

Direct Methane Fuel Cell (DMFC) Testing and Deployment on Unimak Island, AK 2012: A case study for alternate power systems in the Plate Boundary Observatory GPS network.

Ryan Bierma, Max Enders, Ellie Boyce, Warren Gallaher, Karl Feaux

The UNAVCO Plate Boundary Observatory (PBO) Alaska region tested and deployed an EFOY Pro 1600 Direct Methanol Fuel Cell (DMFC) as a supplemental power system at a GPS station/communications hub on Unimak Island, AK. The Tugamak Range (AV35 WTUG) site on Unimak Island supports daily downloads from 6 GPS stations and 4 tiltmeters, and is capable of streaming high rate data. Site instrumentation consists of a Trimble NetRS GPS receiver, an Intuicom 5.8 GHz ethernet bridge, 3 Intuicom 900 MHz ethernet bridges, an 8-port ethernet switch, and a web power relay. The total power consumption is ~26 Watts. We selected this site for fuel cell installation because of its high power demands along with its history of power failures during previous winters.

During the winter of 2012, PBO field engineers, with support from the UNAVCO testing and development engineers in Boulder, CO, completed extensive pre-deployment testing at the PBO Alaska regional office in Anchorage. A full-scale mockup of a new power system for the WTUG site was built at our Anchorage facility that incorporated power from both photovoltaic panels and a fuel cell for battery charging. Our goal was to design a system that functions consistently year round and requires minimal maintenance. Primary design considerations were low photovoltaic input and extreme cold during the winter, with secondary considerations, which include the possibility of damage by bears, earthquakes and lightning strikes. This new system was tested outdoors with variable power load demands and minimal photovoltaic input. Over the course of testing we encountered issues pertaining to frozen mechanical components, frozen exhaust lines, fluid exhaust disposal, and a manufacturer defect with an internal sensor component.

The new combined fuel cell/photovoltaic system was deployed at WTUG during June 2012 with two 28L fuel jugs. The fuel cell produced a total of 32.15 kWh between June 2012 and April 2013. As expected, the unit accounted for a higher proportion of the charging duties as the winter progressed. An average of 0.17 kWh per month was produced during the summer months (June-August), while an average of 6.40 kWh per month was produced during the winter months (December 2012-March 2013) with a peak of 8.07 kWh during January 2013. The fuel cell consumed approximately 28.94L of methanol between June 2012 and April 2013 using the nominal factory fuel consumption rate (0.9L/kWh). There were a total of 11 charge cycles from November 2012 through March 2013, which account for the bulk of the fuel consumption.

Overall this supplemental power system has been a success. This vital link to PBO GPS and tilt data has remained charged and active through the entire Alaskan winter. The Alaska PBO engineering team plans to deploy at least two more fuel cells during 2013 at other power intensive sites, including AC59 Ursus Head near Augustine Volcano and at AV15 on Akutan Island.

