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A fuel cell power system for remote, autonomous, Arctic instrumentation sites.

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We present the system design, results, and lessons learned from a successful autonomous, 65-Watt, direct methanol fuel cell-powered communications node deployment at a tundra field site in the Arctic through the winter season 2010-11. A 1-Watt Linux computer handles data acquisition and system control over a HughesNet broadband satellite link and an IEEE 802.11 wireless local area network. Sealed lead acid batteries provide short term energy storage between fuel cell runs and input from a small photovoltaic array.

Traditionally, battery banks combined with photovoltaic panels and wind turbines are used to power off-grid remote instruments. Solar energy is not available in the winter at high latitudes. Wind power can also be intermittent and of low energy at sites in interior Alaska. Diesel generators are used to overcome these short comings of renewable energy and at sites with higher power requirements. These generators require regular maintenance and generate noise, vibrations, and exhaust fumes that can potentially pollute scientific data. These are important factors at seismic and carbon flux monitoring sites. Direct methanol fuel cells exhaust only small amounts of H2O and CO2, approximately equivalent to human respiration.

Thermal management was a major problem, as the system needed to operate in a simple environmental enclosure, unattended, through Alaskan winter and summer conditions. This prototype system has run in ambient conditions ranging from -40° to +25° C. The fuel cell generates significant heat when operating, which needs to be exhausted from the enclosure even in the winter. Fresh air is needed to replenish the supply of oxygen, but cold winter air can freeze the fuel cell and its water vapor exhaust line.

Methanol has a (usable) energy density .higher than that of standard AGM batteries, allowing a fuel cell-powered system to run up to 10 times longer than an un-renewed battery-powered system of the same dimensions, without incurring any of the negative effects of a diesel generator.