North Dakota Renewable Energy Program
Status Report

Recipient: Packet Digital LLC
Contract Number: R-040-051
Report for time period of: December 1, 2019 - January 31, 2020

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Description of Project
Packet Digital LLC, Nishati, and the U.S. Naval Research Laboratory (NRL) are collaborating to develop and commercialize transportable solar power generation modules capable of delivering up to 1kW, when setup in parallel, for remote military installations, emergency shelters and camps. The end product will eliminate the fuel requirement and noise and will reduce the life cycle cost of standard electromechanical power generation.

Project Tasks
Please describe the progress on all project tasks achieved during the reporting period:

Objective 1: Refine PSG1 electronic design to simplify manufacturing and assembly process -- Progress was already reported in interim 2 report.

● Task 1 – Refine the electronic board designs to reduce the amount of wiring and interconnect needed.
● Task 2 – Assemble the electronics and perform laboratory tests to verify functionality.

Objective 2: Refine PSG1 custom enclosure -- Some of the progress was already reported in interim 2. Below are additional updates:

● Task 1 – Refine overall enclosure design to make the assembly process easier and less expensive.
Objective 3: Design modification of PSG-C1000 to make it lighter -- Progress was already reported in interim 2 report.

- Task 1 – Survey and evaluate economical options for lighter energy storage that will work for PSG-C1000.
- Task 2 – Modify current PSG-C1000 electronic design to support the selected new energy storage.

Objective 4: System integration and field test

- Task 1 – Electronic assembly into the custom enclosure and integration with solar panel.
  - Electronic boards are currently being integrated and tested in the lab for initial functional verification.
  - System integration with solar panels is planned to be done in February 2020.
- Task 2 – Conduct field test.
  - A field test is highly dependent on the local weather condition, especially in this winter season. This will be done after system integration with solar panels is completed.

Objective 5: FCC compliance testing -- Some of the progress was already reported in interim 2.

Below are additional updates:

- Task 1 – Identify FCC accredited testing laboratory to work with and proceed with the testing -- Progress was already reported in interim 2 report.
- Task 2 – Contingency plan, in the unlikely event that FCC test fails, Packet Digital will perform design refinement and re-test.
  - Electronic design modification is currently being done to reduce the amount of electromagnetic interference (EMI) from PSG1.
  - Apply conductive coating on the polycarbonate panel to shield the EMI from PSG1.
A spectrum analyzer, near field probes and a broadband antenna were purchased to help us investigate and check the EMI level while modifying and optimizing the electronic design.

Near field probes have been used most frequently in the lab for quick evaluation of the design modification.

Currently trying to find a suitable location with a reasonably low level of background EMI to perform a pre-FCC emission test.

Objective 6: MIL-STD testing and certification -- This objective is scheduled to start in February 2020.

- Task 1 – Identify MIL-STD accredited testing laboratory to work with.
- Task 2 – Build four identical systems and proceed with the testing.
- Task 3 – Contingency plan, in the event that any of the MIL-STD tests fail, Packet Digital will perform the necessary design reinforcement and re-test.

Objective 7: Looking into potential new design to support further hybridization with gasoline/diesel power generator -- This objective is scheduled to start in February 2020.

- Task 1 – Perform market survey to investigate the potential market demand for such a hybrid system.
- Task 2 – Perform initial design architecture, capturing general functionalities of the hybrid system.

Deliverables
Please describe the progress on project deliverables, as stated in your contract, achieved during the reporting period:

- Report on the improvement in electronic design to simplify manufacturing and assembly process -- Already reported in interim 2 report.

- Report on the improvement in custom enclosure to simplify manufacturing and assembly process -- Some of the progress was already reported in interim 2 report.

Below are additional improvement updates on the latest enclosure design:

- Refine the power display window to better fit the display printed circuit board (PCB) and remove the PCB mounting screws. This not only enhances the appearance of the display but also eliminates the need to screw the display during assembly which not only adds time and resource but also prone to cause water intrusion in the enclosure itself.
- Redesign the aluminum back panel and the polycarbonate front panel where the use of self tapping screws to secure both panels to each other is mostly being replaced with nuts and bolts with integrated cuts on the aluminum panel for the nuts to facilitate easier assembly process.
- Additions of slots for wiring on both aluminum and polycarbonate panels.
- Grounding posts were added to the aluminum panel to facilitate easy grounding connection for the polycarbonate panel.

- Report on the weight reduction of PSG-C1000 inverter module -- Already reported in interim 2 report.

  - Electronic design refinement to reduce EMI is currently ongoing.
  - MIL-STD compliance test is scheduled to start in mid to late March 2020.
PSG1 has been internally evaluated and tested for IP67 compliance. Although IP67 is not a requirement, we would like PSG1 to achieve IP67 compliance rating. The test is currently ongoing.

**Budget**

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<th>Project Associated Expense</th>
<th>NDIC Share</th>
<th>NRL Share</th>
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1 Direct personnel costs plus indirect overhead and G&A
2 Direct materials costs plus G&A

**Expenditures**

Expenditures for the project to date are shown in the table below. Supporting documentation is provided as a separate attachment.

**EXPENDITURES FOR INTERIM 3 REPORTING PERIOD ONLY**

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**CUMULATIVE EXPENDITURES**

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