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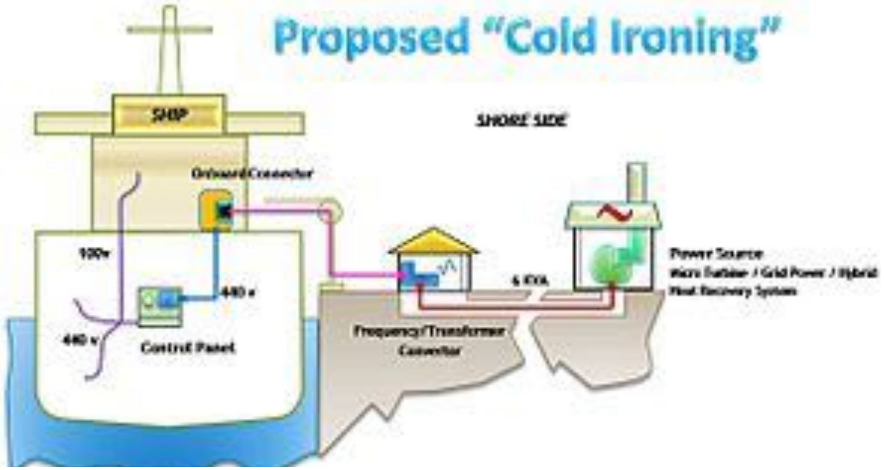
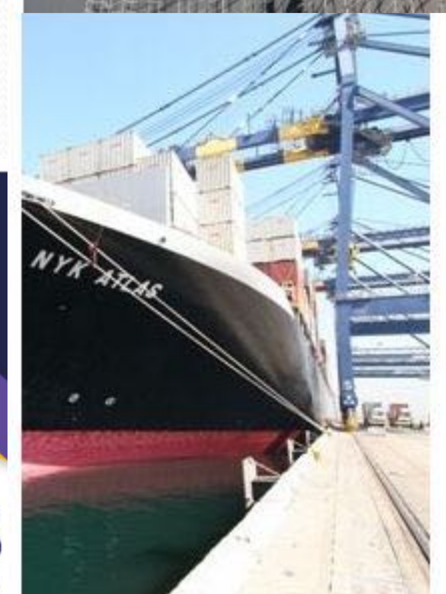
Powering zero – emission marine transpotation



Theodore Kontes

President



Lloyd's Register

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2018 CONFERENCE

elemed

www.elemedproject.eu

27 FEBRUARY 2018

STAVROS NIARCHOS FOUNDATION CULTURAL CENTER, LIGHTHOUSE

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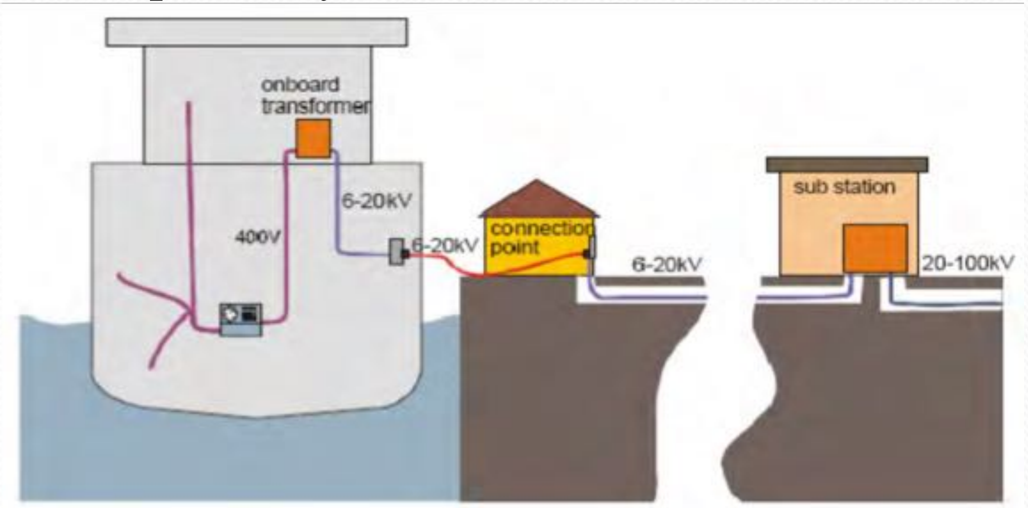
STATISTICS OF COLD IRONING BENEFITS

- World trading fleet stands at more than 50.000 merchant ships.
- Each ship spends some 100 days in port yearly.
- For every 1 KWh of electricity about 200 gr of bunker fuel is consumed.
- Each 1 Kg of bunker oil generates 3.1 Kg of Carbon dioxide.
- Assessed that globally ships use 411,223,484 tones of fuel annually.
- The ports of Halifax / Brookline have install cold Ironing for one cruise ship berth at a cost each 10 Mill $ and 20 Mill $ respectively.



PORTS USING OPS SYSTEM

Port	Country	High Voltage	Low voltage	Frequency
Antwerp	Belgium	6.6 kV		50 Hz/60 Hz
Goteborg	Sweden	6.6 kV/10 kV	400 V	50 Hz
Helsingborg	Sweden		400 V/440 V	50 Hz
Stockholm	Sweden		400 V/690 V	50 HzV
Piteå	Sweden	6 kV		50 Hz
Kemi	Finland	6.6 kV		50 Hz
Oulu	Finland	6.6 kV		50 Hz
Kotka	Finland	6.6 kV		50 Hz
Lübeck	Germany	6.6 kV		50 Hz
Zeebrugge	Belgium	6.6kV		50 Hz
Los Angeles	U.S.A	6.6 kV/11 kV		60 Hz
Long Beach	U.S.A	6.6 kV	480 V	60 Hz
San Francisco	U.S.A	6.6 kV/11 kV		60 Hz
San Diego	U.S.A	6.6 kV/11 kV		60 Hz
Seatlle	U.S.A	6.6 kV/11 kV		60 Hz
Juneau	U.S.A	6.6 kV/11 kV		60 Hz
Pittsburg	U.S.A		440 V	60 Hz
Vancouver	Canada			
Oslo	Norway	6.6kv		50Hz
Rotterdam	Netherlands	6.6kv		50Hz

Recent developments

-the Port of Le Havre (France)

-the Port of Marseille (France)

-the Port of Civitavecchia (Italy)

OPERATIONAL COSTS / SAVINGS

- Savings auxiliary engines fuels.
- Savings maintenance costs.
- Costs electricity charges and taxes.
- Cost about 0,05 € per KWh. Taxes in Europe up to 0,03 € / KWh.
- Costs of standing charges. This is a fixed charge depending on max power consumption i.e. Amsterdam for cruiser 300.000 – 400.000 Euros.
- Fuel cost benefit depends on legislation.
- Less maintenance of auxiliary engines.
- Optimizing cost effectiveness of ops.
  - ✓ Greater number of hours an ops system.
  - ✓ May lower est. invest cost by 10 – 30 % if no frequency converted needed.
  - ✓ Lower invest cost if high voltage power.
  - ✓ By reducing on board power consumption.

ENVIROMENTAL SHIPS CALCULATIONS INDEX

The ESI identifies seagoing ships performing better in reducing air emissions. The ESI evaluates the amount of NOX, and SOX emitted by a ship, including a report scheme on the green house gas emission. ESI is a perfect indicator identifying cleaner ships.

ESI will promote clean ships, used by shippers and ship owners provide a total score which appearing in the ship details. ESI may adapted to IMO approach frame work for environmental protection and considering priorities of ports due to environmental performance of ships and ports promote. Scores may change from port to port. Who knows eventually may apply to lower costs for port costs involved.

Example:

Nitrogen oxides ESI NOx

	Main engine(s)	Auxiliary engine(s)	
NOx Limit Value	17	11.5	g/kWh
NOx Rating	15	11	g/kWh
Δ Emission	2	0.5	
Rated Power	9480	970	kW
Number of engines	1	3	

Calculation of the NOx sub points **{(17 – 15) x 9480/17 + (11.5 – 11) x 970 x 3/11.5} x 1/(9480 + 970 x 3) x 100 = 1241 x 0.008 = 10.0**

This results in an ESI NOx of **(10 x 2)/3 = 6.67**

Sulphur oxides ESI SOx

The average sulphur content of the different fuels is extracted from the bunker delivery notes. The average for the respective fuels is the weighted average over all bunkers.

	HIGH	MID	LOW	
Baseline	3.50	0.50	0.10	% S (m/m)
Actual	2.00	0.40	0.05	% S (m/m)

For the different fuels, the relative improvement compared to the baselines is calculated; see also 'ESI formulas' and 'IMO annex regulations and ESI baselines'

Calculation of the SOx sub points **(3.50 - 2.00) / (3.5 – 0.5) x 30 + (0.50 - 0.40) / (0.5 - 0.1) x 35 + (0.10 - 0.05) / (0.1 - 0.0) x 35 = 15.0 + 8.75 + 17.5 = 41.25**

The resulting ESI SOx is **41.25/3 = 13.75**

Energy Efficiency operational indicator ESI CO2

Reporting every six months of fuel consume, distance give an ESI CO2 of 5 Total ESI score of 6.67+13.75+5=25.42

NOTE: As per MARPOL Annex VI Sulphur limnit in Fuel. The limit value of sulphur content for fuel used at High Seas (HFO – HIGH) changed to 3,5 % on 1/Jan 2012, the limit value for fuel used in SOX – ECA (MDO / Gas oil – LOW) changed to 0,10 % on 1/Jan 2015 From 1/1/2015 the percentage 3,5 / 0,5 / 0,10 are the base lines for fuels categories characterized HIGH / MID / LOW.

VARYING ELECTRICAL FREQUENCIES

Electrical frequencies also differ among vessels categories and sizes.

European ports tend to have more 60 Hz electrical systems on board. While smaller vessels have 50 Hz system. Therefore systems are not always interoperable.

At the moment systems across the world are not interoperable differing on voltage, frequency, and structural design. Lack of standardization and difference in North America (60 Hz) and Europe / Asia (50 Hz).

Also voltage levels differ in
First generation OPS system
standard since it is easier in
OPS and less installation co
for high powers. Cruise term
in Juneau, Vancouver, Seattl
and shortly in Los Angeles c
11 KV and 6.6 KV to cruise

Vessel type	50 Hz	60 Hz
Container vessels (< 140 m)	63 %	37 %
Container vessels (> 140 m)	6 %	94 %
Container vessels (total)	26 %	74 %
RoRo- and vehicle vessels	30 %	70 %
Oil and product tankers	20 %	80 %
Cruise ships (< 200 m)	36 %	64 %
Cruise ships (< 200 m)	--	100 %
Cruise ships (total)	17 %	83 %

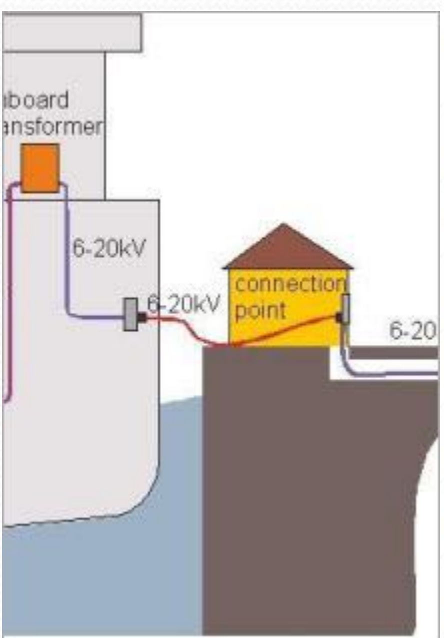
POWER REQUIREMENTS AT BERTH

Power required for OPS system of various vessel types and sizes are presented bellow.

The smaller vessels are represent ships operating in European waters, or apply to other regions.

Power requirements have a significant impact on the costs of an OPS system.

Need to pursue energy reduction options and assess peak power demand in advance.



Vessel type	Average power demand (kW)	Peak power demand (kW)	Peak power demand for 95 % of vessels (kW)
Container vessels (< 140 m)	170	1000	800
Container vessels (> 140 m)	1200	8000	5000
Container vessels (total)	800	2000	4000
RoRo- and vehicle vessels	1500	2000	1800
Oil and product tankers	1400	2700	2500
Cruise ships (< 200 m)	4100	7300	6700
Cruise ships (< 200 m)	7500	11000	9500

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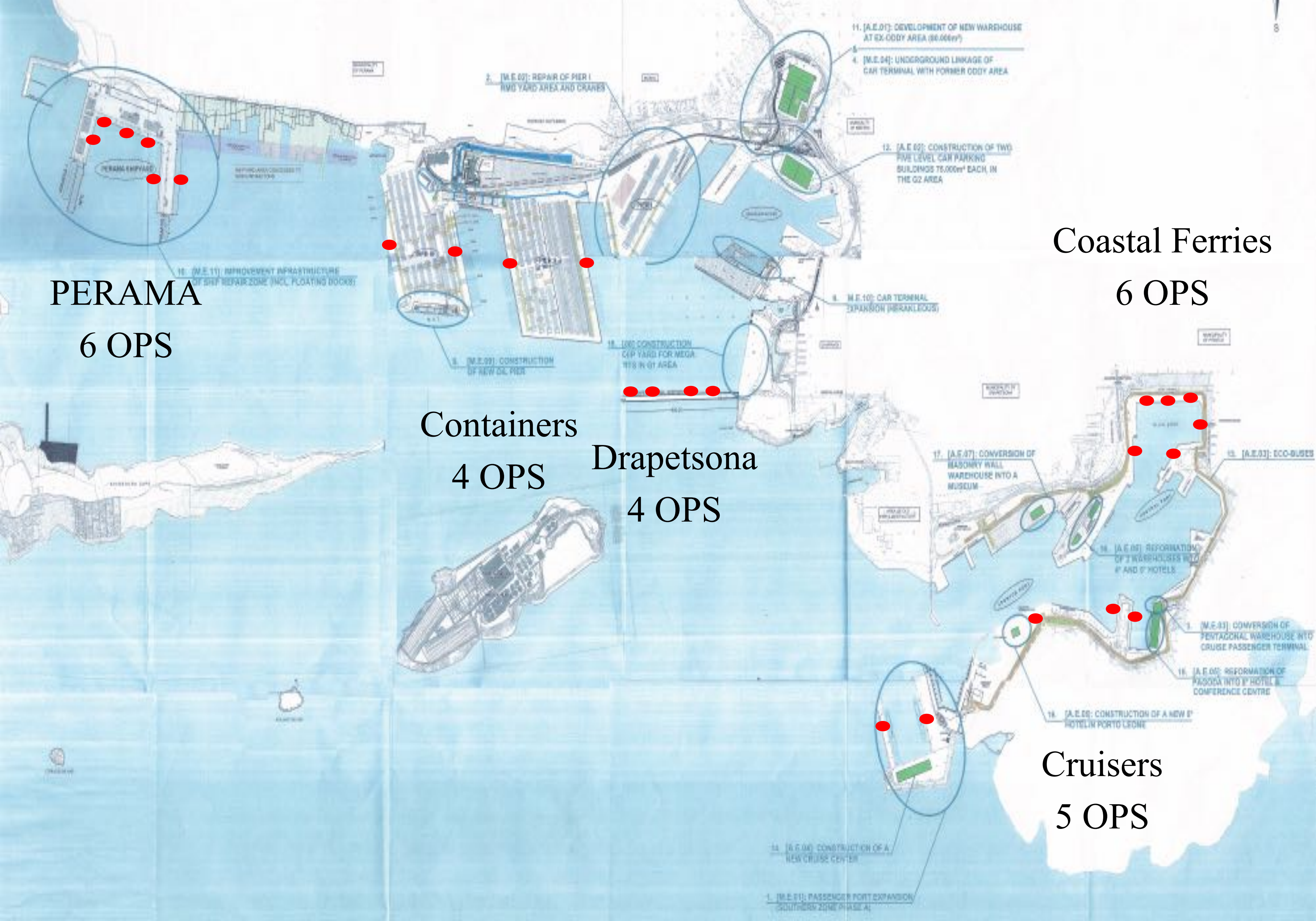
CRUISE VESSELS COLD IRONING APPLICATIONS

- Cold Ironing application in cities harbors provide free emissions energy keeping clean the air environment..
- In order to maintain clean environment (air) in harbors and have valid benefit need to examine the source of energy provided, the type of power generation (wind, LNG, solar e.t.c.) as well as the distance transferring to the cold ironing port.
- Complication of energy / power provided due to type of electrical installation on board and power required. Varying electrical frequencies, power requirements at berth.
- Cold ironing application for cruise vessels is recommended only in long stay destinations (Main harbors) HOMEPORTING and Lay up berths as well as Hotel accommodation.
- In transit destination and mainly in the islands Cold Ironing application is not recommended due to short stay of cruisers, anchorage several times and depending on power and type of energy provided.
- Connectors and Cables are not Internationally standardized.

PIRAEUS HARBOR OPS SYSTEM PROPOSAL



ELEMED POWERING ZERO-EMISSION

Spot article

The ship owners perspective.

The success of shore side power depends on the attitudes of parties on the land side as well as ship owners.

Several ship owners have already invested in ops technology on board their vessels.

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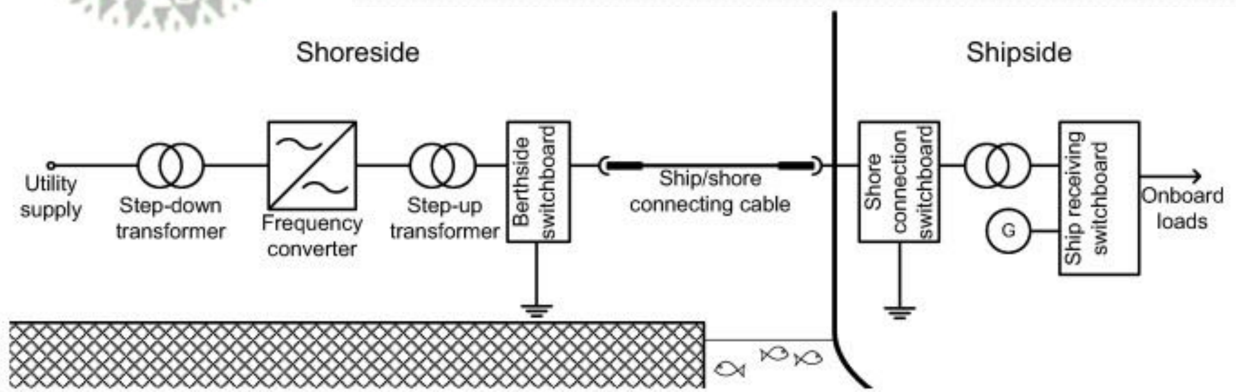

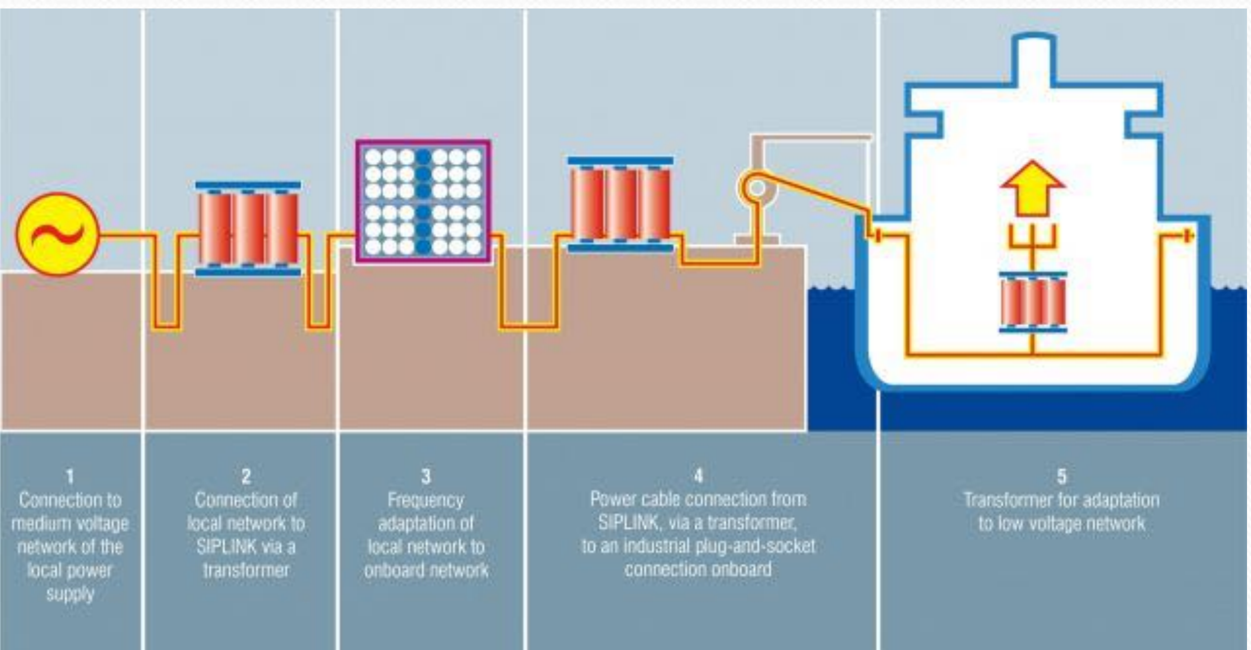

THANK YOU