

DEEP TOWED SEAFLOOR MAPPING SYSTEM REQUIREMENTS

The Naval Research Laboratory seeks to expand its capability to collect dual frequency side scan sonar data and sub bottom reflection profiles to deeper water areas of interest (3000m expanding potentially to 6000m) through upgrade of it's sidescan/chirp subbottom sonar system. The following document provides the required specifications for the upgraded capability.

1. Dual Frequency Full Spectrum Chirp Side Scan Sonar System that meets or exceeds the following specifications:
 - a) Dual center frequencies 100kHz (+/- 25%) and 500 kHz (+/- 25%)
 - b) 100kHz System full spectrum chirp bandwidth 10 kHz minimum
 - c) 100 kHz System pulse length 10ms maximum
 - d) 100kHz System range resolution 15 cm maximum
 - e) 100 kHz System range scale selection 50m – 750m minimum
 - f) 500 kHz System full spectrum chirp bandwidth 50 kHz minimum
 - g) 500 kHz System pulse length 2.5 ms maximum
 - h) 500 kHz System range resolution 3 cm maximum
 - i) 500 kHz system range scale selection 12.5m to 100m minimum
 - j) Transducer source level 210 dB peak (ref 1 micro Pa @ 1m minimum)
 - k) Horizontal beamwidth 1.2 degrees maximum
 - l) Vertical beamwidth 60 degree typical 15 degree tilt from horizontal
 - m) System operational depth 3000m minimum, upgradable to 6000m
 - n) Transducer operational depth 6000m minimum
 - o) Analog to digital conversion 16 bit minimum
 - p) Data sampling frequency minimum 2.5 times Nyquist Frequency

2. Full spectrum Chirp Sub bottom Profiler System that meets or exceeds the following requirements
 - a) Chirp Frequency Band 2 kHz maximum to 16 kHz minimum
 - b) Full spectrum pulse modulation with amplitude and phase weighting
 - c) Transmit Source Level 200dB re 1 micro Pa @ 1m minimum
 - d) Transmit Power 500 watts minimum
 - e) Receiver sensitivity –204 dB re 1 micro Pa @ 1m minimum
 - f) Receiver variable gain 38 to 105 maximum, automatic and manual control
 - g) Receiver noise level over sonar bandwidth at hydrophone input = 70 dB maximum
 - h) System operational depth 3000m minimum, upgradable to 6000m
 - i) Transducer operational depth 6000m minimum

3. Telemetry/multiplex system that meets or exceeds the following required specifications:

- a) Integrated telemetry system capable of providing down link for system control signal from topside electronics and up link for wet end data to topside data
- b) Acquisition and processing system capable of operation using typical coaxial cables on UNOLS oceanographic survey vessels (9000m minimum length)
- c) Compatible for operation with existing Branch A301301 cable.
- d) Provide 115v/230v/1200 watt minimum electrical power to wet end electronics
- e) Link transfer rate 4 mbits/sec minimum
- f) Capable of upgrade to allow operation with fiber optic tow cables

4) Tow body Integrated Depth Sensor with the following minimum specifications:

- a) Depth accuracy 0.01%
- b) Depth resolution 1m max,
- c) Depth range 0-7000m
- d) RS-232 serial interface

5) Physical Requirements

- a) Total wet end tow body weight in air 800-lb. maximum
- b) System configured to allow shore handling with standard lifting equipment (dolly, power tailgate, forklift etc.) and ship board handling on "ships of opportunity" equipped with standard shipboard cranes, davits, winches, A frames etc typically available on oceanographic vessels >50 ft.
- c) System underwater tow fish to tow cable connections to be compatible or adaptable for use with existing Branch A301301 tow cable.
- d) Topside data acquisition, system control, telemetry data link and tow vehicle positioning and control electronics to be installed in shock mounted 19 inch racks housed within transport cases of approximate dimension 32 in height, 27 in width, 28 in depth, (display monitors excluded)
- e) Wet end electronics packages, transducers and interconnecting cables may be removed from tow body and mounted in or on another tow body without major redesign or modification

6) Tow Vehicle Acoustic Positioning System (Integrated Towfish Position Sensing System)

- a) Portable system suitable for use on vessels of opportunity
- b) System compatible with the Government's existing SubScan system
- c) Super short baseline underwater acoustic tow body positioning system
- d) Variable frequency responder (responder converts to ping mode on cable separation).

- e) Receiver frequency bands 8-14kHz, 22-30kHz, 28-40kHz in 500 Hz increments
- f) Transmitter frequency band 5-30kHz in 500 Hz increments
- g) Transmitter pulse width 1-15ms in 0.1 ms increments
- h) System repeatability <0.15% RMS of slant range
- i) Calibrated accuracy <. 25% RMS of slant range
- j) Integrated VRU Unit
- k) RS232 interface for system integration and output

7) Topside Digital Data Acquisition, Display and Processing System

a) Data Acquisition and Storage

- System compatible with the Government's existing SubScan system
- Record minimum 4 channels full resolution digital side scan data, minimum 2 channels full resolution sub-bottom profiler data, one channel digital NMEA navigation data, tow vehicle digital depth data, tow vehicle motion sensor digital data and a minimum of one additional serial data channel
- Store uncorrected data to disk in a minimum of the following formats: SEG-Y, QMIPS, XTF and EdgeTech DF1000 format
- Replay of uncorrected data through system for later review and analysis
- Write uncorrected full resolution data in above formats from disk to 4mm DDS3 DAT tapes during data acquisition phase or alternately writing directly to dual DDS3 DAT tapes during data acquisition.
- Disk space remaining indicator

b) Data Display and Printing

- System compatible with the Government's existing SubScan system
- System display 1024x768 or 1280x1024 pixels, 256 colors/shades of gray, user selectable palates, user defined colors
- Real time/playback image output to Raytheon TDU 850 (user supplied)

c) Side Scan Sonar Data Acquisition Processing and Display

- System compatible with the Government's existing SubScan system
- Real time speed corrected display, full resolution zoom, manual or GPS speed
- Selectable sonar range, start/stop sonar, channel gain
- Sidescan sonar single or multiple channel display, image annotation and screen dump to file/printer capability
- User input water column sound speed
- Compute and apply side scan sonar grazing angle, beam angle, TVG corrections
- Side scan sonar image processing filter, image equalization, contrast control

- Bottom tracking, real time and/or playback display of side scan data in slant range corrected/uncorrected modes and water column removed/present modes
- Real time sidescan sonar mosaic, coverage chart and track plot
- Side Scan sonar target logging, detection, measurement, image capture and storage to database/report

d) Sub-bottom Profiler System Data Acquisition and Display

- System compatible with existing the Government's SubScan system
- User control of sonar on/off, sonar pulse shape (chirp range), pulse duration, pulse rate, output power, receiver gain, time variable gain and sonar delay
- Sub bottom signal heave removal based on towfish motion sensors
- Sub bottom swell filter, envelope normalize, compression, direct path removal
- Display control of video delay, vertical scale, depth grid, and horizontal scale
- Sub bottom reflector tracking, layer velocity specification, feature /target mapping
- Bottom detection and tracking for merging with depth, nav to produce bathymetry
- Sonar calibration correction, seabed reflection coefficient calculation

e) Navigation data acquisition, processing and display

- System compatible with the Government's existing SubScan system
- User input of navigation antenna offsets, input of navigation from external file
- Record/display time date from GPS NMEA navigation system input
- Display/print navigation track plot

g) Tow vehicle data acquisition processing and display

- System compatible with Government's existing SubScan system
- Display tow vehicle altitude, depth, attitude (pitch, heave, roll, heading etc)
- Compute and store towfish layback correction base on cable out parameters
- Interface with Tow Vehicle Acoustic Positioning system to merge navigation and sensor data to display and store in output data format latitude and longitude of tow vehicle as well as range and bearing information.

OPTIONS:

Option 1: Integrated Towfish Motion Sensing Package

Wet end towfish system to be configured with motion sensing package with the following minimum requirements:

Integrated tow body motion sensing system providing digital output of tow body pitch, roll, heading, heave, surge and sway with the following specifications:

- a) Minimum resolution all axes 0.01%
- b) Noise level all axes 0.03 degrees typical
- c) Static accuracy roll, pitch 0.05 degrees typical
- d) Static accuracy heading 0.3 degrees typical
- e) Dynamic accuracy roll, pitch 0.1 degree RMS
- f) Dynamic accuracy heave 2 % relative error plus sensor noise
- g) Heave sensor noise 0.001 m rms.
- h) Heave acceleration range +/- 30 m/sec²
- i) Digital output RS232, 100 Hz maximum output rate, 50 Hz typical
- j) High reliability, no scheduled maintenance, no mechanical wear out parts
- k) Power requirements 12-30V DC. 5 watt max
- l) Temperature range -5 to 55 degrees C, temperature compensated

Data acquisition and display system to be configured with following minimum requirements:

- a) Capability to record, process and display in real time fish heading, pitch roll and heave information from motion sensor.
- b) Capability to post process motion sensor data in combination with depth sensor readings, chirp sub-bottom profiler bottom tracking and navigation data to produce bathymetric output file.

Option 2: Emergency Recovery System

System for recovery of lost towfish with the following minimum requirements:

- a) Variable frequency responder on towfish converts to ping mode on cable separation allowing towfish position to be determined using positioning system.
- b) Acoustically activated release system to cut umbilical cable on demand
- c) Integrated Xenon strobe and Radio direction finder
- d) Tow vehicle positive buoyancy insert
- e) Acoustic release top side transmitter/electronics
- f) System configured to prevent accidental triggering by normal system operation

Option 3: Swath Bathymetry

100kHz side scan sonar system configured to collect interferometric swath bathymetric data with the following minimum requirements:

- a) Wet end hardware to be configured to collect high resolution swath bathymetric data using 100Khz side scan sonar system without major redesign or modification
- b) Data link and acquisition system to be configured utilizing software modules to collect, process and display swath bathymetric data without major redesign or modification
- c) Digital filtering to remove cross talk and interference between sub-bottom and sidescan sonar channels

Option 4: Interface with the Government's existing Geometrics G880 magnetometer

- a) Tow vehicle system to be configured to tow existing Geometrics G880 magnetometer system without major redesign or system modifications
- b) Data link and acquisition system may be configured utilizing software modules to collect, process and display magnetometer data without major redesign or modification

Option 5: 6000 meter capability

- a) Wet end electronics pressure vessel to be configured for 6000m working depth capability without major redesign or modification except for replacement of pressure vessel and connectors
- b) Sidescan and Chirp sub-bottom profiler transducers rated to 6000m working depth

Option 6: Fiber optic tow cable compatibility

- a) Tow vehicle system to be configured to allow option of utilization of UNOLS fiber optic tow cables without major redesign or modification
- b) Data link and system may be upgraded to utilize fiber optic tow cables without major redesign or modification
- c) Fiber optic data link may be upgraded with sufficient power and communication bandwidth to support interface with towed multibeam bathymetric sonar system (Simrad SM20 00)