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PROJECT TITLE:

eHVA Engine Technology Demonstration Project

APPLICANT:

WHPacific, Inc., 300 W. 31st Avenue, Anchorage, AK 99503

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CONTACT INFORMATION:

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PROJECT PARTNERS / CONTRACTORS:

- Sturman Industries, 1 Innovation Way, Woodland Park, CO 80863 (Partner)
- Alaska Center for Energy and Power (ACEP), University of Alaska Fairbanks
  814 Alumni Drive, PO Box 755910, Fairbanks, AK 99775-5910 (Contractor)
- Renewable Nations Institute, 39 Beacon Hill, Chelsea, VT 05038 (Partner)

PROJECT COST:

Grant Funds Requested:	$750,000
Matching Funds Committed:	$1,731,250
Total Project Cost:	**$2,481,250**

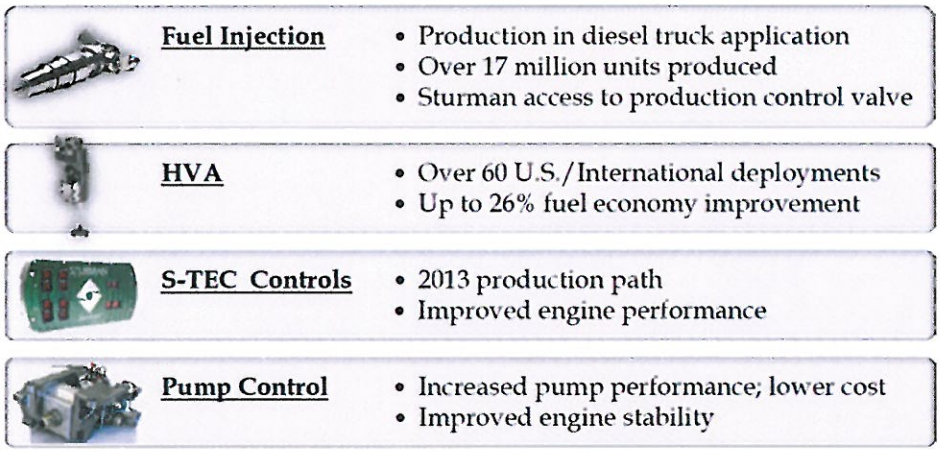
PREVIOUS PROJECT/APPLICATION TITLE(S):

WHPacific has never been a prime applicant to the Emerging Technology Fund. WHPacific has been involved as a proposed engineering sub-contractor for other non-funded applications.

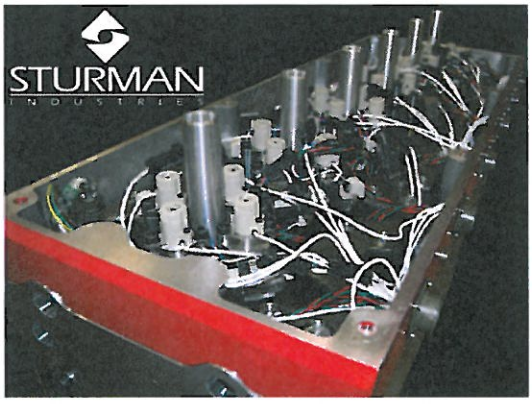
PROJECT DESCRIPTION: The proposed eHVA Engine Technology Demonstration Project (Project) will design, develop, deploy, and test a 1MW nameplate capacity diesel-fired Combined Heat & Power (CHP) co-generation system utilizing emerging electronic engine control technologies and hydraulic valve actuation (eHVA) systems developed by Sturman Industries (Sturman). The eHVA Technology Readiness Level (TRL) is TRL 8 for stationary CHP applications. Heat recovery and power generation equipment integration is required for TRL 9 system operations and field testing. The Project will deploy the emerging eHVA engine-based CHP technology for performance evaluation under load simulation test methodologies for wind-diesel power integration at the ACEP, and isolated field testing at the Red Dog Mine for base load power and heat supply in an Artic operating environment. The Project will demonstrate the peak engine efficiencies in excess of 40% with up to 18% reduction in fuel consumption, as recently achieved in both diesel and natural gas-fired eHVA demonstration programs, including a demonstration project for the California Energy Commission (CEC). (See: http://sturmanindustries.com.dnnmax.com/Portals/0/Documents/PIR-08-023_Final_Report_FINAL_A.pdf)

The eHVA engine-based CHP system will be designed for integration into isolated wind-diesel, mini-grid applications for the rural community- and industrial-scale Alaska market and to accommodate the use of conventional and alternative fuels. Project outcomes will include an eHVA product commercialization plan for remote Artic stationary power applications pursuant to the installation of a modularized 18MW nameplate capacity CHP system for base load power at the Red Dog Mine, located north of Kotzebue, Alaska, and targeted village applications.

TECHNOLOGY DESCRIPTION: Sturman Industries electronic engine combustion control technologies and hydraulic valve actuation (eHVA) systems are proprietary digital-mechanical engine systems consisting of several patented components – digital valves, fuel injectors, hydraulic valve actuators (HVA), S-TEC electronic controls and hydraulic pumps – illustrated below:



eHVA system components are assembled in an advanced "camless" engine cylinder head design that replaces conventional the cylinder head(s), engine camshaft(s), valves, valve springs, and rocker arms. The software controls and hardware configuration enables compression ignition of multiple homogeneous fuel mixtures, the capacity to operate at differing engine cycles (i.e., 2-cycle and 4-cycle), and to deliver automated power optimization for ultra-high fuel efficiency under varying operating speeds and load conditions. The eHVA cylinder head assembly is shown at left; with the hydraulic valve to the right.



The Project will test the eHVA camless cylinder head system on a stock production Cummins ISX15 rated (15-Litre, 400 BHP) compression ignition engine. The 1MW configuration will consist of three ISX engines, each coupled with a 330KW generator, demonstrating scalability, reliability, and improved efficiency for variable load requirements.

PROJECT INNOVATION: The eHVA system increases fuel efficiency through a patented Homogeneous Charged Compression Ignition (HCCI) process that achieves improved fuel mixing and combustion temperature control. The eHVA Camless configuration and HCCI combustion control process: (i) eliminates valve spring compression parasitic power loss; (ii) provides independent control of valve timing and duration (Miller cycle); (iii) improves combustion control adjustment for a large range of liquid and gaseous fuel supply and fuel qualities with aggressive transient control; and (iv) reduces diesel particulate matter (DPM) and nitrogen oxides (NOx). Digital control systems reduce maintenance costs by eliminating significant component engine wear and reducing catastrophic engine failure. eHVA monitoring equipment can diagnose and disable an individual cylinder or engine, and generate automated work orders for engine repair.

At-scale, eHVA-based engine production costs are projected to be priced above the "First Least Cost" of conventional engine technologies, but "Total Life Cycle Cost" is projected with a 1.7 year simple payback (est.) based upon avoided fuel cost savings (cost recovery) at $3.40 per gallon for low-sulfur diesel fuel, and a 1.5 year simple payback (est.) when accounting for greater reliability, reduced maintenance costs, and extended engine lifespan. Furthermore, the feasibility of the proposed eHVA-based CHP for commercial- and community-scale remote wind-diesel power generation applications in remote Artic locations conditions (especially village power applications) are vastly increased due to the technology's ability to accommodate the use of conventional and alternative liquid and gaseous fuels. Alternative engine fuel capacity will be verified at the ACEP test facilities based upon potentially available alternative fuel supplies for the rural Alaska market, including NH_3 (a hydrogen carrier). Alternative fuels generated on-site in remote locations from renewable resources can improve local economies by lowering fuel costs and achieving fuel price stabilization.

PROJECT SITE & DEMONSTRATION ENVIRONMENT: The field project site for eHVA engine technology demonstration is at the Red Dog Mine near Kotzebue. The Red Dog Mine is owned and operated by Red Dog Operations, a joint venture between NANA Regional Corporation, Inc. (NANA), an entity wholly owned by the Inupiat people of Northwest Alaska, and Teck Alaska Incorporated (TECK). To retain site control for the duration of the Project, NANA will hold a Power Purchase Agreement with TECK assigned to WHPacific and/or alternate team member. The 18MW base load electric power demand at Red Dog Mine is representative of the anticipated commercial CHP market targeted by WHPacific in Alaska and lower 48 states.

STATUTORY AND PRIORITY TYPE APPLICATION: The eHVA statutory priority benefits WHPacific, an Alaska corporate and wholly owned business unit of NANA, and the University of Alaska Fairbanks Alaska Center for Energy and Power (ACEP). The Project CHP is a co-generation priority, specifically, electricity production and engine waste heat recovery for space heating and domestic hot water. WHPacific's priority business interest is in the widespread deployment in remote commercial- and community-based, hybrid wind-diesel CHP applications to promote sustainable energy solutions for rural Native Alaskans. Project partners will provide $1,731,250 in cash and/or value-in-kind services.

TECHNOLOGY VALIDATION & DATA COLLECTION: eHVA technology validation will be achieved through parallel data collection protocols established by ACEP and Sturman, and approved by the Alaska Energy Authority (AEA). Parallel systems are required so as to not interfere with eHVA automated combustion controls. Performance metrics for technology validation will include fuel consumption, electricity production and thermal recovery. A Power Purchase Agreement (PPA) with TECK will require audited Project economic data.

SCHEDULE & PROJECT BUDGET:

Schedule/Task	1-Qtr-14	2-Qtr-14	3-Qtr-14	4-Qtr-14	Total
Project Mgt.	$ 131,250	$ 131,250	$ 131,250	$ 131,250	$ 525,000
eHVA Prod. Dev.	$ 775,000	$ 775,000	$ 100,000	$ 100,000	$1,750,000
Verify/Report	$ 43,750	$ 43,750	$ 75,000	$ 43,750	$ 206,250
					$2,481,250

TEAM QUALIFICATIONS:

- **WHPacific:** WHPacific, owned by NANA Development Corporation, is a multi-discipline architecture and engineering (A&E) firm with nearly 400 staff members in 19 offices and annual revenues near $60M. It is the largest Native American-owned A&E firm.
- **Sturman Industries:** Sturman Industries, with over 150 patents associated with eHVA technologies, is a world leader in digital-mechanical hydraulic actuation valves and related control systems with over 13 million valve systems deployed worldwide.
- **Alaska Center for Energy & Power:** ACEP (University of Alaska) is dedicated to applied energy research and testing focused on lowering the cost of energy throughout Alaska and developing economic opportunities for the State, its residents, and its industries.
- **Renewable Nations Institute**: The Institute, established under contract with the United Nations (UN), provided technical assistance services to the Government of Ecuador and the UN to establish the first wind-diesel hybrid energy system under the Kyoto Protocol Clean Development Mechanism (CDM), a $40M international, public-private partnership.

TECHNOLOGY COMMERCIALIZATION: The Institute, in collaboration with Sturman and WHPacific, is supporting the commercialization and marketing of eHVA engine technologies. Primary planning activities are focused on securing a $100M Red Dog Mine Energy & Power Improvement Program contract, developing a $35M eHVA production facility, and supporting capacity building and market development for WHPacific to distribute eHVA product in the commercial- and community-based CHP markets in the State of Alaska and lower 48 states.

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

Signature: 

Name: Harold Hollis, VP AK Region, WHPacific, Inc.

ATTACHMENT: State of Alaska Business License - WHPacific, Inc.