# ENGINEERING EXPLORER'S POST

## FINAL PROJECT: UNDERWATER ROV

## REQUEST FOR PROPOSAL

Denver, CO

**Points of Contact for Information**


Kylie Apelquist
Engineering Explorer Post
RFP Support
Kylie.c.apelquist@lmco.com

McKenzie Malpede
Engineering Explorer Post
RFP Support
mckenzie.malpede@lmco.com

## TABLE OF CONTENTS

## RFP MISSION OBJECTIVE

NASA has shown interest in sending marine missions to two moons in the solar system: Titan and Europa. Before sending a mission to Titan, NASA is interested in testing prototypes of systems that could be used to explore Titan's seas. Your team's mission is to design, build, and operate a Titan submarine that would be able to perform an obstacle course. Your design can be based on and modified from the SeaPerch ROV design (shown in Figure 2) or can be entirely unique.

The course consists of a mesh vault wall (see Figure 3) that sits at the bottom of a body of water. Starting 2' below the surface will be the Vault door. The door will sit within a 24" opening in the wall. In order to open the door, operators will have to manipulate a simple latch and push the vault door open in either direction. On the other side of the wall on the floor of the pool, there will be a series of payloads to be retrieved. Operators will have to attempt to retrieve as many of the payloads as possible in the time provided. Retrieved boxes will have to then be placed in a specific area near the wall on the operator's side. For additional challenges, there will also be payloads that can be stacked on a vertical tower at the bottom of the body of water as well as floating payloads that can be retrieved.

The wall is made of ½" PVC pipe and fittings. The course is designed for a 12' deep pool. The setup when installed in the pool will place the door 2' below the surface. The door is constructed of ½" CPVC pipe and fittings. The door and wall will be covered with a plastic mesh, similar to snow fence.

**Figure 1 – Concept Submarine for Titan**

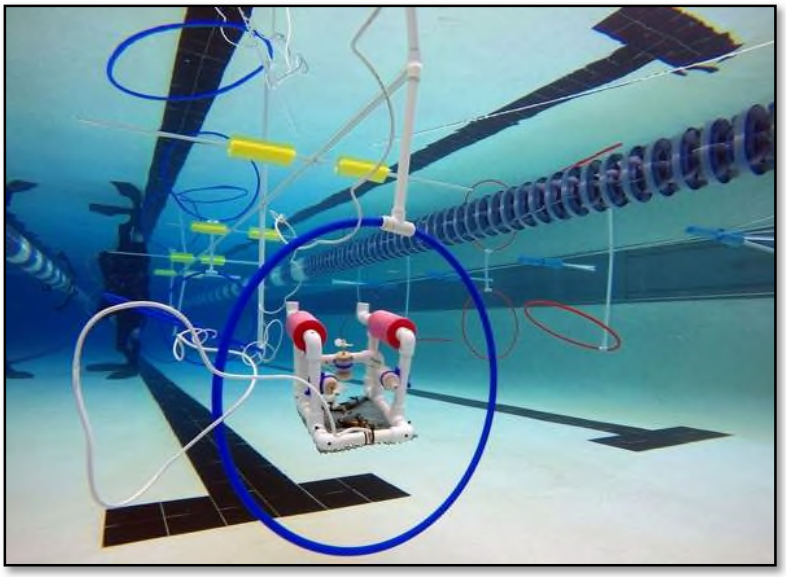

**Figure 2 – SeaPerch ROV Example [credit: www.seaperch.org]**

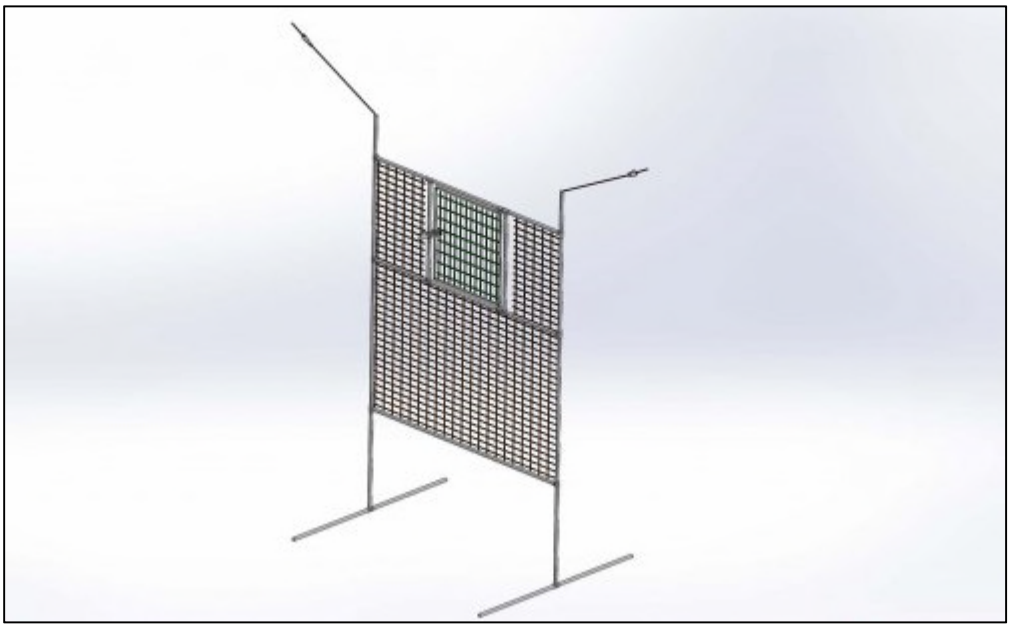

**Figure 3 – Obstacle Wall**

## SECTION A: REQUIREMENTS

### 1. General Requirements

a. The mission shall not exceed a 15 minute period of time.
b. The contractor shall comply with applicable federal, state, and local laws.

### 2. Vehicle Requirements

a. The vehicle shall be able to propel and navigate in an underwater environment
    i. The vehicle shall not be moved via any tethers or cables attached
b. The vehicle volume shall be no larger than 22” in any X/Y/Z direction
c. The vehicle electronics shall be independently powered.
    i. There shall be no external power supplied to the vehicle
    ii. All vehicle power shall be onboard
d. The vehicle shall have a mechanism or attachment with which to pick up and carry payloads
e. The vehicle shall take no longer than 5 minutes to set up.

### 3. Mission Requirements

a. The system shall open and navigate a 24” wide latched door attached to the obstacle wall positioned 2’ below the surface of the water
    i. Successful completion of this requirement is worth 15% of the total technical score
b. The system shall retrieve a variety of weighted payloads from the bottom of the body of water and place them in designated areas
    i. These payloads will be on the opposite side of the obstacle wall
    ii. Each weighted object will be valued at a designated number of points to be redeemed upon proper object placed
    iii. Successful completion of this requirement is worth 50% of the total technical score
c. The system shall retrieve floating payloads on the surface of the water and place them in a designated area
    i. Each floating object will be valued at a designated number of points to be redeemed upon proper object placed
    ii. Successful completion of this requirement is worth 35% of the total technical score

### 4. Safety Requirements

a. The system shall have protections from fan blades to prevent injury.
b. The system shall have proper shielding for electrical components.
c. The system shall be protected from over pressurization if any part of the system uses pressurized gases.
d. The systems shall have protection of internal electrical components from the external water environment.

## SECTION B: DELIVERIES AND PERFORMANCE

### a) RFP Overview – 11/20/2019

*This review is mandatory for each team. An advisor will review this RFP in detail to ensure that the proposal team understands what is required of them*

### b) Proposal Submission – 12/11/2019

*Teams are required to submit their proposals to the customer on this day. Submission shall be both hard copy and digital (PDF or Word document) attached in an email to lmpost.gr-ssc@lmco.com (**Google Drive links or online storage links will not be accepted**)*

### c) Kick-Off Meeting – 1/14/2020

*This review is mandatory for each team. An advisor will walk the proposal team through the reviewed and redlined proposal that was submitted*

### d) Critical Design Review (CDR) – 1/28/2020

*This review is mandatory for each team. The proposal team will develop a "CDR Package" consisting of the items below and present this content to their final project advisor. This CDR Package is to be submitted as either a PowerPoint or PDF attachment in an email to lmpost.gr-ssc@lmco.com. (**Google Drive links or online storage links will not be accepted**)*

- CDR Chart Deck ***(a template will be provided)***
- Cost and Schedule outlines

### e) Test Readiness Reivew (TRR) – 3/10/2020

*This review is mandatory for each team and will include a demonstration to the final project advisor of a working prototype.*

### f) Launch Readiness Review (LRR) – 4/14/2020

*This review is mandatory for each team. A final project advisor will go over the current progress of each team and ensure they are ready for the final exhibition and know the logistics of that day. An "LRR Package" consisting of the items below shall be submitted as either a PowerPoint or PDF attachment in an email to lmpost.gr-ssc@lmco.com*

- LRR Chart Deck ***(to be same format as CDR)***
- Results from prototype testing

### g) Final System Demonstration – 5/2/2019

*Final System Demonstration is to occur on 5/2/2020. Should the demonstration need to be re-schedule due to inclement weather or other reasons, 5/9/2020 will be a backup System Demonstration date.*

### h) Final Presentation – 5/12/2020

*The proposal team will develop a "Final Presentation Package" consisting of the items below and present this content to the entire group (all advisors and other proposal teams). This will be a multimedia package with pictures and video of results highly encouraged. This Final Presentation Package is to be submitted as either a PowerPoint or PDF attachment in an email to lmpost.gr-ssc@lmco.com. (**Google Drive links or online storage links will not be accepted**)*

- Team Introductions/Roles
- Design Overview and Key Features
- Launch Results
- Lessons Learned

## SECTION C: PROPOSAL MILESTONES AND FORMAT

### 1. Proposal Milestones

**Table 1: Proposal Milestones**

| Date | Event |
|---|---|
| *November 20th, 2019* | Final RFP Released |
| *November 20th, 2019* | RFP Review |
| *December 4th, 2019* | RFP Questions Submitted |
| *December 6th, 2019* | RFP Questions Answered |
| *December 11th, 2019* | Proposal Submission and Review |
| *January 14th, 2020* | Contract Award \| Kick-Off Meeting |
| *January 28th, 2020* | Critical Design Review (CDR) |
| *March 10th, 2020* | Test Readiness Review (TRR) |
| *April 14st, 2020* | Launch Readiness Review (LRR) |
| *May 2nd, 2020* | Final System Demonstration |
| *May 9th, 2020* | *-- Backup System Demonstration Date --* |
| *May 12th, 2020* | Final Presentation |
| *May 19th, 2020* | *-- Backup Final Presentation Date --* |

### 1. RFP Questions and Answers (Q&A)

All proposal-related questions related to the RFP should be submitted to the Final Project Advisor by 12/4/2019. Responses to all questions from all proposal teams will be provided to ALL proposal teams no later than 12/6/2019. All answered questions beyond contract award will be distributed to all teams in a reasonable time thereafter.

### 2. Proposal Structure

The Proposal submitted in response to this RFP shall be formatted as follows. Proposal teams must include the name, title, and email address of the individual responsible for inquiries to the proposal. All proposals shall be submitted to the final project advisor by 12/11/2019.

The proposal shall be prepared in accordance with the table below:

| Section | Title | Max Page Limit |
|---|---|---|
| <N/A> | Cover Page | 1 |
| I | Mission Overview / Concept Design Summary | 1 |
| II | Technical | 5 |
| III | Management | 2 |
| IV | Cost Breakdown | 2 |

### 3. Proposal Format

Any proposal pages submitted which exceed the page limitations set forth above will not be evaluated. Format of the above proposal volumes shall be as follows:

- Proposals will be prepared on 8 1/2 x 11 inch paper and typed. Margins shall be 1" for all pages.
- Type size will be no smaller than 10 pt. character height.
- All electronic copies shall be submitted in ".pdf" format to lmpost.gr-ssc@lmco.com and **ATTACHED** (online storage links will not be accepted)

#### 3.1. Cover Page

The Cover Page is limited to 1 page and should include the following

- Proposal Team Name
- Proposal Team Members Names (First and Last)
- Proposal Submission Date

### 3.2. Mission Overview/Concept Design Summary

This section is limitd to 1 page and will contain a brief review of the mission objective and the proposed concept design that will accomplish the stated objective. This section should include information on the advantages of the proposed design over other teams' designs.

### 3.3. Technical

The technical proposal is limited to a maximum of 5 pages. The technical proposal is the basis for evaluating the technical merits of what is being proposed. This section shall contain no price/cost data and shall be organized in the following manner:

| Sub-Section | Title |
|---|---|
| 1.0 | System Overview & Drawings |
| 2.0 | Technical Specification |
| 3.0 | Requirement Verification and Testing |
| 4.0 | Technical Risks & Opportunities |

(1) System Overview & Drawings

The System Overview and Performance must at a minimum include the following:

- A clear description of the problem to be addressed.
- A brief summary of the proposed design, along with a description of other system concepts considered and the rationale for selecting the proposed solution.
- A rough sketch/drawing of the proposed design

(2) Technical Specifications

A list of the key technical requirements that will drive system development, each properly formatted and clearly derived from the requirements.

(3) Requirements Verification and Testing

The proposed Verification approach must at a minimum include the following:

- How this design is going to meet each requirement set forth in Section A of this RFP
- Test Schedule test milestones.

Verification includes the system meeting the specified requirements. Validation includes the system fulfilling the mission.

(4) Technical Risks & Opportunities

The Risks & Opportunities section must include an assessment of all technical risks and opportunities associated with the development of the overall system, development of each major subsystem, system integration, and interfacing with the total system

### 3.4. Management

The management section is limited to 2 pages. The management shall encompass the elements listed below. This section shall contain no price/cost data and shall be organized in the following manner:

| Sub-Section | Title |
|---|---|
| 1.0 | Team Member Roles |
| 2.0 | Schedule |

(1) Team Member Roles

Each team member working on the project shall have a team role as formatted below:

- Full Name
- Contact Information (email/phone/etc…)
- Title and description of what this contributor is responsible for on this project

(2) Schedule

The Schedule must integrate all the management, development, integration, test, and delivery activities. This will be reviewed by a final project advisor and expected to be met by the proposal team throughout the year.

### 3.5. Cost Breakdown

The cost breakdown section is limited to 2 pages. The proposal team shall submit a detailed cost estimate:

- Provide an estimate for the materials for the scope of the work
- Provide a time-based spending plan for the work to be performed (i.e. when will you be procuring materials, will funds need to be spent during testing, etc…)

## SECTION D: EVALUATION CRITERIA AND FACTORS FOR AWARD

### 1. Evaluation Factors for Award

COST: Is the cost reasonable and well justified? Did the team make significant attempts to reduce cost without impacting performance?

FEASIBILITY: Will the proposed technical approach meet all requirements? Can the technical solution be implemented for the proposed cost within the required amount of time?

INNOVATION & CREATIVITY: Is the solution significantly different than the others proposed?

TECHNICAL: Does the team have a reasonable implementation schedule with clearly defined technical milestones? Have they identified the appropriate skills and required number of workers? Does the team have a clear understanding of the risks associated with implementation? Do they have a plan to mitigate these risks?

A scoring rubric will be provided prior to Contract Award.

### 2. Award Limiation

The maximum possible material award amount for a contract is $200.

## SECTION E: REFERENCE MATERIAL AND ADDITIONAL INFORMATION

### 1. Technical References

**SparkFun -** https://www.sparkfun.com/
Great small-scale electronics website that has a number of useful sensors and electronic parts as well as detailed tutorials for using these parts. Located in Boulder, CO

**Arduino -** https://www.arduino.cc/
Arduino-related project resources with sensors and boards for purchase as well as code snippets for use in your programming

**Raspberry Pi -** https://www.raspberrypi.org/ (Watch their video)
Raspberry Pi related project resources, downloads, OS Installs and more

**Adafruit** - https://www.adafruit.com/ (Watch their video)
Great online resource for purchasing and learning to work with small-scale electronics

**McMaster Carr** - https://www.mcmaster.com/
Great resource for a ton of various mechanical parts, fasteners, tools, adhesives, etc…

**Amazon** - https://www.amazon.com/
When in doubt, Amazon has a decent selection of items. If you have an Amazon Prime account, you can get most things with free 2-day shipping

**SeaPerch Kits** - http://www.seaperch.org/order_start
Website for ordering SeaPerch kits ($179)

**SeaPerch Instructions -** http://www.seaperch.org/action/document/download?document_id=254
Construction Manual on how to build SeaPerch kit

**SeaPerch Training Video -** http://www.seaperch.org/online_training_videos
Online training videos on how to build a SeaPerch