Schip en Werf – Officieel orgaan van de Nederlandse Vereniging van Technici op Scheepvaartgebied
De Centrale Bond van Scheepsbouwmeesters in Nederland CEBOSINE
Het Maritiem Research Instituut Nederland MARIN.

Verschijnt vrijdags om de 14 dagen

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Abonnementen

Jaarabonnement 1987	ƒ 78,25
buiten Nederland	ƒ 124,50
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(alle prijzen incl. BTW)
Bij correspondentie inzake abonnementen s.v.p. het 8-cijferige abonnementsnummer vermelden. (Zie adreswikkel.)

Vormgeving en druk
Drukkerij Wyt & Zonen b.v.

ISSN 0036 – 6099

Inhoud

TIJDSCHRIFT VOOR
MARITIEME-EN OFFSHORE-TECHNIEK
SCHIP EN WERF

THE SEMI-SUBMERSIBLE 'SMIT SEMI I'

From design up to realization

By
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1. INTRODUCTION

In the early 1980's Smit Tak International has decided to be more independent of their salvage and towing activities. As a first step two salvage vessels 'ORCA' and 'BARRACUDA' were modified into maintenance and repair service vessels for the inspection, maintenance and repair market (IRM). In 1984 and 1985, another four supply vessels were modified into support vessels and the geographical market, segment has been extended from the Southern part of the North Sea to the Middle- and Far East and the Gulf of Mexico.
At the end of 1984 a project team was established to select the appropriate newbuilding for the IRM/contruction and installation market and to operate as an independent entity in the IRM offshore market, SMIT ISO was founded in 1986.
The new vessel should be able to operate world wide and to have maximum flexibility in equipment and layout and last but not least to compete pricewise with the existing monohull vessels.
This paper will describe the market review, the design selection from concept design up to actual realisation.

2. MARKET REVIEW, DESIGN STAGES AND CONSTRUCTION CONTRACT

In close cooperation Smit International B.V. and Marine Structure Consultants (MSC) B.V. have executed this project development phase. The objective for the project team was a qualitative review of the market including the existing vessels serving the IRM market segment and a feasibility study for the proposed new design.
The IRM and the light to medium installation and construction market segment requires the vessel to have adequate deck space, sufficient crane capacity, a proper positioning system, a saturation diving installation and a sufficient deckload capacity. As the vessel will operate in way of fixed platforms, a flexible connection (gangway) adequate accommodation and workshop facilities should be incorporated.
After intensive discussions, the project team decided to assess and to compare a compact sized semi-submersible with the existing vessels as monohull and 'large' semi-submersibles. The qualitative aspects of the different vessels have been reviewed and are illustrated in figure 1. The general conclusion of this review is:
- monohulls are capable to serve the IRM market, but can not be used for installation and construction work. Furthermore, those vessels are hampered by their limited workability and available deck space
- the 'large' semi-submersible (displacements of about 15,000-20,000 ton) eliminates the disadvantages of the monohulls, but its operational costs, and operations in way of fixed installations in shallow water may be considered as disadvantages

Figure 1.: Qualitative assessment of various units

Activity	medium mono hull	large mono hull	jack-up	Smit Semi	large semi-sub
Underwater					
inspection	+	++	−−	++	++
maintenance	o	+	−−	++	++
repair	o	+	−−	++	++
ROV work	++	++	−−	++	++
subsea compl.	o	+	−−	++	++
splash zone	o	+	−−	+	+
Above water					
hook-up	−−	−−	++	+	++
maintenance	o	+	++	+	++
repair	−−	−−	++	++	++
accommodation	−−	−−	++	+	++
replacement upgrading	−−	−−	+	++	++
Various					
light/medium installation and construction	−−	−−	−−	+	++
well stimulation	−−	+	−−	+	++
platform & debris removal	−−	−−	+	+	++
logistics	−−	o	+	++	++
salvage activities	−−	o	−−	++	++

++ = very good
\+ = good
o = possible
−− = not suitable

– the compact sized semi (displacement of 10,000 tons) has been found to be the best compromise between workability and operational costs.

Therefore, the compact semi design has been selected as the challenge for the project team of Smit International and MSC, to arrive at the appropriate size and shape. The next step of the feasibility study was the definition of the design specification and the concept design including a ball park price for the realization. The design specification for the vessel included the following main elements:
- payload
- operations
- environment
- positioning
- investment costs.

The specification has been more detailed in figure 2. The project

Figure 2.: Design specification

Payload capacity:	– transit payload 1,500 ton – variable deckload 750 ton
Operations:	– crane capacity 150 ton at 30 m – accommodation: utilities for 110 men cabins for 89 men
Environment:	– world wide operations
Positioning:	– joystick DP system – wire mooring system for 100 m waterdepth (DNV POSMOOR-V notation)
Investment costs:	– as low as possible – competitive to monohulls

schedule for the full project was also discussed, starting at the end of 1984 the first unit should be in operation mid 1987. This led to the project schedule as shown in figure 3. During the tender stage, the design of the vessel evolved into the present shape as shown in figure 4 (artist impression), figure 5 (physical size) and Table I (main dimensions). Due to the market influences, especially the equipment of the vessel has been upgraded to include a redundant DP system, a 18-men saturation diving unit, a knuckle boom deck crane and a telescopic gangway. At this stage, Smit International concluded a partnership with the Dutch Government Investment Fund, Maatschappij voor Industriële Projecten (MIP).
On November 10th, 1985, the Board of Directors of Smit International and MIP decided to go ahead with the construction of two semi-submersible vessels and at the end of 1985 the building contract had been awarded to Van der Giessen-de Noord Shipyards. At that time the basic design, prepared by Smit International and Marine Structure Consultants, was finished and fully approved by Lloyd's Register of Shipping.
Consequently, after a thorough check of the basic design and all relevant data, Van der Giessen-de Noord Shipyards has accepted the total design responsibility for the two vessels as part of the building contract. The delivery of the two vessels is scheduled for half 1987 and first quarter of 1988.

Table I: Particulars

Dimensions:	As built design	concept design
Lower hulls (two)		
Length o.a.:	54.00 m	50.4 m
Beam o.a incl. anchor racks:	49.00 m	48.4 m
Depth:	6.60 m	6.4 m
Width (each):	12.48 m	12 m
Maindeck:		
Length o.a.:	50.00 m	43.2 m
Beam moulded:	43.20 m	42.6 m
Clear deck area:	1200 m^2	1100 m^2
Working moonpool:	9.6 m × 9.6 m	9.6 m × 9.6 m
Draught:		
Draught operational:	12.60 m	12.5 m
Draught transit/survival:	6.20 m	5.7 m
Displacement/payload:		
Transit/survival displacement:	7,440 tons	5,800 tons
Operational displacement:	10,470 tons	8,700 tons
Variable payload:	1,750 tons	1,500 tons

Class and Regulations
Lloyd's Register of Shipping OU 100 AI LMC UMS DP (AA) PC column stabilized multi/purpose vessel.

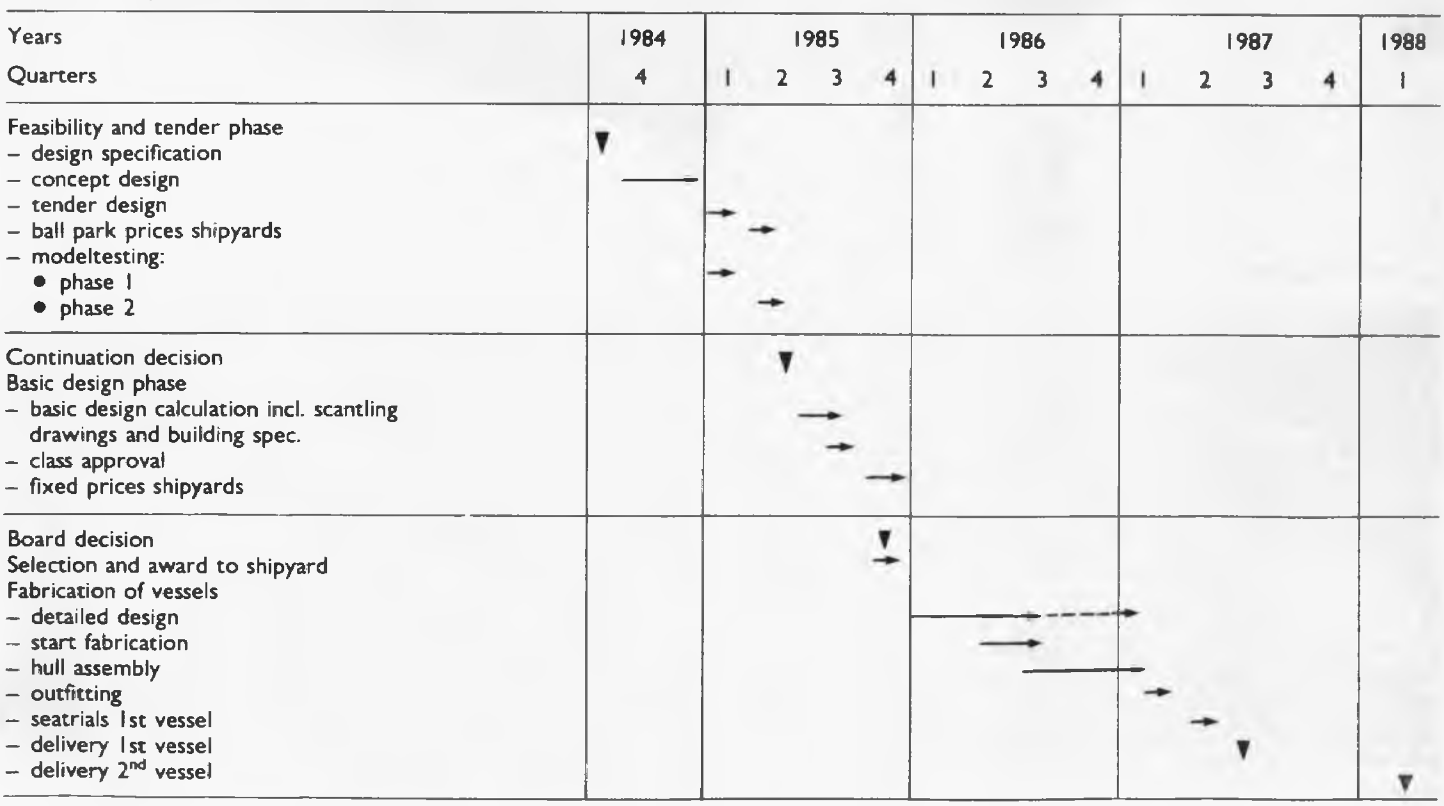
3. DESIGN STUDIES

3.1. Introduction

During the development of the 'Smit Semi I', three design stages can be recognized, being:
- the feasibility stage
- the concept/tender stage
- the basic design stage.

In the feasibility stage emphasis has been given to translate the design specification into overall dimensions of the vessel including an estimation of the cost price involved. During the concept/tender stage, more detailed studies on equipment and layout completed the design specifications and preliminary scantlings have been prepared to obtain ball park prices of selected shipyards. To obtain fixed prices of shipyards during the second half of 1985, the building specifications, basic design calculations and scantling drawings, including Lloyd's Register's approval, have been prepared.
In the feasibility stage and tender stage extensive modeltesting at MARIN test facilities have been carried out on motional behaviour of the vessel. During the basic design stage windtunnel testing at the Dutch Aerospace Laboratories and resistance tests at MARIN have been carried out to complete the environmental data for the positioning keeping and stability studies.

Figure 3: Project schedule



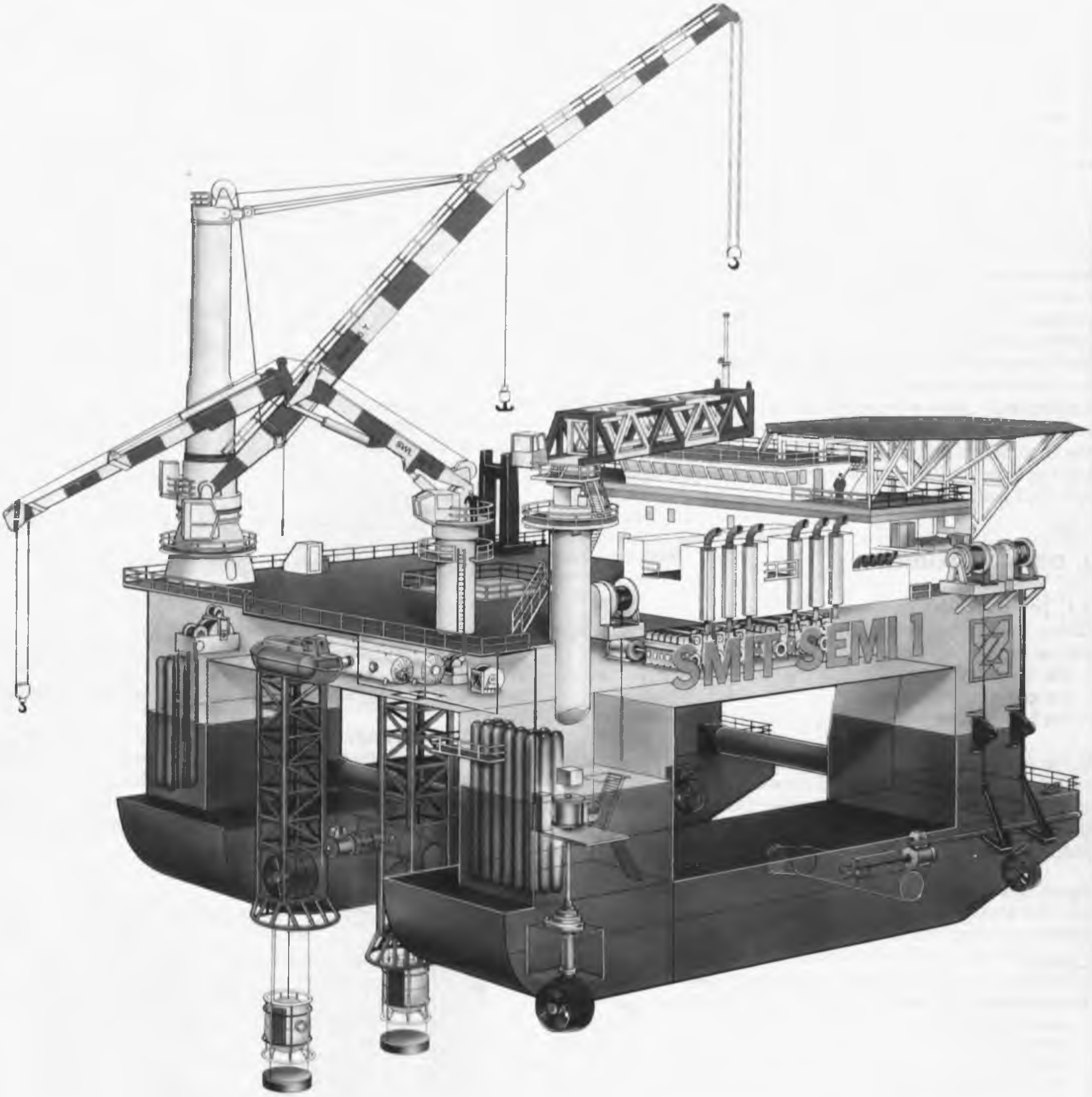


fig. 4 : Artist impression of Smit Semi I

3.2. Feasibility stage

The objective is the set of design criteria which should be fulfilled by the design (see figure 2.). The essential elements, determining the overall size and shape of the design are the required payload, the crane capacity and the world wide operations.
Especially, for these latter two criteria (crane operations and world wide operations) a compromise should be found between stability and motions.
In addition, the overall dimensions should be kept as small as possible to arrive at low investment costs. For crane operations sufficient stability can be achieved with a relatively large waterplane, but the natural periods of the vessel will be reduced to about 18 seconds. Thus the influence of low natural periods on motional behaviour of the vessel should be checked. For worldwide operations the selected areas are North Sea, India, West Africa and

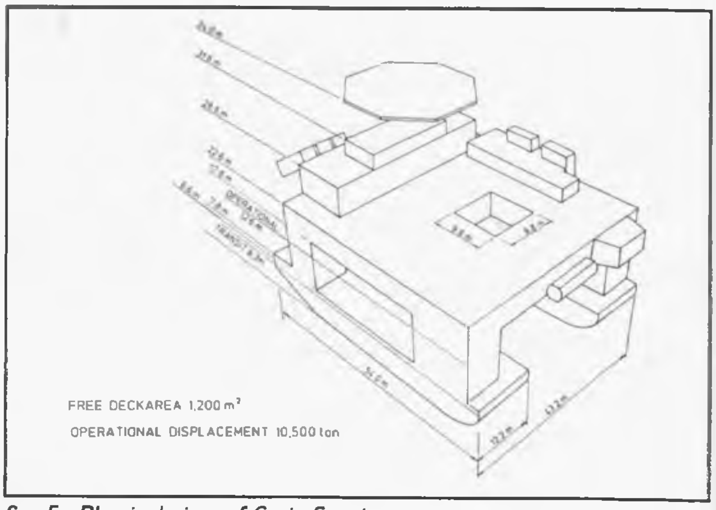


fig. 5: Physical size of Smit Semi

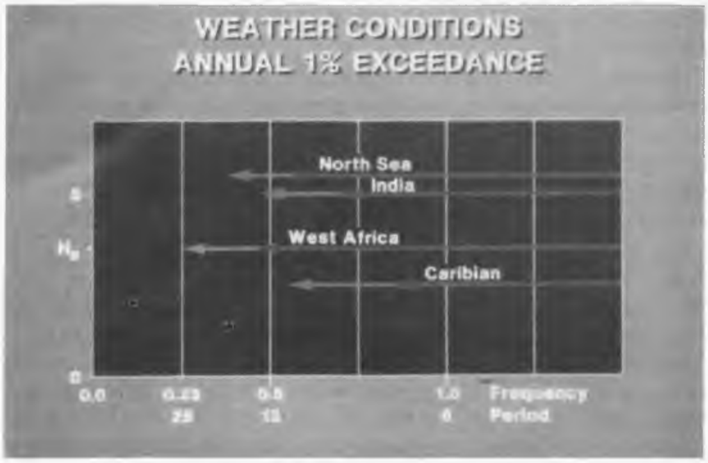


fig. 6 : Weather conditions in selected areas

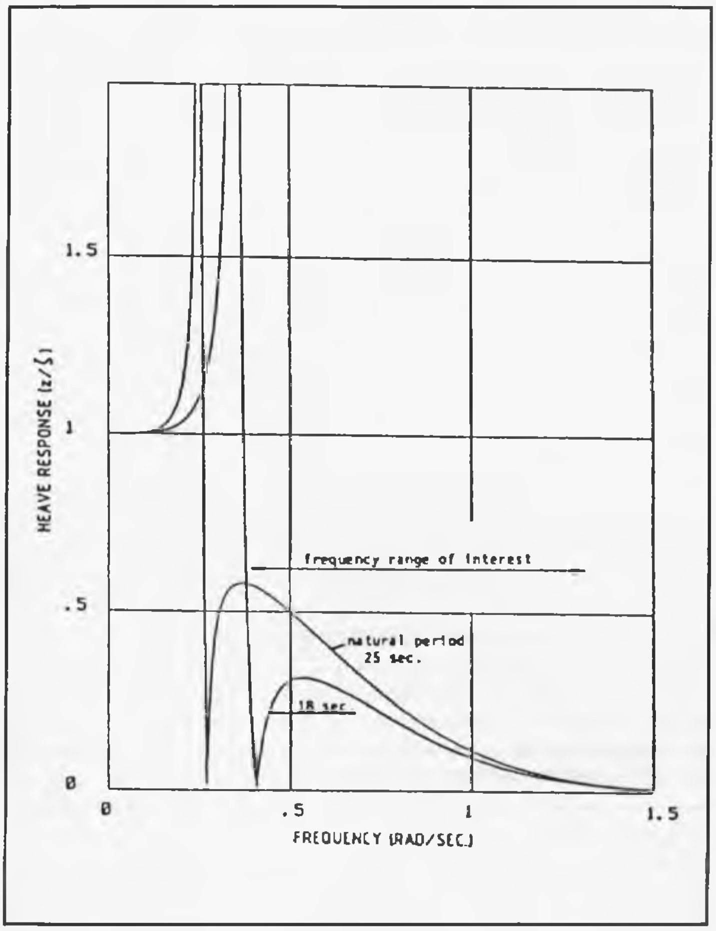


fig. 7: Assessment of natural periods

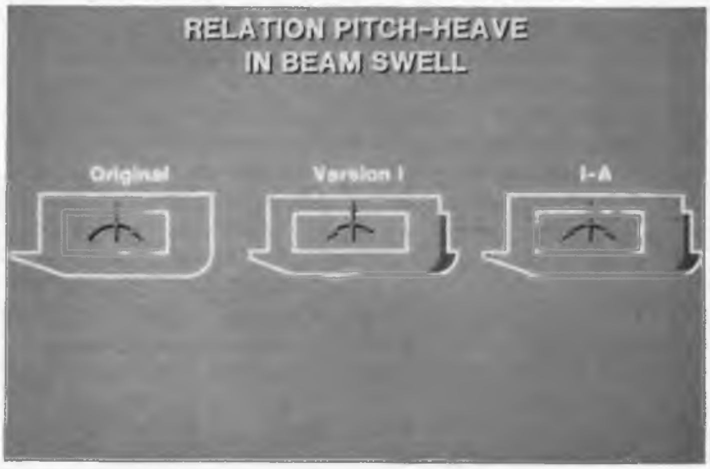


fig.8: Relations of pitch-heave response

Caribean (see figure 6). The sea conditions with periods over 12 seconds occur occasionally in the North Sea and West Africa, while the majority of periods lays below 12 seconds. This implies that natural periods could be around 18 seconds as illustrated in figure 7. The resulting compromise leads to acceptable motions, sufficient stability and small overall dimensions of the vessel. The selected hull shape is of a two floater, four column and buoyant deck structure design, as illustrated in figures 4 and 5, although the original main dimensions were somewhat smaller (width 42.6 m and length 50.4 m with an overall displacement of 8,700 tons). A typical detail of the design is the orientation of the columns. The forward columns are in longitudinal direction and the aft columns in athwarthship direction; this to obtain optimum stability within its dimensions and less wave resistance in transit condition. The asymmetric configuration can have however influence on motional behaviour. Therefore, in this design stage, model testing has been carried out:

- to verify motional behaviour in swell conditions (no litterature is available on motions in swell conditions of semi-submersibles)
- to optimize the layout of the columns.

The location of the columns showed to have influence, being the

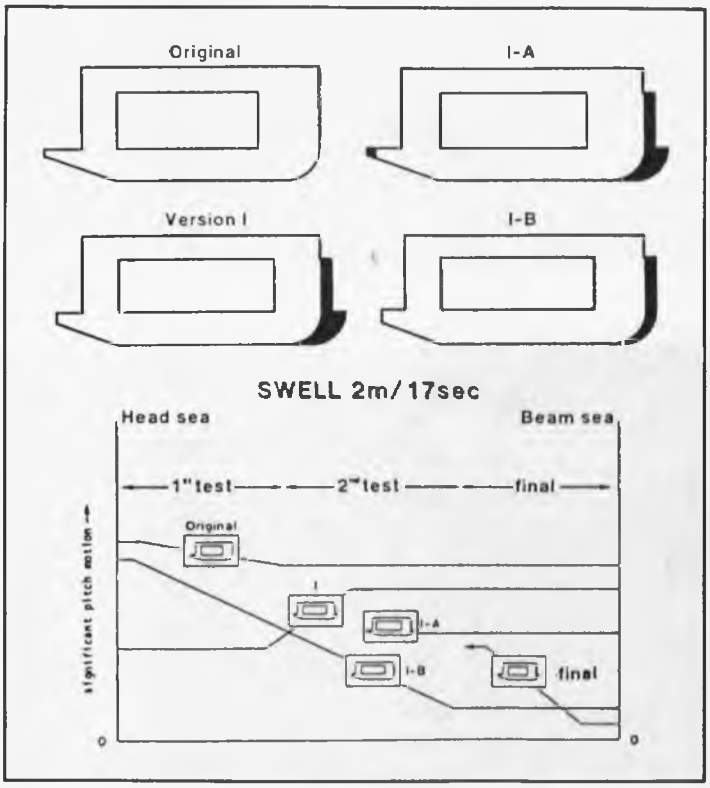


fig.9: Pitch response for various configurations of the vessel

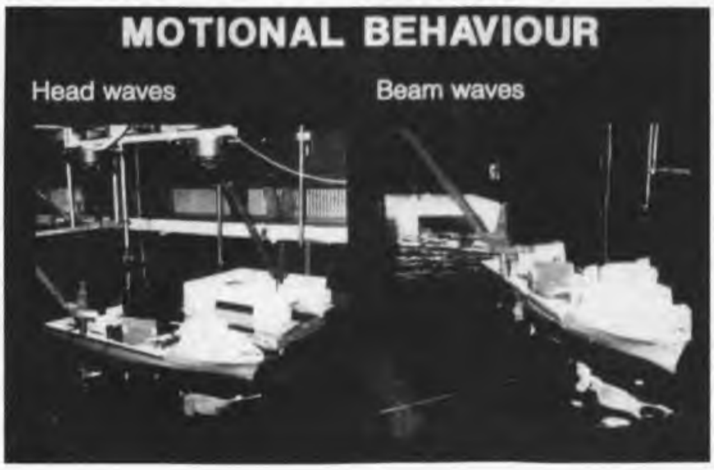


fig. 10: Motional behaviour testing of two vessels

phenomena of pitching in beam seas. Several locations of columns relative to the floaters have been analysed. As shown in figure 8, the pitch behaviour of the original unit is opposite to version I, where the floater has been extended and the column shifted forward. Thus by proper dimensioning of floater size relative to column location this pitch effect in beam seas was significantly reduced as illustrated in figure 9. A more detailed description of this study is given in reference 1.

The final shape of the vessel incorporates the 'nose' to reduce the pitch in head waves and the stern extension to balance floater to column configuration to avoid pitch response in beam waves. Once the exact motions of the vessel were established, modeltesting of the semi-submersible simultaneously with a monohull vessel was carried out as illustrated in figure 10. Results of these tests are shown in figures 11 and 12 for the heave, roll and pitch responses of the two vessels. Both figures illustrate the superior motions response of the Smit Semi.

Translating those figures to workability percentages (figure 13) one recognizes that the Smit Semi workability percentage is about 40 percent higher than the monohull vessel for both crane and diving operations. The conclusion of the feasibility stage of the design development was that a compact semi-submersible is attractive for both objectives: *OPERATION AND PRICE*

3.3. The concept/tender stage

At the start of the concept/tender stage, a second market review was carried out to obtain the reactions on the proposed design. The most important modification to the basic layout was the incorporation of an integrated saturation diving complex and consequently a fully redundant DP system.

To implement these two major modifications, the size of the upper deck was slightly increased to the final dimensions as shown in figure 5 and Table 1.

Concentrating on the position keeping of the vessel, two systems are provided:

- a fully redundant DP system (see figure 14)
- a position mooring system (see figure 15).

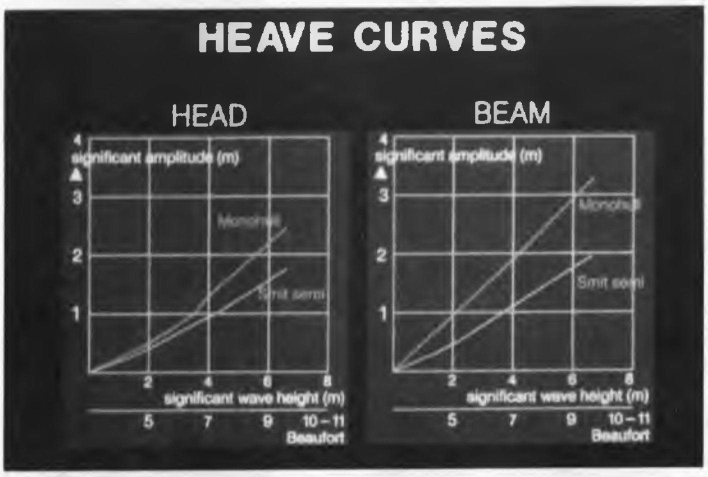


fig. 11: Heave curves

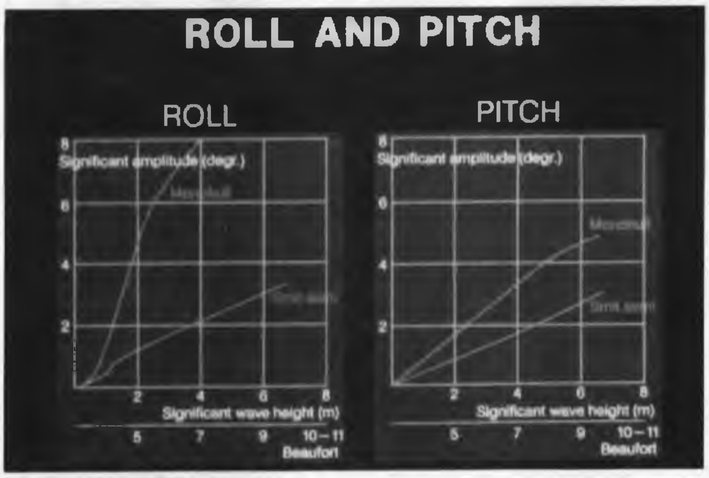


fig. 12: Roll and pitch curves

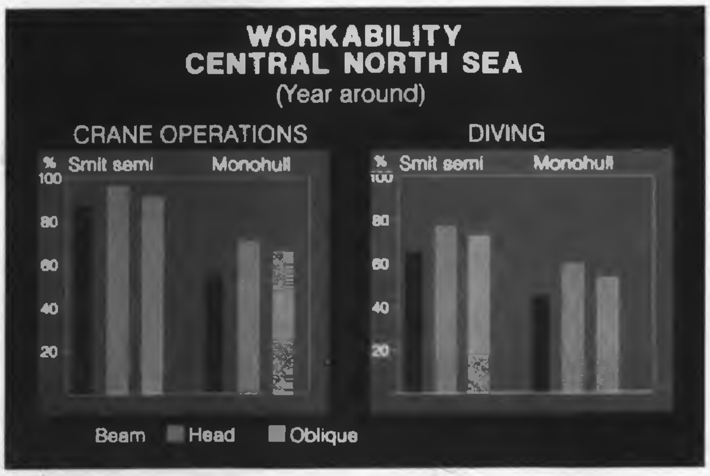


fig. 13: Workability central North Sea (year around)

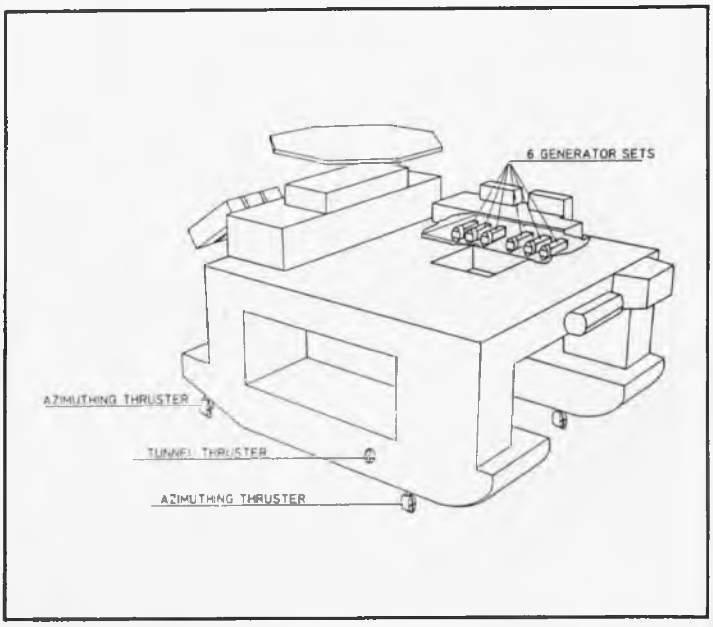


fig. 14: Dynamic positioning system

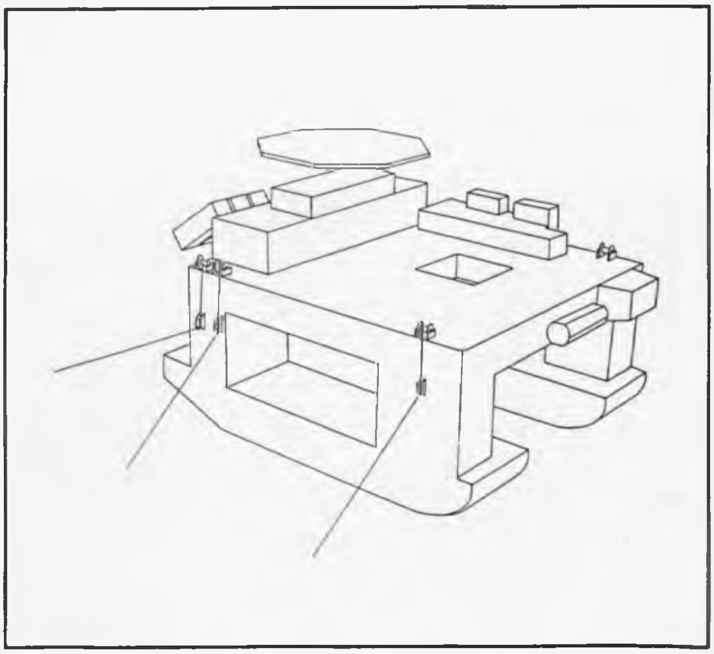


fig. 15: Mooring system

Figure 16.: Design specification of positioning systems

Operational conditions:

	DP system	mooring system
– wind	40 knots (1 min.)	35 knots (1 hour)
– waves	5 m at 8.5 sec.	4.5 m at 8.5 sec.
– current	1 knot	1.7 knots
– waterdepth	450 m	100 m

Transit/survival conditions:

– maximum wave height	36 m
– maximum wind speed (stability)	100 knots
– maximum wind speed (DP system)	70 knots

Class notation:
✠ OU 100 A 1 ✠ LMC UMS,DP (AA) P.C. column stabilized multi purpose support vessel

For every positioning keeping system the first important element to define is the previewed design conditions (see figure 16.). The environmental forces have been determined by wind tunnel testing and current resistance testing.
The incorporation of a DP system has required also redundancy in power generation. As shown in figure 17, two engine rooms are proposed, separated by an A-60 bulkhead. The layout as designed in the concept/tender stage has also been maintained in the final layout. A detailed description will be given in the next paragraph.
The thruster configuration was selected based on redundancy concept in addition to the capacity to operate in shallow waters, thus:
- 2 azimuthing thrusters of 1250 kW each at the stern
- 2 tunnel thrusters of 1250 kW each
- 2 retractable azimuthing thrusters of 1250 kW each underneath the forward columns.

With the MSC computer program 'DYNPOS', the DP capacity plots have been determined, e.g. for operational conditions (see figure 18). In addition to this the ERN/PCR rating has been established resulting into the notation 99.95/99.95/99.3/88 as shown in figure 19.
The 6-point wire mooring system of 54 mm wires of 1200 m length each has been designed to obtain the POSMOOR-V/PMC notation for positional mooring in operating conditions. Thus this mooring system can be safely deployed near fixed platforms for maximum fuel economy. To check the drift-off path after a line failure, transient motions were established, so that the vessel will not hit the fixed platform.
The concept/tender design stage has been concluded by preparing a tender package for shipyard quotations, consisting of outline specifications, design information and preliminary scantling drawings.

3.4. Basic design stage

The main purpose of the basic design stage is the preparation of the design documents to enable Lloyd's Register of Shipping to approve the design. First of all, the design calculations of the previous stages have been reviewed and updated, where necessary. The majority of the design work involves the detailed stability calculations, the structural analysis and the preparation of the basic scantling drawings. The stability calculations included the intact and damage conditions against the stability criteria as set by Department of Energy. An example of waterline damage is shown in figure 20.
The full structural analysis of the design was performed by MSC and results have been incorporated in the design documents. On the other hand Lloyd's Register of Shipping (LR) carried out an independent design appraisal. Both companies checked several loading conditions up to the loss of one brace, using their own developed computer programs, including hydrodynamic- and inertial loads acting on an idealized structural membrane model.

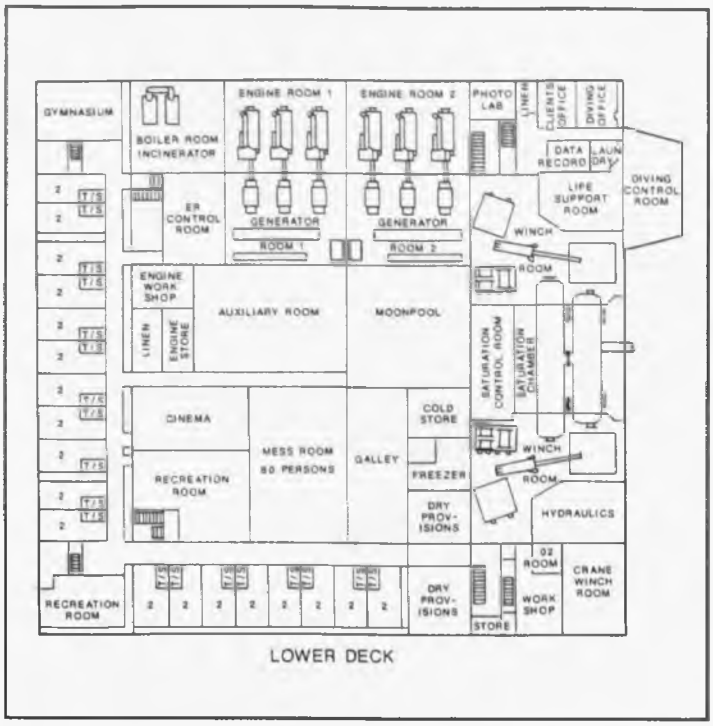


fig. 17: Lower deck layout

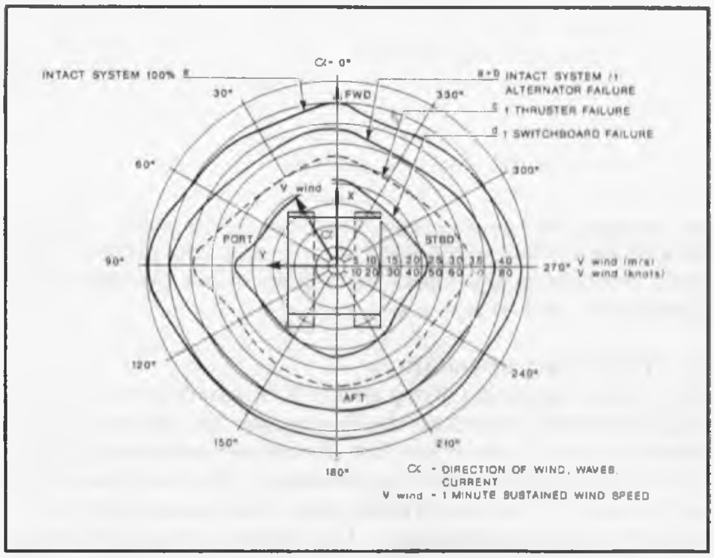


fig. 18: DP capability chart in operational conditions

The analysis includes local- and overall stress, fatigue and buckling. For information the structural models have been generated of the following elements (see figure 21):

	MSC	LR
type of program	SESAM	NASTRAN
plates	2900	1143
grids	–	677
bars	2	51
rods	–	1596

An overall stress plot illustrates one of the loading cases (figure 22).
Experience has shown that, for semi-submersible vessels, the fatigue sensitive areas are usually to be found at the joints between braces and columns and at the connection of column to upper deck.
Therefore, MSC proposed to use a casting at the joint between brace and column to improve the fatigue life of this connection. Detailed studies by MSC as well as LR proved the feasibility.

Figure 19: DP capability ERN/PCR rating

Condition	ERN PCR	Waves (m)	Wind (knots)	Current (knots)	BF
Intact system	99.95	9.15	53	2	10-11
One generator failure	99.95	9.15	53	2	10-11
One thruster failure	99.3	6.7	40	2	9
One switch-board failure	88	3.25	26	2	7

The results of both analyses of MSC and LR show no major differences with respect to the scantlings of the vessels and consequently medio the third quarter of 1985, LR approved the basic scantling drawings.

4. GENERAL DESCRIPTION OF THE 'SMIT SEMI I'

The three dimensional drawing (figure 4), illustrates very clearly the complete layout of the vessel based on the four column semi-submersible concept. As the vessel will serve as a stable and spacious work platform for IRM, installation and construction work above and below sea level, the characteristic elements of the vessel are:
- the accommodation and work spaces
- the diving installation
- the propulsion and positioning
- the cranage
- the gangway.

4.1. Accommodations and utilities

Accommodation and utilities are located on the lower deck (stern and SB side) (see figure 17) and in a two tier deckhouse. In total 89 persons can be accommodated in one- and two person cabins while the utilities and life saving appliances are provided for a complement of 110 persons.

4.2. The diving installation

The 18-men saturation diving system is designed for waterdepth of 450 m and is located on the lower deck (see figure 17). The system consists of two triple-lock deck decompression chambers (DDC) for three six-man living chambers. The three entry locks can be paired in various arrangements, which allow divers to be (de)compressed simultaneously. The two three man submersible decompression chambers (SDC) can operate independently of each other.

The two bell (SDC) handling systems, each consists of:
- a cursor winch with the cursor running along a vertical guide rail, a SDC hoisting/lowering winch, a guide wire winch complete with a 4 ton clump weight and a 96 mm umbilical winch
- a passive heave compensation system for the SDC to allow safe operations to 7 m significant waves.

A total amount of 10,000 m^3 helium is stored in 23 bottles in the forward columns. For emergency evacuation, a self propelled 21-men rated Hyperbaric Lifeboat is installed on the vessel.

4.3. Dynamic positioning system

The dynamic positioning system consists of:
- the power generation sets
- the thrusters
- the control system.

The power generation is provided by six Stork 6SW 280 diesel generator sets each of 1895 kW. The two main engine rooms are fully separated, in such a way that one engine room can operate as emergency to the other in case of a major failure and/or emergen-

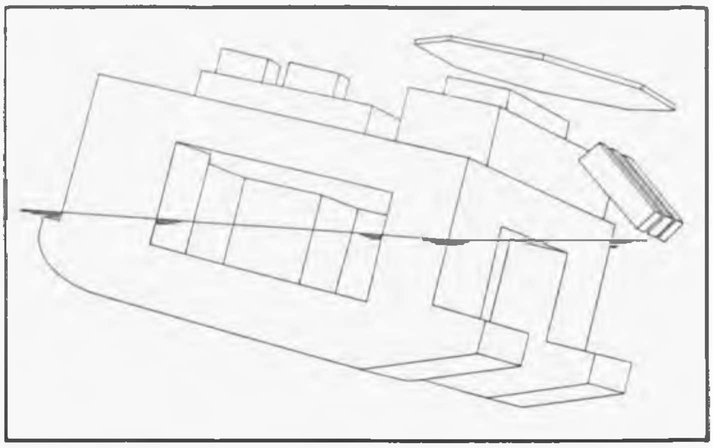


fig. 20: Stability: waterline damage of SB aft column

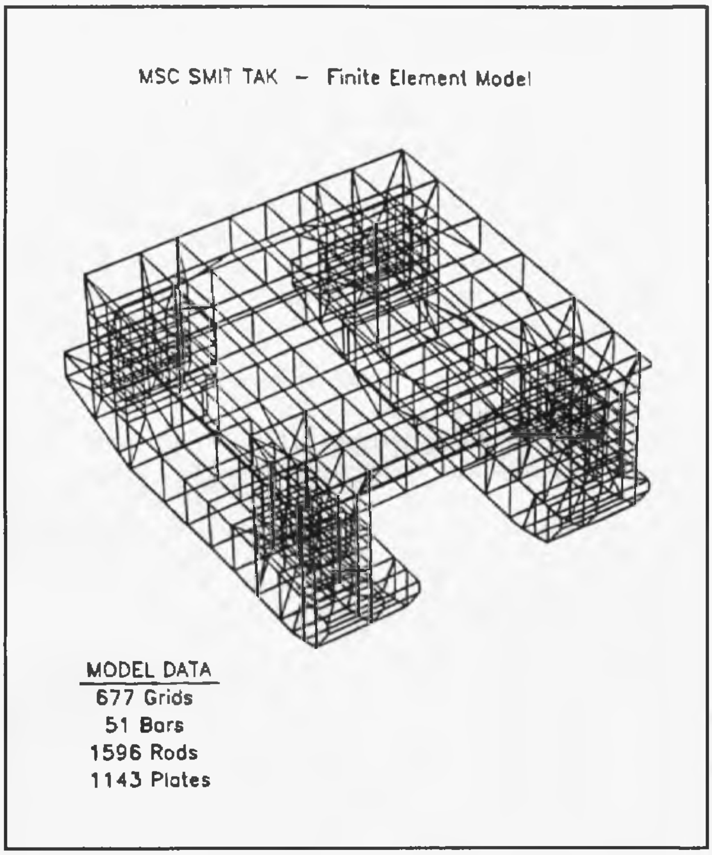


fig. 21: LR's finite element model

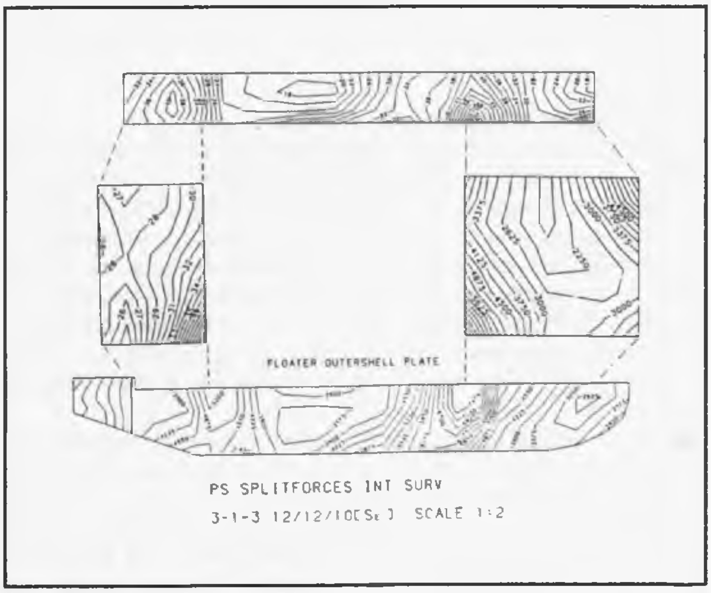


fig. 22: MSC's stress plot

cy. Stand-by generator sets (440 kW respectively 90 kW) are located on main deck level. The complete redundancy of the power generation is also illustrated in the single line diagram (figure 23) from the diesel generator sets, to two 6 kV main switchboards, 440 V switchboards and 220 V switchboards. The DP thrust is generated by Schottel-Lips thrusters with a capacity each of 1250 kW (figure 14):

– two azimuthing thrusters

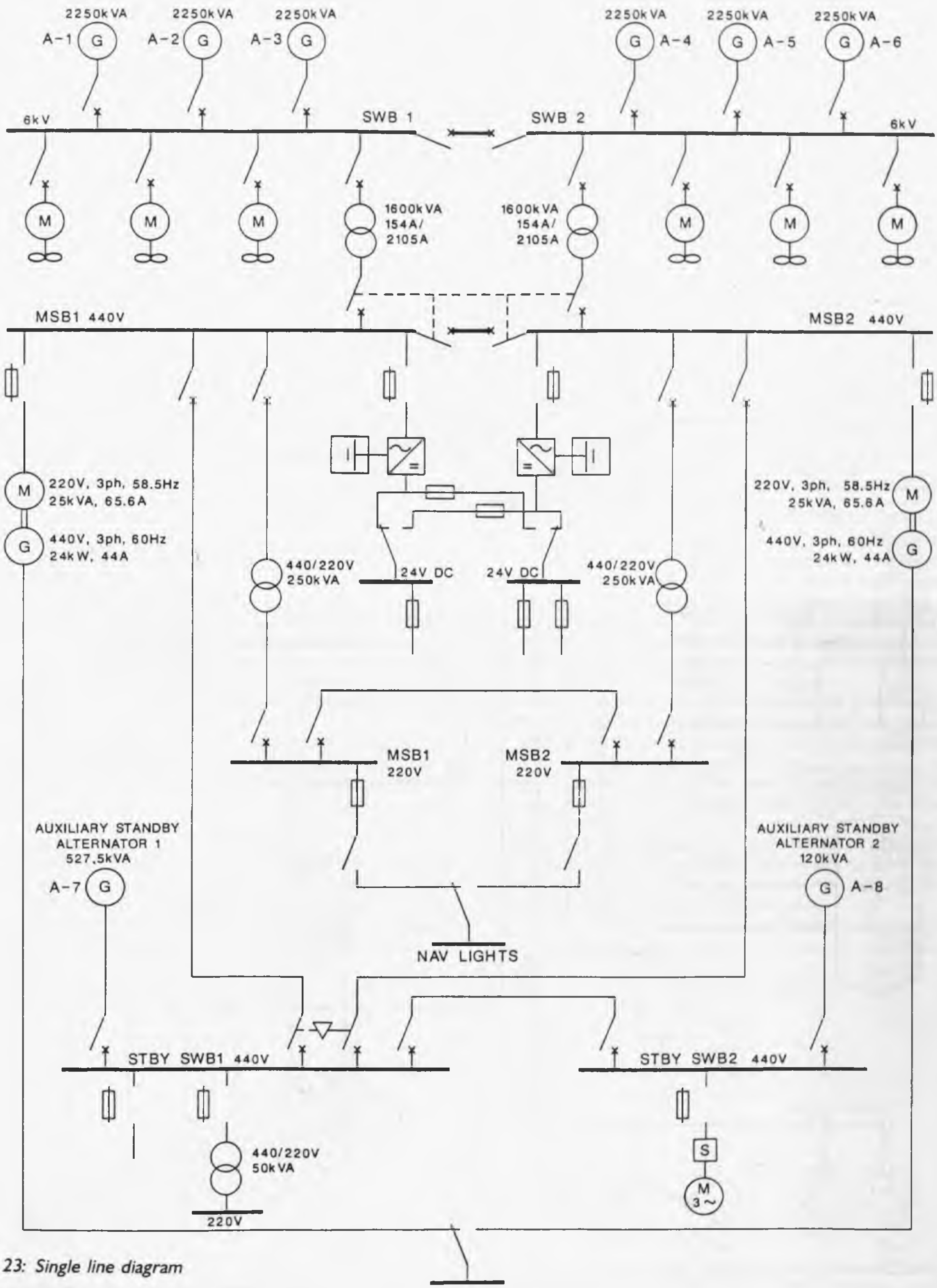


fig. 23: Single line diagram

– two retractable azimuthing thrusters
– two tunnel thrusters.
The DP control system is a Kongsberg ADP 703 voting system (see figure 24), based on the triple modular redundancy concept of 3 independent micro processors, continuously monitoring the input data of the peripherals and reference systems. After voting of all the input data, the thrusters will be commanded.

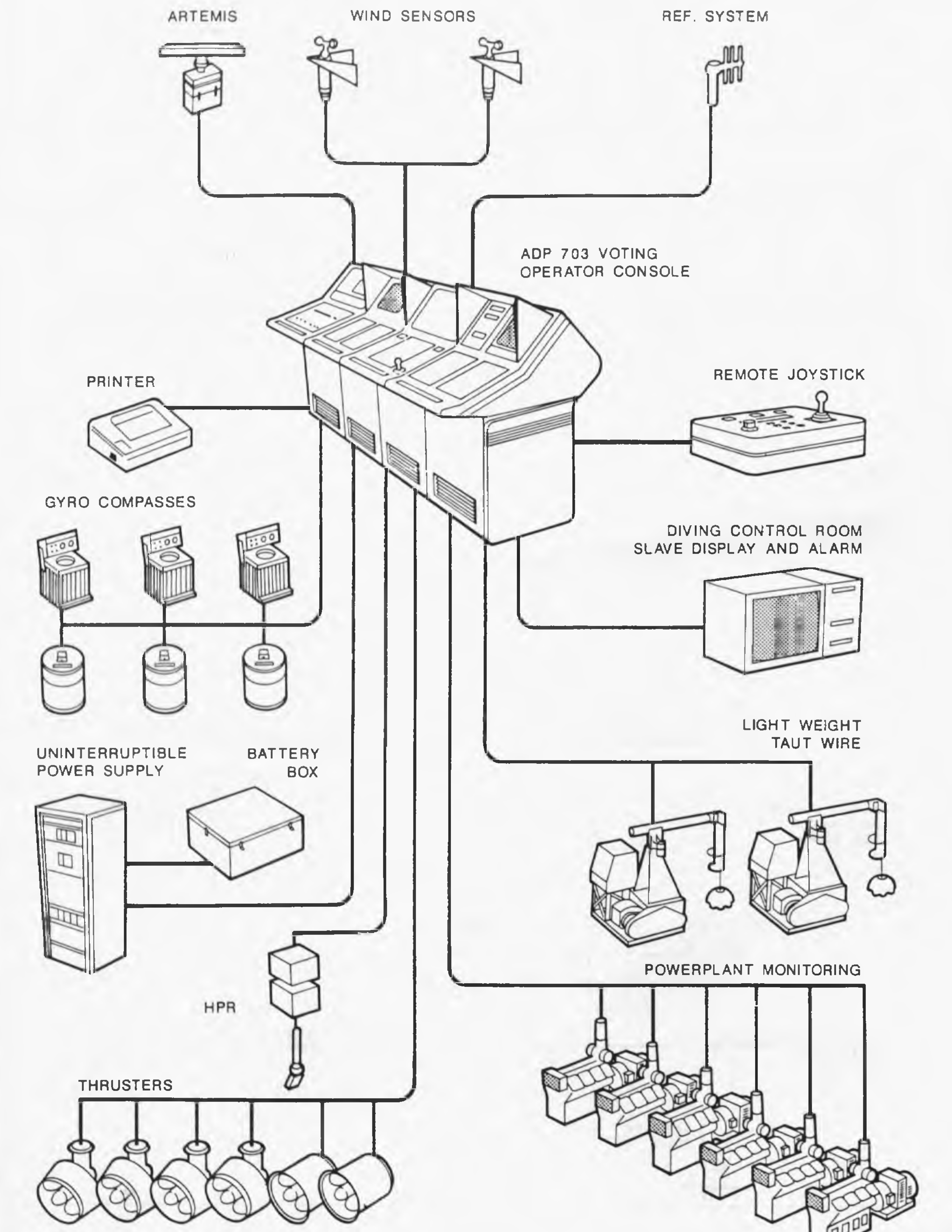


fig. 24: DP control system (ADP 703 voting)

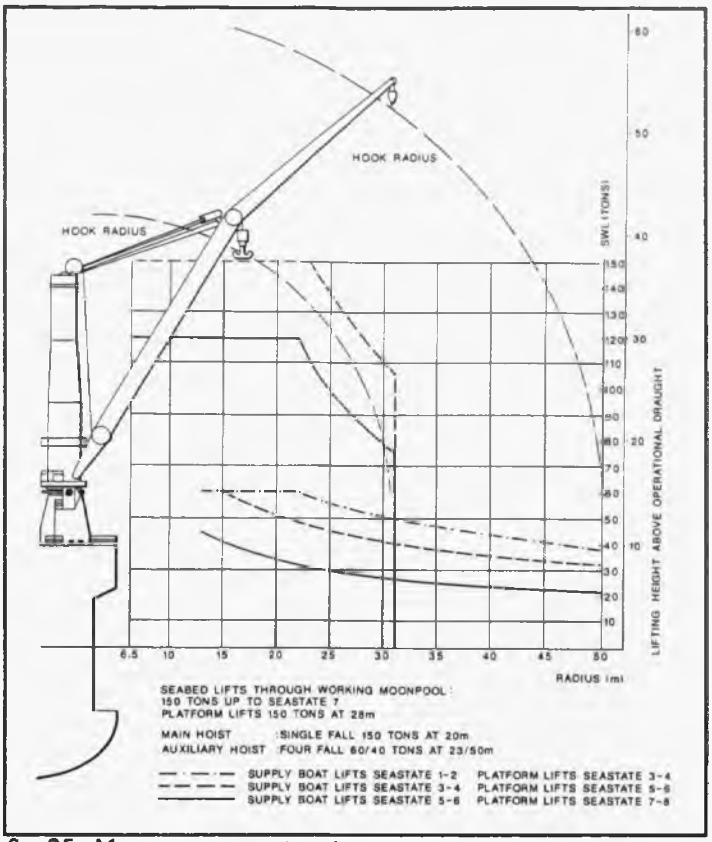


fig. 25: Mast crane capacity chart

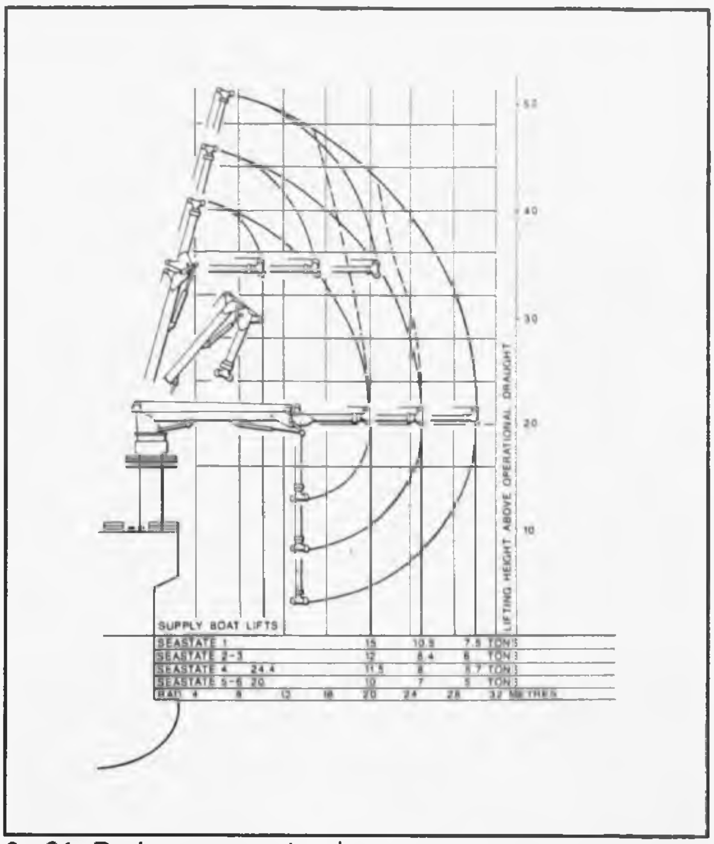


fig. 26: Deck crane capacity chart

4.4. Telescopic gangway

To operate in the way of fixed platforms, the vessel is able to use its telescopic gangway for connection to platforms and transfer of personnel. The elevation height of the gangway of 11.5 m above main deck is selected to serve the majority of fixed platforms in the central and northern North Sea keeping the angles within workable limits. The total extended length is 32 m, with an effective stroke of 12 m. The telescopic gangway has been delivered by Van Seumeren Trading, constructed by Bayards and designed by MSC, and certified by Lloyd's Register.

It should be noted that the crane pedestal and kingpost are identical to the Effer knuckle boom deck crane. An exchange of gangway and knuckle boom is looked after to increase the number of cranes to three.

4.5. Cranage

For light to medium construction and installation jobs, the horizontal and vertical outreach of the cranes is an important factor. The majority of fixed offshore platforms in the central part of the North Sea have an airgap of around 22 m; platforms in the southern North Sea have an airgap of around 17 m. As heavy lift operations will be carried out in mild seastates, the vessel can be positioned near to the fixed platform. This leaves sufficient crane outreach, horizontally and vertically, to cover the fixed platform.

The main crane is of mast head type (make Huisman). The main hoist is 150 ton at 30 m radius, with a maximum hook travel of 350 m (single fall). The auxiliary hoist is 60 ton at maximum radius of 50 m.

The main and auxiliary hoists are fitted with a self-tensioning device and heave compensation (active and passive). These systems are suitable for sinusoid movements with top- trough values of 1.3 m, with minimum period of 10 sec.

Seabed lifts working through the moonpool are possible 150 ton up to seastate 7. For platform lifts of 150 ton at 30 m, the following split-up has been made:

1. Supply boat lifts seastate 1-2; platform lifts seastate 3-4
2. Supply boat lifts seastate 3-4; platform lifts seastate 5-6
3. Supply boat lifts seastate 5-6; platform lifts seastate 7-8.

In figure 25 the crane capacity is illustrated.

The secondary deck crane is an extendable knuckle boom type

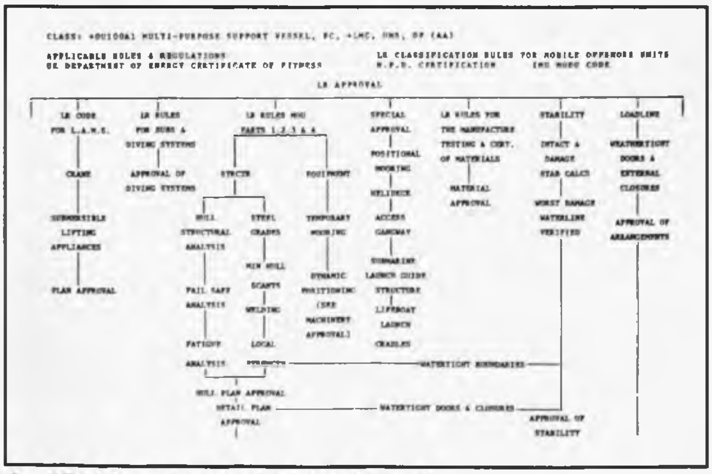


fig. 27: LR approval schedule of vessel

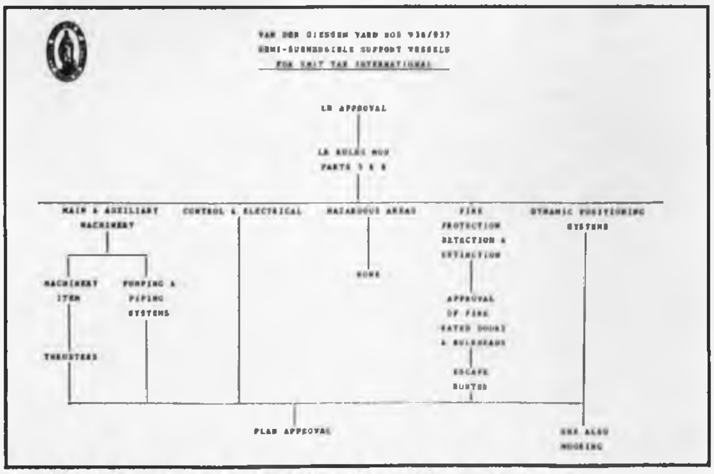


fig. 28: LR approval schedule of machinery systems

(make Van Seumeren-Effer) with a maximum hook travel of 350 m. In figure 26 the capacity is illustrated. Active and passive heave compensation systems are also provided to improve the crane's workability.
Through the extendable boom and the capacity to knuckle, the deck crane can hoist loads for supply boats with a minimum of cable length. Thus slewing of the load is reduced to a minimum, which improves workability as well as safety.

5. CLASSIFICATION/CERTIFICATION OF THE VESSEL

The classification and certification of the vessel consists of three main stages, being:
- the basic design appraisal
- the detailed design appraisal during construction stage
- the classification and certification stage.

5.1. The basic design stage

During this development stage of the project the prime contact is between the designers of the vessel and the classification society LR to verify the concept and to obtain an approval of the main scantlings.

This stage was finished well before the construction contract has been awarded to the shipyard. The basic design calculations and drawings (scantlings and main schematics related to semi-sub operations) have been prepared by MSC in the second quarter of 1985. The building specifications and description of all marine systems were prepared by the technical project group of Smit International. In this manner, the full set of documentation related to the naval architectural and marine systems has been submitted to Lloyd's Register for approval.
This documentation included information on loading conditions, structural analysis, stability, positioning and motions, wind tunnel testing and current resistance testing. The approval has been carried out by the Lloyd's Register Offshore Services Group, which included an independent check on the structural integrity of the design.
This approval has been established in the third quarter of 1985. The independent check resulted finally in the 'main scantling approval' of the design, with only some minor modifications to local scantlings of stiffeners in bottom deck area around the columns.

5.2. The detailed design appraisal during the construction stage

This stage started effectively after awarding of the construction contract and the acceptance of Van der Giessen-de Noord of the total design responsibility. The detailed design has been prepared by the shipyard. The prepared documentation should be such that the vessel can be constructed and secondly be certified for operations in the British and Dutch sector of the Continental Shelf.
As the construction lead time from contract up to delivery of the vessel is only 18 months, a good collaboration between owner, shipyard and classification society is a must. Detailed design drawings should be prepared on a tight schedule and consequently the approval schedule should also be agreed upon by the owner and classification society.
An overview of the complexity of items which are covered by the Classification Society is shown in figures 27 and 28. The essential element in the detailed design stage is the preparation of the necessary documents. These documents are not only related to detailed construction, equipment, layout and system drawings, but also include the preparation of the quality standards and quality control. Especially in today's offshore new building market, this

fig. 30: Smit Semi I in hall prior to load-out

fig. 31: Giant 2 submersible barge in way of Smit Semi I

fig. 29: Production hall and slipway of Van der Giessen-de Noord

fig. 32: Load-out operation in progress

stage requires a vast amount of design documents, to be prepared by the engineering department of the shipyard and its subcontractors.

5.3. The classification/certification stage

As the vessels are built under the classification of LR, the construction of the vessel should be inspected and certified by the classification society. In general, all materials used for the construction and all equipment installed are to be certified and should be witnessed by the LR surveyors. To ensure acceptable quality, quality plans should be prepared by the shipyard and accepted by LR. Furthermore, as part of the quality standard, all materials used should be uniquely identified and all welding procedures should be accepted.
As a result of the survey of the construction and the witness of commissioning and trials of the vessel, the certificates are issued on delivery of the vessels, by the following society and/or National Authorities: LR, NSI, DoT, RLD and CAA. The certificate of fitness is issued by LR and DoT.

6. CONSTRUCTION OF THE VESSEL

The fabrication premises of Van der Giessen-de Noord Shipbuilding Division are dominated by the large covered production hall and slipway (see figure 29). The production hall has the following main characteristics:

– length	260 m
– width	90 m
– height	55 m
– slipway length	250 m
– slipway width	40 m
– lifting capacity	240 ton.

The acceptance of this contract was not only a challenge for the engineering and planning departments, but specially for the production staff to develop an innovative building method, because the width of the semi-submersible (43.6 m) exceeds the width of the slipway (40 m).

The following factors determined the final selection of the building method:
- optimum productivity
- short delivery time
- required quality control
- minimum additional assembly and load-out costs
- maximum use of the covered hall.

Three building methods have been reviewed, namely:
- building on a barge (this method has been skipped due to too high costs)
- building of 3 d-sections in the hall and coupling of the main construction element outside (in view of the short delivery time, this building method was not considered realistic)
- preparation of the slipway in such a way that building of the vessel could be realized in the building hall.

This latter method has been selected because it guarantees the highest productivity for the shipyard and the best quality control, while additional costs for special arrangements were established to be the lowest.
The other advantage was that a more or less finished vessel will be 'launched'. The vessel is ready up to the deckhouse, only helideck, deck cranes and gangway are to be fitted at the outfitting quay. Thus the time span between 'Load-out' and the sea trails is less

fig. 33: Smit Semi I on Giant 2 barge

fig. 34: Smit Semi I afloat

than two months. The only special operation is the load-out operation itself. This operation is carried out in the same manner as with topside facilities of fixed platforms, namely skidding the vessel onto a submersible launch barge. A review of this operation is illustrated in figure 30 to 34. This operation took place on March 13th and 14th, 1987. After the final outfitting and commissioning, the sea trials will be carried out in May and June, including the DP sea trials, diving operations and heavy lift crane operations.

Delivery of the vessel is scheduled for mid June 1987 for the first vessel and March 1988, for the second vessel.

7. CONCLUSIONS

– The selected market segments, IRM and installation and construction work, can be served by the SMIT SEMI at the higher workability percentage than existing monohulls, but at the same competitive day rates. Although characterized by its compactness, the vessel can perform a variety of duties, due to its complete equipment range:

- crane operations up to 150 ton at 30 m
- diving operations by two independent SDC systems up to 450 m waterdepth
- a full redundant DP system (NMD class 2)

– A high technology product delivered by dutch companies from:

- its design by SMIT TAK and MSC
- its ownership of SMIT TAK and MIP
- its construction by Van der Giessen-de Noord Shipyard and its subcontractors.

– A vessel at the highest quality standards available in the industry, by:

- its covered construction method
- the quality assurance/control by both Van der Giessen-de Noord and Lloyd's Register.

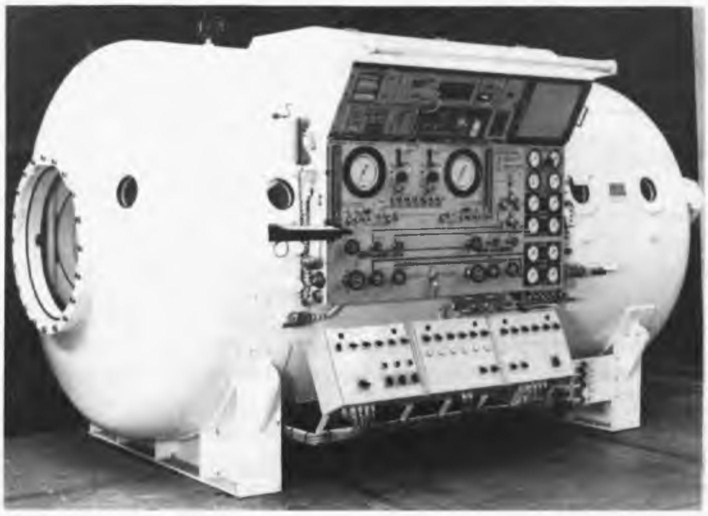
7.1. Acknowledgements
The authors wish to thank the board of directors of SMIT TAK International, Marine Structure Consultants (MSC) B.V., Van der Giessen-de Noord and Lloyd's Register to publish this paper.

7.2. References

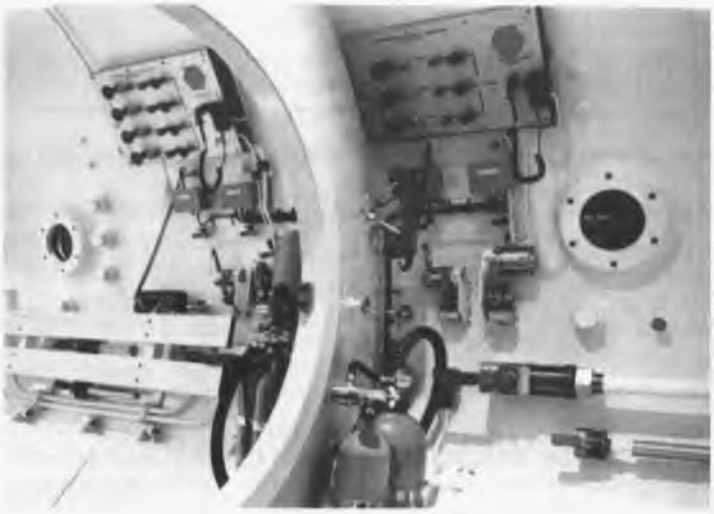
1. Hydrodynamic design of a compact semi-submersible offshore services vessel, by J. A. van Santen, IRO-CONOFF Symposium, February 1986.
2. Design and construction of semi-submersibles, by C. A. Bainbridge, LR publication nr. 78.
3. The classification and certification of two semi-submersible offshore units intended for Messrs. Smit Tak International Towage and Salvage Company, by C. Dam, February 1987.

* Text of a presentation to the members of the Netherlands Society of Marine Technologists. Rotterdam, January 1987.

HYPERBARIC COMPRESSION CHAMBERS



The hyperbaric compression chamber with the outside controlpanel.



The interior with oxigen/mix-gas panels.

On February 27 the presentation of two large hyperbaric treatment compression chambers for the Australian Navy, took place by Aqua Services b.v. in Papendrecht. Both compression chambers were designed and built by Aqua Services b.v., a company that, from the very beginning has presented herself to the market of professional and military diving equipment.

Submarine Escape Training
The two compression chambers with a diameter of 2.20 m and a working pressure of 10 Bars will be installed at the Australian Navy Submarine Escape Training Centre in Perth, Australia.
Both compression chambers have been designed and built as hyperbaric treatment compression chambers to provide efficient and adequate treatment of patients suffering from barotraumas or other diving related injuries.
The external and internal chamber layout has been designed in close co-operation with medical experts in diving deseases, and many components were especially developed by Aqua Services b.v. for this project.
The safety of chamber occupants as well as the safety in operating the chamber was the main requirement for this design. The chamber internal environment is constantly monitored, breathing gasses are constantly analyzed and the results are recorded in a data processor.
All information is recorded such as pressure, time, temperature, oxygen carbondioxyde levels and humidity. With these data, an exact evaluation of a hyperbaric treatment becomes simple and accurate.

Operation
The two compartment chambers are operated from the outside control panel which houses all the control valves, meters and depth gauges as well as all the electrical switches and controls. The operation of the Aqua Services' designed medical lock is very safe and simple.
The capacity of the reducers is enough to pressurize the chamber to a pressure of 5 Bars in less than 2 minutes and to a pressure of 10 Bars in less than 4 minutes. Ascent rates can be exactly regulated in three ranges; 0-15 mtr/hour, 0-2,5 mtr/min., 0-25 mtr/min. All the chosen ascent rates are protected by means of the Aqua Services designed flow fuse, in case of an operators fault or a malfunction of the exhaust valves. This flow fuse closes the exhausts when a pre-set flow is exceeded. The chamber is equipped with an oxygen make up system and an oxygen mix gas breathing system with an overboard dump. The chamber is designed for four occupants, at one side a bed is provided for the patient. The position of this bed can be changed to the middle of the chamber interior and provides then an all-around access for the doctor. The height of the bed can also be adjusted when desired for treatment. The chamber temperature is controlled by the Aqua Breeze heater. Carbondioxide will be absorbed by the Aqua Breeze carbondioxide scrubber.

Technical data

Length:	4140 mm.
Diameter:	2200 mm.
Weight:	7500 kg.

Life support system

Air:	pressurization rate 0-10 Bar in 4 min.
Oxygen:	make up and overboard dump system.
Mix gas:	overboard dump.

Environmental control
Aqua Breeze CO^2 scrubber.
Aqua Breeze heat exchanger.
Oxygen analyser with alarm settings.
Carbondioxide analyser with high alarm setting.

Data recording
Pressure time recorder.
Microprocessor with depth, temperature, humidity, time, O^2 en CO^2 levels-monitoring.

Communication/tv system
Sound powered telephones.
Radio communication with helium unscrambler.
CC TV with monitor.

Safety devices
HP filter system on all gas supply lines.
Fire extinguishers in all compartments.
Emergency power 24V.
Emergency light.
Interlocking device on medical lock door.
Over-pressure relief valve.
Exhaust flow fuses.
Aqua Services alarm unit.

NEDERLANDSE VERENIGING VAN TECHNICI OP SCHEEPVAARTGEBIED

(Netherlands Society of Marine Technologists)

Programma van lezingen en evenementen in het seizoen 1986/1987

De rol van de techniek in de America's Cup 1987**
door Dr. Ir. P. van Oossanen van MARIN
wo. 6 mei 1987 Aula T.U. Delft 20.00 uur
wo. 20 mei 1987 Groningen

A North Sea Ferry for the future, design and construction* **
door Ir. J. M. Huisman en Ir. R. K. Hansen van Nedlloyd
do. 14 mei 1987 Rotterdam

N.B.:

* Lezingen in samenwerking met de Netherlands Branch van het Institute of Marine Engineers.
** Lezingen in samenwerking met de afd. Maritieme Techniek van het KIvI en het Scheepsbouwkundige Gezelschap 'William Froude'.

1. De lezing in Groningen wordt gehouden in Café-Restaurant 'Boschhuis', Hereweg 95 te Groningen, aanvang 20.00 uur.
2. De lezing in Rotterdam wordt gehouden in de Kriterionzaal van het Groothandelsgebouw, Stationsplein 45, aanvang 20.00 uur. Vooraf gezamenlijk aperitief en broodmaaltijd, aanvang 18.00 uur.

VERENIGINGSNIEUWS

In memoriam

C. Koens
Op 8 april 1987 overleed op 52-jarige leeftijd de heer C. Koens, Hoofd Technische Dienst van Smit Internationale Havensleepdiensten B.V. te Rotterdam. De heer Koens was ruim 20 jaar lid van onze vereniging.

Personalia

New president of the Institute of Marine Engineers
The New President of The Institute of Marine Engineers is Mr A. F. Harrold, BSc, CEng, FIMarE, FRINA, FCMS, whose two-years term of office commenced on 12 March 1987. He had been Deputy President since 1983 after three periods of office on its Council totalling 11 years, and has served on or chaired some of its key committees.
Alex Harrold served an apprenticeship with North Eastern Marine Engineering Co. Ltd, Wallsend, from 1941 to 1945. During this time he was awarded the Superintendent's Cup for best apprentice, and the 1943 Scholarship of the North East Coast Institution of Engineers and Shipbuilders, and obtained his BSc degree in Marine Engineering at King's College, University of Durham.
In 1969 Mr Harrold joined the Hill Samuel Group as a Director of Lambert Brothers Shipping Ltd, leaving in 1976 to set up the partnership of Vine, Able & Harrold Ltd, consulting marine engineers. In 1984 he established practice in his own name as a Consulting Marine Engineer and divides his time between London and his home in North Wales.

NIEUWSBERICHTEN

Agenda

Maritime safety update meeting
On June 17th., 1987 the Netherlands Nautical Safety Institute will organize a maritime safety update meeting in Den Haag.
Safety update meetings are one-day series of lectures where maritime safety experts report and discuss their latest findings in scientific and industrial research and development in related safety fields with their collegues from all over the world.
Maritime safety updates may cover several different subjects on one day and they mean to give a 'pin-prick' to existing theories and opinions. There is ample room for discussion.
The topics of the maritime safety update in June will be:
- Immersion hypothermia – a practical review
- Immersion hypothermia 'some recent findings and views concerning treatment'
- Obesity in offshore population
- 'Helicopter transportation suits – a new approach'
- 'A critical approach to the new IMO-requirements with regard to survival suits'.

For more information: Netherlands Nautical Safety Institute, P.O. Box 84480, 2508 Den Haag tel.070-50.51.51

Offshore

Improved safety at oil installations
Production platforms on the Norwegian continental shelf have become safer places of work. The frequency of injury among workers is at 61.2 injuries per thousand man/years, reduced from 69.8 in the previous year. This satisfactory development has happened at a time when activity has increased on platforms. Last year, 9 700 man/years of work were completed, an increase of 13.4% when compared with 1985. There were no fatal accidents last year which resulted in deaths.
Statistics show that most injuries – altogether 85% – happen among employees working for companies specialising in well drilling, catering, maintenance and construction work. These workers undertake 65% of the entire labour input and they are three times as likely to suffer injury than the workers who are permanently employed on these rigs. However, the frequency of injury also declined significantly among hired workers last year compared with 1985.
The Petroleum Directorate points out

that one of the reasons for this development is the marked improvement which has taken place in protection and environmental awareness while, at the same time, the oil companies are better at planning and controlling their activities.

(norinform)

Eight operator tasks awarded in 11th round of concessions

All of the three largest Norwegian oil companies have been awarded operator tasks in the new exploration areas in the Barents Sea on the Norwegian continental shelf. Altogether eight new blocks have now been allocated by the government in this 11th round of concessions; two are situated in the Finnmark west area, two in Bear Island south, two in what is known as strategic area II, four on Haltenbanken and one in the Møre south area.

One block in Finnmark west and blocks in the strategic areas I and II are to be awarded later. It is expected that drilling in the 11th round blocks can be put in hand in June and the assumption is that there will be year-round drilling off north Norway. Altogether 21 oil companies applied for licenses in this round. BP, Mobil, Shell and Total are all disappointed with the outcome although they are hoping to fare better when the final operator tasks for this round are awarded in June.

(norinform)

TNO bundelt krachten voor maritieme en offshore-industrie

TNO heeft een intern samenwerkingsverband geformeerd ten behoeve van onderzoek en ontwikkeling, gericht op de scheepsbouw-, de scheepvaart- en de offshore-industrie. Daarmee worden bestaande of nog verder te ontwikkelen aktiviteiten van een vijftiental TNO-instituten gebundeld.

Het samenwerkingsverband zal bekend worden als Dwarsverband voor Maritiem en Offshore Onderzoek (MOO). Het bestuur van dit dwarsverband wordt gevormd door een negental deskundigen uit de eerdergenoemde instituten. Het staat onder voorzitterschap van Ir. J. B. van den Brug, directeur van TNO-IWECO, Instituut voor Werktuigkundige Constructies.

Het dwarsverband heeft een platformfunctie voor TNO en een aantal coördinerende taken. Enerzijds zal het goed op de hoogte zijn van de marktontwikkelingen op maritiem en offshore-gebied en van daaruit een visie ontwikkelen om op die markt te kunnen inspelen. Daarnaast zal het wervend en sturend optreden inzake onderzoek naar en de ontwikkeling van nieuwe technieken en technologie door instituten van de TNO-organisatie die dit type werk zullen uitvoeren. Bovendien zal het de bekendheid bevorderen over de maritieme expertise in TNO en de samenwerking bevorderen met maritiem georiënteerde instituten buiten TNO en met instellingen voor hoger en voor universitair onderwijs op dit gebied.

Binnen TNO zal ook richting worden gegeven aan de verdere ontwikkeling en vernieuwing van deze expertise op basis van de trends in de maritieme en de offshore-industrie.

Voor nadere informatie: Ir. W. Spuyman, TNO-IWECO, tel. 015-608448.

Diversen

Nieuwe vissersschepen krijgen beperkingen

De Tweede Kamer heeft onlangs met spoed de wijziging van de Visserijwet aangenomen om bij nieuwbouw van schepen het motorvermogen te beperken tot 2000 pk. Minister Braks liet tegelijkertijd weten geen mogelijkheden te zien om in te grijpen in bestaand motorvermogen van schepen.

De minister verwacht door beperking van de boomkor tot 2 x 12 meter op termijn een vermindering van de Nederlandse vangstkapaciteit met 3 tot 8 procent. Daarnaast hoopt de minister spoedig duidelijkheid te hebben over de bedragen beschikbaar voor de sanering van de visserij, al zal volgens de minister een bijdrage van het bedrijfsleven noodzakelijk zijn.

Schuttevaer 11-4-'87

Nederlandse baggermolens werken aan uitbreiding van Hong Kongs container-terminal

De HK International Terminals Ltd (HIT) is met de bouw van 'Terminal 6' begonnen aan een spectaculaire uitbreiding van de havenfaciliteiten. Hiervoor is o.m. de 133 meter lange baggermolen HAM 310 uit Nederland overgekomen: één van de grootste ter wereld. Samen met haar zusterschepen HAM 308 en de P.C.S. van Hattem, is dit vaartuig ingezet bij één van de grootste landwinningsprojecten die ooit in Hong Kong op touw is gezet. Binnen 16 maanden zal in totaal 10 miljoen kubieke meter grond worden verplaatst van de zeetak ten noordwesten van Lantau-eiland naar Kwai Chung, een afstand van 14 kilometer. Het werk wordt uitgevoerd door een joint-venture van HAM, een Japanse bouwonderneming en een Japans handelshuis. Terminal 6 zal uiteindelijk 29 ha groot worden en daarmee zal de overslagcapaciteit van Hong Kong International Terminals Ltd. worden verdubbeld tot 1,6 miljoen containers per jaar.

Annual Summary of Merchant Ships

Merchant ship completions in 1986 fell by 1.3 million gross tonnage from the previous year, according to figures published in Lloyd's Register's "Annual Summary of Merchant Ships Completed 1986".

A total of 16,884,909 gt was completed during the year, compared with 18,156,526 gt in 1985. In terms of ship numbers, the completions totalled 1634 – down by 330. Of the tonnage completed during the year, 3,324,970 gt is to be classed with Lloyd's Register.

The continuing decline in new construction is underlined by the fact that new orders placed during 1986 amounted to only 12.7 million gt – approximately 4.1 million gt less than the total output during the same period.

Japan and South Korea between them accounted for just over 70% of the tonnage completed in the world. Japan's total was 8,177,953 gt (48,5%), compared with 9,502,831 gt (52,3%) in 1985. (Japan's 1985 figures – like those for 1984 – were partly inflated by the completions resulting from the brief boom in 1983 in bulk carrier ordering, including 41 of the original Sanko Line orders).

South Korea completed 3,642,495 gt (21.6%), compared with 2,620,472 gt (14,4%) in 1985, demonstrating the government-backed industry's success in capturing export orders. The largest ship completed in the year was the *Berge Stahl* (365,000 dwt, 200,000 gross), the largest ship ever built in South Korea and the largest ore carrier in the world. Leading countries of build, compared with 1985, were:

Country	*Gross tonnage*	*No of ships*
Japan	8,177,953 (−1,324,878)	648
South Korea	3,642,495 (+1,022,023)	128
China (PRC incl. Taiwan)	641,451 (+ 197,877)	35
Germany (FDR)	515,394 (− 46,984)	79
Brazil	429,855 (− 151,382)	19
Poland	375,305 (+ 14,388)	43
Germany (GDR)	361,669 (+ 3,667)	55
Denmark	361,492 (− 96,104)	46
Yugoslavia	232,996 (− 26,177)	16
Finland	230,788 (+ 17,905)	21
USA	223,396 (+ 43,661)	36

Freight Show Rotterdam 1987
De Freight Show '87 trok de interesse van ruim 37.000 bezoekers. Niet alleen het record aantal bezoekers was opzienbarend dit jaar, voor het eerst in de geschiedenis van Ahoy' Complex Rotterdam N.V. werd met de Freight Show een 'full house' geboekt. De volledige 25.000 vierkante meter aan tentoonstellingscapaciteit werd benut door zo'n kleine 300 exposanten. De standhouders waren unaniem zeer tevreden over de kwaliteit van het bezoek. Opmerkelijk was bovendien dat, ondanks het niet doorgaan van de Internationale Havendagen, veel buitenlandse interesse was voor de vakbeurs, hetgeen duidelijk nog meer perspectief biedt voor de 'show' over twee jaar. De volgende Freight Show Rotterdam zal worden gehouden van 11 tot en met 14 april 1989.

Technische informatie

T.B.N. test kit
Perolin Marine, a daughter of UNITOR Ships Service announces the launch of their Total Base Number testkit.
The T.B.N. testkit is a major advance in portable tests for oil alkalinity. The kit gives results for crankcase and cylinder lubricants in a very short time, normally about 3 minutes. A few of these T.B.N. testkits benefits are: Easy to use, reliable, tested with all leading lube oil brands, after use simply clean with water.
For further informations, please contact: UNITOR - Perolin Waalhaven ZZ 32 3088 HH ROTTERDAM Tel.: 010 - 4293011.

CAD/CAM-koppeling en 'montage': nieuwe studies Metaalinstituut TNO
Het Metaalinstituut TNO in Apeldoorn gaat een vervolg geven aan een recent uitgevoerde studie die tot betere mogelijkheden voor het koppelen van 'CAD'- en 'CAM'-activiteiten in de machinefabriek moet leiden. Ook gaat het instituut onderzoeken door welke factoren montageprocessen voor mechanische en elektromechanische componenten worden bepaald. Beide projecten worden uitgevoerd in gezamenlijke opdracht van enkele tientallen bedrijven en hebben een looptijd van ongeveer een jaar.
Het MI presenteerde de bedrijven op 10 maart de resultaten van een eerder opgedragen studie CAD/CAM-koppeling, die zich toespitste op de vraag welke technische informatie de werkvoorbereiding nodig heeft en welke eisen aan die informatie moeten worden gesteld. De resultaten worden nog aangevuld met die van lopend onderzoek naar het 'functioneel' kiezen van gereedschappen. Het onderzoek heeft al geleid tot voorstellen/suggesties voor een opdeling van de werkstukgeometrie in 'vorm-elementen' om de CAD/CAM-koppeling te vergemakkelijken. Een dergelijke opdeling wordt in het vervolgproject nader onderzocht en verder ontwikkeld. De tweede studie, montageprocessen, omvat een evaluatie van veelgebruikte montagetechnieken voor mechanische en elektromechanische componenten. Een methodische ontleding van deze technieken moet kennis opleveren van de factoren die bepalend zijn voor het montageproces en in het bijzonder het automatisch monteren.
Beide studies worden begeleid door een werkgroep met vertegenwoordigers van een aantal van de belanghebbende bedrijven. Inhaken van andere geïnteresseerde bedrijven is nog mogelijk.
Voor nadere informatie: Metaalinstituut TNO, postbus 541, 7300 AM Apeldoorn, telefoon (055) 773344.

Subdivision and Survival Capabilities for Dry Cargo Ships
Det norske Veritas has recently developed a standard for Subdivision and Survival Capability for Dry Cargo Ships.
The main objective of this new standard is to increase the ship's ability to survive in the event of a collision or any other incident involving ingress of water. The reason to develop the standard was to meet the needs from Owners who want such an additional safety for their ships.
An essential element of the standard is the so-called 'Subdivision Index', which is calculated by using a system of probabilities on damage statistics. The higher this index, the higher the ability to survive damages.
Another key element is the presence of a 'Damage Control Plan', which contains information assisting the ship's Master in the event of a damage.
This standard is offered through the new Class Notation SC. Additionally, DnV may offer advisory services in connection with this new standard, such as assistance in performing calculations and working out the necessary documentation.
Anyone who is now considering to contract a ship in the near future, should take the opportunity to take advantage of this new method of analysing the subdivision of the ship. Even if one cannot design 'the ship which cannot sink', this method will be of help to choose the best arrangement out of several alternatives, and thus obtain a safer ship without compromising cargo handling. This service may prove to be useful for existing ships as well. The presence of a 'Damage Control Plan' is a valuable contribution to the safety of the ship. This plan will clearly point out the vulnerable parts of the ship and also suggest sensible actions to be taken in the event of a damage.
A request for the class SC may be directed to the nearest Det norske Veritas office, where the fee for the class can be obtained upon request and where prices for advisory services and calculation assistance will be given in each particular case.

Laser gated TV camera gives clear image in murky waters
A pulsed illuminator gated television camera, which will aid seabed surveys and salvage operations, has completed successful underwater trials.
The prototype is being developed in Edinburgh, Scotland, by the Ferranti Company's electro-optics department, in conjunction with Osprey Electronics Ltd.
It is based on the Osprey Type OE 1321A underwater unit and fitted with a intensified RCA 4804/H/P2 SIT tube. The camera is gated by a high voltage pulse on the focus electrode of the intensifier section. Laser illumination is provided by a variation of Ferranti's 629 Neodymium YAG laser, which was originally developed for military applications.
The trials demonstrated the greater penetration of a pulsed illuminator gated camera in turbid water. This is greater than conventional underwater camera and lighting arrangements.
Adverse optical conditions in sea water restricts the range of conventional underwater cameras to about ten metres. Even moderate amounts of suspended matter result in a degradation of image. The use of floodlights causes foreground backscatter, giving a veiling glare similar to that experienced by a motorist using headlights to see through fog.
But the glaring effect is overcome by illuminating the subject with a pulsed laser beam. The viewing range of the subject is synchronised by the camera's electronic gating system as each laser pulse arrives. In 32 metres of murky water the new system performs as well as a spotlight located directly in front of the subject.
The trials were carried out in a water tank equipped with turbidity calibration and control facilities to adjust the visibility of the water. Five mirrors provided a path lenght of 40 metres in the eight metre tank.
(LPS)