2006 MATE Center/MTS ROV Committee ROV Competition
For High School & College Students

www.marinetech.org/rov_competition/index.php

Challenging Teams to Design & Build Vehicles for the Next Generation of Ocean Observing Systems

Engineering & Communication

The ability to effectively communicate – both orally and in written form – information about your vehicle and the design and building process is equally as important as how well your vehicle performs!

COMPETITION OVERVIEW

Teaming up with **Ocean.US** and the **Ocean Research Interactive Observatory Networks (ORION) Program**, the 2006 ROV competition challenges students to design and build vehicles to accomplish tasks associated with developing and deploying the next generation of ocean observing systems.

The competition is divided into two competition classes: **RANGER** and **EXPLORER**. The **RANGER** ROVs operate at a maximum of 13 volts, 25 amps. **EXPLORER** vehicles have a higher power limit (51 volts and 40 amps surface power). Eligibility requirements for both classes are listed within the 2006 **General Information** document. Please review these requirements carefully.

In addition to the underwater mission tasks, both classes will be challenged with engineering evaluation interviews, technical reports, and poster displays. The scoring breakdown is as follows:

- Mission
  - **EXPLORER** – 170 points (max), plus a time bonus
  - **RANGER** – 170 points (max), plus a time bonus
- Engineering & communication – 170 points (max)
  - Engineering evaluation – 100 points (max)
  - Technical reports – 50 points (max)
  - Poster displays – 20 points (max)

This document contains information about the evaluation, report, and display requirements. Please see the **Competition Scenarios & Mission Tasks** document for information about the underwater missions. Detailed task specifications, including information about mission "props," are included in the **Mission Task Specifications** document. Refer to the **Design & Building Specifications and Competition Rules** for information about ROV specifications and competition rules.

ENGINEERING EVALUATION

During the competition, teams will be required to give a formal, 15-minute presentation to a panel of judges, individuals who represent science, exploration, and industry. 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 ask your team members questions about your ROV.

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 presentation and 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 delegate 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. Audio visual aids, such as slide projectors, computer projection screens, white boards, etc. may or may not be available; if available, you are **NOT** required to use them. You are permitted 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 (100 points max). These scores will be averaged to obtain your team's final engineering evaluation score. Judges' engineering scores and comments will be returned to you at the end of 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 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 depth rating of your ROV? How did you test this?
- Did you use any pressure cans 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?

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 is a CCD camera? Briefly explain how one works.
- 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?

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?
- Are warning labels and guards posted on potentially hazardous components?
- Is the tether neatly bundled and protected?
- Does the vehicle look aesthetically pleasing yet have practical functionality?

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** below*). 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 CCD 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** below)* 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 fifteen 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.

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.

TECHNICAL REPORT

The technical report is essentially an extension of your engineering score. 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 3 weeks prior to the competition date. **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.**

Submitting your report in advance will give the judges ample time to evaluate the report and address any safety issues before the competition. Note that the same judges who evaluate your technical report will also evaluate your team's engineering presentation. The judges may reference your technical paper during your engineering presentation.

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. **The judges will not review and rescore revised versions of your technical report at the competition venue.** All vehicles intending to compete in the underwater missions must be documented in the technical report (see **Design & Building Specifications and Competition Rules** for more information on this topic).

Each judge on the panel will award a report score (50 points max). These scores will be averaged to obtain your team's final technical report score. Judges' report scores and comments will be returned to you at the end of the event.

Examples of top technical reports from previous years' competitions are posted on the competition web site at www.mpcfaculty.net/jill_zande/report_examples.htm.

The guidelines and required components for the report are:

- **Length is less than 20 pages***
- **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.
- **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 a photo 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, etc.) that were donated, the organization that made the donation, and an estimate of the item's value. A sample expense/budget sheet will be provided 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**
- **Description of a career, organization, or technology that supports ocean observing systems.** You can describe more than one career, organization, and/or technology. You can also describe an observatory system (e.g., the Great Lakes Observatory System or GLOS). Reference at least 2 sources for your information, and include photographs and/or graphics where appropriate.
- **Acknowledgements**
  Please recognize the companies, organizations, 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 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 point for excessive abuse of appendices.

Register with AlumniWeb (www.marinetech.org/alumni)
Teams are required to register 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. The complete team list submitted as part of the technical report will be used to determine if all students have registered.

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 for details and to register.

POSTER DISPLAY

Your poster display is your team's opportunity to create an informative, clear, and concise visual presentation about your ROV. During the competition, your team's display will be evaluated and scored by a second group of judges, individuals who will also represent ocean and space science, exploration, and industry.

Your team will be required to submit a copy of your team's poster presentation materials, so please bring two sets – one to display on the presentation board and one to turn in to competition officials. Please place the materials in a folder with your school/team name and leave it on your display table. The judges will collect these materials once they have finished evaluating your poster display.

Each judge will award a poster score (20 points max). These scores will be averaged to obtain your team's final poster display score. Judges' poster scores and comments will be returned to you at the end of the event.

Competition officials will provide each team with one 3-panel, freestanding 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

For more details about the display board, including a photo, visit www.staples.com and search for project display board item #922528. Competition officials will also provide scissors, tape, glue sticks, adhesives (e.g., Velcro), 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 30+ posters to score, judges will have approximately 6 minutes to evaluate your poster. Make key points. Be concise.

- **Font size that is clearly legible from a distance of 1.5 m**
- **All measurements are in SI units (metric)**
- **Your school/club and team name (if applicable)**
- **Images AND captions**
    - Team photo
    - Photo of your ROV
    - Photo(s) of any special features of your vehicle and building photo(s)
- **Description of your vehicle and why you built it the way that you did**
- **Answers to the following questions:**
    - What was the most rewarding part of this experience?
    - If you were to do this again, what would you do differently?

- **Description of a career, organization, or technology that supports ocean observing systems.** You may use the information that you included in your technical report (*see **Technical Report** above*). Include a photograph or other graphic.
- **Acknowledgements**
  Please recognize any companies, organizations, 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.
- **Other items that you may use 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: This year we will circulate the resumes of students nearing graduation and/or interested in applying for a MATE Center Technical Internship to competition sponsors and other potential employers (think JOBS!). If you are interested in participating in this process, contact the competition coordinator ASAP. There is no obligation to participate.

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.