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Spaarneborg **negotiating the river Trave. This interesting 12,500dwt ro-ro vessel and her two sisters will pioneer a new intermodal system of transporting paper products from Sweden to Belgium, using the newly developed Storaboxes, or SECUs, as they are now known, in conjunction with IPSI philosophies.**

Spaarneborg: pioneering new ideas in cargo handling

Flender Werft has delivered to Wagenborg Shipping the first of a trio of 12,500dwt ro-ro ships designed to load the innovative 90tonne Storabox cassettes (today known as SECUs). Development of this new ship type by Stora Enso has also served as inspiration for the part-EC-sponsored IPSI project, which hopes to offer dramatic improvements in cargo-handling times for ISO containers and trailers. As the basic ship design (Stora and IPSI) is the same, on-going IPSI technology involving automated guided vehicles and automatic cargo securing could be directly applicable to these new ships in future.

At the turn of last year a new ship entered service, that could have a profound influence not only on future handling of unitised cargoes but also on ro-ro hull designs. This is the 12,500dwt *Spaarneborg*, first of a trio from Flender Werft at Lübeck, Germany, for the Dutch owner Wagenborg; all three vessels have been chartered for 15 years (a charter which made their construction possible) to the Swedish forest products and paper giant Stora (today Stora Enso). This organisation will supply around 60% of a total ship's cargo - to be carried on innovative special container-like cassettes originally known as Storaboxes but now called SECUs - Stora Enso cargo units - between Göteborg and Zeebrugge, as part of a new intermodal network. Operator of the trio will be the Belgian ro-ro company Cobelfret.

The idea for this most interesting class of ship came from Mr Olle Widigsson, from Stora Enso Transport & Distribution, and a conceptual design was originated by Mr Per Fagerlund from the Swedish consultancy Globtech Marine. With the assistance of Veden Engineering and the Italian consultancy NAOS, in Trieste, a complete design was formulated. *Spaarneborg* was inspected at Lübeck by *The Naval Architect* just prior to completion.

Designed for 90tonne SECUs (Storaboxes)

Full details of Storaboxes appeared in *The Naval Architect*, June 1998, page 18, but essentially they are large covered cassettes with dimensions of 13.8m x 3.6m wide and 3.6m high (plus 0.7m for the runners) and can contain up to 80tonnes of paper products (making a total unit weight of more than 90tonnes possible). At present, the weight of paper caroges is limited to approximately 74tonnes due to a 25tonne limit on rail wagon axles; however, this will be increased in the future.

These dimensions were chosen to utilise the maximum permissable cargo profile, weight (axle load), and cubic. Extra engineering on the rail side is very limited apart from the future increase in axle load. Boxes will be loaded at the mills and travel by rail and ship without the need for stripping and re-loading until they reach Zeebrugge. They will have to be stripped there because, at the present time, the size of SECUs prevents them being carried on Continental roads or rail tracks.

Cassettes themselves are not new: the Port of Göteborg points out that they are already the mainstay of DFDS Tor Line cargoes from Sweden to the UK (using technology originally introduced by Stora), and are also used by Gorthon Lines on its *Obbola*-class ships (*The Naval Architect*, May 1996, Special Supplement). It is, however, the size of the boxes that is greatly enlarged. Rail links have been provided to a new two-level ramp system at a new terminal in Göteborg's Älvsborg Harbour. Storaboxes have been specially dimensioned to

PRINCIPAL PARTICULARS
SPAARNEBORG

Length, oa	183.40m
Length, bp	173.60m
Breadth, moulded	25.20m
Depth, moulded to main deck	9.30m
Draught, design	7.50m
Draught, scantling	7.80m
Gross	21,005tonnes
Displacement	21,667tonnes
Lightship	9167tonnes
Deadweight, design	12,500dwt
Cargo capacity	132 Storaboxes (other ro-ro cargoes can also be loaded)
Ballast capacity	7804m^3
Main engine	Hanjung-Sulzer 7RTA52U
Output	10,920kW at 135rev/min
Speed, service at 85% MCR output	18knots
Crew	14
Drivers	10 (plus some spare cabins)
Classification	Bureau Veritas I 3/3 E, +Roll-on/Roll-off, Deep Sea, PFA, Veristar, +MACH, +AUT-MS
Flag	The Netherlands

Left: An ideal IPSI ship for containers and trailers would feature a series of kerbs so that automated guided vehicles could place unitised cargoes exactly into position; on the *Spaarneborg* only the strong bulwark barriers seen here will be used, since SECUs will be block-stowed. Right: In the main and tank-top decks, a series of centreline barriers is fitted. Fixed Hamworthy KSE ramps port and starboard lead to the lower level; their lower ends have a hinged section, which stows flush and horizontal to gain four extra SECU positions.

take advantage of increased axle loads on Swedish Railways, but some other railway engineering has also been necessary to accommodate them.

Previously, Stora used the overland rail system and appropriate train ferries to deliver goods to western Europe, but the company expects to save some SKr200 million annually through the use of its new shipping service. With the new system, Stora will be able to carry four tonnes for every metre of rail wagon instead of two tonnes previously. According to the Port of Göteborg, shipments to the UK will also start in 2001, using the same technique.

Influences on the IPSI project

A major theme of the new ship design has been conformity to some of the philosophies of the European Commission's IPSI project, which was 50% financed by EC money; however, none of the planned automated systems are on board - but could easily be included in future. As we explained in our September 1999 edition, page 47, IPSI stands for 'improved port/ship interface' and the consortium is headed by the cargo access specialist Hamworthy KSE; other members of the consortium are Wilson Management, Marintek, Saga, SINTEF, Fraunhofer Gesellschaft, Port & Transport Consultants, NIM, and the Technical University of Delft. In an ideal IPSI-equipped container and trailer ship, the ro-ro decks would be fitted with a series of channels and kerbs, where cargo units would be guided into their exact positions by so-called automated guided vehicles (AGVs) with the aid of globally positioned satellites.

To ensure that the new ships meet this specification, a primary theme of *Spaarneborg's* construction has been the provision a large volume of squared-off cargo space on three decks with no obstructions. One of the main results of this was a decision to place the accommodation and the machinery spaces forward - this position has allowed the owner to use a low-speed main engine, a luxury not often available on a short-sea ro-ro ship. In essence, IPSI promoters claim that cargo loading and discharging operations can be dramatically slashed from 12h to 2h - in the IPSI version (of a ship with hold dimensions tailor-made for ISO boxes), more than 400TEU can be handled hourly.

The owner and operator of this new trio have not yet gone to specifying full kerbs or the use of AGVs; however, a prominent feature is an arrangement on all three levels of strong barriers against the bulwarks, also on the centreline in the main and tanktop decks. SECUs will be block-stowed and secured by two manually operated 'pushers' for each bay, which are stowed in a folded position behind the barriers; it is understood that at the end of the last lane stowed across the deck, there will be a 580mm gap to allow the last two cassettes in each block to be stowed accurately using a 'pusher'. The Port of Göteborg has purchased seven new tractor-translifter combinations for handling the cassettes, whose construction allows a very low trailer to be pushed in underneath. The tractor's 'fifth wheel' plus a mechanism at the translifter's back end will together lift the SECUs.

SECUs will only be carried on ships in one tier. If AGVs were to be employed on these ships in the future, they would not be able to use the tanktop, since they cannot negotiate slopes of more than 4deg, but could do so if larger engines were specified. This would also apply to other vessels with similar ramp arrangements. Current tugmasters can handle these inclinations.

The high point loads of SECUs called for careful structural steelwork detail by Flender Werft's naval architects - the company is a skilled user of Kockums' Tribon CAD/CAM suite, and the complete production of the ship was made using this software, based on the 3D product-information-model concept. However, the linear load of a SECU's feet calls for less structural strength than, for example, an 80tonne Mafi trailer. Hull lines were created using Napa software following tank tests at SSPA in Göteborg, and a complete finite-element study of the hull, together with a vibration analysis, was subcontracted by Flender to the ship's classification society, Bureau Veritas.

A main theme of the IPSI concept is that cargo should be loaded onto ships horizontally at each level (the ideal IPSI ship would therefore only have two cargo decks). *Spaarneborg* has direct access to the main deck through a Hamworthy KSE combined door and ramp which is made

SECUs being manoeuvred on the upper deck of *Spaarneborg* using tractors and translifters at a specially built new terminal in the Älvsborg harbour at Göteborg, during harbour trials. The IPSI concept promotes the idea of direct horizontal access into each 'squared-off'deck, where there would be no obstructions. For this reason, a special raised mooring deck has been fabricated.

watertight by a single-lip EPDM gasket compressed by a stainless steel flat bar. The ramp has finger flaps at both ends, and the overall length is 16m including flaps, with a driveway width of 22.7m; it can be worked at +/-10deg from the horizontal.

Access to the upper deck will be provided directly from shore over a specially designed two-level shore-based ramp constructed at the Älvsborg harbour in Göteborg (this harbour is non-tidal) and a linkspan will be used at tidal Zeebrugge. To allow cargo completely free access, a separate mooring deck has been built over the upper level.

Access to the tanktop is down two large (52.00m x 8.60m) fixed ramps each side of the centreline near the stern door; their forward ends have a hinged section (the hinge is at the tanktop level), which can be stowed flush and horizontal to gain four more SECU positions. These sections can be raised and lowered fully loaded. To ensure a watertight main deck, two large ramp covers, hinged at their forward ends, are fitted. The complete package is operated hydraulically from a Hamworthy KSE power pack in the small aft machinery space (there are small secondary packs for the hydraulic bunkering doors in the shell).

Spaarneborg **features an example of SAJ Instrument's DMS Pro-Hydro dynamic measuring system. This screen is in the wheelhouse.**

125m long propeller shaft

A second innovative feature of *Spaarneborg* is her machinery arrangement. As mentioned, the single main engine - a Hanjung-built Sulzer 7RTA52U low-speed unit - is placed well forward in the hull beneath the accommodation superstructure. As a result, the propeller shaft is an amazing 125m long - almost unheard of in modern shipbuilding, although somewhat shorter lengths made regular appearances in ships of the 1950s and 1960s, when machinery was commonly placed amidships. Flender has also pointed out that not too long ago it installed twin 65m shaftlines in a cargo liner.

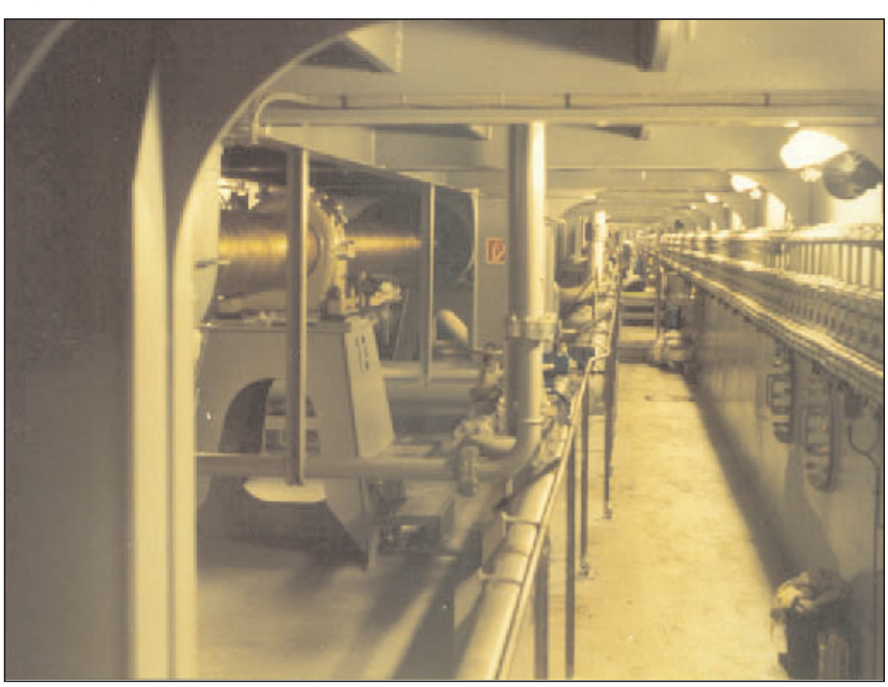
A self-contained shaft tunnel runs under the cargo spaces with a full height walkway alongside. Needless to say, there are numerous bearing supports, plus couplings for the shaft lengths. At the aft end, the shaft terminates in a Thordon sterntube bearing system; this is of the Thor-Lube sealed type, which has been chosen by Wagenborg for 16 of its other recent new ships (it was first used on the company's *Markborg* in 1996). The system uses proven non-metallic Thordon XL bearings together with a non-polluting water-soluble lubricant.

As well as driving a Lips four-bladed CP propeller of 5.2m diameter, the 10,920kW engine also drives off its free end a 1420kVA van Kaick alternator through a Flender Bocholt IMA630B gearbox. Auxiliary electrical supplies come from a pair of 1420kVA van Kaick alternators driven by Wärtsilä 6L20 engines.

Good manoeuvrability should be ensured by a pair of 800kW Lips bow thrusters, plus a similarly sized unit at the stern; these, with a Flender-built 20m^2 fully balanced rudder, should mean that *Spaarneborg* will be able to berth and leave without tugs under most conditions. Heel during cargo operations is controlled by a Frank Mohn pump system, while roll at sea is limited by a pair of Flume tanks positioned at the aft end of the forward superstructure; these will especially be brought into use on lightly loaded or ballast voyages, since the ship has a high GM in that condition.

A fine enclosed wheelhouse contains a comprehensive array of equipment, including Siemens Alpha-Vision displays for the Siemens SIMOS computerised machinery control and fire detection systems, and an SAJ Instrument display for that company's DMS Pro-Hydro dynamic monitoring system.

The propeller shaft has a remarkable length of 125m and is situated in a tunnel with a full-height walkway alongside.



'Green' ship features

Special efforts have been made by both Wagenborg and Stora to ensure that this new trio of vessels is as environment-friendly as possible. Both the main and auxiliary engines will burn heavy fuel with a sulphur content below 1.5%, and *Spaarneborg* and her sisters become the first Sulzer low-speed engined ships to be fitted with selective catalytic reduction (SCR) treatment of the exhaust gas - on both the main and auxiliary engines. In addition, the ABB Fläkt treatment units are understood to be the first for heavy-fuel engines installed before the turbine of the turbocharger. The objective is to achieve NOx emission levels of 2gkW/h or less in compliance with Swedish legislation.

The application of SCR units to low-speed engines in ships has a specific problem because the catalyst requires a minimum temperature for it to work; however today, low-speed engines in general have low exhaust temperatures, especially when operating on part-load. It is for this reason that the SCR unit is fitted before the turbocharger turbine. The slightly higher exhaust temperature of Sulzer engines, compared with competitors, should, it is claimed, give an advantage. The Wärtsilä auxiliary engines will have their SCR units fitted, as usual for four-stroke engines, after the turbochargers.

This new trio of vessels mark an appropriately novel approach to design and operation at the dawn of a new century. It will be most interesting to see if the techniques adopted, and the important input that has been made by these ships to the IPSI concept, are adopted by other owners. Certainly, the automated cargo handling ideas - when commercially ready - will be directly applicable to *Spaarneborg* and her sisters.