

ABB electrical equipment on board the luxury liner 'MV Oriana'

With a gross registered tonnage of 69,153 and a length of 260 meters, the luxury liner 'MV Oriana' is among the largest passenger vessels ever to have been built in a German shipyard. The prestigious order was awarded to Jos. L. Meyer GmbH & Co, Papenburg, by the Peninsular & Oriental Steamship Co (P&O Cruises) of Southampton, UK. ABB Industrietechnik's Marine Division in Hamburg supplied the main electrical equipment for the vessel, which is also the fastest cruise liner to have been built in the last 25 years.

The naming ceremony for the *MV Oriana* took place in Southampton on April 6, 1995, in the presence of Queen Elizabeth II. Like so many of the big ships in the past, the *Oriana* has awakened tremendous public interest, and large coverage has been given by the media to many of its outstanding technical features. The vessel, which was built at the Meyer shipyard in Germany, in the world's largest (370 m long) covered dry dock, had its keel laid in mid-March, 1993, and was ready to leave the dock on July 30, 1994.

The *Oriana* left Southampton on its maiden voyage **1** – a cruise that took it to the Canary Islands, Morocco, Gibraltar and Portugal – in April, 1995. Normally, the liner, which has a crew of 760, will carry 1,760 passengers (maximum capacity 1,975) **2**. It has an overall length of 260 meters, a beam of 32.2 meters, and a maximum draught of 7.9 m. With a gross registered tonnage of 69,153, it even surpasses Cunard's *Queen Elisabeth 2* (69,053 grt). This puts the *Oriana* firmly among the

largest passenger vessels operating in the world today. Despite its impressive size, it is able to pass through the Panama Canal.

A superlative ship

The *Oriana* has a top speed of more than 26 knots (approximately 48 km/h), making it the fastest cruise vessel to have been built in the last 25 years. For maximum passenger comfort, cruise ships normally travel at speeds under rather than over 20 knots, so the *Oriana* will only rarely make use of this top speed.

The ship has 13 decks, 11 of them passenger decks. The total number of cabins is 914, more than half (594) of which offer a view (118 have a balcony).

Ingolf Barra

Carola Kuhrau

ABB Industrietechnik AG

There are 8 suites and 16 luxury cabins. Eight of the cabins are specially equipped for handicapped people.

Unlike most other cruise ships, the *Oriana* has been designed to also undertake round-the-world trips.

'MV Oriana' being fitted out at the Meyer ship operating modes. Two ABB shaft generators for the ship's propulsion.



Highest standards of safety

The *MV Oriana* complies with the regulations and stipulations of the important classification societies and supervisory associations (eg, the national requirements for UK-registered 'Class one passenger vessels' (Department of Trans-

port), including the 'Instructions to Surveyors' and 'Merchant Shipping M' notices, and the stipulations of Lloyd's Register of Shipping and the US Coast Guard).

The *Oriana* has also been designed for maximum safety in the event of emergencies. For example, the ship

has seven fire zones and is divided into 16 watertight sections for full compliance with the latest SOLAS fire protection and fire-fighting regulations. In addition, watertight fire-doors are built into the bulkhead deck.

A total of 3,700 fire detectors are installed throughout the ship. Individually

yard in Papenburg, Germany. The vessel's highly flexible hybrid drive system allows five different can be run as drive motors to produce, together with the four main diesel engines, a total of 48,150 kW

1





The 'MV Oriana', P&O Cruises' newest luxury liner, has a grt of 69,153. The ship, which has fin stabilizers and is fully air-conditioned, carries 1,760 passengers and a crew of 760. The top speed of the 260 meters long and 32.2 meters wide vessel is 26 knots.

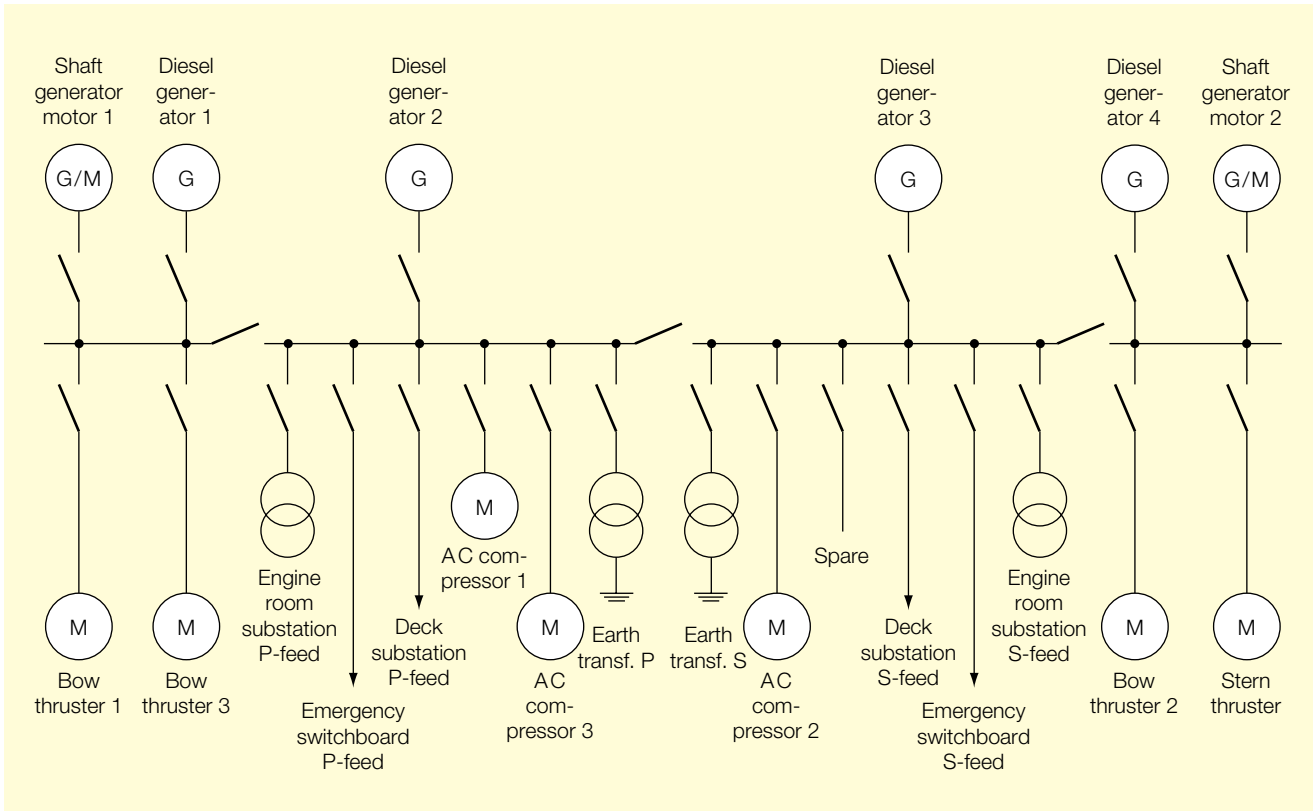
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|--|---|
| 1 The Terrace, with whirlpool | 16 Anderson's club bar |
| 2 Children's play area and paddling pool, next to it Peter Pan's playroom | 17 Monte Carlo Club, casino |
| 3 Pacific Lounge, with stage and dance floor | 18 Curzon Room, saloon with evening entertainment |
| 4 The Oriental Restaurant | 19 Royal Court and Knightsbridge – shopping on two levels |
| 5 The Terrace Bar | 20 Tiffany Court and Bar, top level of an atrium rising over 4 decks, with waterfall |
| 6 The Conservatory, restaurant with outdoor seating | 21 The Riviera Pool, with 2 whirlpools |
| 7 Decibels and Outer Space, teenager's room with video games | 22 The Riviera Bar |
| 8 The Lord's Tavern | 23 Oasis, fitness center with aerobics area, gymnastics room, whirlpools, sauna, massage room, beauty salon, hairdressers and bar |
| 9 Chaplin Cinema | 24 The Crow's Nest, saloon and bar with panoramic view |
| 10 The Crystal Pool | 25 Iberia Room, VIP area next to Crow's Nest |
| 11 Crichton's, for card games, next to it the Thackeray Library | 26 Theater Royal |
| 12 Harlequins Night-Club | |
| 13 The Peninsular Restaurant | |
| 14 Deck games area (tennis, shuffleboard, golf, quoits and clay-pigeon shooting) | |
| 15 Pontoons for easy boarding of tenders | |



One of the two 5.25-MVA shaft generators of type HSG 710 LR6 (IM 1105). The generators, which can also run as motors, driving the shaft train via the gearing, are brushless, self-excited and self-regulating. Self-lubricated journal bearings and freshwater double-pipe coolers are other features of the machines.

3



Single-line diagram of the ship's power supply with the diesel-generator sets and the drives for the bow and stern thrusters

4

addressable, they allow every fire alarm to be precisely located either from the bridge, engine control room or fire protection center. Monitors provide the crew with a good overview of the different sections of the ship and enable relevant information to be accessed quickly. If a fire alarm is not acknowledged within a preset time, a signal is given to begin preprogrammed fire-fighting measures.

Two pontoons built into each side of the ship's hull can be swung out for easy boarding of the tenders. Four automatic gangways are provided for disembarking on land.

Integrated fin stabilizers effectively reduce the ship's rolling motion, with a reduction of 90 percent at a speed of 19 knots claimed by the shipyard.

The *Oriana* is fitted with two four-bladed controllable pitch propellers 5.8 m in diameter, three bow thrusters

and one stern thruster (each rated at 1,500 kW) as well as two spade rudders in the thrust stream. These can be operated either together, using a central joystick, or individually.

Engine room

The *Oriana's* main propulsion system consists of two 11,925-kW and two 7,950-kW four-stroke diesel engines of type MAN B&W L58/64, the former with nine and the latter with six cylinders. The engines, grouped in pairs in a so-called 'father and son' arrangement, act via couplings on gearing which reduces the engine speed from 428 rev/min to 127.6 rev/min for the controllable pitch propellers. Each gear unit is additionally equipped with an ABB shaft generator with which up to 2 x 5,250 kVA of electrical energy can be taken from the main drive in

PTO (power take off) mode. The two synchronous generators are rated at 6,600 V, 60 Hz, for a rotational speed of 1,200 rev/min, and are designed to protection class IP 44 3.

The shaft generators can also be used as motors, being coupled via the gearing in PTI (power take in) mode to the drive shaft. In this case, the electrical power is taken from the auxiliary generators. Thus, five different modes of propulsion are possible:

- Main diesel engine ('father') 2 x 11,925 kW
- Main diesel engine ('son') 2 x 7,950 kW
- Shaft generators as motors 2 x 4,200 kW
- All main diesel engines 39,750 kW
- All main diesel engines plus shaft generators as motors 48,150 kW

5 Four 5.25-MVA diesel-generator sets of type HSG 1120 MM14, rated at 6.6 kV, 60 Hz, work with the two shaft generators to produce electrical energy for the ship's power supply. The total installed generator rating is $6 \times 5,250$ kVA. The machines are brushless, self-excited, self-regulating, and have self-lubricated journal bearings. Freshwater double-pipe coolers are fitted.



The main switchboard (ABB-SACE Univer C) with 30 panels for the ship's 6.6-kV power supply. The compactness of the Univer C switchboard, in which SF₆ puffer circuit-breakers are installed, makes it ideal for use in confined spaces. **6**



The ship's propulsion system employs a version of the highly versatile 'hybrid concept' developed by the Meyer shipyard.

The smaller main diesel engines – the 'sons' – can also be used independently of the propeller system to drive just the shaft generators.

Apart from the two shaft generators, there also are four MAN B&W 5,250-kVA auxiliary diesel-generator sets that provide electrical energy for the ship's power supply. The nominal rotational speed of these four auxiliary sets, which bring the total available generator capacity up to $6 \times 5,250$ kVA **4**, is 514 rev/min. The auxiliary diesel-generators are also equipped with three-phase AC synchronous generators, rated at 6,600 V (60 Hz), from ABB **5**.

Each of the 6.6-kV deck substations with ABB BC3 medium-voltage switchpanels and low-voltage distribution board has two disconnectors for opening the ring network on both sides of damaged equipment or for isolating parts of the network which need to be serviced. A fuse-switch, via which power is fed to the transformers for the low-voltage network, is also included.



A standby generating set with 937-kVA generator (1,800 rev/min) provides back-up in emergencies.

The bow thrusters are driven by three 1,500-kW three-phase induction motors with deep-groove ball bearings and a freshwater double-pipe cooler. Each motor is rated at 6,600 V, 60 Hz (1,187 rev/min). An identical 1,500-kW induction motor is also used to drive the stern thruster. For these machines, ABB has installed two metal-enclosed switchboards with built-in starting transformers, vacuum contactors and programmable controllers.

The compressors for the air-conditioning systems are driven by three three-phase AC induction motors, also from ABB, with self-lubricating journal bearings and freshwater double-pipe coolers.

Compact switchgear

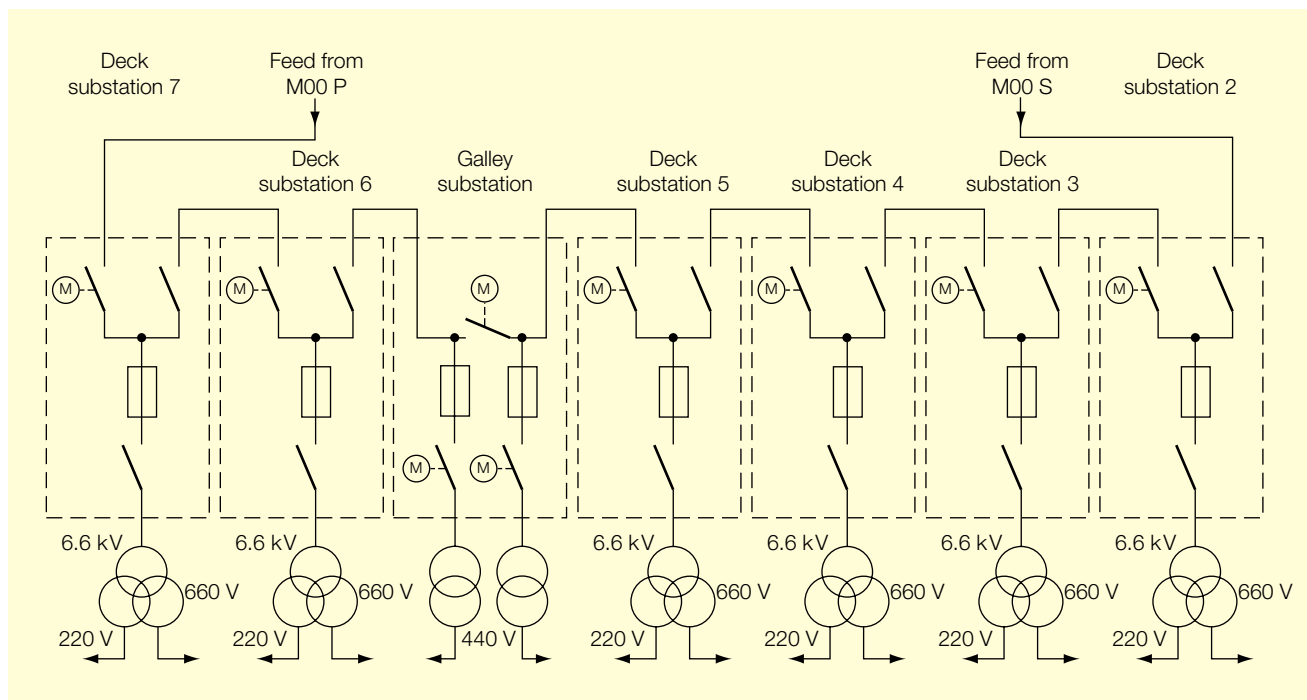
A main switchboard consisting of 30 panels (type ABB-SACE Univer C) **6** distributes the 6.6 kV produced by the four 5.25-MVA diesel-generator sets and the two 5.25-MVA shaft generators. A feature of Univer C switchgear with SF₆-gas puffer circuit-breakers is its compactness, which allows it to be installed in confined spaces. Each of the switchboard panels is divided into metalclad compartments (for the busbars, cable connections, circuit-breaker, voltage transformers and instruments). Interlocks ensure trouble-free switching. Mechanical contact position indicators and inspection windows have been added to ensure maximum safety for the personnel. This type of switchgear is currently in use on many new cruise ships in operation all over the world.

Responsibility for the power supply control lies with Synpol® D, a power management system from ABB's marine division in Hamburg. Its duties include the automatic connection of the thrusters, the air-conditioning plant's compressor and other major power consumers. ABB developed this system especially for power plants on large ships.

Each of the generator control panels contains a Synpol® D unit for controlling and monitoring one diesel-generator set. On the front of each panel is a display that shows all the important operating data, including the voltage, current, power, frequency and power factor. A second display on the panel gives the following information:

- Status of the diesel-generator set
- Measured generator data, eg, rev/min, temperature, etc
- Alarms triggered
- Status of the overall plant

The emergency switchboard consists of nine panels (type MGS). These supply electrical energy to the emergency power supply in the event of the ship's main power supply failing. The emerg-



Single-line diagram of the medium-voltage ring network

8

ency power supply operates at the voltage levels 660 VAC, 440 VAC, 220 VAC, 220 VDC/110 VAC. The standby diesel-generator set is also controlled and monitored by a Synpol® D unit.

A total of seven substations of type BC3 from ABB are installed on the decks **7**. Comprising 24 panels in all, they distribute electrical power in a 6.6-kV ring network. Each of the deck stations has two disconnectors, eg, for opening the ring on both sides of damaged equipment, or for isolating parts of the network on which service work has to be carried out. Each station also has a fuse-switch over which the transformers for the low-voltage network are supplied with power **8**.

Another seven substations, of type MGS, are installed on the decks for the low-voltage distribution. With a total of 30 panels, they supply power to all the LV loads at voltage levels of 660 VAC, 440 VAC, 220 VAC, 220 VDC and 110 VAC. All of these loads are protected by type ABB-SACE moulded-case circuit-breakers and miniature circuit-breakers.

The transformers for the different voltage levels are integrated in the switchboards.

ABB also supplied 11 Resibloc high-voltage transformers rated at 1,000 to 1,500 kVA. These very rugged transformers have glass fiber-reinforced insulation and are built to IEC 726. For a primary voltage rating of 6.6 kV, the secondary voltages are 660, 440 and 220 V. In addition, ABB supplied various low-voltage transformers rated at 220 and 110 V.

All of the installed plant and equipment complies with the requirements of Lloyd's Register of Shipping and satisfies the 100 A1 'Passenger Ship' LMC, CCS regulations.

References

- [1] K. Nienaber: Kreuzfahrtschiff 'Oriana'. HANSA 132 (1995) 4, 22–32.
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- [3] Meyer Werft: P&O 'Oriana'. Brochure 1995.

Authors' address

Ingolf Barra
 Carola Kuhrau
 ABB Industrietechnik AG
 Marine Division
 Kieler Strasse 131
 D-22769 Hamburg
 Germany
 Telefax: +49 40 85345 407