Job Book with Nav & Technical Support Final Report

MGL0910

Lamont Doherty Earth Observatory

R/V Marcus G. Langseth

Endeavour Tomography Experiment

Chief Scientist: Douglas Toomey

Date Created/Revised	Version	Author	Comments
17/01/2009	1.0	D Martinson	
2009-09-20	1.1	A Johnson	Minor updates

Table of Contents

Introduction

Columbia University's Lamont Doherty Earth Observatory is providing the operational, technical, and navigation support for the National Science Foundation's research vessel the *Marcus G. Langseth.*

HSE

The Lamont Doherty Earth Observatory 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 LDEO employee is permitted to intentionally damage the environment through the emission of any substance in any form.

Emergency Response Plan

Medical Procedures

Scope

This section describes the procedures for treating 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.

Treatment of Medical Condition

The research vessel *Marcus G Langseth* 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:

1. Determination of extent of injury or sickness.
2. Advice on procedures for treating illness or injury.
3. Provide contact with nearest medical facility if needed.
4. Instructions for making contact with MAS are detailed in the MAS Medical Protocol Handbook in the ship's Hospital library (Section 9.1.1)
5. 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).
6. Document <u>all treatment that is prescribed through the MAS</u> 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.

Medications

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.
2. Medications and emergency medical supplies are inventoried every three months.
3. No medication is prescribed unless administered by the Captain of Chief Mate.

Serious Injury Situation

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.
2. If an illness or injury is serious, the MAS should be contacted by telephone or fax.
3. In the event of a serious injury, illness or accident, the Columbia University Accident Report should be completed per instructions in Section 12 & 12.5 in the Administrative Procedures Manual.

Life Threatening Situation

1. In the event of a life threatening injury or accident, in consultation with the medical advisory service, Chief Scientist and Designated Person at the Office of Marine Operations, consider diverting to the nearest port for advanced medical treatment.
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:
    a. Medical Advisory Service (Manual, Hospital Library)
    b. Agent's List
    c. Contact numbers in the List of Radio Determination and Special Stations.

Chemical Testing

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 36 CRF4.06.

Contact Information

Name	Position	Cell Phone	E-Mail
Ship's Wheelhouse	Satellite Phone	+11 8816 3183 0511	
Al Walsh	Marine Manager	+1 845 365 8868	alwalsh@ldeo.columbia.edu
Jeff Rupert	Cruise Director	+1 203 346 2892	rupert@ldeo.columbia.edu
Anthony Johnson	Tech In Charge	N/A	ajohnson@ldeo.columbia.edu

Job Specifications

Geodetics

Eastern Lau Spreading Center

UTM Coordinate System

Name:	WGS-84	Semi-Major Axis :	6378137.000
Unit:	Meter	Semi-Minor Axis:	6356752.31424518
Datum:	None	Flattening:	0.003352810665
False Easting:	500000.0000	Inverse of Flattening:	298.257223563000
False Northing:	000000000	Eccentricity:	0.081819190843
Scale Factor:	0.9996	Second Eccentricity:	0.082094437950
Central Meridian:	129°W		
UTM Zone	9 North		

Deliverables

Description	Media	Frequency	Comments
Daily Report	Electronic	Job Completion	Client request
Cruise Final Report	Electronic	Job Completion	Client request
Towing Configuration	Electronic	Job Completion	Client request
Spectra P1/90	Electronic	Job Completion	Client request
Spectra P2/94	Electronic	Job Completion	Client request
Daily Logs	Electronic	Job Completion	Client request
Line Logs	Electronic	Job Completion	Client request
Sequence Report	Electronic	Job Completion	Client request

Area of Operations

The project study will be done between Tonga and Fiji. There are two OBS deployments and shooting plans.

Personnel

Client Contacts

Name	Position	Cell Phone	E-Mail
Al Walsh	Marine Manager	+1 845 365 8868	alwalsh@ldeo.columbia.edu
Jeff Rupert	Cruise Director	+1 203 346 2892	rupert@ldeo.columbia.edu
Anthony Johnson	Tech in Charge	n/a	ajohnson@ldeo.columbia.edu

Equipment

Navigation & Positioning

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-snooping statistical testing techniques.**
- **DGPS and RGPS real-time re-computation.**
- **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.**
- **3D real-time binning, CMP and offset distribution displays. Fully compatible with Concept Systems off-line binning and analysis package, Reflex which includes bin expansion capabilities.**

GPS Systems (used by Spectra)

Primary

The C-Nav 2050 sensor consists of a 22-channel precision GPS sensor with two additional channels for receiving Satellite Based Augmentation System (SBAS) signals and an L-band demodulator for reception of the C-Nav StarFire Network correction service, for decimeter-level position accuracy, anywhere in the world, anytime. The

sensor can output proprietary raw data as fast as 50HZ and Position Velocity Time (PVT) data as fast as 25HZ through two 115kps serial ports.

The C-Nav StarFire network correction service gives an immediate solution for the user utilizing the global Real-Time Gipsey (RTG) and regional Wide Area Correction Transform (WCT) solutions. Additionally, the unit can accept corrections for DGPS, WAAS/EGNOS/SBAS/WCT, thereby assuring seamless position output.

Secondary

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.

Tertiary

Trimble 400 GPS receiver. L1/L2 receiver using SARGAS corrections, providing sub-meter positioning accuracy.

Data Acquisition

No MCS data to be acquired for this project.

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 "spare" guns, a total volume of 6600 cu in., per array (or 2-sub-arrays of 3300 cu in.) 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

Not used for this project.

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 gun string, 23cm behind the center of source, for a total of 4.

Acoustics

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 traveled.

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: 1 on each gun string for total of 4.

Multibeam echosounder

The EM 122 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 122 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 122 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 1504 m/sec.