



## Job Book with Nav/Positioning Report

Client: Lamont Doherty Earth Observatory

Description: Cruise MGL0807

Cruise start date: March 19<sup>th</sup> 2008

Cruise end date: April 16<sup>th</sup> 2008

## Revision History

Version	Description	Date	Approved
1.0	Initial Draft	03/18/2008	
1.1	Additional Notes	04/15/2008	
1.2	Parameters Added	04/16/2008	

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## Introduction

NCS SubSea, Inc. has been contracted to provide positioning and navigation processing services for the operation of Spectra, which accurately plots the ships position in realtime, and Sprint, used to processes the data for a final product.



## **HSE**

NCS conducts its business with the utmost regard for the Health and Safety of our employees, and respect for the environment.

All employees are empowered to stop work immediately in the presence of an uncontrolled hazard. Every employee must be provided access to the appropriate Personal Protective Equipment (PPE) to ensure protection from hazards.

No NCS employee is permitted to intentionally damage the environment through the emission of any substance in any form.

All NCS employees working offshore are required to pass Medical evaluations conducted by Methodist Hospital in Houston, Texas. The evaluations are conducted every two years to the Schlumberger Medtrack standard.

Similarly all personnel are required to pass Sea Survival and Helicopter Underwater Egress Training (HUET) every three years in a US Coast-Guard approved facility.

TITLE	REVISION NO:	DATE EFFECTIVE	SECTION:
MEDICAL PROCEDURES	2	APR. 23, 2005	9.1.
	ORIGINATOR:	APPROVED BY:	PAGE
	Michael Rawson	Paul W. Ljunggren	Page 1 of 1

## Emergency Response Plan

### Medical Procedures

#### 1. Scope

This section describes the procedures for treatment medical problems onboard a research vessel(s) operated by Lamont-Doherty Earth Observatory Office of Marine Operations (OMO).

Any injury or sickness, no matter how minor should be reported to a supervisor or medical person in charge as soon as possible.

#### 2. Treatment of Medical Condition

2.1. The L-DEO research vessel(s) as are all UNOLS ships, is a subscriber to the Medical Advisory Service (MAS) which is on call 24 hours per day to provide medical advice via the Inmarsat telephone:

2.1.1. Determination of extent of injury or sickness.

2.1.2. Advice on procedures for treating illness or injury.

2.1.3. Provide contact with nearest medical facility if needed.

2.2. Instructions for making contact with MAS are detailed in the MAS Medical Protocol Handbook in the ship's Hospital library (Section 9.1.1.)

2.3. Treat the injury or sickness as per medical protocols from the hospital library reference materials (Hospital Library (Section 9.1.1) with medical inventory on board (ref: Quarterly Medical Inventory sheets).

2.4. Document all treatment that is prescribed through the MAS in ship's medical log. All faxes or telexes relating to the treatment should be filed in the personal file of an injured or sick party. Treatments for minor injuries or maladies do not need to be logged.

#### 3. Medications

3.1. All medications maintained by the vessel as medical inventory are stowed in the Ship's Hospital on the aft Port side of A-Deck.

3.2. Medications and emergency medical supplies are inventoried every three months.

3.3. No medication is prescribed unless administered by Captain or Chief Mate.

#### 4. Serious Injury Situation

4.1. Reference should be made to the MAS Medical Protocol Procedures Manual (Section 9.1.1. Hospital Medical Books Library) to determine if an injury is serious enough to contact the medical advisory service.

4.2. If an illness or injury is serious, the MAS should be contacted by telephone or fax.

4.3. In the event of a serious injury, illness or accident, the Columbia University Accident Report should be completed per instructions in Section 12. and 12.5 in the Administrative Procedures manual.

#### 5. Life Threatening Situation

5.1. In the event of life threatening injury or accident, in consultation with the medical advisory service, Chief Scientist and the Designated Person at the Office of Marine Operations, consider diverting to nearest port for advanced medical treatment.

5.2. Notify the appropriate national authorities, and if possible, arrange medical evacuation at sea. The following references should be consulted in the event of a medical diversion:

5.2.1. Medical Advisory Service (Manual, Hospital Library)

5.2.2. Agent's list

5.2.3. Contact numbers in List of Radio Determination and Special Stations.

#### 6. Chemical Testing

6.1. In the event of a serious marine accident as defined in 46 CRF4.03-2, chemical testing shall be carried out as specified in 46 CRF 4.06.

# Job Specifications

## Geodetics

### MGL0807

Satellite Datum  
WGS-84

### MGL0807

Survey Datum  
WGS-84

Spheroid Name:	WGS-84	Semi-Major Axis :	6378137.000
Unit:	Meter	Semi-Minor Axis:	6356752.31424518
Semi-Major Axis	6378137.000	Flattening:	0.003352810665
Inverse of Flattening	298.257223563000	Inverse of Flattening:	298.257223563000

UTM Projection – Hemisphere North – Zone 16

## Deliverables

Description	Media	Frequency	Comments
P1/90 Processed Data			
P2/94 Raw Data			
Daily Log			
Job Book/Final Report		Job Completion	See contents below



## Sequence / Line report

Seq	L. Name	J-Day	DIR	FGSP	LGSP	Distance m. space	Time sec. interval	comments
1	OBS1	0	turn	1001	1080	0	20sec.	Start 9m depth - streamer and guns MGL0807.SCN (001)



### ***Area of Operations***

This is a continuation of work done on trip MGL0804 done on the Caribbean side of Costa Rica and Nicaragua. This work will be done on the Pacific side of the same two countries.



# Personnel

## *Client Contacts*

Name	Position	Cell Phone	E-Mail
Al Walsh	Project Leader		Alwalsh@ldeo.columbia.edu

## *NCS Personnel*

Name	Position	Cell Phone	E-Mail
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Mike Martello	Party Manager	228 238 1368	mike.martello@ncs-subsea.com

## NAVIGATION / QC

### SPECTRA

Spectra is a comprehensive integrated seismic navigation system with a modular design, which allows any *innovations in navigational techniques* to be applied quickly.

Spectra is based on an expandable network of Unix or linux workstations with a dedicated real time navigation sensor acquisition system **RTNu** providing access to a tried and tested database of over 100 different navigation sensors and closure timing to a 50 micro-second resolution.

#### *Benefits of spectra*

- **Navigation acquisition and validation with real time source and streamer positioning for marine seismic surveys ranging from simple 2D and high resolution requirements to extensive 3D multi-streamer, multi-vessel configurations.**
- **Distributed Data Server provides simple connectivity to easily configure complex multi-vessel surveys. Real-time data acquisition units with integrated GPS receiver provide triggering to 50 micro-seconds, allowing remote synchronization of seismic and acoustic systems.**
- **Data logging to UKOOA P1/90, P2/91 and P2/94 standards with full redundancy, providing confidence in data integrity.**
- **Quality Control features providing alarm and audit facility meeting UKOOA guidelines. Extensive on-line graphical analysis features and end of line reporting facilities.**
- **Positioning using Kalman filtering with advanced data-probing statistical testing techniques.**
- **DGPS and RGPS real-time recomputation.**
- **Autopilot interface controlled from instrument room leaving the navigator in charge of steering. This facility is fully integrated with a comprehensive turn planning utility, providing optimum efficiency in line changes.**

#### **When used for 3D:**

- **For 3D use: real-time binning, CMP and offset distribution displays. Fully compatible with Concept Systems off-line binning and analysis package including bin expansion capabilities.**

## Data Acquisition

The seismic data will be acquired using a Marconi Solid Cable system. Sections - 150m -sections to compose the streamer will be used to acquire 636 channels of data on the 24 bit system.

## Positioning

Vessel positioning will be achieved using the Spectra Totally Integrated System, provided by LDEO, which accurately plots the ships position in realtime. The system generates signals by which the “DigiSHOT” commands the Air Guns to fire at pre determined intervals, based on either distance or time as previously determined. This “trigger” also signals the Syntrak 960 -24 recording system to record seismic data from the 8.1km streamer cable, when used.

Real Time positioning of the source and tailbuoy will be achieved with PosNet, a remote gps system which can gives a direct range and bearing in realtime for all events.

## GPS

The C-Nav GPS Receiver combines a dual-frequency, geodetic grade, GPSReceiver with an integrated L-BAND communication RF detector and decoder all linked by an internal microprocessor. Corrections are supplied through satellite link, thus giving a GPS Quality indicator of 2 or GcGPS Corrected Fix.

Seapath 200 is a stand-alone system, which does not require input of data from any other sensors in order to provide accurate heading, roll, pitch and heave. Seapath requires input of DGPS corrections. Seapath provides a real-time heading, attitude, position and velocity solution by integrating the best signal characteristics of two technologies, Inertial Measurement Units (IMU's) and he Global Positioning System (GPS). Seapath utilizes the proven and reliable Seatex MRU 5 inertial sensor and two GPS carrier phase receivers as raw data providers. The raw sensor data are integrated in a Kalman Filter in the Seapath Processing Unit. The Kalman filter is a proven and effective filtering technique for integration of various sensors in a realtime environment, and the filter output provide heading, attitude, and position data required in survey applications.

POS/MV – Uses three sensors – the Inertial Measurement Unit (IMU) and two Global Position System (GPS) receivers. These allow the System to deliver an accurate and comprehensive data set, including:

- Geographic position (latitude, longitude and altitude)
- Heading
- Attitude (roll and pitch)
- Vertical displacement (heave)
- Velocity
- Acceleration
- Angular rate of turn
- Performance metrics
- Fault detection and reporting

## Gyro

The Simrad GC80 gyro has been designated for any size vessel, to enhance the navigation capabilities and reliability. This is done by using basic gyroscopic action to form a stable directional platform.

When the 3 axes (spin axis, horizontal axis, and vertical axis) of the gyro reach a high stable revolution rate, the compass card reflects the True heading in relation to north. This is a factory preset, where a weight is added to the vertical ring (axis). Another, smaller weight is added to the sphere giving a damping effect to the oscillations created by the vertical ring weight. The GyroCompass north-seeking tendency depends upon the fact that north is a right angles to the west-to-east direction in which the earth's rotation carries the compass. A high degree of accuracy is maintained by the use of scheduled "calibration checks" where slight fluctuations (if any) are compensated in Spectra.

## Energy Source

The energy source is a 4 string array, utilizing Bolt internal shuttle guns. Each sub-array dimensions are 16 meters in length with a sub-array cross line separation of 8 meters, and are composed of 10 guns with 1 of the 10 being a "spare" gun leaving a 1650cu in volume per string. Without the "spare" guns, a total volume of 6600 cu in. is reached.

Source synchronization is achieved with a DigiSHOT Seismic Source Controller System. The DigiSHOT control's all airguns within the same array. The timing for each gun is individually controlled.

The system collects and displays graphically the sensor data for all guns in the array. It also collects and displays the gun depth and air pressure supplied to each string.

The sensor data is used to detect when the airgun was triggered and to make the necessary adjustments to airgun timing. The DigiSHOT system provides timing resolution of 0.1ms.

Source positioning will be derived by nominal value and actual RGPS range and bearings, and acoustic positioning pods.

## Cable Compasses

Digicourse Model 5011 Compass Birds will be distributed along the streamer, and used to model the cable shape for the positioning of the receivers. These compasses will be present at every 300 meters. The Model 5011 Compass Bird provides adjustable depth control, depth measurement, ballast information, and compass heading. The heading sensor is a compass designed for in-streamer installation. A digital number (indicative of orientation relative to magnetic North) is latched to a serial pulse train output. All information is transferred to the streamer "coils" when polled and returned to the vessel by wire to the Digicourse computer and to Spectra.

## PosNet

Designed to work with SARGAS reference stations, PosNet can be used in areas where coverage is not available, such as the Costa Rica and Nicaragua waters, where our survey is located. The relative position accuracy of the local targets: gun pods, tailbuoy, is unaffected, as they are independently estimated relative to the vessel, and the vessel position is known sufficient accuracy even without any DGPS correction to obtain sub meter target relative position to the ranges that are used for these operations.

All raw and computed data may be recorded. The Windows XP™ based computer used by PosNet is networked to Spectra and all received data is available for use.

### GUN POSNET PODS

One located on each outside gun string, 23cm behind the center of source, for a total of 2.

### TAILBUOY POSNET POD

One located on tailbuoy.

## Streamer Cable Composition

1. Lead-in – Heavy armored cable that packages the wires and fiber optics and is used to provide the offset from the vessel to the first active section. And to communicate (send/receive) information from the streamer.
2. RVIM – head stretch between the lead in and STU. Its length is 30m upon deployment, and it acts as a “shock absorber” reducing the effect of the vessel’s movement upon the deployed streamer in the water.
3. STU –streamer tension unit is incorporated in order to monitor the tension upon the streamer. This is to protect the steamer from unnecessary “pull” causing damage or loss of streamer.

The streamer is a Syntron Sentry Solid streamer.

4. Length of the “active streamer” is 8100 meters and is composed of 54 x 150 meter long active sections. These sections are connected by modules which control the data flow. Each section contains “communication coils,” located at known positions on the cable, and is used to communicate to “cable levelers, compasses, depth indicators.” This same “coil” can also communicate with the acoustic pods. All is monitored by Spectra and its QC.
5. Tail Stretch is located at the end of the active streamer, after a passive module that terminates the streamer. The 50m tail-stretch, is used similarly as the head-stretch, to reduce unwanted tugging on the streamer.
6. Stic-cable, 75m, is used to send power to the active TailBuoy, for the electronics located there, RGPS, acoustic pod, and radio modem. This data is then, by radio link, sent to the vessel and Spectra. The active tailbuoy GPS will provide for accurate rotation of the streamer to the tailbuoy in processing, providing a highly accurate streamer shape.

# Streamer Layout



S1C1	37.96	S1C7	-1761.04	S1C13	-3561.05	S1C19	-5361.05	S1C25	-7161.05	G1T1	*****
S1C2	-261.04	S1C8	-2061.04	S1C14	-3861.05	S1C20	-5661.05	S1C26	-7461.05	G1T2	*****
S1C3	-561.04	S1C9	-2361.04	S1C15	-4161.05	S1C21	-5961.05	S1C27	-7761.06	G1T3	*****
S1C4	-861.04	S1C10	-2665.05	S1C16	-4461.05	S1C22	-6261.05	S1C28	-7911.06	G1T4	*****
S1C5	-1161.04	S1C11	-2961.05	S1C17	-4761.05	S1C23	-6561.05	S1T1	*****		
S1C6	-1461.04	S1C12	-3261.05	S1C18	-5061.05	S1C24	-6861.05	S1T2	*****		

These S1 Compass offsets are referenced to center near group (cng).

For acoustic offsets – see reference pages.

## Acoustic's

SIPS is the Seismic Integrated Positioning System manufactured in the U. K. by Sonardyne International Ltd.

SIPS is designed for use on marine seismic survey vessels as an acoustic positioning system for airgun arrays, streamers and tailbuoys.

In use for this survey is the 1 way ranging transceiver model number 7785.

The basic operation method of SIPS is the measurement of ranges between in-water units of a seismic system so their relative positions can be calculated.

The distance between units are measured using the principle that sound travels through water at a predictable speed. By measuring the time for sound to travel between two points the range can be calculated. Multiplying the travel time by the speed of sound gives the distance travelled.

The sound used by the SIPS system are very short pulses of a constant high frequency.

The Sips system uses intelligent acoustic transceivers placed at reference points that need to be positioned. The Transceivers have a digital data link with the shipborne equipment to transfer the measured range data.

The devices are also controlled from the surface system using these data links.

The units mounted on the streamers are battery powered and use the streamer embedded coil communications system. Other units are hard wired into the surface system using dedicated communications links. For other applications a radio modem link can be used to communicate with transceivers.

A transceiver is an intelligent unit which can be used to measure distances underwater. SIPS transceivers are commanded by Controller boards mounted in the SIPS Controller rack. The Controllers send commands to the transceivers to initiate the ranging process and then request range data from the transceivers. Transponder units do not have an associated Controller card. A Transponder will transmit an acoustic reply after a preset interval when a particular acoustic signal is received from a transceiver.

Locations: One on each gun string for four; and two on the streamer head for a total of 6.



## **Multibeam echosounder**

The EM 120 multibeam is designed to perform seabed mapping to full ocean depth. The system is cost effective, reliable, and easily operated on workstations with familiar operating systems.

### **Key facts**

The Kongsberg Maritime product is designed to perform seabed mapping to full ocean depth with an unsurpassed resolution, coverage and accuracy. The design is based on more than 50 years of hydrographical experience with echo sounders, sonars and underwater positioning for civilian and military use.

The EM 120 is a complete system. All necessary sensor interfaces, data displays for quality control and sensor calibration, seabed visualization, and data logging are a standard part of the system, as is integrated seabed acoustical imaging capability (sidescan).

The nominal sonar frequency is 12kHz with an angular coverage sector of up to 150 degrees and 191 beams per ping as narrow as 1 degree. Achievable swath width of a flat bottom will normally be approximately six times the water depth. The angular coverage sector and beam pointing angles may be set to vary automatically with depth according to achievable coverage. This maximizes the number of usable beams.

The EM 120 transducers are linear arrays in a Mills cross configuration with separate units for transmit and receive. The arrays are divided into modules (and hence the beamwidth) may be adjusted according to particular installation requirements.

A combination of phase and amplitude detection is used, resulting in an instrument measurement accuracy practically independent of beam pointing angle.

## **Water Column Velocity of Propagation**

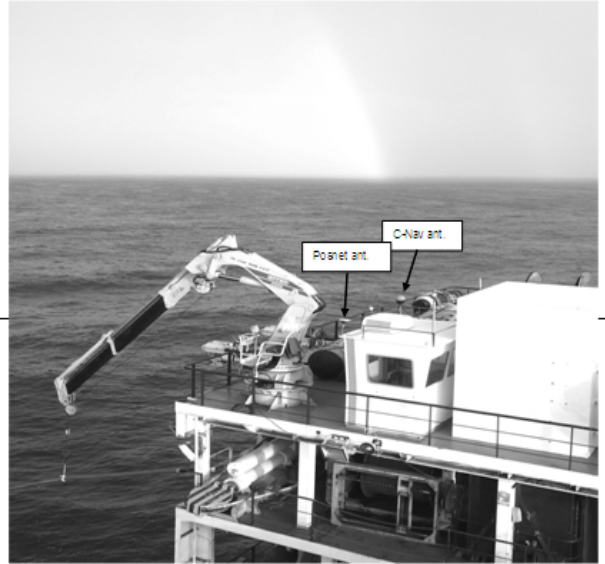
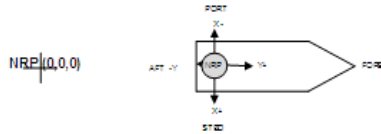
Water velocity for the survey will be assumed at a static 1500 m/sec except for seismic processing.

## **Navigation Data Processing**

[Not a prerequisite for this survey. Sprint is available.](#)

# Navigation Antenna Offsets

r/v Marcus G. Langseth - Navigation Mast



Both C-Nav and Posnet antennas are located on the "observation deck", starboard side above the "winch operator booth", forward of the NRP.

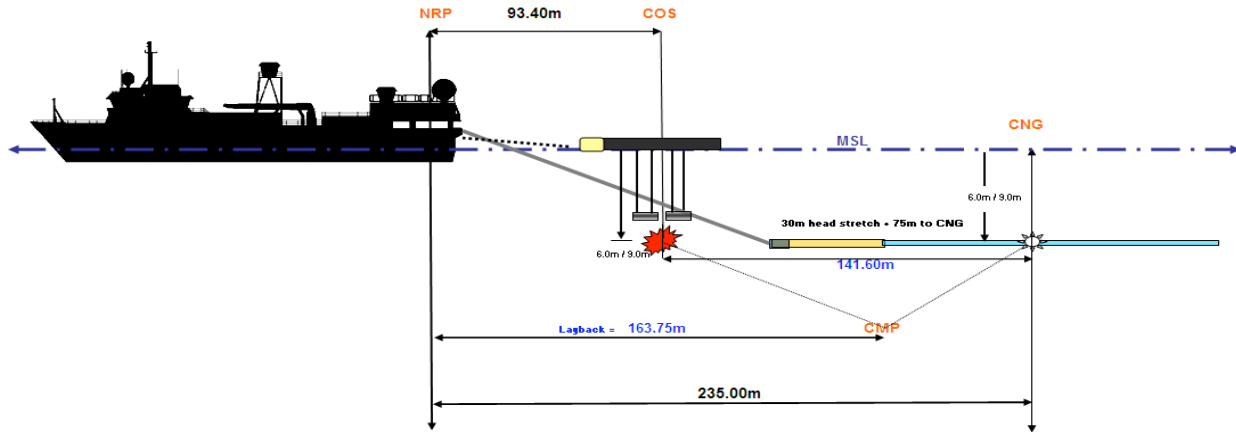
		FORE / AFT (Y)	STBD / PORT (X)	UP / DOWN (Z)
NRP	NAVIGATION REFERENCE POINT	0.000	0.000	0.000
VIG1	C-Nav	4.870	8.065	14.800
VIG2	PosV (on top of M/MO tower)	-1.500	25.300	16.900
VIG3	SeaPath (on top of M/MO tower)	1.500	25.300	16.900
VIR1	PosNet IGPS	4.870	10.453	14.500

All measurements in meters

# FRONT-END OFFSETS

## R/V Marcus G. Langseth - Towing Offsets

\*\*\* Offsets used for sequences 1 to 13 \*\*\*  
 note: Seq. 1 -> Seq 5 - shot with 9 meter streamer & 9 meter gun depths  
 note: Seq. 6 -> Seq 13 shot with 6 meter streamer & 6 meter gun depths



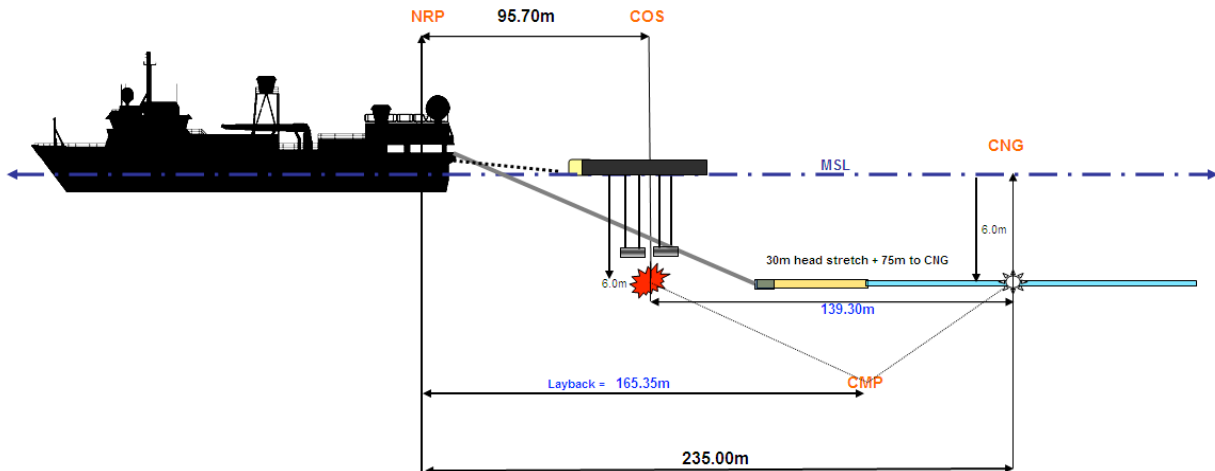
*** Offsets used for sequences 1 to 13 ***		
NRP-Stern	4.20 m	
NRP-COS	93.40 m	
NRP-CNG	235.00 m	
COS-CNG	141.60 m	
NRP-CMP	163.75 m	Lagback

<b>NRP</b>	<b>Nav Reference Point</b>
<b>COS</b>	<b>Centre of Source</b>
<b>CNG</b>	<b>Centre of Near Group (Trace # 001)</b>
<b>CMP</b>	<b>Common Mid-Point</b>
<b>MSL</b>	<b>Mean Sea Level</b>

All measurements in meters

## R/V Marcus G. Langseth - Towing Offsets

\*\*\* Offsets used for sequences 14 to 50 \*\*\*



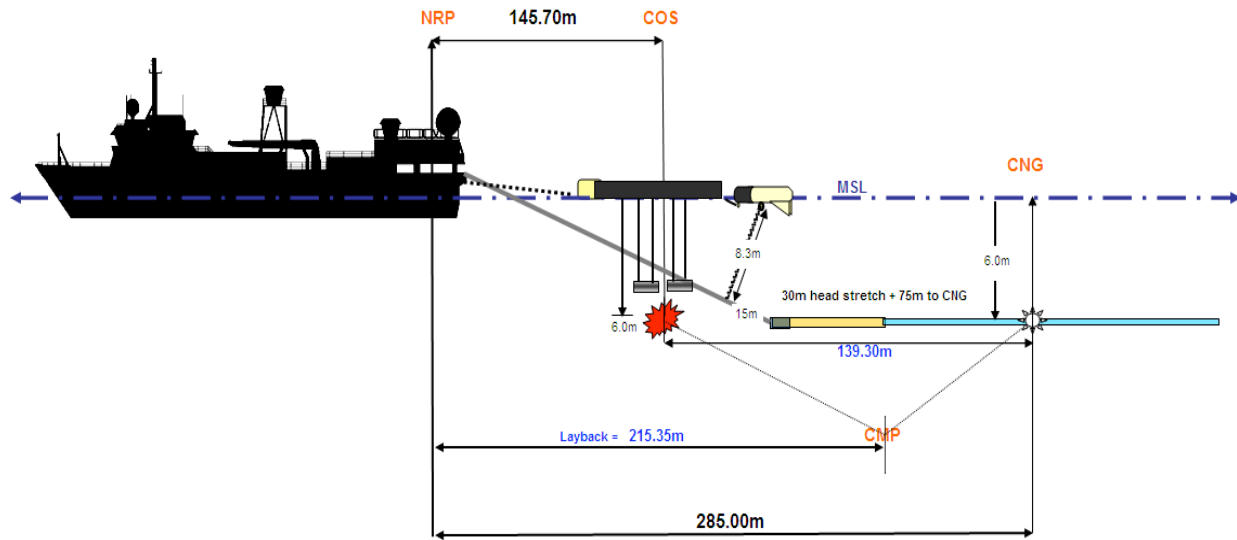
*** Offsets used for sequences 14 to 50 ***		
NRP-Stern	4.20 m	
NRP-COS	95.70 m	
NRP-CNG	235.00 m	
COS-CNG	139.30 m	
NRP-CMP	165.35 m	Lagback

<b>NRP</b>	<b>Nav Reference Point</b>
<b>COS</b>	<b>Centre of Source</b>
<b>CNG</b>	<b>Centre of Near Group (Trace # 001)</b>
<b>CMP</b>	<b>Common Mid-Point</b>
<b>MSL</b>	<b>Mean Sea Level</b>

# FRONT-END OFFSETS (continued)

## R/V Marcus G. Langseth - Towing Offsets

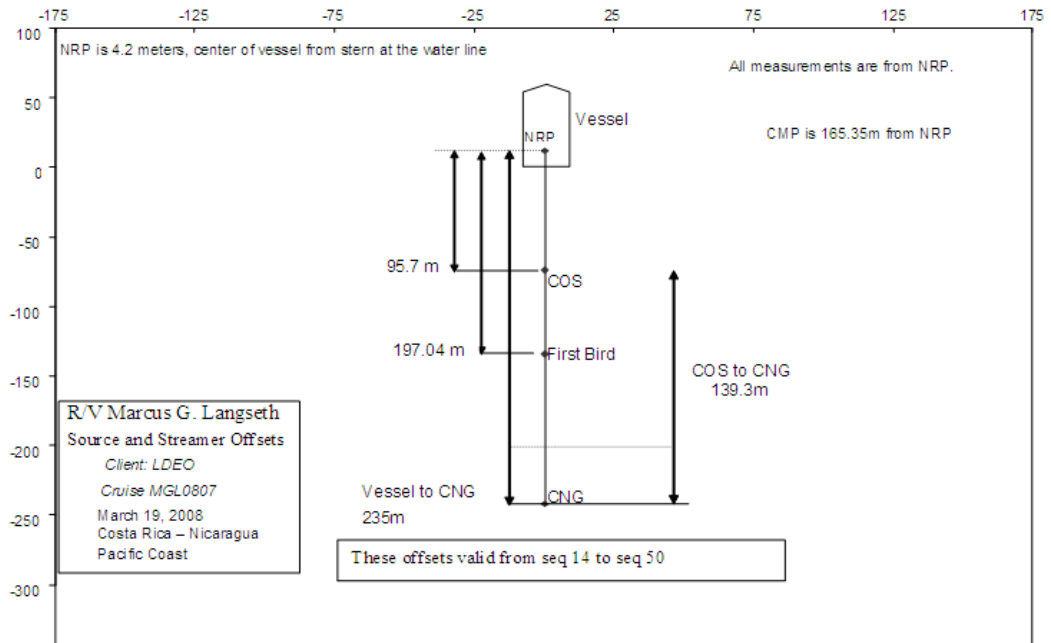
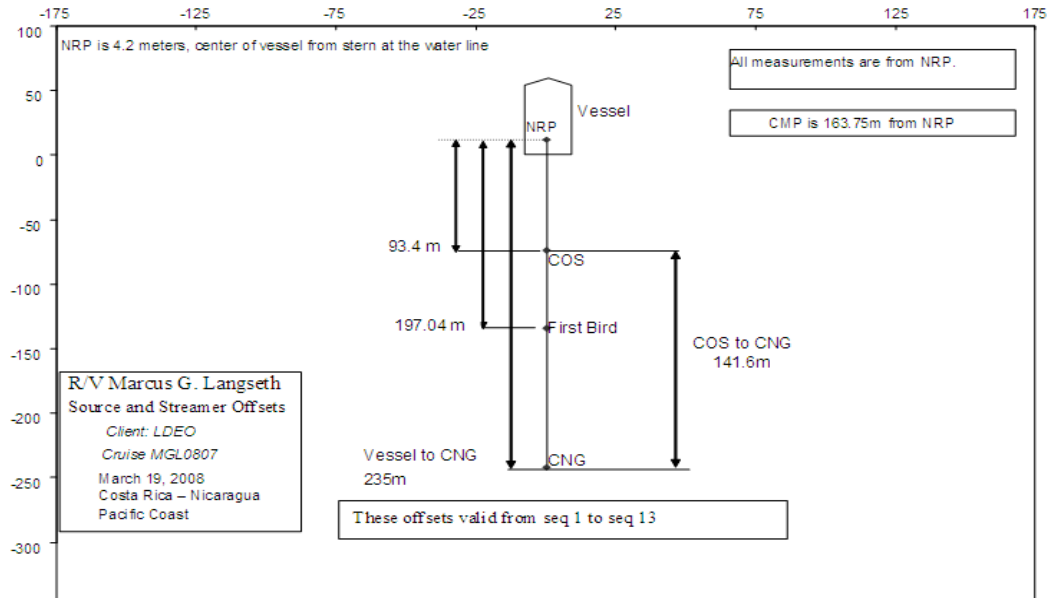
\*\*\* Offsets used for sequence 51 to end of survey \*\*\*



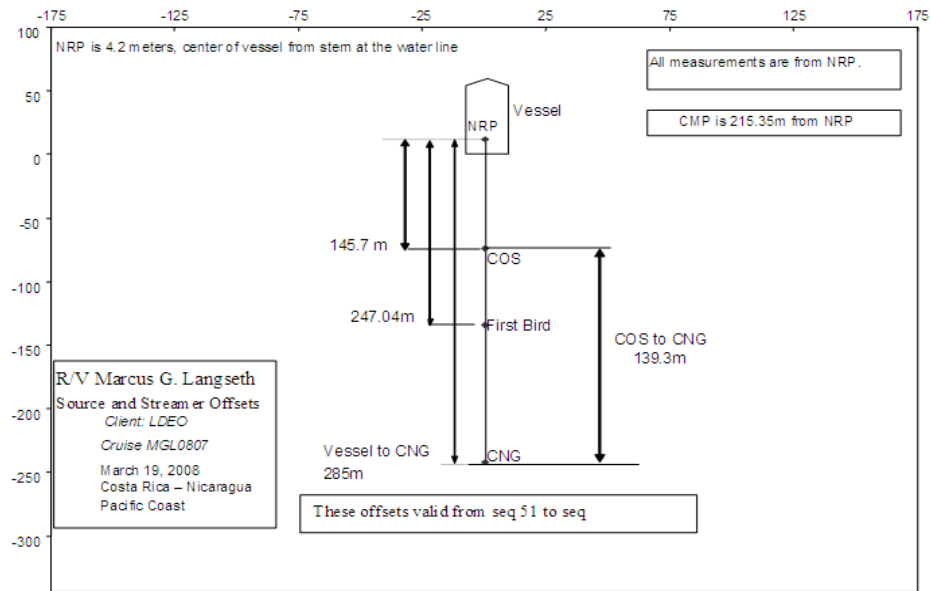
*** Offsets used for sequences 51 to XX ***				
NRP-Stern	4.20 m		IIRP	Nav Reference Point
NRP-COS	145.70 m		COS	Centre of Source
NRP-CNG	285.00 m		CNG	Centre of Near Group (Trace # 001)
COS-CNG	139.30 m		CMP	Common Mid-Point
NRP-CMP	215.35 m	Layback	MSL	Mean Sea Level

Head float installed for Seq 51 and used to end of survey.

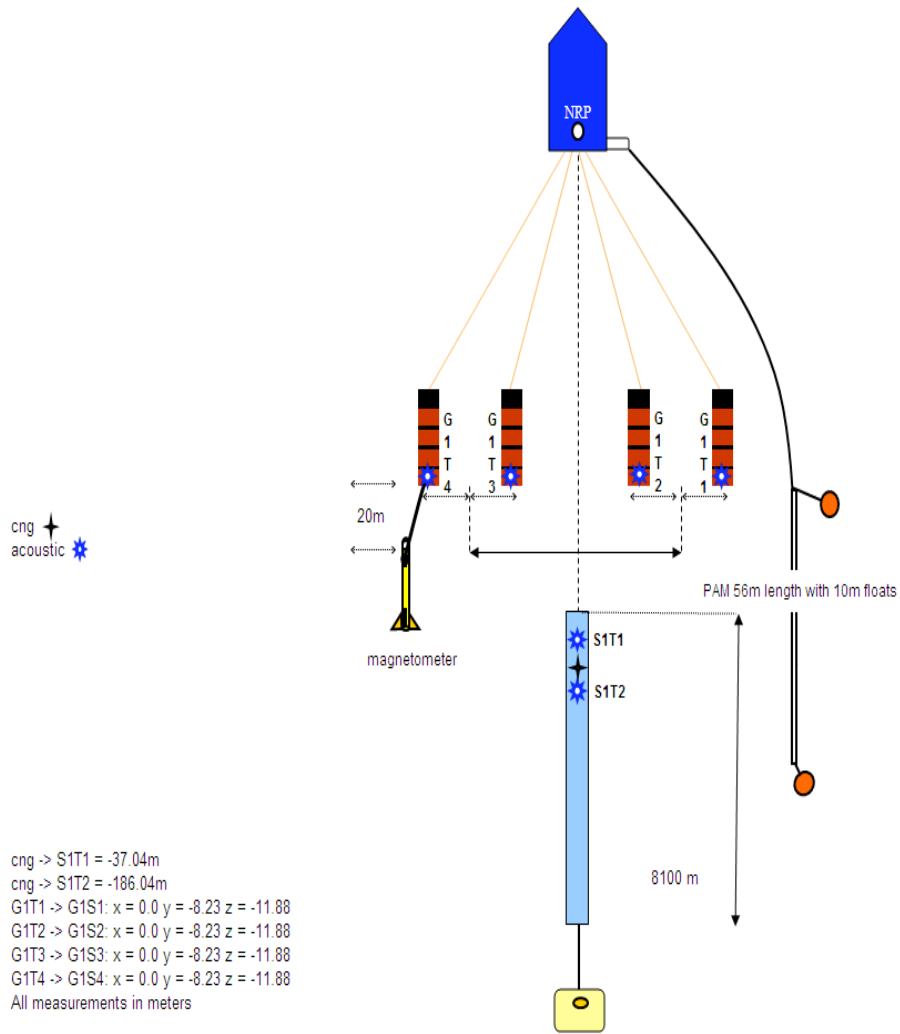
# FRONT-END OFFSETS (OVERHEAD VIEW)



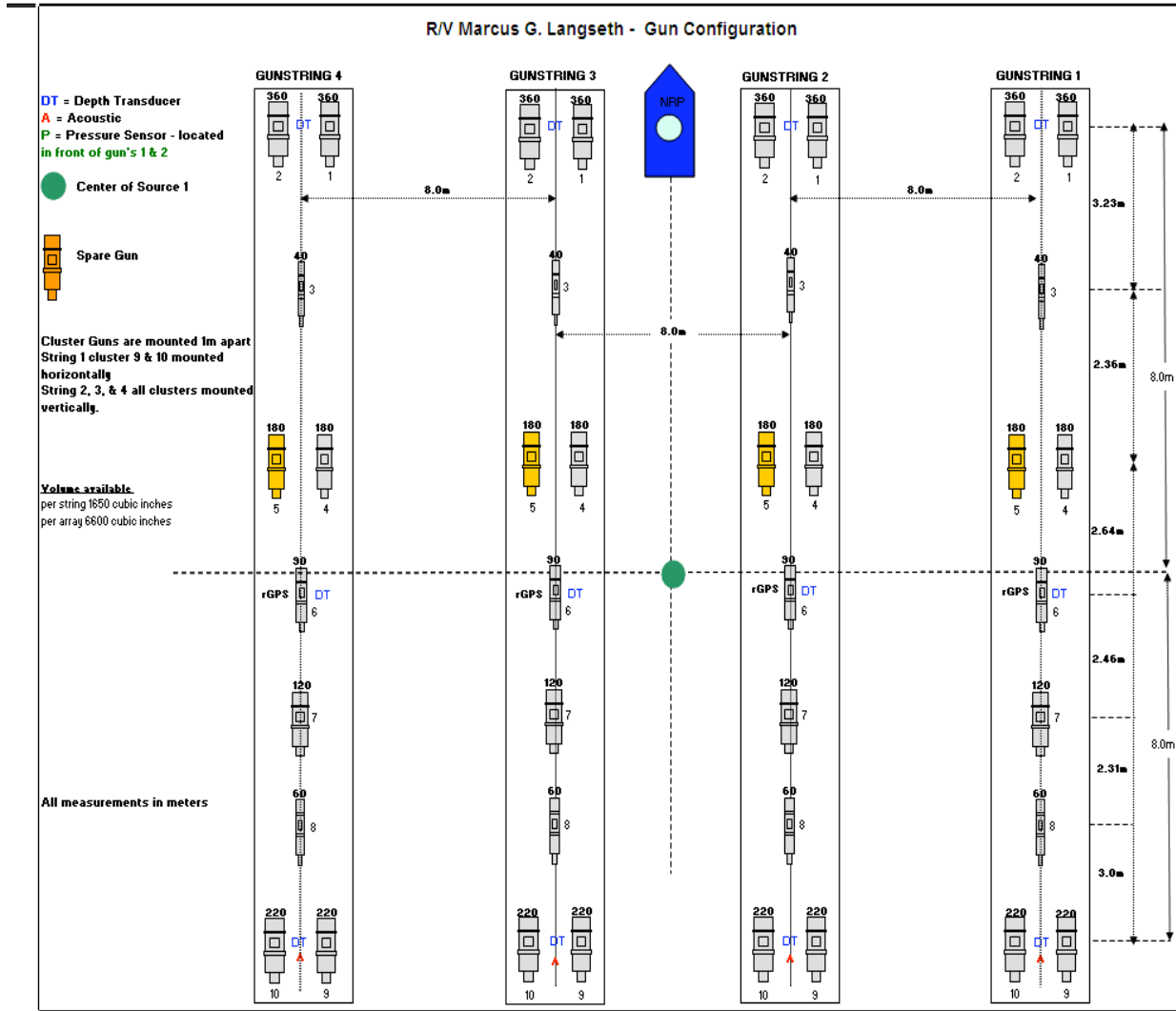
# FRONT-END OFFSETS (OVERHEAD VIEW – continued)



# Acoustic Overhead View



# LANGSETH GUN ARRAY LAYOUT

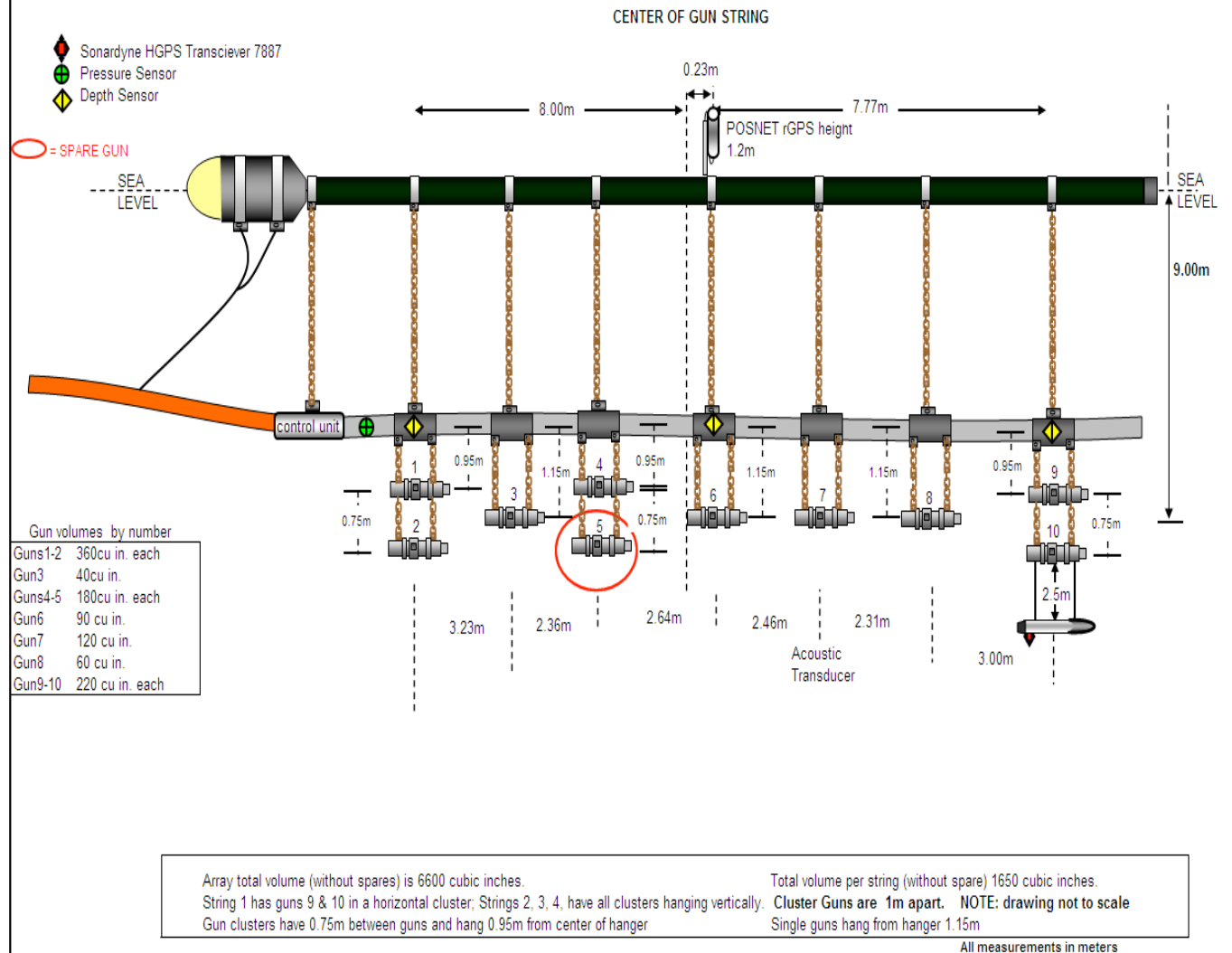


Note: Gun #5, on all strings, is spare gun.  
 Note: Gun strings 2 & 3 do not have rgps on this survey.



# SUB-ARRAY LAYOUT

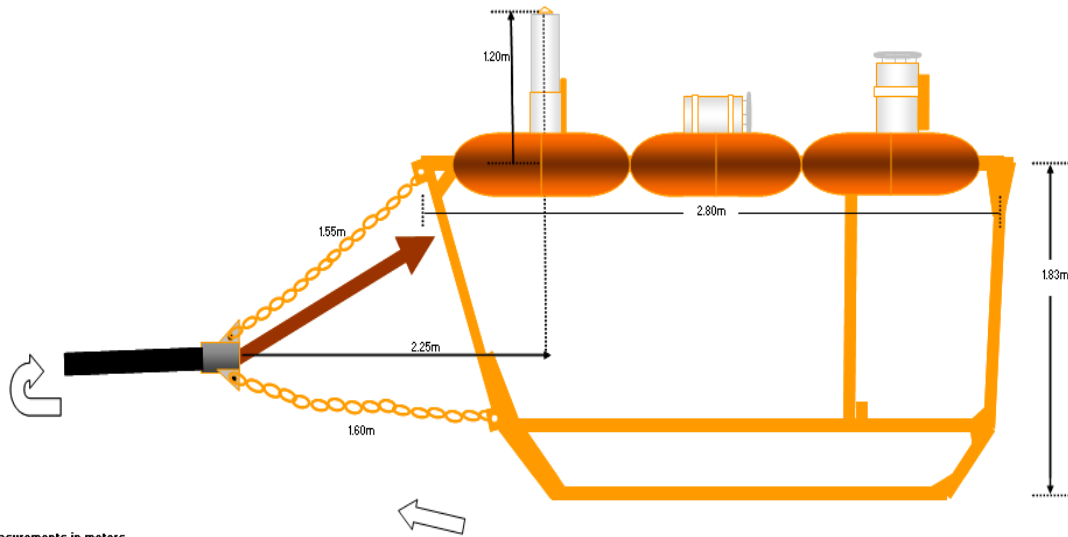
R/V Marcus G. Langseth - Gun Array Offsets



Note: MGL0807 do not have rgps on strings 2 & 3

# TAILBUOY CONFIGURATION

R/V Marcus G. Langseth - Tailbouy



All measurements in meters



## ***Positioning Summary***

## ***Processing Summary***

**ADDITIONAL NOTES:**

## SCN revision history:

File Name	rev. #	seq effected	date	comment with numerical changes listed:
MGL0807.SCN (001)	1	1	20-Mar-08	Create SCN file
		5	22-Mar-08	Mag dec changed on line during seq 5 to 0.45
MGL0807.SCN (002)		9	22-Mar-08	UDO added to log hi-res shot time to P294 record T7010
		13	23-Mar-08	Move S1C28 to last active section - 1st coil location
		13	23-Mar-08	Change SD compasses and acoustics to 2.0
		14	24-Mar-08	Move gunstrings out by 2.3m
	2	17	26-Mar-08	All above changes incorporated and loaded/saved to this revision number
		40	30-Mar-08	Second RTNu added, acoustics configured, and V1R1 RGPS definition added for FRC
MGL0807.SCN (003)	3	44	31-Mar-08	All above changes incorporated and loaded/saved to this revision number
MGL0807.SCN (004)	4	52	4-Apr-08	Source to vessel offset increased by 50 m, streamer to vessel offset increased by 50 m