ATTACHMENT A: STATEMENT OF WORK
for WB-57 Flight Operations for the NOAA SABRE project supplied by

NASA JOHNSON SPACE CENTER (NASA/JSC) to the

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, OCEANIC AND ATMOSPHERIC RESEARCH

Support Agreement SAA-CA-21-34835

7600A Block 11: Requesting Scope

Background

Stratospheric aerosols are an important component of Earth's albedo, and therefore energy balance, and provide surface area for heterogeneous chemical reactions that affect stratospheric ozone levels. Acquiring a comprehensive database of stratospheric aerosol, trace gas and dynamical observations to establish the baseline state and background variability of the stratosphere is essential to (1) developing a complete understanding of stratospheric dynamical and chemical processes that determine aerosol microphysics, radiative properties and heterogeneous chemistry, (2) evaluating the stratospheric response to natural and anthropogenic perturbations including climate change, volcanic eruptions, and potential climate intervention activities, and (3) strengthening the scientific foundation to inform policy decisions related to regulating global emissions that impact the stratosphere (e.g., ozone depleting substances, rocket exhaust) and the potential injection of material into the stratosphere to combat global warming.

Requirements

NOAA is implementing the Stratospheric Aerosol processes, Budget and Radiative Effects (SABRE) project to study the transport, chemistry, microphysics and radiative properties of aerosols in the upper troposphere and lower stratosphere. To achieve the SABRE science goals, NOAA requires a high altitude research aircraft capable of operating in the stratosphere at all latitudes while carrying a comprehensive suite of aerosol and trace gas scientific instruments. SABRE is planned to include multiple flight missions over a period of several years using the NASA WB-57F for stratospheric measurements in different regions and seasons in order to quantify various components of the stratospheric aerosol budget. Opportunities to sample significant stratospheric aerosol perturbations arising from volcanic eruptions or large pyrogenic aerosol injections will also be targeted.

SABRE in situ measurements will greatly enhance the observational database of the chemical, dynamical and microphysical processes that determine the formation, evolution and transport of stratospheric aerosols and their radiative properties. These measurements will be used to refine satellite retrieval of stratospheric aerosol properties and refine the representation of stratospheric aerosol processes in global models to improve the ability to predict the climate and chemical impacts from changes in stratospheric aerosol.

This agreement includes instrument integration and flight activity anticipated through 2023. Period of performance for the overall SABRE agreement runs through the end of FY2024 to allow for schedule flexibility and reconciliation of cost performance to date. Period of performance for the first set of SABRE activities, covered by the 7600B Order #1 and outlined below in the Deliverables Summary, is date of signature through 30 September 2022. Additional deliverables to be performed in FY23 and subsequent years will be funded via follow-on 7600B orders under this agreement. For estimation of the 7600A total amount, anticipated FY23 activities include 61 aircraft usage days, 120.0 flight hours operating from KEFD in Houston, Texas, and a remote mission deployment site, as well as engineering support, labor and mission peculiar costs related to the aircraft deployment.

7600A Block 12/13: Requesting/Servicing Roles

NASA JSC, as the Servicing Agency, will use reasonable efforts to:

1. Provide engineering support for scientific instrument integration and certify airworthiness of Partner instruments flying on the NASA WB-57F
2. Provide project coordination and assist in mission planning and logistics
    a. Mission calendar and daily schedule
    b. Remote deployment planning
    c. Payload satellite communications
3. Conduct high altitude flights to meet science objectives per the anticipated deliverables summary below
    a. Coordinate with science team on flight planning

NOAA OAR, as the Requesting Agency, will use reasonable efforts to:

1. Provide detailed scope and objectives to NASA for individual SABRE project missions
2. Coordinate with NASA JSC on determining SABRE mission logistics and planning
    a. Mission calendar and daily schedule
    b. Weather prediction and flight planning
3. Provide scientific instruments in airworthy condition for integration onto the aircraft
    a. Provide instrument documentation for airworthiness certification
4. Support and operate scientific instruments for measurements during WB-57 flights

Deliverables Summary

The following deliverables are predicated on the current SABRE plans. Timing of deliverables subject to change.

- Phase 1a: 24 usage days, 33 flight hours out of KEFD, Houston, Texas in Q1 FY2022
    - Integration and test activity required to begin at agreement execution
    - Flight hour breakdown: 3.0 high check flight, 6.0 high test, 24.0 mission flights
- Phase 1b: 24 usage days, 33 flight hours out of KEFD, Houston, Texas in Q3 FY2022

  - Integration engineering
  - Flight hour breakdown: 3.0 high check flight, 6.0 high test, 24.0 mission flights
- Phase 1c: FY22 effort for FY23 SABRE mission (year+ planning lead time required for aircraft remote deployment) including:
  - Deployment site assessment and logistics planning
  - Site surveys of remote deployment locations for operations assessment and logistics arrangements
  - Aircraft and payload engineering support

Order Breakdown for SABRE Activities, when signed – 30 September 2022

Order # 1	Cost	Description	Period of Performance
1a	$700,000	24 aircraft usage days with 33 flight hours, and payload engineering support	When signed to 2021-12-15
1b	$700,000	24 aircraft usage days with 33 flight hours, and payload engineering support	2022-01-01 to 2022-09-30
1c	$300,000	FY22 effort for future mission logistics planning, remote site survey s, and aircraft, and payload engineering support	2022-01-01 to 2022-09-30

The estimated $1,400,000 (lines 1a and 1b) in funding for the aircraft operations consists of several components: a daily Aircraft Usage Fee; a per Flight Hour cost; instrument integration engineering billed at an hourly rate; estimated overtime labor charges related to extended crew workdays for flight days; satellite communications costs that are dependent on the bandwidth required.

The estimated $300,000 (line 1c) in future mission logistics planning and support must occur in fiscal year 2022 to prepare for planned flight campaigns in fiscal year 2023. That funding amount includes: labor hours and travel costs to survey possible deployment sites at Fairbanks; labor hours and travel costs to survey facilities for deployment to Keflavik; labor hours to conduct mission planning; labor hours and materials to conduct instrument integration and engineering; and labor hours for aircraft engineering work.

Notional SABRE Payload Plan

Instrument	Location	PI/POC
DLH	L Spear Pod	Glenn Diskin (PI)
Roscoe (tbd)	R Super Pod	Matt McGill (PI)
MMS	Nose + For Trans	Paul Bui (PI)
PALMS-NG	Nose	Gregg Schill (PI)
OCS/CO	L Super Pod	Drew Rollins (PI)
CAS-Depol	R Spear Pod	Harald Schuh (Tech POC) Max Dollner (co-I) Bernadett Weinzierl (PI)
NOAA-AMP (NMASS + UHSAS + CDA)	Pallet pos 1	Chuck Brock (PI/POC) Christina Williamson (PI) Adam Ahern (PI)
SP2	Pallet pos 2	Shuka Schwarz (PI)
SOAP	Pallet pos 2	Chuck Brock (POC)
LIF-SO2, LIF-NO	Pallet pos 3	Drew Rollins (PI) Eleanor Waxman (Co-I)
Strat-CIMS	Pallet pos 4	Drew Rollins (PI) Patrick Veres (PI)
UASO3	L Super Pod	Troy Thornberry (PI)