



# SAMCon

## Shore Connection System On-shore and Onboard



**Emission-free Power Supply**



**SAM  
Electronics**

an  communications company

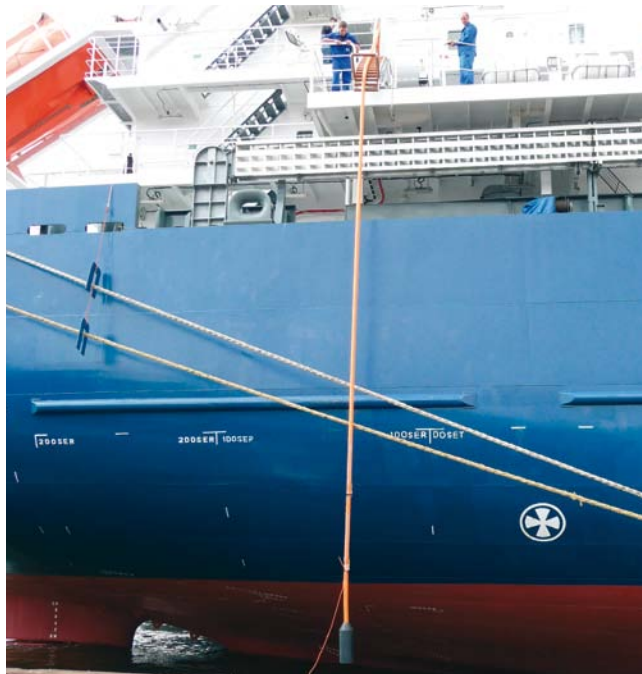
# SAMCon

## On-shore Power Supply System (OPS)



Opening ceremony March 2009 at ICL Terminal Antwerp

Lowering the HV-plug



There is increasing pressure on shipping operators and port authorities worldwide to improve air quality in ports. One solution to reduce emission in ports is using onshore power supply systems (OPS). While staying in port OPS, also known as AMP (Alternative Marine Power), reduces air emissions such as nitrogen oxides (NOx), sulphur oxides (SOx) and diesel fine particulate matter (PM) by switching of the fuel driven power generators on board.

For the OPS program SAM has developed a modular shore connection system called **SAMCon**. It provides all necessary components on board as well as the equipment on shore.

Most of the international operating vessels calling ports in Europe, Far East and America are equipped with 60 Hz power supply systems. Against this European harbors are equipped with 50 Hz power grids. This doesn't match!

**SAMCon** provides solutions to allow vessels to be connected to shore by using frequency conversion to adapt the different type of vessels to shore regardless of the local grid frequency.

**SAMCon** consist of key components like, state-of-the-art switchgears, low loss frequency converters and power transformers, control and protection systems on shore as well as the equipment needed on board of the vessel to plug in at shore.

Due to the different design of ships SAM has developed various solutions in the last years.

In practical operation these systems allows a shore powers supply of the vessel with easy plug in connections. These connections are customized to the demands of the ships to meet the latest IEC standards.

What are the benefits of the system? Customized solutions due to modular system design enables the system to be integrated in different type of ships either for retrofit or new building. Beside the before mentioned items and emission reduction OPS reduces noise in port and on the ship. Furthermore it is possible to do maintenance on diesel engines while at berth.

### Electrical key data

- Power up to 7,5 MVA
- Voltage up to 12kV
- Frequency 50/60 Hz conversion



*Preparation of connection*



*Socket station with connected HV-plug*

# SAMCon

## Single Component Solution



Cable reel with swung out cable guide

Ships management  
and control cabinet



The **SAMCon** system consists of several modules as there are:

### Cable reel [SCS-CR] including

- Medium voltage cable including fibre optic-, control cable and protective earth
- Plug, incl. power-, control- and fibre optic cable contacts for shore connection according to standards required by individual ports
- Cable management system
- Electric or hydraulic drive for the cable reel, depending on the application
- Usable cable length up to 80m, customized solutions available

### Cable reel control box [SCS-OC]

- For control and monitoring of reel and auxiliaries.

### Management and control cabinet [SCS-MC]

- Interface for safety interlocks between shore and ship installation
- Communication between ship and shore, scope of information to be exchanged according to individual port specifications
- Interface to ship automation system

# Container Solution

## Container solution [SCS-C20/40]

For retrofitting of existing vessels SAM is providing container solutions as well as single components for installation on board. Due to the use of 20" standard containers, a flexible location on board is possible. On request or depending on the project, a solution with 40" container is also available.

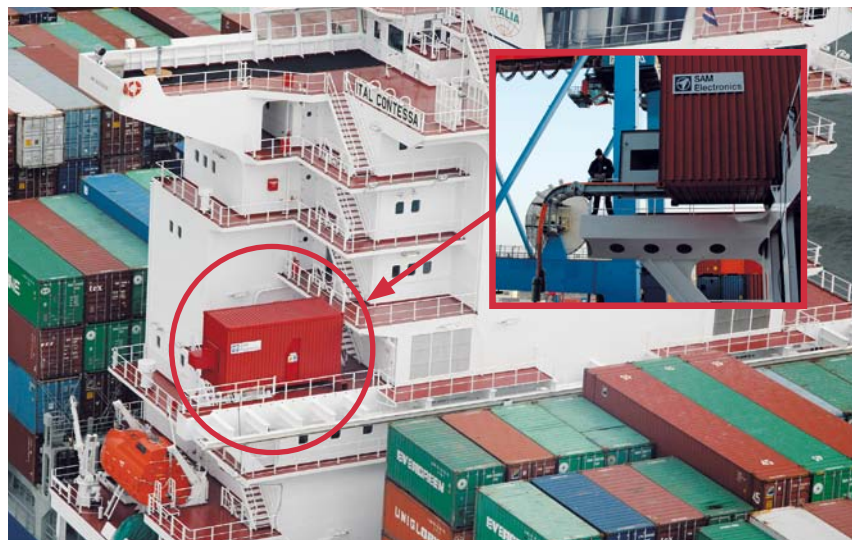
For low voltage applications we are offering a solution with step-down transformer (SCS-TR). The components are either installed in different locations on board or combined in a container.

Typically, the following equipment is installed in a container:

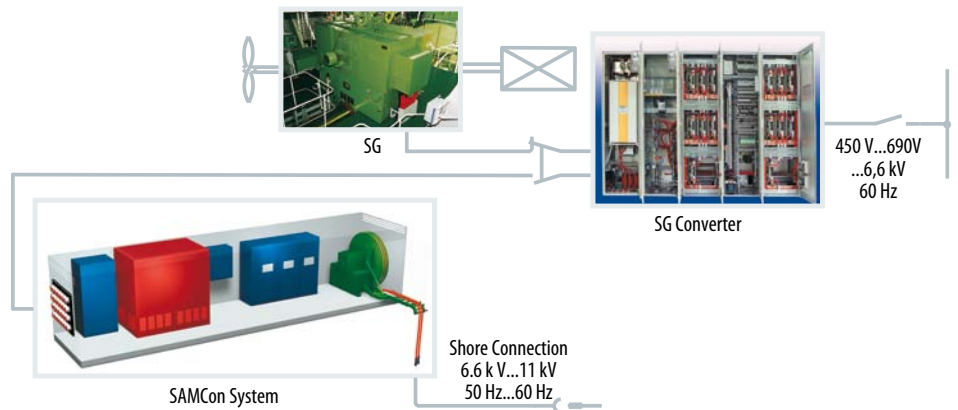
- Cable reel [SCS-CR]
- Cable reel control box [SCS-OC]
- Management and control cabinet [SCS-MC]
- Medium voltage switchboard [SCS-SBD]
- Transformer [SCS-TR]

## Solution for Vessels with shaft generator system

For vessels having a SAM Shaft generator system installed on board we are offering a retrofit using the main components of the installed shaft generator. Instead of feeding the system by the shaft generator we are extending the system with a shore connection system.



Container solution



Installation proposal

# SAMCon

## On-shore Solution

At the beginning of 2009, the SAM project team was able to realise the first complete onshore power supply system, supplying container ships with electrical energy from shore, converted from 50Hz to 60 Hz, in Antwerp ( Belgium).

The on shore 50Hz/60Hz frequency converter is fed from the 15.5kV utility network via circuit breaker and step-down transformer (15.5kV / 690V).

The frequency converter is based on a platform of SAM standard PWM inverter systems (pulse width modulation) with IGBT modules (Insulated Gate Bipolar Transistor) connected to a three-phase bridge unit. Several units are connected in parallel according to the demanded power. Each individual inverter bridge unit is fitted with downstream LC-filter, serial connected reactor and capacitor. As a result of this filter, the output voltage curve is almost sinusoidal, the voltage harmonics are reduced to < 5%. This avoids heat losses and electrical interferences.

*Frequency Converter and switchboard at terminal*



The IGBT's are operating in a 3 kHz pulse frequency mode. To achieve the requested voltage and frequency output the controller changes the pulse width accordingly. Because of the specifically designed IGBT modules (integral freewheeling diodes, anti-parallel arrangement), the PWM inverter is able to supply reactive power into the mains grid.

*Transformer at terminal*



In case of a short circuit, the frequency converter will supply 3 times rated current over a period of 500ms. Automatic frequency and voltage adjustment for load sharing, active and reactive power are provided.

The IGBT's of the converter are watercooled by a closed loop cooling system. The appropriate water pump is installed in the converter panel and a fan cooled heat exchanger (water/air) is located out site the switch board room.

The essential control voltage for the converter, the PLC's power supply (programmable logic controller) and the switchboard control voltage are powered by a UPS unit (uninterruptible power supply). In case of utility voltage drop, the converter will either stay on continuous working operation or will shut down safely, dependent on the dropping duration.

The shore supply and converter systems are controlled by two microprocessor units. One unit belongs to the converter, the other PLC unit belongs to the control cabinet on ship side. The PLC's are connected via fibre optic core, which is integral part of the power cable. They are electrically connected after plug-in.

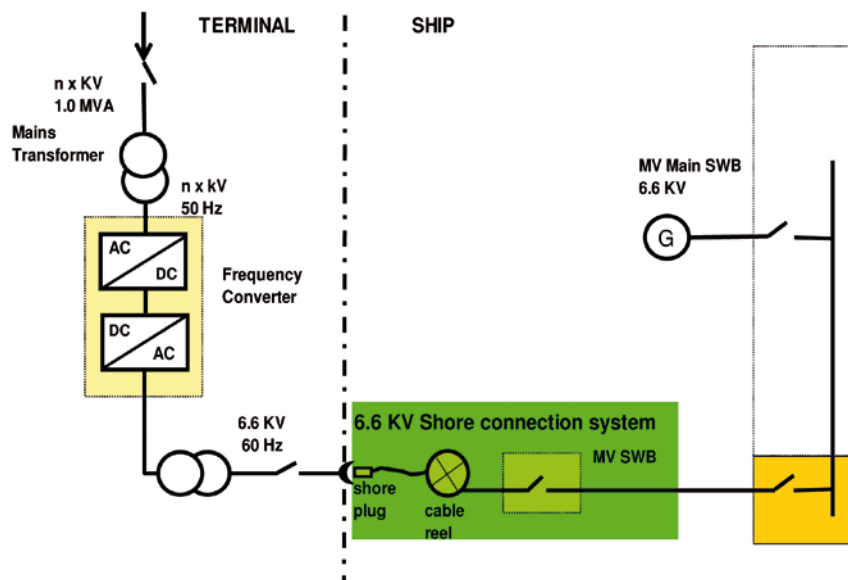
These units ensure correct control conditions under all operating circumstances and monitor all system related functions and malfunctions. All necessary conditions are monitored and displayed on shore and ship during start sequence and system operation, e.g.:

- Safety conditions
- Inverter protection systems
- Operation status
- Failure status, etc.

Abnormal conditions (disturbances, faults) will stop automatically the system during the start-up sequence and operating period.

Fault and/ or stop signals will automatically exchange between the two PLC's. Fault identification and monitoring/ displaying are available on both PLC's.

Different test modes are provided for full shore system check (receptacle to converter) without the need of shore power connected vessel.



Principle diagram of OPS-systems



Inner view of the converter at the terminal

# SAMCon

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