Autonomous, Continuously Recording Broadband Seismic Stations at High-Latitude

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IRIS PASSCAL is in the third year of an NSF funded development and acquisition effort to establish a pool of cold-hardened seismic stations specifically for high-latitude broadband deployments. We have two complete years of field trials and have successfully recorded continuous seismic data during both years with data recovery rates of ~90%. Our design is premised on a 2W autonomous system recording to local media capable of lasting two years without service. The system is composed of four new design elements: a heavily insulated station enclosure; a state-of-health (SOH) Iridium modem; a light weight, easily deployed solar panel mount; and a power system that includes power switching between primary (Lithium Thionyl Chloride) and secondary batteries.

The station enclosures have proved most critical in keeping our data acquisition systems operating within manufacturer specifications and primary batteries within a 50-70% efficiency range. Enclosures with 2.5cm-thick vacuum panels and 5cm of foam insulation have kept interior enclosure temperatures 25-30°C above background (typically below -50°C). This austral summer we are deploying version three of our enclosures. Significant changes in the design are thicker vacuum panels (5cm), more robust construction, and simplified cable routing.

An important aspect of our station design is easy installation and minimal weight. To simplify installation our station enclosures are packed with datalogger, SOH communications and batteries in the lab or base camp, so that access to the internal components is not necessary at the remote site. Bulkhead connectors allow a user to

fully interact with the system without ever having to open the enclosure. Solar panel mounts are also fully constructed prior to deployment. Once on site, digging two large holes (one for the enclosure and one for the broadband seismometer) and constructing the site takes roughly 2 hours. A station designed to record continuously for 12-14 months is deployed with approximately 2000Ah of battery capacity and weighs ~225 kg. Doubling the primary battery capacity for a two-year station increases the weight by only 50kg.

Our development effort has proven the ability to install deep field, continuously recording broadband stations in extreme, high-latitude environments. Continued development on Iridium communications for partial or complete data transmission is ongoing, as is further refinement of our power system.