Statement of Work

Autonomous Underwater Vehicle (AUV)

Phase I – Development & Demonstration



**HISTORY CHANGE LOG**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| REV | DATE | ORIGINATOR | USED ON | SUMMARY DESCRIPTION OF CHANGES |
| - | 11/27/2023 | Tom G. | X314159-AUV | Initial release. |
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# Introduction

## Scope

This Statement of Work (SOW) defines the scope of work necessary to develop, build, test and demonstrate a prototype for an autonomous underwater vehicle (AUV) with the following capabilities.

* Surveillance and reconnaissance, e.g. identification of underwater mines and other subsurface weapons.
* Recovery of reusable underwater targets, test torpedoes, etc.
* Manipulative abilities sufficient to attach recovery lines to objects.

## Background

The tasks associated with the AUV to be developed are being performed by dolphins trained by the Department of the Navy. The use of dolphins is to be phased out over the next three years, resulting in a gap in capabilities, to be filled by the AUV. The CONTRACTOR shall develop and demonstrate a prototype AUV to meet the requirements specified in the associated Space and Naval Warfare Systems Command (SPAWAR) contract 645\_667-M16-A1A. The AUV shall designed to operate autonomously, with manual control via ultra-high frequency (UHF) communication while on the surface, and very-low frequency (VLF) communication while submerged.

## Period of Performance

The period of performance (PoP) will be a maximum18 months after receipt of order (ARO), with an objective PoP of 12 months.

# Applicable Documents

The following documents form a part of this SOW to the extent specified herein. In the event of a conflict between the documents specified below and the content of the SOW, the SOW shall take precedence. In all cases, SPAWAR shall be notified of any conflicts. Nothing in this document, however, supersedes applicable law and regulations unless a specific exemption has been obtained and incorporated as part of the contract. The following documents of the most recent released issue at the time of the award form a part of this SOW to the extent specified herein.

## Contract Documents

Table 2-1 Contract Documents

|  |  |
| --- | --- |
| **Document Number** | **Title** |
| 645\_667-M16-A1A | Autonomous Underwater Vehicle (AUV) Prototype |

# Program Tasks

The CONTRACTOR shall provide all necessary labor, materials, and facilities required to perform the work described by this SOW and to meet all delivery requirements and the terms of the related contract.

## Program Management and Control

### Monthly Status Review

The CONTRACTOR and SPAWAR shall conduct a monthly review. The dates for the monthly reviews will be agreed upon by both the CONTRACTOR and SPAWAR a minimum of 14 days prior to the review. These reviews may take place at the CONTRACTOR’s facility or virtually at SPAWAR’s discretion.

### Monthly Status Report

The CONTRACTOR shall submit Monthly Status Reports (MSR) (CDRL-001) by close of business on the fifth working day after the CONTRACTOR’s accounting month end during the period of performance. The monthly status report shall be electronically sent to SPAWAR’s Contract Manager (CM) and Technical Lead. Content of the MSR will include the following items at a minimum:

1. Contract Status Summary
   1. Programmatic accomplishments
   2. Technical status and accomplishments
2. Issues & Concerns
3. Action Item Review/Status
4. Schedule Update
5. Identification of Long Lead Materials necessary to meet prototype demonstration date

### Program Management Reviews

The CONTRACTOR shall hold a Program Management Review (PMR) meeting with SPAWAR’s representatives, coinciding with the reviews defined below, to review the progress of the program and discuss technical, status, management status, and discuss the current monthly status report (MSR). The meetings shall be held at the CONTRACTOR’s facility or virtually, at SPAWAR’s discretion. Program action items shall be agreed upon at the meeting, and the agreements included as part of the monthly program review minutes.

### Integrated Master Schedule

The CONTRACTOR shall submit an integrated master schedule (IMS) (CDRL-002) for the duration of the contract phase, as well as a notional schedule for completion of engineering and manufacturing development (EMD) and low-rate initial production (LRIP). The schedule shall show how the CONTRACTOR will meet deliverable dates, program milestones and risk mitigation milestones.

The schedule status shall be provided to SPAWAR’s technical representative and CM in conjunction with the monthly status report.

### Quality Management

The CONTRACTOR shall plan, implement, and maintain a quality management system. The quality management program (CDRL-006) shall be described as part of the first MSR.

### Configuration & Data Management

The CONTRACTOR shall maintain a configuration management system for all items required by this SOW that assures the configuration identification, control, status accounting, reporting, and auditing of all deliverable items. The CONTRACTOR shall maintain a configuration management system that adheres to established CONTRACTOR configuration management Policies and Procedures provided to SPAWAR (CDRL-005), and that is subject to SPAWAR’s review and approval. Authorization to proceed with changes to the baseline configuration shall be provided to the CONTRACTOR by means of appropriate contractual direction prior to change implementation.

### Drawings

The CONTRACTOR shall provide one (1) legible reproducible set and a soft copy set of all CONTRACTOR drawings for any contractual deliverable units (prototypes, brassboards, etc.) in accordance with any established non-disclosure agreement in effect. Documents shall include all fabrication and assembly drawings and Bill of Materials (BOMs).

## Technical Tasks

### Engineering

The CONTRACTOR shall perform all necessary design, engineering, analyses, modeling, and documentation required to define and build the AUV in the prototype.

The CONTRACTOR shall maintain a complete set of current documentation to allow for a seamless transition to LRIP.

### Interface Definition

The CONTRACTOR shall support SPAWAR in refining required interface definitions from a support vessel to the AUV or support equipment to include physical dimensions, electrical interfaces, connectors, isolation, radio frequencies, and network interfaces.

### Software Design

The CONTRACTOR shall provide a software design document (SDD) for the Mission Planning, AUV, and Data Analysis software to SPAWAR. The initial SDD (CDRL-007) shall be submitted to SPAWAR’s Program Manager (PM), CM and Technical Lead as part of the third MSR and updated monthly for each subsequent MSR submittal. The SDD shall include the following artifacts at a minimum:

* Activity diagrams to illustrate the concept of operations for each computer software configuration item (CSCI)
* A failure modes, effects and criticality analysis (FMECA) to show that there are no modules in any CSCI that are single points of failure
* A complete description of each CSCI

### Reliability Analysis

The CONTRACTOR shall provide a reliability estimate or prediction for the prototype AUV based on planned component quality and stress levels. The CONTRACTOR shall update the reliability estimate upon receipt of an EMD/LRIP follow-on contract. The reliability analysis shall include analyses showing that any limited life components exceed design and operational life requirements. The initial reliability analysis (CDRL-008) shall be submitted to the PM, CM and Technical Lead as part of the third MSR and updated monthly for each subsequent MSR submittal.

The CONTRACTOR shall update the reliability prediction as the design matures.

The CONTRACTOR shall mitigate any Single Point Failures in the AUV design that would prevent the overall system from functioning, including communication, software and hardware faults.

The CONTRACTOR shall track and report all failures occurring during development, integration and test of the prototype units to support SPAWAR’s failure trend analysis.

### Structural Modeling

The CONTRACTOR shall perform and provide the results of structural modeling that shows the critical stresses and margin to yield for the manipulator and overall AUV design, to include stresses incurred during launch and recovery. Structural analysis results (CDRL-011) are to be submitted in conjunction with Preliminary Design Review package (CDRL-004) to the PM, CM and Technical Lead and updated for Critical Design Review Package (CDRL-009).

### Milestone Reviews

The CONTRACTOR shall conduct milestone reviews with the BUYER identified below. Minutes of the actions and agreements at each review (CDRL-003) shall be submitted to the SPAWAR PM, CM and Technical Lead with the final review package.

Table 3-1 Milestone Reviews

|  |  |
| --- | --- |
| Review | Due Date |
| Preliminary Design Review | 6 Months ARO |
| Critical Design Review | 9 Months ARO |
| Demonstration Test Readiness Review | 11 Months ARO |

#### Preliminary Design Review

The CONTRACTOR shall conduct a Preliminary Design Review (PDR) no later than six months ARO on a mutually agreed date that SPAWAR will attend, virtually or in person. A draft version of the PDR Package (CDRL-004) will be electronically sent to SPAWAR’s PM, CM and Technical Lead at least 10 working days prior to the review. Topics covered in the Preliminary Design Review will include the following as a minimum:

1. Chassis and mechanical design drawings
2. Detailed schematics and board layouts
3. Software design, including activity and other diagrams to show operational concept
4. Structural analysis
5. Predicted performance estimates
6. Updated schedule
7. CM process
8. Action Item Status

The Preliminary Design Review shall serve as a control gate for agreement on modifications, performance characteristics and physical characteristics prior to committing to the initial fabrication of the prototype AUV. The final presentation package and minutes taken at the Preliminary Design Review shall be prepared and submitted to SPAWAR within 3 working days after the meeting. Program action items shall be agreed upon at the meeting, and the agreements included as part of the minutes.

#### Critical Design Review

The CONTRACTOR shall conduct a Critical Design Review (CDR) no later than nine months ARO on a mutually agreed date that SPAWAR will attend, virtually or in person. A draft version of the CDR Package (CDRL-009) will be electronically sent to SPAWAR’s PM, CM and Technical Lead at least 10 working days prior to the review. Topics covered in the CDR will include the following as a minimum:

1. Prototype circuit card schematics and board layouts
2. Prototype chassis and mechanical design drawings
3. Updated software design artifacts
4. Updated performance estimates for production units
5. Updated schedule
6. Proposed test plan for prototype unit
7. Action Item Status

The Critical Design Review shall serve as a control gate for agreement on modifications, performance characteristics and physical characteristics prior to committing to the final fabrication of the prototype AUV to be demonstrated. The final presentation package and minutes taken at the CDR shall be prepared and submitted to SPAWAR within 3 working days after the meeting. Program action items shall be agreed upon at the meeting, and the agreements included as part of the minutes.

#### Demonstration Test Readiness Review

The CONTRACTOR shall conduct a Demonstration Test Readiness Review (TRR) in conjunction with the completed build of the final prototype unit on a mutually agreed date that SPAWAR will attend, virtually or in person. A draft version of the Demonstration TRR Package (CDRL-010) will be electronically sent to SPAWAR’s PM, CM and Technical Lead 10 working days prior to the review. Topics covered in the TRR will include the following as a minimum:

1. Verification Matrix showing traceability of all requirements to demonstration test plans
2. Completed test plans
3. Completed test procedures
4. Identification and description of demonstration setup and demonstration personnel

The Demonstration TRR shall serve as a control gate for the beginning of an abbreviated EMD to update the design based on any findings from the demonstration, followed by low-rate initial production. The final presentation package and minutes taken at the Test Readiness Review shall be prepared and submitted to SPAWAR within 3 working days after the meeting. Program action items shall be agreed upon at the meeting, and the agreements included as part of the minutes.

# HARDWARE DELIVERABLES

## Delivery Quantities and Schedule

The CONTRACTOR shall adhere to the delivery schedule shown below in Table 4-1. The quantity listed in Table 4-1 represent the quantity required for the AUV demonstration.

Table 4-1. Demonstration Hardware List

|  |  |  |
| --- | --- | --- |
| QTY | Description | Due Date |
| 1 | AUV with Manipulator | 11 Months ARO |
| 1 | Launch and Recovery System (Simplified) |
| 1 | Mission Planning & Data Analysis Computer |

# contract data requirements list (CDRL)

The Contract Data Requirements List (CDRL) is shown in Table 5-1.

Table 5-1. Subcontract Data Requirements List

|  |  |  |
| --- | --- | --- |
| CDRL# | Description | Due Date |
| 001 | Monthly Status Report | 5 working days after accounting month end |
| 002 | Master Schedule | Updates with the MSR packages 5 working days after month end |
| 003 | Milestone Review Meeting Minutes | 3 working days after design change review meeting |
| 004 | Preliminary Design Review Package | Draft 10 working days prior to review  Final 3 working days after review with minutes |
| 005 | CONTRACTOR’s Configuration Management Plan | Delivered as part of Preliminary Design Review Package |
| 006 | Quality Assurance Program Plan | Delivered as part of Preliminary Design Review Package  Update at Critical Design Review |
| 007 | Software Design Documents | Delivered as part of Preliminary Design Review Package  Update at Critical Design Review |
| 008 | Reliability Analysis | Initial at May MSR  Updates as part of subsequent MSRs |
| 009 | Critical Design Review Package | Draft 10 working days prior to review  Final 3 working days after review with minutes |
| 010 | Test Readiness Review Package | Draft 10 working days prior to review  Final 3 working days after review with minutes |
| 011 | Structural Analysis Results | Delivered as part of Preliminary Design Review Package  Update at Critical Design Review |

# acronyms and abbreviations

Below is the list of acronyms and abbreviations used in this document.

Table 6-1 Acronyms and Definitions

| Abbreviation | Definition |
| --- | --- |
| ARO | After Receipt of Order |
| AUV | Autonomous Underwater Vehicle |
| BOM | Bill of Materials |
| CDR | Critical Design Review |
| CDRL | Contract Data Requirements List |
| CM | Configuration Manager/Management |
| CSCI | Computer Software Configuration Item |
| EMD | Engineering and Manufacturing Development |
| FMECA | Failure Modes, Effects and Criticality Analysis |
| IMS | Integrated Master Schedule |
| LRIP | Low-Rate Initial Production |
| MSR | Monthly Status Report |
| PDR | Preliminary Design Review |
| PM | Program Manager |
| PMR | Program Management Review |
| PoP | Period of Performance |
| SDD | Software Design Document |
| SOW | Statement of Work |
| SPAWAR | Space and Naval Warfare |
| TRR | Test Readiness Review |
| UHF | Ultra-High Frequency |
| VLF | Very-Low Frequency |