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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force **Date:** February 2020

Appropriation/Budget Activity 3620F: <i>Research, Development, Test & Evaluation, Space Force I BA 4: Advanced Component Development & Prototypes (ACD&P)</i>	R-1 Program Element (Number/Name) PE 1206422SF / <i>Weather System Follow-on</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	0.000	0.000	0.000	83.384	0.000	83.384	62.284	58.817	68.018	22.897	297.300	592.700
644289: <i>Weather System Follow-On</i>	0.000	0.000	0.000	83.384	0.000	83.384	62.284	58.817	68.018	22.897	297.300	592.700
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Program MDAP/MAIS Code: 488

A. Mission Description and Budget Item Justification

Based on completion of the Space-Based Environmental Monitoring (SBEM) Joint Requirements Oversight Council (JROC) Memo 092-14, capabilities will be developed to satisfy weather gaps for which no known mitigation exists. Weather System Follow-on (WSF) is a component of SBEM efforts to develop capabilities to satisfy weather Gap 3 Ocean Surface Vector Winds (OSVW), Gap 8 Tropical Cyclone Intensity (TCI), and Gap 11 Low Earth Orbit (LEO) Energetic Charged Particles (LEO ECP). Gap 3 OSVW and Gap 8 TCI require a space-based microwave sensor to provide polarimetric ocean surface wind direction and speed required for naval sea operations, as well as fighter sortie generations and marine amphibious operations. Gap 11 LEO ECP requires in situ ECP sensor for space situational awareness. The earliest possible launch options are being integrated in the design for critical gaps.

DoD established WSF as a Pre-Major Defense Acquisition Program (MDAP) with the Space Force as the lead component. Based on the SBEM AoA results, the WSF initial thrusts will be to enable:

- 1) DoD use of data collected by civil, international and other DoD space systems;
- 2) Timely weather collection over broad oceans in support of maneuvering forces;
- 3) Space weather capabilities to characterize operational orbits, space situational awareness, and the ionosphere.

Secondary investments may be supported to address weather gaps identified in the SBEM AoA and validated by the JROC.

Space acquisition must respond with speed and agility to emerging adversary threats. Space & Missile Systems Center (SMC) is transforming the organization and implementation of space acquisition to an enterprise approach, maximizing innovation and resiliency, leveraging international, commercial, and mission partnerships, and managing program/project priorities according to an integrated unclassified/classified enterprise space architecture. Expanding the appropriate acquisition authorities and contract mechanisms to deliver capability sooner, SMC will strategically execute experimentation, prototyping, risk reduction, and other efforts to develop new or repurpose capabilities.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver WSF weapon system capability. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 1206392SF and 1206398SF.

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This effort is in Budget Activity 4, Advanced Component Development and Prototypes (ACD&P), because efforts are necessary to evaluate integrated technologies, representative modes or prototype systems in a high fidelity and realistic operating environment.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	0.000	0.000	0.000	0.000
Current President's Budget	0.000	0.000	83.384	0.000	83.384
Total Adjustments	0.000	0.000	83.384	0.000	83.384
• 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	83.384	0.000	83.384

Change Summary Explanation

FY 2021: +\$83.384M; funds starting in FY 2021 were transferred from RDT&E, Air Force to RDT&E, Space Force; total includes a \$28.654M increase to fund WSF-M to Service Cost Position.

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: WSF Microwave Satellite (SV1-2)</p> <p>Description: WSF Microwave Satellite (SV1-2): The Space Force awarded a contract to Ball Aerospace and Technologies Corp. to develop the WSF - Microwave (WSF-M) Space Vehicle (SV) to meet all three capability gaps. WSF-M SV-2 will be an option to exercise, should SF wish to replenish WSF constellation post-SV-1. SV-2 will be functionally equivalent to SV-1. The WSF-M SV-1 projected Initial Launch Capability (ILC) is FY 2024. Secondary investments may be supported to address weather gaps identified in the SBEM AoA and validated by the JROC.</p> <p>FY 2020 Plans: N/A</p> <p>FY 2021 Plans: Complete Microwave Imaging (MWI) flight payload Integration & Test (I&T). Initiate SV-1 I&T to accommodate the MWI flight payload and ECP sensor. Continue WSF-M Ground Segment Development to include, but not limited to Command and Control System Mission Unique Software (MUS) to operate the WSF-M SV. Rapidly respond to implement system resiliency and</p>	0.000	0.000	79.846

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C. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
situational awareness necessary to operate in the contested space domain. Activities may include, but are not limited to program office support, studies, technical analysis, prototyping, technology maturation, etc.				
FY 2020 to FY 2021 Increase/Decrease Statement: N/A				
Title: COWVR Tech Demo		0.000	0.000	1.494
Description: The Compact Ocean Surface Wind Vector Radiometer (COWVR) launch objective supports Category A Weather Requirements, as codified in JROC Memo 092-014, providing on-orbit technology demonstration of the new COWVR technology to deliver Weather Gap #3, Ocean Surface Vector Winds (OSVW) and Gap #8, Tropical Cyclone Intensity (TCI). This will be a cooperative mission with NASA for integrating the sensor onto the International Space Station (ISS) as a weather technology demonstration project. The new mission designation for the COWVR launch will be Space Test Program Houston Mission #8 (STP-H8). Demonstrating COWVR technology in the space environment remains an important milestone for the microwave data weather mission in lieu of the ORS-6 cancellation. Unlike ORS-6, COVWR will fly on the ISS and the residual operational capability is not guaranteed as a result. Due to this restructure, the projected COWVR launch will be delayed from FY 2019 to FY 2021.				
FY 2020 Plans: N/A				
FY 2021 Plans: Complete launch preparations for STP-H8 mission; launch STP-H8 mission onto International Space Station; integrate COWVR onto International Space Station; checkout COWVR sensor and initiate sensor data calibration/validation. This funding includes but is not limited to payload interface unit, associated electronics, integration, system and environmental testing, launch, and ground operations establishment.				
FY 2020 to FY 2021 Increase/Decrease Statement: N/A				
Title: ECP		0.000	0.000	2.044
Description: Energetic Charged Particles (ECP) will fulfill the Space-based Environmental Monitoring (SBEM) Weather Gap 11 and address the Secretary of the Air Force (SECAF) policy which directs each USSF Satellite Office to plan for and integrate ECP sensors on all pre-Milestone B new satellite acquisitions. To accomplish this requirement, the ECP sensor will be integrated on the WSF-M satellite.				
FY 2020 Plans:				

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C. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
N/A			
<i>FY 2021 Plans:</i> Continue support to the WSF-M prime contractor for design reviews. Complete the WSF-M ECP sensor development. Fabricate and test a CEASE 3 engineering design unit. Support integration of ECP data processing software into the WSF-M ground segment. Fabricate and test ECP flight unit, put flight unit in storage until delivery to the prime contractor for integration onto WSF-M SV-1.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> N/A			
Accomplishments/Planned Programs Subtotals	0.000	0.000	83.384

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

N/A

Remarks

E. Acquisition Strategy

DoD established WSF as a pre-MDAP. The acquisition strategy for WSF is based on validated SBEM AoA results from FY2014 and subsequent acquisition strategy development activities that were conducted in FY 2015. The WSF acquisition strategy focuses on streamlined acquisition process for providing materiel solutions to OSVW, TCI & LEO ECP, as validated by the JROC; deliver microwave sensing solution to address DoD needs for OSVW and TCI capabilities and deliver space environment sensing solution to address LEO ECP capabilities for on-orbit attributions and anomaly resolutions.

The Space Force is conducting a technology demonstration of the Compact Ocean Surface Wind Vector Radiometer (COWVR) sensor in partnership with NASA Space Test Program (STP) to launch and integrate with International Space Station (ISS), utilizing their unique technology demonstration capabilities for on-orbit demonstration of COWVR technology. SMC's STP is the leading SF organization spearheading the NASA partnership, while SMC Development Corps. is responsible for the COWVR project and funding and providing programmatic support to enable COWVR sensor to ISS integration/technology demonstration.

The program awarded a contract for WSF satellite, capable of meeting all three weather capability gaps, in a full and open competition environment, in order to reduce overall program cost. The Space Force is procuring one WSF-M satellite with an option for a second satellite. WSF-M first satellite (SV-1) ILC is FY 2024 to mitigate any potential weather coverage gaps. WSF-M SV-2 ILC is currently projected for FY 2028. The WSF SV-2 will be functionally equivalent to SV-1. Naval Research Lab Blossom Point Tracking Facility (BPTF) will be used as a viable unclassified EGS-compatible SOC for WSF-M. BPTF consists of a satellite mission operations center, multiple ground antennas including via SFSCN, and an existing infrastructure capable of providing space system command, control, and communications (C3).

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The WSF ECP sensor development will leverage current AFRL sensor and hazard assessment technology to accelerate availability of ECP sensor for integration on WSF-M and other planned SF satellite acquisitions. The SF intends to transition AFRL's technology to industry for production via competitive award. Two Tech Demo ECP sensors are projected to be delivered and ready for satellite integration by FY 2022. Post-Tech Demo ECP phase, each respective program offices will be responsible for the procurement/integration and sustainment of the sensors required to meet the SecAF's Space Situational Awareness (SSA) policy.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Air Force **Date:** February 2020

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Product Development (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
COWVR Technology Demonstration	Various	Various : Various	-	-		-		1.494	Apr 2021	-		1.494	0.000	1.494	-
WSF Microwave System (SV1-2)	C/FFP	Ball Aerospace : Boulder, CO	-	-		-		60.020	Nov 2020	-		60.020	Continuing	Continuing	-
ECP	Various	Various : Various, NM	-	-		-		2.044	Jan 2021	-		2.044	Continuing	Continuing	-
Enterprise Systems Engineering & Integration	C/CPIF	Engility Corp. : Andover, MA	-	-		-		3.282	Nov 2020	-		3.282	Continuing	Continuing	-
Technical Mission Analysis	RO	Aerospace Corp : El Segundo, CA	-	-		-		5.298	Oct 2020	-		5.298	Continuing	Continuing	-
Ground	MIPR	NRL : Welcome, MD	-	-		-		4.461	Dec 2020	-		4.461	0.000	4.461	-
Subtotal			-	-		-		76.599		-		76.599	Continuing	Continuing	N/A

Management Services (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
FFRDC	RO	Aerospace Corp : El Segundo, CA	-	-		-		3.929	Nov 2020	-		3.929	Continuing	Continuing	-
Other Support	Various	Various : Various	-	-		-		1.312	Nov 2020	-		1.312	Continuing	Continuing	-
A&AS	Various	Various : Various	-	-		-		1.544	Nov 2020	-		1.544	Continuing	Continuing	-
Subtotal			-	-		-		6.785		-		6.785	Continuing	Continuing	N/A

Project Cost Totals	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
	-	-	0.000	83.384	-	83.384	Continuing	Continuing	N/A

Remarks

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Air Force **Date:** February 2020

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	FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
	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
<i>Weather System Follow-On</i>																												
COWVR Technology Demonstration I&T																												
COWVR Technology Demonstration Launch Ops																												
COWVR Technology Demonstration On-Orbit Operations																												
WSF SV-1 Production																												
WSF Microwave Imaging Integration and Test																												
WSF Microwave Ground Segment Development																												
WSF Microwave ECP Sensor Complete																												
WSF Microwave SV-1 Integration and Test																												
WSF Microwave Ground Integration and Test																												
WSF SV-2 Production																												
WSF Microwave SV-1 Initial Launch Capability																												
WSF Microwave Initial Operational Capability																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Air Force **Date:** February 2020

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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>Weather System Follow-On</i>				
COWVR Technology Demonstration I&T	1	2021	2	2021
COWVR Technology Demonstration Launch Ops	2	2021	2	2021
COWVR Technology Demonstration On-Orbit Operations	2	2021	2	2024
WSF SV-1 Production	1	2021	1	2022
WSF Microwave Imaging Integration and Test	1	2021	4	2021
WSF Microwave Ground Segment Development	1	2021	3	2022
WSF Microwave ECP Sensor Complete	2	2022	2	2022
WSF Microwave SV-1 Integration and Test	3	2021	4	2022
WSF Microwave Ground Integration and Test	3	2022	3	2023
WSF SV-2 Production	1	2023	4	2024
WSF Microwave SV-1 Initial Launch Capability	2	2023	2	2024
WSF Microwave Initial Operational Capability	3	2023	4	2024