Shore-to-ship power
An effective solution for port emissions reduction
Shore Side Electricity
Article 5
Member States shall ensure that the need for shore-side electricity supply for inland waterway vessels and sea-going ships in maritime and inland ports is assessed in their national policy frameworks. Such shore-side electricity supply shall be installed as a priority in ports of the TEN-T Core Network, and in other ports, by 31 December 2025, unless there is no demand and the costs are disproportionate to the benefits, including environmental benefits.

Article 6
Member States shall ensure that shore-side electricity supply installations for maritime transport, deployed or renewed as from 18 November 2017, comply with the technical specifications set out in point 1.7 of Annex II.

Annex II.1.7 Shore-side electricity supply sea-going ships
Shore-side electricity supply for seagoing ships, including the design, installation and testing of the systems, shall comply with the technical specifications of the IEC/ISO/IEEE 80005-1 standard.
An environmental issue
Emissions from vessels docked in port

- Auxiliary engines run by ships in port produce SOx, NOx, CO₂ and particle discharge as well as noise and vibration.

- These pollutants cause negative health and environmental impact on the surrounding communities.
An environmental issue
10,000 cars vs. 1 cruise vessel

1 vessel emits NO\textsubscript{X} during 8h equivalent to 10,000 cars going from Zurich to London

Cars: $10,000 \text{ cars} \times 0.1 \text{ g/km} \times 1,000 \text{ km} = 1.0 \text{ t NOx}$

Vessel: $1 \text{ ship} \times 11.8 \text{ kg/MWh} \times 8 \text{ h} \times 12 \text{ MW} = 1.1 \text{ t NOx}$
More than 100,000 vessels dock at 4,500 ports worldwide.

- Noise
- Emissions
- Vibration

900 Million metric tons of CO₂ emitted annually at ports worldwide.

220X

Equal to 220 coal-fired plants.
ABB Shore-to-ship power
Transfer the Power Generation out of the ports

Where do YOU prefer to live?
Port emissions reduction

Challenge I: Customer landscape

- EC, IMO, WMF, IAHP, IACS, ISO, IEC, ESPO, ICS, etc.
- Governments, City Authorities
- Power Supplier
- Port Authorities
- Suppliers:
  - Cavotec
  - ABB
  - Siemens
  - SAM
  - Electronics
  - Others...
- Ship Owners
- Oil Companies
- TOP 5 Auxiliary Engine Manufacturers:
  1. MAN B&W
  2. Daewoo
  3. Wartsila/Sulzer
  4. Yanmar
  5. MAK
- Engine Manufacturers
Port emissions reduction

Challenge II: Capital
Port emissions reduction
Challenge III: Global spread
Port emissions reduction
Challenge IV: Grid frequency

<table>
<thead>
<tr>
<th>Frequency on board</th>
<th>50 Hz</th>
<th>60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container (&lt;140m)</td>
<td>63 %</td>
<td>37 %</td>
</tr>
<tr>
<td>Container (&gt;140m)</td>
<td>6 %</td>
<td>94 %</td>
</tr>
<tr>
<td>Container tot</td>
<td>26 %</td>
<td>74 %</td>
</tr>
<tr>
<td>Ferry / RORO</td>
<td>30 %</td>
<td>70 %</td>
</tr>
<tr>
<td>Tanker</td>
<td>20 %</td>
<td>80 %</td>
</tr>
<tr>
<td>Cruise (&lt;200m)</td>
<td>36 %</td>
<td>64 %</td>
</tr>
<tr>
<td>Cruise (&gt;200m)</td>
<td>-</td>
<td>100 %</td>
</tr>
<tr>
<td>Crociera tot</td>
<td>17 %</td>
<td>83 %</td>
</tr>
</tbody>
</table>
ABB Shore-to-ship power Technology

Shore-to-ship power standards
- IEC / ISO / IEEE 80005-1, High Voltage shore side electricity
- IEC / ISO / IEEE 80005-2, Communication Protocol
- IEC / ISO / IEEE 80005-3, Low Voltage shore side electricity

Power ratings
- Medium voltage : up to 20MVA per vessel
- Low voltage : typical < 1MVA
### Specific Requirement for Vessel Type

<table>
<thead>
<tr>
<th></th>
<th>Bulk Carrier (LVSC)</th>
<th>HV Low consumption Ro-ro/Ferry &amp; Container</th>
<th>Ro-ro / Ferry</th>
<th>Container</th>
<th>Cruise</th>
<th>LNG</th>
<th>tanker</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>400 V @ 50 Hz</td>
<td>6,6 &amp; 11 kV</td>
<td>11 kV</td>
<td>6,6 &amp; 11 kV</td>
<td>6,6 kV</td>
<td>6,6 kV</td>
<td>6,6 kV</td>
</tr>
<tr>
<td></td>
<td>440 V @ 60 Hz</td>
<td></td>
<td>11 kV</td>
<td>6,6 &amp; 11 kV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>690 V @ 50 &amp; 60 Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max Power cons</strong></td>
<td>1 MVA</td>
<td>&lt;4 MVA</td>
<td>6,5 MVA</td>
<td>7,5 MVA</td>
<td>16/20 MVA</td>
<td>10,7 MVA</td>
<td>7,2 MVA</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>50 &amp; 60 Hz (according to voltage as for [S7])</td>
<td>50 &amp; 60 Hz</td>
<td>60 &amp; 50 Hz</td>
<td>60 Hz mainly</td>
<td>60 Hz mainly</td>
<td>60 Hz mainly</td>
<td>60 Hz</td>
</tr>
<tr>
<td><strong>Plugs/ cables</strong></td>
<td>From 1 to 5 accordingly to voltage and power</td>
<td>1 or 2 @ 6,6 kV</td>
<td>1 @ 11 kV</td>
<td>1</td>
<td>2</td>
<td>4+1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Transformer for voltage adaptation</strong></td>
<td>Depend if voltage on-board is standard value: 400-440-690 V</td>
<td>Usually on-board (mainly LV vessels)</td>
<td>Usually on-board (mainly LV vessels)</td>
<td>Usually on-shore</td>
<td>On-shore</td>
<td>Usually on-shore</td>
<td>Usually on-shore</td>
</tr>
<tr>
<td><strong>Galvanic insulation</strong></td>
<td>On-shore</td>
<td>On-shore for container vessels, on-board or on-shore for Ro-ro &amp; Ferry</td>
<td>On-board or on-shore</td>
<td>On-shore</td>
<td>On-shore</td>
<td>Onshore</td>
<td>On-shore</td>
</tr>
</tbody>
</table>

1. Defined in Table 1 of paragraph 7.3 of [IEC/ISO/IEEE 80005-3](http://example.com/1)
2. As for Annex B of [IEC/ISO/IEEE 80005-1] low consumption inland water Ro-ro & ferry can use 6,6 kV, one plug rated for 11 kV.
3. In case this transformer has galvanically insulated windings, this transformer can be the same of the next row.
Shore-to-ship power – Rotterdam, The Netherlands
One of the world’s largest S2SP installations

- Customer: Stena Line B.V., a subsidiary of Stena AB, one of the world’s largest ferry companies
- Year of commissioning: 2012
- The entire installation, both onshore and onboard the ships, was accomplished within a year and was activated at the Stena Line ferry terminal at the port of Rotterdam in June 2012.

- Customer needs
- Complete electrical infrastructure to simultaneously power several vessels while berthed in the port of Hoek van Holland

- ABB response
- Turnkey shore-to-ship power installation including design, engineering, project management, installation and commissioning
- Complete substation and automation package based on PCS 6000 static frequency converters rated at 6 MVA

- Customer benefits
- Mitigation of negative impact of ferry operations on the local community and the environment
- Reduction of fleet’s fuel consumption
- Greenhouse gas emissions reduced by 98%
- Less noise and vibrations
Stena Line Hoek van Holland
Stena Case
Movie Hoek v Holland
Locations
Customer: Processkontroll Elektriska AB Stenungsund
Year of commissioning: 2010

Shore-to-ship power – Gothenburg, Sweden
First 50/60 Hz shore connection in Sweden

Customer needs
- Shoreside power supply to a vast number of Stena Line vessels while at berth

ABB response
- Turnkey 11kV Grid Integration, including Safe+ GIS switchgear 6 bays 50Hz, 4 bays 60Hz, and 2 transformers type Resibloc
- Two static frequency converters 1250kVA
- PLC system type AC500

Customer benefits
- Dependable project execution from design to start-up, and state-of-the-art equipment
- Reliable shoreside power supply to ferries
- Reduced emissions, low-frequency noise and vibrations
- Better environment for passengers, crew, dockworkers and local residents
Shore-to-ship power – Fincantieri, Italy

Customer: Fincantieri
Year of commissioning: 2014

Customer needs
- Shore power supply for Castellamare shipyard for newly built vessels
- Outdoor solution with minimized civil works
- Short delivery time of 15 weeks

ABB response
- Standard containerized solution, air-cooled, including frequency converter, isolation transformer, LV switchgear
- One static frequency converter PCS100, 1000kVA, rack-mounted

Customer benefits
- Scalable solution suitable for all shipyards
- Lower OPEX costs than 60 Hz diesel genset
- Improved efficiency at partial loads
- High reliability owing to converter redundancy
Power and productivity for a better world™