

R025-C: Solar Soaring Power Manager Phase II
Submitted by Packet Digital
Principal Investigator: Andrew Paulsen
Request for \$350,000; Total Project Costs \$1,000,000

Technical Advisor Comments

- Two reviewers recommended fund, one recommended funding may be considered.
- Of the 65% match, \$50,000 comes from a Private Investor and \$600,000 comes from the Naval Research Lab (NRL.)
- All 3 reviewers had reservations regarding the achievability of the proposal.
 - 1 reviewer was surprised that the work could be completed in 9 months.
 - Applicant agrees that this is an aggressive timeline, but feels that the performance in Phase I provides evidence that it is achievable.
 - 1 reviewer felt that Objective 1 has already been met according to the achievements in the proposal and questioned why a more challenging goal was not provided. The reviewer is skeptical that the team will achieve an efficiency close to 40%.
 - The applicant has responded that in Phase I, they achieved individual solar cells at about 32.5%. NRL reported a value of about 36% in June 2015, and they have straightforward solar cell design improvements to implement to increase this value further. Because of this, they are confident that within six months, they will achieve a solar cell with efficiency of approximately 40%.
 - 1 reviewer did not feel this team should be working with solar cell development.
 - The applicant stated that that the solar cell development efforts at NRL are also funded by the NRL. Thus, the ND REP will be directly benefiting from the extensive, PV expertise of the NRL team, and when the team is successful in achieving the proposed solar cell technologies, North Dakota will be the direct beneficiary of this technology.
- There were several concerns regarding the methodology.
 - 1 reviewer stated that modifications to the SBXC airframe were listed as an achievement from Phase I, however the methodology is changing to using a new airframe which will require design and integration work to be re-accomplished. The reviewer also felt that the techniques to be used for power management were vague.
 - The applicant responded that the goal in Phase I was to demonstrate the most challenging key aspects, using a commercially available aircraft to simplify the effort. The goal was achieved and they determined that a remaining challenge to achieving persistent endurance was an optimized airframe. Thus, prototyping a well-designed airframe is a natural next step in Phase II that will serve the dual purpose of enabling a revolutionary SUAS capability and establishing a new manufacturing effort in North Dakota.
 - 1 reviewer felt that the methodology needed more detail and was confusing, stating "...the team states that 40% efficient PV cells would enable eternal endurance flights, yet elsewhere it is noted that to achieve eternal flight a 50% airframe weight reduction is required along with 50% more area of the solar array. Neither of these is being addressed by the work in the project and it is unclear how or when such developments will be undertaken..." and "...reliance on finding a new storage technology outside of the project team is concerning..."
 - The applicant responded that "The increased solar cell efficiency, increased battery capacity, and reduced airframe weight are all intercorrelated aspects that can be tuned in unison to achieve the goal of persistent endurance. For example, if we can reduce the weight by 50% then we can add more batteries at the same capacity. Alternatively, if we can included higher capacity batteries with more, higher efficiency solar cells, then we may be able to remain at the present airframe weight. In the proposal, we stated general goals that we are striving to meet, but a more specific set of performance parameters will come from our continued work into Phase II."
 - The applicant also states that they are moving forward with battery technology that is readily available in the marketplace. However, emerging technologies are a continuous

- area of exploration since technology can advance overnight. Should a more viable technology become apparent they would explore that avenue.
- 1 reviewer felt that the major lacking component was that there is no reference to cost and questioned if a UAS that can fly twice as long but costs more than 2x as much is worth it.
 - The applicant replied that they are targeting no more than a 25% increase in the cost of the airplane over presently available battery or fuel powered systems. The airframe, batteries, and power system are not expected to have any major cost drivers that would raise the price. The solar array, however, may increase cost. One of the primary foci in Phase II will be establishing a path to allow cost effective manufacturing of these arrays, which adds the extra potential benefit of increased manufacturing jobs in North Dakota.

Technical Advisor Recommendations

Fund. This proposal has several strengths. It offers a tangible step forward toward the advancement of UAS and solar energy utilization in North Dakota. It also provides a pathway for new manufacturing possibilities for state businesses and subsequent job creation.

The reviewers point out some concerns that should be carefully considered along with the clarification provided from the applicant. The Naval Research Lab's involvement as a partner adds credibility to the proposal and would considerably leverage the REP's funds. The applicant's results from the first phase of the project help demonstrate potential success.

Suggested Contingencies If Funded

- None.