



U T S D C

REQUEST FOR PROPOSAL

UNIVERSITY OF TORONTO SPACE DESIGN CONTEST

February 18, 2011

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Section 1

Introduction

The University of Toronto Space Design Contest (UTSDC) is an annual contest which presents a space related problem to teams of up to 5 students and tasks them to design and propose an innovative solution. Designs are judged by distinguished professors at the University of Toronto and members of the space industry. Teams prepare a solution for that year's problem, submit a short report, and have the opportunity to present it in the Design Fair hosted in May. Each year's design challenge is delivered through a Request for Proposal (RFP). This year's RFP is presented in this document.

1.1 Advanced Life Support Systems

After the moon, Mars has been the goal for the next long-term, manned space exploration mission. Space agencies have long understood that for humans to perform space exploration outside of low earth orbit, it is neither practical nor economical to resupply basic necessities, like food, water and oxygen, from Earth. As a result, agencies such as CSA, NASA and the ESA are currently developing Advanced Life Support Systems (ALSS) to allow humans to perform long-term, manned exploration missions. The systems provide methods to recycle air and water, dispose of or recycle waste, as well as grow food.

Section 2

Problem Summary

Introduction

It is the year 2050. NASA and the world's other space agencies have created the Coalition of World Space Agencies (COWSA) to design the first long-term human settlement of Mars. In the past 40 years, space exploration has changed, but not drastically. All travel to space occurs either via solid-rockets or via the second generation shuttle program. There is limited space tourism; most activities in space are conducted to further our scientific understanding of the world. The next frontier in space exploration is long-term human settlements in space. A lunar space-port has recently been built, but is currently being supplied entirely from earth. The new Martian settlement is the first step for true space colonization. Due to the logistics involved in travelling from Earth to Mars, the new settlement needs to be entirely self-sufficient. COWSA is currently looking for a proposal for an in-situ system to that would allow the inhabitants of the Martian settlement receive the appropriate nutrients. The winning proposal will receive funding from COWSA to develop and implement this system.

Existing Technologies

Unlike previous years, contestants cannot use the projects from earlier competitions. Competitors can assume the existence of the following systems/technologies:

- Lunar Space Port
- Ares I Crew Launch Vehicle
- Ares V Cargo Vehicle
- Orion Crew Vehicle
- Any other existing technology
- Any other technology or infrastructure that could exist in 2050

Further technical details will be given to contestants after registration (see Section 3.2).

2.1 Objectives

The objectives of the Advanced Life Support Systems (ALSS) are as follows:

1. Design a system to provide food for 100 people living on Mars.
2. Demonstrate this system is technically feasible.
3. Demonstrate this system is sustainable.
4. Demonstrate this systems meets the nutritional requirements for humans.
5. Ensure that this system does not damage the existing Martian environment.

2.2 Proposal Formatting

The Proposal (Final Report) should be printed on Letter paper with 1 inch margins, using a 12-point standard font type. Reports shall be no longer than 20 pages (excluding title page, table of contents, diagrams, bibliography and appendices). **The content within the 20 pages must be self sufficient and any information past this will not be read.** Appendices, however may be included at the end of the Report. There is no limit to the length of the Appendices, but they must only be used for background calculations or for clarification purposes. **They must not introduce new design features.** The main body of text should refer to the Appendices when necessary. Proposals should include a table of contents, title page, and works cited (see Section 4.4). The outline of the Proposal should follow that of Section 2.3. However, headings/sections may be rearranged or changed completely if the authors submit a document clearly outlining where the required information for each heading in Section 2.3 is located in their Report. Submission instructions and evaluation criteria are listed in Sections 3.4 and 4.1.

2.3 Proposal Content

Every Proposal submitted must contain the following content. It is recommended that teams outline their proposal using the headings of the following subsections.

2.3.1 Nutrient Growth System

In this section, you will explain your nutrient growth system. You must include what organisms you choose to grow and how this satisfies nutrition requirements for the members of the settlements.

Technical Risks

What are the major technical risks and bottlenecks of your design? How do these affect the likelihood of success? What improvements could be made to increase chances of success? What makes your design more promising than others? What trade-offs did you need to make to come up with your design?

2.3.2 Infrastructure on Mars

Your nutrient growth system may require supporting infrastructure. What kind of resources will you need on Mars? What support systems need to be in place in order for your system to function?

Technical Risks

What are the major technical risks and bottlenecks of your design? How do these affect the likelihood of success? What improvements could be made to increase chances of success? What makes your design more promising than others? What trade-offs did you need to make to come up with your design?

2.3.3 Transportation Mode

To start the mission, some of the equipment or food may have to be transported from the Earth. Is it energy efficient and cost effective? What is the optimal route from the Earth to your destination? How many trips will you need to start the mission?

2.3.4 Mission Timeline

You need to provide a timeline to document the mission progress. How many years do you need to reach full productivity? How often can you harvest?

2.3.5 Mission Budget

The mission you choose to carry out will be a collaborative effort between governments, private agencies and your team. Reasonable financial support will be given to your team by world governments. However it must be shown, that this aid is used sensibly and responsibly. Given the financial history of spaceflight missions, estimate the costs associated with your proposal. Furthermore, estimate the costs associated with your proposed design. Present your estimates in a budget breakdown to show where each cost is allocated and how you arrive at your final cost estimate.

Budget Justification

Demonstrate the reasoning behind the values provided in your Mission Budget. How do they compare to similar missions done in the past by government and space agencies? Why do they differ or why are they so similar to these benchmarks?

Section 3

Project Timeline

The UTSDC project has several deadlines which are important to note. Registration forms and further information can be found on UTSDC's website (www.utspace.com). Please read the following Section carefully.

3.1 Welcome Night and Information Session

The Information Session is to give prospective and registered contestants an in depth overview of the University of Toronto Space Design Contest. The event will be hosted at the University of Toronto St. George Campus on **October 23, 2010**. The session will run in the evening and will cover this year's topic, overview of the judging scheme and will allow participants to ask questions about this year's RFP. Guests at the event will include the Contest Executives and selected researchers at the University from Astrophysics and Aerospace.

3.2 Registration

Contestants are required to complete a team registration form located on UTSDC's website under the "Registration" section. A registration fee of \$90 must be sent in to accompany registration before Friday **December 13, 2011**. Registration after this date will require a late fee and contestants must submit a payment of \$100 before Friday **January 15, 2011**. After this date, registration will be closed.

Contestants are encouraged to ask their school, family and friends for sponsorship. Payment must be made in cash, cheque, or money order. It can be mailed in, dropped off, or brought in to the contestant information session.

Payments should be made out to:

University of Toronto Space Design Contest
c/o U of T Engineering Society
Sanford Fleming Building, Suite B740
10 King's College Rd.
Toronto, Ontario CANADA M5S 3G4

3.3 Space Workshop

The Contest Workshop will be held on Saturday **February 19, 2011** at the University of Toronto Institute for Aerospace Studies. The event will allow contestants to personally meet leaders in Aerospace research. Teams will be paired with a single researcher and will receive advice on the current state of their project. Since each researcher will have a particular concentration, afterwards, teams will be allowed to share their progress with the other researchers at the Workshop.

The event will run from 10:00AM to 4:00PM. Food will be provided. Contestants are required to express their intent on attending the event by registering on our website (www.utspace.com) under the "Registration" section, before **January 31, 2011**. After this date, new attendants to the event will not be accommodated.

The Workshop will be held at:

University of Toronto Institute for Aerospace Studies
4925 Dufferin Street
Toronto, Ontario
CANADA M3H 5T6

3.4 Final Report

The Final Report is one of the three deliverables for the Contest and is worth 60% of the contestants' overall score. Final reports must be submitted in both a hardcopy and softcopy (electronic) format. The softcopy version of the report must be in **PDF** format. The hardcopy version **must** be accompanied by a health and a release form for *each* contestant. These can be found on UTSDC's website under the "Downloads" section. The hardcopy version of the Final Report and health/release form can be submitted by mail or in person (during 9 AM to 4 PM on weekdays) to:

University of Toronto Space Design Contest
c/o U of T Engineering Society
Sanford Fleming Building, Suite B740
10 King's College Rd.
Toronto, Ontario
CANADA M5S 3G4

The softcopy version of the Final Report should be mailed to *judging@utspace.com*. The Final Reports must be postmarked/received (hardcopy) or timestamped (softcopy) no later than Monday **March 28, 2011**. For a more information on the Final Report please see Section 4.1.

3.5 Design Fair

The Design Fair is aimed to let contestants showcase their work to the UTSDC Judges and the general public. This year, the Fair will be held during **May 12 to May 15, 2011** on the University of Toronto St. George Campus. Contestants will be housed in one of the residence facilities during the duration of the Fair. Each team must exhibit a Design Display and give a Design Presentation on their proposal. These two deliverables encompass 40% (20% each) of the contestants' overall score.

For a more information on the Design Fair Presentation and Display, please see Sections 4.2 and 4.3.

Section 4

Evaluation

Each team must submit and exhibit 3 deliverables: Final Report (60%), Design Presentation (20%) and Design Display (20%). The following section explains the strict guidelines, which must be adhered to, for each deliverable. Please read carefully.

4.1 Final Report

The Final Report is worth 60% of the contestants' overall score. Reports shall be no longer than 20 pages (excluding title page, table of contents, diagrams, bibliography and appendices). **The content within the 20 pages must be self sufficient and any information past this will not be read.** Appendices, however may be included at the end of the Report. There is no limit to the length of the Appendices, but they must only be used for background calculations or for clarification purposes. **They must not introduce new design features.** For more information on the Report format see Section 2.2.

A hardcopy and softcopy (electronic) format must be submitted and postmarked no later than Monday **March 28, 2010**. The hardcopy version **must** be accompanied by a health and a release form for *each* contestant. Instructions for the delivery of the hardcopy of the Final Report are found in Section 3.4. The electronic copy of the Final Report must be in **PDF** format. All other formats (.doc, .docx, .tex, etc.) will not be accepted.

The mark breakdown of the Final Report is as follows:

Nutrient Growth System	20%
Design	10%
Justification	10%
Infrastructure	40%
Design	20%
Justification	20%
Transportation	10%
Mission Timeline	10%
Mission Budget	10%
Formatting	10%
Structure	5%
Clarity	5%
TOTAL	100%

For more information on the requirements of each category, please see the RFP Supplement. A detailed marking rubric will be released after the final Registration date.

4.2 Design Fair Presentation

At the Design Fair, each team is expected to give a 10 minute presentation, highlighting the team's proposal to address the given problem (Section 2) to a panel of judges. There will be an additional 5 minutes at the end of the presentation for questions from the judges. The presentation should include the major design features of your ALSS as well as the important infrastructure. Before presenting, each team **must** provide the judges with a copy of written presentation materials and references.

A panel of judges will mark the teams, based on on several criteria including content,creativity, structure, group dynamics, time management, delivery, use of visuals/ aids, and ability to answer questions. A detailed marking rubric will be released after the final Registration date.

4.3 Design Fair Display

Each team must bring a Display to the Design Fair to exhibit their work to the judges and general public. During this part of the Fair, teams are expected to stay alongside their Displays. The Display should be visually appealing and should contain critical information related the team’s design. Teams are encouraged to use models, diagrams and graphs to convey their information. Contestants may bring a laptop with media or material for the Display.

Displays will be scored based on several criteria including creativity, visual appeal, quality of information, discussion with judges, and presentation delivery. A detailed marking rubric will be released after the final Registration date.

4.4 Academic Honesty

The University of Toronto Space Design Contest takes academic honesty very seriously and any team that is caught plagiarizing material will be **disqualified** from the Contest. Plagiarism is the “*use or close imitation of the language and thoughts of another author and the representation of them as one’s own original work*”¹. This includes, but is not limited to, any language in the Final Report, text, diagrams or ideas not of the authors. A simple rule is the following: if it is not your own idea, cite it. Simply using a bibliography is not acceptable.

Works cited must follow a **MLA Citation Style**. An example of this style presented below:

Our spacecraft will use a bi-propellant engine, which has been shown to have more versatile options² than regular monopropellant, electric and solid propellant engines.

4.5 Penalties

Penalties will be assigned to reports which do not follow the outlined formatting in Section 2. Further penalties will be issued if there are missing citations or if the hardcopy submitted is not bound. A maximum penalty of 2.5% will be assigned *per* violation. The actual penalty value will be based on the severity of rule violation.

¹Random House, Random House Compact Unabridged Dictionary, 1995

²Humble, W., ”Space Propulsion Analysis and Design”, McGraw-Hill, 1995