



Photo by Flying Focus-Castricum.

## J.F.J. DE NUL

### A NEW GENERATION TRAILING SUCTION HOPPER DREDGER COMPLETED BY "DE MERWEDE"

DESIGNERS & BUILDERS : **Merwede Shipyard**, Hardinxveld-Giessendam, the Netherlands.

OWNERS : **Jan de Nul N.V.**, Hofstade-Aalst, Belgium.

The *J.F.J. de Nul*, the largest trailing suction hopper dredger in the world today, was recently commissioned less than two years after both parties, **De Merwede** and **Jan de Nul**, signed the construction contract. The twin-screw ship was launched in May of this year, eleven months after the first section was laid down.

Completed to an extensive owner's specification the sophisticated vessel heralds a new generation of trailing suction hopper dredgers not only by its size but also by the combination of duties which it is capable of performing.

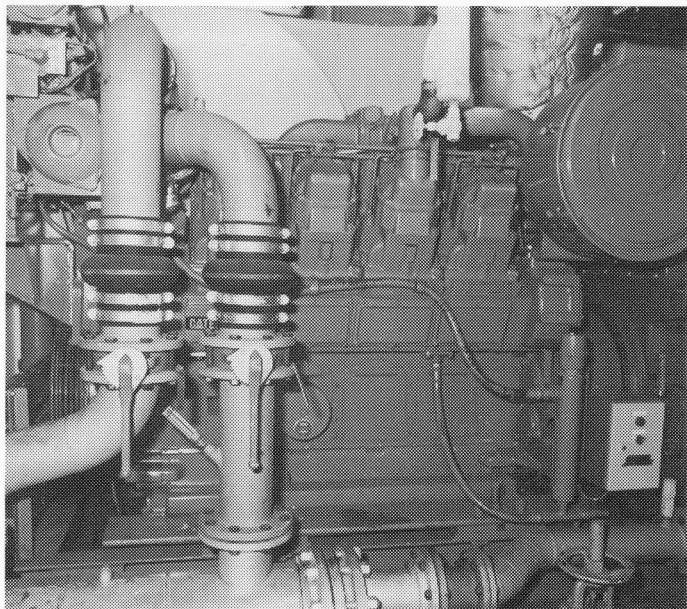
#### Design Criteria.

Following is a list of design criteria specified by the owners.

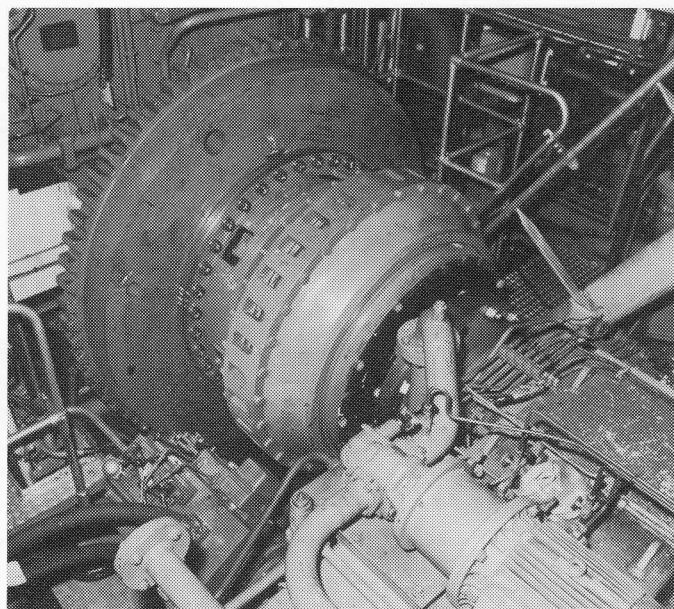
- \* The dredger should be suitable to perform major dredging, reclamation, offshore and back-filling contracts.
- \* Climatic operating conditions may vary from tropical (+50°C) to arctic (-20°C).

- \* The hopper capacity to be approximately 11,000 cu.m.
- \* Dredging to be carried out by means of one or two trailing suction pipes and a deep-dredging configuration by means of a third suction pipe.
- \* Capable of delivering the spoil either into the hopper or directly overboard when too lean.
- \* Capable of dumping the spoil through two rows of hinged double box-shaped bottom doors of the positive opening type.
- \* A shallow-water dumping system to be arranged with no parts to protrude from the ship's bottom.
- \* Capability to - prior to dredging - remove excess water from the hopper by means of the dredging pumps or ejectors fed by the jet pumps, to be installed.
- \* Capable of pumping the spoil up to eight kilometres from the hopper to the shore by means of the dredgepump(s) and self-emptying system.

- \* The bow connection arrangement suitable for coupling to a flexible floating pipeline.
- \* Capable of discharging the hopper load to the sea bed through a trailing suction pipe.
- \* Suction pipe dragheads to be fitted with high-pressure water jets for loosening compact soil.
- \* A semi-deep hopper loading system to be arranged.
- \* To install a de-gassing system in the inboard suction pipeline fed by the jet water pumps.
- \* Capable of diluting the hopper contents at selected places by using the jet water pumps.
- \* Each bottom door to be operated hydraulically by remote control from the wheelhouse.
- \* The hopper to have an open top and coamings.
- \* The cylindrical type overflows to be continuously adjustable from about 4,500 cu.m to maximum hopper capacity and hydraulically controlled from the wheelhouse.
- \* Two non-reversible propulsion diesel engines each driving a controllable pitch propeller through a reduction gear box.
- \* Propellers operating in nozzles.
- \* Each one of the propulsion engines to drive an AC main alternator for the generation of the electric power supply to the drives of the jet



The Caterpillar alternator set



The Spiroflex coupling

pump, the two bow thrusters and the hydraulic pumps.

- \* The dredgepumps to be driven off the main engines through a two-speed gear box.
- \* The engine room to be arranged for un-attended operation, the main engines to run on HFO or MDO and the auxiliaries to use MDO.
- \* Modern accommodation, air conditioned throughout, to be erected above the main deck and arranged for a complement of 40 persons.
- \* A deck crane with a SWL of 30/40 tonnes to be installed for the handling of heavy weights and engine room components during repairs.
- \* A trimming tank to be installed in the fore peak compartment and to be connected to the delivery line of the jet water pumps.
- \* The vessel to comply with the requirements of Bureau Veritas, the Belgian Shipping Inspectorate, the Canadian Shipping Act and other appropriate international rules and regulations in force.

**General Arrangement.**

The vessel is of the single-deck type with ex-

tended forecastle deck on which the accommodation and wheelhouse superstructure has been erected. The propulsion and dredging machinery plants have been installed aft. The hull with twin-chine flat bilge strakes has a transom stern and a double bottom in way of the engine, pump and bow thruster compartments. Tween-decks have been fitted in the engine, pump and bow thruster rooms as well as in the buoyancy spaces. The bow anchors are stored in anchor recesses while the Flipper Delta stern anchor is stored on a transom bracket.

The *J.F.J. de Nul* has the following main particulars:

Length oa. . . . .	144.00 m
Length bp. . . . .	127.00 m
Breadth mid. . . . .	25.50 m
Depth mid. . . . .	10.60 m
Draught on summer loadline . . . . .	7.80 m
Draught at dredging freeboard . . . . .	9.20 m
Deadweight capacity at 9.20 m . . . . .	17,150 t
Hopper capacity in cu.m . . . . .	11,750
Speed on dredging draught. . . . .	15.2 kn

**Operational depths:**

Standard dredging mode . . . . .	30/45m
Deep-dredging mode . . . . .	75 m
Fall pipe discharge . . . . .	300 m
Diameter suction pipes. . . . .	1,100 mm

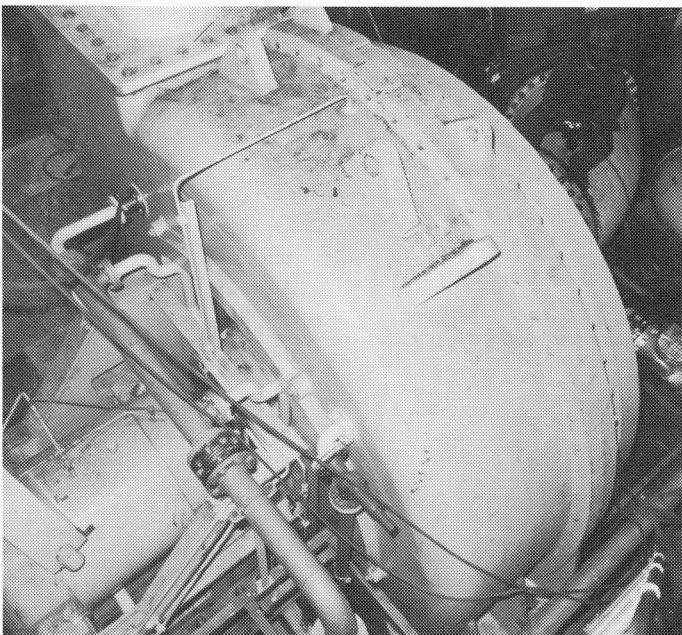
**Tank capacities in cu.m:**

Heavy fuel oil . . . . .	1,300
Marine diesel oil. . . . .	294
Lubricating oil . . . . .	50
Fresh water . . . . .	212
Water ballast . . . . .	1,464

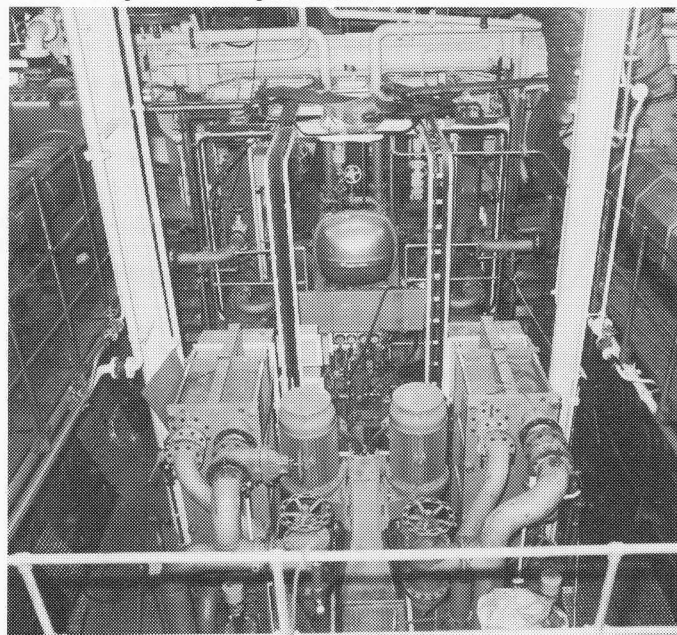
Equipped with five transverse watertight bulkheads the hull contains the following compartments (from the stern towards the stem):

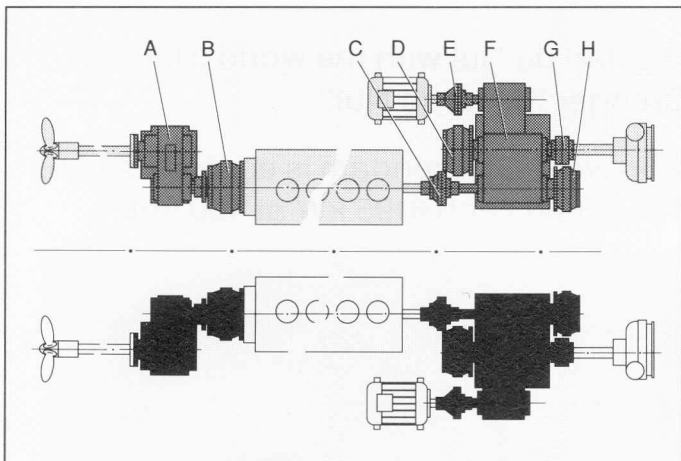
- \* the after peak compartment with water ballast tank and the steering gear room;
- \* the engine room, the engine control room, the workshop, stores and the separator room arranged at tweendeck level;
- \* the main pump room;
- \* the hopper with box-type centre keelson, the port and starboard buoyancy spaces with fuel tanks and the port side alleyway on tween-

One of the dredge pumps



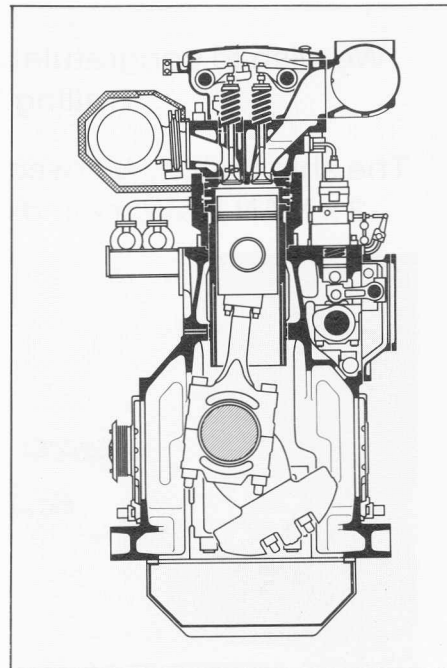
View in the engine room during construction





The propulsion plant with Lohmann + Stolterfoht power transmission systems

- Legend: A Navilus GCH1060 reduction gear;  
 B Pneumaflex KAP380 highly elastic clutch;  
 C Spiroflex KJO370 highly elastic coupling;  
 D Pneumastar KUM370 torsionally stiff friction clutch;  
 E Spiroflex KJO160 highly elastic coupling;  
 F Navilus GJZ2750 2-speed gear;  
 G Dentilus VZH35 gear coupling;  
 H Pneumastar KUM350 torsionally stiff friction clutch.



Section through the MAN-B&W L 48/60 four-stroke propulsion engine.

- deck level which provides a connecting passage between fore and aft ship.
- \* a compartment containing the bow thruster room, storage space, fresh water tanks, a moon pool and on tweendeck level spaces for accommodation and services.
- \* the fore peak with chain lockers and water ballast/trim tank.

On main deck level above the engine room, service compartments include workshops, store rooms, the air conditioning compartment, a changing room with shower and toilet and the ship's office.

**Propulsion, auxiliaries and control equipment.**

The dredger is powered by two MAN-B&W marine diesel engines of the type 7L 48/60 from the makers' 48/60 range. Both four-stroke diesel engines have a maximum continuous rating of 6,195 kW at 450 rev/min. The after end of each one of these engines has been fitted with a Lohmann + Stolterfoht reduction gear box of the type GCH 1060 SO with a ratio of 3.148:1. The output is transmitted to both of the ship's Lips

controllable-pitch propeller systems. Each propeller has a diameter of 4,000 mm and has been installed in a van de Giessen type 19A/VAST propeller nozzle provided with a stainless steel AISI 316 anti cavitation liner. On the front each main engine carries a second Lohmann + Stolterfoht reduction gear box of the type GJZ 2750 SO to drive a 2,200 kW Ansaldo type GSCR 640/4 3-phase 660 V-60 Hz shaft generator and a 4,400 kW dredgepump. The Lohmann + Stolterfoht equipment on board the record-size dredger *J.F.J. de Nul* was also mentioned on page 73 of *HSB International*, Vol.41 no 5/6.

The MAN-B&W 48/60 engine range is backed by the manufacturer's 55 years of heavy oil, four-stroke engine construction and almost a century of building internal combustion engines. The series incorporates in-line and Vee-form engine types. At 450 rev/min the cylinder output is 975 kW, at 428 rev/min the MCR/cylinder is 840 kW. Thus, the in-line versions cover an output range from 5,000 to 8,800 kW and the V-engines have MCRs ranging from 10,000 to 17,500 kW. Fuel consumption at 100 per cent ECR (Economy Continuous Rating) is

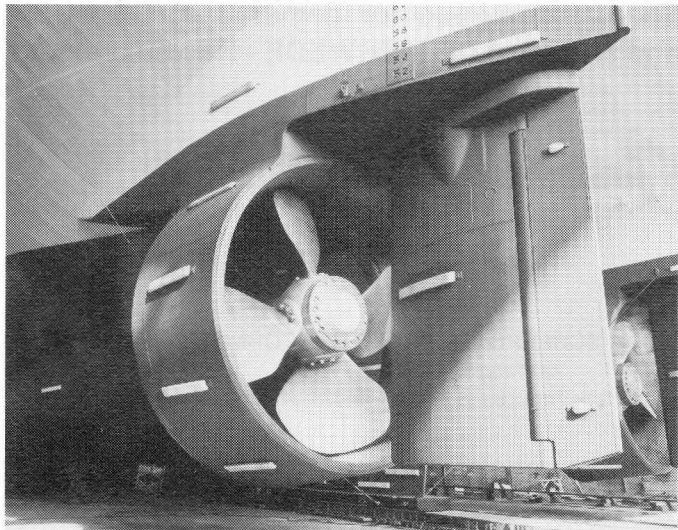
177 g/kWh and at 85 per cent ECR 173 g/kWh. The engines, designed for the use of heavy fuel oil, are of robust design and maintenance-friendly, built for decades of trouble-free use in heavy-duty marine, offshore and onshore plants.

In addition to both shaft alternators the ship carries three generator sets for the supply of electrical power. Two sets incorporate a Caterpillar type 3508B DI-TA and an 840 kVA Ansaldo MXR 400 MB/4 AC alternator each and the third set consists of a type 3406B DI-T Caterpillar engine and an Ansaldo alternator type M7R 315 SA/4 of 262.5 kVA.

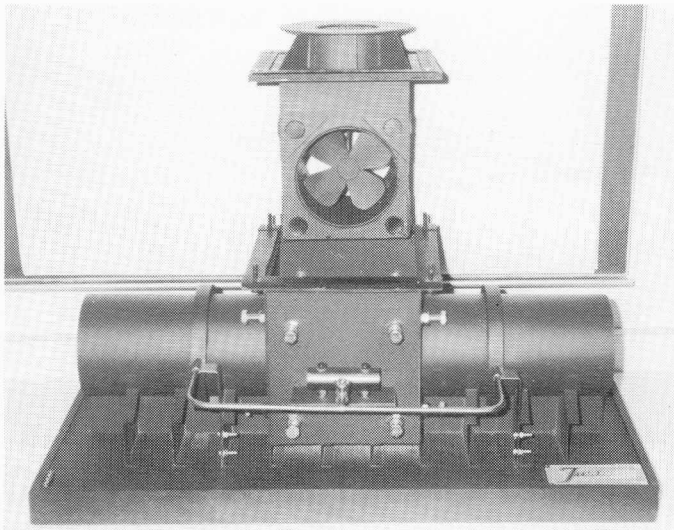
**Dynamic position**

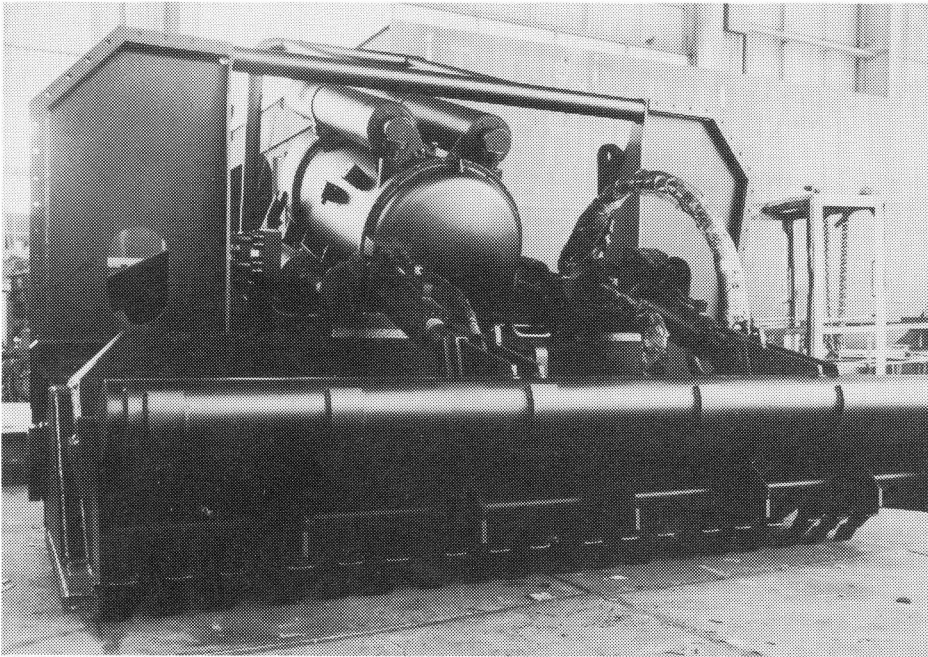
Directional control of the vessel is achieved by a displacement type twin-rudder system and two demountable Jastram Werke bow thrusters. The two rudders are of the Barkemeyer Schiffstechnik BRA 28-42-15/18 flap type and are operated by two synchronised Brusselle electro-hydraulic steering engines. These 4-ram units are of the type HMSE 150M and develop a torque of 250 kNm, providing a rudder angle of

The Barkemeyer rudder and Lips cp propeller



The Jastram bowthruster installation





J.F.J. de Nul's draghead

43°. The steering gear also incorporates the rudder carrier and all moving parts are operating in an oil bath to eliminate specific maintenance and lubrication. The power pack of each engine includes two variable delivery pumps and one 17 kW electric motor.

The bow thrusters are of the type BU 100 F fitted with fixed pitch propellers developing a thrust of 8 tonnes each. The output of each thruster is 625 kW at 317 rev/min.

The ship's anchoring equipment includes two 4.21-t Pool type bower anchors handled by one **Brusselle** windlass, having a pull of 290 kN at 10m m/min winding speed, arranged for 60 mm U3 chain cable with a total length of 577.5 m and one 7-t Flipper Delta stern anchor and **Brusselle** windlass with automatic cable guidance system, a pull of 450 kN at 10m/min and a barrel capacity of 400 m of steel wire.

The ship's thermal oil heating system incorporates one MDO-fired thermal oil heater with a capacity of 2,000 kW and two exhaust gas heat exchangers with a capacity of 790 kW each. These heat exchangers are fitted with two flue gas dampers with external ball bearings. If the temperature of the thermal oil increases a temperature controller opens the by-pass flue gas damper to check the rise. The fully automatic oil-fired heater is in stand-by mode and is only switched on when the heat produced in the exhaust gas system is insufficient. The system is designed to eliminate vibrations generated by pulsating flue gases and other sources.

**Dredging equipment.**

The dredger has been fitted with two IHC trailing suction pipes with a diameter of 1,100 mm and constructed for a dredging depth range between 30 and 45 metres and one trailing suction tube with a diameter of 900 mm arranged for a dredging depth of 75 metres and fitted with an IHC submersible dredgepump which is driven by an 1,800 kW electric motor.

Furthermore installed are one **Van der Graaf** bow connection system with one connection and one runner-bow connection winch with a nominal pull of 450 kN and 30 kN respectively. These **Brusselle** winches are hydraulically powered. This arrangement for shore discharge has a diameter of 900 mm as has the 900 mm

shore discharge arrangement installed amidships.

The hopper is fitted with two sets of nine hydraulically operated hopper doors with a clear discharge opening of 4.3x4.7 m, two sets of two shallow water dumping doors and two sets of nine suction channel doors.

The two dredgepumps have been manufactured by **IHC Holland** and are of the type 250-45-110. They have been equipped with a 5-blade impeller and are driven by the ship's main diesel engines.

The **Brusselle** suction pipe winches include two draghead handling winches with a pull of 450 kN, two intermediate winches with a pull of 410 kN, two trunnion winches with a pull of 320 kN and one trunnion winch of 460 kN as well as one underwater pump winch of 915 kN. All winches are fitted with grooved drums and store the required wire length in a single layer. The eight winches have capacities ranging between 32 and 91.5 tonnes and are hydraulically powered.

The ship also carries a **Buitendijk Techniek** model 315 deck crane with a swl of 30 tonnes at 20.5 m reach and 40 tonnes at a radius of 16.25 m and a **Van Leusden** overhead pump room crane with a swl of 20 tonnes.

**Accommodation.**

The ship's accommodation has been arranged in the superstructure forward and is air conditioned throughout by a **Stork Bronswerk** air treatment system incorporating three units with DX-22 evaporators which in turn are connected to six condensing units (conits) with an aggregate cooling capacity of 1 MW. The living quarters, amenities and service areas occupy five decks and the interior design is by **Frank De Clercq** of Ghent, Belgium. **Merwede's** furniture and joinery department fitted out the accommodation.

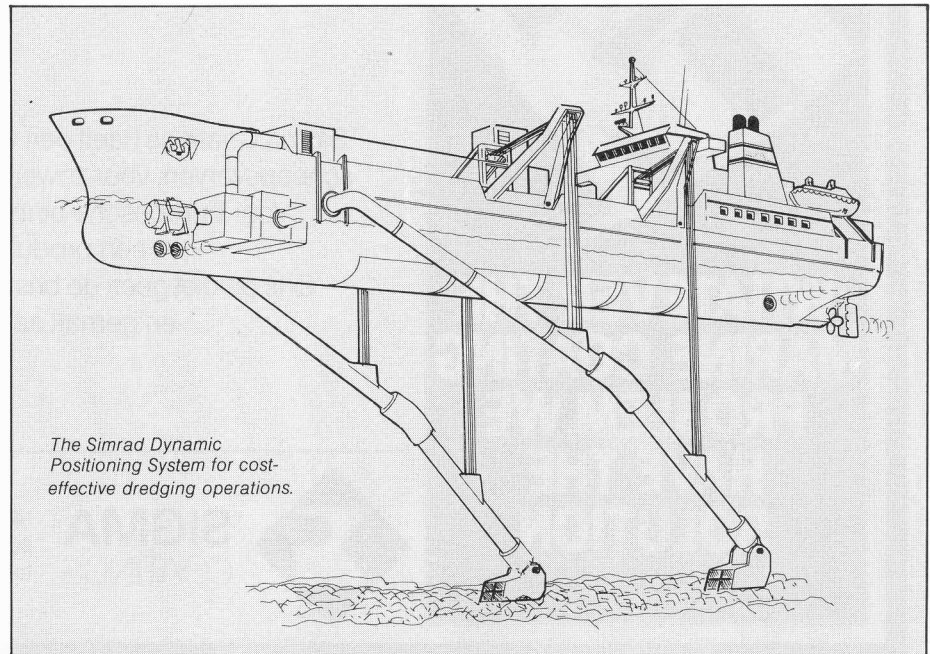
In the tweendeck forward a gymnasium, a shower and toilet facility, the laundry, a provision room, cold stores and the bonded store have been arranged.

One deck up in the forecabin on the main deck are four twin-berth cabins each with a shower and wc unit, a galley with food elevator down to the provision stores, two messrooms, a bar/TV room, the ship's hospital, an electronics workshop and three separate toilets.

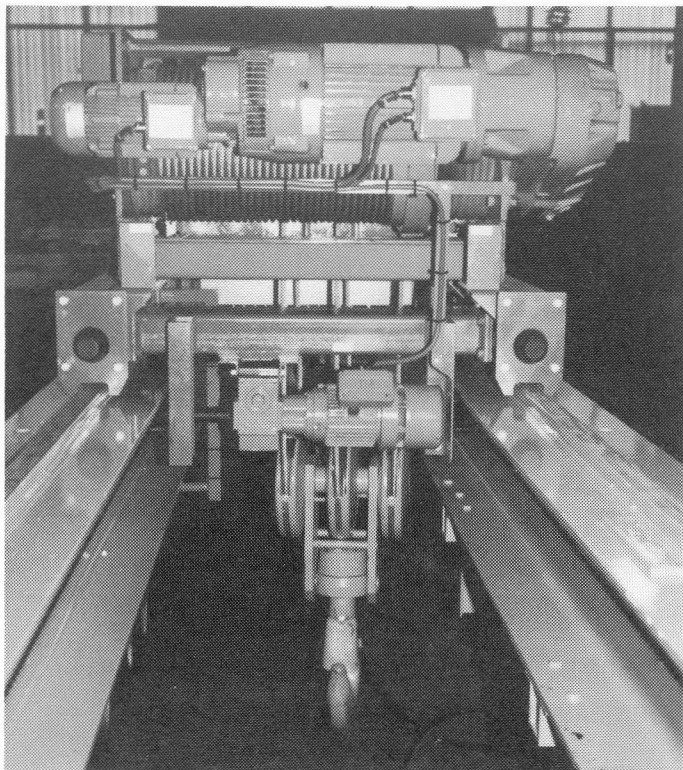
On the forecabin deck the ship's main entrance lobby has been arranged together with six twin-berth cabins, five single berth cabins and a changing room with shower and wc. All cabins have their own en-suite shower and toilet facility. On starboard gravity davits for the ship's enclosed lifeboat have been installed with additional inflatable liferafts at both sides.

On C-deck level, the (boat) embarkation deck for the starboard lifeboat, a superintendent cabin with shower and toilet and ten additional single berth cabins have been arranged all with private shower and toilet facility. Amidships on this deck is the air conditioning room with **Stork-Bronswerk** equipment. A gravity davit, to handle the second totally enclosed lifeboat, has been installed on the port side. This boat is entered on B-deck.

B-deck or lower bridge deck is used for the arrangement of four spacious 'apartments' for the owner, the customer, the captain and the chief



The Simrad Dynamic Positioning System for cost-effective dredging operations.



The van Leusden overhead crane



The J.F.J. de Nul alongside shipyard "De Merwede"

engineer respectively. Each one of these apartments incorporates a dayroom, a bedroom and a sanitary unit with shower and toilet. Furthermore arranged are a ship's office, a converter room and an extra toilet.

The upper or A-deck contains the ship's enormous wheelhouse which accommodates the ship's command centre and the dredgemaster's control centre. Forward, aft and in the wings the wheelhouse protrudes beyond the construction of the superstructure to enhance the field of vision and create ample space for the installation of the ship's control consoles.

**Electronics.**

The *J.F.J. de Nul* is fitted with a sophisticated and comprehensive Integrated Monitoring and Control (IMC) system incorporating a supervisory system with several sub-systems in a single network and with terminals where large numbers of data are being processed. The sub-systems monitor and control the ship's navigational, machinery and dredging functions while the supervisory system and the sub-systems communicate exclusively over a local area network (LAN). The supervisory system consists of four operating stations, three at the dredge control desks and one at the navigation control console. Each station is able to control all available functions. The system's software has been supplied in one integrated package by IHC Systems.

Supplied by **Radio Holland B.V.**, Rotterdam is the vessel's **Simrad Albatross** type ADP 701 Dynamic Positioning (DP) system which controls the ship's propellers, the rudders and the bow thrusters. Accurate manoeuvring and draghead force compensation are key factors in a successful dredging operation. The DP system has been interfaced with a pitch and roll sensor, a draught measuring system with sensors at the perpendiculars, the Doppler log, the gyro compass, wind sensor, positioning/survey system,

IMC system, suction pipe position, jet pump speed, dredge pump load and main generator loads. Four operation modes can be selected viz.:

- \* Autopilot mode: to control the vessel's heading when free sailing. No positioning system is required.
- \* Joystick mode: to manually control the vessel's heading. No positioning system is required.
- \* Station keeping mode: to control the vessel at a selected position and heading. The heading may also be chosen by the DP system to minimize the power required to keep the ship on station. Any point on the vessel can be selected as a reference point (centre of gravity, bow, draghead(s), etc.) A positioning system is required.
- \* Auto-track mode: the vessel follows a programmed track at a selected speed monitoring the vessel's position and draghead tension. This mode is used when dredging, during controlled dumping etc to reduce operator strain and reduce the risk of operator error with damage consequences. Reference points which can be selected include the centre of gravity, the bow, the dragheads to provide optimum coverage of a pre-determined area. Tracks are entered into the DP system from the DP console or by the survey system.

In DP-backed dredging tailored dredging functions and advanced mathematic modelling techniques are combined to achieve accurate control of the draghead(s) position, accurate vessel position and speed control, optimum power distribution and vessel heading to reduce fuel consumption. The system also provides accurate speed control and immediate sea current update.

In dredging modes one or two dragheads may be deployed. The tension on each draghead may vary significantly depending on seabed substance, speed and deflection angle on suction pumps and dragheads. By accurate measurement of the dredging forces in combination with suction pipe elevation and azimuth the draghead forces are automatically compensated by the system.

As the vessel has been constructed and equipped for world-wide operations the following navigational aids and communications equipment has been installed:

- \* from **SP Radio**: two RT-2047 VHF sets with RM-2042 DSC controller, one RT-2047 VHF set, one VHF-DSC watch keeping receiver type RM-2042 and one watch keeping receiver type R-501, one MF/HF RT station with digital selective calling type Compact-2100/DSC, one TOR installation with printer buffer;
- \* from **Furuno**: one Navtex NX-500 receiver and two FE-881 NK II echo sounders;
- \* from **Anschutz**: one magnetic compass, one Standard 14 twin gyro compass and one automatic pilot with steering and rudder indication systems.

Furthermore provided are a **Motorola** type MCR-4500 XL mobile telephone for the Benelux network, one **JRC** satcom installation type JUE/45A Mx II, one **Ramantenn** G-82/RH radio direction finder, one **Phillips** MK5/Prof/DS integrated satellite navigation system GPS/Decca Navigator, an **EDO** MRQ-4015 D/RH Doppler log, from **Jotron**: one Tron-30S Epirb and two Tron/Sart radar transponders and from **Racal Decca**: an Arpa 2690/6BT radar set and one Bridgemaster C252/6 radar set.

The *J.F.J. de Nul* has been constructed to comply with the Rules and Regulations of Bureau Veritas class 1 3/3 ■ E Hopper Dredger (Deep Sea) AUT-MS Ice Class 1A.

List of equipment on board the hopper dredger

**J.F.J. de Nul.**

(partial list)

**Ajax-De Boer B.V.,**

Amsterdam . . . . . : CO<sub>2</sub> fire fighting installation

**Alfa-Laval, Maarssen** . . . . . : lubricating oil separator, Nirex fresh water generator & fuel oil separator

**A.M.W., H.I. Ambacht** . . . . . : Pasilac heat exchangers

**Anker, Het, Schelluinen** . . . . . : windows & portholes

**Bakker, Sliedrecht** . . . . . : electrical installation

**Barkemeyer**

**Schiffstechnik, (D)** . . . . . : spade-type flap rudders

**Breejen, Den, Sliedrecht** . . . . . : painting

**Brusselle Marine**

**Industries, (B)** . . . . . : windlass & winches, steering gear

**Buitendijk Techniek b.v.,**

Zwijndrecht . . . . . : travelling deck crane

**Cetema b.v., Oss** . . . . . : cathodic protection system

**Coopra-Rotterdam B.A.,**

Rotterdam . . . . . : steel

**De Hoop Groenpol,**

Rotterdam . . . . . : Ansaldo motors & alternators

**Econosto,**

Capelle a/d IJssel . . . . . : air whistle & fittings

**Elga Benelux b.v.,**

Rotterdam . . . . . : welding electrodes

**Eijle, van, Vlaardingen** . . . . . : Hatlapa starting air compressors

**Geveke Motoren,**

Papendrecht . . . . . : Caterpillar alternator sets

**Grijp Buizen, v.d.,**

Papendrecht . . . . . : dredging, suction & delivery pipelines

**Hatenboer-Demi b.v.,**

Rotterdam . . . . . : fresh water hydrophore system

**Hydraudyne, Boxtel** . . . . . : hydraulic installation

**Hydraudyne Bruinhof,**

Rotterdam . . . . . : Lohmann + Stolterfoht gear boxes for dredgepumps and main engines

**IHC Holland, Kinderdijk** . . . . . : suction pipes & gantries, dredgepumps & jet pumps

**IHC Systems v.o.f.,**

Sliedrecht . . . . . : dredging instruments

**INA, Rotterdam** . . . . . : Racal Decca radars

**J.V.S., Papendrecht** . . . . . : Jastram bow thrusters

**Jong TH., A. de,**

Schiedam . . . . . : IMO lubricating oil pumps

**Ketting, IJmuiden** . . . . . : Atlas Copco compressors

**Kopcke, Hoboken (B)** . . . . . : safety equipment

**Korevaar, Sliedrecht** . . . . . : sanitary equipment

**Kroon, Hoogezand** . . . . . : Alvesta fire doors & Rockment TNF wall & ceiling system

**Leusden b.v., van,**

Etten Leur . . . . . : overhead travelling cranes

**Lips, Drunen** . . . . . : c.p. propeller systems

**Machine Support, Leiden** . . . . . : Epocast engine supports

**Magolux S.A., (B)** . . . . . : castings

**MAN B&W,**

Augsburg (D) . . . . . : main diesel engines

**Marin Assist,**

Zoeterwoude . . . . . : life rafts

**Materiaal Metingen**

**Europe b.v.,**

Ridderkerk : Al accommodation ladder

**Merwede Meubel & Interieurbouw,**

Hardinxveld-Giessendam : joinery & furniture

**Mulder & Rijke b.v.,**

IJmuiden . . . . . : totally enclosed lifeboats

**N R Koeling,**

Krimpen a/d IJssel . . . . . : refrigerated store room

**Nieuwburg Ruplako,**

Krimpen aan de IJssel . . . . . : insulation

**Nijhuis Pompen,**

Winterswijk . . . . . : pumps

**O.D.S., Barendrecht** . . . . . : steel pipes

**Qua Vac b.v., Weesp** . . . . . : laundry & galley equipment

**Radio Holland,**

Rotterdam . . . . . : communication & navigation equipment, DP system

**Regenboog Apotheek,**

Hoogvliet . . . . . : medical supplies

**Schat Davit Company,**

Utrecht . . . . . : liferaft & lifeboat davits

**Seadrec Ltd,**

Schotland (GB) . . . . . : sluice valves

**Sigma Coatings,**

Rotterdam . . . . . : paint

**Simrad Albatross, (N)** . . . . . : dynamic positioning system

**Smits Neuchâtel,**

Nieuwegein . . . . . : floating floors

**Stork Bronswerk b.v.,**

Amersfoort . . . . . : air conditioning, heating & ventilation systems

**Stork Kwant, Assen** . . . . . : emergency telegraph system

**S.A. Soudometal,**

Brussels (B) . . . . . : welding rectifiers

**TeamTec A/S, (N)** . . . . . : incinerator

**Thofex, Rotterdam** . . . . . : machine tools

**TIO, Capelle a/d IJssel** . . . . . : exhaust gas silencer

**Uittenbogaart, Rotterdam** . . . . . : oily water separator & sewage plant

**Verlinde Nederland bv,**

Soesterberg . . . . . : electric hoists

**Waukesha-Lips, Drunen** . . . . . : sterntube bearings & seals

**Wiesloch b.v., Spijkenisse** . . . . . : thermal fluid heater

**Winel, Assen** . . . . . : watertight doors

**Witzel b.v., Wouter,**

Enschede . . . . . : butterfly valves

**Wortelboer,**

Rotterdam . . . . . : anchors & chain cables



**AMPAK**

Ook voor de kathodische bescherming van de J.F.J. DE NUL werden Ampak anoden toegepast. Ampak anoden zijn naast levering in Rotterdam en Antwerpen o.a. uit voorraad leverbaar in Hamburg, Bremen, Honkong, Singapore, Piraeus, Karachi etc.

Voor betrouwbare en vaktechnische adviezen:

**cetema b.v.**

**IJsselstraat 41, Postbus 19, 5340 AA Oss,**

**Tel: 04120-81888, Telex: 37460, Fax: 04120-31675**



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Het schilderwerk op de  
J.F.J. DE NUL  
is uitgevoerd door

**Den Breejen & Zn.  
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