

Kill Switch (Emergency Stop) Specifications, v0.7

Background

The Maritime RobotX Rules specify that each competing craft must have two emergency stop systems:

- a hard-wired, on-board, emergency stop system
- a wireless remote emergency stop, located off-board, operating on its unique frequency and link

These are also known as kill switches or E-Stops. The purpose of this document is to provide specifications and guidance so that teams can meet these requirements. Note that kill switch requirements apply to both Autonomous Surface Vehicles (ASVs) and Autonomous Underwater Vehicles (AUVs), when used as an offboard sensor.

Requirements

Both systems must operate independently of the vehicle’s other systems and upon activation of either system (on-board or off-board), the switch must instantaneously disconnect power from the vehicle’s thruster units. An example of how to implement this is shown in Figure 1. System should be designed such that power, to the thrusters, cannot be restored until the emergency switch is reset. This applies to both surface and underwater vehicles.

The TD staff will conduct a detailed engineering and safety inspection in which teams will be required to demonstrate proper operation of all emergency systems.

Onboard Emergency Stop

All vehicles must have an onboard emergency stop capable of being actuated by personnel from a support craft. For personnel safety, the switch may be triggered from a distance by a wooden or plastic pole/paddle for surface craft, and by divers for AUVs. Keeping this in mind, teams should select rugged and reliable components for their safety system.

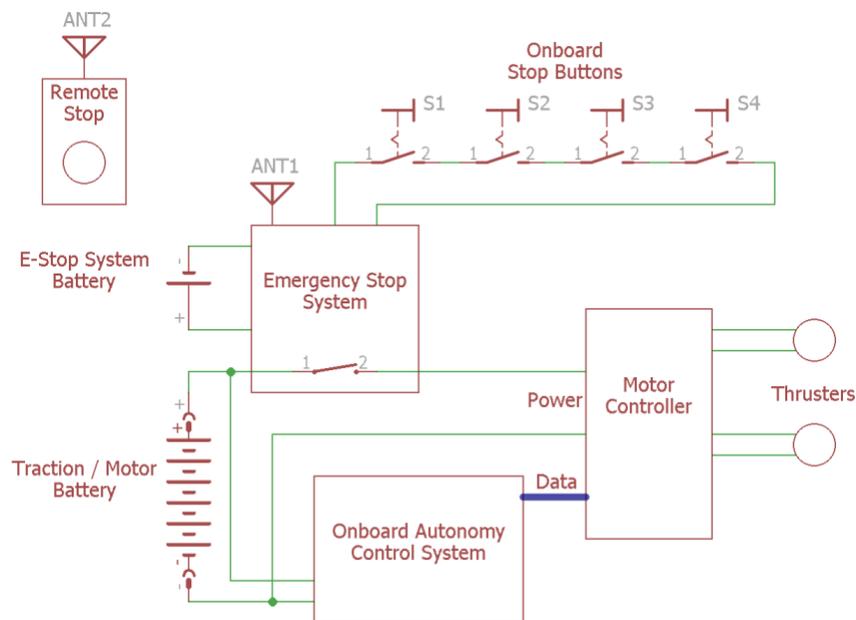


Figure 1: Sample emergency stop circuit

WAM-V Autonomous Surface Vehicle

For the WAM-V, teams will be required to place activation switches, for the emergency stop system, on each of the four arms leading from the payload deck, to the skid plate, or suspension bracket on the pontoons. Examples of acceptable kill switch placement are shown in Figure 2. This switch must be demonstrated to disable AMS thrusters within 1 second of activation in all AMS operating modes.



Figure 2. Kill Switch Placement Examples

Autonomous Underwater Vehicle

Off-board autonomous underwater vehicles should have the capability to be immobilized, allowing support teams to safely approach vehicle, when necessary.

- The AUV must be wired such that disconnecting the tether shall engage the emergency stop system.
- Both the onboard and remotely activated kill switches for the AMS must also kill propulsion power to any off-board systems such as AUVs.
- Engaging the emergency stop system shall cut power to ALL the thrusters immediately.
- If AUV is self-powered (has its own internal batteries), then the AUV must have an on-board physical kill switch that cuts power to its thrusters so that support teams can safely approach the AUV.

E-Stop button

A large, red button should be installed in such a way that safety personnel, from the support craft can easily actuate the button. The engage/disengage button should be red in color and have a 'press to activate and turn to reset' feature. This button, momentary contact switch or not, on actuation, should cut power to the thrusters immediately on actuation. The thrusters must remain in a powered-down state until the judge gives permission for the team to reinitialize the system. An example of a suitable button is shown in Figure 3. This particular switch was found at McMaster-Carr, and it can be found here: <http://www.mcmaster.com/#6785k21/=rjy8d1>



Figure 3. Example Kill Switch

Wireless Emergency Stop

All vehicles must be equipped with a portable, handheld, Wireless Emergency Stop controller. This controller must immediately disconnect power to the vehicle's thruster units when actuated. It should be **independent of any software controlled functionality of the operator's station**. This includes operating on radios independent of the standard command and control system. Example: if teams are using a computer or other embedded system to relay control signals (tele-operation or autonomous mode) to the unmanned system, the emergency stop should be independent of this setup.

The on-board component of the system must operate independently of the rest of the vehicle power, control, and communications systems. This means that it should have an independent power source and use an independent RF system that does not interact or interfere with the TD network or vehicle command and control systems. In addition, this system must also meet host country RF guidelines for frequency and transmit power.

TEAMS NOTE: This is a Preliminary Draft of the Kill Switch Specifications. Contact Aamir Qaiyumi, Maritime RobotX Challenge Technical Director, at Aamir.Qaiyumi@RobotX.org with questions, or post your questions on the [RobotX Community Forum](#).