

North Dakota Renewable Energy Program Status Report

Recipient: Packet Digital LLC

Contract Number: R-032-041

Report for time period of: June 01 - August 31, 2018

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, and a variety of commercial uses such as but not limited to outdoors activities (RV campers, remote cabins, etc.), household backup power generation, and remote job sites. The end product will eliminate the fuel requirement and noise and reduce the life cycle cost of standard electromechanical power generation.

Project Tasks

Significant progress has been made on this project, primarily focusing on market research requirements capture, and system architecture.

- Objective 1&2 for inverters and batteries evaluation are completed (see Interim I report).
- Market research for military and commercial requirements capture initiated.
- Evaluation of solar panel configurations for MPPT was completed and a preferred configuration was designed and its performance was simulated. The system leverages the existing, field proven, Nishati panels and enclosure. Proprietary details are outlined in appendix A.

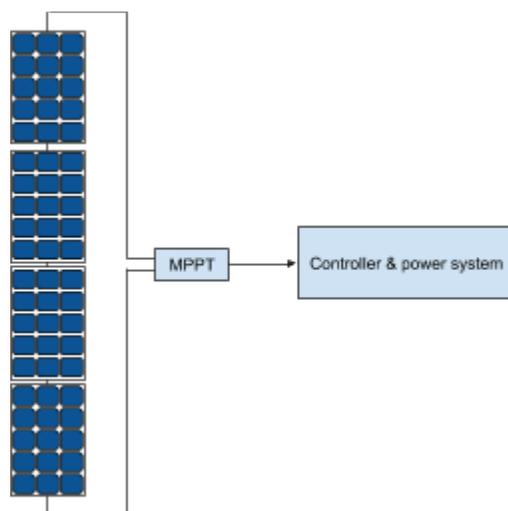


Figure 1: Selected solar panel configuration for MPPT

- Expedition 570 solar panel modelling for power simulation and analysis of the selected configuration. See Appendix A for the solar panel IV data.
- High level architecture of the system was defined, as shown in Appendix A. This architecture accommodates the system performance and features needed for the US military application, which is the most stringent application. The architecture defines the logic blocks of the system, such as integrated battery chargers, USB charging ports, a power sharing port, a main controller, and a maximum power point tracker.
- Additional hardware development identified such as bidirectional buck/boost power converters, USB charger, firmware update support, and communication with smart batteries.
- Electronic hardware design initiated and some components have been ordered to facilitate prototyping.
- Initial space claim analysis was performed to determine the possible locations and size of the electronics enclosure and battery trays. Several areas in the enclosure were identified as possible locations for the electronics, primarily consisting of the thin area between the panel and the enclosure when stowed. This will be further refined in the next interim as electrical and mechanical design progresses.
- A cooperative research and development agreement (CRADA) with the U.S. Naval Research Laboratory has been negotiated and completed. This agreement formalizes the partnership and roles of Packet Digital and NRL.

Deliverables

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

- Major parts of power electronics and hardware including smart batteries (BB2590) have been identified
- Innovative MPPT algorithm has been developed and transitioning into hardware design
- Custom enclosure for individual electronic components and integrated system will be designed when all the hardwares have been finalized and verified.
- Documentation of system testing is pending system completion
- Transition to manufacturing readiness is pending system test and verification
- Commercialization partner (Nishati) and distribution are in ongoing discussion

Expenditures

Expenditures for the first, second, and project to date are shown in the tables below. Supporting documentation is provided in a separate attachment.

EXPENDITURES FOR INTERIM 1 REPORTING PERIOD ONLY					
Project Expense	NDIC	Packet Digital	NRL	Nishati	Total
Total Personnel Costs	\$90,106.89	\$0.00	\$167,344.42	\$0.00	\$257,451.31
Software Costs/Materials	\$0.00	\$0.00	\$4,211.45	\$295.00	\$4,506.45
Total	\$90,106.89	\$0.00	\$171,555.87	\$295.00	\$261,957.76

EXPENDITURES FOR THIS REPORTING PERIOD ONLY					
Project Expense	NDIC	Packet Digital	NRL	Nishati	Total
Total Personnel Costs	\$113,250.91	\$15,719.77	\$0.00	\$16,973.19	\$145,943.87
Software Costs/Materials	\$1,186.03	\$0.00	\$0.00	\$0.00	\$1,186.03
Total	\$114,436.94	\$15,719.77	\$0.00	\$16,973.19	\$147,129.90

CUMULATIVE EXPENDITURES					
Project Expense	NDIC	Packet Digital	NRL	Nishati	Total
Total Personnel Costs	\$203,357.80	\$15,719.77	\$167,344.42	\$16,973.19	\$403,395.19
Software Costs/Materials	\$1,186.03	\$0.00	\$4,211.45	\$295.00	\$5,692.48
Total	\$204,543.83	\$15,719.77	\$171,555.87	\$17,268.19	\$409,087.66