VESSEL & SYSTEMS SPECIFICATION

3D SEISMIC RESEARCH VESSEL

CONTENTS PAGE

Chapter **Page**

Chapter **Page**

1. INTRODUCTION

This vessel specification report is intended to describe in detail a 6-streamers, 3D seismic survey vessel; newly built by 2011 in India; completely outfitted and equipped for continuous seismic survey operations. The vessel was designed and built with primary emphasis to health, environment, safety and safe working environment for personnel onboard.

The specification gives extra importance on the seismic equipments and the related seismic systems onboard.

1.1. GENERAL SPECIFICATION

1.1.1. Flag & Port of Registry

The vessel is flying under the flag state and Port of Registry of Panama

1.1.2. Classification

The vessel is registered and shall be maintained to meet the minimum requirements of Det Norske Veritas (DNV), DNV+1A1,SF,E0,AUTR,DP2,Clean class

1.1.3. Regulations

The vessel shall be maintained in full compliance with all International Conventions, Resolutions and their latest amendments, in addition to applicable flag state requirements. These includes, but not limited to:-

1. National Authorities rules and regulations for unlimited trades.
2. Safety requirements regarding general arrangement, mechanism and safety equipment for seagoing Vessels.
3. SOLAS 1997 with later amendments including ISPS code.
4. Load Line Convention 1966, with amendments.
5. MARPOL 1973/1978 Regulations, with amendments
6. International Safety Management Code
7. International Convention on Tonnage Measurements 1969.
8. International Convention for Preventing Collision at Sea 1972, with amendments.
9. STCW 1995, with amendments.
10. Rules and regulations governing navigation through the Panama Canal and Suez Canal, including its Tonnage Regulations.
11. The Vessel shall be equipped for area A3 acc. to GMDSS rules, and according to International registration 1973 and Radio regulations 1982.

All necessary certificates in original forms will be kept on board. Copies to be made available in shore based office.

1.2. MAIN TECHNICAL SPECIFICATION

1.2.1. Main dimensions

Length Overall	: 73.40 m
Length Between Perpendiculars	: 64.0 m
Breadth (Moulded)	: 19.20 m
Depth (Moulded)	: 7.60 m
Draft	: 6.30 m

1.2.2. Cargo Capacities

Deadweight	: 2200 Tonnes
Fuel Oil	: 1600 m3
Ballast Water	: 1800 m3
Fresh Water	: 800 m3
Fresh Water Maker	: 25 Tons/day approx.

1.2.3. Speed & Endurance

Speed, Max, in calm sea	: 14 knots
Pulling Capacity at 5 knots	: 66 Tons

2. MACHINERIES and EQUIPMENTS

2.1. VESSEL ENGINES

2.1.1. Main Engine

The vessel is fitted with two (2) main engines, HYUNDAI-HIMSEN 8H25/33P, 8 cylinders, 4-stroke Diesel Engines with performance capacity of 2320 kW at 900 rpm each, which are resilient mounted on the ship's structure to power the main propulsion systems.

Another one (1) additional engine of 2000 kW is also fitted to drive the forward Azimuth thruster.

2.1.2. Auxiliary Engine/Generator

Three (3) units of STAMFORD Diesel generators model HCM534D, 4-cycle, with capacity of 440 kW at 1800 rpm each

2.1.3. Shaft Generators

Two (2) units of AVK-Stamford generators model DSG 86 K1-4W with capacity of 1600kW (2000 kVA), 1800rpm.

2.1.4. Emergency Generators

One (1) unit of STAMFORD generators model UCM274D, 4-cycle, with capacity of 85 kW, 1800rpm

2.1.5. Uninterrupted Power Supply (UPS)

Main electrical power is at 440 Volt / 60 Hz.

All electrical installation, systems, equipment, switch gear etc. shall fully comply with Class rules and requirements from Authority.

2.1.6. Propulsion System

The ship is fitted with Controllable Pitch Propeller (CPP) type propulsion with electric hydraulic remote control system.

2.1.6.1. Main Propeller

The main propulsion system is powered by the two (2) main diesel engines, and consists of:

- Type/Model: 2 x Berg Propulsion BCP760
- Diameter: 2.9 m
- Power: 2320 kW per unit
- Propeller speed: 230 rpm
- Number of blades: 4

2.1.6.2. Bow Thrusters

<u>Tunnel Thruster</u>

- Type/Model: 1 x Kawasaki KT-130B3
- Diameter: 2 m
- Power: 800 kW per unit
- Propeller Speed: 346 rpm
- Number of Blades: 4, skewed type

<u>Azimuth Thruster</u>

- Retractable type.
- Power: 2000kW
- Number of blades -4

2.1.6.3. Stern Thrusters

- Type/Model: 2 x Kawasaki KT-88B3
- Diameter: 1.65 m
- Power: 590 kW per unit
- Propeller Speed: 416 rpm
- Number of Blades: 4, skewed type

2.1.7. Dynamic Positioning System

Kongsberg K-Pos DP-21, a dual redundant dynamic positioning system, consists of:-

- One (1) dual redundant controller unit (K-Pos DPC-2)
- Two (2) operator stations (K-Pos OS)
- The Extended Kalman filter principles
- Independent three-axis Joystick mode interface
- Sensors and Position Reference Systems
- Human-Machine Interface (HMI)

2.2. DECK EQUIPMENTS

2.2.1. Cranes

The vessel is fitted with two knuckle boom deck cranes at the middle deck hangar, each with lifting capacity of 3 Tons at 16 m SWL.

2.2.2. Anchoring and Mooring Equipment

- 2 x Stockless Spec Anchors Grade K3
- 1 x Plimsoll Hydraulic Anchor Windlass/Mooring Winch, 150 m capacity
- 2 x Plimsoll Hydraulic Vertical Capstan, rated pull at 8 Tons x 15 m/min
- 2 x Plimsoll Hydraulic Tugger Winch, rated pull at 10 Tons x 15m/min
- 6 x Odim Streamer winches
- 6 x Odim Umbilical winches

2.3. CREW EQUIPMENTS

2.3.1. Accommodation

The vessel is fitted with cabins to accommodate a total of 70 crew onboard + 1 Hospital bunk. The cabins consist of: State Cabins: 4
1-men cabins: 26
2-men cabins: 20

All cabins and other facilities onboard the vessel such as gymnasium and instrument room, are fully air-conditioned.
Laundry room is complete with 2 washing machines and 2 tumble dryers.

2.3.2. Life Saving Appliances

All life saving appliances are according to SOLAS requirements, including but not limited to the following:-

- Life Rafts : according to rules for 70 persons
- Fast Rescue Boat : 1 x FRC, approved type
- Life Boat : 1 x MOB boat, 6 men
- Life Jackets : 70 pieces
- Life Buoys : 4 x with light & line, 2 x with line, 2 x with light & smoke
- Survival Suits : 44 pieces (Thermo Insulated)

2.3.3. Fire Fighting Appliances

All fire fighting appliances are according to SOLAS requirements, including but not limited to the following:-

- Machinery Spaces : CO_2 total flooding
- Accommodation : Portable extinguishers according to rules
- Engine Room : CO_2 protected
- Fire Detection : Class approved fire detecting and alarm system
- Main Fire Pump : 2 x 1400 m3/hr, 16 bar
- Emergency Fire Pump : 1 x 40 m3/hr, 7 bar
- Fire Fighting Monitors : 2 x water monitors at 1200 m3/hr, 12 bar

3. NAVIGATION and COMMUNICATION EQUIPMENTS

3.1. NAVIGATION EQUIPMENTS

-	Radar No. 1	: Sperry Arpa S band, 10 cm
-	Radar No. 2	: Sperry Arpa X band, 3 cm
-	ECDIS	: 2 sets
-	DGPS	: 1 x DGPS
-	Auto Pilot	: 1 x high accuracy auto pilot
-	Gyrocompass	: 3 x Gyrocompasses
-	Magnetic Compass	: 1 x magnetic compass
-	Speed Log	: 1 x Doppler type speed log
-	Echo Sounder	: 1 x Echo Sounder
-	Navtex Receiver	: Standard Radio
-	AIS	: 1 x AIS, IMO approved type
-	Navigation Lights	: 3 x searchlights
-	Clinometers	: 2 x Clinometers
-	GMDSS	: GMDSS installation in accordance to IMO regulations for vessel operating within Sea Area A3

The Bridge navigation equipment, such as the Gyrocompass, echo sounder, and DGPS, may be co-shared for the seismic navigation department, for survey positioning purposes.

3.2. COMMUNICATION EQUIPMENTS

-	Radio Class / Category	: HF / MF
-	Transmitter / Receiver	: 1 x HF/MF radio station, 150 W with DSC
-	Radio GMDSS (VHF)	: 3 x portable radios
-	Radar Transponder	: 2 x radar transponders
-	EPIRB	: Jotron, TRON 45SX
-	Inmarsat C	: 2 x Inmarsat C with EGC receiver
-	Inmarsat F	: Satcom Fleet 77
-	VSAT	: Seatel 4996, KU-band
-	Internal Communication	: PA & intercom System
		: VHF internal communication system
		: Loudhailer
		: MOB Alarms
		: CCTV System, spread from Back deck to Bridge

4. SEISMIC EQUIPMENTS

4.1. SEISMIC SOURCE

4.1.1. Air Guns

Manufacturer	: Sercel, France
Type	: G. Gun II
Number of Array	: 2
Number of Sub-array	: 3
Array Configuration	: Parallel cluster
Active Air Guns	: 2 x 34
Source Volume	: 2 x 4,360 cu.inch
Operating Pressure	: 2,000 PSI
Source Floating System	: Rigid Floats
Length of umbilical	: 300 m

Figure 1: G.Gun Parallel Configuration

G. Gun family is used as the seismic source due to its promise to deliver high degree of stability and performance, and since the gun can be deployed and retrieved without being pressurized at all, it promises safe handling for the crew onboard. Its relatively small and light features also translate to quick assembling and dismantling of source and optimization of deck space.

All changes done to the source are to be communicated to the Gun Mechanics on duty and recorded in the observer's log.

4.1.2. Gun Controller System

Manufacturer	: SEAMAP
Type	: GunLink 2000
Timing Resolution	: 0.1 ms
Fire Detect Window	: 120 ms
Max. Operating Pressure	: 2000 PSI

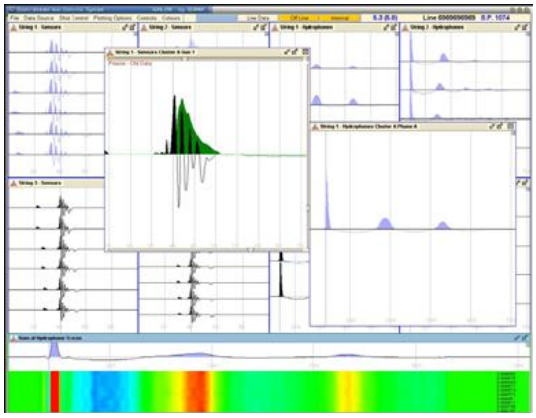


Figure 2: GunLink 2000 interface

The GunLink 2000 system provides the followings:-

- Onboard firing control, monitors individual gun fire time
- Real time data and indicators to monitor deteriorating gun performance
- Sensor timing monitoring
- Near field phone monitoring
- Depth and high pressure inputs
- Fault detection & self diagnosis
- Twin screen graphical user interface
- Direct interface to vessel's MOB system

4.1.3. Air Compressors

Three (3) air compressors are fitted to supply air pressure to the seismic sources

- Power : Max 1100 kW
- Speed : Max 1200 rpm
- Capacity : 1800 cfm

These units are placed on resilient mounts within the compressor room, whereby adequate air supply/ventilation is maintained to allow all compressor units to operate simultaneously

4.2. SEISMIC STREAMER

4.2.1. Streamer Cable

Figure 3: SENTINEL solid streamer

- Manufacturer : Sercel, France
- Streamer Type : SENTINEL Solid Acquisition Section (SSAS)
- Max Length : 8,000 m
- Length per Section : 150 m
- Group Interval : 12.5 m
- Diameter : 59.5 mm
- Max Operating Depth : 22 m
- Hydrophones per Group : 8 x Sercel's Hydrophones
- Group Sensitivity : 19.7 V/bar @ 20^{o}C

The Sentinel solid streamers are used due to its promised of rugged reliability and superior acoustic performance for improved noise quality especially in rough weather conditions. This translates to lesser down time and improved acquisition effectiveness. Sufficient spare parts will be maintained on board to assist fast repair and maintenance for continuous acquisition operation.

4.2.2. Depth Controller

- Manufacturer : Sercel, France
- Type : Nautilus birds
- Configuration : 1 every 300 m Streamer
- Operating Depth : 0 - 60 m
- Operating Temperature : -10°C to +50°C

Figure 4: NAUTILUS Streamer Node

Depth measurement and steering control of the streamer is done by positioning of "birds" which are attached onto the streamer cable and linked to onboard Positioning Control System.

Birds are used in conjunction with other depth controller devices, such as tail buoys, acoustics, depth transducers, GPS, etc. to provide an accurate streamer positioning at all times during operations.

4.3. SEISMIC SYSTEM

4.3.1. Seismic Recording System

- Manufacturer : Sercel, France
- Model : Seal CMXL 2000
- Channel Capacity : Max. 20,000
- Recording Format : SEG D 8058
- Recording Media : 3592 IBM tape drive
- Number of Cartridges : 6 drivers
- Sampling rates : 0.25 ms, 0.5 ms, 1.2 ms, 4 ms

The CMXL system is made of pairs of LCI/LMP boards to manage the flow of acquired data between the streamers and the various recording and peripheral equipment (tape drives, plotter, navigation and positioning, QC) via SCSI and Ethernet links.

On-board, the Central Unit of the Seal System can be interfaced with any of the external systems used in the instrument room, such as the source synchronizer, positioning and navigation systems and processing systems. The auxiliary channels acquisition unit can be easily placed in the most convenient location.

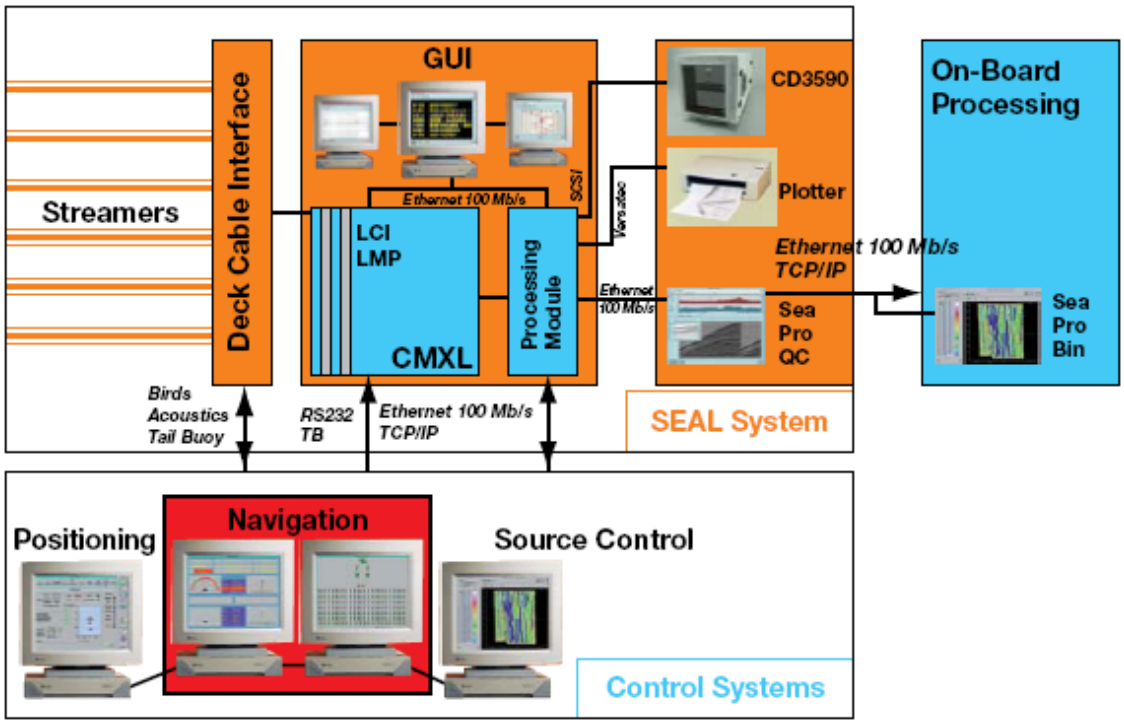


Figure 5: Seal CMXL 2000 System Configuration

Seal QC System

The Seal CMXL system has inbuilt QC system called “Seal eSQC Pro”, which is implemented online with standard marine acquisition systems to offer a tool for real-time QC of seismic data, without the need for any tape manipulation. All QC functions are performed in parallel with the seismic data acquisition without affecting marine operations. Moreover, eSQC Pro gives any authorized person the ability to access the seismic data remotely from a standard PC platform connected to the Internet in real-time.

The eSQC Pro is commonly useful as the first layer of QC data processing after data acquisition.

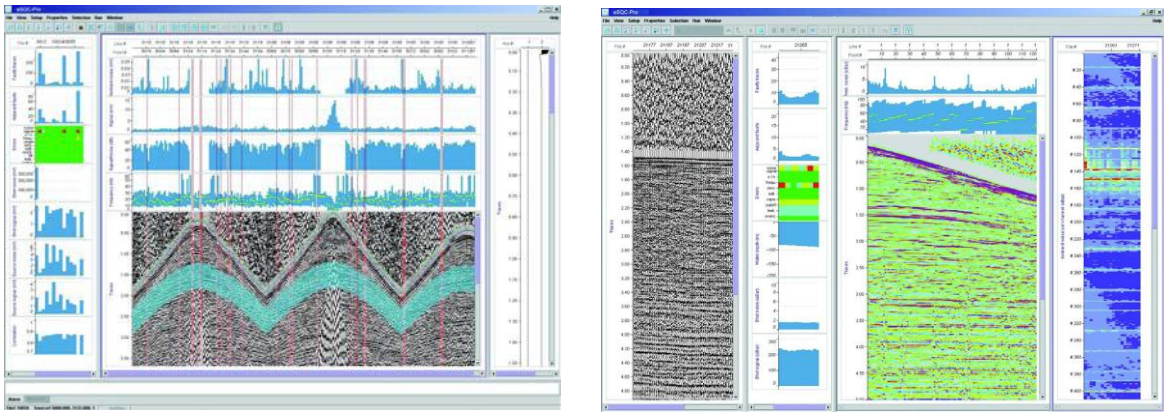


Figure 6: eSQC Pro System Display

4.3.2. Seismic Navigation System

The navigation systems shall compute and display real-time vessel position and velocity, by incorporating some, if not all, measurements from the following systems:-

- Radio Navigation System
- Gyro Compass
- Echo Sounder
- Differential Global Positioning System (DGPS)

There are two different Navigation system installed on board :-

SeaPro Nav

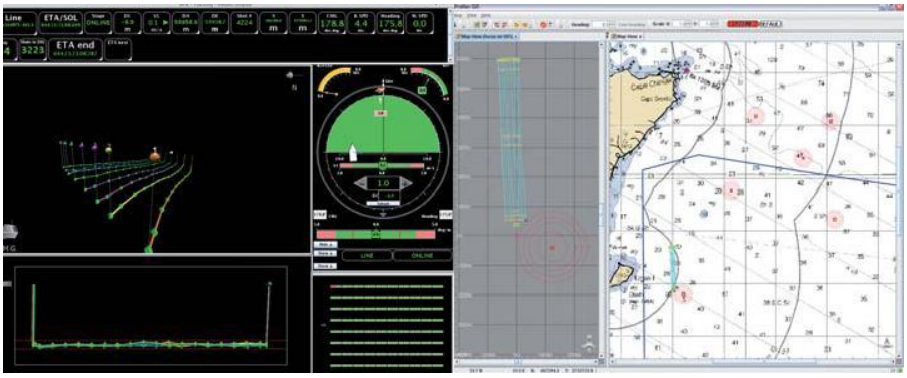


Figure 7: SeaPro Nav System Display

The vessel is equipped with "SeaPro Nav" real-time navigation system by Sercel as the primary navigation system, which provides positioning, control and acquisition by using off-the-shelf hardware to provide sensor interfacing and true GPS time stamping and triggering; it also provides distribution of real time navigation information which can be easily accessed from anywhere by using client/server interface; and lastly it provides data management from planning to QC.

SeaPro Bin

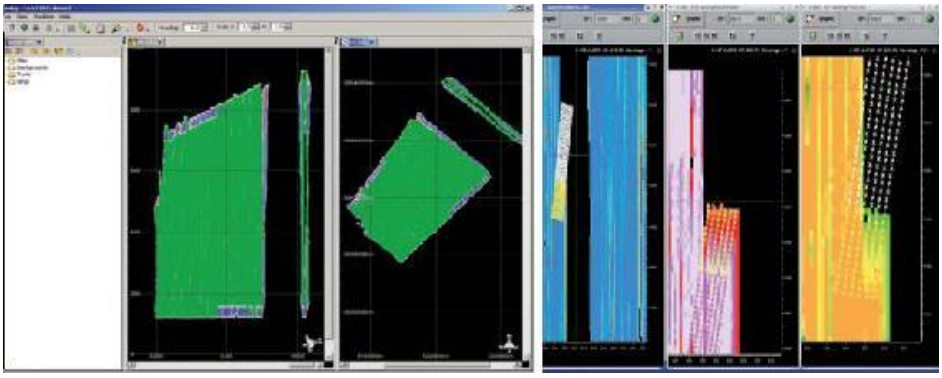


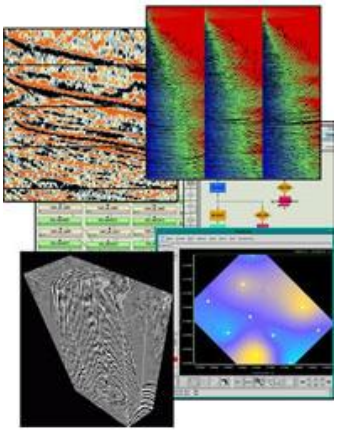
Figure 8: SeaPro Bin System Display

"SeaPro Bin" by Sercel is a binning tool that manages 3D seismic survey attributes by providing coverage analysis for infill environment and real-time binning analysis.

4.3.3. Seismic Processing & QC System

CGG GeoCluster software contains a comprehensive set of modules and applications covering all aspects of seismic processing, QC and imaging. This software, which includes several tools for signal processing, simulation and inversion, enables researchers to process seismic data and to explore the composition of the earth's layers.

It is promised that the system can improve signal-to-noise quality and the lateral expression of seismic data, as well as improves calculations, reducing the processing time for seismic data while delivering better image quality



- Manufacturer : CGG Veritas
- Software Type : 2D/3D GeoCluster
- Hardware : Cluster 8 Nodes Dual 5150, 32 x cores

Figure 9: GeoCluster Seismic processing