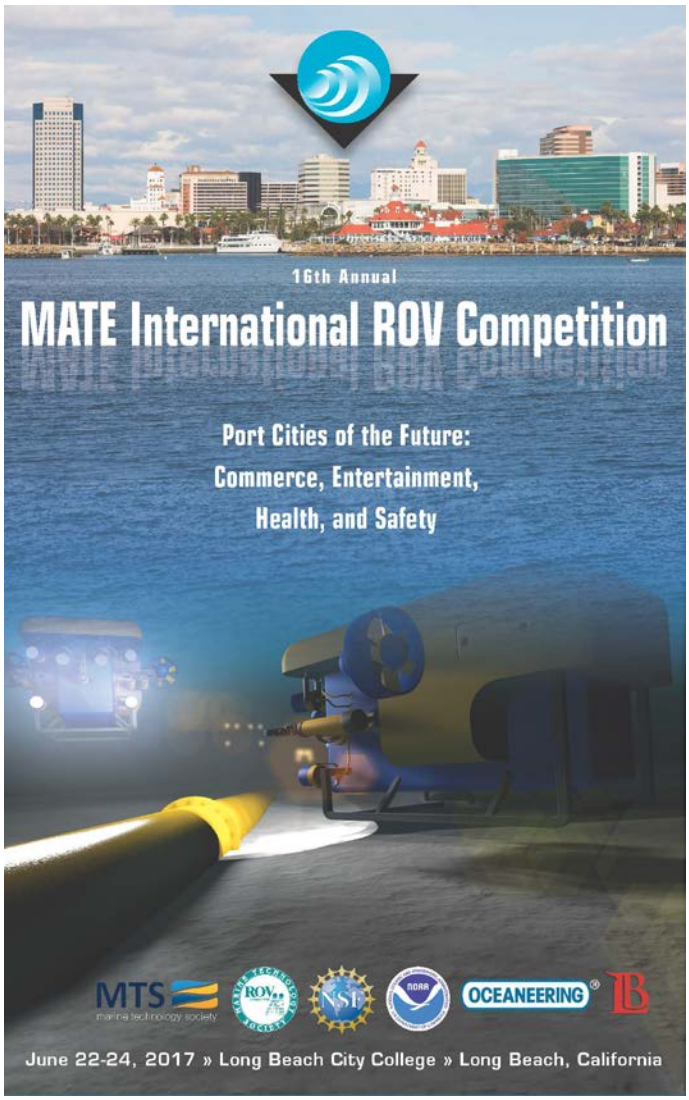
2017 MATE ROV COMPETITION: PRODUCT DEMONSTRATION AND SPECS BRIEFING



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MATE Competition Philosophy

The MATE ROV competition is about **student learning**.

It is designed to be an event that challenges **students** to apply the physics, math, electronics, and engineering skills they are learning in the classroom to solving problems from the marine workplace.

Mentors (teachers, parents, working professionals) are expected to limit their input to educational and inspirational roles and encouraged to focus on the benefits of the **learning process** and not simply on "winning" the competition.

Port Cities of the Future: Commerce, Entertainment, Health, and Safety

CONTEXT

The Port of Long Beach is one of the world's busiest seaports. It is the second-busiest container port in the United States, after the Port of Los Angeles, which it connects to. Acting as a major gateway for trade between the United States and Asia, the port occupies 13 km^2 of land with 40 km of waterfront in the city of Long Beach, California. The Port of Long Beach is located less than 3 km southwest of downtown Long Beach and approximately 40 km south of downtown Los Angeles.

The port has 10 piers, 80 ship berths, 66 gantry cranes, and 22 shipping terminals. More than 2,000 vessels call at the Port of Long Beach each year, moving $180 billion in cargo. Each year, it handles more than 6.8 million 20-foot container units; on a daily average, it is possible for the port to handle of up 30,000 cargo containers. In U.S. dollars, the seaport generates nearly $100 billion in trade each year. It provides more than 316,000 jobs in Southern California; 1.4 million jobs throughout the U.S. are related to Long Beach-generated trade.

In addition to **commerce**, the port includes cruise ships and activities related to tourism and **entertainment**.

Docked in Long Beach Harbor is the RMS (Royal Mail Ship) Queen Mary, a colossal ship bigger, faster, and more powerful than the RMS Titanic. Built in Scotland, the 1,000-foot ship made her maiden voyage on May 27, 1936. After three years of hosting the world's rich and famous across the Atlantic, she was called into service during World War II. She became known as "The Grey Ghost," carrying more than 800,000 troops, traveling more than 600,000 miles, and playing a significant role in virtually every major Allied campaign, including the D-Day invasion. In 1967, she was withdrawn from service after more than 1,000 transatlantic crossings. That same year, the Queen Mary was sold for $3.45 million to the City of Long Beach for use as a maritime museum and hotel.

With all of the activity and vessel traffic, the Port of Long Beach is not immune to accidents and pollution. Thousands of dollars have been spent on the removal and remediation of contaminated sites, such as the IR Site 7 remediation dredging project to remove chemicals that entered the harbor from

the former Long Beach Naval Station operations. More than 400,000m^2 of contaminated sediments were sequestered during that project. In addition, each year thousands of containers fall off of cargo ships, sometimes in harbors as ships are entering or leaving port.

The Port of Long Beach is governed by the City of Long Beach. The City Charter created the Long Beach Harbor Department to promote and develop the Port. The Harbor Department's primary responsibility is the **health** and **safety** of the port and waterfront.

NEED

The Port of Long Beach has issued a request for proposals (RFP) for a remotely operated vehicle and crew that can operate in the sometimes confined and often precarious conditions of the port and waterfront. Specifically, the port managers are in need of an ROV that can 1) assist with the installation of a Hyperloop system to expedite the delivery of goods and streamline **commerce**; 2) conduct maintenance on the port's water and light show to guarantee uninterrupted **entertainment**; 3) identify and collect samples of contaminated sediment then remediate the area to protect the **health** of people and the environment; and 4) identify the contents of containers that fell off of a cargo ship into the harbor and map the accident site to ensure the **safety** of the port and its operations.

Before launch and operations, the ROV must complete a series of "product demonstrations" staged in the swimming pool on the campus of Long Beach City College and at various regional locations. (Depth requirements vary depending on competition class; see **SPECS** below.) Companies that successfully complete the product demonstrations and deliver exceptional engineering and communication components (e.g. technical documentation, product presentations, and marketing displays) will be awarded the contract.

REFERENCES

www.polb.com/about/facts.asp
https://en.wikipedia.org/wiki/Port_of_Long_Beach
www.legendsofamerica.com/ca-queenmary.html
http://losangeles.cbslocal.com/2015/06/02/5-cargo-containers-fall-into-water-at-port-of-la/
http://ascelibrary.org/doi/abs/10.1061/9780784413067.019

DESIGN BRIEF

Below is a summary of the product demonstrations organized by competition class. All four product demonstration tasks will be attempted in one product demonstration run.

EXPLORER

Commerce: Hyperloop Construction

- Insert two rebar reinforcement rods into position in the steel baseplate.
- Install the frame onto the baseplate.
- Remove a pin to release the chains holding the frame.

- Transport and position the hose for pouring concrete into the frame.
- Retrieve the three positioning beacons and return them to the surface.

Entertainment: Light and Water Show Maintenance

- Disconnect the power cable from the platform.
- Turn the valve to stop the flow of water to the platform.
- Disengage the locking mechanism at the base of the fountain.
- Remove the old fountain.
- Install the new fountain.
- Re-engage the locking mechanism at the base of the fountain.
- Turn the valve to restore the flow of water to the platform.
- Reconnect the power cable to the platform.
- Return the old fountain to the surface, side of the pool.

Health: Environmental Cleanup

- Use a simulated Raman laser to determine if contaminants are present in two sediment samples.
- Collect a 100 ml sediment sample from the contaminated area and return it to the surface. The sediments will be simulated by agar.
- Collect two clams from the contaminated area and return them to the surface.
- Place a cap over the contaminated sediments.

Safety: Risk Mitigation

- Locate the four cargo containers.
- Activate each container's Radio Frequency IDentification (RFID). This will be simulated by shining a light into a port on the side of the container to activate the sensor.
- Obtain RFID data via Bluetooth.
- Use the data to determine the container's identification number, contents, and if the contents are high risk. (MATE will provide you with a container manifest.)
- Attach a buoy marker to the eye-bolt on the container with high-risk cargo.
- Determine the distance from the high-risk container to the other three containers.
- Determine the direction from the high-risk container to the other three containers.
- Use distance and direction to make a survey map of the incident site. (MATE will provide a blank map with 0.25 meter squares.)

RANGER

Commerce: Hyperloop Construction

- Insert two rebar reinforcement rods into position in the steel baseplate.
- Install the frame onto the baseplate.
- Remove a pin to release the chains holding the frame.
- Transport and position the hose for pouring concrete into the frame.

- Retrieve the three positioning beacons and return them to the surface.

Entertainment: Light and Water Show Maintenance

- Disconnect the power cable from the platform.
- Turn the valve to stop the flow of water to the platform.
- Disengage the locking mechanism at the base of the fountain.
- Remove the old fountain.
- Install the new fountain.
- Re-engage the locking mechanism at the base of the fountain.
- Turn the valve to restore the flow of water to the platform.
- Reconnect the power cable to the platform.
- Return the old fountain to the surface, side of the pool.

Health: Environmental Cleanup

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- Collect a 100 ml sediment sample from the contaminated area and return it to the surface. The sediments will be simulated by agar.
- Collect two clams from the contaminated area and return them to the surface.
- Place a cap over the contaminated sediments.

Safety: Risk Mitigation

- Locate the four cargo containers.
- Insert the sensor provided by MATE into the port on the side of each container to activate the RFID. The RFID will be simulated by LED lights on the surface at the side of the pool.
- Use the data to determine the container's identification number, contents, and if the contents are high risk. (MATE will provide you with a container manifest.)
- Attach a buoy marker to the U-bolt on the container with high-risk cargo.
- Determine the distance from the high-risk container to the other three containers.
- Determine the direction from the high-risk container to the other three containers.
- Use distance and direction to make a survey map of the incident site. (MATE will provide a blank map with 0.25 meter squares.)

NAVIGATOR

Commerce: Hyperloop Construction

- Insert one rebar reinforcement rod into position in the steel baseplate.
- Install the frame onto the baseplate.
- Remove a pin to release the chains holding the frame.
- Transport and position the hose for pouring concrete into the frame.
- Retrieve the three positioning beacons and return them to the surface.

Entertainment: Light and Water Show Maintenance

- Disconnect the power cable from the platform.
- Turn the valve to stop the flow of water to the platform.
- Remove the old fountain.
- Install the new fountain.
- Turn the valve to restore the flow of water to the platform.
- Reconnect the power cable to the platform.
- Return the old fountain to the surface, side of the pool.

Health: Environmental Cleanup

- Collect a sediment sample from the contaminated area and return it to the surface.
- Collect two clams from the contaminated area and return them to the surface.
- Place a cap over the contaminated area.

Safety: Risk Mitigation

- Locate the two cargo containers.
- Insert the sensor provided by MATE into the port on the side of each container to activate the RFID. The RFID will be simulated by LED lights on the surface at the side of the pool.
- Use the data to determine the container's identification number, contents, and if the contents are high risk. (MATE will provide you with a container manifest.)
- Attach a buoy marker to the U-bolt on the container with high-risk cargo.

SCOUT

Commerce: Hyperloop Construction

- Install the frame onto the baseplate.
- Transport and position the hose for pouring concrete into the frame.
- Retrieve the three positioning beacons and return them to the surface.

Entertainment: Light and Water Show Maintenance

- Turn the valve to stop the flow of water to the platform.
- Remove the old fountain.
- Install the new fountain.
- Turn the valve to restore the flow of water to the platform.
- Return the old fountain to the surface, side of the pool.

Health: Environmental Cleanup

- Collect a sediment sample from the contaminated area and return it to the surface.
- Collect two clams from the contaminated area and return them to the surface.
- Place a cap over the contaminated area.

Safety: Risk Mitigation

- Locate the four cargo containers.
- Use a magnetic reed switch to activate the RFID. In this scenario, the RFID will only respond if the cargo is high-risk.
- Deploy a marker on each container that contains high-risk cargo.

SPECS

What follows is a summary of the electrical and fluid power requirements for each competition class. The complete design and building specifications will be included within the competition manual.

NOTE: Watch for new safety requirements and additional, detailed electrical specifications within the competition manuals.

EXPLORER

- ***New in 2017!*** 48 volts, 30 amps DC. Conversion to lower voltages must be done on the ROV, not topside. Onboard electrical power is not permitted.
- Pneumatics and hydraulics are permitted provided that the team passes the MATE Fluid Power Safety Quiz and follows the specifications included within the competition manual.
- Lasers are permitted provided that the team follows the specifications included within the competition manual.
- Camera is required.
- Depth requirement at the international competition: 3.7 meters.
- Maximum size: 85 cm. Vehicles above this size will not be allowed to compete in the product demonstration. See below for additional details on size requirements.
- ***New in 2017!*** Maximum weight: 25 kg. See below for additional details on weight requirements.

RANGER

- 12 volts, 25 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Onboard electrical power is not permitted.
- Pneumatics and hydraulics are permitted provided that the team passes the MATE Fluid Power Safety Quiz and follows the specifications included within the competition manual.
- Lasers are permitted provided that the team follows the specifications included within the competition manual.
- Camera is required.
- Depth requirement at the international competition: 3.1 meters. Depth requirement may vary at regional competitions. The regional coordinator will provide this information.
- Maximum size: 75 cm. Vehicles above this size will not be allowed to compete in the product demonstration. See below for additional details on size and weight requirements.
- ***New in 2017!*** Maximum weight: 20 kg. See below for additional details on weight requirements.

NAVIGATOR *(only available at certain regionals)*

- 12 volts, 15 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Onboard electrical power is not permitted.
- Manually-powered hydraulics and pneumatics are permitted. Pneumatic systems cannot exceed ambient pool pressure and must follow the fluid power specifications included within the competition manual.
- Lasers are NOT permitted.
- Camera is required.
- Depth requirement: Varies depending on the regional event. The regional coordinator will provide this information.
- ***New in 2017!*** Anderson Powerpole connectors are required on all vehicles.
- Maximum size limit: None. See below for additional details on size requirements.

SCOUT

- 12 volts, 15 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Onboard electrical power is not permitted.
- Manually-powered hydraulics and pneumatics are permitted. Pneumatic systems cannot exceed ambient pool pressure and must follow the fluid power specifications included within the competition manual.
- Lasers are NOT permitted.
- Depth requirement: Varies depending on the regional event. The regional coordinator will provide this information.
- ***New in 2017!*** Anderson Powerpole connectors are required on all vehicles.
- Maximum size limit: None. See below for additional details on size requirements.

SIZE AND WEIGHT POINT VALUES

The Port of Long Beach has included an ROV size and weight requirement in the request for proposals (RFP). Smaller, lighter vehicles will be given special consideration and vehicles above a certain size and weight will not be considered.

All size and weight measurements will include the vehicle, all tools and components, and the tether. The topside control system and 1 meter of tether going into the control system will **NOT** be included in the length or weight measurement. To receive points for smaller sized vehicles, the two **largest** dimensions of the vehicle and tether must fit through a round hole of the following dimensions:

EXPLORER

Size		Weight (in air)	
< 58 cm diameter	**+20 points**	**< 17 kg**	**+20 points**
58.1 to 64 cm diameter	**+10 points**	**17.01 kg to 19 kg**	**+10 points**
64.1 to 70 cm diameter	**+5 points**	**19.01 kg to 22 kg**	**+5 points**

Vehicles above 85 cm in diameter, or greater than 25 kg in weight, will not be allowed to compete in the product demonstration.

RANGER

Size		Weight (in air)	
< 48 cm diameter	**+20 points**	**< 11 kg**	**+20 points**
48.01 cm to 54 cm	**+10 points**	**11.01 kg to 12 kg**	**+10 points**
54.01 cm to 60 cm	**+5 points**	**12.01 kg to 14 kg**	**+5 points**

Vehicles above 75 cm in diameter, or greater than 20 kg in weight, will not be allowed to compete in the product demonstration.

NAVIGATOR

Size	
< 44 cm diameter	**+10 points**
44.01 cm to 54 cm	**+5 points**

SCOUT

Size	
< 40 cm diameter	**+10 points**
40.01 cm to 48 cm	**+5 points**

NOTE: In addition to the size and/or weight limitations described above, companies must be able to transport the vehicle and associated equipment to the product demonstration station and to the product presentation room. The ROV systems must be capable of being safely hand launched.

RESOURCES

Teams are permitted to use the materials of their choice provided that they are safe, will not damage or otherwise mar the competition environment, and are within the defined design and building specifications.

Teams are encouraged to focus on engineering a vehicle to complete the product demonstration tasks; when considering design choices, teams should ask themselves which one most efficiently and effectively allows them to solve the problem. Re-using components built by previous team members is permitted provided that the current team members evaluate, understand, and can explain their engineering and operational principles. Using or re-using commercial components is also permitted, provided that team members evaluate, understand, and can explain their engineering and operational principles. Teams will be questioned extensively on their overall design and component selections during their technical sales presentations.

TIME

The complete competition manual will be released by November 15, 2016; teams have from that date until the regional events in the spring of 2017 to construct their vehicles and prepare the engineering and communication components (technical documentation, product presentations, and marketing displays). Visit the MATE web site at www.marinetech.org or request to be added to the MATE competition listserv to ensure a timely delivery.