

**IRIS Instrumentation Committee Meeting  
DIA Marriott Courtyard  
April 22-23, 2001**

**Committee Members:** John Collins, Jim Fowler, Bob Hutt, Selwyn Sacks,  
Frank Vernon

**IRIS Liaison:** Rhett Butler, Shane Ingate

**USGS Liaison:** Ray Buland

**Visitors:** None

**Action Items:**

Bob Hutt Will look up vibration spec.  
Provide his facility for testing Sodern seismometer.  
Will call Nanometrics to offer to test Trillium 2  
Will call Guralp to offer to test CMG-1  
Sent Frank plots for sensors with respect to LNM

Ray Buland will find out earthquake shaking operating specification.

Jim Fowler will contact Sodern about testing seismometer  
Will be working with KMI to arrange testing for the Chronos when KMI is ready.  
Will talk with KMI to get permission to distribute preliminary Chronos results.

Frank Vernon will talk to Jon Berger about distributing ppt presentation.  
Will send preliminary minutes for review  
Will prepare draft of technical specifications for review

Q680, Q730, and SAN2012 self noise of datalogger is less than self-noise of STS-1 from at periods longer than 0.5 seconds.

Bob Hutt show theoretical noise for STS-1 below low noise model in the range 500sec-2hz

Showed theoretical noise for 54000 below low noise model in the range 200secs-5hz

Showed theoretical noise for CMG3T below low noise model in the range 80secs-12hz

Q330 – STS1 system self-noise is below low noise model in the range 1000 seconds- 2 Hz

Measured digitizer self-noise combined with predicted self-noise of STS-1, 54000, CMG3T, STS2 and must be below low noise model and not compromise low noise site.

Ray proposes examining whether current sample rates are appropriate for future complete station installation. Ray proposes integrating sensor and digitizer purchasing into one system.

Rhett – No new STS1 seismometers are being produced. He is pursuing aftermarket approach by trying to purchase any available STS1s from current users.

### Discussion of GSN Datalogger Specs

- Clip Level ±20V peak-to-peak differential analog input
- Configurable gain 0db and 20db or 30db or 40db
- Noise Level Should specifications be based on NLNM? Should another specification be made for “noisy” sites?
- Linearity 120 db
- Time tag 1 ms
- Power Power used is related to noise performance of datalogger. Datalogger system should be 2 watts per channel or better.
- Recording and Storage Capability No moving parts, >= 1 Gbytes, Hot swappable, Pluggable, 1 year of data
- Telemetry Capability Data telemetry must be error corrected, must support standard IP communications protocol(s), must support a variety of communications technologies, and must be capable of transmitting back logged and triggered data without interrupting real-time data delivery. Command and control capability.
- Connectivity – Provide for secure communication, avoid China syndrome where data logger can be reconfigured by host country.
- Temperature Range - operational (-20C to +60C), storage (-20C to +60C), noise and sensitivity vs. temp (+10C to +30C)
- Calibrator Sine, Step, Random telegraph, ability to schedule calibration
- EMI-RFI Must be able to operate without interference from RF signals at sites which do not exceed the “Limits for General Population/Uncontrolled Exposure” as defined by the FCC in the FCC document titled “A Local Government Official’s Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance”, June 2, 2000.
- Reliability 40,000 hours MTBF and a 10-year projected life.
- Maintenance Board level or Unit level replacement, supply schematics.
- Size, Physical Characteristics Vendors are encouraged but not required to provide solutions for 6.5” ID borehole
- Authentication Vendors are encouraged but not required to propose path for future upgradeability for IMS authentication
- Storage Format Permanent storage must use lossless compression and either provide miniseed or software to convert to miniseed
- Datalogger configuration Configuration information stored in each datalogger should allow reconstruction of the complete datalogger transfer function for all active datastreams. Configuration information should include:
- Manufacturer name

- Datalogger type
- Datalogger serial number
- Board serial numbers and version numbers
- Factory calibration parameters including:
  - Nominal poles and zeros response if applicable
  - Fir filter coefficients
  - A/D conversion factors for each channel

Data latency order 1200 samples or less over telemetry links

Number of high-resolution channels – minimum of three channels incremental by three channels ad infinitum

Number of auxiliary analog channels – 16 channels at 16 bit max sample rate 1 sps.

Visual power and status indicator.

SOH monitoring Capable of providing state-of-health (SOH) monitoring. SOH parameters include the following as a minimum: mass position, internal temperature and voltages, external power sources, external power source history, and battery voltages. SOH parameters shall be available in continuous telemetry packets for ease of monitoring SOH without special requests.

Anti-alias filtering: All channels shall be derived using linear phase “brick-wall” filters with high frequency corner  $f_c$  at least 80% of the Nyquist frequency and stop band amplitude (Nyquist to higher frequencies) at least 95 dB below the pass band. Pass band (DC to  $f_c$ ) ripple shall be less than 5%.

Power System 11.5 V to 18 V

Bob Hutt – If datalogger gets into a hung state, there shall be a provision for an alternate means of communication.

Cost, technical performance, and manufacturers prior performance on similar contracts will be considered for evaluation.

## **April 22-23, 2001**

Suggested to have separate rfp for dataloggers appropriate for low noise and high noise sites.

Shane suggests standardization may not be optimal for the community.

Encourage bidding for digitizer that is 10-15 db noisier with lower power for high noise sites.

Rhett – 85% of network can use higher noise and lower power stations. 15% stations will need low noise digitizers.

Frank is concerned about the indirect costs from having multiple dataloggers.

Recognized that multiple datalogger types may result in multiple telemetry and software systems.

Working with single vendor who provides low noise and high noise solutions may be advantageous. But multiple vendor solutions are also viable for meeting GSN requirements.

Need vibration specification. Bob Hutt will look up.

Must survive three-foot drop onto concrete floor onto any corner.

Ray will find out earthquake shaking operating specification.

Review of Berger-Wielandt-Zumberge *New Broadband Optical Seismometer*. Committee finds results intriguing and encourages further development.

Ray suggests that it may be useful in the structural engineering context for measuring displacement of different parts of structures.

Shane discussed his Instrument Workshop proposal.

Jim – discussed progress with KMI sensor Chronos that appears to be better than 40T. KMI is putting serious effort to develop this seismometer. Specifications for self-noise are comparable to STS-2.

French Mars sensor is comparable to STS-1. Two years ago French company Sodern suggested it might cost \$2M NRE, first 100 units at \$65k, and \$45k thereafter. Needs testing at ABQ before progressing. Jim will contact and Bob Hutt offers his facility for testing.

Shane – Nanometrics is developing Trillium 2 sensor, which may be better than a STS-2. May be a prototype build sometime this summer.

Bob Hutt will call Nanometrics to offer to test Trillium 2 and Guralp to CMG-1.

Jim will be working with KMI to arrange testing for the Chronos when KMI is ready. Jim will talk with KMI to get permission to distribute preliminary Chronos results.

Frank will talk to Jon Berger about distributing ppt presentation.

Rhett wants to know if STS-2 can be made to perform similar to STS-1? Some claims by Ruedi Widmer and Peter Melichar indicate that STS-2s can perform similarly to STS-1s in deep mines. Can STS2-s be made to perform at STS1 levels at standard GSN changes by shielding, temperature and pressure insulation.

Shane suggested arrays, but Rhett says that to date the GSN Committee has not been receptive to arrays at GSN sites, except for the proposed 3-D array in the quiet-sector at the South Pole.

Committee suggests that the long term health of geosciences that sensor development be encouraged. Execom should work on developing funding resources for five graduate or postgraduate fellowships in the seismic sensor development NSF funding with a GEO level program of at least \$2M/year for 10 years.