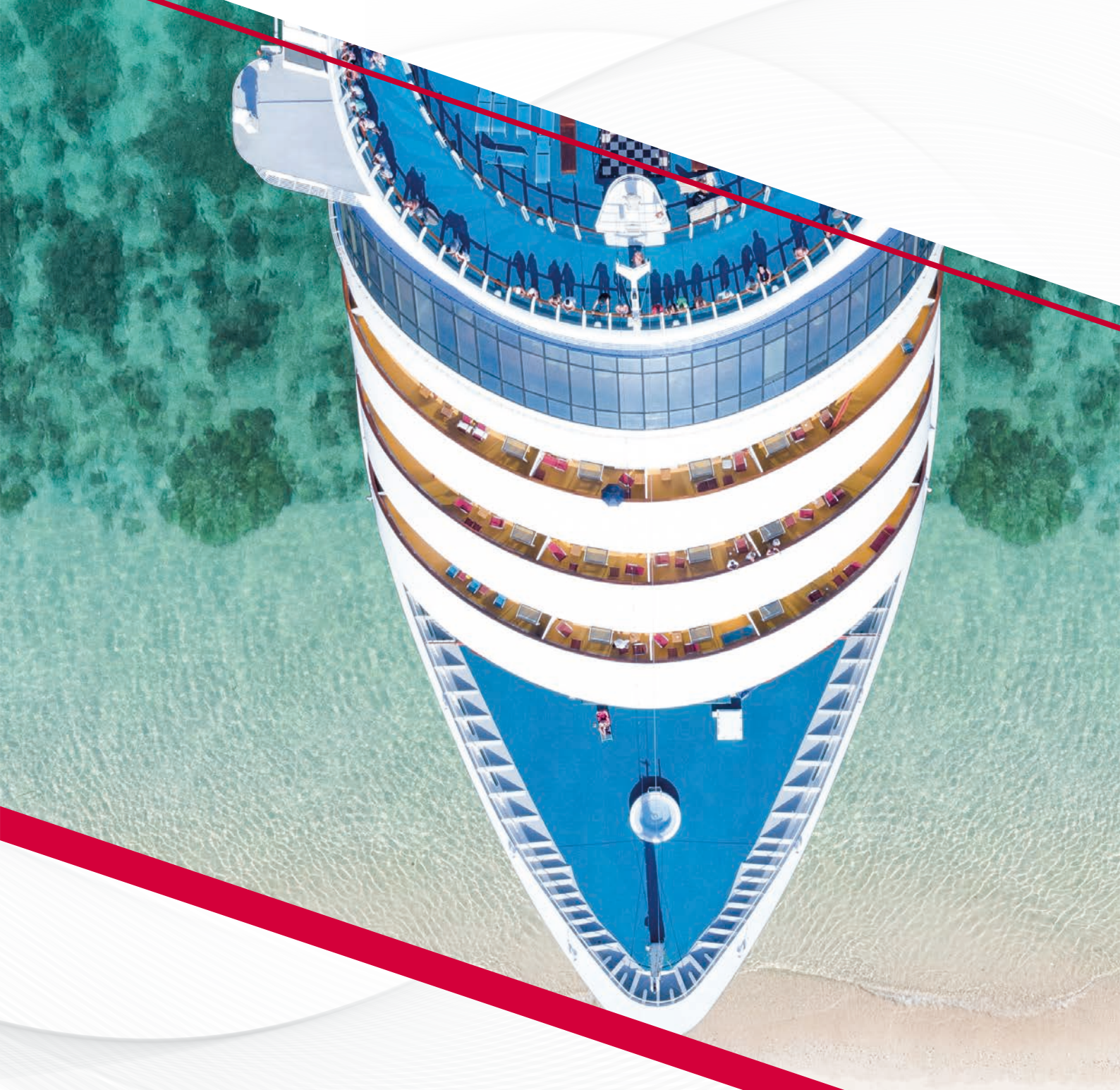


INGEGRID™ Shore Power Converter

LOW/MEDIUM VOLTAGE — WATER COOLED

1 MVA up to 16MVA

INGEGRID™ Shore Power

Shore to ship connection

SFCs in Shore to Ship applications

European and world-wide legislation is evolving into more respectful politics that increasingly request **emissions cutting in harbors**.

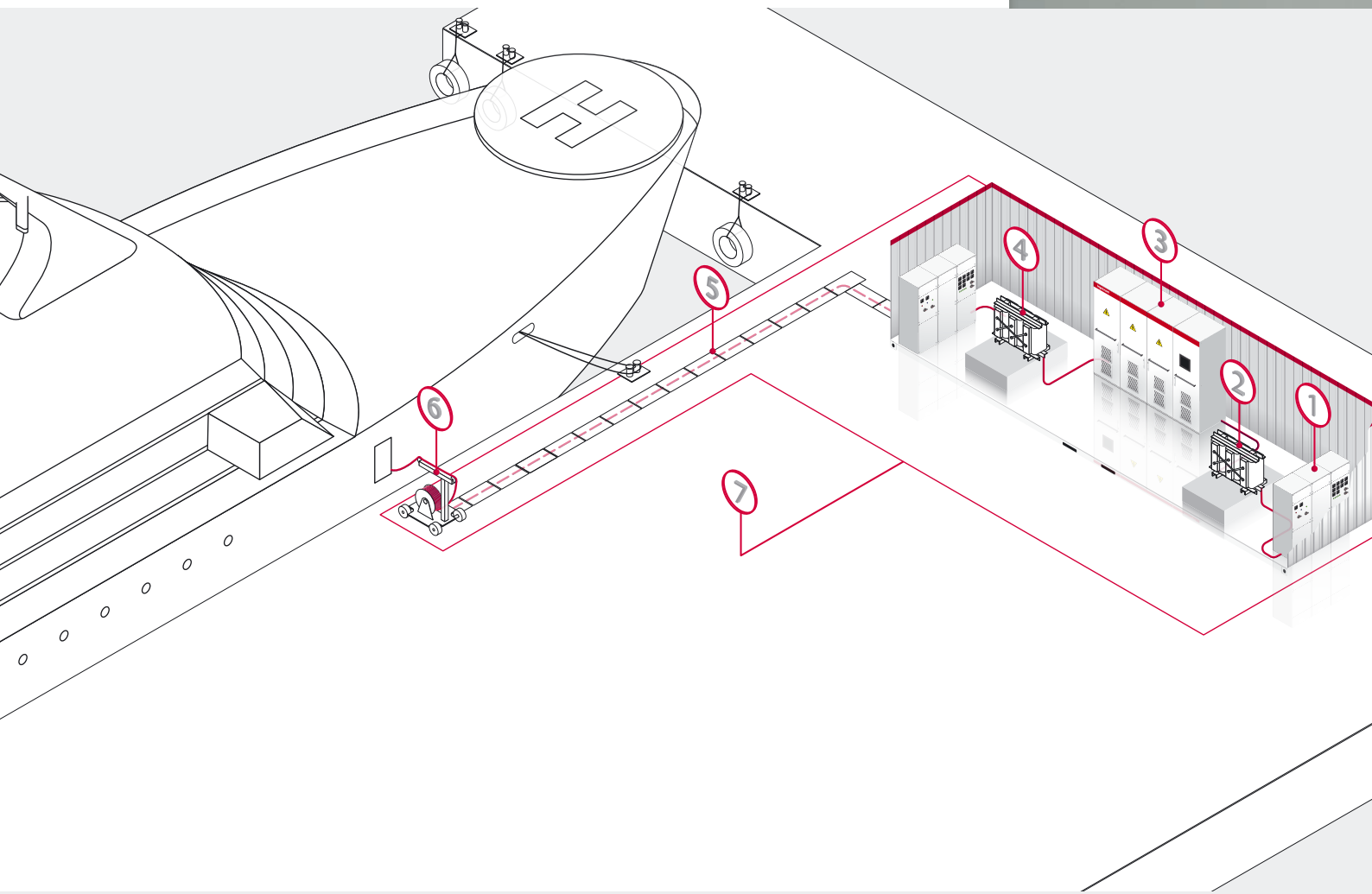
One way of aspiring to a **zero-emission reality in ports** is to prevent vessels and ships of using their motors and diesel generators whenever they are in port-side area. This is only achievable by supplying them with **alternative power sources** that stem from renewable generation.

SFCs in **Shore Connections** act as **charging-stations** for electric-powered (or more currently common hybrid-powered) ships. When these ships arrive to the port, they can connect through a **Feeding Terminal** to the **Substation** where the **Frequency Converter**, and the rest of components are allocated.

At Ingeteam we supply solutions for both the connection from the **substation to the ship**, and also internally in the **ship power distribution**.

Our **INGEGRID™** Variable Frequency Drives are vastly used in the marine industry, where we have supplied **more than 2.5 GW** in **Variable Frequency Drive**s for marine applications

1. Grid side switchgear. I **2.** Grid side transformer. I **3.** Converter 50Hz to 60 Hz. I **4.**Shore side transformer. I **5.** Shore side switchgear. I **6.** Shore side cable management system. I **7.** Protection, control and safety.



Containerized solutions for ports up to 16MVA

SFC Features

- Containerized, portable and scalable
- Power management & remote control
- Fully customizable for each case and opportunity
- European quality standards

SFC Benefits

- Long life cycle with standardised service
- Total flexibility and quick operation
- Green solution for ports
- Safety, quality and performance

What is a SFC?

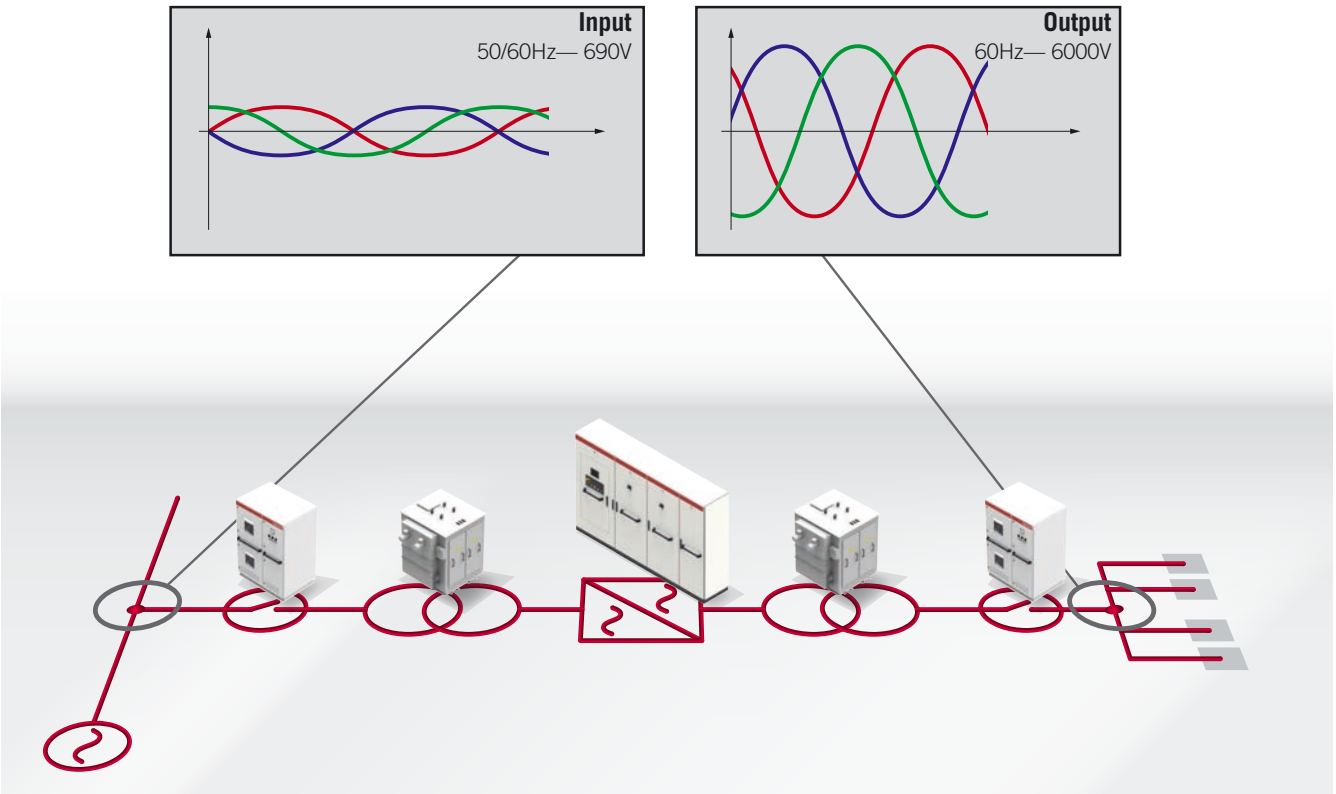
A **Shore Converter** is a type of **Static Frequency Converter** (a variable frequency drive) connected to two non-mechanical ends, which means, there is no motor or generator connected to the output of the converter.

It helps to change fixed grid power through **AC** to **AC** by inner electronic parts function, and is divided, as any conventional frequency drive, by a **rectifier**, a **dc-link** and an **inverter**.

Generally, it is used to modify the frequency between to different power sources. Most common sectors of application are **marine ports**, **traction railways** and **industrial factories**.

Especially in the marine industry, there are many names for which the SFCs are referred: **Shore to Ship, Cold Ironing, Dual Frequency Converter, On-Shore Power Supply, 50 Hz to 60 Hz Converter, Shore Power Supply, Frequency Changer, Shore box** …

In essence, independent to the naming, the application is the same, and although several configurations and possibilities can be developed, the main objective is to supply power between to grids that have different properties.



How does a Static Frequency Converter work?

Static Frequency Converters (SFCs) are Variable Frequency Drives (VFDs) that have the objective of switching the incoming frequency of the grid (i.e. 50 Hz), to the frequency requested by the end application (i.e. 60 Hz internal grid in a vessel).

The solution implies firstly an Input Switchgear that is connected to a Step-Down Rectifier Transformer, which varies the voltage from the grid primary (i.e. 20 kV), to the service voltage of the Variable Frequency Drive.

This Variable Frequency Drive is at the same time connected to an Output Transformer (normally step-up), which converts the voltage to the required one by the end application, that is finally protected by an Output Switchgear.

Converters, Switchgears, and even Transformers can be integrated inside of Electric Rooms/Electric Containers, that are portable and installable in the point where this frequency conversion needs to be performed.

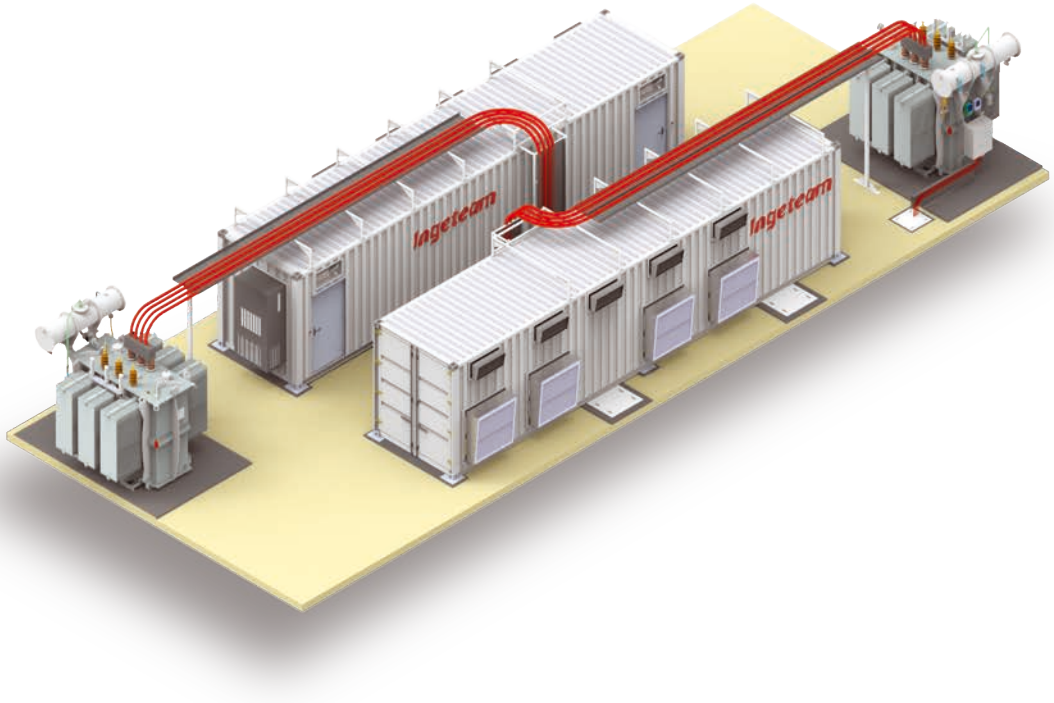
Control System

The Control System is based in state-of-art platforms, including an HMI for the monitoring included in the converter, with a synchronized system for a consistent and aligned operation of the application.

The connection interface can include many Communication Protocols (Ethernet TCP/IP, Modbus TCP, Profinet, etc.).

The remote control of the converter is possible thanks to the **WebApp Application**, offering communication between the drive, application and the service engineer, which is accessible 24/7, uses encryption and data access protection to ensure safety, and provides utilities as audio & video or file transfer.

WebApp Application is a comprehensive troubleshooting tool, with different accessible menus to configure the equipment, record fault-finding registers or visualize event logs, alarms, trips, etc., through a service-oriented approach, intuitive operation and easy use.



INGEGRID™ Shore Power

Shore to ship connection

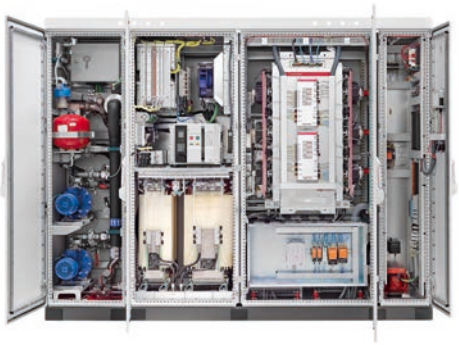
Low Voltage solution

Containerized Up to 10MVA

Low voltage (600V) water-cooled converter with active front end rectifier inside a **20 feet HC ISO electric container**, and equiped with LC filter and main circuit breaker input and sinusoidal filter output.

2.5 MVA power steps up to 10 MVA

INGEDRIVE LV 800



INGEGRID SC

INGEGRID

Medium Voltage solution

4 MVA power steps up to 16 MVA

Containerized up to 16MVA

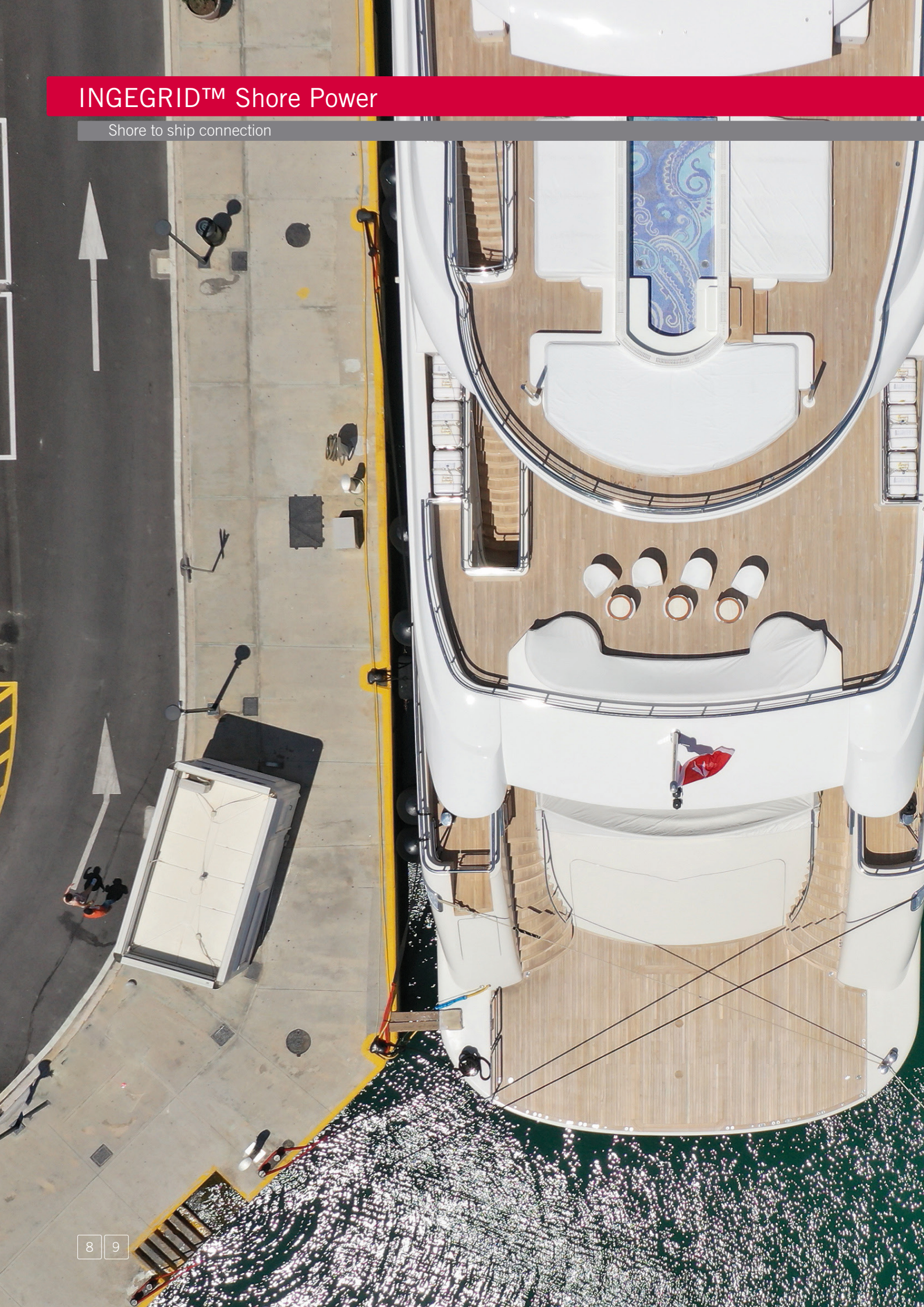
Medium voltage (3.0kV) water-cooled converter with active front end rectifier inside a **20 feet HC ISO electric container**, and equiped with LC filter and main circuit breaker input and sinusoidal filter output.

INGEDRIVE MV 100

INGEGRID SC

INGEGRID™ Shore Power

Shore to ship connection



Why Ingeteam?

flexible + customized

One of Ingeteam's cornerstones and hallmarks by which our clients recognise us is our flexibility and ability to customise our products, services and solutions which, together with the high standards of quality in our products, make INGEGRID a leading reference in the major sectors where we are present.

Flexibility: Adapting ourselves to design requirements, adapting our products to specific applications, offering flexible service and support whenever and wherever our clients need it.

Customization, taking the main element of any INGEGRID™ equipment which is the BPM (Basic Power Module) or power module. Ingeteam's design and engineering department adapts the final product to comply with each client's specific requirements, without compromising reliability or robustness and increasing usability and optimisation for each application. We not only manufacture devices but also personalise them to offer the best solution in a wide range of sectors including the marine sector, industry, mining, and oil & gas. Perhaps this is why over 90% of our clients rate us as being flexible and as providing highly-customizable solutions. These two cornerstones are complemented with demanding quality standards which all of our products are subjected to, allowing Ingeteam to offer:

More than 45 years' experience in power converters

Over 45 years' experience in power electronics for applications in a wide range of sectors including energy generation, industry, mining and the marine sector have created an extensive, solid knowledge base. This enables our design and engineering department to advise our clients on the best option and adapt equipment and software to each particular application, thus offering custom-made solutions.

Load tests of all equipment at rated current

With the aim of including the latest advances in power electronics in INGEGRID™ equipment, Ingeteam boasts the largest power electronics laboratory in southern Europe and one of the biggest in the world. The testing and validating facilities cover a surface area of 13.000 m2 with a capacity for testing equipment over 40MVA and with voltages up to 6.6 kV and a team of international engineers and researchers.

Hence, Ingeteam offers combined or specific tests, besides the routine tests carried out on all INGEGRID™ equipment.

Manufactured 100% in Europe

Ingeteam designs and manufactures the entire INGEGRID™ range in its logistics and manufacturing centres in Europe. Ingeteam always works with mainly european leading brands and directly controls the entire manufacturing process to thus ensure the final quality of its products.

Hence, the flexibility, development capacity, customisation and quality of our products are key points which make our clients consider us as technological partners..

CRS 360° CUSTOMER RELATIONSHIP SERVICE

CRS360º Support

In our commitment to offering our clients complete and personalised solutions, Ingeteam offers a 360º CRS (Customer Relationship Service) with all of our product range, providing you with comprehensive consultancy, direct technical support, training and maintenance services throughout the lifetime of our products.

360º CRS is a dynamic, personalised service that covers all of stages and contact points between Ingeteam and our clients. The 360º CRS programme is supported by a professional technical team whose goal is client satisfaction and continuous improvement of products and services, always hand in hand with the latest advances and technologies in each application sector.

The following services are part of the 360º CRS programme

Support with technicians and engineers. Direct access to design engineers and R+D

During the warranty period, in the event of an incident, Ingeteam guarantees assistance with key technicians and engineers providing advice and high-quality support to our clients.

Additionally, Ingeteam offers its clients the option to extend out-of hours customer support services provided by the Ingedrive technical support team by means of customized contracts to suit the needs of our clients.

25-year life cycle incl. service + spares

Ingeteam guarantees the repair service of the entire INGEGRID™ family for a period of 25 years after the date of purchase of our equipment.

Remote Access

INGEGRID™ products are ready to be monitored remotely which enables Ingeteam's technical team to offer our clients the option to track and analyse any incident in a device remotely.

Commissioning

The commissioning of INGGRID™ equipment is carried out by highly-qualified, multidisciplinary staff with experience in a wide range of sectors, to ensure your installation has best adaptation and best performance. This, together with the fact that devices leave the factory having been completely tested and verified, makes the commissioning time considerably shorter.

Spare Parts Stock

Ingeteam has designed the INGEGRID™ range based on the concept of power stacks. This enables us to have a permanent stock of main converter components in our logistical and manufacturing centres, reducing the supply times for immediately attending to potential emergencies to a minimum.

Repairs [Field Service]

Anytime, anywhere. The aim of INGEGRID™ Support is to minimise the impact of a potential stoppage or incident in our devices.

Technical Support and Engineering

Ingeteam offers its clients pre-sales technical and engineering support in order to provide assistance and advice during the initial stages and from the project definition to the commissioning of our equipment and delivery of our installations.

Training [Training Centre]

Ingeteam's team of course leaders offers comprehensive, customized theory and practical programmes to meet the training requirements of its clients.

Ingeteam has a specific area for providing theory and practical classes where we have specific material and converters with different topologies from the entire INGEGRID™ range. The different options can be summarised in two levels in which the subject content and depth of learning is adapted to the student and to the aim of the course.

- User Level Course:
  Explains maintenance and troubleshooting Aimed at users and end users.
- Expert Level Course :
  Aimed at equipment commissioning engineers. Suitable for integrators.

www.ingeteam.com

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