Woods Hole Oceanographic Institution

Progress Report on the Development of the Seafloor Borehole Array Seismic System (Phase II) July 14, 1992 to January 31, 1996

by

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Technical Memorandum

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INTRODUCTION

The Seafloor Borehole Array Seismic System (SEABASS) was originally developed to record autonomously on the seafloor the signals received on a four-sonde three-component borehole geophone array in the VLF band (2-50Hz) (Stephen et al., 1994). The system is designed to use the wireline re-entry capability (Spiess, 1993; Spiess et al., 1992) to install and retrieve the seafloor instrumentation (Figures 1 and 2). Following the successful demonstration of this technology on the LFASE (Low Frequency Acoustic-Seismic Experiment) project in September 1989, it was decided to extend the capability to broadband (1000sec-5Hz) borehole seismometers which could be used for permanent seafloor seismic observatories in the Ocean Seismic Network (Orcutt and Stephen, 1993; Purdy and Dziewonski, 1988; Purdy and Orcutt, 1995; Stephen, 1995; Sutton and Barstow, 1990; Sutton et al., 1988; Sutton et al., 1965).

The Broadband Borehole Seismic System (BBS2) is the prototype system for permanent broadband borehole seismic observatories on the seafloor. It has three major components: i) a broadband borehole seismometer, the Teledyne 54000, modified for seafloor operations by Scripps-IGPP; ii) the re-entry system provided by Scripps-MPL; and iii) the seafloor recording system developed by WHOI. Because of the similarity of the seafloor recording system to SEABASS we have named this new system SEABASS-II. This report discusses the development of SEABASS-II at WHOI in the period from July 14, 1992 to January 31, 1996. The motivation for the project and a work statement are contained in WHOI proposals 7016 and 7016.1.

This report is a collection of documentation prepared while the work was being carried out. Some of the issues discussed in early memos were subsequently changed. Modifications and further testing of SEABASS-II, as well as final system integration tests with the borehole and re-entry systems (both of which are also still being modified and tested) have still to be carried out in preparation for the OSN Pilot Experiment Cruise in Spring 1997. This is a preliminary report only and presents work in progress. It will be useful to the engineering team as a historical reference of the sequence of events in the development of SEABASS-II but it should not be considered as a technical manual for the instrumentation.

The SEABASS-II recording system is designed to interface with a modified REFTEK acquisition system (REF TEK, 1991a; REF TEK, 1991b) in the sonde. Early in the program a study was carried out to compare hard disks and DAT (Digital Audio Tapes) tapes as recording media (Peal, 1993) and it was decided to use hard disks.

The OSN Pilot Experiment will be carried out in ODP Hole 843B which was drilled on ODP Leg 136 in February-March, 1991. Reports that will be useful in preparing for the OSN Pilot experiment include the Leg 136 Preliminary Report (Dziewonski et al., 1991), the Leg 136 Operations Report (Harding, 1991), a discussion of well log results from Hole 843B (Goldberg and Moos, 1992), a report on casing hanger assemblies (Deep Sea Drilling Project, 1983) and a drawing of the cone used at Hole 843B (Ocean Drilling Program, 1987).

Results of system integration tests carried out at Scripps-IGPP and the Pinon Flat Observatory in the Fall of 1994 are summarized in separate reports (Stephen et al., in prep; Vernon et al., 1994). A description of the Pinon Flat Observatory is given by Wyatt and Agnew (Wyatt and Agnew, 1994).

Figure 2: This schematic shows a frame similar to SEABASS-II sitting in the re-entry cone on the seafloor. The top of the package protrudes above the cone for grappling.

Figure 1: This schematic diagram shows the configuration of equipment used in a wireline deployed borehole seismic system. On B³S² the leader/re-entry guide and the four satellite array are replaced by a single sonde containing the camera and lights for re-entry as well as the three component broadband seismometer. This report discusses primarily the development of the seafloor data recording package, SEABASS-II. The thruster (control vehicle) is used to manoeuvre the array into the borehole. One advantage of this system over other ocean bottom seismometers is that the ship remains tethered to the seafloor system after deployment and data can be acquired onboard ship prior to releasing the tether.

2.1 Preliminary Notes

Memo to: File 2.1.1 Koelsch/Stephen 12/31/91

From: Don Koelsch and Ralph Stephen

Date: 31 December, 1991

Subject: Converting the Broadband Borehole Seismic System for a
three month deployment

To make the Broadband Borehole Seismic System (B³S²) able to collect continuous data for three months there are numerous issues to consider. There are, however, two areas that will eventually limit the deployment life. They are mass storage capacity and power requirements.

Summary of Assumptions

- 1) 50% data compression by 1994 (not currently available).
- 2) Sampling at 1.5X Nyquist (at least twice is generally recommended.)
- 3) SIO digitizing electronics consumes 3.0Watts or less.
- 4) All budgets based on current salaries and O/H without considering inflation.
- 5) New mass storage recorders will have same power consumption per megabyte as Mountain Optech recorders.

Mass Storage Requirements

Since the upper limit of the frequency response of the Teledyne 54000 is 6Hz the digitization rate need only be 12 samples/second. It is proposed to digitize at 18 samples/sec (1.5 times Nyquist). If each sample requires 3 bytes and we have a three component seismograph then the total data capacity for a 90 day deployment will be:

$$\begin{aligned} & 3 \text{ components} \times 18 \text{ samples/sec} \times 3 \text{ bytes/sample} \\ & \times 3600 \text{ sec/hr} \times 24 \text{ hours} \times 90 \text{ days} = 1.26 \text{ Gigabytes} \end{aligned}$$

Further since data compression techniques are advancing quickly we can expect 50% compression by 1994. Therefore only 630Megabytes of storage will be needed. With our existing Mountain Optech optical disk recorder @ 200Megabytes/recorder we could get better than

80 days of full time recording (figure there would be 30Mbytes of overhead per disk). This would require a minimum of changes and costs. By the time a three month deployment would be required there may be other mass storage recording systems available such as multiple platter Winchester hard drives. These have the potential capacity of over a gigabyte/recorder.

Power Requirements

In autonomous seafloor operation B³S² consists of the following sub-systems: 1) Borehole seismometer (Teledyne KS54000); 2) borehole digitizing and control electronics (SIO); 3) seafloor control system (SEABASS-BCU); and 4) the seafloor recording system (SEABASS-DRU).

The SEABASS control system will be modified in phase 1 to take advantage of the slow data rate. The CGG interface electronics will be replaced with very low power circuits which receive the digital data from the Teledyne KS54000 and SIO interface. The current 8 Watts will be reduced to less than 4 Watts.

The KS54000 will consume 4 Watts (in continuous operation). We estimate that the SIO digitizing electronics will consume 3.0 Watts. The present Mountain Optech based recording system requires 67 Amp-hours at 24 Volts (1.6KWH) to fill it. (Data will be stored in a buffer as it is acquired and data files will be burst to the recorder periodically. The recorder is not on continuously.) The first three sub-systems, which do run continuously, consume a total of 11 Watts. For a 27 day deployment this corresponds to 7.2 Kilowatt hours or 10 lead acid cells. (Compensated for temperature and aging each wet cell provides 30 Amp-hours at 24 Volts or 0.72KWH.) Three additional batteries are required to fill the recorder. (Although the 27 day period will not fill all three recorders we will continue to assume 3 batteries to allow for a safety factor.) So for the 27 day engineering test we would use 13 lead acid cells. These would just fit on the present SEABASS frame.

To extend this to a 90 day deployment would require 24 KWH for the first three sub-systems or 36 batteries including the recorder. Clearly this is too many batteries for our frame. Lithium batteries have a large power to volume ratio and a study was made to ascertain how large the battery would be for a 90 day deployment. Power Conversion Inc. #660-5A5 cells at ocean bottom

temperatures have a rating of 25 Amp-hours at 2.8V (70 Watt-hours/cell). To obtain the necessary 25.36KWH (23.76KWH plus 1.6KWH for the recorder) would require approximately 372 cells. They could be housed in two 8" internal diameter x 78" long pressure cases. Of course lithium batteries have inherent dangers and suitable protection circuits would have to be designed and implemented to minimize the chances of catastrophic failure. The cost of batteries per deployment would be about \$8600.

Tentative budgets to modify the BBBSS to take 3 months of continuous 3 component data

Recorders:

Recorder Option 1: Change recorders to a higher density

Tasks:		Eng.*	Tech*	Supplies	
1. Select and mount recorders		1	1	10K	
2. Write new SCSI drivers		1		1K	
3. Test		0.5	1		
Total		2.5	2		
		39K	16.6K	11K	66.6K

- Risks:
1. New recorders are not tested for ocean environment nor ruggedized.
 2. Long term reliability not verified.
 3. Larger data sets will require more recorder power.

Recorder Option 2: Keep existing recorders and use data compression

Tasks:					
1. Write software module to compress data by 50%		2	0.5	2K	
Total		31K	4.2K	2K	37.4K

- Risks:
1. Compression may not be 50%.
 2. Compression may cause loss of data.
 3. Computer power of system may not be adequate.
 4. Only 80 days of continuous data.

Power Systems (assuming recorder option 2**):

Power System Option 1: Pressure compensated lead acid

Tasks:	Eng.*	Tech*	Supplies	
1. Mount 36+ batteries (new frame)	2	2	15K	
2. Remake battery junction box	0.5	0.5	3K	
3. Redo cabling	0.5	0.5	2K	
Total	3.0	3.0		
	47K	25K	20K	91.7K

(Battery costs of \$54,000 are in the seatest budget and are not included here. Batteries are good for 2 deployments within 6 months.)

- Risks: 1. Frame will be too large.
2. Power/volume ratio too low.

- Advantages: 1. Safe system.
2. Batteries do not need pressure cases.

Power System Option 2: Lithium battery packs

Tasks:	1. Design battery pack	0.5		
	2. Design safety circuits	2.0	2.0	3K
	3. Build pressure vessels	1.5	1.0	20K
	4. Modify frame	1.0	3.0	10K
	5. New cabling	0.5	0.5	2K
	Total	5.5	6.5	
		86K	54K	35K
				175K

(Battery costs of \$8,600 per deployment would be in the seatest budget and are not included here.)

- Risks: 1. High power lithium power pack is hazardous.
2. Primary batteries require full replacement for each deployment.
3. Cannot air ship lithium battery pack.
4. Needs pressure housings.

- Advantages: 1. Will fit on existing frame.
2. High power/volume ratio.

* Assumes 15.6K/month engineer and 8.3K/month technician with benefits, lab overhead and G&A.

** Recorder option 1 requires the recorders to be on approximately twice as long. If we use recorder option 1, power system option 1

would not change. Power system option 2 would increase by about \$15K for a third battery pressure case. The cost of batteries in the deployment budgets for each power system option would increase 10%.

Supplemental Program for Three Month Acquisition

Budget Options

(Includes development costs for recorders and power systems plus the cost of batteries for a one month engineering cruise and a three month pilot experiment.)

	Recorder Opt#1 (Mass storage - Untested, expensive, 90+ day recording)	Recorder Opt#2 (Mountain Optech's - Data compression, 80 day max recording)
Power Opt#1 (Lead-acid - Safe, big and cheap)	Rec - 66.6K Pow- 91.7K <u>Bat - 79.0K</u> Tot - 237.3K	Rec - 37.4K Pow-91.7K Bat - 72.0K Tot - 201.1K
Power Opt#2 (Lithiums - Dangerous, small new housings)	Rec - 66.6K Pow-190K <u>Bat - 12.7K</u> Tot - 269.3K	Rec - 37.4K Pow-175K Bat - 11.5K Tot - 223.9K

includes purchase of recorder

Note: Batteries are included in deployment budgets.

2.2.1 Orcutt/Willoughby 9/1/92

September 1, 1992

Don Koelsch
Woods Hole Oceanographic Institute
Woods Hole, Massachusetts

Dear Don:

Here is a preliminary version of the interface specifications as we now see them. Please circulate this among your colleagues on this project. Some of the things described in this document are tentative at this time, and of course almost all of it is still subject to debate. We still haven't made a final decision as to which of the auxiliary sensors will actually be useful, and we have not yet worked out the details of the commands to be sent down the wire.

John Orcutt and I have our tickets to fly into Providence late on September 9, and are looking forward to spending the next day discussing all this with you. If you have any comments or questions about the interface specification, give David Willoughby a call at (619)534-2213, and we'll see if we can work things out before the meeting.

Sincerely,

John Orcutt

David Willoughby

Sept. 1, 1992

BROAD-BAND BOREHOLE SEISMOGRAPH INTERFACE DEFINITION

This document delineates the details of the interface between the Borehole Instrumentation Package (BIP) being fabricated at Woods Hole, and the Broadband Borehole Sensor package (BBS) to be built at Scripps.

In accordance with proposal figure V.7, we plan to use well-logging cable with seven 18-gauge conductors. The cable with connectors, and a mating connector to be mounted on the BBS are to be supplied by Woods Hole (using a Gerhardt-Owens connector, per D. Koelsch). The original assignment of the wires in the cable/connector assembly was as follows:

1. POWER AND TIME FLAG
2. FSK DATA UPLINK (SEISMIC DATA)
3. FULL DUPLEX COMMUNICATION LINK
4. COMMON (DATA & POWER CIRCUITS)
5. VIDEO CONTROL AND POWER
6. VIDEO COMMON
7. SPARE

It should not be necessary to use FSK for data transmission over a 100 m cable, and the maximum data rates (see below) are sufficiently low that a dedicated "seismic data only" line is not necessary. We therefore propose one modification of the wire assignment: the use of lines 2 and 3 as SERIAL DATA UP and SERIAL DATA DOWN, respectively. This will make it possible to use of standard serial interface hardware, and will allow simple interfacing with an ASCII terminal during deployment.

We envision two modes of operation for the system. While the packages are being lowered from the surface vessel into the borehole, the system would operate in "Emplacement Mode". In this mode, the data transmitted to the surface would consist entirely of "state of health" monitors. It would be necessary to transmit only a minimum of seismometer data to the surface to ensure that all three components of the sensor remain functional.

Once the BBS has been placed in the borehole, the system would be switched to "Data Acquisition Mode", in which seismic data would be acquired at 20 samp/s and transmitted to the surface continuously. The transmission of some state of health monitors (accelerometers, for example) would be eliminated completely, while others would be transmitted less frequently than in the Emplacement mode. A command from the surface would allow the system to be toggled between the two modes.

1. POWER AND TIME FLAG (from BIP to BBS).

Power and the time flag will be separated by low- and hi-pass filters in the BBS.

The peak power requirements of the BBS should not exceed 13 watts with seismometer centering motor(s) running: 10 watts for motor operation, ~2 watts for seismometer operation and ~1 watt for the Refraction Technology data acquisition system. A maximum capacity of at least 18 watts should be available to allow for power conversion inefficiency, deliverable as 24 V. @ 0.75 amps max. At this peak load, power line noise and regulation are not at all critical, since real data are not being acquired while the motors are operating.

In "Data Acquisition Mode", the continuous power consumption of the BBS should be reduced to between 2 and 4 watts, deliverable as 24 volts at a maximum of 0.2 amps. In this configuration, power line noise (ripple) and regulation are much more critical.

John Sherwin at Teledyne claims that power supply noise is not much of an issue as long as the voltage is between 22 and 28 volts. 5% ripple (≈ 120 mV) would probably be tolerable, as the KS54000 has its own tightly spec'd internal regulator.

The Refraction Technology system includes power converters that normally take 12 volts in and makes +5 for the logic and ± 5.25 for the analog electronics. President Paul Passmore says that (1) these will clean up any input power line noise very effectively, and that 25-50 mV of ripple is probably OK (they actually use battery chargers as test supplies) and (2) they can modify the converters to take a 24 volt input instead of 12.

The standard Ref Tek data logging system uses a 1 Hz time mark to synchronize the sample timing generator, so a pulse at the beginning of each second would be an ideal time flag. The width is not critical, as the rising or falling edge will determine the time. Don Koelsch has suggested that a pulse width between 5 and 10 μ s would be supplied.

2. SERIAL DATA (COMMANDS) DOWNLINK:

As the calculations below indicate, 4800 baud should be adequate for the most critical functions in the uplink; the same data rate can be used for the downlink commands. All data in both directions would be transmitted in "standard" 8-bit bytes. This would make it possible to use a standard Refraction Technology serial interface to transmit serial data, eliminating the need for the custom interface originally proposed. Additional line drive capability could be added to the uplink if necessary.

3. SERIAL DATA UPLINK:

S.O.P. for Ref Tek is to send 1024 byte blocks with 24-byte header, 1000 bytes of data. Header includes time tag to nearest ms for first sample, unit I.D., etc.

In Data Acquisition Mode, if we sample data on 3 channels at 24 bits, that's 9 bytes/sample interval. At 20 samp/s, that's 180 bytes/s. Not allowing for start and stop bits, header info., etc., that comes to 1440 bits/s; thus a 2400 baud rate would barely work -- 4800 baud allows some margin. We are also proposing to implement data compression in the BBS package, which will reduce the data transmission requirements by at least a factor of 2.

We also have to deal with a number of auxiliary sensors. The following list is based on a combination of the sensors used in the Ngendel borehole experiment and additional sensors which we feel would be useful:

1. Up to 3 Temperature sensors (-5°C to 35°C)
2. Up to 6 accelerometers (2 sets of 3-axis)
3. 1 external absolute pressure gauge
4. 1 condensation resistance (humidity).
5. 3 mass position monitors.
6. 5 voltage monitors (24 volts in, sensor 8 v., Ref Tek +5 v., ± 5.25 v.)
7. 2 electrical current sensors (seismometer, data logger)
8. 1 status byte (3 element status bits, 1 logic supply bit, 4 spare)

Total of the above is 22 sensors. Some of these may be eliminated after further evaluation.

8-bit resolution would be adequate for most of these sensors. However, the lowest-resolution digitizer produced by Ref Tek is a 16-bit unit. In the worst (most data-intensive) case, we could transmit each digitized sensor value as two bytes, for a total of 44 bytes. But if there is any

advantage to doing so, most of the A-to-D outputs for these data channels could be truncated to one byte for transmission.

All of these inputs can be directly digitized at relatively low rates except the accelerometers, which must be digitized rapidly enough to catch the highest values in order to be useful. There is, however, no need to transmit all the digitized values; maxima are sufficient. This could be accomplished by software selection of the maximum values between successive data transmissions, or by digitizing the outputs of analog peak detectors rather than the outputs of the accelerometers themselves. The latter option would also reduce the digitizing rate requirements, though it might also be desirable to transmit the positive and negative peaks separately for at least the vertical accelerometers so that the direction of the cable forces causing the accelerations can be determined. This would add two more A-to-D input signals to the above list.

All of the auxiliary (state of health) sensors would be digitized and transmitted when in the Emplacement Mode; in the Data Acquisition Mode only items 1 and 4 through 8 in the list above would need to be digitized and transmitted as part of the data stream (15 bytes).

4. DATA & POWER CIRCUIT COMMON (no comment)

5. VIDEO CONTROL AND POWER

The power and bandwidth requirements for the video camera and lights, are:

Power: 100 watts, 50V. @ 2A typ. (mostly for the lights)

Signal: 750 KHz

This line will connect directly to the MPL thruster, so the BIP will just provide the connection between the thruster and the BBS. Voltage drop in the wires will be significant (on the order of a few volts), but the camera power supply is not very sensitive to reduced voltage, so the only result will be a slight reduction in light intensity. In the past, when voltage drop was a more severe problem, Tony Boegeman has added a booster battery to make up the difference.

6. VIDEO COMMON

We could probably get away with using the same common for the lights and video that we use for the rest of the system, since the video system will not be operating once the seismometer is acquiring real data. However, the voltage drop in the video ground wire could be significant, and a wire is available for a separate ground so we might as well use it. Incidentally, Boegeman says he grounds everything in the video system to seawater, so the parallel current path through the water should minimize the voltage drop.

7. SPARE

MEMORANDUM

To: Dave Willoughby
From: D. E. Koelsch
Re: Various issues.

Date: Sept. 4, 1992

Don

Quick note to discuss interfacing.

We had a meeting of the WHOI players yesterday, 3 Sept. 1992. There were a few items to add to the list issues that we should think about before the meeting.

1. What is the format and instructions to set the REF TEK software clock?

2. Ralph is concerned about delivery of both the Tele-dyne and REF TEK equipment. Will they be able to meet the schedule we proposed in the contract of Jan. 1, 1993?

3. Communication between the ship and the sonde and communication between the BCU and the sonde. Can we share the same link?

4. Fail safe issues revisited:

a) Can power be disconnected from the 54000 and reapplied again?

b) Will REF TEK be able to handle this? Of course each time power is turned the software clock will have to be reset, but is there some other "gotchas" that must be taken into consideration?

c) If we put in 2 each 1 giga-byte drives there will be plenty of data storage capacity that we will not have to compress the data. However if data compression still turns out to be necessary we should carefully consider where that compression should be done, i.e. sonde or BCU.

Attached is an alternate field data format that we wish you would consider. I believe there are advantages to this type of format which allow us to recover data where there has been bit hits or improper file storage.

Preliminary battery calculations, using your latest estimates indicate that the battery cases necessary for a 3 month deployment are as follows:

If 10" ID cases are used then we need 2 cases 43" long full of PCI # 660-5S lithium cells for the required 21 KWH.

If 8" ID cases are used then we will need 3 cases 48" long full of PCI 660-5S lithium cells.

when

DATA FORMAT

A set of data samples

This allows you to tell how many samples we have missed if something goes wrong.

Every minute there would be a header. In that header

there would be time

Sec. X 1	}	1 byte
Sec. X 10		
Min. X 1	}	1 byte
Min. X 10		
Hrs. X 1	}	1 byte
Hrs. X 10		
J. Day X 1	9 bits	} 2 bytes
Year	7 bits	
Total		5 bytes

Sync pulse

12 bytes of '0' put this in 12 byte word every minute!

We acquire data at

$$12 \times 20 \text{ bytes/sec} = 240$$

$$240 \times 60 = 14,400 \text{ bytes/min}$$

every minute put in 24 bytes of header

$$\Rightarrow 14,424 \text{ bytes/minute}$$

$$= 14,424 \times 24 \times 60 = 20.77 \text{ M bytes/day}$$

for 90 days (3 months)

$$= 20.77 \times 90 = 1.87 \text{ Giga-bytes Total}$$

Therefore 2 ea 1 Giga-byte recorders
would be adequate
for the job

9/4/92

DEK

Sept. 8, 1992

BROAD-BAND BOREHOLE SEISMOGRAPH INTERFACE DEFINITION, VERSION 2.0

This document delineates the details of the interface between the Sonde Control Unit (SCU) being fabricated at Woods Hole, and the Broadband Borehole Sensor package (BBS) to be built at Scripps.

In accordance with proposal figure V.7, we plan to use well-logging cable with seven 18-gauge conductors. The cable with connectors, and a mating connector to be mounted on the BBS are to be supplied by Woods Hole (using a Gerhardt-Owens connector, per D. Koelsch). The original assignment of the wires in the cable/connector assembly was as follows:

1. POWER AND TIME FLAG
2. FSK DATA UPLINK (SEISMIC DATA)
3. FULL DUPLEX FSK COMMUNICATION LINK
4. COMMON (DATA & POWER CIRCUITS)
5. VIDEO CONTROL AND POWER
6. VIDEO COMMON
7. SPARE

The original version of this document proposed the elimination of the bi-directional data link and the use of frequency shift keying (FSK) for data, status and command transmission. After conferring with D. E. Boegeman, D. Koelsch and J. A. Orcutt, it appears that (1) the cable between the BBS and the SCU will have to be about 325 m (1000') long rather than 100 m as originally believed, and (2) the hardware for the FSK links is on hand and has been thoroughly tested. In view of this, we concur that the communications and data links should use FSK as originally proposed. Unfortunately, the use of 1000' of cable makes voltage losses in the power lines a much more significant issue than previously thought.

We still envision two modes of operation for the system. While the packages are being lowered from the surface vessel into the borehole, the system would operate in "Emplacement Mode". Once the BBS has been locked in the borehole and leveled, the system would be switched to "Data Acquisition Mode", in which seismic data would be acquired at 20 samp/s and transmitted to the surface continuously. The transmission of some state of health monitors (accelerometers, for example) would be eliminated completely, while others would be transmitted less frequently than in the Emplacement mode. A command from the surface would allow the system to be toggled between the two modes.

1. POWER AND TIME FLAG (from BIP to BBS).

Power and the time flag will be separated by low- and hi-pass filters in the BBS. The standard Ref Tek data logging system uses a 1 Hz time mark to synchronize the sample timing generator, so a pulse at the beginning of each second would be an ideal time flag. The width is not critical, as the rising or falling edge will determine the time. Don Koelsch has suggested that a pulse width between 5 and 10 μ s would be supplied.

In "Data Acquisition Mode", the continuous power consumption of the BBS should be between 2 and 4 watts, deliverable as 28 volts at a maximum of ~ 0.16 amps. At this current, the voltage drop in each line in the cable between the SCU and the BBS would be ~ 1.8 volts. If the voltage for this supply is set to about 28 volts at the SCU, the voltage at the BBS will be about 24.4 volts; this should fall within the tolerances of the input requirements of the seismometer and data acquisition systems. Note that the above figure does not include voltage drop in the ground wire— that will be discussed below. Though noise on the signal lines is critical in this mode, both John Sherwin at

Teledyne and Paul Passmore at Ref Tek have assured me that their systems are well isolated from power line noise by internal converters.

If it is necessary to re-level the seismometer after entering the Data Acquisition Mode, only one motor at a time should be activated; each motor consumes an additional 100 mA; this will add 1.1 volts to the drop in each line, yielding 22.2 volts at the seismometer, which is still just within its input range.

With a total current of .26 mA, approximately 1.5 watts of power would be lost in the cable. To minimize this loss, we propose to use the power and return lines for the video and light system in parallel with the power and return lines for the seismometer and data acquisition system, once the video system is turned off and/or the thruster is disconnected. A description of this arrangement is presented below.

We also plan to include a power converter in the BBS that would supply the seismometer and data acquisition systems using the high voltage power supplied for the video and lights, so that during the initial leveling of the seismometers in Emplacement Mode, several motors could be operated simultaneously -- this will be discussed below.

2. FSK DATA UPLINK:

S.O.P. for Ref Tek is to send 1024 byte blocks with 24-byte header, 1000 bytes of data. Header includes time tag to nearest ms for first sample, unit I.D., etc.

In Data Acquisition Mode, if we sample data on 3 channels at 24 bits, that's 9 bytes/ sample interval. At 20 samp/s, that's 180 bytes/s. Not allowing for start and stop bits, header info., etc., that comes to 1440 bits/s. Data compression will further reduce this by an estimated minimum factor of two; thus a 2400 baud should be an adequate data rate.

We propose to use one of two Ref Tek serial ports to transmit data to the FSK encoder. This way, software and hardware testing can be accomplished using an ordinary serial interface to log the data, by simply bypassing the FSK encoder.

3. FULL DUPLEX FSK COMMUNICATIONS LINK:

As above, 2400 baud should be adequate for the most critical functions. The FSK encoder/decoder would be connected to the Data In and Data Out lines of a second serial port in the Ref Tek data acquisition system. All data in both directions would be transmitted in "standard" 8-bit bytes. This would make it possible to bypass the FSK system so that an ASCII terminal could be used for testing in the lab and in the field (wherever a short connecting link could be used).

4. DATA & POWER CIRCUIT COMMON:

See below.

5. VIDEO CONTROL AND POWER

The power and bandwidth requirements for the video camera and lights, are:

Power: 100 watts, 50V. @ 2A typ. (mostly for the lights)
Signal: 750 KHz

Because of the resistance of the cable, it is impractical to send this power down the wire in this form; instead, we propose to send 220 volts at approx. 0.5 amp down the wire, and put a converter in the BBS to supply the 50 volts required by this system. In addition, we would install a

220 volt -to- 24 volt converter to operate the data acquisition system with a minimum of line loss while still attached to the thruster. Once this system is turned off, the dedicated video power and return lines would be connected in parallel with the 24-volt power for the data acquisition system. Relays activated by the presence of 220 volts on the line would switch this connection.

A Interlock relay controlled by the computer in the BBS would disconnect the 220 volt relay coil from the 24 volt system when the 220 volt system was turned off, and would prevent 220 volts from appearing on the 24-volt line when the lines were being transferred from the 220 volt system to supplying 24 volts.

6. VIDEO COMMON (see above)

7. SPARE (still available!)

David Willoughby

BROAD BAND BOREHOLE SEISMIC SYSTEM B³ S²
First Engineering Meeting 9/10/92

Agenda

- 08:30 Welcoming
- 08:45 Sonde:
- Mechanical
 - Size, weight, cable strength & length
 - Weak link, clamping or slacking
 - Connectors
 - Electrical
 - Power, voltages & currents, minimization & profile
 - Centering - how often batteries supply power?
- 10:30 Interfacing
- TV & lights, power 300, #20 wire
 - Power down soft tether, how much necessary at one time
 - Battery configuration & switch over
 - Data formats
 - up cable to surface
 - from BBS to BCU
 - disk format
 - where and what should be in Aux data - how much recorded
 - data compression
 - data baud rate 4800 kp (HD B3) - *OK*
 - communication baud
- 12:00 Lunch
- 13:00 Fail Safe Systems
- Reset computers on power up
 - Graceful startup
 - Operational parameters in EEPROM
 - What constitutes the need for a reset
 - Reconstruction of corrupted data ✓
- 14:30 Surface displays & read outs
- Separate operator stations for WHOI, IGPP, & MPL²
 - Separate communications to BCU & BBS
- 15:30 Timing:
- Setting clocks
 - Integrating time into data stream
 - Surface clock
- 16:00 Pinion Flats
- 1st test
 - Woods Hole supplies what?
 - How deep is the deployment
- 16:30 Milestone definition review
- More detailed than proposal
 - Next WHOI/SIO engineering meeting

pen notes with Don & Dave at IGPP
2 Dec/92

MEMORANDUM

To: LIST
From: Don Koelsch & Ken Peal
Re: Broad Band Borehole Seismic System engineering meeting report

Date: Sept. 17, 1992

Attached is the report that covers the topics we discussed at the B3S2 meeting we had on Sept. 10, 1992. It shows what topics were covered and what decisions were made. It also indicates, by ACTION items, tasks that have high priority.

There are a couple of more concerns which were not brought up at the meeting:

1. Power during ship-board phase:- all power to BBS will go down the video line at 220 volts DC. It will be reduced in the BBS to 24 volts for REF TEK and 54000 systems. It will also be reduced to 50 volts for the video and lights.

2. We need 2 inventories of gear:- the first list what equipment WHOI expects to put on the BIP, this includes weight in air and water and dimensions. The second is the same information about the sonde (BBS).

3. There must be more thought given to what constitutes a failure that causes a Power On Reset (POR). Should it be simply no data coming from the BBS or should there be some "quality checking" software that causes a POR.

4. Will SIO take the responsibility for breaking up water flow in the hole with plugs or fuller brush or should this can of worms be reopened?

5. Is there enough concern about water currents flowing over the BIP and causing seismic noise to require a current sensor with its data logged on the disk?

6. Should there be a flow meter included in future plans for this equipment? Should we submit another proposal in the future to incorporate this sensor into the B3S2 equipment?

List:

SIO/IGPP
J. Orcutt
D. Willoughby

WHOI
H. Berteaux
A. Bocconcelli
R. Goldsbrough
M. Gould
D. Koelsch
K. Peal
✓ R. Stephen

Broad Band Borehole Seismic System

Notes of first engineering meeting 10 Sept 92

Attendees

D.Koelsch
J.Orcutt
K.Peal
R.Stephen
D.Willoughby

Hole

water depth 4411.6m (Fig. X.1 of proposal)
10" ID casing to 270.0 m Below Sea Floor (BSF)
not cased below
Total depth 317.7m BSF

Sonde

Seismometer not including pressure case.

- 170 lb in air, 6 ft long
- Teledyne 54000
- delivery Jan 93
- do not cycle power after deployment this will require separate power line from BIP
- setup and centering controlled from ship only.

Centering

- may take 24 hours
- only do it once when still connected to ship

Pressure case

- To be determined ? *~12'*
- possible 7"OD, *5/8"* wall 7075T6 Al ACTION: SIO 22 OCT memo

Cable

- WHOI has 2 shots:- 1100' and 13000' lengths
- 7 conductor, #20, 10.15 ohm/1000 ft
- being pull tested
- should be 18,500 lb breaking:- check WHOI
- Working strength only .5 of breaking strength

**Dave will update this by Jan 1/93*

Weights/breakaway design

- .630" tow cable 14,500' @ 0.5 lb/ft = 7270 lb
- BIP in water *829* 1000? *2614* ACTION: WHOI
- thruster *1500* 2000? ACTION: SIO
- sensor with REFTEK *1500* 2000? ACTION: SIO
- if breakaway at 10,000 lb. total at overboard sheave is 22,000; OK for 0.53 cable?
- ACTION: WHOI
- Check BIP frame strength ACTION: WHOI
- Check strength of soft tether :- need 13,000

meeting.txt

page 1

17 Sept 92

see item #1 in 9/18/92 memo
16,000 lbs weight on cable.

12,500 lbs at the end of the cable

2000 lbs

Cable slacking mechanism

- tentatively NOT required
- final decision Dec 92

no - D.W.
ACTION: SIO ✓ *still in the air*

Deployment

- place sonde system on bottom of hole
- Manufacture BIP to sonde cables at sea or when best estimate of hole depth is determined *Item 5 of 7/8*
- extra length gives cable slack
- We need distance from throat of cone to bottom of hole accurate to 1 meter. Can Fred supply the measurement? *yes he will!* *D.W.*

ACTION: SIO

Connectors

- Gerhardt Owens or equivalent
- WHOI to specify and purchase
- 3 bulkhead connectors and 5 cable connectors
- Send 1 bulkhead to SIO ACTION: WHOI
- This insures compatibility!

Power minimization

- REFTEK now 2 W, assume 2 W but... ACTION: SIO
- Teledyne now 2 W, assume 1 W
- BIP probably 2 W
- total 5 or 6 W including cable losses
- say 10 W at batteries
- Power strategy for BBS, BRG, BIP & thruster still needs to be sorted out by Dan, Dave & Tony for all phases of the deployment.
- Power for "set-up" will be supplied from ship

Interfacing

Use of the 7 conductors (Strawman)

- 1. power and 1 PPS
- 2. FSK data up, 4800 baud ASCII
- 3. FSK command full duplex, 2400 baud ASCII or half duplex, SAIL protocol
- 4. power common
- 5. switched video, 220V and 24V power
- 6. video/lights common
- 7. Teledyne power (not cycled once it is on)

End-of-deployment seismometer lock

- need separate batteries in BBS for power and control for emergency mass locking
- ACTION: SIO
- Mass locking criteria
- loss of main power
- Seascan time-out
- acoustic command (no state of health??)

ACTION: WHOI

ACTION: WHOI

Don't turn off batteries when voltage drops below a certain level

For duration long enough to screw-up sensors.

*power deis to 54000
time in sonde
acoustic command (?)*

timed out by REFTEK clock

separately

Acoustic transponder commands

- state of health ACTION: WHOI
- acted on lock-for-recovery ACTION: WHOI - 7
- There are 4 commands available in the 8202
three are taken by Release, Enable, and
Disable. The forth can be used as a state
of health indication.

Time

- REFTEK is software clock (1 PPS + PLL)
- need to set and check REFTEK vs. standard
- how is it done now (F.Vernon)? ACTION: SIO — 29 NOV 92
- set/check sequence to use Seascan as standard? *see*

Data compression *(no)*

- optional at recorder ACTION: WHOI no
- not on communication links
- Make study determining how much data would be
lost if there is a drop-out in the compressed
data. ACTION: *SIO N/A*

Data formats

- time tagging may preclude Koelsch format
- need details of REFTEK format with 24 bit A/D
ie. what exactly is in the 1024 byte block
ACTION: SIO *see above*
- add scan counter to REFTEK format?
ACTION: SIO *see above*
- engineering data which will come to the BCU
via the communication link will be buffered
in the BCU to 1024 REFTEK size blocks, then
merged with the data into separate files on
the disk. *Ken/Blair*

Engineering (AUX) data

- internal temperature in BBS
- voltages in BBS
- voltages in BIP
- seismometer engineering (mass position, status)
- inclinometer in BBS
- compass in BBS (*MP4 - in next contract*) ACTION: SIO *see above*
- time check results ACTION: SIO

How should all devices talk to each other?

- ship to thruster
- ship to BIP
- ship to BBS
- BIP to BBS
- SAIL/parity/network ACTION: WHOI *see above*
- command/response protocol (Don's overhead) ACTION: WHOI

Fail Safe Mechanisms

Data reconstruction

- OK for 4 second blocks
- maybe on individual scans

Reset computers

- no data (to be defined) from BBS . cycle power
- loss of control on ship, cycle power to BIP

Cable problems

- backup battery on BIP ^{in a sonde} in case of soft tether problem ACTION: WHOI
- short in 7-conductor cable ?????

Thruster failure

- use acoustic release to disconnect if Teledyne is leveled
- haul back otherwise

Teledyne failure modes

- ??

ACTION: SIO

BIP

- cycle among three recorders ACTION: WHOI
- watchdog different from LFASE ACTION: WHOI
- need EEPROM? ACTION: WHOI
- DRU emergency recovery by acoustic release

Surface displays and controls

Need detailed block diagram

ACTION: WHOI *we have these for the last meeting*

Timing

- Surface clock - purchase WWV receiver for WWV-H to use for at sea pilot experiment ACTION: SIO
- Pinon has suitable gear

Seascan

- which one to use?
- modify LFASE unit?
- borrow from WHOI or SIO OBS?

ACTION: WHOI

*- modify LFASE clock
- resolved
- determine*

Pinon Flats tests

- 100 m deep hole. 10" ID casing, concrete bottom
- Probably start March 93 using Teledyne in native mode. WHOI does not participate in this phase ACTION: SIO
- 1 Jan 94 for integrated system

*- resolved
- determine*

Other milestones

- System integration starts 1 Sept. 93 at WHOI (SIO sends REF TEK to WHOI for preliminary integration.

Miscellaneous

- Confirm that there will be TV and lights on the BIP as well as the BRG ACTION: SIO
- Make a list of all gear that goes on BIP with sizes and wet & dry weights. ACTION: WHOI
- Determine if wet cell is needed on BIP to boost voltage for the BRG TV & lights ACTION: SIO
- Three month deployment with many dissimilar metals means that all parties must pay strict attention to corrosion problems. One of the most troublesome areas is connector mounting areas. Also since the BBS to BIP cable is metal it may have to be isolated from the pressure cases.

-ask Tony ✓
*3 #14-400
1 case 211p.*
-ask Tony ✓

9/18/92

TO: DON KOELSCH

FROM: DAVID WILLOUGHBY

SUBJ: BROADBAND BOREHOLE SEISMOMETER STUFF

Howdy!

I got together with several people at MPL yesterday and we discussed some of the questions that were raised at the meeting last week.

1. Gary Austin tells me that the breaking strength of the .68 wire is about 24,000 pounds and the yield strength is about 16,000. According to Gary, .68" wire weighs about .6 lbs./ft. in water, so the wire would weigh about 8700 lbs rather than the 7000 we had estimated. The thruster weighs about 2200 lbs. in air; they don't know the weight in water. Adding in 2000 lbs. for the WHOI BIP it would take a 22,900 lb. pull to break a 10,000 lb. weak link, which is beyond the wire yield point and frighteningly close to the breaking strength. Their new engineer suggested that we might want to use a release hook rather than the 10,000 lb. weak link, though I don't especially like the added complexity of that solution. Ideas?
2. The last time they used this system, they used RG-58 coax as the cable in the "soft tether" from the thruster. The voltage drop in RG-58 would be worse than ridiculous with our power requirements, but they said they can make the soft tether using any kind of wire we want! We need to think about this. If the total power consumption of the lights & camera, BIP and sonde doesn't exceed 200 watts at any one time, the current at 220 AC volts would be no more than an amp, and 14 gauge wire would yield a voltage drop of not more than 2.5 volts/1000'.
3. Yes, one can run the thruster and send up to 100 watts of power down to the BIP at the same time.
4. An extended discussion about the mechanical arrangement for the TV, lights, pressure sensor, etc., led to the conclusion that the best solution would be to build a new pressure housing for them that would mount on the bottom of the seismometer pressure case; the existing arrangement is very long and skinny, and would

not be a reasonable support for the sonde if it was resting on the bottom of the hole. Boegeman & co. figure that 2' of 7" O.D. pressure case would do the job. I still need to run this past John O. (who's still out of town) to see if we can afford it, but it sounds like the way to go.

5. The logging run will only be able to measure the depth of the hole with an accuracy of about a foot or so (and they pointed out that a rock could fall in and change the depth after the logging run), so it seems unlikely that we'll be able to make the cable to the BIP just the right length to leave a few inches of slack when the sonde hits bottom. A cable slacker may be necessary after all. Will discuss this with J.O. when he gets back also.

O. Williams@breedsd.edu

2.3 Progress Meeting at SIO December 2, 1992

Subject: Meeting and clock question.

2.3.1 Peal 11/11/92

-text follows this line--

Ave: a couple questions:

\

. We really would like to decide tomorrow (12 Nov) about the meeting next week as I am leaving Saturday (I am going for the ONR OBS facility review at SIO on Monday). So please give Don a call whether or not it is a go.

. We have been looking at the specific problem of clock and timing in the Reftek for the downhole project. This is an update because it is sort of an in-between-us problem so your input is needed.

At present I am trying to see if we could use the BCU and the Seascan clock so that the Reftek operates exactly as it was designed to when connected to an external clock (Omega or GPS). This means that the BCU must "fool" the Reftek into believing that it has an operating Omega or GPS connected. The implications are that we (the BCU) need to generate a good 1 PPS and also send a special ASCII string every second, synchronized with the 1PPS. The string contains the current time and also a status character that tells the Reftek that the Omega or GPS is locked and thus that the time is good. The Reftek uses these inputs in a digital phase comparator scheme to keep its internal clock locked to the external clock. This internal clock is what it uses to time tag the data.

If the string is not present, the Reftek doesn't have the status character from the timing receiver so assumes that it is broken or has lost lock and then ignores the 1 PPS. This means that it runs on its internal TCXO which is probably only good to 1 in 10^6 . This in turn means that we really need to keep the ASCII string running all the time.

I got this info from a Reftek Application note about timing and from conversations with Phil Davidson of Reftek.

I will look at the implications on our computing load but the requirement to generate the ASCII string every second is a bit unpleasant.

Please let me know what you think of this and if you are exploring it at all. Any better ideas?

Regards ... kp

by@igppam.ucsd.edu Wed Nov 11 13:33:29 1992
 turn-Path: <david_willoughby@igppam.ucsd.edu>
 ceived: from ucsd.edu ([132.239.1.1]) by hurdle.who.edu (4.1/SMI-4.1)
 id AA02595; Wed, 11 Nov 92 13:32:56 EST
 ceived: from igppam.ucsd.edu by ucsd.edu; id AA0600S
 sendmail 5.67/UCSD-2.2-sun via SMTP
 Wed, 11 Nov 92 10:32:03 -0800 for kpeal@hurdle.who.edu
 ssage-Id: <9211111832.AA06008@ucsd.edu>
 te: 11 Nov 92 10:29:46 U
 om: "David Willoughby" <david_willoughby@igppam.ucsd.edu>
 oject: Re: Meeting and clock questi
 : kpeal@hurdle.who.edu
 atus: R

Reply to: RE>Meeting and clock questions

I've scheduled no official meeting since Orcutt is out of town, a couple of
 other key people aren't around and we're going to sea in a little over a week.
 However, if you want to stop by for an informal get-together, I'll be around --
 usually in by 10 (sic) and here 'til after 6, though I'll probably be down
 the ship Thursday and Friday.

While back, I started wondering why on earth we're putting the SeaScan clock
 in the BIP rather than in the sonde, since the precise timing is needed only in
 the latter. Though we haven't really discussed it, I'd like to propose that we
 use it in our package -- then we just have to modify the RefTek software to
 (1) eliminate the need for an ASCII string every second and (2) go fetch the
 time from the SeaScan every once in a while for a check on the software clock.
 Making minor mods to the Ref Tek code appears to be no problem: we have a good
 programmer available and Pres. Passmore of Ref Tek says that he'll be happy to
 send us source code and support our changes.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Memorandum

To: Broadband Seismic System Participants
From: Ralph Stephen and Donald Koelsch
Date: December 9, 1992

~~~~~

Dear Colleagues:

Enclosed are the minutes of the meeting at San Diego. If you have any questions or additions, please let me know.

We feel it was a very successful interchange and thank you for attending.

Regards,

Ralph Stephen
Senior Scientist

Don Koelsch
Principal Engineer

xc: T. Boegeman, MPL
F. Spiess, MPL
R. Zimmerman, MPL
D. Willoughby, IGPP
J. Orcutt, IGPP
G. Offield, IGPP
F. Vernon, IGPP
R. Stephen, WHOI
D. Koelsch, WHOI

BROADBAND BOREHOLE SEISMIC SYSTEM

Notes of second engineering meeting, December 2, 1992

Place: Scripps Institution of Oceanography

Attendees:

G. Austin, SIO/MPL
 T. Boegeman, SIO/MPL
 C. Holingstead, SIO/IGPP
 D. Koelsch, WHOI
 G. Offield, SIO/IGPP
 J. Orcutt, SIO/IGPP
 F. Spiess, SIO/MPL
 R. Stephen, WHOI
 F. Vernon, SIO/IGPP
 D. Willoughby, SIO/IGPP
 R. Zimmerman, SIO/MPL

1. Introduction:

R. Stephen presented agenda for meeting which was agreed upon by attendees. (Appendix A).

2. Interface Issues:

See	Fig. 1 - simplified Surface Block Diagram	REV 2
	Fig. 2 - Simplified BIP Block Diagram	REV 3
	Fig. 3 - Simplified Sonde Block Diagram	REV 3

These reflect changes and additions decided at the meeting.

- a) Surface Block Diagram (Fig. 1):
  - i) WHOI data analysis station added. It listens only to the 4800 baud (bits/sec) data stream and does not have any control functions. The analysis programs are yet to be determined.
- b) BIP Block Diagram (Fig. 2):
  - i) MPL module will provide 50 VDC not 100 VDC. This voltage, converted in the Sonde to about 26VDC will be used to power the leveling and mass centering motors in the 54000 seismometer. This will have a maximum of 10 watts. If only one motor is energized at a time, the required power is much less (to be determined).
- c) Sonde Block Diagram (Fig. 3):
  - i) Normally, REFTEK power is 12VDC. REFTEK has offered to change this to 24VDC which will make better use of the 24 volt battery system. D. Willoughby will tie this down.

**Action - IGPP
Willoughby**

- ii) Pin 6 of the connector will be allocated to Re-entry Instrumentation Circuit Return and is connected to sea water (earth).

**Action - IGPP
Willoughby**

- ii) Pin 6 will be electrically connected to sea water (earth).

iii) Motor power supply (more than 24V) will be diode coupled with the 24V normal power to the Teledyne 54000.

iv) Re-entry instrumentation will include pressure, compass and acoustics as well as television and lights. The funding for the added instrumentation will be obtained from the deployment contract of 1994. MPL-Dr. Spiess, Tony and Richard will have much greater input in its preparation.

3. Timing Issues:

- a) WHOI sends down a Time Hack (PT) and REFTEK inserts a record in the data stream that contains only time and engineering data. No loss of data will occur during this operation.

Action - IGPP
Willoughby/Offield

Question: Will our (Sea Scan Time) be incorporated into the data stream? For example, if we send down on the com 1 link the time when a time hack (PT) will occur, can this value be placed somewhere in the data stream along with REFTEK time. This would give us a log of time differences between Sea Scan Time and REFTEK time. REFTEK could then determine if this offset is too great, and then would request from the BCU a new ASCII time word to resynchronize REFTEK time with Sea Scan time.

Action - IGPP
Willoughby/Offield

- b) ASCII time data word is latched by REFTEK and tags a particular 1/sec pulse. Format of this data word to be supplied by IGPP.

Action - IGPP
Willoughby/Offield

- c) ASCII time word heartbeat will be sent via a dedicated communication port. Could it be sent through COM Port 1 on some predetermined schedule like once each hour?

Action - IGPP
Willoughby/Offield

- d) Time synchronization will be via IPPS originating in the Sea Scan clock.

- e) End of experiment time will be stored and acted on by the REFTEK computer. This value will be loaded after leveling and mass centering and stored in battery backed up RAM in REFTEK.

Action - IGPP
Willoughby/Offield

4. Grounding:

- a) BIP and Sonde will share a common signal and power ground.

- b) MPL will have its circuit common connected to sea water.

- c) Power supplied by MPL to the BIP will use isolated DC to DC converters.

- d) Signals will be passed around the isolated power grounds by opto-couplers provided by MPL in the MPL chassis installed in the BCU.

5. Telemetry System (Fig. 2 and 3):

- Pin 1 a) REFTEK Power 12VDC (24VDC if REFTEK agrees).
b) IPPS for clock timing, output will be a 10 m sec wide pulse at +5 volt logic level.
- Pin 2 a) 54000 electronic power is 24VDC.
b) FSK for 4800 baud data up link. Output of the telemetry module will be +5 V logic level.
c) FSK for 2400 baud ASCII heartbeat time down. Input and output to the telemetry modules will be +5V logic level.
- Pin 3 When using re-entry system placed in parallel with pins 4 and 5.
When not using re-entry system - FSK full duplex up and down. Input and output to the telemetry modules will be +5V logic level.
- Pin 4 When using re-entry system pin 4 is placed in parallel with pins 3 and 5.
When not using re-entry system it carries -
a) 50VDC for 54000 motors
b) Pulse time hack for time check. 10 m sec wide positive pulse at output of telemetry module will be +5V logic level.
- Pin 5 Reserved for re-entry system
- Pin 6 Sea water and copper return for re-entry system.
- Pin 7 BIP and Sonde circuit common (not tied to sea water).

Power for the telemetry module installed in the Sonde will be provided by the REFTEK - +12VDC at 4ma. and +5VDC at 2ma.

The mechanical configuration of the telemetry module will be supplied by IGPP.

**Action IGPP
Willoughby**

6. Cable:

- a) Pinon Flats cable to be supplied by WHOI, shipped by 15 March 1993. Specifications:
125 meters long
terminated one end
No shear pin

**Action WHOI
Bocconcelli**

- b) Second cable supplied by WHOI, shipped by July 1993. Specifications:
300 meters
terminated at one end
No shear pin

**Action - WHOI
Bocconcelli**

- c) A third cable, terminated both ends, will be assembled at sea for the final experiment.
- d) Breakaway specifications agreed on in case Sonde gets stuck in hole.
i) Breakaway occurs at the Sonde leaving a standard 'fishing connection' for Sonde retrieval.

ii) Tentative loads - Alex's memo modified.

<u>device</u>	<u>weight in water</u>
BIP	1000 lbs
Sonde	500 lbs
MPL thruster	2000 lbs
.68 cable	8000 lbs
logging cable	<u>256 lbs</u>
Total	11,822

Limit at overboarding sheave is 15,000 lbs, (re. Dr. Spiess) leaving 3000 lbs for the breakaway specification.

**Action - WHOI
Bocconcelli**

(See Item 12)

e) There will be no cable slacking mechanism.

f) The bulkhead connection needs to be designed and delivered (1) to IGPP by 3/15/92.

**Action - WHOI
Bocconcelli**

7. Equipment list and diagram of BIP:

Transponders, releases, battery cases, etc.

**Action - WHOI
Gould**

8. Power Structure and Estimate - (Appendix B):

a) Shows that voltages are needed at what stage and where these voltages originate.

b) Power budget estimate shows that a 14.86 KWH battery should run the system for 3 months. Since each of three batteries can hold 8 KWH and lithium power, there is a physical battery capacity of 24 KWH. If the more optimistic figure is realized, only two cases would be needed. These power estimates must be kept up to date.

**Action - IGPP (all hands)
Action - WHOI (all hands)**

9. Fail Safe Issues:

a) While lowering and deployed in the hole, but before 54000 is fully tested, the controlled interlock relay in the BCU has the release hook electrically disconnected.

b) After 54000 has been certified operational, the interlock relay is closed. The release hook can then be energized on command by MPL, or by acoustic command through the BCU. The release hook power is supplied by a 9V alkaline battery mounted in the BCU as in the LFASE experiment.

c) Mass locking occurs when:

i) The main battery has fallen below a certain value. To avoid ambiguity, WHOI turns off batteries when level falls below a specified level. The Sonde senses this low voltage condition and locks the mass. Batteries in the Sonde supply the mass locking power.

ii) When timed experiment ends, 90 days. REFTEK keeps track of this time and issues the locking command. Batteries in the Sonde supply the mass locking power.

- d) Still undecided - How to respond to a thruster failure after the 54000 mass has been unlocked but before the system is certified working or if we have to recover the instrument early.

Action -IGPP
MPL
WHOI

- e) Watch dog timers will be in:

i) REFTEK

ii) BCU

a) If BCU does not cycle then it does a power up reset (PUR) on itself.

b) If no data is received from REFTEK then the BCU interrupts REFTEK power and REFTEK does a PUR.

10. Pinon Flats Tests:

Except for supplying terminated cables, WHOI will not participate in Pinon Flats tests until 'full up' test in December, 1993. All three organizations will participate in the 'full up' tests.

11. Deployment and Communication:

Updated deployment and communication view graphs are in Appendix C. These reflect additions and changes we agreed to at the December 2, 1992 meeting.

12. Borehole seismometer package:

- a) Dimensions and weights (weight and day) are summarized in Dave Willoughby's memo of Dec. 8, 1992 (Appendix D). These will change the breakaway specifications in Section 6.d.ii.).

13. Data Recording:

- a) There will be no data compression in the seafloor recording system or 4800 baud data stream.
- b) Field format, real time analysis format, archive format and exchange formats are still to be determined.

Action Item - WHOI
(Stephen, Peal)
IGPP (Vernon
Offield, Orcutt)

AGENDA FOR B3S2 MEETINGS DECEMBER 2-3,1992

- I. MPL, IGPP and WHOI on December 2.
  - 1. Shipboard deployment scenario.
  - 2. Interface functions.
  - 3. Power grid.
  - 4. Weak link strategy.
  - 5. Fail safe scenarios.
  - 6. Schedule of project milestones with MPL.

- II. IGPP and WHOI on December 2
  - 1. Definition of field format and data exchange formats.
  - 2. Data acquisition, storage and exchange responsibilities.

- III. IGPP and WHOI on December 3
  - 1. Summarize progress on the September action items
  - 2. Update power budget of Reftek and Teledyne 54000
  - 3. Update the Pinon Flat test schedule
  - 4. Visit Pinon Flat (??)

APPENDIX B

BROADBAND BOREHOLE SEISMIC SYSTEM

POWER STRUCTURE - What voltages and when they are needed

Phase	BIP	MPL/BCU
<u>Deployment</u>		
BIP	24 VDC, Batteries	
Teledyne motors		
Teledyne elect.		
REFTEK		
BRG TV		
BRG Lights		
<u>Lowering & Searching</u>		
BIP		28 VDC
Teledyne motors		
Teledyne elect.		
REFTEK		
BRG TV		50 VDC
BRG Lights		50 VDC
<u>Lowering into hole</u>		
BIP		28 VDC
Teledyne motors		
Teledyne elect.		
REFTEK		
BIP TV		50 VDC
BIP Lights		24 VDC, batt

Phase _____ BIP _____ MPL/BCU _____

Fully deployed leveling
connected to ship

BIP	_____	28 VDC _____
Teledyne motors	_____	50 VDC 10 W _____
Teledyne elect.	24 VDC 1-2 W	_____
REFTEK	24 VDC 1-2 W	_____
BRG TV	_____	_____
BRG Lights	_____	_____

Fully deployed taking
data connected to ship

BIP	_____	28 VDC _____
Teledyne motors	_____	50 VDC _____
Teledyne elect.	24 VDC 1-2 W	_____
REFTEK	24 VDC 1-2 W	_____
BRG TV	_____	_____
BRG Lights	_____	_____

Autonomous
operation

BIP	24 VDC, batt	_____
Teledyne motors	_____	_____
Teledyne elect.	24 VDC 1-2 W	_____
REFTEK	24 VDC 1-2 W	_____
BRG TV	_____	_____
BRG Lights	_____	_____

BROADBAND BOREHOLE SEISMIC SYSTEM

Power Estimates For Three Month Deployment

		Pessimistic	Optimistic
LOPACS, BCU computer	100 ma, 5 VDC	0.75 w.	0.5 w.
CPU			
2 m bytes memory			
Memory control			
Control & communications	20 ma, 5 VDC	0.20 w.	0.10 w.
FSK Data up link	5 ma, 12 VDC	0.08 w.	0.06 w.
FSK Control link			
Timing to REF TEK			
Other circuits in BCU			
Quality control	10 ma, 5 VDC	0.06 w.	0.05 w.
Failsafe			
ASCII time converter	20 ma, 5 VDC	0.25 w.	0.10 w.
	Circuit watts required	1.34 w.	0.81 w.
	Power supply Eff. 70%	1.74 w.	1.05 w.
REFTEK			
Taking data	42 ma, 22-30 VDC	2.0 w.	1.0 w.
54000			
Taking data	42 ma, 22-30 VDC	2.0 w.	1.0 w.
	Total wattage used without recorder	5.71 w	3.05 w.
	Implies for 90 day deployment	12.4 kwh	6.50 kwh
RECORDER			
	120 AMP. Hrs at 12 VDC	1.44 kwh	
	20 AMP. Hrs at 5 VDC	.10 kwh	
	Total wattage used by recorder	1.54 kwh	
	Total for recorder with eff. of 60%	2.46 kwh	
	Implies for 2 gbyte of data	2.46 kwh	
Grand total, power needed		<u>14.86 kwh</u>	<u>8.96 kwh</u>

APPENDIX C

Shipboard Deployment Sequence

1. Individule testing:- Not connected together
2. BCU connected to Sonde for testing through deck cable, and 300 m 7conductor cable like last phase of Pinon Flats
3. On deck, Sonde, BCU, & Thruster all connected. Talking from laboratory through MPL or deck cable.
4. Over the side, before lowering:- All connected Laboratory talking through MPL (.680 cable).
5. Searching for Hole:- Only TV & lights are on. MPL in Lab talking to thruster & TV.
6. Lowering into hole- TV & lights on BIP
7. In the hole, Sonde deployed on bottom of hole Teledyne 54000 ON & leveling active. REFTEK & BIP ON, All power from surface. Shipboard recording phase of 72 hrs. for set up and quality control. Switch back and forth from surface to battery power for final testing before letting go.
8. In the hole, after disconnect (3 month mode). Teledyne, REFTEK, & BIP ON. All power from batteries.
9. Recovery: Teledyne 54000 clamped, clamping power from batteries contained in sonde.

MASS CLAMPING ISSUES TO THINK ABOUT-

- a) If we wish to recover early from a ship of opportunity.
- b) If the tether or Deep Tow fails after unclamping the mass and before we are convinced the system is working.

Communications & Power from Thruster to BIP

I. Communications.

1. Video up.
2. Data up, 4800 b.
3. Time hack from Sea Scan clock--up
4. BIP/SONDE Command link--

2400 b. Full Duplex
 8 bit, even parity, 1 stop bit
5. Video Command link--

2400 b. Full Duplex
 8 bit, odd parity, 1 stop bit
6. Tether release
 ENABLED by BCU
 COMMANDED by BCU or MPL

Same
Channel

Same
Channel

II. Power.

1. Light power.
2. 28 VDC power for BIP
3. Teledyne 54000 Motor Power (50 VDC)
4. Soft tether Release power.

W.H.D.L.

KDEL SCH
Dec. 8, 1992

COMMUNICATIONS & POWER FROM BIP TO SONDE

I. Communications.

1. Seismic data upi- 4800 b. FSK.
2. Time 'heartbeat' down, ASCII, 2400 b.
3. 1 PPS Time sync pulse for REFTEK.
4. Pulse Time (PT) REFTEK 'time check' command
5. Command link:- 2400 b. Full Duplex,
8 bit, even parity, 1 stop bit

II. Power.

1. 24 to 28 VDC for REFTEK
changed from 11 to 15 VDC
Can be interrupted to reset cpu.
2. 24 VDC for Teledyne 54000
Once turned and device leveled it
is left on.
3. Power for leveling & clamping motors.
Derived from shore power-
50 VDC generated in MPL sub-chassis
in BCU. Output of 50 to 24+ V dc to
dc converter is diode coupled to
54000 electronic power. (Fig. 3).

PINON FLATS DEPLOYMENT SCENARIO

1. Teledyne 54000 in Sonde package to
test deployment schemes. IGPP only
2. Teledyne 54000 with REFTEK in Sonde pkg.
Control from a PC. (IGPP supplied)
Only IGPP people participating
3. Teledyne 54000 with REFTEK (Full up sonde)

WHOI's BCU & DRU
Telemetry sonde/BIP fully functional.
WHOI to ship van to arrive San Diego
by mid Dec. 1993

WHOI.

KOELSCH

Dec. 8, 1992

Date: 8 Dec/82

Appendix C

TO: distribution

FROM: David Willoughby, SIO/IGPP

SUBJ: Borehole seismometer package weight.

I have made a first pass at a guesstimate of the limits on the weight of the borehole seismometer package (sonde) part of the Broad Band Borehole Seismic System. All components fit into a 7 1/2" O.D. tube with a 5/8" or 3/4" wall, depending upon availability. Estimates indicate maximum and minimum probable quantities; thus, for example, the maximum weight is based on a 3/4" wall tube, while the minimum is based on the 5/8" wall version.

	Length		Weight	
	Min.	Max.	Min.	Max.
Seismometer ass'y w/o cover	72"	72"	120 lb	135 lb.
Ref Tek data logger (2 cards wide)	20"	22"	15	30
Teledyne 1612 controller & ancillaries	8"	8"	3	4
Logic & batteries for back up locking sys.	2"	4"	2	3
Other stuff:	6"	26"	--	20
Total length of sonde pressure case:	108"	132"		
	(9')	(11')		
Pressure case housing:				
9' of 7 1/2" O.D. X 5/8" tube:			126 lb.	
11' of 7 1/2" O.D. X 3/4" tube:				182 lb.
End caps			10	10
Total weight of sonde in air:			276 lb.	394 lb.
Total weight in water:			100 b.	179 lb.

The above calculations do not include the MPL re-entry unit, containing the camera, lights and pressure gauge, that mounts on the bottom of the sonde. Preliminary estimates for this unit are 24" length and 70 lbs. weight in air (based on an average density of the innards that is similar to that of the sonde). This yields a weight in water of about 31 lb.

Thus the totals for the sonde plus the MPL unit are:

	Min.	Max.
Length:	11'-0"	13'-0"
Weight in air:	346 lb.	434 lb.
Weight in water:	131 lb.	210 lb.

Until we have progressed further with the design, and have actually taken delivery of the major components, it will be difficult to obtain more accurate estimates.

Return-Path

Received: f1

2.4.1 Spiess/Gould 5/26/95

6.12/8.6

ESMTP id K2

From: mgould@cliff.who.edu

Received: from cliff.who.edu (cliff [128.128.16.150]) by aqua.who.edu (8.6.11/8.6.11) with SMTP id KAA20500; Fri, 26 May 1995 10:31:24 -0400

Received: from cc:Mail by cliff.who.edu

id AA801509741; Fri, 26 May 95 10:35:30 est

Date: Fri, 26 May 95 10:35:30 est

Encoding: 165 Text

Message-Id: <9504268015.AA801509741@cliff.who.edu>

To: tbolmer@aqua.who.edu, dkoelsch@aqua.who.edu, kpeal@aqua.who.edu, rstephen@aqua.who.edu

Subject: OSN equipment deployment meeting

Received: by ccmail from mail.ucsd.edu

>From fns@mpl.ucsd.edu

X-Envelope-From: fns@mpl.ucsd.edu

Received: from [137.110.133.113] by mail.ucsd.edu; id WAA16451

sendmail 8.6.12/UCSD-2.2-sun via SMTP

Thu, 25 May 1995 22:27:03 -0700

Message-Id: <199505260527.WAA16451@mail.ucsd.edu>

X-Sender: fns@murex.ucsd.edu

Mime-Version: 1.0

Content-Type: text/plain; charset="us-ascii"

Date: Thu, 25 May 1995 21:30:42 -0800

To: mgould@cliff.who.edu, vince@mpl.ucsd.edu, jah@mpl.ucsd.edu, cpm@mpl.ucsd.edu, richard@mpl.ucsd.edu, john_orcutt@igppqm.ucsd.edu

From: fns@mpl.ucsd.edu (Fred Spiess)

Subject: OSN equipment deployment meeting

Everybody:

As some of you already know, we have arranged with Matt Gould to take advantage of a trip he is making to San Diego to have an initial meeting about equipment deployment.

All those who are interested will meet in the conference room in MPL Building 4 on Point Loma on June 5, at 9 am. I hope that this will not take more than a couple of hours.

Matt has prepared a preliminary agenda, and will bring comments on those topics from the WHOI people. Matt please let any of them who are in town at that time know they are welcome to take part.

Fred.

Matt's agenda message:

From: mgould@cliff.who.edu

Date: Wed, 24 May 95 15:14:08 est

Encoding: 120 Text

To: tbolmer@aqua.who.edu, dkoelsch@aqua.who.edu, kpeal@aqua.who.edu, rstephen@aqua.who.edu, fns@mpl.ucsd.edu, vince@mpl.ucsd.edu

Subject: B3S2 shipboard deployment

Partial agenda for B3S2 Deployment Meeting at MPL in San Diego on June 5, 1995 May 23,1995

Basic deployment procedure

The array and Bottom Instrument Package (BIP)

The Soft Tether and Thruster

Crane picks for deployment of the Logging cable or the winch?

Identify Interface areas

Borehole Re-entry Guide (BRG) Is it

part of the tool or separate?
 Inter Ocean Releases?
 A battery on the BIP for camera and lights?
 Etc....

B3S2 Shipboard Deployment Notes

Matthew Gould

January 30, 1995

Rev. 5/24/95

The following is one scenario of a shipboard deployment of the B3S2 down hole sonde, the seafloor support gear and the MPL gear. Assuming that the set up on the deck of the MELVILLE will be similar to our previous joint venture with the LFASE experiment off of Florida in 1989, we can deploy the array in a similar way.

Deck gear needed for this operation will be:

Ship's crane
 small winch for the Soft Tether

capstan for Bull Rope
 fairlead block and 4 bolt deck mount
 1 1/2" Bull Rope at least two deck cleats for tag lines
 .680" fairlead blocks and accumulators
 at least 2, 50 ft. and 2, 75 ft. tag lines
 MPL's pipe flagpole stopper

Blocks needed in the A-frame:

1 for the Bull Rope, Port side
 1 for the .680" Coax, Center
 1 for the Soft Tether, Starboard side

First, the Bottom Instrument Package (BIP) should be placed inside the stern Aframe toward the port side. The downhole tool can be placed on the starboard side of the Aframe with the top facing aft and the bottom end of the logging cable connected to the tool. Flake out the 300 meter length of the 7 conductor logging cable and make the connection to the bottom of the BIP. The actual length of the logging cable will be determined by the data acquired on the Wiper cruise. Make the connection to the top of the BIP with the SOFT TETHER, reaved through the block at the top, on the starboard side, of the Aframe. A 20 foot piece of 1 inch nylon line should be spliced on to one of the upper sloping strength members, leading to the top hub, then lightly tape it down to the wire mesh exposing the free eye so it may easily be hooked upon recovery. At this time a complete system checkout can occur with or without the deck cable. After the checkout, using the cable clamps that were supplied by AMG for the 34 conductor cable, with the proper sized inserts, the crane can pick the tool and lower it into the stopper block mounted in the expanded steel decking over the stern ramp. The rest of the 300 meters of the logging cable can be deployed in the same pick and clamp fashion, this should take less than 1 hour even stopping to install the cable stabilizing rigs along the way.

At the top end of the logging cable, is the first tricky part. Ten feet below the upper Gerhart Owens termination will be a kevlar YALE GRIP with the eye pointing up and a 11 foot line spliced into it. Stop off the logging cable just below the YALE GRIP. At this point we must move the BIP into position. Using the port block at the top of the Aframe, rig a slip line of about 30 feet length through two of the top three BIP frame members to the BULL ROPE. The Bull Rope is reaved through a fairlead block on the deck to the capstan. Rig slipping tag lines running forward to deck

cleats and aft through the Aframe around to the port and starboard bollards. Now you can break the BIP free from the tie down chains and with the Aframe in the up position, lift the BIP and move it aft over the stern. When the BIP is over the stern and the bottom is about the same height as the deck, hold it there. At this time hook the upper eye of the 11 foot line (the lower end is spliced to the YALE GRIP) into the crane whip and take the strain off of the cable clamp. Remove the clamp. Lower the crane whip so the strain comes onto the BIP, then remove the eye from the crane and place it in one of the snap hooks mounted on the bottom of the BIP, MAKE SURE TO LEAD THE LINE ON THE INSIDE OF THE BOTTOM RING. Now the load is on the BIP, and the BIP is on the BULL ROPE. Lower the BIP into the water and let the SOFT TETHER take the load. Remove the BULL ROPE slipline and the Slipping taglines, then lower away the SOFT TETHER. The top of the SOFT TETHER will be stopped off onto the pipe flag pole, mounted on the decking next to the cable stopper. A sling long enough to reach the center line, of the ship, will be shackled into the top eye of the Soft Tether and the pipe flag pole. The thruster can now be moved into the Aframe and rigged for deployment. Slip lines can be rigged to the thruster in a similar fashion as the BIP and the .680" EM cable is connected to the top of the thruster. Now the thruster can be picked up and positioned over the top end of the SOFT TETHER and the mechanical and electrical connections can be completed. Remove the SOFT TETHER from the pipe flag pole and lower the thruster into the water. It would now be a good time to do a final system check to make sure that everything is functioning properly, then remove all slip lines and lower away the whole array. This scenario will be discussed at a meeting on June 5, 1995, in San Diego, with Dr. Speiss and the MPL group. Details will be discussed for this procedure and the recovery operation will be examined.

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W.H.O.I.
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Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.11/8.6.11) with SMTP id IAA00466 for <rstephen@gannet.who.edu>; Thu, 22 Jun 1995 08:38:05 -0400

From: mgould@cliff.who.edu

Received: from cliff.who.edu (cliff [128.128.16.150]) by aqua.who.edu (8.6.11/8.6.11) with SMTP id IAA12303; Thu, 22 Jun 1995 08:34:13 -0400

Received: from cc:Mail by cliff.who.edu

id AA803835475; Thu, 22 Jun 95 08:36:47 est

Date: Thu, 22 Jun 95 08:36:47 est

Encoding: 17 Text

Message-Id: <9505228038.AA803835475@cliff.who.edu>

To: fnspeiss@mpl.ucsd.edu, richard@mpl.ucsd.edu, john_orcutt@igppqm.ucsd.edu, paul_zimmer@igppqm.ucsd.edu, david_willoughby@igppqm.ucsd.edu, rstephen@aqua.who.edu, kpeal@aqua.who.edu, tbolmer@aqua.who.edu, mgould@cliff.who.edu, glen_offield@igppqm.ucsd.edu, vernon@yin.ucsd.edu, gary@mpl.ucsd.edu

Subject: Whoi PFO pullout

I had a very successful trip to San Diego and Pinon Flats June 3, thru June 8, and the van has returned here in good shape.

I want to thank Glen and everyone that got the van and trailer emptied of the gear that was staying at Pinon. It was very helpful not to worry about what was to stay and what was coming to Woods Hole. I also want to thank Gary Austin, Without his help it would have been a much more arduous trip.

The meeting at MPL on June 5 was good and we identified some problem areas and ironed out some others, a report from me will follow in the U.S. Mail.

Thank you
Matthew Gould
mgould@who.edu

**Broad Band Borehole Seismic System
(B3S2)**

Summary of a
Meeting at MPL, Point Loma
San Diego, CA
June 5, 1995

Present:

Dr. F. N. Speiss	MPL
Dr. J. Orcutt	IGPP
R. Zimmerman	MPL
P. Zimmer	IGPP
G. Austin	MPL
M. Gould	WHOI

The subject of this meeting was to discuss the shipboard deployment and recovery of the B3S2 system.

Reference Memo below:

B3S2 Shipboard Deployment Notes

Matthew Gould
January 30, 1995
Rev. 5/24/95

The following is one scenario of a shipboard deployment of the B3S2 downhole sonde, the seafloor support gear and the MPL gear.

Assuming that the set up on the deck of the MELVILLE will be similar to our previous joint venture with the LFASE experiment off of Florida in 1989, we can deploy the array in a similar way.

Deck gear needed for this operation will be:

- Ship's crane
- small winch for the Soft Tether
- capstan for Bull Rope
- fairlead block and 4 bolt deck mount plate
- 1 1/2" Bull Rope
- at least two deck cleats for tag lines
- .680" fairlead blocks and accumulators
- at least 2, 50 ft. and 2, 75 ft. tag lines
- MPL's pipe flagpole stopper

Blocks needed in the A-frame:

- 1 for the Bull Rope, Port side
- 1 for the .680" Coax, Center
- 1 for the Soft Tether, Starboard side

First, the Bottom Instrument Package (BIP) should be placed inside the stern Aframe toward the port side. The downhole tool can be placed on the starboard side of the Aframe with the top facing aft and the bottom end of the logging cable connected to the tool. Flake out the 300 meter length of the 7 conductor logging cable and make the connection to the bottom of the BIP. The actual length of the logging cable will be determined by the data acquired on the Wiper cruise. Make the connection to the top of the BIP with the SOFT TETHER, reaved through the block at the top, on the starboard side, of the Aframe. A 20 foot piece of 1 inch nylon line should be spliced on to one of the upper sloping strength members, leading to the top hub, then lightly tape it down to the wire mesh exposing the free eye so it may easily be hooked upon recovery. At this time a complete system checkout can occur with or without the deck cable. After the checkout, using the cable clamps that were supplied by AMG for the 34 conductor cable, with the proper sized inserts, the crane can pick the tool and lower it into the stopper block mounted in the expanded steel decking over the stern ramp. The rest of the 300 meters of the logging cable can be deployed in the same pick and clamp fashion, this should take less than 1 hour even stopping to install the cable stabilizing rigs along the way.

At the top end of the logging cable, is the first tricky part. Ten feet below the upper Gerhart Owens termination will be a kevlar YALE GRIP with the eye pointing up and a 11 foot line spliced into it. Stop off the logging cable just below the YALE GRIP. At this point we must move the BIP into position. Using the port block at the top of the Aframe, rig a slip line of about 30 feet length through two of the top three BIP frame members to the BULL ROPE. The Bull Rope is reaved through a fairlead block on the deck to the capstan. Rig slipping tag lines running forward to deck cleats and aft through the Aframe around to the port and starboard bollards. Now you can break the BIP free from the tie down chains and with the Aframe in the up position, lift the BIP and move it aft over the stern. When the BIP is over the stern and the bottom is about the same height as the deck, hold it there. At this time hook the upper eye of the 11 foot line (the lower end is spliced to the YALE GRIP) into the crane whip and take the strain off of the cable clamp. Remove the clamp. Lower the crane whip so the strain comes onto the BIP, then remove the eye from the crane and place it in one of the snap hooks mounted on the bottom of the BIP, **MAKE SURE TO LEAD THE LINE ON THE INSIDE OF THE BOTTOM RING.**

Now the load is on the BIP, and the BIP is on the BULL ROPE. Lower the BIP into the water and let the SOFT TETHER take the load. Remove the BULL ROPE slipline and the Slipping taglines, then lower away the SOFT TETHER.

The top of the SOFT TETHER will be stopped off onto the pipe flag pole, mounted on the decking next to the cable stopper. A sling long enough to reach the center line, of the ship, will be shackled into the top eye of the Soft Tether and the pipe flag pole. The thruster can now be moved into the Aframe and rigged for deployment. Slip lines can be rigged to the thruster in a similar fashion as the BIP and the .680" EM cable is connected to the top of the thruster. Now the thruster can be picked up and positioned over the top end of the SOFT TETHER and the mechanical and electrical connections can be completed. Remove the SOFT TETHER from the pipe flag pole and lower the thruster into the water. It would now be a good time to do a final system check to make sure that everything is functioning properly, then remove all slip lines and lower away the whole array.

This scenario will be discussed at a meeting on June 5, 1995, in San Diego, with Dr. Speiss and the MPL group. Details will be discussed for this procedure and the recovery operation will be examined.

Matthew Gould
W.H.O.I.
Iselin 253 Mail Stop #27
98 Water St.
Woods Hole, MA 02543-1054
Tel: (508) 289-2639

The first thing that was discussed was the probability that the ship we used would be the ROGER REVELLE (AGOR 24). The REVELLE is the ship of choice but there are some problems, such as it has not been delivered to Scripps yet and NSF has stated that they will not fund any time on her in 1996. We discussed some of the differences between the REVELLE and the MELVILLE, such as the space on deck and the handling gear available. We decided that the above scenario would work aboard either vessel with some very minor modifications.

Dr. Speiss' reluctance to have the 300 meters of 7 conductor Logging cable flaked out on deck, for deployment by crane picks, prompted discussion on alternatives. The best one seems to be a two bay winch, one bay for the logging cable and one for the soft tether. I am looking into winches here, Gary has a couple of possible candidates there that need a separator installed.

Recovery of the system was discussed in two cases. One case is, if we get deployed and have to bring the gear back on deck, because of some system failure, before we are decoupled from the BIP. We determined that this would be relatively easy, that we could just reverse the deployment scenario, because we would still be attached to everything. The second case was the planned recovery operation, when we come back after three months to grapple the BIP with the thruster. The length of the tether from the thruster to the hook was discussed. The consensus seemed to be that 15 feet of tether would give good visibility from the thruster and be a good length for handling the load transfer at the surface, keeping the BIP in the water while the Thruster would be at the rail.

Because of the lack of reverse cant of the stern, we will be looking at a way to install a short overhang, to keep the cable or any instruments from banging into the stern while we are stopped off between phases of the deployment. Possibly securing the expanded metal platform that covered the stern ramp of the MELVILLE to the deck of the REVELLE. The platform has the plate for the AMG cable clamps that we will need to stop off the logging cable at the top of the tool and again at the bottom of the BIP. This will also allow a shorter tether on the pick up hook of the thruster, so that the BIP will be able to be just in the water and not have to be down below the waterline during thruster recovery.

Thirty days of ship time has been requested for deployment of this project and "BBOBS". Current thinking is that there will be two legs to accomplish the tasks. The first leg will deploy a navigation net, locate and log the hole, install a "packer" in the hole close to

the bottom of the casing, and deploy the buried "BBOBS" sensor. The second leg will deploy the unburied "BBOBS" sensor and the B3S2 system.

Some short notes and presently unresolved questions:

How can we tell if the Inter Ocean release has released the soft tether?

Is there a capstan on the fantail of the REVELLE?

We must be able to get to both ends of the logging cable and the soft tether, even when they are wound onto a winch drum.

MPL has the Inter Ocean releases.

MPL will be unable to work on these issues until October 1995.

The downhole tool will be 19 1/2 ft. long including MPL's BRG.

MPL may need space on the BIP for 1 or 2 DSPL battery cases.

That is about all I can think of for now, if anyone has any additions or corrections to this meeting summary please feel free to chime in.

Matthew Gould

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TOP OF CONE 4409.8 M

TOP OF REFLECTORS

~~4415.9~~ 4415.9

NOTE: ALL DEPTHS IN METERS BELOW DRILLER'S DATUM

15,519.0

RE-ENTRY CONE/CASING PROFILE

LEG 136 HOLE 843B

LEG-136

67

11 MARCH 1991

843B

LAT N 20.529

Lon W 159.05662

F.T. Alex

3.2 Cable Specifications

3.2.1 Felice 10/7/92

Lamont-Doherty Geological Observatory | Palisades, N.Y. 10964
of Columbia University

Cable: LAMONTGEO
Palisades New York State
TWX-710-576-2653

Telephone: (914) 359-2900

FAX: (914) 365-3182

Fax Transmission
3 Pages Total

To: Alex Bocconelli, Woods Hole Oceanographic Institute

From: Frank Filice

Alex,

Enclosed is a sheet from Camesa Cable for wireline specifications. The 7 conductor 15/32 wireline you mentioned should be more than adequate for the maximum weight that you want to pull, that is assuming the cableheads are built properly. It looks as all of the 15/32 wireline armor have the same strength, 338 lbs. inner and 535 lbs. outer. For 10,000#, you could use 12 inner and 12 outer armors for a total estimated strength of 10,476#. Be sure that the winch unit and associated equipment being used can meet and/or exceed the pre-set breaking strength of the cablehead.

I have used standard GO type cableheads on downhole locking geophones in producing wells for over two months continuous time with no problems. I can't stress enough, as Erich mentioned before, the importance of building the cablehead properly and using the DC silicone grease in the head itself.

One last precaution; we talked briefly about the type of wireline you were using. You mentioned a black coating on the poly insulation of the wireline. This coating is conductive and must be removed from the wire conductors. Trichloroethylene and/or WD40 soaked on a rag will slowly dissolve this coating. If it is not totally removed, there is a good chance that in a conductive fluid there will be leakage between your conductors and the armor.

Another source of wireline equipment, which is larger than Comprobe and MLS combined, is Computalog Wireline Products in Fort Worth.

COMPUTALOG Wireline Products
7450 Winscott Road
Fort Worth, Texas 76216
(817) 249-7200 Fax (817) 249-7222

If there is anything else we can help you with, please let us know.

Thanks,

Frank Filice

Enclosure: Camesa Cable Specifications

CABLE SPECIFICATIONS

CABLE TYPE	NOM. DIA. IN.	MAX. TEMP °F	BREAKING STRENGTH LBS.	WEIGHT LBS./MH	ARMOR WIRES IN/OUT	WIRE S.S./LBS IN/OUT	STRETCH IN/MH/ M LB	MIN. SKEAVE DIA IN	COND. RES. Ω/MH	ARMOR RES. Ω/MH	COND. CAP. pF/IN	MAX. VOLT D.C.
1-N10RP	1/10	300	1,000	20	12/18	44/44						
1-N12RP	1/8	300	1,500	25	12/18	64/64	6.3	5	24	22	55	300
1-N12RZ	1/8	500	1,500	29	12/18	64/64	6.5	7	24	13	50	300
1-N12RA	1/8	550	1,500	30	12/18	64/64	6.5	7	24	13	40	300
1-L18RP	3/16	300	4,000	65	12/12	110/280	2.8	14	10	6.0	58	1000
1-L18RX	3/16	400	4,000	65	12/12	110/280	2.6	14	10	6.0	55	1000
1-L18RZ	3/16	500	4,000	67	12/12	110/280	2.6	14	10	6.0	65	1000
1-L18RA	3/16	550	4,000	68	12/12	110/280	2.6	14	10	6.0	55	1000
1-L20SP	2/10	300	4,800	82	12/12	139/338	2.3	14	8.6	4.5	65	1000
1-L20SX	2/10	400	4,800	82	12/12	139/338	2.3	14	8.6	4.5	60	1000
1-L20SZ	2/10	500	4,800	84	12/12	139/338	2.3	14	8.6	4.5	75	1000
1-L20SA	2/10	550	4,800	85	12/12	139/338	2.3	14	8.6	4.5	60	1000
1-K22PP	7/32	300	5,000	91	15/15	139/280	1.8	14	4.4	4.3	60	1000
1-K22PX	7/32	400	5,000	91	15/15	139/280	1.8	14	4.4	4.3	55	1000
1-K22PZ	7/32	500	5,000	94	15/15	139/280	1.8	14	4.4	4.3	70	1000
1-K22PA	7/32	550	5,000	97	15/15	139/280	1.8	14	4.4	4.3	55	1000
1-K22SP	7/32	300	5,000	59	15/15	139/280	1.8	14	6.6	4.3	50	1000
1-K22SX	7/32	400	5,000	80	15/15	139/280	1.8	14	6.6	4.3	46	1000
1-K22SZ	7/32	500	5,000	90	15/15	139/280	1.8	14	6.6	4.3	55	1000
1-K22SA	7/32	550	5,000	93	15/15	139/280	1.8	14	6.6	4.3	46	1000
1-F22RP	7/32	300	5,000	89	11/15	212/280	1.8	14	10	4.5	45	1000
1-F22RTZ	7/32	500	5,000	92	11/15	212/280	1.8	14	10	4.5	50	1000
1-N22SP	7/32	300	5,000	90	12/18	212/212	1.8	14	6.6	4.4	50	1000
1-N22SZ	7/32	500	5,000	93	12/18	212/212	1.8	14	6.6	4.4	56	1000
1-N22PA	7/32	550	5,000	94	18/18	110/212	1.8	14	3.5	4.9	52	1000
1-N25PP	1/4	300	7,200	120	12/18	280/280		16	4.4	3.5	50	1000
1-N32WP	5/16	300	11,000	185	12/18	434/434	1.3	17	3.5	2.0	50	1500
1-N32WX	5/16	400	11,000	184	12/18	434/434	1.3	17	3.5	2.0	46	1500
1-N32WZX	5/16	420	11,000	187	12/18	434/434	1.3	17	3.5	2.0	55	1500
1-N32WTZ	5/16	500	11,000	191	12/18	434/434	1.3	17	3.5	2.0	50	1500
1-N32WTA	5/16	550	11,000	192	12/18	434/434	1.3	17	3.5	2.0	45	1500
1-N38WP	3/8	300	14,000	253	12/18	600/600	1.0	20	3.5	1.5	40	1500
1-N38WX	3/8	400	14,000	252	12/18	600/600	1.0	20	3.5	1.5	35	1500
1-N38WZX	3/8	420	14,000	255	12/18	600/600	1.0	20	3.5	1.5	50	1500
1-N38WTZ	3/8	500	14,000	260	12/18	600/600	1.0	20	3.5	1.5	45	1500
1-N38WTA	3/8	550	14,000	262	12/18	600/600	1.0	20	3.5	1.5	35	1500
1-N42WP	7/16	300	19,500	318	12/18	776/776	0.7	23	3.5	1.2	40	1500
1-N42WZX	7/16	420	19,500	320	12/18	776/776	0.7	23	3.5	1.2	45	1500
1-N42WTZ	7/16	500	19,500	325	12/18	776/776	0.7	23	3.5	1.2	42	1500
4-H18RPX	3/16	300	3,300	81	18/18	72/139		14	24	6.8	40	300
4-H18RZX	3/16	420	3,300	82	18/18	72/139		14	24	6.8	50	300
4-H18RTZ	3/16	500	3,300	83	18/18	72/139		14	24	6.8	45	300
7-H25RP	1/4	300	7,200	110	18/18	139/280	2.0	18	25	3.7	70	300
7-H32RP	5/16	300	9,500	180	18/18	212/434	1.8	17	18	7.7	60	1000
7-H35RP	11/32	300	10,500	210	18/18	280/535	1.6	19	16	6.5	55	1000
7-H38RP	3/8	300	12,000	240	18/18	338/560	1.4	20	10.4	5.8	67	1000
7-H42RP	7/16	300	18,000	314	18/18	410/776	.85	23	10.4	1.3	58	1000
7-H42RX	7/16	400	18,000	313	18/18	410/776	.85	23	10.4	1.3	55	1000
7-H42RZ	7/16	500	18,000	317	18/18	410/776	.85	23	10.4	1.3	65	1000
7-H42RTZ	7/16	500	18,000	320	18/18	410/776	.85	23	10.4	1.3	60	1000
7-H42RA	7/16	550	18,000	321	18/18	410/776	.85	23	10.4	1.3	55	1000
7-J46RP	15/32	300	18,000	326	24/24	338/535	.80	20	10.4	1.2	42	1000
7-J46RX	15/32	400	18,000	325	24/24	338/535	.80	20	10.4	1.2	40	1000
7-J46RTZ	15/32	500	18,000	332	24/24	338/535	.80	20	10.4	1.2	45	1000
7-J46RA	15/32	550	18,000	334	24/24	338/535	.80	20	10.4	1.2	40	1000
7-Q52RP	17/32	300	24,500	435	19/20	600/950		25	10.4	1.0	40	1000
7-Q52RTZ	17/32	500	24,500	442	19/20	600/950		25	10.4	1.0	45	1000

*F—Propylene Copolymer

T—FEP Teflon

X—Camlex

A—PFA

Z—Tefzel

MEMORANDUM

To: Dave Willoughby *Don* Date: 11/4/92
From: Don Koelsch
Re: Cable specifications for the down hole cable.

Enclosed is the specifications for the 7 conductor logging cable made by Camesa. These specs. agree very closely with our measurements on the cable we have and will use. Our measurements follow:

Resistance any conductor	9.6 ohms/kft.
Capacitance:	
Center conductor to any other	21.7 nF/kft.
Any two outer conductors	20.4 nF/kft.
Any outer conductor to armor	41.0 nF/kft.
Breaking strength	
Sample #1	17,600 lbs.
Sample #2	17,050 lbs.
Yield strength	
Sample #1	13,500 lbs.
Sample #2	13,500 lbs.
Diameter	15/32 in.

Unfortunately our tensile machine does not have a chart output. We had to estimate the yield point by noting the point on a dial meter at which elongation increased without a corresponding increase of tension. We believe this number is good to within 5%.

The above numbers agree with the estimates you have been using and this just confirms there are no surprises.

We have found a supplier for the cable termination but still do not know a manufacturer for the mating bulkhead connector. LDGO has a design and we are pursuing that avenue. We will keep you posted.

I have received your memo concerning your meeting with MPL and are digesting it to have a response very shortly. In the meantime I'm calling MPL to clarify a couple of points.

Have you made any decisions about when it is convenient to have the next meeting.

cc. Richard Zimmerman, MPL
Alex Bocconcelli, WHOI
Matt Gould, WHOI
Ralph Stephen, WHOI

CABLE SPECIFICATIONS

CABLE TYPE	NOM. DIA. IN.	MAX. TEMP. °F	BREAKING STRENGTH LB.	WEIGHT lbs/MF	ARMOR WIRES IN/OUT	WIRE B.S./lbs IN/OUT	STRETCH IN/MF	MIN. SKEAVE DIA. IN.	COND. RES. Ω/MF	ARMOR RES. Ω/MF	COND. CAP. pF/ft	MAX. VOLT. V.C.
1-N10RP	1/10	300	1,000	20	12/18	44/44		6	24	22	55	300
1-N12RP	1/8	300	1,500	28	12/18	64/64	6.5	7	24	13	42	300
1-N12RZ	1/8	500	1,500	29	12/18	64/64	6.5	7	24	13	50	300
1-N12RA	1/8	550	1,500	30	12/18	64/64	6.5	7	24	13	40	300
1-L18RP	3/16	300	4,000	65	12/12	110/280	2.6	14	10	6.0	58	1000
1-L18RX	3/16	400	4,000	65	12/12	110/280	2.6	14	10	6.0	55	1000
1-L18RZ	3/16	500	4,000	67	12/12	110/280	2.6	14	10	6.0	65	1000
1-L18RA	3/16	550	4,000	68	12/12	110/280	2.6	14	10	6.0	55	1000
1-L20SP	2/10	300	4,800	82	12/12	139/338	2.3	14	6.6	4.5	65	1000
1-L20SX	2/10	400	4,800	82	12/12	139/338	2.3	14	6.6	4.5	60	1000
1-L20SZ	2/10	500	4,800	84	12/12	139/338	2.3	14	6.6	4.5	75	1000
1-L20SA	2/10	550	4,800	85	12/12	139/338	2.3	14	6.6	4.5	60	1000
1-K22PP	7/32	300	5,000	91	15/15	139/280	1.8	14	4.4	4.3	60	1000
1-K22PX	7/32	400	5,000	91	15/15	139/280	1.8	14	4.4	4.3	55	1000
1-K22PZ	7/32	500	5,000	94	15/15	139/280	1.8	14	4.4	4.3	70	1000
1-K22PA	7/32	550	5,000	97	15/15	139/280	1.8	14	4.4	4.3	55	1000
1-K22SP	7/32	300	5,000	89	15/15	139/280	1.8	14	6.6	4.3	50	1000
1-K22SX	7/32	400	5,000	88	15/15	139/280	1.8	14	6.6	4.3	46	1000
1-K22SZ	7/32	500	5,000	90	15/15	139/280	1.8	14	6.6	4.3	55	1000
1-K22SA	7/32	550	5,000	93	15/15	139/280	1.8	14	6.6	4.3	46	1000
1-F22RP	7/32	300	5,000	89	11/15	212/280	1.6	14	6.6	4.3	45	1000
1-F22RTZ	7/32	500	5,000	92	11/15	212/280	1.6	14	10	4.5	50	1000
1-N22SP	7/32	300	5,000	80	12/18	212/212	1.8	14	6.6	4.4	50	1000
1-N22SZ	7/32	500	5,000	93	12/18	212/212	1.8	14	6.6	4.4	58	1000
1-N22PA	7/32	550	5,000	94	18/18	110/212	1.8	14	3.5	4.3	52	1000
1-N25PP	1/4	300	7,200	120	12/18	280/280		16	4.4	3.5	50	1000
1-N32WP	5/16	300	11,000	185	12/18	434/434	1.3	17	3.5	2.0	50	1500
1-N32WX	5/16	400	11,000	184	12/18	434/434	1.3	17	3.5	2.0	48	1500
1-N32WZ	5/16	420	11,000	187	12/18	434/434	1.3	17	3.5	2.0	55	1500
1-N32WTZ	5/16	500	11,000	191	12/18	434/434	1.3	17	3.5	2.0	50	1500
1-N32WTA	5/16	550	11,000	192	12/18	434/434	1.3	17	3.5	2.0	45	1500
1-N38WP	3/8	300	14,000	253	12/18	600/600	1.0	20	3.5	1.5	40	1500
1-N38WX	3/8	400	14,000	252	12/18	600/600	1.0	20	3.5	1.5	35	1500
1-N38WZ	3/8	420	14,000	255	12/18	600/600	1.0	20	3.5	1.5	50	1500
1-N38WTZ	3/8	500	14,000	260	12/18	600/600	1.0	20	3.5	1.5	45	1500
1-N38WTA	3/8	550	14,000	262	12/18	600/600	1.0	20	3.5	1.5	35	1500
1-N42WP	7/16	300	19,500	318	12/18	776/776	0.7	23	3.5	1.2	40	1500
1-N42WZ	7/16	420	19,500	320	12/18	776/776	0.7	23	3.5	1.2	45	1500
1-N42WTZ	7/16	500	19,500	325	12/18	776/776	0.7	23	3.5	1.2	42	1500
4-H18RPX	3/16	300	3,300	61	18/18	72/139		14	24	6.8	40	300
4-H18RZX	3/16	420	3,300	62	18/18	72/139		14	24	6.8	50	300
4-H18RTZ	3/16	500	3,300	63	18/18	72/139		14	24	6.8	45	300
7-H25RP	1/4	300	7,200	110	18/18	139/280	2.0	18	25	3.7	70	300
7-H32RP	5/16	300	9,500	180	18/18	212/434	1.8	17	16	7.7	60	1000
7-H35RP	11/32	300	10,500	210	18/18	280/535	1.6	19	16	6.5	55	1000
7-H38RP	3/8	300	12,000	240	18/18	338/560	1.4	20	10.4	5.8	67	1000
7-H42RP	7/16	300	18,000	314	18/18	410/776	.85	23	10.4	1.3	58	1000
7-H42RX	7/16	400	18,000	313	18/18	410/776	.85	23	10.4	1.3	55	1000
7-H42RZ	7/16	500	18,000	317	18/18	410/776	.85	23	10.4	1.3	65	1000
7-H42RTZ	7/16	500	18,000	320	18/18	410/776	.85	23	10.4	1.3	60	1000
7-H42RA	7/16	550	18,000	321	18/18	410/776	.85	23	10.4	1.3	55	1000
7-J46RX	15/32	400	18,000	325	24/24	338/535	.80	20	10.4	1.2	40	1000
7-J46RTZ	15/32	500	18,000	332	24/24	338/535	.80	20	10.4	1.2	45	1000
7-J46RA	15/32	550	18,000	334	24/24	338/535	.80	20	10.4	1.2	40	1000
7-Q52RP	17/32	300	24,500	435	19/20	600/950		25	10.4	1.0	40	1000
7-Q52RTZ	17/32	500	24,500	442	19/20	600/950		25	10.4	1.0	45	1000

*P—Propylene Copolymer
X—Camlex
Z—Telzel

T—FEP Teflon
A—PFA

Office Memorandum

TO: Don Koelsch
FROM: Alessandro Bocconcelli
SUBJECT: B3S2 Shear Pin Requirements
DATE: November 25th, 1992

This is a summary of the wet weight calculations for the proposed B3S2 re-entry assembly. The total wet weight of the array determines the size and nature of the shear pin.

1 - Logging cable, 312.2 m.	256	lbs
2 - Ship cable (+ 1% for slack), 4462 m	8,066	"
3 - SIO thruster	1,500	"
4 - SIO sonde	1,800	"
5 - WHOI BIP	1,000	"
Total Estimated Wet Weight	12,622	lbs

Dave and Gary will send me more accurate weights for the sonde and the thruster in ten days.

According to M. Jordan, applications engineer at Rochester, the working load for a used .680 m. (dia) oceanographic cable should not exceed 20,000 lbs. If the pull at the sheave is over this peak load there exists a good possibility of damaging the copper conductors of the coax cable. The shear pin located at the sonde connector should then be rated for 7,000 Lbs. This can be accomplished by thinning out the logging cable at the sonde cablehead termination (leave eight inner wires and eight outer wires) or by modifying the cablehead design by introducing a shear pin system similar to the AMG connectors used for the LFASE project.

We should also consult with D.G. O'Brien and find out if they can provide an assembly with a molded cablehead connector at one end and a mating bulkhead receptacle with shear pin. The other end should be terminated on board in order to match the right depth of the hole. They built similar EM assemblies in the past and they were very successful.

cc: R. Stephen

Received: from igppqm.ucsd.edu
 received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.12/8.6.12) with
 ESMTP id NAA20430 for <rstephen@gannet.who.edu>; Wed, 10 Apr 1996 13:19:07 -0400
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) with ESMTP id NAA06595; Wed, 10 Apr 1996 13:15:48 -0400
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 id AA15303 to rstephen@who.edu; Wed, 10 Apr 96 10:15:37 PDT
 Message-Id: <n1382991154.2264@igppqm.ucsd.edu>
 Date: 10 Apr 1996 10:14:58 -0800
 From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 Subject: Re: 7-conductor cable
 To: "ralph stephen" <rstephen@who.edu>
 Cc: "Dave Willoughby" <ewing28@ewing.ldgo.columbia.edu>,
 "Frank Vernon" <vernon@yin.ucsd.edu>, "Fred Spiess" <fns@mpl.ucsd.edu>,
 jah@mpl.ucsd.edu, kpeal@who.edu, mgould@who.edu, rstephen@who.edu,
 "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 X-Mailer: Mail*Link SMTP/QM 3.0.0

Reply to: RE>>7-conductor cable

We have two 7-conductor logging cables. Both are terminated at the sonde end, but both are open at the BCU end. The 125 m cable is at IGPP and the 300m cable is at Pinon. Both cables are functional although, as noted, both are terminated at one end. While all my engineers are at sea right now, I'm not aware that we have any termination kits. Both should probably be reterminated at some point although this is hardly an emergency - since both cable are operating, we do have a spare if other problems develop.

 Date: 4/8/96 1:01 PM
 To: John Orcutt
 From: ralph stephen
 Received: by igppqm.ucsd.edu with SMTP; 8 Apr 1996 13:00:09 -0800
 Received: from localhost (localhost [127.0.0.1]) by gannet.who.edu (8.6.12/8.6.12) with SMTP id RAA20052; Mon, 8 Apr 1996 17:03:05 -0400
 From: ralph stephen <rstephen@who.edu>
 Message-Id: <199604082103.RAA20052@gannet.who.edu>
 X-Authentication-Warning: gannet.who.edu: Host localhost didn't use HELO protocol
 To: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 cc: rstephen@who.edu, "Frank Vernon" <vernon@yin.ucsd.edu>,
 "Dave Willoughby" <ewing28@ewing.ldgo.columbia.edu>, mgould@who.edu, kpeal@who.edu, fns@mpl.ucsd.edu (Fred Spiess), jah@mpl.ucsd.edu
 Subject: Re: 7-conductor cable
 In-reply-to: Your message of "08 Apr 96 10:36:23 -0800."
 <n1383162609.5795@igppqm.ucsd.edu>
 Date: Mon, 08 Apr 96 17:03:05 -0400
 X-Mts: smtp

John,

We have a total of three cables for the B3S2 operation. You have two and we have the third, which we plan to use on the OSN-1 deployment, here at WHOI. It was our intention to terminate the third cable when we were at sea, or shortly before sailing (after Fred's wiper trip), when we knew how deep the hole would be open and what depth we would put the sonde. The two you now have would be used as spares, if they are long enough.

Some useful depths:

Nominal depth of wet hole at PFO: 100m

Actual depth to top of sonde during October '94 PFO tests: 79m

Water depth: 4418m Below Rig Floor, 4407m below sea level, *
 Total depth of Hole 843B: 313.4m Below Seafloor, *
 Depth to Basement: 242.5m Below Seafloor, *
 Depth of casing: 251.5m Below Seafloor, *

Notes: On OSN-1 it would be nice to clamp the sonde within casing but below the level of basement (say 243m). Fred's packer needs to be in casing (say around 250m). One estimate of IGPP/MPL sonde length is 22feet6inches or about 7m.

* - from Leg 136 Initial Reports Volume, depths in hole will be confirmed by Fred's caliper run on the CV cruise.

Cable Summary (from memo of December 9, 1992):

- 125m length terminated one end, at SIO
- 300m length terminated one end, at SIO **
- third cable to be cut and terminated at both ends at sea, length about 240m, at WHOI

** this cable was used in October 1994 for the power tests at IGPP as well as some of the downhole tests at PFO

I have lost track of which cables at PFO were terminated at both ends during the PFO tests, were reterminated, were shortened, or were damaged. Based on your message I guess that the 300m cable was shortened a bit and reterminated by Matt last year and that this cable is now causing problems. You are now using the 125m cable which was the back-up. (The fact that this cable is only 125m long will be important if folks make power loss measurements on the cable. The power consumption of the sonde and the loss in the cable are still outstanding issues. See Ken's memo of April 3.) Are both cables at PFO now terminated at both ends? If so, in an emergency either cable could be turned over and the upper connector replaced with alligator clips.

The actual termination hardware could be a problem. Gearhard-Owens no longer makes the connector and at least some pieces must be machined from scratch. I do not know how many parts Matt has nor do I know how many pieces can be re-used from an old or damaged connector. I am trying to get through to Matt to resolve these issues.

We are trying to save our travel and salary money until the integration tests. ('Trips to San Diego' was one of the items that the reviewers suggested we cut back on.) Another option is for you to mail us just the old connector(s) and Matt could make up a new cable (a fourth one, say 300m long) using our supply here. We would only have to ship the cable one-way and it would save an airfare.

Another issue is what cables to use during the October dock tests and any over-the-side tests from Revelle prior to confirming the available depth in Hole 843B.

Ken has proposed a 'mini integration test' in July (his April 3 e-mail) and cable issues could be resolved then if it happens. Ken is still waiting for feed-back on this.

It would be a shame to lose testing time at PFO over cable issues and we agree that you should have a back-up cable to save time if your operating cable fails again. Can you give us more data? Specifically:

- 1) How many sets of cable termination hardware do you have and which cables (300m or 125m) are they on? Are the cables terminated both ends or one end

only?

2) Which cable is presently working?

3) What are the symptoms of the cable that is not working?

4) Could we combine a cable repair trip with a mini-integration test (see Ken's April 3 e-mail to Glen copied below)?

Regards, Ralph.

```
>Return-Path: John_Orcutt@igppqm.ucsd.edu
>Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu
>(8.6.12/8.6.12) with ESMTP id OAA20016 for <rstephen@gannet.who.edu>; Mon,
8
>Apr 1996 14:41:13 -0400
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<rstephen@who.edu>;
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gannet.who.edu
>(8.6.12/8.6.12) with ESMTP id OAA19951 for <ralphs@gannet.who.edu>; Mon, 8
Apr
>1996 14:41:10 -0400
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by
>UCSD.EDU (8.7.4/8.6.9) with SMTP id LAA27222; Mon, 8 Apr 1996 11:38:05 -0700

>(PDT)
>Received: from igppqm.ucsd.edu by igpp.UCSD.EDU (4.1/UCSDGENERIC.4)
> id AA12687 to ewing28@ewing.lldgo.columbia.edu; Mon, 8 Apr 96 11:38:02
>PDT
>Message-Id: <n1383162609.57955@igppqm.ucsd.edu>
>Date: 8 Apr 1996 10:36:23 -0800
>From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
>Subject: 7-conductor cable
>To: "Ralph Stephen" <ralphs@gannet.who.edu>
>Cc: "Frank Vernon" <vernon@yin.ucsd.edu>,
> "Dave Willoughby" <ewing28@ewing.lldgo.columbia.edu>,
> "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
>X-Mailer: Mail*Link SMTP/QM 3.0.0
>
>4/8/96 11:31 AM
>
>Ralph, as you're aware we had some difficulties with the 7-conductor logging
>cables. The cable we plan to use for the deployment (the one we used for
the
>joint IGPP/WHOI test last year) developed a short at the connector (Matt
>Gould determined and cut it off) and we've gone to the backup cable for our
>testing. At some point, this cable will need to be reterminated. There is
>no great rush about this (unless our standby cable develops a problem as we
>pull the instrument in and out of the hole), but is something that needs to
>be done. We could ship the whole thing back to WHOI at some point, but this
>is relatively expensive to do. The alternative would be to have someone at
>WHOI spend a day or two here to reterminate the cable and get it ready for
>sea. How do you want to deal with this?
```

```
*Return-Path: kpeal@hurdle.who.edu
*Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu
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3
*Apr 1996 15:55:44 -0500
*Received: from hurdle.who.edu (hurdle.who.edu [128.128.92.91]) by
```

3.3.1 Scholz 9/15/92

**Lamont-Doherty Geological Observatory | Palisades, N.Y. 10964
of Columbia University**

Cable: LAMONTGEO
Palisades New York State
TWX-710-576-2653

Telephone: (914) 359-2800

FAX: (914) 365-3182

**FAX Transmission
11 pages Total**

To: Alex Bocconelli
WHOI

Sept. 15, 1992

Re: Cablehead for OSN-1 Seismometer

Dear Alex,

When I first heard your application, I was a little concerned. Three months is considerably longer, obviously, than normal logging deployments. The more I think about it; however, the more I think it might work but special attention should be paid to the situation.

The Gearhart-Owen cablehead is the default for scientific prototypes. There are several other designs but typically these are much more involved. All designs that I am aware of rely on grease-block to prevent water invasion into the electrical connection.

I've attached a sketch of the GO type cablehead. Note on the body of the head, there is a 1/4"-20 set screw. The grease is normally pumped in here via a Zerk fitting, then the set screw is replaced. Above that point, the top sub threads onto the main body, capturing the rope socket. The rope socket is the mechanical connection from the armor to the cablehead.

Ordinarily we don't worry about it, unless the boreholes are high temperature but I think you may want to modify the cableheads slightly. First, you might consider replacing the set screw with a 1/16"NPT socket hex plug. Alternatively, you could use a screw fit with an O-ring under the head but then you'll need to machine a flat on the body. Next, I would use one of the Loctite seal/thread-lock compounds on the main thread and the upper set screw. Finally, I'd put a heavy shrink-tube over the spring. The idea is that usually you're only worried about water getting into the head itself but in a long deployment, water is likely to wick up into the inner core of the wireline. On Teflon wirelines, the inner core is completely surrounded by a neoprene jacket thus providing a secondary barrier. Theoretically, the only

opening in that jacket is at the ropesocket connection. If the volume up past the rope socket is completely filled with grease, integrity should be better.

We use a special version of the cablehead for high temperature service. The main difference is that the body is extended from approx. 3 inches to 6 inches. The extra length allows a longer path for the water through a grease. While your application is not Hi-T, you may want to use the longer body anyway, just for the excess grease.

Typically, we use the Dow-Corning #112 for greasing the head. DC #111 will do in a pinch but is not as thick as #112. Both are virtually insoluble in water. We stock #112 on the ship if you need some. For Hi-T work we use one of the Dupont Krytox grease which, for one thing, is significantly denser than water but I think the #112 will do for your application.

Wirelines: The standard wireline onboard the ship is the Vector 746-P and the Vector 746-NA, polyprop. and Teflon respectively. Both are 15/32" and seven conductor. I'm assuming your cable is similar, see attached specs. If so, I would recommend using the Teflon as apposed to the poly. The inner core design is better on the Teflon because it is molded neoprene rather than the fiber wrapped poly. Also the conductor insulation is less likely to deteriorate. I've noticed that the poly insulation tends to crack easily especially on older drums. Appears to be oxidation damage.

Finally, the suppliers below do not sell the tool end of cablehead beyond the electrical connector. Your machine shop will need to build it in but the design is fairly simple. The two suppliers are Comprobe and Mineral Logging systems. Of the two, I prefer the Mineral Logging product, also they are the only manufacturer of the extended body (reference the Sandia design). Mineral sells two versions of the tool connector, plastic and fiber. The later is intended for Hi-T but we use it exclusively because it's more rugged. Don't let them sell you the Hi-T connector for the cablehead end, you don't need it and it's ridiculously expensive.

The part number for the tool connector at Mineral is #06-9715-200.

Mineral Logging Systems, Inc.
8821C Forum Way
P.O. Box 40498
Fort Worth, TEXAS

76140

☎ 817-293-1777   Attn: Lonnie Wyatt

Comprobe, Inc.
9632 Crowley Rd.
Fort Worth, TEXAS 76134

☎ 817-293-7333 Attn: Lynn Gray Breaux

At any rate, I hope the above is useful. I maybe a bit overzealous but it would be awfully disappointing to not get good data on account of a fouled wireline. If we can be of any further assistance on this or any other matter concerning your deployment, please feel free to contact myself or my counterpart, Frank Filice, at ☎ 914-359-2900 ext. 733 or 734 respectively. Fax 914-365-3182 or E-mail "Erich@Lamont.LDGO.Columbia.EDU".

Thank you

Erich Scholz

Enclosure: Gohead, Go Assm, Vector

cc: Goldberg, Rodway, Filice, file

END

LEHEADS/CCL'S
CE 8-a / 1977

THIS PAGE SUPERCEDES CABLEHEADS/CCL STAGE 8-1977

1-1/2" O.D.

MULTI-CONDUCTOR CABLEHEAD ASSEMBLIES (Cone Type)

ALLOY STEEL, 7-CONDUCTOR CABLEHEAD ASSEMBLY (COMPLETE)

15/32" Cable, 04-9703-00
3/8" Cable, 04-9703-01
5/16" Cable, 04-9703-02
3/16" Cable, 04-9703-03
9/16" Cable, 04-9703-04
7/16" Cable, 04-9703-05

STAINLESS STEEL, 7-CONDUCTOR CABLEHEAD ASSEMBLY (COMPLETE)

15/32" Cable, 04-9600-00
3/8" Cable, 04-9600-01
5/16" Cable, 04-9600-02
3/16" Cable, 04-9600-03

COILED SPRING (Alloy)

For 5/16", 3/8", 15/32", 9/16" & 7/16" Cable
04-9703-28

For 3/16" Cable, 04-9703-29

COILED SPRING (Stainless)

For 5/16", 3/8", 15/32" & 9/16"
04-9703-28

For 3/16" Cable, 04-9703-29

WASHER

3/16" CABLE - 04-9703-52

5/16" CABLE - 04-9703-51

3/8" CABLE - 04-9703-50

9/16" & 15/32" CABLE - 04-9703-49

STINGER OR TOP SUB (Alloy)

15/32" Cable, 04-9703-36

3/8" Cable, 04-9703-37

5/16" Cable, 04-9703-38

3/16" Cable, 04-9703-39

9/16" Cable, 04-9703-40

7/16" Cable, 04-9703-41

(Stainless Steel)

5/16" Cable, 04-9600-32

3/8" Cable, 04-9600-31

15/32" Cable, 04-9600-30

CONE

15/32" Cable, 04-9703-43

3/8" Cable, 04-9703-44

5/16" Cable, 04-9703-45

3/16" Cable, 04-9703-46

9/16" Cable, 04-9703-47

7/16" Cable, 04-9703-48

SLEEVE, CONNECTOR

04-9703-27

CABLEHEAD SLEEVE (Alloy)

04-9703-23

CABLEHEAD SLEEVE (Stainless Steel)

04-9600-22

FEMALE PIN CONNECTOR (7 Pin)

(For 7-Conductor Cable)

04-9715-15

THREAD PROTECTOR

04-9703-21

GUP
15/32", 3/8", 5/16", 3/16", 7/16" Cable
04-9703-24

9/16" Cable, 04-9703-25

SET SCREW (Socket Head)

1/4-28 x 1/4" LONG

15-1606-83

SET SCREW

(Socket Head)

1/4 - 20 x 3/16 Lg.

15-1606-80

INSULATING BOOT

15/32" & 9/16" Cable, 04-9703-31 (Orange)

5/16" & 3/8" Cable, 04-9703-32 (Black)

7/16" Cable, 04-9703-35 (Green)

"VITON" (70 Duro)

"O" RING

15-5681-13

"VITON" (70 Duro)

"O" RINGS (2 Required)

15-5681-16

QUICK-CHANGE COLLAR (Alloy)

04-9703-22

QUICK-CHANGE COLLAR

(Stainless Steel)

04-9600-21

Seven Conductor Wireline Cable

Cable Type	Cable OD	Part Number	Inner Armor	Outer Armor	Insulation Material	Conductor AWG	DCR O/KFt	Armor DCR O/KFt	Capacitance pF/Ft	Maximum Temp. (° F)	Weight Lbs/KFt	Strength Lbf	Break
3/8"	0.395"	A10331	20X0.033"	24X0.042"	P	20	10.9	1.6	56	300	270	13,600	
	0.365"	A10182	17X0.041"	23X0.044"	Z	20	10.9	1.6	68	410	281	13,600	
7/16"	0.427"	A20081	18X0.042"	18X0.059"	P	20	10.9	1.2	55	300	325	16,500	
	0.427"	A20170	18X0.042"	18X0.059"	V	20	10.9	1.2	51	400	324	16,500	
	0.427"	A20101	18X0.042"	18X0.059"	Z	20	10.9	1.2	63	430	329	16,500	
	0.427"	A20134	18X0.042"	18X0.059"	TA	20	10.9	1.2	40	550	338	16,500	
1 1/32"	0.464"	A20009	24X0.038"	24X0.049"	P	20	10.9	1.2	40	300	336	16,700	
	0.464"	A20142	24X0.038"	24X0.049"	V	20	10.9	1.2	37	400	336	16,700	
PFA	0.464"	A20058	24X0.038"	24X0.049"	NA	20	10.9	1.2	55	500	349	16,700	
FEB	0.464"	A20007	24X0.038"	24X0.049"	PT	20	10.9	1.2	55	450	349	16,700	
	0.464"	A20184	24X0.038"	24X0.049"	Z	20	10.9	1.2	58	400	357	15,700	
	0.464"	A20059	24X0.038"	24X0.049"	HT	20	10.9	1.2	56	300	352	18,500	
High Strength 1 1/32"	0.520"	A20240	17X0.038"	23X0.052"	P	20	10.9	0.9	42	300	448	23,400	
	0.520"	A20247	17X0.038"	23X0.052"	HT	20	10.9	0.9	37	400	451	23,400	
1 1/32"	0.520"	A20248	17X0.038"	23X0.052"	HT	20	10.9	0.9	57	450	457	23,400	

Ten Conductor Wireline Bridge Cable

Ten Conductor Wireline Bridge Cable												
Cable Type	Cable OD	Part Number	Center stress member	Cable Sheath Material	Insulation Material	Conductor AWG	DCR Ω/kFt	Voltage rating V. rms	Capacitance pF/Ft	Maximum Temp. (°F)	Weight Lbs/kFt	Break Strength Lbf
High temperature bridge	0.810"	B41032	9/32"	Nitrile rubber	Teflon	21	45	600	45	450	418	11,000
Gas resistant bridge	0.810"	C41005	9/32"	Polyurethane	Teflon	21	45	600	40	250	399	11,000

of the

regional cable

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from conduct with

Principles of

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TITLE NOT EXTENDED

Conductor Wireline Bridge Cable

Ten Conductor Wireline Bridge Cable												
Cable Type	Cable OD	Part Number	Center Wire member	Cable Sheath Material	Insulation Material	Conductor AWG	DCR %/Ft	Voltage rating V. rms	Capacitance pF/Ft	Maximum Temp. (° F)	Weight Lbs/1000 Ft	Break Strength Lbs
High temperature bridge	0.810"	B41032	8/32"	Nitrile rubber	Teflon	21	45	600	45	450	418	11,000
Gas resistant bridge	0.810"	C41005	8/32"	Polyurethane	Teflon	21	45	600	40	250	399	11,000

7-46 P WIRELINE CABLE

SCALE: 10/1

.464 CABLE DIA.
(AFTER PRESTRESS)

APRIL 3, 1989

BY: AJS

APRIL 3, 1989

BY: AJS

CABLE REHEADING INSTRUCTIONS 1-1/2" O.D. Seven Conductor Cone Type Cablehead.

STEP 1 - OPTIONAL. Tape cable about 3' from end. Taper off cable by cutting a few outer strands progressively shorter fitting them back into lay of armor. Then remove tape.

STEP 2. Install spring on sub. Slide sub assembly, cup and cone on end of cable taking care to face them in proper direction.

STEP 3. Tape cable again 12" from end between cone and cup. Place taped cable in vise and slide cone to top of vise.

STEP 4. Unwind outer strands of the cable. Bend down 90° at top of cone taking care to uniformly space and cut to 6" lengths. Unwind four inner strands equally spaced around the cone and do likewise.

STEP 5. Loosen vise - remove tape below cone and raise cable about 2". Replace cable in vise and cut unwanted outer strands 1/4" below 90° bend.

STEP 6. Loosen vise and lower cable until cone returns to bent wires and tighten vise. Bend all wanted wires down around cone as far as practicable taking care to uniformly space.

EP 7. Lock cup in vise and work ends of wires into cup. It helpful to cut some of last wires a little shorter to stagger problem of stabbing them into the cup.

STEP 8. Work wire strands through cup until cone and strands are seated in cup. Do not allow any strands to be crossed in cup. Slide washer down over inner armor and tap washer with hammer to further seat cone.

STEP 9. Move cable up in vise and file a notch in all strands as close to bottom of cup as practicable and bend them back and forth until they break.

STEP 10. Notch inner strands with corner of file $3/8''$ above washer to weaken them for breaking.

STEP 11. Unwind inner strands and bend them back and forth until they break at filed notch.

STEP 12. Bend $3/8''$ ends down with long nose pliers and cut off as short as practicable. This protects insulated conductors from puncture damage.

EP 13. Tape exposed ends of inner armor and insulated conductors up $1/2$ " from washer. Use knife to carefully peel (do not cut) away fabric insulation from conductors immediately above tape.

STEP 14. Remove fabric insulation to top of tape. Separate plastic covered conductors.

TEP 15. Coat plastic insulation with No Gall (48-3051-25). Thread conductors through neoprene boot in same order they appear in cable.

STEP 16. Slide boot down to tape. Cut conductors off $2-3/4$ " above washer, strip insulation back $1/8$ " from conductor ends and tin with solder.

STEP 17. Solder tinned conductor ends to female connector starting with connector pin marked by red dot and color coded conductor. Connect remaining conductors to pins in sequence according to lay of cable.

STEP 18. Coat conductors with No Gall (48-3051-25). Slide neoprene boot upward and over lip of connector.

STEP 19. Split sleeve and open it up as much as necessary to slide over conductors. After sleeve has been opened, smooth cut areas with a file. Slide each conductor through split in sleeve continuing until all conductors are inside of sleeve and close sleeve back together being careful not to pinch insulation or boot. Secure boot on connector fully insulating conductor pins. Use an ohmmeter to make continuity and leakage check.

STEP 20. Slide sleeve upward and over lower end of boot then grasp connector and sleeve assembly and coil excess wire within sleeve until sleeve rests on washer.

STEP 21. Slip quick change nut over body with interior threads up. Place body over female connector with body key aligned to red dot on connector.

STEP 22. Turn assembly upside down and clamp body in vise. Hold cable tightly in hand to prevent rotation and screw sub to body making up tight with 12" pipe wrench. Use Allen wrench to lock sub to body with 1/4-20 set screw.

STEP 23. Remove 1/4-28 set screw from body and replace with grease fitting. Fill cavity completely with No Gall® using any standard grease gun. Remove grease fitting and replace 1/4-28 set screw.

When conductors are rubber insulated instead of plastic insulated substitute DC-3 lubricant for No Gall (48-3051-25). The latter will cause rubber to deteriorate.

Tolerances		Angles	
Fractions	Decimals		
Material		SS 316	
DATE	10-2-92	DRAFT	A. BOCCONCELLI
PROJ. NO.	81894-3.03	APPVD	
SCALE	FULL	REV.	

Woods Hole Oceanographic Institution
Ocean Systems & Moorings Lab
Ocean Engineering Dept.

CABLEHEAD ASSEMBLY FOR
TESTER DIA. WELL LOGGING CABLE
- STRAWMAN (CROSS SECTION)

DWG. No. 185-1 REV. 1 of 1

APPROVED
VERSION

Office Memorandum

TO: Don Koelsch
FROM: Alex and Matt
SUBJECT: B3S2 Shear Pin Requirements
DATE: January 8th, 1993

Three cablehead terminations for the 15/32" logging cable were tested at the tensile machine to verify their ultimate breaking strength ("shear pin").

The method used to achieve the desired "shear pin" = 3,000 Lbs was the one suggested by Frank Filice at Lamont-Doherty. The cable was terminated following the standard procedure but only six wires of the outer layer were actually terminated inside the cup/cone assembly. By doing so the estimated breaking strength was of 3,210 Lbs. The test results are as follows:

Sample 1 broke at: 3,350 Lbs
Sample 2 broke at: 3,200 Lbs
Sample 3 broke at: 3,330 Lbs

After the cable broke inside the termination it pulled out with very little effort.

We are also planning to deploy one termination in the well for one month and then test it at the tensile machine, this should give us a good idea how eventual corrosion affects termination strength.

3.4.1 Koelsch 25/9/92

MEMORANDUM

To: Dave Willoughby
From: Don Koelsch
Re: Signal organization on the BIP to BBS cable revisited.

Enclosed find diagrams on the latest thoughts on the conductor use of the seven conductor cable. The actual pin numbers are not important except we both must agree on them before construction is completed. Note that we propose to multiplex the 4800 baud data up link with the power down to the 54000 on the same wire. This frees up a conductor allowing the video with power for the lights and camera to have a pair of dedicated wires. MPL can then run their power system with a sea water return without forcing the same constraint on the BIP and the BBS, an important factor when designing for a long deployment. All power from the surface to the Broad Band Borehole Seismic System will be isolated by DC to DC converters (or AC to DC power supplies) in the MPL module in the BCU.

Power to the 54000 would be applied through a latching relay in the BBS controlled by commands originating from the ship (IGPP operators station) through the REF TEK. The REF TEK would measure and confirm the presence of the 54000 power. This system REF TEK power can be cycled to do a 'power on reset (POR)' without interrupting seismometer power.

We believe that the physical layer of EIA 485 can maintain the 2400 baud communications link over the 300 meter long cable. The protocol will be SAIL (half duplex) which has the ability to independently addresses each system. Talkers include surface, BCU, and the BBS.

One of the outstanding issues that have to be determined soon is how is the software clock in REF TEK set and checked. This a possible stumbling block that needs to be settled soon so we can design circuits and write software.

copies:

<u>SIO\IGPP</u>	<u>SIO/MPL</u>	<u>WHOI</u>
J. Orcut	F. Speiss	R. Goldsborough
	R. Zimmerman	K. Peal
	T. Boegerman	R. Stephen

7 conductor cable to BIP

Woods Hole Oceanographic Institution

Woods Hole, MA 02543

Don Koelisch

Title

Simplified Sonde Block Diagram

Size Document Number

SMPLBLK8

Date: September 25, 1992 Sheet 1 of 1

REV

1

MEMORANDUM

To: Dave Willoughby
From: D. E. Koelsch *Don*
Re: Cable interface allocations.

Date: March 9, 1993

Enclosed are the revised diagrams which reflect the concerns that you, Glen, and MPL had. This implementation provides for a full duplex 2400b link to the sonde so long as the video system is off. It, also places the 1 PPS timing signal on a separate dedicated conductor to assure noise free pulses. Glen is concerned about spurious pulses causing confusion in the timing phase lock loop in Ref Tek. Note that to give MPL maximum copper for the video/lighting system there are three conductors (3, 4, and 5) in parallel whenever video power is applied.

Mass centering power would be obtained when MPL turns on the -50 Vdc. This voltage transfers conductor #5 to the -50 Vdc which in turn powers the 50 V to 28 V isolated DC to DC converter. This provides the extra power for the mass centering and leveling motors. The video power and mass centering power can not be on at the same time but I don't believe this is a bad constraint.

The other feature is the DPDT latching relay in the sonde controlled by the Ref Tek. It would turn the 54000 power on or off as directed. Once in the desired state, indicated by the power sense contact, it requires no additional power.

We believe this instrumentation will, with the addition of two specialized test chassis, allow us to operate, and deploy the system; and test independently the major sub-systems. Ken and I are writing a document to define how communication links and data flow would be routed for each phase of the program. We hope to get this out within the next week.

copy: T. Boegeman - SIO/MPL
G. Offield - SIO/IGPP
J. Orcutt - SIO/IGPP
K. Peal - WHOI
F. Spiess - SIO/MPL
~~R. Stephen~~ - WHOI
D. Willoughby - SIO/IGPP
R. Zimmerman - SIO/MPL

7 conductor cable to BIP

7 conductor cable
to BBS

Woods Hole Oceanographic Institution
Woods Hole, Ma 02543
Don Koelach

Title: Simplified BIP Block Diagram BBS
Size: Document Number: SMPBLK1.ROB
Date: March 4, 1983 Sheet 1 of 1
REV 8

3.4.3 Koelsch 4/15/94

Woods Hole Oceanographic Institution

Woods Hole, MA 02543

Phone: (617) 548-1400

Telex: 951679

Don Koelsch

April 15, 1994

Vince Palvachek
Marine Physical Lab.
291 Rosecrans
Bldg. 4, Bayside
San Diego, CA 92106

Re: High power requirements for the TV & light system.

Vince:

After thinking about your concerns about having to get 500 watts of power down to the Borehole Reentry Guide (BRG) I've come up with a possible solution. See the enclosed diagram. This hinges on you supplying -24Vdc to power the cable transfer relays. Note diodes protect and isolate the relay coils from the communication signals. Relay power would be applied at a minimum of 0.2 seconds before the BRG main power is applied. This gives the relays time to settle down and would not require the relays to switch high DC voltage at high currents that power the BRG. Conversely The high power would be turned OFF before the relays are deenergized.

I have been unable to find a 6PDT relay that has high enough contact ratings. Therefore, I suggest using 2 Aromat SP4-DC24 4PDT units at each end of the cable. They have ample contact ratings and only require 300 milliwatts of coil power for each relay. The contacts are rated at 300 watts each which seems like a bit of overkill. Perhaps you can locate a 6PDT unit-- there is still time to change. If you decide to split the functions of the conductors please keep in mind that although the cable is rated at 500 Volts I'd prefer not to push it any harder than 300 Volts.

Let me know what you think of this system when you get back from sea. This change shouldn't impact what Dave Willoughby has done but we will all must agree before any changes are made,

We still have the MPL control chassis that resides in the BCU. Let me know when you will require this and we will strip it out of the BCU and send it to you. Right now we are testing the rest of the system running through that chassis and until you actually need we would to keep it while debugging the main system.

On another subject. Concerning the communications protocol from the ship to the thruster and BCU, we are planning on a full duplex 2400 baud link using 7 bits plus even parity. You would use 7 bits plus odd parity. This is the system that was used on LFASE (actually Tony's idea).

Regards,

Don
Donald E. Koelsch

cc. Dave Willoughby, SIO/IGPP
Ken Peal WHOI
Ralph Stephen WHOI

Feb.21, 1996

**BROAD-BAND BOREHOLE SEISMIC SYSTEM (B³S²)
7-CONDUCTOR E/M CABLE INTERFACE DEFINITION, VERSION 7.0**

This document delineates what I believe to be the current version of the interface between the WHOI Bottom Instrumentation Package (BIP) and the IGPP Broadband Borehole Sensor package. This version is based on the notes on Woods Hole's "Sonde Communication Board" schematic dated October 19, 1993. The assignment of the wires in the E/M cable/connector assembly is as follows:

1. 4800 BAUD DATA UPLINK & 24V. DAS & SENSOR POWER
2. GND
3. 2400 BAUD COMM. LINK UP (SONSND) & MPL VIDEO & LIGHT POWER.
4. 2400 BAUD COMM. LINK DOWN (SONRCV) & MPL VIDEO & LIGHT POWER.
5. -50 V. FOR SONDE BOOSTER POWER CONVERTER, OR MPL VIDEO & LIGHT POWER.
6. 1 PPS FROM BIP TO SONDE.
7. COMMON
8. EARTH (SEAWATER GND). (Pin 8 on bulkhead connector = E/M cable shield)

Annotations:

1. 4800 BAUD DATA UPLINK & REF. TEK. POWER. Is this still EIA-485? Maximum current for this power line is ≤ 600 mA without external boost from converter (measured 2/16/96, with all locking motors running, but without either holelock solenoid activated.) Maximum voltage is about 30 volts at the sonde. Can this be turned off when the MPL VIDEO & LIGHT system is active to minimize noise contamination of the video signal?
2. GND. Which ground is this? EARTH (8) or COMMON (7)? Note that seawater ground and system common get tied together when MPLVIDEO & LIGHT POWER is applied.
3. 2400 BAUD COMM. LINK UP (SONSND) & MPL VIDEO & LIGHT POWER. This line is switched; when the relay operated by line 5 is active, it serves to provide an additional wire for MPL VIDEO & LIGHT POWER. Is the 2400 baud still FSK? Where is it converted from 5-volt logic to FSK?
4. 2400 BAUD COMM. LINK DOWN (SONRCV) & MPL VIDEO & LIGHT POWER. Similar to above except opposite direction of signal flow.
5. -50 V. FOR SONDE BOOSTER POWER CONVERTER, OR MPL VIDEO & LIGHT POWER. As presently configured, a 50-volt relay connected to this line switches lines (3), (4) and (5) to connect to the MPL VIDEO & LIGHT system when +50 volts is applied to line (5). When -50 volts is applied, it is fed to the SONDE BOOSTER POWER CONVERTER.

MPL had originally intended to use +50V to supply their re-entry package video, lights and pressure sensor at the bottom of the sonde. They would now prefer to use 220VAC instead. There are at least a couple of ways to modify the WHOI Sonde Communication Board to accomodate this. The simplest involves using the existing 50-volt relay (K1) on this line, and applying 220 VAC to only lines (3) and (4) to power the MPL VIDEO & LIGHT system when +50 volts is applied to this line. This would require separating CABLE 5 from pins 8 and 9 of K1. L2 could also be replaced with a jumper, and D2 and C2 eliminated.

Alternately, a 220-volt AC relay could be substituted for the 50-volt relay, allowing line (5) to be used to transmit the 220VAC along with lines (3) and (4). This would also require protection circuitry between this line and the SONDE BOOSTER POWER CONVERTER. In either case, a 6-volt (approx.) zener diode should be added between Vcc and GND (D8 anode to D9 cathode); with the existing protection consisting of D8 and D9, an overvoltage could just be passed along to Vcc, rather than being pulled down to Vcc.

6. 1PPS FROM BIP TO SONDE. The 1 Hz pulse is used to keep the Ref Tek DAS in the sonde synchronized with the SeaScan clock in the BIP.
7. COMMON. System return for DAS and sensor. Connected to EARTH (8) when MPL VIDEO & LIGHTS are operational.
8. EARTH. Shield and seawater ground for MPL VIDEO & LIGHTS.

Received: from aqua.who.who.edu (aqua [128.128.16.1]) by gannet.who.who.edu (8.6.12/8.6.12) id RAA07698 for <rstephen@gannet.who.who.edu>; Fri, 23 Feb 1996 17:25:22 -0500
 Received: from hurdle.who.who.edu (hurdle [128.128.92.91]) by aqua.who.who.edu (8.6.11/8.6.11) with ESMTTP id RAA16318; Fri, 23 Feb 1996 17:22:07 -0500
 Received: (from kpeal@localhost) by hurdle.who.who.edu (8.6.12/8.6.9) id RAA05965; Fri, 23 Feb 1996 17:17:40 -0500
 Date: Fri, 23 Feb 1996 17:17:40 -0500
 From: Ken Peal <kpeal@hurdle.who.who.edu>
 Message-Id: <199602232217.RAA05965@hurdle.who.who.edu>
 To: john_orcutt@igppqm.ucsd.edu, rstephen@who.who.edu, richard@mpl.ucsd.edu, glen_offield@igppqm.ucsd.edu
 Cc: dwilloughby@ucsd.edu, rgoldsborough@who.who.edu
 Subject: OSN borehole video/power question

Gentlemen:

23 Feb 96

To help get good video there are two changes being discussed:

- use 110 VAC power
- minimize sources of crosstalk on the cable.

To make the change to using AC power, I suggest the following:

- zero volts on cable 5 is the idle condition so that cables 3 and 4 assume their default allocation
- negative 50 volts on cable 5 is fed through on cable 5 to the booster supply for the Teledyne motors
- positive 50 volts on cable 5 switches relays in the BCU and in the sonde to reallocate cables 3 and 4 to carry the MPL video and power
- after the relays are switched, MPL video and power can be applied and are carried by cables 3 and 4
- cable 5 does not carry the MPL video and power.

Note that it is necessary to turn on the positive 50 volts then delay (say a second) before turning on the AC power. This will ensure that both relays switch thus avoiding damage to the circuitry in the BCU and sonde. It appears that there may have been a race problem with the previous design and this should avoid it. Richard, is a delay like this acceptable?

To minimize crosstalk, we can reallocate cables 3 and 4. At present they carry the 2400 baud communication (up and down). I suggest that we change cable 3 to be 4800 data (currently cable 1) and cable 4 to be 1 PPS (currently cable 6). With these changes, the two noise sources will be disconnected during video operation. Note that the DAS starts a 3 hour timeout when the 1 PPS stops which leads to locking the Teledyne. When the video is running I presume we are not unlocked but Glen needs to determine if this is problem.

We can also rework the wiring to be sure it is suitable for this use.

Comments? ... kp

al@hurdle.who1.edu

received: from aqua.who1.edu (aqua [128.128.16.1]) by gannet.who1.edu (8
 ESMTTP id MAA09329 for <rstephen@gannet.who1.edu>; Fri, 1 Mar 1996 12:44:36 -0500
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 ith ESMTTP id MAA09840; Fri, 1 Mar 1996 12:41:14 -0500
 Received: (from kpeal@localhost) by hurdle.who1.edu (8.6.12/8.6.9) id MAA08352; Fri, 1 Mar
 1996 12:36:53 -0500
 Date: Fri, 1 Mar 1996 12:36:53 -0500
 From: Ken Peal <kpeal@hurdle.who1.edu>
 Message-Id: <199603011736.MAA08352@hurdle.who1.edu>
 To: dwilloughby@ucsd.edu
 Cc: glen_offield@igppqm.ucsd.edu, john_orcutt@igppqm.ucsd.edu,
 rstephen@who1.edu, rgoldsborough@who1.edu
 Subject: 7 conductor cable allocation

Dave et al:

1 Mar 96

The allocation of the 7-conductor cable now and after the
 proposed change is shown below.

Present configuration

(assumes MPL uses +50V for video and light power)

Conductor	function cable5=0 or -50V	function cable 5=+50V
1	4800 baud up	4800 baud up
2	28V power down	28V power down
3	2400 baud up	MPL video+power
4	2400 baud down	MPL video+power
5	0 or -50V	MPL video+power
6	1 PPS down	1 PPS down
7	Ground	Ground
armour	Ground	Ground

After proposed change

(assumes MPL uses +50V to control relay switch and a higher
voltage for video and light power)

Conductor	function cable5=0 or -50V	function cable 5=+50V
1	2400 baud up	2400 baud up
2	28V power down	28V power down
3	4800 baud up	MPL video+power
4	2400 baud down	MPL video+power
5	0 or -50V	+50V
6	1 PPS down	1 PPS down
7	Ground	Ground
armour	Ground	Ground

Notes:

1. The armour and ground are connected in the SCU which is the small pressure case on the WHOI frame where the 7 conductor cable converts to DG Obrien to enter the BCU.
2. The -50V turns on an additional DC-DC converter in the sonde to power the Teledyne motors.
3. 4800 baud is seismic data from DAS.
4. 2400 baud up is sonde send.
5. 2400 baud down is sonde rcv.
6. Another proposed change will increase the nominal 28V power

3.5.1 Koelsch 3/1/93

Woods Hole Oceanographic Institution
Department of Geology & Geophysics

Memorandum

To: Distribution
From: D. Koelsch
Date: March 1, 1993
Subject: B3 S2 Block Diagram

~~~~~

Enclosed is the block diagram and artist's sketch of the WHOI BIP as we see it and as agreed at our December meeting.

Distribution:

J. Orcutt - SIO/IGPP
F. Spiess - SIO/MPL
R. Stephen - WHOI
F. Vernon - SIO/IGPP
D. Willoughby - SIO/IGPP
R. Zimmerman - SIO/MPL

/kl

Woods Hole Oceanographic Institution	
Dept. of Applied Physics and Engineering	
Woods Hole, MA 02545	
DDO K021SCH	
Title	
Bottom Instrument Package, Block Diagram	
Size	B
Document Number	BIP-BLK.SCH
REV	1
Date	JANUARY 4, 1993 Sheet 1 of 1

UNIVERSITY OF CALIFOR

3.6.1 Willoughby 10/26/93

107

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INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS
SCRIPPS INSTITUTION OF OCEANOGRAPHYLA JOLLA, CALIFORNIA 92093-0225
FAX (619) 534-6354

Date

FAX TRANSMITTAL

TO:

FROM:

DON KOELSCHDAVID WILLOUGHBYW.H.O.I.

Scripps Instn. Oceanography, IGPP

(508) 548-1400, X2249

Univ. of California, San Diego

FAX (508) 457-2194

La Jolla, CA 92093-0225

Phone: (619) 534-2213FAX: (619) 534-5332FAX contains this cover page and 3 additional page(s).

=====

108

108

TO: DON KOELSCH, KEN PEAL, WHOI
FR: DAVID WILLOUGHBY, UCSD/SIO/IGPP
RE: WHOI I/O BOARD

I enclose a simple outline for the WHOI I/O board per our conversation of last week, along with a cross-sectional view of the pressure case showing the rails to which it will be mounted. Any "tall" components should be mounted away from the edge to clear the 60° clearance line shown on the cross-section.

A couple of other items:

- (1) My notes indicate that the connection between the Ref Tek DAS and the WHOI I/O board will be via 20-pin IDC header. Could you send me a pinout when you have it?
- (2) For the "full up" test next year, the 7-conductor electro-mechanical cable will have to be terminated somehow at the upper (BIP) end. How do you want to handle this?

LENGTH AS REQUIRED, NOT TO EXCEED 12"

NOTE: COMPONENTS NOT TO
PROTRUDE MORE THAN 1-1/2"
ABOVE OR BELOW CIRCUIT BOARD

UCSD, IGPP 0225
La Jolla, CA. 92093-0225

B³S²

DRAWN BY D.F. WILLOUGHBY

DATE OCT. 25, 1993

DRAWING
NUMBER

9005

OCEAN BOTTOM SEISMOLOGY
TITLE
W.H.O.I.
INTERFACE BOARD

UCSD, IGPP 0225 La Jolla, CA. 92093-0225		OCEAN BOTTOM SEISMOLOGY	
SIO IGPP		TITLE	
Tolerances +/- (unless specified) x/x .x .xx .xxx angular 1/64" .1" .01" .005" 1deg		Pressure Case Cross Section	
DO NOT SCALE THIS DRAWING		DRAWING NUMBER	
DRAWN BGBH/DFW		2018	
DATE August 1, 1993		SCALE 1/2 FULL	

Need 25.76 kWh
 $(63 \text{ string}) \left(\frac{65 \text{ cells}}{\text{string}} \right) \left(\frac{10 \text{ AH}}{\text{cell}} \right)$
 (1.25 V/mm)
 $= 22.05 \text{ kWh}$

Layout for alkaline 'D' cells in a 10" ID case
 Broad Band Borehole Seismic System
 Power Supply

Need 25,76 kWh

calculation check

(40 strings) (5 cells/string)

(20 kWh) (3.5 V/mv)

= 22.4 kWh

(48 strings) (5 cells/string)

(20 kWh) (3.5 V/mv)

= 26.88 kWh

cost for

48 strings

\$18,480

from 45/cell

+ 200 assembly cost/module

\$15,440/module

32 Cells & 5 blanks
Configuration #1

Notes:

1. Two cases could contain 48 strings, but calculations indicate only 40 strings⁶⁰ are necessary for a 90 day deployment. So we would only populate 5 modules per case.
2. The weight of the cells is 77 lbs.
3. The weight of the case is 190 lbs.
4. The combined weight in air is 267 lbs.
5. The combined weight in water is 92 lbs.
6. The estimated cost of making 10 modules is \$ 15,600.

Layout for lithium 'DD' cells in a 10" case
Broad Band Borehole Seismic System
Power Supply

Kaliph Stephen

3.8.1 Willoughby 10/22/92

**BROADBAND BOREHOLE SEISMOMETER
MEETING AT SIO
October 22, 1992
Notes by D. Willoughby**

On October 22, representatives of the three SIO groups involved in the Broad Band Borehole Seismic System (IGPP OBS, IGPP Broadband Seismometry and MPL Thruster) met to discuss various aspects of the project.

- **Sonde to be set on the bottom of the hole.** We essentially finalized the decision to put the sonde in the bottom of the hole rather than try to suspend it in the cased part. Ideally, we would grout or permanently lock a sleeve into the bottom of the hole, into which the seismometer would then be locked. The technique for doing this has not been established, however, and needs further discussion and closer examination.
- **Weak link at the sonde.** Previously, we had discussed using a 10,000 lb. shear pin to separate the BIP from the sonde if the sonde became lodged in the hole. However, this would require excessive force at the surface ($\approx 10,000$ lbs. of cable and equipment + 10,000 lbs. to break the pin.) MPL personnel suggested that a shear pin with a breaking strength of about 4,000 lbs. (about twice the maximum estimated weight of the sonde) would be adequate to protect against accidental breakage and would reduce the force required at the surface to within acceptable limits.

It was also suggested that the shear pin be placed at the upper (BIP) end of the cable between the BIP and the sonde, with the end of the cable attached to an assembly that would rest in the re-entry cone after breaking the pin, to facilitate attempted recovery of the sonde at a later date.

- **Sonde pressure case and "Re-Entry Package".** As noted previously, we plan to put the seismometer in a 7" O.D. 3/8" wall aluminum pressure case, and to attach another smaller pressure case -- the "Re-Entry Package" -- to the lower end of it. The Re-Entry Package would contain the video camera, lights, absolute pressure gauge and a receiving hydrophone. The hydrophone would be used to determine the distance between the end of the string and the ocean bottom before lowering the package into the hole (to be sure we don't set the package on the bottom). The pressure gauge would be used to determine that the depth of the package continues to increase as we lower it into the hole (*i.e.* that it doesn't get stuck in the casing).

These devices would be electrically connected directly to the MPL thruster system, independent of the electronics in the sonde and the BIP, using the two wires in the interface cable that are dedicated to the video system and its common return.

The Re-Entry Package would rest directly on the bottom of the hole and would support the weight of the seismometer pressure case. It would be fabricated of the same material as the seismometer case, and would probably not need to be more than 2' long.

- **Interface definition and communications protocol changes.** MPL would like to avoid modifying their data communications system for the thruster to accommodate SAIL protocol. Instead, they propose to separate thruster communications from communications with the BIP and sonde by assigning the latter a different frequency band (500-700 Khz) in the link between the thruster and the ship.

This would be the same frequency band that is used for the video signal, but that doesn't pose a problem since it should not be necessary to use the communications link during the brief period that the video camera is in operation while aligning the sonde with the re-entry cone. A switch located in the BIP would be used to transfer this link back and forth between the video system and an FSK/RS-485 converter connected to the communications ports for BIP and sonde. SAIL addresses could then be used to distinguish communications to the BIP and the sonde, or the even/odd parity scheme previously used to distinguish between communications to and from the thruster and the BIP could be used instead. It would appear to be simpler to use the even/odd parity scheme rather than implement SAIL in the various processors.

MPL would like to use their video system without any modification, using a combined 50VDC/video signal line between the thruster and the Re-Entry Package. Tony Boegeman estimated that about 80 watts of lights should suffice for the video camera. Previously, we had proposed using 220VDC to minimize the current required to operate the lights, but this would have necessitated substantial modification of the existing MPL electronics. (Note: it was suggested at the meeting that Don Koelsch was proposed the plan to use 220 volts, but this was actually an idea that I started when Richard Zimmerman told me that delivering 220 from the thruster to a power converter in the sonde would pose no problem. I suggested mixing it with the video signal at the September WHOI meeting and since everyone there liked that, we went with it.

In order to overcome the voltage drop problem posed by passing the required current through one #20 wire of the 7-conductor cable between the BIP and the sonde, relays would switch two lines from their normal use for RS-485 communication to serve as 50-volt supply lines whenever the video system is in operation, reducing the effective resistance of the supply link from about 10Ω to 3Ω . Since the video system uses a seawater ground, resistance in the return line is not a problem. This system would preclude use of the communications link while the video system is operating, but that has already been made impossible by the use of the video signal band for communications in the link between the BIP and the surface as discussed above.

- **Seismometer mass locking and holelock unlocking.** Previously, we had established a need for a battery powered, processor-independent system that would lock the seismometer masses if BIP power failed before the conclusion of the experiment. It will also be necessary to unlock the holelock assembly at the same time (or just after locking the masses) in order to facilitate removal of the sonde from the hole, unless the holelock mechanism is designed so that it releases itself when upward force is applied.

In addition, we identified a couple of other failure modes. If the thruster fails catastrophically during the installation and leveling process, we would want to lock the masses and unlock the sonde from the hole as above so that the entire string could be winched to the surface. On the other hand, if the thruster fails after the seismometer has been installed and leveled, we would simply want to disconnect the soft tether from the thruster to the BIP and leave the system in place while the thruster is recovered. Either of these responses could be activated by commands to an acoustic transponder on the BIP, and the selection of which of the two responses would be selected could either be determined by the use of two different command codes, or by a switch that is toggled after the seismometer is leveled and has begun acquiring data.

DFW

NOTES FROM A TRIP TO TELEDYNE AND REFRACTION TECHNOLOGY
OCTOBER 28-29, 1992
D. Willoughby

At Teledyne, the following were among the issues discussed:

1. There is no problem with running the mass locking motors too far - limit switches prevent overruns. So locking the masses remotely is trivial.
2. The O.D. of the inner assembly containing the seismometers is ≈ 4.94 ".
3. O.D. Starkey suggested the use of sensitive tiltmeters from PMD Engineering, Bloomfield, Connecticut.
4. Any centering device at the upper end of the package must be radially stiff but vertically compliant to allow for expansion and contraction of the package without stressing the case and causing tilt deformations. Temperature changes of a μ degree produce package tilts on the order of picoradians, which are significant to the seismometer signal.
5. Teledyne did a version of the KS54000 for Sandia that included the installation controller as part of the seismometer package; we may be able to obtain this version. Model no. was KS54000-0104, whereas the version we get is a -0103. This was a package about 18" long containing the additional electronics. This version of the seismometer also had additional state-of-health monitors and safety features such as separate carrier (drive) signals for each of the three components.
6. There are no more KS54000-0102 manuals; the -0103 version is now in the presses and should be available by the end of November.
7. The leveling sequence consists of rotating the two horizontals 'til their tilts are minimized, then to compute the angle D as discussed in the manual.
8. The variation in gravity near the poles means that our units will not operate properly at latitudes above 60° N. For starters, the compensation spring on the vertical will then be far enough off that it will bottom out against the stops.
9. Chip accelerometers are available from Kistler (?), and from Analog Devices (model ADXL50). Visually indicating shock accelerometers are available from Shockwatch, Media Recovery, Inc., Dallas, TX. Internal pressure sensors are from PSI, Inc.
10. I shot several photographs of the seismometers, hold-locking mechanisms and centering mechanisms. I'll bring them in as soon as I get them developed.

My visit to RefTek was much shorter.

1. I have copies of plots illustrating the noise performance of the Crytal 24-bit A/D board, and a brief report accompanying them.
2. Passmore said he had no problem with giving us the source code for the data logger so we could modify it, but implored us to return our modified version to him along with documentation of any hardware changes, so that they can keep copies in their documentation system. They could then implement the board changes themselves and test the systems with our software before shipping them.

DESCRIPTION OF DESIGN
OF BOREHOLE LOCK, PRESSURE CASE,
AND CABLE SLACKER FOR B³S².
by Crispin B. Hollinshead
10 March 1993

SUMMARY: The object of this research program is to deploy a Teledyne KS54000-0103 3-axis long period seismometer into a borehole in the ocean floor at a water depth of 4400m. A pressure case will house the seismometer and interface electronics. During deployment, this sensor package will be suspended from the recording package (developed at WHOI) which sits at the mouth of the borehole. The sensor package must then be clamped rigidly into the borehole casing to provide adequate coupling. After the sensor package is clamped, the suspending cable must be slacked to decouple from the recording package. For recovery, the clamping system must break away from the casing when sufficient upward force is applied.

Because of the extended deployment desired (1 year), and the depleted oxygen environment of the borehole, corrosion considerations dictated use of 6Al-4V ELI titanium for the pressure case and end caps. The holelock assemblies are 316 stainless steel with zinc anodes.

There are 2 holelock assemblies, one at each end of the sensor pressure case. (See dwg #2001) Each holelock clamping system uses the ambient water pressure (7000 psi), to wedge three arms against the sides of the metal casing in the borehole. This is activated by a solenoid valve relieving the pressure on one side of a piston into a pressure flask that remains at approximately one atmosphere. The clamp wedge is not reversible, but the clamp arms have break away sections which collapse when the sensor package is extracted. The activation of the upper hole lock releases the tension on the support cable.

HOLELOCK: The holelock assembly uses the ambient pressure to provide the clamping force (See dwgs. #2002, 2007, 2008). A piston driven cone-shaped wedge (P/N 004) expands three clamping arms (ass'y. #2011) out against the sides of the cased borehole. A wedge system was chosen because it produces a known clamping force over a wide range of diameters, and because it will remain locked even if a leak relieves the driving piston after clamping. At 7000 PSI operating pressure, the .75" diameter piston exerts a force of 3100 lbs. The angle of the wedge is 8°. This mechanical advantage minus friction (coefficient of friction figured at .16) gives a total clamping pressure of 3350 lbs. on each arm.

A small pressure flask (known as the Valve Tube Ass'y, dwgs. #2004, 2008, ass'y. #2011) which retains the surface pressure of one atmosphere (≈ 15 p.s.i.), contains a high pressure solenoid valve (P/N SV02-33), which is normally closed. When activated, the valve vents one side of the piston that drives the wedge into the flask; the ambient ocean pressure on the other side of the piston drives it into the cylinder. A control orifice (#57 hole in P/N 007-1) limits the flow rate so that the entire stroke of the piston takes 5 seconds. This is necessary to prevent clamping shock from damaging the seismometer. A small hydraulic fluid reservoir (dwg. #2007 P/N 027-1, 027-2, 027-3) is used to keep sea water out of the actual clamping piston cylinder.

The 8° angle of the cone-shaped wedge was chosen based on the angle of a collet chuck in a milling machine. Once the clamp has been activated, the ambient pressure ensures continued clamping. Even if the clamping pressure should be relieved due to leakage, the wedge should not move. Two failure modes have been considered. The first is the leaking of pressure across the piston o-ring. The second case is the failure of the solenoid valve. In each case the clamp should be unaffected, since there is no way to generate a positive pressure to force the piston out of the cylinder.

The wedge is designed to provide rapid expansion up to 9.25" diameter, and then clamps into a casing ranging from 9.25" D. to 10.25" diameter. This range allows for a test of the clamp in a 9.5" diameter pressure test facility at IGPP, as well as adjusting to a range of actual casing diameters.

The pressure flask is made from titanium, for the same reasons as the main pressure case. However, the rest of the holelock is made of 316 stainless steel. This is the most corrosion resistant of the steels, but the long deployments being considered require the use of zinc anodes. The choice of 316 is primarily for cost considerations. The stainless steel and the titanium are separated by a Teflon insulator (dwg. #2008, P/N 025-1) to prevent electrolysis. The insulator has an "O" ring on each side to provide a pressure seal since low pressure hydraulic fluid flows from the cylinder to the pressure flask. The bolts holding these parts together fit through oversize holes with shoulder washers (P/N 025-2) to isolate everything electrically. An Impulse feed-through provides the electrical connection to the solenoid inside the pressure flask.

Each clamping arm (dwg. #2011, P/N 013-1) has a break away section, secured with a shear pin (P/N 006-1). The clamping forces are along the arm and the weight of the sensor package is held by solid mechanical stops (P/N 013-2). However, the forces generated by extracting the sensor package from the borehole will shear the pins and allow the break away parts to pivot clear. This 316 stainless steel pin is designed as .125" D., which correspond to a shear resistance of 516 lbs. The mechanical advantage of the geometry of the arm means that an extraction force of 190 lbs. per arm will be required to pull everything loose. There are 6 arms total, giving 1140 lbs.

Since most of the holelock is made of 316 stainless steel, insulating washers and shoulder washers for bolts are needed to isolate it from the titanium pressure case.

CABLE SLACKER: A 7-conductor load-bearing cable connects the sensor package to the recording package at the mouth of the borehole. During deployment the sensor package is suspended from this cable, but after the sensor is clamped into the casing, the tension must be relieved in this cable to decouple the sensor from the vibration of the recording package. The cable slacker is activated by the motion of the upper holelock wedge. (See dwg. #2005.) As the wedge moves to clamp the arms, it releases three dogs (P/N 023-2) which captured the lower end of a tube (P/N 020). The 7 conductor cable is attached through a strain-bearing bulkhead connector (P/N 028) to the upper end of the tube. When released, the tube can move upward about 11", thus relieving the tension in the cable. The sequence for clamping is to activate the lower hole lock first, thus supporting the weight of the sensor package. The upper hole lock is then activated, further supporting the sensor and stabilizing the top end. The cable is slacked while the upper holelock assembly is being deployed.

The length of the connecting cable is stabilized in the borehole to prevent whipping. This is accomplished with spring arm clamps spaced along the length of the cable. (See dwg. #2015.)

The slacker assembly has a limit stop which allows the entire sensor package to be pulled out of the borehole. The weakest link in this assembly is the set of 6 1/4"-20 bolts holding the bulkhead connector to the slacker tube. The limit on these bolts is over 12,000 lbs., which is well above the breaking point of the weak link designed into the connecting cable assembly. The entire cable slacker assembly is made of 316 stainless steel.

PRESSURE CASE: Refer to dwg. #2012. The outside diameter of the seismometer case is 5.375" and the inner diameter of the borehole is 10". The pressure case is a 6" inside diameter titanium tube with a 1/2" wall (P/N 031). The end caps (P/N 029.0F, 029.5F, 029.7) are bolted into the ends of the tube, and each cap is sealed with two o-rings, one face seal and one gland seal. The tube and end caps are 6Al-4V ELI

titanium, which was chosen for its high tensile strength and very high resistance to corrosion. The ELI alloy is particularly formulated to minimize stress crack corrosion, the only form of corrosion to which titanium is at all susceptible.

Electrical connection is through Impulse connectors. The top end has one 8-pin, for signal and power, and one 2-pin for activating the upper holelock. The bottom end has two 2-pin connectors, one for the lower holelock and one for power and signals to the Marine Physical Lab borehole re-entry package which will be attached to the bottom of the lower holelock assembly..

The seismometer is rigidly mounted to the lower end cap and constrained laterally at the top end, decoupling it from any expansion/contraction in the pressure case. The electronics part of the package is mounted from the upper end cap. This section will include the repackaged Teledyne Controller, which drives the various leveling motors, and a repackaged Refraction Technology data logger, which will configure the data stream to be sent up the 7-conductor cable to the Woods Hole recording package at the mouth of the borehole. The length of the electronics package (and hence the total length of the pressure case) will be minimized to fit the electronics as the design proceeds.

Slacker

Electronics Section

Teledyne KS54000-0103

MPL Entry Package

Upper Holelock

Main Pressure Case

Lower Holelock

4'-0"

12'-4"

2'-10"

3'-4"

22'-6"

UCSD, IGPP 0225 La Jolla, CA. 92093-0225		SIO & IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances ±: (unless specified) X/4 X .XX .XXX angular 1/64" .1" .005" 1deg		DO NOT SCALE THIS DRAWING		TITLE Complete Sonde Assembly	
DRAWN BY C B Hollinshead		DATE 9 Mar 83		DRAWING NUMBER 2001	

Deployed in borehole ready to clamp

Clamped in borehole with slacker released

UCSD, IGPP 0225 La Jolla, CA. 92093-0225		SIO IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances +/- (unless specified) X/X .X .XX .XXX angular 1/64" .1" .01" .005" 1deg		DO NOT SCALE THIS DRAWING		TITLE Complete Hole Lock Ass'y.	
DRAWN BY C B Hollnhead		DATE 26 Feb 93		DRAWING NUMBER 2002	
		SCALE

UCSD, IGPP 0225 La Jolla, CA, 92093-0225		SIO IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances +/- (unless specified)		DO NOT SCALE		TITLE	
3/16" .005	3/32" .005	3/16" .005	3/32" .005	Bottom of Hole Lock Ass'y.	
1/8" .005	1/16" .005	1/8" .005	1/16" .005	DRAWING NUMBER	
DRAWN BY C B Hollinshead		DATE 11 Mar 93		2004	
		SCALE 1/2X

023-2
Dog Pin
3 places

023-1
Dog
3 places

019-3
Stop Flange

2006
Slacker Frame

020
Slacker Tube

028
Bulkhead
Connector

1/4-20 x 1.25"
316 SS hex hd
6 places

019-2
Orientation
Pin

8-32 x 1/2"
SS RH
6 places

UCSD, IGPP 0225 La Jolla, CA. 92093-0225		SIO IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances +/- (unless specified) X/A X XX XXX angular 1/64" .1" .01" .005" 1deg		DO NOT SCALE THIS DRAWING		TITLE Slacker Assembly	
DRAWN BY C.B. Hollinshead		DATE 11 Mar 93		DRAWING NUMBER 2005	
		SCALE			

021-2
Top Ring

021-1
Frame Bar
6 places

022
Base Ring

1

Weld rods (021-1) to rings (021-2) & (022). Rings must be parallel. Hole in (021-2) should be centered between rods. Rods ends are flush w/ bottom surface of ring (022).

After welding, machine bottom of (022) flat, and bore inner dia. of (021-2) to 2.28", concentric with ring (022).

UCSD, IGPP 0225
La Jolla, CA. 92093-0225

SIO IGPP

Tolerances +/- (unless specified)
3/32" x .01" .005" .005" .005"
1/64" .01" .005" .005" .005"

DO NOT SCALE
THIS DRAWING
DRAWN BY C B Hollingshead
DATE 11 Mar 93 SCALE

OCEAN BOTTOM SEISMOLOGY

TITLE
Slacker Frame Assembly

DRAWING
NUMBER
2006

UCSD, IGPP 0225 La Jolla, CA, 92093-0225		SIO IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances ± (unless specified)		DO NOT SCALE THIS DRAWING		TITLE Piston/Cylinder Assembly	
X/X .X .XX .XXX angular		1/64" .1" .01" .005" 1deg		DRAWING NUMBER 2007	
DRAWN BY C B Hollinshead		DATE 13 Mar 83		SCALE

Weld entire circumference
with Titanium 6Al-4V

010
Valve Tube Cap

After welding,
machine spotface and
32 finish surfaces.
See (010).

008
Valve Tube Flange

009
Valve Tube

UCSD, IGPP 0225 La Jolla, CA. 92093-0225		SIO IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances +/- (unless specified) 3/16" x .01" .005" .005" .005" .005"		DO NOT SCALE THIS DRAWING		TITLE Valve Tube Assembly	
DRAWN BY C.B. Hollinshead		DATE 11 Mar 93		DRAWING NUMBER 2010	

After welding, machine surface flat, machine
"O" ring groove, and drill bolt pattern. See (008).

6 assemblies req'd

Install (013-1) in (2010) using pin (006-1), press arm against Pressure Pad (013-2) and then drill 1/8" thru (013-1). See (013).

Collapsed configuration

UCSD, IOOS 0225
La Jolla, CA. 92093-0225

Tolerances ±: (unless specified)
1/4" ± .01" .005" 1deg

DATE 11 Mar 93 SCALE

OCEAN BOTTOM SEISMOLOGY

Arm Assembly

DRAWING NUMBER 2011

Top End Cap

Main Pressure Case Tube

Bottom End Cap

Electronics Section

Teledyne KS54000-0103

UC80, IGPP 0225 La Jolla, CA. 92093-0225		SIO IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances $\pm$ (unless specified) X/4 .X .XX .XXX angular 1/64" .1" .01" .005" 16g		DO NOT SCALE THIS DRAWING		TITLE Sonde Pressure Case	
DRAWN BY C B Hollnbeased		DATE 11 Mar 93		DRAWING NUMBER 2012	
		SCALE

Deployed, Prior to Clamp

Clamped, Valve Energized

Clamped, Valve De-energized

UCSD, IGPP 0228 La Jolla, CA. 92093-0225		SIO IGPP		OCEAN BOTTOM SEISMOLOGY	
Tolerances +/- (unless specified) X/X .X .XX .XXX angular 1/64" .1" .01" .005" 1deg		DO NOT SCALE THIS DRAWING		TITLE Hydraulic System Schematic	
DRAWN BY		DATE		DRAWING NUMBER 2016	
		SCALE

**BROAD BAND BOREHOLE
SEISMIC SYSTEM
SONDE BLOCK DIAGRAM**

D. F. Willoughby
March 24, 1993

Department of Geology & Geophysics
Telephone: (508) 457-2000
Fax: (508) 457-2150

April 29, 1993

Mr. Dave Willoughby and Dr. John Orcutt
University of California
Scripps Institution of Oceanography
(IGPP) Ocean Bottom Seismology Lab
La Jolla, CA 92093

Dear Dave and John:

This letter is written in response to your request for comments in your memo dated March 26, 1993.

Mechanical:

We've asked Matthew Gould to evaluate the mechanical design and his comments are attached. We have a few other concerns as well:

1. If we make the termination at the SCU full strength, will there be enough strength in the .680" cable at the overboarding sheave if a cable stabilizer hangs up.
2. We suggest that the cable stabilizer have three springs to hold the cable to the center of the hole and not jamb it against the side as shown.
3. What loading breaks the shear pins in the clamping mechanism? Is this consistent with the 3000 lbs break-away specification as stipulated in the December, 1992 minutes?
4. We suggest sending the mechanical design to the ODP for input.
5. There must be a temperature profile of the borehole. It should be obtained and distributed to all hands.
6. Since the force of the clamping mechanism depends on the ambient pressure, can adequate testing be done in the shallow Pinon Flats hole?

Electrical/Electronic:

1. On the WHOI board I believe the diode matrix is connected wrong. See the WHOI drawing SMPLBLK1.R08 for correct hook up.

2. The relay on the Power Distribution Board is a latching relay because once the 54000 is turned on, it shouldn't be turned off even when it is necessary to do a power up reset on the REF TEK system. See attached diagram.
3. How much power (voltage and current) is required by the holelock solenoid valves? Can this power come from the +24V MOT power?

Very truly yours,

Ralph A. Stephen
Senior Scientist

Donald E. Koelsch
Principal Engineer

/kl
enclosure
xc: K. Peal

OFFICE MEMORANDUM

April 12, 1993

To: Don Koelsch

From: Matthew Gould

Re: Memo of 3/26/93 from John Orcutt and Dave Willoughby

I have looked at the memo and drawings from SCRIPPS and have come up with a couple of concerns that I have with the mechanical end of things.

Because of the queries I have made concerning the problems of zinc anodes with stainless steel, I would like to suggest that perhaps a low carbon steel alloy, such as cold rolled 1020 or 1018 be used as anodes. The problem seems to be more in the high strength alloys, such as 17-4 PH, and the by-product of hydrogen with the deterioration of the zinc, possibly creating an environment where "hydrogen embrittlement" may become a factor. This may be a problem for us in a long term deployment or a warm hole, even with the 316 alloy. There is also a problem with the zinc oxide protecting the zinc and cutting down the contact area and the efficiency of the anode, where as the steel tends to slough off the corrosion a little easier.

Another question I had was the materials constructing the "Cable Stabilizing Rig" as far as corrosion is concerned. Should the clamps for this system be tapered on both sides on both ends, so there is no possibility for hanging up on either entry to or recovery from the hole?

In the hydraulic system, if pressure leaks by the Cone piston O-ring is there enough volume in the empty chamber to accommodate any extra oil or sea water? Is there any way to assure that there are no air bubbles between the clamping cone piston and the valve? I am also wondering what the minimum pressure would be to actuate and what is the minimum pressure to maintain an adequate clamping force to hold the tool in place? Will it work in the hole at Pinion Flats? If you have to fill the hole with water and it drains out what happens to the clamping force?

These questions and suggestions are what comes to mind after reading the SIO memo I hope they may be useful to you.

Matthew Gould

xc: Ralph Stephen
Ken Peal
SIO/IGPP
John Orcutt
Dave Willoughby

NOTE: The latching relay could be a 4PDT version if necessary.

Applied Ocean Physics and Engineering Dept.
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Don Koelsch

Title

Sonde Power Switching

Size Document Number

A

andpwrw.sch

REV

1

prj

1

she

May 4, 1993

TO: Ralph Stephen, Don Koelsch, WHOI; cc: John Orcutt
FR: David Willoughby, SIO/IGPP
RE: Questions in your letter of April 29

Though I assume you weren't really expecting a reply to your comments in your letter, I thought I would reply to assuage any fears that any of the points you raised were not being considered. In order:

Mechanical:

1. It will be difficult for the cable stabilizer to "hang up" since the three very weak springs will centralize the wire and are tapered to the wire at the ends.
2. Though the drawing doesn't make it clear, we intended all along to have three springs at each stabilizer to center the cable in the hole. Incidentally, Gary Austin at MPL has pointed me toward a commercial "bowspring centralizer" from Comprobe, Inc., that might suit our purposes with minor modifications and would presumably be less expensive than fabricating our cable stabilizers from scratch.
3. According to Cris Hollinshead's notes, the shear pins are designed to break with an 1140 lb. upward pull on the cable.
4. We're planning to send copies of the design to the ODP.
5. There is a temperature log; I enclose a copy. I got this from John O. and assumed everyone that needed it knew about it and had access to it.
6. The locking mechanism is designed to be tested two ways: First, at a pressure test facility here at IGPP we will test the clamping and breakaway forces at 7000 psi. For the test at Piñon Flat, the hydraulic system has been designed so that it can be externally pressurized. The use of "ordinary" hydraulic components will only allow us to do this test at about 3000 psi, but if the coupling at this pressure proves adequate, it should be even more solid at bottom pressure.

Electrical/Electronic:

1. Yup, the diode matrix was connected wrong. Not an error in concept, just a mistake in execution.
2. Though I didn't show this detail, I intended the relays on the Power Distribution Board to be latching relays. I just didn't want to rearrange the drawing to show two coils or a latching mechanism.
3. I can't find my Circle Seal catalog to confirm the specs on the solenoid valves, but it was our plan to use the +24V MOT power to activate them. Their current consumption is rather high (1/2A?), so we will probably have to use the -50V. to +24V. converter to provide adequate voltage, as with the seismometer motors.

Figure 6

Apr 96 14:02:40 UTC
Replied: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu> rstephen
Return-Path: John_Orcutt@igppqm.ucsd.edu
Received: from aqua.who.i.edu (aqua [128.128.16.1]) by gannet.who.i.edu (8.6.12/8.6.12) with
ESMTP id OAA25317 for <rstephen@gannet.who.i.edu>; Thu, 25 Apr 1996 14:06:27 -0400
Received: from gannet.who.i.edu (gannet.who.i.edu [128.128.20.11]) by aqua.who.i.edu (8.6.11/
8.6.11) with ESMTP id OAA16882 for <rstephen@who.i.edu>; Thu, 25 Apr 1996 14:03:03 -0400
Received: from UCSD.EDU (mailbox2.ucsd.edu [132.239.1.54]) by gannet.who.i.edu (8.6.12/8.6.
12) with ESMTP id OAA25326 for <ralphs@gannet.who.i.edu>; Thu, 25 Apr 1996 14:06:24 -0400
Received: from igpp.ucsd.edu [132.239.152.7] (igpp.ucsd.edu [132.239.152.7]) by UCSD.EDU (
8.7.4/8.6.9) with SMTP id LAA24496 for <ralphs@gannet.who.i.edu>; Thu, 25 Apr 1996 11:02:55
-0700 (PDT)
Received: from igppqm.ucsd.edu by igpp.UCSD.EDU (4.1/UCSDGENERIC.4)
id AA29917 to ralphs@gannet.who.i.edu; Thu, 25 Apr 96 11:02:50 PDT
Message-Id: <n1381692291.23942@igppqm.ucsd.edu>
Date: 25 Apr 1996 11:02:25 -0800
From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
Subject: borehole sensor
To: "Ralph Stephen" <ralphs@gannet.who.i.edu>
Cc: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
X-Mailer: Mail*Link SMTP/QM 3.0.0

4/25/96 10:59 AM

Ralph, we found out some time ago that there was nothing wrong with the
seismometer we sent back to Teledyne. The problem lay in the rather archaic
software that Teledyne provides and not with the sensor - it wasn't broken.
The trip to/from Texas had some value in that it allowed them to bring the
electronics in the seismometer up to the newest IDA specs. The seismometer
is again identical to the instruments being installed around the world.
Thought you would probably like to know..

in_Orcutt@igppqm.ucsd.edu
 Received: from aqua.whoiedu (aqua [128.128.16.1]) by gannet.whoiedu (8.6.12/8.6.12) with
 ESMTP id PAA25380 for <rstephen@gannet.whoiedu>; Thu, 25 Apr 1996 15:26:15 -0400
 Received: from UCSD.EDU (mailbox2.ucsd.edu [132.239.1.54]) by aqua.whoiedu (8.6.11/8.6.11
) with ESMTP id PAA17898 for <rstephen@whoiedu>; Thu, 25 Apr 1996 15:22:48 -0400
 Received: from igpp.ucsd.edu [132.239.152.7] (igpp.ucsd.edu [132.239.152.7]) by UCSD.EDU (8.7.4/8.6.9) with SMTP id MAA29483 for <rstephen@whoiedu>; Thu, 25 Apr 1996 12:22:46 -0700 (PDT)
 Received: from igppqm.ucsd.edu by igpp.UCSD.EDU (4.1/UCSDGENERIC.4)
 id AA06211 to rstephen@whoiedu; Thu, 25 Apr 96 12:22:42 PDT
 Message-Id: <n1381687500.9615@igppqm.ucsd.edu>
 Date: 25 Apr 1996 12:21:29 -0800
 From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 Subject: Re: borehole sensor
 To: "ralph stephen" <rstephen@whoiedu>
 X-Mailer: Mail*Link SMTP/QM 3.0.0

Reply to: RE>>borehole sensor

Yes, this is the one we'll use at sea. However, the replacement sensor which we have been using shows behavior essentially identical to the sensor we shipped. It has been a good test, in a way, in that it has shown that the data we record is independent of the sensor itself and depends solely on the locking, etc.

 Date: 4/25/96 11:45 AM
 To: John Orcutt
 From: ralph stephen
 Received: by igppqm.ucsd.edu with SMTP; 25 Apr 1996 11:40:25 -0800
 Received: from localhost (localhost [127.0.0.1]) by gannet.whoiedu (8.6.12/8.6.12) with SMTP id OAA25283; Thu, 25 Apr 1996 14:42:47 -0400
 From: ralph stephen <rstephen@whoiedu>
 Message-Id: <199604251842.OAA25283@gannet.whoiedu>
 X-Authentication-Warning: gannet.whoiedu: Host localhost didn't use HELO protocol
 To: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 cc: rstephen@gannet.whoiedu
 Subject: Re: borehole sensor
 In-reply-to: Your message of "25 Apr 96 11:02:25 -0800."
 <n1381692291.23942@igppqm.ucsd.edu>
 Date: Thu, 25 Apr 96 14:42:47 -0400
 X-Mts: smtp

John,

Thanks for the update. Will the original sensor be the one we use at sea? We should probably still carry out at least a one month test at PFO of the sonde in its "at-sea" configuration, that is with the titanium housing and Fred's re-entry guide components.

Regards, Ralph.

3.9.1 Bocconcelli 1/27/94

TO: Don Koelsch
FROM: Alessandro Bocconcelli
SUBJECT: CORROSION
DATE: January 27th, 1994

If the BCU reentry package is to be deployed for an extended time at sea we should seriously worry about corrosion protection. The cage is made of Aluminum 6061 T6 which is good for short deployment but has been known to corrode during "long" deployment. All the anodized pressure cases (7075 - T6) should also be checked for integrity and re-anodized if necessary. It would be very useful to find out which kind of environment we are expecting for the next deployment since aluminum corrosion is dependent on temperature, PH, dissolved oxygen, presence of sulfites, etc.

I just completed a Marine Corrosion seminar which has opened my eyes on this issue and made me realize that we have to be very "corrosion conscious" on the B3S2 project.

Received: from aqua.who. 3.10.1 Peal 11/1/95
ESMTP id QAA17921 for <rstephen@gannet.who.who.edu>; Wed, 1 Nov 1995 16:56:31 -0500
Received: from hurdle.who.who.edu (hurdle [128.128.92.91]) by aqua.who.who.edu (8.6.11/8.6.11) with ESMTP id QAA04542; Wed, 1 Nov 1995 16:55:54 -0500
Received: (from kpeal@localhost) by hurdle.who.who.edu (8.6.12/8.6.9) id QAA00703; Wed, 1 Nov 1995 16:51:13 -0500
Date: Wed, 1 Nov 1995 16:51:13 -0500
From: Ken Peal <kpeal@hurdle.who.who.edu>
Message-Id: <199511012151.QAA00703@hurdle.who.who.edu>
To: richard@mpl.ucsd.edu
Cc: fns@mpl.ucsd.edu, rstephen@who.who.edu, rgoldsborough@who.who.edu, tomb@snark.who.who.edu, mgould@who.who.edu
Subject: Start on interfacing?

Richard: 1 Nov 95

Back in May I said that I would be looking at the BBBSS/LFASE stuff in a "couple of months". Well I finally got a couple of days together and have made a start. I hope that maybe you will be able to think about it in the next few weeks so we will have some quality time together (I couldn't resist that, sorry). I remember that your group was busy through the summer until about October so I hope this is a good time to start. Rob Goldsborough will also be working with me on this and he will be back from sea next week.

Here is the status. The last couple of days I have got back to speed a bit on our BCU documentation and have removed the MPL chassis from the BCU chassis. We need to make a couple of cables then I will be back on the air in the simple BCU-and-sonde mode but without your chassis. When that happens, I will ship the chassis to you as requested and we can start talking about what the interface needs to be like.

In simple terms this chassis deals with:

- telemetry on the coax
- release of the soft tether from the frame
- TV and lights on the frame
- TV and lights on the BRG
- power for BCU, Teledyne, and RefTek.

We need to decide how to specify this interface in detail then work out ways do some tests of the system simulating the portions that we are omitting now (telemetry, CV, coax, lab gear). The intent is to be sure the integration (at MPL?) will not be too difficult. Then of course we need to decide when things will happen.

So if you are around now, let me know what you think of this and also send me an address that I can ship the chassis to.

Regards ... kp

Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.12/8.6.12) with
 ESMTP id RAA23422 for <rstephen@gannet.who.edu>; Mon, 4 Dec 1995 17:10:14 -0500
 Received: from hurdle.who.edu (hurdle [128.128.92.91]) by aqua.who.edu (8.6.11/8.6.11) w
 ith ESMTP id RAA07200 for <rstephen@who.edu>; Mon, 4 Dec 1995 17:08:49 -0500
 Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id RAA02282; Mon, 4 Dec
 1995 17:04:56 -0500
 Date: Mon, 4 Dec 1995 17:04:56 -0500
 From: Ken Peal <kpeal@hurdle.who.edu>
 Message-Id: <199512042204.RAA02282@hurdle.who.edu>
 To: rstephen@who.edu
 Subject: message from MPL

>From richard@mpl.ucsd.edu Tue Nov 28 20:09:53 1995
 Received: from mail.ucsd.edu (ucsd.edu [132.239.254.201]) by hurdle.who.edu (8.6.12/8.6.9
) with ESMTP id UAA00568 for <kpeal@hurdle.who.edu>; Tue, 28 Nov 1995 20:09:52 -0500
 Received: from chiton.ucsd.edu by mail.ucsd.edu; id RAA03576
 sendmail 8.6.12/UCSD-2.2-sun via SMTP
 Tue, 28 Nov 1995 17:13:05 -0800 for <kpeal@hurdle.who.edu>
 Received: from pyramid by chiton.ucsd.edu (5.x/SMI-SVR4-UCSD.1)
 id AA22525; Tue, 28 Nov 1995 17:12:12 -0800
 Date: Tue, 28 Nov 1995 17:12:12 -0800
 Message-Id: <9511290112.AA22525@chiton.ucsd.edu>
 X-Sender: richard@mpl.ucsd.edu
 X-Mailer: Windows Eudora Light Version 1.5.2
 Mime-Version: 1.0
 Content-Type: text/plain; charset="us-ascii"
 To: Ken Peal <kpeal@hurdle.who.edu>
 From: Richard Zimmerman <richard@mpl.ucsd.edu>
 Subject: Re: Got the chassis?
 Status: RO

At 11:44 AM 11/28/95 -0500, you wrote:

>Richard: 28 Nov 95

>

> Did you receive the chassis we shipped you?

>

> As a place to start, maybe you could let us know if you see

>any surprises or mysteries in the list of signals that I

>included. Also what changes if any you foresee.

>

> Regards ... kp

>

> Hi Ken,

yes I did receive the interface package in good condition. Most of it is
 pretty straightforward but the main difference will be that we are now
 bringing down 220VC from the thruster instead of DC. In that context I would
 like to know if I should consider this package the maximum envelope that is
 available to us or is there some more space if needed ?

RZ

BBBSS MPL Telemetry Chassis Interface

Description of connectors:

J8	Molex 6 pin, 0.093 type
J9	Molex 15 pin, 0.062 type
J10	Molex 9 pin, 0.062 type
J11	Molex 2 pin, 0.093 type
J12	Molex 15 pin, 0.062 type
J13	Molex 6 pin, 0.062 type
J14	DG O'Brien, 3 pin, on end cap, battery
J15	DG O'Brien, 14 pin, on end cap, downhole
J16	DG O'Brien, 5 pin, on end cap, EM cable
J24	Molex 5 pin, 0.062 type

Name	Pin	Signal	Description
J8			BCU signals
	1	-BAT	Battery power to BCU from J11, J14
	2	+BAT	Battery power to BCU from J11, J14
	3	n.c.	
	4	+28V MPL	MPL power (from ship)
	5	-50V MPL	input power from MPL to 54000 motors
	6	MPL GND	MPL ground
J9			BCU signals
	1	Cable3	direct to cable 3
	2	Cable1	direct to cable 1
	3	AQ SYNC-	CGG sync, not used
	4	Cable5	direct to cable 5
	5	Cable4	direct to cable 4
	6	AQ SYNC+	CGG sync, not used
	7	n.c.	
	8	n.c.	
	9	Earth	chassis ground, cable 7
	10	Cable6	direct to cable 6
	11	n.c.	
	12	MPL Video	from BRG to MPL (thruster)
	13	-BAT	ground / BRG 4 / 100.02
	14	REL MTR	switched power to hook release motor
	15	REL MTR CMD	power from MPL for hook release motor

J10

BCU signals

1	MPL RCV	serial comm to MPL
2	MPL SEND	serial comm from MPL
3	MPL RTN	ground
4	4800b SW	seismic data from BCU to ship
5	GND	ground
6	BTFLAG2	buffered time hack from Seascan clock
7	RELEASE CMD	asserted when Cmd D and no MPL power
8	n.c.	
9	BTFRTN	ground

J11

J14 end cap signals

1	-BAT	ground
2	+BAT	battery power to BCU from J14

J12

J15 end cap signals

1	Cable3	
2	Cable1	
3	AQ SYNC-	CGG sync, not used
4	Cable5	
5	Cable4	
6	AQ SYNC+	CGG sync, not used
7	Cable5	
8	Cable2	wired to J8-2
9	COMMANDS	wired to J9-9, earth
10	Cable6	
11	BRG3	
12	BRG1	
13	Cable7	
14	BRG4	
15	BRG2	

J13

J16 end cap signals

1	TELEMETRY OUT-	
2	shield	
3	REL MTR	switched power to hook release motor
4	HELPER BAT	battery input for local MPL supplies
5	TV LIGHTS	
6	n.c.	

J24

local MPL power supplies (in BCU)

1	MPL GND	ground
2	MPL +24	helper battery in
3	CONTROL	power supply control
4	+60V	power out
5	60V RTN	ground

4.1 Communication and Data Flow

4.1.1 Koelsch 11/13/92

Bigelow 1 FAX Machine Number is: (508) 457-2194

TRANSMIT TO: Richard ZimmermanInstitution/Company: Scripps Institute of Oceanography, MPLTelephone Number: 619 534 5255From: Don KoelschDepartment: Applied Ocean Physics & EngineeringDate: Nov. 20, 1992 Pages (Including Cover Sheet): 4

If you experience difficulty receiving this, or you do not receive all of the pages, please call and speak with Shirley Bowman at (508) 457-2000 ext. 2727.

This document is being sent from a XEROX TELECOPIER 7024.

*Copy of the documentation
I sent to Dave Willoughby 11/13/92.
If you have any questions call me.
D.K.*

Dave Welloughby

From: Don Koelsch

Date: 11/13/92

Subject: Interconnections & signal definitions Of
Memorandum

This is my latest thinking. As we discussed there is a 100 volt power supply as part of the MPL module in the BCU (or the BIP). This would make a good source for the motor driver power in the 54000.

Also note that the ASCII time string would be sent down a separate Comm. link on the deployed 54000 power line.

Conductors 3 & 4 are switched by applying power to the lights and would give MPL 3 conductors for light power with a resistance of 3 ohms. The PT time back is to force the REF TEK to take a record. If this record has no seismic data then it still has header and time information. This is a method of checking the REF TEK time with Sea Scan time.

Call me and let me know what you think of all this.

Regards

Don

Soft tether coax

Woods Hole Oceanographic Institution

Woods Hole, Ma 02543

Don Koelsch

Title

Simplified BIP Block Diagram

Size Document Number

SMPPLBK1

Date: November 13, 1982 Sheet

of

REV

2

7 conductor cable to BIP

Woods Hole Oceanographic Institution

Woods Hole, MA 02543

Don Koelsch

Title

Simplified Sonde Block Diagram

Size Document Number

A

SMPPLK2

Date: November 13, 1982 Sheet 1 of 1

REV

2

TO: Distribution RA pt 13 Jan 93

FROM: K. Peal

RE: Telephone conversation with Glen Offield, 7 Jan 93

1. Clock and timing

We have a choice here between

- WHOI simulating Kinematics time interface (1 PPS plus special-format ASCII string each second) and
- IGPP modifying timing portion of 'Reftek' software.

Agreed on the latter.

Thus WHOI will send a string in Kinematics format based on Seascan time but only occasionally (once per hour or some such). IGPP will change the software so the clock runs on the 1 PPS and uses the string to simply change the time if it is wrong. WHOI needs to ensure that the 1 PPS line is clean (no repeated glitches at odd times during the second) and that the string always comes at the same time relative to the 1 PPS. Also WHOI needs to send the string after a reset of the Reftek and at power up to synchronize Reftek time with Seascan time.

Immediately before sending each Kinematics string, WHOI will initiate a triggered record which serves as a measure of any time offset in the Reftek relative to the Seascan before the time is corrected using the Kinematics string.

Note the question of how often to send the string needs to be answered.

2. Serial line protocol

Electronics is simplified if the serial communications between BIP and Reftek is RS-485 rather than RS-232 (or logic level) because the latter requires an FSK modem. The reason to discuss this was that RS-485 is inherently half duplex leading to possible software implications. It now appears that RS-485 chips can suppress the received signal during transmission so that the main half duplex problem is avoided (you do not hear yourself talk). This needs a little more investigation since line turn-around still takes place (it really is half duplex).

WHOI requested that we use only one serial port for both command/reply and the Kinematics time string (simplifying usage of the 7 lines). IGPP agreed that this is no problem.

Another implication of using RS-485 is that an addressing protocol is required since there are several devices on the line

at all times. IGPP will adapt their currently used protocol which includes addressing and send it (in preliminary form) to WHOI.

3. Data format and QC plans

Discussed the issue of data format for two reasons:

- real time QC on the ship while connected to cable
- data playback of the BIP disk after recovery.

IGPP can 'easily' do display of the real time data using VME/68000 system if data uses the present format. If format changes or if the machine is a PC, it is not so easy. IGPP will send preliminary format to WHOI. Note the BIP will add some state-of-health blocks to the data stream from the Reftek but they will be in PASSCAL compatible format.

If BIP disk is made to be DOS compatible, a conversion step on a PC will be required as well as transfer to a workstation class system (Sun). WHOI is looking at recording the disk using the 'PASSCAL spiral' format rather than making it DOS compatible.

Distribution:

Don Koelsch
Glen Offield, IGPP (via email)
John Orcutt, IGPP (via email)
Ralph Stephen
Dave Willoughby, SIO (via email)

BBSS COMMUNICATION and DATA FLOW

In order to test the BBSS system and to prepare it for deployment, each laboratory must be able to test their individual sub-system independently. The enclosed diagrams show the communications and data paths for each phase of development, predeployment preparation, and deployment. Figure 1 shows the full block diagram. The Sonde Test Unit and the Sonde Simulator are used to test the appropriate unit with the ~~FSK~~ telemetry and 7 conductor cable or with logic signals without the 7 conductor cable.

WHOI BIP Test Alone

Figure 2 shows the use of the Sonde Simulator with sonde type signals generated by data and communication computers. These might very easily be the Data Quick Look Recording CPU but are shown as separate items for clarity. Power for the BIP is supplied through the Deck Test Cable. Test records can be recorded in the BIP and played back through the Deck Test Cable. Records can also be recorded on the High Capacity Data Recorder. The hook-up can be changed either to go through the 7 conductor cable or not. The BCU will, on command, be able to accept either ~~FSK~~ or logic signals from the Sonde Simulator.

WHOI BIP Test Through MPL

For WHOI to test the BIP with MPL in the system (Fig. 3), the hook-up is almost the same except power for the BIP is supplied down through the 0.680 cable and the thruster. Since the equipment is still on deck, the Deck Test Cable is still connected and by means of a switch in the Lab Switch Matrix, control can be switched from MPL system to the Deck Test Cable. This same configuration would be used in Pinon Flats if MPL participated in that phase and in the pre-deployment phase.

IGPP Test Sonde Alone

IGPP would use the configuration shown in Figure 4 to test the sonde autonomously. This would be used in the laboratory, at Pinon Flats in the hole, or at sea for pre-deployment check out. There could be a special connector on the sonde that, for testing purposes, would bypass the FSK circuits and accept logic level signals. The sonde would obtain its power from the Sonde Power Supplies that plug into the Sonde Test Unit.

IGPP Test Sonde Through MPL and BIP

This configuration independently tests the sonde through MPL and BIP sub-systems when they are on deck and before deployment (Fig. 5). WHOI would switch the communication link connecting the IGPP Control CPU directly to the sonde.

Pinon Flats and Deck Test Without MPL

Figure 6 is the configuration that would be used for the 'full-up' Pinon Flats and deck tests before connecting to the MPL sub-system. In this configuration data can be recorded in the BIP, on the High Capacity Data Recorder, and on the Data Quick Look Recording CPU. All signals and power would go through the Deck Test Cable.

System Deck Test Just Prior to Launch

Full-up deck test as shown in Figure 7 would be performed just prior to launching. Control could be either through the Deck Test Cable or finally through the MPL sub-system. To deploy the BBBSS, the Deck Test Cable is removed, the Soft Tether is disconnected and the system is put over the side. This configuration is also used after the sonde is in the hole while the 54000 is being clamped and leveled.

Search and Entry Phase

When lowering to the sea floor and searching for the hole all power and communications to the BBBSS are disabled because the full power/bandwidth of the 0.680 Cable is needed for the MPL search and positioning equipment (Fig. 8).

Autonomous Operation

Figure 9 shows the deployed system autonomously taking data for the experiment.

Debriefing Operation after Recovery

When the system is back aboard it will be debriefed before opening the case (Figure 10). This will allow reading of parameters that have been stored in EEPROM or low power battery backed up RAM. We will also want to measure the offset of the real time clock and transfer some typical records from the BIP hard disk to laboratory High Capacity Data Recorder. IGPP will be able to interrogate the Ref Tek and 54000 to determine if it has clamped and for any other information that would be indicative of its health.

Fig. 1 System Block Diagram

Applied Physics and Ocean Engineering Dept. Woods Hole Oceanographic Institution Woods Hole, MA 02543 Dan Keeloch			
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File	FULLBLK.BLK	Date	MARCH 15, 1983
		Page	1 OF 10

Fig. 3 MHOI tests BIP with no Sonde, but through MPL system. Either with or without the 75 Ohm coaxial cable. This system can be used for deck test or could be used when MPL is at Pinon Place.

Applied Physics and Ocean Engineering Dept.
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Dan Keasch

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COMM-FIS.BLK
Date: March 15, 1983 Sheet 3 of 10

FIG. 4 Ippg tests sende autonomously by using the Sende Test Unit. Testing can be done when using or not using the 7 conductor cable.

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Dan Koelich

Title
Communication and Data Flow Block Diagram
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REV
4
Date: March 18, 1993 Sheet 4 of 10

Fig. 8 This configuration is used for the pinon plate test and the deck test when bypassing the MPL sub-system

Fig. 4. Lowering to the sea floor, searching for and lowering into the hole.

Fig. 2 Sonde clamped in hole and system autonomously taking data.

Applied Physics and Ocean Engineering Dept.
 Woods Hole Oceanographic Institution
 Woods Hole, MA 02543
 Don Kozlisch

Title
 Communication and Data Flow Block Diagram
 Size Document Number
 8 COMF108.SLK
 Date: March 16, 1985 Sheet 9 of 10

~~Cleer~~

23 Oct 93

Hope these documents get through OK. There are three:

1. this note
2. the document describing the basic I/O modules required
3. the block diagram (postscript) referred to in document 2.

Once these initial pieces are ready, the main programs can be created. More on that later.

See you Monday.

.... kp

Downhole Recorder

I/O Software Modules and Speed Tests

The control software for this system is based on handling the sensor data in digital form after it is digitized in the Reftek system. The work described here creates and tests the necessary software I/O modules for this to be done.

Refer to the block diagram attached. The data stream starts at the Reftek acquisition system. It is transmitted as serial asynchronous data to the BCU where the GCAT computer receives the data and stores it on disk. When the ship is present, the data is also sent via the MPL telemetry to the ship for recording and evaluation. Here PC#1 receives the data and passes it to a SPARC10 for display and PC#2 receives the data and stores it on disk.

The GCAT is a low power single-board computer based on Chips and Technologies F8680 chip. It runs DOS (version 5.0). A standard serial COM port receives the sensor data. A two megabyte PCMCIA device which acts as floppy B: serves as a buffer for the disk. A Trantor SCSI host adapter is used which operates through the GCAT printer port (PRN:). A second COM port is used for other communications.

In Lab PC #1, the serial data are received and written to short disk files on the SPARC. A display program on the SPARC provides real time display using these files. The network connection is made with PCNFS.

In Lab PC #2, the serial data are received then written on the disk as in the GCAT. In this case however, the disk is spinning so no secondary buffering is required.

The serial data format is described in attachment 1. Although the data rate is low, it is important that no packets are lost during transmission.

The data format on disk is described in a second attachment. This format is used to enable the disks to be read directly by processing systems (SPARC stations) without a transcribing step. This will simplify data recovery and allow use of existing software.

The I/O modules required are:

1. receive the serial asynchronous data
2. store the data on disk.
3. In addition a third may be required if speed problems are encountered in the GCAT. This will use the PCMCIA device as extended memory rather than as a pseudo-floppy disk to buffer the data for the Winchester disk.

The serial input module is similar to the "putch/getch" of most C libraries but uses direct chip register access. It will probably be interrupt driven.

The disk storage module accesses the SCSI host adapter in the PC (Trantor) to send logical blocks to the SCSI controller in the disk directly.

Four tests are planned to ensure that the I/O modules are performing as required.

1. GCAT serial data input, writing to PCMCIA as B:. Ensure that all packets are received on a continuous basis and that none is lost during file open/close. If a problem arises due to DOS activities, change to EMS driver for PCMCIA. If a problem is found here due to the EMS driver, do direct control of extended memory registers.
2. As test 1 but add the Winchester output.
3. Lab PC #2 receiving serial input, with output to the Winchester disk.
4. LAB PC #1 receiving serial input, with output to the SAFRC disk using PCNFS. This is the lowest priority test because lost packets here are less serious.

Attachment 1

Downhole Recorder

Serial Data Format

The data from the downhole digitizer package (IGPP/Reftek) is bit-serial asynchronous characters. The characters are formatted in two types of packets: a status packet and a data packet. Both start with a 16 byte header.

HEADER STRUCTURE

Map	Length	Type	Description
AA	2	alpha	Packet start flag: DA for data and ST for status.
BB	2	binary	checksum (makes the raw sum of all bytes in the packet equal zero).
B	1	binary	packet length (including this header)
B	1	binary	channel number (1,2,3 for data or 0 for status)
BB	2	binary	status flags (undefined at present)
BB	2	binary	packet index number (increments each packet)
NNNNNN	6	BCD	time of first sample (DDDHMMSSMMM)

DATA PACKET

Each data packet contains a header structure then one second of data (20 samples) for one channel (uncompressed data). Each sample consists of three bytes (24 bits) in least-to-most significant order. Thus a complete data packet will be 16 byte header plus $20 * 3$ bytes for a total of 76 bytes.

STATUS PACKET

Each status packet contains a header structure plus undefined status data. In the current test program (SONDSIM), there are 60 bytes of status so both packets are 76 bytes in length. This may change of course.

Parts of the packets are unspecified because the IGPP hardware is still being put together. Also we want to be able to add status in the BCU to the data stream coming from the Reftek and we haven't decided on bits yet either.

The real time portion of the system generates a status packet and three data packets (channels 1, 2, and 3) every second as serial data at 4800 baud.

Attachment 2

Downhole Recorder

Disk Format

The disk surface is treated as a linear series of logical blocks numbered from 0 to the last. The first two blocks are not used for data. Block one will contain label and partition information to make the disk compatible with Unix. The second block has a pointer maintained by the controlling program which tells which block on disk is to be used next for data. The value of the pointer is the logical block number to be used next.

All other blocks contain data. In this case the data are simply the packets described in the "data format" document.

TO: R.Stephen D.. 4.2.1 Peal 11/29/92 29 Nov 92

FROM: K.Peal

RE: BBBSS data format

These are some initial thoughts on data format.

It looks to me as though the PASSCAL data format will do what we need and since the Reftek system is in use, it will provide data in this format. Thus what we need to do is to learn about this format and adapt it as necessary. A starting point is the Reftek document:

PASSCAL recording format (version 2.46, 14 May 1991).

Basic data recording and descriptions of the mode of operation are well supported in this format.

As described in my "clock interfacing" memo, we can use a zero length triggered data record to do an in situ clock check of the Reftek internal time against Seascan.

There is also provision for pretty flexible state-of-health information which we can use to include any engineering data we feel is necessary. This is simply a matter of collecting engineering data in a buffer in the BIP in the correct format and sending it to the surface or to the recorder when appropriate.

The system itself generates a state-of-health record when it detects a time jerk (that is when it is necessary to slew its time by more than a specified amount).

The general flow seems to be for the Reftek system to generate and store into RAM various types of records (packets) as they occur. Retrieving these records from RAM and storing or transmitting them somewhere is an independent process. Our plan is to have the records flowing directly to the BIP and/or the surface ship so we are treating the RAM as simply a FIFO. This seems perfectly appropriate and demonstrates the flexibility of the Reftek design.

An area we need to discuss is plans for data processing during the tethered operation and after instrument recovery. We need to know more about the software available from Reftek. Is it thought to be useful? What DOS structure does the PC version of this software assume? We need to think whether we will be in the DOS world or SUN/UNIX.

The reason for these questions is that I have two choices for how to put the PASSCAL data stream onto the recorder:

- in raw PASSCAL form (as is done by the Reftek itself)
- in DOS files (which would be easier for us).

While the latter seems preferable, there are still questions such as how much data to include in each file. Again perhaps the Reftek software has dealt with this. There may be some rational ways to make this choice.

It seems that we need to develop an approach to the processing question in conjunction with IGPP to avoid overlap or screwups.

TO: Distribution

Ra ftH

13 Jan 93

FROM: K. Peal

RE: Telephone conversation with Glen Offield, 7 Jan 93

1. Clock and timing

We have a choice here between

- WHOI simulating Kinematics time interface (1 PPS plus special-format ASCII string each second) and
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Thus WHOI will send a string in Kinematics format based on Seascan time but only occasionally (once per hour or some such). IGPP will change the software so the clock runs on the 1 PPS and uses the string to simply change the time if it is wrong. WHOI needs to ensure that the 1 PPS line is clean (no repeated glitches at odd times during the second) and that the string always comes at the same time relative to the 1 PPS. Also WHOI needs to send the string after a reset of the Reftek and at power up to synchronize Reftek time with Seascan time.

Immediately before sending each Kinematics string, WHOI will initiate a triggered record which serves as a measure of any time offset in the Reftek relative to the Seascan before the time is corrected using the Kinematics string.

Note the question of how often to send the string needs to be answered.

2. Serial line protocol

Electronics is simplified if the serial communications between BIP and Reftek is RS-485 rather than RS-232 (or logic level) because the latter requires an FSK modem. The reason to discuss this was that RS-485 is inherently half duplex leading to possible software implications. It now appears that RS-485 chips can suppress the received signal during transmission so that the main half duplex problem is avoided (you do not hear yourself talk). This needs a little more investigation since line turn-around still takes place (it really is half duplex).

WHOI requested that we use only one serial port for both command/reply and the Kinematics time string (simplifying usage of the 7 lines). IGPP agreed that this is no problem.

Another implication of using RS-485 is that an addressing protocol is required since there are several devices on the line

at all times. IGPP will adapt their currently used protocol which includes addressing and send it (in preliminary form) to WHOI.

3. Data format and QC plans

Discussed the issue of data format for two reasons:

- real time QC on the ship while connected to cable
- data playback of the BIP disk after recovery.

IGPP can 'easily' do display of the real time data using VME/68000 system if data uses the present format. If format changes or if the machine is a PC, it is not so easy. IGPP will send preliminary format to WHOI. Note the BIP will add some state-of-health blocks to the data stream from the Reftek but they will be in PASSCAL compatible format.

If BIP disk is made to be DOS compatible, a conversion step on a PC will be required as well as transfer to a workstation class system (Sun). WHOI is looking at recording the disk using the 'PASSCAL spiral' format rather than making it DOS compatible.

Distribution:

Don Koelsch
Glen Offield, IGPP (via email)
John Orcutt, IGPP (via email)
Ralph Stephen
Dave Willoughby, SIO (via email)

Message-Id: <9310220344.AA01340@hurdle.who.i.edu>
To: allen@iris.washington.edu, tomb@snark.who.i.edu, dkoelsch@frosty1
Subject: Initial formatting ideas
From: RO

Tom Bolmer and Allen Nance: 21 Oct 93

Tom Bolmer will be handling our data processing and is thinking about some basic issues so I am sending this for his benefit. Also there are a couple of questions for Allen.

I seem to have lost the email file I got from Allen Nance, so will recreate it (you can see, it's no big deal!).

There are two types of packets: a status packet and a data packet. Both start with a 16 byte header.

HEADER STRUCTURE

Cap	Length	Type	Description
A	2	alpha	Packet start flag. Allen suggested DT for data and ST for status. I suggest we use DA and ST since they are a little more different from each other. Allen: OK?
B	2	binary	checksum (makes the raw sum of all bytes in the packet equal zero).
	1	binary	packet length (including this header)
	1	binary	channel number (1,2,3 for data or 0 for status)
B	2	binary	status flags (undefined at present)
B	2	binary	packet index number (increments each packet)
NNNNN	6	BCD	time of first sample (DDDHHMMSSMMM)

DATA PACKET

Each data packet contains a header structure then one second of data (20 samples) for one channel (uncompressed data). Each sample consists of three bytes (24 bits) in least-to-most significant order. Thus a complete data packet will be 16 byte header plus 20 * 3 bytes for a total of 76 bytes.

STATUS PACKET

Each status packet contains a header structure plus undefined status data. In the test program (SONDSIM), I made this 60 bytes of status so both packets are 76 bytes in length. This may change of course.

Parts of the packets are unspecified because the IGPP hardware is still being put together. Also we want to be able to add status in the BCU to the data stream coming from the Reftek and we haven't decided on bits yet either.

Allen: any news from your end about status bits yet?

... as serial data at 4000 baud. In the sonde simulator
have ordered them with the three data packets first (1,
then 2, then 3) then the status packet but processing
software should be able to cope with any order and with
missing packets too.

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My plan for the real time display is to pass data to
you (SPARC10) using PCNFS. I will flush and close every few
seconds (to be specified) so a new file will be created on
the SPARC every few seconds. What we need is a program that
plots a simple time series of the data then looks for the
next file to be created. We will decide on a display format
and the program should be designed to just do that format
and look for the new file. We do NOT want extensive user
interaction with this real time program - that will come in
the quick look program which will be designed for the user
to play with yesterday's data. This latter is the topic for
another day (and other people).

Allen: let us know if there are any mis-statements in
the above.

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al@hurdle
 received: by hurdle.who.edu (4.1/SMI-4.1)
 id AA07304; Fri, 19 Nov 93 11:35:24 EST
 Date: Fri, 19 Nov 93 11:35:24 EST
 From: kpeal@hurdle (Ken Peal)
 Message-Id: <9311191635.AA07304@hurdle.who.edu>
 To: ralphs@gannet.who.edu
 Subject: BBBSS format

Ralph: This is what I got from Allen Nance. I will send him a note to see why we are changing it from their "standard" format. I hope you don't mind about not meeting on Tuesday, but I am really under the gun on several things and we are going away for Thanksgiving. I will be here so we could talk on Tuesday if you like. Regards kp

Ken,

I have structured these packets with two goals in mind.

1. To minimize data loss when a packet is lost. This is why I have one channel/packet instead of three.
 2. Break out the status info from the packet header so that we can have more flexibility in changing the status information structure. This will also make it easier for you to add information onto the end of the packet before it is recorded.
- Note: David Willoughby at UCSD will be giving me more info next week that we allow me to start filling in the status packet.

Feel free to make any suggestions for things that would make the packet structure better for your purposes.

Allen Nance

DAS Packet Structure

Two types of packets will be generated by the DAS. One is a status packet and the other is a data packet. Both types of packets will start with 16 byte header.

Header Structure

Map	Length	Type	Description
AA	2	ALPHA	Packet start flag DT=data ST=Status
BB	2	Binary	Checksum
B	1	Binary	Packet Length
B	1	Binary	Channel (1,2,3 and 0 for status)
BB	2	Binary	Status flags
BB	2	Binary	Packet index number (increments each packet)
NNNNNN	6	BCD	Time of first sample DDDHHMMSSMMM

Data Packet

Each packet will contain one second of data (20 samples) for one channel and will be uncompressed data. Each data sample will consist of three bytes (24 bits) in least to most significant order. Therefore a packet of data with a 16 byte header as described above will contain 76 (16 + 20*3) bytes. Since there are three channels, three data packets will be sent each second.

Status Packet

The status packet will start with a 16 byte header. All of the
status info is yet to be defined.
Status packets will be sent at one second intervals.

al@hurdle.who.edu
received: by hurdle.who.edu (4.1/SMI-4.1)
id AA12373; Wed, 30 Mar 94 09:16:07 EST
Date: Wed, 30 Mar 94 09:16:07 EST
From: kpeal@hurdle.who.edu (Ken Peal)
Message-Id: <9403301416.AA12373@hurdle.who.edu>
To: allen@iris.washington.edu
Cc: ralphs@gannet.who.edu, dkoelsch@gannet, glen_offield@igppqm.ucsd.edu
Subject: Interface details - IMPORTANT STUFF

Allen: 30 Mar 94

Here is a summary of what we discussed on the phone yesterday as well as some other related thoughts.

The "new" 80 byte packet format as described in your email of 3 Feb is now pretty well fixed. Let me know of any differences ASAP. Obviously we can make changes later but let's hope they are minor.

The packet sequence is always channel 1 then 2 then 3. When status packets are inserted they will be outside this sequence.

You will send a status packet in response to every time string from us. Nominally these will occur every 30 minutes. You will have a timeout so that a status packet is sent every 60 minutes if none has been sent in response to a time string.

In addition to the periodic status packets sent in response to the time string, you will send unsolicited status packets whenever:

- a time tear occurs
- other to-be-specified changes in status data occur.

Need input from Ralph and John et al. about what changes should cause this extra packet.

In addition, your system can be set to send packets every second for your use on the ship when connected to the sonde. You will advise the syntax of the command to enable and disable this mode.

I think now that the test mode of status packets every minute that we discussed is probably not needed since we will get a status packet in response to our time string (which we can send manually for test purposes).

We talked about our sending the time strings all the time (currently we send them only while acquiring). For example when the system is connected for your checkout - that is with the BCU communications matrix set to connect the Reftek directly to the ship - we would still send time strings. The problem with this is that in order for the BCU to send the time string we need to switch the matrix so that it connects the BCU to the Reftek then return it to the Reftek-to-ship mode afterwards. Since this interrupts your connection, it could create problems with your testing.

I suggest that for the moment we consider doing the time string "by hand" when in this mode. This would mean that at our mutual convenience, we switch the connection back to the BCU-to-ship mode to issue the command, then switch to the BCU-to-Reftek mode to send the string then switch back to the Reftek-to-ship connection. This may sound complicated but in fact can be done in a matter of a few seconds.

Note that the 1 PPS does not stop (ever) and that when we do send a time string it will always be synchronized with the 1 PPS.

We also talked about our recording data when the system is set for your direct connected tests. At the moment we cannot do this but it does seem like a good idea so that we could record some data at the same time as you do then compare the results. Note that the problem of the time strings is the same here: when we begin acquisition, we send an initial time string and do so again every 30 minutes thereafter. We need to decide how serious this matrix switching problem is.

As part of this matrix switching picture, let me remind you how it works. When the BCU first boots up, the matrix is set for BCU-to-ship waiting for operator commands to the BCU. When it is switched to a position where it cannot talk, there are two ways to switch it back to the BCU-to-ship mode: cycle MPL power (which causes a reset) or send the string "reconnect_BCU". Since it always monitors communications, it will see this string and switch the matrix back to the BCU-to-ship connection. This was implemented in case we wanted to switch the matrix back gracefully - i.e. without cycling MPL power.

We had built in the ability to stop the 1 PPS as an indication of end of experiment but have been reminded that this function is being done by you. We will disable this function in our unit.

You are still on track to provide us with a card cage in May so we can resolve interface questions. The earlier in May the better.

Finally, after the call Don and I remembered that the interaction with the MPL telemetry needs to be considered. This is just a reminder to you in case you have forgotten. All telemetry between the ship and the underwater unit goes through MPL. Since MPL use this same channel for control of certain ocean bottom functions, we have an agreement that we use even parity and MPL uses odd. This should present no problem but probably does assume that nobody uses binary data on the link. Is this a problem?

Regards kp

4.3.1 Peal 1/10/94

TO: Distribution 10 January, 1994

FROM: K.Peal

RE: Software tasks

Attached is a description of the software needed for the BBBSS.

The sonde simulator and data checker programs exist (although the workstation version of the checker does not).

The core of the BCU program (read the data stream and write to disk) exists, I am starting to build the remaining parts. This will be my main activity for the next few weeks.

The lab forwarder and recorder will be done by Cleo Zani. Again the core parts already exist, Cleo is adding the finishing touches.

The real time display is being done by Tom Bolmer.

Any comments, changes, the sooner the better.

Distribution

T.Bolmer
D.Koelsch
R.Stephen

Specification for Control Programs

BBBSS Project

1. Introduction

This document describes the programs needed for the WHOI portion of the broadband borehole seismic system. This includes the following modules.

1.1 Sonde simulator - generates a simulated data stream for testing the WHOI portion of the system when the SIO part of the equipment is not present.

1.2 Data checker - checks for missing data or invalid format in recorded data.

1.3 Bottom control unit - the deployed controller program that receives data from the Reftek system and stores it on disk.

1.4 Laboratory recorder - shipboard computer program that receives data from the BCU and stores it on disk.

1.5 Laboratory forwarder - shipboard computer program that receives data from the BCU and forwards it to the laboratory workstation for display.

1.6 Real time display - shipboard workstation program that displays the data received from the laboratory forwarder.

1.7 Quick look and other processing - programs are needed for these functions but are not covered by this document.

2. Sonde simulator

2.1 General description

The program generates a data stream which is designed to be similar to that from the Reftek complete with incrementing time and packet number. Details of the format necessary to make it actually simulate the Reftek format will be changed as necessary by recompiling the program.

2.2 Sequence of operation

The program runs continuously when invoked.

2.3 Environment

The program runs on a PC in the DOS environment. Two COM ports are required.

2.4 Operator interaction

The program takes command line arguments to select which COM port to use for data and for communication. The program is terminated by striking escape.

2.5 Input/output details

The program can take a 1 PPS input from a clock if available to synchronise the output. This will be in the form of an "@" character input on the same port as that used for the data output. If the 1 PPS is not available, the program uses the PC's internal clock.

Output is serial asynchronous data at 4800 baud on the selected COM port under interrupt control. The actual format is groups of three data packets and one status packet sent at full baud rate starting at the beginning of each second. The format of the packets is described in appendix A.

Communication uses the selected COM port at 2400 baud. Support for input commands (time string and others) will be added if necessary.

3. Data checker

3.1 General description

BBBSS data stored on a hard disk are checked to ensure that no packets are missed or corrupted.

3.2 Sequence of operation

This function is performed by two programs, one to read the disk and write a system file, a second program to check the file contents.

3.3 Environment

A simple version of these programs runs on a PC in the DOS environment. A more extensive version runs on a workstation under Unix. To access the disk, a SCSI host adapter is installed. For use with a PC, the ASPI manager, loaded at boot time, is also required.

3.4 Operator interaction

The program takes as command line arguments the disk ID and a range of LBAs to check on the disk. Any operator key stroke terminates the program.

3.5 Input/output details

The input is taken from the selected disk. It is assumed to be written in serial LBAs using the data and status packets described in appendix A.

When initial synchronization with the data structure has been achieved, the packet ID and the time of the first sample are recorded. Similarly this information is recorded when any of the following occur:

- loss of synch (can't find next packet start flag)
- packet number or sample time out of sequence
- invalid packet sequence (should be X,Y,Z,status)
- invalid checksum.

During processing, a count is kept of the number of valid packets found and the number of times some form of resynchronization was necessary.

Output goes to the standard out device and may be redirected.

4. Bottom control unit

4.1 General description

The data stream from the Reftek is received, recorded on disk and sent to the surface via the MPL thruster if present. Time control is performed using the Seascan clock: 1 PPS pulses are sent to the Reftek as well as a time string in Truetime format sent at regular intervals. Operator control of various functions is provided when the ship is connected. Self check is performed when requested.

4.2 Sequence of operation

4.2.1 Startup

At first power up, the PROM (emulating drive A:) is accessed. The BIOS and the autoexec.bat and config.sys files ensure that operation begins as follows:

- communications set for surface-to-BCU
- one disk powered
- COM1 set for 4800 8N1
- COM2 set for 2400 8N1
- COM3 set for 9600 7E1.

Operator communication uses the serial port rather than a keyboard and display. Thus the serial communication from the surface acts as the console.

One of the disks is powered so that the Trantor SCSI adapter is active which in turn means that the Trantor ASPI manager finds both the adapter and a disk and thus loads itself in memory.

Operation then transfers to the application program. When it starts, I/O is initialized as follows:

- watchdog feeds active
- release relay disarmed (latching relay)
- the disk is turned off
- port 220 out, all zeros
- port 2D0 out, all zeros.

At this point, the program executes a branch to one of several modes as follows. If the "MPL bit" is on, it enters command mode. If the "MPL bit" is off and the "sonde_OK bit" is on, it enters autonomous acquisition mode. If the "MPL bit" is off but the "sonde_OK bit" is not on, the system enters recover mode.

4.2.2 Acquisition

In acquisition mode, the system switches the communications to connect it to the Reftek and turns on power to the Reftek. It receives the serial data from the Reftek, adds engineering status packets as described below and stores data on disk. The 1 PPS is enabled, an initial time string is sent then time strings are sent every hour thereafter. When the end of experiment time is reached, the program enters recover mode.

In acquisition mode, the system also responds to a transponder interrupt by executing a test (to be defined) with the result controlling the transponder reply.

If the "MPL bit" is asserted when in acquisition mode, the program reverts to command mode.

4.2.3 Command

In command mode the system responds to operator commands. The commands supported are outlined in 4.4 below.

In addition, if the "MPL bit" goes off and the "sonde_OK" bit is on it goes to autonomous acquisition mode. If the "MPL bit" goes off and the "sonde_OK bit" is off it goes to recover mode.

While in command mode, before entering acquisition mode, several operator inputs are required. These set variables in EEPROM which ensure correct operation in acquisition mode. The sonde must be centered and the sonde_OK bit set. The tether release must be armed and a corresponding bit set in EEPROM. The experiment stop time must be set. Finally the disk operating structures must be set.

4.2.4 Recover

In recover mode the system turns off power to the Reftek and sets indicators in EEPROM to ensure valid response to succeeding watchdog interrupts.

4.3 Environment

The program runs on a PC-like single board computer called a GCAT, running DOS 5.0. I/O includes two serial ports on the GCAT plus a third on a LOPACS MEM I/O board. The MEM I/O board also provides parallel I/O bits. A modified LFASE NRZ buffer card provides EEPROM, A/D converter, switch for the 4800 baud data line, and more I/O bits.

The GCAT provides a parallel port to which is connected a Trantor SCSI host adapter. Three Winchester disk drives are daisy chained to this adapter providing a total capacity of 3.15 Gbytes.

The autoexec.bat file transfers control to a serial communications port so no keyboard or video display is needed for operation. Also at boot time, a Trantor ASPI manager is loaded.

4.4 Operator interaction

When operating in command mode, the system supports the following operator commands:

- turn off CPU power
- power on/off to the Reftek
- power on/off to DRU
- select disk drive (1,2,3)
- power on/off to selected drive
- write test data to selected disk
- read selected LBAs from selected disk and send via data link
- report status structure of all drives
- reset status structure of all drives
- start/stop time string to Reftek
- set rate of time string repetition
- send one time string to Reftek
- read and display engineering data
- do self test and report result
- arm/disarm release relay and confirm
- switch comm link to surface-to-Reftek
- switch comm link to BCU-to-Reftek
 - ("reconnect_BCU" causes switch back to surface-to-BCU)
- reset Seascan clock
- check clock
- set clock alarm
- set/clear EEPROM data
 - sonde centered or not
 - release relay armed or not
 - end of experiment time
- go to acquisition mode
- go to recover mode.

4.5 Input/output details

4.5.1 Power control

During normal operation the system is powered continuously. During the initial period of the deployment it is planned to turn the system off to avoid drain on the battery. Thus no low power operating mode (sleep) is needed.

When the system turns itself off, some circuitry is still powered so the following actions are able to turn power on again:

- clock alarm
- MPL power on
- transponder interrupt
- communications link character.

4.5.2 Input/output bits

Type	Ident	Name	Init	Meaning
out	220/0	(AQUI_CMD)	x	(not used)
out	220/1	(TEST_CMD)	x	(not used)
out	220/2	MATRIX_CTL0	0	COM control
out	220/3	WATCH DOG RESET	0	feed dog
out	220/4	XPONDER RPLY	0	trig active xponder
out	220/5	OPERATING IND	0	high if OK (to both)
out	220/6	WRC RST CMD	0	reset Seascan clock
out	220/7	MATRIX_CTL1	0	COM control

MATRIX_CTL1	MATRIX_CTL0	
0	0	surface-GCAT
0	1	sonde-GCAT
1	0	surface-sonde
1	1	MPL-sonde

in	220/0	S1FPS	from Seascan clock
in	220/1	4800b DATA ON	OS on data stream
in	220/2	(CGG CLOCK ON)	(not used)
in	220/3	LEAK_BCU	high is leak
in	220/4	LEAK_DRU	high is leak
in	220/5	BBMPL PWR DET	MPL power bit
in	220/6	(AQUI SYNCHRO)	(not used)
in	220/7	BREADY	BCU ready

out	2D0/0	PWR DN CMD	0	high turns CPU off
out	2D0/1	REFTEK PWR CMD	0	high is Reftek on
out	2D0/2	DRU PWR CMD	0	high is DRU on
out	2D0/3	RCDR 1 CMD	0	high is #1 on
out	2D0/4	RCDR 2 CMD	0	high is #2 on
out	2D0/5	RCDR 3 CMD	0	high is #3 on
out	2D0/6	ARM REL RELAY	0	enables RELMTR
out	2D0/7	DISARM REL RELAY	1	blocks RELMTR
in	2D0/0	TIME_WKUP		Seascan SYNC
in	2D0/1	XPNDR1 WKUP		got xpndr1 cmd ??
in	2D0/2	XPNDR2 WKUP		got xpndr2 cmd ??
in	2D0/3	MPL WKUP		MPL power detect
in	2D0/4	COMM WKUP		input on COM
in	2D0/5	WDOG WKUP		dog bite
in	2D0/6	RELAY STATUS		high is armed
in	2D0/7	(not used)		

4.5.3 Interrupts

IRQA	(CGG byte from Altera)	(not used)
IRQB	MANY_WKUPS	XPNDR1 or 2 or MPL
IRQC	A/D EOC	high is conversion done

Note: each interrupt can be strapped to one of IRQ2, IRQ3, IRQ4, IRQ5, IRQ6, IRQ7 on backplane.

4.5.4 Transponder functions

Two functions are controlled by either of the two acoustic transponders. These are:

- release the tether (transponder command D),
- release the DRU (transponder release).

In order for the tether to be released, the GCAT must first have armed the release relay on command from the operator. When the transponder command D function is received, the actual tether release takes place without GCAT intervention. However since the GCAT does get the transponder interrupt, it is used for a second purpose - to invoke the self test.

Thus the transponder command to release the tether actually has two functions. Primarily it releases the tether, but it also invokes the self test. If the release command is sent when the release relay is not armed or when the tether has already been released, only the self test occurs.

Details of the self test are not yet defined.

4.5.5 A/D converter

out	22C/0	MUX0	x	analog select, 0
out	22C/1	MUX1	x	analog select, 1
out	22C/2	MUX2	x	analog select, 2
out	22C/3	MUX3	x	analog select, 3

Note: any write to 22C selects the analog channel and starts conversion.

in	22C/0	data 0	A/D reading, bit 0
in	22C/1	data 1	A/D reading, bit 1
in	22C/2	data 2	A/D reading, bit 2
in	22C/3	data 3	A/D reading, bit 3
in	22C/4	data 4	A/D reading, bit 4
in	22C/5	data 5	A/D reading, bit 5
in	22C/6	data 6	A/D reading, bit 6
in	22C/7	data 7	A/D reading, bit 7

chan	name	conversion
0	roll	$88.7728 - 0.6536 * A$
1	pitch	$88.7728 - 0.6536 * A$
2	24 v bat	$A/10$
3	28 v MPL	$A/7.242$
4	5 v	$A/40.8$
5	12 v	$A/16.932$
6	- 12 v	$-A/16.932$
7	SUS 5 v	$A/40.8$
8	DRU 5 v	$A/40.8$
9	DRU 12 v	$A/16.932$

where A is the A/D reading (0 - 255)

4.5.6 Watchdog

As currently configured, the watchdog must be fed by processor pulses more often than every 2.28 hours (8192 seconds) or the watchdog will turn off the power then turn it back on again. This achieves a system restart. The bit to prevent the restart is 220/3.

The restart bit (220/3) is toggled in the routine that turns on the disk power. With a data rate of about 300 bytes/second and using a 2 Mbyte buffer, a disk turn on should occur every 1.8 hours. However since the format is not yet finalized, it is possible that the watchdog timer should be lengthened (the basic data rate of 228 bytes/second fills the buffer in about 2.4 hours).

In the event of a system lockup when operating connected to the ship, the watchdog is the only CPU reset provided. This assumes that the disk writes are not taking place and that a wait of over two hours is acceptable to achieve the system reset.

4.5.7 EEPROM

out	230(all)	data	data latched for EEPROM
in	230(all)	data	data read from EEPROM
out	231/0	CE	CE to EEPROM
out	231/1	OEN	OE to EEPROM
out	231/2	WE	WE to EEPROM
out	232(all)	address	A0 - A7 to EEPROM
out	233/0	address	A8 to EEPROM
out	233/1	address	A9 to EEPROM
out	233/2	address	A10 to EEPROM

Note:

write sequence

- out 232, set lower addresses
- out 233, set upper addresses
- out 230, set data to be written
- out 231, set CE and WE (5), strobe EEPROM
- out 231, set 0, reset lines to EEPROM

read sequence

- out 232, set lower addresses
- out 233, set upper addresses
- out 231, set CE, OEN (3), read EEPROM
- int 230, read data
- out 231, set 0, reset lines to EEPROM

Use of EEPROM includes the following:

- sonde status (centered or not, locked or not)
- release relay status
- current status structures for the three disks
- time for the end of the experiment.
- check character.

4.5.8 Serial communications

GCAT COM1

- input is Reftek data
- if RTS asserted, output is Reftek data plus engineering data from GCAT/BCU to MPL etc
- if RTS not asserted, only Reftek data goes to MPL etc

- 4800 baud
- when the Reftek is powered, any gap in data of greater than 30 seconds causes the system to cycle power to the Reftek.

GCAT COM2

- operator console (command formats not yet defined)
- goes to switching matrix
- time string
 - sDDD:HH:MM:SSq<CR>
 - where s is ASCII SOH
 - q is quality indicator (space means OK)
- 2400 baud

GCAT COM3

- hardware is on MEM I/O board
- goes to Seascan clock (via C2) as SAIL/OC
- to set MUX and enable UART
 - out 0x81 to 2E0
 - address UART at 3E8
 - divide freq by 16 for 9600 baud
- 5 second timeouts are used on all commands to the clock.

4.5.9 Disk I/O

Disk recording is performed according to the format described in appendix A and B.

Data are collected into a 2 Mbyte buffer in memory then dumped to disk. This is done to minimize the time that the disks are running during a deployment. At each turn-on a single drive is powered and its status checked after spin up. When writing is complete, the status structure is written to the disk and also to the EEPROM.

The procedure is as follows:

- power on to DRU
- power on to selected drive
- wait for spin-up with timeout
- check drive status
- write data with timeout
- write status structure on drive with timeout
- write status structure to EEPROM
- power off to drive and DRU.

If timeouts or errors occur, turn off the current drive and try the task using the next drive.

5. Laboratory recorder

5.1 General description

This program receives the serial data from the BCU and stores it on disk. It provides real time display of the recorder status and permits the operator to change disks while operating.

It also does the clock check between the laboratory Truetime clock and the Seascan clock in the bottom control unit (BCU).

5.2 Sequence of operation

Once invoked, the program records data whenever serial input is being received. Under operator control it also performs the clock check.

5.3 Environment

The program runs on a PC in the DOS environment. A SCSI host adapter is used to access the disk. The ASPI manager, loaded at boot time, is also required. Two Winchester disks are mounted in an external SCSI enclosure in removable chassis.

One COM port is used for the serial input, a second is required to interface to the Truetime clock.

5.4 Operator interaction

The program takes as command line arguments:
the SCSI ID of the disk to use
the first LBA to use on the disk
the COM ports for the data and the Truetime clock.

During operation, the operator can change the disk in use. This allows a disk to be removed for examination on another computer while data recording continues.

Operator intervention may be requested by the program if it encounters disk errors.

5.5 Input/output details

The primary input is the serial data stream from the BCU. Its format is described in appendix A. The primary output is the data recorded on a disk using the format described in appendix B.

The use of the two storage disks is controlled by the following algorithm. Initially data are recorded on either the default or the selected storage drive. If errors occur, or if the selected drive becomes full, try to switch to the other

drive. If the second drive also exhibits errors, stop output and report the problem to the operator, asking for a retry. It is possible in this case that input data may be lost.

A live CRT display is used for the following items:

- status structure for both disks
- last operator selections
 - disk
 - start LBA
- the header from the last packet of each type processed.

Operator input causes a change to an operator dialog display followed by a return to the above display when the dialog is complete.

The clock check function is performed largely in hardware. The function of this program is to retrieve the latched data from the Truetime clock which is compared to the value from the Seascan.

6. Laboratory forwarder

6.1 General description

The serial data from the BCU is processed and stored on a workstation in files containing selected lengths of data. The length of the files is controlled by the operator.

6.2 Sequence of operation

The program runs continuously when invoked.

6.3 Environment

The program runs on a PC in the DOS environment. Sun's PCNFS is required in order to write files on the workstation for real time display.

A COM port is required for the serial data from the BCU.

6.4 Operator interaction

The program takes command line arguments to select:

- COM port to use for the serial data
- the destination path to use for the output files
- length of the output files in seconds.

During operation, the operator can change the path and the file size and stop program operation.

6.5 Input/output details

The primary input is the serial data stream from the BCU. Its format is described in appendix A. The primary output is the data recorded in files formatted as in appendix C. The real time display program then displays these files for viewing.

Note the file should contain three data packets from the same second. This requires additional synchronization with the incoming data stream after the basic packet synchronization is achieved.

The files written on the workstation are named PLOTME.001 and PLOTME.002. When one of the files is complete, it is closed and the other one is opened for writing (not updating). The real time display program meanwhile watches the file and when it is full size, processes then plots it.

A live CRT display is used for the following items:
current (workstation) path
disk file in use

number of files written
current file size in seconds
the header from the last packet of each type processed.

Operator input causes a change to an operator dialog display followed by a return to the above display when the dialog is complete.

7. Real time display

7.1 General description

This program processes the files created by the laboratory forwarder program. It reads each file, converts it to MATLAB format then displays the data as a time series in a MATLAB window. The MATLAB file may optionally be saved or deleted.

7.2 Sequence of operation

The program checks for the existence and size of files of the correct name and processes them one at a time when full size. During processing and waiting for the new file, the old display is retained. Thus the previous time series is displayed until a new one is received.

7.3 Environment

The program runs on a workstation in a Unix environment with MATLAB.

7.4 Operator interaction

During operation of the program, the operator can change the setting of the save switch which determines whether the MATLAB files are save or deleted.

7.5 Input/output details

The files created by the forwarder program serve as input to this program. The format of each is as described in appendix C. Output is a three channel display of the time series with date, time, identification, etc from the packet header.

The input files are converted to MATLAB for plotting and possible other analysis. The MATLAB files may be deleted after being displayed or they may be renamed using the time and date information in the header.

Appendix A Packet formats

There are two types of packets: a status packet and a data packet. Both start with a 16 byte header.

HEADER STRUCTURE

Map	Length	Type	Description
AA	2	alpha	Packet start flag. DT for data and ST for status.
BB	2	binary	checksum (makes the raw sum of all bytes in the packet equal zero).
B	1	binary	packet length (including this header)
B	1	binary	channel number (1,2,3 for data or 0 for status)
BB	2	binary	status flags (undefined at present)
BB	2	binary	packet index number (increments each packet)
NNNNNN	6	BCD	time of first sample (DDDHMMSSMMM)

DATA PACKET

Each data packet contains a header structure then one second of data (20 samples) for one channel (uncompressed data). Each sample consists of three bytes (24 bits) in least-to-most significant order. Thus a complete data packet will be 16 byte header plus 20 * 3 bytes for a total of 76 bytes.

STATUS PACKET

Each status packet contains a header structure plus undefined status data.

Appendix B Main storage disk format

The storage disks have data written to them in a linear or flat-file fashion. Each disk is viewed as a single long series of storage areas called logical blocks which are written sequentially. Any given block is identified by its number or address and is referred to as the LBA (logical block address).

In order to retain compatability with Unix, the first two logical blocks are not used for data. These are used by the operating system for label and partitioning information.

The third block is used to store the structure containing current write control information on the disk so data readback can be performed without use of supporting information. This structure is updated by the recording system every time data are written to the disk. For security the structure is also written to an LBA near the end of the disk.

Appendix C Display file format

Each file saved for use by the real time display program contains several seconds of data. Thus for a file of length n seconds, the structure is as follows. Note that the status packets are ignored for this purpose.

```
file size in seconds
data packet for channel 1 for time t
data packet for channel 2 for time t
data packet for channel 3 for time t
status packet
data packet for channel 1 for time t+1
data packet for channel 2 for time t+1
data packet for channel 3 for time t+1
status packet
data packet for channel 1 for time t+2
data packet for channel 2 for time t+2
data packet for channel 3 for time t+2
status packet
.
.
.
data packet for channel 1 for time t+n-1
data packet for channel 2 for time t+n-1
data packet for channel 3 for time t+n-1.
status packet
```

Broadband Borehole Bottom Control Unit Data Flow and Recording K.Peal, WHOI

Summary

The broadband borehole Bottom Control Unit (BCU) receives data from a Reftek acquisition system which is located downhole. The received data are stored on one of three Winchester disks in the BCU which is located in the borehole re-entry cone. The controller for the BCU is a low power PC clone called a GCAT with a SCSI host adapter connected to an unmodified SCSI bus with three Micropolis 1.2 Gbyte disks (model 2112). Special circuitry and sequencing are used to control power to the host adapter and the three disks to limit power dissipation. Data are collected by the GCAT into a 2 Mbyte memory buffer until the buffer is full, then the SCSI portion of the system is powered and the data dumped to the disk.

Hardware/Software outline

The incoming data appears as RS-232 data at a COM port of the GCAT. It is read into a memory buffer under control of Greenleaf interrupt functions. The application program extracts data from this buffer by searching for the known Reftek packet format. Each packet is copied to a 2 Mbyte PCMCIA using application software (originally the PCMCIA was configured as a floppy drive under DOS, but this was found to cause missed interrupts to the Greenleaf functions with resultant lost data bytes). When the PCMCIA is full, the complete 2 Mbytes are copied to one of the hard disks.

During the transfer to disk, new packets are not being removed from the incoming buffer. The buffer provides for several minutes of disk transfer activity without incoming data being overwritten. Although the disk transfers normally occur much more quickly, this allows for cases where disk errors occur necessitating retries or for the process of changing to a new disk when one becomes full.

The three disks are connected to a single SCSI bus via Kingston Technology Data Express disk carriers which provide for hot swap and permit operation of one unit while the other two are powered off. A SCSI host adapter from Trantor (now sold by Adaptec) uses the PC's printer port allowing it to be powered down when not in use. The Trantor company provides an ASPI driver for the host adapter which must be loaded into memory. For the driver to load correctly, it must find the host adapter and a disk at boot time. In order to satisfy this requirement, special circuitry turns on power to the disk and the adapter at boot time. All disk transfers are effected by table driven calls to this ASPI driver. Data are transferred in groups of packets chosen so that packet and logical block boundaries coincide.

The data are written as a stream of packets to the disk at increasing logical block addresses (LBA). That is, the disk is written as a single non-formatted file. The first two logical blocks (0 and 1) are required by UNIX for partition and label information (the disks are read on a workstation under UNIX). In order to keep track of where on the disk to write the next group of packets, a structure is maintained for each disk which contains a pointer to the next LBA to write. Three copies of this structure are maintained for each disk: one copy is stored at LBA 3, another at the last LBA on disk, a third copy is maintained in memory. Whenever a disk is to be accessed, these three copies are assembled and if they do not agree, a majority vote process is

applied. Since UNIX uses some LBA's as spares, we are not able to write to the nominal last block on disk. Thus some small amount of capacity is lost in addition to that needed for the two disk copies of the next LBA.

Files involved

A list of relevant files is attached.

Software initiation

When the application program starts, three forms of initiation are required:
 data input via the Greenleaf functions
 PCMCIA storage
 disk output.

The Greenleaf functions are initiated in routine InitializeCommPort() in pacacq.c. This contains Greenleaf calls to start input and use a 50,000 byte local memory buffer. This provides about 3.5 minutes of input buffering.

All PCMCIA transfers are handled with WCfopen(), WCfwrite(), etc calls written by Wordcraft (WC, C.Zani) to emulate the normal fopen(), fwrite() calls. Actual transfer is done through a memory address window by manipulating registers. Initiation is performed by routine InitializeDataFiles() in pacacq.c which calls WCfopen() to open a PCMCIA "file". The nominal 2 Mbyte PCMCIA provides about 2.3 hours of output buffering.

Disk initiation normally requires locating the ASPI driver in memory and being sure that one or more disks are connected and running. In the case of a battery powered system it is desirable to do this without powering the disks. This is performed by using a short file which contains dummy disk structures. This file is read at the start of the program then when the disk accesses occur, the actual disk structures are read from the disks.

The routines to perform the disk initiation are:

InitializeSCSIDevices() in acquit.c
 ASPIEntryQuery() in aspienqu.c
 OpenASPI() in openclos.c
 - the open call to the ASPI driver
 GetASPIEntryPoint() in getaspie.c
 - gets the ASPI driver entry point
 CloseASPI() in openclos.c
 - the close call to the ASPI driver
 GetSCSIDev() in scsidevf.c
 - reads the file of disk structures
 FirstDevice() in selectde.c
 - selects the first valid disk
 CheckDevices() in selectde.c
 - checks that there are valid disks
 DisplaySCSIDevice() in dispfile.c
 - displays the disk structures.

Detailed input transfer sequence

With interrupts running, the input buffer is being filled continuously. The input transfer to this application is performed by extracting packets from the input buffer and moving them to the PCMCIA buffer (called the RAM drive). At this time the retransmission of the packets to the surface is performed with WHOI data added to the status packets if appropriate. The routines to perform this (all in pacacq.c) are:

```
RecordReadyForRAMDrive()
ReceivedNumber()
IsHeader()
sendApacket()
CopyRecordToRAMDrive().
```

Detailed output transfer sequence

When the RAM drive is full, the program stops extracting packets from the input buffer and moves the complete PCMCIA data buffer to disk using the ASPI driver. This involves powering the selected drive, reading from this disk the blocks which contain the next block pointer values (referred to as the FATs), building the logical block addresses to write on disk and doing the transfer. Built into this process are loops to retry operations if necessary on the same disk and changes to other disks when operations fail. The program is built so that it will continue trying all disks in a loop if no satisfactory write occurs - the only exit from the loop is a successful write.

The top level routine is CopyRAMDriveToDisk() in acquit.c, the application program. This calls DeInitializeDataFiles() in pacacq.c to close the PCMCIA file then the main data writing loop PCMFileCopy() in acquit.c. Routines called in PCMFileCopy() are:

```
PowerUpSCSI() in selectde.c
SetBlockAddress() in buildblo.c
OpenRAMFileForReading() in acquit.c
FillDataBuffer() in acquit.c
ExecuteSCSIWrite() in scsiwrit.c
CloseRAMFileForReading() in acquit.c
PowerDownSCSI() in selectde.c.
```

The routine PowerUpSCSI() involves these routines:

```
feed_watchdog() in stubs.c
power() in power.c
delay()
ExecuteSCSIPowerUp() in scsipwer.c
ReadFATs() in scsifat.c.
```

Routine `ExecuteSCSIPowerUp()` turns on the drive, does a dummy SCSI read then issues a reset. It involves these routines:

- `TellDevice()` in `telldevi.c`
- `SetSRB()` in `setsrb.c`
- `power()` in `power.c`
- `ASPIEntry()` in `aspidata.c`
- `StartSecondsWaiting()` in `waiting.c`
- `ResetSCSIDevice()` in `resetscs.c`.

The routine `PowerDownSCSI()` involves these routines:

- `WriteFATs()` in `scsifat.c`
- `power()` in `power.c`.

The routine `ExecuteSCSIWrite()` does the call to `ASPIEntry()` which does the data transfer. It deals with error returns `ABORT`, `RETRY`, `SEVERE`, and `REBOOT` (see next section). It involves these routines:

- `SetSRB()` in `setsrb.c`
- `BuildBlockAddress()` in `buildblo.c`
- `NextDevice()` in `selectde.c`
- `PowerUpSCSI()` in `selectde.c`
- `SwapCDBStuff()` in `swapcdbs.c`
- `ASPIEntry()` in `aspidata.c`
- `StartSecondsWaiting()` in `waiting.c`.

BBBSS Disk Error Handling

The SCSI controller in the disks, the host adapter and driver software perform many control and error checking functions. As a result, provision is made for many error returns from the various elements in the sequence. The intent is for the program to try to continue to collect data under all circumstances. Only when all three disks are marked as `FULL` does the program cease to collect data.

A log of all disk errors is kept in EEPROM during operation. In addition, a coded version of the errors is added to the status packet which is sent to the ship and is stored on disk.

This section describes the action taken by the program with regard to possible disk errors. The action taken depends on which of five types of error occurs. First the five types - `NOSTART`, `RETRY`, `SEVERE`, `ABORT`, `REBOOT` - will be described.

The process of transferring data from memory to disk involves several steps. Initially the system collects data into a memory buffer then transfers it to the 2 Mbyte buffer on the PCMCIA card. When this buffer is full, the disk which is currently in use is turned on. If the selected disk powers up successfully, the process of transferring the complete PCMCIA buffer to disk is

begun. If a problem is detected during power up, a NOSTART error type is registered and the next drive is selected.

When a disk has been powered successfully, a table pointing to data buffers is passed to the ASPI driver which moves that data to the disk for storage. This involves the driver dealing with the Trantor host adapter, and in turn with the drive itself. In this process error returns are possible

- i) from the driver, referred to as SCSI error codes;
- ii) from the adapter, referred to as HOST error codes;
- iii) from the disk at various levels, referred to as
TARGET error codes,
SENSE KEY error codes and
additional SENSE CODES.

These errors are not all independent; some faults will generate several codes.

Four error types have been defined from these error returns. A RETRY type leads to the same operation being retried on the same drive up to three times. If the error remains, it is reclassified as a SEVERE type. A SEVERE type leads to an immediate return to the calling routine which causes the program to turn off the current drive and begin the same operation again with the next drive.

An ABORT type causes the calling routine to issue a SCSI ABORT I/O request. If this is processed correctly, the same operation is retried. If this is not processed correctly, the calling routine issues a SCSI RESET DEVICE request. If this is processed correctly, the same operation is retried on the same drive. If it is not processed correctly, it is treated as a SEVERE error (return and move to next drive).

Note that when moving to the next drive, the sequence is a circle. That is, it will try drive number 1 as the next drive after number 3. Also a drive which is in use when an error occurs is not eliminated from the sequence the next time around.

A REBOOT type causes the application program to abort. This returns the BCU to the DOS prompt. The watchdog will eventually "bite" and reboot the system.

The returns and their types are as follows.

SOURCE	DEFINITION	TYPE
SCSI	request in progress	ABORT
	request completed	(none)
	request aborted by host	SEVERE
	completed with error	RETRY
	invalid request	SEVERE
	adapter not installed	REBOOT
	device type not valid	SEVERE
	(unused)	SEVERE
HOST	did not detect any error	(none)
	selection timeout	SEVERE
	data over-run/under-run	RETRY
	unexpected bus free	ABORT
	target bus phase sequence	ABORT
	(unused)	SEVERE
TARGET	no target status	(none)
	check status	ABORT
	specified target/LUN busy	ABORT
	reservation conflict	ABORT
	(unused)	SEVERE
SENSE KEY	no sense keys	(none)
	successful recovery by drive	(none)
	drive cannot be accessed	ABORT
	flaw in medium/error in data	RETRY
	hardware failure	REBOOT
	illegal parameter in call	ABORT
	drive is write protected	SEVERE
	drive aborted the command	RETRY
	search command was satisfied	(none)
	data did not verify	RETRY
	(not implemented)	SEVERE
	(unused)	SEVERE
	Additional SENSE CODES	
	(no sense code)	(none)
	drive could not seek in time	RETRY
	error during write	RETRY
	drive is not ready	ABORT
	drive LUN could not be addressed	ABORT
	drive could not rezero	RETRY
	firmware failed to communicate	ABORT
	sector ID field could not be read	RETRY
	block could not be written/read	ABORT
	no sector header address?	ABORT
	no sector header data?	ABORT

improper block sequence	ABORT
miscompare between disk and CDB	ABORT
no sector data	ABORT
read recovery using retries	(none)
read recovery using ECC	(none)
error accessing defect list	ABORT
parameter list too long	ABORT
no primary defect list	ABORT
compare error	ABORT
initiator issued an invalid command	ABORT
addressed block was not valid	ABORT
illegal function for this LUN	ABORT
incorrect value in a CDB field	ABORT
invalid LUN	ABORT
incorrect value in parameter field	ABORT
disk is write protected	SEVERE
drive has been reset	RETRY
drive's mode select parameters have changed	RETRY
drive's format structures are corrupted	SEVERE
no remaining alternate tracks	SEVERE
drive RAM memory error	RETRY
initiator message reject	ABORT
SCSI detected an internal firmware error	RETRY
SCSI firmware detected a timeout error	RETRY
internal parity error	RETRY
initiator sent a detected-error message	RETRY
initiator sent an illegal SCSI message	ABORT
(unused)	ABORT
(not implemented)	ABORT

Volume in drive B is SCRATCHA001
Directory of B:\

ACQUIT	C	9901	10-24-94	10:33p
ASPIDATA	C	1219	09-26-94	5:13p
ASPIENQU	C	1143	02-14-94	3:28a
BUILDBLO	C	1011	02-21-94	9:57p
DISKMAXL	C	640	10-23-94	12:48a
DISPFILE	C	919	02-21-94	3:20p
DISPLSEN	C	1079	07-01-94	4:57p
FATREAD	C	2795	09-28-94	3:27p
FATWRIT	C	2016	09-26-94	8:55p
GETASPIE	C	1525	02-11-94	8:35p
GRIPE	C	926	09-27-94	3:46p
OPENCLOS	C	351	02-10-94	6:31p
PACACQ	C	11676	10-24-94	9:17p
PORTIO	C	1339	02-08-94	4:35p
POWER	C	909	03-15-94	1:43p
RESETSCS	C	2482	09-26-94	1:14p
SCSIDEVF	C	1175	02-16-94	9:05p
SCSIFAT	C	5260	03-07-94	6:17p
SCSIPOLL	C	4587	07-01-94	5:11p
SCSIPWER	C	2388	09-27-94	6:02p
SCSIREAD	C	2722	09-27-94	6:00p
SCSIWRIT	C	2785	09-27-94	6:01p
SELECTDE	C	2717	10-03-94	3:31p
SETSRB	C	594	02-04-94	1:24a
STARTUP	C	3483	09-28-94	12:26p
STUBS	C	745	03-09-94	2:39p
SWAPCAPA	C	445	02-04-94	1:24a
SWAPCDBS	C	525	02-10-94	7:14p
SWAPSAAS	C	515	02-10-94	7:16p
TELLDEVI	C	705	02-04-94	1:24a
WAITING	C	407	02-04-94	1:24a
31 file(s)		68984	bytes	
		1324544	bytes free	

Volume in drive B is SCRATCHA001
Directory of B:\

ACQUIT	H	84	03-15-94	3:17p
APPLSTRU	H	856	09-26-94	4:35p
ASPIDATA	H	2079	09-24-94	7:52p
ASPIDefs	H	1036	06-26-94	9:31p
ASPIENQU	H	210	02-14-94	3:29a
ASPIFILE	H	95	02-13-94	5:51p
ASPIQUER	H	234	02-14-94	4:14p
ASPIRESO	H	359	12-20-93	10:06p
ASPISTRU	H	3772	06-25-94	7:37p
BUILDBLO	H	285	12-04-93	12:34a
CHEKALRM	H	34	04-26-94	1:25p
COMMAND	H	1381	04-20-94	2:51p
COMPILEV	H	223	02-13-94	6:19p
COMSCAN2	H	35	02-15-94	9:17p
DEFINES	H	552	02-02-94	12:46a
DISKMAXL	H	226	12-02-93	10:34p
DISPFILE	H	223	02-19-94	9:17p
DISPLGDT	H	233	12-02-93	6:56p
DISPLHAI	H	243	12-02-93	6:56p
DISPLSEN	H	669	06-26-94	9:33p
DISPLSRB	H	229	12-02-93	6:56p
DISPLSRC	H	228	12-04-93	12:10a
DISPLSRD	H	231	12-03-93	12:02a
DISPLSWR	H	232	12-05-93	11:49a
ENGINEER	H	665	09-27-94	6:09p
EXTERNS	H	789	09-27-94	7:57p
FATREAD	H	223	02-18-94	9:39p
FATWRIT	H	224	02-18-94	9:49p
FUNCDEFS	H	3083	04-26-94	1:26p
GETASPIE	H	246	12-02-93	6:49p
GETDEVIC	H	260	12-02-93	6:32p
GRIPE	H	625	12-13-93	10:19p
HOSTADAP	H	249	12-02-93	6:32p
INFORM	H	264	12-02-93	5:59p
MESSAGE	H	49	02-23-94	1:54a
MYWATCH	H	53	03-04-94	4:58p
OPENCLOS	H	248	12-02-93	6:49p
PACACQ	H	1231	02-25-94	6:18p
PACKET2	H	1255	05-03-94	2:49p
PARAM	H	613	01-22-94	2:16p
PAUSE	H	31	12-14-93	12:52p
PCMFILE	H	1672	02-01-94	12:02a
QUERYFOR	H	279	02-14-94	4:14p
RESETSCS	H	271	06-25-94	7:15p
SCSIDEFS	H	1581	10-23-94	12:45a
SCSIDEVF	H	96	02-14-94	7:09p
SCSIFAT	H	235	02-13-94	6:23p

SCSIPOLL	H	4403	09-27-94	4:00p
SCSIPWER	H	213	02-21-94	4:08p
SCSIRCAP	H	221	12-04-93	12:03a
SCSIREAD	H	224	12-02-93	10:26p
SCSIWRIT	H	225	12-05-93	11:49a
SELECTDE	H	339	02-21-94	4:19p
SENDER	H	31	03-09-94	2:37p
SETSRB	H	238	12-02-93	6:52p
SIGNON	H	224	02-16-94	6:41p
STARTUP	H	697	09-27-94	7:57p
STR2TMPF	H	244	12-02-93	11:20p
STRNREV	H	489	12-04-93	10:07p
SWAPCAPA	H	221	12-04-93	10:41p
SWAPCDBS	H	216	12-04-93	10:54p
SWAPSAAS	H	218	12-04-93	11:04p
TELLDEVI	H	216	12-02-93	7:08p
WAITING	H	256	12-02-93	11:20p
		64	file(s)	36666 bytes
				1324544 bytes free

4.4 Power Budget

4.4.1 Koelsch 1/21/92

MEMORANDUM

To: Ralph Stephen
 From: D. E. Koelsch *Don*
 Re: Battery calculations for SEABASS equipment.

Date: 1/21/92

First there are some baseline assumptions that have to be made:

1. Battery capacity is calculated by the product of voltage and the ampere-hour rating ($38 \times 24 \times .8 = 729.6$ watt-hrs. available energy). A de-rating by 15% for 0 degrees C and a further 2% /month for the deployment time is factored into this calculation. Figuring at least a 2 month deployment and the fact that these batteries had been acquired almost a year before the LFASE cruise the derating figure is 80% of a new battery at room temperature.

2. The unattended deployment time will be 30 days.

3. There will be a data acquisition and recording period of 6 minutes every hour (10% duty cycle)

4. There will be 10 three hour special acquisitions.

5. Data transfer to recorders will be at 4 kBytes/sec. (32 kbits/sec)

6. Current requirements as stated before:

<i>.003</i>	<i>.0026</i> A	Standby power down mode.
	.380 A	Standby CPU ON. <i>.33</i>
<i>.72</i>	.740 A	CPU ON, DTU ON. <i>.3</i>
<i>1.45</i>	1.600 A	CPU ON, Recorders ON, DTU ON
	<i>1.82</i> A	CPU on, DTU on, Recorder on.

7. DTU and recorders are not on at the same time.

To fill the disks without having to rewrite any records will require 41 hours. $[(600 \times 10) / (4 \times 10 \times 3600) = 41]$. It will require an additional 41 hours to acquire the data. Standby

Let:

E = energy required to take the data
 take data
 E = energy required to store the data
 Xfer data
 E = energy required for Standby power down mode
 Power down

Then:

E = E + E + E
 TOTAL take data Xfer data Power down

Now:

E = $24 \times .72 \times 41 = 728.2$ watt-hours *0.709 kW*
 take data
 E = $24 \times 1.45 \times 41 = 1574.4$ " " *16*
 Xfer data
 E = $24 \times .0026 \times (720 - 82) = 39.8$ " "
 Power down *24 .003 1500*

E
TOTAL

130
2343.4 watt-hours
~~2343.4~~

Therefore the minimum number of batteries needed is:

$$2343.4/729.6 = 3.21 \Rightarrow \underline{4 \text{ batteries.}}$$

Now in case one for the batteries malfunctions it was deemed wise, by me, to have a fifth unit as added insurance for this one shot deployment.

To address the fact that we ran out of power during the deployment an understanding of the software is necessary. First, when there is a record, to write to the disk the program will attempt to write it as the next file on the then active recorder. It tries to write this file 3 times. If it is unable to do this the program moves on to the next recorder and tries again to write the file. The program will continue to try to write and move to next recorder until there is no more power. Since there was one full disk and one partially filled disk and one recorder couldn't write the program kept cycling trying to store data.

I hope this puts the battery issue to rest.

oelsch@gannet.who.edu
 bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA03436; Thu, 26 Jan 1995 16:42:47 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA14502; Thu, 26 Jan 1995 16:33:51 -0500
 Received: by aqua.who.edu (5.57/Unix3.0-C)
 id AA00257; Thu, 26 Jan 95 16:42:07 -0500
 Received: by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA03410; Thu, 26 Jan 1995 16:42:45 -0500
 Date: Thu, 26 Jan 1995 16:42:45 -0500
 From: don koelsch <dskoelsch@gannet.who.edu>
 Message-Id: <9501262142.AA03410@gannet.who.edu>
 To: rstephena@aqua.who.edu

Ralph:

Jan 26, 1995

This is memo on the battery calculations that we discussed 1/25/95

From data we took at IGPP Yard with the 300 m of cable between the BCU and the Sonde showed:

1. We must maintain 24 volts from the batteries because this gives only 17.1 volts to the SONDE. Any lower and the SONDE stops working.

2. The Sonde is designed to work at 24 volts. To supply this the BIP we must design a battery system will not fall below 29 volts at end life.

3. Current measurements, using an averaging current meter the following observations were made while supplying 30 volts to the system.

BCU	100 ma	3 Watts
DAS (REF-TEK)	200 ma	6 Watts
KS 54000	250 ma	7.5 Watts
TOTAL	550 ma	16.5 Watts

To supply this power for 90 days the battery must start at greater than 30 volts and not fall below 24 volts at end life. A current of 550 ma for 2160 hours needs 1188 AH of battery. To get 30 volts at end life there must be 9 batteries in a series string.

Wilson-Greatbatch Ltd. (Electro-Chem) battery # CSC93 is a DD size Lithium Oxyhalide primary cell having a rated capacity of 30 AH at room temperature. These should be derated for 1. Zero degrees C, 2. Low per cell current drain, 3. Delay of available current due to build up of a passivation layer. I believe in using a conservative figure of 66% of rated ampere-hours. I will, however, give the costs for both 20 and for 25 AH derating.

If 20 AH rating is used:

1188 AH/20 AH/cell-string = 59.4 (60 strings of 9 cells each) or 540 cells. We can fit 4 strings per deck => 15 decks. At 6 decks per pressure we will fill 2 cases with 3 decks in the 3rd case. We also need a deck to run the recorders; another 36 cells. These would be in the DRU. We therefore need 16 decks of batteries holding 576 cells. Assembly costs may be as high as \$250 per deck. Total costs (16 X 250) + (576 X \$45.00) = \$29,920.

If 25 AH rating is used:

1188 AH/25 AH/cell-string = 47.5 (48 strings of 9 cells each) or 432 cells. We can fit 4 strings per deck => 12 decks. This fits into 2 of our cases. We still need a deck to run the recorders. The total number of cells is 432 + 36 = 470 cells. Total cost of this more optimistic rating is (13 X \$250) + (470 X \$45.00) = \$24,400.

The battery protection and connection circuits still must be built and installed in the cases and the entire battery assembled (time for a technician).

Hope this helps you with your budget.

al@hurdle.who.edu
 aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu
 ESMTTP id PAA05532 for <rstephen@gannet.who.edu>; Wed, 14 Feb 1996 15:16:00 -0500
 Received: from hurdle.who.edu (hurdle [128.128.92.91]) by aqua.who.edu (8.6.11/8.6.11) with ESMTTP id PAA01955; Wed, 14 Feb 1996 15:12:59 -0500
 Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id PAA01826; Wed, 14 Feb 1996 15:08:06 -0500
 Date: Wed, 14 Feb 1996 15:08:06 -0500
 From: Ken Peal <kpeal@hurdle.who.edu>
 Message-Id: <199602142008.PAA01826@hurdle.who.edu>
 To: glen_offield@igppqm.ucsd.edu, richard@mpl.ucsd.edu
 Cc: rstephen@who.edu, rgoldsborough@who.edu, mgould@who.edu
 Subject: Borehole power decision

Glen, Richard:

14 Feb 96

We have pretty well settled on the battery design for the borehole and want to get your approval. The problem is that we need to deal with higher voltages because of the drop in the 7 conductor cable. To cut to the chase, the results are:

MPL input at BCU 30 to 36 volts
 input to sonde 18 to 35 volts.

The questions are:

Richard: can you give us 30 to 36 volts?

Glen: can you live with 18 to 35 volts?

The following is info about how we reached this conclusion. I will FAX you a version with the plot.

During the October 94 tests at IGPP, we did a voltage drop test with the complete system: the BCU in the WHOI trailer, the cable on the reel on the trailer and the DAS, Teledyne, etc in the IGPP lab. Voltages were measured at the input to the sonde power supply for various power supply voltages at the BCU. The results are in the attached plot. The low end was determined when things in the sonde started to shut down:

DAS only dies at 16 volts at the BCU
 DAS+Teledyne dies at 22 volts at the BCU
 DAS+Teledyne+moto IC dies at 24 volts at the BCU.

The battery provides power for the DAS and Teledyne but not for the moto IC. Thus the battery voltage must be greater than 22 to prevent DAS shutdown. Say we choose 24 volts as the battery end of life. Based on Electrochem DD size BCX (3B76) this means we need 8 cells per string leading to an operating range of 24 to 30 volts.

To ensure that the moto IC energy comes from the MPL/CV power and not the battery then we need a range of 30 to 36 volts from the CV at the BCU.

The resultant input range at the DAS then is:

minimum: 18 volts for battery end-of-life with
 DAS+Teledyne load
 maximum: 35 volts for 36 volt CV input with DAS-alone
 load.

Note this wider range also means that we need to change the power supplies in the BCU.

Please let me know if you see any problem here.

Regards ... kp

sal@hurdle
..... aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu
ESMTP id IAA29213 for <rstephen@gannet.who.edu>; Thu, 15 Feb 1996 08:03:51 -0500
Received: from hurdle.who.edu (hurdle [128.128.92.91]) by aqua.who.edu (8.6.11/8.6.11) w
ith ESMTP id IAA06071; Thu, 15 Feb 1996 08:00:49 -0500
Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id HAA02036; Thu, 15 Fe
b 1996 07:56:29 -0500
Date: Thu, 15 Feb 1996 07:56:29 -0500
From: Ken Peal <kpeal@hurdle.who.edu>
Message-Id: <199602151256.HAA02036@hurdle.who.edu>
To: richard@mpl.ucsd.edu, glen_offield@igppqm.ucsd.edu
Cc: rstephen@who.edu, rgoldsborough@who.edu
Subject: Borehole current profile

Richard, Glen:

15 Feb 96

There are three parts to the current profile: the
background, the disk, and the Teledyne motors.

1. Background. Depending on what is powered this is between 250
and 600 mA at 30 volts.
2. Disk. Approximately every 2.5 hours during acquisition, a
disk spins up to write data. This takes about 110 seconds. The
first approximately 10 seconds is at 1.5 A, the next 10 seconds
at 1 A, and 90 seconds at 0.8 A. All these are at 30 volts.
3. Teledyne motors. Glen, can you give us an estimate for this
portion? The Teledyne moto IC is included in the background, but
I presume the actual leveling motor drain is additional.

Regards ... kp

Received: from aqua.who.i.edu (aqua [128.128.16.1]) by gannet.who.i.edu
 ESMTP id OAA06630 for <rstephen@gannet.who.i.edu>; Fri, 16 Feb 1996 14:26:37 -0500
 Received: from hurdle.who.i.edu (hurdle [128.128.92.91]) by aqua.who.i.edu (8.6.11/8.6.11) w
 ith ESMTP id OAA20778; Fri, 16 Feb 1996 14:23:33 -0500
 Received: (from kpeal@localhost) by hurdle.who.i.edu (8.6.12/8.6.9) id OAA02722; Fri, 16 Fe
 b 1996 14:19:07 -0500
 Date: Fri, 16 Feb 1996 14:19:07 -0500
 From: Ken Peal <kpeal@hurdle.who.i.edu>
 Message-Id: <199602161919.OAA02722@hurdle.who.i.edu>
 To: dwilloughby@ucsd.edu, glen_offfield@igppqm.ucsd.edu, richard@mpl.ucsd.edu
 Cc: rstephen@who.i.edu, rgoldsborough@who.i.edu
 Subject: Borehole power questions

Dave, Glen, Richard:

16 Feb 96

Dave, I need some help understanding your messages about the borehole power question.

You say that the current for the seismometer and moto IC alone is 2.2 mA and end up suggesting we allow for 3 mA to cover everything. That just doesn't jibe with what we saw and if I make it 2.2 Amps instead of 2.2 mA it still seems wrong.

We had indication that the moto IC takes about 180 mA idling and the Teledyne take about 160 mA. I suppose the motors could be 100 mA each so the total would be 0.7A. Is that what you meant?

If there is any doubt about how to get this correct, I would like to take Glen up on his offer to make some measurements now in the lab.

I also have trouble with the voltage question. The measurements we made in the IGPP parking lot were "volts at BCU", "volts in to sonde PS" and "volts from sonde PS". The stuff I plotted was the "BCU" and the "input" to the sonde (the "output" seemed to be just 0.8 volts less than the "input"). I assumed that both the DAS and the seismometer saw the "sonde input" volts but you seem to say that the "output" is what the Teledyne sees. I don't know what is in your system - just wondering.

However, I still have trouble if we are going to put nearly 34 volts onto a 28 volt device! I can think of three ways to avoid this.

1. Limit the maximum MPL input to less than 36 volts. This raises other questions:

- is the MPL voltage going to be variable during the deployment - Richard, can you help here?
- when the batteries are new they will be over 30 volts so we don't have much range to play with.

2. Change the Teledyne supplies to deal with 36 volts. Dave, is this too horrible to contemplate?

3. Never turn on the Teledyne unless the DAS is also on. At least in this case we only put about 30 volts onto the 24 volt device. This is easy but a bit hairy. Glen, is the DAS ever off?

Regards ... kp

1_Orcutt@i

qua.who.edu (aqua [128.128.16.1]) by gannet.who.edu

ESMTP id XAA06545 for <rstephen@gannet.who.edu>; Mon, 19 Feb 1996 23:43:10 -0500

Received: from gannet.who.edu (gannet [128.128.20.11]) by aqua.who.edu (8.6.11/8.6.11) with ESMTP id XAA07822 for <rstephen@who.edu>; Mon, 19 Feb 1996 23:40:02 -0500

Received: from mail.ucsd.edu (ucsd.edu [132.239.254.201]) by gannet.who.edu (8.6.12/8.6.12) with ESMTP id XAA07068 for <ralphs@gannet.who.edu>; Mon, 19 Feb 1996 23:43:07 -0500

Received: from igpp.UCSD.EDU by mail.ucsd.edu; id UAA02292

sendmail 8.6.12/UCSD-2.2-sun via SMTP

Mon, 19 Feb 1996 20:39:58 -0800

Received: from igppqm.ucsd.edu by igpp.UCSD.EDU (4.1/UCSDGENERIC.4)

id AA25748 to ralphs@gannet.who.edu; Mon, 19 Feb 96 20:40:00 PST

Message-Id: <n1387360094.37641@igppqm.ucsd.edu>

Date: 19 Feb 1996 20:38:21 -0800

From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>

Subject: Power Requirements

To: "Ken Peal" <kpeal@aqua.who.edu>, "Richard" <richard@mpl.ucsd.edu>,

"Glen Offield" <Glen_Offield@igppqm.ucsd.edu>,

"David Willoughby" <David_Willoughby@igppqm.ucsd.edu>

Cc: "Richard Goldsborough" <rgoldsborough@who.edu>,

"Matt Gould" <mgould@who.edu>,

"Ralph Stephen" <ralphs@gannet.who.edu>,

"Frank Vernon" <vernon@yin.UCSD.EDU>,

"John Orcutt" <John_Orcutt@igppqm.ucsd.edu>

X-Mailer: Mail*Link SMTP/QM 3.0.0

2/19/96 20:38

Based on the e-mails I've read it appears that everyone agrees with Ken Peal's estimates for battery voltage needs (though Glen has noted that the DAS can work to 36 V and need not be limited to 35 V).

It also appears that the Teledyne power needs are quite modest for the motors. 33 - 72 mW compared to the BCU background of 7.5 - 18 W.

Does anyone expect that the low temperatures at the seafloor are likely to change the numbers we've measured and worked with at room temperature? Is there a likelihood that this will lead to a power underestimate. Certainly, the batteries themselves must be "derated" for seafloor operation, but is it possible that the power needs will also go up at low temperature? Should we try to test this later in the year? We've got room in a cold vault for the sonde and electronics as well as the BCU. Anyone feel we should try this out?

al@hurdle.wi
 Received: from aqua.who.i.edu (aqua [128.128.16.1]) by gannet.who.i.edu
 ESMTP id RAA07656 for <rstephen@gannet.who.i.edu>; Fri, 23 Feb 1996 17:23:37 -0500
 Received: from hurdle.who.i.edu (hurdle [128.128.92.91]) by aqua.who.i.edu (8.6.11/8.6.11) w
 ith ESMTP id RAA16299; Fri, 23 Feb 1996 17:20:42 -0500
 Received: (from kpeal@localhost) by hurdle.who.i.edu (8.6.12/8.6.9) id RAA05962; Fri, 23 Fe
 b 1996 17:16:02 -0500
 Date: Fri, 23 Feb 1996 17:16:02 -0500
 From: Ken Peal <kpeal@hurdle.who.i.edu>
 Message-Id: <199602232216.RAA05962@hurdle.who.i.edu>
 To: john_orcutt@igppqm.ucsd.edu, rstephen@who.i.edu, richard@mpl.ucsd.edu,
 glen_offield@igppqm.ucsd.edu
 Cc: dwilloughby@ucsd.edu, rgoldsborough@who.i.edu
 Subject: OSN borehole power info

Gentlemen:

23 Feb 96

Here are strawman estimated power and voltage values.
 Unless there are some objections these will become the values we
 can all use.

1. ***** Power drains *****

	drain, mA at 30V	power Watts
BCU (excludes disks)	78	2.34
DAS	88	2.64
Teledyne	160	4.80
moto IC	128	3.84
motors	206	6.18

Totals (excluding disks)

from batteries	9.78
from MPL CV	19.80

2. ***** Voltages *****

Battery	24 to 30 volts
MPL	34 volts at CV
At sonde	18 to 33 volts

3. ***** Notes *****

1. We have reduced the BCU power somewhat from previous estimates by eliminating our analog engineering section.
2. Teledyne input voltage limit of 28 volts is a worry.
3. Disks take 45 watts for about 10 seconds during spinup then lower for the duration of the transfer.
4. We plan extended cold room tests of the BCU starting soon. Will check current drains at that time.
5. We derate batteries by 1/3 for cold and low drain rate.

To: Ralph Stephen
From: Don Koelsch
Date: 8 March 1989
Subject: Webb Research Corp. Precision Clock

4.5.1 Koelsch 3/8/89

Office Memorandum

This memo is a result of a meeting/tutorial session by Pierre on 2/6/89.

General

The frequency of a crystal oscillator is controlled by two major effects which are temperature and aging. Both the crystal and its associated electronics are influenced by these two parameters. To measure time accurately for short term deployments, the most dominant effect is due to changes in temperature. To determine accurate time in a long term deployment, the aging rate is the most dominant parameter.

WRC calibrates and compensates for temperature variations and sets the output (clock frequency) frequency. It does not, however, dynamically adjust the frequency for predicted aging.

Temperature Correction

The clock is placed in an environmental chamber and the temperature is varied between -2°C to 26°C . The change in the crystal frequency vs. temperature is recorded and the data is entered into an onboard ROM. This information is used to adjust the real time clock frequency by adding or subtracting pulses. Correction for temperatures greater than 26°C and less than -2°C are obtained by extrapolating the measured data with a best fit cubic equation.

The system becomes inaccurate when the clock experiences a step change in the temperature. This is because the temperature is measured on the outside of the crystal housing and there is a thermal time constant between it and the crystal. Pierre has supporting data that thermal shock on S/N 13 creates a shift in time of 0.5 ms. S/N 13 is one of the units to go to SI0. He is willing to make the measurement on our unit (S/N 12) but since we can read time from the instrument in situ we both felt it would be more important not to interrupt the ongoing aging test.

The second assumption is that the shape of the temperature dependence curve remains constant with time. Pierre has some data which, in the time frame of a year to support this.

Aging

Crystal aging is defined as the change in resonant frequency with time. It is caused by many processes; the most important are:

- Atoms of the gold electrode migrate into the crystal lattice changing the mass of the crystal.
- Fatigue of the mechanical mounting.
- The vacuum in the crystal housing changes which affects the mechanical loading on the face of the crystal.
- Changes in the value of the oscillator circuit components.

WRC does not dynamically compensate for aging rate. There is, however, a method to set the clock frequency to a precisely accurate value.

Calibration

The following is the recommended procedure to obtain the best time accuracy for our LFASE deployment.

- 1) Take time drift data points starting as soon as possible (we have started). Plot these points, Δt on the Y axis against time on the X axis. Estimate the slope and apply this correction to the frequency at day Zero. Do this at the start of the cruise.
- 2) Before deployment, set the clock time to satellite time (1 ms resolution).
- 3) Deploy instrument.
- 4) During the seven day exercise, keep track of the offset.
- 5) Plot data to determine the in situ aging rate which should not have changed.
- 6) Do not apply new offset correction or readjust clock frequency.
- 7) Temperature is now very stable and changes of time offset will be due to aging.
- 8) Since the aging rate is assumed, a constant over the 30-day experiment, a time correction can be extrapolated to the end of the experiment.

Data to Date and Its Implications

<u>Julian Day</u>	<u>Satellite Time</u> GMT	<u>WR Time</u> EST
34	Clock frequency & time offset set	
56	13:55.21	08:55,20.995
60	21:46.54	16:46,53.993
66	16:33.45	11:33,44.990

This shows 5 millisec change in 10 days

Implies $\rightarrow 0.5$ millisec/day drift

Since: $1 \text{ millisec/day} = 10^{-8} \frac{\Delta f}{f} \text{ aging}^*$

Implies $\rightarrow .5 \text{ millisec/day} = 5 \times 10^{-9} \frac{\Delta f}{f} \text{ slope of the aging rate}$

Since the clock frequency and time were set on Julian day 34. To obtain the aging rate to compare to the specifications

$$\frac{5 \times 10^{-9}}{32} = 1.56 \times 10^{-10} \text{ aging rate.}$$

Specification of the clock crystal is 2.5×10^{-10} maximum aging rate.

* This constant is obtained by working through the math.

Conclusions

We have the ability to measure the in situ performance of the clock for the first seven days of the experiment. This enables us to predict its performance through to the end of the experiment and apply the necessary corrections to the data. Any offset caused by thermal shock during deployment can be corrected because we can measure time drift and offset after the instrument attains thermal equilibrium.

If time offset measurements can be made at recovery, this would further enhance the accuracy of time determinations during the experiment. This is how the OBS people have to do it because they do not have the ability to check time during the deployment. They must measure time offset at the start and end of a deployment and use straight line corrections.

By using the calibration procedure we should be able to calculate the time of an event to an accuracy better than our analog filters will allow.

kl

cc: R. Goldsborough

TO: R.Stephen, D.Koelsch

29 Nov 92

FROM: K.Peal

RE: Clock interfacing for BBBSS

This is a description of how I believe we should interface the Seascan clock in the BIP to the Reftek in the Sonde. This solution allows us to make maximum use of the Reftek system software without change and provides for actual time checks of the Reftek timing system against the Seascan while deployed.

In summary, the recommended scheme has two parts.

1. The BIP electronics simulates a standard Reftek time module (Omega or GPS) for continuous timekeeping in the Reftek
2. During acquisition the BIP controller occasionally interrupts normal continuous operation to do a check of the Reftek clock against the Seascan.

I have talked repeatedly about this to Phil Davidson at Reftek and believe it will work. We should check with a knowledgeable outside user of Reftek equipment - perhaps someone at IGPP or IRIS - then fix the design so we can proceed.

To fully understand the details you need to read three Reftek documents:

- application note #3, Timekeeping
- command format spec. (version 2.45, May 30,1991)
- PASSCAL recording format (version 2.46, May 14,1991)

HARDWARE

We need to provide from the BIP a 1 PPS pulse and an ASCII time string every second to the Reftek Master clock system. The 1 PPS must be synchronised with the ASCII string or at least stay in constant phase with it so there is no doubt about which second is which. To simplify things in our case, the ASCII string will use a different serial port at the Reftek from that used for the commands and replies.

In addition, we need a time hack on a separate line which will go to the Reftek "pulse time" input. It must be derived from the Seascan's trigger output. This is the input used to initiate "triggered" recording.

PROTOCOL

The Reftek runs a phase locked loop using the 1 PPS to keep time to the millisecond. It uses the ASCII time string to adjust the seconds every few seconds if necessary. If the ASCII string stops, the tracking stops so we need to keep both running

at all times.

For the record, here is the format of the ASCII string:

sDDD:HH:MM:SSq<CR><LF>

where 's' is SOH (ASCII 01)

DDD is day of year (001 to 365)

HH is hour

MM is minute

SS is second

'q' is quality indicator

(space means the time module is working OK)

The start bit of <CR> should be aligned with 1 PPS.

SETTING AND CHECKING THE SEASCAN CLOCK

This will be done as before during LFASE using a special time check channel through the MPL telemetry.

REFTEK OPERATION AND TIMING

At powerup the Reftek CPU gets time from an internal battery backed clock chip and starts running the phase locked loop if correct signals are present (1 PPS plus the ASCII string with 'space' quality). It makes time corrections as necessary so its internal time matches that in the ASCII string.

The BIP sends commands to start continuous acquisition and the Reftek puts its time in the data records. Occasionally - perhaps once per day - the BIP stops continuous operation to perform the clock check as described below.

To check the Reftek clock, the BIP commands the Reftek to take a triggered record with zero data then initiates a time check from the Seascan. The on-time hack from the Seascan is routed to the Reftek's pulse time input causing the triggered record to be taken. The data in this record is simply the Reftek time. Since we know the time of the Seascan hack, we can compare it with the Reftek recorded time and thus have a clock check.

It is anticipated that this procedure will take only a second or two to complete so a very small portion of continuous data will be missed. The period between time checks will be determined on the basis of the experience with the proposed Reftek/BIP timing system in tests but probably once per day will be more than enough.

TO: Distribution *Ra PH* 13 Jan 93

FROM: K. Peal *KP*

RE: Telephone conversation with Glen Offield, 7 Jan 93

1. Clock and timing

We have a choice here between

- WHOI simulating Kinematics time interface (1 PPS plus special-format ASCII string each second) and
- IGPP modifying timing portion of 'Reftek' software.

Agreed on the latter.

Thus WHOI will send a string in Kinematics format based on Seascan time but only occasionally (once per hour or some such). IGPP will change the software so the clock runs on the 1 PPS and uses the string to simply change the time if it is wrong. WHOI needs to ensure that the 1 PPS line is clean (no repeated glitches at odd times during the second) and that the string always comes at the same time relative to the 1 PPS. Also WHOI needs to send the string after a reset of the Reftek and at power up to synchronize Reftek time with Seascan time.

Immediately before sending each Kinematics string, WHOI will initiate a triggered record which serves as a measure of any time offset in the Reftek relative to the Seascan before the time is corrected using the Kinematics string.

Note the question of how often to send the string needs to be answered.

2. Serial line protocol

Electronics is simplified if the serial communications between BIP and Reftek is RS-485 rather than RS-232 (or logic level) because the latter requires an FSK modem. The reason to discuss this was that RS-485 is inherently half duplex leading to possible software implications. It now appears that RS-485 chips can suppress the received signal during transmission so that the main half duplex problem is avoided (you do not hear yourself talk). This needs a little more investigation since line turn-around still takes place (it really is half duplex).

WHOI requested that we use only one serial port for both command/reply and the Kinematics time string (simplifying usage of the 7 lines). IGPP agreed that this is no problem.

Another implication of using RS-485 is that an addressing protocol is required since there are several devices on the line

3. Data format and QC plans

- real time QC on the ship while connected to cable
- data playback of the BIP disk after recovery.

If BIP disk is made to be DOS compatible, a conversion step on a PC will be required as well as transfer to a workstation class system (Sun). WHOI is looking at recording the disk using the 'PASSCAL spiral' format rather than making it DOS compatible.

Distribution: [redacted] takes [redacted] [redacted] half [redacted]
Don Koelsch
Glen Offield, IGPP (via email) [redacted]
John Orcutt, IGPP (via email) [redacted]
Ralph Stephen [redacted]
Dave Willoughby, SIO (via email)

TO: Distribution

5 Jan 95

FROM: K. Peal

RE: OBS clock drift

Attached is an analysis of the problem. It does not provide THE ANSWER.

Basically we need to decide what drift rate we can accept for the two 1995 deployments and choose which of the three approaches to take.

Distribution:
J. Bailey
J. Collins
J. Hallinan
D. Koelsch
M. Purdy
B. Wooding

1 week = 7 days

= 168 hours

= 10,080 minutes

= 604,800 seconds

= 604,800,000 nanoseconds

SECOF clock drift by other time
to 3 msec/week

0.2×10^{-9}
or 0.2×10^{-9}
 2×10^{-8}

→ 39 msec/3 months
156 msec/year

- we take 1 sample every 20 msec (20Hz)

so we should get the correct number of samples for the three month interval
however, the accuracy of the absolute time of a sample could be off by 0.040 sec. We should make this clear to investigators and state the accuracy with the experiment. Times can be corrected after the experiment if necessary.

OBS Clock Adjustments for Juan de Fuca and MELT

Background

The attached table (by Bailey) shows the drifts we have experienced (in usec/day) for FARA and 504B. We have been assuming that the specification for the clock is 1 msec per week which is 142.8 usec/day (or 1.6×10^{-9}).

Prior to FARA01, we tracked the clocks for several weeks at room temperature and made adjustments to each clock's internal X register value in an effort to minimize the drift. During this effort, we observed that the response to changes in the X values was not consistent and we did not see a smooth reduction in drift. For the deployment, best guess values were used.

After FARA01, most clocks were left unchanged for the second deployment. However, the four clocks marked * in the table were given adjusted X values based on their drift during the FARA01 deployment. While this did not achieve the 142.8 usec per day goal, it did make a substantial improvement.

Prior to the 504B cruise all clocks were tracked at room temperature but no adjustments were made. Just prior to the first deployment most clocks were given an updated X value based on the results of the above tracking. Thereafter no adjustments were made. Again the 142.8 usec per day was not generally achieved.

Seascan Clock Specifications

At a recent meeting with P. Tillier of Seascan, we were advised that the clock specification should be 150 msec per year which is nearly 3 msec per week (4.8×10^{-9}). Prior to this we were lead to believe that 1 msec per week (1.6×10^{-9}) was a good number to use. It appears that he has adjusted the spec on the basis of what users are achieving.

He indicated that end point corrections should be used for all long deployments to compensate for aging (as is stated in the clock manual). Also, users who need better timing than the 5×10^{-9} need to do end point corrections. This assumes that the drift is linear and that the offset caused by the thermal shock is small compared to the overall drift. His experience is that the offset due to thermal shock is of the order of 0.5 msec.

For reference, assuming a maximum drift of one sample time over the deployment, our two 1995 operations are as follows:

Juan de Fuca - 128 s/s for 2 months
- 1.5×10^{-9}

MELT - 16 s/s for 7 months
- 3.4×10^{-9} .

We need to decide exactly what drift specification we need for these two experiments.

Recent results from the S-Tether Thetis experiment

This experiment offered a unique opportunity to observe the drift of a Seascan clock against a time standard during a deployment. The clock was part of the tomography transceiver which in this case was deployed on an S-tether mooring with a surface buoy. The system was augmented with electronics in the surface buoy which performed occasional clock checks against GPS and also telemetered the data via ARGOS.

Prior to the experiment, two clocks were tracked in the lab at various temperatures. They were found to be drifting at about 2×10^{-8} at 13 degrees C (the deployment was to be in water at about 13 degrees C). After tracking the clocks at 12, 13 and 14 degrees C, values for offset correction were computed from the performance at 13 degrees C. The clocks were then tracked again for several days. The result was as follows:

- $+2 \times 10^{-9}$ at 13 degrees C
- -4×10^{-9} at 12 degrees C
- $+7 \times 10^{-9}$ at 14 degrees C.

It thus appeared that the performance was acceptable for the deployment.

During the deployment, the clock was checked against GPS every 12 hours. Over the period of the deployment (110 days), the drift rate slowly moved from 1.7×10^{-8} to 1.5×10^{-8} . The temperature at the transceiver was fairly constant at 13.3 degrees C throughout the deployment. Thus there is an order of magnitude discrepancy from the expected 2×10^{-9} .

To check for the effect of the thermal shock we compare the last time check on the ship prior to the deployment with the first check received through ARGOS. The difference between these two is 1.001 msec. Although this difference does agree with the predicted value, it also represents a drift rate of 1.8×10^{-8} . Thus what apparently happened is that the clock was drifting at about 2×10^{-8} all the time rather than the expected 2×10^{-9} .

The data appears in the attached figure, panels "Transceiver Clock Offset" and "Clock Offset Difference, 12h". The latter

shows the difference between each pair of offset measurements (which occur every 12 hours).

From this data we see no evidence of a time shift caused by the thermal shock at deployment. While the drift rate is reasonably linear (showing some aging) it is about an order of magnitude greater than expected. At this point there is no explanation for these discrepancies.

Recommended action for OBS clocks

It is clear that clock 31 has a problem that is not related to oscillator calibration. We have seen more than one episode of sudden time shifts of multiple seconds. We will check various possible causes in house then if necessary send it to Seascan for repair.

During January, P.Tillier will be doing a calibration of two clocks from D.Willoughby of SIO. Pierre has offered to calibrate one of our clocks at the same time (for a nominal charge) to see if we can determine the cause of our large drifts. Clock 30 would be a good candidate.

To cope with the remaining clock drift problems we have three courses of action.

1. Use end point correction. Although this is compute intensive, one possible approach is to use end point correction without doing further adjustments of the clocks. For the nominal 7 months, this would mean correcting for offsets of up to 0.2 sec over the deployment. Due to the length of the deployment, we should in any case be prepared to do this on MELT data to cope with offsets caused by aging.

2. Recalibrate the clocks. P.Tillier feels that component aging may have caused degradation of the thermometer measurements. This leads to erratic behaviour at room temperature and means that room temperature adjustments do not lead to good cold temperature performance. The cost for this is \$8000.00 for 16 clocks. Pierre claims that after this calibration we can expect a drift rate of about 5×10^{-9} and we can then do adjustments at room temperature which will improve the clock performance at cold.

3. Using the clocks in their present condition, perform the tracking and adjusting with the clocks in the cold room. Although the experience from the S-Tether deployment was disappointing, the results of the four OBS clocks that were adjusted between FARA01 and FARA02 indicate that adjustment at ocean bottom temperature should be able to substantially improve

the in situ drift. Also we feel that the adjustments being performed before FARA were using too short a measurement period. A cold room adjustment sequence would require all clocks to be in the cold room for approximately two weeks with regular tracking but only one or two adjustments.

CLOCK	FARA 01	FARA 02	504B 1	504B 2	504B 3
17	-860	-1544	-191	-302	-348
18	-837	-298	+34	-29	-180
20			-167	-547	-773
27	-2305	*-463	-804	-1014	-1146
28	-1017	-1414	+366	+129	-42
29	-518	+33	+325	+211	+41
30	-2468	* +23	-1803	-1815	-486
31	(-1112) est.	-1792	-5753	-6097	-5505
32	-1399	* -253	-161	-338	-471
34	-688	-957	-425		-344
37	-721	-953	+173	+160	+165
39	-401	-505			
41	+2829	* +253			
46	-819	-1160	-268	-488	-570
51	-392	-422	+50	-149	-278

* These four clocks were cal'd by there ocean bottom drift from FARA 01 for the second FARA deployment.

All clock drifts are in Microseconds per day.

52 ms per year = 142.8 uS/day

STether Battery Voltage

STether System Voltage

STether Bridge Voltage

Transceiver Clock Offset

GPS Buoy Location

sal@hurdle.whoi.edu

Received: from bravo by gannet.whoi.edu; (5.65/1.1.8.2/10Jan95-1113AM)

id AA01932; Thu, 19 Jan 1995 22:50:11 -0500

Received: from AQUA.WHOI.EDU by bravo.whoi.edu (AIX 3.2/UCB 5.64/4.03)

id AA12799; Thu, 19 Jan 1995 22:41:21 -0500

Received: by aqua.whoi.edu (5.57/Ultrix3.0-C)

id AA09121; Thu, 19 Jan 95 22:49:39 -0500

Received: by hurdle.whoi.edu (4.1/SMI-4.1)

id AA10344; Thu, 19 Jan 95 22:47:29 EST

Date: Thu, 19 Jan 95 22:47:29 EST

From: kpeal@hurdle.whoi.edu (Ken Peal)

Message-Id: <9501200347.AA10344@hurdle.whoi.edu>

To: vernon@yin.ucsd.edu

Cc: rstephena@aqua.whoi.edu, mgould@aqua.whoi.edu, dkoelsch@aqua.whoi.edu,
tomb@snark.whoi.edu

Subject: Problem with PFO test

Frank: 19 Jan 95

After we talked yesterday, I thought about what to do if you conclude that the problem is caused by the Seascan clock's invalid day number. The obvious thing to try would be to set the Seascan to the correct day number and see if that solves the problem. Unfortunately for various reasons it is very difficult to set the clock. I would say that it really needs me to do it because it requires a wierd lashup with test leads, a special test box and a power supply as well as three connections to the two COM ports of one of our PC's. It turns out I will be out there on 16 and 17 Feb (for a MELT meeting and to talk BBOBS with Glen, I hope), but that is quite a while to wait.

If you want to do something in the meantime, I think the best idea is to stop the time strings from being sent to the DAS. Then I presume the DAS would use its internal time and we could see if the problem is solved. To do this we would need to restart the BCU in the mode where it waits for operator input. When it is in this mode, it does not send the time strings.

If this is what you want to do then I request that somebody do the "site visit" first. That would get us the information from the console that we cannot get from the status packets in the disk data stream. I would also get a final clock check which we would like.

Hope this helps. Call me and we can talk it over.

Regards ... kp

) Jan 95 09

ken@hurdle.whoiedu (Ken Peal) rstephen@whoiedu (Ralph Stephen) john_orcutt
 t@igppgm.ucsd.edu (John Orcutt) vernon@yin.ucsd.edu (Frank Vernon) glen_offield@ig
 ppqm.ucsd.edu (Glen Offield) dkoelsch@aqua.whoiedu (Don Koelsch) tomb@snark.whoiedu (Tom Bolmer) mgould@aqua.whoiedu (Matt Gould)

Return-Path: kpeal@hurdle.whoiedu

Received: from bravo by gannet.whoiedu; (5.65/1.1.8.2/10Jan95-1113AM)

id AA03983; Sun, 29 Jan 1995 22:21:02 -0500

Received: from AQUA.WHOI.EDU by bravo.whoiedu (AIX 3.2/UCB 5.64/4.03)

id AA11426; Sun, 29 Jan 1995 22:12:02 -0500

Received: by aqua.whoiedu (5.57/Ultrix3.0-C)

id AA17422; Sun, 29 Jan 95 22:19:52 -0500

Received: by hurdle.whoiedu (4.1/SMI-4.1)

id AA15591; Sun, 29 Jan 95 22:17:39 EST

Date: Sun, 29 Jan 95 22:17:39 EST

From: kpeal@hurdle.whoiedu (Ken Peal)

Message-Id: <9501300317.AA15591@hurdle.whoiedu>

To: john_orcutt@igppgm.ucsd.edu, rstephen@aqua.whoiedu, vernon@yin.ucsd.edu, glen_offield@igppgm.ucsd.edu

Cc: dkoelsch@aqua.whoiedu, tomb@snark.whoiedu, mgould@aqua.whoiedu

Subject: What to do about PFO problem

Gentlemen:

29 Jan 95

It now appears pretty certain that the data problem at PFO was caused by a misunderstanding about the clocks: the DAS clock uses day of year while the Seascan uses day number. This may sound like a trivial difference but ... the Seascan's day number just keeps on increasing (it was originally designed to be the last four digits of Julian day) whereas the DAS wants to go from 1 to 365 (or 366) then back to 1 again on 1 January.

One solution would be to change the Seascan clock but that is the most difficult because its processor is a 68HC11 programmed in assembly.

It is more reasonable for us to correct the day number that comes from the Seascan in either the BCU or the DAS. Since the BCU is serving as the interface to the Seascan clock, it seems like the obvious place to do the correction. Also the change to the BCU can be made with minimal interference to the test at PFO.

I have taken a look at the change necessary to the BCU. The only problem is how to deal with leap year since 1994 was not a leap year but 1996 (when we hope to do the Pilot Experiment) will be. I have built an algorithm that will change any number between 1 and 9999 to a value between 1 and 366. If the variable LEAP (stored in EEPROM) is 0, then it just does modulo 365 division. If LEAP is set to 1, then it treats the first year as a leap year (366 days) but all others are 365. I think this should be OK since the actual deployment length is three months, not years.

I am pretty sure that I can make this change and burn a PROM here at WHOI (even though lots of our stuff is still in the van at PFO) but there are two problems: installation and testing. I will be in La Jolla for a meeting the week of 13 Feb and could probably arrange to go to the site then and do both the installation and testing. However, if people want it fixed sooner, then we need to talk about sending a PROM out to Glen (probably) and trying to talk him through the change. I think this is probably less efficient and more risky than waiting until I go and do it.

Once this change is made, we need to decide what testing to do and how long to run the system before shutting down. I suggest that we simply start acquisition again without resetting the Seascan clock. We then need to be sure that the DAS/BCU and the Sun are collecting data OK even though the Seascan day number is at 410 (or whatever).

This could be accomplished by checking both the BCU and Sun data after an overnight test, but probably a longer run is also appropriate.

Before this problem was uncovered, we had planned to let the system run until the BCU had filled two of its three disks. I think the nominal shutdown date was about 24 Feb based on my estimate that the switchover to the second disk was to take place about 13 Feb. Because the clock problem did affect the DAS, we cannot now be sure how full the disks are. We need to go to the site and look at the engineering data to determine this.

Here is a scenario:

- I do the change at the site,
- we check the data after an overnight test
- we leave the system running until the second disk changeover happens
- Matt Gould does the shutdown on a separate trip as originally planned - date to be determined.

In summary then, we need some kind of consensus SOON on the answers these questions:

1. Does the clock fix that I propose sound OK?
2. Is it OK to wait until mid Feb to do the fix?
3. Is an overnight test sufficient?
4. Should we wait for the second disk change before shutdown?

Stephen@gannet
 Received: from bravo by gannet.whoiedu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA04077; Mon, 30 Jan 1995 09:33:36 -0500
 Received: from AQUA.WHOI.EDU by bravo.whoiedu (AIX 3.2/UCB 5.64/4.03)
 id AA14467; Mon, 30 Jan 1995 09:24:36 -0500
 Received: by aqua.whoiedu (5.57/Ultrix3.0-C)
 id AA26864; Mon, 30 Jan 95 09:32:50 -0500
 Received: from localhost by gannet.whoiedu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA04069; Mon, 30 Jan 1995 09:33:32 -0500
 Message-Id: <9501301433.AA04069@gannet.whoiedu>
 To: kpeal@hurdle.whoiedu (Ken Peal)
 Cc: rstephen@aqua.whoiedu (Ralph Stephen),
 john_orcutt@igppqm.ucsd.edu (John Orcutt),
 vernon@yin.ucsd.edu (Frank Vernon),
 glen_offield@igppqm.ucsd.edu (Glen Offield),
 dkoelsch@aqua.whoiedu (Don Koelsch), tomb@snark.whoiedu (Tom Bolmer),
 mgould@aqua.whoiedu (Matt Gould)
 Subject: Re: What to do about PFO problem
 In-Reply-To: Your message of "Sun, 29 Jan 95 22:17:39 EST."
 <9501300317.AA15591@hurdle.whoiedu>
 Date: Mon, 30 Jan 95 09:33:32 -0500
 From: rstephen@gannet.whoiedu
 X-Mts: smtp

Ken,

- 1) The clock fix sounds OK.
- 2) Waiting until mid-Feb is OK. I suggest that nothing be done at PFO until you go out. I will also be out in La Jolla. My current itinerary is to leave Feb 13 and return Feb 16. Can I be of any help? I can change my travel plans.
- 3) Some things that I think need to be done while you are at PFO: a) check if the data are OK on the BCU recorders; b) do your BCU software fix; c) check drift of the SEASCAN clock; d) check the power consumption; e) do the overnight recorder test; f) leave the gear running until Matt et al go out.
- 4) I suggest that Matt, Dave and others stay on schedule and pull the gear the week of Feb 20, whether or not the second disk has filled. Let's hope that the BCU recorders have been acquiring data faithfully but with possibly incorrect days written on disk. There have been a number of earthquakes this year that it would be interesting to see on our gear. If the BCU recorders have not been recording this year it would take too long to fill the second disk. Perhaps we could do a 'recorder switch over test' as part of our cold room tests this spring and summer.

Regards, Ralph.

nb@snark.who...
Received: from bravo by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA04986; Wed, 1 Feb 1995 13:19:28 -0500
Received: from AQUA.WHOI.EDU by bravo.who.i.edu (AIX 3.2/UCB 5.64/4.03)
id AA14828; Wed, 1 Feb 1995 13:10:25 -0500
Received: by aqua.who.i.edu (5.57/Unix3.0-C)
id AA23187; Wed, 1 Feb 95 13:18:38 -0500
Received: from localhost by snark; (5.65/1.1.8.2/05Jan95-8.2MPM)
id AA12578; Wed, 1 Feb 1995 13:18:11 -0500
Message-Id: <9502011818.AA12578@snark>
To: kpeal@aqua.who.i.edu
Cc: rstephen@aqua.who.i.edu, tomb@snark.who.i.edu, dkoelsch@aqua.who.i.edu
Subject: "bad" 1994 data correction
Date: Wed, 01 Feb 95 13:18:05 -0500
From: tomb@snark.who.i.edu
X-Mts: smtp

I sent the below on 1/23/95. I made an error in sending this. The 1995 data had errors not the 1994 data. I have a series of the whole day plots by dbpick from 359 - 364 and 1 - 8 being made now. I will have to look for 365 and 366. I will send a set down to Ken and leave a set for Ralph. So it appears the the 1994 data we have ftped back is pretty clean but the 1995 data is not looking complete.

< In a side note. For day 4 in 1995 there are 13 segments of data <stored. It looks like there are 12 89+ minute segments with a 21 <minute segment at the end. This gives about 18.3 hours in a 24 hour <time period. Frank has built his "descriptor file" so that though the <raw data is stored in one file per channel it plots in 13 segments. I <have looked up the header words he has used and it makes sense to me. <The real question here is why so many segments and not continuous or at <least contiguous data? Is what I see in the plot a function of the <clocks not changing dates as Ken's last message talked about? The <other 4 days of data in 1994 have similar confused file sizes when I do <a directory of them.

Tom

02 Feb 95 09:

From: vernon@yin.ucsd.edu (Frank Vernon)
 Return-Path: kpeal@hurdle.who.edu
 Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA05111; Thu, 2 Feb 1995 08:24:59 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA17564; Thu, 2 Feb 1995 08:15:56 -0500
 Received: by aqua.who.edu (5.57/Ultrix3.0-C)
 id AA00304; Thu, 2 Feb 95 08:24:09 -0500
 Received: by hurdle.who.edu (4.1/SMI-4.1)
 id AA17563; Thu, 2 Feb 95 08:21:56 EST
 Date: Thu, 2 Feb 95 08:21:56 EST
 From: kpeal@hurdle.who.edu (Ken Peal)
 Message-Id: <9502021321.AA17563@hurdle.who.edu>
 To: glen_offield@igppqm.ucsd.edu
 Cc: rstephena@aqua.who.edu, dkoelsch@aqua.who.edu, tomb@snark.who.edu,
 mgould@aqua.who.edu
 Subject: Pinon test clock fix

Glen:

2 Feb 95

Happy Ground Hog Day (2 Feb). I suppose that is no big deal in California!

I have prepared the PROMs and will ship stuff to you. The shipment should include:

- two PROMs (just two copies of the same thing)
- blue battery clamp for separating boards
- key for removing disks
- instructions.

The plan I am working on is this:

- you visit PFO next week to change the PROM, etc
- I arrive in La Jolla late 13 Feb
- you and I work on BBOBS and/or BBBSS 14 and 15 Feb
- you bug out 16 Feb
- I do MELT meetings 16 and 17 Feb
- I visit PFO 18 Feb if necessary
- I return to WHOI 19 Feb.

One item we have not talked about. We looked back at some power drain measurements and found that the Reftek/DAS was taking 6 watts. Is that what you expect? In the detailed instructions, I have suggested that you make a measurement as part of the PROM change. Let me know what you think.

Thanks in advance for your help

Regards ... kp

al@hurdle.v

..... from bravo by gannet.whoiedu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA06056; Mon, 6 Feb 1995 15:36:51 -0500
Received: from AQUA.WHOI.EDU by bravo.whoiedu (AIX 3.2/UCB 5.64/4.03)
id AA13968; Mon, 6 Feb 1995 15:36:04 -0500
Received: by aqua.whoiedu (5.57/Ultrix3.0-C)
id AA09290; Mon, 6 Feb 95 15:35:54 -0500
Received: by hurdle.whoiedu (4.1/SMI-4.1)
id AA18971; Mon, 6 Feb 95 15:33:41 EST
Date: Mon, 6 Feb 95 15:33:41 EST
From: kpeal@hurdle.whoiedu (Ken Peal)
Message-Id: <9502062033.AA18971@hurdle.whoiedu>
To: rstephena@aqu.whoiedu, dkoelsch@aqu.whoiedu, tomb@snark.whoiedu,
mgould@aqu.whoiedu
Subject: New PROM is installed at PFO

Hello:

6 Feb 95

Yesterday, I received a call from Glen Offield from PFO. He had just installed my new PROM and called to report that it seemed to be working OK and to ask some questions. I told him to hold the two disks (one from the NEC, the other from the BCU) and the PROCOMM log for me to carry home.

I guess Tom should try to get access to the new data (via telnet) as soon as possible so we can see for ourselves if all is well. If I need to go to PFO next week, I need to take the right stuff with me next Monday so the sooner the better.

If the system is working OK then we should have over three weeks additional data before the planned shutdown date.

If you want Glen to send the BCU disk instead of waiting until I come back, let me know and I will tell him.

Regards ... kp

al@hurd...
 ravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA07479; Fri, 10 Feb 1995 11:50:06 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA18696; Fri, 10 Feb 1995 11:49:15 -0500
 Received: by aqua.who.edu (5.57/Ultrix3.0-C)
 id AA03830; Fri, 10 Feb 95 11:49:06 -0500
 Received: by hurdle.who.edu (4.1/SMI-4.1)
 id AA19790; Fri, 10 Feb 95 11:46:50 EST
 Date: Fri, 10 Feb 95 11:46:50 EST
 From: kpeal@hurdle.who.edu (Ken Peal)
 Message-Id: <9502101646.AA19790@hurdle.who.edu>
 To: rstephen@aqua.who.edu, dkoelsch@aqua.who.edu
 Subject: forwarded message 1

>From John_Orcutt@igppqm.ucsd.edu Thu Feb 9 14:38:29 1995
 Return-Path: <John_Orcutt@igppqm.ucsd.edu>
 Received: from ucsd.edu by hurdle.who.edu (4.1/SMI-4.1)
 id AA19563; Thu, 9 Feb 95 14:38:25 EST
 Received: from igppqm.ucsd.edu by ucsd.edu; id LAA24262
 sendmail 8.6.9/UCSD-2.2-sun via SMTP
 Thu, 9 Feb 1995 11:39:46 -0800 for <kpeal@hurdle.who.edu>
 Message-Id: <n1419792498.25446@igppqm.ucsd.edu>
 Date: 9 Feb 1995 11:34:58 -0800
 From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 Subject: Re: FWD>Corrupted clock pro
 To: "Ken Peal" <kpeal@hurdle.who.edu>,
 "David Willoughby" <David_Willoughby@igppqm.ucsd.edu>
 Cc: "Glen Offield" <Glen_Offield@igppqm.ucsd.edu>
 X-Mailer: Mail*Link SMTP/QM 3.0.0
 Status: R

Reply to: RE>>FWD>Corrupted clock problem in BBBSS

I think that's right unless, as you say, time goes to Hell in a handbasket permanently and I guess we're sunk in that case anyway.

 Date: 2/9/95 11:01 AM
 To: John Orcutt
 From: David Willoughby

If the only by-product of a bad time string is 30 minutes of data with bad time stamps, maybe this problem isn't worth dealing with. After all, we'll have a known number of samples at known intervals, and if the time reverts to the correct value at the next half-hour mark, we can just re-calculate the time stamps for the half hour where they're bad when the data is processed. While re-calculating time stamps during post-processing is a bit of a pain, Ken seems to think this scenario is pretty unlikely.

Of course, if the time goes completely to Hell and never recovers, there isn't much you can do about it anyway.

DFW

 Date: 2/9/95 8:20
 To: David Willoughby
 From: John Orcutt

What do we want to do about this? In some ways, it would be better to simply record the Seascan clock value in the data string, but not jam time into the Reftek. At very low frequencies, this practice could lead to some very strange shifts in apparent frequencies. However, the frequencies are probably too low for us to worry about anyway. We should send Ken a coherent reply from here.

 Date: 2/9/95 5:23 AM
 From: Ken Peal
 Received: by igppqm.ucsd.edu with SMTP; 9 Feb 1995 05:20:50 -0800

a.who.edu (5.57/Ultrix3.0-C)
 -- 35; Thu, 9 Feb 95 08:21:01 -0500
 Received: by hurdle.who.edu (4.1/SMI-4.1)
 id AA19420; Thu, 9 Feb 95 08:18:44 EST
 Date: Thu, 9 Feb 95 08:18:44 EST
 From: kpeal@hurdle.who.edu (Ken Peal)
 Message-Id: <9502091318.AA19420@hurdle.who.edu>
 To: glen_offield@igppqm.ucsd.edu, vernon@yin.ucsd.edu,
 john_orcutt@igppqm.ucsd.edu, rstephen@aqua, dkoelsch@aqua
 Cc: mgould@aqua, tomb@snark.who.edu
 Subject: Corrupted clock problem in BBBSS

Glen et al: 9 Feb 95

This is about the question Glen has raised regarding a potential problem with the time strings.

To review (for those who missed the last class), the BCU reads time from the Seascan clock every 30 minutes, formats it to look like the standard Truetime string, and sends it to the Reftek/DAS synchronized with the appropriate 1 PPS. The Reftek compares this time with its current time and does a jam set of its clock if it is different (by how much?). By local agreement, receipt of a time string also causes the Reftek to generate and send one status packet.

The problem Glen raises is that if the time string is corrupted in such a way that all characters have good parity but one or more characters is in fact bad, the Reftek will jam a bad time with resultant data corruption. Since the strings come only every 30 minutes, the Reftek will have bad time for that long. In other applications, the time strings are more frequent and the Reftek software only changes the clock when it has received three strings which represent a clock shift. What can we do in the present case to make it more robust?

There are two ways that we could send a bad time string to the Reftek:

- we get a bad value from the Seascan
- the string is corrupted during transmission to the Reftek.

Although we view both of these as quite unlikely, here are two possible solutions.

1. Retain the 30 minute time string period (as an operator set parameter) but send three strings in quick succession every 30 minutes. This should avoid background loading in the BCU program but still increase reliability by actually reading the clock three times and sending the three values. In this case, probably the status packet should be sent every three time strings instead of every time as at present. One problem here is keeping the Reftek in synch with the three strings: if it somehow got to using the last of one set of three and the first two of the next set of three (30 minutes later) there could be trouble. I guess it needs to look for three strings within a minute, say.
2. Add a message check character (checksum, say) on each string to the Reftek which would further reduce the odds of a transmission error.

If we implement one of these, we need to do some system testing. Is it worth trying to do some testing at PFO before we move our van etc back to WHOI? Since making the Reftek change requires pulling out the sonde it does require some effort.

Please advise ... kp

al@hurdle.who.i.edu
 ravo by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA07520; Fri, 10 Feb 1995 11:57:51 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.i.edu (AIX 3.2/UCB 5.64/4.03)
 id AA15119; Fri, 10 Feb 1995 11:57:01 -0500
 Received: by aqua.who.i.edu (5.57/Ultrex3.0-C)
 id AA03922; Fri, 10 Feb 95 11:56:52 -0500
 Received: by hurdle.who.i.edu (4.1/SMI-4.1)
 id AA19817; Fri, 10 Feb 95 11:54:36 EST
 Date: Fri, 10 Feb 95 11:54:36 EST
 From: kpeal@hurdle.who.i.edu (Ken Peal)
 Message-Id: <9502101654.AA19817@hurdle.who.i.edu>
 To: rstephen@aqua.who.i.edu, dkoelsch@aqua.who.i.edu
 Subject: Fowarded message 3

>From Glen_Offield@igppqm.ucsd.edu Thu Feb 9 17:01:55 1995
 Return-Path: <Glen_Offield@igppqm.ucsd.edu>
 Received: from ucsd.edu by hurdle.who.i.edu (4.1/SMI-4.1)
 id AA19616; Thu, 9 Feb 95 17:01:52 EST
 Received: from igppqm.ucsd.edu by ucsd.edu; id OAA26060
 sendmail 8.6.9/UCSD-2.2-sun via SMTP
 Thu, 9 Feb 1995 14:03:50 -0800 for <kpeal@hurdle.who.i.edu>
 Message-Id: <n1419783875.48671@igppqm.ucsd.edu>
 Date: 9 Feb 1995 14:00:16 -0800
 From: "Glen Offield" <Glen_Offield@igppqm.ucsd.edu>
 Subject: re- Dave's Questions
 To: "David Willoughby" <David_Willoughby@igppqm.ucsd.edu>
 Cc: "Ken Peal" <kpeal@hurdle.who.i.edu>, "Frank Vernon" <vernon@yin.ucsd.edu>,
 "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 X-Mailer: Mail*Link SMTP/QM 3.0.0
 Status: R

Reply to: re: Dave's Questions

Dave,

a. Post-processing time correction is a time consuming and unnecessary burden particularly when a "relatively simple" software change in the sonde can eliminate the need.

b. I have extensive experience with transmission of time commands over many media (wire included) and I guarantee this error will happen. Adding the "3-in-a row" plus checksum onto the time string will insure correct time at the DAS. I believe that the effective cost of this change -vs- the effective cost of 30 minutes of lost data is a bargain.

c. If you decide to do the "upper-lock noise test" before March 1, let me know ASAP. It is conceivable that both Ken and Allen could have new "time" EPROMs ready for installation when you do your test. If you schedule the retrieval of the sonde for the noise test on February 18, I (and possibly Ken) could be there to verify the new firmware. Allen has committed, but Ken must investigate the Seascan clock a bit further and will let me know tomorrow (02/10). If Ken cannot produce his firmware change with confidence before next week, we will not attempt to install any new firmware during your noise test. As this new firmware is required, and must be tested in the full-up configuration, WHOI will consider delaying their trailer removal until April.

d. The b3s2 SUN is fully functional at PFO just as before. It has only been relocated to the PFO trailers for access to the internet. Control of the sonde is selected via the IGPP/WHOI command switch located in the WHOI trailer. The SUN operator may communicate with personnel in the WHOI via walkie-talkie. Once WHOI removes their trailer in March, the SUN will remain as is - only the power supplies, clock and BCU Simulator will remain at the well head.

l@hurdle.who.i.edu
savo by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA07464; Fri, 10 Feb 1995 11:22:36 -0500
Received: from AQUA.WHOI.EDU by bravo.who.i.edu (AIX 3.2/UCB 5.64/4.03)
id AA11269; Fri, 10 Feb 1995 11:21:45 -0500
Received: by aqua.who.i.edu (5.57/Ultrix3.0-C)
id AA03215; Fri, 10 Feb 95 11:21:36 -0500
Received: by hurdle.who.i.edu (4.1/SMI-4.1)
id AA19772; Fri, 10 Feb 95 11:19:19 EST
Date: Fri, 10 Feb 95 11:19:19 EST
From: kpeal@hurdle.who.i.edu (Ken Peal)
Message-Id: <9502101619.AA19772@hurdle.who.i.edu>
To: glen_offield@igppgm.ucsd.edu
Cc: rstephen@aqua.who.i.edu, dkoelsch@aqua.who.i.edu
Subject: Secure clock strings

Glen: 10 Feb 95

I have an hour this morning so I thought I would push on with this before talking to you. I have made the change and sent another PROM - hope I did it OK. We need to talk about how to actually do the installation and test.

The topic is how to fix things so that we feel secure about the time strings going from the BCU to the Reftek. I have done what we discussed: change the BCU program so that when it sends the time string to the Reftek it actually does it three times as quickly as possible. The string is also changed to include an XOR checksum. We can still select the interval between when we send the strings as before - we are using 30 minutes at present. We expect that we will receive only one status packet in response to the three strings. The operator command to send the strings manually will also do it three times but only give the visual output after the third time.

There are two questions: what is the separation between the three strings and what is the new string format?

The answer to the first one is "I don't know", but I am sure that the time will be consistent and repeatable. We will need to try it to be sure that it is consistent and to find out what the separation is.

The old string was 15 characters:
<0x01>DDD:HH:MM:SS<space><CR>.

The new string is 17 characters:
<0x01>DDD:HH:MM:SS<space><xor1><xor2><CR>.

I used that same routine that generates the XOR in the data packets. The XOR is calculated over the complete string as shown above with zeros in place of the two xor bytes.

TRANSPONDER FUNCTIONS

There are three responses available upon command. We propose the following use of these functions.

1. Release the DRU. This is the same as in LFASE.
2. Lock the mass in the KSI54000 in case the ship schedule requires early recovery.
3. Release the 'soft tether' and perform a test of the system. Since a state of health check would only be used after the tether has been released or in the shipboard data recording phase this command can do double duty.

an 96 17:1
 <kpeal@hurdle.who.edu> rstephen@who.edu rgoldsborou
 d@who.edu
 Return-Path: kpeal@hurdle.who.edu
 Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.12/8.6.12) with
 ESMTP id XAA23073 for <rstephen@gannet.who.edu>; Wed, 17 Jan 1996 23:04:04 -0500
 Received: from hurdle.who.edu (hurdle [128.128.92.91]) by aqua.who.edu (8.6.11/8.6.11) w
 ith ESMTP id XAA13693; Wed, 17 Jan 1996 23:01:39 -0500
 Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id WAA11122; Wed, 17 Ja
 n 1996 22:57:33 -0500
 Date: Wed, 17 Jan 1996 22:57:33 -0500
 From: Ken Peal <kpeal@hurdle.who.edu>
 Message-Id: <199601180357.WAA11122@hurdle.who.edu>
 To: rstephen@who.edu, rgoldsborough@who.edu, mgould@who.edu
 Subject: BBBSS transponder functions

Possible use of acoustic transponder replies
 with BBBSS

1. Introduction

In order to settle on the acoustic transponder function for the system in its present mode, details of the previous operation were first recalled. Comments are welcomed regarding the accuracy of this portion of the document!

2. LFASE use

The transponders were modified so they no longer functioned as releases operating their own mechanism. The former release function (command A) was wired to the external squibbs to cause release of the DRU.

Receipt of the release command also caused a status reply from the transponder based on the value of two hardware bits available to the processor in the BCU.

Receipt of the disable command (command B) also caused a status reply based on the value of the two hardware bits. This command also disabled operation of the transponder's ranging ping.

Receipt of the enable command (command C) caused the transponder to enable - that is, reply to pings for ranging purposes. No status reply was sent in this case.

The fourth command, called command D, ran the motor (~~if enabled~~) to release the coax from the BIP and also caused a "take data" command to the BCU. The rationale was that while the system was connected to the ship, the take data command would not be needed so the release function would happen (~~if the release relay was enabled~~). After the system was disconnected from the ship, it would serve as the take data function. In addition to taking data, the BCU initiated a transponder reply which was different from those described above. In this case, one of the hardware lines was needed to initiate the transponder transmission so only the other line can indicate data - 1 or 0. This is referred to as a command D reply to distinguish it from the normal status reply described above.

- A+B give some status reply

- C does nothing we care about.

*- gives different status reply
 D releases hook if no MPL power
 - takes data if MPL power*

- release relay is a surface stand-off so we don't drop the BCU on somebody

xpndr.doc

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17 Jan 96

3. Acoustics for the various replies

In the case of a status reply, there are four replies possible on the basis of the two hardware lines as follows:

STADAT	STATRIG	acoustic reply
0	0	4 pings @ 4 sec, then 4 at 7 sec
0	1	6 pings @ 7 sec.
1	0	4 pings at 7 sec, then 4 @ 4 sec
1	1	12 pings at 4 sec

(there is also reference to 10 pings @ 4 sec - how???)

} from A+B - replies if transponder OK

In command D reply, two replies are possible:

0	1	6 pings @ 7 sec
1	1	12 pings @ 4 sec

} from D - replies if BCU -OK.

4. Replies and meanings for LFASE

The meaning of the hardware bits follows.

Status reply

STADAT:	0 - BCU off
	1 - BCU on
STATRIG:	0 - not in 1 hour mode
	1 - in 1 hour mode

Command D reply

STADAT:	0 - BCU off - not possible
	1 - BCU on.

5. Suggested BBBSS use

In this case the acoustics will be the same as for LFASE, but the meaning of the STADAT and STATRIG are different as follows:

Status reply

STADAT:	0 - no disk errors and REFTEK data on
	1 - disk errors or no REFTEK
STATRIG:	0 - Reftek data on
	1 - no Reftek data being received

Command D reply

STADAT:	0 - no watchdog bites
	1 - watchdog bites.

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17 Jan 96

MEMORANDUM

To: Dave Willoughby
From: D. E. Koelsch
Re: BCU Simulator Connections

Date: April 12, 1994

I'm sending you the latest SONDE Communication Board along with the BCU Simulator. There is also documentation showing how to connect it and what signals and equipment will be necessary to be able to run the SONDE through 7 conductor cable.

Let me know how this works out and call if you have any questions. Glen asked if we would send this soon.

Regards,

Don

cc: Glen Offield, SIO/IGPP
Ralph Stephen, WHOI
Ken Peal, WHOI

BCU Simulator Test Setup
Don Koelsch
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Don Koelsch

Introduction

The object of this system is to be able to test and operate the SONDE through the 7 conductor logging cable. Using the BCU Simulator, testing can be done without the actual BCU. We have also built a SONDE Simulator so that we can test the BCU without the actual SONDE. Since the interface, in each case is the same we can then have reasonable assurance that the two systems will be electrically compatible.

Equipment needed

1. Power Supply for SONDE operating power.
28 - 32Vdc at 1 amp.
2. Power Supply for Simulator power.
5Vdc at 20 ma.
3. Power Supply for SONDE clamping and centering power.
-50Vdc at 1 amp.
4. Power Supply for TV and light system simulation.
+50Vdc at 2 amp.
5. PC-AT to: a) supply the time string and operating commands to the REFTEK, suggest output from COM1; b) supply the 1 per second pulses to the REFTEK, suggest output from COM2.
6. PC-AT or UNIX work station to receive the 4800 baud data from the SONDE.
7. WHOI Bottom Control Unit Simulator.
8. WHOI SONDE Communication Board, Mod. 1-27-94 mounted in SONDE.
9. Seven conductor well logging cable with G.O. connector on SONDE end.

Procedure

1. Hook up: Connect equipment as per diagram.
2. Make sure all switches on SONDE simulator are OFF.
3. Program 'Command and Timing computer to:
 - a) Output a properly formatted time string at 2400 baud on Com1 in synchronism with the 1PPS, on Com2.
 - b) Output a 10ms pulse once per second on Com2 for the REFTEK. Suggest sending an @ at 110 baud.
 - c) Accommodate all commands to and replies from REFTEK.

4. Program the 'Data Receiving' computer to receive the 4800 baud data from the REFTEK.

5. Install the SONDE Communication Board into the SONDE. See the board schematic for connector pin outs.

6. Turn on power supplies and proceed with testing or operation.

7. Although it shouldn't be a problem it would be best not to turn on the +50Vdc and the -50Vdc power at the same time.

Enclosed are schematics for the:

1. BCU Simulator
2. Sonde Communication Board
3. BCU Simulator Test Setup

If you have any questions or suggestions please call me at (508) 457-2000 X2249.

Good Luck,
Don

5. "Fail Safe" Measures

5.1 Stephen 1/23/96

- check mods for new cone

- jitter on MPL telemetry
for clock checks.

- work out shipboard test logic

CEANOGRAPHIC INSTITUTION
Department of Geology & Geophysics
360 Woods Hole Rd., MS 24
Woods Hole, MA 02543-1542

Ralph A. Stephen
Senior Scientist
Clark Lab South 278

Telephone: (508) 289-2583
Email: rstephen@whoi.edu
Fax: (508) 457-2150

Memo to: Ken Peal / Rob Goldsborough

From: Ralph Stephen *RJS*

Date: January 23, 1996

Subject: Integration tests, transponder commands and fail safe measures

Comments in red made
at meeting with Ken
on Feb. 6/96

I have been going through my own files for relevant memos that may help planning for the coming year. Attached are two memos ("Summary of the OSN Pilot Experiment Test Schedule" - Attachment 1 and "Koelsch memo of March 13, 1993" - Attachment 2) that might help to guide our thoughts on what needs to be done and how. Also my August 4 memo to Ken is a pretty good summary of the broad tasks and available funds.

Regarding the transponder command and reply definitions (Ken's e-mail of 18 January - Attachment 3) Ken's suggestions sound fine. Command A, formerly used to release the DRU, will be free to command logic in the sonde if we like (see below). - can't do

There has been discussion between IGPP and WHOI regarding fail-safe options in case we lose contact with the BIP while still mechanically connected, as happened on LFASE. See Willoughby's memo of October 22, 1992 (Attachment 4) for a brief summary. Also there was some testing of the EMLA during the WHOI/IGPP tests in October 1994 (see draft PFO technical report - Attachment 5). This was only a partial test and the EMLA was not included in the Pinon Flat configuration. (The EMLA, Emergency Mass Lock Assembly, is used to lock the seismometer if the sonde does not get power after a given time. It has batteries to power the locking mechanism autonomously. In the Oct. '94 tests there was no way to enable it; it was always on. So if power was off, during shipping for example or while launching the BIP from the ship, the EMLA would be activated and presumably would drain its batteries. One of Dave's tasks was to provide the capability to enable it on the seafloor or at PFO through the REFTEK.) The real motivation for the EMLA was to lock the seismometers at the end of the experiment which would occur, by definition, when the BCU power completely drained. *below some threshold.*

Now there are two options if we lose electronic connection to the BIP during installation: i) everything has been tested and we want to leave the system on the seafloor to record autonomously, or ii) the tests are not complete (we may need as much as 24hrs for the sensor to settle properly) and we want to recover the whole seafloor and borehole package. For option i) the BCU is smart enough to go on battery power if it loses MPL power and it will go into autonomous recording mode, triggered by the watchdog if necessary. In this case we want to be able to check the state of health of the BCU acoustically (Commands A and B in Ken's memo) and then to release the MPL cable (Command D in Ken's memo but without the "take data" option.). For option ii) we could just pull the sonde, but because the BCU is

As of Feb '96, Peal & Offield agreed on locking mass when pps stops for a certain amount of time (~2 hours)

providing battery power the seismometer will not unlock. One thought here is to use the release portion of Command A to either turn off BCU power (risky to have anything do this ^{N/A} that might fail) or to signal the EMLA directly to lock the seismometer. IGPP objected to any suggestion for the latter case other than total power loss because it could cause unintentional locking if something went wrong. So I recall that when we left PFO, the understanding was that if the system failed under option ii) we would just recover the sonde, unlocked. We may want to check that IGPP is still happy with this.

I hope this discussion helps.

implemented pps
check.

If MPL power fails:

if Sonde OK = 0 then sonde locks after ~2 hrs
and we pull back-up

if Sonde OK = 1 then BCU goes autonomous and
we release hook with command D

- when we send command D we get
acoustic reply that BCU is working
and whether there have been
watch dog time outs

- then we could send command A to
see if REFTEK data OK.

This is all OK if we have ship's power to stay on
station

If we lose station ^{and MPL power} keeping / we could send command
D to release hook ^{and turn MPL power off} or we could risk pulling
the sonde out unlocked. ↗

If we lose station keeping with MPL power on then release
hook with MPL command or risk pulling the sonde out
unlocked IGPP can relock

Attachment #1: Summary of the OSN Pilot Experiment Test
Schedule (see Section 7.2)

Attachment #2: BBBSS Communication and Data Flow
(see Section 4.1.3)

Attachment #3: Possible Use of Acoustic Transponder
Replies with BBBSS
(see Section 4.6.1)

Attachment #4: Broadband Borehole Seismometer Meeting
at SIO (see Section 3.8.1)

Attachment #5: B³S² Summary of Integration and
Field Tests at ICGP and PFO
(Oct. 94 - June 95) (see PFO report)

; Jan 96 12:00

Replied: Ken Peal <kpeal@hurdle.who.edu> rstephen

Return-Path: kpeal@hurdle.who.edu

Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.12/8.6.12) with ESMTP id WAA00894 for <rstephen@gannet.who.edu>; Wed, 24 Jan 1996 22:42:46 -0500

Received: from hurdle.who.edu (hurdle [128.128.92.91]) by aqua.who.edu (8.6.11/8.6.11) with ESMTP id WAA05135; Wed, 24 Jan 1996 22:40:12 -0500

Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id WAA00741; Wed, 24 Jan 1996 22:36:05 -0500

Date: Wed, 24 Jan 1996 22:36:05 -0500

From: Ken Peal <kpeal@hurdle.who.edu>

Message-Id: <199601250336.WAA00741@hurdle.who.edu>

To: rstephen@who.edu, rgoldsborough@who.edu

Cc: glen_offield@igppqm.ucsd.edu

Subject: BBBSS seismometer lock

Ralph, Rob:

24 Jan 96

I talked to Glen Offield about the seismometer lock problem and we suggest the following.

At present if we lose communications with the ship while connected via the coax and the CV, we have two choices.

1. If we have enabled the release relay, we can disconnect the soft tether using the acoustic transponder command (and leave the system to acquire data).
2. If we have not enabled the release relay, we must pull out. If the Teledyne is unlocked, it may sustain damage.

A suggested new function will cope with the possibility of damage in the latter case. It requires hardware and software changes as follows:

- WHOI adds circuitry to gate the 1 PPS signal sent to the Reftek (this circuitry was in place but has been disabled)

- IGPP adds software to invoke emergency lock of the Teledyne if the 1 PPS signal stops for longer than a predefined period of time

- WHOI changes the software that deals with the MPL power detect:

- start autonomous operation if MPL power goes away and if the release relay has been enabled
- stop the 1 PPS output to the Reftek if MPL power goes away and if the release relay has not been enabled.

These things always seem to need some time to percolate, so let's hear the angles when people have thought about it.

Regards ... kp

Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu
ESMTP id PAA06632 for <rstephen@gannet.who.edu>; Fri, 16 Feb 1996 15:18:37 -0500
Received: from hurdle.who.edu (hurdle [128.128.92.91]) by aqua.who.edu (8.6.11/8.6.11) with ESMTP id PAA21295; Fri, 16 Feb 1996 15:15:32 -0500
Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id PAA02878; Fri, 16 Feb 1996 15:10:59 -0500
Date: Fri, 16 Feb 1996 15:10:59 -0500
From: Ken Peal <kpeal@hurdle.who.edu>
Message-Id: <199602162010.PAA02878@hurdle.who.edu>
To: glen_offield@igppqm.ucsd.edu
Cc: rstephen@who.edu, rgoldsborough@who.edu
Subject: Borehole questions

Glen: 16 Feb 96

Some detailed borehole questions.

1. In thinking through some of the deployment plans, we have a concern: once the system is deployed and in the hole, what do we need to do to ensure that the DAS clock agrees with the Seascan? There may be a time when we first start collecting data on the ship up the wire line that the BCU is in passive mode so no time strings are being sent. If this happens can we send one set of three strings "manually" (that is by operator command from the ship to the BCU) and be assured that the DAS time is then correct?

2. Does the DAS/sonde have a low voltage detector in the borehole case? You mentioned it in connection with BBOBS, but I wondered about this case.

3. Regarding the 1 PPS timeout that we have now implemented to lock the Teledyne. There is a possibility that the BCU could temporarily die in such a way as to inhibit the 1 PPS to the DAS. If this happens, the BCU will also not be writing to disk so after about 2.5 hours a watchdog will reset the system and if it recovers then will restart the 1 PPS and continue operation. To prevent locking the Teledyne in this case, you will need to implement say a three hour delay before doing the lock. Is this possible?

4. Your question about the mass position data is probably a SMOP. Tom Bolmer is at sea right now so I will let him know when he returns.

Regards ... kp

al@hurdle.w.

Received: from aqua.whoiedu (aqua [128.128.16.1]) by gannet.whoiedu (ESMTP id JAA32661 for <rstephen@gannet.whoiedu>; Fri, 26 Jan 1996 09:59:20 -0500)
 Received: from hurdle.whoiedu (hurdle [128.128.92.91]) by aqua.whoiedu (8.6.11/8.6.11) with ESMTP id JAA16730 for <rstephen@whoiedu>; Fri, 26 Jan 1996 09:56:44 -0500
 Received: (from kpeal@localhost) by hurdle.whoiedu (8.6.12/8.6.9) id JAA00416; Fri, 26 Jan 1996 09:52:36 -0500
 Date: Fri, 26 Jan 1996 09:52:36 -0500
 From: Ken Peal <kpeal@hurdle.whoiedu>
 Message-Id: <199601261452.JAA00416@hurdle.whoiedu>
 To: rstephen@whoiedu
 Subject: Message of interest

>From Glen_Offield@igppqm.ucsd.edu Thu Jan 25 20:48:40 1996
 Received: from mail.ucsd.edu (ucsd.edu [132.239.254.201]) by hurdle.whoiedu (8.6.12/8.6.9) with ESMTP id UAA01164 for <kpeal@hurdle.whoiedu>; Thu, 25 Jan 1996 20:48:39 -0500
 Received: from igpp.UCSD.EDU by mail.ucsd.edu; id RAA26957
 sendmail 8.6.12/UCSD-2.2-sun via SMTP
 Thu, 25 Jan 1996 17:52:44 -0800 for <kpeal@hurdle.whoiedu>
 Received: from igppqm.ucsd.edu by igpp.UCSD.EDU (4.1/UCSDGENERIC.4) id AA20659 to kpeal@hurdle.whoiedu; Thu, 25 Jan 96 17:52:49 PST
 Message-Id: <n1389530131.17838@igppqm.ucsd.edu>
 Date: 25 Jan 1996 17:51:17 -0800
 From: "Glen Offield" <Glen_Offield@igppqm.ucsd.edu>
 Subject: Partial answers I owe you-
 To: "Ken Peal" <kpeal@hurdle.whoiedu>
 X-Mailer: Mail*Link SMTP/QM 3.0.0
 Status: RO
 X-Status:

b3s2

Firmware Change:

I plan on implementing the 'lock if 1 pps fails' feature before a parking lot test of the sonde that I have planned on 02/05. We will reinstall the sonde at PFO on 02/07 containing this new firmware. If the powers that be change their mind, I need to know by 01/31.

6.1 IGPP Test Plan

6.1.1 Koelsch 9/14/94

**TEST PLAN
B3S2, at IGPP OCT. 1994**

DAY 0: (Before WHOI ships equipment to IGPP)

At WHOI.

WHOI tests their system with the Sonde simulator - see figure 1.

At IGPP.

IGPP tests their system with the BCU simulator and 7 conductor armoured cable - see figure 2

R.Stephen could be at IGPP 30 Sept to observe these tests.

DAY 1: (Monday)

In IGPP yard.

Task 1.1 Unpack van.

Task 1.2 Confirm all computers have not suffered shipping damage.

Task 1.3 Get computers set up in both IGPP lab. space and in van.

Task 1.4 Set up BCU connections to armored cable, sonde simulator

DAY 2: (Tuesday)

In IGPP yard.

Test 2.1 Set up WHOI system as our test. (Fig1)

Test 2.2 Set up GOES clock with antenna. Make sure it synchronizes.

Test 2.3 Turn on "battery" shore power to BCU/DRU.

Result:

Recording system 'boots' because of no MPL or deck power.

It begins to take and record data from the sonde simulator.

Test 2.4 Turn on MPL/deck power.

GCAT (BCU CPU) reboots and sets up GCAT to surface communication and waits for surface commands.

4800 baud data is transmitted to surface.

Take simulated data (from test CPU) record the data on the lab recorder, Lab Forwarder to UNIX box, display data.

Test 2.5

Test data recorded in BCU.

1. Read and retransmit data to surface.

2. Put BCU hard drive into UNIX box and run QC on it.

Test 2.6

Test Sea Scan clock Set and read functions.

DAY 3: (Wednesday) - see figure 3, Integrated Operation

In IGPP yard.

Test 3.1 Connect armored cable to sonde which is set up vertically outside building.

Connect data and communication cables to IGPP control CPU.

Confirm communication link to sonde is working.

Test 3.2 Turn -50 volts on.

Confirm clamping mechanism works.

Confirm mass centering mechanism works. Comm link to surface ON.

Record and monitor real time data on WHOI deck recording system.

Compare data with baseline data previously taken at IGPP.

Test 3.3 WHOI reconnect recognition string (reconnect_bcu).

Make sure that comm link transfers to BCU-to-surface mode.

Test 3.4 Power consumption.
Measure power consumption in all modes.
Test 3.5 Battery test
Connect battery
Confirm control and acquisition still work
Test 3.6 Overnight run
Reconnect to shore power
Take data overnight

DAY 4: (Thursday)

In IGPP yard.

Test 4.1

Examine data from overnight test
Debug and repair or change so that previous tests work.

Test 4.2 Overnight test on battery

Connect battery
Disconnect deck cable
Start overnight test on battery taking seismic data in yard.

DAY 5: (Friday)

In IGPP yard.

Action 5.1

Evaluate data from overnight Test 4.2.

Action 5.2

Debug and fix any problems.

Action 5.3

Dismantle and pack van for transport to Pinion Flats.

DAY 6: (Saturday)

Truck equipment to Pinion Flats.

Unpack van and set up equipment as it was at IGPP yard.

DAY 7: (Sunday)

At Pinion Flats

Action 7.1

Deploy sonde in hole with the 7 conductor armored cable.
Clamp it.
Center the masses while monitoring data.

Action 7.2

Take a few hours of data to confirm proper operation.

Action 7.3

Recover sonde and repeat Actions 7.1 through 7.2
to test repeatability of hole lock clamping.
This may run into DAY 8 and make everything slip a day.

Action 7.4

Run overnight on shore power.

DAY 8: (Monday)

Action 8.1

Confirm overnight data is good.

Action 8.2 Battery operation.

Switch over to battery power
Take two hours of data. Read it for any errors.

Action 8.3 Long term battery operation test.

Set up equipment to run on batteries (WHOI supplied).

Run a 48 hour test with all shore power off and no personnel in the area.

DAY 9 & 10: (Tuesday & Wednesday)

Run unattended test.

Discuss criteria to determine when sonde is "working" (i.e. measuring ground motion).

DAY 11: (Thursday)

Action 11.1

Return to site.

Evaluate data.

Action 11.2

Reconfigure equipment for 2 month recording test (Fig. 4).

DAY 12: (Friday)

Action 12.1

Start 2 month recording test.

Shut down site for remainder of test.

Fig. 2 IGPP's YARD TEST
(to be completed before WHOI ships)

APPLIED OCEAN PHYSICS & ENGINEERING
WOODS HOLE OCEANOGRAPHIC INSTITUTION
WOODS HOLE, MA 02543
Don Koelich
233P
GMP/ST

BCU Simulator
Test Setup

6.2.1 Koelsch 12/20/93

Test at IGPP and Deck test before deployment

Condition:

MPL not connected
Power applied through Deck test cable
+24 Vdc supply (either battery or power supply)
+28 Vdc applied through Deck test cable
-50 Vdc applied through Deck test cable
2400b Full duplex Com Link connected through Deck test cable
4800b Data uplink through Deck test cable
Watch-dog reset circuit disabled

Procedure:

Turn on battery power

Response:

- a) GCAT gets power and resets
- b) Senses MPL/deck power
- c) Reads Battery backed up or EPROM bit, TRUE if we are in the borehole
- d) If b. and c. are FALSE then go to SLEEP
- e) KSI 54000 is applied to Pin 2 of the cable as soon as battery power is turned ON.

Procedure:

Turn on Deck 28 Vdc supply.

Response:

- a) GCAT wakes up on MPL ON edge.
- b) Turns on REFTEK power
- c) Starts 1 PPS pulses down Pin 6 of the cable.
- d) Senses Deck test cable plugged in and connects Com Link between BCU and Deck.
- e) GCAT responds with MENU
- f) REFTEK sends 4800b Data to GCAT and Deck

Procedure:

Turn on Deck -50 Vdc

Response:

Operator selects from MENU what to do next

Menu

1. Time check with surface clock
2. Shift communication to REFTEK talking to Surface.
3. Record data
4. Write a test record read it and compare
5. Read engineering data and report it to surface
6. Set bit in memory that we are in the hole.
 - a) S= SET BIT
 - b) C= CLEAR BIT
7. Arm/disarm tether release relay and report status
 - a) A= ARM
 - b) D= DISARM

B3S2 OPERATIONS FLOW

Start Conditions:

All power OFF
KSI 54000 mass locked

Preparing to go over the side:

Battery power ON (plugged in)
GCAT in 'SLEEP' mode
Low Power to KSI 54000 ON
Tether release relay is NOT ARMED.

Over the side 'mid-water' Testing:

MPL power ON, Senses 28 Vdc coming ON (edge triggered)
communications. Link (2400b full duplex) defaults surface to GCAT
REFTEK power ON
KSI 54000 low power via relay in Sonde (ON/OFF IGPP call)
Data link (4800b) connected to Surface & GCAT.

Pre-search using acoustic Navigation to get near cone.

If 54000 power is on-- request from surface to shut OFF
Put BCU to 'SLEEP'

Video search & borehole deployment.

Camera & lights at bottom of Sonde are on
Video to surface
Switching between TV on BIP & Sonde as required
Sonde and Bip totally deployed

MPL turns on +28 Vdc, GCAT comes out of SLEEP

MPL turns on -50 Vdc

Turns on REFTEK

Turns on 1 PPS

Sends TIME to REFTEK

Operation suspends and TIME is sent to REFTEK every ~~TD~~ 1308
minutes.

4800b data comes up to surface (Also to BCU, GCAT)

Com Link defaults BCU to Surface

KSI54000 power is still on from when battery was plugged in

On command from surface

Com Link transferred to condition Sonde to Surface

GCAT listening for 'special' address message then transfers

Con Link back to default - BCU to Surface

IGPP commanding Sonde from surface

Commands Sonde to 'LOCK' into borehole.

Turns on KSI54000 via the latching relay in Sonde

Unlocks and Centers Mass

Monitors and records(?) data for proper operation.

WHOI Records data on ship.

Monitoring phase, system working and ready to release tether.

Com Link Surface to either BCU or REFTEK

Tether release latching relay ARMED

Set bit in either ROM or BBU memory that is read when MPL power goes away and initiates tether release sequence.

Check SEA SCAN clock

Record Data on ship

Record data in BCU

Initiate autonomous mode phase 'Graceful Release'.

Turn OFF MPL +28 Vdc

Turn OFF MPL -50 Vdc

4800b data link still active

2400b Com Link still active

Command tether release via command from surface

Autonomous mode phase emergency release.

If: MPL power goes away and there is no communication from surface after TBD timeout or when a Release command is issued from a Transponder.

Then: Release tether.

revert to autonomous mode.

When in autonomous mode:

If no 'disk writes' for a TBD time cycle power to GCAT (hard ware determined

If no Data from REFTEK cycle power to REFTEK (software determined).

Other conditions:

Communication protocols

Surface to BCU

8 bits of Data

1 Start bit

1 Stop bit

Positive parity

Surface to MPL Module

8 bits Data

1 Start bit

1 Stop bit

Negative parity

GCAT always listens for a distinctive command then it reverts to communicating GCAT to Surface. Time is always sent to the Sonde every TBD minutes.

Emergency Responses

If MPL loses power or commands:

Condition: While going down.

Response: Same as 'Over the side Mid-water testing'

Condition: Sonde locked in borehole and beginning testing
Not centered and mass not locked

Response: Wait TBD minutes and stop 1 PPS signals
REFTEK issues a lock mass command upon no 1 PPS signals.

Condition: When mass centered
Initial testing complete
BIP Release Relay has been armed

Response: See autonomous mode 'Emergency Release'

7.1 WHOI Progress Reports

TO: Ralph Stephen 7.1.1 Peal 5/10/93
FROM: Don Koelsch
RE: Progress report list for B3S2
DATE: May 11, 1993

-Attended meeting on Dec. 12, 1993 at Scripts which defined:
(see minutes of meeting Dec. 9, 1992)

1. the interface between the Bottom Control Unit (BCU) and the Scripts.
2. the timing issues so that time is inserted in the record stream and is synchronized with the Sea Scan precision clock.
3. agreed on a schedule to supply downhole cables to IGPP. First 300 m. cable has been terminated and sent as of March 30, 1993.
4. agreed that if a cable slacking mechanism should be needed it would be at the sonde.
5. made refined estimate of power budget.
6. minutes of this meeting was sent to all participants

-Downhole telemetry electronics was designed, breadboarded, and tested this includes the: (see memo Koelsch to Willoughby March 9, 1993)

1. 1PPS time strobe.
2. full duplex 2400 baud communication link.
3. 4800 baud data up link
4. conductor allocation switching matrix for various modes of operation ie. searching for the hole, powering from the ship while leveling and mass centering, powering from and storing data in the BCU, supplying power for the clamping mechanism.

-defined the data flow and communication requirements for each phase of the program. This was sent to all hands in the form of a series of diagrams. Since there has been no feedback it is assumed all concur and WHOI is going ahead with this system configuration.

-

Office Memorandum

TO: Don Koelsch
FROM: Alessandro Bocconcelli and Matthew Gould
SUBJECT: B3S2 Progress Report
DATE: May 11th, 1993

- collected information on new borehole (OSN-1) and reentry cone drawings
- calculated weight budget for new reentry array
- investigated design modifications for BCU reentry package to fit new reentry cone
- well logging cable terminations: found proper technology and procured a total of 5 connectors from Halliburton. Prepared tool box with connector spares. Designed polyurethane boot for cablehead termination
- tested and spooled out well logging cable. Cut three sections, terminated one with cablehead connector and shipped to SIO.
- designed Sonde Control Unit (SCU)
- designed new layout for BCU frame: modifications to increase underwater batteries storage
- modified data recovery chassis to accomodate new hard disks
- investigated requirement and design of built-in weak link
- tested cable terminations in tensile machine for built-in weak link.
- built battery storage pressure vessels and pressure tested at full depth at W.H.O.I.
- designed and built mating receptacle for cablehead termination (well logging cable)
- procured new bulkhead connector from D.G. O'Brien
- designed new pick up point for BCU frame recovery

7.1.3 Peal 5/10/93

TO: D.Koelsch

10 May 93

FROM: K.Peal *K*

RE: Status of recorder portion of BBBSS

Recorder selection

Recorder selection tests complete, report written.
Recorders purchased.

Underwater portion

Hardware design changes complete and documented.
Hardware of BCU and DRU modified.
Recorders installed in DRU.
Software design changes begun.

Shipboard portion

Recorder purchased.
New operating configuration designed.
Computers modified.
Software design changes begun.

Integration and test

Test equipment and configurations defined.
(Don - status of design of test boxes?)
Software modules defined.
Software design begun.

7.2.1 Koelsch/Peal 3/22/94

1. Apply battery power 31 volts (power supply)

This applies power to sonde (CABLE 2)

GCAT (B3S2 computer) is not powered.

is GCAT in the BCU

2. Apply Deck or MPL power.

GCAT is powered by sensing the presence of MPL power.

and does a 'power-up-reset'.

Turns on 1PPS pulses (down CABLE 6).

If SondeOK bit is off & MPL PWR bit is on

Communication is set from BCU to Surface MPL/Deck

Waits for Keyboard input.

[Escape] brings up the prompt

HELP-- Refer to Document on keyboard commands & STATUS

Go through functions as shown in the HELP screen - *specify more clearly*

3. Apply -50 volts to CABLE 5, watch indication on Sonde Simulator

Communication and Data to and from Sonde still active.

4. End of Experiment (EOEX)

Defined by either Time as set into EEPROM previous to the site or Low Battery Voltage (LBV) (see Failsafe features).

If B3S2 must be recovered before the End of Experiment time

there is no mechanism to lock the mass. OK

is clock checked? or calibrated? yes using program called 'clock'

We need to test:

- a) that HP is displaying data in real time
- b) that data ^{lab} on/disk can be read on HP
- c) that data on BCU disk can be read, transmitted to surface & displayed

This should be done in 'lab test' and 'deck test' still to be done!

How do we test Transponder Functions

- a) how do we test the transponders themselves?
- b) how do we test response to their commands?
- c) rethink transponder control logic?

will be done before P.F.

Can we take a hard disk out for testing (from the lab recorder) without losing data? *yes*

Think about synching HP real time O/P so glitches do not occur.

Disk access

Every time there is a disk write the Watch Dog is reset
 If there are no writes for about 135 minutes the GCAT will
 be shut down and a power-up reset will occur, then if the
 Sondeck bit is set and MPL pwr bit is off the system will
 go back "to work". OK

Disk malfunction

*'error returns
 need to be looked
 at'*

If the addressed disk does not come up 'READY', the next disk
 is selected and data recorded on it. The program will go around
 this loop until either the battery fails or until all available
 disk space is filled.

*how is this
 determining*

Battery failure

Hardware circuit detects LBV, about 15 volts, and stops
 the 1PPS signal to the sonde. The REFTEK senses the
 absence of the 1PPS. If they do not reappear within some period
 of time ~~(TBD)~~ the 54000 mass will be locked. Power for this
 supplied by a battery in the sonde.

2000sec

REFTEK failure

There is a watchdog circuit in the REFTEK system which reboots
 the REFTEK if there is a failure (Failure mode is not known).

*do we have to
 about handling
 when REFTEK
 reboots*

Recovery failure

If wireline recovery is not possible, the transponder Command A
 will release just the Data Recording Unit (DRU) and it will
 return to the surface allowing data recovery.

*is there a meaningful
 test for this in the
 lab and at PP?*

- what about clock problems?

- how often are Sauscan times entered into the process (30 mins)

- sent to REFTEK

- are they ever recorded as part of our
 engineering data

- time tears are flagged in REFTEK status info

What about shipboard power ~~loss~~
 failures or glitches?

Deployment procedures

While on deck through Deck cable.

Energize system by laboratory power supplies.

Exercise all functions as listed in the HELP menu.

Confirm communications to REFTEK.

Confirm DATA is being generated by REFTEK

Set End of Experiment Time (greater than or equal to actual end of exp 4 time).

Same only through MPL

Power is supplied by MPL through 0.680 deployment cable.

Check out TV systems.

Going over the side

Conditions:

Battery connected

MPL not connected while deploying 'soft tether' (Does this consume battery power? -sonde is turned off.)

Sondeok bit in EEPROM is not set.

Power applied to Sonde Power wire (Cable 2)

No 1PPS on Cable 6.

BCU is not powered.

Mass in 54000 is locked.

No communications from ship to system.

No mass 'locking power', -50 Vdc.

Tether release relay in not armed state. good!

-what about REFTEK
+ BCU

Sonde, BIP, and Thruster is deployed to about 300 meters or lowering.

Conditions:

MPL power is turned on and is sensed by the MPL PWR detect bit. This causes power to be applied to the GCAT, it boots and communication defaults Deck/MPL to surface.

Data link defaults REFTEK to surface. ← if sonde sensor is clamped what does REFTEK data look like?

Checkout:

Confirm all functions in HELP menu operate.

Confirm TV and Thruster system are operational.

Confirm REFTEK is operational.

Perform all test on 54000 that can be done while mass is clamped

Search and borehole deployment

Conditions:

Sondeok bit is still not set. Prevents going to 'work'

Tether release relay is not armed.

MPL power to sonde is OFF preventing going to 'work'.

MPL turns on TV at bottom of sonde to search for cone.

Once Sonde is in hole then MPL switches to BIP TV to confirm that BIP is deployed vertically in cone. good

Clamping and Testing

Procedure:

MPL turns off TV system.

MPL turns on tethered operating power (+32 Vdc) to BIP causing a POWER UP reset to GCAT.

MPL completes communication and data link to surface.

MPL turns on clamping and mass centering power (-50 Vdc) to BIP.

On the surface Communication is switched to IGPP.
 IGPP issues the Sonde locking command.
 IGPP turns on power to 54000 through latching relay in sonde.
 WHOI listens and records all data coming up the DATA channel.
 IGPP Centers the 54000 mass and does all other tests that
 determine proper operation.

Proper operation confirmed:

Set Sondeok bit
 Arm tether release relay
 Check and set EOEX time.

Monitoring Stage:

MPL turn OFF and ON -50 Vdc to BIP as needed.

Record data on ship (WHOI)

Recenter mass as needed.

If sonde fails: turn off Sondeok bit and disarm tether
 release relay.

If MPL fails transponder Command D will release the tether. *good*

When monitoring stage ends, send the Release Tether command to BCU

*does this clamp
 perphones? maybe?*

Long term deployment:

After tether has been released:

If system is not taking and recording data the watch dog will
 bark causing a power up reset. The BCU will then look at
 the MPL pwr detect bit and the Sondeok bit and will start to
 receive and record data.

Recovery:

Conditions:

Mass in 54000 locked by stopping the 1PPS signals at EOEX or
 Low Battery Voltage detection.

*Seacan time should be calibrated while BCU is on seafloor
 and checked after recovery.*

BBBSS BCU Program

1. Overview

The BCU is controlled by a PC clone which runs a program called BCUPROG.exe to do most functions. When power is applied and the BCU runs, it uses the following rules to decide what to do:

- if MPL power is on, wait for operator input
- if MPL power is off and if the EEPROM/bit indicating that ~~the sonde is OK~~ is on, start acquisition *sondeOK*
- if the MPL power is off and the bit is not set, enter the recovery mode (stop 1 PPS to Reftek)
- if the present time is after the stated end of experiment time, enter the recovery mode.

Aspects of operation that are controlled by parameters stored in EEPROM are as follows:

- sondeOK bit ON means sonde has been deployed and is ready to operate, CLEAR means it is not operational
- the time period (in minutes) between transmissions of the time string to the Reftek
- the time when the experiment should end (*absolute time or relative duration*)
- whether to send the received data "as is" direct to the surface or to receive and retransmit it augmented by BCU engineering values (data stored on disk always includes engineering data) *what are the BCU engineering data?*

Furthermore, several diagnostic modes can be set in EEPROM parameters:

- verbose flag generates considerable screen output during acquisition
- details flag gives some useful output about disk writes (when acquisition is self started, both of these are off)
- the number of buffers in each transfer to disk is nominally 107, but can be set to smaller values to cause more frequent disk activity for testing
- the divisor is nominally 1 but can be set to 2 to cause more frequent disk activity.

*(how much time?)
~ 2 hours.*

- is 'read after write' to disk meaningful or necessary

2. Description of commands

Following is a description of the commands in the order in which they appear in the help file. To obtain the help file while BCUPROG is operating, hit the ESCape key to get the prompt "Command processor" then type "help<CR>". Commands may be entered in upper or lower case. All commands are terminated with return (<CR>).

To enter any of the commands, it is necessary to first hit the ESCape key (but not <CR>) to get the prompt "Command processor". The command should then be entered as it appears in the help file. A few commands require arguments as described below. Any incorrect entry yields the "Huh?" reply. If this happens it is necessary to hit ESCape again to enter a command.

When the prompt has been received, the operator is allowed 5 seconds to begin entering a command. If nothing is entered, the "Huh?" reply is received. It is then necessary to hit ESCape again to enter a command. *why?*

Once command entry has begun, the system waits forever for it to be finished. During this time, if acquisition is active, the input buffer is being filled with received data. When it is full (about 2.7 minutes) input data is lost.

What!!!

"dru off"

Turns off the recorder section power.

"dru on"

Turns on the recorder section power.

"deck-sonde"

Switches the communication matrix to connect the sonde to the deck communications (MPL telemetry or deck cable).

"bcu-sonde"

Switches the communication matrix to connect the sonde to the BCU.

"mpl-sonde"

Switches the communication matrix to connect the sonde to the deck communications (MPL telemetry or deck cable).

"verbose"

A toggle which determines whether or not the extended screen output is generated during acquisition.

*put reasonable
default values
in help file, where
appropriate.*

"feed dog"

Resets the watchdog counter to hold off a power cycle and restart for approximately two hours.

"selftest"

Initiates a test of the BCU. Not implemented.

"engdata"

Reads and displays engineering data. See output attached.

"quit"

Exits bcuprog.

"help"

Generates the list of operator commands.

"sel drive n"

Selects disk drive number 'n' to be used next. The number corresponds to the position in the DRU chassis - 1,2, or 3.

"drive on"

Turns on disk drive power. This spins up the selected drive then reads and displays the pointer information from it.

"drive off"

Turns off the selected disk drive.

"format drive"

Powers the selected drive and changes the pointers on disk back to the startup values (LBA 3).

"disk read"

Powers the selected disk drive, reads a block and sends it via telemetry to the surface. Not implemented. *← important test.*

"disk write"

Powers the selected disk drive, writes a block of dummy data. Not implemented.

← could be important test.

"wake seascan"

Asserts the reset line to the Seascan clock to bring it out of sleep enabling it to be addressed.

"addr seascan"

Sends the address string to the Seascan clock. It is then open and will respond to commands to read its time or set alarm.

"sleep seascan"

Sends the string to the Seascan clock which puts it into the low power mode.

*How can we ensure that
valid data is not
overwritten*

"read time"

Sends the string to the Seascan clock which causes it to read and send the current time. Reports the time to the operator. This command also does wakeup and addressing of the clock.

"set alarm xxxx xx:xx:xx"

Sends the time value entered (xxxx xx:xx:xx) to the clock to be used as an alarm. The format is the same as that reported from the "read time" command.

"get end time"

Reads and displays the current end of experiment time from the EEPROM.

"set end time xxxx xx:xx:xx"

Sets the time value entered (xxxx xx:xx:xx) as the new end of experiment time in the EEPROM. (real time!) *does this work off Seascan clock or processor clock?*

"get tperiod"

Reads and displays the current time string period from the EEPROM. This is the interval between successive time strings sent to the Reftek during acquisition.

"set tperiod n (min)"

Sets the time period entered (n) as the new time string period in the EEPROM. (eg. n =)

"send t"

Sends the current time to the Reftek in time string format. Also sets the Seascan alarm to a time in the future by the amount of the time string period. Note that the system sends the string just this one time however - it does not respond to the alarm when it rings.

"set sondeok"

Sets the flag in EEPROM to indicate that the sonde is ready to be operated.

"clear sondeok"

Resets the flag in EEPROM to indicate that the sonde is not ready to be operated.

"data direct"

Sets the flag in EEPROM to control the data path used during acquisition so that the data sent to the surface is direct from the Reftek rather than passed through the BCU.

"data retrans"

Sets the flag in EEPROM to control the data path used during acquisition so that the data sent to the surface is retransmitted

from the BCU after the addition of BCU engineering data to status packets.

"arm release"

Switches the release relay to the position where the release function is armed.

"disable release"

Switches the release relay to the position where the release function is disarmed.

"divisor 1|2"

Sets the divisor used during acquisition to be 1 (normal) or 2 (faster disk writes). This is a value stored in EEPROM.

"buffers n"

Sets the number of buffers in the primary data file to be 'n'. The normal value is 107. Smaller values cause more frequent disk writes for testing. This is a value stored in EEPROM. Entering "buffers 0" sets it back to the normal value of 107. (2-secs)

~2 hrs
"details 0|1"

Sets the flag used during acquisition to determine how much screen output appears during disk writes. This is a value stored in EEPROM.

"show params"

Reads all the parameters (EEPROM and other) related to acquisition and displays them as in the attached sample.

"start acq"

Starts data acquisition under operator control. This is different from automatically started acquisition in that most of the operator control and display functions are still active and that it can be stopped by the operator.

"stop acq"

Stops data acquisition under operator control.

"start recovery"

Enters the recovery mode which means that the 1 PPS signal to the Reftek is stopped, causing the Reftek eventually to reclamp the sonde for recovery. This is the mode entered when the end of experiment time is reached. The only exit from this mode is to stop BCUPROG using the "quit" command (hit ESCape, wait up to 5 seconds for the prompt, then type "quit").

Could this be
accidentally
left as 2

if this is called
accidentally
is it
catastrophic

3. Sequence of operation

When the battery power is first applied the BCU power is off. When MPL power is applied, BCU power is turned on. When the BCU is powered, it boots the GCAT and runs BCUPROG.

An operator uses the above commands to set:

- time string period
- experiment end time
- sonde OK bit
- divisor = 1
- buffers = 0 (program selects 107, the default).

It may also be necessary to "format" the disk drives. This entails resetting the "next block" pointers that are stored on the disks back to the nominal start value (3). The next block pointers are provided so that a disk can be read without need for separate documentation - the pointer values which are stored on the disk can be read to determine how much of the disk has been used.

Operation can then be begun using the "start acq" command for test purposes or by turning off MPL power. If operation is begun manually (start acq) most of the above commands can still be used. If it is begun by turning off MPL power, operator control can only be regained by resetting the GCAT.

An initial time string is sent to the Reftek, then the alarm is set for the time string period so that succeeding time strings will be sent at the selected interval. Next the data acquisition parameters are calculated and displayed and acquisition is begun.

Data are received into a memory buffer under interrupt control. This buffer can hold approximately 2.7 minutes of data before overflowing allowing various background functions to be performed. These functions include servicing operator requests and moving the data to other storage buffers.

The program retrieves packets from the interrupt buffer and stores them in the primary file (a 2 Mbyte PCMCIA memory card). This is the point where the engineering data are added when appropriate. When the card is filled, the selected disk is powered and the data are copied from the card to the disk. Then the program returns to moving data from the interrupt buffer to the PCMCIA card.

During acquisition, the program also services interrupts from the clock and the transponders. If the clock interrupt is for a time string, then the Seascan is read, the string is

*Is there a pt
or does w
happen w
27*

formatted and then sent ~~in~~ synchron^{ously} with the 1 PPS signal. If the interrupt is for the end of the experiment, acquisition is stopped and the 1 PPS signal to the Reftek is turned off.

If the interrupt is from one of the transponders, it is simply cleared. The action to be taken on this interrupt is not defined.

(
what are the
options &
consequences here?

Command processor (Mar 15 1994):
help

290

Commands are:

dru off	dru on	deck-sonde
bcu-sonde	mpl-sonde	verbose
feed dog	selftest	engdata
quit	help	sel drive n
drive on	drive off	format drive
disk read	disk write	wake seascan
addr seascan	sleep seascan	read time
set alarm xxxx xx:xx:xx	get end time	set end time xxxx xx:xx:xx
get tperiod	set tperiod n (min)	send t
set sondeok	clear sondeok	data direct
data retrans	arm release	disable release
divisor 1 2	buffers n	details 0 1
show params	start acq	stop acq
start recovery		

Command processor (Mar 15 1994):
show params

Experiment status:

- sonde OK bit is clear	- acquisition active flag is off
* - release relay is disabled	- Tstring_period (min) 30
- data path is retrans	- MPL power is ON
* - acq divisor is 1	* buffers 2
* - details flag is YES	* verbose flag is NO
- selected disk is 1	- dogbites count is 0
- end time 0100 00:00:00	

Interval that real times
are sent to REPTER

day hr min sec

↑
the default here
should be a big
number.

* should not be changed after ~~xx~~ is enabled.
- think about hardware
there when gear is
over the scale.

* - go/no go decision and end time should be set to a number
greater than or equal to the actual end of experiment?

Engineering values

voltage 24v bat: 25.50
voltage 28v MPL: 31.21
voltage 5v : 4.85
voltage 12v : 11.64
voltage -12v : -11.82
voltage SUS 5v : 4.83
voltage DRU 5v : 0.02
voltage DRU 12v: 0.00
attitude roll: 49.56
attitude pitch: 77.01
4800 baud data: ON
1 PPS: ON
BCU leak: NO
DRU leak: NO

} how are these acquired?
do we respond to these?

time?

Fig. 1 System Block Diagram

Title		Laboratory Test & Demonstration Set-up
Size/Document Number	B	C:\SETSMIC\B352\DWGS\LABTEST.BLK
REV	2	
Date:	April 7, 1994	Sheet of 10

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Summary of the OSN Pilot Experiment Test Schedule

1. B3S2 System Integration

1.1 Already funded:

1.1.1 BBS system tests at PFO (in OCE-91-17266)

Purpose: Test clamping and ambient noise issues in a wet hole in the development of BBS. Results compared to IDA and ANZA stations.

Location, Date - PFO
 - Fall 1993- Fall 1994

Issues : Noise below 0.01Hz is still a problem on horizontals, but it may not be caused by the clamp or the water present in the well. Tests will continue in 1995 and 1996. These tests will, by definition, be finished by the IGPP/MPL Borehole System Test in March 1996 (see 1.1.6). done

1.1.2 SEABASS-II bench tests (in OCE-91-18943)

Purpose: Test subsystems of SEABASS-II and the integrated SEABASS-II system.

Location, Date: System test in October 1994 at WHOI prior to shipping to SIO. Subsystem tests throughout 1993 and 1994 at WHOI

Issues: Clock drift, power consumption, cold chamber tests still need to be done. done

1.1.3 B3S2 PFO Test (in OCE-91-17266 and OCE-91-18943)

Purpose: Integrate and test IGPP (BBS) and WHOI (SEABASS-II) systems at IGPP and PFO. Broad band seismic data (ambient noise and earthquakes) was acquired over a period of four months.

Location, Date - PFO
 - October 1994- March 1995

Issues : Power consumption of system is well above initial design estimates. MPL telemetry and borehole gear was not included in the test. Sonde is not the sonde that will be used at OSN-1. Handshaking between two clocks was thoroughly addressed. done

1.1.4 BCU Cold Chamber Test (in WHOI portion of Hiatus proposal, OCE-94-16902, pending)

Purpose: Check operation, recording, and power consumption of BCU at seafloor temperature.

Location, Date - WHOI
 - ~~September-November 1995~~ March '96

Issues: Confirm that BCU electronics and data recorders function to specifications in prolonged use (at least one month) at seafloor temperatures (4degrees C). Check power

± 5°F

consumption under these conditions. Test a lithium battery pack under cold temperature and low drain conditions to confirm manufacturers specs (about a twelve hour test).

1.1.5 MPL only telemetry test (in MPL Hiatus proposal?)

Purpose: Test the telemetry from the CIEM electronics, through the softtether, through the CV and up the 0.68" coax cable.

Location, Date - Point Loma
 - ~~January-February 1996~~ May-June '96

Issues: This uses real cables maybe with the CV in the water off the dock.

1.1.6 IGPP/MPL Borehole System test at PFO (in MPL and IGPP Hiatus proposal?)

Purpose: Deploy the seafloor borehole gear (titanium housing, lights, camera, etc) at PFO and acquire a reference seismic data set (about 2 weeks) in the wet hole prior to the cruise. Compare seismic results to data from the IDA dry hole installation. Confirm that television and lights, clamps, locks, calibration electronics, etc function to specifications in the integrated system.

Location, Date - PFO ^{2- July-August}
 - ~~March 1996~~ May-June '96

1.2 Funds Requested in Pilot Experiment Proposal

1.2.1 - MPL/WHOI Telemetry test

Purpose: Test that the MPL telemetry (data and command channels) works between the SEABASS-BCU and SEABASS deck gear. MPL has an electronics package (the equivalent of the LFASE CIEM) that sits in the BCU housing. The MPL seafloor and deck gear will be sent to WHOI for installation and testing.

Location, Date - ~~WHOI Pt. Loma~~
 - ~~March-April 1996~~ May-June '96

Issues: This is a dry test without real cables. Presumably MPL will have tested the telemetry through the cable in 1.1.5 above. Ground loops that could occur when the system is submerged will not be tested.

1.2.2 - B3S2 System integration test

Purpose: Test all components of the B3S2 system (MPL, IGPP, WHOI) dry on land. Test control of sensor, clamps, re-entry guide lights and TV, clocks, release hook, DRU release, BIP transponders, seafloor recording, shipboard recording, record dock side noise, confirm power consumption, test battery operation, etc

Location, Date - ~~Honolulu ashore and/or on board REVELLE~~ Pt. Loma
 - ~~October 1996~~, duration - 7 days
 May-June

1.2.3 - B3S2 Wet Test

- Impossible to get low drain
 - No drain threshold

Purpose: Assemble all of the gear over-the-side. Check communications to CV, BIP, and BBS. If OK, go ahead with re-entry, clamping and shipboard data acquisition. If OK leave system on seafloor for three months.

Location, Date

- On board REVELLE at OSN-1

- October 1996

November

Pt. Loma

?

Son of PFO?

2. BBOBS System Integration

2.1 Already funded

This is a description of the proposed stages in the integration and test of the BBOBS. The tests described here are those that involve more than one institution - it is assumed that each group will have performed various preliminary tests to ensure that the relevant equipment is ready for these integration tests.

2.1.1 - Mockup sensor burial and release

Purpose: To perform a dry then a wet test of the burial frame with mockups provided by WHOI for the sensor and the main electronics. The system is operated in shallow water to bury then release the mockup packages.

Equipment under test

- RSMAS burial frame
 - burial motor and support frame
 - releases for sensor and main package
 - necessary electronics and sensors
- RSMAS PC to control and operate burial motor etc

Equipment to support test

- WHOI sensor and main electronics mockups
- test EM cable with telemetry
 - for lowering the frame
 - provides power to burial motor
 - provides telemetry over short EM cable
 - probably 7 conductor cable provided by RSMAS
 - needed for tests 1 and 4 in place of MPL CV etc
- RSMAS mud pits
 - 55 gallon drums
 - one buried on land
 - one buried near dock

Location, date

- Miami

- July 1995

Procedure, performed by RSMAS

- assemble all packages on frame
- power, test operation

- perform insertion and release on land and off dock
- diver confirms valid operation off dock
- recover released packages

2.1.2 - Sensor, recording and telemetry operation

Purpose: To perform levelling, startup and acquisition of Guralp sensor using WHOI sensor controller and IGPP DAS. Measure power drains and evaluate collected data. Test acoustic modem operation at short ranges.

Equipment under test

- WHOI sensor leveller and sensor controller
- Guralp sensor
- WHOI surface PC for sensor control
- WHOI Sun for data evaluation
- IGPP DAS including Seascan clock and acoustic modem
- Datasonics deck unit
- IGPP Sun for data acquisition and control
- WHOI sensor in bottom placement configuration
- WHOI main electronics in pressure cases

Equipment to support test

- dock van
- J frame and winch at dock well
- multiconductor cable to dock van
- WHOI short period battery

Location, date - WHOI lab and dock
 - August/September 1995

Procedure, performed by WHOI and IGPP

- assemble sensor controller and DAS in lab
- confirm subsystem operation when integrated
- confirm global command operation
- confirm autostart and EOE
- confirm failure mode operation
 - DAS dies
 - SC dies
 - battery dies
- do lab levelling and acquisition
- assemble sensor and electronics in pressure cases
- do repeated levelling with sensor deployed off dock
- do record-to-serial
 - wire and acoustic
 - collect and evaluate data
- retrieve and evaluate disk data

2.1.3 - Vault test of completed sensor

Purpose: To confirm that the Guralp performance is not degraded by the presence of the gimbals, levelling mechanism, etc., make comparisons with PASSCAL CMG3T sensor on same pair, confirm operation of DAS continuous recording for 1-2 weeks.

Equipment under test

- WHOI sensor package, complete
- second Guralp unmounted
- IGPP DAS and Seascan clock
- second DAS

Equipment to support test

- WHOI tilt platform, to simulate non-level installation

Location, date: - Lamont Doherty Earth Observatory, IRIS vault
 - November 1995

Procedure, performed by WHOI

- arrange for use of vault, install equipment
- sensor package on tilt platform
- unmounted Guralp on pier
- run systems with sensor package at various tilts
- collect and evaluate data

2.1.4 - Sensor burial and electronics deployment

Purpose: Bury an operating sensor using RSMAS frame in shallow water. Confirm that valid data are acquired. Perform complete burial and release of functioning sensor and DAS electronics. Confirm valid release of both packages and associated cables.

Equipment under test

- RSMAS burial frame
 - burial motor and support frame
 - releases for sensor and main package
 - necessary electronics and sensors
- RSMAS PC to control and operate burial motor
- WHOI sensor in insertion configuration
- WHOI main electronics in pressure cases
- WHOI PC and Sun for operation and data evaluation

Equipment to support test

- test EM cable with telemetry
 - for lowering the frame
 - provides power to burial motor
 - provides telemetry over short EM cable
 - probably 7 conductor cable provided by RSMAS
 - needed for tests 1 and 4 in place of MPL CV etc
- WHOI short period battery
- RSMAS mud pits

- 55 gallon drums
- one buried on land
- one buried near dock

Location, date: - Miami dock and R/V Seward Johnson
 - February 1996

Procedure, performed by RSMAS and WHOI

- assemble burial frame with main package and sensor
- test burial functions and DAS/sensor functions
- do dry then off the dock
- confirm valid sensor operation using telemetry
- recover frame and deployed packages
- retrieve and evaluate data
- cruise challenges
 - station keeping
 - bottom type
 - confirmation of operation

2.2 Funds Requested in Pilot Experiment Proposal

2.2.1 - Integration of MPL equipment on RSMAS frame

Purpose: To operate the burial frame after it has been integrated with MPL telemetry, TV and lights.

Equipment under test

- RSMAS burial frame
 - burial motor and support frame
 - releases for sensor and main package
 - necessary electronics and sensors
- RSMAS control PC to operate burial motor
- MPL TV and lights
- MPL telemetry

Equipment to support test

- MPL cable simulator
- WHOI sensor and main electronics mockups
- RSMAS mud pits
 - 55 gallon drums
 - one buried on land
 - one buried on dock

Location, date - Miami
 - May 1996

Procedure, performed by RSMAS

- assemble and debug electronics
- operate motor and releases through MPL telemetry

2.2.2 - RSMAS operation with MPL CV

Purpose: To confirm burial and release operation of RSMAS frame when integrated with MPL CV and cable. Primarily the RSMAS to MPL integration of telemetry and power must be performed. In addition, the MPL to burial frame mechanical and electrical connections must be made and checked.

Equipment under test

- RSMAS burial frame
 - burial motor and support frame
 - MPL power and telemetry interface
 - releases for sensor and main package
 - necessary electronics and sensors
- RSMAS control PC to operate burial motor
- MPL CV
- MPL soft tether

Equipment to support test

- WHOI sensor and main electronics mockups
- MPL 0.68 co-ax cable (test version)

Location, date - MPL dock
 - June 1996, subject to CV availability

Procedure, performed by RSMAS and MPL

- assemble electronics and mechanicals on dock
- TV and lights tests
- operate burial and releases

2.2.3 - Full-up test deployment

Purpose: This is the final integration of all portions of the system before assembly in Hawaii. Operation of the Guralp is important to confirm valid data when deployed in this final configuration.

Equipment under test

- MPL control vehicle
- MPL topside telemetry and power interface
- MPL soft tether
- RSMAS burial frame
 - burial motor and support frame
 - MPL power and telemetry interface
 - releases for sensor and main package
 - necessary electronics and sensors
- IGPP/WHOI sensor in insertion configuration
- IGPP/WHOI main electronics in pressure cases
- WHOI main battery

- RSMAS, MPL, WHOI, IGPP PCs necessary for control

Equipment to support test

- MPL 0.68 co-ax cable (test version)

Location, date

- MPL dock and in water
- July 1996, subject to CV availability

Procedure, performed by MPL, RSMAS, IGPP, WHOI

- assemble equipment on dock
- interconnect, apply power and confirm operation
- control burial system through telemetry, do mock burial
- confirm power conditions
- control sensor through telemetry, do unlock and operate
- deploy frame and CV off dock
- repeat operation tests
- do release of sensor and main package
- collect acoustic data
- collect data in DAS
- end of experiment command
- recover equipment
- retrieve, evaluate disk data

2.2.4 - Shipboard wet test

Purpose: Confirm full system operation after shipment and reassembly before deployment.

Equipment under test

- MPL control vehicle
- MPL topside telemetry and power interface
- MPL soft tether
- RSMAS burial frame
 - burial motor and support frame
 - MPL power and telemetry interface
 - releases for sensor and main package
 - necessary electronics and sensors
- IGPP/WHOI sensor in insertion configuration
- IGPP/WHOI main electronics in pressure cases
- WHOI main battery
- RSMAS, MPL, WHOI, IGPP PCs necessary for control

Equipment to support test

- ship's 0.68 co-ax cable
- ship's winch
- etc

Location, date:

- aboard R/V Revelle at OSN-1
- October 1996

Procedure, performed by MPL, RSMAS, IGPP, WHOI

- assemble BBOBS on burial frame
- rig to MPL soft tether and CV
- power and test functions on deck
- deploy and test communications etc before lowering

urn-Path: kpeal@hurdle.who.edu
 Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu
 ESMTMP id NAA01765 for <rstephen@gannet.who.edu>; Thu, 7 Sep 1995 13:55:07 -0400
 Received: from hurdle.who.edu (hurdle [128.128.92.91]) by aqua.who.edu (8.6.11/8.6.11) w
 ith ESMTMP id NAA12929 for <rstephen@who.edu>; Thu, 7 Sep 1995 13:49:48 -0400
 Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id NAA02986; Thu, 7 Sep
 1995 13:46:23 -0400
 Date: Thu, 7 Sep 1995 13:46:23 -0400
 From: Ken Peal <kpeal@hurdle.who.edu>
 Message-Id: <199509071746.NAA02986@hurdle.who.edu>
 To: rstephen@who.edu
 Subject: Talking document

Ralph: I thought this might be a useful document for our meeting tomorrow.
 Hope your house sale is progressing.

Regards ... kp

BBBSS Plans

Final Integration and Pilot Experiment Preparation

At this stage the system is largely designed and portions have been tested. What is needed is to put the pieces together in stages and to test the resultant subsystems and the final complete system. In order to plan this work, there are three items that need attention:

- refine interfaces between the groups
- plan the stages of integration
- define and agree on a schedule.

The outline below is a work plan - when this is agreed on, each area needs to be looked at and expanded as necessary.

1. Interfaces

Much of this may seem obvious but it will help to look at each area in detail.

1.1 Shipboard

This is the interface between MPL's electronics and the IGPP and WHOI computers. The hardware consists of two communications channels and a time strobe signal.

1.2 SEABASS frame

- This involves MPL and WHOI. The two areas are:
- soft tether mechanical connection and release
 - details of the electrical interface.

- is there a TV on the BIP

Since the MPL chassis in the BCU will be new, both aspects need to be looked at. This includes things like:
 release hook design and operation,
 communications interfaces,
 timing,
 power for the Reftek, the Teledyne and the lights,
 video switching.

In addition, the MPL chassis must fit in our BCU chassis.

1.3 Sonde - IGPP/WHOI

This should be pretty stable after our PFO tests. The interface occurs on our "sonde communications" board in the sonde and involves data and control communications, the 1 PPS, power and power control. Both the mechanical and electronic portions of this are well proven.

1.4 Sonde - MPL/WHOI

This interface also occurs on the "sonde communications" board and involves the BRG signals: light power and video.

1.5 Sonde - IGPP/MPL

This is the mechanical integration of the two portions of the sonde: the IGPP sensor and holelock with the MPL BRG.

2. System integration

This is presented as a series of stages at which parts of the system from different groups are integrated. Not discussed is the work done by each group to prepare for these stages.

2.1 Installation of MPL chassis in WHOI BCU

The new telemetry module from MPL will be integrated with WHOI's BCU. Prior to this, the BCU needs to be set up in simulated PFO mode again at WHOI and the old MPL chassis returned to MPL.

Integration of the new chassis will be eased if MPL also provide a "CV simulator" that replaces:

- the soft tether,
- the control vehicle,
- the 0.68 coax, and
- the MPL shipboard electronics.

This will enable the integration to occur at WHOI including possible reworks while minimizing cross-country trips by people and equipment.

2.2 Integration of IGPP sonde with MPL BRG

This should be done (probably at IGPP) to get a completed downhole unit. Tests need to be specified for operation of all parts of the system. In addition, tests at Pinon Flats could be done with this portion of the system using the 7 conductor cable and the BCU simulator.

2.3 Final integration at MPL

This stage really involves several steps:

- set up and test WHOI equipment in a lab at MPL
- replace WHOI's sonde simulator with the integrated sonde
- replace MPL's CV simulator with the actual CV and simulated 0.68 cable
- assemble the WHOI equipment in pressure cases on the frame. *for a dock test.*

Initial stages of this process will use shore power. Testing on battery will be performed when the integration problems are resolved. At this stage, detailed plans for the shipboard testing and deployment need to be worked out.

2.4 Wet test of complete system

①

*

Milestone

by May '96

Depending on schedule and logistics, this may be performed off the MPL dock, during a test cruise in fall 1996 or during the Pilot experiment. A test plan is needed.

3. Schedule

A complete schedule needs to be worked out with all groups involved, however some milestones can be put in place now.

October 1995 - MPL will be ready to start new design work on BBOBS and BBBSS so we need to have our system set up at WHOI and make the necessary wiring changes so we can ship the old MPL chassis to them. We also need to start work on interfaces and detailed integration plans at this time.

November 1995 to January 1996 - Peal and Goldsborough work on BCU items that need attention including cold testing and battery design.

February 1996 - It would be nice if a prototype MPL chassis were available at this point along with a CV simulator so we could do the integration.

March - May 1996 - It would be nice if the sonde were brought to its final form and PFO tests performed during this period.

August 1996 - Present plan is to do BBOBS integration at MPL during August 1996. Combining BBBSS final integration with this work seems attractive.

lab integration test
of B³S²

Spiess on JdF
in Aug?

rn-Path: John_Orc
Received: from igppqm 7.5.1 Orcutt 12/20/93 982
sendmail 8.6.4/UCSD-2.2 Sun via SMIL
Mon, 20 Dec 1993 17:23:00 -0800
Message-Id: <199312210123.RAA09982@ucsd.edu>
Date: 20 Dec 1993 17:20:09 -0800
From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
Subject: Pinon
To: "Jean Francois Karczewski" <cartouche@geoscop.fr>
Cc: "Ralph Stephen" <ralphs@gannet.who.edu>, Frank_Vernon@igppqm.ucsd.edu,
David_Willoughby@igppqm.ucsd.edu

Subject: Pinon Time:17:22
Date:12/20/93
OFFICE MEMO
Jean Francois:

To amplify on my earlier note regarding Pinon, the hole we are using for testing is the same diameter as an ODP hole; that is, the casing internal diameter is 10 inches and the hole is 100 m deep. The bottom 10 m of the hole is uncased and the hole is filled with fresh water.

There is electrical power available at the hole; 110 volts AC 60 Hz and 220 VAC is also available. There are two cables of 18 gauge copper; each cable has three twisted pairs. These data cables run to the IDA PFO vault and many other wires then run to the trailers where there are workstations, etc. which can be accessed by Internet.

Do you have a data logger for use with the OFP borehole instrument? Do you need cable? We do have two 7 conductor cables we're using for the OSN borehole instrument and they are connected to the pressure housing with impulse connectors. Ralph has mentioned that the WHOI recording system is available for recording and we also have Reftek (PASSCAL) and IDA recording systems here which could be used for data logging. The IDA system is easy to interface with the workstations for Internet access to the data.

Could you let us know more about what you might need for a summer test at Pinon? I'm sure that we can get this put together.

8.1 Koelsch et al 1/4/94

DRAFT**Specifications of the WHOI/SIO Broadband Borehole Seismic System (B³S²)**

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(14 January, 1994)

Introduction

The goal of the Ocean Seismic Network (OSN) community is to deploy three component broadband seismometers on and/or within the deep seafloor and to record the data for periods of three months or more. Broadband seismometers typically have a frequency response ranging from a few thousandths Hertz to a few Hertz (periods ranging from less than 200secs to greater than 0.5secs). The OSN community is a multi-laboratory, multi-national group. Some of the laboratories have greater expertise in sensor development and others have expertise in recording techniques while still others specialize in precision instrument placement on the ocean floor.

Because recorders are mechanical devices they tend to radiate noise into the ocean. Also, for long term deployments the necessary batteries, control electronics and recording devices are so large and heavy that it may be difficult to get good coupling to true earth motion. Therefore, it would be desirable to deploy the recording package separately from the sensors. In the case of a borehole seismometer the recording package is too large and too noisy to be in the hole.

This document defines a proposed set of standards that would allow up to a 500 meter separation between the two packages. Addressed are both the mechanical and electrical interface issues. The communications protocol is left to be addressed at a later time. The specifications described here are based on a wireline capability to deploy and maintain instruments on/in the seafloor. Prototype versions of the system are described in Spiess et al (1992) and Stephen et al

(in press). The Broadband Borehole Seismic System (B^3S^2) is a funded program in the U.S. which will use a wireline capability to deploy a broadband, three component borehole seismometer in the deep sea. One goal of this report is to initiate a dialog which will lead to uniform interface standards for wireline and submersible assisted deployment systems.

The B3S2 Deployment Scenario

A typical B^3S^2 deployment consists of four phases. Phase 1 consists of the search for the re-entry cone and the placement of the sensor and bottom instrument package (BIP). For a borehole deployment a TV camera is incorporated in the sensor. The BIP sits in the re-entry cone and the borehole sensor can be up to 500m in the hole. For a seafloor deployment, the sensor would be close hauled to the BIP and the TV camera would be mounted on the BIP. When the desired site is reached, the sensor is mechanically released from the BIP. Up to 500 meters of cable that is played out along the bottom until the BIP is set on the seafloor. This gets the noisy recorder away from the sensor. Both borehole and seafloor deployments use the MPL/SIO thruster system.

Phase 2, the monitoring phase, maintains the communication and data links to the surface through the MPL/SIO thruster. Power to run the system is supplied from the surface. Once surface power is interrupted, the communication link and power supply revert to the BIP.

Phase 3 is the autonomous recording phase. Once there is verification that the system is working the cable at the top of the BIP is released. Data are recorded for the life of the batteries or until the storage medium is filled.

Phase 4 is recovery which is accomplished by grappling using a thruster assisted hook.

B3S2 Timing and Recording System

In the B^3S^2 system actual time is kept in the bottom control unit on the BIP using a Sea Scan (WRC) clock which consumes less than 0.07Watts. This time is sent via the communication link (format to be determined) to the borehole sonde once a second.

B³S² uses a REFTEK digitization and data telemetry package. In the REFTEK scenario the sensor package merges time with the data. Clock information, engineering data and state of health information measured by the recording and sensor packages, are merged with the 4800b data stream. The recorder in the BIP receives the data, puts it into logical blocks and stores it on a 1 giga-byte hard disk. The existing BCU has 3 hard disks. It is suggested that any given experiment only requires 2 giga-bytes of storage thereby having a third disk in case one fails.

The Sensor/Recording Package Interface

The following pages list the mechanical and electrical specifications of the seven conductor cable that joins the sensor to the recording package in the B³S² system. These specifications are being proposed to initiate progress towards defining a standard interface for OSN. The ultimate objectives of a standard interface are to facilitate the deployment and maintenance of seafloor seismic stations with a range of technologies (wireline systems, submersibles, ROV's, etc). The OSN community should review these specifications and provide their input in a timely fashion.

This B³S² system acquires data over a bandwidth from 1000sec to 5Hz at a digitization rate of 20 samples/sec on three channels with 24bit resolution. It is assumed that the sensor package including digitiser consumes less than 7Watts. The command link between the recording package and the sensor is standard RS-232 and data telemetry from the sonde to the recording package is carried out at asynchronous 4800baud.

References

- Spiess, F.N., Boegeman, D.E., and Lowenstein, C. (1992). "First ocean-research-ship-supported fly-in re-entry to a deep ocean drill hole," MTS J. **26**, 3-10.
- Stephen, R.A., Koelsch, D., Berteaux, H., Bocconcelli, A., Bolmer, S., Cretin, J., Etourmy, N., Fabre, A., Goldsborough, R., Gould, M., Kery, S., Laurent, J., Omnes, G., Peal, K., Swift, S., Turpening, R., and Zani, C. (in press). "The seafloor borehole array seismic system (SEABASS) and VLF ambient noise," Mar. Geophys. Res.

Mechanical Specifications:

Interconnection cable:	Wireline cable Schlumberger #A2007 Type 7-46P (Fig. 1)
Specifications:	7 ea #20 conductors (6 around 1) 2 contra helical wound carbon steel armor jackets Outside Diameter .46" Resistance 1.2 Ω /kFt Capacitance 50 pF/Ft. Breaking strength = 15,000 lbs. Weight in air = 350 lbs/kFt. Weight in H ₂ O = 270 lbs/kFt.
Cable termination:	Gearhard-Owen connector may be purchased from Haliburton (Fig. 2). P/N 006-9600-000 mechanical P/N 006-3715-020 electrical connector
Bulkhead connector:	Woods Hole Oceanographic has drawings to make bulkheads connectors as required.

Electrical Specifications:

- I. As designed to interface with REFTEK seismometer control and digitizing system in the Broadband Borehole Seismic System.

During search and deployment phase:

CABLE 1	Not used (computer in Bottom Control Unit [BCU] is OFF)
CABLE 2	28 Vdc @ 2.5w seismometer power
CABLE 3	TV camera & light power down and video up to surface - SIO/MPL*
CABLE 4	TV camera and light power down and video up to surface - SIO/MPL*
CABLE 5	TV camera and light power down and video up to surface - SIO/MPL*
CABLE 6	Not used (computer in BCU is OFF)
CABLE 7	Earth and circuit common
ARMOR	Earth, TV and light power return

* Three conductors must be paralleled to get enough power down to the lights at the bottom of the string. For an ocean bottom deployment the TV and lights would be on the frame and make switching the conductors unnecessary

During surface monitoring phase:

CABLE 1	28 Vdc @ 2 Watts of power maximum 59 REFTEK and 4800baud data to recording unit.
CABLE 2	28 Vdc @ 2 Watts power to seismometer package
CABLE 3	2400baud asynchronous communication (sensor to recorder) Mark > 4 Volts Space < 3 Volts 8 bits of data 1 start bit 1 stop bit 1 parity bit (strappable either even or odd)
CABLE 4	2400baud asynchronous communication (recorder to sensor) Mark > 4 Volts Space < 3 Volts 8 bits of data 1 start bit 1 stop bit 1 parity bit (strappable, even or odd)
CABLE 5	-50 Vdc @ 10W supplied from surface power, (MPL/SIO) used to level or center the seismometer mass or to release the sonde locking arms
CABLE 6	1 pulse per second REF TEK uses this to phase lock loop time. High > 4 Volts Low < 3 Volts Pulse length 10 ± 1 milli-second
ARMOR	EARTH

During autonomous phase:

Same as monitoring phase except:

CABLE 5	Not used
---------	----------

II. An alternative system if REFTEK seismometer control and digitization are not used.

During search and deployment phase a TV is needed at end of cable (as for borehole re-entry):

All conductors in parallel	TV and lights
ARMOR	TV and lights return

During monitoring phase:

CABLE 1	up to 4800baud asynchronous data +3V to +7V = MARK -3V to -7V = space 8 bits of data
---------	---

1 start bit
1 stop bit
no parity

CABLE 2 28 Vdc @ 4 Watts of power maximum

CABLE 3 2400baud asynchronous communication
(sensor to recorder)
+3V to +7V = MARK
-3V to -7V = space
8 bits of data
1 start bit
1 stop bit
1 parity bit (strappable to either even or odd)

CABLE 4 2400 baud asynchronous communication
(recorder to sensor)
+3V to +7V = MARK
-3V to -7V = space
8 bits of data
1 start bit
1 stop bit
1 parity bit (strappable to either even or odd)

CABLE 5 -50Vdc @ 10 Watts, supplied from surface by MPL/SIO,
used to level or center the seismometer mass or release the
sonde locking arms.

CABLE 6 Precision Time Base (PTB)
1 kHz square wave
High + +5V $\pm$ 2V
Low = 0V $\pm$ 1V
1 second marks will increase the amplitude of the PTB so
that:
High = 10V $\pm$ 2
Low = 0V $\pm$ 1
Duration = 10 milli-second

CABLE 7 Circuit common, NOT EARTH

ARMOR EARTH (Sea Water)

Duration autonomous phase:

Same as monitoring phase except

CABLE 5 Not used

COPPER STRANDS - O.D. = .038
EPC JACKET - O.D. = .098

CABLE FILLER (CONDUCTIVE)
AND TWINE

O.D. = .312

CONDUCTIVE TAPE BINDER

CARBON STEEL ARMOR

24 - .039

24 - .048

COPPER STRANDS - O.D. = .043

EPC JACKET - O.D. = .102

7-46 P WIRELINE CABLE

SCALE: 10/1

.464 CABLE DIA.
(AFTER PRESTRESS)

APRIL 3, 1989

BY: AJS

Wireline Products

7 Conductor 1-1/2 O.D. (GO)

Index	Part Number	Qty	Description	Cable Size
1	*703021-001		Assy. Cablehead, 1-1/2 O.D., 7 Cond	3/16, 7/32
	**703021-002		Assy. Cablehead, 1-1/2 O.D., 7 Cond	5/16
	***703021-003		Assy. Cablehead, 1-1/2 O.D., 7 Cond	7/16
	703021-004		Assy. Cablehead, 1-1/2 O.D., 7 Cond	1/4
	703021-005		Assy. Cablehead, 1-1/2 O.D., 7 Cond	3/8
2	000453-000	1	Spring	3/16, 7/32
	000454-000	1	Spring	1/4, 5/16
	000455-000	1	Spring	7/16
3	000456-000	1	Upper Section	3/16, 7/32
	000456-001	1	Upper Section (Stainless Steel)	3/16, 7/32
	000457-000	1	Upper Section	5/16
	000457-001	1	Upper Section (Stainless Steel)	5/16
	000458-000	1	Upper Section	7/16
	000458-001	1	Upper Section (Stainless Steel)	7/16
	000456-002	1	Upper Section	1/4
	000456-003	1	Upper Section	3/8
4	000459-000	1	Cone Retainer	ALL
5	000460-000	1	Rehead Cone	3/16, 7/32
	000461-000	1	Rehead Cone	5/16
	000462-000	1	Rehead Cone	7/16
	000460-001	1	Rehead Cone	1/4
	000460-002	1	Rehead Cone	3/8
6	000463-000	1	Washer	3/16, 7/32
	000464-000	1	Washer	5/16, 3/8
7	851200-000	1	1/4-20 x 3/16 Soc. Set. Screw	ALL
8	000465-000	1	Sleeve	ALL
9	851210-000	1	1/4-28 x 3/16 Soc. Set. Screw	ALL
10	000495-000	1	Boot	ALL
11	000466-000	1	Contact Sub	ALL
12	842113-070	1	"O" Ring, 2-113, 70 Durometer	ALL
13	000496-000	1	Female Connector	ALL
14	842116-090	2	"O" Ring, 2-116, 90 Durometer	ALL
15	000497-000	1	Quick-Change Collar	ALL
16	001375-000	1	Thread Protector	ALL

Also Available

- * 703021-101 (Stainless Steel)
- ** 703021-102 (Stainless Steel)
- *** 703021-103 (Stainless Steel)

PROPOSAL FOR STANDART CONNEXIONS AND CABLES FOR THE
SEABOTTOM OBSERVATORY (OFM PROJECT)

L.Floury, J.F.Rolin DITI/Ifremer

J.F.Karczewski, J.C.Koenig DT/INSU

(08 March 94)

1/ INTRODUCTION

The installation of the different sub-systems concerned with the Ocean Bottom Observatory e.g in French OFM as described during the June 92 Hawaiian IRIS workshop can be used as a baseline to define few different type of electric cable link:

- TYPE 1: All fixed cables between hermetic packages and/or any other fixed equipment installed on the central structure as for exemple the data logger and data recorder.
- TYPE 2: cable with a termination connexion/déconnexion inside water submitted to high pressure; this is used to link few units installed separately during the "drop" from the vessel using the "shuttle" system developped by Ifremer that can be moved on the bottom by the manned submersible or by the future ROV 6000 and obviously connected to the submersible or the ROV.
- TYPE 3: cable not necessarily terminated by an under water connexion/deconnexion but used during the installation by the manned submersible or the ROV .
- TYPE 4: cable with armor and conductors like wireline to link the Ocean Borehole Sensor to the main package located on the bottom of the sea.

2/CONNEXIONS:

2.1 Plug not connected/deconnected under water.

The different equipment are designed to be immersed for a long duration :more than 1 year. The different containers can be made of alloy of aluminium, titanium or non conductive composite material but with some metallic view ports.

We are in favor of use of non metallic connector like XSE (700 b max) and XSL (1400 b max) provided by BRANTNER. This solution is a very good garanty against the corrosion problems.

Caution: dynamometric tool must be used for mounting; it is very usefull to design a mechanical protection against shocks always possible during sea-operation.

2.2 Plug connected/deconnected under water.

OCEAN DESIGN provide a connector more reliable than similar model from ELECTRO-OCEANIC (this last one is used to connect NADIA (shuttle for diagraphy) and the submersible NAUTILE). US and Canadian experimenters successfully use the OD BLUE since 2 years ,particularly inside the instruments installed in the CORK of the ODP holes.

The OD BLUE model is already used by JP.Foucher for an hydrogeological station designed with a set thermal sensors to be installed in june 94 inside a hole during the next leg ODP 156.

The immersed connection/deconnection will be used in July 95 on board the NAUTILE equiped with a PC to recover the data.

2.3 Special connectors.

The Borehole instruments require the use of a wireline with conductors. Mainly 2 different cables are commonly used: Schumberger logging cable for diagraphy and cable with a central metallic armor. This last version is used for the hydrogeological station by the AMG company who design specific terminations in which the electrical connection is made with KEMLON material.

On board NADIA the Borehole tool is installed using the 5/16" diagraphy cable terminated by a standart GEARHART OWEN connector. The mating connector on the tool is made by the experimenter. This solution is not convenient for a long duration experiment due to the use of different material stainless steel, steel, anodized aluminium. The solution proposed by AMG is too expensive. It seems better to select BRANTNER with a central

armor cable (see Ref MSS-CCP-SC).

3/ ELECTRICAL CABLES

3.1/ Self assembled cables.

This solution is built around an external polyurethane shield (diameter 15X21) inside are installed various conductive cables. The shield is filled with dielectric oil and so the flexibility of the cable made like this put the cable without constraint of outside pressure. this solution is extremely promissing for the choice of cables particularly for shielded cables. This kind of composite cable was used succesfully with a shield 15X21 during the campaign to deploy the OFM1 (april-may 92).

3.3/ Standart cables.

OD BLUE connectors are delivered with standart 4N5 cable surrounded by Neoprene shield. BRANTER connectors can be delivered with or without cables shielded with either Neoprene or Polyurethane shield. It is possible to order any combination of these connectors and cable even mixed with any length without intermediate special junction.

4/ PROPOSAL for STANDART CABLING.

Type 1: BRANTNER connexions and mixed electrical conductors.

Type 2: OD BLUE connexions with 4N5 cable.

Type 3: BRANTNER connexions with mixed cable surrounded either Neoprene or Polyurethane

Type 4: BRANTNER connexion with central armored cable.

5/ IFREMER technical staff propose to write a a specification for the different type of connexions in order to make reference test : pressure, temperature, cycle of connexion/deconnexion with variable duration.

FIGURE INTERCONNECTION

OFM - BLOCK diagramme
Block diagram

BRANTNER & ASSOC., INC.

IA CON® UNDERWATER CONNECTORS/CABLES

MSS-CCR (IN-LINE RECEPTACLE)

MSS-CCR (Cable Connector Receptacle)—Mates with MSS-CCP
(same internally and front end as MSS-BCR)

G, K, L, M sizes have round keyway. O, P and Q have square keyway.

Refer to page 49 for contact configurations

SHELL SIZE	G	K	L	M	O	P	Q
A — Diameter	1.37	1.87	2.12	2.50	3.00	3.25	3.87
B — Wrench Flar	1.78	1.62	1.87	2.25	2.75	3.00	3.62
C — Length	5.5	6.7	7.0	9.5	10.0	11.5	12.0

MSS-CCP-SC (Stress Core Termination)

(for termination of cables with stranded wire rope
mechanical members located in the center of the cable)

Strength is carried thru
CCP coupling nut and
BCR or CCR threads.

- Refer to chart on page 47
- Wire Rope
- Strength Nut
- Swadge Ball

The stress core termination shown above can be accomplished in all the MSS series sizes with the exception of the MSS-G.

This type of termination will develop the full breaking strength of the electro mechanical cable.

For externally armored cables, see "ARMOR TERMINATION" section.

CONNECTOR BODIES DO
NOT COME MOLDED TO
CABLES UNLESS SO
SPECIFIED WHEN ORDERING

O. D. BLUE™

sectioned view:

PARTS LIST		
PLUG NUT	POLYIMIDE	7
PLUG BODY	NYLON	8
ROTATION LOCK	NYLON	9
SEAL	COUPLER RUBBER	4
BACKSHELL BODY	COUPLER RUBBER	3
CABLE	POLYIMIDE	2
DESCRIPTION	MATERIAL SPECIFICATION	ITEM

PARTS LIST (continued)		
PLUG PACKAGE	NYLON	14
COUPLER SPRING	COUPLER	13
SELECTIVE FOLD	COUPLER	12
SEAL	COUPLER RUBBER	11
BACKSHELL	NYLON	10
BACKSHELL NUT	COUPLER	9
BACKSHELL LOCK	COUPLER	8
DESCRIPTION	MATERIAL SPECIFICATION	ITEM

O. D. BLUE physical specifications:

(applies to both thread-together and SNAP version unless otherwise stated)

size:	mated length 5.8 inches
weight:	< 2 ounces
mating force:	
thread-together:	< 4 pounds
SNAP:	10-20 pounds
temperature range:	-2 to +60 deg. C.
pressure range:	-10 to +10,000 psig used in-line
cycle lifetime:	> 500 mate/demate cycles
submerged lifetime:	> 12 years mated in seawater
shell material:	high strength plastic
thread-together nut mat:	high strength plastic
SNAP sleeve material:	high strength plastic
probe material:	glass-reinforced epoxy
dielectric filler:	silicone compound
plug contact mat:	copper alloy C36000 gold plated per MIL-G-45204,C.
socket contact mat:	BeCu gold plated per MIL-G-45204,C.

O. D. BLUE electrical specifications:

(applies to both thread-together and SNAP version)

current rating:	5 AMPS/circuit
contact resistance:	< .01 OHMS @ 3 AMPS
breakdown voltage:	> 1000 VOLTS AC or DC
seawater resistance:	> 1 GIGOHM @ 1000 VDC after 500 submerged mate/demate cycles
internal resistance:	> 1 GIGOHM @ 1000 VDC between circuits after 500 submerged mate/demate cycles

All O.D. BLUE connectors include 2' pigtails or can be terminated to the rubber jacketed cable of your choice, (3/8" O.D. maximum.)

od

BRANTNER & ASSOC., INC.

SEA CON® UNDERWATER CONNECTORS/CABLES

OPEN FOLD-OUT PAGE

XSL SERIES

DESCRIPTION:

The XSL is our oldest connector set in this series, originating over 25 years ago. Manufactured of special glass reinforced epoxy, it has proven itself in many various types of harsh environments. These connectors are easily bonded to mating neoprene or polyurethane. Field detachable units available. (See page 24.) This XSL connector is also available in a Pressure Bulkhead, Oil Filled (POF) Series (page 53).

SPECIFICATIONS—

Pressure range — atmospheric to 20,000 PSI
 Contacts — brass, gold plated (MS-G-45200)
 Temperature range — -70° to 200°F
 O Rings — Buna N 70 durometer
 Voltage — see rating below each contact configuration

- 1 — Electrical Contact (Solder Point)
- 2 — O Ring 2-123
- 3 — O Ring 2-96
- 4 — O Ring 2-17
- 5 — Right Internal Reinforcement Potting
- 6 — Keyway
- 7 — Coupling Nut — Plastic (36 optional)
- 8 — C Ring 5700-87

NOTE — XSL-20-BCR utilizes O-ring 5-254

NOTE: XSL-8 and 8 configurations have reverse key — all others have no key

OPTIONS—

- Pigtails (Bulkhead conn. low pressure side)
- Add .P after the part number.
- Dummy Connectors — DSP for Dummy Sealing Plug (Seals Receptacle).
- DSR for Dummy

Sealing Receptacle (Seals Plug).

- Nut & Washer Set for Bulkhead Conn. Installation.
- Open face pressure resistance on either plug or receptacle.

XSL-8-BCR available with 3/4-16 installation thd.

*Mated lengths shown vary depending upon cable diameters and type of mold.

FACE VIEW BCR

NEW CONTACT CONFIGURATIONS:

XSL-4-10 AWG-600 VRMS
 XSL-2-10 + 3-16 AWG

XSL-2	XSL-6	XSL-6	XSL-8	XSL-10	XSL-12	XSL-20
1x6 awg 1x10 awg 700 VRMS	1x14 awg 4x16 awg 600 VRMS	6x16 awg 600 VRMS	8x16 awg 300 VRMS	10x16 awg 200 VRMS	12x16 awg 150 VRMS	20x20 awg 100 VRMS

AVAILABLE CONTACT CONFIGURATIONS
 FACE VIEW BCR SHOWN

(See other side of page for XSL photo and special XSL BCP)

BRANTNER & ASSOC., INC.

SEA CON[®] UNDERWATER CONNECTORS/CABLES

DESCRIPTION:

The XSE is our newest connector set in this series. Its development was prompted by the need for the particular thread size and maximum diameter containing 12 contacts. Also, manufactured of glass reinforced epoxy it is easily bonded to by neoprene and polyurethane.

XSE SERIES

Featuring an extremely wide and oversized key/keyway (90°).

Cablage qui permet d'établir la liaison avec la station hydrogrique et son ordinateur de dans la sphère du Nautile.

STATION HYDROGRIQUE

9.1 Shipboard Quick Look Software

325

Dear Ralph,

9.1.1 Doult 5/19/94

I thought you might like to see the latest output from the BBBSS MATLAB display program DISP_ACQ. A copy of the screen from a recent test is attached.

- CH 1 input was a sine of a little over 2 Hz and peak amplitude about 9 Volts
- CH 2 input was a power supply set at approximately -5 volts. Note that what look like major excursions are really about +/- 0.1 millivolts!
- CH 3 input was shorted. MATLAB isn't doing too good a job on the axes, but the excursions are about .01 mv and there seems to be a DC offset of about 24 mv. A comparable offset was seen on CH 2 when it was shorted.

Any comments / suggestions re the display would be appreciated! One possibility would be to change the range of the frequency display to cover a more meaningful geophysical range.

Sincerely,

Jim Doult

To: Ken Peal, Ralph Stephen and Don Koelsch
 From: Tom Bolmer
 Re: Status of programs for B3S2 9.2 Quality Control Software
 August 31, 1994 9.2.1 Bolmer 8/31/94

I figure it is time to bring you up to date on where I am in development of code to convert the raw data on the B3S2 disks to something that we can handout.

- 1) I have a program that converts ROSE formatted files to the CSS format that the dbpick program from Frank Vernon needs. This looks to me to be fully functional. ROSE format was chosen to develop with since the data in the LFASE set are well known and there is no uncertainty as to what it should look like.
- 2) The subroutines that created the above conversion were spliced into the program that reads the raw B3S2 disk and creates some output data format. I have plotted the B3S2 data using the dbpick program from Frank. I have one data base file that needs work but I think I am close to a fully working version of this program.
- 3) I have worked on the chksond program some more and have more options and error checking in it now. The two programs above are using the same core suite of subroutines to read and test the B3S2 raw data (see 8 below).
- 4) To date this latest round of writing was done on the SparcStation 10 up in this office. I still have to get the program to compile and link on the HP. I think some of my earlier errors at converting code from the DecStation to the HP was a poor but at times lucky usage of pointers. I think that things are much better now and that the code is cleaner and should be more transportable.
- 5) To do:
 - a) compile, link and run all code on the HP
 - b) complete installation of error checking in the programs
 - c) add changes as they are needed
 - d) get more information about the header and status packets so that we can output the information. Perhaps a separate program for Status packet output should be written.
- 6) It still is not clear to me what the agreed upon data exchange format is to be. I remember that it was to be CSS and the other day Ralph mentioned SEED. I have yet to email Frank this question. If it is to be SEED then I have a whole new learning curve to go through.
- 7) For shipping, if the computers and I end up going to California, I figure at least a good solid week of loading the van which should include some form of a test of the setup and network in the van.
- 8) In my last run of the checking program I keep getting times in headers that were before the time in previous packets. This didn't seem very good to me. The good part of that is that I have some more things that the checking program can do now. I found this by first thinking that it would be a good idea to output the time in the packet before the one that flags the index counter was wrong. This lead to the times being all out of order (see sheet 1). I next put in a time checker routine that can output a line if the current packet time is before the previous packet time. The program calculates the difference in seconds and prints that out (see sheet 2). I then put an option in that outputs the time in every packet as it reads them. I was beginning to not believe what I was programming. This indeed showed that there is a time problem (see sheet 3).

I hope that for this disk number this time problem is documented or at least explainable. Otherwise, I guess I have bad news. I hope that all this has done for me is to lead me into more useful checks on the data set.

attached: 3 sheets

Checking BBBSS data files for index order on disk number:
date of this run is: Tue Aug 30 13:50:18 1994

you want to read up to block number 28480 skipping 1000 bytess
you have asked to read 175872 packets
the program will first skip 1000 blocks

Checking the disk on drive: /dev/rsd2a

the packet now starts with DA at block 1000,byte 0
previous packet time was at: 000:00:00:00.000
last good time was at: 000:00:00:00.000
disk: 10772 count at: 0 block 1000 byte 80 at: 124:17:31:34.010
previous packet time was at: 124:19:33:05.040
last good time was at: 124:19:33:05.040
disk: 0 count at: 32769 block 4437 byte 96 at: 124:19:33:05.040
previous packet time was at: 124:19:55:49.000
last good time was at: 124:19:55:49.000
disk: 3859 count at: 4115 block 5080 byte 80 at: 124:19:54:24.030
previous packet time was at: 124:22:20:04.000
last good time was at: 124:22:20:04.000
disk: 29971 count at: 30227 block 9200 byte 80 at: 124:22:18:40.020
previous packet time was at: 124:22:34:07.050
last good time was at: 124:22:34:07.050
disk: 0 count at: 32769 block 9637 byte 176 at: 124:22:34:07.050
previous packet time was at: 125:00:44:20.040
last good time was at: 125:00:44:20.040
disk: 23314 count at: 23570 block 13320 byte 80 at: 125:00:42:55.010
previous packet time was at: 125:01:35:09.010
last good time was at: 125:01:35:09.010
disk: 0 count at: 32769 block 14797 byte 256 at: 125:01:35:10.050
previous packet time was at: 125:03:08:35.090
last good time was at: 125:03:08:35.090
disk: 16657 count at: 16913 block 17440 byte 80 at: 125:03:07:11.000
previous packet time was at: 125:04:36:11.020
last good time was at: 125:04:36:11.020
disk: 0 count at: 32769 block 19957 byte 336 at: 125:04:36:12.000
previous packet time was at: 125:05:32:51.010
last good time was at: 125:05:32:51.010
disk: 10000 count at: 10256 block 21560 byte 80 at: 125:05:31:27.030
previous packet time was at: 125:07:37:14.020
last good time was at: 125:07:37:14.020
disk: 0 count at: 32769 block 25117 byte 416 at: 125:07:37:14.020
previous packet time was at: 125:07:57:07.000
last good time was at: 125:07:57:07.000
disk: 3343 count at: 3599 block 25680 byte 80 at: 125:07:55:42.030

the last counter for the number of packets is: 175872 at block 28480
last good time at: 000:00:00:00.000

Checking BBBSS data files for index order on disk number: 2209
 date of this run is: Tue Aug 30 16:32:55 1994

you want to read up to block number 28480 skipping 1000 blocks
 you have asked to read 175872 packets
 the program will first skip 1000 blocks

Checking the disk on drive: /dev/rsd2a

the packet now starts with DA at block 1000, byte 0

previous packet time was at: 000:00:00:00.000

last good time was at: 000:00:00:00.000

disk: 10772 count at: 0 block 1000 byte 80 at: 124:17:31:34.010

previous packet time was at: 124:19:33:05.040

last good time was at: 124:19:33:05.040

disk: 0 count at: 32769 block 4437 byte 96 at: 124:19:33:05.040

3 DA this packet is 84.970 seconds later than the one before !!!!!!

previous packet time was at: 124:19:55:49.000

last good time was at: 124:19:55:49.000

disk: 3859 count at: 4115 block 5080 byte 80 at: 124:19:54:24.030

2 DA this packet is 83.980 seconds later than the one before !!!!!!

previous packet time was at: 124:22:20:04.000

last good time was at: 124:22:20:04.000

disk: 29971 count at: 30227 block 9200 byte 80 at: 124:22:18:40.020

previous packet time was at: 124:22:34:07.050

last good time was at: 124:22:34:07.050

disk: 0 count at: 32769 block 9637 byte 176 at: 124:22:34:07.050

3 DA this packet is 85.030 seconds later than the one before !!!!!!

previous packet time was at: 125:00:44:20.040

last good time was at: 125:00:44:20.040

disk: 23314 count at: 23570 block 13320 byte 80 at: 125:00:42:55.010

previous packet time was at: 125:01:35:09.010

last good time was at: 125:01:35:09.010

disk: 0 count at: 32769 block 14797 byte 256 at: 125:01:35:10.050

2 DA this packet is 84.090 seconds later than the one before !!!!!!

previous packet time was at: 125:03:08:35.090

last good time was at: 125:03:08:35.090

disk: 16657 count at: 16913 block 17440 byte 80 at: 125:03:07:11.000

previous packet time was at: 125:04:36:11.020

last good time was at: 125:04:36:11.020

disk: 0 count at: 32769 block 19957 byte 336 at: 125:04:36:12.000

1 DA this packet is 83.980 seconds later than the one before !!!!!!

previous packet time was at: 125:05:32:51.010

last good time was at: 125:05:32:51.010

disk: 10000 count at: 10256 block 21560 byte 80 at: 125:05:31:27.030

previous packet time was at: 125:07:37:14.020

last good time was at: 125:07:37:14.020

disk: 0 count at: 32769 block 25117 byte 416 at: 125:07:37:14.020

2 DA this packet is 84.970 seconds later than the one before !!!!!!

previous packet time was at: 125:07:57:07.000

last good time was at: 125:07:57:07.000

disk: 3343 count at: 3599 block 25680 byte 80 at: 125:07:55:42.030

the last counter for the number of packets is: 175872 at block 28480

last good time at: 000:00:00:00.000

Checking BBBSS data files for index order on disk number:

date of this run is: ~~Thu Jun 29 21:05:40 1991~~ *aug 30*

you want to read up to block number 5090 skipping 5075 bytess
 you have asked to read 96 packets
 the program will first skip 5075 blocks

Checking the disk on drive: /dev/rsd2a

the packet now starts with DA at block 5075, byte 0

flag DA headerindex is 4083 at: 124:19:55:39.010

previous packet time was

at: 000:00:00:00.000

last good time was

at: 000:00:00:00.000

disk: 4083 count at: 0 block 5075 byte 80 at: 124:19:55:39.010

flag DA headerindex is 4084 at: 124:19:55:39.010

flag DA headerindex is 4085 at: 124:19:55:39.010

flag DA headerindex is 4086 at: 124:19:55:40.050

flag DA headerindex is 4087 at: 124:19:55:40.050

flag DA headerindex is 4088 at: 124:19:55:40.050

flag DA headerindex is 4089 at: 124:19:55:41.040

flag DA headerindex is 4090 at: 124:19:55:41.040

flag DA headerindex is 4091 at: 124:19:55:41.040

flag DA headerindex is 4092 at: 124:19:55:42.030

flag DA headerindex is 4093 at: 124:19:55:42.030

flag DA headerindex is 4094 at: 124:19:55:42.030

flag ST headerindex is 4095 at: 124:19:55:42.080

flag DA headerindex is 4096 at: 124:19:55:43.020

flag DA headerindex is 4097 at: 124:19:55:43.020

flag DA headerindex is 4098 at: 124:19:55:43.020

flag DA headerindex is 4099 at: 124:19:55:44.000

flag DA headerindex is 4100 at: 124:19:55:44.000

flag DA headerindex is 4101 at: 124:19:55:44.000

flag DA headerindex is 4102 at: 124:19:55:45.050

flag DA headerindex is 4103 at: 124:19:55:45.050

flag DA headerindex is 4104 at: 124:19:55:45.050

flag DA headerindex is 4105 at: 124:19:55:46.040

flag DA headerindex is 4106 at: 124:19:55:46.040

flag DA headerindex is 4107 at: 124:19:55:46.040

flag DA headerindex is 4108 at: 124:19:55:47.020

flag DA headerindex is 4109 at: 124:19:55:47.020

flag DA headerindex is 4110 at: 124:19:55:47.020

flag DA headerindex is 4111 at: 124:19:55:48.010

flag DA headerindex is 4112 at: 124:19:55:48.010

flag DA headerindex is 4113 at: 124:19:55:48.010

flag DA headerindex is 4114 at: 124:19:55:49.000

flag DA headerindex is 3859 at: 124:19:54:24.030

previous packet time was

at: 124:19:55:49.000

last good time was

at: 124:19:55:49.000

disk: 3859 count at: 4115 block 5080 byte 80 at: 124:19:54:24.030

flag DA headerindex is 3860 at: 124:19:54:25.020

flag DA headerindex is 3861 at: 124:19:54:25.020

flag DA headerindex is 3862 at: 124:19:54:25.020

flag DA headerindex is 3863 at: 124:19:54:26.010

flag DA headerindex is 3864 at: 124:19:54:26.010

flag DA headerindex is 3865 at: 124:19:54:26.010

flag DA headerindex is 3866 at: 124:19:54:27.000

flag DA headerindex is 3867 at: 124:19:54:27.000

flag DA headerindex is 3868 at: 124:19:54:27.000

flag DA headerindex is 3869 at: 124:19:54:28.040

flag DA headerindex is 3870 at: 124:19:54:28.040

flag DA headerindex is 3871 at: 124:19:54:28.040

flag DA headerindex is 3872 at: 124:19:54:29.030

flag DA headerindex is 3873 at: 124:19:54:29.030

flag DA headerindex is 3874 at: 124:19:54:29.030

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