Underwater Training and Testing

Performance Work Statement (PWS)

1.0 Objective and Scope

The Contractor shall provide the infrastructure, personnel, training, materials, foods, supplies, and operational support necessary to execute a multi-day Underwater Training / Testing Capability Demonstration. The primary objective is to systematically demonstrate and evaluate the contractor's ability to perform spaceflight-analog training. Secondary objective is to perform human research, and technology maturation within a subsea environment.

2.0 General Requirements

The Contractor shall demonstrate the following technical and operational capabilities across the contract lifecycle:

a) **Subsea Saturation Habitat**: Support four (4) NASA-provided participants simultaneously for a minimum of five (5) continuous days at a minimum depth of 12 meters.

b) **Helmet Diving Operations**: Provide umbilical-based helmet diving from the habitat for with four (4) NASA-provided participants.

c) **Bi-Directional Telemetry**: Deliver real-time, bi-directional audio and video streaming between the control center and divers.

d) **Facility Control Center**: Operate a shore- or vessel-based facility control center allowing NASA-provided personnel to monitor, log, and interact with the habitat, diver crewmembers, and vehicle systems.

e) **Data Integration & Compliance**: Collect, monitor, and integrate human research, performance, health, medical, vehicle, and environmental data while ensuring compliance with federal data protection regulations.

f) **Payload Integration**: Provide standardized mechanical, physical, and software interfaces to accommodate NASA-provided payloads, mockups, and operational software tools.

g) **JSC Remote Mission Control**: Establish real-time bi-directional connectivity with NASA Johnson Space Center (JSC). Provide an adjustable communications latency emulator to simulate Earth-to-Moon or Earth-to-Mars delays.

h) **Regulatory & Readiness Compliance**: Maintain compliance with all state and federal safety and environmental regulations for subsea build, deployment, and operations.

i) **Schedule:** All mission timelines, durations, and crew allocations must remain flexible to accommodate unpredictable NASA crew scheduling constraints and research asset availability.

3.0 Tasks and Deliverables

Daily training that may occur via Microsoft Teams or another electronic platform.

Minimum of two (2) computer-based tests/ questionnaire (e.g. ANAM battery

Biological sample (e.g. blood, saliva) collection demonstration

Contractor shall provide a notional schedule.

Minimum of four technology demonstrations

Task 1: Planning & Facility Readiness (Base Period)

The Contractor shall establish the operational baseline and complete facility validation.

- **Task 1.1: Coordination Plan**: Identify Contractor Responsible Persons (RPs) and establish a joint NASA-Contractor coordination framework.
- **Task 1.2: Joint Test Plan**: Co-develop a Joint Test Plan outlining the criteria for evaluating all technical and training capabilities.
- **Task 1.3: Facility Site Visit & NASA Readiness Review:** Provide data, personnel support, and facility documentation to allow NASA to complete a Facility and Test Readiness Review.
- **Task 1**.4 Facility must be RFF certified in accordance with JPR 1700.1L. Facility must complete an internal Facility and Test readiness review.
- **Task 1.5: Participant Processing**: Support NASA-provided participant selection and medical clearance screening workflows.

Task 2: Training & Facility Demonstration Mission (Base Period)

The Contractor shall execute the initial training blocks and the baseline saturation mission.

- **Task 2.1: Test Readiness Review**: Conduct a formal Training Readiness Review prior to entering the water or beginning hazardous testing.

- **Task 2.2: Diver & Habitat Training**: Complete working diver and pre-saturation helmet dive training for 6 NASA personnel. Complete habitat operations training for 6 NASA personnel. Training shall prepare participants to assume operational responsibilities inside the habitat and in shore/vessel support roles.
- **Task 2.3: Baseline Saturation Execution**: Execute a minimum 5-day mission utilizing 2 NASA-provided habitat crewmembers and 2 NASA-provided shore/vessel mission support personnel.
- **Task 2.4: Integration Documentation**: Document the formal NASA-Contractor Integration Process for future payload, research, and training activities.
- **Task 2.5: Reporting**: Deliver a Joint NASA-Contractor Report and outbrief detailing demonstrated capabilities, ConOps recommendations, and architectural designs for future scalable training (up to higher crew capacities).

Task 3: Integrated Space Analog Demonstration Mission (Option 1)

- **Task 3.1: Analog Mission Planning**: Develop a Joint Test Plan and a flight-like Mission Timeline derived from base period findings. Conduct a formal Mission Readiness Review (MRR).
- **Task 3.2: Saturation Mission Execution**: Execute a minimum 5-day integrated space analog mission utilizing 4 NASA habitat personnel and 4 NASA shore/vessel support personnel.
- **Task 3.3: Rescue Diver Provision**: Ensure at least one (1) NASA participant is certified as a Habitat Rescue Diver.

Task 4: Integrated Artemis Surface Mission Rehearsal (Option 2)

- **Task 4.1: Artemis ConOps Planning**: Develop a Joint Test Plan, an Institutional Review Board (IRB) approved protocol matching Artemis human research objectives, and an active timeline integrated into NASA mission systems software.
- **Task 4.2: Extended Saturation Execution**: Execute a minimum 10-day integrated Artemis surface simulation mission with 4 NASA habitat personnel and 6 NASA shore/vessel support personnel.
- **Task 4.3: Advanced Operations**: Support advanced individual competency, commander readiness, and team dynamic training protocols during active saturation.

4.0 Performance Assumptions and Constraints

- **Participant Profiles**: NASA participants may include astronauts, flight controllers, or test subjects who may have zero diving experience beyond basic open-water scuba certification. Contractor training programs shall accommodate this baseline.
- **Limited Training, Research and Technology Demonstrations**: All training materials, mission designs, and evaluation scenarios shall be created collaboratively to align directly with NASA's Training Needs Assessment and astronaut training focus. Secondarily, Human Research Program (HRP), Mars Campaign Office (MCO), Science Mission Directorate, and Space Technology Mission Directorate research and priorities.