Medium Voltage On shore Power Supply Plant for Cruise Ships in the Port of Livorno

Ing. Giovanni Paolo Spadoni - Technical & Commercial Director
Summary

Livorno Port Authority & Porto di Livorno 2000 s.r.l. Environmental Commitment

Basic Analysis

The solution carried out for the Onshore Power Supply and the consequent environmental advantages

Livorno O.P.S. Technical Characteristics

Official testing

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Acknowledgments
The Environmental Commitment

Â The Livorno Port Authority and Porto di Livorno 2000, since the beginning of their activity, have inserted the environmental component in their decision making process;
Â This was put into practice by making effective an Environment Managing System complying with ISO 14001 and EMAS regulations.
By the studies performed in the last years it was found out that the quality of the air in the port area, and, more generally, in the town of Livorno is strongly influenced by the emissions of the ships operating at the port quays.
The fuel consumption and the consequent emissions are mainly caused by the necessity to keep running in the port all the ship electrical apparatus and this is valid in particular for the passenger ships who moreover are berthed at the quays located as near as possible to the cities.
The Environmental Commitment

The utilization of an OnShore Power Supplyng (O.P.S.) Plant allows the elimination of the emission sources and the substantial reduction of the pollutants emitted remotely, due to the intrinsic better efficiency of the electric generation in a shore power station versus the generation made aboard the ship. In particular Porto di Livorno 2000 is member of an electricity purchasing consortium, who can grant the supplying of 100% power produced by renewable sources.

<table>
<thead>
<tr>
<th>Main pollutants reduction by O.P.S. plant utilization vs:</th>
<th>NOₓ</th>
<th>SO₂</th>
<th>Dust</th>
<th>VOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use on board of 2,7% Sulfur Fuel Oil:</td>
<td>-97%</td>
<td>-96%</td>
<td>-96%</td>
<td>-94%</td>
</tr>
<tr>
<td>Use on board of 0,1% Sulfur Refined Fuel Oil:</td>
<td>-97%</td>
<td>0%</td>
<td>-89%</td>
<td>-94%</td>
</tr>
</tbody>
</table>
The Solution Carried out

The possible mitigation interventions for these phenomena consist in the utilization of reduced environmental impact fuels and the supplying of electrical power to the ships during their staying at the port berth (Onshore Power Supply)

<table>
<thead>
<tr>
<th>Power supplying sub-station</th>
<th>Power Cables</th>
<th>Pier Sub-Station</th>
<th>Pier Connecting Terminal</th>
<th>On Board Installement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(out of the port area)</td>
<td></td>
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</table>
The main environmental advantages

- Local impact mitigation on the air matrix through the elimination of some relevant emission sources;

- Global reduction of the emitted pollutants through the utilization of electrical power generation systems more efficient than those used aboard the ships;

- Acoustic impact reduction for the ships moored in port on the town residential areas thanks to switching off the generators of the ships berthed in the proximity of the passenger terminal.
The solution carried out

- For the completion of the project Livorno Port Authority received specific co-financing from the Italian Ministry of Environment (60%) and from the Region of Tuscany (20%);

- The intervention was performed by a total expenditure of about €3,5 millions;
The solution carried out

- The plant was located at the "Calataò (Quay) Sgarallino nearby the town and where the medium size cruise ships take berth.
The solution carried out

- In the absence of a technical standard the plant was planned and built to supply electrical power according to the characteristics of the ship installment.

- Some technical information:
  - Maximum Deliverable Power: 12 MW
  - Maximum Available Power: 7 MW
  - Supply Voltage: 6, 6 and 11 kV
  - Supply Frequency: 50 and 60 Hz
The solution carried out

- The power, supplied by ENEL Distribution, is furnished at medium voltage in the electrical sub-station at the pier;
- Through a dedicated section of the plant, the characteristic of the electric vector are duly adapted: in particular, according to the ship type to be supplied, the converter & transformer system furnish the power at 6,6 or 11 kV, at 50 or 60 Hertz.
Plant Characteristics

- From this sub-station, equipped by the necessary protection and maneuvering devices at medium voltage, together with the auxiliary services, the power is transferred to the pier side by an underground line consisting of a set of three 630 mm² section cables;
- At the pier side are available n. 3 connection sub-stations. According to the position along the pier of the ship to be supplied, the power will be collected by one or the other connecting point.

Position of the connecting sub-stations at the pier.

View of the connections present at any connecting station at the pier.
Plant Characteristics

- The connecting stations at the pier are joint to the electric sub-station by an underground duct. A mobile rubber-tired device, carrying about 65 meters of cable consisting in n.4 triple-pole 300 mm² section cables, connects the pier sub-station and the plant onboard the ship;
- Once on board the medium voltage line will be connected to the ship receiving switchboard.
The future developments

- The new port plan was developed with the aim to adequately the port capacity to the expected increase (in number and dimensions) of the passenger ships.
- By the same environmental considerations the Port Authority is planning to extend the electrical power supplying to three additional connecting sub-stations (marked in red), at the Alto Fondale and Orlando quays.
Official testing

- The Sgarallino Quay O.P.S. was tested on November 9th 2015 connecting the Italian Navy Fregate "Carlo Bergaminiò"
- At the beginning of 2017 the plant was transferred under the Porto di Livorno 2000 s.r.l. concession and management and an agreement was established with CRE (Consortium for Energy Resources) for the supplying of 100% green electrical power to the plant, under the brand "Renewable Energy"
The future developments

- Before entering in a new executive project it will be necessary to understand the trend of the cruise industry under the emission reduction point of view.
- The new-building orders seem to privilege the LNG fuelling system, that can be used both for the main engines and the generators substantially reducing the emissions while the ships are in port but also when in navigation.
- By recent information, only the 20% of the cruise ship new buildings will be equipped by the shore power connecting switchboard.
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- Site Managers: Ing. Fabio Bonacci- Ing. Massimiliano Micheletti
- Director of Operation: Fabio Ceccarini
- Safety & Security Coordinator: Ing. Massimo Vivaldi
- Works Execution: GEMMO S.P.A. i Arcugnano VI
- Sub Contractors & Suppliers:
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  - Conductix s.r.l.
  - Nidec-ASI S.p.A.
  - Costruire s.r.l.
  - Costruzioni Santi s.r.l.
  - IL Mare s.r.l.
- Official Test: Ing. Stefano Rum
- Porto di Livorno 2000 s.r.l. Technical Staff:
  - Ing. Giovanni Paolo Spadoni
  - Ing. Francesco Deri
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