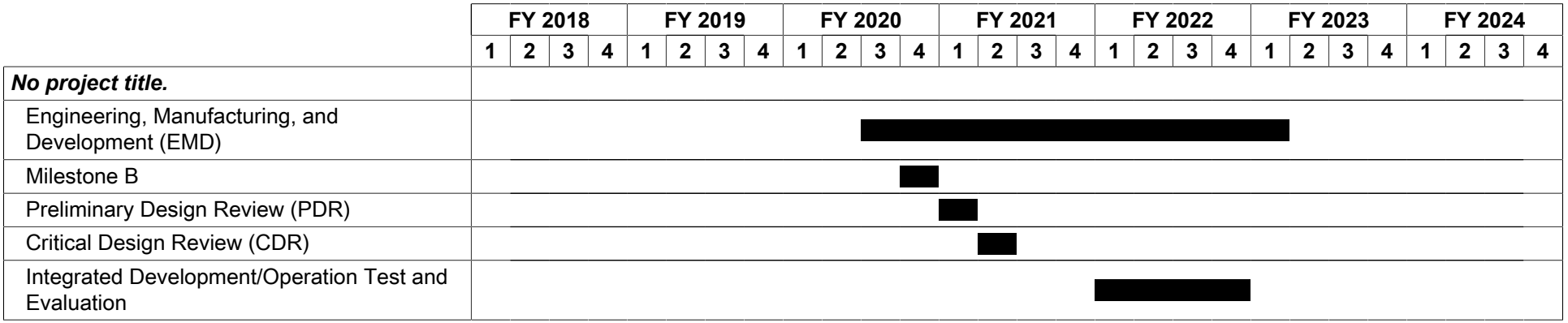

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 671307 / *C-5 REPLACE MULTIFUNCT CONTROL AND DISPLAY (RMCD)*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
No project title.				
Engineering, Manufacturing, and Development (EMD)	3	2020	1	2023
Milestone B	4	2020	4	2020
Preliminary Design Review (PDR)	1	2021	1	2021
Critical Design Review (CDR)	2	2021	2	2021
Integrated Development/Operation Test and Evaluation	1	2022	4	2022

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force			Date: February 2019
Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 0401119F / *C-5 Airlift Squadrons (IF)*	Project (Number/Name) 675358 / *C-5 Mission Computer-Mission Sys Equip-Weather Radar*	

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
675358: *C-5 Mission Computer-Mission Sys Equip-Weather Radar*	-	4.797	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.797
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The C-5M core mission computer (CMC) and weather radar (WxRadar) replacement program is a comprehensive, permanent sustainment modification, as described in validated requirements per AMC AF Form 1067s 11-152 and 11-153, to mitigate the obsolescence of the current CMC and WxRadar. This effort modifies the current CMC to obtain sufficient capacity/capability to support integration of the WxRadar with margin for growth to accommodate future requirements. This includes requirements to meet calendar year 2020 FAA Automatic Dependent Surveillance-Broadcast (ADS-B) Out and Communication, Navigation, Surveillance/Air Traffic Management (CNS/ATM) requirements. Mission systems equipment includes, but is not limited to, a redesign of the C-5M lavatory system. Examples of other mission systems equipment include troop seats, crew entry door and ladder, and interior trim.

The CMC/WxRadar modification is necessary to keep the C-5M worldwide deployable. This effort replaces the APS-133 WxRadar, resolving severe diminishing manufacturing source (DMS) issues, using the Rockwell Collins WXR-2100 commercial off-the-shelf WxRadar, which is common to other aircraft platforms, and provides the same capability as the APS-133. The effort also replaces the current core processing module (CPM) cards in the CMC with new Honeywell CPM II cards, providing additional processing speed and throughput capacity.

The CMC/WxRadar program is the baseline for all future modifications to the C-5M. The modification helps to maintain aircraft availability as the current APS-133 WxRadar and current CPM cards are both facing severe diminishing manufacturing source (DMS) issues. Failure to upgrade the WxRadar and CMC to support calendar year 2020 CNS/ATM mandates and a new weather radar will create a significant operational impact.

Available funds will be used for program management administration, studies and analysis, risk reduction efforts, Advisory and Assistance Services, change orders, and other government costs such as travel, directorate support, government furnished equipment (GFE), and over and above costs. Funding may also be used to address Diminishing Manufacturing Sources (DMS) through studies and analysis, bridge buys, life-of-type buys, etc.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: C-5M Mission Computer / Weather Radar Program	4.797	0.000	-
Description: Core mission computer modification and weather radar replacement will enable the C-5M to achieve wartime mission requirements by maintaining fleet availability (mission capable rate) and program management administration (PMA).			
FY 2019 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675358 / *C-5 Mission Computer-Mission Sys Equip-Weather Radar*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Program complete. N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** N/A			
Accomplishments/Planned Programs Subtotals	4.797	0.000	-

C. 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
• APAF 05 Line Item C00500: *C-5*	15.613	28.353	32.422	-	32.422	15.365	6.928	1.007	-	0.000	99.688
• APAF 06 Line Item 000999: *Initial Spares*	1.952	0.647	0.000	-	0.000	0.000	0.000	0.000	-	0.000	2.599
• APAF 07 Line Item 000075: *Other Production*	0.000	0.000	0.000	-	0.000	0.000	0.000	0.000	-	0.000	0.000

Remarks

D. Acquisition Strategy

The acquisition strategy for this project considered every opportunity to use commercial components to modernize the C-5M core mission computer and weather radar and maintain aircraft availability in support of mobility missions worldwide. The strategy is for the prime contractor, Lockheed Martin Aero (LMA), to procure the core mission computer cards and weather radar, integrate and test those components, and install on two (2) EMD aircraft. The sole-source contract is predominately CPIF (Cost Plus Incentive Fee) with some FFP (Firm Fixed Price) elements.

Mission Systems Equipment program: The mission systems equipment redesign requires RDT&E funding for commercial off-the-shelf (COTS) proofing. Funds are required for validation and verification of the lavatory design and installation. The Mission Systems Equipment contract method was competitive through the Defense Technical Information Center (DTIC). Wyle Science, Technical, and Engineering Group was the selected source, and the contract type is Cost Plus Fixed Fee (CPFF).

E. Performance Metrics

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.

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 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675358 / *C-5 Mission Computer-Mission Sys Equip-Weather Radar*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Core Mission Computer / Weather Radar Program Hardware/Software Design, Development, Integration, Data Management, Technical Data Rights, Systems Engineering, and Program Management	SS/TBD	Various : Varios	-	2.391		-		-		-		-	0.000	2.391	85.539
		Subtotal	-	2.391		-		-		-		-	0.000	2.391	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Core Mission Computer / Weather Radar Program Trainers & Simulators	SS/ Various	Lockheed Martin Aero : Marietta, GA	-	2.406		-		-		-		-	0.000	2.406	2.599
Core Mission Computer / Weather Radar Program Other Govt Costs (OGC)	Various	Various : TBD	-	0.000		-		-		-		-	0.000	0.000	3.390
		Subtotal	-	2.406		-		-		-		-	0.000	2.406	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Core Mission Computer / Weather Radar Program Developmental and Operational Test and Evaluation	Various	Various : NV	-	0.000		-		-		-		-	0.000	0.000	7.452
		Subtotal	-	0.000		-		-		-		-	0.000	0.000	N/A

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 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675358 / *C-5 Mission Computer-Mission Sys Equip-Weather Radar*

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Core Mission Computer / Weather Radar Program PMA Government Costs	Various	AFLCMC/WLS : Dayton, OH	-	0.000		-		-		-		-	0.000	0.000	8.283
		Subtotal	-	0.000		-		-		-		-	0.000	0.000	N/A

	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	-	4.797		0.000		-		-		-	0.000	4.797	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675358 / *C-5 Mission Computer-Mission Sys Equip-Weather Radar*

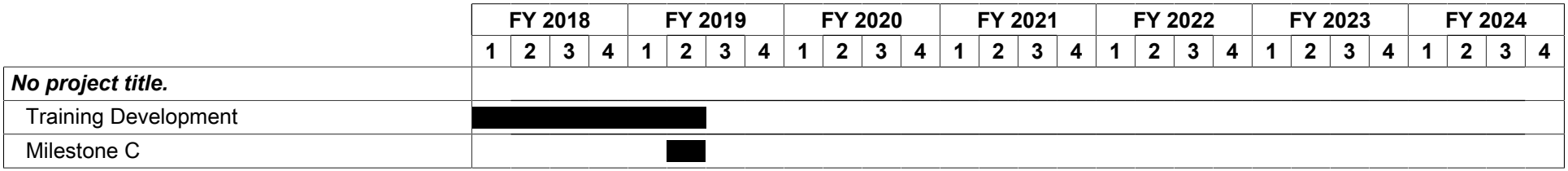

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675358 / *C-5 Mission Computer-Mission Sys Equip-Weather Radar*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
No project title.				
Training Development	1	2018	2	2019
Milestone C	2	2019	2	2019

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force			Date: February 2019
Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 0401119F / *C-5 Airlift Squadrons (IF)*	Project (Number/Name) 675359 / *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ ATM)*	

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
675359: *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ATM)*	-	6.636	25.071	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	31.707
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

C-5M communication, navigation, surveillance/air traffic management (CNS/ATM) program is a comprehensive effort to ensure appropriate CNS/ATM system design architectures are developed and equipment is installed on the C-5M to allow aircraft operation in accordance with civil airspace access mandates for both the US national airspace system (NAS) and international civil airspace. Also, the program will add equipment to meet outstanding National Security Agency mandates for encryption of voice communications. The C-5M CNS/ATM program ensures system standardization and interoperability with other DoD systems to the maximum extent possible and directly supports airworthiness certification of the C-5M. CNS/ATM requirements include, but are not limited to, capabilities such as automatic dependence surveillance-broadcast out (ADS-B Out), identification friend or foe (IFF) mode 5, satellite communication equipment replacement, and beyond line-of-sight voice radio replacement. It is anticipated equipment will be predominately commercial off-the-shelf or non-developmental items.

The current ARC-210 radio for VHF voice communications is facing diminishing manufacturing source (DMS) supply issues and additionally will no longer be capable of providing secure voice communications due to the development of new crypto algorithms. Addition of next generation ARC-210 radios with embedded Integrated Waveform (IW) and Second-generation Anti-jam Tactical UHF Radio for NATO (SATURN) and associated cryptologic equipment will enable the C-5M to meet NSA mandates for secure communications and allow aircrews to continue to communicate securely over VHF, UHF, HF, or MILSATCOM.

The current generation of satellites that support services used on the C-5M to provide oceanic controller/pilot data link communications (CPDLCs) to air traffic control and aircraft communications addressing and reporting system (ACARS) beyond-line-of-sight command and control messages will no longer be functional after 2016. The next generation of satellites will accommodate legacy C-5M SATCOM equipment for an interim period of time to allow for integration of upgraded SATCOM equipment compatible with this satellite constellation. Without this modification, the C-5M will be unable to fly oceanic tracks and will not be able to meet aircraft separation distance requirements for civil airspace access.

Automatic Dependent Surveillance-Broadcast Out (ADS-B Out) is a next generation surveillance technology that transitions key aspects of air traffic control from terrestrial based technologies to satellite enabled technologies to provide controllers a more accurate picture of aircraft positioning. ADS-B Out will allow aircraft to provide continuous broadcast of aircraft position to both controllers and other aircraft equipped with ADS-B In capable avionics. International mandates for ADS-B Out for civil airspace access call for equipage by 2020.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675359 / *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ ATM)*

Available funds will be used for program management administration, studies and analysis, risk reduction efforts, Advisory and Assistance Services, change orders, and other government costs such as travel, directorate support, government furnished equipment (GFE), and over and above costs. Funding may also be used to address Diminishing Manufacturing Sources (DMS) through studies and analysis, bridge buys, life-of-type buys, etc.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver C-5M weapon system capability. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0605826F, 0605827F, 0605828F, 0605829F, 0605830F, 0605831F, 0605832F, 0605898F and 605833F.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: C-5M CNS/ATM	6.636	25.071	-
Description: C-5M CNS/ATM program will install multiple aircraft avionic equipment pieces to enable the C-5M to meet multiple NSA encryption and international/national airspace access mandates while mitigating diminishing manufacturing source issues. ***FY 2019 Plans:*** CNS/ATM system design supports incorporation of ARC-210 Gen V radios, SATCOM replacement equipment, ADS-B Out, and IFF mode 5 into the C-5M. Efforts will include software design as well as hardware analysis for compatibility with existing C-5M system architecture. Ensure test cases are prepared and ready to support the start of qualification testing. FY19 funding supports completion of Development Test & Evaluation (DT&E), Operational Test & Evaluation (OT&E), and delivery of Tech Data Package (TDP). ***FY 2019 to FY 2020 Increase/Decrease Statement:*** EMD ends in FY19. No funds in FY20.			
Accomplishments/Planned Programs Subtotals	6.636	25.071	-

C. 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
• APAF 05 Line Item C00500: *C-5*	0.000	28.613	32.386	-	32.386	32.743	22.745	30.458	26.475	0.000	173.420
• APAF 06 Line Item 000999: *Initial Spares*	0.000	2.108	2.053	-	2.053	0.409	0.000	1.972	2.028	0.000	8.570
• APAF 07 Line Item 000075: *Other Production*	0.000	0.000	0.585	-	0.585	3.644	0.000	0.000	3.295	0.000	7.524

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675359 / *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ ATM)*

D. Acquisition Strategy

CNS/ATM program: Engineering and Manufacturing Development (EMD) for incorporation of the ARC-210 Gen V radio, SATCOM replacement equipment, ADS-B Out, and IFF mode 5 into the C-5M began in Dec 2016. The acquisition strategy for this program will consider every opportunity to use commercial components to modernize the C-5M CNS/ATM equipment to meet CY2020 mandates for global civil airspace access. The strategy is for the prime contractor, Lockheed Martin Aero (LMA), to procure CNS/ATM equipment, develop software, test and integrate those components, and install on two (2) EMD aircraft. The equipment integration will require RDT&E funding for commercial off-the-shelf and non-developmental item proofing.

E. Performance Metrics

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.

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 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675359 / *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ ATM)*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
CNS/ATM hardware/ software design, development, integration, data management, technical data rights, systems engineering, program management, and spares	Various	Lockheed Martin Aero : Marietta, GA	-	1.092	Feb 2018	16.151	Nov 2018	-		-		-	0.000	17.243	86.532
		Subtotal	-	1.092		16.151		-		-		-	0.000	17.243	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
CNS/ATM Other Government Cost	Various	AFLCMC/WLS : Dayton, OH	-	2.379	Dec 2017	1.318	Nov 2018	-		-		-	0.000	3.697	4.078
CNS/ATM Training	Various	Lockheed Martin Aero : Marietta, GA	-	0.012	Feb 2018	0.000	Nov 2018	-		-		-	0.000	0.012	0.300
CNS/ATM Peculiar Support Equipment	Various	Lockheed Martin Aero : Marietta, GA	-	0.000	Feb 2018	0.000	Feb 2019	-		-		-	0.000	0.000	0.018
CNS/ATM Trainers & Simulators	Various	Various : Various	-	0.000	Feb 2018	2.120	Nov 2018	-		-		-	0.000	2.120	3.221
		Subtotal	-	2.391		3.438		-		-		-	0.000	5.829	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
CNS/ATM System Test/ Qual/SIL	Various	Lockheed Martin Aero : Marietta, GA	-	1.038	Feb 2018	2.024	Nov 2018	-		-		-	0.000	3.062	8.662

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 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675359 / *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ ATM)*

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
CNS/ATM System Test - Government	Various	Edwards AFB : CA	-	1.841	Feb 2018	3.123	Oct 2018	-		-		-	0.000	4.964	4.250
		Subtotal	-	2.879		5.147		-		-		-	0.000	8.026	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
CNS/ATM Program Management Administration	Various	AFLCMC/WLS : Dayton, OH	-	0.131	Jun 2018	0.189	Jun 2019	-		-		-	0.000	0.320	0.949
CNS/ATM Travel	Various	AFLCMC/WLS : Dayton, OH	-	0.143	Oct 2017	0.146	Oct 2018	-		-		-	0.000	0.289	1.213
		Subtotal	-	0.274		0.335		-		-		-	0.000	0.609	N/A

	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	-	6.636		25.071		-		-		-	0.000	31.707	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675359 / *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ ATM)*

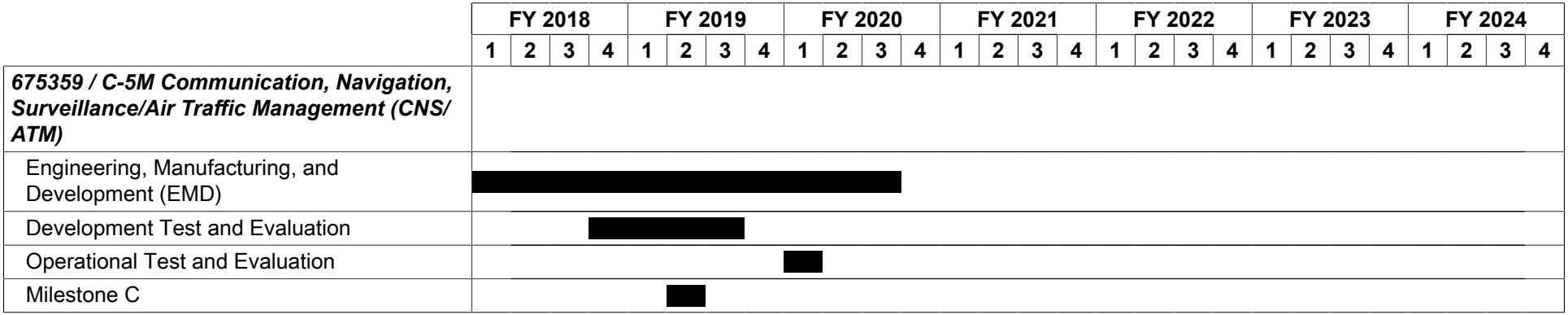

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 7	**R-1 Program Element (Number/Name)** PE 0401119F / *C-5 Airlift Squadrons (IF)*	**Project (Number/Name)** 675359 / *C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ ATM)*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
675359 / C-5M Communication, Navigation, Surveillance/Air Traffic Management (CNS/ATM)				
Engineering, Manufacturing, and Development (EMD)	1	2018	3	2020
Development Test and Evaluation	4	2018	3	2019
Operational Test and Evaluation	1	2020	1	2020
Milestone C	2	2019	2	2019

Note

CNS/ATM will support completion of formal qualification testing, installation and functional check of hardware, design and development of aircrew and maintenance training system modification, and developmental test and evaluation.