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Converting a 13-turbine California Windplant to Hydrogen Fuel Production Without Electricity Grid Connection: R & D and Demonstration

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Alaska Applied Sciences, Inc. (AASI) delivered electric energy from its Palm Springs R&D windplant to the SCE grid for 21 years, until the PPA expired in 2012. We improved many aspects of the vintage-1985 turbine design to improve its durability, reliability, and energy capture. In 2005, AASI completed a blade manufacturing R&D project, for small wind turbines, on DE-FG36-03GO13140 Final report: www.osti.gov/servlets/purl/859303-oXetpM/

AASI is now ready to convert its Palm Springs windplant entirely to "distributed" Hydrogen fuel output, with no connection to the SCE grid, to help prepare the wind industry for a larger market than the electricity grid: CO2-emissions-free (CEF) transportation fuel. Wind-source Gaseous Hydrogen (GH2) and Anhydrous Ammonia (NH3) fuels via underground pipelines, with annual-scale firming storage of these fuels at less than $ 1.00 per kWh capital cost.

These 13 vintage-1985 turbines are equipped with common, rugged, low-cost, three-phase, 60 hp induction motors as generators. This windplant is the perfect test bed for R&D and demonstration of a novel, low-cost, high-efficiency technology system for producing high-purity Hydrogen fuel from wind-generated electricity, from single or multiple "distributed" turbines, with no connection to the electricity grid. Modified for Self Excited Induction Generator (SEIG) mode, the turbines would be closely coupled via simple, smart rectification on a DC bus to the electrolyzer stacks, via a SCADA system integrating the complete wind-to-Hydrogen plant, to reduce system complexity and capital and O&M costs. This will boost conversion efficiency (reduce kWhe per kg Hydrogen), thus reducing plant gate Hydrogen fuel cost in several ways. See videos, above: we have demonstrated SEIG mode operation on one of our Palm Springs turbines.

This has been AASI's mission for fifteen years: implementing the vision of urging the renewable energy (RE) industry to seriously consider alternatives to electricity systems for gathering and transmission, affordable annual-scale firming storage, and distribution and integration of Carbon-emissions-free (CEF) energy at small or large scales. Hydrogen and Anhydrous Ammonia (NH_3) are the attractive alternatives. See AASI Principal Bill Leighty's research papers and presentations at: www.leightyfoundation.org/earth.php See the conference videos, above.

No other company has proposed demonstrating this technology of SEIG-equipped turbines, closely coupled to electrolysis stacks or NH_3 synthesis reactors, on an operating multi-turbine windplant. This project's success could be scaled to multi-MW turbines and windplants, to produce, for example, an estimated 8 million tons of Hydrogen fuel required for California's transportation sector in year 2050 -- a larger market for CEF energy than electricity for the California (CA) grid. The project's Hydrogen fuel may be delivered to Sunline Transit, 15 miles east on I-10, and / or to other local markets -- in the short term via tube trailer, eventually via dedicated underground GH2 and NH_3 pipelines.

Major wind turbine OEM's will independently develop and adopt this SEIG technology, motivated by:

- Lower capex and O&M costs of Hydrogen and Ammonia energy production, transmission, and storage systems vis-a-vis electricity systems, at distributed to continental scales;
- Higher value per wind-generated kWh for Hydrogen and Ammonia fuel production than for the electricity grid;
- Wind deployment over far wider geographic areas, serving the Hydrogen and Ammonia fuel markets via pipelines.

AASI has demonstrated SEIG mode operation on one of its stranded Palm Springs turbines, delivering rectified "wild AC", from the variable speed turbine, as "wild DC", to a DC resistive load bank: https://vimeo.com/160472532

Video of AASI's Palm Springs windplant in 2005, delivering electricity to the SCE grid at constant turbine RPM, with their induction motors-as-generators locked at 60 Hz, is at: https://vimeo.com/86851009