

R022-A: Solar Soaring Power Manger (Phase I)  
Submitted by Packet Digital  
Principal Investigator: Andrew Paulsen  
Request for \$500,000; Total Project Costs \$1,010,000

**Technical Advisor Comments**

- One reviewer recommended fund, one recommended funding may be considered.
- The 50% match comes from industry (\$250,000) & DOE (\$260,000).
- 1 reviewer commented, "...the proposal could have been more explicit to optimize that some of the modeling could be focused on ND geography and uses. For example, modeling the "optimum bandgap combination" for the solar "UAV environment" is vague. A solar UAV for agriculture in ND may have different optimums as opposed to a solar UAV for winter wildlife monitoring in Alaska..."
- Both reviewers felt the project was likely achievable, however 1 reviewer had concerns about the achievability of the targeted 40% efficient flexible solar cell within the time and budget proposed.
- Both reviewers felt more information about the methodology was needed and had the following concerns about the planned methodology.
  - "...Systems engineering assumptions appear to be made that may limit outcomes."
  - "...While the algorithm and power management system development tasks follow a logical progression, there are significant shortcomings in the six-junction cell approach..."
- 1 reviewer commented, "The team states that NRL has demonstrated "the most advanced solar cells demonstrating 33% efficiency," but there are no references or further detail provided. Furthermore, this "most advanced" cell is not present anywhere on the NREL record cell efficiency chart, making it very unclear what is being referenced."
- 1 reviewer commented, "...It should be noted that there are already claims of greater than 40% efficient solar, but the methods used to measure that 40% vary. The proposal did not make it clear how the 40% objective would be measured, but I think it is adequate to make sure the measurements and results are documented after the testing is over."
- Both reviewers felt that the budget was low for the work being proposed.
- 1 reviewer stated, "Reliability was not mentioned in the proposal. If UAS is going to exist "perpetually" it is going to need very highly reliable components. If the power management circuitry breaks, the UAV will come down. Reliability should be included in the systems engineering approach from the onset."
- 1 reviewer stated, "Powered flight is only one manifestation of UAS. Lighter than air (example helium blimps) are perfect for some missions (spot monitoring, communications relay, etc...but may need circuits and processors tuned to lighter than air flight vs powered flight."
- 1 reviewer stated, "...The cost is not discussed/addressed, leaving the market potential and cost feasibility unknown."
- Regarding the project management plan, the reviewers had the following concerns:
  - The test phase is a concern if the technology is optimized for one season and the project completion occurs in another. Current tests appear to occur in April/May 2015 (spring). If the power management is optimized for other seasons (winter, summer), the schedule may be a bit out of synch. Also, the project management plan (page 13) looks like it accounts for one design cycle for the power conversion circuitry. It would be interesting to have multiple design cycles if allowed to test the conversion circuitry.
  - It is not clear why solar cell development/modeling is not to begin until 1 month into the project start given that this is a very challenging element of the project.
  - The team states that actual battery selection is critical to allowing the development of the battery charging algorithm, but there is no milestone, task, or associate date listed in the program plan to indicate when this will happen.

**Technical Advisor Recommendations**

Fund. The proposal offers exciting opportunities for the advancement of UAS and solar energy utilization in North Dakota. More exciting still, is the partnership of North Dakota companies with manufacturing possibilities in a new

industry. North Dakota is poised to be a leader in the emerging UAS field, and this project, if successful, would only strengthen that position.

The reviewers point out some concerns that should be carefully considered with clarification provided from the applicant. However, the benefits to North Dakota if the project is successful outweigh the risks. Having the Naval Research Lab involved as a partner adds additional credibility to the proposal.

**Suggested Contingencies If Funded**

- None.