



## **GUIDELINES FOR WRITING THE IEEE/PELS SOLAR SPLASH TECHNICAL REPORT**

March 10, 2015

### **THE BASICS**

A substantial technical report documenting your design is due from each team participating in the IEEE/PELS Solar Splash. The report describes the design and the process through which you arrived at the design. These guidelines have been updated to reflect recent revisions in the required report format. The length of the Main Body of the report should not exceed 20 pages. Within that page limit, describe your work fully and concisely. Additional relevant material may be included in appendices. Focus the bulk of your report on the details of the work that you have done for this year's competition.

The most important objectives of the report are to describe: (1) the overall project objectives for this year, (2) the design process for each of the sub-systems, (3) the project management activities, and (4) the project conclusions and recommendations. For each of the sub-systems, the current design, the analysis of design alternatives, and the design testing and evaluation should be presented. Organize the report so that the discussion of each sub-system provides a complete description of your efforts. Be sure to provide the overall objectives before providing a discussion of the detailed design process for the sub-systems.

**Certain information is required to be submitted by the teams in the Technical Report. See below under the "Details" section, especially the parts associated with the Cover Sheet and the Required Appendices.**

### **THE AUDIENCE**

Write your report as if it were the document you would love to have had when you started out on the project. That is, you are writing to your peers who have some engineering expertise but who are not familiar with the project. Thus, it is extremely important to set the scene with a clear description of the problem statement and design goals for this year's boat.

### **FORMAT AND FONTS**

The report should be written in Times New Roman, 12-point font, single spaced, with ample (1 .00" left and right, 1.00" top and bottom) margins on all sides. Number each page in sequence including those in appendices. Use either indentations (allows more words per page) or a blank line to mark new paragraphs, not both. Make your report visually pleasing; an important part of communicating the information.

## HEADINGS

There are four levels of section headings with established specifications: primary; secondary; tertiary; and quaternary heads (adapted from IEEE guidelines).

- Primary headings are enumerated by Roman numerals and centered above the text.
- Secondary headings are enumerated by capital letters followed by followed by periods, flush left, upper and lower case, and italic.
- Tertiary headings are enumerated by Arabic numerals followed by parentheses. They are indented one em, and run into the text in their sections, italic, upper and lower case, and followed by a colon.
- Quaternary headings are identical to tertiary headings, except that they are indented two ems, lower case letters are used as labels, and only the first letter of the heading is capitalized.
- Reference and Acknowledgment headings are unlike all other section headings in text. They are never enumerated. They are simply primary headings without labels.
- The primary heading(s) in the Appendix or Appendices are set according to the usual style, using letters (Appendix A) for each heading.

## VISUALS, FIGURES, AND TABLES

As engineers, you have the gift of being able to communicate through visuals as well as through words. Annotated images, photos, and line drawings which describe the problem statement and design concepts can replace many words. Take care in the design of the drawings. If hand-lettered, use guidelines. Make sure they are not cluttered. A good caption is not merely a title, but is descriptive and explains the figure or table. Note that the caption for a table goes above the table, while the caption for a figure goes below the figure. All tables and figures must be referred to in the text! The discussion in the text should include the observations and/or conclusions that you expect the reader to conclude from the figure/table. Use these to effectively communicate your message.

Plots/graphs are a great way to communicate technical information. Please take care in formatting a plot and/or table so it is readable and informative. Make liberal use of annotations on the graphic/plot to improve the effectiveness of the figure.

## SOURCE INFORMATION

If your design reached a point where you use (or recommend) specific components such as motors, bearings or materials, include complete information about the component(s) in an appendix. This means listing the part name, part number, company name and company address. There should be enough information for a reader to purchase the same item.

## **SPELLING**

There should be NO spelling errors. One spelling mistake drops your professional credibility down to near zero. Be sure to proofread your report carefully. Do not blindly depend on spell checkers. For example, many spell checkers will find the following sentence acceptable. "Spell check will not fined words witch are miss used butt spelled rite!"

## **PHRASES AND WORDS WHICH SHOULD NOT BE IN YOUR REPORT**

Here's a list of favorite words, phrases and punctuation errors that tend to crop up in the work of many report writers. You can probably add your own. Let's eliminate them from your report.

### **Phrase to Eliminate**

plugged into the equation  
figure out  
junk  
figure 2  
Figure 2  
appendix 1  
a lot of  
cheap  
assumptions had to be made  
can't  
didn't  
to quickly design  
The first thing,  
a couple of  
OK  
in order to  
fairly  
very  
looked at  
fairly good  
decided upon  
in between  
significantly

### **Suggested Replacement**

substituted into the equation  
determine  
(eliminate)  
Fig. 2 (capitalize)  
Fig. 2  
Appendix A (capitalize)  
considerable  
inexpensive (or low cost)  
assumptions were required  
cannot  
did not  
to design quickly  
First,  
two  
(eliminate)  
to  
very  
(consider dropping)  
considered  
good  
chose  
between  
(consider dropping)

## **REPORT ORGANIZATION**

The organization of the report has been revised. Please read these guidelines carefully and follow them. The objective of the report is to provide an overview of the status of your present boat, your design objectives for this year, and the process you used to evaluate and select your design. The focus of your report should be on changes to your boat that you have made this year.

The required sections are described in more detail in a subsequent section. The required major sections in the report are listed below. Please note that the Cover Page, Executive Summary, Table of Contents, References, and Appendices do not count in the 20 page limit for the Main Body of the report.

*Cover Page*

*Executive Summary*

*Table of Contents*

*Overall Project Objectives*

*Solar System Design*

*Electrical System*

*Power Electronics System*

*Hull Design*

*Drive Train and Steering*

*Data Acquisition and/or Communications*

*Project Management*

*Conclusions and Recommendations*

*References*

*Appendices*



The “Main Body” of the report is limited to 20 pages maximum

## Details on Selected Sections of the Report

### COVER PAGE

The cover page should contain:

- Project title
- Date
- Team members
- Project advisor

We encourage you to be creative with the front page. Consider including an illustration or a graphic which best defines the project. Experiment with the format of the title. Use your graphic design abilities to create a cover that is professional and motivates the reader.

### EXECUTIVE SUMMARY

Limit the executive summary to two pages (maximum). Your target audience for this is the busy executive who will read no further and your objective is to condense all of the design into an overview of two pages. Make sure the most important parts of the problem statement, your design and your recommendations are clearly communicated here. Imagine that your project report, along with 20 others, goes to the CEO who will make a decision to fund one of them (probably based solely on the content of the Executive Summary). This is likely the most important part of the report you will write. Whether writing or speaking, the ability to effectively communicate a short summary of your message is essential. It's the written version of an "elevator speech." Write this section last, but leave yourself plenty of time. Spend sufficient time do a good job on this section.

### OVERALL PROJECT OBJECTIVES (for this year)

The content and level of detail of the Main Body will vary depending on whether you are building a new boat or are modifying an existing boat this year. If you are building a new boat, then you should address each of these topics in as much detail as possible. If you are modifying an existing boat, then provide detailed discussions of the revised/new sub-systems and overview summaries of the sub-systems that are not being modified this year. For example, if you are using the same solar system as last year with no modifications, then just provide an overview of that sub-system. If you significantly changed your solar system, then provide the design details. We expect you to focus your discussion on the details of those sub-systems that you modified this year. You are required to have a section in the report that addresses each of the following sub-systems:

- a) Solar System
- b) Electrical System
- c) Power Electronics System
- d) Hull Design
- e) Drive Train and Steering
- f) Data Acquisition and/or communications

## **A SECTION FOR EACH OF THE SUB-SYSTEMS**

For each of the sub-systems listed above; provide a section that describes the design and analysis process that you used to develop your final design. These sections will be the main technical content of the report and will provide insight into your engineering approach. In the discussion of each of the sub-systems, consider using the following topics; as appropriate.

### **Current design (previous years)**

- Overview of current design
- What is/are the problem(s) or issues?
- What are you trying to improve? (design requirements)

### **Analysis of Design Concepts**

- Design description
- Design alternatives/tradeoffs
- Supporting analyses
- Rationale for choice

### **Design Testing and Evaluation**

- Prototype construction
- Test procedures
- Test results
- Evaluation of performance
- Discussion

The level of detail in each of the sub-system sections will depend on whether you have a new boat or are making modifications to your current boat. If your boat is new this year, then balance your reporting on each of these topics. If you focused your efforts on improving a particular sub-system, then provide a detailed discussion of those activities. Focus on the modifications that you completed for this year. Take care in the organization of your report and always keep the reader aware of how this year's modifications fit into the bigger picture. Be sure to clearly communicate the design process was followed.

## **PROJECT MANAGEMENT**

Project management of a multi-disciplinary project is a challenge that requires a focused effort to be successful. What were your challenges; your successes? Think of the “success” of your team in terms of both the technical performance of your boat and the performance of your team. What did you learn about managing an engineering project/team during this year? How did you handle the design efforts of the different sub-systems? What initiatives/approaches to project management did you apply and how effective were they? How did you finance your project? Do you have recommendations for financing sources and fund raising approaches? How are you addressing the sustainability of the boat team in future years? Did you have focused recruiting and

succession planning efforts for your project? Be sure to cover the following topics in this section.

- Team members and leadership roles
- Project planning and schedule
- Financial and fund-raising
- Strategy for team continuity and sustainability
- Discussion and self-evaluation

## CONCLUSIONS AND RECOMMENDATIONS

If not done so in the main body, here is where you assess your design, even if it is a paper one. Discuss the strengths and weaknesses of the design. Discuss what's next to do. In addition, this section should contain some reflections on the design process. Were you satisfied with the process? Did you stick to your original plans? How would the team improve the process if assigned to another project? This section should also address the following topics.

- Strengths/weaknesses
- Did we meet our overall and sub-system objectives?
- Reflection on the design process?
- Where we go from here?
- Lessons learned

## REFERENCES

Reference citations should have a standard format that engineers can understand. Citations should be in the text and references listed in a section titled "References" that appears at the end of the report but before the appendices. In the text of the report, references should be cited with a number in square brackets. The numbering of the references should correspond to the order that they appear within the text. In the References Section, the references should be ordered in the same order that they appear in the text. The format of the references should follow the IEEE guidelines.

The IEEE has published style guidelines for writing technical papers which can be found at <http://www.ieee.org/documents/stylemanual.pdf>. This link provides insight into many formats, techniques, and other issues which will arise during preparation of your report. Additional guidance on grammar and usage can be found in *The Chicago Manual of Style* at <http://www.chicagomanualofstyle.org/home.html>. For example, reference formats for a journal article, a book, and a vendor data sheet are shown below. Journal and magazine names and book titles should be italicized. Examples of this format follow.

- [1] J. Morehouse, "How to design good boats," *Journal of Good Engineering Design*, vol. 15, pp. 30-40, 2013.
- [2] D. Luneau and R. Hogan, *Design of Great Boats*, Minneapolis, MN: ABC Press, 2012.
- [3] *Hot Shot Motor Data Sheet*, PMI Electric Motors, Inc. Phoenix, AZ, 2004.

## APPENDICES

The appendices should include any supporting documentation related to the design that would interrupt the flow of information if included in the main body of the report. Material which appears in appendices may include: parts drawings, assembly drawings, vendor data sheets, calculation results, long equation derivations, software source code and test results. Each appendix is lettered and appears in the table of contents.

### **There are four “Required Appendices”**

- **Appendix A: Battery Documentation (see Rule 7.10.2)**
- **Appendix B: Flotation Calculations (see Rule 7.14.2)**
- **Appendix C: Proof of Insurance (see Rule 2.8)**
- **Appendix D: Team Roster**
  - Name, degree program, year, team role
  - Please include all of the members that have contributed to the project; whether they actually are attending the competition or not.
  - This information is very important to the Solar Splash organizers because it documents how many students have actually participated in the project and the degree programs of those students. These are useful metrics because they help us to quantify the student participation in Solar Splash. Please list everyone who has contributed to your project in any way.

Each appendix should start with a few sentences describing the contents of the appendix. Avoid appendix bloat when possible. Be sure that the material included in the appendices is relevant to your project and not just filler. For example, when including data sheets, you should only include information that is directly relevant to your project. If a data sheet lists many part numbers or part options, be sure to highlight the one you selected for your design. Be concise. There is no bonus for extra bulk!

Appendices which list components selected for the design should include at least the following for each part: (1) component name, (2) complete model or part number, (3) price, (4) manufacturer (who makes the part, including name, address and telephone number). Similar information should be documented for services you used (e.g. a professional machine shop) or purchased (e.g. a software package). All appendices should be referred to in the body of the report. If you can't find a place to do this in the report, the material probably is not worth including as an appendix.

## Scoring Criteria for Technical Reports for Solar Splash

The following is the point system the judges will use in scoring your report:

1. Organization	15 points
How well does the report follow the guidelines? Does it contain all of the elements mentioned in the Report Organization section? Points are deducted in this category for exceeding 20 pages in the main body.	
2. Executive Summary	10 points
How well does the Executive Summary describe the project? Is it complete, concise, and clearly written?	
3. Technical Content	40 points
How technically informative is the report? How well does it detail the design process, analysis, performance and results of testing?	
4. Style	15 points
Includes writing clarity, grammar and spelling	
5. Graphics	20 points
Quality and professionalism of drawings and graphs	
Total	<hr/> 100 points*

\* This 100-point score will be normalized to 90 points for the competition scoring.