XI.13 High-Efficiency, Ultra-High Pressure Electrolysis with Direct Linkage to Photovoltaic Arrays (Phase II Project)

Mr. Thomas Jackson
Avalence, LLC
1240 Oronoque Road
Milford, CT 06460
Phone: (203) 701-0052; E-mail: tj@avalence.com

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The production of hydrogen fuel from renewable resources such as solar and wind in distributed-generation, small-scale applications would provide an environmentally-benign, truly sustainable transportation fuel supply. But before this can be achieved, the hydrogen generating systems must become as reliable as home appliances (e.g., central air conditioning or furnaces), which require only annual maintenance. The primary source of reliability problems is the separate mechanical compressor, which supplies high pressure hydrogen for portable applications, and its elimination is critical to achieving this goal. This project will develop a prototype of a renewably powered, hydrogen fuel producer that supplies high-pressure gas (5,000 to 10,000 psi) to a hydrogen fuel dispenser for the depot-style fueling of commercial or agricultural vehicles, without additional compression or power conditioning equipment. The approach will be based on an innovative ultra-high pressure electrolysis system that has the potential to deliver hydrogen fuel at pressures exceeding 10,000 psi, directly from the electrolysis cell. Phase I ran parametric tests on an ultra-high pressure electrolysis cell to determine the efficiency of producing fuel grade hydrogen; linked an existing high-pressure electrolyzer to a PV array and ran additional tests to determine production at various light conditions and electrolyzer cell configurations; and developed a conceptual design for a stand-alone, PV-powered, high-pressure electrolyzer system that includes a hydrogen fuel dispenser. Phase II will complete the detailed system design and demonstrate key systems related to the safety and manufacture of a hydrogen fueling station. Then, the hydrogen fueling station will be fabricated and tested.