Electrifying Port Infrastructure

ESL Power Systems, Inc.

Corona, CA

- Established in 1991
- 100% Employee Owned (ESOP)
  - About 180 employees
- Production facilities - over 50,000 SqFt.
  - Fabrication facility for enclosures, brackets, panels…
  - Assembly and test facility
  - Offices in both facilities
- Fully integrated, OEM/Custom Manufacturer
- Products installed in over 64 countries
- Multiple UL files (489, 508A, 1008, 231, 891, 50…)

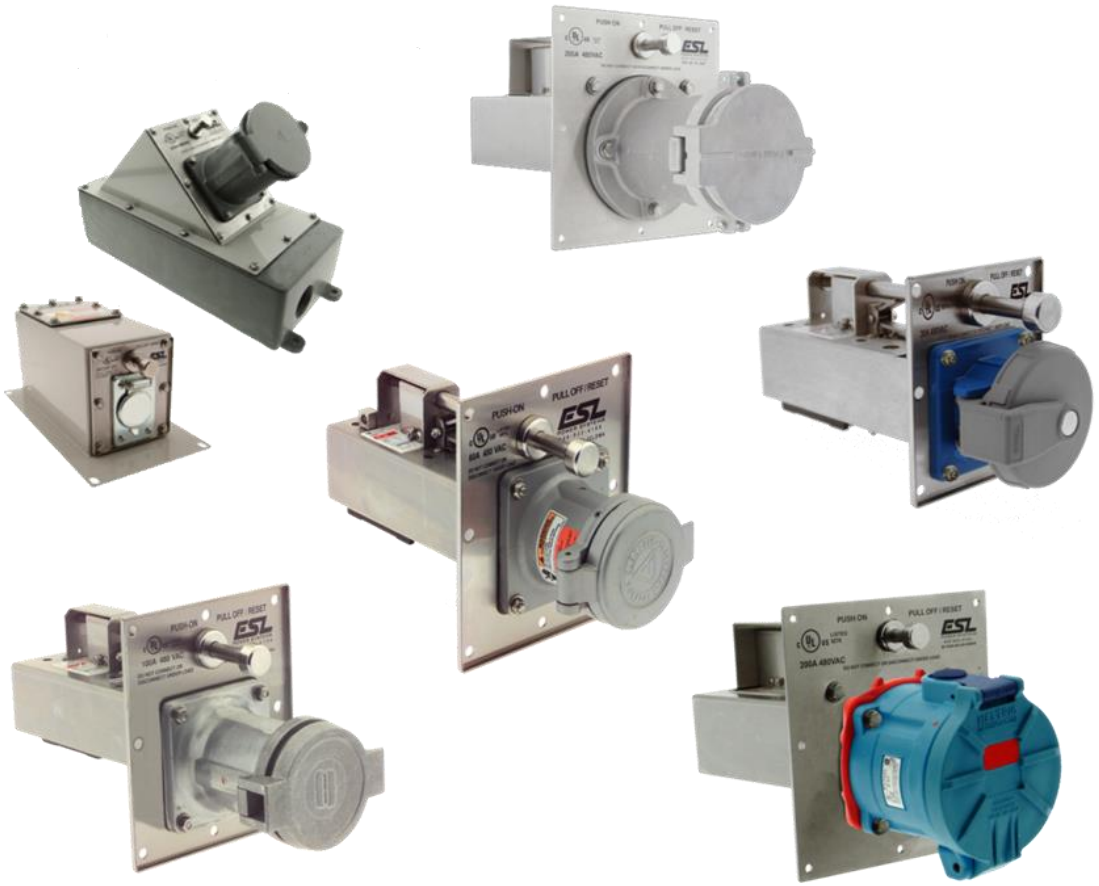
ESL designs and builds custom electrical solutions to safely connect and disconnect equipment from power.

Reefer Outlet Assemblies (ROAs)

Medium Voltage Disconnect Cabinets

Commercial Shore Power Solutions

Safety-Interlock Power Module



- Prevents “Making or Breaking” Under Load (Safety-interlocked)
- Functions as a Manual Disconnect
- Provides Branch Circuit Protection
- Modular Design - Easy to Install and to Maintain
- Fabricated with Stainless Steel Components
- Optional Pilot Light, Auxiliary Contact and Shunt Trip
- Factory Rebuild Program Available

Port Terminal – Reefer Outlet Assemblies

Market leader of safety-interlocked reefer outlet assemblies for refrigerated container and truck power connections:

- Prevents “making” or “breaking” under load
- “Push Rod” functions as manual disconnect
- Provides circuit branch protection
- Modular design provides easy maintenance and installation

Variety of Outlet Assemblies

- Pedestal / Pad Mount Assemblies
- Bunker Mount Assemblies
- Rack / Wall-Mount Assemblies
- Single-Gang Modules
- Rear Actuated Assemblies
- Portable Distribution Trees
- Reefer Sharing Units RSU’s





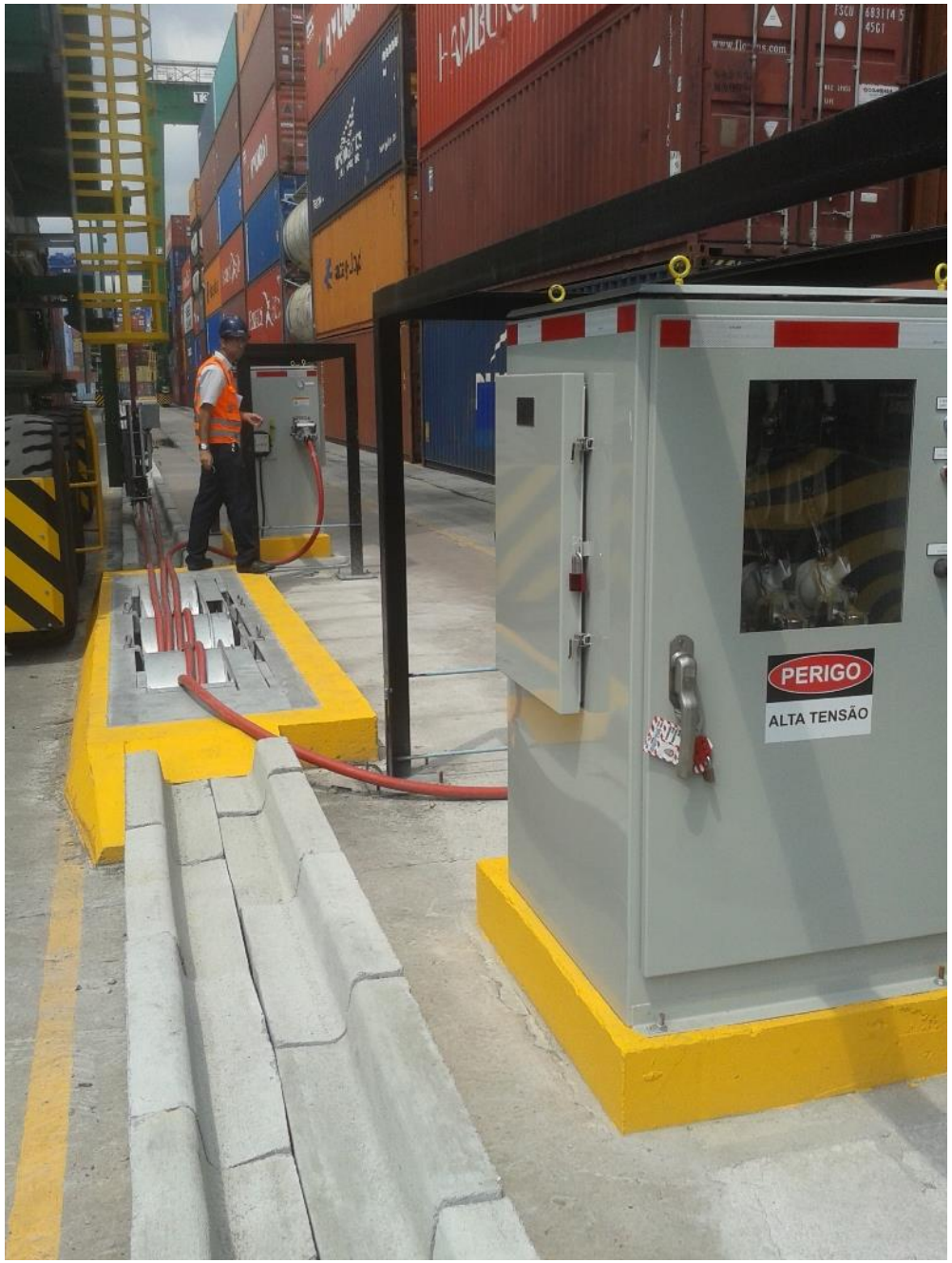


Questions to consider

- How many reefer containers do you handle or manage at site?
- Reefer projected growth rate in the next 5-10 years?
- What specific power requirements (voltage, amperage, frequency plug type)?
- Access and typical duration of reefer to connection
- How do you handle reefer containers?
- Storage area constraints
- What are the budget or cost considerations for implementing reefer outlets?
- Are there regulatory or compliance standards that need to be considered?
- Specific environmental conditions or temperature control needs for reefers?

Medium Voltage Disconnect Cabinets

(Electric Gantry Cranes)

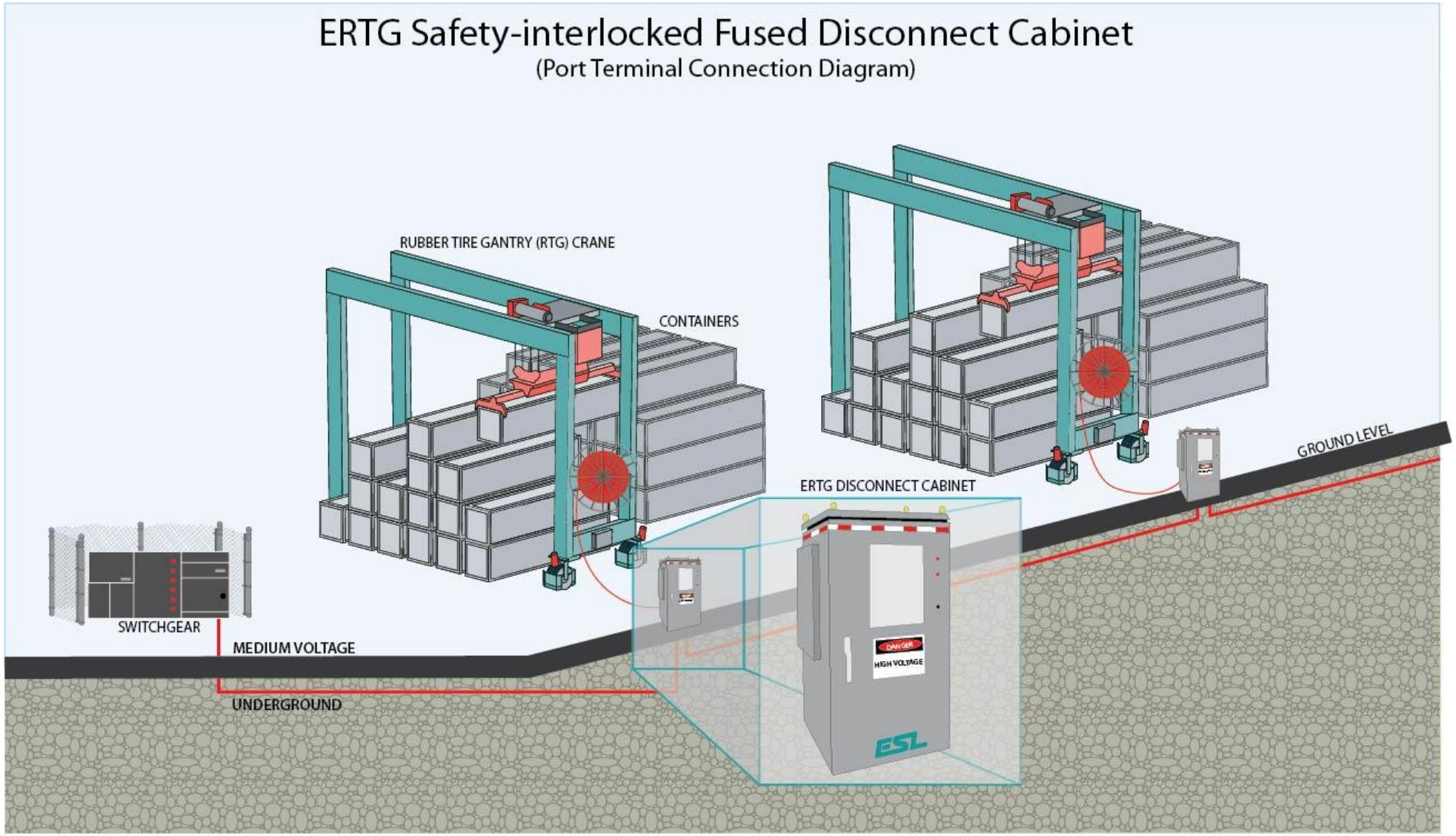


Medium Voltage Disconnect Cabinets

Safety-interlocked Fused Disconnect Cabinets:

- 10GA/12GA 304 stainless steel construction
- Common voltages: 4160 V 60Hz
- Medium voltage allows for lighter cable and longer runs
- Compact footprint minimizes obstructions in the yard
- Daisy-chaining several disconnect cabinets
  - Minimizes the number of MV circuit breakers required
  - Reduced space required
  - Reduced cost

Medium Voltage Disconnect Cabinet Daisy Chaining



Medium Voltage Disconnect Cabinet Benefits

- **Safety:**
  - Prevents operators from connecting or disconnecting under load
  - Ground check prior to energizing
  - Continuous ground fault monitoring
- **Reduced Costs:** allows for "daisy chaining" multiple cabinets.
- **Durability:** built with 10GA/12GA 304 stainless steel

Commercial Shore Power Solutions

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Shore Power International Standards:

IEC/ISO/IEEE High Voltage Shore Connection (HVSC) Standard
80005-01 High Voltage vessels 6.6 kV, 3-phase & 11 kV, 3-phase, larger than 1 MVA load
(Published by IEC, currently in use)

80005-03 Low Voltage vessels up to 690 V, 3-phase and 1 MVA load
(Standard under development)

Future standards under consideration:
Electric vessel DC connection/charging
Automatic and autonomous vessel connection

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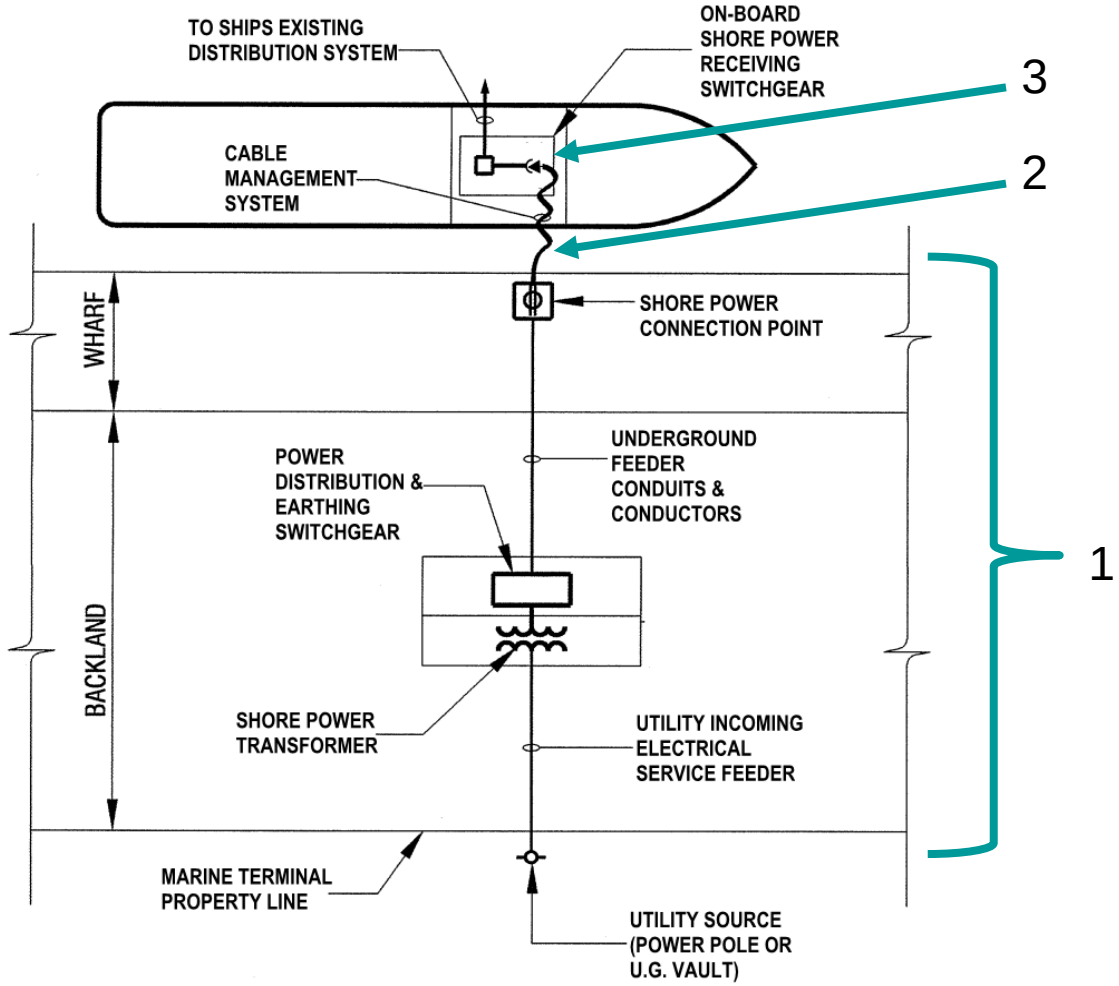
Shore Power is the electrical power distribution, delivery and connection system enabling a ship to connect to shore-based electrical source, while at berth.

Shore Power system is comprised of three (3) major sub-systems:

1) Shore side power infrastructure
2) Cable management system
3) Ship side power infrastructure



SHORE POWER SCHEMATIC DIAGRAM

PREPARED BY: H3 ENGINEERING SOLUTIONS, INC.
VAHIK HADDADIAN, P.E.

Commercial Shore Power Solutions

“ESL has manufactured 95% of all SPO boxes for container terminals in USA”

Commercial Shore Power Outlet Connection

- (2) 320A, 7.2kV Proconect receptacles
- 12GA, 304 stainless-steel enclosure, type 4X, powder coated texture gray (RAL 7038)
- External Ground
- incoming feeder cable terminated (crimped) to receptacle lugs
- Clamped, grounded, removable top
- Available options:
  - Earthing switch
  - External fiber optic box
  - Kirk locks/keys on receptacles
  - Kirk key transfer box
  - Internal bus for feeders, factory wired from bus to receptacle
  - Heater
  - Thermostat
  - De-humidistat

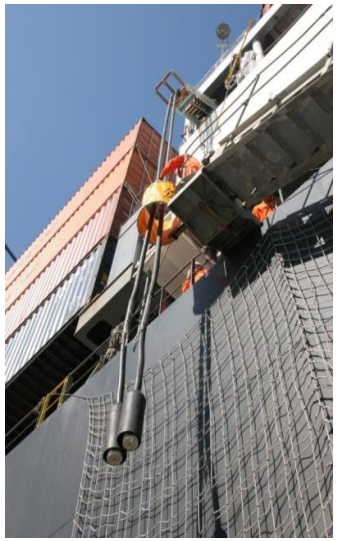
Commercial Shore Power Solutions

Vessel on-board connection point

Container Vessels

- Two receptacles per vessel connection
- Up to 7.5 MVA per berth capacity
- System voltage of 6.6 kV 3-phase
- On-board vessel cable management system
- Shoreside Shore Power Outlet connection

Shoreside Shore Power Outlet connection



Cable management system on board container vessel

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Typical cruise vessel

on-board shore power connection point

Cruise vessels

- Per Vessel
  1. Four power receptacles
  2. One neutral receptacle
- 6.6kV or 11 kV system voltage
- Up to 24 MVA per berth capacity
- On-shore vessel cable management system
- Shoreside Shore Power Outlet Connection

Shore based mobile cable management system

Shoreside shore power outlet connection point

Shore Power Lessons Learned

- High importance of early and frequent interaction and planning between:
  1. Ports
  2. Regulatory Agencies
  3. Utilities
- Need for shore power system designs to be flexible
  1. Designated locations for shore power vaults and cables to ensure all size vessels and types can connect
- System should account for future demand
  1. Could include other terminals, berths, and electrification of other port equipment
  2. Reliability and availability of shore power system ensures successful operations
- Having a ship pre-approval system to quickly plug in for repeat ships
- Deliver emissions reductions for the local community
  1. Local residents notice when the system in not working
- Public funding sources are critical for shore power development

Source: https://www.epa.gov/ports-initiative/shore-power-technology-assessment-us-ports

Summary

Ports worldwide are moving towards electrification for sustainable and safe operations. Key electrical power solutions, such as reefer outlets, eRTG disconnects, and shore power systems, are crucial for efficient port operations.

Electrification requires understanding the unique challenges of maritime facilities, compliance with industry standards, and customized solutions. By addressing these aspects, we can develop technologies that support a cleaner, more efficient future for goods movement.

Through partnerships and innovation, port electrification offers significant environmental and operational benefits, paving the way for sustainable maritime development.