# SEVEN OCEANS

## MERWEDE SHIPYARD DELIVERS RIGID REELED PIPE LAY / OFFSHORE CONSTRUCTION VESSEL

*Builders: Merwede Shipyard, Hardinxveld-Giessendam, Netherlands*
*Owners: Subsea 7, Aberdeen, Scotland*

In a joint effort with Huisman-Itrec from Schiedam, Merwede Shipyard has recently delivered 'Seven Oceans', a 160 m pipe-laying ship. While Merwede Shipyard was responsible for the design and production of the ship systems and the integration of the pipelay spread, Huisman Itrec took on the design and manufacturing of all the pipe-laying systems.
The 'Seven Oceans' is a deepwater rigid and flexlay lay vessel intended for the installation of rigid pipes up to a diameter of 16" on the ocean floor in depths up to 3000 m. The ship can deploy two Remote Operated Vehicles (ROV's) which can monitor the pipelaying activities from nearby. Besides pure pipelaying, the ship will be used for subsea construction, ROV support and survey activities. The vessel will be mainly operated in the deepwater oil fields offshore Brazil and West-Africa.
The main reason Subsea 7 opted for the Merwede Shipyard - Huisman Itrec combination is the turnkey project approach and the guarantee of a delivery on time. The turnkey project approach was essential as Subsea 7 did not want to get caught in-between a yard and the supplier of the pipelay installation. The guarantee of a delivery on time was essential as Subsea 7 wished to engage in projects for 'Seven Oceans' when the building had not yet started. The new ship will allow Subsea 7 to lay pipes at greater depths than possible until now.

### Loading procedure

Centrally in the ship is a large reel for the storage of the rigid pipe. In a typical loading scenario, the ship will anchor herself with her stern facing the shore. The pipe can then be reeled-in from a production facility on shore, almost eliminating the need to weld or coat pipes in the difficult conditions off-shore. The main reel has a capacity of 3500 tons, the equivalent of 12 to 120 km of pipe, depending on the diameter and weight of the pipe. As the pipe is wound upon the reel, it is subjected to a first plastic deformation. The second and last deformation follows when the pipe is straightened again for installation. Any consequent plastic deformations are not allowed, as


*The lay ramp is placed on a skid beam and can be tilted forward*

they would have a too large impact on the strength of the pipe.

## Pipe laying

The pipelaying activities are mostly concentrated on a tower on the aft deck called the "lay ramp". This tower is based on a large skidbeam, allowing an athwartships movement to align the tower with the neatly stored pipe on the main reel. At the top of the tower is a large wheel, called the "aligner wheel". The entire tower can be tilted forward from the vertical position through about 45 degrees. The angle is adjusted to the water depth and the characteristics of the pipe to be laid. The lower position is mainly used when loading and when pipelaying in shallow waters. The latter is called S-laying, as the pipe takes the shape of a stretched-out letter S during the procedure. When pipelaying in deep waters, the tower is in the vertical position. This procedure is called J-laying.

## PLET handling

Pipeline End Terminations (PLETs) are manifolds which are installed in subsea pipeline systems. The 'Seven Oceans' is equipped with a system intended to make the operation of handling and installing these objects safer and more efficient. The system consists of the following main components:

- A deck mounted rail system, which uses trolleys to bring PLETs from their on-deck storage position to the aft end of the vessel.
- A PLET manipulator which can lift the PLET and install it on the aft side of the pipelay tower.
- A PLET line up tool in the tower which can hold and adjust the PLET so that it can be offered up for welding to the pipeline.

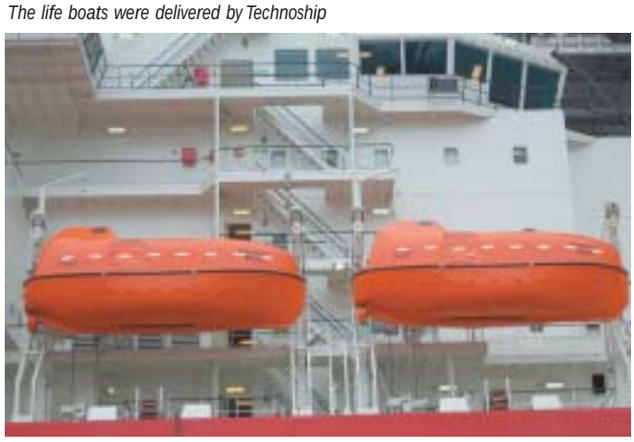
The system is designed to handle PLETs of up to 40 tonnes weight and length of 9m.

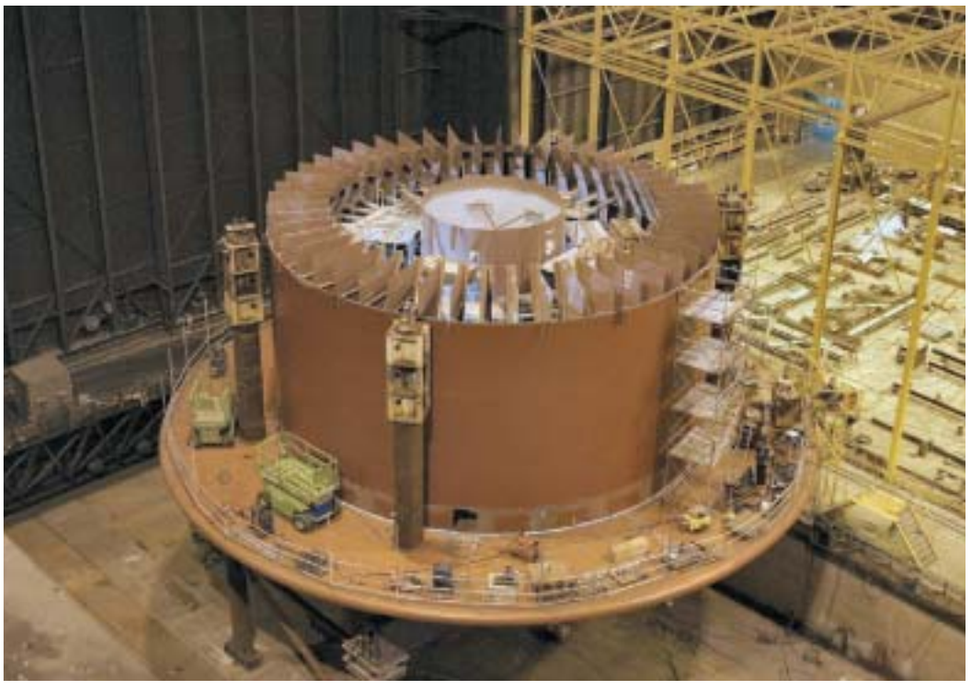
## Lay ramp equipment

Just below the wheel, on the aft side of the tower, is the so-called "straightener". This device is composed of four caterpillar tracks, similar to the ones found on military tanks, which straighten the pipe. Below the straightener is the so-called "Solex-drive". Much like the way the front wheel was propelled in the classic Solex motorcycles, the Solex-drive can move the pipe up and down along the aft tower. Finally, the "tensioner" can provide a pull onto the pipe of up to 400 tons. This is necessary to compensate the force of the rigid pipe on the reel and to pull the pipe off the reel. The pipe is in part elastically deformed, which turns the reel into a gigantic

*The 3500 ton capacity main reel is located in a well on the main deck*

*The life boats were delivered by Technoship*





** The main reel has a diameter of 28 metres and is 10 metres wide*

coil spring. At the lower part of the tower are the workstations, where pipes can be capped or welded together and their coating is repaired when damaged. The piggy-back line and anodes are fixed onto the pipe. Finally the pipe can be lowered into the depths.
A piggy-back reel on the aft deck allows for a secondary pipe or cable to be attached to the main pipe.

## ROV

The 'Seven Oceans' is equipped with two ROV's (remote operated vehicles). These are stored in a large ROV hangar at the aft side of the superstructure. Each ROV fits into a protective basket, which can be brought to the ship's side through an overhead beam crane. The basket can then be lowered into the water along tracks on the ship's side, acting as an "outboard elevator". This way the ROV is brought through the "splash zone" in a controlled manner, after which the ROV can be maneuvered out of its basket. This solution avoids having the extremely expensive ROV's suspended on a slinging wire in heavy seas. A commonly used alternative is a moonpool, but this can lead to unpleasant situations if the ROV in an emergency has to surface next to the ship, with its umbilical still going through the moonpool. The ROV's are used to monitor the positioning of the pipe on the seabed from close by and for assisting during subsea construction works. The data generated by the ROV during pipelaying is used as an input into the dynamic positioning system.

## Design synergy

The entire ship has been designed around the space and strength requirements dictated by the Huisman-delivered pipelaying equipment. The client, Subsea 7, had a separate turn-key contract with both Merwede Shipyard and Huisman Itrec. The two contractors also have a contract with each other detailing the interfacing and the responsibilities of either partner. The collaborative effort was experienced as positive by all parties, and will be continued in consecutive projects.

## Hull

The ships hull lines are designed to give the vessel good seakeeping performance. To be able to lay pipe in a seastate with a significant wave height hs=3.0 meter the vessel is given ample freeboard in order to avoid deck wetness. Roll accelerations are reduced by 2 passive anti roll tanks. The vessels trial speed at design draught with 3 thrusters @ 90% of maximum power is 14.5 knots. On the stern, two extensions above the waterline allow for the handling of the stern anchors and provide a good vantage point to monitor the pipelaying activities. Anchors are often used to lock the starting or finishing point of a pipe onto the seabed.
The vessel is built under Lloyd's register class and features the following main characteristics:

### Principal Particulars

| | |
|---|---|
| Length o.a. | 157.31 m |
| Length b.p.p. | 138.32 m |
| Beam mld. | 28.40 m |
| Depth | 12.50 m |
| Design draught | 7.50 m |
| Trial speed | 14.5 knots |

### Capacity

| | |
|---|---|
| Deadweight | 11.500 ton |
| Occupants | 120 persons |

### Tank capacities

| | |
|---|---|
| IFO Fuel | 1750 cu.m |
| MGO Fuel | 2900 cu.m |
| Ballast water | 3400 cu.m |
| Technical fresh water | 580 cu.m |
| Anti-heel tanks | 1530 cu.m |
| Stabiliser tanks | 700 cu.m |
| Potable water | 640 cu.m |

## Diesel-Electric propulsion

Due to the variety of operational profiles, the multitude of power consumers on board and the requirements for dynamic positioning, the 'Seven Oceans' is an ideal application for a diesel-electric propulsion installation. Six gensets powered by Wärtsilä dual-fuel

**The superstructure was placed after the launching of the hull*

*Six Wärtsilä dual fuel engines provide a total of 20.160 kW*

engines provide a total of 20.160 kW of power. The consumers for propulsion include the following:

– 3 Wärtsilä/Lips azimuthing thrusters (each 2.950 kW);
– 2 retractable azimuthing bow thrusters (each 2.400 kW);
– 1 tunnel bow thruster (2.200 kW).

Each of these thrusters is located in a separate room. The retractable bow thrusters are more effective and less noisy, but a tunnel thruster was necessary for maneuvering in shallow water and ports. The engines can run on cheaper IFO-180 during transit and switch to MGO in dynamic positioning mode to avoid excessive pollution of the gensets when running at low loads.

## Dynamic Positioning

The ship has a class notation of DP-2, which is sufficient for pipelaying activities. The subdivision of the vessel and all of its systems is prepared for DP-3, due to which the owner will be able to market the vessel as DP-2+ and if needed she can be easily upgraded to DP-3. The DP-system is interfaced with the data provided by the ROV's, several gauges measuring the tension in the pipe and the route to be followed. This allows the pipe to be laid on a pre defined path of just a few meters wide at 3000 metres depth.

The navigation bridge is a very large affair, with the standard navigation bridge facing forward. Facing aft is a full beam operations and control room with a dynamic positioning bridge on portside, a pipelaying bridge in the center and a survey bridge on the starboard side. Due to the diesel-electric propulsion, the navigation bridge is very quiet. At full steam during seatrials, the recorded noise level in the wheelhouse was only 48 dB(A).

## Helideck

Above the bridge deck is the helideck with a large helipad above the bow and a dedicated reception and waiting area. The helipad is constructed of a special A0-rated aluminium and is suitable for S61 helicopters. It is equipped with a fixed foam fire fighting system. In a seaway, the movements of the helipad are electronically logged and sent to shore to determine whether it is safe to make a landing onboard.


*The ROV's are launched in a protective cage*

## Accommodation

Below the bridgedeck are four decks almost entirely dedicated to sleeping quarters. The fore-castle deck houses a number of offices, conference rooms and recreation rooms among which a recreation room, games room, library, smoking lounge and quiet lounge. The galley, the mess and a number of provision stores are located on the main deck as well as the sauna and the fitness room.

## Forward engine rooms

Taking full advantage of the flexibility of a diesel-electric propulsion, the engine rooms are located in the fore ship. The engine rooms are completely separated. The midship sections contain the well for the main reel, while

**The azimuthing stern thrusters are equipped with propeller nozzles*

**Two out of three bow thrusters are of the retractable type*

*Bouters installed the spacious galley*

*The A & R winch is located below the aft deck*

*The mast carries the navigation and communication equipment*

in the aft ship is a room for the abandonment and retrieval (A&R) winch and a heeling pump room.

In the double bottom are a number of bunker tanks and technical fresh water tanks, which can be used to fill newly laid piping. In this way, the pipe loses its buoyancy and does not corrode because of salt water.

### Stability Catch-22

The stability requirements had a profound effect on the design of the vessel. Different situations require very different stability characteristics.

During pipelaying, the weight of the pipe is suspended to the top of the tower on the aft deck. This calls for a high transverse stability. In order to lower the center of gravity, the main deck is stepped resulting in a lowering of the deckhouse by 1 m. The ship also has a relatively wide beam increasing the GM further. During most loading cases however, there is excess stability. It is also beneficial to increase the roll period to 15-20 seconds, well over the typical encounter frequency. To accomplish this, the 'Seven Oceans' is equipped with two full beam stabilizer tanks at 16 m above the waterline. The length of the tanks is a function of the vessel's natural roll period, in order to diminish resonant roll as much as possible. The tanks can also be filled 100 % to raise the center of gravity. The ballast tanks in the sides are divided horizontally, giving the option to fill only the upper half if the captain wants to further decrease the GM (and thus increase the ship's roll period).

### Cranes

The 'Seven Oceans' can also be used to install templates (large subsea manifolds) on the ocean floor. In this case, the piggy-back reel is removed from the aft deck and provides the space for the template. The main crane onboard is located on the portside and has a SWL of 400 tons at 16.5 m. It is equipped with a heave compensator. A smaller crane on starboard has a SWL of 40 tons, while another one mounted to the aft deck tower can lift 12 tons at a distance of 25 meters.

### Fuel viscosity control system

Mar-In Controls has installed control equipment and fuel supply units (Booster modules) onboard the 'Seven Oceans'. The fuel supply modules are equipped with a pneumatic pressure control system having a PI function to ensure a constant pressure downstream of the feederpumps. This eliminates the pressure fluctuations caused by the varying fuel demand of the diesel engines.

The flowmeters installed in the booster modules are equipped with an alarm system activating a bypass valve. The crew is automatically alarmed if the flowmeter is blocked. The Viscosity Measurement device uses a patented Teflon coated capillary preventing fuel oil deposits on the inside of the capillary wall, eliminating erroneous readings and ensuring long lasting precision and reliability.

### Navigation equipment

The 'Seven Oceans' is equipped with the highly sophisticated NACOS 35-5 System (Navigation and Command System) and GMDSS for regions A1+A2+A3. The package of navigational aids and electronic communications systems was supplied by SAM-

*The main switchboard is the heart of the diesel-electric propulsion installation*

*The navigation bridge is one of four control stations in the wheelhouse*

Electronics Nederland BV. The Integrated Navigation and Command System NACOS 35-5 includes a.o. the following components:

- one X-band Chart Radar;
- one S-Band Chart Radar;
- two ECDIS-systems / ChartPilot-1100 (for paperless sailing);
- one TrackPilot-1100, Track keeping system with dedicated Conning Monitor;
- one NACOS slave station for the DP desk with Trackpilot operation panel
- one AIS unit (DEBEG-3400), fully integrated in the NACOS/ Radar system;
- one complete VDR system/ DEBEG-4300;
- one speed log;
- one Echo sounder Skipper GDS 101;
- one GPS navigator DEBEG-4422;
- one Weatherfax DEBEG 2952;
- three Gyrocompass systems NAVIGAT X with repeaters and ROT displays;
- one Magnetic compass system NAVIPOL II.

## Communication equipment

The GMDSS radio station fulfilling the requirements of IMO/SOLAS 74 for sea area A1,A2,A3 consists of the following:

- one MF/HF SSB/DSC 500 Watt DEBEG-3105;
- two VHF/DSC radio telephones DEBEG 5022;
- two Inmarsat-C terminals/ DEBEG-3220C;
- one Inmarsat FLEET 77 terminal;
- two EPIRBS/ DEBEG -3545;
- six Radar transponders system/DEBEG-5900;
- one Navtex/DEBEG-2902;
- three GMDSS handheld VHF sets/ DEBEG SP-3300;
- one batterycharger DEBEG 9218;
- one DEBEG 9565 remote alarm unit.

In addition, the ship is equipped with a Helibeacon, a dedicated helipad antenna and dedicated VHF equipment for communication with approaching helicopters.

## Conclusion

With 'Seven Oceans' heading to the Gulf of Mexico for its first assignment, the yard is working on a second vessel for Subsea 7, which is to be named 'Seven Seas'. This will be a flexible pipe lay vessel. For the same client, also a diving support vessel is on order to be delivered in April 2009.

Merwede Shipyard is part of the IHC Holland Merwede group, which recently announced a healthy order book of 650 million euro. To cope with the demand and the current boom in the off-shore market, the group has purchased the covered slipway at Krimpen a/d IJssel, which was formerly known as the Van Der Giessen / De Noord shipyard.

New orders include several suction hopper dredgers, cutter suction dredgers, a heavy lift vessel and a multi-purpose offshore support vessel.

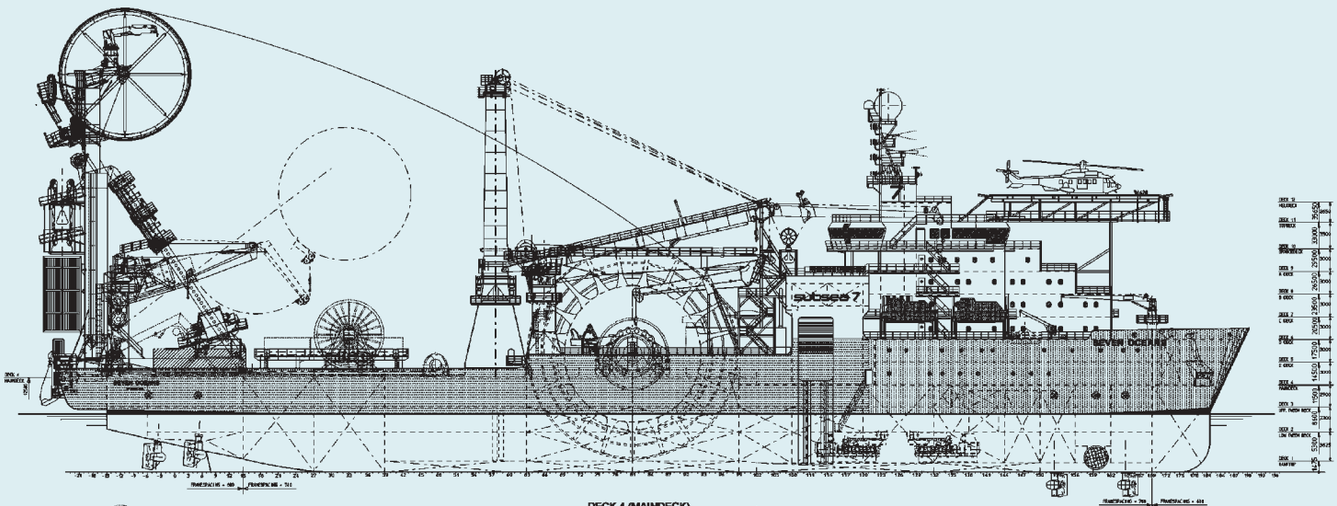
Subsea 7 is also expanding and is currently setting up an office in Rotterdam which will provide work to some 80 employees within the next few years.

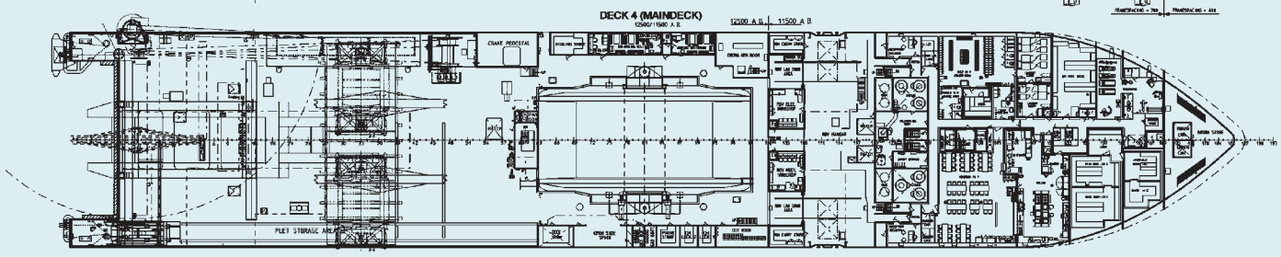
** Photo by D. Jansen, Dordrecht, The Netherlands*

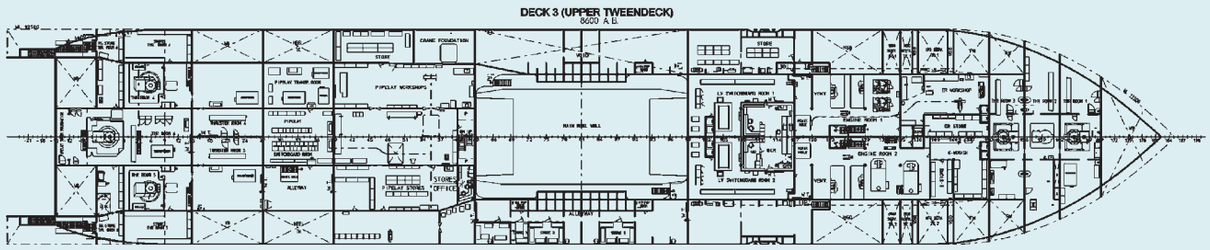
**Subcontractors and suppliers of equipment fitted on board the 'Seven Oceans'**
(partial list)

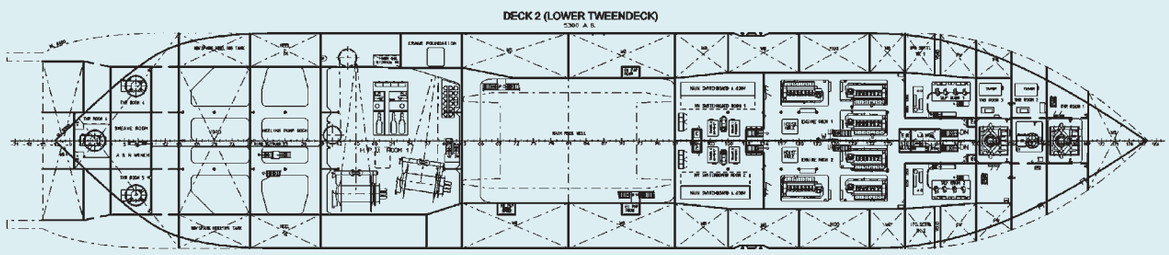
**Aalborg Industries,** Spijkenisse .: oil fired heaters
**Ajax Fire Protection,** Amsterdam .: fire fighting systems
**Allard-Europe,** Turnhout (B) .: Wide Body Sheave; ropes
**Alldoorco Bedrijfsdeuren,** Nijkerk .: rollerdoors
**Allweiler Pumps Benelux,** Utrecht .: centrifugal- and screw spindle pumps
**AMW-Marine,** H.I.Ambacht .: plate heat exchangers
**Arcelor Projects,** Moerdijk .: steel
**Bakker Sliedrecht Electro Industrie,** Sliedrecht .: e-motor for bowthruster with controls
**Blomsma Signs & Safety,** Zoetermeer .: IMO / Solas signalling marks
**Boer Staal, De,** Uitgeest .: steel plates, profiles and bulb flats
**Bouter,** Zoetermeer .: galley equipment
**Brabant Mobiel,** Oosterhout .: paint applicator
**Brummelen Machine- en Apparatenfabriek, Van,** Leeuwarden .: ROV hangar shell doors
**Centa Nederland,** Stellendam .: flexible couplings
**Corrosion & Water-Control,** Moerkapelle .: impressed current anti-fouling (ICAF) system; impressed current cathodic Protection (ICCP) system
**Croon Elektrotechniek,** Spijkenisse .: electrical installation
**Dekker & Stam,** Hardinxveld-Giessendam .: fuel
**Discom,** Alblasserdam .: exhaust silencer
**Econosto Nederland,** Capelle a/d IJssel .: valves
**Frank Mohn,** Bergen (N) .: anti-heeling pumping system
**GN Piping,** Sliedrecht .: piping
**GS-Hydro Benelux,** Barendrecht : hydraulic piping
**Haberman,** Strijen .: engineroom floors
**Hamworthy,** Rotterdam .: sewage units
**Hassink,** Ridderkerk .: grinding
**Hatenboer-Water,** Rotterdam .: sea water desalination system; post treatment skid; fresh water hydrophore & treatment module; hot water calorifiers
**Helder & May,** Europoort RT .: nautec SX and nautec FS subfloors
**Hempel (The Nederlands),** Vlaardingen .: paint systems
**Holland Marine Lifts,** Hardinxveld-Giessendam .: crew lift
**Hoogland-Mennens,** Dordrecht .: workshop equipment
**Huisman-Itrec,** Schiedam .: pipe laying equipment and main crane
**Inglasco Fire Systems,** Rotterdam .: safety equipment; firehoses; nozzles; fireman's outfits; glassfibre cabinets & storage boxes; helicopter rescue equipment
**Intersona,** Heerde .: noise and vibration calculations; sea trial measurements
**Johnson Controls Systems & Service,** Dordrecht .: airconditioning; heating and ventilation
**Leeuwen Buizen Van,** Zwijndrecht .: steel pipes and components
**Lloyd's Register EMEA,** Rotterdam .: classification
**Loggers Rubbertechniek,** Dordrecht .: expansion joints for exhaust system
**Loipart,** Sweden .: laundry equipment
**Lubrafil,** Barendrecht .: *Boll & Kirch* automatic fuel filter
**Machine Support,** Ridderkerk .: damming and chocking of the retractable thrusters
**Maderas Jumilla,** Jumilla-Murcia (E) .: toilet units
**Mar-In Controls,** Krimpen a/d IJssel .: fuel supply module
**MARIN,** Wageningen .: modeltesting
**Marine Aluminium,** Norway .: helicopterdeck
**Maritme Research Institute Netherlands,** Wageningen .: model testing; powering and seakeeping
**Marktechnical,** Dongen .: pressure transmitters; pressure switches; thermostats; valve; cranes
**Merwede Interior,** Hardinxveld- Giessendam .: outfitting accommodation
**Metalix,** Kinderdijk .: steel package musketeer doors; tank vent check valves.
**N.R. Koeling,** Krimpen a/d IJssel .: provision refrigirating installation
**National Oilwell Norway,** Norway .: offshore crane
**Nieuwburg & Zn. L.,** Krimpen a/d IJssel .: insulation
**Norsafe,** Faervik (N) .: life- and rescue boats with davits
**Oléus,** Hardewijk .: lubricants
**Onboard-Napa,** Finland .: loading computer
**Polypal Netherlands,** Venlo .: racks in stores
**Radio Holland Netherlands,** Rotterdam .: communication system; entertainment system
**Roemeg,** Waalwijk .: *Grenamat-MBM* walls /ceilings
**SAM Electronics Nederland,** Rotterdam .: communication and navigation equipment
**Schmitt Anchors & Chaincables,** Rotterdam .: anchors and chains
**Ship's Equipment Centre (SEC),** Groningen .: winches mooring equipment
**SGB Holland,** Arkel .: scaffolding
**Sperre Rotterdam,** Ridderkerk .: *Sperre* starting air compressors & receivers; TMC working air compressors and dryers and receivers.
**SPM Instrument,** Drunen .: bearing monitoring equipment
**SST Staalsnijtechniek,** Dordrecht .: flamecutting-parts
**Statendam Steel Plates,** Oosterhout .: steel
**System Floor Technics,** Doetinchem .: wheelhouse floor
**TeamTec,** Gjeving (N) .: incinerator
**Technoship,** Apeldoorn .: life- and rescue boats with davits
**Theunissen Technical Trading,** Malden .: *Aqua Signal* lighting; *SeaTeleCom* communication equipment; *Seematz* window wipers; *MTC Brattberg* cable transits seals
**Trinoxx,** Rotterdam .: ROV doors
**TTS Marine ASA,** Norway .: cranes
**Uittenbogaart T.B.,** Rotterdam .: *Deerberg* bale compactor;
**Viking Life-Saving,** Zwijndrecht .: life rafts with davits
**Volvo Penta Europe,** Beesd .: emergency diesel engine
**Wartsila Nederland,** Zwolle .: *Wärtsila* generator sets; steerable thrusters, for the main propulsion and DPS system during pipe laying application; retractable steerable thrusters, each, for DPS; tunnel thruster, for both Dynamic Positioning or mooring of the vessel.
**Westfalia Separator,** Rotterdam: lube-oil; fuel separators
**Winel,** Assen .: WT steel and GRP sliding doors; musketeerdoors; RMO tank vent check valves; central closing systems hatches
**Wingerden & Zonen H.K. van,** Vuren .: windows; side lights

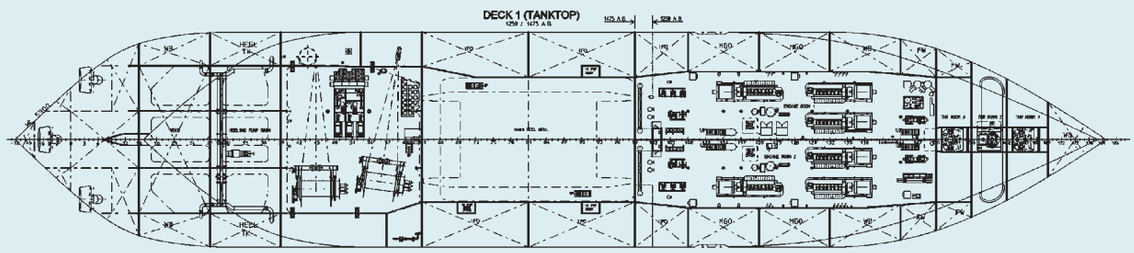
## GENERAL ARRANGEMENT






DOUBLE BOTTOM TANK ARR.