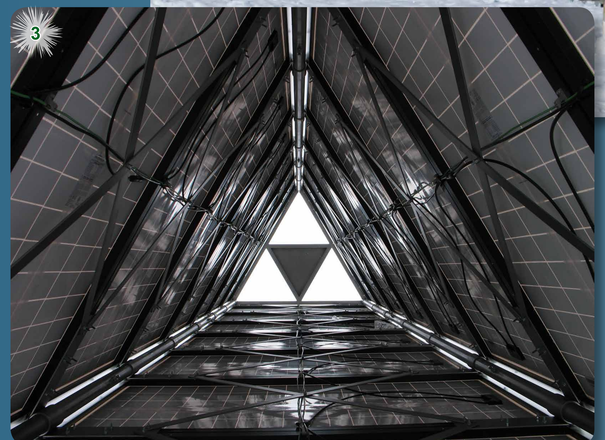
Poster C13C - 0693

Maximizing Solar Energy Capture Through Multi-Azimuth PV Arrays

(Evolution in array design for high latitude projects)

1. **Imnavait Creek, Alaska.** *Autonomous year-round hybrid solar / wind power system with conventional south facing 650 Watt PV array. Steep angle sheds snow and maximizes winter solar production. This system was designed by ABS-Alaskan, deployed and maintained by CH2M HILL Polar Services.*

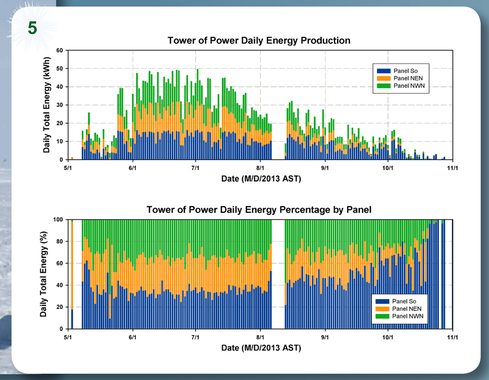
2. **Ivotuk, Alaska.** *Autonomous year-round hybrid solar / wind / diesel power and communications system. This is the beginning of the multi-azimuth PV array design. One array faces due south, while a second array faces SSW. This increases the total time that solar power is produced each day. Also, this site tends to experience morning overcast and fog, clearing in the afternoon. The SSW array capitalizes on local meteorological conditions. The PV angle is set for approximately 68 degrees, or the latitude of the site. This results in the best angle of incidence in the shoulder seasons, thus maximizing overall annual production. The generator module was designed by Northern Power Systems. Renewable energy components added by CH2M HILL Polar Services.*



3. **Looking inside the ToP.** *The triangulated design utilizes the aluminum frames of the PV panels as structural members, greatly reducing the weight of the structure while remaining very strong. Wind loads are dramatically reduced, while the vertical design minimizes snow accumulation and capitalizes on reflected light.*

4. **The Tower of Power (ToP) at Summit Station, Greenland.** *This three sided PV array is a grid-interactive system, tying in to the local diesel generators to offset fuel usage. Deploying a total of 4.92kW of PV, the system produced >4MW of energy in its first year of operation. Feeding to three separate inverters, the 3-phase system produces power 24 hours per day in mid-summer, reducing potential problems with power quality with this simple diesel generator system.*

Photo: Nick Salava



5. **Orienting PV panels south (or north in the southern hemisphere) still produces the greatest net energy yield.** *However, there can be compelling reasons to orient panels in other directions. Producing energy more evenly over the course of the day, taking advantage of local meteorological conditions, or reducing the amount of energy storage required can all be accomplished by employing multi-azimuth arrays. The graphs above illustrate that the ENE and WNW facing facets of the ToP produce about 2/3 the net energy per facet as the south facing facet. By evening out the RE power input to the rudimentary diesel generator grid, stability and phase balancing is maintained.*

6. **The Solar Chalet, Toolik Field Station, Alaska.** *This is a summer-only science project with a relatively high continuous load of around 500 Watts. Solar with generator back-up. By employing multi-azimuth PV arrays that produce power for the majority of the day, the energy storage requirement is significantly reduced. With this project, the east / west facing arrays perform double duty, providing some weather protection for the equipment, while still allowing snow to scour through without creating massive drifts.*

Photo: Eric Klein

7. **The Solar Chalet, designed and constructed by CH2M HILL Polar Services.** *The A-frame design is inherently strong, lightweight, and relatively easy to deploy. A third, fairly conventional array faces south. Longer DC runs can be accommodated by series connecting the PV panels to transmit the power at higher voltages. Maximum power point tracking (MPPT) charge controllers then step down the voltage to match the battery bank nominal voltage.*

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Please visit NSF at http://www.nsf.gov/geo/plr/arctic/res_log_sup.jsp

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Tracy Dahl is a technical specialist focusing primarily on renewable energy and appropriate technology solutions in support of the National Science Foundation's Arctic Program. He works for Polar Field Services, part of the CH2M HILL Polar Services partnership. He works very closely with colleagues at SRI International (another of the partners) in developing remote power and communications solutions to advance polar science objectives. Working in the Arctic and Antarctic for 20 years, Tracy has learned what works and what doesn't. Check out other technological solutions at www.polarpower.org.

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