U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

2021 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
WIND ENERGY TECHNOLOGIES OFFICE

Sandia National Laboratories

T39 – Defense and Disast Deployable Turbine

NREL Transforming ENERGY

INL Idaho National Laboratory

Tech RD&T - Distributed Wind

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FY21 Peer Review - Project Overview

Project Summary:

The Department of Defense (DoD) conducts a wide range of missions throughout the world, including defense and humanitarian crisis response. These missions currently depend on reliable access to liquid fuel sourced through a complex global logistics system. Generating power on location with wind technology, whether at a contingency base or disaster response coordination point, can reduce the risk of disruption or attack during fuel transport and enhance mission impact. The U.S. military has identified the need for increased energy diversity in their strategic planning and investments. Much of the focus on renewable energy for the military thus far has been on solar photovoltaics so this project is focused on the potential for wind systems to provide another viable energy alternative.

Project Objective(s) 2019-2020:

- Assess the market potential and value of deployable wind systems based on application and location
- Develop wind system requirements in partnership with military and industry stakeholders
- Assess current commercial systems based on the requirements and identify areas for improvement

Overall Project Objectives (life of project):

- Facilitate the development and deployment of deployable wind technology as a viable source of power for defense and disaster response.

Project Start Year: FY19
Expected Completion Year: FY21
Total expected duration: 3 years

FY19 - FY20 Budget: $800,000

Key Project Personnel:
Brian Naughton, Robert Preus, Tony Jimenez, Brent Summerville, Jake Gentle, Dylan Reen, Eric Lang

Key DOE Personnel:
Patrick Gilman
Bret Barker

Deployable Wind Turbines at radar facility in AK. (U.S. Air Force photo/Capt Jason Goins)

Project Impact

Goal: Facilitate development of deployable wind technology

Challenge	Action
What is the market opportunity?	Market opportunity assessment for deployable wind turbines in defense and disaster response applications
Why wind energy, what is the potential value to the mission?	Modeling and simulation analysis to identify deployable wind technologies and scenarios that could provide maximum value in terms of application specific metrics (e.g. avoided fuel)
How should the wind technology be designed to provide most value?	Design guidelines to facilitate technology development that meets application needs Performance Specification to support a specific procurement action
Who are the potential first customers to partner with?	Stakeholder engagement list Field testing locations list Performance Specification Advisory Board

Program Performance – Scope, Schedule, Execution

Project Execution Approach

- Project kickoff meeting established a clear project charter with a goal and primary project objectives with associated deliverables indicating successful completion
- Major project tasks and associated deliverables are assigned to a lead laboratory with support and review provided by the other laboratory staff to ensure efficient and rigorous work
- Team meetings held every two weeks to share information, interim results, and coordination of activities
- Extensive stakeholder engagement activities were planned and sequenced throughout the project to ensure the tasks and analysis were relevant and valuable and the communication of results was effective and reached the right audiences

Milestones and Deliverables

- All major milestones and deliverables have been met on time or within the following quarter
- Project risks were addressed with Go/No-Go decision points each year and the scope and/or schedule was adjusted in the following year plan as needed
- Where appropriate and beneficial, draft results and deliverables were shared with external stakeholders for feedback to refine scope and relevance and to improve clarity

Program Performance – Accomplishments & Progress

Market Assessment Report

- Technical information on energy use by service
- Stakeholder information regarding offices with missions relevant to fund development and deployment of operational energy technologies

U.S. Army 2007 tactical electric generator requirements

Generator Size (kW)	Qty Required for Army
2	9,576
3	19,122
5	14,779
10	12,001
15	4,370
30	3,085
60	2,950
100/200/DPGDS	568
Total	66,451

U.S. military offices with missions relevant to the project (partial list)

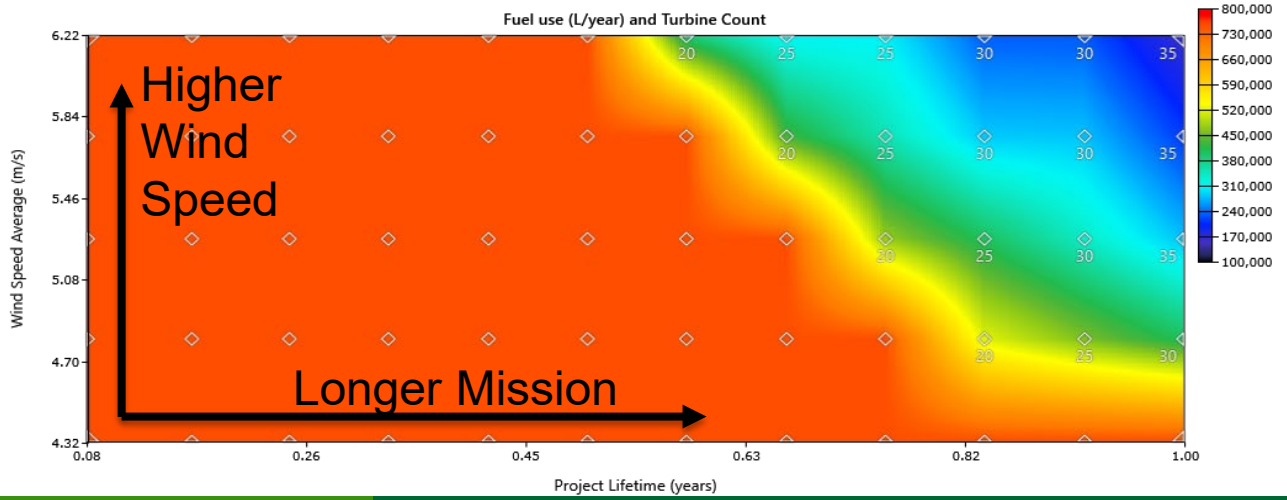
Office	Relevance to D3T project
U.S. Army	
Program Executive Office Combat Support and Combat Service Support (PEO CS&CSS)	Home of the Army Project Manager, Expeditionary Energy & Sustainment Systems (PM E2S2) with a mission to provide integrated, scalable, and affordable expeditionary energy, force sustainment, and contingency basing capabilities that reduce sustainment demand for the Warfighter across the range of joint operations.
Energy Branch, U.S. Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC) and Construction Engineering Research Laboratory (CERL)	CERL directs its research efforts toward increasing the Army's ability to more efficiently design, construct, operate and maintain its installations and contingency bases, and ensure environmental quality and safety at a reduced life-cycle cost. CERL has test and evaluation capabilities, including an experimental forward operating base where new technologies can be installed.
U.S. Marine Corps	
U.S. Marine Corps. Expeditionary Energy Office (E2O)	Primary office with responsibility to analyze, develop, and direct the Marine Corps' energy strategy in order to optimize expeditionary capabilities across all warfighting functions. Two programs, Ground Renewable Expeditionary Energy Network System (GREENS) and Solar Portable Alternative Communications Energy System (SPACES), are examples of renewable technologies E2O has invested in.
U.S. Navy	
Office of the Deputy Assistant Secretary of the Navy Energy (DASNE)	Provides operational energy policy, guidance, and oversight across the Navy. Current priorities include directed energy and battery storage, but there is some interest in renewable energy for forward operating bases and dismounted soldiers.
U.S. Air Force	
Office of the Assistant Secretary for Installations, Environment and Energy	Provides operational energy policy, guidance and oversight across the Air Force. Primary focus is on using jet fuel more efficiently and fuel logistics planning.

Program Performance – Accomplishments & Progress

Modeling Deployable Wind Value

- The System of System Analysis Toolkit (SoSAT) is a modeling and simulation tool primarily used by the US military to study impacts on operations, logistics, and operational energy
- SoSAT was used to estimate the impact of deployable wind systems compared to a mobile diesel generator for a 30-day mission of a hypothetical Army Infantry Brigade Combat Team operating a network of bases

Wind Resource	Turbine Count (15 kW rated power)	Battery Storage (sized to capture all excess generation)	Commercial Wind Turbine		Large Rotor Wind Turbine	
			Generator Operating Hours	Percent Reduction Compared to Baseline (%)	Generator Operating Hours	Percent Reduction Compared to Baseline (%)
Good	20	No	15,642	41	13,486	49
		Yes	15,047	44	12,567	53
	40	No	12,424	53	10,401	61
		Yes	7,079	73	4,404	83
Low	20	No	20,769	22	18,264	31
		Yes	20,651	22	18,021	32
	40	No	17,425	35	15,133	43
		Yes	16,048	40	12,189	54



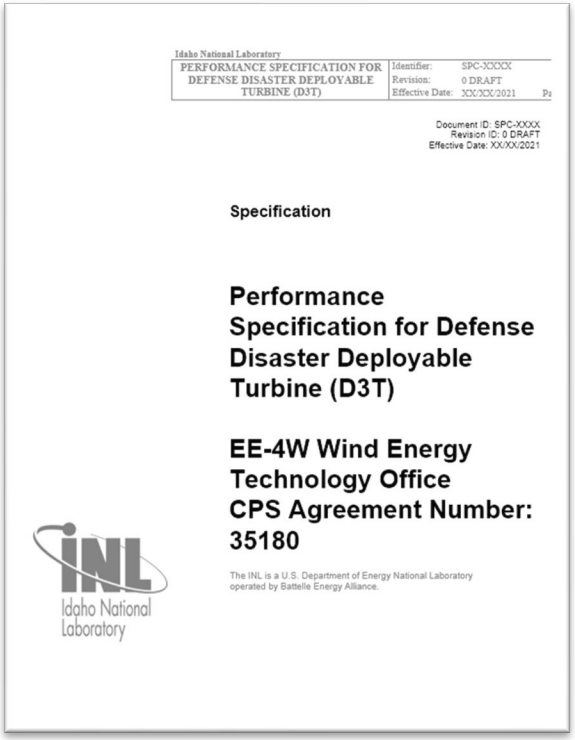
The microgrid design tool HOMER was used to optimize the architecture of a single contingency base to minimize overall logistical requirements. This figure shows the number of wind turbines (diamonds, blank = 0) that are optimal given the mission length and average wind resource. The color indicates total diesel consumption.

Program Performance – Accomplishments & Progress

Design Guidelines

- Incorporates input from both military and industry stakeholders along with public reports and other reference documentation
- Information gaps, especially technical, are being addressed with technical studies using a variety of analysis and simulation tools.
- Design guidance covers three different power scales:
  - ~3 kW (small mobile team)
  - ~15-20 kW (Forward Operating Base)
  - ~100 kW (Enduring base)
- Document is out for comments now and will be published later this year

Project Performance - Upcoming Activities


Idaho National Laboratory

PERFORMANCE SPECIFICATION FOR DEFENSE DISASTER DEPLOYABLE TURBINE (D3T)

Identifier: SPC-XXXX
Revision: 0 DRAFT
Effective Date: XX/XX/2021

Document ID: SPC-XXXX
Revision ID: 0 DRAFT
Effective Date: XX/XX/2021

Specification

Performance Specification for Defense Disaster Deployable Turbine (D3T)

EE-4W Wind Energy Technology Office
CPS Agreement Number: 35180

The INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance.

INL Idaho National Laboratory

- Disseminate information to industry and military stakeholders
- Discuss new opportunities to partner with military and industry stakeholders to develop, deploy, and test hardware in the field

Field Testing Site Name	Location (city/state)	Owner Organization
Future Capabilities Integration Laboratory (FCIL) (formerly Base Camp Integration Lab BCIL)	Fort Devens, MA	U.S. Army
Contingency Basing Integration Training Evaluation Center (CBITEC)	Fort Leonard Wood, MO	U.S. Army
Army Expeditionary Warrior Experiment (AEWE)	Fort Benning, GA	U.S. Army
Expeditionary Energy Concepts (E2C) (formerly Experimental Forward Operating Base ExFOB)	Various USMC Bases	U.S. Marine Corps
Marine Corps Air Ground Combat Center	Camp Wilson, Twentynine Palms, CA	U.S. Marine Corps
Basic Expeditionary Airman Skills Training (BEAST) facility	Lackland Air Force Base, TX	U.S. Air Force
ERDC Forward Operating Base Laboratory Engineer Research and Development Center - Construction Engineering Research Lab	Champaign, IL	U.S. Army Corps of Engineers


US Army Future Capabilities Integration Lab

Stakeholder Engagement & Information Sharing

Stakeholder engagement is a core strategy of this project. Information is gathered from military and industry stakeholders, consolidated and enhanced with technical analyses, and shared back out to form a common knowledge base about the opportunity and value of deployable wind technology.

Events

- Expeditionary Power & Energy Summit, 2019
- Defense Techconnect, 2019 & 2020
- Operational Energy Summit, 2020
- Distributed Wind Conference, 2019 & 2020
- Distributed Wind Research Program Workshop, 2020
- AFWERX challenge "Reimagining Fixed and Mobile Energy Generation"
- Deployable Wind Performance Specification Advisory Board Meeting

Interviews

- 36 Wind energy and system integration companies
- 13 Defense Department offices related to operational energy

Key Takeaways and Closing Remarks

Market Assessment of deployable wind for defense and disaster response applications

Technical Analysis to quantify potential value of deployable wind systems to application needs

Design Guidelines to provide a common public reference for all stakeholders to bridge military performance requirements to turbine design capabilities

Stakeholder Engagement

Presented and attended 4 conferences on military energy and 2 conferences on distributed wind technology

Interviewed 36 wind turbine and system integration companies

Interviewed 13 Defense Department offices with energy related missions

Convened military Advisory Board to identify opportunities and approaches to procure and test a deployable wind turbine