



**MATE**  
MARINE  
ADVANCED  
TECHNOLOGY  
EDUCATION  
CENTER

## 2010 MATE International ROV Competition

[www.marinetech.org/rov\\_competition/index.php](http://www.marinetech.org/rov_competition/index.php)



### *ROVs in Treacherous Terrain: Science Erupts on Loihi, Hawaii's Undersea Volcano*

June 24 – 26, 2010  
University of Hawaii at Hilo  
The Big Island of Hawaii



UNIVERSITY  
OF HAWAII  
HILO



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## ENGINEERING & COMMUNICATION

The ability to effectively communicate information about your vehicle and the design and building process is equally as important as how well your vehicle performs. To emphasize this point, the competition requires teams to submit technical reports, prepare and deliver engineering presentations, and create poster displays.

### COMPETITION OVERVIEW

The ROV competition is divided into two competition classes: **RANGER** and **EXPLORER**. (The SCOUT class is also available at the MATE Monterey Bay, Pacific Northwest, Big Island, and Southern California Regional ROV Contests. See the individual web sites of these contests for more information.) Eligibility requirements for both classes are listed within the 2010 [General Information](#) document. Please review these requirements carefully.

The 2010 competition focuses on the Loihi seamount, an active undersea volcano that rises more than 3,000 meters above the seafloor. The mission tasks challenge teams to deploy instruments, take sensor readings, plot data, and collect samples of geologic features as well as organisms that inhabit the volcano's flanks.

The competition consists of underwater missions, technical reports, engineering presentations, and poster displays with the following scoring breakdown:

- Mission
  - **EXPLORER** – 300 points (max), plus a time bonus
  - **RANGER** – 300 points (max), plus a time bonus
- Engineering & communication – 200 points (max)
  - Technical reports – 80 points (max)
  - Engineering evaluations – 80 points (max)
  - Poster displays – 40 points (max)

*This* document, [Engineering & Communication](#), contains information about the technical report, engineering evaluation, and poster display requirements. Information about the underwater mission tasks can be found within the [Competition Missions](#) document; photos and SolidWorks files are located in the [Mission Prop Photos](#) and [SolidWorks Assemblies and Drawings](#) documents, respectfully. The [Design & Building Specifications and Competition Rules](#) document contains information about ROV specifications and competition rules.

## **REGISTER WITH ALUMNIWEB ([www.marinetech.org/alumni](http://www.marinetech.org/alumni))**

Teams are **required** to register (or to update the registration information of) each student team member with MATE's AlumniWeb, a web site designed to help MATE follow the progress of students, instructors, mentors, and others who have participated in MATE's programs. AlumniWeb also helps the MATE Center to demonstrate the impact of the competition program to its funding agencies, which in turn helps the MATE Center to continue to offset expenses associated with the competition events.

Students are required to complete the entire AlumniWeb form. Note that personal contact information provided to MATE's AlumniWeb is confidential. It will not be shared with anyone outside of the MATE staff. Visit [www.marinetech.org/alumni](http://www.marinetech.org/alumni) for details and to register.

## **REMINDER ABOUT THE USE OF COMMERCIAL PLUG-AND-PLAY SYSTEMS**

The purpose of the MATE ROV competition is to introduce teams to technical and engineering challenges from the real world. The learning experience comes from designing and building an ROV from readily available and inexpensive components, testing it, and analyzing the inevitable failures, then working on successive, more reliable, and effective solutions. The use of professionally designed and built, "plug-and-play" systems short-circuits this process and is therefore highly discouraged. See the [Design & Building Specifications and Competition Rules](#) document for further discussion about this topic.

## **TECHNICAL REPORT**

Prior to the competition, teams will be required to submit a technical report that will be reviewed and evaluated by a panel of judges, individuals who represent science, exploration, government, and industry. (**Note: These individuals may not be the same judges who evaluate your team's engineering presentation.**) Keeping a project notebook(s) will help with this report. Your project notebook(s) will provide you with both content and reference information and help you to organize your report.

**Technical reports must be submitted to the competition coordinator 4 weeks prior to the competition date.** (Note that regional contests' deadlines may vary. See [www.marinetech.org/rov\\_competition/2010/regional\\_contests.php](http://www.marinetech.org/rov_competition/2010/regional_contests.php) for more information.) **The report should be sent electronically as a pdf attached to an e-mail or as a pdf saved on a CD-ROM or disc and snail-mailed to the competition coordinator. The report should not exceed a file size of 2MB.**

Any changes or additions that you make to your ROV that differ from the information in the technical report that you submit can be presented to the judges as part of your poster display and/or during your team's engineering presentation. **Note that the judges will not review and rescore revised versions of your technical report during the competition.**

Each judge on the panel will award a report score (80 points max). Judges' report scores and comments will be returned to you shortly after the event.

Examples of top technical reports from previous years' competitions are posted on the competition web site at [www.marinetech.org/rov\\_competition/report\\_examples.php](http://www.marinetech.org/rov_competition/report_examples.php).

The guidelines and required components for the report are:

**Note: Make sure to label any and all figures, graphs, diagrams, and photographs.**

- **Length is less than 20 pages\***
- **Font size of at least 12 points (font type can vary)**
- **All measurements are in SI units (metric)**
- **Title page** that includes:
  - Your project/ROV name
  - School/club name
  - Team name (if applicable)

- **COMPLETE** list of team members (you can also include degree/area of study and expected graduation date)
  - Names of your instructor(s) and/or mentor(s)
- **Abstract (250 words or less)** that is concise and clearly summarizes the project.
- **Table of contents**
- **Photograph(s) of your completed ROV**  
You are permitted to make modifications that may change the look of your vehicle between the time you submit your report and the competition; however this must be a photo(s) of your completed, intact vehicle, not photos of individual systems and/or payload.
- **Budget/expense sheet**  
Keep an accounting of your monies and expenditures. In addition to funds, list any items (building materials, equipment, travel stipends, etc.) that were donated, the organization that made the donation, and an estimate of the item's value. A sample expense/budget sheet is provided on the competition web site at [www.marinetech.org/rov\\_competition/2010/nonvehicle\\_requirements.php](http://www.marinetech.org/rov_competition/2010/nonvehicle_requirements.php) as an example of how you can organize and report this information.
- **Electrical schematic**  
Make sure to highlight safety features such as circuit breakers and fuses. This schematic may be NEATLY drawn by hand or created using a CAD software program (e.g., OroCAD).
- **Block-diagram or flow-chart of software in the ROV (if applicable)**  
This flow diagram should detail the software code written for your control system or other elements of your ROV. If you are using a purchased control system that utilizes software, you are encouraged to learn about its operation and describe it in a diagram.
- **Design rationale** presented in a clear and logical manner.
- **Description of at least one challenge** that your team faced and what methods were used to overcome it. These can include both technical and those challenges related to working as a team, such as team dynamics and dealing with individual personalities.
- **Explanation of troubleshooting technique(s)** used to overcome technical problems.
- **Description of at least one lesson learned or skill gained** during the design and building process.
- **Discussion of future improvements**
- **Information about the Loihi seamount, including the processes that created it and/or the research, technologies, and/or people who explore and study it.** You can broaden this to the entire Hawaiian-Emperor seamount chain, or keep it focused specifically on Loihi. Reference at least 2 sources for your information. Include a photograph or other graphic where appropriate, making sure to credit the source. Do not copy information directly from a book or web site. Synthesize the information and draw parallels between it and your work.
- **Reflections on the experience.** This can be written from the point of view of the team as a whole or each individual team member can contribute. It can include personal or professional accomplishments achieved as a result of participating in the competition.
- **References.** List any books, journal articles, magazines, trade publications, web sites, and professional advice that you utilized as sources of information for your work.
- **Acknowledgements**  
Please recognize the companies, organizations (including the MATE Center), professionals from industry, and/or mentors who helped to support your team by donating funds, building supplies, equipment, site visits to facilities, time, and/or technical expertise. You can include companies, organizations, and/or individuals that provided logistical and/or moral support (e.g. your parents, siblings, or pets). Regional competition teams should also acknowledge regional contest supporters.

\*You are permitted to include appendices that exceed the 20-page limit if the appendices are critical to explaining a particular aspect of your vehicle. However, judges reserve the right to deduct points for excessive abuse of appendices.

## **NEW IN 2010!!! TEAM SPEC SHEET**

This year teams are required to submit a “team spec sheet” along with their technical reports. The goal of the team spec sheet is to provide the judges with a “snapshot” of the competing teams. The spec sheet is designed to include basic information about your team and vehicle.

**Teams must submit the team spec sheet to the competition coordinator 4 weeks prior to the competition date.** (Note that regional contests’ deadlines may vary. See [www.marinetech.org/rov\\_competition/2010/regional\\_contests.php](http://www.marinetech.org/rov_competition/2010/regional_contests.php) for more information.) **The spec sheet should be sent electronically as a pdf attached to an e-mail or as a pdf saved on a CD-ROM or disc and snail-mailed to the competition coordinator.**

**The spec sheet should NOT exceed one page in length and should follow the font style requirements of the technical report.**

Team spec sheets must include the following information:

### **TEAM SPECS**

- **School name.** In addition to your school’s name, your team name can be included here.
- **Home state**
- **Distance traveled to the international competition**
- **First-time MATE ROV competition participant?** Be sure to specify if your school and/or your team members are “new” or “returning.” If your team has participated in a regional contest before but this is your team’s first trip to the international competition, please indicate that, too.
- **Team photo and caption indicating team member name and role (e.g. team captain).** This photo should include all of the team members, especially those planning to travel to the international event.
- **Range of grade levels represented by your team members**

### **ROV SPECS**

- **ROV name** if applicable
- **Total cost.** Be sure to include the approximate cost of any donated items.
- **Primary material(s) used in construction** (e.g. PVC, aluminum, acrylic)
- **Approximate dimensions in metric units**
- **Total weight in AIR in kilograms.**
- **Safety features**
- **Special features**
- **Photo of the vehicle**

### **ENGINEERING EVALUATION**

During the competition, teams will be required to give a 15-minute presentation to a panel of judges, individuals who represent science, exploration, government, and industry. **(Note: These individuals may not be the same judges who evaluate your team’s engineering presentation.)** Your team’s presentation should describe the engineering behind your vehicle’s design and operation and address any possible safety issues. It should also highlight any design innovations or creative solutions to solving the mission tasks. After the presentation, the judges will take 10-15 minutes to ask your team members questions about your ROV. The judges will evaluate both your presentation and responses to their questions.

**Instructors, mentors, family members, friends, and members of other teams are permitted to attend this evaluation.** However, we ask that those in attendance be respectful and courteous throughout the team’s presentation and follow-up question and answer period. Be mindful that this evaluation may be a stressful time for the presenting team. If the room becomes crowded or the spectators become distracting, it is up to the judges’ discretion to request that some or all spectators leave the presentation. **While they are permitted to attend, instructors and mentors are not allowed to participate in the interview process.**

### Who presents?

All student members of your team must participate in this presentation. Your team can choose to designate one team member to give the complete, 15-minute talk or divide topics up among one, two, or all of your teammates. You will be required to have your ROV with you. **You are also required to bring a print-out of your electrical schematic as well as software code, if applicable.** MATE will not provide audio visual aids, such as slide projectors, computer projection screens, white boards, etc.; however, you are welcome to bring your own. You are also welcome to distribute handouts to help judges better understand the information that you are presenting. During the question and answer period, all team members must be present and prepared to answer.

Each judge on the panel will award an engineering score (80 points max). Judges' engineering scores and comments will be returned to you shortly after the event.

The judges' panel will focus on the features of your ROV's design and the process that went into building the vehicle. The judges will pay particular attention to whether or not the vehicle was built by the students from "scratch" or excessively uses complete, off-the-shelf systems. Design originality and innovation as well as safeguards to prevent injury or damage to the underwater environment will be noted. The use of complete, commercially-available systems is highly discouraged (see [Design & Building Specifications and Competition Rules](#) for more information on this topic).

Here are some examples of questions that the judges may ask. **NOTE: These are only examples and may not be the actual questions asked.** Your team must be prepared to answer questions other than those examples listed below.

### Structure

- How did you decide on the shape of the vehicle and the materials used to build it?
- What is the design depth rating of your ROV? Did you test this? How?
- Did you use any pressure housings in your design? Explain how you designed and built these.
- What are o-rings and how do they work?
- How much did it cost to build your vehicle?
- How much does your ROV weigh in air? In water?

### Control system

- What type of control scheme have you used? Why?
- How does your control system work?
- How many conductors are in the tether?
- What devices/functions does your system control?
- Is there some unique feature of your control system?
- How did you waterproof your underwater electrical connections?

### Propulsion

- How many thrusters does your vehicle have? Why?
- How much thrust does each produce?
- How many watts does one thruster use at full rpm?
- How many amps does one thruster draw under full load?
- Explain how you measured thrust.
- How is power (watts) used by one thruster related to the thrust it produces?
- Do you know the forward speed of your ROV? How did you measure this?

### Ballast System

- How does your ROV ballast system work?
- Explain what stability is.
- Why is it important to consider stability in the design of ROVs?

### **Sensors**

- What type of camera did you choose? How did you waterproof it?
- What do your sensors measure or detect?
- What unique features are incorporated into your sensors?
- What additional sensors (other than a camera) have you put on your ROV? Why?

### **Payload Tools**

- What type of payload tool(s) did you design to accomplish the missions and why?
- Explain how this tool(s) works.

### **Resources**

- Did the project meet the budget?
- What equipment/building supplies were donated, built, or bought?
- Did you economize yet produce a functional and robust vehicle?

### **System Design**

- Can the vehicle accomplish the mission tasks?
- What are the strengths of the design?
- What are the weaknesses?
- Do the safety systems work?

### **Originality**

- Does the design of the vehicle and its systems exhibit unique concepts?
- Does the vehicle make excess use of commercially-available systems?
- Are there any innovations or modifications that resulted in higher functionality and reduced costs?
- If you are using the same vehicle as last year, why? What are the advantages? What, if any, modifications or additions did you make?

### **Workmanship**

- What is the overall quality of the workmanship?
- Are the electrical systems neatly run and wired?
- Is it easy to access components for maintenance?
- Is the tether neatly bundled and protected?
- Can the tether withstand the strain from the vehicle weight, handling, and operation?
- Does the vehicle look aesthetically pleasing yet have practical functionality?

### **Safety**

- What potential safety hazards did you identify then address?
- Are warning labels and safeguards posted on potentially hazardous components?
- Did your team develop a safety checklist or protocol?

### **Mission Theme**

- What role do ROVs play in the mission theme?
- What organizations or individuals work closely on the mission theme?
- What is one recent technological advance that could benefit the mission theme?

### **Preparing for your engineering presentation and evaluation**

- Make sure that every member of your team has a good, general working knowledge of your vehicle, even though they may have specialized in one specific aspect of its design and construction.
- Your team should keep a project notebook. Project notebooks are a requirement in all scientific and technical work. They are the daily, detailed notes that you keep when developing and building your project. They are also useful as the primary reference and source of information when creating your team's technical report (see **Technical Report above**). Write down relevant technical and procedural issues throughout your design and building process.

- Research the specifications of the components that you use in your vehicle. For example, look up the specs of your ROV's camera and be familiar with such numbers as the amount of propulsive force the thrusters produce, the weight of your ROV, etc.
- Freely share information among your team members.
- Produce clear, simplified diagrams that you may choose to use in your presentation.
- Make sure that your vehicle is complete and in working condition.
- Write a concise technical report (see **Technical Report** above) and make sure all the members of your team have contributed to it. Ask every member of the team to read it over to catch any errors or omissions. This exercise will help to familiarize all team members with all aspects of the project.
- Practice your presentation. Generally, you will have more to say about your ROV than can be presented in 15 minutes. That is why it is critical to organize your material and practice communicating it. Ask instructors or mentors to give you feedback. Practice your presentation more than once so that you become comfortable speaking in front of other people in a coherent and organized way.
- When your team is prepared and knows the material well, you will all be more comfortable and confident. This will come across favorably to the judges.

**Note: The engineering presentation is designed to be a face-to-face interaction where students and representatives from industry become engaged in conversation. To that end, Power Point presentations are discouraged, but not disallowed. However, if your team chooses to create a Power Point presentation, you are responsible for supplying a laptop, LCD projector, screen, and/or other devices and materials needed to present your Power Point.**

#### **Other important items**

- If during the engineering presentation it becomes apparent that instructors, mentors, and other adults associated with the team exercised more than an advisory role, judges reserve the right to deduct points or, in extreme cases, disqualify teams.
- Your team is discouraged from using off-the-shelf, plug-and-play systems. You are encouraged to demonstrate innovation and creativity in the construction of your vehicle and its systems. This will also be reflected in your engineering evaluation score.

#### **POSTER DISPLAY**

Your team's poster display should be an informative, clear, and concise visual presentation about your ROV and how you designed and built it to accomplish the mission tasks. During the competition event, your team's display will be evaluated and scored by a completely different group of judges, individuals who will represent science, exploration, government, industry, and education/outreach.

While some poster judges will have a technical background, others will have a communications and public relations background. In addition, there will be visitors to the competition who may not completely understand what an ROV is or how it is used. **You should create your posters with this audience in mind.**

Each judge will award a poster score (40 points max). Judges' poster scores and comments will be returned to you shortly after the event.

MATE will provide each team with one 3-panel, free-standing presentation display board (although you may bring your own). Each display board is:

- Made out of black, corrugated cardboard
- Free-standing; no easels or stands are required
- 36" tall with a total width of 48"
- Comprised of three panels
  - One 24" wide by 36" tall center panel
  - Two 12" wide by 36" tall side panels

**Note: You are welcome to bring your own poster display board, but the space that the text and photographs/graphics occupy CANNOT exceed 36" tall by 48" wide. For example, team names CANNOT be mounted above the poster board. NO EXCEPTIONS!**

For more details about the display board, visit [www.staples.com](http://www.staples.com) and search for project display board item #922528. MATE will also provide scissors, tape, glue sticks, adhesives, and other means of attaching display items to the presentation board, although you are also welcome to bring your own.

The guidelines and required components for the poster display are:

**Note:** Keep in mind that, with 40+ posters to score, the judges will have approximately 10 minutes to evaluate your poster. Make key points. Be concise. Keep the general public in mind. **Also, make sure to label any and all figures, graphs, diagrams, and photographs.**

### GENERAL GUIDELINES

- **Font size that is clearly legible from a distance of 1.5 m.**
- **Choose a font style and use it throughout.**
- **All measurements are in SI units (metric).** Exceptions include ½-inch PVC pipe and other items described or sold in imperial units.
- **Include headers (see REQUIRED COMPONENTS below).**
- **Photos should be clear and high-quality for the print sizes that you choose.**
- **EVERY PHOTO MUST HAVE A CAPTION!** No caption = no credit for that photo. Also include photo credits.
- **Items that you MAY include in your poster or have on display include:**
  - Diagrams or sketches (CAD drawings, for example)
  - Photo journals
  - Copies of your team's technical report
  - Resumes of individual team members

**Note:** Again this year we plan to circulate the resumes of students nearing graduation and/or interested in applying for a MATE Center Technical Internship to competition sponsors (i.e., employers – think JOBS!) participating in the **Ocean Career Expo**. If you are interested in participating in this process, contact the competition coordinator ASAP. There is no obligation to participate.
- **Items that you MAY NOT include in your poster or have on display:**
  - Flip charts
  - Video screens on the actual poster board

### REQUIRED COMPONENTS

**Note: The following are REQUIRED headers.** These headers not only assist the judges in evaluating your display, they also make your poster easy to read.

- **School (or club) and Team Name.** Make sure that your team name is in large, bold font (larger than any other font on your poster). Include your school or club name as well as your team name, if it is different than your school or club name. Include your geographic location (i.e. city and state). If you are an international team, include the city and country.
- **Abstract (concise – 150 word limit).** Include a written summary of your ROV and how it was designed and built to accomplish the competition mission tasks. Make sure to relate the mission tasks to how ROVs are used in the real world. Don't assume that your audience knows what an ROV is or knows details about the missions.
- **Team Information.** Include photo(s) (group or individual) of all of the members of your team. Provide a brief description of each team member. This description should include the person's name and information such as grade level, area of expertise, career goals, etc.
- **Design Rationale.** This section should be the bulk of your poster display. It will be worth the most points.
  - Why did your team build your ROV the way that you did?
  - What were your constraints – technical, financial, and/or other?

- Include photos of your ROV. Make sure to highlight the various systems of your vehicle.
- Include photos or drawings (by CAD or by hand) of any special features of your vehicle and how these features relate to the mission tasks, safety, general operations, etc.
- **Team Reflection.** Answer the following questions:
  - What was the most rewarding part of this experience?
  - If you were to do this again, what would you do differently?
- **Mission Theme.** This section should present Information about the Loihi seamount, including the processes that created it and/or the research, technologies, and/or people who explore and study it. You may use the information that you included in your technical report (see **Technical Report** above). Include a photograph or other graphic, making sure to credit the source. Do not copy information directly from a book or web site. Synthesize the information and draw parallels between it and your work.
- **Acknowledgements**  
Please recognize any companies, organizations (including the MATE Center), professionals from industry, and/or mentors who helped to support your team by donating funds, building supplies, equipment, site visits to facilities, time, and/or technical expertise. You can include companies, organizations, and/or individuals that provided logistical and/or moral support (e.g. your parents, siblings, or pets). Regional competition teams should also acknowledge regional contest supporters.

#### **Recommendations for your poster display:**

We recommend using Microsoft PowerPoint or Publisher slide presentation program to create your team's poster presentation. PowerPoint will allow you to include both text and photos, which should make creating your presentation relatively easy. Once you've created your slide presentation in PowerPoint, you can print out each individual slide and tile the slides along the presentation board. For example, the two side panels will hold four 8 ½" x 11" pieces of paper; the center panel has room for eight. You may want to use 24-lbs. or higher stock, such as cardstock, paper for text and photographic paper for images to ensure presentation quality display materials.

**Note: "Accessories" such as video footage, PowerPoint slide presentations running on laptop computers, video projections, etc. are permitted but should be used with discretion. Remember that the judges will have a limited amount of time to evaluate your poster and may find excessive use of audio or video presentations distracting.**

#### **OTHER AWARD CATEGORIES**

In addition to the awards based on point scoring (e.g. missions, technical report, engineering presentations, and poster), the MATE Center presents awards in the following categories:

- Sharkpedo award
- Biggest Bang for the Buck
- Design Elegance
- Safety Conscious
- Aloha Team Spirit
- Guts & Glory
- Engineering MVP awards
- Flying Fish award
- gROVer award
- Martin Bowen Memorial Inspiration for Future Engineers award

For a description of each of these award categories and the 2009 award winners, visit [www.marinetech.org/rov\\_competition/2009/2009\\_award\\_winners.pdf](http://www.marinetech.org/rov_competition/2009/2009_award_winners.pdf)