

## EXPLORER Class Micro-ROV

### TASK 1: ENSURING PUBLIC SAFETY: DAM INSPECTION AND REPAIR

- **Deploying a secondary, micro-ROV from the primary ROV to inspect the inside of the drain pipe for indicators of possible dam failure**
  - **Identifying areas of muddy water flow inside the pipe using:**
    - **Micro-ROV only connected to main ROV by fiber optic cabling – ?? points**
    - **Micro-ROV connected to main ROV by copper wiring – ?? points**
  - **Docking the micro-ROV to the primary ROV – 5 points**

**Note on ?? points:** The overall point distribution for Task 1 is still a work in progress. However, companies that use fiber optics will receive 10 more points than companies that use copper wiring.

#### **Product Demonstration Notes:**

Companies must build and deploy a secondary ROV from their primary ROV to inspect the inside of a drain pipe for indicators of possible dam failure. The drain pipe will be no longer than 3.1 meters and constructed from [6-inch Corex drain pipe](#). The Corex drain pipe will rest on the bottom of the pool. Over its 3.1 meter length the Corex drain pipe may curve up to 90°. The far end of the pipe will terminate with an end cap.

Companies must use their micro-ROV to inspect the inside of the drain pipe for muddy water flow, which indicates possible dam failure. The muddy water flow will be simulated by 4-inch long strands of brown foam sheeting placed inside the pipe.

Companies will receive points when they successfully identify the area of muddy water flow in the pipe. Successfully identifying the muddy water flow is defined as showing the station judge an image of the brown foam sheeting inside the 6-inch pipe on the company's video display.

Companies whose micro-ROV is attached to the primary ROV only by fiber optic cables will receive ?? points when they successfully identify the area of muddy water. To receive these points, fiber optic cable must be the only connection between the primary ROV and the micro-ROV.

Companies whose micro-ROV is attached to the primary ROV by copper (or other non-fiber optic) wiring will receive ?? points when they successfully identify the area of muddy water.

Companies should be prepared for low light levels inside the Corex drain pipe.

Once the pipe inspection is complete, the micro-ROV must reattach to or dock with the primary ROV. Companies will receive 5 points for successfully docking with their primary ROV. Successfully docking is defined as the micro-ROV attached to or docked with the primary ROV. Also, the micro-ROV tether must be managed and completely contained within the frame of the primary ROV or micro-ROV. No part of the tether may be outside of, or hang below, either ROV. After completing the pipe inspection task, companies must demonstrate to the station judge that the ROV is attached to or docked with the

primary ROV and that the tether is properly stowed before moving on to complete other product demonstration tasks. Companies that do not have a properly stowed micro-ROV or tether may return to the surface to remove the micro-ROV system or repack the micro-ROV or its tether inside the primary ROV. Companies that return to the surface to complete this step will not receive points for docking their micro-ROV within the primary ROV, but may continue on to other tasks.

Once the micro-ROV has successfully docked with the primary ROV (companies have received 5 points for docking), companies may choose to return to the surface and remove the micro-ROV from their primary ROV. Companies will not lose points, or otherwise be penalized, for removing their micro-ROV after completing the pipeline inspection task. Companies may return to the surface and remove their micro-ROV without docking. They will not lose points, or otherwise be penalized but will not receive the 5 points for docking.

NOTE: Companies may not use the micro-ROV to complete other competition tasks or as an additional camera viewpoint away from the primary ROV. Companies will not receive points for completing other tasks if the micro-ROV is in the water and not attached to or docked with the primary ROV.

**Micro-ROV specifications:**

The micro-ROV must be able to move through a 6-inch curving Corex pipe. The minimum bending radius for the pipe will be 152 cm; the pipe may bend 90° over 2.4 meters of length. The micro-ROV must be included with the primary ROV during size and weight measurements.

The micro-ROV falls under the Non-ROV rules and specifications. See **Error! Reference source not found.** for more information. Below is a summary of the micro-ROV NRD rules.

Micro-ROVs can be powered from the primary ROV or from batteries onboard the device. Micro-ROV power is limited to 12 VDC maximum and 6 amps maximum. If powered from ROV power, the micro-ROV must have a 7.5 amp (or smaller) fuse at the point of connection to ROV power.

If on board power is used, the specifications of ELEC-NRD-004 must be met.

Micro-ROVs are permitted to contain thrusters and cameras.

## **PART 3: VEHICLE DESIGN & BUILDING SPECIFICATIONS**

### **2.2.1 Safety documentation requirements**

DOC-003: SID Non-ROV Device: Companies utilizing an independent sensor or other electrically powered, non-ROV device to complete a product demonstration task must submit a SID for this device. The micro-ROV is a non-ROV device; companies must include an SID for their micro-ROV. This diagram must be completed to the specifications listed in DOC-001. The non-ROV device SID may be included on

the main electrical SID or as a separate one 8.5" x 11" page document. Companies must include fuse calculations for the micro-ROV on their non-ROV device SID.

DOC-004: Micro-ROV Design: Companies will be required to submit a one page written and visual (photo) description of their micro-ROV for pipe inspection. This document must specify whether your micro-ROV uses on board power or receives power from the main ROV. If the micro-ROV uses onboard batteries, you MUST include the type of battery used. Companies should note whether their micro-ROV only uses fiber optic cabling to connect to the main ROV or whether copper wire carries power between the micro-ROV and main ROV.

### *3.3.1 Non-ROV Device Power Specifications*

In 2019, the micro-ROV deployed from the main ROV falls under the following NRD power specifications.

ELEC-NRD-001: Non-ROV devices can be powered from the surface running through the ROV (and ROV tether) or from batteries onboard the device. Power is limited to 12 VDC maximum and 6 amps maximum.

ELEC-NRD-002: The micro-ROV may contain thrusters and cameras.

ELEC-NRD-003: If powered from the surface through the ROV, the micro-ROV must have a 7.5 amp (or smaller) fuse at the point of connection to the ROV.

ELEC-NRD-004: Onboard power is allowed for non-ROV devices. If onboard batteries are being used, the following specifications must be met:

- Batteries must be primary (non-rechargeable).
- AAA, AA, A, A23, C, D or 9V alkaline batteries are allowed. No other size or chemical composition is allowed. 12 volt, outdoor, rechargeable batteries are **NOT** allowed. High discharge LiPo batteries are **NOT** allowed.
- Batteries are mounted in a manner that they are not loose inside the container.
- A fuse (7.5 amps max) must be installed within 5 cm of the battery positive terminal.
- The enclosure housing must be designed so that it will open if the pressure inside the housing is greater than the outside pressure.
- Any pressure relief plug **MUST** be at least 2.5 cm in diameter. Smaller plugs will not pass safety inspection.
- The enclosure housing must be designed so that it will release pressure if pressure inside the housing is greater than the outside pressure. Under no condition should the housing be built with fasteners to hold the device together if there is no pressure release valve. At least one opening must serve as a pressure release. This can be achieved by:
  - The battery holder must be mounted in a manner that will allow the end cap to freely open if pressure develops inside the housing.
  - Battery containers utilize a pressure release valve **AND** a Schrader valve. The pressure release valve must be rated no more than 3 psi.

Companies using a pressure release valve for their onboard battery container provide specifications and factory cut sheets of the valve used to the [Competition Technical Manager](#) no later than March 15<sup>th</sup>, 2019 for review by the MATE safety committee.

Examples of acceptable methods for housing batteries include:

- A PVC pipe with wires penetrating one end and the opposite end plugged with a pressure release plug (rubber stopper, etc.). Note: Any pressure release plug MUST be at least 2.5 cm in diameter. Smaller plugs will not pass safety inspection.
- Cylinder with batteries mounted inside. One end of the cylinder sealed with caps and O-rings, but no fastening devices holding the end cap on.
- Cylinder with both a properly rated pressure release valve and a Schrader valve.

ELEC-NRD-005: An SID must be submitted for any non-ROV device that uses electrical power.

### **3.3.5 Tether Voltages**

The signals in the tether must meet the following specifications:

All cameras, including USB cameras, must be powered by the MATE supply. Powering a USB camera from the MATE supply can be accomplished by using a USB repeater / extender that has a separate power input at the far (ROV) end. The ROV must convert the 48V to 12V or 5V as needed to power the device from the MATE 48 volt supply. This conversion must be done on the ROV. USB cameras plugged directly into laptops are not allowed. Be sure to denote camera power on your SID.

#### **Note for 2019!!!**

If a company is using fiber optics and onboard power for their micro-ROV, cameras on the micro-ROV may be powered from the onboard batteries.