The partners involved in the project

		Contact	Phone	Fax
RESEARCH INSTITUTES				
MARIN	(NL)	J van Heerd	31 317 493385	1 317 493245
NEA	(NL)	FWM van den Bergh	31 70 3988357	31 3954186
Versuchanstalt für Binnenschiffbau	(DE)	A Gronarz	49 203 993690	49 203 361373
MARITIME MANUFACTURES/SUPPLIERS				
ABB Industry Oy, Marine Division	(FI)	E Hentunen	358 10 2222923	358 10 2222350
DEIF A/S	(DK)	J Hansen	45 96149614	45 97524720
ABB Azipod OY	(FI)	T Lassila	358 10 2226024	358 10 2226060
Fischcon Trading & Engineering B.V.	(NL)	EJ Huijsen	31 347 371366	31 347 373459
NEWAGE International	(GB)	R Logan	44 1780484708	44 1780484100
El-Marine i Göteborg AB	(SE)	O Svan	46 31513010	46 31225657
AB Volvo Penta	(SE)	B Carlsson	46 31 668226	46 31 518457
INLAND SHIPYARDS				
Scheepswerf Grave	(NL)	RGC van Kessel	31 486 472464	31 486 475988
Van Grevenstein's Scheepswerf	(NL)	JF van Grevenstein	31 180 512200	31 180 518658
Joh.v.Duijvendijk Scheepswerf	(NL)	J van Duijvendijk	31 180 517033	31 180 510680
Scheepswerf de Kaap	(NL)	K van der Werf	31 522 253333	31 522 262254
Gebr. Kooiman	(NL)	MB Kooiman	31 78 6100477	31 78 6100477
Nieuwe Schelde Werven	(BE)	F van Bogget	32 3 7741145	32 3 7745672
Neue Ruhrorter Schiffwerft	(DE)	HG Becker	49 203 4500513	49 203 4500524
INLAND SHIPPING COMPANY				
Chemgas BV	(NL)	Th de Jong	31 10 2412240	31 10 4366736
CLASSIFICATION SOCIETIES				
Bureau Veritas	(FR)	AW van Elsacker	31 10 2822666	31 10 4145763
Germanische Lloyd	(DE)	H Dölling	49 4036149491	49 4036149200
Lloyd's Register	(GB)	M Rasica	31 10 4145088	31 10 4115105
PROJECT CO-ORDINATION				
BOS Foundation E-mail: mgo@fme.nl	(NL)	M. Goldan	31 79 3531169	31 79 3531155

INBISHIP™

NEW OPPORTUNITIES

FOR INLAND WATERWAY TRANSPORT

COMMON EUROPEAN INLAND SHIP CONCEPT

BRITE EURAM Project 2130

Inbiship™ is an innovative approach to inland ship design which aims to minimise the impact on the environment, reduce energy consumption and improve safety and economical efficiency in inland shipping operations.

How seven small European shipyards and their associates from the maritime industry responded to current market challenges: an example of European co-operation between SME's and industrial giants in the field of maritime research and development sponsored by the European Commission within the Brite-Euram programme.

1 Background: facts and figures

Inland shipping plays an important role in European transport by providing cost efficient and environmental friendly links for about 50 % of all transport volume between sea ports and hinterland. Recent studies indicate a steady growth in inland waterborne transport volumes. Additional opportunities have arisen with the opening of the Main-Danube link and the intensifying trade between West and East Europe. The current West European inland fleet comprises some 12,000 ships and a total loading capacity of some 11 million tonnes.

However about 60 % of the tonnage consists of ships older than 25 years which, in view of operational costs, recent (technical) regulations and growing awareness for safety and protection of the environment along European waterways (the new Rhine Convention), will have to be replaced within the next 15 years. EEC council regulations on structural improvement in inland shipping (the "Scrapping Scheme", EEC 110/89) stimulated the exchange of old-for-new tonnage. Efficient and safe inland shipping is a priority within the EEC agenda on mobility, safety and environmental sustainability.

2 The problem

Due to low freight rates over the past years the transport market turned to minimisation of investments in tonnage replacement by importing ships and ships' hulls of conventional design and marginal quality from cheap labour countries. The inland shipbuilding industry in the Netherlands, Germany and Belgium, having failed to meet existing market requirements for low cost ships, low operating costs and the flexibility to operate profitably along shallow waterways, experienced significant loss of market share. A competitive edge can only be regained through offering innovative ship concepts with improved "earning" capability, at market prices.

Earning capability is determined by operational costs and flexibility. Reducing the fuel bill is a primary target for the ship owner; additional targets are meeting established emission levels, reducing maintenance costs and improving operability at reduced draughts and in shallow waterways. The complexity of the ship and ship operations do not, however, allow for simple, itemised technical solutions whereas inland shipyards, mostly small and medium size enterprises of limited RTD capabilities and financial resources, cannot achieve these targets without the aid of major maritime suppliers and research institutes.

3 The challenge

Preliminary studies conducted by several West European inland shipyards and maritime suppliers have indicated that by integrating the supply of power to the various ship systems within a central electric power supply plant, improvements on all the above targets might be obtained. The outstanding features of this concept are electric propulsion, fully azimuthing podded propulsion drive with lowering/hoisting capability for adjusting propeller immersion and an advanced power management system to match ship power demands with on board power supply. Major consideration must also be given to the hydrodynamic aspects of the hull and the new propulsion arrangement, in particular the form of the after body and the position of the propulsion units.

4 The response

In order to take the concept beyond the initial feasibility study, a consortium was formed around a core group of inland shipyards from Belgium, Germany and the Netherlands, with the aim of developing, building and validating, by full scale monitoring, an innovative inland ship concept which would include the above features. To facilitate the necessary research work the consortium applied for EU funding from the CRAFT programme for small and medium size enterprises (SMEs). Following the two-step CRAFT procedure a request for a research award (step 1) was submitted. The award was granted in October 1995, after which a full research proposal (step 2) was prepared for the DG XII Brite Euram programme.

The specific industrial objectives of Inbiship are:

1. Development of a ship concept on the basis of:
   a. diesel-electric power plant with 15 % lower fuel consumption, emission levels and maintenance costs;
   b. an electric propulsion system incorporating retractable podded-type thrusters;
   c. corresponding optimum hull lines in terms of resistance and location of retractable thrusters.
2. Validation of the concept by means of the following:
   a. computer simulations;
   b. model tests in towing tank (hull lines, position of thrusters, manoeuvring);
   c. bench tests of prototype innovative components and systems configuration.
3. Obtain approval of compliance of innovative features with respect to relevant statutory requirements.

As a research project a tanker was chosen. This type of ship incorporates very complex on board power requirements and statutory regulations. All these industrial objectives will be achieved within two years.

5 The Inbiship consortium

The project proposal was submitted in January 1997 and finally approved in May . After brief negotiations a contract was signed by the prime industrial proposer, shipyard De Kaap of the Netherlands, and by the Maritiem Research Institute Netherlands (MARIN). The management and co-ordination of the project was subcontracted to the BOS Foundation, an affiliation of the Netherlands' Shipbuilding Industry Association VNSI.

The consortium comprises five international groups of enterprises, starting with the research institutes (MARIN, NEA and VBD), maritime suppliers (Volvo Penta for ship diesel motors, NEWAGE Int. for electric generators, El Marin for switch boards, FISHCON for powering systems, DEIF for power management systems, ABB Industry Oy for frequency converters and electric motors and ABB Azipod Oy for propulsion systems and components), Shipyards (Grave, Van Grevensteins' Scheepswerf, Joh. V. Duijvendijk Scheepswerf, Scheepswerf de Kaap, Gebr. Kooiman, Nieuwe Schelde Werven and Neue Ruhrorter Schiffwerft), the shipping company Chemgas, and the classification societies Bureau Veritas, Germanischer Lloyd and Lloyd's Register,

6 The way ahead

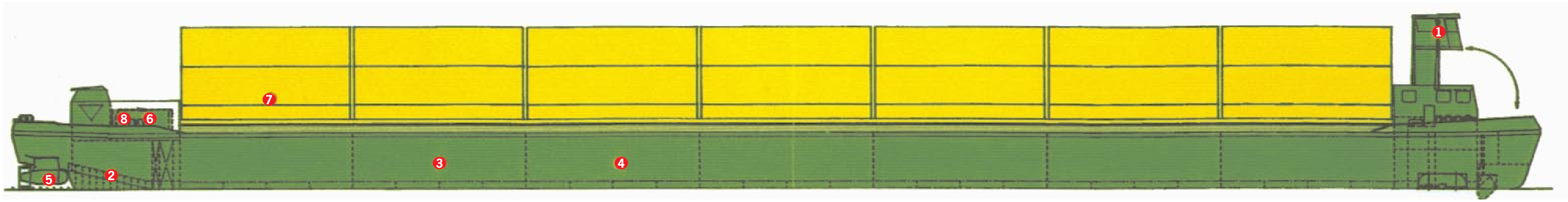
The Inbiship project demonstrates that small and medium size European maritime enterprises are willing and able to meet current market challenges and that opportunities offered by the European Commission are within their reach. Most important is the way ahead : research and development of a new, more efficient and environmentally friendly inland ship design for the benefit of industry and society.

7 Information

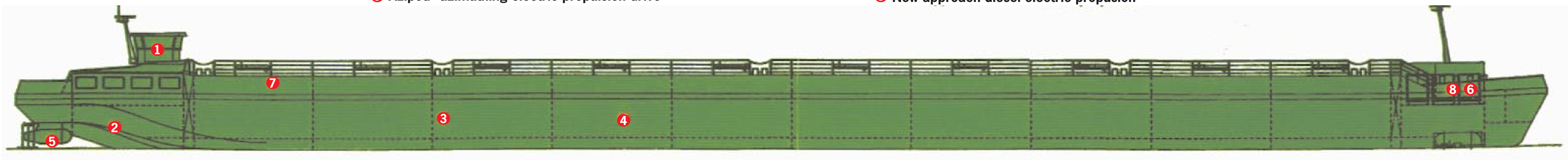
For additional information about the Inbiship project or consortium please contact :

M. Goldan,
BOS Foundation for
Shipyard and Industry Development,
PO Box 138
2700 AC Zoetermeer, the Netherlands
tel 31 79 3531169,
fax 31 79 3531155,
E-mail MGO@FME.NL

INBISHIP™: CONTAINER, DRY CARGO/BULK AND TANKER SHIP



1. One man bridge system including databased ship monitoring system
2. New hull design
3. Increased volume and payload capacity up to 30%
4. Light ship structure design
5. Azipod® azimuthing electric propulsion drive
6. Marine generating sets, each in individually sound insulated boxes
7. Cargo friendly design
8. New approach diesel electric propusion



Inland ships : Current Concept

Inland ships today use mechanical power transmission systems in which the main engines are coupled to the propellers by means of reduction gears. This arrangement places the engine room in the aft part of the ship. The engine room requires large casings that penetrate the deck house or the cargo area, hereby severely limiting optimal cargo hold arrangements and volumes.

Inbiship™: the New Approach

The Inbiship™ project adopts a new approach which benefits from experience obtained with new trends and developments in short sea shipping, e.g. the introduction of diesel-electric propulsion. This technology creates entirely new possibilities in ship design because the location of the engine room no longer dictates the arrangement of holds and compartments beneath the main deck; the power generating plant can be located anywhere in the ship.

Cargo Friendly Design

Diesel-electric propulsion and the flexibility obtained in the location of the engine room eliminates the need for either side or central casings within the cargo area. This is a great benefit which allows cargo hold capacity to be maximised and all cargo spaces to be completely free from obstructing structures.

New Hull Lines

The flexibility obtained through the application of diesel-electric powering and electric propulsion is used to improve the under water body shape. New body lines were developed by Versuchanstalt für Binnenschiffbau (VBD) and MARIN to accommodate the projected twin podded propulsion arrangement, hereby increasing cargo volume and payload capacity by up to 30 % with respect to conventional designs.

Following computer simulations, extended resistance and propulsion model tests, including manoeuvring and emergency stop were carried out at various draught conditions in deep and shallow water. The results indicate about 10% better performance in comparison with current modern inland ship designs.

Light Ship Structural Design

The Inbiship™ concept is based on the latest state of the art regarding hull structural design and the use of high performance materials to improve payload capacity and life time expectancy. The structural design, outline specification and general arrangement is a joint development by the seven shipyards involved in the project, co-ordinated by Scheepswerf de Kaap.

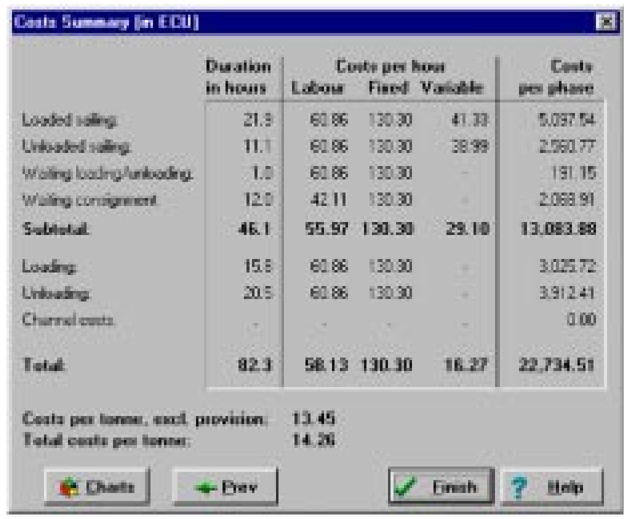
Applications

The Inbiship™ concept is applicable to all types, classes and sizes of inland ships such as dry cargo and bulk ships, container ships, tankers and passenger ships as well as to various operational areas and speeds. The diesel-electric power plant is a very effective solution for applications requiring large auxiliary power for cargo handling, heating, ventilation and air conditioning, such as tankers and passenger ships.

Exploitation Model

The evaluation and choice of particular technical solutions must rely on relevant economical criteria. To support such decisions a computer aided Exploitation Model was developed by NEA to simulate inland shipping operations. The model uses, amongst other inputs, detailed digitalized databases of the Western European infrastructure. Operational costs, fuel consumption and emissions can be calculated in detail for specific journey profiles (origin-destination pairs, particular ships, various cargo-sizes).

Exploitation Model:



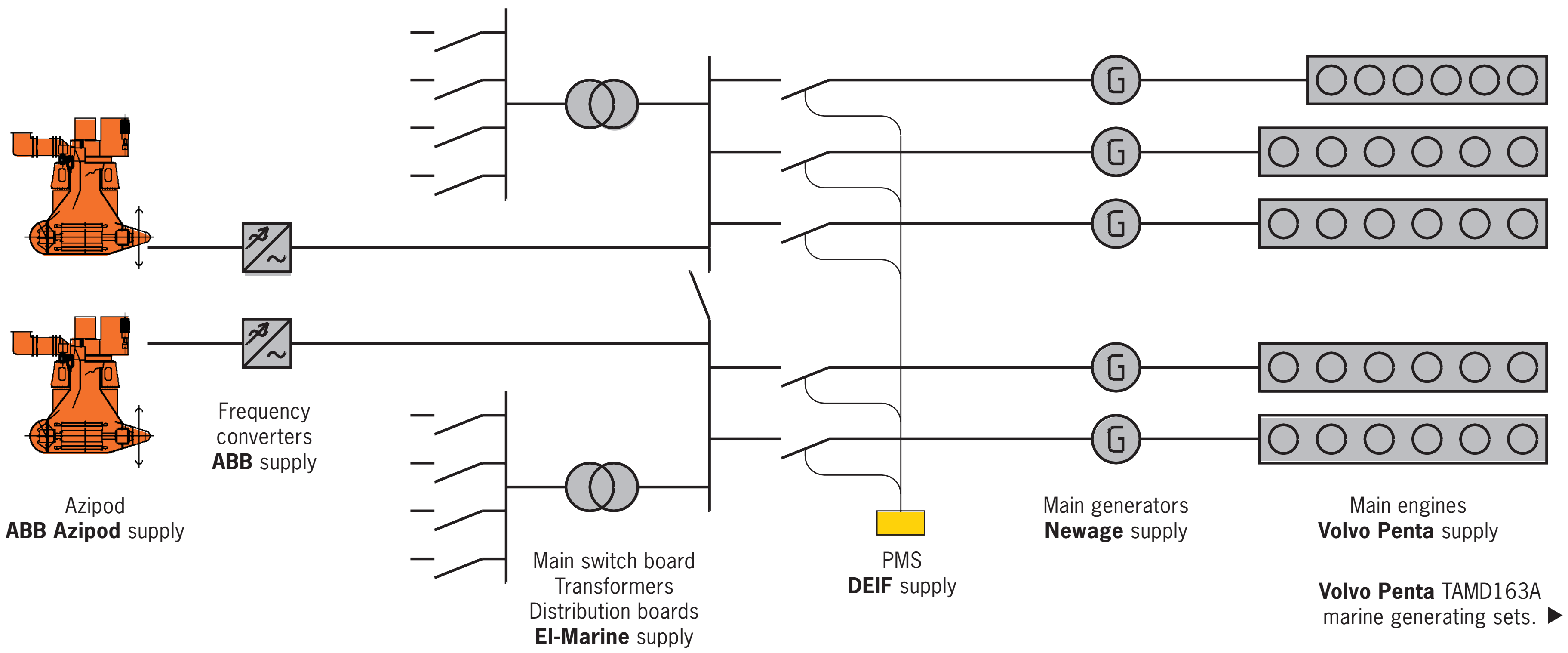
Costs Summary [in ECU]

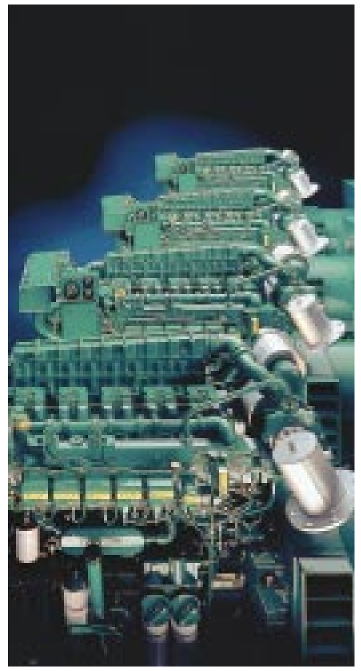
	Duration in hours	Costs per hour Labour	Fixed	Variable	Costs per phase
Loaded sailing:	21.3	60.86	130.30	41.33	5,097.54
Unloaded sailing:	11.1	60.86	130.30	38.99	2,590.77
Waiting loading/unloading:	1.0	60.86	130.30	-	191.15
Waiting consignment:	12.0	42.11	130.30	-	2,068.91
Subtotal:	**46.1**	**55.97**	**130.30**	**29.10**	**13,083.88**
Loading:	15.6	60.86	130.30	-	3,025.72
Unloading:	20.5	60.86	130.30	-	3,912.41
Channel costs:	-	-	-	-	0.00
Total:	**82.3**	**58.13**	**130.30**	**16.27**	**22,734.51**

Costs per tonne, excl. provision: 13.45
Total costs per tonne: 14.26

Charts | Prev | Finish | Help

DIESEL ELECTRIC POWER PLANT PRINCIPLE





Volvo Penta TAMD163A
marine generating sets. ▶

Diesel-Electric Power Plant

Diesel-electric power plants and propulsion solutions have clear merits which may vary from one ship type to another. The safety aspects of diesel-electric propulsion are commonly regarded as being related to redundancy in different ways. The number of power generating units is large enough to ensure propulsion capability and steerage way irrespective of any component failure. In addition the units can be located in different compartments to safeguard against loss of power in case one compartment has been destroyed by fire or flooding.

A summary of advantages:

- Flexibility – the installed power generating capacity can be used for various ship functions and different situations;
- Propeller torque capability – full torque at any propeller speed;
- Permits running diesels engines at stable load with smoother transients and at optimum specific fuel consumption, thereby reducing emissions and impact on the environment;
- Uniform machinery - simple spare parts logistics, maintenance, crew training, etc;
- Flexibility in location of main engines allows optimising of cargo space volumes and arrangements;
- Redundancy, both in the sense of safety and freedom of maintenance routines.
- Advanced PMS and Monitoring System enables to lower the requirements on number or qualifications of needed crew.
- Optional long term maintenance contract.
- No extra power supply needed for bow thrusters.

Power Plant Application in the Inbiship™ Concept

The power plant consists of five Volvo Penta diesel generator sets comprising four 430 kW and one 150 kW low emission type Volvo Penta marine diesel engines closed coupled to Newage-type generators feeding the electrical network as one integrated system. The generating sets are each equipped with automatic start and stop, automatic load sharing unit, synchroniser and alarm and monitoring system. To reduce noise and allow for easy installation and servicing each generator set is placed in an insulated structure (sound box).

The number and size of the generating sets can be altered to suit particular needs such as ship size, ship operations, cargo handling and speed requirements. There are no separate auxiliary units which is an additional benefit of the power plant principle.

The propulsion system can be made redundant and separated according to RP class notation.

The generator sets are located in two separate engine rooms feeding two separate electrical networks linked together by a bus-tie breaker. Each network consists of a main switchboard with transformer and distribution boards , frequency converter and electrical pod drive.

The electrical system, with main switchboards, transformers and distribution boards, has been developed by El-Marine i Göteborg AB. For power plant management a Delomatic Multi Functional system for control and protection of the generator plant, including a power management system (PMS) and monitoring system for inland shipping requirements, was developed by Deif A/S. Power output is matched to demand by the (power) management system that operates the required number of engines at any given time. As a result each engine operates at optimum efficiency, which ensures low fuel consumption and minimum emissions. A Deif Delovision (MMI and Scada system for Delomatic) located on the bridge gives an instantaneous overview of the power plant status, data logging, historical and real time trending.

The installation design of the power plant, piping and ventilation has been developed by Fischcon Trading & Engineering B.V.

Azipod® – Azimuthing Electric Propulsion Drive

Azipod®, by ABB Azipod Oy, is a podded propulsion drive azimuthing through 360 degrees and developed for the Inbiship Concept with a vertical lowering and hoisting mechanism. The drive incorporates an AC motor that directly drives a fixed pitch (FP) propeller.

The twin Azipod® rudder propeller units, each of 670 kW propulsion power, have the propulsion motor located inside the pod. The speed of the electrical motor is controlled by a ABB frequency converter, with full and smooth torque availability in either direction from zero to nominal speed.

The podded propulsion arrangement has a number of benefits when compared to a conventional propeller drive :

- much higher side thrust;
- better manoeuvring capability and shorter docking time
- the pods operate in an even wake field which improves propulsion characteristics and results in approx 5 % lower propulsion power requirements
- Propeller-induced pressure pulses are smaller, meaning greater comfort and lighter steel construction.
- In the case of one unit failing, manoeuvring capability is maintained giving a higher level of safety.

This technology means that the installed propulsion power of the diesel-electric drive is equal to that of a mechanical drive, i.e. the differences in transmission losses of about 5% are compensated by the improvement in the efficiency of the Azipod® propulsion system.