Sand Point Inverter-Battery System

A project abstract for the Emerging Energy Technology Fund grant program

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Applicant Contact Information:

Mark Huber, President

TDX Power, Inc.

615 E 82nd Avenue, Suite 200

Anchorage, AK 99518

907-762-8450

Applicant Partners:

- TDX Sand Point Generating
- Inverter Manufacturer (TBD)
- Battery Manufacturer (TBD)

Budget:

Total Project Cost	Grant Funds Requested	Match Committed
$665,000	$665,000	N/A

Previous Grant Funding:

The Sand Point wind-diesel system received funding from AEA through grant numbers: 2195264 & 2195446.

1. PROJECT SUMMARY

a. PROJECT DESCRIPTION

TDX Power intends to build on a successful wind-diesel power system at Sand Point, Alaska, by adding an energy storage component to its Sand Point Generating power plant. An analysis of 2012 operational data shows that only 15 minutes of energy storage at full load would result in up to 2785 hours of "wind only" operation, resulting in savings in excess of 27,000 gallons and $120,000 per year. This application covers the first major step to obtain these savings, as described below.

The project includes the design and demonstration of an inverter-battery based wind-only system in Sand Point, Alaska. The project is split into two phases. Phase 1 includes final design, procurement, installation, testing and 12 months of monitoring of a modular electronic power converter coupled with an appropriate battery technology. The primary goal of phase 1 is to identify, implement, and thoroughly test commercially available equipment (batteries and inverter) and control strategies that enable the integration of storage/inverter technology into a functioning wind-diesel power system. Testing will include wind-only operation in Sand Point when load levels are low to moderate. All operational data will be recorded and analyzed by TDX. For Phase 1, the inverter and battery storage system will be sized to accommodate 1 year of testing, but will not provide for wind-only operation in all load conditions, nor will the batteries be sized to maintain long-term (10-20 year) health. Phase 2 will build on the Phase 1 installation by upgrading the battery system in size and/or chemistry to obtain the lowest life-cycle cost of ownership. Inverter modules may be added during Phase 2 in order to increase available power levels. The system controls will remain intact and largely unchanged.

This two phase approach minimizes project risk in each stage of development to help ensure success. This application covers Phase 1 development, as described above. Phase 2 will be funded in the future.

Within Phase 1, TDX Power will perform the system design and prepare detailed equipment specifications in close coordination with inverter and battery manufacturers. During the design phase, energy modeling will be updated based on the battery management constraints, equipment dispatch, cycling and other constraints. Procurement will include a robust analysis of pricing, capabilities, and past performance. The equipment will be fully containerized in marine-grade enclosures and tested prior to shipment to Sand Point.

Installation within Sand Point Generating's facility is straightforward, including setting the containerized equipment and tying directly into the 480 volt bus. Once commissioned, we plan to operate and closely monitor the wind-battery-diesel system, including "diesel off" mode, for a 12 month period. A full report will include operational data, results, recommendations, and lessons learned.

Battery chemistry has not been selected for this application. Based on the available funding, we do not expect to size the battery pack for long term (10-20 year) operation. However, the budget does include funding to procure a battery system with enough power (kw) and energy (kwh) capacity to enable wind-only operation over the course of the 12 month test period.

b. Project Innovation

The project involves the application of existing commercial technology – grid forming inverters and battery energy storage – in a fully operational wind-diesel power system. The equipment and control methods have been developed, but have not yet been demonstrated in a wind-only application in Alaska.

Bidirectional grid-forming inverters are commercially available from multiple vendors. The technology is mature, and is a perfect match for the needs of this project. The key to project success is to develop a detailed specification for battery and inverter technology that clearly identifies all functional requirements of the equipment. In contrast to other 'wind only' projects currently in development, the inverter will be a proven, commercially available product, including fully developed and tested integrated grid-forming controls and battery management.

c. Project Site and Demonstration Environment

Access to excess wind capacity, highly experienced in-house wind-diesel controls engineers, skilled wind-diesel operators, year-round scheduled shipping routes help make Sand Point the ideal test bed for an inverter-based wind-only demonstration. The infrastructure is right-sized to take advantage of wind-only operation. The wind- diesel system is fully functional, including wind turbines, master controller, secondary load, automatic diesel dispatch. The addition of an inverter and battery would be a significant but incremental step in the evolution of the Sand Point power system.

The existing wind-diesel architecture in Sand Point utilizes a diesel generator set to establish grid frequency and voltage. The wind farm acts in response to this established grid and requires a diesel genset to be online in order for the turbine to run. In other words, there is no "diesels OFF" or "wind only" operation.

The inverter functions as a generation source, operating in parallel with the existing diesel- and wind-powered sources. TDX Power will maintain overall system level control and oversight, with each generation source having its own controller for internal functions.

d. Priority

This project meets the criteria for priority consideration under both AS 42.45.375 and 3 AAC 107.705. The primary goal of the project is to demonstrate the utilization of energy storage to reduce fuel consumption. This technology would be widely applicable throughout the State of Alaska.

2. TECHNOLOGY VALIDATION AND DATA COLLECTION

a. Objectives

The primary objective of this project is to demonstrate that existing inverter technology can be successfully combined with energy storage to implement "diesel off" operation of a wind-diesel power system. TDX Power will implement and validate that the inverter can handle all the mode transitions especially "grid-forming" to "grid-tie". Battery performance will be closely monitored and compared with the manufacturer's design predictions.

b. Data Collection

All data will be collected using the SCADA system at the site, which collects 1Hz data samples to file and provides for remote data access and retrieval.

3. PROJECT SCHEDULE AND PROJECT BUDGET

The project duration is just over 2 years, based on preliminary quotes from inverter and battery vendors:

Task	Start Date	End Date	Duration
Engineering	Jan 2014	April 2014	12 Weeks
Procurement	April 2014	May 2014	5 Weeks
Fabrication	May 2014	Nov 2014	24 Weeks
Factory Acceptance Testing	Nov 2014	Nov 2014	2 Weeks
Shipping	Nov 2014	Jan 2015	6 Weeks
Installation & Commissioning	Jan 2015	Feb 2015	4 Weeks
Monitoring & Reporting	Feb 2015	Feb 2016	52 Weeks

The project budget is broken down per the following table. No matching funds are being offered for this project.

Item	Budget
Engineering & Vendor Selection	$91,000
Procurement, incl. Containerized Inverter & Batteries	$435,000
Freight & Installation	$65,000
Commissioning & Startup	$50,000
Monitoring & Reporting (12 months)	$24,000
Total Project Budget (Phase 1)	**$665,000**

4. PROJECT TEAM QUALIFICATIONS

TDX Power is well qualified to perform the work described in this application. Within the last four years, TDX Power has implemented the following wind-diesel systems at diverse sites across the state:

- Two successful wind-diesel projects (EPC role)
- One project currently in construction (EPC role)
- Three wind-diesel designs completed

As an integrated engineering, construction, commissioning, and operations company, we thoroughly vet our designs and equipment suppliers and pay special attention to details that may affect operations.

5. DISCUSSION OF COMMERCIALIZATION OF FUNDED TECHNOLOGY

The technology required to build out a battery-inverter based wind-only system appears to be fully developed, but has not been demonstrated in Alaska. There are reports of a few permanent installations in other parts of the world, but detailed data is not available to the Alaskan market.

TDX Power has the expertise in-house to specify the proper equipment, select qualified vendors, and integrate an inverter and batteries into a functioning wind-diesel system.

Selecting and demonstrating operation of a bi-directional grid-forming inverter in “diesel off” mode is a prerequisite to successfully implement any battery technology in a utility-scale ‘diesel off” scenario. Application of commercial inverter technology to a wind-only application is an incremental step. Permanent installations in similar applications have been accomplished, including PV-battery-diesel systems from multiple inverter manufacturers. A demonstration project based on clear requirements from a system integrator such as TDX Power is a reasonable next step for this technology.

There are many battery technologies that can be applied to wind-diesel power systems, which typically require high power, low energy solutions. An array of battery characteristics needs to be considered in order to select the proper battery for minimal life cycle cost. This is the primary task of Phase 2 of this project (not funded with this application).

6. SIGNED APPLICANT CERTIFICATION

By signature on this application, I certify that we are complying and will comply with the amount of matching funds being offered.

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Mark Huber, President