GUIDELINES FOR ONSHORE POWER SUPPLY (OPS) FOR SHIPS

PROPOSED TECHNICAL WORKING GROUP

TERMS OF REFERENCE

1. Historical Background Definition of the Problem

Climate change is a very big challenge for our world and for the maritime industry. The agreed goal of the Paris Climate Agreement is to keep the increase in global average temperature to well below 2°C above pre-industrial levels. Maritime transport is a key driver in achieving this goal as it emits around 940 million tonnes of CO2 annually and, thus, is responsible for approximately 2.5% of global green-house gas emissions.

One field of action is to decarbonise vessels´ port stays. While in port, ships normally use their auxiliary engines to produce electricity. If the electricity is produced from a renewable source onshore, the greenhouse gas (GHG) emissions will be reduced. It will also reduce other air emissions, noise, vibration and engine wear-and-tear.

Connecting the ship to the electricity network on shore is called Onshore Power Supply (OPS). It might also be known as cold ironing, shore side electricity (SSE), shore connection, shore to ship power, alternative maritime power etc.

Some ports (i.e. Hamburg, Kiel, Stockholm) have already installed OPS systems, mainly for cruise vessels. Anecdotal evidence suggests a sketchy standardisation framework and challenging operational and safety aspects to be addressed. However, it appears that there is no clear business case, as shore-supplied electricity is more expensive as on-board generated one. Expectation amongst (European Union) ports is that the European Union will make shore-side electricity mandatory for seagoing-vessels, increasing the demand for relevant knowledge on OPS.

The long-term future of OPS unclear as carbon-neutral fuels might partly challenge OPS´ claim of emissions reductions in ports. But even then, battery-powered vessels, improved electricity storage solutions and smart-grids in ports might provide alternative use-cases.

Amongst practitioners and academics alike, there is an ongoing discussion about design, implementation, financing and operating as well as safety aspects of OPS. Additionally, there is a plethora of reports from research and government organisations, including IMO, ISO and

MSA.[1] However, it appears that there is no clear "To-do-List" of how to design and implement OPS-systems from scratch, and if there is a report that can be dubbed as such, it is very much geared around technical issues.

2. Objectives

The purpose of this Working Group (WG) is to develop an international guideline for planning, design, finance, implementation and operations as well as maintenance of OPS to ships while in harbour, including an assessment of future uses of OPS within a port´s micro-grid.

Discussions amongst a panel of European OPS-experts suggest that OPS are addressed in various reports, but there is a clear lack of focus on technical implementation, particularly from an organisational perspective. Further, an additional report on OPS should address an observable degree of fragmentation, and merge available information on OPS into a single comprehensive document. Emphasis should be on issues that can be be generalised for a large number of ports, rather than focusing on port-specific topics.

It needs to cover the scope from connection to the main powergrid[2] to the berth side connection and gives a clear roadmap for OPS projects. It might include OPS whilst at anchor. Charging of batteries on electric-powered ships and interaction of OPS within smart-grids covering a port should be included in the report. Methods other than OPS for reducing emissions from ships, such as cleaning the emissions, are outside the scope of this WG.

3. Earlier reports to be reviewed

PIANC

- 178 Climate Change Adaptation Planning for Ports and Inland Waterways (2020)
- 159 Renewables and Energy Efficiency for Maritime Ports (2019)
- 188 Carbon Management for Port and Navigation Infrastructure (2019)
- 184 Design Principles for Dry Bulk Marine Terminals (2019)
- 172 Design of Small- to Mid-Scale Marine LNG Terminals Including Bunkering (2016)
- 153 Recommendations for the Design and Assessment of Marine Oil and Petrochemical Terminals (2016)
- 149 Guidelines for Marina Design (2017)
- 152 Guidelines for Cruise Terminals (2016)
- 135 Design Principles for Small and Medium Marine Container Terminals (2014)
- 134 Design and Operational Guidelines for Superyacht Facilities (2013)

Selected third-party reports/publications (for full title see references below):

- (British Ports Association, 2015)
- (European Commission, 2006)

[1] A comprehensive literature research has been compiled by Qi et. al. (2020) providing a systematic review of current research on shore power.

[2] In terms of load capacity, the transmission system operator might require a scope beyond the major grid connection point.

- (European Maritime Safety Agency (EMSA), 2022)
- (International Standards Organisation (ISO), 2019)
- (SSPA Sweden AB, 2022)
- (OCIMF, pending)
- (Qi, Wang, & Peng, 2020)

An ad-hoc Working Group commissioned by MARCOM[3] reviewed the third-party sources and concludes as follows:

- **Technical aspects** appear to be covered fairly sufficiently, but, in particular the SSPA-report (SSPA Sweden AB, 2022) needs an update.
- **Organisational topics,** such as organisational models for providing OPS, and related contractual arrangements/financing flows as well as risk allocations are insufficiently covered. Although analogies can be drawn from public-private interaction in other public infrastructure sectors, such as roads, the economics and legal structures of the energy market as the commercial basis for OPS warrant a particular focus.
- The **future of OPS** caused some discussion amongst the members of the ad-hoc Working Group, as the increasing uptake of alternative fuels in shipping might prove OPS as a sole source of decarbonised electrical energy obsolete in future. As such, the report should also focus on possible roles of OPS within ports´ electrical grids as a facilitator for integration, energy storage, to name the most apparent ones.

4. Scope of work

The following topics might warrant closer scrutiny (see Chapter 5 for suggestions concerning the report´s method to address below´s topics):

Definition of OPS

- Onshore Power Supply (OPS) vs cold Ironing, Shore side electricity (SSE), shore connection, shore to ship power, alternative maritime power etc.

Why OPS?

- Regulatory requirements (in Europe: EU "fit-for-55")
- Stakeholders to be involved
- Port-city-interface to be addressed
- Environmental requirements
- Customer demand (shipping companies, esp. cruise)
- Benefits of OPS

What ships with what (future) power requirements?

- Requirement and scope of vessel size-type forecast, availability of OPS-ready vessels

[3] Ad-hoc Working Group on OPS, contributing members: Dr. Lars Stemmler, bremenports, Germany (moderator); Dirk Mahrholz, Head Electrician, bremenports; Uwe Radke, Head of electrical engineering, Hamburg Port Authority, Germany; Geraud Hervé, OPS specialist, HAROPORTS, France; Lisa Sarodnik, Port of Kiel, Germany.

- Requirements of different types of ships regarding energy consumption (peak requirements, voltage, current, position of plugs), including electric powered ships (as per IEC/ISO/IEEE 80005-1)

What power supply is available in the port?

- Typical measurements (peak supply, voltage, current)
- Constraints from local power grid (max. load, frequency).
- Available infrastructure connecting grid and port
- Consideration of other users/terminals etc. -> impact on port grid.
- Consideration of regulatory restrictions, such as limited supply of other users from OPS-stations

OPS and renewable sources of energy

- How do the sources of the onshore electrical energy affect the environmental benefits of the OPS project. Is OPS still "green" without renewable energy?
- Investigation of the feasibility of storage facilities (batteries, compressed or liquid air respectively CO2, electrolyser, wind turbines) for OPS

Available standards to be considered when planning for OPS

- IEC/ISO/IEEE 80005-1 as international standard for OPS (all other applicable national standards for electrical engineering to be considered as well)
- Considering if there are parts missing in the standards that instead should be covered in this report. (OPS standards exist, this is cooperative work under reference; further, if necessary, low voltage is currently not covered.[4]

Technical aspects

Electrical engineering

- Presentation/coverage of different technical solutions available on the market related to OPS, including pros and cons.
- Mobile (land-side vs. sea-side) vs. fixed installations (capacity constraints vs. flexibility)
- Safety aspects, such as grounding, overload, lightning protection
- Costs (CAPEX, OPEX)

Civil engineering

- Necessary civil infrastructures in relevant port areas, esp. for dedicated OPS-equipped berths and buildings/containers/cable-trays etc.
- Potential interference with other quay-side equipment, such as ship-to-shore cranes, straddle carriers/AGVs etc.
- Costs (CAPEX, OPEX)

Implementation time horizons (port infrastructure, grid upgrades)
Market research and availability of suppliers

Operational aspects

- Operating procedures, OPS Compatibility Assessment procedures,
- Organisational concepts (public, private, public-private provision and operation of OPS; operational vs. maintenance aspects)

---

[4] WG will leverage available information to underpin their recommendations and guidelines)

- Process integration (mooring/unmooring, crane operations, esp. rail-mounted)
- Integration into port security/business continuity planning
- Planning trade-offs: Berth planning (logistics vs. electrical requirements of terminal operators)
- Safety / accessibility of quay/sub-station (esp. automated terminals)
- Metering
- Required human capacity/staff requirements
- Vulnerable events and how to overcome these.

Commercial aspects

- Procurement of required energy/contracting models/contracting parties
- Charging schemes
- Invoicing procedures
- The business model of OPS installations. Who will bear the cost? Can OPS be operated on a commercial basis? Best cooperation models?
- CAPEX/OPEX overview
- Public funding: EU, National or regional support schemes; e.g. EU Cohesion funds for reciprocal programs
- Risk analysis and risk mitigation strategies

Legal aspects

- (Renewable) energy-law- and tax-law-related issues (national/international laws, incl. port-/flag-state requirements)
- How to incentivise using OPS, such as by harbour due discounts, integration into the Environmental Ship Index, IMO regulation (carbon emissions index)?
- Liability and insurance
- Permitting and plan approval procedures (construction, operation, environmental)

Case studies on different types of OPS projects (from feasibility to execution, depending on suitable cases, state-of-the-art and available information)[5].

- Technical best-practice
- Planning: typical planning timelines
- Procedural best-practice: A clear roadmap to the delivery of OPS installation in the port.
- Port co-operation: Possibilities to gain momentum by looking into a multiport project approach. Reciprocity [viz. Key advocacy point of European Onshore Power Supply Association[6]] what are the benefits
- Lessons learned of existing operators

[5] Case-studies might be complemented by expert interviews as outlined in Chapter 5.
[6] https://www.eopsa.eu/

Future opportunities of OPS

- What future uses might OPS have/integration into wider environmental strategies (battery barge, inland shipping, last-mile going electric, ships as energy storage)
- Development of a port micro-grid?

5. Intended product

The intended product might be less than a new PIANC guideline but rather a kind of checklist that can be used together with pertinent processes, stakeholders and standards aiming at building OPS from scratch. The report will assist and inform port owners, consultants and construction companies involved in OPS-related master-planning, design and construction projects to set up OPS in their respective ports.

The information in the WG report will outline key ingredients required to design and implement universal and reliable high capacity power connections; as such Chapter 4 of these ToR shall not be interpreted as a strict outline of a table of content, but more as a humble suggestion of what topic areas might warrant closer scrutiny. As OPS is a subject area seeing rapid development the scope of work might well be explored by extracting and discussing relevant content by means of expert interviews, case-studies and best-practice examples revealing barriers and success-factors for implementation.

6. Working Group membership

Working group membership should include:

Competencies	**Organisations**
• marine electrical engineers • grid electrical engineers • port management specialists (PPP, public procurement, commercial) • port designers / port engineers • environmental specialists	• port authorities/owners • ship owners • energy companies/grid operators • designers and suppliers of shore power systems
Additionally, representatives from	
• IAPH representative • Eopsa Representative • Port-city political leaders (if possible)	

7. Target audience

The intended report will target port authorities, terminals, clients and consultants.

8. Relevance

8.1. Relevance to countries in transition, etc.

The guideline will be of significant value to countries in transition, since it´s important to cut green-house gases on a global scale. There could of course be challenges with OPS solutions in countries in transition, how the electricity is produced on shore, lack of electricity etc., but the report will be a tool for taking the right decisions.

8.2. Climate Change and Adaptation

This report will be an important report in the "green transition" and in reduction of GHG. Issues like sea level rise and other climate-change related risks should also be considered in the report since it could affect where you place for example substations.

8.3. Working with Nature

n/a

8.4. UN Sustainable Development Goals

OPS connections make it possible to reduce GHG and other emission and links to many of the17 Sustainable Development Goals (SDGs) approved by the United Nations in 2015, such as climate action (SDG13), sustainable cities and communities (SDG11), affordable and clean energy (SDG7) and good health and well-being (SDG3).

9. References

British Ports Association. (2015). *Reducing Emissions from Shipping in Ports: Examining the Barriers to Shore Power.*

European Commission. (12. 05 2006). COMMISSION RECOMMENDATION on the promotion of shore-side electricity for use by ships at berth in Community ports. *Official Journal of the European Union*, S. L 125/38.

European Maritime Safety Agency (EMSA). (2022). *Shore-Side Electricity: Guidance to Port Authorities and Administrations. Part 1: Equipment and Technology*. Lissabon.

European Maritime Safety Agency. (2022). *Shore-Side Electricity: Guidance to Port Authorities and Administrations. Part 2: Planning, Operations and Safety.* Lissabon.

International Maritime Organisation / Global Maritime Energy Efficiency Partnerships. (2020). *Shore Power: Applicability and Assumptions*. Abgerufen am 24. 11 2022 von https://glomeep.imo.org/technology/shore-power/

International Standards Organisation (ISO). (2019). *IEC/IEEE 80005-1:2019 Utility connections in port — Part 1.*

OCIMF. (pending). *Information Paper on Onshore Power Supply.*

Qi, J., Wang, S., & Peng, C. (2020). Shore power management for maritime transportation: Status and Perspectives. *Maritime Transport Research*, S. Vol. 1, 100004, https://doi.org/10.1016/j.martra.2020.100004.

SSPA Sweden AB. (2022). *Connecting vessels to shoreside electricity in Sweden.* Report No: RR41199360-01-00-A, Gothenborg.