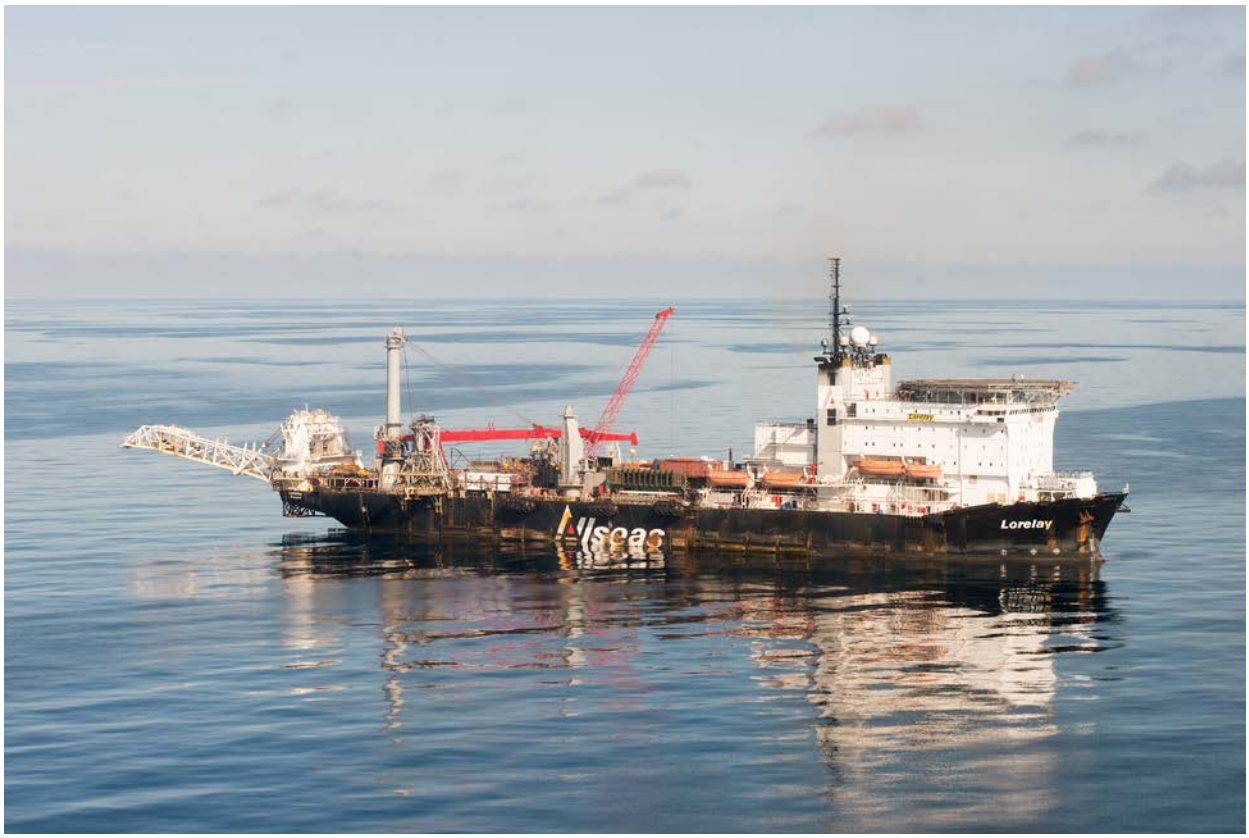

Description of Allseas'

Dynamically positioned pipelay

vessel *Lorelay*

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1.0 INTRODUCTION

Lorelay is a versatile vessel optimised for the execution of medium- and small- diameter pipelay projects of any length, and associated work such as installation of risers and subsea protection frames. As the world's first pipelay vessel to operate on full dynamic positioning, *Lorelay* represented a new generation of offshore pipelay vessel. Her ship shape allows for a high transit speed and her large pipe storage capacity means she is less dependent on offshore supply. Being able to manoeuvre precisely and safely, and having excellent workability, *Lorelay* has made her mark worldwide.

Working on dynamic positioning, *Lorelay* offers the safest pipelay method in congested areas, where anchors could endanger the integrity of existing pipelines. Pipeline start-ups and laydowns are executed in a very short time, so that interference with other activities near platforms is minimised. The DP system also enables *Lorelay* to operate in unlimited water depths; in 1996 *Lorelay* rewrote the industry record books by laying rigid steel pipe to a depth of 1645 m (5400 ft).

2.0 TECHNICAL DATA

2.1 Dimensions

Length overall (incl. stinger)	:	236.00 m	(774 ft)
Length overall (excl. stinger)	:	182.48 m	(598 ft)
Length between perpendiculars	:	149.75 m	(491 ft)
Breadth, moulded	:	25.80 m	(85 ft)
Depth to main deck	:	15.50 m	(51 ft)
Operating draught	:	6.00–9.00 m	(20–30 ft)
Displacement (at 9 m draught)	:	29,256 t	
Total pipe hold capacity	:	8200 t	
Accommodation	:	230 persons (1 and 2 berth cabins)	
Helideck	:	Maximum take-off weight 12.8 t; suitable for Sikorsky S-61 and S-92 helicopters	

2.2 Classification

Lorelay has been built under the supervision of Lloyd's Register (LR) maritime classification society, in accordance with the applicable rules and regulations. She is classed as:
LR 100 A1, Pipe Layer, *IWS, LI, (✠) LMC, UMS, DP (AAA).

Lorelay complies with all the applicable international regulations including subsequent International Maritime Organization (IMO) resolutions and amendments.

2.3 Power configuration

Lorelay is powered by a diesel-electric propulsion concept. Her power plant consists of four main diesel engine generator sets supplying electrical power for propulsion, station-keeping and all other services on board.

Propulsion and steering is controlled by a combination of six thrusters, driven by seven high voltage (3.3 kV) electric motors. Each propulsion unit contains a Hyundai three-phase variable rpm squirrel cage induction motor driving a fixed-pitch propeller. Variable speed is controlled by Ansaldo Sistemi Industriali frequency converters, located adjacent to each of the propulsion motors.

2.3.1 Engines

Main engines	:	4 x 4440 kW Stork-Werkspoor 6SW-280
Emergency generator	:	1 x 365 kW General Motors 16V71
Total installed power	:	17,760 kW

2.3.2 Propulsion

Propeller	:	1 x 6000 kW Schottel-Lips fixed-pitch
Thrusters	:	2 x 5000 kW Wärtsilä fixed pitch azimuth thrusters
Maximum speed	:	16 knots

2.3.3 Positioning

Aft	:	1 x 6000 kW Schottel-Lips fixed-pitch propeller 2 x 5000 kW Wärtsilä fixed pitch azimuth thrusters
Forward	:	2 x 2550 kW Schottel-Lips fixed-pitch tunnel thrusters 1 x 3000 kW Schottel-Lips fixed-pitch retractable azimuth thruster

2.4 Deck equipment

2.4.1 Special purpose crane

The heave-compensated heavy lift mast crane, manufactured by Huisman, is pedestal-mounted and installed on the starboard side.

Capacity main hoist	:	300 t (661 kips) double line at 14 m (46 ft) radius 200 t (441 kips) double line at 22 m (72 ft) radius 100 t (220 kips) double line at 37 m (121 ft) radius Single line speed 0-10 m/min (0-33 ft/min) Single line heave compensation stroke 10 m (33 ft)

2.4.2 Pipe transfer crane

The single-hoist, pedestal-mounted pipe transfer crane, manufactured by Huisman, is electrically driven and installed on the starboard mid-ship. The crane wire is guided over a shock absorber (stroke 1,750 mm) which lowers impact forces when items are lifted from supply vessels.

Capacity main hoist	:	16 t (35 kips) single line at 33 m (108 ft) radius

3.0 PIPELAY SYSTEM DESCRIPTION

3.1 Firing line

The firing line consists of the following main components:

- Line-up station
- Six single-joint welding stations, located on trolleys
- Three coating stations (optional additional stations depending on project requirements)
- Non-destructive testing (NDT) station
- Three tensioners (55 t each); optional 4th tensioner of 100 t
- Roller supports in between the work stations.

Welding trolleys provide a work platform for the welding operators and welding equipment. Each trolley is equipped with automatic welding systems, storage space for welding consumables, electrical power, water and working air and gas supplies.

The trolleys can be connected to the pipe, and thus move simultaneously with the pipe, ensuring welding operators are not hindered by a moving pipe as a result of ship motions. Up to two welders and welding systems can be accommodated per trolley. When *Lorelay* moves 12 m (40 ft) forward to make a so-called "pull", the trolleys are temporarily disconnected from the pipe. The trolleys move on rails integrated in the firing line floor foundation.

The NDT station is located between the second and third tensioners. All tensioners have been designed to allow the passing of in-line structures such as T-pieces, etc. The three rollerboxes ahead of the stinger can be lifted to a height of 2.5 m (8 ft) to allow for the installation of special structures in the pipeline.

3.2 Pipelay system components

Pipelay stinger	:	Adjustable stinger with maximum length of 72 m (236 ft), which can accommodate radii from 70–270 m (230–886 ft). Vertical departure angle is achieved at a radius of 70 m (230 ft). Six cameras and an acoustic pipe position measuring device mounted on stinger tip. Vertical and horizontal load indicators positioned on the final three rollerboxes. Stinger rollerboxes, with a capacity of 70 t, 45 t (aft 3) and 40 t (tip).

Stinger winches : Two hydraulic double-drum winches, capacity each:
- 2 x 25 t at 13 m/min
- 2 x 6 t at 65 m/min

The four stinger wires are reeved in a six-part tackle and fitted with peak shavers to reduce peak loads.
Drum capacity of 600 m x 40 mm wire.
Brake capacity (full drum) of 2 x 30 t.

Pipe tensioner system : Three hydraulic SAS tensioners, capacity each:
- 55 t at 66 m/min (one machine online)
- 110 t at 33 m/min (two machines online)
- 165 t at 20 m/min (three machines online)

Optional 4th hydraulic SAS tensioner, with a 100 t capacity.
Total installed power 850 kW.

A&R system : Electrically-driven Bodewes A&R traction winch, capacity:
- 275 t at 15.5 m/min
- 184 t at 23 m/min

Winch is controlled by electric motors, located at each end of the pinion shaft. Storage drum capacity of 3800 m x 3" cable.

: Hydraulic SAS winch, capacity:
- 115 t at 33 m/min

Drum capacity of 1500 m x 2.5" cable. Eight layers, with a maximum breaking strength of 263 t. Brake capacity (full drum) 135 t.

3.3 Welding system

The firing line is equipped with the *Phoenix* automatic welding system, designed and manufactured in-house by Allseas. The dual/triple-torch welding bugs feature enhanced welding characteristics, including improved welding quality, and further optimise deposit and welding speeds.

The essential welding parameters of each welding bug are computer-controlled as a function of weld pass number and location on the pipe circumference. All passes are applied externally, with the root pass using retractable backing shoes positioned on the internal line-up clamp. This ensures positive and controlled penetration of the root pass, even when pipe misalignment is unfavourable.

Phoenix can readily utilise gas metal arc welding, pulsed gas metal arc welding, flux-cored arc welding or combinations thereof, and is also convertible to gas tungsten arc welding. All welding bugs can use these processes at any station in both the uphill and downhill welding directions. When used for downhill gas metal arc welding, as is common in pipeline welding, *Phoenix* can utilise either a single head or a dual head mode on each welding bug, positioned on either side of the pipe in each welding station.

3.4 Pipe handling

3.4.1 Pipe loading

Line pipe and associated materials can be supplied offshore by a variety of pipe carriers. To facilitate the pipe transfer process, a pipe transfer crane (PTC) is fitted on the starboard side. The outreach of the PTC is sufficient to unload from large pipe carriers, which maintain their position alongside (either by joystick or DP control) at a safe distance of approximately 10 m (33 ft). Cargo barges and/or cargo vessels can also be moored alongside *Lorelay* to supply pipe. For this purpose, she is fitted with fenders and mooring equipment.

After unloading, the pipe joints can be entered directly into the production process via the main deck longitudinal conveyor, or lowered into the cargo hold for storage. The hold is provided with two pipe elevators; the forward elevator can handle two single joints, and the aft elevator one single joint.

If required, the whip hoist on the special purpose crane (SPC) can be operated simultaneously to speed up the loading process. In such a scenario, the SPC lowers pipe joints through the aft hatch while the PTC lowers pipe onto the main deck longitudinal conveyor. *Lorelay's* transportation and storage capacity is large enough to accommodate peak supply rates. The maximum capacity of the pipe cargo hold is 8200 t.

3.4.2 Pipe transportation system

In the pipe hold, individual pipe joints are picked up by an overhead crane, equipped with a spreader bar capable of lifting 20 t. Both the crane and the spreader can be continuously tracked by a state-of-the-art camera system. The system, upgraded in 2012, eliminates the need for crew to work in the hold. A longitudinal conveyor transports the pipe joint in the hold, where it is lifted to the main deck by one of the single-joint elevators.

Once at the main deck level, the pipe is positioned onto the main deck longitudinal conveyor and transferred to the preparation area, located at the bow of the vessel below the accommodation quarters. Here, facilities are available for inspection, cleaning, bevel preparation and preheating.

Using a walking beam and transverse buggy, a section of pipe is placed onto the line-up carriage where it is aligned with the rest of the pipeline. Three tensioners, supported by roller supports, keep the pipe under constant tension and prevent it from slipping.

The majority of the pipe handling equipment is hydraulically driven. Manufactured by CRC-Evans (USA) and Bauhuis (NL), it is been designed for pipe outside diameters up to 28". The gantry cranes are fabricated by Van Leusden (NL) and carry the Lloyd's Register class approval.

3.5 Dynamic positioning

Lorelay is equipped with a fully redundant dynamic positioning system, supplied by Kongsberg, which complies with Lloyd's Register DP (AAA) and NMD Class 3 certification.

Installed reference systems

- 2 x Lightweight taut wire systems for operations up to 600 m (1969 ft) water depth
- Sonardyne LUSBL acoustic underwater navigation system, especially for deepwater operation
- 3 x DGPS systems
- 3 x Octans motion reference units
- 2 x Fanbeams
- 1 x Radius positioning system

DP control modes

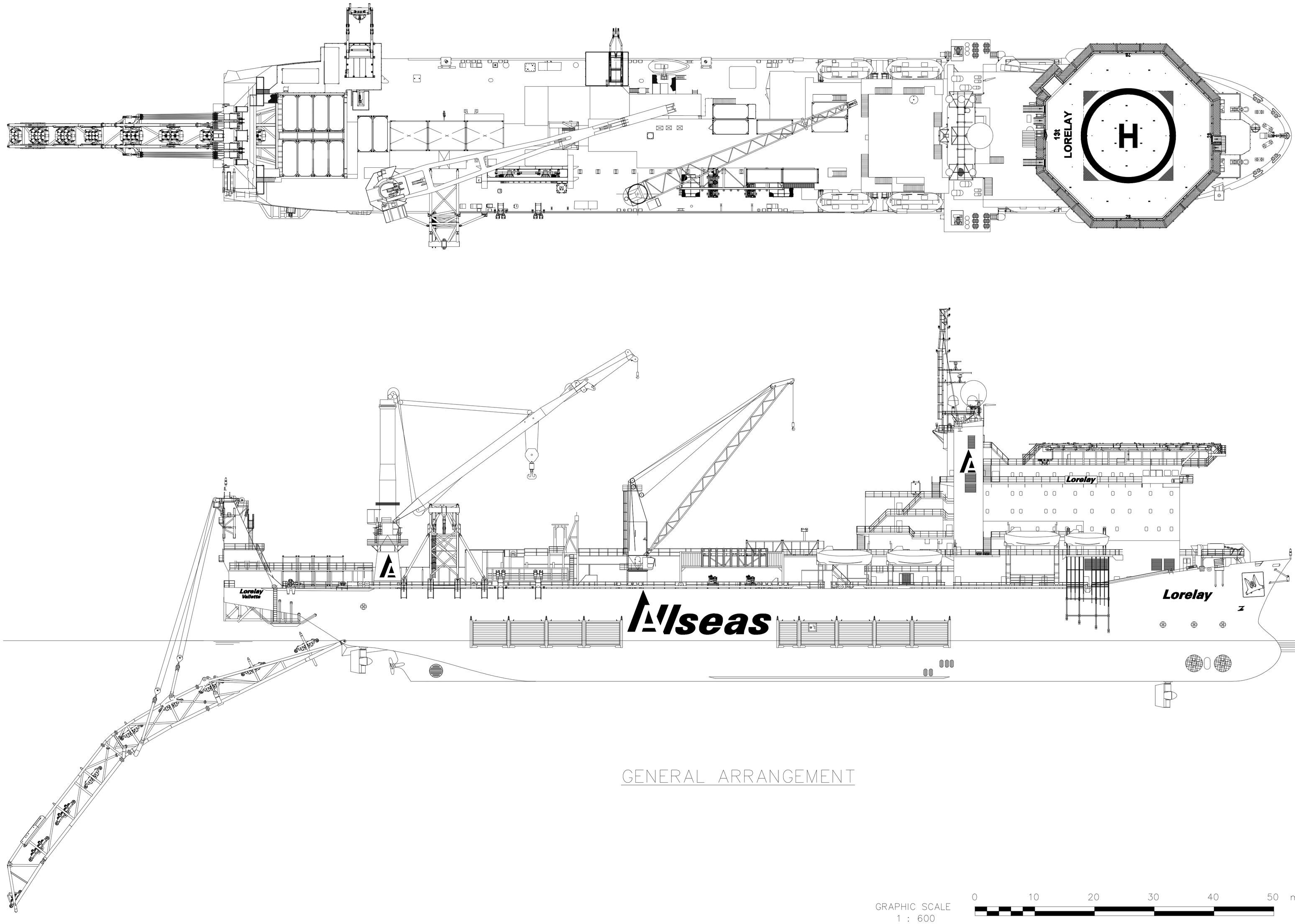
- Auto mode, with the capacity to select the rotational axis of the system around the centre of gravity of the vessel and several other offset locations
- ROV / subsea tracking mode, which can follow an ROV, a trenching machine or other subsea vehicles at a speed of up to 2 knots
- Pipelay mode, which allows data interface with tensioners and A&R winch for DP pipelay controls
- Manual mode, with single joystick control
- Class 3 mode, which allows vessel to work in the most critical circumstances such as adjacent to structures, etc.

3.6 Subsea survey and intervention system

Lorelay is equipped with a ROV system for underwater surveys and intervention work; the main components are:

- 1 x 150 HP work class ROV, depth rating 4000 m (13,123 ft)
- 1 x Tether management system (TMS), long excursion, storage capacity up to 1500 m (4920 ft)
- ROV launch and recovery system, SWL 12 t
- 1 x ROV umbilical winch, active heave compensated, storage capacity up to 4000 m (13,123 ft)
- Dedicated control cabin and workshop

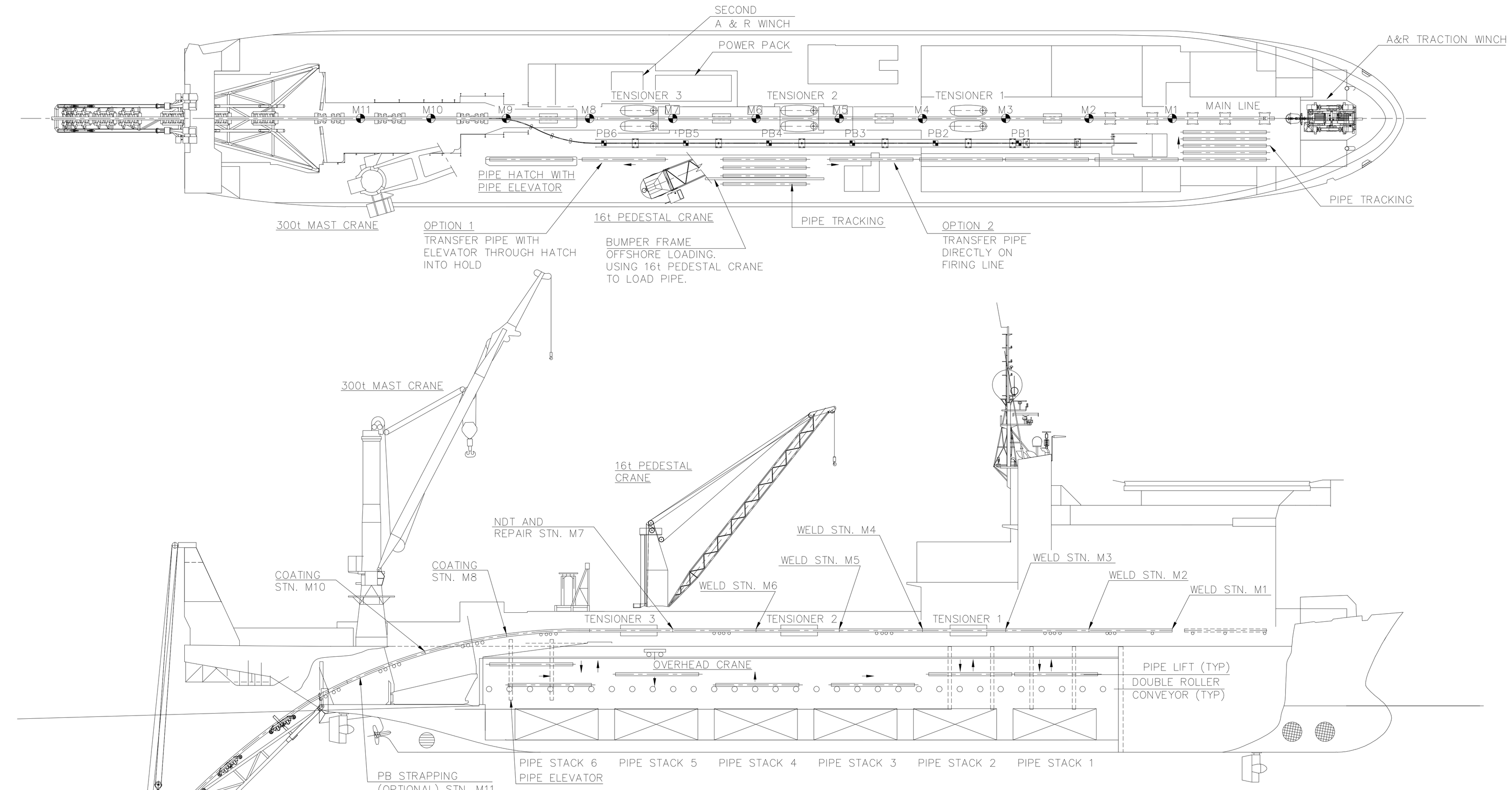
DRAWINGS



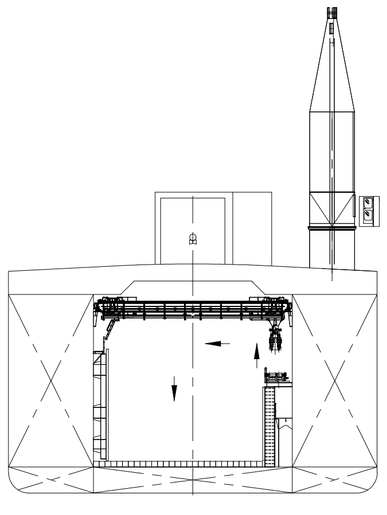
GENERAL ARRANGEMENT

GRAPHIC SCALE
1 : 600

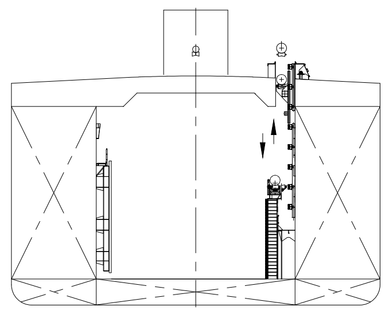
0 10 20 30 40 50 m



SECTIONAL ELEVATION



TYP. CROSS SECTION



CROSS SECTION AT HATCH

PRINCIPAL PARTICULARS

LENGTH OVERALL	182.50 m
LENGTH BETWEEN PERPENDICULARS	149.75 m
BREADTH MOULDED	25.80 m
DEPTH	15.50 m
DRAUGHT	6.0–9.0 m
DISPLACEMENT	29250 T

GRAPHIC SCALE
1 : 600