



Maritime RobotX Challenge Primer

Preliminary RobotX Resource Guide

Introduction: Purpose and Scope

This document is intended for students who are considering participation in the Maritime RobotX Challenge. The document provides references to overviews of engineering and organizational considerations for designing, building, and operating a vehicle for this event. Development of a maritime system requires knowledge of multiple engineering disciplines, as well as good organizational and execution skills. The Naval Engineering Support Team (NEST) primer, referenced heavily in this and the associated documents, provides a brief overview of these topics to acquaint readers with the subjects, knowledge, and skills important to competitive teams, as well as practical tips and advice based on experience developing and operating AUVs. References in this guide are intended to provide a starting point for RobotX competitors' exploration of these fields, not a prescriptive guide to implementation.

Propulsion System

See the RobotX Propulsion Examples and the NEST primer (available from the [RobotX website](#)), sections 3.3 and 4.2.

Batteries: Types, Safety and Charging

See the NEST primer, sections 3.12 (pages 71-73) and 4.6 (pages 79-81), aggregated in the RobotX Batteries Guide. **Note that Li-Po battery packs need safety and balancing circuits and must be labeled HAZMAT when shipped. Each team should understand and follow both their own country's regulations as well as those of the host nation.**

References from the NEST primer:

www.BatteryUniversity.com This is an educational website that offers practical information for battery users. The material is condensed into essays of about 1000 words and covers most aspects of battery use.

www.buchmann.ca This is an informational website that carries the book entitled: "*Batteries in a Portable World — A handbook on rechargeable batteries for non-engineers*". The website also includes articles suggesting the best battery choice for a given application, how to restore weak batteries and maintenance methods to prolong battery life.

<http://ibet.asttbc.org/batterys.htm> The first part of this two-part article by Isidor Buchmann, focuses on the needs of the different battery chemistries, what applications are suitable and how one can get the most out of them. The second part touches on cell behavior.

www.madkatz.com/ev/nec1999Article625.html NEC 1999 National Electrical Code, Article 625 - Electric Vehicle Charging System, Section 626-29, Indoor Sites. This National Electrical Code article provides insight into ventilation requirements/recommendations when charging batteries.

www.nema.org National Electrical Manufacturers Association web site.

www.dot.gov U.S. Department of Transportation web site.

www.iataonline.com International Air Transport Association web site.

www.fedex.com/us/services/options/express/dangerousgoods/resources.html FedEx offers helpful aids and procedures for shipping dangerous goods such as batteries.

www.seabird.com/pdf_documents/LithiumBatteryShippingGuidelines_003.pdf This site provides interpretations of shipping requirements and laws for lithium batteries as interpreted by Sea-Bird Electronics, Inc.

www.rayovac.com/technical/ev_faq08.htm Rayovac cites regulations and requirements regarding shipment by air of Lithium primary and rechargeable batteries as provided by IATA in its Dangerous Goods Regulations.

www.cpsc.gov/CPSCPUB/PUBS/5088.pdf The Consumer Product Safety Commission produced this simple product safety alert for discussing household batteries and how they may rupture or cause chemical burns.

<http://www.ehso.com/ehshome/batteries.php> This site provides information regarding household batteries. Included are some examples of environmental hazards and disposal methods as well as general information regarding battery types.

Maritime System Design Practices

See the NEST primer, sections 3 and 4, including the sections on fluid dynamics, hull forms, stability, propulsion, etc.

Host Nation Infrastructure Considerations

A document is being generated by the host nation. This will be posted to the [RobotX website](#) when it is complete.

Electrical Safety

The NEST primer covers various aspects of electrical safety throughout but does not have a dedicated section. Competitors should be aware of the impact of wire gauge, ensuring that the wires they use have sufficient carrying capacity. Circuit breakers and fuses should be used where appropriate, and

motor controller current ratings should be respected. Battery charging safety is covered in the NEST primer sections referenced above and summarized in the RobotX Battery Guide.

Electrical Safety References

Chapter 8: Power Systems from Underwater Robotics, by Dr. Steven W. Moore, Harry Bohm, and Vickie Jensen: http://www.marinetech.org/underwater_robotics/.

Sample pages at:

<http://www.marinetech.org/files/marine/files/Underwater%20Robotics%20Text/CH8%20Page%20421-2.pdf>

Guide from FIRST:

http://www.usfirst.org/uploadedFiles/Community/FRC/Team_Resources/Team_Resources_Assets/FRC_Team_Safety_Manual.pdf