CRUISE ID: EX1004 Leg 4

Bitung to Guam

MAPPING CRUISE REPORT

September 14, 2010

By

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1. Purpose

The purpose of this report is to briefly describe the data acquisition and processing for EX1004 Leg 4 data, without going into a very detailed description of the multibeam and ancillary sensor setup. For details about setup of the various equipment / sensors please refer to 'NOAA Ship *Okeanos Explorer* 2010 Readiness Report' which can be obtained from the ship.

The talented and patient crew of the NOAA Ship *Okeanos Explorer* is greatly appreciated for their efforts in helping make the INDEX-SATAL 2010 mission a success.

2. Participating Personnel (mapping related activities only)

Joe Pica, CDR	Ship's Master
Meme Lobecker	Expedition Coordinator / Mapping Team Lead
Elaine Stuart	Senior Survey Technician
Colleen Peters	Senior Survey Technician
Shannon Hoy	Mapping Watchstander

3. Background of INDEX-SATAL 2010 Expedition

This cruise was the transit cruise returning to US waters after the INDEX-SATAL 2010 expedition (Indonesia Exploration – Sangihe Talaud Region). Data collection occurred only after re-entering US waters near Guam. The purpose of the was the exploration of the area specifically approved by the Indonesia government, located to the north of Sulawesi, Indonesia (shown in Figure 1). The area extends from 2°N to 6° 24'N, and 124° 45' E to 128°E, covering an area of the seafloor approximately 80,000 square kilometers in size. The coordinates of INDEX-SATAL 2010 are provided in Table 1. See mapping reports for EX1004 Legs 1, 2, and 3 for more information.

4. Mapping Sonar Setup

The NOAA Ship *Okeanos Explorer* (EX) is equipped with a 30 kHz Kongsberg EM 302 multibeam sonar. All sensors were powered down during the majority of this cruise during transit through the Exclusive Economic Zones of Indonesia, Palau, and Micronesia. EM 302 bottom bathymetric and backscatter data collection began on August 19. No water column backscatter data was collected, as there were no water column anomalies detected.

The ship used a POS MV version 4 to record and correct the multibeam data for any vessel motion. C-NAV GPS system provided DGPS correctors with positional accuracy expected to be better than 2.0 m.

All corrections (motion, sound speed profile, sound speed at sonar head, draft, sensor offsets) are applied during real time data acquisition. XBT casts (Deep Blue, max depth 760 m) were applied every 6 hours and/or as necessary to correct for sound speed. XBT cast data were converted to SIS compliant format using NOAA Velocipy. See Appendix A for a complete list of software used for data processing.

5. Data Acquisition Summary

Table 2 lists the transducer and attitude sensor offsets determined during the 2010 sea acceptance testing. For complete processing unit setup utilized for the cruise, please refer to Appendix B.

	Roll	Pitch	Heading
TX Transducer	0.0	0.0	359.98
RX Transducer	0.0	0.0	0.03
Attitude	0	-0.8	0.0

Table 1. Angular offsets for Transmit (TX) and Receive (TX) transducer and attitude sensor.

The TX36 LC board in slot #16 of the EM302 transmit-receive unit remained in failed status throughout the cruise. An earlier attempt (during EX1004 Leg2) to replace the board revealed that slot #16 was still frying transmit boards.

The TX36 slot #16 in the TRU has been consistently frying transmit boards since field season 2009. As part of ongoing testing to determine the problem with TX36 slot #16 Kongsberg suggested swapping out the TX RIO board #8 and running a series of internal tests. The mapping department performed this test during the transit back to Guam after INDEX-SATAL data collection was finished. On August 19, after crossing into the US EEZ (Guam), the EM302 was powered on and test was conducted, per guidance from Kongsberg engineers. See Appendix D for complete test steps. At the time of writing this report, Kongsberg analysis of test results is still imminent.

6. Multibeam Data Processing and Archival Procedures

Field Data Processing

For quality control purposes, all raw multibeam data was imported, cleaned and gridded (50 meter cell size) in CARIS 6.1 at sea in near real time. Gridded data were exported to ASCII xyz text files. These xyz's were then used to generate Fledermaus v.6 *.sd objects. Each *.sd object was then exported to a georeferenced image (embedded geotiff).

Shoreside Data Processing and Data Archiving

All field cleaning and processing was checked shoreside after the cruise was completed. Each bathymetry file was then exported to ASCII xyz text file, which contained every accepted sounding. These text files were then gridded (50 meter cell size) in Fledermaus DMagic, and an .sd object was generated. The .sd object was then exported to geotiff.

All raw and processed multibeam data will be archived with NGDC with individual metadata records. All processed data products are in Latitude/Longitude coordinates, WGS84 datum. All raw and processed multibeam data products will be accessible via www.ngdc.noaa.gov.

Archived multibeam products include:

1) Level 00
   a) Raw multibeam bathymetry files. (*.all)
2) Level 01
   a) ASCII xyz text file of each multibeam bathymetry line file, cleaned, not gridded. (*.txt)
3) Level 02
   a) ASCII xyz text file of all multibeam bathymetry gridded at 50 meter cell size. (*.xyz)
   b) Fledermaus v. 6 .sd object of 50 meter bathymetry grid. (*.sd)
   c) Georeferenced (geotiff) image of 50 meter bathymetry grid(*.tif)

7. Multibeam Data Quality Assessment

Data Quality Assessment
Swath coverage and data quality was excellent throughout the cruise. This was largely due to excellent survey conditions, including calm seas and a generally highly acoustically reflective seafloor.

Visual comparison in CARIS to adjacent data collected during EX1004 Leg 1 showed excellent consistency between datasets, with less than 1% water depth differences in areas of coverage overlap.

8. Cruise Statistics for Okeanos Explorer

Cruise Dates	14 August – 20 August 2010
Weather delays days	0
Line kilometers surveyed	233.2 km
Square kilometers mapped	1853 km^2
Number of multibeam files	4
Number of partial mapping days	1
Number of XBT casts	3
Number of CTD casts	0
Number of ROV dives	0
Beginning draft 7/22/10	FWD: 14’3”; AFT: 14’2.5”
Ending draft 8/14/10	FWD: 13’9”; AFT 14’ 5.5”

Table 2. Mapping statistics.

9. Cruise Calendar
For a more detailed account of daily events, see *Daily Cruise Log (section 10).*

August 2010						
Mon	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
					14 Depart Port of Bitung, North Sulawesi, Indonesia	15 Continue transit to Guam. All scientific sensors secured.
16 Continue transit to Guam. All scientific sensors secured.	17 Continue transit to Guam. All scientific sensors secured.	18 Continue transit to Guam. All scientific sensors secured.	19 Commence EM302 testing and mapping operations.	20 Arrive Guam. Tied up at dock 0807		

10. Daily Cruise Log

ALL DATES AND TIMES IN SHIP TIME, which was
August 14
Departed Port of Bitung, North Sulawesi, Indonesia. Heading to Guam. Expected arrival in Guam in the morning on August 19.

August 15
In transit to Guam. All scientific sensors secured in foreign EEZs.

August 16
In transit to Guam. All scientific sensors secured in foreign EEZs.

August 17
In transit to Guam. All scientific sensors secured in foreign EEZs.

August 18
In transit to Guam. All scientific sensors secured in foreign EEZs.

August 19
In transit to Guam. Crossed into US EEZ (Guam). Tested EM302 with new TX RIO board and new TX 36 LC board in slot 16. Results were sent immediately to Kongsberg technicians for analysis.

Throughout all testing, the three status lamps in SIS were green. After running the final tests, it was discovered that the SH (sonar head) lamp had turned red. The power was cycled on the TRU, the EM302 computer, and the circuit breaker regulating TRU power. Pinging was started and data quality looked good, with no noise and excellent swath coverage, and BISTs showed normal numbers, so survey was commenced. The TRU was restarted at the 1800 XBT, and all lamps in SIS came up green. Survey continued overnight.

August 20
Surveyed in morning until reaching pilot buoy in the morning. Alongside in Guam at 0807. We arrived one day later than planned due to head currents.

11. Appendices

Appendix A: Software versions in use during EX1004 Leg 3

Software	Version	Purpose
CARIS HIPS and SIPS	6.1 Service Pack 2	Multibeam processing
ECDIS		Ship line keeping
ESRI – ArcMap	9.3	Map products
Fledermaus	6.7.0h Build 419 Pro	Multibeam QC, Line planning
Fledermaus	7.2.0 Build 411 Pro, 32 bit Edition	
Hypack	9.0.0.22	Survey planning
Hypack	9.0.4.0	Realtime monitoring
Kongsberg SIS (installed 2/12/10)	3.6.4 build 174	EM302 data acquisition
Velocipy (NOAA)	10.7	XBT processing

Appendix B: EM302 PU Parameters in use during EX1004 Leg 4

```
#// Database Parameters

#// Seafloor Information System
#// Kongsberg Maritime AS
#// Saved:  2010.08.06 15:34:49

#// Build info:
#* SIS:              [Version: 3.6.4,
Build: 174 , DBVersion 16.0 CD
generated: Mon Mar 30 2009
14:00:00]
[Fox ver = 1.6.29]
[db ver = 16, proc = 16.0]
[OTL = 4.0.-95]
[ACE ver = 5.5]
[Coin ver = 2.4.4]
[Simage ver = 1.6.2a]
[Dime ver = DIME v0.9]
[STLPort ver = 513]
[FreeType ver = 2.1.9]
[TIFF ver = 3.8.2]
[GeoTIFF ver = 1230]
[GridEngine ver = 2.3.0]

#* Language          [3] #// Current
language, 1-Norwegian, 2-
German,3-English, 4-Spanish

#* Type              [302]
#* Serial no.        [101]
#* Number of heads   [2]
#* System descriptor  [50331648]
#// 03000000

#//
**********
**********
*********
#// Installation parameters


#{ Input Setup #// All Input setup
parameters

  #{ COM1 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #* Baud rate:       [9600]
      #* Data bits        [8]
      #* Stop bits:       [1]
      #* Parity:          [NONE]
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None            [1] [0]
      #* GGK             [1] [0]
      #* GGA             [1] [1]
      #* GGA_RTK          [1] [0]
      #* SIMRAD90         [1] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
      #* Attitude        [0] [0]
      #* MK39 Mod2 Attitude,  [0]
[0]
      #* ZDA Clock        [1] [1]
      #* HDT Heading      [0] [0]
      #* SKR82 Heading    [0] [0]
      #* DBS Depth        [1] [0]
      #* DBT Depth        [1] [0]
      #* EA500 Depth      [0] [0]
      #* ROV. depth       [1] [0]
      #* Height, special purp [1] [0]
      #* Ethernet AttVel   [0] [0]
    #} Input Formats

  #} COM1

  #{ COM2 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #* Baud rate:       [19200]
      #* Data bits        [8]
      #* Stop bits:       [1]
      #* Parity:          [NONE]
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None            [0] [1]
      #* GGK             [0] [0]
      #* GGA             [0] [0]
      #* GGA_RTK          [0] [0]
      #* SIMRAD90         [0] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
      #* Attitude        [1] [1]
      #* MK39 Mod2 Attitude,  [0]
[0]
      #* ZDA Clock        [0] [0]
      #* HDT Heading      [0] [0]
      #* SKR82 Heading    [0] [0]
      #* DBS Depth        [0] [0]
      #* DBT Depth        [0] [0]
      #* EA500 Depth      [0] [0]
      #* ROV. depth       [0] [0]
      #* Height, special purp [0] [0]
      #* Ethernet AttVel   [0] [0]
    #} Input Formats

  #} COM2

  #{ COM3 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #* Baud rate:       [4800]
      #* Data bits        [8]
      #* Stop bits:       [1]
      #* Parity:          [NONE]
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None            [1] [1]
      #* GGK             [1] [0]
      #* GGA             [1] [0]
      #* GGA_RTK          [1] [0]
      #* SIMRAD90         [1] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
      #* Attitude        [0] [0]
      #* MK39 Mod2 Attitude,  [0]
[0]
      #* ZDA Clock        [0] [0]
      #* HDT Heading      [1] [1]
      #* SKR82 Heading    [0] [0]
      #* DBS Depth        [1] [0]
      #* DBT Depth        [1] [0]
      #* EA500 Depth      [0] [0]
      #* ROV. depth       [1] [0]
      #* Height, special purp [1] [0]
      #* Ethernet AttVel   [0] [0]
    #} Input Formats

  #} COM3

  #{ COM4 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #* Baud rate:       [9600]
      #* Data bits        [8]
      #* Stop bits:       [1]
      #* Parity:          [NONE]
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None            [1] [1]
      #* GGK             [1] [0]
      #* GGA             [1] [0]
      #* GGA_RTK          [1] [0]
      #* SIMRAD90         [1] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
      #* Attitude        [0] [0]
      #* MK39 Mod2 Attitude,  [0]
[0]
      #* ZDA Clock        [0] [0]
      #* HDT Heading      [0] [0]
      #* SKR82 Heading    [0] [0]
      #* DBS Depth        [0] [0]
      #* DBT Depth        [0] [0]
      #* EA500 Depth      [0] [0]
      #* ROV. depth       [0] [0]
      #* Height, special purp [0] [0]
      #* Ethernet AttVel   [0] [0]
    #} Input Formats

  #} COM4

  #{ UDP2 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #// N/A
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None            [1] [1]
      #* GGK             [1] [0]
      #* GGA             [1] [0]
      #* GGA_RTK          [1] [0]
      #* SIMRAD90         [1] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
```

```
        #* Attitude           [0] [0]
        #* MK39 Mod2 Attitude,  [0]
[0]
        #* ZDA Clock          [0] [0]
        #* HDT Heading        [0] [0]
        #* SKR82 Heading      [0] [0]
        #* DBS Depth          [0] [0]
        #* DBT Depth          [0] [0]
        #* EA500 Depth        [1] [0]
        #* ROV. depth         [0] [0]
        #* Height, special purp [0] [0]
        #* Ethernet AttVel     [0] [0]
    #} Input Formats

  #} UDP2

  #{ UDP3 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #// N/A
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None             [0] [1]
      #* GGK              [0] [0]
      #* GGA              [0] [0]
      #* GGA_RTK          [0] [0]
      #* SIMRAD90         [0] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
      #* Attitude         [0] [0]
      #* MK39 Mod2 Attitude,  [0]
[0]
      #* ZDA Clock         [0] [0]
      #* HDT Heading       [1] [0]
      #* SKR82 Heading     [0] [0]
      #* DBS Depth         [1] [0]
      #* DBT Depth         [1] [0]
      #* EA500 Depth       [0] [0]
      #* ROV. depth        [1] [0]
      #* Height, special purp [1] [0]
      #* Ethernet AttVel    [0] [0]
    #} Input Formats

  #} UDP3

  #{ UDP4 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #// N/A
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None             [0] [1]
      #* GGK              [0] [0]
      #* GGA              [0] [0]
      #* GGA_RTK          [0] [0]
      #* SIMRAD90         [0] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
      #* Attitude         [1] [0]
      #* MK39 Mod2 Attitude,  [0]
[0]
      #* ZDA Clock         [0] [0]
      #* HDT Heading       [1] [0]
      #* SKR82 Heading     [0] [0]
      #* DBS Depth         [1] [0]
      #* DBT Depth         [1] [0]
      #* EA500 Depth       [0] [0]
      #* ROV. depth        [1] [0]
      #* Height, special purp [1] [0]
      #* Ethernet AttVel    [0] [0]
    #} Input Formats

  #} UDP4

  #{ UDP5 #// Link settings.

    #{ Com. settings #// Serial line
parameter settings.
      #// N/A
    #} Com. settings

    #{ Position #// Position input
settings.
      #* None             [0] [0]
      #* GGK              [0] [0]
      #* GGA              [0] [0]
      #* GGA_RTK          [0] [0]
      #* SIMRAD90         [0] [0]
    #} Position

    #{ Input Formats #// Format
input settings.
      #* Attitude         [0] [0]
      #* MK39 Mod2 Attitude,  [0]
[0]
      #* ZDA Clock         [0] [0]
      #* HDT Heading       [0] [0]
      #* SKR82 Heading     [0] [0]
      #* DBS Depth         [0] [0]
      #* DBT Depth         [0] [0]
      #* EA500 Depth       [0] [0]
      #* ROV. depth        [0] [0]
      #* Height, special purp [0] [0]
      #* Ethernet AttVel    [1] [1]
    #} Input Formats

    #{ Attitude Velocity settings #//
Only relevant for UDP5 on EM122,
EM302 and EM710, currently
      #* Attitude 1        [1] [1]
      #* Attitude 2        [1] [0]
      #* Use Ethernet 2     [1] [1]
      #* Port:              [5602]
      #* IP addr.:
[192.168.2.20]
      #* Net mask:
[255.255.255.0]
    #} Attitude Velocity settings

  #} UDP5


  #{ Misc. #// Misc. input settings.
    #* External Trigger    [1] [0]
  #} Misc.

#} Input Setup

#{ Output Setup #// All Output setup
parameters

  #* PU broadcast enable  [1] [1]
  #* Log watercolumn to s [1] [1]

  #{ Host UDP1 #// Host UDP1
Port: 16100

    #{ Datagram subscription #//
      #* Depth            [0] [0]
      #* Raw range and beam a [0]
[0]
      #* Seabed Image      [0] [0]
      #* Central Beams     [0] [0]
      #* Position          [0] [0]
      #* Attitude          [0] [0]
      #* Heading           [0] [0]
      #* Height            [0] [0]
      #* Clock             [0] [0]
      #* Single beam echosoun [0]
[0]
      #* Sound Speed Profile  [0] [1]
      #* Runtime Parameters   [0] [1]
      #* Installation Paramet [0] [1]
      #* BIST Reply          [0] [1]
      #* Status parameters    [0] [1]
      #* PU Broadcast        [0] [0]
      #* Stave Display       [0] [0]
      #* Water Column        [0] [0]
      #* Internal, Range Data [0] [0]
      #* Internal, Scope Data [0] [0]
    #} Datagram subscription

  #} Host UDP1


  #{ Host UDP2 #// Host UDP2
Port: 16101

    #{ Datagram subscription #//
      #* Depth            [1] [1]
      #* Raw range and beam a [1]
[1]
      #* Seabed Image      [1] [1]
      #* Central Beams     [1] [0]
      #* Position          [1] [1]
      #* Attitude          [1] [1]
      #* Heading           [1] [1]
      #* Height            [1] [1]
      #* Clock             [1] [1]
      #* Single beam echosoun [1]
[1]
      #* Sound Speed Profile  [0] [1]
      #* Runtime Parameters   [0] [1]
      #* Installation Paramet [0] [1]
      #* BIST Reply          [1] [1]
      #* Status parameters    [0] [1]
      #* PU Broadcast        [1] [0]
      #* Stave Display       [0] [1]
      #* Water Column        [0] [1]
      #* Internal, Range Data [1] [0]
      #* Internal, Scope Data [1] [0]
    #} Datagram subscription

  #} Host UDP2


  #{ Host UDP3 #// Host UDP3
Port: 16102
```

```
    #{ Datagram subscription #//
      #* Depth              [0] [1]
      #* Raw range and beam a [0]
[0]
      #* Seabed Image       [0] [0]
      #* Central Beams      [0] [0]
      #* Position           [0] [0]
      #* Attitude           [0] [1]
      #* Heading            [0] [0]
      #* Height             [0] [1]
      #* Clock              [0] [0]
      #* Single beam echosoun [0]
[1]
      #* Sound Speed Profile  [0] [1]
      #* Runtime Parameters   [0] [0]
      #* Installation Paramet [0] [1]
      #* BIST Reply          [0] [0]
      #* Status parameters    [0] [0]
      #* PU Broadcast        [0] [0]
      #* Stave Display       [0] [0]
      #* Water Column        [0] [0]
      #* Internal, Range Data [0] [0]
      #* Internal, Scope Data [0] [1]
    #} Datagram subscription

  #} Host UDP3


  #{ Host UDP4 #// Host UDP4 Port
16103

    #{ Datagram subscription #//
      #* Depth              [1] [1]
      #* Raw range and beam a [1]
[0]
      #* Seabed Image       [1] [0]
      #* Central Beams      [1] [0]
      #* Position           [1] [0]
      #* Attitude           [1] [0]
      #* Heading            [1] [0]
      #* Height             [1] [0]
      #* Clock              [1] [0]
      #* Single beam echosoun [1]
[0]
      #* Sound Speed Profile  [1] [0]
      #* Runtime Parameters   [1] [0]
      #* Installation Paramet [1] [0]
      #* BIST Reply          [1] [0]
      #* Status parameters    [1] [0]
      #* PU Broadcast        [1] [0]
      #* Stave Display       [1] [0]
      #* Water Column        [1] [0]
      #* Internal, Range Data [1] [0]
      #* Internal, Scope Data [1] [0]
    #} Datagram subscription

  #} Host UDP4


  #{ Watercolumn #// Host UDP4
Port 16103

    #{ Datagram subscription #//
      #* Depth              [1] [1]
      #* Raw range and beam a [1]
[1]
      #* Seabed Image       [1] [1]
      #* Central Beams      [1] [0]
      #* Position           [1] [1]
      #* Attitude           [1] [1]
      #* Heading            [1] [1]
      #* Height             [1] [1]
      #* Clock              [1] [1]
      #* Single beam echosoun [1]
[1]
      #* Sound Speed Profile  [1] [1]
      #* Runtime Parameters   [1] [1]
      #* Installation Paramet [1] [1]
      #* BIST Reply          [1] [1]
      #* Status parameters    [1] [1]
      #* PU Broadcast        [1] [0]
      #* Stave Display       [1] [0]
      #* Water Column        [1] [1]
      #* Internal, Range Data [1] [0]
      #* Internal, Scope Data [1] [0]
    #} Datagram subscription

  #} Watercolumn

#} Output Setup

#{ Clock Setup #// All Clock setup
parameters

  #{ Clock #// All clock settings.
    #* Source:           [1] #//
External ZDA Clock
    #* 1PPS Clock Synch.   [1] [1]
    #* Offset (sec.):     [0]
  #} Clock

#} Clock Setup

#{ Settings #// Sensor setup
parameters

  #{ Positioning System Settings #//
Position related settings.

    #{ COM1 #// Positioning System
Ports:
      #* P1T              [0] #//
System
      #* P1M              [0] #//
Enable position motion correction
      #* P1D              [0.000] #//
Position delay (sec.):
      #* P1G              [WGS84] #//
Datum:
      #* P1Q              [1] #//
Enable
      #* Pos. qual. indicator [] #//
    #} COM1

  #} Positioning System Settings

  #{ Motion Sensor Settings #//
Motion related settings.

    #{ COM2 #// Motion Sensor
Ports:
      #* MRP              [RP] #//
Rotation (POSMV/MRU)
      #* MSD              [0] #//
Motion Delay (msec.):
      #* MAS              [1.00] #//
Motion Sensor Roll Scaling:
    #} COM2

  #} Motion Sensor Settings

  #{ Active Sensors #//
    #* APS              [0] [COM1]
#// Position:
    #* ARO              [2] [COM2]
#// Motion:
    #* AHE              [2] [COM2]
#// Motion:
    #* AHS              [3] [COM3]
#// Heading:
  #} Active Sensors

#} Settings

#{ Locations #// All location
parameters

  #{ Location offset (m) #//

    #{ Pos, COM1: #//
      #* P1X              [0.00] #//
Forward (X)
      #* P1Y              [0.00] #//
Starboard (Y)
      #* P1Z              [0.00] #//
Downward (Z)
    #} Pos, COM1:

    #{ Pos, COM3: #//
      #* P2X              [0.00] #//
Forward (X)
      #* P2Y              [0.00] #//
Starboard (Y)
      #* P2Z              [0.00] #//
Downward (Z)
    #} Pos, COM3:

    #{ Pos, COM4/UDP2: #//
      #* P3X              [0.00] #//
Forward (X)
      #* P3Y              [0.00] #//
Starboard (Y)
      #* P3Z              [0.00] #//
Downward (Z)
    #} Pos, COM4/UDP2:

    #{ TX Transducer: #//
      #* S1X              [6.147] #//
Forward (X)
      #* S1Y              [1.822] #//
Starboard (Y)
      #* S1Z              [6.796] #//
Downward (Z)
    #} TX Transducer:

    #{ RX Transducer: #//
      #* S2X              [2.497] #//
Forward (X)
      #* S2Y              [2.481] #//
Starboard (Y)
      #* S2Z              [6.790] #//
Downward (Z)
    #} RX Transducer:

    #{ Attitude 1, COM2: #//
      #* MSX              [0.00] #//
Forward (X)
      #* MSY              [0.00] #//
Starboard (Y)
```

```
      #* MSZ                [0.00] #//
Downward (Z)
    #} Attitude 1, COM2:

    #{ Attitude 2, COM3: #//
      #* NSX                [0.00] #//
Forward (X)
      #* NSY                [0.00] #//
Starboard (Y)
      #* NSZ                [0.00] #//
Downward (Z)
    #} Attitude 2, COM3:

    #{ Waterline: #//
      #* WLZ                [1.838] #//
Downward (Z)
    #} Waterline:

  #} Location offset (m)

#} Locations

#{ Angular Offsets #// All angular
offset parameters

  #{ Offset angles (deg.) #//

    #{ TX Transducer: #//
      #* S1R                [0.00] #//
Roll
      #* S1P                [0.00] #//
Pitch
      #* S1H                [359.98] #//
Heading
    #} TX Transducer:

    #{ RX Transducer: #//
      #* S2R                [0.00] #//
Roll
      #* S2P                [0.00] #//
Pitch
      #* S2H                [0.03] #//
Heading
    #} RX Transducer:

    #{ Attitude 1, COM2: #//
      #* MSR                [0.00] #//
Roll
      #* MSP                [-0.80] #//
Pitch
      #* MSG                [0.00] #//
Heading
    #} Attitude 1, COM2:

    #{ Attitude 2, COM3: #//
      #* NSR                [0.00] #//
Roll
      #* NSP                [0.00] #//
Pitch
      #* NSG                [0.00] #//
Heading
    #} Attitude 2, COM3:

    #{ Stand-alone Heading: #//
      #* GCG                [0.00] #//
Heading
    #} Stand-alone Heading:

  #} Offset angles (deg.)

#} Angular Offsets

#{ ROV. Specific #// All ROV
specific parameters

  #{ Depth/Pressure Sensor #//
    #* DSF                [1.00] #//
Scaling:
    #* DSO                [0.00] #//
Offset:
    #* DSD                [0.00] #//
Delay:
    #* DSH                [NI] #//
Disable Heave Sensor
  #} Depth/Pressure Sensor

#} ROV. Specific

#{ System Parameters #// All system
parameters

  #{ System Gain Offset #//
    #* GO1                [0.0] #// BS
Offset (dB)
  #} System Gain Offset

  #{ Opening angles #//
    #* S1S                [0] #// TX
Opening angle:
    #* S2S                [1] #// RX
Opening angle:
  #} Opening angles

#} System Parameters

#//
*********************************
*********************************
*********
#// Runtime parameters


#{ Sounder Main #//

  #{ Sector Coverage #//

    #{ Max. angle (deg.): #//
      #* MPA                [75] #//
Port
      #* MSA                [75] #//
Starboard
    #} Max. angle (deg.):

    #{ Max. Coverage (m): #//
      #* MPC                [5000] #//
Port
      #* MSC                [5000] #//
Starboard
    #} Max. Coverage (m):

    #* ACM                [1] #//
Angular Coverage mode: AUTO
    #* BSP                [2] #// Beam
Spacing: HIDENS EQDIST

  #} Sector Coverage

  #{ Depth Settings #//
    #* FDE                [4500] #//
Force Depth (m)
    #* MID                [50] #// Min.
Depth (m):
    #* MAD                [7000] #//
Max. Depth (m):
    #* DSM                [0] #// Dual
swath mode: OFF
    #* PMO                [0] #// Ping
Mode: AUTO
    #* FME                [1] #// FM
enable
  #} Depth Settings

  #{ Stabilization #//
    #* YPS                [1] #// Pitch
stabilization
    #* TXA                [-2] #// Along
Direction (deg.):

    #{ Yaw Stabilization #//
      #* YSM                [2] #//
Mode: REL. MEAN HEADING
      #* YMA                [300] #//
Heading:
      #* HFI                [1] #//
Heading filter: MEDIUM
    #} Yaw Stabilization

  #} Stabilization
#} Sounder Main

#{ Sound Speed #//

  #{ Sound Speed at Transducer #//
    #* SHS                [0] #// Source
SENSOR
    #* SST                [15000] #//
Sound Speed (dm/sec.):
    #* Sensor Offset (m/sec [0] #//
    #* Filter (sec.):      [5] #//
  #} Sound Speed at Transducer

#} Sound Speed

#{ Filter and Gains #//

  #{ Filtering #//
    #* SFS                [2] #// Spike
Filter Strength: MEDIUM
    #* PEF                [0] #//
Penetration Filter Strength: OFF
    #* RGS                [0] #// Range
Gate: SMALL
    #* SLF                [1] #// Slope
    #* AEF                [1] #//
Aeration
    #* STF                [1] #// Sector
Tracking
    #* IFF                [1] #//
Interference
  #} Filtering

  #{ Absorption Coefficient #//
    #* ABC                [6.279] #//
31.5 kHz
  #} Absorption Coefficient

  #{ Normal incidence sector #//
    #* TCA                [6] #// Angle
from nadir (deg.):
  #} Normal incidence sector
```

```
  #{ Mammal protection #//
    #* TXP                [0] #// TX
power level (dB): Max.
    #* SSR                [0] #// Soft
startup ramp time (min.):
  #} Mammal protection
#} Filter and Gains

#{ Data Cleaning #//
  #* Active rule:
[STANDARD] #//
  #{ STANDARD #//
    #*
PingProc.maxPingCountRadius
[10]
    #* PingProc.radiusFactor
[0.050000]
    #* PingProc.medianFactor
[1.500000]
    #* PingProc.beamNumberRadius
[3]
    #* PingProc.sufficientPointCount
[40]
    #* PingProc.neighborhoodType
[Elliptical]
    #* PingProc.timeRule.use
[false]
    #* PingProc.overhangRule.use
[false]
    #* PingProc.medianRule.use
[false]
    #*
PingProc.medianRule.depthFactor
[0.050000]
    #*
PingProc.medianRule.minPointCoun
t              [6]
    #* PingProc.quantileRule.use
[false]
    #*
PingProc.quantileRule.quantile
[0.100000]
    #*
PingProc.quantileRule.scaleFactor
[6.000000]
    #*
PingProc.quantileRule.minPointCou
nt             [40]
    #* GridProc.minPoints
[8]
    #* GridProc.depthFactor
[0.200000]
    #*
GridProc.removeTooFewPoints
[false]
    #*
GridProc.surfaceFitting.surfaceDegr
ee             [1]
    #*
GridProc.surfaceFitting.tukeyConsta
nt             [6.000000]
    #*
GridProc.surfaceFitting.maxIteration
[10]
    #*
GridProc.surfaceFitting.convCriterio
n              [0.010000]
    #*
GridProc.surfaceDistanceDepthRule.
use            [false]
    #*
GridProc.surfaceDistanceDepthRule.
depthFactor    [0.050000]
    #*
GridProc.surfaceDistancePointRule.
use            [false]
    #*
GridProc.surfaceDistancePointRule.s
caleFactor     [1.000000]
    #*
GridProc.surfaceDistanceUnitRule.u
se             [false]
    #*
GridProc.surfaceDistanceUnitRule.s
caleFactor     [1.000000]
    #*
GridProc.surfaceDistanceStDevRule.
use            [false]
    #*
GridProc.surfaceDistanceStDevRule.
scaleFactor    [2.000000]
    #*
GridProc.surfaceAngleRule.use
[false]
    #*
GridProc.surfaceAngleRule.minAngl
e              [20.000000]
    #* SonarProc.use
[false]
    #* SonarProc.gridSizeFactor
[4]
    #* SonarProc.mergerType
[Average]
    #* SonarProc.interpolatorType
[TopHat]
    #* SonarProc.interpolatorRadius
[1]
    #* SonarProc.fillInOnly
[true]
  #} STANDARD

  #{ Seabed Image Processing #//
    #* Seabed Image Process [1] [0]
  #} Seabed Image Processing
#} Data Cleaning

#{ Advanced param. #//
#} Advanced param.
```

Appendix C: Tables of Files Collected during EX1004 Leg 4

EX1004 LEG 4 MULTIBEAM FILE LOG					
DATE (GMT)	**MB LINE FILENAME**	**SVP FILE APPLIED**	**JULIAN DAY**	**SOG (kts)**	**HDG (deg)**
8/19/2010	0000_20100819_030250_EX.all	XBT_081910_02.asvp	231	8	067
08/19/2010	0001_20100819_085330_EX.all	XBT_081910_03.asvp; XBT_081910_04.asvp	231	7.5	070
8/19/2011	0002_20100819_145332_EX.all	XBT_081910_04.asvp	231	8	065
8/19/2011	0003_20100819_185306_EX.all	XBT_081910_04.asvp	231	5	010

EX1004 LEG 4 SVP LOG				
DATE (GMT)	**TIME (GMT)**	**XBT/CTD FILE NAME**	**LAT/LONG (WGS84)**	**NOTES**
8/19/2010	02:52:00	XBT #1	12 29.99255N 142 35.29492E	Bad cast
8/19/2010	02:54:15	XBT_081910_02.asvp	12 30.1134N 142 35.56738E	
8/19/2010	08:29	XBT_081910_03.asvp	12 48.5228N 143 17.6952E	
8/19/2010	14:35	XBT_081910_04.asvp	13 8.3856N 144 2.8486E	

Appendix D: EM302 Testing Steps

TEST STEPS FOR EX1004 Leg4 TXRIO / TX36 LC #16 TESTING
Internal BISTs – Impedance Checks

- Keep BIST log

1. RUN BISTS WITH OLD TX RIO, FRIED TX36LC #16
    a. HYPERTERMINAL/TELNET/INTERNAL BIST *(Okeanos_Explorer_Internal_BIST_old_txrio_old_tx36LC_081910_1.TXT)*
    b. REGULAR BIST *(081910_1.txt)*
2. REPLACE TX RIO WITH SPARE
3. RUN BISTS WITH NEW TX RIO, FRIED TX36LC # 16
    a. HYPERTERMINAL/TELNET/INTERNAL BIST *(Okeanos_Explorer_Internal_BIST_new_txrio_old_tx36LC_081910_2.TXT, Okeanos_Explorer_Internal_BIST_new_txrio_old_tx36LC_081910_3.TXT)*
    b. REGULAR BIST *(081910_2.txt)*

4. REPLACE FRIED TX36LC #16 WITH SPARE
5. ****DO NOT PING****
6. RUN BISTS WITH NEW TX RIO, NEW TX36LC #16
    a. HYPERTERMINAL/TELNET/INTERNAL BIST *(Okeanos_Explorer_Internal_BIST_new_txrio_new_tx36LC_081910_4.TXT)*
    b. REGULAR BIST *(081910_3.txt)*
7. PUT OLD FRIED TX36#16 BOARD BACK IN UNTIL KONGSBERG EVALUATES RESULTS OF BISTS *(081910_4.txt)*
8. OK TO LEAVE THE NEW TXRIO IN THE TRU AND PING

HYPERTERMINAL/TELNET BIST PROCEDURE:

Please start up Hyper-Terminal session and proceed as follows:

Name – BIST
Connect using - "TCP/Winsock"
Host Address - 157.237.14.60
Port - Default (23)
This basically is a telnet session through Hyper-Terminal*

Now click on Transfer and select "Capture Text"

This will bring up a window which allows you to save a file and where to save file, browse to your desk top and save file as < Okeanos_Explorer_Internal_BIST_xxx > (xxx is to identify Old Board or New Board) select <save> then on next window select <start>

To start the actual test procedure you should see on your screen at present is - >

Type in bist and then < enter >

Now on screen should see the following –

bist

========== EMX BIST menu ========
0: BSP test 7: TX channels
1: TX36 test 8: RX noise level
2: RX32 test 9: RX noise spectrum
3: Power Supply 15: Software date/version
5: Nibble bus test 20: SingleChannels
6: RX channels -1: Quit

Detailed reports:
30: TX channels slot 1 - 5 35: RX noise level graphical view
31: TX channels slot 6 - 10 36: RX noise spectrum graphical view
32: TX channels slot 11 - 15
33: TX channels slot 16 - 20
Select test:

After the “Select test:” type in 30 and then < enter > (this will run test #30)
Once completed type in 31 and then < enter > to run test #31
Repeat for 32 , then 33
Once all done will need to exit out of this BIST menu by typing in -1 < enter >
This should take you back to the prompt - > at which point you can exit out of Hyper-Terminal

Once all tests are run go to your desk top and verify that the file you created at the beginning < Okeanos_Explorer_Internal_BIST_xxx > contains all the results of the tests you have just run. If all looks good please send files to us -

Appendix E: Summary map of EX1004 Legs 1 and 4 EM302 Multibeam Data