



#Onshore Power Supply - #OPS

Guideline for a comprehensive and successful OPS Tender

Checklist and additional information



~ EUROPEAN ONSHORE POWER SUPPLY ASSOCIATION ~

Why we can!

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Introduction

The implementation of Onshore Power Supply (OPS) is rapidly taking place across Europe, creating a growing need for sharing knowledge, fostering collaboration, and providing guidance to ensure technologies are effectively deployed.

The purpose of this document is to de-mystify OPS, technologies, approaches and stakeholders to ensure successful project specification and implementation, and to equip key stakeholders with a sufficient level of knowledge to not only specify an OPS system but also understand and review the available options.

This document also outlines specific recommendations for updating the EOPSA 'OPS Tender Guideline' to reflect the association's position that port authorities should have the flexibility to delegate OPS responsibilities to external experts, special-purpose vehicles (SPVs), or joint ventures (JVs).

EOPSA's mission is to accelerate the deployment of OPS in the European ports. Together with its members, EOPSA help deliver the electrification solutions in the 21st century decarbonized port & port-city expectations. Decarbonization through electrification and shore power not only serves the upcoming EU legislation, but first and foremost, social, health and economic objectives. Each elected official is keenly aware of the social cost associated with a port ecosystem pollution and the benefits of collaboration.

Methodology

In this document you will find:

- **The checklist**
The aim of this document is to list in a simple and straightforward manner the key issues that can most influence the definition of an OPS project. We also recommend to analyze and complete as many of the issues as possible based on the available information or specific criteria for the future installation.
- **The guide**
This document lists the key work packages, technologies or aspects of a tender and provides recommendations to the tenderer for each of them.



All the points outlined in this guide refer to the attached document: "[Checklist for a Comprehensive and Successful OPS Tender](#)".

These 2 documents cover the following five chapters:

1. Power considerations
2. Operation
3. Conversion substation
4. Cable Management Systems (CMS)
5. Automation and Supervision

To achieve this, each chapter follows a standardized format:

1. **Introduction** – Outlines the context, scope, and relevance of the topic within the OPS framework.
2. **Existing Solution** – Presents an overview of current technologies, practices, and configurations available in the market, supported by real-world examples.
3. **Recommendations**– Provides practical guidance and best practices based on the collective expertise of EOPSA members, aimed at supporting the specification, design, and implementation of OPS systems.

This methodology ensures that each topic is addressed comprehensively, balancing technical depth with operational insight, and promoting harmonization across OPS projects in Europe and beyond.



List of Abbreviations and Acronyms

		Definition
OPS	Onshore Power Supply	Onshore Power Supply – the supply of electrical power to ships at berth, directly to the receiving ship, from a shore-side electrical power source, at a given voltage and frequency, feeding the onboard main distribution switchboard. OPS replaces primarily the onboard electricity generation from auxiliary generators.
SBC	Shore-side Battery Charging	Shore-side Battery Charging – Charging of onboard Battery Energy Storage Systems (BESS) by shore power supply, either AC or DC, using a connection protocol suitable for the specific BESS onboard, at a specified charging power.
TSO	Transmission System Operator	Transmission of electrical power at national/regional level, between generation plants (upstream) and distribution (downstream).
DSO	Distribution System Operator	Maintenance of both short- and long-term capability of equipment, installations, and networks to supply electricity in a continuous and reliable way while meeting the quality requirements in force.
RSO	Receiving Ship Operator	SSE Electricity ship consumer at berth, responsible for ensuring interoperability and interconnectivity on shipside. 1 st connection certification and maintenance of conditions for connectivity. Responsible for keeping load.
MG	Microgenerators	Any operator developing and operating units of microgeneration of electricity, integrated within the port, supplying electrical power to Port Grid. Ex: Generators, PV, Solar, Wind, Fuel Cell.
HVSC	High Voltage Shore Connection	
LVSC	Low Voltage Shore Connection	
SSE	Shore-side Electricity	
SPB	Shore-side Power Banking	
SSI	Ship-Shore Interface	
BS	Battery swapping	
PG	Port Generation	
CA/MBP	(Port) Competent Authority / Management Body of the Port	
(PAA)	Port Authorities/Administrations	
MV	Medium Voltage	
LV	Low Voltage	
SIL	Safety Integrity Level	
SCADA	Supervisory Control and Data Acquisition	



General Considerations

Environmental impact

OPS Projects dramatically reduce the environmental impact of Maritime & Shipping activities (CO₂, NO_x, SO_x, PM10 & PM2.5, vibration, and noise).

On the basis of 132g of CO₂ for a car per 100km that consumes 5 liters of petrol, it would take 488,636 cars travelling 100km to emit the same amount of CO₂ as a 10MVA cruise ship for a 10-hour stopover, i.e. 64.5 tonnes of CO₂. FACT: When a cruise liner is connected to the electricity grid, CO₂, NO_x & SO_x are eliminated, a true benefit to local citizens ([reference : EOPSA White paper, October 2022](#)).

We therefore encourage the tenderer to also consider this goal when specifying and selecting its systems and suppliers. In this context, the AFIR regulation is key, as it provides a relevant framework for infrastructure development and environmental compliance.

Safety

Disclaimer: The IEC standard for OPS does not cover in detail the personnel safety requirements for the operation of the different subsystems.

The following guide recommends in each section to document the specific requirements for the ports & terminal.

Stakeholders

An OPS System introduces within ports new systems, new procedures and new interactions between existing or new stakeholders.

We recommend the tenderer to involve during the tender preparation stakeholders of current and future installation to integrate their requirements and anticipate mapping of roles, responsibilities or competencies.

We particularly recommend including representatives of Port Authority, Terminal Operators, marine operators, Linesmen & vessel crew (non-exhaustive list), energy companies.



Governance

The contracting authority may choose between various delivery models, including own-operate, design-build-operate, or concession-based models.

1. Power considerations

1.1. Introduction

The maritime industry is evolving, and port electrification is at the heart of this transformation. Onshore Power Supply (OPS) systems are crucial for providing reliable and sustainable electricity to docked vessels. This chapter covers key considerations for implementing OPS systems.

By considering these factors, ports can implement efficient, adaptable, and environmentally friendly OPS systems that meet current and future demands.

The points outlined in this section refer to the attached document: 'Guideline for a Comprehensive and Successful OPS Tender Checklist 10.03.2025 v.0.

1.2. Power source origin

This section outlines the necessary requirements to ensure an adequate power source for the project. The following sections detail the various aspects that need to be considered and verified.

1.2.1. National electricity grid

- **Utility Name:** Identify the name of the utility company providing the electricity and any specific standards that must be adhered to.
- **Grid Capacity:** Confirm whether there is sufficient additional grid capacity available to meet the project's needs. This can be verified with a Yes/No response.



1.2.2. Distribution Network Operator (DNO)

- **Operator Name:** Provide the name of the Distribution Network Operator.
- **Specifications:** Determine if there are any particular specifications that must be adhered to. If applicable, refer to these specifications.

1.2.3. Distribution System Operator (DSO)

- **Operator Name:** Provide the name of the Distribution System Operator.
- **Specifications:** Similar to the DNO, verify if there are any specific requirements that must be met. Refer to these specifications if applicable.

1.2.4. Local port internal distributed energy system

Confirm whether there is an existing local port internal distributed energy system in place. This can be verified with a Yes/No response.

Usually the local available grid will be a utility grid but could also be a private grid or even a micro grid, with renewable sources integrated. Here below some examples:

- **Renewable energy installations:** Include solar panels, wind turbines, and hydroelectric systems.
Potential Use: These installations can be part of a distributed energy system, providing sustainable and environmentally friendly power. For example, solar panels installed on port buildings or wind turbines located nearby can generate renewable energy for port operation

- **Dedicated power plants:** Power plants specifically built to supply electricity to the port.

Potential Use: These plants can be integrated into the port's internal energy system to ensure a dedicated and reliable power source.



- **Energy storage systems:** Systems like batteries and flywheels that store energy for later use.

Potential Use: These systems can store excess energy generated from renewable sources or the local grid and provide backup power during peak demand or outages.



- **Mobile generators:** Portable generators that can be moved and used as needed.
Potential Use: Mobile generators can provide temporary power solutions during emergencies or for specific operations within the port.

In summary, verifying the power source is a crucial step to ensure the project's feasibility. Each aspect mentioned must be carefully evaluated and documented to ensure all necessary requirements are met.

1.3. Input electrical data from the grid

This section outlines the necessary requirements for input electrical data from the grid to ensure compatibility and efficiency for the project. The following sections detail the various aspects that need to be considered and verified.

Grid supply voltage

Voltage Levels: OPS systems are typically connected to high or medium voltage grids, usually in the range of 33 kV, 66 kV, or 110 kV on the primary side.



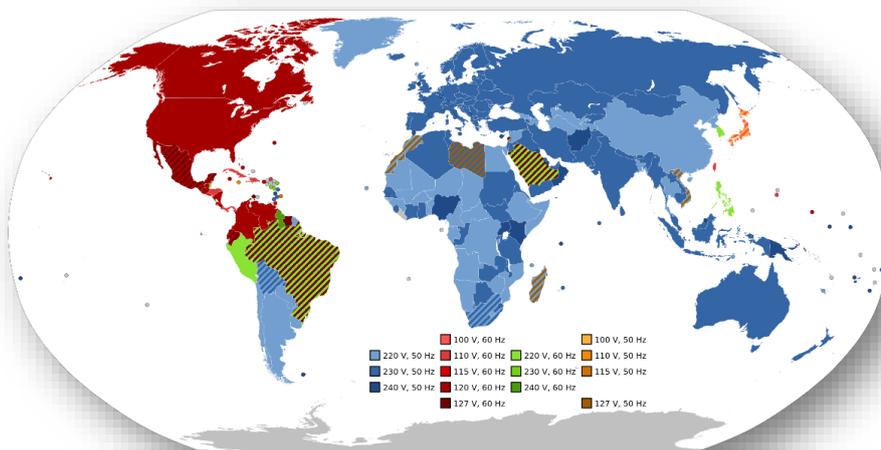
Frequency

Standard: For European land networks, the norm is 50 Hz.

Global Frequency Levels:

- **50 Hz:** Predominantly used in Europe, most of Asia, Africa, and Australia.
- **60 Hz:** Commonly used in North America (USA and Canada), parts of South America (e.g., Brazil), and some other regions.
- **Japan:** Unique in using both 50 Hz (Eastern Japan) and 60 Hz (Western Japan), depending on the region.

Fig. Electricity Voltages & Frequencies by Country Around the World





Load capacity

The load capacity of an OPS system is the maximum electrical power it can handle safely. Understanding this capacity is essential to ensure the system can meet the power demands of the connected equipment without risking overloads or failures. This knowledge helps in designing a reliable and safe power supply system.

- **Calculation:** Load capacity is measured in kVA, where $kW = kVA \times \text{Power Factor}$

Power factor

The power factor of an electric load is the ratio of real power (in kilowatts, kW) to apparent power (in kilovolt-amperes, kVA). This ratio indicates how effectively electrical power is being converted into useful work. A power factor of 1 (or unity) means all the power is being effectively used, while a lower power factor indicates inefficiencies due to reactive power.

The power factor for the OPS system is typically defined by the port electrical team. This is based on the Distribution System Operator (DSO) power factor limits and the existing power factor of the port's electrical system. The DSO sets specific standards that must be adhered to, ensuring that the power factor remains within acceptable limits to maintain grid stability and efficiency.

On the vessel side, the power factor typically ranges between 0.8 and 0.9. This range ensures that the vessel's electrical systems operate efficiently and are compatible with the shore power supply. Maintaining a power factor within this range helps in reducing energy losses and ensuring stable power delivery to the vessel.

Power quality

- **Parameters:** The level of harmonics, voltage variation, and existing power quality are crucial to verify that the grid is compatible with the vessel.



Table 3.3 - Summary table with example power quality variations, their common causes, sources, effect, and examples of power conditioning solutions.

Example waveshape or RMS variation	Causes	Sources	Effects	Examples of power conditioning solutions
	Impulsive transient (transient disturbance)	Lightning Electrostatic discharge Load switching Capacitor switching	Affects computer components and power electronics	A. Surge arrestors B. Filters C. Isolation transformers
	Oscillatory transients (transient disturbance)	Line/cable switching Capacitor switching Load switching	Destroys computer components and power electronics	A. Surge arrestors B. Filters C. Isolation transformers
	Sags/swells (RMS disturbance)	Remote system faults	Motors stalling and overheating Computer failures ASDs shutting down	Ferroresonant (Constant Voltage) transformers Energy storage technologies Uninterruptible Power Supply (UPS) Backup generators
	Interruptions (RMS disturbance)	System protection Breakers Fuses Maintenance	Loss production Equipment shutdown	Energy Storage technologies Uninterruptible Power Supply (UPS) Backup generators
	Undervoltage/overvoltage (steady state variation)	Motor starting Load variations Load dropping	Shortens lives of motors and lighting filaments	Voltage regulators Ferroresonant (Constant Voltage) transformers
	Harmonic distortion (steady state variation)	Nonlinear loads System resonance	Overheating transformers and motors Fuses blow Relays trip Meters malfunction	Active or passive filters Transformers with cancellation of zero sequence components.
	Voltage flicker (steady state variation)	Intermittent loads Motor starting Arc furnaces	Lights flicker Irritation	Static VAR systems

Refer to Table 3.3 from EMSA Guidance on SEE to Port Authorities and Administrations.

Short circuit capacity

Short circuit capacity refers to the maximum current that can flow through an electrical system during a short circuit event. A short circuit occurs when an unintended low-resistance path allows a large amount of current to bypass the normal load, leading to potentially dangerous conditions

- **Design Requirements:** Substations must be designed to withstand the maximum expected short-circuit currents in the installation, both on the medium voltage side and the low voltage side.



Assessment of the capability to the grid connection

Harmonic limits refer to the maximum allowable levels of harmonic distortion in the electrical system. Harmonics are voltage or current waveforms that are multiples of the fundamental frequency, and they can cause various issues in power systems

Harmonic limits are directly related to **power quality** and define the current harmonic limit for the shore connection system and assess disturbances created by the OPS to the grid.

Impedance

Network impedance directly affects the quality and stability of the electrical supply to ships. Incorrect impedance can cause issues such as voltage fluctuations, energy losses, and equipment overheating. Additionally, it is essential for the proper sizing of circuit breakers and fuses to ensure these devices function correctly in the event of short circuits.

Power reversibility need

- Purpose: Power reversibility allows ports to receive electricity from vessels or enables vessels to maintain minimum loads on their generators. This can be beneficial for energy management and operational flexibility.
- Challenge: Implementing power reversibility impacts capital expenditure (CAPEX) and the physical footprint of the installation. It also requires specific agreements with the Distribution System Operator (DSO) to ensure proper coordination and compliance.
- Examples: There are real-world examples of power reversibility in OPS installations. One notable example is the Port of Los Angeles. They have implemented shore power systems that allow vessels to connect to the local grid and supply power back to the port when needed.

Metering requirements

- Purpose
 - Contractual measurement: Metering is essential for accurately measuring the electricity supplied, which is crucial for billing and contractual agreements

- Quality assessment: It also helps in assessing the quality of the electricity, ensuring that parameters like voltage, frequency, and harmonics are within acceptable limits.
- Local energy authority requirements
 - It's important to determine if there are specific metering requirements or agreements with the local energy authority. These requirements ensure compliance with local regulations and standards.
- Metering examples in OPS installations.
 1. **Main connection point:** This is where the shore power connects to the vessel. Meters here measure the total electricity supplied to the vessel.
 2. **Distribution panels:** Located within the vessel, these panels distribute power to various systems. Meters here monitor the quality and quantity of electricity used by different subsystems.
 3. **Generator interface:** If the vessel's generators are used, meters at this interface measure the power generated and ensure it meets quality standards.
 4. **Utility interface:** At the port's utility connection, meters measure the electricity supplied to the port and any power fed back from the vessel.

Conclusion

In summary, verifying the input electrical data from the grid is a crucial step to ensure the project's feasibility and compatibility. Each aspect mentioned must be carefully evaluated and documented to ensure all necessary requirements are met.

1.4. Future power demand to be connected

The implementation of OPS inside the existing Port Electrical Infrastructure requires taking some precautions. First, a clear understanding of the future power demand from ships in call to connect is essential. Then ships' power demand must be fully integrated inside the global port electrical infrastructure.

- If this new power demand exceeds the existing port electrical infrastructure capabilities, an additional survey must be done with DNO (Distribution Network Operator) or DSO (Distribution System Operator) to increase and to adapt as possible the upstream electrical network capabilities for the future needs or to find, inside the port itself, local alternative



sources of generation like solar panels or wind turbines or new technologies to produce and store sometimes the extra power demand.

- If this new power demand remains under the port electrical infrastructure capabilities, nothing special must be done inside the port infrastructure, nevertheless, discussions with DNO remain necessary due to the high level of power required by several ships like Cruises. This must be contextualized in each port involved.

Future power demand to be connected (MVA)

- Purpose: To ensure the OPS installation can handle the expected power demand from vessels. This helps with designing a system that meets future needs without overloading.
- Calculation: Use the 80005-1 standard levels per vessel type and multiply by the maximum number of vessels to be connected in parallel.

Perform a finer analysis considering the actual consumption of the vessels and their berth occupancy levels, if available.

- Example: If the standard level for a vessel type is 2 MVA and you expect to connect 5 vessels in parallel, the future power demand would be $2 \text{ MVA} \times 5 = 10 \text{ MVA}$.
- Perform a finer analysis considering the actual consumption of the vessels and their berth occupancy levels, if available.

Max power per berth (MVA)

- Determine the maximum power required for each berth based on vessel types and their power needs.

Single or multiple vessels operations (N°)

- Purpose: To plan for the number of vessels that need to be connected simultaneously, ensuring the OPS system can manage multiple connections without compromising performance.
- Calculation: Determine how many ships need to be connected and when, based on operational schedules.



Type of Vessels (List)

- Purpose: Identify the types of vessels using the port, which helps in defining the peak power requirements and designing the OPS installation accordingly.
- Calculation: List the vessel types and their respective power requirements.
- Example: If the port handles container ships (4 MVA), tankers (5 MVA), and cruise ships (6 MVA), these values will guide the design.

Here's a chart showing different types of vessels and their typical power consumption values in MVA.

Type of Vessel	Typical Power Consumption (MVA)
Container Ships	4 - 6 MVA
Tankers	2 - 5 MVA
Cruise Ships	6 - 14 MVA
Ro-Ro (Roll-on/Roll-off)	1 - 3 MVA
Bulk Carriers	1 - 4 MVA

An assessment should be done considering the number and type of vessels as well as the contemporaneity of the vessel connection to the shore power installation in order to define the maximum peak power. For vessels, we recommend using the recommended power for each vessel type. For vessel not covered in the annex, the power consumption at berth of the vessel scheduled for calls in the port shall be collected.

IEC Standards are defined to match current power demand of most vessels, but also foreseen evolutions. For ports that do not have limited vessels calls (like RoRo), it permits to ensure compatibility. On the other hand, shipyards are also driven by the standard to limit their consumption to the identified limits to ensure the possibility to connect in most of the port. In some words, using the standard proposed power per vessel type will ensure the ports have the best compatibility for the future, and avoid painful upgrades.



Maximum supply size estimated (MVA)

- Purpose: To calculate the total power supply needed based on vessel types and operational requirements, ensuring the OPS installation is adequately sized to meet demand.
- Calculation: Sum the power requirements of all vessels expected to be connected simultaneously.
- Example: If the port expects to connect 2 container ships (4 MVA each) and 1 tanker (5 MVA) at the same time, the maximum supply size would be $2 \times 4 \text{ MVA} + 5 \text{ MVA} = 13 \text{ MVA}$.

Step by step practical example: Estimating maximum supply size in MVA for a port

Let's consider a port that needs to estimate the maximum supply size for its OPS installation. Here's a step-by-step example:

- 1. Identify vessel types and their power consumption**
 - Container Ships: 4 MVA each
 - Tankers: 5 MVA each
 - Cruise Ships: 6 MVA each
- 2. Determine the number of vessels to be connected simultaneously**
 - The port plans to connect 2 container ships, 1 tanker, and 1 cruise ship at the same time.
- 3. Calculate the Total Power Demand:**
 - Container Ships: $2 \times 4 \text{ MVA} = 8 \text{ MVA}$
 - Tanker: $1 \times 5 \text{ MVA} = 5 \text{ MVA}$
 - Cruise Ship: $1 \times 6 \text{ MVA} = 6 \text{ MVA}$
- 4. Summing up the Power Requirements:**
 - Total Power Demand: $8 \text{ MVA} + 5 \text{ MVA} + 6 \text{ MVA} = 19 \text{ MVA}$



1.5. Upgradability, scalability and flexibility

EOPSA members' recommendation: The electrical infrastructure needs to be aware of the future phases of the OPS to ensure compatibility and scalability. This includes planning for potential upgrades, integrating new technologies, and maintaining flexibility to adapt to evolving requirements.

- **Compatibility:** Ensuring the electrical infrastructure can accommodate future phases of the OPS project.

Example: The electrical infrastructure is designed to accommodate future expansions of the OPS system, including higher power demands and integration with renewable energy sources

Example: The shore power system is compatible with various vessel types and can be upgraded to meet future requirements

- **Scalability:** Planning for potential upgrades and expansions to handle increased power demands and new technologies.

Example: The OPS installation includes modular components that can be easily expanded to handle increased power demands as the port grows

Example: The electrical system is designed with scalability in mind, allowing for seamless integration of new technologies and additional capacity

- **Flexibility:** Maintaining the ability to adapt to evolving requirements and integrate new technologies seamlessly.

Example: The OPS system is flexible enough to adapt to changing requirements, including the integration of smart grid technologies and renewable energy sources

Example: The infrastructure allows for quick adjustments to accommodate different vessel types and operational needs, ensuring continuous improvement and adaptation



1.6. Environmental aspects

EOPSA Recommendation: Use the average environmental data from the past 10 years to ensure they are representative of the port location.

1. Maximum & minimum external ambient temperature (°C)

- o Standard solutions are designed to operate within specific temperature ranges (0°C to 40°C for conversion substation electrical equipment and -10°C to 45°C for operation of the CMS systems).

Purpose: Operational Efficiency: Indicating the minimum and maximum ambient temperature is crucial for ensuring that all equipment operates efficiently within the specified range. This helps prevent overheating, freezing, and other temperature-related issues that could compromise the performance and longevity of the equipment.

Conditions outside this range require customized solutions. Such as:

- **Enhanced Cooling Systems:** To prevent overheating in high-temperature environments.
- **Heating Elements:** To ensure proper functioning in extremely cold conditions.
- **Insulation:** To protect equipment from temperature fluctuations.
- **Environmental Monitoring:** Systems to continuously monitor and adjust conditions to keep them within safe limits.

The maximum and minimum external ambient temperatures along European coasts can vary significantly depending on the region. Here are some general observations:

Region	Maximum Temperature (°C)	Minimum Temperature (°C)
Northern Europe (e.g., Baltic Sea)	25°C to 30°C (summer)	-20°C to -30°C (winter)
Western Europe (e.g., Atlantic Coast)	20°C to 25°C	Above -10°C
Southern Europe (e.g., Mediterranean Coast)	35°C to 40°C (summer)	Rarely below 0°C



2. Hurricane/Typhoon Risk (Yes/No):

Purpose: Determine if the port is in an area prone to hurricanes or typhoons, which impacts the design and robustness of the infrastructure.

Ports located in areas prone to hurricanes or typhoons face significant challenges:

- **Infrastructure Damage:** High winds, heavy rainfall, and storm surges can cause substantial damage to port infrastructure, including terminals, piers, and equipment.
- **Operational Disruptions:** Hurricanes and typhoons can halt port operations, leading to delays in shipping and logistics
- **Increased Maintenance Costs:** Ports in high-risk areas may require more frequent maintenance and upgrades to withstand extreme weather conditions.
- **Safety Concerns:** Ensuring the safety of workers and protecting cargo during extreme weather events is crucial.

3. Snow: Maximum Snow Load (kg/m²):

Purpose: Indicate the maximum snow load on record.

The maximum snow load on record can significantly impact on the design and mechanical sizing of equipment, like the CMS.

The maximum snow load on record for European coasts can vary significantly depending on the region and specific environmental conditions. Here are some general observations:

- **Northern Europe (e.g., Baltic Sea):** Snow loads can reach up to 200 kg/m² during severe winters.
- **Western Europe:** Typically experiences milder winters, with snow loads generally ranging from 50 to 100 kg/m².



4. Icing Level (mm or cm):

Purpose: Indicate the average thickness of the ice layer that forms in the port.

This variability necessitates careful consideration in the design and mechanical sizing of equipment to ensure it can withstand the additional load and potential operational challenges posed by ice accumulation.



The average ice thickness along European coasts can vary significantly depending on the region and specific environmental conditions. Here are some general observations:

- **Northern Europe (e.g., Baltic Sea):** Ice thickness can range from a few centimeters to over 50 cm during severe winters.
- **Western Europe:** Generally, experiences milder winters with less significant ice formation, often just a few millimeters to a few centimeters.

5. **Average Solar Radiation (Watt/m²):**

Purpose: Indicate the average solar radiation, which impacts electronic equipment, and the level of protection required.

In Europe, average solar radiation values vary depending on the region and season. Generally, they range from about 800 to 1200 W/m². Southern Europe tends to receive higher solar radiation compared to northern regions due to its proximity to the equator and generally sunnier climate.

6. **Humidity (%):**

Purpose: Measure humidity levels to ensure equipment can operate effectively in the port's environment.

The humidity levels along European coasts can vary significantly depending on the region. Here are some general observations:

Region	Average Humidity (%)
Northern Europe (e.g., Baltic Sea)	80% to 90%
Western Europe (e.g., Atlantic Coast)	70% to 80%
Southern Europe (e.g., Mediterranean Coast)	60% to 70%

7. **Saline and Corrosive Environments Level (Normal or High):**

Purpose: Assess the saline levels, which can vary depending on proximity to the shore. Ports are typically corrosive environments, requiring special planning and equipment.

8. **Dust Level (Yes/No):**

Purpose: Indicate the dust level in the port's exterior, impacting the IP rating for the design of equipment like electrical cabinets.



9. **Risk of Flooding (Yes/No):**

Purpose: If there is a risk, place substations or other electrical equipment on the second floor to avoid damage.

10. **Flooding Level Above Sea Level (m or cm):**

Purpose: Determine the water level above a reference level (e.g., sea level) on the quay and operating areas, impacting the design and placement of infrastructure.

11. **Noise Level Limitation (Yes/No):**

Purpose: Assess noise levels from transformers, fans, and frequency converters to ensure compliance with regulations and minimize disturbance.

12. **Seismic Risk (Yes/No):**

Purpose: Determine if the port is in an area with seismic activity, which affects the structural design and stability of the infrastructure.

13. **Wind Speed (km/h or m/s):**

Purpose: Measure wind speeds to ensure structures can withstand typical conditions. For example, for CMS system the maximum wind in operation (deployment, connection) and for storage or resting position. By default: 20m/s (72km/h) for operation.

14. **Wind Speed Max Destruction (km/h or m/s):**

Purpose: Identify the maximum wind speed that can cause significant damage.

1.7. Expected lifetime

Years: The port authority requires an expected lifetime for the requested OPS system, specifying the period (in years) before a major overhaul or replacement is necessary.

Purpose: Defining the expected lifetime is crucial for planning the long-term viability and sustainability of the OPS system. It ensures that the system meets the operational and financial goals set by the port authority.

Impact on Technology and CAPEX: The expected lifetime requirement significantly influences the choice of conversion technology and the capital expenditure (CAPEX). Longer lifetimes may



necessitate more robust and advanced technologies, which can increase initial costs but reduce long-term maintenance and replacement expenses.

Concession Time and Financial Investment: The expected lifetime is typically included in the business plan and is essential for determining the optimal lifetime of the OPS system.

2. Operation

This guide does not aim to develop deeply into this section.

2.1. Introduction

OPS systems should connect to the local medium or high voltage grid.

2.2. Existing solution

Mode of operation: Here are the different ways to make the connection:

Manual Operation

- **Pros:** This method allows for greater control and flexibility, especially useful for handling unexpected situations or varying ship configurations.
- **Cons:** It requires more manpower and time, and there is a higher risk of human error during the connection process.
- **Challenges:**
 - **Training:** Ensuring that all personnel are adequately trained to handle the connections safely and efficiently.
 - **Consistency:** Maintaining consistent connection quality despite the manual process.



Automatic Operation

- **Pros:** This method is faster and more efficient, reducing the risk of human error and minimizing the time required for connection.
- **Cons:** It involves higher initial setup costs and requires sophisticated technology and regular maintenance.
- **Challenges**
 - Technology Maintenance: Ensuring that robotic systems are regularly maintained and updated to prevent malfunctions.
 - Initial Costs: Managing the higher upfront investment required for the automatic system.

Semi-Automatic Operation

- **Pros:** Combines the benefits of manual and automatic systems, allowing human intervention when necessary while automating routine tasks.
- **Cons:** It still requires significant manpower and training, and there can be issues with partial automation.
- **Challenges**
 - Coordination: Ensuring seamless coordination between manual and automatic processes.
 - System Integration: Integrating the semi-automatic system with existing port infrastructure and ship systems.

2.3. Recommendation

The bidder must provide detailed information on the following aspects to ensure a well-prepared and accurate operational proposal.



2.3.1. Mode of operation

Type of Connection

Please note that the type of connection, depending on the type of ship, and in the number of vessels operating at the same time, will determine the type of operation.

Operation of the OPS System

Determine whether the OPS system will be operated by port employees or an external company. This decision impacts training requirements, operational protocols, and overall system management.

Interface with vessels

Establish clear operational boundaries between the OPS system and the ship. This includes defining the interface requirements and ensuring seamless communication and coordination with vessel operators.

Single or multiple vessels operations

- Operating an OPS system for a single vessel involves connecting one ship to shore power at a time.
- Operating an OPS system for multiple vessels simultaneously involves connecting several ships to shore power at the same time.

Mode of Operation

Manual / Automatic / Semi-Automatic

Determine how you want to use your system

Estimate of Necessary Resources: Provide an estimate of the resources required for each mode of operation including:

- **Manpower:** Number of Skilled technicians per shift
- **Technology:** Basic tools (gloves, voltage testers, connection cables.) and equipment for manual connections or/and automated systems (sensors, control software.)
- **Maintenance costs:** Periodic training for personnel, regular maintenance of manual and automated components.

Lifetime of the system

What is the expected lifetime of the system (i.e., the time before a major overhaul or replacement is needed)?

Please note that this requirement will affect the choice of conversion technology and capital expenditure (CAPEX).



2.3.2. Maintenance

1. Maintenance

- **OPS System Maintenance:** Determine whether local port personnel or subcontractors will be responsible for maintaining the OPS system. This decision impacts on the overall maintenance strategy and resource allocation.

2. Maintenance Parameters: Identify necessary parameters such as the quality of electrical connections, endurance of plugs, and the efficiency of energy distribution systems. Here below some examples:

- **Total Harmonic Distortion (THD):** Ensuring low THD in the shore power supply is crucial to prevent damage to shipboard electrical systems. Implementing stringent THD monitoring to maintain power quality.
- **Voltage Stability:** Consistent voltage levels are necessary to avoid fluctuations that can disrupt onboard systems
- **Challenges:**
 - **Wear and Tear:** Frequent plugging and unplugging can lead to wear and tear, reducing the lifespan of connectors. Implementing regular maintenance schedules and using robust materials can help address this issue.
 - **Corrosion:** Electrical connections exposed to marine environments are prone to corrosion, which can degrade performance and safety. Regular inspections and maintenance are required to mitigate this issue.
- **Grid Stability:** Maintaining grid stability while accommodating varying loads from multiple ships can be complex. Advanced monitoring and control systems are necessary to ensure reliable power distribution.



3. Predictive Maintenance

- **Data Collection:** For effective predictive maintenance, collect data at various points in the system, including temperature, vibration, pressure, and electrical load.
- **Data Transmission:** Ensure that collected data is sent to a centralized monitoring system for analysis and scheduling of maintenance.

4. Response Time

- **Expected Uptime and Response Times:** Define expected response times for repair and maintenance based on the criticality of system components. Faster response times typically require more resources and higher costs.

2.3.3. Training

The training program for Operation & Maintenance (O&M) personnel is designed to ensure that staff are well-equipped with the necessary skills and knowledge to effectively manage and maintain OPS installations.

This includes understanding the differences between medium voltage (MV) and low voltage (LV) systems, and the specific precautions required for each.

Differences between medium voltage and low voltage installation maintenance and operation considerations

Medium Voltage (MV) Systems:

- **Voltage Range:** Typically, between 1 kV and 35 kV.
- **Maintenance Considerations:** Requires specialized equipment and training due to higher risk of electrical hazards. Regular inspections and maintenance of transformers, switchgear, and circuit breakers are essential.
- **Operation Considerations:** MV systems are crucial for efficient power distribution over long distances with lower power losses. Operators must be trained in handling high-load equipment and managing voltage levels safely.

Low Voltage (LV) Systems:

- **Voltage Range:** Up to 1 kV



- **Maintenance Considerations:** Generally, it involves simpler procedures compared to MV systems. Routine checks of wiring, circuit breakers, and protective devices are necessary.
- **Operation Considerations:** LV systems are used for applications requiring lower power, such as lighting, communication systems, and security systems. Operators need to be familiar with basic electrical safety and troubleshooting techniques.

Precautions and Considerations

- **Safety Protocols:** Both MV and LV systems require adherence to strict safety protocols to prevent electrical hazards. Personnel must be trained in emergency response procedures and the use of personal protective equipment (PPE).
- **Note:** routine work is not considered in this training. Focus on complex tasks that require specialized knowledge and skills, such as fault diagnosis and system upgrades.

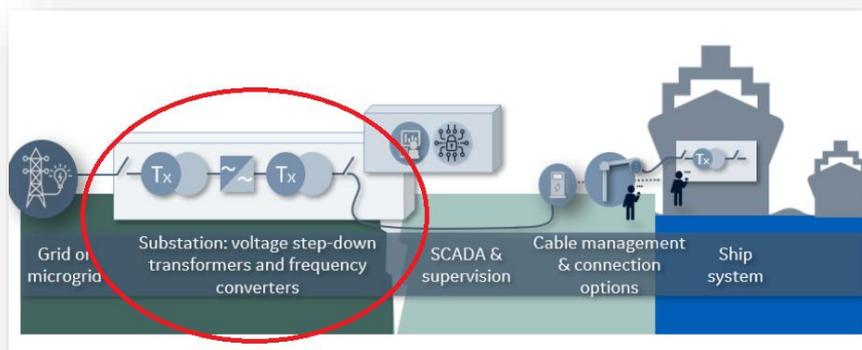
3. Conversion substation

3.1. Introduction

This chapter delves into the critical role of conversion substations within OPS systems. Conversion substations are pivotal in adapting the land network grid frequency and voltage to meet the specific requirements of docked vessels. This chapter will explore the main functions of conversion substations, their essential components, existing solutions, and provide recommendations for optimal design and implementation.

3.1.1. Main function

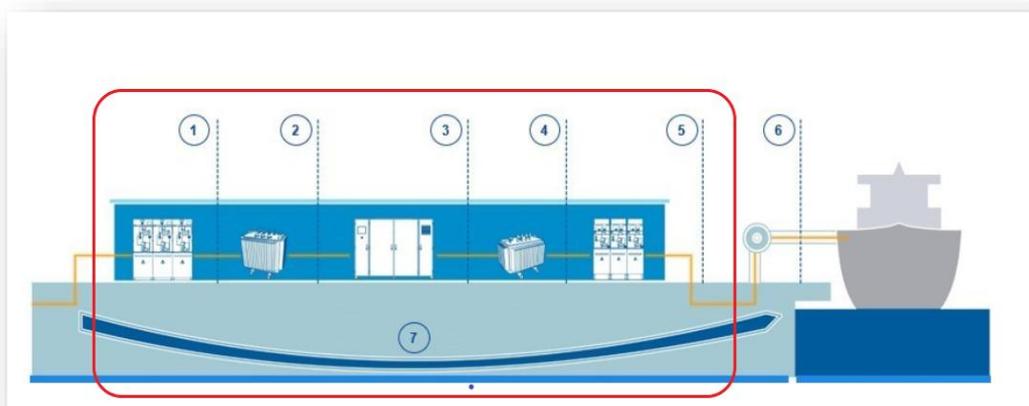
The conversion substation main function is to adapt land network grid frequency and voltage to the vessel one. It also ensures the protection of vessel supply, and all the automation and safety to connect the vessels by port employees.



Systems to provide protected, safe electrical interfaces from grids to users and ship

The Conversion Substation system shall be designed in compliance with the requirements of: IEC/IEEE 80005 It should also adhere to other relevant IEC standards and safety regulations to ensure optimal performance and safety.

3.1.2. Main components





3.1.2.1. Medium voltage switchgear for grid connection

Components: Circuit breakers and protection relays to safeguard electrical installations on the grid side; connects and protects the medium voltage transmission lines to end-users, ensuring reliable power distribution.

3.1.2.2 Step-Down transformer

The role of these transformers is to reduce network voltage to 3.3, 6.6, or 11 kV, as required by the frequency converter, and adapt transmission voltage to port distribution voltage, facilitating efficient power conversion.

3.1.2.3. Frequency converter (50/60 Hz)

Frequency converters are devices used to change the frequency of electrical power supplied to a system.

Function:

- Ensures power quality at the vessel side and provides fast protection.
- Includes neutral earthing resistor/ground resistance for ground fault detection on shore cables or vessel side.

3.1.2.4. Transformers (Port Side)

The role of these transformers is to adapt the land network converter voltage level to the vessel voltage.

After frequency setting, voltage is stepped up to 6.6 or 11 kV for distribution through the port to the ship's connection point. Standardizes connection, allows for 25% more energy transfer, reduces cable requirements, and simplifies connection operations.



3.1.2.5. Medium Voltage Switchgear for Ship Connection

Circuit breakers, line feeders, and protection are relays to protect electrical installations and permit reconfiguration of the substation for conversion hub.

They also detect abnormal conditions and trigger circuit breakers to isolate faulty sections, ensuring system stability and safety.

3.1.2.6. Enclosure

Enclosures can be civil works or prefabricated, typically container type (metal) or prefabricated concrete. Equipment requirements and space availability at the port define the best solution.

3.1.2.7. Protection, Control & Security

Integration with SCADA systems for safety, predictive maintenance, configuration services, and commissioning tests of switchgear and transformers.

3.1.3. Safety considerations

Everywhere LV or HV are present, classic electrical safety rules for equipment applies, minimizing exposure to personnel. It is only needed to specify that converters will be located in electrical rooms, accessible by trained people.

Note:

- For ports supplying diverse types of vessels with the same conversion station, the Electrical protection scheme should not consider only the two main frequencies, but also the differing voltages and power demands and protections related
- Substation layout and operation plan should minimize personnel exposure to the electrical equipment. It could be worth planning a specific operating room separated from power equipment.



3.1.4. Modularity

Modularity is a key feature in the design of conversion substations for OPS systems. This modular approach enhances the flexibility, scalability, and efficiency of power distribution to docked vessels. By incorporating modular components, the system can adapt to varying demands and operational scenarios at ports.

- **Capability for Each Conversion to Connect to Several Berths:** The conversion substation is designed to connect to multiple berths, allowing for flexible and efficient power distribution to various vessels docked at the port. This capability ensures that power can be supplied to different ships simultaneously, optimizing the use of available infrastructure and resources.
- **Possibility to Put Conversions in Parallel (Hot Connection/Disconnection):** The system supports parallel operation of multiple conversions, enabling hot connection and disconnection without interrupting the power supply. This feature allows for seamless transitions and maintenance activities, ensuring continuous and reliable power delivery to vessels even during system adjustments or expansions.

3.1.5. Synchronization Schemes

Synchronization schemes are essential in OPS systems to ensure the stable and efficient transfer of electrical power from shore to docked vessels. These schemes coordinate the electrical parameters between the shore-based power supply and the vessel's electrical systems, preventing disruptions and ensuring seamless integration.

Types of Synchronization Schemes:

1. Vessels Only Synchronizing on the OPS: In this scheme, vessels synchronize exclusively with the OPS system. This approach simplifies the synchronization process by focusing solely on the interaction between the shore power supply and the vessel. It ensures that the vessel's electrical systems are aligned with the OPS, providing a stable and reliable power transfer.

2. All Scenarios from IEC 80005-1: The IEC/IEEE 80005-1 standard outlines various synchronization scenarios for high-voltage shore connection (HVSC) systems.

. These scenarios include comprehensive synchronization options that cater to different operational needs and conditions. By adhering to these standards, OPS systems can ensure compatibility and safety across a wide range of vessels and shore power configurations.



Importance of Synchronization Schemes:

Synchronization schemes are crucial for maintaining power quality and operational safety. They prevent issues such as phase mismatches, frequency variations, and voltage discrepancies that could disrupt the power supply or damage equipment. Proper synchronization ensures that vessels receive consistent and reliable power, enabling smooth operations while docked.

3.2. Existing solutions

This section aims to gather the existing solutions and technologies available in the market today.

The technical specification should focus on the key drivers for the project: port need, flexibility, maintainability, and reliability, while being open to different conversion proposals (topologies, technologies, etc.), allowing for various types of solutions that may offer better economic and technical value to the customer, both in terms of reliability and 'whole life' cost.

3.2.1. Type of Substation

According to the IEC/IEEE 80005-1:2019 standard, which governs High Voltage Shore Connection (HVSC) systems, the conversion substations can be implemented using several types of solutions depending on the port and vessel requirements. These are the main types of conversion substations or solutions described or implied in the standard:

Types of Conversion Substations under IEC 80005-1

1. Fixed Substations

- Permanently installed onshore.
- Typically used in large ports with high and consistent OPS demand.
- Can include:
 - HV switchgear



- Transformers
- Frequency converters (rotating or static)
- Control and monitoring systems



2. Mobile Substations

- Mounted on trailers or containers.
- Provide flexibility for ports with multiple berths or variable OPS needs.
- Often used during pilot projects or in ports with limited space.

3. Containerized E-Houses

- Prefabricated modular substations housed in containers.
- Include all necessary components: switchgear, transformers, converters, and control systems.
- Easy to deploy and relocate.



4. Frequency Conversion Solutions

- Shore power systems must accommodate frequency differences, as approximately 70% of ships operate at 60 Hz while around 30% of ports supply power at 50 Hz. Therefore, shore connection systems must be designed to support both frequencies to ensure compatibility and seamless operation.
- Two main types:
 - **Rotating converters** (motor-generator sets)
 - **Static converters** (semiconductor-based)



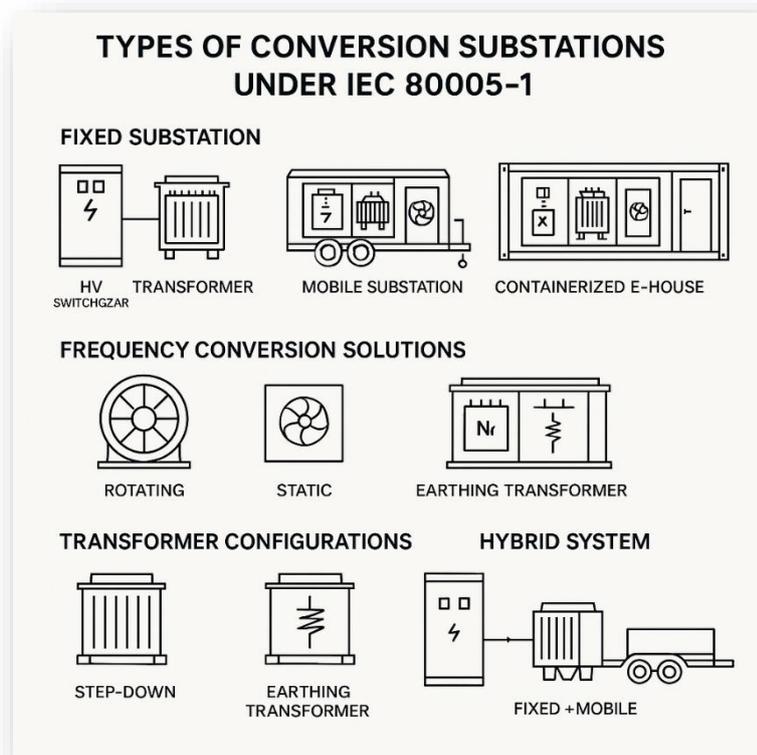
5. Transformer Configurations

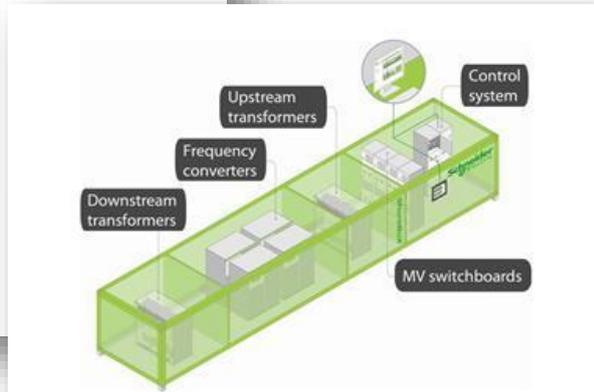
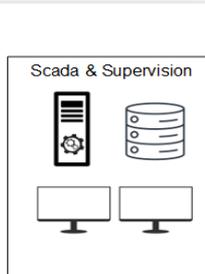
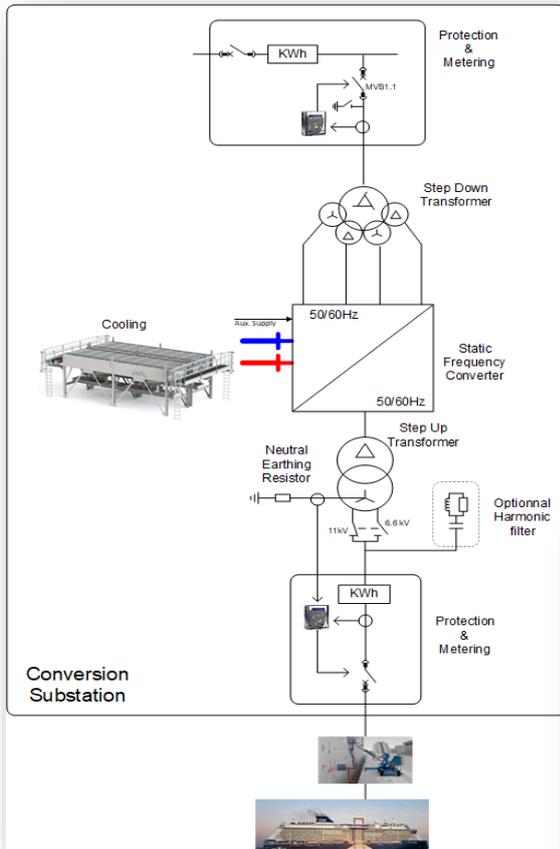
- Used to adapt voltage levels between shore supply and ship requirements.
- May include:
 - **Step-down transformers**
 - **Earthing transformers with resistors** for safety and fault management

6. Hybrid Systems

- Combine fixed and mobile elements.
- Allow ports to scale up OPS capabilities gradually.

These solutions are designed to meet the **interoperability, safety, and environmental goals** of the IEC 80005 series, ensuring compatibility between ships and ports globally.





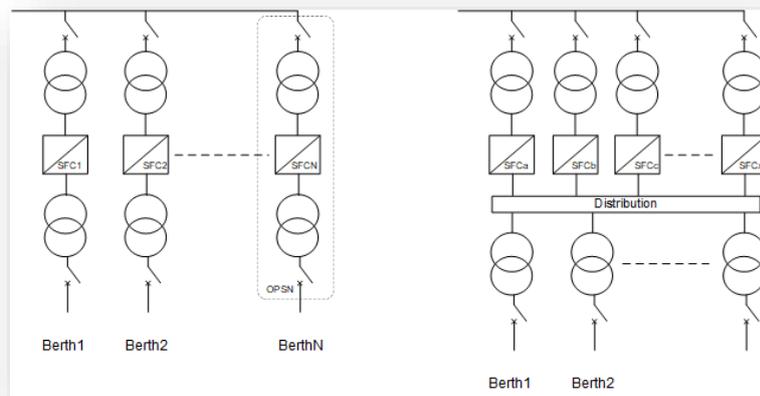
Typical conversion substation



3.2.2. Dedicated or hub SLD

Two main types of substations exist:

Dedicated conversion system per port berth or Conversion Hub Substation. Here below the SLD (Single Line diagram) for each type:



Dedicated supply SLD

Conversion Hub SLD

Supply Substation (Dedicated SLD)

This type of substation is designed to serve a single OPS connection point—typically one berth or vessel.

- **Straightforward design:** Power flows directly from the grid through a transformer and, if needed, a frequency converter, then straight to the ship.
- **Best suited for small or medium-sized ports** with limited OPS demand.
- **Simple to operate and maintain**, since it's tailored for one specific load.
- **Limited scalability:** If more OPS points are needed, additional dedicated substations must be built.

Real-world example: A ferry terminal with one OPS-equipped berth, where the entire substation is dedicated to that single connection.



2.2. Conversion Hub Substation (Hub SLD)

This is a **centralized substation** that supplies power to **multiple OPS connection points** across a terminal or port.

- **More complex**, but highly **efficient and scalable**.
- Includes **multiple transformers, frequency converters, and distribution panels**.
- **Ideal for large ports** with several OPS-equipped berths or plans for future expansion.
- Enables **load management, redundancy**, and better use of infrastructure.
- **Composed of several conversion subsystems**, which can be configured to dispatch power to different berths as needed.
- **Designed for flexibility**: not all berths need to be used simultaneously, and power can be allocated dynamically.
- Allows **parallel operation of converters**, increasing power capacity per berth when needed, while also providing **redundancy** and limiting the total installed conversion power.
- In large ports, it also supports **gradual power dispatching** to new vessel calls, giving operators time to analyze and adapt to the vessel's actual power consumption.

Real-world example: A cruise terminal with several berths, powered from a single conversion hub that distributes energy as needed, adapting in real time to ship schedules and power demands.

3.2.3. MV Switchgears

Medium Voltage (MV) switchgear is essential for protecting electrical installations on both the grid side and vessel side. It also allows for the reconfiguration of the substation for conversion hubs, ensuring flexibility and reliability in power distribution.



Main types of MV Switchgear

3. **GIS (Gas Insulated Switchgear):** Gas-insulated switchgear uses gas to fully insulate and protect various components of a power system.

Advantages: Highly recommended and often required by port authorities due to their ability to withstand harsh environmental conditions like humidity and salty atmospheres¹. GIS is compact, reliable, and offers excellent arc quenching properties.

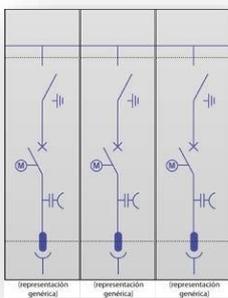
Disadvantages: Higher initial cost compared to AIS, but lower maintenance requirements over **time**.

4. **AIS (Air Insulated Switchgear):** Air-insulated switchgear uses air at atmospheric pressure to insulate and protect electrical components¹.

Advantages: Generally, it is less expensive to construct and easier to install.

Disadvantages: Sensitive to environmental conditions and require more frequent maintenance. Not sealed, making it less suitable for harsh environments.

Primary Switchgear



Primary switchgear is predominantly used in distribution substations and scenarios where current requirements exceed 630 or 800 amps.

It acts as a key connection point between incoming power transformers and outgoing distribution feeders. These systems are designed for high reliability and safety, often including features such as remote control, arc protection, and modular configurations to adapt to different project needs.

Secondary Switchgear

Secondary switchgear is mostly used for transformer substations. Its reduced size makes it an excellent option when building a compact substation. These switchgears are designed to handle medium voltage levels and are essential for distributing electrical power efficiently and safely within a substation.

- **Compact Design:** Ideal for space-constrained environments, allowing for efficient use of available space
- **Environmental Protection:** Gas insulation provides excellent protection against harsh environmental conditions, ensuring long-term reliability.
- **High Reliability:** Designed to meet stringent safety and performance standards, ensuring consistent and reliable operation.
- **Low Maintenance:** Requires minimal maintenance, reducing operational costs and downtime



3.2.4. Type of transformers

Liquid-Immersed transformers

Medium voltage transformers with recyclable and reusable natural biodegradable dielectric liquid. They are hermetically constructed and completely filled in a metal tank that is equipotential and grounded. The exterior finish is C5 for good performance in demanding climatic conditions.

They offer high fire resistance and zero toxicity to aquatic organisms, making them an eco-friendlier alternative with better performance and longevity in saline environments compared to conventional transformers. These transformers will be installed on metal skids for proper installation and mobility requirements.





Dry-Type Transformers

Dry-type transformers are designed for safe and efficient operation in indoor and environmentally sensitive areas. They do not use liquid insulation, which eliminates the risk of leaks and reduces fire hazards. They are built with high-quality insulation materials and enclosed in ventilated or cast-resin housings to ensure durability and thermal performance. Dry-type transformers are also known for their low noise levels and resistance to moisture, dust, and corrosive environments.

Neutral Earthing resistor (NER)

In OPS environments, Neutral Earthing Resistors (NERs) are essential for enhancing system protection and operational safety. Installed between the neutral point of a transformer or generator and the ground, the NER limits fault currents and mitigates transient overvoltage by providing a controlled path to earth.

These units are designed for high reliability and are typically enclosed in robust, weather-resistant housing suitable for both indoor and outdoor OPS installations. By reducing the impact of electrical faults, NERs help protect critical equipment, ensure personnel safety, and maintain power continuity in demanding operational conditions.

Three-Phase Distribution Transformer (TSA)



The TSA is a three-phase distribution transformer tailored for OPS projects, operating at 50 Hz and compliant with IEC 60076-1 and the Eco-design Directive 2009/125/EC. It features a hermetically sealed, fully filled design with natural cooling using biodegradable ester dielectric liquid (Class K, IEC 61100), offering a high flash point above 300°C for enhanced fire safety.

Equipped with a thermometer with dual contacts and a maximum temperature indicator, the transformer is rated at 20 kV primary, 250 kVA, with a 420 V/B2 secondary. For OPS deployment, it is mounted on a metal skid to facilitate secure installation and mobility in medium-to-low voltage (MV/LV) transformer stations, even in remote or harsh environments.



3.2.5. Type of Frequency Converters

Frequency converters are devices used to change the frequency of electrical power supplied to a system. In the context of OPS systems, frequency converters play a crucial role in ensuring that the power provided by the shore matches the frequency requirements of the docked vessels. This is essential because different regions and vessels may operate on different electrical frequencies, typically 50 Hz or 60 Hz.

Here below the two main types of frequency converters:

1. **Static Frequency Converters:**

- Use solid-state electronics to convert frequency. They are compact, efficient, and suitable for various industrial applications.
- Ideal for ports where space is limited and high efficiency is required.

2. **Rotary Frequency Converters:**

- Use motor-generator sets to convert frequency. They are robust and can handle larger power loads.
- Suitable for ports with high power demands and where reliability is crucial.

3.3. Recommendation

The bidder must detail the following aspects to ensure accurate proposal preparation.

3.3.1. Footprint constraint: Space & Access.

The bidder must detail the following aspects to ensure an accurate proposal preparation of the Installation.

3.3.1.1. *Space & Access*

Available Land Footprint

- **Limited Space:** Ports often have limited space available for new infrastructure. This requires careful planning to optimize the use of available land.



- **Compact Design:** Conversion substations need to be designed compactly to fit within the constrained areas of the port. This includes substations, transformers, and frequency converters.
- **Integration with Existing Infrastructure:** The conversion substation must be integrated with existing port infrastructure without disrupting current operations.

Soil and Building Constraints

- **Soil Conditions:** Geotechnical assessments are necessary to determine the soil's load-bearing capacity and stability. This ensures that the foundation can support the weight of the OPS equipment.
- **Building Regulations:** Compliance with local building codes and regulations is essential. This includes considerations for foundation depth, structural integrity, and environmental impact.

3.3.1.2. Access limitations

- **Delivery Routes:** Ensure that there are clear and accessible routes for delivering large equipment to the installation site. This may involve coordinating with port authorities to manage traffic and logistics.
- **Maintenance Access:** Plan for sufficient space around the OPS equipment for maintenance activities. This includes access points for technicians and space for mobile equipment.

3.3.1.3. Base Load

Ground Loading: Determine if there is a maximum ground loading for the conversion substation location. This involves assessing the soil's load-bearing capacity and ensuring the foundation can support the weight of the equipment.



Note: the tendered shall verify that the requested installation space and type is compatible with the upgradability/scalability requirement of the system linked with forecasted port evolution.



3.3.2. Installation type for the substation

Installation Type	Advantages	Disadvantages
Indoor Substation	<ul style="list-style-type: none"> - Space Efficiency: Compact and can be integrated into existing buildings. - Environmental Protection: Equipment is protected from weather conditions. - Safety: Enhanced safety for personnel. - Noise Reduction: Minimizes noise emissions. 	<ul style="list-style-type: none"> - Higher Initial Cost: More expensive construction and integration. - Complex Installation: Requires careful planning to fit within existing structures.
Outdoor Substation	<ul style="list-style-type: none"> - Ease of Installation: Simpler to install and expand. - Lower Initial Cost: Generally, less expensive to construct. - Accessibility: Easier access for maintenance and repairs. 	<ul style="list-style-type: none"> - Space Requirements: Requires more land area. - Environmental Exposure: Equipment exposed to weather conditions. - Safety Concerns: Higher risk of exposure to external hazards.
Plug & Play: Metallic Enclosure	<ul style="list-style-type: none"> - Flexibility: Metallic enclosures are one of the most flexible and widely used Plug & Play solutions. - Mobility: Can be moved to another location if needed. 	
Plug & Play: Fiberglass Enclosure	<ul style="list-style-type: none"> - Durability: Lightweight, corrosion-resistant, and maintenance-free. - Widely Used: Popular in the UK market for various applications. 	
Concrete Enclosure	<ul style="list-style-type: none"> - Robustness: Provides strong protection and durability. - Security: Offers enhanced security for the equipment. 	<ul style="list-style-type: none"> - Permit Delays: Obtaining necessary construction permits may cause delays and longer delivery times, for example, 20 weeks for permits.

MV switchgears should be selected according to electrical, size and environmental requirements.

IEC 80005-1 requirements should be carefully followed.



Where controlled ambient conditions are not guaranteed, GIS type switchgears should be selected.

3.3.3. Transformers

This section outlines the necessary requirements and constraints related to transformer installations.

Type of Insulation

Are there any constraints regarding the type of transformer insulation? Common options include:

- **Dry Type:** Uses air as the cooling medium, suitable for indoor installations where fire safety is a concern.
- **Esther Oil:** A biodegradable and less flammable option compared to traditional mineral oil.
- **Bio Oil:** An environmentally friendly alternative that offers high fire safety and biodegradability.

Installation Constraints

Are there any constraints regarding the location of the transformer? Considerations include:

4. **Indoor:** Requires adequate ventilation and space for maintenance. Suitable for environments where protection from weather is needed.
5. **Outdoor:** Must be designed to withstand environmental conditions such as temperature extremes, wind, and precipitation.



Energizing the Transformer

Are there any grid code limitations regarding energizing or de-energizing the transformer?

If there are no limitations, it is important to highlight the different solutions for transformers that can be switched on or off and the number of operations that can be performed.

This limitation affects the type of solution, usage, and lifetime. The solution should be adapted to the intended usage by the end user.

Here below, some advantages and Disadvantages of Switching On-Off Transformers in OPS Systems.

Advantages	Details
Flexibility in Operations	<p>Adaptability: Allows flexible management of power supply, enabling operators to switch transformers on or off based on demand and operational requirements.</p> <p>Maintenance: Facilitates easier maintenance and troubleshooting by allowing transformers to be de-energized safely.</p>
Efficiency	<p>Energy Savings: Switching off transformers when not in use can save energy and reduce operational costs.</p> <p>Load Management: Helps in managing load distribution effectively, preventing overloads and ensuring stable power supply.</p>
Safety	<p>Reduced Risk: De-energizing transformers during maintenance reduces the risk of electrical accidents and enhances safety for maintenance personnel.</p>
Disadvantages	Details
Inrush Currents	<p>High Initial Currents: Switching transformers on can cause inrush currents, which are high initial currents that can trip breakers and cause stress on the electrical system.</p> <p>Equipment Stress: Frequent switching can lead to mechanical and electrical stress on the transformer components, potentially reducing their lifespan.</p>
Operational Complexity	<p>Coordination: Requires careful coordination and planning to ensure that switching operations do not disrupt the power supply or cause instability in the system.</p> <p>Monitoring: Continuous monitoring is needed to manage switching operations effectively and prevent issues.</p>
Cost	<p>Switching Equipment: Additional costs for installing and maintaining switching equipment, such as load break switches and inrush current management devices.</p> <p>Maintenance: Increased maintenance requirements due to the mechanical and electrical stress caused by frequent switching.</p>



Local Applicable Requirements

Are there any local requirements such as ECO design directives that need to be considered?

These requirements can impact on the price, consumption, dimensions, and technical limitations of the transformer. For instance, ECO design directives may mandate higher efficiency levels, which could affect the overall design and cost of the transformer.

3.3.4. Frequency Converters (If required)

This section outlines the necessary requirements and constraints related to Frequency converters.

3.3.4.1. Preferred Attributes

- **Efficiency, Flexibility, Redundancy:** If a frequency converter is required, it is important to choose the preferred attributes based on the specific needs of the OPS system.
 - **Efficiency:** Prioritizes energy savings and optimal performance.
 - **Flexibility:** Allows adaptable operations and easy integration with various systems.
 - **Redundancy:** Ensures reliability and continuous operation by providing backup options.

3.3.4.2. Indoor/Outdoor Type

- **Location Limitations:** Determine whether the frequency converter will be installed indoors or outdoors.
 - **Indoor:** Requires adequate ventilation and space for maintenance. Suitable for environments where protection from weather is needed.



- **Outdoor:** Must be designed to withstand environmental conditions such as temperature extremes, wind, and precipitation.

3.3.4.3. Accessibility to the Converter Room

- **Access During Operation:** If a frequency converter is required, clarify whether access to the converter room is permitted during operation. This is important for maintenance and monitoring purposes.

3.3.4.4. Cooling System: Air/Water Availability

- **Cooling Preferences:** Define the preferred cooling system for the frequency converter.
 - **Air Cooling:** Suitable for lower power applications and simpler installations. Requires clean, dry environments.
 - **Water Cooling:** Necessary for higher power applications. More efficient in removing heat but requires a reliable water source.
 - **Combination:** Some systems may use both air and water cooling to optimize performance.

3.3.4.5. Cooling System: Open/Closed Loop

- **Cooling Loop Preferences:** Define whether the cooling system should be an open or closed loop.
 - **Open Loop:** Uses external water sources and is simpler but may be less efficient and harder to control.
 - **Closed Loop:** Recirculates cooling water within the system, offering better control and efficiency.



3.3.5. Visual Aspects

- **Equipment Camouflage**

In areas where visibility is important, it may be necessary to hide or camouflage OPS-related equipment like cables, generators, or heat exchangers. This helps prevent them from being seen from certain angles and better integrates them with their surroundings.

Ports often use landscaping, architectural elements, and specific color schemes to hide or integrate equipment like cables, generators, and heat exchangers into their surroundings.

For example, the Port of Los Angeles uses green walls and other natural elements to camouflage OPS equipment. Similarly, the Port of Rotterdam strategically places OPS installations in less visible areas and uses conduits to hide cables.

- **Color Restrictions**

Some local regulations or design standards may require OPS equipment and infrastructure to use specific colors that match the overall aesthetic of the port.

- **Location**

Aesthetic limitations can influence where OPS installations are placed, preventing them from being in visible or high-traffic areas. This could interfere with the visual experience of port visitors and users.

- **Visual Impact of Cables**

The installation of cables and connections for the OPS system can pose an aesthetic challenge, especially if they need to be visible. Solutions like covers or conduits may be needed to minimize visual impact.



4. Cable Management Systems

4.1. Introduction

4.1.1. Main functions

A shore power cable management system (CMS) is a system that is designed to control, monitor and handle the power and control cables, and connectors that connect ships to shore-side electricity while at berth.

For typical shore connection application, specific equipment is necessary due to the operational and safety constraints resulting from the frequent, and temporary, connection of moving vessels (due to draft or tidal variation) to a fixed shore. Without such equipment, a shore connection operation with unmanaged cables would be unsafe, unreliable, and inefficient.

The cable management system shall fulfil the following key functions:

- a) be capable of moving the ship-to-shore connection cable, enabling the cable to reach between the supply point and the receiving point
- b) be capable of maintaining an optimum length of cable which minimizes slack cable, and prevents the tension limits from being exceeded
- c) be equipped with a device, independent of its control system, to monitor maximum cable tension and maximum cable pay-out
- d) address the risk of submersion by prevention or through the equipment's design
- e) be positioned to prevent interference with ship berthing and mooring systems, including the systems of ships that do not connect to shore power while berthed at the facility
- f) maintain the bending radius of cables above the minimum bending radius recommended by the manufacturer during deployment, in steady-state operation and when stowed
- g) be capable of supporting the cables over the entire range of ships draughts and tidal ranges
- h) be capable of retrieving and stowing the cables once operations are complete



4.1.2. Design Minimum Standards

The cable management system shall be designed to be in compliance with requirements of:

- IEC/IEEE 80005-1 - Part 1: High voltage shore connection (HVSC) systems
- IEC PAS 80005-3 - Part 3: Low voltage shore connection (LVSC) systems
- IEC/IEEE 80005-2 - Part 2: HVSC/LVSC systems-Data communication for monitoring and control
- IEC 62613-1: Plugs, sockets-outlets and ship couples for HVSC. Part 1 (General requirements)
- IEC 62613-2: Plugs, sockets-outlets and ship couples for HVSC. Part 2 (Dimensional compatibility)
- IEC 60309-5: Plugs, sockets-outlets and ship couples for LVSC. Part 5 (Dimensional compatibility)

The CMS on shore is exposed to the harsh maritime environment. To ensure that the interface equipment is fit for purposes, the environmental conditions shall be specified. The expected performance of the CMS in these conditions shall also be specified. Typically, shall the CMS be able to operate in these conditions or to withstand these conditions, necessitating or not particular maintenance before the next operations.

4.2. Existing Solutions Overview of CMS Technologies and solution

A CMS is an engineering synthesis of a multitude of constraints such as:

- The type of vessels to be connected and the position(s) of their connection points.
- The layout of the quay or berths
- The environment in which the connection must be made and maintained.
- The specific operational requirements from the ports and/or the vessels.

Given the diversity of the above situations, cable management systems are often customized for each vessel type, terminal and even berth. After more than 20 years, there is now a diversity of system concepts and technologies.

Vessels (type, dimensions, position, equipment...) influence drastically the type of CMS to be provided. The IEC 80005-1 and its ship type-based annexes are defining compatibility and safety requirements for the electrical and control system of the different ship types. There is however no

standard or guideline to homogenize the position of the connection point on the vessels, nor where the vessel must dock alongside a given berth. Consequently, the tender documentation will need to provide such information.

4.2.1. CMS for Cruise

It exists a variety of systems today with varying architecture, footprint and function and operation. Here are some examples.

Mobile Cable Management System (MCMS)

A MCMS brings the Ship to shore cable in front of the vessel hatch. The system is connected to the grid through shore-side cables stored in a cable reel on the MCMS. The cables could be laid on the floor or in trenches. The MCMS can be self-propelled or towable.

Mobile CMS with Cable Chain

Similar to the previous system but with a cable chain installed underground providing a connection to the grid. This connection could be permanent or established before each connection.

Fix CMS

Simple solution adapted for berth having either the freedom of positioning the vessel hatch right in front of the CMS, or for berths welcoming vessel with a known and defined hatch position.





4.2.2. CMS for RoPax/RoRo/PCTC

A variety of solutions to meet the needs of a berth connecting to a specific vessel, or multiple different vessels. The CMS would have flexibility both in height and longitudinal coverage.

Fixed Jib Crane CMS (with or without telescopic arm)

A jib-crane solution that is permanently installed on the shore side at a fixed location for a fast and safe vessel connection to shoreside electricity. The CMS height and reach are designed to each terminal's needs.

Mobile Cable Management System (MCMS)

A MCMS brings the Ship to shore cable in front of the vessel hatch. The system is connected to the grid through shore-side cables stored in a cable reel on the MCMS. The cables could be laid on the floor or in trenches. The MCMS can be self-propelled or towable.



Fix Arm Jib Crane CMS



Foldable arm Jib Crane CMS



Telescopic CMS with Reel



4.2.3. Connection point for Containership

As per IEC 80005-1 the CMS for container is on the vessel, the shore is therefore hosting a connection point.

Fix connection point

Floor mounted or underground connection point have been the historical solution for container terminals



Fix Socket Box underground

Fix Connection points Add-on: To increase the coverage of fix connection points, complementary systems have been created to close the gap between a fix connection point and the vessel connection area.



Liftable connection point add-on



Self powered Connection point add-on



Mobile connection points: These systems propose a mobile connection able to cover between 100m and 400m of quay with only 1 connection mobile connection point and 1 to the substation. They can be installed in different positions typically at the quay edge: on top of the quay or on the quay wall.



Mobile connection point on the quay wall



Mobile connection point from Cable Reel with Cable chain

4.2.4. Other vessels

For various other types of vessels, a versatile cable reel system could be used.





4.3. Recommendations

As presented in the introduction, a CMS is an engineering synthesis of constraints coming from 4 main domains: The vessel(S), the berth(s), the environment, and the operations. As a result, a CMS is often customized by project, or even by berth and a great deal of information is necessary to design a suitable CMS.

The below listed information can be provided directly in the tender or in attached documents such as drawings of the quay/berth.

4.3.1. Standards

As for the other subsystem, the IEC 80005 series give a good framework to what a cable management system should do. However, the standard leaves also open certain points for interpretation or as option, hence the tender shall specify:

- Whether the system shall be fully compliant with IEC 80005-1/3 or if deviations are allowed or required.
- Which options described in the IEC 80005-1/3 have been selected (e.g. Use of communication)
- If other technical standards or guidelines are applicable
- The order of precedence in case of contradiction between standards, guidelines, or specific technical requirements that might be listed in the tender. Examples: Local habits/standard vs international, industry specific standard like O&G vs others.

EOPSA Recommendation: For efficiency reasons we recommend giving by default precedence to 80005-1/3 requirements and occasionally & explicitly deviate from that approach if /when necessary.

4.3.2. Space & Access: Quay or berth information

The space available on the berth to install, move into place and operate a CMS is a key driver of the CMS design and performance. It is recommended to give in the tender document the maximum



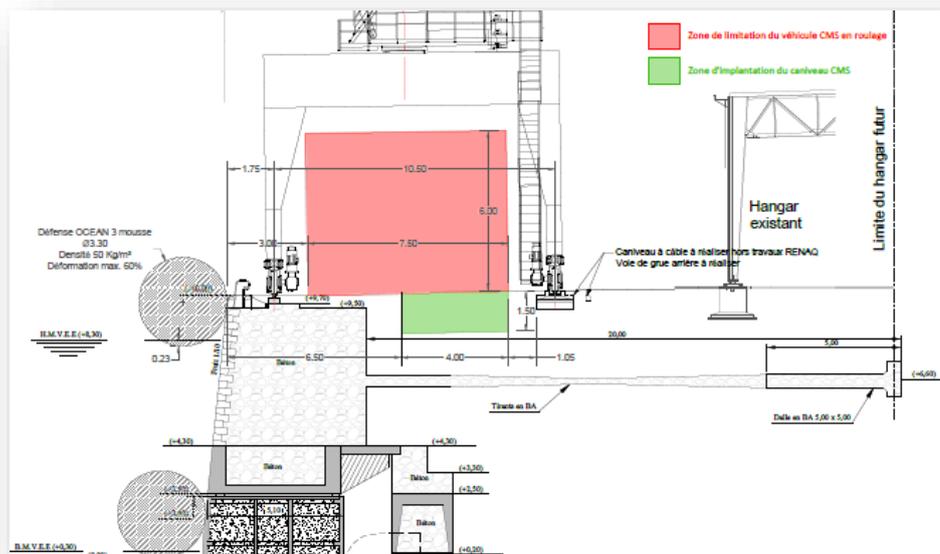
information available concerning the spatial, structural, or operational constraints on the berth but also to specify clearly whether some constraints are absolute or negotiable.

Eg: the position of a CMS might be constrained by existing equipment or procedure/order of operation. Signaling such constraint as negotiable could allow CMS providers to propose more cost efficient, compact, or operational friendly equipment.

Typical information to be provided is:

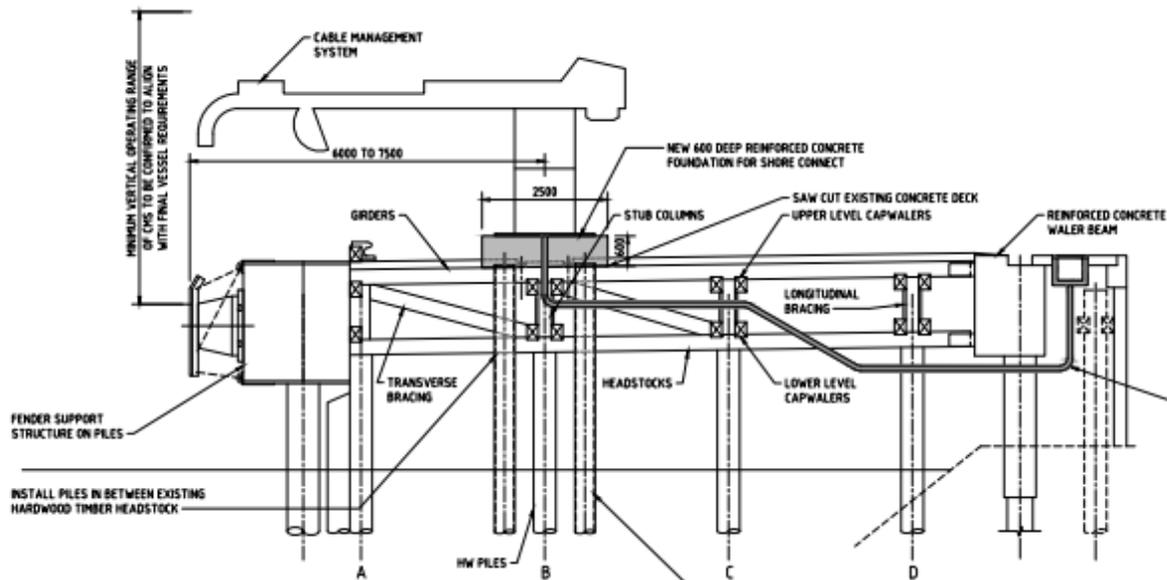
- The available space on the quay (footprint) but also above the quay (operating volume) and below the quay surface are available for the installation or movement of the CMS and its operations
- The dimensions (compressed/uncompressed) and type of fenders
- The position, nature, and dimensions of quay furniture (Bollard, Fire hydrant, fresh water/wastewater tank connection, fences,) and their own operating volume if relevant.
- The position, dimensions and operating volumes of other mobile equipment or personal potentially using the berth at the same time as the CMS. Typically Cranes, Passenger boarding bridges, trucks, and other service vehicles

Most of the above information can be easily communicated via General Arrangement and Cross section drawings of the existing or planned berths. (examples below).





Quay cross section with spatial constraints on, above and below quay surface for a mobile CMS



Quay cross section for a fixed CMS

4.3.3. Location on the quay for the connection

In the top view drawing, indicate the area where the connection with the vessel could take place.

The tender shall specify the exact or the likely positions of the vessels shore power connection hatches along the quay.

This information can be obtained through a berthing analysis and results communicated via drawings.

Typical results of such berthing analysis are:

- 1 or a few distinct connection points
- 1 or few areas typically 10m or 20m long along the quay
- A continuous area all along the quay

Combined with the general arrangement and cross section drawings of the berth this information will impact significantly the early stage of the project with the selection of the right concepts but also the detailed design.



The tender document shall specify the relative position and dimensions of the shore power hatches and connection point the different vessel(s) calling or intended to call at the port

- Min/Max height of the access point of the vessels compared to the vessel floating line (water level), taking into account draft variation.

Note: In case of connection point accessible through hatches, the min/max height shall refer to the center of the hatch

Hatch dimension (width/height)

Position of the connection points for Power and control inside the hull or maximum required length of cable inside the vessel.

If not specified, we recommend using the following dimensions for different ship types

- Cruise: 5m
- RoRo/RoPax/PCTC: 3m
- Containerships: not applicable CMS on ship
- Other ship types: case by case, we recommend a fleet census

4.3.4. Maximum number of connections per CMS per year

By setting up a maximum number of connections per year, per CMS, it can effectively manages the design and maintenance of the OPS system. This information would help to analyze and have information about the following points:

- **Annual Connection Limit:** Determine the maximum number of connections the CMS can handle per year. This helps in planning the capacity and ensuring the system can meet the demand.
- **Usage Patterns:** Analyze the usage patterns to understand peak times and average connection rates. This information is crucial for optimizing the system's performance.
- **Maintenance Schedule:** Establish a maintenance schedule based on the connection limits to ensure the system remains reliable and efficient.
- **Scalability:** Plan for scalability to accommodate future growth in the number of connections.



4.3.5. On board sockets and connection hatch location

This calculation helps ensure that the CMS system can accommodate the varying heights of different vessels, providing reliable and efficient shore power connections.

EOPSA members' recommendation; For each quay, provide extreme measurements for the different expected vessels.

Maximum height relative to the quay: To get this data, take the high tide and the empty vessel situation and calculate the following:

- Maximum height relative to the quay = High tide sea level + ship type max hatch height*

*Ship type max hatch height by default:

Cruise Ships: 5 meters

Ferries: 10 meters

Minimum height relative to the quay: To get this data, take the low tide and laden vessel situation and calculate the following:

- Minimum height relative to the quay = low tide sea level + ship type minimum hatch height*

*Ship type minimum hatch height by default:

Cruise Ships: 3 meters

Ferries: 5 meters

Distance between socket and hull (Depth): Determine the distance required to reach the sockets inside the vessel. This measurement ensures that the OPS system can effectively connect to the ship's electrical system, taking into account the depth of the hull and the location of the sockets.

4.3.6. Operation

Beyond the technical constraints mentioned above, the operational requirements of the future operator of the OPS installation can significantly influence the type and features of the CMS to be selected. For many ports and terminals, operating an OPS installation, particularly a CMS, is a new experience, making it challenging to envision the operational aspects.

Ports can reach out to the growing number of ports and terminals equipped with OPS systems in Europe and worldwide to gain insights and feedback. However, it's important to remember that the feedback will be limited to the specific perspectives and constraints of those ports and terminals.

EOPSA recommends allocating sufficient time during the tender preparation to discuss in depth the expected operations of the CMS at the terminal. This includes examining the impact of various requirements on the technical feasibility, cost, and other operational aspects of the equipment.

Key aspects to consider include:

- **Additional tools or equipment required for CMS handling**
(e.g., truck, forklift, crane)
- **Time constraints for CMS operation**
 - When the system must or must not be operated
 - Required speed for connection and disconnection
- **Interfaces or potential conflicts with other berth operations**
(e.g., mooring, loading/unloading, cargo handling, passenger boarding bridges, or reuse of OPS equipment on another berth)
- **Operational constraints related to time of day or weather conditions**
(e.g., night operations, rain, wind, or local regulations and customs)
- **Interaction with other systems or teams**
 - CMS handling only
 - CMS and substation operation
 - Coordination with other technical or operational teams
- **Staffing requirements**
 - Number, qualifications, and responsibilities of maintenance personnel
 - Maintenance frequency and scheduling
- **Training needs**
 - Initial and ongoing training to ensure skill retention and safe operation



4.3.6.1. Who Operates the CMS?

Identify the Key Role: Defining this role is crucial for the operation, training provided by the supplier, and understanding the responsibility for the proper functioning of the equipment. The key roles examples are Port Authority or Terminal Operator.

4.3.6.2. How many people are expected to be operating the CMS?

Operating the CMS involves:

- Controlling the equipment and handling cables and sockets as primary operations
- Manage the equipment and handle cables and sockets. They are responsible for controlling the equipment, ensuring proper connections, and performing maintenance tasks.

Depending on the project scope, the CMS may be operated by no personnel or by multiple teams, each consisting of 3 to 4 qualified operators.

4.3.7. Tide Variations

The tender shall also specify the range of tidal variations to be considered for each given berth.

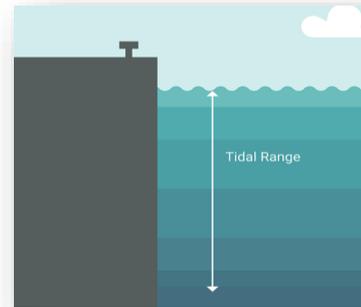
Typically, the following information shall be provided

- Reference level and distance to the quay level
- high tide level
- low tide level

For operations, EOPSA members' recommendation is using the regular high spring tides and low neap tides levels instead of the historical high/low or decennial or centennial values.

High Tide Level: Meters Above Sea Level: Use the regular high spring tide reference level and distance to the quay level.

Low Tide Level: Meters Above Sea Level: Use low neap tides levels reference level and distance to the quay level.



4.3.8. Interfaces

When implementing an OPS system, it is essential to clearly define the interfaces with other systems to ensure seamless integration, operational efficiency, and clarity of responsibilities.

Given the varying scope of supply for the Cable Management System (CMS), the nature and complexity of these interfaces can differ significantly. EOPSA strongly recommends that the tender documentation explicitly defines all relevant interfaces, with particular attention to the following areas:

1. Interface with the Electrical Distribution System

- Type and specifications of cables and connectors
- Exact location of the interface (e.g., on the CMS, on the quay, or elsewhere)
- Responsibilities for the supply and installation of these components

2. Interface with the Control System

- Number, type, and location of cables and connectors
- Communication protocols to be used
- Integration with existing or planned control infrastructure



3. Interface with Civil Works

- Dimensions, weight, and positioning of equipment to be installed
- Responsibilities for the supply and installation of fixed infrastructure
- Timeline for design finalization and installation coordination

4. Interface with Other Subsystems

In some cases, interfaces with other subsystems may be left to the general contractor's discretion and not fully specified in the tender. If so, it is recommended that tenderers allocate sufficient time and resources for coordination among contractors and subcontractors to define and agree on these interfaces during the project execution phase.

5. Automation and supervision

5.1. Introduction

The operational methodology of an OPS System is crucial in ensuring the safe, efficient and reliable operation of the system. Whilst every system may have different control requirements and schemes, there are fundamentally two main parts required to operate an OPS system, namely the Automation and Supervision

The tender must include a detailed description of the required system operation and the necessary interactions with stakeholders.

Automation System

The Automation system refers to the control functionality and subsequent software programming required to operate all of the equipment required in a shore power system. For a typical system, the automation system would read the requested system input parameters and then control the shore power system to ensure that those parameters were achieved whilst also ensuring safe



operation within the system design limits. Depending upon system scope, this may also include operation of the connection/disconnection system and any ancillary sources of power.

Supervision System

Unlike the Automation system, the role of the supervision system is to allow the key Port stakeholders to input and extract high level information from the system. Whilst the details of the Automation System are rarely seen, the Supervision system would typically consist of a local HMI screen (human machine interface), or SCADA PC through which the key system parameters can be input and then monitored. This system would also alert the user to any system abnormalities in the form of alarm text or fault messages.

The purpose of the Automation and Supervision system together should be to ensure maximum visibility of the system status whilst also achieving minimum exposure of Port personnel to any electrical safety risks by providing all data to a safe location.

5.2. Existing solutions

Here are some of the advanced solutions available in the market for automation and supervision systems in ports:

Automation Systems

- **Comprehensive Automation Solutions:** These systems include electrical and control systems that enhance operational efficiency and safety. They integrate with existing infrastructure and provide real-time monitoring and control.
- **Energy Management and Control Systems:** These solutions focus on optimizing energy use, managing power distribution, and improving operational efficiency. They are designed to reduce operational costs and enhance reliability.
- **Integrated Automation Systems:** These systems offer a combination of energy management, control systems, and digital solutions to streamline port operations and ensure smooth functioning.

Supervision Systems

- **Advanced SCADA Systems:** These systems provide real-time data acquisition, monitoring, and control. They enhance operational visibility and improve decision-making processes.



- Comprehensive Monitoring and Control Systems: These solutions include SCADA and HMI systems that offer detailed insights into port operations and improve operational efficiency.
- Integrated Supervision Solutions: These systems combine advanced monitoring and control capabilities with seamless integration into existing infrastructure, ensuring reliable and efficient port operations.

5.3. Recommendations

5.3.1. Automation system considerations

The main reason to implement an automated OPS system is to avoid manual operations, which can be time-consuming, prone to human error, and potentially hazardous. Automation enhances efficiency, safety, and reliability in port operations.

5.3.1.1. Safety Integrity Level (SIL)

SIL is a measure of the reliability and performance of safety systems, indicating the level of risk reduction provided by a safety function. There are three SIL levels (SIL 1 to SIL 3), with higher levels corresponding to greater risk reduction and reliability.

- SIL 1: Provides the integrity required to avoid relatively minor incidents.
- SIL 2: Ensures the integrity to avoid more serious incidents, potentially resulting in serious injury or death to one or more persons.
- SIL 3: Required to avoid serious incidents involving multiple fatalities and/or serious injuries.

If there is an expected safety rating for the system, please state.

Note: If the operators of the system are not trained and certified for high-voltage (HV) equipment operation, the system will likely need to be fully automated.



5.3.1.2. Redundancy in Automation System

A redundant automation system in ports involves incorporating backup components and systems to ensure continuous operation in case of primary system failures. This redundancy can be applied to various aspects, such as power supplies, network connections, and control systems.

While redundant automation systems in ports offer significant benefits in terms of reliability, safety, and performance, they also come with challenges related to cost, complexity, maintenance, cybersecurity, and training. Careful planning and investment are required to maximize the advantages while mitigating the challenges.

5.3.1.3. Cybersecurity in Automation System

Integrating the OPS system into the existing cybersecurity framework enhances protection against cyber threats, ensures operational continuity, meets regulatory compliance, maintains data integrity, and can lead to significant cost savings. However, this integration also presents challenges such as increased complexity, the need for substantial resource allocation, the necessity to keep up with evolving threats, ensuring interoperability between different systems, and the requirement for ongoing training for personnel. Balancing these benefits and challenges is crucial for successful integration

5.3.1.4. The level of automation required

Relation to the Workforce

Implementing an automated OPS system could change the need for manual labor, allowing port operators to focus on more skilled tasks such as monitoring and maintaining automated systems.

Training and upskilling the existing workforce are essential to ensure they can effectively manage and operate the automated systems.



5.3.1.5. Key Roles in Operating the System

Defining these roles is essential for the successful operation of the OPS system. It helps with providing targeted training by the supplier, ensuring that each team member understands their responsibilities and can perform their tasks effectively.

Team for Manual System Operation

In a manual system, the team typically includes:

- **Electrical Technicians:** Skilled in handling high-voltage equipment and performing manual operations. They are responsible for physically connecting and disconnecting ships to the OPS system, ensuring safe and efficient power transfer.
- **Maintenance Personnel:** Responsible for regular maintenance and troubleshooting of the system. They perform routine checks, repairs, and ensure that all equipment is in good order.
- **Safety Officers:** Ensure compliance with safety protocols and procedures. They monitor operations to prevent accidents, conduct safety drills, and ensure that all personnel follow safety guidelines.

Team for Automatic System Operation

In an automated system, the team usually comprises:

- **System Operators:** Trained to monitor and control the automated OPS system using SCADA (Supervisory Control and Data Acquisition) interfaces. They oversee the system's performance, respond to alerts, and ensure that the automation processes run smoothly.
- **IT Specialists:** Manage cybersecurity and network integration to ensure secure and reliable operations. They protect the system from cyber threats, ensure seamless communication between different components, and handle any IT-related issues.
- **Maintenance Technicians:** Focus on preventive maintenance and system diagnostics, leveraging Asset Performance Management (APM) tools. They use data analytics to predict and prevent equipment failures, ensuring that the system operates efficiently.
- **Safety Engineers:** Ensure the automated system adheres to safety standards and protocols. They design and implement safety measures, conduct risk assessments, and ensure that the automation system is safe for operators and equipment.



Determining whether an on-site operator is necessary is crucial for ensuring smooth operations and immediate response to any issues that may arise

5.3.1.6. Operating locations

From where would they be operating the automation system? The location from which the OPS automation system is operated is crucial for efficient and safe port operations. This should be defined by the client based on their specific needs and infrastructure. Common examples include:

- **Control Room:** Centralized location where operators can monitor and control the OPS system using SCADA interfaces.
- **Operations Centre:** A hub for coordinating port activities, including the management of the OPS system.
- **CMS (Central Management System):** A system that integrates various operational aspects, providing a comprehensive view and control of port operations.
- **Conversion Substation:** A facility where electrical power is converted to the required voltage levels for shore power supply, often equipped with automation controls.

5.3.1.7. Visible Information in the Automation System

In an OPS system at a port, it's crucial to have comprehensive and accurate data to ensure smooth and efficient operations. This should include:

Information to be Visible in the Automation System

- **Single Line Diagram (SLD):** This diagram provides a clear and simplified representation of the electrical network, helping operators understand the system layout and quickly identify any issues.
- **Protection and Control:** Ensuring the system has robust protection and control mechanisms is vital for preventing faults and managing the electrical flow safely.
- **Testing & Configuration:** Regular testing and proper configuration are essential to maintain system reliability and performance, allowing for timely adjustments and updates.

- **Emergency Functionalities:** Having emergency functionalities visible ensure that operators can respond swiftly to any unexpected situations, minimizing downtime and enhancing safety.

Required Input Parameters. Here below some examples:

- **Frequency:** Accurate frequency data is necessary to maintain the stability of the electrical supply and ensure compatibility with various equipment.
- **Voltage Level:** Monitoring voltage levels helps in maintaining the correct power supply to different parts of the port, preventing overloading and ensuring efficient energy use.
- **Cranes:** Including data on cranes helps in managing their power requirements and ensuring they operate smoothly without interruptions.
- **Prevision Consumptions:** Forecasting power consumption allows for better planning and resource allocation, ensuring the system can meet future demands.

Required Output Data

- **Real Power Consumption:** Tracking real power consumption helps in understanding actual energy usage, optimizing operations, and reducing costs.
- **Power Quality:** Monitoring power quality ensures that the electrical supply is stable and reliable, preventing damage to sensitive equipment and maintaining operational efficiency
- **Anticipated failure modes:** Refer to the potential ways in which a system might fail. Identifying these modes is crucial for several reasons: Proactive Maintenance, Operational Efficiency, Safety, Cost Savings and Reliability. Here below some examples of anticipated failure modes:
 - **Equipment Failure:** Wear and tear, manufacturing defects, or inadequate maintenance can lead to equipment failure. Example: Transformer failure disrupts power supply.
 - **Human Error:** Mistakes by operators, such as incorrect configuration or delayed response to alarms.
 - **Common Mode Failures:** Multiple systems failing due to a shared cause, like a design flaw or external event. Example: Software bug affecting multiple control systems.
 - **Cybersecurity Breaches:** Attacks compromising data integrity and control mechanisms.



- Environmental Factors: Natural events like storms or earthquakes damaging infrastructure

5.3.2. Supervision system considerations

When implementing an OPS system in a port, it's essential to consider the supervision system to ensure efficient and reliable operations.

SCADA stands for Supervisory Control and Data Acquisition. It is a control system architecture that uses computers, networked data communications, and graphical user interfaces (GUIs) to manage and control industrial processes. SCADA systems collect real-time data from sensors and devices, process this data, and display it on Human-Machine Interfaces (HMIs) for operators to monitor and control the processes.

The SCADA system plays a crucial role in managing the automation of the OPS on the shore side, ensuring the safety of operators. It serves as the main interface for port operators, allowing them to start and stop the OPS, record power consumption, and handle billing. Additionally, for the conversion hub, the SCADA system manages all reconfigurations to match the power capabilities requested at port berths.

Various manufacturers offer supervision systems for OPS systems, and while their solutions may be similar, the choice often depends on cultural habits and operational preferences. These systems can operate in fully manual, semi-automatic, or fully automatic modes.

Here are some key considerations:

5.3.2.1 Existing SCADA System

If the port already has a SCADA system, specifying the type (e.g., Geo SCADA, Modbus, DNP3) helps in planning integration.



5.3.2.2 Necessity of SCADA System

Implementing a SCADA system is often necessary for OPS projects to ensure real-time monitoring and control. For instance, SCADA systems in energy management allow for accurate measurement and remote monitoring, enhancing reliability and safety.

5.3.2.3 Required Functionalities

Key functionalities like data storage duration, alarm systems, and remote access levels are crucial for effective monitoring. For example, SCADA systems can store data for extended periods, allowing detailed analysis and reporting. Alarm systems can alert operators to issues like equipment failures or cybersecurity breaches.

5.3.2.4 Integration Capabilities

Integration with the port's energy system ensures coordinated operations. For example, integrating SCADA with the port's energy management system can optimize energy use and enhance operational efficiency.

5.3.2.5 Operation Location

Knowing where the supervision system will be operated from helps in planning the necessary infrastructure. For example, if the system is operated from a central control room, ensuring robust communication links and access to all necessary data is essential.

By considering these aspects, the supervision system for the OPS project can be designed to enhance reliability, safety, and efficiency, ensuring smooth port operations.





5.3.3. Preventive Maintenance

The supervision system, also known as Asset Performance Management (APM), plays a crucial role in monitoring assets and assisting operators with preventive maintenance needs.

Preventive maintenance involves regularly scheduled inspections, adjustments, and repairs to prevent unexpected breakdowns. Unlike reactive maintenance, which deals with issues after they occur, preventive maintenance focuses on minimizing downtime and extending the equipment's lifespan.

Preventive maintenance in an OPS system at a port involves scheduled activities designed to prevent equipment failures and extend the lifespan of the equipment. Here are some key types of preventive maintenance:

- **Routine Inspections:** Regular inspections of electrical components, transformers, and other critical equipment help identify potential issues before they lead to failures. For example, inspecting transformers for signs of wear or overheating can prevent unexpected power outages.
- **Lubrication:** Proper lubrication of moving parts, such as cranes and mechanical systems, reduces friction and wear. This includes selecting the right lubricant, applying it at the correct frequency, and ensuring all lubrication points are adequately serviced.
- **Cleaning:** Regular cleaning of equipment and systems prevents the buildup of dust and debris, which can cause overheating and reduce efficiency. For example, cleaning cooling systems and air filters ensure optimal performance.
- **Component Replacements:** Replacing worn-out components, such as filters, belts, and seals, before they fail ensures continuous operation. For instance, replacing air filters with electrical systems prevents dust accumulation and overheating.
- **Calibration:** Periodic calibration of sensors and control systems ensures accurate data collection and system performance. This includes calibrating voltage and frequency sensors to maintain stable power supply.
- **Software Updates:** Updating software and firmware in control systems and SCADA systems ensure they are protected against vulnerabilities and operate efficiently. Regular updates can prevent cybersecurity breaches and improve system reliability.
- **Predictive Maintenance:** Using advanced monitoring technologies and data analytics to predict when equipment failure is likely to occur. This proactive approach allows for



- scheduling maintenance activities in advance, reducing downtime and improving efficiency.

For preventive maintenance, specific modules and hardware are required rather than standard solutions. This includes:

- **Condition Monitoring Sensors:** These sensors monitor the health of equipment and detect signs of wear or degradation.
- **Data Analytics Tools:** Tools that analyze data from sensors to predict potential failures and schedule maintenance activities.
- **Maintenance Management Software:** Software that helps plan, schedule, and track maintenance tasks, ensuring timely interventions.



6. Conclusion

Decarbonizing maritime transport requires the rapid, coordinated, and technically robust deployment of OPS systems across European ports. This guide, developed by EOPSA members, serves as a practical and actionable resource for both public and private stakeholders involved in OPS projects.

By combining field experience, technical standards, and industry best practices, it aims to reduce uncertainty, enhance the quality of tenders, and support the delivery of safe, reliable, and future-ready installations.

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Annex 1 - Checklist for a comprehensive and successful OPS tender

GENERAL INFORMATION					
Checklist	To be fulfilled	Magnitude	Additional information	Comments	
1 POWER SOURCE ORIGIN					
	National electricity grid		The name of the utility and any particular standard		
		Yes/No	Is sufficient additional grid capacity available?		
	DNO (Distribution Network Operator)		Name		Is there any particular specification that we have to adhere to? Please refer to it.
	DSO (Distribution System Operator)		Name		Is there any particular specification that we have to adhere to? Please refer to it.
	Local port internal distributed energy system		Yes/No	Is there an existing local port internal distributed energy system in place?	
2 INPUT ELECTRICAL DATA FROM THE GRID					
	Grid supply voltage		kV	OPS systems are typically connected to high or medium voltage grids, typically in the range of 33 kV, 66 kV, or 110 kV on the primary side.	
	Frequency		Hz	50/60 Hz	
	Load capacity		kVA	$kW = kVA \times \text{Power Factor}$	
	Power factor			The power factor of an electric load is the ratio of real power to apparent power. This information is usually defined by port electrical team, based on the DSO Power factor limit and existing power factor.	
	Power quality			Level of harmonics, voltage variation and existing power quality are important to verify that the grid is compatible with the vessel (See Table 3.3 from EMSA Guidance on SEE to Port Authorities and Administrations).	
	Short circuit capacity		kA	Substations must be designed to withstand the maximum expected short-circuit currents in the installation, both on the medium voltage side and the low voltage side.	
	Assessment of the capability to the grid connection			Define the current harmonic limit for the Shore connection system. Disturbance create by the OPS to the Grid.	
	Impedance		(Ω)	The network impedance directly affects the quality and stability of the electrical supply to ships. Incorrect impedance can cause issues such as voltage fluctuations, energy losses, and equipment overheating. Additionally, it is essential for the proper sizing of circuit breakers and fuses, ensuring that these devices function correctly in the event of short circuits.	
	Power reversibility need			This feature is useful if the ports want to get supply from the vessels, or if some vessels need to have minimum loads on their	

				generator. It is usually not included as it impacts CAPEX, footprint and requires specific agreement with DSO.	
	Metering requirements			Metering is emphasized as a function with a dual purpose: measuring the electricity supplied for contractual reasons and assessing quality parameters. Is there a requirement or agreement with the local energy authority?	
3	FUTURE POWER DEMAND TO BE CONNECTED				
	Future power demand to be connected		MVA	By taking the 80005-1 standard levels per vessel type and multiplying by the maximum number of vessel to be connected in parallel By a finer analysis considering the actual consumption of the vessels and their berth occupancy levels if available	
	Max power per berth		MVA		
	Single or multiple vessels operations		N°	How many ships you need to connect and when?	
	Type of vessels		List	Vessel types in order to define the maximum peak power requirement.	
	Maximum supply size estimated		MVA	Calculated based on the data above.	
4	UPGRADABILITY / SCALABILITY			What upgradability or scalability plans does the port authority have in mind for the OPS infrastructure at the port? The tendered shall verify that the requested installation space and type is compatible with the upgradability/scalability requirement of the system linked with forecasted port evolution.	
	EOPSA members' recommendation	The electrical infrastructure needs to be aware of the future phases of the OPS to ensure compatibility and scalability. This includes planning for potential upgrades, integrating new technologies, and maintaining flexibility to adapt to evolving requirements			
5	ENVIRONMENTAL ASPECTS				
	EOPSA members' recommendation	Use the average environmental data from the past 10 years to ensure they are representative of the location of the port			
	Maximum external ambient temperature		°C	Any conditions outside this range will require a personalized, specific solution or customization. For example : The standard solutions are designed to operate correctly within an ambient temperature range of 0°C to 40°C (For Conversion substation electrical equipment) and -10°C to 45 °C (for CMS System).	
	Minimum external ambient temperature		°C		
	Hurricane/ Typhoon risk		Yes/No	Is the port located in an area with a risk of typhoons and/or hurricanes?	
	Snow: maximum snow load		kg/m²	Indicate the maximum snow load on record. This information impacts the mechanical sizing of some equipment, such as the CMS.	
	Icing level		(mm) or (cm)	Indicate the average thickness of the ice layer that forms in the port. This data affects the mechanical sizing of certain equipment.	
	Average solar radiation		Watt/m2	Indicate the average solar radiation, which impacts electronic equipment and therefore the level of protection we need to provide.	
	Humidity		%		

	Saline and Corrosive Environments level		Normal or High.	Please take into account that the saline levels can vary depending on how close the substation is to the shore. Ports are very corrosive places, so we must plan how to handle this (standard products are not design for this environments).	
	Dust level		Yes/No	Indicate the dust level in the exterior of the port, which will impact the IP rating for the design of certain equipment such as electrical cabinets.	
	Risk of Flooding		Yes/No	Additional information	
	If there is a risk of Flooding , level above sea level.		(m) or (cm)	On the quay and the depots/operating area and parking, is the water level above a reference level (e.g., sea level)? Examples? Yes/No. Impact on GC, architecture.	
	Noise level limitation		Yes/No	Coming from transformers, fans, frequency converters.	
	Seismic risk		Yes/No	Is the port located in an area with a risk of seismic activity?	
	Wind speed		(km/h) or (m/s)		
	Wind speed Max Destruction		(km/h) or (m/s)	It refers to the maximum wind speed that can cause significant damage to structures, vegetation, and other surfaces. According to the NOAA National Severe Storms Laboratory: Damaging winds are classified as those exceeding 50-60 mph (80-97 km/h). Severe storm winds can reach up to 100 mph (160 km/h) and can produce a path of destruction extending for hundreds of miles.	
6	EXPECTED LIFE TIME				
			Years	What is the expected lifetime that the port authority desires for the requested OPS system? The requested information is the time period (in years) before a major overhaul or replacement of the system. Note: The lifetime requirement will impact the technology of conversion and the CAPEX .This information is usually included in the business plan. Concession time and financial of investment.	
OPERATION					
	Checklist	To be fulfilled	Magnitude	Additional information	Comments
1	MODE OF OPERATION: Please note that the type of connection, depending on the type of ship, will determine the type of operation.				
	Who would operate the OPS system?			Port employees / External company?	
	Interface with vessels			Have you defined the need to operate the system with the final users (ships)? Limits between operation of the OPS and the ship.	
	Mode of operation		Manual / Automatic /Semi automatic	How do you want to use your system? Explain the different ways to make the connection: Manual / Automatic. Pros and cons of each method.	
2	MAINTENANCE				
	Maintain the substation			Who will maintain the substation? (Local port personnel or subcontractor).	
	Maintenance parameters			What are the necessary parameters for maintenance? The quality of the connection - Endurance of the plug. Electrical installation (energy distribution).	
	Predictive Maintenance			If you want to have predictive maintenance, you need data at each point of the diagram. What are the data? Where should the data be sent?	

	Response time		Hours/days/weeks	<p>What are the expected uptime and response times for repair and maintenance? NOTE: The less stringent the response times, the cheaper the service will be. This means that if the system allows for more flexible and extended response times, the overall cost of the service can be reduced. This is because less immediate resources and rapid interventions are required, leading to lower operational costs. Conversely, if the system demands very tight and immediate response times, the service will be more expensive due to the need for more resources and quicker interventions.</p>	
3 TRAINING					
	Training			<p>What are the training expectations, if any, for the O&M personnel?</p> <p>This context is explained in the Word document. It details the differences between Medium Voltage (MV) and Low Voltage (LV), including how to operate MV while taking necessary precautions. The document provides examples from the industry and refer to relevant standards, emphasizing that routine work is not considered.</p>	
CONVERSION SUBSTATION					
	Checklist	To be fulfilled	Magnitude	Additional information	Comments
1 FOOTPRINT CONSTRAINT: Space & access					
	Space available & constraints		Drawings	Please define the space available for the installation of the substation, as well as any installation constraints related to the soil or building. Please attach as many plans as possible to identify these restrictions in as much detail as possible.	
	Access limitations		Drawings	Any restrictions on access for equipment deliveries and maintenance activities should be considered. Please attach as many plans as possible to identify these restrictions in as much detail as possible.	
	Base load			Is there a maximum ground loading for the substation location?	
2 INSTALLATION TYPE FOR THE SUBSTATION					
	Indoor Substation		Yes/No	Are existing buildings/Switchrooms available that can be used? Would you prefer an indoor substation within an existing building, featuring dedicated infrastructure?	
	Outdoor Substation		Yes/No	What type of outdoor substation is preferred?	
	Plug & Play: Metallic enclosure		Yes/No	Metallic enclosures are one of the most flexible and widely used Plug & Play solutions (Flexibility to move to another place).	
	Plug & Play: Other		Yes/No	Another type of enclosure for an outdoor substation can be those made of fiberglass, a Plug & play solution widely used in the UK market	
	Concrete enclosure		Yes/No	Take into account that obtaining the necessary construction permits may cause delays and longer delivery times, for example, 20 weeks for permits.	

3 TRANSFORMERS					
	Type of insulation		Identified the constraints	Are there any constraints regarding the type of transformer insulation? Such as: Dry Type, Esther Oil or Bio Oil?	
	Installation constraints		Identified the constraints	Are there any constraints regarding the location of the transformer? Indoor / Outdoor / other	
	Energising the transformer		Identified the limitations	Are there any grid code limitations regarding energizing or de-energizing the transformer? If there are no limitations, we need to highlight the different solutions for transformers that can be switched on or off and the number of operations that can be performed. This limitation affects the type of solution, usage, and lifetime. The solution should be adapted to the intended usage by the end user	
	Local applicable requirements			Example: ECO design directives are applicable? Explain the impact price, consumption, dimensions.. Technical limitations.	
4 FREQUENCY CONVERTER (If required)					
	What is your preference? Efficiency, flexibility , redundancy		Choose one of the options.	If a frequency converter is required, what are the preferred attributes: Efficiency / flexibility / redundancy / other?	
	Indoor /Outdoor type		Choose one of the options.	If a frequency converter is required, are there any limitations regarding its location? For example, inside or outside?	
	Accessibility to the converter room		Yes/No	If a frequency converter is required, is access to the converter room permitted during operation?	
	Cooling : air / water availability		Define your preference	If a frequency converter is required, the cooling system could be air, water, or a combination of both. Are there any location-based limitations that would affect the choice between air or water cooling? The choice depends on the power of the frequency inverter and the architecture they want to apply. Higher power requires a water cooling system. Do they have a preference? Note: If you require any clarification, please contact EOPSA experts (contacts in the word document)	
	Cooling : Open / Closed loop		Define your preference	If a frequency converter is required, the cooling system could be a closed or an open loop. Are there any limitations that would affect the choice between these two options?	
5 VISUAL ASPECTS					
	Equipment Camouflage			In areas where visibility is important, it may be necessary to hide or camouflage OPS-related equipment, such as cables, generators, or heat exchangers, to prevent them from being seen from certain angles or to better integrate with the surroundings.	
	Colour restrictions			Some local regulations or design standards may require OPS equipment and infrastructure to use specific colours that align with the overall aesthetic of the port, thus limiting design options.	
	Location			Aesthetic limitations can influence the location of OPS installations, preventing them from being placed in visible or high-traffic areas, which could interfere with the visual experience of port visitors and users.	
	Visual Impact of Cables			Visual Impact of cables: The installation of cables and connections for the OPS system can pose an aesthetic challenge, especially if they need to be visible. This may require solutions that minimize visual impact, such as the use of covers or conduits.	

CABLE MANAGEMENT SYSTEM

Checklist	To be fulfilled	Magnitude	Additional information
1. STANDARDS			
IEC 80005-1/3		Yes/No Deviation	Should the system be fully compliant with IEC 80005-1/3, or are deviations allowed or required? In case of deviations, indicate them.
Version of the standard		Year	Indicate the version of the standard being referenced.
Type of ship		Choose one of the options.	Are the types of vessels commercial, non-commercial (e.g., Navy), or both?
IEC 80005-1/3 options		Indicate the selected Options	Which options described in the IEC 80005-1/3 standard have been selected, such as the use of communication FO for containers?
Other standards/Guidelines applies?		Yes/No (indicate)	If other technical standards or guidelines are applicable, could you provide examples? Additionally, how are conflicts or preferences between local country standards addressed?
Order of preference		Indicate the order	List the order of precedence in case of contradictions between standards, guidelines, or specific technical requirements that might be listed in the tender. Example 1 : Local practices/standards Vs international standards, Example 2: Industry-specific standards such as those for oil and gas Vs other sectors
EOPSA members' recommendation	For efficiency reasons, we recommend prioritizing the 80005-1/3 requirements by default and only deviating from this approach explicitly and when necessary.		
2 SPACE & ACCESS: Quay or berth information			
Available Volume for operation		Drawings	The available space on the quay, identified with a plan view and elevation view of the CMS location on the berth.
Available Volume for displacement /Transport		Drawings	(For mobile CMS) Consider the pathways, as the CMS will not operate at a fixed point, but will have a specific route along the quay.
Available Volume for parking		Drawings	(For mobile CMS)
Maximum load for operation		Tn /m2	To be consulted with your civil engineering experts.
Maximum load for Transport		Tn /m2	(For mobile CMS). Consider the pathways. To be consulted with your civil engineering experts.
Maximum load for Parking		Tn /m2	(For mobile CMS) To be consulted with your civil engineering experts.
Fender Type		Type	Indicate the type of defences used in the berths. (Examples: Omega, V fender)
Compressed Dimensions		m	Indicate the size of the fender when it is compressed and when it is decompressed.
Uncompressed Dimensions		m	This data affects the sizing of the CMS arm.
Type of quay furniture (Utilities network)		List/ Give the position and operation	For example: Bollard, fire hydrant, fresh water/wastewater tank connection, and fences have an impact on cable passages.
Mobile equipment or personal		List/ Give the position and operation	Typically, mobile or personal equipment at a port includes cranes, passenger boarding bridges, trucks, and various service vehicles.
External vertical drawing of the quay		Drawings	With the aim of identifying the location of elements such as fenders/safety ladders, which can be found on the external vertical plane of the quay.
Cross section & Top view drawings of the existing or planned berths		Drawings	To be consulted with your civil engineering experts. Google Earth images can be helpful, but they are not sufficient for this precise technical proposal of the CMS.
General Arrangement drawings of the existing or planned berths		Drawings	
EOPSA members' recommendation	A visit to the port is necessary to validate the environment in order to prepare the offer		
3 LOCATION ON THE QUAY FOR THE CONNECTION			

			Drawings	In the top view drawing, indicate the area where the connection with the vessel could take place.
4 MAXIMUM NUMBER OF CONNECTIONS PER CMS PER YEAR				
	CMS N°1		n° Connections /Year	This will quantify your design and maintenance plan.
	CMS N°2		n° Connections /Year	
	CMS N°3		n° Connections /Year	
5 ON BOARD SOCKETS AND CONNECTION HATCH LOCATION				
	EOPSA members' recommendation	For each quay, provide the extreme measurement for the different expected vessels.		
	Maximum height relative to the quay		m	To get this data take the high tide & the empty vessel situation and calculate the following: --> Maximum height relative to the quay = High tide sea level + ship type max hatch height* *Ship type max hatch height by default: Cruise: 5 m Ferry: 10 m
	Minimum height relative to the quay		m	To get this data take the low tide & laden vessel situation and calculate the following: --> Minimum height relative to the quay = low tide sea level + ship type minimum hatch height* **Ship type min hatch height by default: Cruise: 3 m Ferry: 5 m
	Distance between socket and hull (depth)		m	The purpose of this data is to determine the distance required to reach the sockets inside the vessel.
6 OPERATION				
	Who operates the CMS?		Identify the key role	Defining this role is important for the operation, for the training provided by the supplier, and to understand the responsibility for the proper functioning of the equipment. The key roles examples are: Port Authority, Terminal Operator..
	How many people are expected to operate the CMS ?		N° of people	Operating the CMS involves controlling the equipment and handling cables and sockets as primary operations.
7 TIDE VARIATIONS				
	High tide level		m above sea level	We recommend to use the regular high spring tide reference level and distance to the quay level.
	Low tide level			We recommend to use low neap tides levels reference level and distance to the quay level.
AUTOMATION & SUPERVISION				
	Checklist	To be fulfilled	Magnitude	Additional information
1 AUTOMATION SUPERVISION CONSIDERATIONS				
	SIL (Safety Integrity Rating)		Level SIL 1, 2, 3	Is there an expected safety rating for the system? If so, please specify. Note: If the operators are not trained and certified for high-voltage equipment operation, the system will likely need to be fully automated.
	Redundant System		Yes/No	Do you want your automation system to be redundant?
	Cybersecurity		Specify	Which is the existing OPS Cybersecurity system that you already have? The OPS system must be integrated in the system.
	Level of automation required		Manual /Automated	Could you specify what level of automation is required for the OPS?
	Who operates the system?		Identify the key role	Defining this role is important for the operation, for the training provided by the

				supplier, and to understand the responsibility for the proper functioning of the equipment. The key roles examples are: Port Authority, Port operator, Ship operator...
	Team to operate in case of manual system			
	Team to operate in case of Automatic system			
	From where would they be operating the automation system?		List	To be defined. Example: Control room, operations centre, CMS, Conversion substation.
	Which information you want to be visible in the Automation system?		List	Examples: SLD - single line diagram, Protection and control, testing & configuration, emergency functionalities..
	Required input parameters			To set the system we need, frequency, level of voltage, the cranes, Prevision consumptions.
	Required output Data			Ex: Real Power consumption, Power quality
2	SUPERVISION SYSTEM CONSIDERATIONS			
	Do you already have a Scada system in the port ?		Yes/No (type)	If the port already has a SCADA system, please specify the type.
	SCADA system		Yes/No	Is the implementation of a SCADA system necessary for the operation and monitoring of the OPS?
	If yes, SCADA System required functionalities		List	Which information you want to be visible in the Scada system? For example: data storage duration, alarm systems, remote access levels, and compatibility with existing infrastructure.
	If yes, SCADA System integration capabilities		List	Does it need to be integrated with the port energy system ?
	From where would they be operating the supervision system?			
3	PREVENTIVE MAINTENANCE			
	Preventive maintenance		Yes/No	Would you like to have preventive maintenance? For preventive maintenance, specific modules and hardware are required, rather than a standard solutions.