



# Ocean CLASS AGOR

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## Integrated Survey System

10 March 2009



**ALION**  
SCIENCE AND TECHNOLOGY



# Integrated Survey System

- Background
  - ISS60 is basis for ISS-2000
- ISS-2000
  - ISS-2000 Real Time Data Acquisition
  - Acquisition Data Flow
  - System Architecture
  - Equipment
- Generic Sensor Format (GSF)
  - Definition
  - Widely used hydrographic community

*An integrated survey system is not stated in the SMR's. In researching the scientific mission equipment we would like to consider including ISS-2000 for providing a uniform data collection and data format system on the new Ocean CLASS AGOR.*



# ISS Background

- Hydrographic survey software produced by SAIC Marine Science & Technology Division (MSTD) Newport, RI
  - **ISS-60** – NAVOCEANO's tactical shipboard acquisition software
  - **ISS-2000** – Commercial data acquisition package, similar to ISS-60
  - **SABER** – Data Processing software
- SAIC/ MSTD has performed over 45 high-resolution shallow water surveys for safety of navigation under contract to NOAA since 1995.
- SAIC/MSTD have consistently received and “Excellent” rating from NOAA for their services.
- All SAIC NOAA surveys use ISS-2000 for Survey Planning, Data Acquisition and Data Archiving.





# ISS & SABER on UNOLS Ships

- *R/V KILO MOANA*
  - ISS-2000 was temporarily installed for a 2005 UNH mission in Alaska.
  - ISS-2000 was integrated with the sonar suite for hydrographic operations.
  
- *R/V ROGER REVELLE*
  - SABER was used during the 2008 SAIC survey for UNH EEZ survey.
  - SABER was brought aboard for post-processing of the hydrographic data.

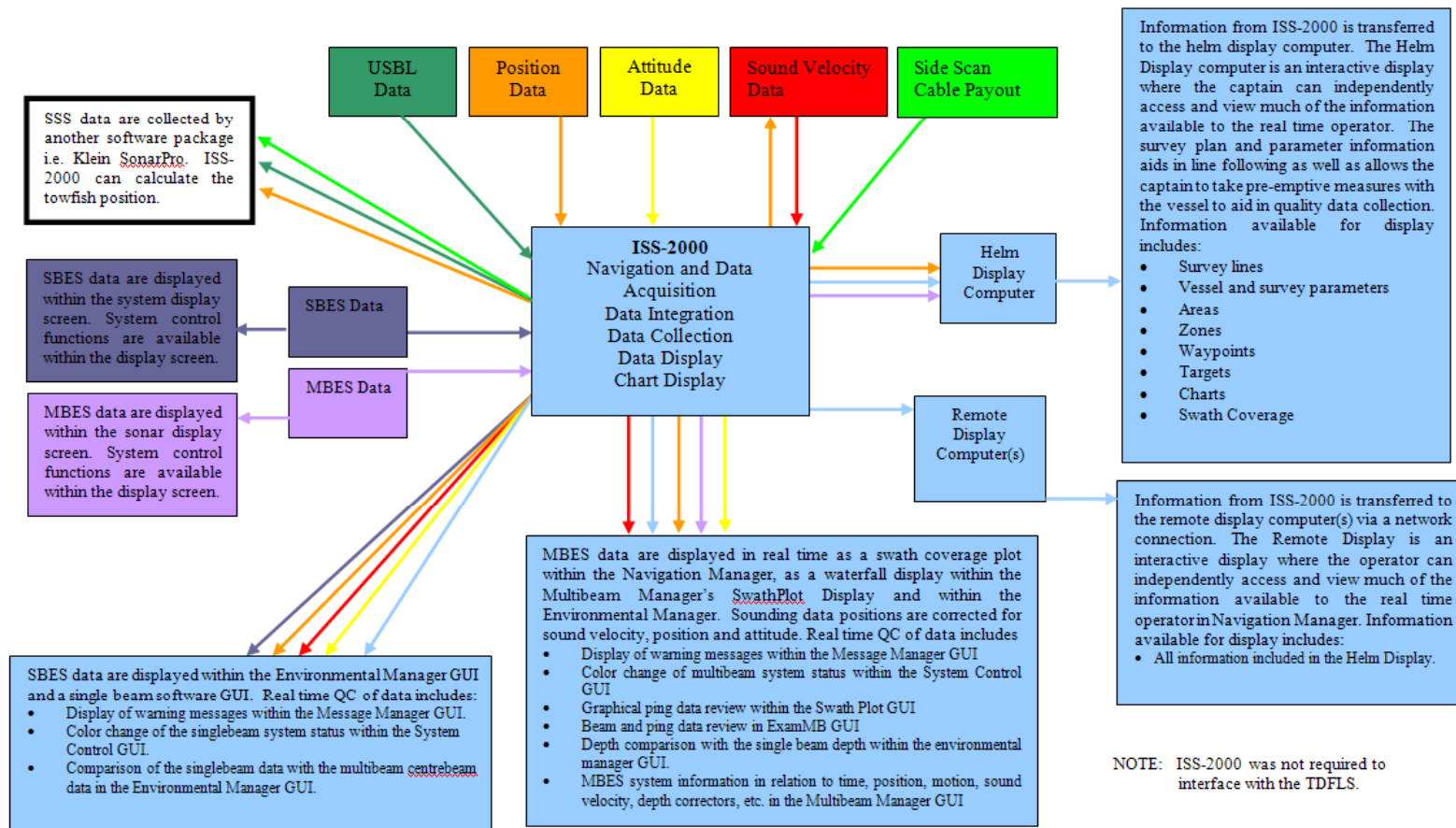




# Integrated Survey System

## Why use ISS-2000?

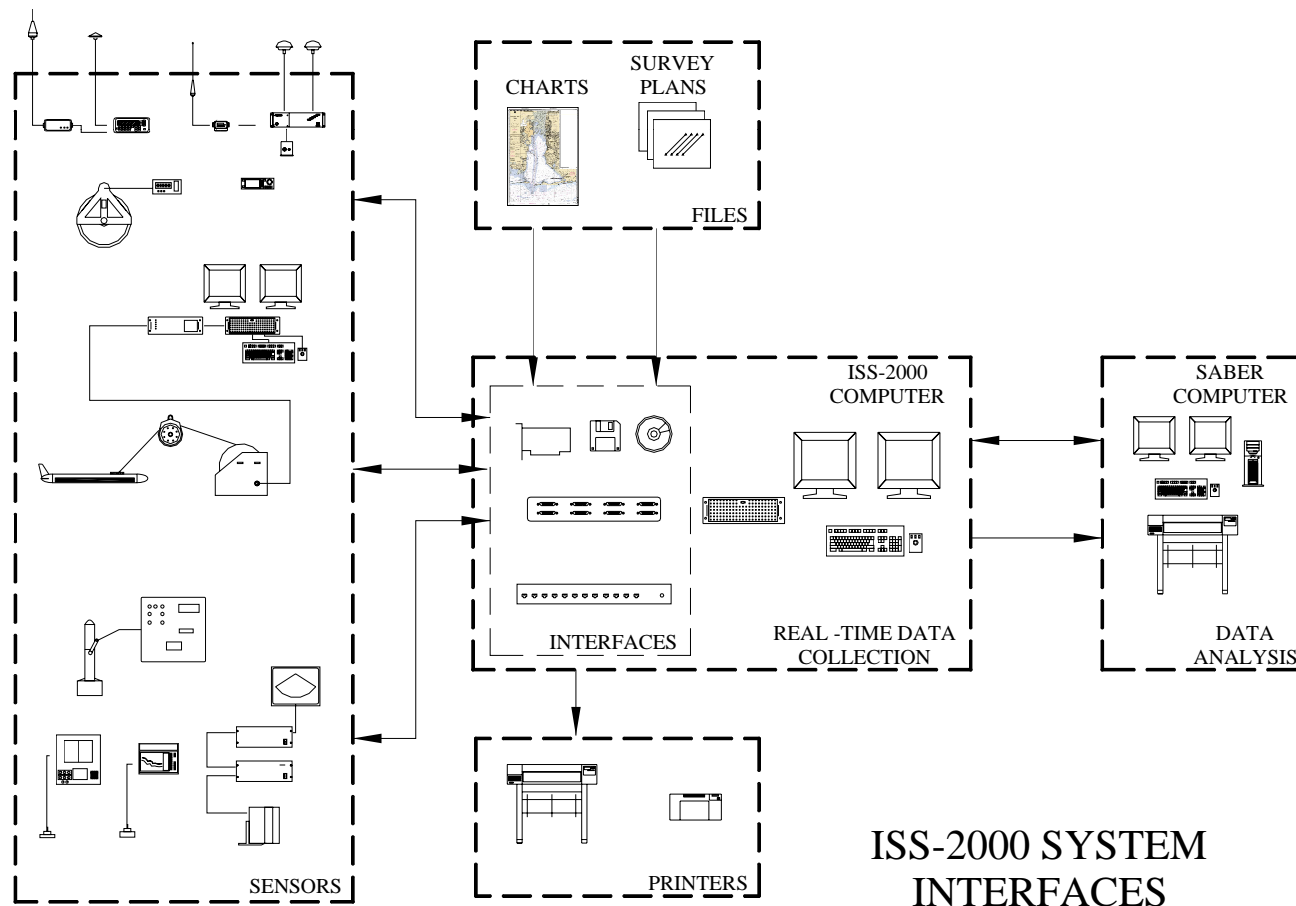
- Single monitoring workstation for multiple oceanographic equipment
- Real time navigation monitoring and editing
- Real time data analysis
- Data archiving to processing computers and/or NAS





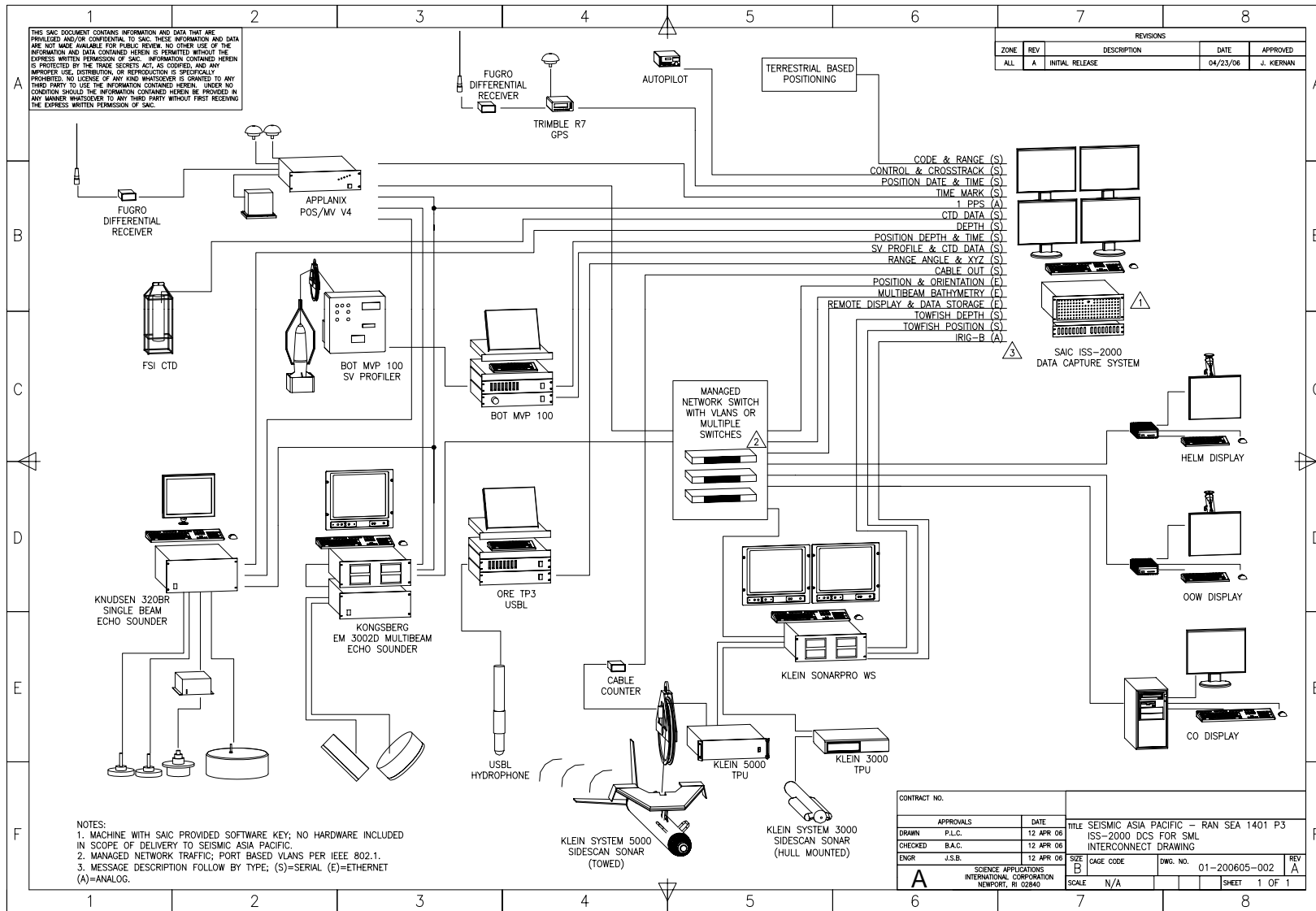
# ISS Simplified Overview

- ISS-2000 consists of a 4U rack mounted computer and dual monitors
- The ISS-2000 computer is built with a timing card for timing synchronization
- The computer uses multiple port expansion digi-boards for serial interfaces
- ISS-2000 uses a VLAN for setting up isolated IP networks to minimize data traffic





# ISS System Schematic



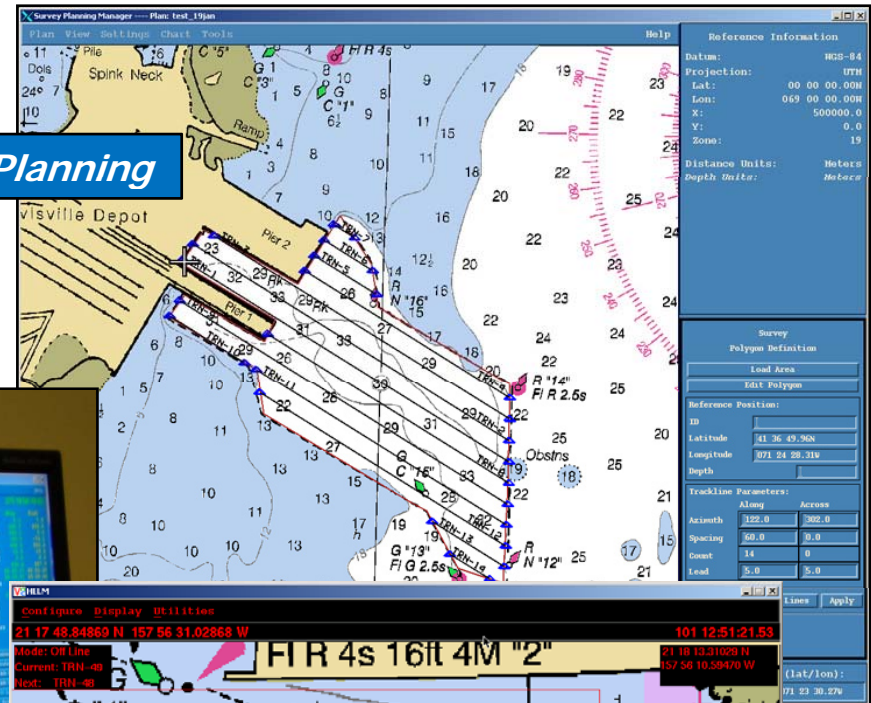


# ISS-2000 Components

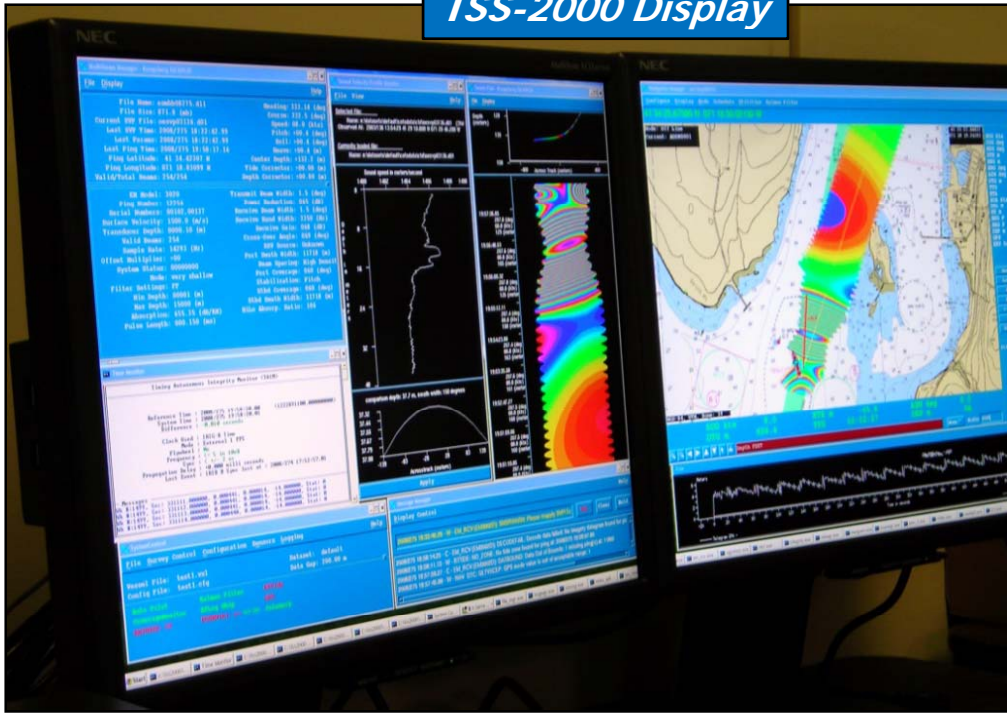
## ISS-2000 Real Time Data Acquisition

- Workstation w/ timing module
- ISS-2000 software
- Survey Planning software
- Helm Display software

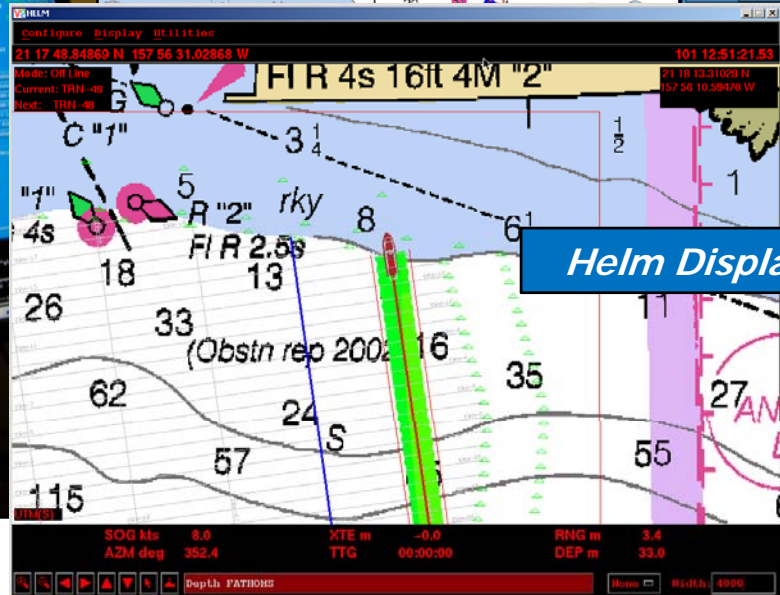
*Survey Planning*



*ISS-2000 Display*



*Helm Display*







# ISS Timing Analysis

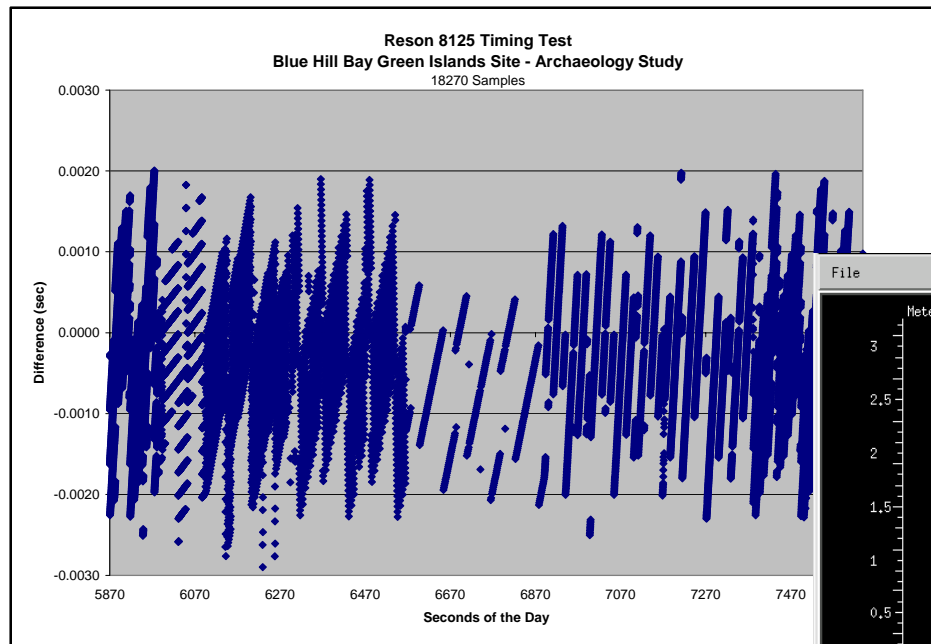
- The internal timing card receives an analog 1 PPS signal and serial time message to synchronize to the GPS receiver.
- The serial message options are NMEA ZDA, UTC and Novatel TM1B.

```
Time Monitor
Timing Autonomous Integrity Monitor (TAIM)

Reference Time : 2005/354 17:07:35.11
System Time : 2005/354 17:07:35.16
Difference : -0.051 seconds

Clock Used : IRIG-B Time
Mode : External 1 PPS
Flywheel : No
Frequency : <= 5 in 10e8
Sync : < +/- 2 us
Propogation Delay : +0.000 milli seconds
Last Event : IRIB B set at : 2005/353 20:46:06.11

-- Messages
$GPZDA,170732.11,20.12.2005,00.00*60
$GPZDA,170733.11,20.12.2005,00.00*61
$GPZDA,170734.11,20.12.2005,00.00*66
$GPZDA,170735.11,20.12.2005,00.00*67
```



```
c:\iss2000\bin\syncstime.exe

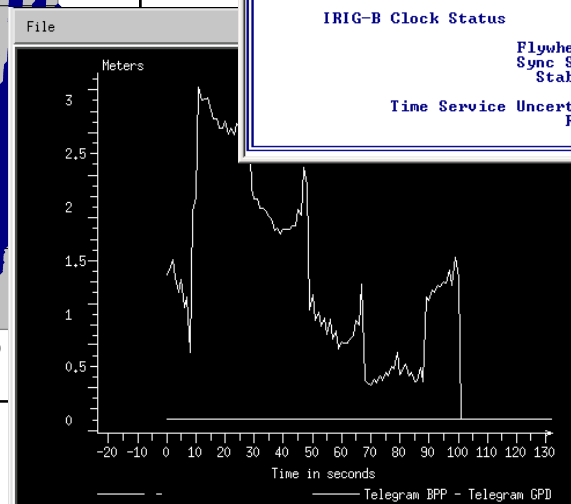
Precise Time Service
based on
Datum BC 635
IRIG-B Time Code Generator

Log File: clk_sync.log

CPU Clock Status
CPU Time: 2005/334 16:11:10.616
IRIG-B Time: 2005/334 16:11:10.619
Current CPU Difference: -0.003495, -0.003477
Last CPU Update was from: 2005/334 16:07:59.002
to: 2005/334 16:07:59.023

IRIG-B Clock Status
Mode: External 1PPS
Flywheeling: No
Sync Status: Yes
Stability: <=5 in 10e8

Time Service Uncertainty: -0.0000030, 0
Resets: 361
```





# ISS Parameter Controls

- The operator can control many of the equipment settings from ISS-2000 software through Parameter Control interfaces.
- Does not increase the number of operators required and provides a single control interface for different equipment.

**Parameter Values**

Group	Subgroup	Name	Parameter Value
Auto Pilot	: Prog. Cntrl	: Enabled	: :True
Cable Payout	: Prog. Cntrl	: Enabled	: :True
Catenary	: Prog. Cntrl	: Enabled	: :True
CoverageMonitor	: Prog. Cntrl	: Enabled	: :True
DTCDataDisplay	: Prog. Cntrl	: Enabled	: :True
EchoTrack	: Prog. Cntrl	: Enabled	: :False
Env. Mgr.	: Prog. Cntrl	: Enabled	: :True
FishBath	: Prog. Cntrl	: Enabled	: :False
GPS	: Prog. Cntrl	: Enabled	: :True
GPSMon	: Prog. Cntrl	: Enabled	: :True
Helm Display	: Prog. Cntrl	: Enabled	: S*:False
Kalman Filter	: Prog. Cntrl	: Enabled	: :True
KF-Lite	: Prog. Cntrl	: Enabled	: :False
KFLog Ship	: Prog. Cntrl	: Enabled	: :True
Klein 5000	: Prog. Cntrl	: Enabled	: :True
MAGYNAV	: Prog. Cntrl	: Enabled	: :False
MB Mgr.	: Prog. Cntrl	: Enabled	: :True
MergeServe	: Prog. Cntrl	: Enabled	: :True
MessageMgr	: Prog. Cntrl	: Enabled	: :True
Monarch RPM	: Prog. Cntrl	: Enabled	: :True
MVP30	: Prog. Cntrl	: Enabled	: :False
MVP Out	: Prog. Cntrl	: Enabled	: :True
Nav. Mgr.	: Prog. Cntrl	: Enabled	: :True
Navisound	: Prog. Cntrl	: Enabled	: :False
NMEA Broadcast	: Prog. Cntrl	: Enabled	: :True
NMEA Heading	: Prog. Cntrl	: Enabled	: :False
POSMV V3	: Prog. Cntrl	: Enabled	: :True
Reson	: Prog. Cntrl	: Enabled	: :True
RTTide	: Prog. Cntrl	: Enabled	: :False
UTCOutput	: Prog. Cntrl	: Enabled	: :True

**Program Controls**

Buttons: Set Default, Search..., Details..., Toggle, Apply, Done

**Parameter Values**

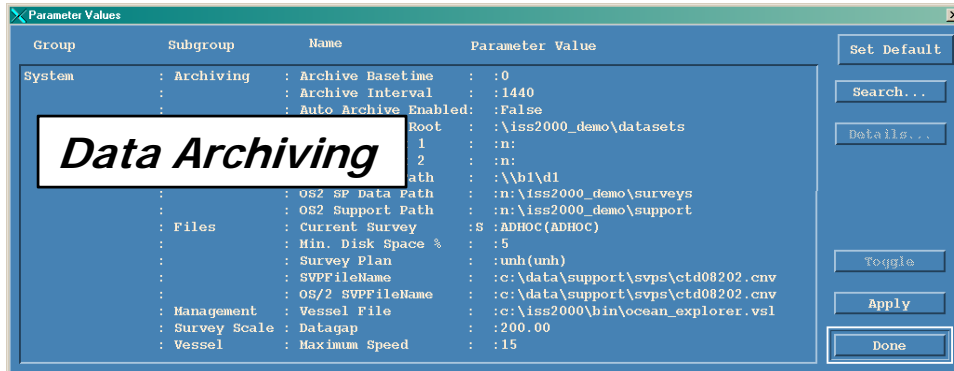
Group	Subgroup	Name	Parameter Value
EM3002D	: File Cntrl	: Change Interval	: :1440
	: Location	: Position Name	: :EM3002D Xdcr
		: x	: :0.0
		: y	: :0.0
		: z	: :0.0
	: Prog. Cntrl	: Calculate TPE	: :False
		: Create Dump File	: :False
		: Enabled	: :True
		: Flag Offline Data	: :False
		: Like Message Timer	: :60
		: Logging Enable Flag	: :True
		: Log Nominal Depth	: :False
		: Merge Navigation	: :True
		: Read Timeout	: :30.000000
		: Receive Data Socket	: :3020
		: Set. Squat Source	: :Manual
		: Swath Width Cutoff	: :90.0
		: Tide Correct	: :True
		: Time Sync Toler	: :0.000000
		: Log Imagery Data	: :True
		: TX Enabled	: :True
		: TX Like MSG Timer	: :60
		: TX Read Timeout	: :3
		: Pinging	: :False
		: Pinging Port Num	: :2056
		: Pinging Host	: :em3002d
		: ParamRequestEnabled	: :True
		: ParamRequestPortNum	: :3021
		: ParamRequestHost	: :em3002d
		: SVP Out Enabled	: :True
		: SVP Out Port Num	: :3022
		: SVP Out Host	: :em3002d
		: SVP Out Format	: :KSimrad
		: SONDE Format	: :S00
EM3002D-RAW.ALL	: Prog. Cntrl	: Enabled	: :False
		: Like Message Timer	: :60
		: LoggerStatus Host	: :em3002d
		: LoggerStatus Port	: :2072
		: Read Timeout	: :10
		: RemoteControl Host	: :em3002d
		: RemoteControl Port	: :2062
	: Prog. Bntrl	: Remote Dataset Root	: :\\192.168.3.1\c\datasets

**Multibeam Control**

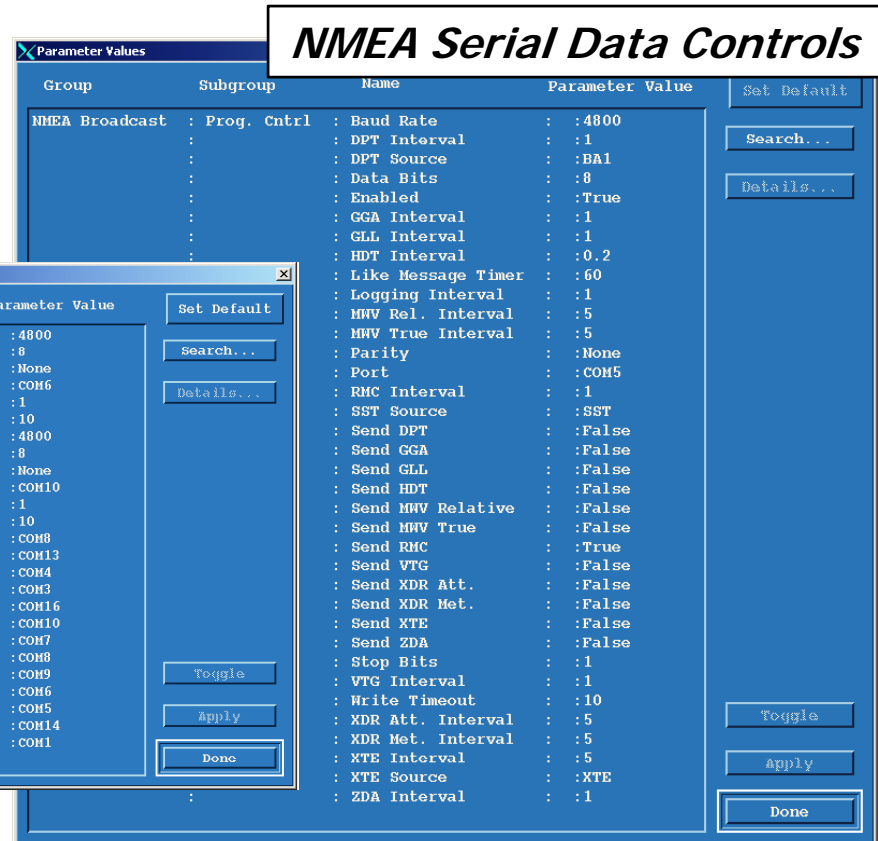
Buttons: Set Default, Search..., Details..., Toggle, Apply, Done



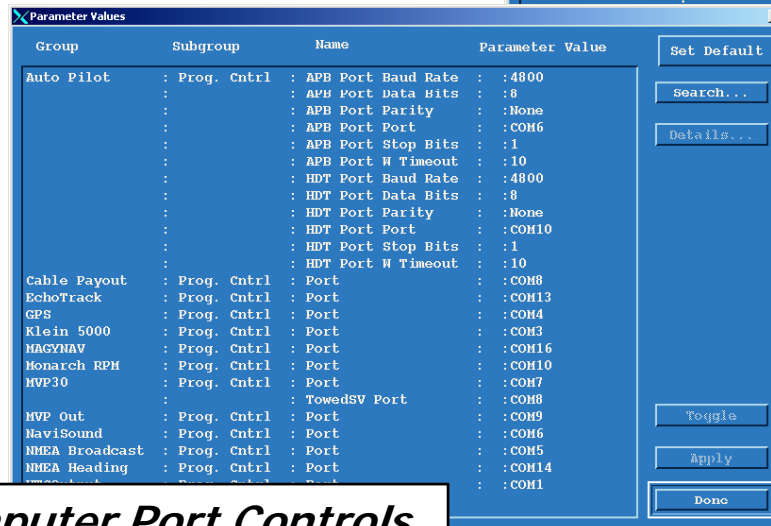
# ISS Parameter Controls



- Once the network is established data archiving can be set to auto-archive files during data acquisition.



- ISS-2000 multiple port configuration can be controlled in one GUI.
- The single interface allows for quicker troubleshooting of port configuration.





# ISS Alarm Control Settings

- ISS-2000 is designed to automatically alarm the operator when the system is exceeding the operator set parameters.
- Allowing the operator to monitor the integrated system in real time.

Group	Subgroup	Name	Parameter Value	
Cable Payout	: Prog. Cntrl	: Read Timeout	: :3	Set Default
EchoTrack	: Prog. Cntrl	: Read Timeout	: :10	Search...
GPS	: Prog. Cntrl	: Read Timeout	: :10	Details...
Klein 5000	: Prog. Cntrl	: Read Timeout	: :3	
MAGYNAV	: Prog. Cntrl	: Write Timeout	: :10	
Monarch RPM	: Prog. Cntrl	: Read Timeout	: :3	
MVP30	: Prog. Cntrl	: Read Timeout	: :10	
MVP Out	: Prog. Cntrl	: Read Timeout	: :10	
		: Write Timeout	: :10	
NaviSound	: Prog. Cntrl	: Read Timeout	: :10	
NMEA Broadcast	: Prog. Cntrl	: Write Timeout	: :10	Toggle
NMEA Heading	: Prog. Cntrl	: Read Timeout	: :10	Apply
POSMV V3	: Prog. Cntrl	: Read Timeout	: :10.000000	Done
Reson	: Prog. Cntrl	: Read Timeout	: :3	
UTCOutput	: Prog. Cntrl	: Write Timeout	: :1	

*Time Out Controls*

A read timeout is the amount of time (in seconds) that can pass without receiving raw sensor data before issuing and alarm via the Message Manager.

The write timeout is the amount of time (in seconds) that can pass between receipts of raw data from a DTC before issuing an alarm.



# ISS Message Manager

Group	Subgroup	Name	Parameter Value	Set Default
Cable Payout	Prog. Cntrl	Logging Interval	: 1	
Catenary	Prog. Cntrl	Logging Interval	: 1	
EchoTrack	Log Interval	Off Line	: :01	
		On Line	: :01	
		On Station	: :01	
		Underway	: :01	
	Prog. Cntrl	Logging Interval	: :2.0	
GPS	Prog. Cntrl	Logging Interval	: 1	
KFLog Ship090	Prog. Cntrl	Logging Interval	: 1.0	
Klein 5000	Prog. Cntrl	Logging Interval	: 1	
MAGYNAV	Prog. Cntrl	Logging Interval	: 1	
Monarch RPM	Prog. Cntrl	Logging Interval	: 1	
MVP30	Prog. Cntrl	Logging Interval	: 1	
NaviSound GSF1	Log Interval	Off Line	: :01	
		On Line	: :01	
		On Station	: :01	
		Underway	: :01	
NaviSound GSF2	Log Interval	Off Line	: :01	
		On Line	: :01	
		On Station	: :01	
		Underway	: :01	
NMEA Broadcast	Prog. Cntrl	Logging Interval	: 1	
NMEA Heading	Prog. Cntrl	Logging Interval	: 1	
POSMV V3	Prog. Cntrl	Logging Interval	: :0.5	
UTCoutput	Prog. Cntrl	Logging Interval	: :0.5	

**Logging Interval Controls**

- Logging intervals can be set for each sensor.
- During ISS-2000 operations messages are generated and written to the Survey Report File.
- The **Message Manager** window is automatically started when **System Control** is initiated.

**System Control**

File Survey Control Configuration Sensors Logging

Vessel File: davidson.vsl Dataset: testbed  
Config File: davidson.cfg Data Gap: 200.00 m

GPS CoverageMonitor POSMV V3 Monarch RPM  
Kalman Filter KFLog Ship RTTide  
Auto Pilot NaviSound Reson

**Message Manager**

Display Control

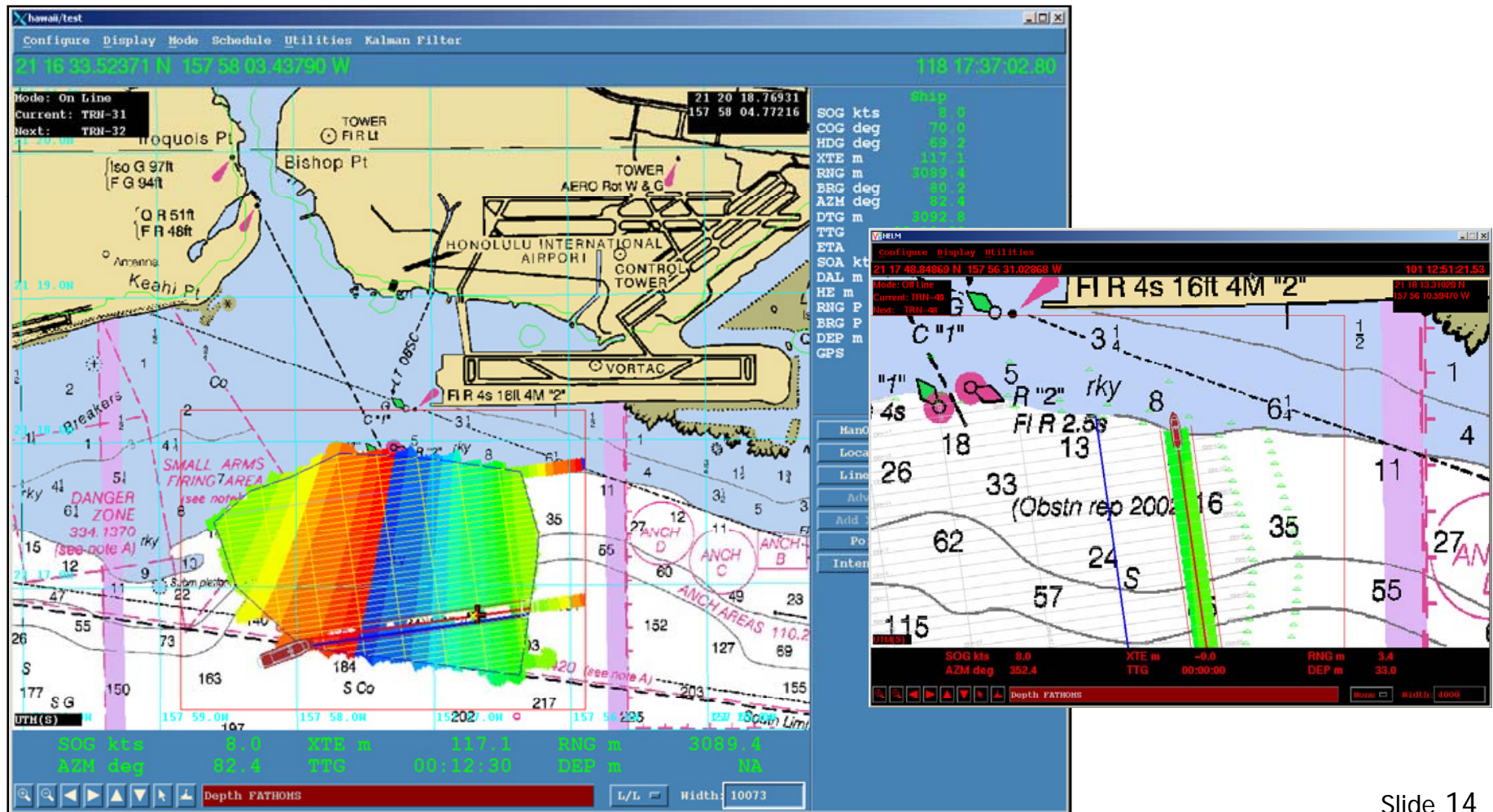
2004/001 00:08:34.77 - W - RTTIDE: NO\_ZONE: No tidal zor [Ack] [Clear] [Hold]

2004/001 00:08:39.50 - W - TAIM: IRIGBFLYING: IRIG B Flywheeling at : 2004/001 00:08:39.5  
2004/001 00:08:39.50 - C - TAIM: TIMEOUT: Timeout reading input data  
2004/001 00:08:34.77 - W - RTTIDE: NO\_ZONE: No tidal zone(s) could be found in the surv  
2004/001 00:08:26.14 - I - POS/MV v3: NEWFILE: New File Created: m:\datasets\testbed\po  
2004/001 00:08:18.61 - I - KFLOG\_SHIP: NEWFILE: New File Created: m:\datasets\testbed\k  
2004/001 00:08:18.02 - W - NavMar: DEPTHTIMEOFF: Depth time differs from system time l



# ISS Navigation Controls

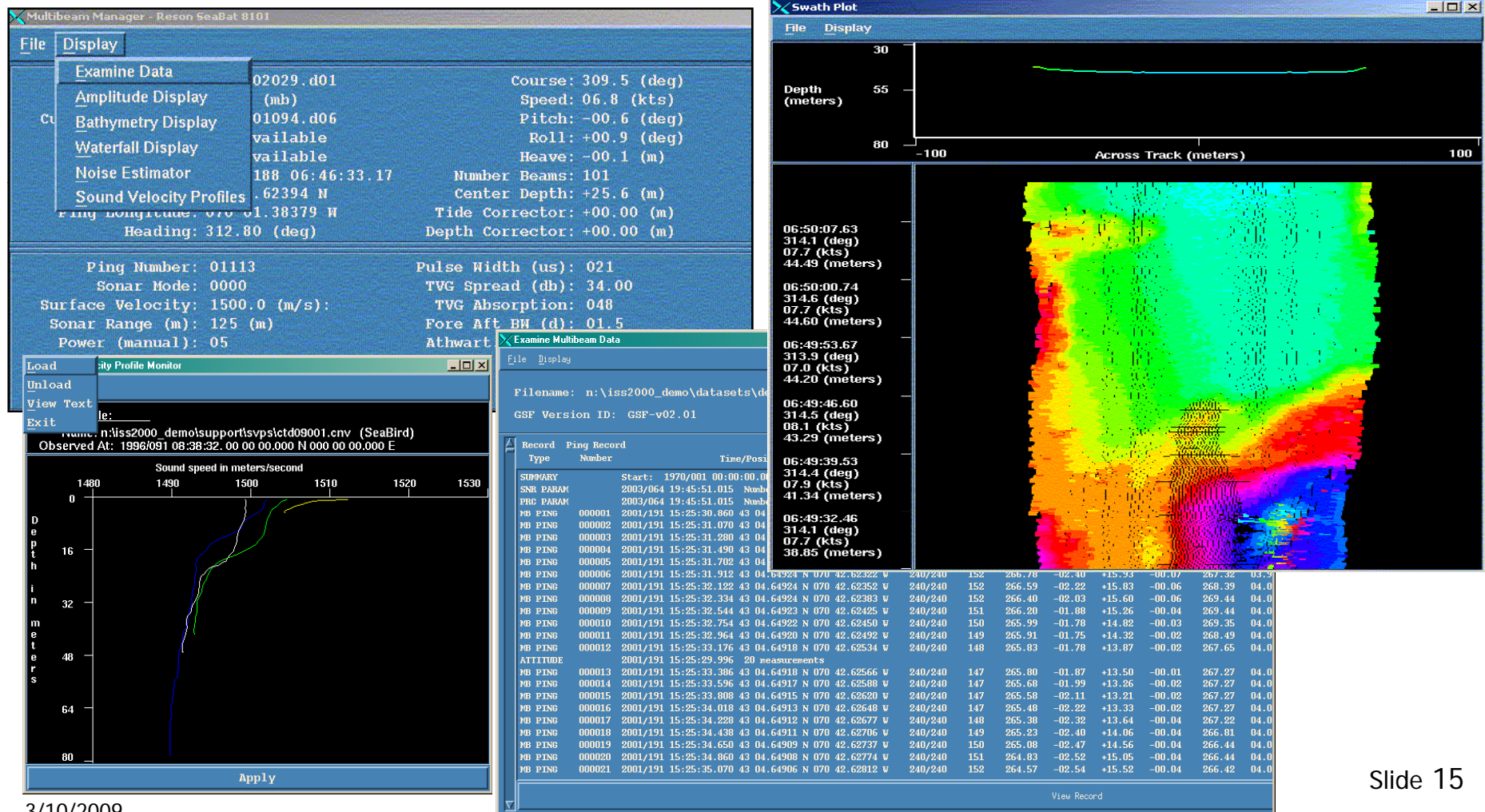
- The Navigation Display allows the operator to view the data in real time while monitoring the survey progress and navigation information.





# ISS Multibeam Controls

- Multibeam data can be viewed in real time to verify data quality.
- SVP cast can be applied and verified in real time.



3/10/2009

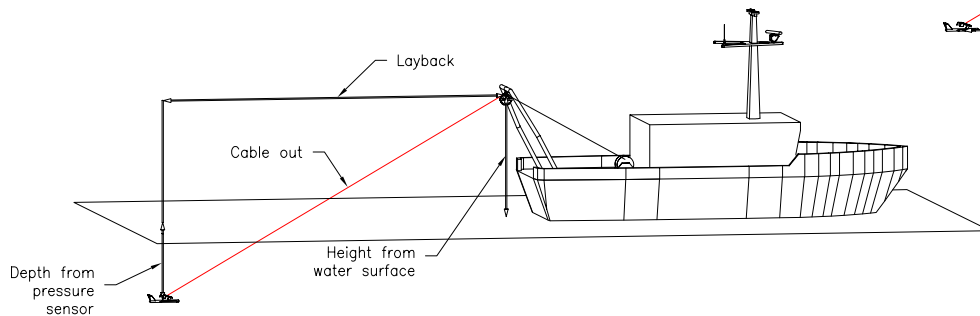
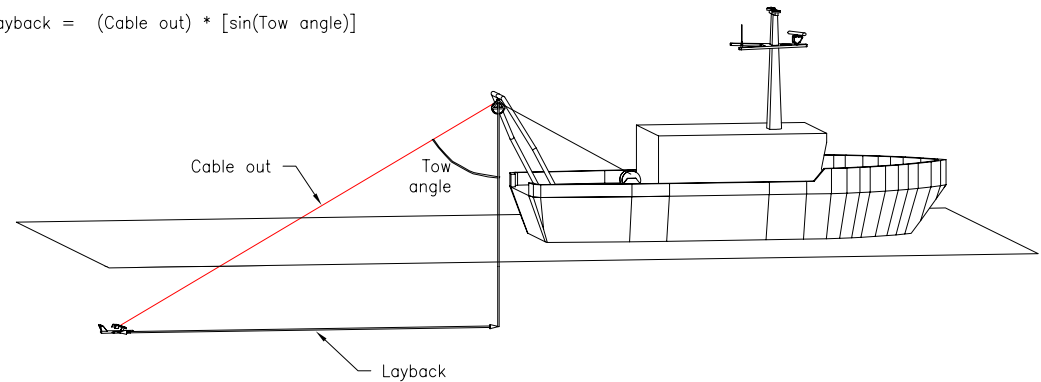
Slide 15



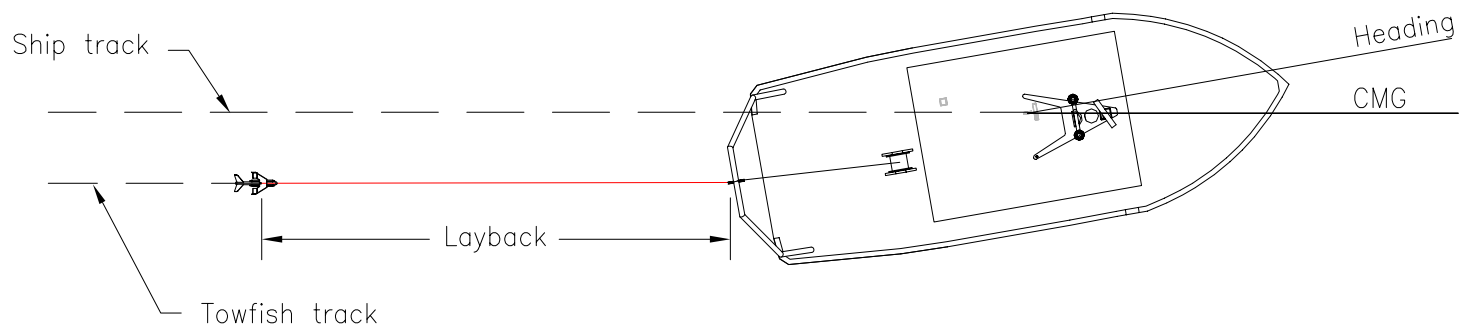
# ISS Tow Body Positioning

- ISS-2000 can handle positioning of towed arrays using proven algorithms.

$$\text{Layback} = (\text{Cable out}) * [\sin(\text{Tow angle})]$$



$$\text{Layback} = \sqrt{(\text{Cable out})^2 - [(\text{Depth} + \text{Height})]^2}$$



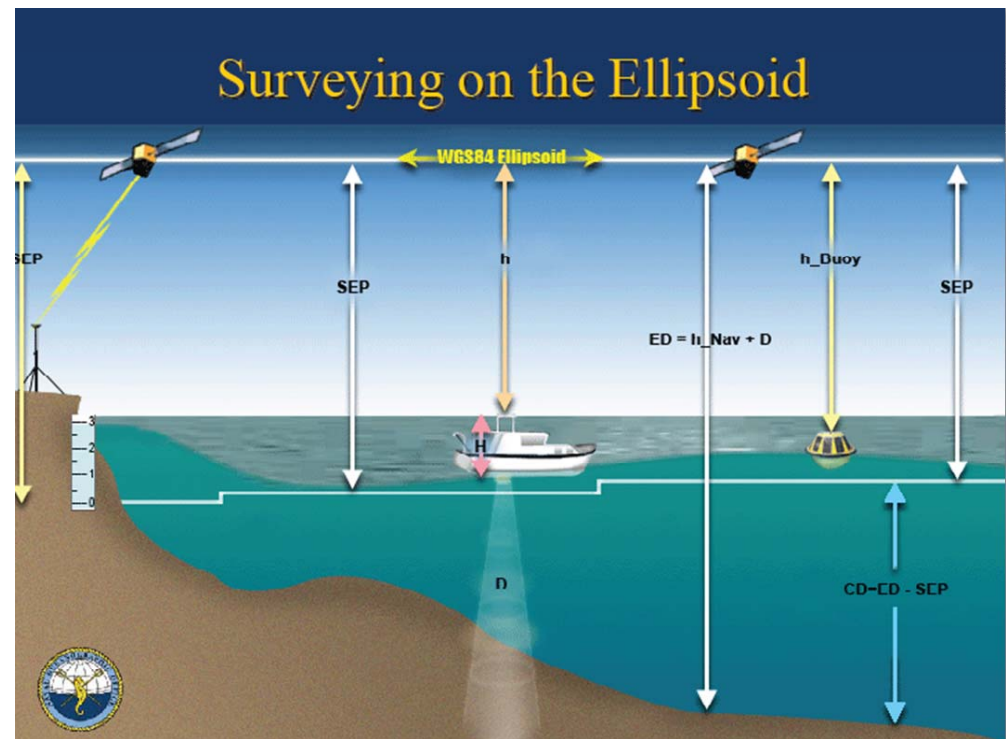




# ISS Development (*Example*)

- Ellipsoidal Survey

- Application first being implemented in post-processing (SABER)
- Updates for GPS and POS/MV DTC's to record and apply data
- Updates to GSF to support recording ellipsoidal height and SEP (Separation Between the Chart Datum and the WGS-84 Ellipsoid) for each ping
- Implement into data acquisition and merge for near real-time display





# ISS-2000 GSF Format

- ISS-60 and ISS-2000 collect swath bathymetry and beam amplitude imagery data in GSF Format.
- GSF is designed to efficiently store and exchange information produced by geophysical measurement systems before it has been processed into either vector or raster form.
- Generic Sensor Format (GSF) is a standard file format for bathymetry data and widely used in the maritime community (US and the UK).
- Single-file format (one file saves all information)
  - Objective is to store all swath oriented information
  - Currently limited to one source of position
  - Currently limited to one source of motion
  - Not currently supporting the water column data

File Display

Filename: 46mbi08092\_p\_100.d03  
GSF Version ID: GSF-v02.07 File Size: 123.6 Mbytes Sonar: Simrad EM3002

Record Type	Ping Number	Record Number	Time/Position	Valid/Total Beams	Ctr. Beam	Heading (degs)	Pitch (degs)	Roll (degs)	Heave (meters)	Course (degs)	Speed (knots)	Tide Cor. (meters)	Depth Cor. (meters)	Flags
SUMMARY			Start: 1970/001 00:00:00.000 End: 1970/001 00:00:00.000 Lat: 00 00.00000 N - 00 00.00000 N Lon: 000 00.00000 E - 000 00.00000 E Depth: 0.00 - 0.00											
COMMENT			2008/092 15:25:38.081 CLASSIFICATION: *** UNCLASSIFIED PUBLIC DOMAIN *** : 100 PUBLIC RELEASE											
SNR PARAM			2008/092 15:11:00.403 Number of params: 76											
PRC PARAM			2008/092 15:11:00.403 Number of params: 31											
SVP			Position: 30 13.00000 N 088 59.70000 W Observation Time: 2008/092 15:13:00.000 Application Time: 2008/092 15:17:34.658 Number of points: 11											
COMMENT			2008/092 15:17:34.658 SVP_FILE_NAME: /data2/datasets/gpz_day3_p_100/cotsdata/svp/SV092002.CTD											
ATTITUDE			2008/092 15:25:36.052 51 measurements											
MB PING	000001		2008/092 15:25:36.054 30 12.87208 N 089 00.36417 W 254/254 129 097.10 +01.00 +00.88 +00.06 087.53 07.98 +00.00 +0000.00 0000 (G)											
HV NAV ER			2008/092 15:25:36.054 Describes Record Type: Swath Bathymetry Ping Horizontal Error: 00000.107 Vertical Error: 00000.153 Type: SPSG											
MB PING	000002		2008/092 15:25:36.085 30 12.87208 N 089 00.36409 W 254/254 129 097.14 +01.12 +01.01 +00.05 087.54 07.98 +00.00 +0000.00 0000 (G)											
MB PING	000003		2008/092 15:25:36.116 30 12.87208 N 089 00.36401 W 254/254 129 097.20 +01.23 +01.14 +00.04 087.55 07.98 +00.00 +0000.00 0000 (G)											
MB PING	000004		2008/092 15:25:36.152 30 12.87209 N 089 00.36392 W 247/254 129 097.25 +01.35 +01.27 +00.02 087.57 07.97 +00.00 +0000.00 0000 (G)											

View Record

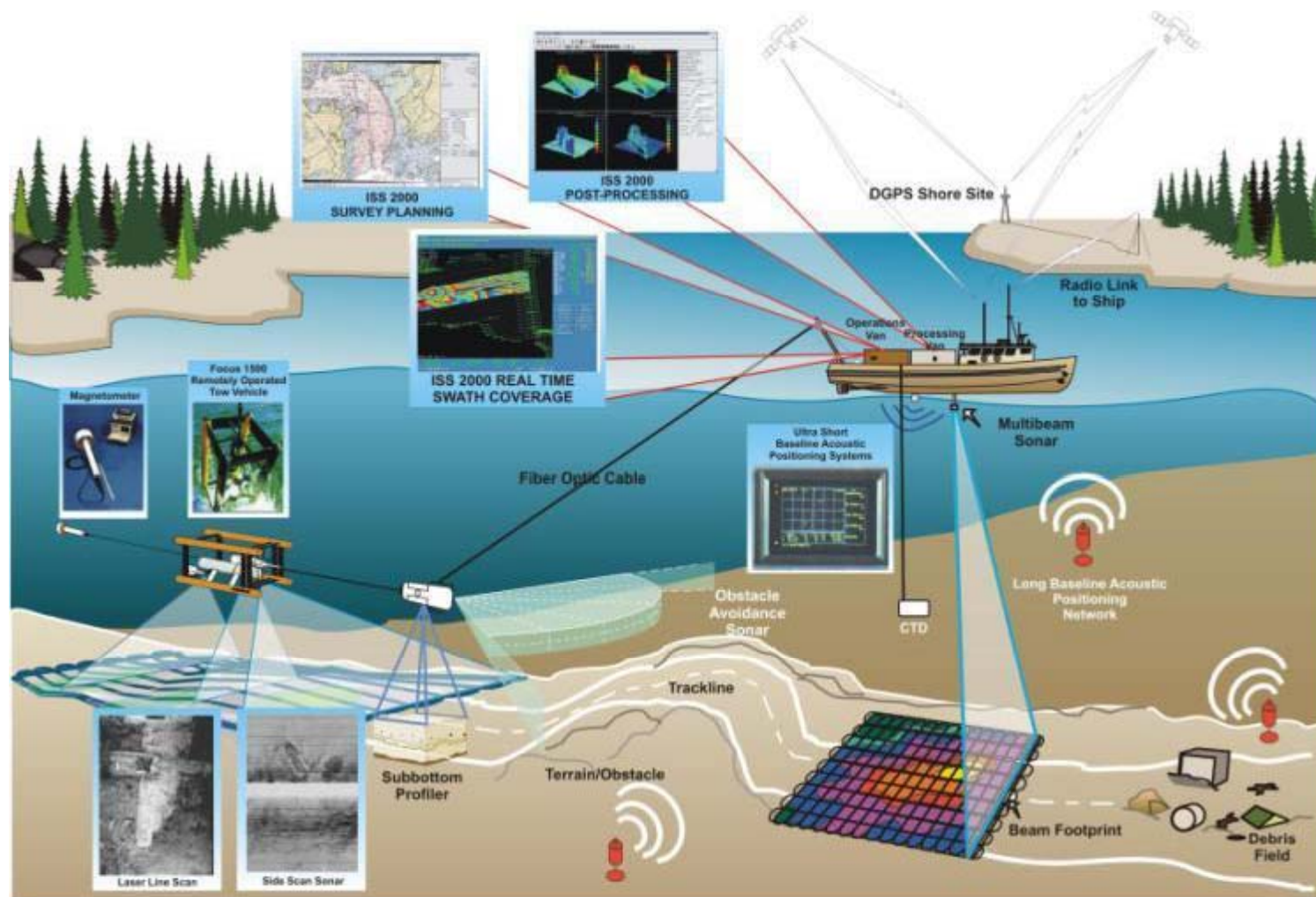


# ISS-2000 GSF Supported Equipment

- **Multibeam echo sounders**
  - Kongsberg EM100
  - Kongsberg EM120
  - Kongsberg EM121
  - Kongsberg EM121A
  - Kongsberg EM122
  - Kongsberg EM300
  - Kongsberg EM302
  - Kongsberg EM710
  - Kongsberg EM950
  - Kongsberg EM1000
  - Kongsberg EM1002
  - Kongsberg EM3000 and EM3000D
  - Kongsberg EM3002 and EM3002D
- **Interferrometric Side-Scan Systems**
  - GeoAcoustics GS+
- **Single-beam echo sounders**
  - Odom Echotrac
  - ODEC Bathy2000
  - Reson Navisound
- **Multibeam echo sounders**
  - RESON 8101
  - RESON 8111
  - RESON 8125
  - RESON 8150
  - RESON 8160
  - RESON 7125
  - RESON SEABAT 9001
  - RESON SEABAT 9002
  - RESON SEABAT 9003
  - Elac Bottomchart Mk II
  - SeaBeam 2100 series
- **Position & Orientation System**
  - Applanix POSMV
  - Kongsberg Seapath 200



# Integrated Survey System





# Ocean CLASS AGOR

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Questions?