Woods Hole Oceanographic Institution

Tests of the Broadband Borehole Seismic System (B^3S^2) at Scripps IGPP and the Pinon Flat Observatory October 1994 to June 1995

by

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August 1997

Technical Memorandum

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I. Purpose

The broadband borehole seismic system (B3S2) is being developed as one component of the Ocean Seismic Network (OSN) Pilot Experiment which will be carried out at the OSN-1 Site off Hawaii in Winter 1998. The other major instruments being developed for the experiment are a Broadband Ocean Bottom Seismometer and a Shallow Buried Broadband Ocean Bottom Seismometer.

B3S2 consists of four major components: 1) a borehole sonde with a re-entry guide, Teledyne 54000 broadband seismometer, and REFTEK digitizing system, 2) a seafloor acquisition and recording system (SEABASS), 3) a control vehicle for deploying the sonde in a borehole, and 4) shipboard command and control electronics. The deployment system is very similar to the SEABASS configuration used on LFASE (Stephen et al, 1994). The purposes of the tests at Pinon Flat were: 1) to integrate the borehole sonde and seafloor and shipboard electronics which had been constructed by different groups: WHOI and SIO/IGPP; 2) test the combined subsystem in a wet borehole environment using actual cables and simulating seafloor conditions; and 3) acquire seismic ambient noise and earthquake data over approximately a three month period for comparison with known stations at the Pinon Flat Observatory. The integration of the SIO/MPL re-entry guide and control vehicle systems was to be carried out in a separate stage of the project.

Broadly speaking there were eight phases to the tests. Details of the first two phases are given in the narrative below and the disk files that were created in the various phases are summarized in the Appendix B.

- Phase 1 (October 16-21, 1994/JD 94289-94294) consisted of system integration and testing at SIO/IGPP.

- Phase 2 (October 22-25/JD 94295-94298) consisted of installation and field testing at PFO.

- Phase 3 (October 25-December 31/JD 94298-94365) consisted of recording actual borehole data at PFO. The data look quite good. Results can be compared with STS-2's running at the ANZA station but the IDA Teledyne 54000 in the adjacent borehole was not running.

- In Phase 4 (January 1 -February 5, 1995/ JD 95001-95036) the data are corrupted by a bad day number and are essentially useless.

- In Phase 5 (February 5- February 23/ JD95036-95054) the day number was corrected, the data look OK and we should have IDA data with which to compare.

- In Phase 6 (February 23- April 15 /JD 95054-95105) we ran new BCU and DAS firmware which had been modified to handle a new time string format. There were timing problems with this configuration and the sonde was removed and reinstalled in the hole a couple of times.

- In Phase 7 (April 15- June 5 /JD 95105-156) the sonde was removed from the hole but acquisition continued recording time marks and triangle waves only.

- In Phase 8 the WHOI van returned to Woods Hole and sonde testing continued at IGPP and PFO.

II. Narrative

Phase 1. La Jolla

- Don, Ken and Tom go out Sunday October 16, Ralph goes out Monday October 17 and Matt goes out Thursday October 20.

- trailer setup in yard, Monday October 17
 - initial integration and debugging
 - by Tuesday night BCU and sonde are connected over seven conductor cable.
- Some issues: the time hack scenario, 30V PSU was required instead of 24V PSU to account for losses in the cable, at PFO WHOI will not have ethernet to the van, but SIO will telemeter data back to La Jolla on an hourly basis.
- overnight tests: Wednesday night recorded triangle waves, Thursday night recorded seismometer data with sonde in Daves office
 - BBOBS meetings (on Wednesday until about 4:30 and Thursday until about 1:30)
 - Tom works on dbpick for displaying data on the SUN (Thursday)
 - temperature data from the sonde needs a shift: actual temperature = reading +11.65degrees.
 - confirmed geophone orientation with Frank. Sonde uses the GSO standard orientation which is a left handed system with up positive. Channel 1 is vertical (up positive). Channel 2 is North-South with North positive. Channel 3 is East-West with East positive.
 - At low power levels, REFTEK switches between high and low current states; something to do with a relay.
 - Glen modifies DAS for low power
 - some issues: power should be left on sonde even if power to REFTEK cycles on and off, Frank wants UTC on seafloor (good luck!), we can set the SEASCAN clock in the lab but on the seafloor we can only read time from it, we need 50msec accuracy but what about drift, new version of dbpick
 - Battery limiting circuit not built yet (lithiums should not be drained completely.
 - Some power notes on Friday: We have a maximum (from the proposal assuming 3 pressure housings) of 390 cells @ 70 W/hrs/cell=27.2KWH. To fill the recorders requires 1KWH. On Friday October 21 the sonde, REFTEK and BCU draw 30V @ 0.400Amps or 12Watts. This does not include the mods that Glen was working on on Thursday. Ninety deployment days is 2120hrs @ 12W is 25.44KWH plus 1KWH for recorders gives 26.4KWH. Pretty close to available power supply. The lithiums start initially at about 31.2V; then a long plateau at about 28V; at the end of the nominal time they are at 27.4V; equipment craps out at 22V. and Don's cut-off voltage will be about 22V. See Appendix E for more on batteries and power supply issues.
 - On Friday: tested battery only boot-up (watch dog); tested sonde lock (To save time the time-out feature of the EMLA was not checked on this integration test. We did not have the EMLA at PFO. EMLA will be redesigned before seatest so that it can be armed from REFTEK.); set SEASCAN and clock checks; dbpick scans of all overnight data; put IGPP gear in housing (crimped wire on flood indicator on first try; at the last minute tested Glen's new lower power DAS (but no numbers).
 - Gear packed by Friday night.

Phase 2. PFO, October

- move, setup Saturday October 22; Don and Ken visit R/V Ewing; truck stuck in sand at PFO; everyone on site and setting-up by noon.
- all gear rigged for surface testing by 2:00; 1pps from SEASCAN seem to go away if you fiddle with connectors; SEASCAN reset and time set to UTC; hydraulic lines are 230feet long, water is down about 60feet.
- deployment; started in hole at 2:30; tool was down by 3:15; upper hole lock did not fire; back up by 4:30 and trouble shooting; measured length of cable from top of the sonde to the top of casing - 79m; Don, Ken, Ralph, Matt, Tom, Chris, Dave leave for hotel (Royal Plaza in Indio) by 7:00PM; Frank stays at PFO.
- NOTE: 1) REFTEK clock gets reset from BCU so we need to acquire a few samples on BCU early in the seafloor deployment.
- 2) WE NEED A GOOSE NECK FOR THE TOP OF THE TOOL!

- Sunday, October 23: all on site by 9:20, van was very hot. Sonde problem was fixed by 10:10. Problem was a nut on an FET that shorted to the casing. This cable is the WHOI 300m - terminated at both ends. The winch drum seems too small for the cable. Started down again at 11:00. Because there is no ambient pressure in the shallow hole the arms are pumped out rather than 'slammed' out. The cable slacker slacks one foot but the effect at the surface is subtle. Acquiring test data by 11:30. Unlocked seismometers at 11:50. (Glen Offield arrives.) Level seismometer; vertical takes some time (about 30min); when levelled mass positions are: vertical - -4.3V, N-S - 0.0V, E-W - 0.0V. At 19:45Z Ken and I reset DAS clock (about 9sec off, gap in data, still had 3sec??). At 29620:11:00Z and 20:14:00Z hit top of hole to see if event would be observed on sonde. At 21:14Z reset GCAT. About 5-6sec of data is lost when GCAT resets. Ralph left site at 3:30 Local to visit R/V Ewing in San Diego.

- Monday October 24: All WHOI personnel on site by 9:20. Can cars arrival be seen seismically? Two cars arrived at 2971600Z and one car at 2971620Z. Tested a new version of dbpick with a day file from 291: overnight tests on previous Tuesday and saw tooth. [Files IGPP1, IGPP2, IGPP3, IGPP4 and IGPP6 were scanned. Ambient noise appears quietest on N-S channel. Vertical channel is labelled HA01. 3min gap at 0400 on IGPP6.] More clock shifts of 10sec or so. More hammer tests between 2:50 and 3:18local (see schedule). From 3:30 to 5:30 prepared for and carried out "over-the-side" and "battery operation" tests. This simulates the situation when power is removed from the BCU during over-the-side operations on deployment. All power off at 5:15. Battery on at 5:20 for overnight battery only operation. Workstations are off. Large seismic event occurred at 5:25. Everyone off site by 7:45. (Cars leave at about 5:50, 7:00 and 7:45.

NOTE: AT SEA, FOR SHIP BOARD RECORDING, USE RETRANSMIT MODE.
Apparently in direct mode, attempts to write to the BCU cause glitches in the data.

NOTE: THE STS2's AT THE ANZA STATION ARE GOING AWAY JAN 1/95.

Notes on hammer tests. Nine hits were made at the IDA hole and six at the empty hole. The Empty hole is about 25feet due east (magnetic) from b3s2 hole. The IDA hole is about 20feet at N40E (magnetic). The magnetic declination is 13degrees East of North. On two minute intervals starting at 297:2150:00 the following hits were made at the IDA hole: 3 - vertical (hit down), 3 - N-S (hit from south to north), 3 - E-W (hit from west to east). At two minute intervals starting at 297:2208:00 the following hits were made at the empty hole: 2 - down, 2 - from north to south, 2 - from east to west. Checked disk "hammer". Frank's code does something funny at 2200.

- Tuesday, October 25: Arrive on site about 8:00AM. Stopped battery operation at about 8:20.

- picnic with Cecil Green and others
- setup for long run; All packed by 4:00; check internet connections at Sun in Frank's van until 5:00. Ralph and Ken leave for LA. Tom takes some personal time. Don and Frank back to San Diego.

- Reviewed Pin5 (day298 file, on batteries); apparent time tears at 0800 and 1200 due to bug in Franks code when you filter at the Nyquist (eg 1-10Hz). Magnitude 2.9 earthquake at Landers, CA about 0240L (0940GMT)

- remote facilities available

III. Results

During the tests at San Diego and PFO, many interface details were worked out between the IGPP and WHOI equipment; most are not enumerated here.

The following more significant engineering problems are outlined.

1. Seascan day number.

The Seascan clock uses a day number with four digits that roll over at 9999. Normally this number is the bottom four digits of the classical Julian day. The Reftek clock however uses day number of year. A software modification was made to the BCU to convert the Seascan day number to a day number between 1 and 365 (or 366) then send it to the Reftek. A flag is included in the conversion code to indicate if the present year is a leap year. This flag needs to be set correctly for the year of deployment.

2. Time string security.

Prior to the San Diego and PFO tests, if the time string received by the Reftek from the BCU differed from its internal time, the new value from the string was used to reset the Reftek clock. Although the string did include character parity, this was deemed risky since any error would cause corrupted data for up to 30 minutes. During the period at PFO, software changes in the BCU and the Reftek were implemented to add check characters to the string and to send the string three times instead of once. Only if all three strings are valid and represent a time change does the Reftek clock now get changed.

3. Battery design and power converters

Due to a combination of greater than estimated power drain and voltage drop on the conductors of the 7-conductor cable, a higher voltage main battery is recommended. Detailed measurements are recorded in appendix E which indicate that the minimum of approximately 24 volts is required at the BCU for reliable operation. This may require strings of 9 cells with a maximum voltage of nearly 35 volts. This may require that power conversion devices be re-evaluated.

Power drain measurements of the BCU, Reftek and Teledyne indicate a total of approximately 12 watts exclusive of the disks. This represents about 400 mA for the nominal 3 months which is nearly 900 AHrs. Using Electrochem double D lithiums derated to 20 AHrs then requires about 400 cells yielding a cost for materials of approximately \$20,000.

4. Unresolved items.

For the record, the following items relating to the WHOI BIP need to be dealt with before the Pilot Experiment cruise.

a. BCU cold tests. The system needs to be operated at ocean bottom temperature for an extended period to identify any problems relating to the disks and power drain.

b. MPL interface. A new CIEM will be provided and needs to be integrated and tested.

c. Transponder logic definition. Details of the remote release and status check need to be decided upon and tested.

- d. Support software update. Some of the support programs have not been used for some time and may require minor updates to correspond with changes in other parts of the system.
- e. Seascan clock drift evaluation. Data from an extended period of operation of the Seascan clock needs to be evaluated to determine the ageing rate and to decide if calibration is required.
- f. Refurbishment of all pressure cases and other frame items. Much of this equipment has not been used since the LFASE experiment in 1989 and will need cleaning and testing.
- g. Definition of at sea preparation procedures. Because changes have been made in all parts of the system, it will be important for all investigators to decide on a detailed preparation plan to be followed during the cruise.

IV. Acknowledgements

We would like to thank Fred Spiess for his flat bed trailer that was used to take the WHOI van to Pinon Flat. Gary Austin provided hardware and assistance in deploying the borehole equipment at Pinon Flat. Also Jin Doult wrote some trouble shooting software for the real time data acquisition system. This work was carried out under NSF Grants No. OCE-91-18943 and OCE No. OCE-95-05730: "A Broadband Borehole Seismometer for the Deep Ocean - Development and Land Testing"

V. References

Wyatt, F.K. and Agnew, D.C., (1994). *Pinon Flat Observatory: A field guide*. Internal Report, Scripps Institution of Oceanography.

Appendix A. Data Summary

	Date	SIO data				DATA DISKS			Deck	Deck	Comments
		Julian Day	at WHOI	hours	BCU	BCU	BCU	BCU			
	year/day										
10/20	94293				1	2	3				
10/21	94294										
10/22	94295										
10/23	94296										
10/24	94297										
10/25	94298							4074	9235_C	begin PFO recording	
10/26	94299							4074	9235_C		
10/27	94300		24.00					4074	9235_C		
10/28	94301		24.00					4074	9235_C		
10/29	94302		24.00					4074	9235_C		
10/30	94303		24.00					4074	9235_C		
10/31	94304		24.00					4074	9235_C		
11/01	94305		16.00					4074	9235_C		
11/02	94306		06.00					4074	9235_C		
11/03	94307							4074	9235_C		
11/04	94308		00.58		6241_C			4074	9235_C	Glen service, Seascan clock check	
11/05	94309		24.00		6241_C				2209_C_T		
11/06	94310		24.00		6241_C				2209_C_T		
11/07	94311		24.00		6241_C				2209_C_T		
11/08	94312		24.00		6241_C				2209_C_T		
11/09	94313		24.00		6241_C				2209_C_T		
11/10	94314		13.00		6241_C				2209_C_T		
11/11	94315		00.15		6241_C				2209_C_T		
11/12	94316		01.54		6241_C				2209_C_T		
11/13	94317		05.92		6241_C				2209_C_T		
11/14	94318		24.00		6241_C				2209_C_T		
11/15	94319		24.00		6241_C				2209_C_T		
11/16	94320		24.00		6241_C				2209_C_T		
11/17	94321		24.00		6241_C				2209_C_T		
11/18	94322		24.00		6241_C				2209_C_T		
11/19	94323		24.00		6241_C				2209_C_T		
11/20	94324		24.00		6241_C				2209_C_T		
11/21	94325		24.00		6241_C				2209_C_T		
11/22	94326		24.00		6241_C				2209_C_T		

C = chksond run, T= transcribed from removable disk
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	Date	SIO data				DATA DISKS				Deck	Deck	Comments
		Julian Day	at WHOI	hours	BCU	BCU	BCU	BCU	BCU			
11/23	year/day	94327	24.00	6241_C	1	2	3			2209_C_T		
11/24	94328	24.00	6241_C							2209_C_T		
11/25	94329	24.00	6241_C							2209_C_T		
11/26	94330	22.30	6241_C							2209_C_T		
11/27	94331	24.00	6241_C							7259_C		SIO cpu code change, status now recorded, BCU service, Clock check
11/28	94332	24.00	6241_C							7259_C		
11/29	94333	24.00	6241_C							7259_C		
11/30	94334	24.00	6241_C							7259_C		
12/01	94335	24.00	6241_C							7259_C		
12/02	94336	24.00	6241_C							7259_C		
12/03	94337	24.00	6241_C							7259_C		
12/04	94338	24.00	6241_C							7259_C		
12/05	94339	24.00	6241_C							7259_C		
12/06	94340	24.00	6241_C							7259_C		
12/07	94341	24.00	6241_C							7259_C		
12/08	94342	24.00	6241_C							7259_C		
12/09	94343	24.00	6241_C							7259_C		
12/10	94344	24.00	6241_C							7259_C		
12/11	94345	24.00	6241_C							7259_C		
12/12	94346	24.00	6241_C							7259_C		
12/13	94347	19.00	6241_C							7259_C		
12/14	94348		6241_C							7259_C		
12/15	94349	07.00	6241_C							7259_C		
12/16	94350	24.00	6241_C							7259_C		
12/17	94351	24.00	6241_C							7259_C		
12/18	94352	24.00	6241_C							7259_C		
12/19	94353	24.00	6241_C							7259_C		
12/20	94354	24.00	6241_C							7259_C		
12/21	94355	24.00	6241_C							7259_C		
12/22	94356	24.00	6241_C							7259_C		
12/23	94357	24.00	6241_C							7259_C		
12/24	94358	24.00	6241_C							7259_C		
12/25	94359	24.00	6241_C		6199_C					7259_C		deck disk full???
12/26	94360	24.00			6199_C					7259_C		

C = chksond run, T= transcribed from removable disk
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	Date		SIO data		DATA DISKS				Deck	Deck	Comments
	Julian Day	year/day	at WHOI	hours	BCU	BCU	BCU	BCU			
12/27	94361	24.00			1	2	3	6199_C		7259_C	
12/28	94362	24.00						6199_C		7259_C	
12/29	94363	24.00						6199_C		7259_C	
12/30	94364	24.00						6199_C		7259_C	
12/31	94365	24.00						6199_C		7259_C	
01/01	94366							6199_C		7259_C	
01/01	95001	11.23						6199_C		7259_C	corrupted day numbers start
01/02	95002	23.31						6199_C		7259_C	
01/03	95003	21.23						6199_C		7259_C	
01/04	95004	17.81						6199_C		7259_C	
01/05	95005	03.00						6199_C		7259_C	
01/06	95006	05.26						6199_C		7259_C	
01/07	95007	19.85						6199_C		7259_C	
01/08	95008	10.47						6199_C		7259_C	
01/09	95009	05.48						6199_C		7259_C	
01/10	95010	22.64						6199_C		7259_C	
01/11	95011	22.53						6199_C		7259_C	
01/12	95012	22.73						6199_C		7259_C	
01/13	95013							6199_C		7259_C	
01/14	95014									7259_C	
01/15	95015									7259_C	
01/16	95016									7259_C	
01/17	95017									7259	
01/18	95018									7259	SIO learn about Seascan specs
01/19	95019									7259	
01/20	95020									7259	
01/21	95021									7259	
01/22	95022									7259	
01/23	95023									7259	
01/24	95024									7259	
01/25	95025									7259	
01/26	95026									7259	Seascan problem confirmed
01/27	95027									7259	
01/28	95028									7259	

C = chksond run, T= transcribed from removable disk
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	Date	SIO data			DATA DISKS			Deck	Deck	Comments
		Julian Day	at WHOI	hours	BCU	BCU	BCU			
	year/day				1	2	3			
01/29	95029								7259	
01/30	95030								7259	
01/31	95031								7259	
02/01	95032								7259	
02/02	95033								7259	
02/03	95034								7259	
02/04	95035								7259	
02/05	95036								7259	
02/06	95037		07.31		9235_C			4074	7259	new BCU firmware corrects day numbers
02/07	95038		24.00		9235_C			4074		
02/08	95039		24.00		9235_C			4074		
02/09	95040		24.00		9235_C			4074		
02/10	95041		24.00		9235_C			4074		
02/11	95042		24.00		9235_C			4074		
02/12	95043		24.00		9235_C			4074		
02/13	95044		24.00		9235_C			4074		
02/14	95045		17.00		9235_C			4074		
02/15	95046		08.59		9235_C			4074		
02/16	95047		16.00		9235_C			4074		
02/17	95048				9235_C			4074		
02/18	95049				9235_C			4074		Glen and Ken at site, time string tests
02/19	95050				9235_C			4074		
02/20	95051				9235_C			4074		
02/21	95052				9235_C			4074		
02/22	95053				9235_C			4074		
02/23	95054		01.67		9235_C			4074		
02/24	95055		19.55		9235_C			4074		new BCU & DAS firmware installed, BCU service, clock check, re-install sonde
02/25	95056		24.11		9235_C			4074		
02/26	95057		24.00		9235_C			4074		
02/27	95058		24.00		9235_C			4074		
02/28	95059		24.00		9235_C			4074		
03/01	95060		24.00		9235_C			4074		
03/02	95061		24.00		9235_C			4074		
03/03	95062		24.00		9235_C			4074		

C = chksond run, T= transcribed from removable disk

	Date	SIO data	DATA DISKS			Deck	Deck	Comments
	Julian Day year/day	at WHOI hours	BCU 1	BCU 2	BCU 3			
03/04	95063	24.00	9235_C			4074		
03/05	95064	24.00	9235_C			4074		
03/06	95065	24.00	9235_C			4074		
03/07	95066	24.00	9235_C			4074		
03/08	95067	24.00	9235_C			4074		
03/09	95068	24.00	9235_C			4074		
03/10	95069	24.00	9235_C			4074		
03/11	95070	08.00	9235_C			4074		
03/12	95071		9235_C			4074		
03/13	95072		9235_C			4074		
03/14	95073		9235_C			4074		
03/15	95074	04.49	9235_C			4074		new BCU Prom installed, wrong prom
03/16	95075	21.62	9235_C			4074		
03/17	95076	24.00	9235_C			4074		
03/18	95077	24.00	9235_C			4074		
03/19	95078	24.00	9235_C			4074		
03/20	95079	24.00	9235_C			4074		
03/21	95080	24.00	9235_C			4074		
03/22	95081	18.59	9235_C			4074		Glen time tests, Sonde removed from hole, Truetime - not locked
03/23	95082		9235_C			4074		
03/24	95083		9235_C			4074		
03/25	95084		9235_C			4074		
03/26	95085		9235_C			4074		
03/27	95086		9235_C			4074		
03/28	95087		9235_C			4074		
03/29	95088		9235_C			4074		
03/30	95089		9235_C			4074		
03/31	95090		9235_C			4074		
04/01	95091		9235_C			4074		
04/02	95092		9235_C			4074		
04/03	95093		9235_C			4074		
04/04	95094		9235_C			4074		
04/05	95095		9235_C			4074		
04/06	95096		9235_C			4074		

	Date	SIO data Julian Day at WHOI year/day hours	DATA DISKS				Deck	Deck	Comments
			BCU	BCU	BCU	BCU			
04/07	95097		1	2	3				
04/08	95098		9235_C				4074		
04/09	95099		9235_C				4074		
04/10	95100		9235_C				4074		Glen & Allen, Sonde to IGPP, Time marks and triangle recording, Allen fix BCU firm
04/11	95101		9235_C				4074		
04/12	95102		9235_C				4074		
04/13	95103		9235_C				4074		
04/14	95104		9235_C				4074		
04/15	95105		9235_C				4074		
04/16	95106		9235_C				4074		Glen service BCU, install fixed BCU & DAS programs, clock check, recording triang
04/17	95107			6199_C			4074		
04/18	95108			6199_C			4074		
04/19	95109			6199_C			4074		
04/20	95110			6199_C			4074		
04/21	95111			6199_C			4074		
04/22	95112			6199_C			4074		
04/23	95113			6199_C			4074		Glen BCU service and clock check
04/24	95114								
04/25	95115								
04/26	95116								
04/27	95117								
04/28	95118								
04/29	95119								
04/30	95120								
05/01	95121								
05/02	95122								
05/03	95123								
05/04	95124								Re-install sonde after modifications
05/05	95125								
05/06	95126								
05/07	95127								
05/08	95128								
05/09	95129	02.92	9235_C						
05/10	95130	21.00	9235_C			2209_C			

Date	SIO data	DATA DISKS			Deck	Deck	Comments
		BCU 1	BCU 2	BCU 3			
Julian Day year/day	hours						
05/11 95131	07.87			2209_C			
05/12 95132	24.00			2209_C			
05/13 95133	24.00			2209_C			
05/14 95134	24.00			2209_C			
05/15 95135	24.00			2209_C			
05/16 95136	19.93			2209_C			
05/17 95137	24.00			2209_C			
05/18 95138	24.00			2209_C			
05/19 95139	24.00			2209_C			
05/20 95140	24.00			2209_C			
05/21 95141	24.00			2209_C			
05/22 95142	24.00			2209_C			
05/23 95143	24.00			2209_C			
05/24 95144	14.00			2209_C			
05/25 95145	10.00			2209_C			
05/26 95146	24.00			2209_C			
05/27 95147	24.00			2209_C			
05/28 95148	24.00			2209_C			
05/29 95149	19.00			2209_C			
05/30 95150				2209_C			
05/31 95151				2209_C			
06/01 95152				2209_C			
06/02 95153							
06/03 95154							

Appendix B Test details and chronology

Phase 1 - yard tests at IGPP

17 Oct 94/290 to 21 Oct 94/294

First overnight at IGPP

Start 291 00:25	Ship	6199	238535
	BCU	7259	43
End 291 15:44	Ship	6199	264335
	BCU	7259	25883

Overnight test with triangle input

Start 293 02:03	Ship	3270	126643
	BCU	7259	25883
End 293 15:14	Ship	3270	148923
	BCU	7259	48242

Overnight test with seismometer in IGPP lab

Start 294 02:17	Ship	3270	148923
	BCU	7259	48243
End 294 15:42	Ship	3270	171643
	BCU	7259	71003

Phase 2 - installation and preliminary testing at PFO

22 Oct 94/295 to 25 Oct 94/298

Overnight test of new program version at PFO

Start 296 01:40	BCU	2209	2043000
		2209	2047280
		6199	264335
End 296 16:16	BCU	6199	284694

First PFO seismometer test, in hole, locked, levelled, settling

Start 296 18:31	Ship	9235	3
Start 296 22:00??	BCU	4074	557683
End 297 18:20	Ship	9235	40402
	BCU	4074	591682

Data read back program READER

Start 297 00:00:00	BCU	4074	??
	Ship	9235	40443
End 297 01:00:00	BCU	4074	??
	Ship	9235	42204

Hammer blow tests

Start 297 21:50:00	Ship	9235	42203
End 297 22:18:00	Ship	9235	43362
BBBSS hole	vertical	21:50:01	
	vertical	21:52:01.5	
	vertical	21:54:00	

	NS	21:56:00
	NS	21:58:00
	NS	22:00:00.3
	WE	22:02:00.5
	WE	22:04:00
	WE	22:06:00
Empty hole	vertical	22:08:00
	vertical	22:10:00.5
	NS	22:12:00.5
	NS	22:14:00.5
	EW	22:16:00
	EW	22:18:00

Phase 3 - long term test
25 Oct 94/298 to 31 Dec 94/365

Long term test starts 2200Z, 298. Recording on BCU disk 3 and NEC as well as IGPP Sun located in WHOI trailer. Sun does not record status packets from DAS. Occasional Sun fault causes many false files to be created.

Site visit - 4 Nov

Glen performed the first BCU service check and Seascan clock check. Also remove disk 9235 from NEC, install disk 2209. After service check, recording continues on BCU disk 1.

Site visit - 26 Nov

Glen and Allen make changes to Sun to solve the occasional problem (caused by additional application running) and to add the status to the recorded data. Also do standard BCU service, clock check and change NEC disk from 2209 to 7259.

Subsequent analysis indicates that BCU filled disk 1 and switched to disk 2 as scheduled on 25 Dec.

Phase 4 - corrupted data caused by day numbers greater than 365
1 Jan 95/001 to 5 Feb 95/036

Seascan clock which is the source of system time does not roll day number at 365, rather it just continues counting (to max of 9999 if permitted). This causes a problem with the DAS which has day of year logic causing the Sun to generate short files and generally corrupt the data. This problem was not identified until 18 Jan because IGPP was not aware of Seascan specs. When Glen returned from trip on 26 Jan problem was confirmed and repair plans begun.

Site visit 5 Feb 95

Glen performed standard service and clock check then installed new GCAT PROM sent from WHOI. New version assumes the present year is not a leap year and converts the Seascan day number to a number between 1 and 365. Glen removed disk 6241 from BCU 1 and installed 9235 in its place. Also moved disk 4074 from BCU 3 to NEC.

Phase 5 - operation with GCAT correcting Seascan day numbers 5 Feb 95/036 to 23 Feb 95/054

Site visit 18 Feb

Glen and Ken do standard BCU service, clock check and test changes to improve time string integrity. This involves adding a check character to the time string and sending the string three times for each time set. Also measure power drain again. After testing, the system was left in the 5 Feb mode while changes to both BCU and DAS are prepared.

Phase 6 - data interruptions while adding XOR to time string 23 Feb 95/054 to 15 Apr 95/105

Site visit 23 Feb

Do standard BCU service, clock check and install new PROMs in both BCU and DAS to implement the improved time string integrity. Seems to work but later discover that strings are not being accepted by DAS. Re-install Sonde.

Site visit 15 Mar 95

Glen installed new BCU PROM to fix erroneous version provided for 23 Feb visit (but due to batch file error, same version installed again).

Site visit 22 Mar 95

Glen performing tests to understand Sun and time string problems. Removed Sonde from the hole. System left not recording. Problem with Truetime - not locked.

Site visit 9 Apr 95

Glen and Allen at site. After discovering BCU program error, Allen creates special firmware to accept three time strings without XOR. Sonde taken back to IGPP. Installed disk 2209 in BCU 3. Left system recording time marks and triangle only.

Phase 7 - valid data recording and sonde tests 15 Apr 95/105 to end

Site visit 15 Apr 95

Glen performed standard BCU service, could not do clock check. Installed corrected BCU program (really) and corresponding DAS program. Repaired sonde comm board then restarted system, did standard service, clock check, and started NEC. Left system still recording triangle.

Site visit 23 Apr 95

Glen does standard service and clock check. Removed disk 4074 from NEC (was full).

Site visit 22 May

Install sonde after modifications (now has cal and modified holelocks).

Site visit 1 June

Final visit before pullout

Site visit 5 June

All equipment packed and moved to San Diego for further tests at MPL, IGPP and WHOI.

Appendix C. Field Personnel

WHOI

Ralph A Stephen, senior scientist, Co-PI

Donald E Koelsch, principal engineer, Co-PI

Kenneth R Peal, senior engineer

Matthew R Gould, engineering assistant III

Stephen T Bolmer, senior information systems assistant

IGPP

D.Glen Offield, ??

F.Vernon

Real Time Systems (2)

Allen Nance

PFO

Caretaker

Appendix D: Battery and power supply issues

This section provides the detailed power drain and voltage drop measurements made during the PFO tests.

1. Power dropout tests.

The system was operated with the 300 meter cable in the yard at IGPP powered from a bench supply. The supply voltage was reduced with various loads until some form of failure occurred. These data will be used to determine the configuration of the battery for deployment (number of cells per string, min and max voltages etc). The results follow:

Connection	volts at BCU	volts to sonde PS	volts from sonde PS
Reftek only			
	32.9	31.1	30.4
	28.1	26.0	25.4
	24.0	21.9	21.1
	22.0	19.75	19.0
	20.0	17.5	16.7
	16.0	13.2	13.0 dies
Reftek+seismometer			
	32.9	28.3	27.5
	28.0	22.7	21.9
	24.0	17.9	17.1
	22.0	15.3	14.5 restarts
	20.0	14.3	13.5
	20.3	14.3	13.4 dies
Reftek+seismometer+Moto IC			
	33.0	26.9	26.1
	28.0	20.1	19.3
	24.4	15/18	dies

2. Power drain.

The current load from a bench power supply was measured on several occasions while parts of the system were turned on and off. These data will be used to estimate the deployment period obtained from a given battery configuration.

18 October 94, in IGPP yard (these values appear to be in error)

Load	supply (volts)	drain (mA)	power (watts)
BCU alone	30.0	100	3.0
BCU,DAS	30.0	300	9.0
BCU,DAS,moto IC	not recorded		
BCU,DAS,Teledyne	30.0	550	16.5
BCU,DAS,Teledyne, moto IC	30.0	700	21.0

18 February 1995, at PFO

Load	supply (volts)	drain (mA)	power (watts)
BCU alone		not recorded	
BCU,DAS	30.0	230	6.9
BCU,DAS,moto IC	30.0	248	7.4
BCU,DAS,Teledyne	30.0	393	11.76
BCU,DAS,Teledyne, moto IC	30.0	540	16.2

June 1995, at PFO

Load	supply (volts)	drain (mA)	power (watts)
BCU alone	30.3	147	4.45
BCU,DAS	30.25	234	7.0785
BCU,DAS,moto IC	30.2	250	7.55
BCU,DAS,Teledyne	30.2	384	11.597
BCU,DAS,Teledyne, moto IC	30.2	565	17.063

3. Straw man main battery design.

Using a nominal drain of 12 watts for three months gives 26 KWhr or 870 Ahr. Derating the batteries to 20 Ahr leads to 44 parallel strings. To get 31 - 35 volts, use 9 cells per string for a total of 396 cells.

4. The following notes summarize a phone conversation between Ralph and Don on Wednesday January 25/95. There is a May 5, 1994 memo on power issues.

At PFO we had to supply 30V rather than 24V to allow for losses in the cable. Don measured the BCU plus DAS(REFTEK) at 9W. The BCU alone consumed 3.0W. The BCU, DAS and sonde consumed 16.5W!

In summary:

	DAS	SONDE	BCU	TOTAL
targets in proposals and memos	<2W	<2W	2W	6.0W
lab. measurements	DAS+SONDE=7-10W (Willoughby) 4W			about 14W
at PFO	6.0W	7.5W	3.0W	16.5W

Consumption of 16.5W for B3S2 compares to about 10W for BBOBS.

9 batteries/string gives 25 Amp-hrs at 31-35V.

$0.55\text{Amps current for } 2160\text{hrs (90 days)} = 1188\text{Amp-hours}$

$1188\text{Amp-hours} / 25\text{Amp-hrs/string} = 48\text{ strings}$

$48\text{ strings} \times 9\text{ batteries} = 432\text{ batteries}$

$432\text{ batteries @ } \$45 = \$19,440$

plus two strings for DRU = 18 batteries for a total of 450 batteries

Total cost for cells \$20,250

assemble 13 decks at \$250/deck = \$3,250

Total for assembled batteries = \$23,500 (Based on 25 Amp-hours)

If we derate for temperature, shelf life, current drain, etc to 20 Amp-hours the cost goes up to \$29,920. There would be 558 batteries (62 strings), and they would fit in three pressure housings.

Appendix E: Correspondence on Pinon Flat Tests

E.1.a. 1/19/95

K. Peal

Return-Path: kpeal@hurdle.who.i.edu
 Received: from bravo by gannet.who.i.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.who.i.edu (AIX 3.2/UCB 5.64/4.03)
 id AA12799; Thu, 19 Jan 1995 22:41:21 -0500
 Received: by aqua.who.i.edu (5.57/Ultrix3.0-C)
 id AA09121; Thu, 19 Jan 95 22:49:39 -0500
 Received: by hurdle.who.i.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.who.i.edu (Ken Peal)
 Message-Id: <9501200347.AA10344@hurdle.who.i.edu>
 To: vernon@yin.ucsd.edu
 Cc: rstephens@aqua.who.i.edu, mgould@aqua.who.i.edu, dkoelsch@aqua.who.i.edu,
 tomb@snark.who.i.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

Replied: Mon, 30 Jan 95 09:33:33 -0500
 Replied: kpeal@hurdle.who.i.edu (Ken Peal) rstephen@who.i.edu (Ralph Stephen) joh
 Return-Path: kpeal@hurdle.who.i.edu
 Received: from bravo by gannet.who.i.edu; (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.who.i.edu (AIX 3.2/UCB 5.64/4.03)
 id AA11426; Sun, 29 Jan 1995 22:12:02 -0500
 Received: by aqua.who.i.edu (5.57/ULtrix3.0-C)
 id AA17422; Sun, 29 Jan 95 22:19:52 -0500
 Received: by hurdle.who.i.edu (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.who.i.edu (Ken Peal)
 Message-Id: <9501300317.AA15591@hurdle.who.i.edu>
 To: john_orcutt@igppqm.ucsd.edu, rstephen@aqua.who.i.edu, vernon@yin.ucsd.edu,
 glen_offield@igppqm.ucsd.edu
 Cc: dkoelsch@aqua.who.i.edu, tomb@snark.who.i.edu, mgould@aqua.who.i.edu
 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?

```

Forwarded: Thu, 02 Feb 95 09:00:59 -0500
Forwarded: vernon@yin.ucsd.edu (Frank Vernon)
Return-Path: kpeal@hurdle.who.i.edu
Received: from bravo by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
    id AA051111; Thu, 2 Feb 1995 08:24:59 -0500
Received: from AQUA.WHOI.EDU by bravo.who.i.edu (AIX 3.2/UCB 5.64/4.03)
    id AA17564; Thu, 2 Feb 1995 08:15:56 -0500
Received: by aqua.who.i.edu (5.57/Ultrix3.0-C)
    id AA00304; Thu, 2 Feb 95 08:24:09 -0500
Received: by hurdle.who.i.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.i.edu (Ken Peal)
Message-Id: <9502021321.AA17563@hurdle.who.i.edu>
To: glen_offield@igppqm.ucsd.edu
Cc: rstephen@aqua.who.i.edu, dkoelsch@aqua.who.i.edu, tomb@snark.who.i.edu,
    mgould@aqua.who.i.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

Return-Path: kpeal@hurdle.who.edu
 Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA05128; Thu, 2 Feb 1995 08:28:31 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA16031; Thu, 2 Feb 1995 08:19:28 -0500
 Received: by aqua.who.edu (5.57/Ultrix3.0-C)
 id AA00326; Thu, 2 Feb 95 08:27:41 -0500
 Received: by hurdle.who.edu (4.1/SMI-4.1)
 id AA17573; Thu, 2 Feb 95 08:25:28 EST
 Date: Thu, 2 Feb 95 08:25:28 EST
 From: kpeal@hurdle.who.edu (Ken Peal)
 Message-Id: <9502021325.AA17573@hurdle.who.edu>
 To: glen_offield@igppqm.ucsd.edu
 Cc: rstephen@aqua.who.edu, dkoelsch@aqua.who.edu, tomb@snark.who.edu,
 mgould@aqua.who.edu
 Subject: Instructions for PFO clock fix

Glen: I am including these in the package, but here is another copy.

February 1995 Pinon Flats Site Visit

(Revised version of the 10 Nov 94, 9 Jan 95 instructions)

General Plan

For Glen's visit in February to fix the clock problem, we recommend following the instructions in the order below. The general sequence is:

1. Check BCU status
2. Check Seascan clock
3. Swap BCU disk
4. Change PROM in BCU
5. Start BCU, Reftek, and Sun
6. Make power drain measurements

1. BCU Status

I understand that the Reftek is pretty upset at the bad day numbers we are generating. If it is sending corrupted packets the BCU may also be confused. However, I think that it will still come up and respond to us if you follow the instructions for a site visit that I sent before. I include them below just in case. If things go awry, capture what ever happens in the PROCOMM log file anyway.

BCU Status Instructions

- connect and power Zeos laptop as necessary
- laptop boots and runs PROCOMM
- hit any key to start PROCOMM (as requested)
- PROCOMM settings should be 2400 E81
- start log file, hit alt F1, enter file name as "(daynumber).log" then hit CR (use daynumber from Truetime clock)
- connect BCU cable (from lab switch box "Command Link") to laptop serial port if necessary
- turn on "28 volt deck" power supply (to 30 volts)
- current meter on power supply should initially read about 600 mA then change to 400 mA
- wait for system to reset and boot (about 15 seconds!)
- prompt is "Hit ESC to enter command"
- hit ESC, enter "sel drive 1"
- hit ESC, enter "drive on"

- after drive spinup, observe disk status structure
- hit ESC, enter "drive off"
- repeat above four instructions for drives 2 and 3
- hit ESC, enter "engdata"
- observe voltages etc, after about 10 seconds
- hit ESC, enter "show params"
- observe experiment parameters
- leave Zeos running with log file open
- go to next section

2. Do BCU clock check (on NEC 286 computer)

- we assume that the acquisition program that was running on the NEC has stopped because it has filled the disk
- turn on monitor power
- unlock keyboard if necessary (key switch on NEC)
- if pinwheel is turning, acquisition program is still running, hit ESC (this is unlikely)
- if system is at DOS prompt, proceed
- if something is wrong, RESET computer using key switch on NEC

- move to correct directory, enter "ncd exe"
- connect cables as in drawing for Clock Check
- to run CLOCK, enter "clock" on NEC 286 computer keyboard
- program lists configuration info
- program tries to read times from Truetime and Seascan
- if no problems:
 - program says "Clock format set ..."
 - program prints single line every 30 seconds with times and offset, "TrueTime ... Seascan ... diff ..."
- record times and offset from screen
- hit ESC, program will stop when cycle completes
- if errors occur:
 - program says "error in clock.c (nn): message"
 - probably means it cannot access Truetime or Seascan
 - call for help
- to prepare for the next steps, do the cable reconfiguration from "Connection for Clock Check" to "Connection for Operation"

3. Swap BCU disk

Locate the two BCU electronic racks on the wall shelves. Unfortunately when we left the site there was a pile of empty boxes in the van which makes these racks a bit difficult to approach - tough luck! In one of the racks are three disks. Insert the key in the top disk mount (I have included a key in the shipment, they are all the same) and turn it 90 degrees clockwise (from horizontal to vertical). This unlocks the disk (and also turns off power if it is on). Remove this disk. My records show this is disk 6241, but I want the top disk of the three whichever one it is. Bring this disk back to La Jolla, I will take it back with me.

Next insert the new disk (9235, I think) that I sent to Frank in January. Turn the key 90 degrees counter clockwise so the disk will come on when we access it.

4. Change PROM in BCU

This is pretty straightforward but I have put down all the steps just to be sure.

4.1 Power off

Turn off both power supplies and the batteries. The power supplies are on the shelf - one is labelled "28 volt deck", the other is right beside it. The batteries are in a PVC case with an aluminum end cap on a shelf below the BCU. There is a switch labelled "on/off" (surprise!) on the end cap. Turn it to "off".

4.2 Change PROM

Locate the two BCU electronic racks on the wall shelves. One of the electronics racks has the three disks, the other one has the GCAT which is the processor whose program we are changing. There are two sets of circuit boards in this rack: one set is 4 x 5 boards with a 44 pin backplane; the other is a set of PC style boards. One of the PC boards is a Vector PC board with two smaller boards mounted on it along with several ribbon cables. These small boards are the GCAT. Remove the PC board with the GCAT on it from the bucket - leave the ribbon cables connected. When the board is out of the bucket, disconnect the ribbons at their far end - make a note of where they are connected!.

The GCAT is on the PC board but not secured; lift it off the board. Using the blue battery clamp I sent in the package (it is a "taker-aparter" from Onset) separate the two boards in the GCAT sandwich. This may seem silly but the taker-aparter is really safer - please use it. The PROM is labelled "4.01", note where pin 1 is, then remove it, being careful not to damage traces etc. under the PROM. Install either of the PROMs I sent ("4.03" or "4.04" - they are the same) and reassemble things.

4.3 Power on

First, be sure that the cables are as in "Connection for Operation" - this really means that the Zeos is connected to the Command Link on the Lab Switch Box. Turn on the "28 volt deck" power supply first, then the other power supply on the shelf. Finally turn on the batteries. After the system startup and boot time, you should get the prompt on the Zeos laptop: "Hit ESC to enter command (Feb 01 1995)" - note new date. If this does not happen, try turning off the "28 volt deck" supply for 30 seconds then turning it back on. If there is trouble here, it could be the PROM of course, but the change was pretty simple, so let's try talking if you get stuck.

I presume that the Reftek and sonde also start when power comes on. If not, then I presume that you know what to do.

5. Start BCU, Reftek and Sun

Assuming that you get the prompt OK from the BCU, proceed with the steps below. This is really the BCU status, augmented a bit to check that the new PROM is working OK.

- Zeos should be still running PROCOMM, log file open
- cables should be connected as in drawing for Operation
- hit ESC, enter "read time"
- after a few seconds, observe Seascan time, day number should be greater than 365
- hit ESC, enter "send t"
- after a few seconds, observe two times, the first one is less than 365 (to Reftek), the other is greater than 365 (alarm to Seascan) - if this works we are "on the air"!
- hit ESC, enter "sel drive 1"
- hit ESC, enter "drive on"

- after drive spinup, observe disk status structure
- hit ESC, enter "drive off"
- repeat above four instructions for drives 2 and 3
- hit ESC, enter "engdata"
- observe voltages etc, after about 10 seconds
- hit ESC, enter "show params"
- observe experiment parameters
- turn off "28 volt deck" power supply
- wait until power supply volt meter reads less than 5 volts
- change "deck connection" switch to "active"
- return to "not active", leave in "not active" position
- wait for system to reset and reboot (about 15 seconds!)
- observe BCU acquisition startup ending with "ready"
- close PROCOMM log file, hit alt F1 on Zeos
- exit procomm, hit alt "x", then "y"
- put floppy in laptop floppy slot
- copy log file to floppy, enter "copy (daynumber).log a:"
- park laptop system, enter "bye"
- disconnect serial cable if laptop is being removed
- turn off laptop

At this point, the BCU and Reftek should be operating. Take whatever action is necessary to get the Sun working and check that all is well there.

6. Power Drain Measurements

In October, I made the following measurements. We were surprised at the Reftek (DAS) power drain = 6 watts. We need to resolve what if anything is wrong here. Could you do these again maybe a different way?

Power drain measurements, 18 Oct 94:

- power supply at 30 volts		
- BCU alone	100 mA	power is 3 W
- turn on DAS	300 mA	6
- turn on 54000	550 mA	7.5
- turn on IC	700	4.5

E.2.a. 2/9/95

K. Peal

Return-Path: kpeal@hurdle.who.edu
 Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA07148; Thu, 9 Feb 1995 08:22:28 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA18351; Thu, 9 Feb 1995 08:21:38 -0500
 Received: by aqua.who.edu (5.57/Ultrix3.0-C)
 id AA19585; 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, rstephena@aquas.who.edu,
 dkoelsch@aquas.who.edu
 Cc: mgould@aquas.who.edu, 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

Return-Path: kpeal@hurdle.who.edu
 Received: from bravo by gannet.who.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.edu (AIX 3.2/UCB 5.64/4.03)
 id AA11269; Fri, 10 Feb 1995 11:21:45 -0500
 Received: by aqua.who.edu (5.57/Unix3.0-C)
 id AA03215; Fri, 10 Feb 95 11:21:36 -0500
 Received: by hurdle.who.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.edu (Ken Peal)
 Message-Id: <9502101619.AA19772@hurdle.who.edu>
 To: glen_offield@igppqm.ucsd.edu
 Cc: rstephena@aquawhoi.edu, dkoelsch@aquawhoi.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.

Return-Path: kpeal@hurdle.who.edu
 Received: from bravo 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@aquawhoi.edu, dkoelsch@aquawhoi.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

Return-Path: kpeal@hurdle.who.edu
 Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.12/8.6.1
 Received: by aqua.who.edu (5.57/Ultrix3.0-C)
 id AA25016; Thu, 13 Apr 95 11:42:06 -0400
 Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id LAA07286; Thu
 Date: Thu, 13 Apr 1995 11:39:19 -0400
 From: Ken Peal <kpeal@hurdle.who.edu>
 Message-Id: <199504131539.LAA07286@hurdle.who.edu>
 To: glen_offield@igppgm.ucsd.edu
 Cc: rstephen@aqua.who.edu, dkoelsch@aqua.who.edu, mgould@aqua.who.edu
 Subject: PFO test issues

Glen: 13 Apr 95

1. Fixing my goof (AGAIN!)

I looked over the firmware change we did after I discovered my goof of 18 Feb looking for something wrong. The most likely explanation is that the batch file I gave you on the floppy had one line commented out during testing! Unfortunately it is the line that copies the new binary file from the floppy to the NEC hard disk. So with the line commented out, we would go through all the motions then end up burning the old binary file since it was left on the NEC after our visit to the site 18 Feb. STUPID!!

I am not completely sure of course, so we should check, but it does explain the symptoms. I have put the stuff on Hurdle that you need to do the job - most of it is identical to the stuff I sent back in February. I ran another test this morning and it really does the string correctly.

Just to be sure I have put all the stuff on Hurdle for you to retrieve. I put them in directory /home/users/guest/ken2glen. I put it on using ftp in BINARY mode. I copied it back and compared the files so I am sure that all is well. For some reason ftp defaults to ASCII rather than BINARY so be careful if you retrieve the binary files.

The only difference is one line is the batch file MAKEPROM.BAT but make sure you use the new one or else edit the old one. The other files should all be the same as you had on the floppy I sent.

The files are:
 image (binary)
 rd_512_t.drv (binary)
 124011.b02 (binary)
 makeprom.bat (ASCII)
 romdisk.pgm. (ASCII)

The instructions to do the burn are the same as last time. Connect the EP1140 PROM burner to the printer port of the NEC then install a blank PROM. Insert the floppy in the NEC and type:

```
B: <CR>
MAKEPROM <CR>
```

This loads the file into the NEC and then loads the needed files into the PROM burner. There are three files, not just one. When all are loaded, it stops and you need to do the actual burn as follows:

```
<ESC> D P.
```

When the burning is done (it takes several minutes) you need to exit the PROM burning program:

```
<ESC><ESC> Q.
```

When you have installed the PROM in the BCU and fired it up you should see that the time strings now have a <CR> after each one so they overwrite on the console. Obviously testing with the DAS is also needed.

In addition, I suggest that you check the programs in the PROM directory on the BCU. To do this, use the operator command "quit" which exits the BCU program and returns you to DOS. Then do a "dir" and you should see something like one of the listings included at the end of this message. One is the 18 Feb version, the other is the 21 Feb version. We hope it is the latter at this point! To return to the BCU program, type BCUPROG.

2. Your question about the problem with the clock check: "Error in clock.c (105) read".

The error is telling us that when the program sent the ESC to the BCU, it did not get a prompt. Probably you had a cable connected wrong or maybe the BCU was not in the right mode. Another possibility - less likely - is that the NEC had a copy of PROCOMM still running that had the COM port allocated so the CLOCK program could not get it. A reboot of the NEC would solve this.

I don't think this indicates damage because you were able to do everything else - the BCU was working OK.

3. Wireline modem info.

The schematic is a bit confusing. ALL the resistors shown on the schematic are add-ons. Don gave them designations even though they are not in the etch. You will have to trace lines to determine which is which. You said the smoked resistor was connected to U1 so I suppose it is R4. In that case it should be 100 ohms not 1.1K. It may work at 1.1K but that is a bit high. It may have looked symmetrical but it really is not. Don added the various resistors to reduce ringing and to protect the components against capacitive discharge from the cable.

4. PFO pullout schedule.

After we have this time string thing working for a couple of weeks I feel that we are pretty well done what needs to be tested with regard to the system operation. The remaining problems relate to the sonde itself which you can work on using the BCU simulator with Sun recording. Let me know if you agree.

Since I am going on a cruise next week, we think that we should delay the pullout from the 8 May date to early June. If you go to PFO tomorrow and the fix works, we have several weeks of operation before early June. If there is still a problem, I would consider going out to PFO with you again in early May to get it solved. Then we still have some operating time before early June.

We really don't want to leave our equipment there much past June because we need to start working on the equipment through the summer along with our other projects. It is risky to leave the work on this stuff to the fall or later because of people's schedules.

Regards ...kp
(directory listings follow)

Volume in drive C is KEN_12-92

Volume Serial Number is 172D-1CD2
 Directory of C:\USR\SEISMICS\BBBSS\GCATROM\APP

```

.                <DIR>          05-17-93    5:10p
..               <DIR>          05-17-93    5:10p
CONFIG    SYS           30 03-18-94    7:10p
DASCOMBC  EXE        38500 09-30-94    1:41p
PWRMGR    EXE         3734 02-03-94    1:29p
SCSIDEV   DAT         234 01-01-80    1:45a
STARTPRT  EXE         6516 02-07-94    2:00p
ASPIFILE  EXE        41252 05-02-94    8:55p
READER    EXE        63738 09-29-94    9:20p
MODE      COM        23537 04-09-91    5:00a
MA338     SYS         8443 10-26-92    5:58p
BCUPROG   EXE       103556 02-18-95    2:59p  -- this is the old one
AUTOEXEC  BAT         58 05-26-94    5:53p
      14 file(s)          289598 bytes
                        111063040 bytes free

```

Volume in drive C is KEN_12-92
 Volume Serial Number is 172D-1CD2
 Directory of C:\USR\SEISMICS\BBBSS\GCATROM\APP

```

.                <DIR>          05-17-93    5:10p
..               <DIR>          05-17-93    5:10p
CONFIG    SYS           30 03-18-94    7:10p
DASCOMBC  EXE        38500 09-30-94    1:41p
PWRMGR    EXE         3734 02-03-94    1:29p
SCSIDEV   DAT         234 01-01-80    1:45a
STARTPRT  EXE         6516 02-07-94    2:00p
ASPIFILE  EXE        41252 05-02-94    8:55p
READER    EXE        63738 09-29-94    9:20p
MODE      COM        23537 04-09-91    5:00a
BCUPROG   EXE       103572 02-21-95    4:39p  --this is the right one!!
MA338     SYS         8443 10-26-92    5:58p
AUTOEXEC  BAT         58 05-26-94    5:53p
      14 file(s)          289614 bytes
                        111067136 bytes free

```

E.3.a. 12/29/94
K. Peal

Return-Path: kpeal@hurdle.who.edu
Received: by aqua.who.edu (5.57/Ultrix3.0-C)
id AA17084; Thu, 29 Dec 94 10:56:35 -0500
Received: by hurdle.who.edu (4.1/SMI-4.1)
id AA01696; Thu, 29 Dec 94 10:54:34 EST
Date: Thu, 29 Dec 94 10:54:34 EST
From: kpeal@hurdle.who.edu (Ken Peal)
Message-Id: <9412291554.AA01696@hurdle.who.edu>
To: rstephen@aqua, dkoelsch@aqua, tomb@snark.who.edu, mgould@aqua
Subject: Full disk switching at PFO

Ralph, Don, Tom, Matt:

29 Dec 94

I was expecting to see a switch to the second BCU disk about 25 Dec but Tom tells me he sees no disk errors at all in the status data up to 27 Dec.

That made me look back at the code in the BCU and I discovered that when a disk fills and the system switches to using the next disk there is no error recorded. As a result we will not be able to see by looking at the disk status data which disk is in use. It is possible to determine this info by using the operator keyboard - that is the way it was intended to be used. What we are looking at here is the data stream which is going to the disk, not the operator status info.

I think it is not necessary to record which disk is in use on the disk itself since you normally know which disk you are looking at when you see this data. If anybody really wants to change this, we need to look at the status packet again - it is pretty tightly packed now - and decide what info we want to eliminate from it.

So the short answer is we will not know when disk changes happened until somebody goes to the site. At this point we have evidence that everything is working OK and that there are no disk errors.

Return-Path: tomb@snark.who.edu
Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA13191; Wed, 8 Mar 1995 10:56:40 -0500
Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
id AA14888; Wed, 8 Mar 1995 10:54:40 -0500
Received: by aqua.who.edu (5.57/Unix3.0-C)
id AA26842; Wed, 8 Mar 95 10:55:06 -0500
Received: from localhost by snark; (5.65/1.1.8.2/05Jan95-8.2MPM)
id AA15804; Wed, 8 Mar 1995 10:53:38 -0500
Message-Id: <9503081553.AA15804@snark>
To: kpeal@aqua.who.edu
Cc: rstephen@aqua.who.edu, dkoelsch@aqua.who.edu, mgould@aqua.who.edu,
tomb@snark.who.edu
Subject: disks from pinyon
Date: Wed, 08 Mar 95 10:53:32 -0500
From: tomb@snark.who.edu
X-Mts: smtp

I have finally checked the two disks that just came back from Pinon.
The disk (6241) that was in the BCU goes from day 308 to day 359
at 12:46:57 Z (good pick at the stop date!). In the chksond output
file I see no timing errors. It looks like a clean run.

The disk (7259) that was connected to the NEC in the van goes
from day 330 to day 016 at 11:00 Z. But, at day 367 at 00:00:00.000
the times start shifting back and forth by +/- 31,622,400 ish seconds
(roughly) 366 days. Looking at the data I wonder if it is all there
but needs a time "correction" that removes the possible resets. The
time shift shows a packet is x seconds before the last one and the next
time error shows that the packet is now x+2 seconds later than the last
packet. This theme of 2 seconds difference should let us "decode" the
disk "properly". We should be able to figure this pattern out.

I have sent Ken a listing of the two chksond runs. I have only
sent lines 1-2000 and 4340-4440 of the disk 7259 since it was so large
an output file.

As of about an hour ago the data at SIO is still at day 55 at 1800
with no new data.

Tom

Return-Path: kpeal@hurdle.who.edu
 Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA17821; Thu, 23 Mar 1995 15:01:08 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA12962; Thu, 23 Mar 1995 14:58:54 -0500
 Received: by aqua.who.edu (5.57/Unix3.0-C)
 id AA19730; Thu, 23 Mar 95 14:59:17 -0500
 Received: by hurdle.who.edu (4.1/SMI-4.1)
 id AA02221; Thu, 23 Mar 95 14:56:46 EST
 Date: Thu, 23 Mar 95 14:56:46 EST
 From: kpeal@hurdle.who.edu (Ken Peal)
 Message-Id: <9503231956.AA02221@hurdle.who.edu>
 To: rstephena@aqu.who.edu, tomb@snark.who.edu
 Subject: Data wrap on disk 2209

Ralph, Tom: 23 Mar 95

I took a quick look at some of the code that deals with the disk writing. The apparent loop back where some data from the end of the disk appeared at the beginning is fully explainable and did not happen!

First, Tom was looking at a disk block that we should not look at during processing. We should not even look for packets before block number 3 - blocks 0 and 1 are for UNIX, block two is for the acquisition program to store its pointer. When we look at a block before block 3 we will usually see data that is out of order and it will cause the program to miss the first valid packet in block 3. Don't do it!

Second, why is there data in block 2? When the acquisition program does a disk write, it reads the next block pointer from block 2, uses it to write the data then updates the next block pointer by writing a new value in block 2. When we write to a disk the smallest amount of data that can be written is one block. Thus when we write the next block pointer (one block), we copy it into a one block sized data buffer for convenience then do the write of the whole buffer. Since this buffer had been used for data, it will have old data in it in addition to the pointer which will then be written to disk in block 2. Normally this old data has already been written to the disk where it belongs.

Third, are we losing data? The answer is, yes but not much. At the end of operation, the program tries to write any data buffers to the disk. Since it normally writes in sets of 20 blocks, it only does a write in these circumstances if it has 20 complete blocks ready. In the case of disk 2209, it did write the blocks it had but then there was a bit more in the data buffer. Since it was less than 20 blocks, it was discarded. What we saw in block 2 was about a second of data that was discarded when the program was stopped by the operator. In the worst case I think we could lose up to 20 buffers (about 43 seconds of data).

Fourth, does data wrap when the disk fills? The answer is, no. What we saw was not in the valid data part of the disk. I have done end of disk tests and the system just stops writing as it should.

Regards ... kp

Return-Path: tomb@snark.who.i.edu
 Received: from bravo by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA23182; Mon, 3 Apr 1995 11:02:20 -0400
 Received: from AQUA.WHOI.EDU by bravo.who.i.edu (AIX 3.2/UCB 5.64/4.03)
 id AA11988; Mon, 3 Apr 1995 10:59:56 -0400
 Received: by aqua.who.i.edu (5.57/Ultrix3.0-C)
 id AA07491; Mon, 3 Apr 95 11:00:15 -0400
 Received: from localhost by snark; (5.65/1.1.8.2/05Jan95-8.2MPM)
 id AA06761; Mon, 3 Apr 1995 10:57:38 -0400
 Message-Id: <9504031457.AA06761@snark>
 To: vernon@yin.ucsd.edu
 Cc: kpeal@aqua.who.i.edu, tomb@snark.who.i.edu, glen_offield@igppqm.ucsd.edu,
 allen@iris.washington.edu, rstephen@aqua.who.i.edu
 Subject: code to read PFO status files
 Date: Mon, 03 Apr 95 10:57:31 -0400
 From: tomb@snark.who.i.edu
 X-Mts: smtp

Frank;

I will be sending a uuencoded compressed tar file of our code that reads status packets (among other things). This code can read the status packets from the hard drives we are recording on at PFO or the binary file you are saving at PFO and I am ftping back from palapa. This code is the one we use to check a disk to see if all the packets are there and complete and that time is in the right order on the disk.

This code is far from a slick, well documented package that is easy to jump into. It is a series of patches and fixes joined into a whole. The subroutine where I write out the status words is write_status805.c. packet80a.h has the structure that has the SIO status words in it:

```
typedef struct status
{
    unsigned char SIO[30];
    unsigned char WHOI[30];
} STATUS;
```

```
typedef struct statuspacket
{
    HEADER hdr;
    STATUS status;
} STATUSPACKET;
```

I haven't the foggiest how well you'll be able to follow this code. I assume that you can get into write_status805.c and make it write out the words in the SIO structure you need.

I made a test compile and run of day 95046 status from PFO and included that in the tar file. status.day046 has the "translated" WHOI status info. The file chksond.day046 has our normal disk check data in it. The file chksond.day046.hours would have the block and byte location of the start every whole hour in it if this was a disk check run. The normal disk check will check the counter header word and see if it is 1 larger than the previous packet's counter. If that counter is not in order that information is printed out. In the case of a status file this will probably happen for every packet since they are not written every packet. The output file will then show a disk counter (header word), a count (program counter and the previous count found), the block and byte location of the program (WARNING: This is the END of the packet location not the start!! The program is telling where it is NOW that I have read this packet not where it was BEFORE it read the packet reported upon), and the current time written in the file.

To run the program you need parameters in the file chksond.par (name is hardwired into the program and the file needs to be in the

local directory where the program is being run from). The output files will clobber previous ones of the same name, so rename before a rerun. I enclose below a key for the parameter file. Also see the file chksond805.doc in the tar file. It has instructions that I left for Ralph before my cruise last fall. The final line in the parameter file is the one that names the status file to be read if line 5 has option 4. This will be the option you run under. The file below is the one I used to test the program before taring the code.

```
chksond.par:
2      # drive number, needed if reading hard drive only
day046 # disk drive number (this string utilized in output file name)
0      # blocks from start of drive to skip, 2 for a harddisk, 0 for status file
5      # total number of blocks to read
4      # 1 for hp, 2 for dec, 3 for SUN, 4 for raw data file named below
0      # 1 for each time value output (time of every packet), 0 for
only at counter changes
0      # 1 for time output from the packet before a change is noted, 0 for not
0      # 1 to check that time increases properly and report errors
(flags packets not 1 second apart), 0 for not
1      # 1 to output status data, 0 to not
0      # 1 least to most, 0 most to least index numbers
.../.. /pinyon/95046.status_packets      # status file to be read
```

I hope this helps. Please feel free to contact me about this if you need help

-Tom

[illegible]

Return-Path: rstephen@whoi.edu
Received: from aqua.whoi.edu (aqua [128.128.16.1]) by gannet.whoi.edu (8.6.12/8.6.1)
Received: from gannet.whoi.edu (gannet [128.128.20.11]) by aqua.whoi.edu (8.6.11/8.6.12)
Received: from localhost (localhost [127.0.0.1]) by gannet.whoi.edu (8.6.12/8.6.12)
From: ralph stephen <rstephen@whoi.edu>
Message-Id: <199505161929.PAA26444@gannet.whoi.edu>
X-Authentication-Warning: gannet.whoi.edu: Host localhost didn't use HELO protocol
To: Ken Peal <kpeal@hurdle.whoi.edu>, dkoelsch@whoi.edu
cc: tbolmer@whoi.edu, rstephen@whoi.edu
Subject: B3S2 PFO report
Date: Tue, 16 May 95 15:29:53 -0400
X-Mts: smtp

Kne/Don,

I spoke with Frank this PM regarding PFO activities.

a) Frank seems to feel that we acquired good data from Feb 7 to Mar 21. There are complete day files without timing problems. Presumably between Feb 5 and Feb 23 the data was acquired with a fix in the BCU only. Between Feb 23 and Mar 21 the data was acquired with changes in both the DAS and the BCU. I don't know what happened between Mar 21 and April 9 (the date when the sonde was pulled to go back to IGPP). Also it is not clear if the IDA station was running at all in this period.

b) Between May 8 and May 16, data was acquired with the sonde in the wet hole but above the water table. It is their intention to put it back down the wet hole below the water table and to record from May 16 to June 2. The IDA station will not be running for any of these intervals.

We need to confirm this schedule with our notes and to pull off and examine Frank's day files.

By the way, Frank did not know that Vince was leaving.

Regards, Ralph.

E.4.a. 3/21/95

K. Peal

Return-Path: kpeal@hurdle.who.i.edu
 Received: from bravo by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA17077; Tue, 21 Mar 1995 21:08:29 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.i.edu (AIX 3.2/UCB 5.64/4.03)
 id AA15935; Tue, 21 Mar 1995 21:06:16 -0500
 Received: by aqua.who.i.edu (5.57/Ultrix3.0-C)
 id AA04040; Tue, 21 Mar 95 21:06:40 -0500
 Received: by hurdle.who.i.edu (4.1/SMI-4.1)
 id AA01319; Tue, 21 Mar 95 21:04:11 EST
 Date: Tue, 21 Mar 95 21:04:11 EST
 From: kpeal@hurdle.who.i.edu (Ken Peal)
 Message-Id: <9503220204.AA01319@hurdle.who.i.edu>
 To: glen_offield@igppgm.ucsd.edu
 Cc: rstephen@aqua.who.i.edu, tomb@snark.who.i.edu
 Subject: PFO visit 22 Mar 95

Glen: 21 Mar 95
 I will leave a phone message also but,....

1. I talked to Ralph and Tom after your call today and learned about a new "data glitch" problem. In looking at the data collected since the 23 Feb change, they have seen frequent glitches which are "non-seismic". From the sounds of it they may be digital glitches but beyond that I have no idea. Ralph will FAX you some samples in case it is new to you. I told him your FAX was 619 534-9873 - hope that is the right one.

2. The above seems like a serious problem, I presume that Frank has not been looking at this data. If he is around now maybe you could pass on copies of the FAXs to him too.

3. Ralph and Tom have also seen a time problem which I presume is related to the problem you and I have discussed - the DAS time is wrong. Tom sees it as a data overlap of less than an hour every few days.

4. About BCU disks. If you are going to take the sonde back to San Diego tomorrow then there is no point leaving the BCU operating. In general, we want to continue recording DAS data on the BCU whenever the sonde is operating at PFO. If it comes to a choice between having a disk on the BCU or on the NEC, choose the BCU.

5. When we were at PFO on 18 Feb, I recorded the following:
 BCU disk 1, 9235, 514,083 blocks used
 BCU disk 2, 6199, 1,714,483 blocks used
 BCU disk 3, 4074, 399,843 blocks used.

Apparently we later in the day moved disk 4074 over to the NEC, so we are left with 9235 and 6199 on the BCU. The recording rate is 240.0444 bytes/second and the disks hold 2,047,320 blocks (512 bytes each). Assuming that 9235 and 6199 are still in the BCU, I believe we will fill them on 5 April.

We will prepare one of the disks we have here and send it to you. Of course this assumes that you will be out there again before 5 April. I am hoping that you are bringing the sonde back to San Diego tomorrow and will take it out to PFO again before 5 April. If this looks unlikely, I would say tomorrow you should move 4074 back to BCU 3. As of 18 Feb, it had 41 days capacity left so that should be OK.

Good luck tomorrow, we really need to attack these two problems during this test because it now appears there will be no support for another test like this from the Pilot Experiment funds. Thus when we pull out of PFO (in May?) we will not get

another chance until Hawaii (Oct 96!). I hate to say it, but if necessary I would go out to PFO again to help resolve this.

Regards ... kp

0020 282A
0D00 252A
@051:23:44:59 *%
@051:23:44:59 *%

Hope this stuff helps. Regards ... kp

E.5.a 2/3/95
K. Peal

Return-Path: kpeal@hurdle.who.edu
Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA05473; Fri, 3 Feb 1995 09:09:04 -0500
Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
id AA12151; Fri, 3 Feb 1995 08:59:57 -0500
Received: by aqua.who.edu (5.57/Ultrix3.0-C)
id AA09655; Fri, 3 Feb 95 09:08:12 -0500
Received: by hurdle.who.edu (4.1/SMI-4.1)
id AA18090; Fri, 3 Feb 95 09:06:00 EST
Date: Fri, 3 Feb 95 09:06:00 EST
From: kpeal@hurdle.who.edu (Ken Peal)
Message-Id: <9502031406.AA18090@hurdle.who.edu>
To: rstephen@aqua.who.edu, dkoelsch@aqua.who.edu
Subject: Attached message from Glen

Ralph, Don: Note item "c". I have not thought about it yet but guess they are planning to set up recording without the BCU.

>From Glen_Offield@igppqm.ucsd.edu Thu Feb 2 17:05:22 1995
Return-Path: <Glen_Offield@igppqm.ucsd.edu>
Received: from ucsd.edu by hurdle.who.edu (4.1/SMI-4.1)
id AA17845; Thu, 2 Feb 95 17:05:15 EST
Received: from igppqm.ucsd.edu by ucsd.edu; id OAA23556
sendmail 8.6.9/UCSD-2.2-sun via SMTP
Thu, 2 Feb 1995 14:06:15 -0800 for <kpeal@hurdle.who.edu>
Message-Id: <n1420388524.94532@igppqm.ucsd.edu>
Date: 2 Feb 1995 14:03:42 -0800
From: "Glen Offield" <Glen_Offield@igppqm.ucsd.edu>
Subject: February's b3s2
To: "David Willoughby" <David_Willoughby@igppqm.ucsd.edu>
Cc: "Ken Peal" <kpeal@hurdle.who.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

Dave,

In follow-up to our conversation yesterday:

- a. Frank stated that the offset present in the PFBH at this time is not a concern so it will not be necessary for you to re-level the masses when I go out next week.
- b. Frank suggests that you pull the sensor out of the hole at the same time WHOI removes their trailer. The sensor should return to IGPP so that you may begin work to remove the horizontal noise problem.
- c. When Ken is here on 02/14 we can discuss what equipment we may need to borrow from them to allow us to operate in the "record -to- SUN only" mode once we re-enter the hole.

regards,

Glen

Return-Path: kpeal@hurdle.who.edu
 Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA07557; Fri, 10 Feb 1995 13:06:51 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA18714; Fri, 10 Feb 1995 13:06:00 -0500
 Received: by aqua.who.edu (5.57/Unix3.0-C)
 id AA04549; Fri, 10 Feb 95 13:03:51 -0500
 Received: by hurdle.who.edu (4.1/SMI-4.1)
 id AA19881; Fri, 10 Feb 95 13:01:33 EST
 Date: Fri, 10 Feb 95 13:01:33 EST
 From: kpeal@hurdle.who.edu (Ken Peal)
 Message-Id: <9502101801.AA19881@hurdle.who.edu>
 To: rstephena@aqua.who.edu, dkoelsch@aqua.who.edu, mgould@aqua.who.edu,
 tomb@snark.who.edu
 Cc: glen_offield@igppgm.ucsd.edu
 Subject: Plan for PFO test termination

Ralph, Don, Matt, Tom: 10 Feb 95
 So here is the plan (per Glen and Ken 12:00 EST).

18 Feb

Glen (and probably Ken) go to Pinon, install the BCU PROM that does the three time strings, measure the actual time between the three for several hours to be sure it works and is consistent. Then probably replace the current PROM (the one that does correct the day number) and leave it running.

19 or 20 Feb

Alan Nance does the change to the Reftek PROMs (using the time measured 18 Feb) and ships them to Glen (Alan is somewhere else, not in La Jolla).

21 or 22 Feb

Glen, Dave Willoughby et al go to PFO to pull out the sonde, change the Reftek PROMs, change the BCU PROM again, and reinstall everything. If the new PROMs work OK, this is the start of the "noise test" - leave it running in this mode. If problems, fix them.

1 March (or thereabouts)

Matt, Dave, (Gary?) et al go to PFO to pull out the sonde (end of the "noise test") and also pack and ship the WHOI van etc back to WHOI. The MPL trailer etc are also returned at this point.

After 1 March

Dave et al probably will do more sonde tests at PFO using the BCU simulator at the hole wired to their control computer probably at the other house on the site.

Regards ... kp

Return-Path: rstephen@gannet.who.edu
Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA09368; Wed, 22 Feb 1995 13:02:37 -0500
Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
id AA15570; Wed, 22 Feb 1995 13:01:35 -0500
Received: by aqua.who.edu (5.57/Ultrix3.0-C)
id AA16277; Wed, 22 Feb 95 13:01:22 -0500
Received: from localhost by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA09355; Wed, 22 Feb 1995 13:02:33 -0500
Message-Id: <9502221802.AA09355@gannet.who.edu>
To: "Frank Vernon" <vernon@yin.ucsd.edu>
Cc: rstephen@aqua.who.edu, "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
Subject: PFO stuff
Date: Wed, 22 Feb 95 13:02:33 -0500
From: rstephen@gannet.who.edu
X-Mts: smtp

Frank,

You may recall that around the Xmas time period we discussed having simultaneous measurements at PFO of wet hole (ours) and dry hole (Holly's) seismographs. Since most of our stuff up until Feb 9 was no good, has Holly's gear been recording since then. If not can we get it going for the rest of the PFO tests.

Ralph.

Return-Path: John_Orcutt@igppqm.ucsd.edu
 Received: from bravo by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA09718; Thu, 23 Feb 1995 23:28:30 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.i.edu (AIX 3.2/UCB 5.64/4.03)
 id AA11992; Thu, 23 Feb 1995 23:27:27 -0500
 Received: by aqua.who.i.edu (5.57/Ultrix3.0-C)
 id AA01959; Thu, 23 Feb 95 23:27:14 -0500
 Received: from igppqm.ucsd.edu by ucsd.edu; id UAA28342
 sendmail 8.6.10/UCSD-2.2-sun via SMTP
 Thu, 23 Feb 1995 20:27:10 -0800 for <rstephen@aqua.who.i.edu>
 Message-Id: <n1418551284.98836@igppqm.ucsd.edu>
 Date: 23 Feb 1995 20:25:30 -0800
 From: "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 Subject: Re: PFO stuff
 To: "Frank Vernon" <vernon@yin.ucsd.edu>, rstephen@aqua.who.i.edu
 X-Mailer: Mail*Link SMTP/QM 3.0.0

Reply to: RE>PFO stuff

It is recording.

 Date: 2/22/95 10:05
 To: John Orcutt
 From: rstephen@aqua.who.i.edu
 Received: by igppqm.ucsd.edu with SMTP; 22 Feb 1995 10:01:02 -0800
 Received: by aqua.who.i.edu (5.57/Ultrix3.0-C)
 id AA16273; Wed, 22 Feb 95 13:01:21 -0500
 Received: from localhost by gannet.who.i.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA09355; Wed, 22 Feb 1995 13:02:33 -0500
 Message-Id: <9502221802.AA09355@gannet.who.i.edu>
 To: "Frank Vernon" <vernon@yin.ucsd.edu>
 Cc: rstephen@aqua.who.i.edu, "John Orcutt" <John_Orcutt@igppqm.ucsd.edu>
 Subject: PFO stuff
 Date: Wed, 22 Feb 95 13:02:33 -0500
 From: rstephen@aqua.who.i.edu
 X-Mts: smtp

Frank,

You may recall that around the Xmas time period we discussed having simultaneous measurements at PFO of wet hole (ours) and dry hole (Holly's) seismographs. Since most of our stuff up until Feb 9 was no good, has Holly's gear been recording since then. If not can we get it going for the rest of the PFO tests.

Ralph.

Return-Path: kpeal@hurdle.who.edu
Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
id AA17914; Thu, 23 Mar 1995 17:04:13 -0500
Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
id AA12622; Thu, 23 Mar 1995 17:01:59 -0500
Received: by aqua.who.edu (5.57/Ultrix3.0-C)
id AA21087; Thu, 23 Mar 95 17:02:22 -0500
Received: by hurdle.who.edu (4.1/SMI-4.1)
id AA02263; Thu, 23 Mar 95 16:59:51 EST
Date: Thu, 23 Mar 95 16:59:51 EST
From: kpeal@hurdle.who.edu (Ken Peal)
Message-Id: <9503232159.AA02263@hurdle.who.edu>
To: rstephen@aqua.who.edu, dkoelsch@aqua.who.edu, mgould@aqua.who.edu,
tomb@snark.who.edu
Subject: Report of latest PFO visit

Ralph, Don, Matt, Tom: 23 Mar 95

Just talked to Glen about their visit to PFO yesterday.
They pulled the sonde and brought it back to San Diego. Chris
Hollingshead is scheduled to be in San Diego 10 April to "repair
the upper holelock". When that is done they plan to deploy it
again at PFO probably the week of 17 April.

At the moment no recording is taking place at PFO.

Glen and Allen Nance plan to go to PFO in the next week or
so to work on the time string problem. It now appears that the
DAS is getting an error for every string we are sending so is not
correcting its time. I plan to be by my phone when they are at
PFO. Hope we can get this resolved.

Regards ... kp

Return-Path: kpeal@hurdle.who.edu
 Received: from bravo by gannet.who.edu; (5.65/1.1.8.2/10Jan95-1113AM)
 id AA12729; Mon, 6 Mar 1995 23:08:16 -0500
 Received: from AQUA.WHOI.EDU by bravo.who.edu (AIX 3.2/UCB 5.64/4.03)
 id AA13183; Mon, 6 Mar 1995 23:06:17 -0500
 Received: by aqua.who.edu (5.57/Ultrix3.0-C)
 id AA10047; Mon, 6 Mar 95 23:06:46 -0500
 Received: by hurdle.who.edu (4.1/SMT-4.1)
 id AA26761; Mon, 6 Mar 95 23:04:22 EST
 Date: Mon, 6 Mar 95 23:04:22 EST
 From: kpeal@hurdle.who.edu (Ken Peal)
 Message-Id: <9503070404.AA26761@hurdle.who.edu>
 To: rstephenaqua.who.edu, dkoelsch@aqua.who.edu, tomb@snark.who.edu,
 mgould@aqua.who.edu
 Subject: Latest from PFO

Gentlemen:

6 Mar 95

I had a conversation with Glen Offield tonight catching up on BBBSS things - mostly from their trip to PFO on 23 Feb. Here is a summary.

1. During the normal service BCU procedure that he does for me, our second disk did not spin up. He cycled the key switch and that seemed to bring it back. This is not what he originally told me, but I will look at the code and be sure there is a timeout on this. Also not sure how long he waited - some of our timeouts are rather long.
2. The PROCOMM log from our servicing is on their PC but it can't write to a floppy just now. Will eventually get it to us (when Zimmer comes back).
3. The 5 Feb clock check was done after changing the Truetime to lock onto WEST. He will send me the time check data. We will leave it on WEST now.
4. When they turned on MOTO IC, their Sun bombed. This was a real surprise. When things were restored, the DAS gave some funny status info - another surprise. Maybe the Sun is not robust enough against the MOTO IC output that is meant for their PC. Glen will have Allen look into this. Is the cabling the same now as when we were there?
5. We should be able to get some data from their Sun in the new format. Frank has looked at some since the 23 Feb visit. Tom, let me know if you have trouble. Frank will be looking at some more data soon.
6. There was some trouble with the hole lock when they reinstalled the sonde. Although the one lock seemed to fire when commanded and they did read current to the solenoid, there was some feeling that the sonde was slipping down the hole. There was debate as to whether it was cable weight or if maybe one lock was insufficient to hold the sonde. They tied off the cable and left it for another day. It is recording data. They plan to visit again next week and look into this (when Zimmer returns).
7. Glen is thinking about another way to confirm hole lock fire. The use of microswitch or optical both have difficulty.
8. The new time string format and related changes now seem to be OK. Glen tried various tests and confirmed that the DAS does accept the time from the BCU and jam its clock as desired.
9. Not sure how to test the other new feature - time phase error.
10. There seems to be a power problem in the trailer when they turn on the 50 volt power supply to fire the hole lock. It causes something to reset - hear some beeps. Glen wasn't sure but I think it is probably the NEC rather than the BCU. It is possible that the UPS is not working which would mean that the NEC might die but the BCU is on the battery so

should be OK.

Regards ... kp

Return-Path: mgould@cliff.who.edu
Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.12/8.6.1
From: mgould@cliff.who.edu
Received: from cliff.who.edu (cliff [128.128.16.150]) by aqua.who.edu (8.6.11/8.6
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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

Return-Path: kpeal@hurdle.who.edu
 Received: from aqua.who.edu (aqua [128.128.16.1]) by gannet.who.edu (8.6.12/8.6.1
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 Received: (from kpeal@localhost) by hurdle.who.edu (8.6.12/8.6.9) id RAA01964; Fri
 Date: Fri, 26 May 1995 17:24:30 -0400
 From: Ken Peal <kpeal@hurdle.who.edu>
 Message-Id: <199505262124.RAA01964@hurdle.who.edu>
 To: glen_offield@igppqm.ucsd.edu
 Cc: rstephen@who.edu
 Subject: Current drain measurements

Glen: 26 May 95
 When you go to PFO next week, could you try to do another set of current drain measurements. It is the last time that we will have everything together before I have to make the battery and the info I have at the moment is unsatisfactory.

The basic problem is that the measurements you and I did in February are much lower than a set I took quickly in October in the yard at IGPP. I can explain part of the difference because we had considerable drop in the cable in October - it was before we added the shield to help avoid this problem. It would be really helpful if you were able to reproduce something like the numbers we got in February.

For reference, here are the values.

18 October
 Power supply at 30 volts.
 Measured with power supply meter.

BCU alone	100 mA
BCU plus DAS	300
BCU, DAS, Teledyne	550
BCU, DAS, Teledyne, moto IC	700.

18 February
 Deck supply off
 Battery supply at 30 volts
 Battery disconnected
 Measured with Fluke DMM.

BCU, DAS	230 mA
BCU, DAS, moto IC	248
BCU, DAS, Teledyne	393
BCU, DAS, Teledyne, moto IC	540.

The crucial measurement of course is the one with BCU, DAS and Teledyne. In October we got 16.5 watts, in February 11.8 watts.

Hope you can help. Thanks.

We also need to talk about BBOBS. What is your schedule for the next couple of months?

Regards ... kp