March 29, 2023

Hon. Steven S. Cliff
Executive Officer
California Air Resources Board
Clerk's Office
1001 I Street
Sacramento, CA 95814

Submitted by email: shorepower@arb.ca.gov

SUBJECT: PORTS OF LOS ANGELES AND LONG BEACH COMMENTS ON CALIFORNIA AIR RESOURCES BOARD AT BERTH REGULATION INTERIM EVALUATION

Dear Dr. Cliff,

The ports of Los Angeles and Long Beach (Ports) appreciate the hard work California Air Resources Board (CARB) staff put into assembling the At Berth Regulation Interim Evaluation Report (Interim Evaluation) given the complexities of the regulation and the varying states of the technology. The Ports would like to provide comments on the following items related to the Interim Evaluation recently released on December 1, 2022:

- CARB's proposed delay of the zero-emission (ZE) cargo-handling equipment (CHE) rulemaking;
- Timeline for approval of various emission control technologies;
- The international standard for Ro-Ro/auto carrier; and
- Limited information on administration of the Remediation fund.

Proposed Delay of the ZE Cargo Handling Equipment Rulemaking

In the Executive Summary - Conclusion portion of the Interim Evaluation, it states the "…*need to shift course from promulgating a zero-emission cargo handling equipment (CHE) rulemaking to the exploration of measures to achieve additional reductions from OGVs*." The Port's strongly encourage CARB not to delay this critical rulemaking. When the Port's adopted the Clean Air Action Plan Update in 2017, we set a goal of zero emission terminal operations by 2030 understanding a zero emission CHE rule from CARB would follow in order to create regulatory certainty and to drive the market for zero emission technologies. This move away from ZE CHE rulemaking will slow equipment and technology development among CHE original equipment manufacturers (OEMs) and limit the potential for creating a sustainable market for ZE CHE sales. Public subsidy, on its own, is not enough to create a market. Additionally, the cost of equipment continues to increase due to inflation, discouraging further voluntary transition of terminal fleets. The terminal operators will need clear regulatory requirements for CHE, including timelines for transition, in order to adequately plan for zero emission operations, and to ensure additional diesel equipment is not purchased as older equipment is removed from their fleets. The Ports acknowledge that vessels are an important source of emissions to tackle – however, vessels are also the most expensive and challenging sources to provide solutions for controlling emissions.

Timeline for Approval of Emission Control Technologies

CARB staff provided general information in the Interim Evaluation on the state of the various emission capture and control technologies. It is encouraging to hear that the STAX demonstration project is likely to receive a CARB Executive Order for tanker vessels in the first half of 2024. However, based on the volume of vessels that call the San Pedro Bay Ports, more than one system will be necessary to meet the demand for tanker and Ro-Ro vessels. These systems will take time to manufacture and deploy and each manufacturer must achieve their own respective Executive Order.

Additionally, the Interim Evaluation does not provide an estimated timeframe for other emission capture and control technologies to receive CARB Executive Orders. The Ports believe a more detailed status update on these other companies will help vessel and terminal operators understand the market for emission control technologies capable of treating the newly regulated vessel types. Vessel and terminal operators should have assurance that the technology will be CARB approved prior to the implementation of the At Berth Regulation.

RoRo/Auto Carrier Standard

The 2007 At Berth Regulation gave the industry at least seven years for a standard to be developed, infrastructure to be designed, and shore power connections to be installed before the first regulated OGVs needed to connect to shore power at 50% of vessel visits. The updated 2020 At Berth Regulation only provides five years to do the same work to ensure the newly regulated vessel types can connect to shore power for all visits. The Ports played a vital role in developing the standards to meet the 2007 At Berth Regulation. The Ports continue to have a strong voice in trying to establish a standard for Ro-Ro/auto carriers.

The Ports had originally anticipated the standard for onshore electrical power supply to be either 6.6 kV or 11 kV. Staff had anticipated the decision would be finalized through standard adoption by December 2022. However, no standard has been agreed upon yet. The delay in setting a finalized standard has delayed design as well as construction. The right equipment must be included within a bid package and subsequently ordered at the start of the construction phase. Without a finalized international standard, the specifications/details that engineers need to provide for all electrical equipment, conduits, and cabling cannot be finalized. It would not make sense to build both 6.6 kV and 11 kV on shore power supply since it would result in stranded assets and millions of dollars in excessive expenditures.

Furthermore, the lack of a standard has delayed vessel-side shore power installations. Vessel operators need to know the standard in order to install the appropriate vessel side infrastructure. They cannot assume and be left with a vessel that has the wrong infrastructure installed. The standard seems to be leaning towards 11 kV, but a majority of the Ro-Ro/auto carriers that call to the Ports use 6.6 kV. If the standard is set at 11 kV, the vessel operators that currently use 6.6 kV on their vessels will need even more time to be able to retrofit and install the standard infrastructure on their vessels that would allow them to connect to 11 kV at ports worldwide. These ships will need to be dry docked and retrofits of this nature take approximately 3-5 years to complete.

Without a shore power standard for Ro-Ros, the public health benefits of the At Berth Regulation will be substantially limited. There are no public health benefits reaped if a shore power equipped ship cannot plug into the shore side infrastructure, because they were built to different specifications due to a lack of shore power standards.

Finally, in a meeting between California Association of Port Authorities (CAPA) and CARB staff on December 20, 2022, CARB staff indicated they believed some terminals may be ready to comply by the respective regulatory deadlines defined in the At Berth Regulation. However, none of the California seaports on the call stated they have a single terminal operator that can feasibly meet these deadlines. CARB staff stated they would review more detailed information on terminal infrastructure build out times if provided and pass that information along to their Executive Team. Please see Appendix A for an updated POLA timeline for our Ro-Ro terminal and Appendix B for POLB’s 2021 Shore Power Assessment that was previously submitted to CARB, but was not used in development of the Interim Evaluation. These timelines demonstrate that compliance with the regulation by the January 1, 2025 deadline is not feasible.

Limited Information on Administration of the Remediation Fund

The Interim Evaluation states that compliance can be achieved through the use of TIEs/VIEs, payment into the remediation fund or use of an innovative concept. However, at this time terminals or vessel operators who would wish to use the remediation fund to comply would not know how to do so as there is no mechanism set up to collect the funds even though the implementation of the first part of the updated At Berth Regulation began January 1, 2023. Likewise, there is no detail on who can use the funding for emission reduction projects, what type of emission reduction projects are eligible, and where exactly at the Ports the projects have to take place. The Ports believe funding collected from a terminal should be banked for that specific terminal and then be used for other emission reduction strategies at the terminal. This would provide an opportunity for the terminal operator to mitigate the emissions at the location where the uncontrolled emissions initially occurred.

The Ports wish to continue to work with CARB staff to ensure the implementation of the At Berth Regulation is successful. Please feel free contact Teresa Pisano (POLA) at TPisano@portla.org or Morgan Caswell (POLB) at Morgan.Caswell@polb.com.

Sincerely,

MATTHEW ARMS
Director of Environmental Planning
Port of Long Beach

CHRISTOPHER CANNON
Director of Environmental Management
Port of Los Angeles

CC:TD:TP:AC
APP No.: 110131-860

THE PORT OF LOS ANGELES
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APPENDIX A

Port of Los Angeles Wallenius Wilhelmsen Solutions Shore Power Construction Evaluation

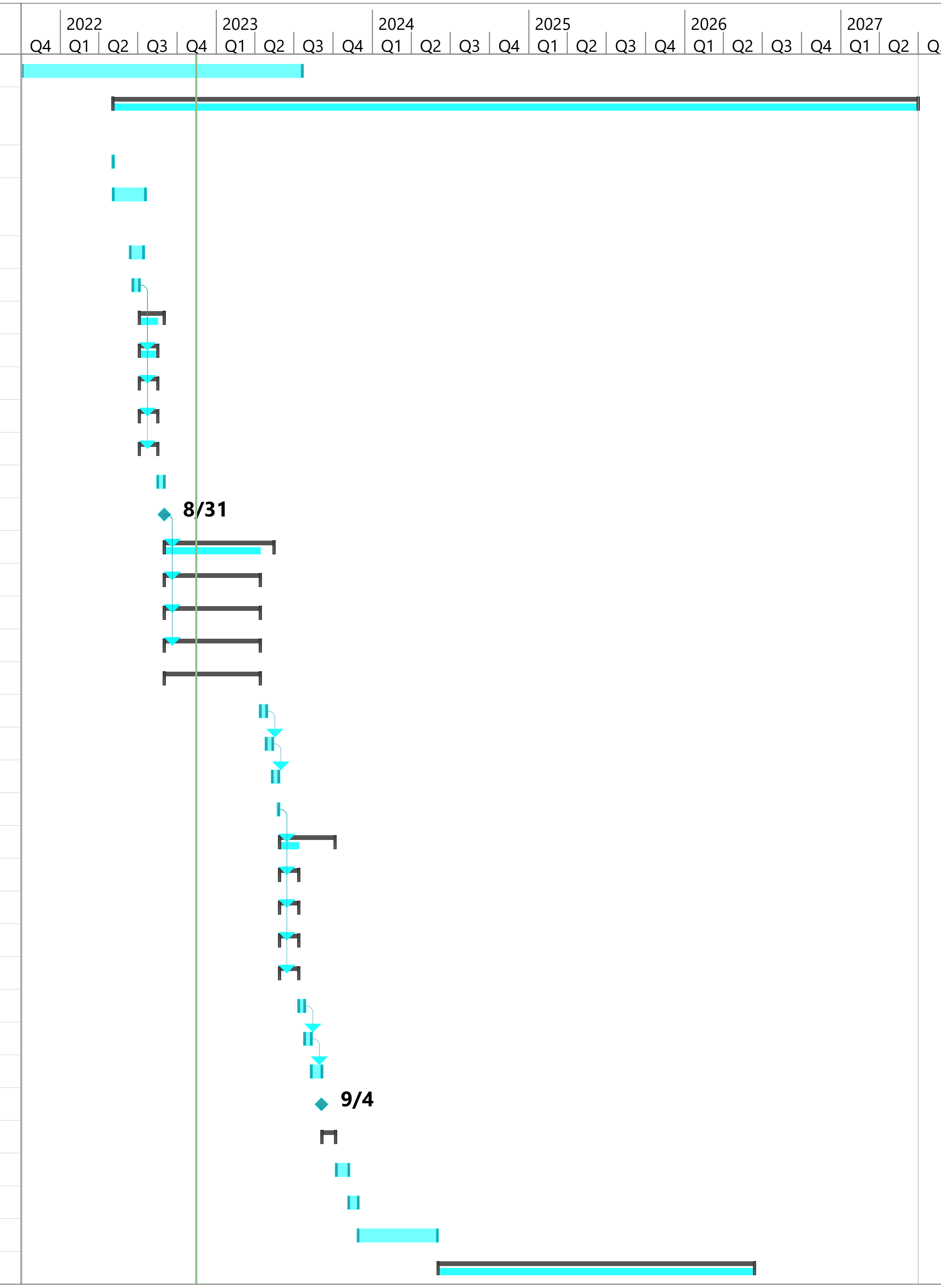
The Port of Los Angeles (POLA) has one auto carrier terminal, Wallenius Wilhelmsen Solutions (WWS), located at Berths 196-199. POLA had started the process to construct the shore power installation at WWS in October 2021. Terminal and port plans were submitted with an expected timeline of shore power construction completion assuming that the international standard for shore power connection of auto carrier vessels would be finalized by December 2022 and supply chain disruption would have eased. As of February 1, 2023, no international standard has been set for auto carrier vessels. Additionally, delivery times for essential equipment to provide electrical power to WWS has more than doubled.

Figure 1 shows the new estimated time for construction completion of shore power at Berths 196-199. The new estimated completion time is mid-2026. This new estimated completion time is assuming the international standard is set before the end of the first quarter of 2023. If the standard adoption continues to be delayed, the completion time for our shore power construction will further be delayed beyond the current mid-2026 estimation.

POLA and WWS are currently working together on an updated terminal plan that would incorporate the currently estimated timeline.

FIGURE 1 - POLA Estimated Shore Power Installation for WWS

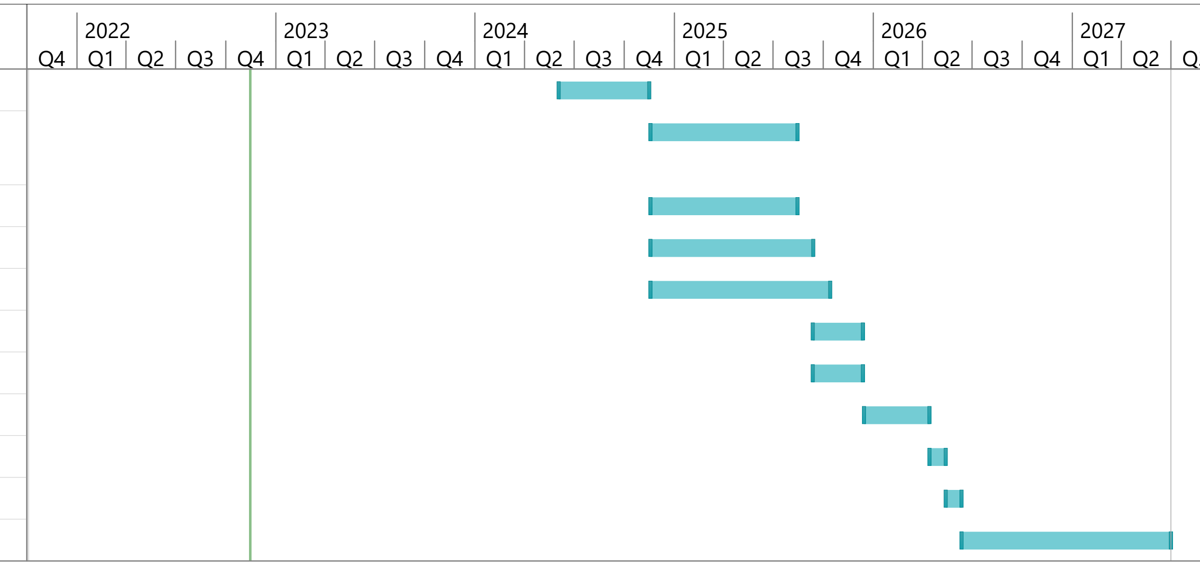
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		LADWP Design Completion	655 days	Mon 10/4/21	Thu 7/20/23		
2		**Berth 195-199 WWL Terminal Alternative Maritime Power**	**1884 days**	**Wed 5/4/22**	**Wed 6/30/27**		
3		PDC Approval	1 day	Wed 5/4/22	Wed 5/4/22		
4		Planning, Investigations, Collecting data, Coordination with Tenant	75 days	Thu 5/5/22	Mon 7/18/22		
5		APP Approval	31 days	Tue 6/14/22	Thu 7/14/22		
6		Master Sheet Templates	15 days	Mon 6/20/22	Mon 7/4/22		
7		**40% Design**	**58 days**	**Tue 7/5/22**	**Wed 8/31/22**		
8		**Electrical Design**	**43 days**	**Tue 7/5/22**	**Tue 8/16/22**	**6**	
10		**Structural Design**	**43 days**	**Tue 7/5/22**	**Tue 8/16/22**	**6**	
14		**Storm Drain Design**	**43 days**	**Tue 7/5/22**	**Tue 8/16/22**	**6**	
18		**Grading and Paving Design**	**43 days**	**Tue 7/5/22**	**Tue 8/16/22**	**6**	
22		40% Design Review	15 days	Wed 8/17/22	Wed 8/31/22		
23		40% Design Set Completion	0 days	Wed 8/31/22	Wed 8/31/22		
24		**80% Design**	**257 days**	**Thu 9/1/22**	**Mon 5/15/23**	**23**	
25		**Electrical Design**	**225 days**	**Thu 9/1/22**	**Thu 4/13/23**	**23**	
32		**Structural Design**	**225 days**	**Thu 9/1/22**	**Thu 4/13/23**	**23**	
36		**Storm Drain Design**	**225 days**	**Thu 9/1/22**	**Thu 4/13/23**	**23**	
40		**Grading and Paving Design**	**225 days**	**Thu 9/1/22**	**Thu 4/13/23**		
44		80% QA/QC and Implementation	15 days	Fri 4/14/23	Fri 4/28/23		
45		80% Design In-House Review	15 days	Fri 4/28/23	Fri 5/12/23	44	
46		80% Plan Corrections	15 days	Fri 5/12/23	Fri 5/26/23	45	
47		80% Design Set Completion	1 day	Fri 5/26/23	Fri 5/26/23		
48		**100% Design**	**130 days**	**Mon 5/29/23**	**Thu 10/5/23**	**47**	
49		**Electrical Design**	**45 days**	**Mon 5/29/23**	**Wed 7/12/23**	**47**	
52		**Structural Design**	**45 days**	**Mon 5/29/23**	**Wed 7/12/23**	**47**	
55		**Storm Drain Design**	**45 days**	**Mon 5/29/23**	**Wed 7/12/23**	**47**	
58		**Striping & Signage Design**	**45 days**	**Mon 5/29/23**	**Wed 7/12/23**	**47**	
61		100% Design In-House Review	14 days	Thu 7/13/23	Wed 7/26/23		
62		100% QA/QC and Implementation	15 days	Thu 7/27/23	Thu 8/10/23	61	
63		100% Plan Corrections	25 days	Fri 8/11/23	Mon 9/4/23	62	
64		100% Design Set Completion	0 days	Mon 9/4/23	Mon 9/4/23		
65		**Signatures**	**32 days**	**Tue 9/5/23**	**Fri 10/6/23**		
67		City Attorney Approval	29 days	Mon 10/9/23	Mon 11/6/23		
68		Executive Director Approval	22 days	Tue 11/7/23	Tue 11/28/23		
69		**Bid & Award**	**185 days**	**Wed 11/29/23**	**Fri 5/31/24**		
70		**Construction**	**740 days**	**Mon 6/3/24**	**Fri 6/12/26**		



Project: 041422 Schedule_POLA
Date: Tue 11/15/22

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
71			Submittals, Procurement, Mobilization	166 days	Mon 6/3/24	Fri 11/15/24		
72			High/Low Voltage Infrastructure/AMP Boxes	270 days	Mon 11/18/24	Thu 8/14/25		
73			All Substations Concrete Foundation	270 days	Mon 11/18/24	Thu 8/14/25		
74			All AMP Equipment Delivery	299 days	Mon 11/18/24	Fri 9/12/25		
75			LTC Transformer Delivery	330 days	Mon 11/18/24	Mon 10/13/25		
76			All Low Voltage Wiring Installation	92 days	Fri 9/12/25	Fri 12/12/25		
77			All High Voltage Wiring Installation	92 days	Fri 9/12/25	Fri 12/12/25		
78			Complete Equipment Commissioning	120 days	Mon 12/15/25	Mon 4/13/26		
79			AMP Testing for RORO Ship	30 days	Tue 4/14/26	Wed 5/13/26		
80			Demobilization	29 days	Thu 5/14/26	Thu 6/11/26		
81			**As-Builts & Project Close Out**	384 days	Fri 6/12/26	Wed 6/30/27		



Project: 041422 Schedule_POLA
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Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Appendix B

Port of Long Beach

Feasibility Report
Shore Power for Container Terminals
Tanker and Ro-Ro Vessels at Non-Container Terminals

Prepared In Association With EnSafe

www.p2sinc.com

December 6, 2021
(Supersedes September 27)
P2S Project # 21-0320

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The California Air Resources Board adopted a new Control Measure for Vessels At Berth, commonly known as the At Berth Regulation, effective January 1, 2021, which expands shore power requirements for container, passenger, and refrigerated cargo vessels, and introduces emission control requirements for roll-on, roll-off (Ro-Ro), and tanker vessels at berth. The expanded requirements begin for container vessels in 2023, Ro-Ro vessels in 2025, and tanker vessels in 2025 for the San Pedro Bay Port Complex and 2027 for the rest of the State. The Port of Long Beach (POLB) container, Ro-Ro and tanker terminals were reviewed by P2S Engineering and EnSafe at a high level to assess the state of infrastructure and to recommend solutions to install or expand shore power systems for ships at berth. The study considered any electrical infrastructure requirements to support land-based emission capture and control systems.

-Pier B Petro Diamond (B82-B83)

-Pier B Marathon Petroleum (B76-B79) on the inner part of Channel 2 and LBT (B84-B87)

-Pier B Toyota Logistics (B82-B83)

-Pier F Chemoil Marine Terminal (F208-F209)

-Pier F SSA (F204-F207).

-Pier T Marathon Petroleum (T121)

Some of the limitations of this study are discussed within this document and the applicable standards are reviewed. Recommendations per terminal are presented. Costs associated with the recommendations are included, as well as a timeline to design and construct the options presented. Costs for tanker terminals are heavily impacted by the need for a new dolphin to house shore power infrastructure equipment. A summary of costs by terminal is presented in Table ES-1 and Table ES-2 in 2021 dollars. Costs per terminal are heavily impacted by the number of shore power outlets (SPOs). Table ES-1 presents the costs for one SPO per berth. Table ES-2 presents the costs for two SPOs per berth. The exact number of SPOs for a specific terminal will vary based on the configuration of the terminal and the vessels that are anticipated to call. Table ES-3 provides costs for land-based alternative infrastructure and movable supply equipment.

Table ES-1 Shore Power Cost by Terminal with One SPO*							
Terminal	Berth	Design Cost[1]	Construction Cost	Design/Construction "Soft" Cost[2]	Total Cost	Project Contingency Cost[3]	Total Cost w/ Contingency
Pier B Petro Diamond	B82 & B83	-	-	-	-	-	-
Pier B Marathon Petroleum	B77 & B79	$7,600,000	$38,000,000	$20,900,000	$66,500,000	$26,600,000	$93,100,000
Pier B Marathon Petroleum	B85 & B87	$7,600,000	$38,000,000	$20,900,000	$66,500,000	$26,600,000	$93,100,000
Pier B Toyota Logistics	B82 & B83	$660,000	$3,300,000	$1,815,000	$5,775,000	$2,310,000	$8,085,000
Pier F Chemoil Marine	F209	$3,800,000	$19,000,000	$10,450,000	$33,250,000	$13,300,000	$46,550,000
Pier F SSA	F204 - F207	$1,320,000	$6,600,000	$3,630,000	$11,550,000	$4,620,000	$16,170,000
Pier T Marathon Petroleum	T121	-	-	-	-	-	-
Total Non-Container Shore Power		**$20,980,000**	**$104,900,000**	**$57,695,000**	**$183,575,000**	**$73,430,000**	**$257,005,000**

* Costs are presented in 2021 dollars and do not include the planning and construction required for SCE infrastructure/service.
(1) Estimated to be 20% of Construction Cost
(2) Estimated to be 55% of Construction Cost
(3) Estimated to be 40% of Construction Cost

Table ES-2: Shore Power Cost by Terminal with Two SPOs*							
Terminal	**Berth**	**Design Cost[1]**	**Construction Cost**	**Design/Construction "Soft" Cost[2]**	**Total Cost**	**Project Contingency Cost[3]**	**Total with Contingency**
Pier B Petro Diamond	B82 & B83	$ -	$ -	$ -	$ -	$ -	$ -
Pier B Marathon Petroleum	B77 & B79	$12,620,000	$63,100,000	$34,705,000	$110,425,000	$44,170,000	$154,595,000
Pier B Marathon Petroleum	B85 & B87	$12,620,000	$63,100,000	$34,705,000	$110,425,000	$44,170,000	$154,595,000
Pier B Toyota Logistics	B82 & B83	$900,000	$4,500,000	$2,475,000	$7,875,000	$3,150,000	$11,025,000
Pier F Chemoil Marine	F209	$6,300,000	$31,500,000	$17,325,000	$55,125,000	$22,050,000	$77,175,000
Pier F SSA	F204 - F207	$1,820,000	$9,100,000	$5,005,000	$15,925,000	$6,370,000	$22,295,000
Pier T Marathon Petroleum	T121	-	-	-	-	-	-

* Costs are presented in 2021 dollars and do not include the planning and construction costs required for SCE infrastructure/service.
(1) Estimated to be 20% of Construction Cost
(2) Estimated to be 55% of Construction Cost
(3) Estimated to be 40% of Construction Cost

Table ES-3: Alternative Compliance Infrastructure and Supplemental Shore Power Equipment Cost*							
Terminal	**Berth**	**Design Cost[1]**	**Construction Cost**	**Design/Construction "Soft" Cost[2]**	**Total Cost**	**Project Contingency Cost[3]**	**Total with Contingency**
Land Based Unit Infra-structure	N/A	$500,000	$2,500,000	$1,375,000	$4,375,000	$1,750,000	$6,125,000
Movable Supply Equipment	N/A	$20,000	$600,000	$330,000	$1,050,000	$420,000	$1,470,000

* Costs are presented in 2021 dollars and do not include the planning and construction required for SCE infrastructure/service.
(1) Estimated to be 20% of Construction Cost
(2) Estimated to be 55% of Construction Cost
(3) Estimated to be 40% of Construction Cost

Table ES-4 provides the estimated duration for entitlements (e.g., CEQA), design, bidding, and construction of the available at-berth compliance solutions.

Table ES-4: Design and Construction Duration by Installation Type*					
Solutions	Duration				
	Entitlements	Design	Bidding	Construction	Total
Tanker Terminal Shore Power	6 Months	24 Months	6 Months	24 Months	60 Months
Ro-Ro Terminal Shore Power	6 Months	24 Months	6 Months	24 Months	60 Months
Electrical Infrastructure Land-Based Alternative	6 months	24 Months	6 Months	18 Months	54 Months
Movable Supply Equipment	N/A	2 Months	6 Months	12 Months	20 Months

* Durations do not include the planning and construction of SCE infrastructure.

Durations assumed that the terminal-specific solution has been selected and do not include iterative deliberations between the Port, tenant, vessel operators, and related stakeholders. Shore power installations are assumed to qualify for a Categorical Exemption under the California Environmental Quality Act (CEQA). All recommendations will require coordination with terminal operators and POLB procedures.

With the exception of Berth T121, **none of the non-container terminals involved in this study, specifically Ro-Ro and tanker terminals, have adequate capacity to provide electrical power to the vessels visiting their terminals**. Therefore, with the exception of T121, all the non-container terminals will need to obtain new electrical services from SCE to establish shore power capability.

Please note that SCE required service, associated planning, construction, and costs are not included in Tables ES-1, ES-2, ES-3, and ES-4. Previous shore power projects took three years for SCE planning and design and two years for construction. SCE's work is further discussed in the body of the report but is expected to run in parallel with the Port's design and construction timeline.

Costs and schedule presented in this report are based on data and assumptions as currently understood. New data will necessitate additional review as they may change the recommended solutions as well as the estimated cost and schedule to implement them.

PURPOSE

This report is intended to assess the state of existing infrastructure, as well as the necessary additional infrastructure required to ensure adequate shore power capability for compliance with Regulation Order of California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 7.5, Sections 93130- 93.134.14 (CARB's At Berth Rule) while ships are at-berth for container and non-container terminals at the Port of Long Beach (POLB). This assessment will maximize berth use and provide flexibility for shore power.

This report examines the means to provide shore power to tanker and Ro-Ro vessels that call at POLB non-container terminals where there are no existing shore power outlets (SPOs). These non-container terminals are limited to:

-Pier B Petro Diamond (B82-B83)

-Pier B Marathon Petroleum (B76-B79) on the inner part of Channel 2 and LBT (B84-B87)

-Pier B Toyota Logistics (B82- B83)

-Pier F Chemoil Marine Terminal (F208-F209)

-Pier F SSA (F204-F207)

-Pier T Marathon Petroleum (T121)

Stakeholders should be aware of the limitations of this preliminary investigation given the high level of uncertainty for each terminal's future operations. These stakeholders include, but are not limited to, regulators, port administrators, terminal operators, vessel owners and operators, designers of vessels and terminals, and organizations that develop standards for such applications.

BACKGROUND

IEC/IEEE STANDARD

The only recognized world standard for "Cold Ironing" of ships is the "IEC/IEEE 80005-1: Utility connections in port - Part 1: High Voltage Shore Connection (HVSC) Systems - General requirements". This standard defines the technical requirements for a given ship's electrical modifications and the electrical installations on shore to allow the ship to connect to shore power system for the purpose of "cold ironing", i.e. turning off the ship's auxiliary generators and running on the shore power system. Ships that do not conform to these technical requirements of the standard may find it impossible to connect to compliant shore power supplies. Because of this fact, reference is made in this report to this standard, highlighting certain requirements in the standard that apply to the subject matter outlined below. Tanker vessels and Ro-Ro vessels that must comply with this standard are electrically sized to require more than 1 MVA of power to operate. 1 MVA is equal to 1000 KVA or 1,000,000 VA. MVA stands for Mega-Volt Amperes. KVA stands for Kilo-Volt Amperes and VA stands for Volt Amperes.

The "IEC/IEEE 80005-3: Utility connections in port - Part 3: Low Voltage Shore Connection (HVSC) Systems - General requirements" is intended to be a global standard that ships and ports around the world must comply with, to successfully "cold iron" ships at ports, where ships require up to 1 MVA while at berth. Since in this study it is assumed there are no vessels to be considered that require less than 1 MVA power, there will be no further discussion regarding this particular standard.

For "cold ironing" purposes, the IEC/IEEE 80005-1 standard, identifies the electrical service voltage per vessel type. For tanker vessels that voltage is 6.6 KV, or 6,600 Volts. For Ro-Ro vessels that voltage is 11 KV, or 11,000 Volts.

With the MVA known and the KV established, the electrical modifications for both ship and shore can proceed to be designed and coordinated, so that any ship can successfully "cold iron" at any port. For the United States it is assumed that all ship will require shore power at 60 HZ. However, some vessels are designed to operate at 50 HZ. If POLB tenants will be required to accommodate both 60HZ and 50HZ, then a frequency converter will be required. Such a frequency converter is expensive and costs for such equipment are not included in this report.

CONTAINER TERMINAL

POLB has Shore Power Outlet (SPO) installations at the following container terminals:

1. Pier A, SSA Terminal: 3 Berths, A90 - A94.
2. Pier C, SSA/Matson Terminal: 2 Berths, C60 - C62.
3. Pier E, LBCT Terminal at Middle Harbor: 3 Berths[1], E22- E26.
4. Pier G, ITS Terminal:
    a. 2 Berths, G232 - G236
    b. 2 Berths, G227 – G235.
5. Pier J, PCT/SSA Terminal:
    a. 2 Berths, J245 – J247.
    b. 3 Berths, J266 – J270.
6. Pier T, TTI Terminal: 4 Berths, T132 – T140.

[1] 2 Berths are in use and 1 Berth recently completed construction.

All POLB container terminals are equipped presently with SPOs that are designed for providing shore power to all container ships. However, ships sometimes do not berth where a convenient SPO may be accessible and thus the need arises to accommodate those ships for cold ironing purposes, with Movable Supply Equipment commonly referred to as a cable reel system. An example Movable Supply Equipment unit is presented in Figure 1 below.

FIGURE 1: Example Movable Supply Equipment

SPO LOCATIONS AND LIMITATIONS

Container terminals at the Port are equipped with multiple SPOs per berth. The multiple SPOs are intended to provide flexibility for the variety of container ship sizes and configurations that may call a terminal. Some container terminals were designed with SPOs equidistant apart (e.g., 200 ft between SPOs). Other terminals were designed based on the configurations of forecasted vessel calls. In the latter case, SPOs are not necessarily equidistant and instead may be closer or further from each other based on a berthing analysis performed during the design of the shore power system. Both approaches have their limitations and can result in a lack of flexibility when servicing the wide variety of container ship sizes.

To increase shore power flexibility terminal operators may consider adding SPOs to a berth. Terminal operational requirements may necessitate the installation of additional SPOs, perhaps because many vessels require a more convenient SPO to connect to, than what is installed on the wharf. Another SPO may be added to the system by merely abandoning an existing SPO and replacing with a new one at another location or adding a new SPO without abandoning an existing one.

Complications may arise when adding an SPO without abandonment. Adding an SPO is not the only work needed on the wharf, but also extending conduits and wiring from the wharf to the backland area where the electrical substation is located. Additional equipment will have to be installed at the substation which will consist of a power switch and a grounding switch that each require a footprint of 3 ft. wide and 6 ft. deep. If multiple SPOs are to be installed, then multiple of these switches will also have to be installed. In short, adding SPOs has its own limitations and cannot be freely placed on the wharf as desired without causing an interference with other requirements.

The IEC/IEEE 80005-1 standard, in Paragraph 10.4 requires that a compatibility assessment study be performed to make sure a ship may be able to "cold iron" at a particular berth. Among other requirements, one requirement is to determine if the ship has sufficient cable length to reach the SPO intended for use. This assessment should be performed collaboratively by the terminal and vessel operator. If such assessments are not conducted and the burden of satisfying this requirement is left to the ship only or the terminal operator only, it places an undue burden on either party to utilize cold ironing installations efficiently.

NON-CONTAINER TERMINAL

The non-container terminals addressed in this report were selected by POLB based on a review of applicability of the At Berth Rule as of July 2021.

Non-container terminals at the POLB referenced within this document include terminals where tanker vessels and Ro-Ro vessels will be berthing, and where the At-Berth Regulations requires them to connect to shore power, or use an alternative emission control strategy, to limit auxiliary engine emissions.

ALTERNATIVE TO SHORE POWER

The At-Berth Regulation also allows alternative methods for eliminating emissions from ships at berth, provided that the method is approved by CARB. The only alternative method approved by CARB historically for container vessels is "capture and control systems" that can be deployed on a barge or land side.

The barge or land-based alternative captures the emissions from a ship's smokestack, while allowing the ship's generators to stay in service and provide the electrical power that the ship requires while at berth. However, the capture and control system itself will require power, while serving a ship at berth. Land-based systems will most likely utilize grid electricity and therefore will require a dedicated electrical connection. It is not feasible to connect barge-based systems to the grid while in operation. Therefore, the barge-based systems will utilize on-board generators or equivalent to supply the system power. Per the CARB At Berth Rule, these generators must be "grid neutral" in terms of greenhouse gases. This grid neutral requirement means that the capture and control system generator cannot emit more greenhouse gas emissions than the average emissions of the California grid.

SCE UTILITY SERVICE

In light of the large size of electrical services required for the non-container terminals at POLB, it would be of benefit to briefly outline the impact of the electric services involved. There are several alternative methods for obtaining this utility service. However, for purposes of this report, it is assumed that Southern California Edison (SCE) will be the utility company that will provide these electrical services.

With the exception of Berth T121, **none of the non-container terminals involved in this study, have adequate capacity to provide electrical power to the vessels visiting their terminals**. Therefore, with the exception of T121, all the non-container terminals will need to obtain new electrical services to establish shore power capability.

In order to service new shore power installations, SCE may have to install additional transmission lines, or perhaps upgrade their existing lines. Considering the geographical locations of the non-container terminals, there could be two such line extensions involved. One line serving the Pier B non-container terminals and another for Pier F terminals. SCE has preliminarily indicated there is capacity on the circuit feeding Pier F but a detailed application for service will be required to confirm the circuit's capacity to meet additional shore power demand. SCE has indicated that a line extension would be necessary to service new shore power for the non-container terminals on Pier B. For reference, Figure 2 provides a sketch of the Port showing the relative positions of the Piers.

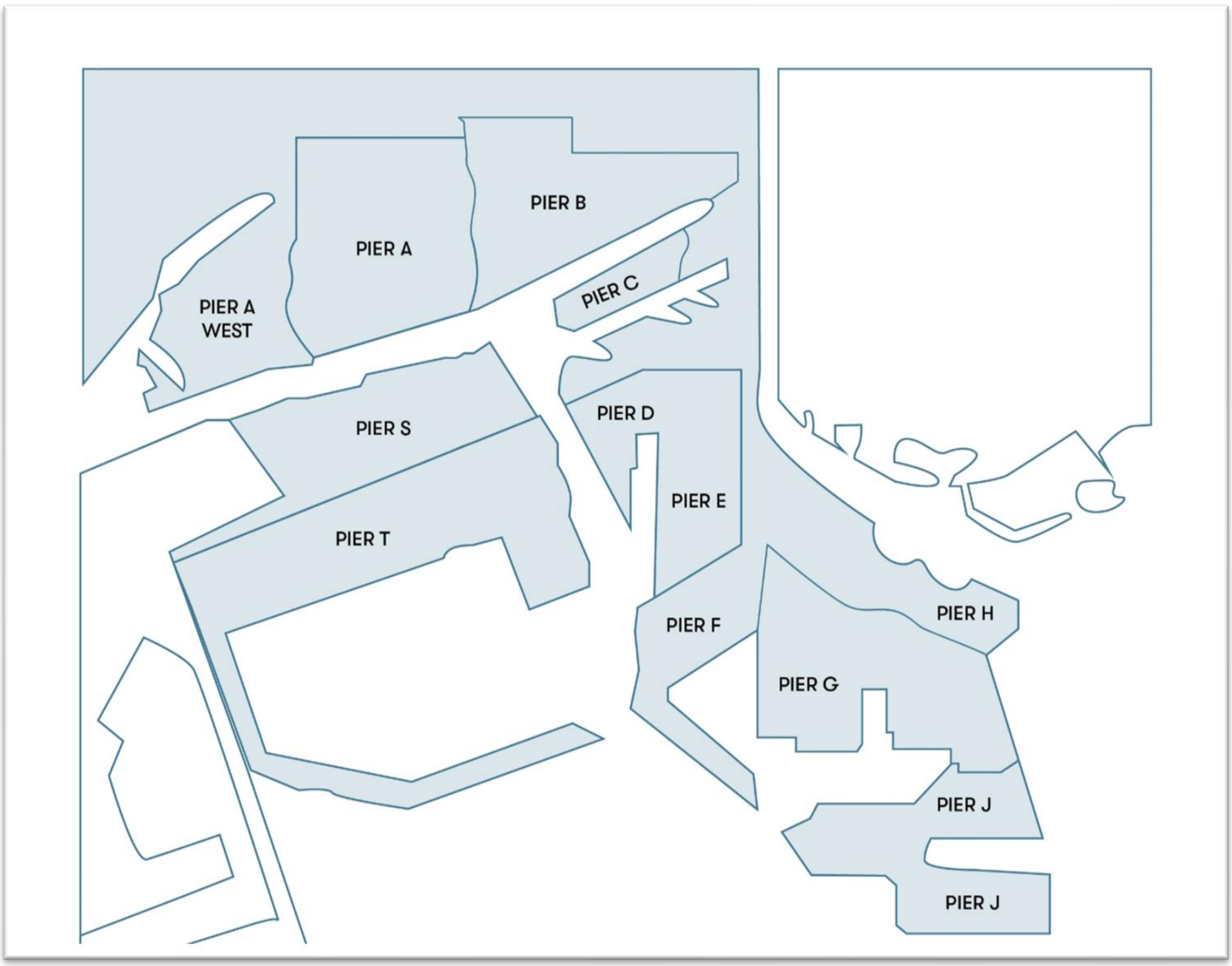


FIGURE 2: Pier Map, Port of Long Beach

Typically, SCE is required to obtain approval from California Public Utilities Commission (CPUC) in order to construct facilities required for such a project as providing electrical services for tanker and Ro-Ro vessels, unless SCE qualifies for an exemption authorized by the CPUC. CPUC approval may require up to 48 months, while the Exemption process can sometimes require about 6 months. For this study, it is assumed that SCE will be able to proceed with an Exemption. The timeline for SCE's work is expected to run in parallel with the Port's design and construction timeline.

There are two scenarios for SCE to provide these services:

1. If the existing SCE transmission lines serving these terminals have adequate capacity to serve the vessels, then a tenant may obtain additional power by submitting a service request, as is often done routinely. This report does not address legal or regulatory issues and the allocation of the cost for such service is beyond the scope of this report.
2. If the existing SCE transmission lines serving these terminals do not have adequate capacity to serve new shore power systems, then SCE will have to install new transmission lines extending them to the terminals before they can provide additional power to the terminals, as described in preceding paragraph (1). Based on past container terminal projects for shore power, such an installation will require three or more years for preparing plans and obtaining necessary approvals and an additional two years for installation. That would be a total of 5 years duration assuming that SCE proceeds at the same pace as it did in 2009 for additional service to Pier G, which POLB considered to be unduly slow. This assumption does not take into account developments since 2009. Cost for planning and approvals are estimated to be around $750,000, but the actual figure would need to be confirmed with SCE. The SCE cost for design and installation will most likely be in excess of $25 Million for Pier B and another $25 Million for Pier F if additional transmission lines are required. These ballpark costs estimates are based on SCE's cost to extend additional service to Pier G in 2009, the most recent relevant example project at the Port. The allocation of these costs is beyond the scope of this report.

The estimated time for the Port to complete the entitlements, design, bidding, and construction of shore power for tanker and Ro-Ro terminals is 60 months (5 years). If SCE's works in parallel with the Port's effort and takes no longer than the 2009 Pier G project (5 years), the necessary infrastructure could be available without adding significant time to the overall project duration. However, delays in SCE's work could cause delays in the overall timeline to deliver new shore power for Ro-Ro and tanker terminals.

ELECTRIFICATION OF NON-CONTAINER TERMINALS

TYPES OF SHIPS

Based on a preliminary inspection of the non-container terminals and the cooperation of the terminal operators, it was concluded that the tanker vessels and Ro-Ro vessels were visiting the following non-container terminals, as follows:

-Pier B Petro Diamond (B82-B83): Tanker vessels

-Pier B Marathon Petroleum (B76-B79) on the inner part of Channel 2 and LBT (B84-B87): Tanker vessels

-Pier B Toyota Logistics (B82-B83): Ro-Ro vessels

-Pier F Chemoil Marine Terminal (F208-F209): Tanker vessels

-Pier F SSA Berth 204-207: Ro-Ro vessels

-Pier T Marathon Petroleum (T121): Tanker vessels

Ro-Ro ships are explicitly identified in the applicable standard IEC/IEEE 80005-1 with requirements that Ro-Ro ships must comply with. Similarly, for the tanker vessels, the same standard has explicitly identified tanker vessel with specific requirements that tanker vessels must comply with. However, the requirements for these ships differ such that if shore power for one type of ship is fitted on the wharf, the same installation CANNOT serve tankers or container ships.

Presently there are no Ro-Ro-type ships that have been retrofitted to accept shore power visiting the POLB. Although there may be some Ro-Ro vessels in the global fleet that are retrofitted to accept shore power, they do not necessarily follow the IEC/IEEE standards. There are Ro-Ro ships that claim to have retrofitted in accordance with the IEC/IEEE 80005-1 standard, however no such vessel has visited any of the non-container terminals at the POLB as of this date.

In summary, all non-container terminals need to comply with the IEC/IEEE standard. Table 1 is a summary of the non-container terminals and the applicable Annexes for the vessels being served.

Table 1: Non-Container Terminals and Applicable Standards

Non-Container Terminal	IEC/IEEE 80005-1[2]	Type of Vessels
Pier B Petro Diamond (B82-B83)	(Annex F)	Tanker
Pier B Marathon Petroleum T2 (B76-B79) on the inner part of Channel 2 and LBT (B84-B87)	(Annex F)	Tanker
Pier B Toyota Logistics (B82-B83)	(Annex B)	Ro-Ro
Pier F Chemoil Marine Terminal (F208-F209)	(Annex F)	Tanker
Pier F SSA Berth 204-207	(Annex B)	Ro-Ro
Pier T Marathon Petroleum (T121)	(Annex F)	Tanker

AVAILABLE SOLUTIONS

At the POLB, the non-container terminals mentioned in this report, with the exception of T121, have no "cold ironing" facilities as of this writing. The POLB container terminals all have shore power capacity. However, some berths may exhibit limited flexibility due to the location of the SPOs. The following options are available to enhance the ability of the Port's terminals to comply with the CARB At-Berth Rule. These options are further detailed in this section

- Shore Power installation at Tanker Terminals
- Shore Power installation at Ro-Ro Terminals
- Alternative Compliance via Land-based or Barge-Based Emission Capture and Control
- Movable Supply Equipment at container terminals with existing shore power capability.

[2] Assumed no tanker vessel or Ro-Ro vessel of 1 MVA or less will visit POLB non-container terminals.

The above options are recommended for considerations and subject to interpretation and approval by authorities having jurisdiction, such as the local building officials, terminal operators, Board of Harbor Commissioners and CARB personnel. Table 2 provides the locations of diagrams of each of the available non-container terminal compliance options.

Table 2: Operations and Solutions Summary	
Operations	Solutions
a) Tanker Vessels	See Diagram on Sheet E4
b) Ro-Ro Ships.	See Diagram on Sheet E5
c) Land-Based Alternative	See Diagram on Sheet E6

TANKER VESSEL

Attached Drawing Sheet E4 shows a typical site plan for a tanker vessel "Cold Ironing" application, complying with IEC/IEEE 80005-1, Annex F.

The cables delivering electrical power to a tanker vessel will be spooled on a cable manager, as specified in paragraph 7.2 of the IEC/IEEE 80005-1 standard. This "Power Cable Manager" will have three cables, each with a power rating of 3.6 MVA. The voltage serving the vessel shall be 6.6 KV. Detail 2 on Sheet E4 shows a Power Cable Manager that is presently in use at T121 of the POLB.

For tanker vessels, the IEC/IEEE 80005-1 standard has another requirement to provide a "Control Cable Management System", in addition to the cable manager for power cables. Therefore, two cable managers will be necessary to be provided, one for power cables and another one for control cables. Detail 2 on Sheet E4 shows a "Control Cable Management System".

Furthermore, unlike the Movable Supply Equipment that is permitted by the IEC/IEEE 80005-1 standard within a container terminal and with container ships, such "cable reel" is not permitted for use in a tanker vessel application due to the fact that the standard requires the "cable reel" for a tanker vessel be located on shore, whereas the "cable reel" for a container ship may be located on the ship itself. Additionally, the IEC/IEEE 80005-1 standard, in paragraph F.4.6.4, requires that the equipment used for "cold ironing" of a tanker vessel at berth be located outside the hazardous classified areas[3]. This report then will use these

[3] In general, the hazardous classified area are those regions of a tanker vessel and terminal where fire or explosion hazards may exist. The National Electric Code (NEC) and the International Electrotechnical Commission (IEC) include extensive definitions and discussion of classified areas as well as constraints on electrical systems within those areas. The cost to install and operate a shore power system within the hazardous classified area would likely be prohibitively expensive.

requirements for tanker vessels as established in the IEC/IEEE 80005-1 standard in describing the modifications required on shore.

It is assumed that tanker vessels will have a crane to lift the shore power cables from shore to the ship. This is unlike the container ships where they lower the cables from the ship to the wharf for a shore power connection. Most likely this lifting crane and the ship connectors will be at the stern of the ship to meet the requirements of the IEC/IEEE 80005-1 standard, particularly if the equipment have to be located out of the hazardous classified areas.

To add flexibility to berthing locations of tanker vessels, the “Power Cable Manager” and the “Control Cable Management System” is recommended to be mounted on a platform to allow moving the system along the wharf. Wharf space constraints may make such a movable system impractical at some terminals. These terminals may require special shore power designs or wharf modifications to meet the IEC/IEEE Standard.

RO-RO SHIP

The attached Drawing Sheet E5, shows a site plan for Ro-Ro ships, complying with IEC/IEEE 80005-1, Annex B.

A previous study, prepared on behalf of the Port, identified the typical power demand at a Ro-Ro berth as approximately 1.5 MVA[4]. This is substantially less than the IEC/IEEE 80005-1 standard which requires that one cable be used for the Ro-Ro system and the maximum power demand to be 6.5 MVA. This report will use the 6.5 MVA that is included in the Standard.

The IEC/IEEE 80005-1 standard in paragraph B.4.6.4 specifies that the electrical equipment installation needed for the “cold ironing” of Ro-Ro ships shall not be installed in areas that may become hazardous areas. For nominal voltage, the standard IEC/IEEE 80005-1, paragraph B.5.1 specifies the use of 11 KV.

The IEC/IEEE 80005-1 standard, in paragraph B.7.2.1 requires the cable management system serving a Ro-Ro ship to be located on shore-side facility.

To add flexibility to berthing locations of Ro-Ro ships, it is recommended to provide a crane on shore, that can lift the cables from shore to ship and can also travel along the wharf.

BARGE SOLUTION OR LAND-BASED ALTERNATIVE

Barge-based alternatives are expected to operate independently of the terminal infrastructure and therefore terminal upgrades are not anticipated for this solution. For a land-based alternative, an electrical outlet will be provided on wharf as shown in Drawing Sheet E6.

[4] 03-30-2004. *Cold Ironing Cost Effectiveness Study*. Environ.

For this report, the discussion of power to the land-based unit will be limited to the extent of providing electrical outlets at the wharves where a capture and control system may connect to grid power. One such outlet is suggested per berth.

MOVABLE SUPPLY EQUIPMENT

Movable Supply Equipment, commonly referred to as a “cable reel system” may be an alternative where a vessel’s own cable does not reach the SPO at a particular berth. The “cable reel” solution will provide the physical means to allow vessels, with insufficient cable lengths to reach an SPO and make connection.

In the course of IEC/IEEE 80005-1 Standard development the terms “movable supply”, “managed cable extension”, and “cable reel”, were used interchangeably and thus may have confused the readers. In this regard the Standard’s final version in Paragraph 7.1 clearly states that “Ship-to-shore connection cable extensions shall not be permitted”. This requirement applies to all vessels, except for the container vessels. Annex D of the Standard, in Paragraph D.6.1 states “The supply point ashore can be fixed or movable….”. In short, Movable Supply Equipment is allowed for container vessel cold ironing application only. Tanker and Ro-Ro terminals can not use Movable Supply Equipment and therefore must rely on other strategies to provide berthing flexibility (e.g., additional SPOs).

Movable Supply Equipment for “cold ironing” applications are now available in a number of design configurations. The designs vary based on manufacturer and application, although they have similarities. Nevertheless, a customer will need to specify some requirements for their particular wharf and use. Hence, there will be some planning and preparation involved. Even if the customer decides to purchase a nominally identical unit that the manufacturer had constructed previously, some planning and preparation will be involved to assure compatibility of the cable reel fabricated with the application it is intended for.

COST OF AVAILABLE SOLUTIONS

The non-container terminals have an extensive number of berthing scenarios. This presents design challenges to ensure that shore power is accessible to all vessels and all berthing configurations. As an example, if a ship berths at the same facility in any manner it chooses, such as starboard or port side, then twice as many connection points will needed than if the same ship berthed the same side consistently. Furthermore, if ships of different sizes visit the same berth, additional SPOs and substations will have to be provided on wharf to accommodate facilities on shore for “cold ironing” of these ships. It should be noted that the IEC/IEEE Standard does not limit the length of shore power cables. However, practical considerations, such as available storage space on the wharf and the weight of the cables, will limit the viable length of cables. That said, longer shore power cables can provide additional flexibility when designing shore power systems.

As noted above, the allocation of costs between various entities is beyond the scope if this report.

For cost estimating purposes, this report will assume that each non-container terminal will be equipped with a shore power system designed to service tanker vessels or a shore power system designed to service Ro-Ro vessels. Therefore, the cost of implementing the available solutions, within the limits as described, is presented in this section. Design cost will be taken at 20% of the construction cost. Program and construction management are assumed to be 55% of the construction cost. A 40% contingency is assumed based on the early phases of planning and preliminary design.

TANKER VESSEL

Attached drawing Sheet E4 shows a typical site plan for a tanker vessel “Cold Ironing” application.

The existing electrical services for the tanker terminals are not adequate for providing shore power to tanker vessels. Therefore, a new electrical service from the utility company, Southern California Edison Co. (SCE) will be required to provide shore power at tanker terminals.

Per the IEC/IEEE Standard, a minimum of one “Power Cable Manager” and one “Control Cable Manager” is needed for each tanker vessel. Two sets will be required if some flexibility is desired for tanker vessels berthing portside or starboard side, or if a vessel has its inlet connectors at opposite ends of the vessels. However, the cost estimate included in this report is for one set only, unless specifically stated otherwise.

To give further berthing flexibility, movable platforms can be provided to adjust the cable manager to the proper location with respect to the connection points on the ship. Ideally the cable manager must be located vertically under the connection points of the tanker vessel, with no more than 10 degree deviation.

1. A crane on the wharf needs to be available to lift the cables from the wharf deck to the tanker vessel’s deck.
2. A cost for such a crane is also included in the estimate.

Dolphins will be required at some of the non-container terminals to mount the electrical equipment necessary to provide shore power to the tanker vessel.

A total cost of $46.6M is estimated for serving a tanker vessel and includes one dolphin as shown on Sheet E1. Cost for an additional dolphin, if necessary, is estimated to be $16M in raw construction cost and a total of $39.2M including design, management, and contingency. Further details of the cost estimate are included in the Appendix.

RO-RO SHIP

Attached drawing Sheet E5 shows a site plan for Ro-Ro ships, complying with IEC/IEEE 80005-1, Annex B.

The existing electrical services for the non-container terminals are not adequate for providing shore power to a Ro-Ro ship. Therefore, the total cost estimate includes a new electrical service from the utility company, SCE.

For the non-container terminals, the shore power system can be installed on the wharf deck. A power trench and a crane for lifting the cables from the wharf deck to the ship’s deck and the cable manager can be integrated together to provide a flexible shore power outlet to the Ro-Ro ship.

A total cost of $8.1M is estimated for an installation as shown in the drawing Sheet No. E5. Further details of the cost estimate are included in the Appendix.

LAND BASED ALTERNATIVE

For a land-based unit an electrical outlet will be provided on wharf, as shown in Drawing Sheet E6.

The existing electrical services for the non-container terminals have limited additional capacity. As such they are unlikely to have adequate power to support a land-based unit. Therefore, the total cost estimate includes a new electrical service form the utility company, SCE.

For this report, we will estimate the cost on the basis that 480 V shore power will be made available for this operation.

The cost shown in Table 3 is for grid power at the wharf only. This total cost is $6.1M per one outlet on the wharf. Preliminary estimates for a "capture and control" system is $10M[5] and is not included in Table 3. Further details of the cost estimate are included in the Appendix.

MOVABLE SUPPLY EQUIPMENT

The cost for Movable Supply Equipment that meets the IEC/IEEE 80005-1 standard varies due to the cable reel's particular application, but mainly due to the cable length required. A cable reel with approximately 200 ft. of cables will cost approximately $300,000, whereas a cable reel with about 600 ft. of cables will cost approximately of $500,000. For cost estimation purposes a price of $600,000 has been used in this report to account for terminal variability.

DESIGN AND CONSTRUCTION SCHEDULE

This section will address the time required to plan and design for the recommended solutions as well as the construction duration. For this report to put some boundaries for the design and construction periods, the assumption is made that these periods begin when there is a clear definition of all the design parameters. This is a significant assumption, because most projects would require a number of meetings involving POLB management and terminal operators to evaluate and review the options they have to consider before they are able to conclude what is needed to design and construct.

The time period for construction of any of the solutions is also assumed to begin when the POLB Board approves the Notice to Proceed (NTP) date. The end of construction period will be when the POLB Board determines that the project is substantially complete. The estimated durations for entitlements, design, bidding, and construction are summarized in Table 5 for the options presented in this report.

[5] As of this report capture and control systems are not readily available commercially and therefore costs are difficult to estimate. A recent CARB grant of $10M was awarded for the construction and demonstration of a capture and control system for tankers.

Table 5: Design and Construction Duration by Installation Type					
Solutions	Duration				
	Entitlements	Design	Bidding	Construction	Total
Tanker Terminal Shore Power	6 Months	24 Months	6 Months	24 Months	60 Months
Ro-Ro Terminal Shore Power	6 Months	24 Months	6 Months	24 Months	60 Months
Electrical Infrastructure Land-Based Alternative	6 months	24 Months	6 Months	18 Months	54 Months
Movable Supply Equipment	N/A	2 Months	6 Months	12 Months	20 Months

TANKER VESSEL

Attached figure Sheet E4 shows a site plan of a typical berth in a terminal showing the components required to deliver shore power to a tanker vessel.

The time required to build such a facility represents construction involving one dolphin with cable managers on a movable platform. The movable platform is needed to accommodate a variety of tanker vessel sizes that may visit the terminal.

Design duration is estimated to require a 2-year period. Construction duration for such an installation will be 2 years. Entitlements and bidding are each estimated to require 6 months.

RO-RO

Attached drawing Sheet E5 shows a site plan of a typical berth and the components required to deliver shore power to a Ro-Ro ship.

The duration presented for this option, includes the time required to build a movable crane that can lift the shore power cables necessary to deliver electrical power to a Ro-Ro ship. The movable crane is needed to accommodate a variety of Ro-Ro ship sizes that may visit the terminal.

Design of a Ro-Ro shore power system will be new at the Port. Although IEC/IEEE 80005-1 provides the fundamental requirements for Ro-Ro shore power, there are many design options that much be considered to best serve the terminal and anticipated vessel calls. As shown in drawing Sheet E5 a power trench may be used for the crane to move on. Additional major considerations include the number of SPOs and proximity of the substation. However, there are other options, and this being a new type of installation will draw the attention of the terminal operator, vessel operators, workers in the area, city inspectors, Port management, manufacturers, contractors, and designers. All will have input into the system and an agreement needs to be reached on the exact requirements before fabrication and installation takes place. This coordination, until an agreement is reached, is naturally a slow process and time consuming in arranging meetings, demonstrations, and sharing observations together.

Design duration is estimated to require a 2-year period. Construction duration for such an installation will be 2 years. Entitlements and bidding are each estimated to require 6 months.

LAND-BASED ALTERNATIVE

Attached drawing Sheet E6 shows a site plan for this application.

Design duration is estimated to require a 2-year period. Construction duration for such an installation will be 18 months. Entitlements and bidding are each estimated to require 6 months.

MOVABLE SUPPLY EQUIPMENT

It is estimated that a cable reel design will require a period of two months. The construction period required, will be 12 months. Entitlements are not anticipated for movable supply equipment. Bidding is estimated to require 6 months.

RECOMMENDED SHORE POWER SOLUTIONS FOR NON-CONTAINER TERMINALS

In applying the findings in the discussions above, this section will provide the solutions recommended to supply shore power to the non-container terminals in question. Costs presented in this section are inclusive of design, program/construction management, construction, and contingency. A summary of the costs per terminal with a single SPO are presented in Table 3. Table 4 presents costs per terminal with two SPOs each. For cost estimation purposes the following assumptions have been used:

- Design costs are 20 percent of construction costs
- Program/construction management and oversight are 55 percent of construction costs
- Contingency is calculated as 40 percent of the sum of all other costs

Table 3: Shore Power Cost by Terminal with One SPO*							
Terminal	Berth	Design Cost[1]	Construction Cost	Design/Construction "Soft" Cost[2]	Total Cost	Project Contingency Cost[3]	Total w/ Contingency
Pier B Petro Diamond	B82 & B83	-	-	-	-	-	-
Pier B Marathon Petroleum	B77 & B79	$7,600,000	$38,000,000	$20,900,000	$66,500,000	$26,600,000	$93,100,000
Pier B Marathon Petroleum	B85 & B87	$7,600,000	$38,000,000	$20,900,000	$66,500,000	$26,600,000	$93,100,000
Pier B Toyota Logistics	B82 & B83	$660,000	$3,300,000	$1,815,000	$5,775,000	$2,310,000	$8,085,000
Pier F Chemoil Marine	F209	$3,800,000	$19,000,000	$10,450,000	$33,250,000	$13,300,000	$46,550,000
Pier F SSA	F204 & F207	$1,320,000	$6,600,000	$3,630,000	$11,550,000	$4,620,000	$16,170,000
Pier T Marathon Petroleum	T121	-	-	-	-	-	-
Total Non-Container Shore Power		$20,980,000	$104,900,000	$57,695,000	$183,575,000	$73,430,000	$257,005,000

* Costs are presented in 2021 dollars and do not include the planning and construction required for SCE infrastructure/service.

(1) Estimated to be 20% of Construction Cost

(2) Estimated to be 55% of Construction Cost

(3) Estimated to be 40% of Construction Cost

Table 4: Shore Power Cost by Terminal with Two SPOs							
Terminal	**Berth**	**Design Cost[1]**	**Construction Cost**	**Design/Construction "Soft" Cost[2]**	**Total Cost**	**Project Contingency Cost[3]**	**Total with Contingency**
Pier B Petro Diamond	B82 and B83	$ -	$ -	$ -	$ -	$ -	$ -
Pier B Marathon Petroleum	B77 and B79	$12,620,000	$63,100,000	$34,705,000	$110,425,000	$44,170,000	$154,595,000
Pier B Marathon Petroleum	B85 and B87	$12,620,000	$63,100,000	$34,705,000	$110,425,000	$44,170,000	$154,595,000
Pier B Toyota Logistics	B82 & B83	$900,000	$4,500,000	$2,475,000	$7,875,000	$3,150,000	$11,025,000
Pier F Chemoil Marine	F209	$6,300,000	$31,500,000	$17,325,000	$55,125,000	$22,050,000	$77,175,000
Pier F SSA	F204 - F207	$1,820,000	$9,100,000	$5,005,000	$15,925,000	$6,370,000	$22,295,000
Pier T Marathon Petroleum	T121	-	-	-	-	-	-

* Costs are presented in 2021 dollars and do not include the planning and construction required for SCE infrastructure/service.
(1) Estimated to be 20% of Construction Cost
(2) Estimated to be 55% of Construction Cost
(3) Estimated to be 40% of Construction Cost

Table 5 provides costs for land-based alternative infrastructure and movable supply equipment.

Table 5: Alternative Compliance Infrastructure and Supplemental Shore Power Equipment Cost*							
Terminal	**Berth**	**Design Cost[1]**	**Construction Cost**	**Design/Construction "Soft" Cost[2]**	**Total Cost**	**Project Contingency Cost[3]**	**Total with Contingency**
Land Based Unit Infra-structure	N/A	$500,000	$2,500,000	$1,375,000	$4,375,000	$1,750,000	$6,125,000
Movable Supply Equipment	N/A	$20,000	$600,000	$330,000	$1,050,000	$420,000	$1,470,000

* Costs are presented in 2021 dollars and do not include the planning and construction required for SCE infrastructure/service.
(1) Estimated to be 20% of Construction Cost
(2) Estimated to be 55% of Construction Cost
(3) Estimated to be 40% of Construction Cost

PIER B PETRO DIAMOND TERMINAL

At Pier B, Petro Diamond terminal, tanker vessels are served. Drawing Sheet E1 shows Berths B82 and B83 where Petro Diamond serves the tanker vessels. However, Petro Diamond has a 3rd preferential agreement for the use of those berths. Petro Diamond is exempt currently from the At Berth Rule requirements due to the number of vessel calls per year at the terminal, which falls below the threshold required by the Rule.

National Gypsum has 1st preferential use of the same berths as Petro Diamond, while Toyota has 2nd preferential use. National Gypsum uses gypsum cement carriers and Toyota uses Ro-Ro ships. Although National Gypsum is mentioned here, the dry bulk vessels that call National Gypsum terminal are not included in the At Berth Rule and therefore are not further addressed in this report.

For Pier B, Petro Diamond Terminal, both berths require no modifications, B82 and B83. Cost: none.

PIER B MARATHON PETROLEUM T2 (B76-B79) TERMINAL

At Pier B, Marathon Petroleum, T2 terminal, tanker vessels are served. Applying the standard design, Drawing Sheet E1 shows where the terminal would need to provide shore power to the ships.

Electrical substations and associated equipment would need to be installed at each berth for tanker vessels, namely Berth B77 and B79, as depicted on the drawing. The drawings and strategies in this report are preliminary and theoretical. As such, the exact locations and configuration of shore power equipment will be determined by the Port and terminal operator as part of a more detailed design analysis.

For Pier B, Marathon Petroleum T2 Terminal, both berths modifications, B77 and B79, will be at a cost of $93.1M with one SPO per berth and $154.6M with two SPOs per berth[6].

PIER B MARATHON PETROLEUM LBT (B84-B87) TERMINAL

At Pier B, Marathon Petroleum LBT terminal, tanker vessels are served. Applying the standard design, Drawing Sheet E1 shows where the terminal needs to provide shore power to the ships.

Electrical substations and associated equipment need to be installed at each berth for tanker vessels, namely Berth B85 and B87, as depicted on the drawing. The drawings and strategies in this report are preliminary and theoretical. As such, the exact locations and configuration of shore power equipment will be determined by the Port and terminal operator as part of a more detailed design analysis.

For Pier B, Marathon Petroleum LBT Terminal, both berths modifications, B85 and B87, will be at a cost of $93.1M with one SPO per berth and $154.6M with two SPOs per berth.

PIER B TOYOTA LOGISTICS TERMINAL

At Pier B, Toyota Logistics terminal, Ro-Ro vessels are served.

The Toyota terminal serves only Ro-Ro ships. Applying the standard design, Drawing Sheet E1 shows where the terminal needs to provide shore power to the ships. Electrical substations and associated equipment need to be installed at one berth for Ro-Ro ships, namely Berth B83, as depicted on the drawing. The drawings and strategies in this report are preliminary and theoretical. As such, the exact locations and

[6] The number of SPOs installed per berth will vary based on terminal operations and forecasted vessel types calling the terminal. This report includes costs for one SPO, the minimum necessary to delivery shore power. In addition, the costs for two SPOs per berth is presented to provide a sense of the costs for additional SPOs.

configuration of shore power equipment will be determined by the Port and terminal operator as part of a more detailed design analysis.

For Pier B, Toyota Logistics Terminal, the berth modifications at B83, will be at a cost of $8.1M with one SPO per berth and $11.0M with two SPOs per berth.

PIER F CHEMOIL MARINE TERMINAL

At Pier F, Chemoil Marine terminal, tanker vessels are served. Applying the standard design, Drawing Sheet E3 shows where the shore “Power Cable Manager” and the “Control Cable Management System” is recommended for installation. The drawing also shows that the wharf assigned to Chemoil, and the terminal’s backland facilities are detached from each other. The drawings and strategies in this report are preliminary and theoretical. As such, the exact locations and configuration of shore power equipment will be determined by the Port and terminal operator as part of a more detailed design analysis.

Per the IEC/IEEE standard, Paragraph F.7.1, these tanker vessels require over 10.8 MVA of electrical power, while at berth.

For Pier F, Chemoil Marine Terminal, the berth modifications, at F209, will be at a cost of $46.6M with one SPO per berth and $77.2M with two SPOs per berth.

PIER F, SSA, BERTHS 204-206 TERMINAL

At Pier F, SSA, Berths 204-206 terminal, Ro-Ro vessels are served. Drawing Sheet E2 shows where the shore power arrangement will have to be and so is recommended for installation. Electrical substations and associated equipment need to be installed at Berth B204-206. The drawings and strategies in this report are preliminary and theoretical. As such, the exact locations and configuration of shore power equipment will be determined by the Port and terminal operator as part of a more detailed design analysis.

For Pier F, SSA Terminal, the berth modifications at F204 and F206, will be at a cost of $16.2M with one SPO per berth and $22.3M with two SPOs per berth.

PIER T MARATHON PETROLEUM, BERTH T121 TERMINAL

At Pier T, Marathon Petroleum, Berth T121 terminal, tanker vessels are served. This terminal has shore power in accordance with the IEC/IEEE 80005-1, Annex F, Standard. As a matter of fact, the standard was written around what was designed and built at Pier T, Berth 121, as an acceptable means for providing shore power to tanker vessels. Photo in Detail 2 of Sheet E4 shows the installation at Pier T and where the “Power Cable Manager” and the “Control Cable Management System” are located.

There is currently no need to do additional work at Pier T since shore power is available and the terminal has space for only one tanker vessel. If the types of calling the terminal were, to change it is feasible that adjustments to the shore power configuration may be necessary. Such adjustments to the configuration should not require additional service from SCE.

CONCLUSION

The existing POLB container terminals and non-container terminals serving tankers and Ro-Ro vessels were reviewed at a high level to assess the state of infrastructure at POLB and to recommend solutions to install shore-power systems for ships at berth. Some of the limitations were discussed and the applicable standards were reviewed. Costs associated with the recommendations are included, as well as a timeline to design and construct the options that were discussed in this report.

Design standards from IEC/IEEE 80005-1 is available for the safe and effective implementation of shore power for tankers and Ro-Ro vessels. For terminals opting to utilize alternatives to shore power, compliance pathways exist via capture and control solutions. The cost and timeline to implement the solutions presented in this report will be heavily impacted by individual terminal decisions. Ultimately, a terminal operator's compliance strategy will require additional evaluation and coordination with POLB, and SCE.

Costs and schedule presented in this report are based on data and experience at the Port. Additional analysis will be required to refine project costs and timelines.

FIGURES

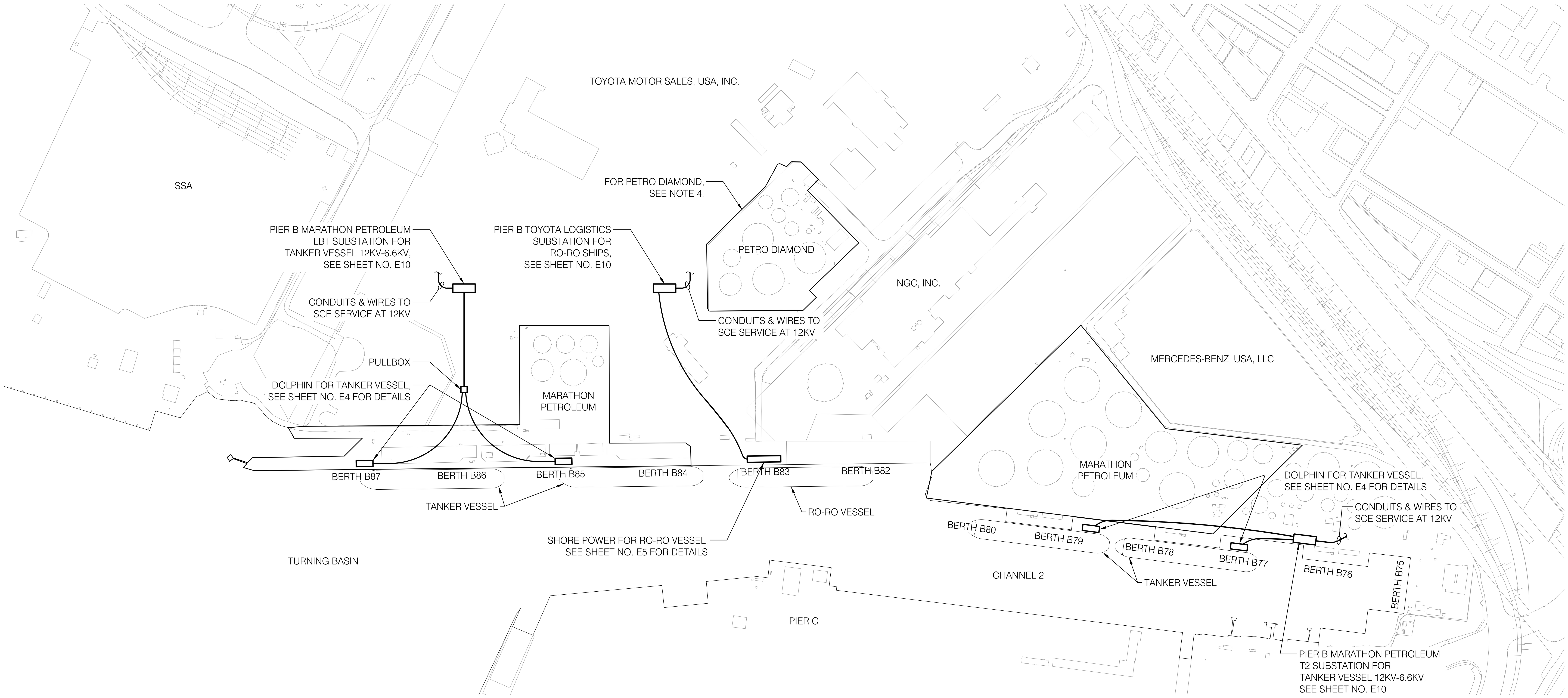
GENERAL NOTES

1) THIS DRAWING ILLUSTRATES HOW SHORE POWER CAN BE MADE AVAILABLE TO SHIPS AT WHARVES.

2) EXACT LOCATIONS AND QUANTITIES OF EQUIPMENT REQUIRED FOR SHORE POWER INSTALLATIONS CAN ONLY BE DETERMINED IF VESSEL PARTICULARS ARE DEFINED, SUCH AS; WHAT VESSEL SIZE IS IN KVA, WHAT TYPE OF VESSEL IT IS (TANKER, RO-RO), WHERE THE VESSEL INLET IS LOCATED AND SIMILAR DATA.

3) SCE SERVICES AND SUBSTATION LOCATIONS ARE DIAGRAMMATIC. FOR EXACT SERVICE LOCATIONS FROM SCE, AND SUBSTATION LOCATIONS, IT IS NECESSARY TO DETERMINE AVAILABLE PROPERTY SITE FOR SUBSTATION AND A RESPONSIBLE PARTY THAT WILL SIGN TO THE SCE METER FOR ELECTRICAL POWER BILLING, AMONG OTHER DATA NEEDED.

4) FOR PETRO DIAMOND, THERE ARE NO PROVISIONS MADE FOR SHORE POWER, BECAUSE OF CARB EXEMPTION.



PIER B SITE PLAN

NOT TO SCALE

1 / E1

N

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Project Title

CARB - POLB
Non-Container Terminals

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Number	Description	Date

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Sheet Title

POLB Pier B Site Plan
Petro Diamond
Marathon Petroleum
Toyota

Sheet Number

E1

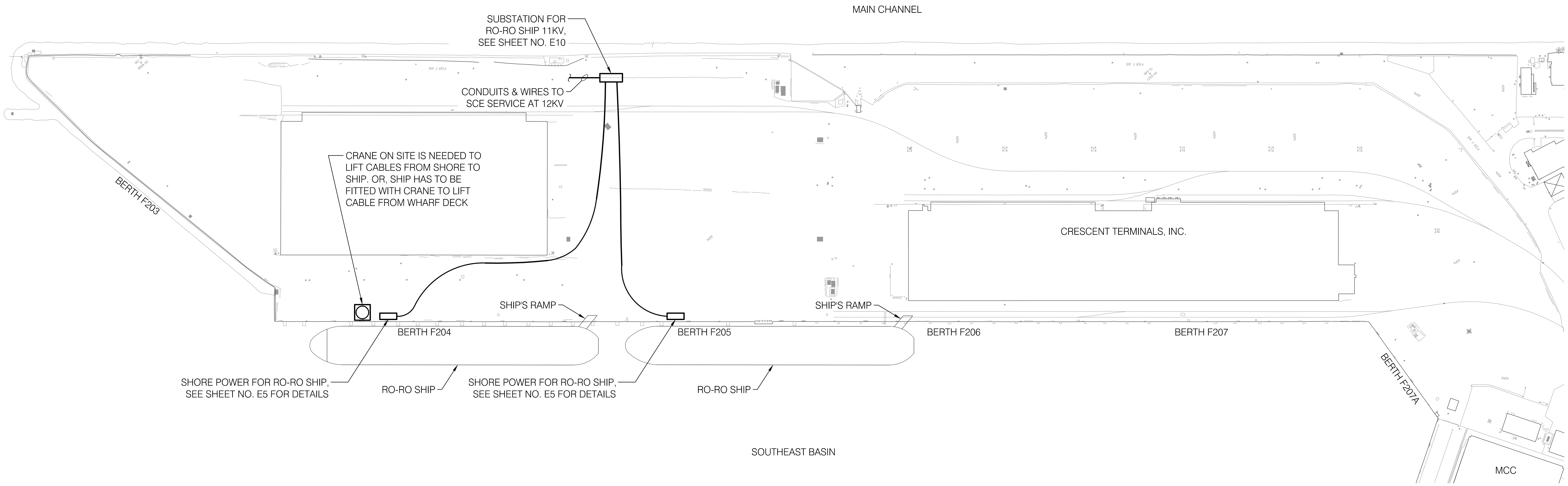
P2S No. 21-0320

GENERAL NOTES

1) THIS DRAWING ILLUSTRATES HOW SHORE POWER CAN BE MADE AVAILABLE TO SHIPS AT WHARVES.

2) EXACT LOCATIONS AND QUANTITIES OF EQUIPMENT REQUIRED FOR SHORE POWER INSTALLATIONS CAN ONLY BE DETERMINED IF VESSEL PARTICULARS ARE DEFINED, SUCH AS; WHAT VESSEL SIZE IS IN KVA, WHAT TYPE OF VESSEL IT IS (TANKER, RO-RO), WHERE THE VESSEL INLET IS LOCATED AND SIMILAR DATA.

3) SCE SERVICES AND SUBSTATION LOCATIONS ARE DIAGRAMMATIC. FOR EXACT SERVICE LOCATIONS FROM SCE, AND SUBSTATION LOCATIONS, IT IS NECESSARY TO DETERMINE AVAILABLE PROPERTY SITE FOR SUBSTATION AND A RESPONSIBLE PARTY THAT WILL SIGN TO THE SCE METER FOR ELECTRICAL POWER BILLING, AMONG OTHER DATA NEEDED.



PIER F SITE PLAN - BERTH F203-F207

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E2

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Sheet Title

POLB Pier F Site Plan
Berth F203-F207
SSA

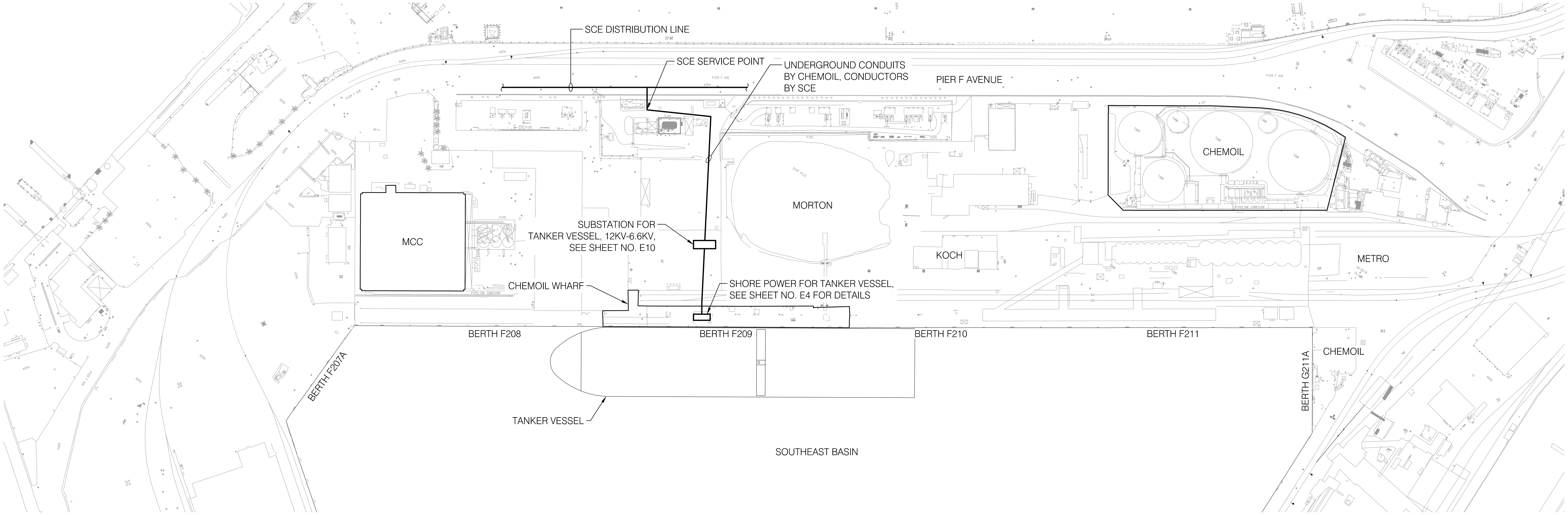
Sheet Number

E2

P2S No. 21-0320

GENERAL NOTES

1) THIS DRAWING ILLUSTRATES HOW SHORE POWER CAN BE MADE AVAILABLE TO SHIPS AT WHARVES.
2) EXACT LOCATIONS AND QUANTITIES OF EQUIPMENT REQUIRED FOR SHORE POWER INSTALLATIONS CAN ONLY BE DETERMINED IF VESSEL PARTICULARS ARE DEFINED, SUCH AS; WHAT VESSEL SIZE IS IN KVA, WHAT TYPE OF VESSEL IT IS (TANKER, RO-RO, DRY BULK), WHERE THE VESSEL INLET IS LOCATED AND SIMILAR DATA.
3) SCE SERVICES AND SUBSTATION LOCATIONS ARE DIAGRAMMATIC. FOR EXACT SERVICE LOCATIONS FROM SCE, AND SUBSTATION LOCATIONS, IT IS NECESSARY TO DETERMINE AVAILABLE PROPERTY SITE FOR SUBSTATION AND A RESPONSIBLE PARTY THAT WILL SIGN TO THE SCE METER FOR ELECTRICAL POWER BILLING, AMONG OTHER DATA NEEDED.



PIER F SITE PLAN - BERTH F208-F211
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E3

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Sheet Title
POLB Pier F Site Plan
Berth F208-F209
Chemoil

Sheet Number
E3

P2S No. 21-0320

GENERAL NOTES

1) THIS DRAWING ILLUSTRATES HOW SHORE POWER CAN BE MADE AVAILABLE TO SHIPS AT WHARVES.
2) EXACT LOCATIONS AND QUANTITIES OF EQUIPMENT REQUIRED FOR SHORE POWER INSTALLATIONS CAN ONLY BE DETERMINED IF VESSEL PARTICULARS ARE DEFINED, SUCH AS; WHAT VESSEL SIZE IS IN KVA, WHAT TYPE OF VESSEL IT IS (TANKER, RO-RO, DRY BULK), WHERE THE VESSEL INLET IS LOCATED AND SIMILAR DATA.
3) SCE SERVICES AND SUBSTATION LOCATIONS ARE DIAGRAMMATIC. FOR EXACT SERVICE LOCATIONS FROM SCE, AND SUBSTATION LOCATIONS, IT IS NECESSARY TO DETERMINE AVAILABLE PROPERTY SITE FOR SUBSTATION AND A RESPONSIBLE PARTY THAT WILL SIGN TO THE SCE METER FOR ELECTRICAL POWER BILLING, AMONG OTHER DATA NEEDED.

MAJOR COMPONENTS - TANKER VESSEL

TO "COLD IRON" A TANKER VESSEL AT A TYPICAL POLB FACILITY, THE FOLLOWING MAJOR COMPONENTS ARE NEEDED ON SHORE, IN COMPLIANCE WITH IEC/IEEE 80005-1 STANDARD:

1) ELECTRICAL SERVICE AT 12.47KV FROM UTILITY COMPANY (SCE AT POLB).
2) AN ELECTRICAL SUBSTATION WITH 10.8 MVA CAPACITY AT 6.6KV.
3) "POWER CABLE MANAGER" AND "CONTROL CABLE MANAGEMENT SYSTEM" ON A MOVABLE PLATFORM. TWO SUCH PLATFORMS WILL BE NEEDED PER BERTH, OUTSIDE THE HAZARDOUS CLASSIFIED ZONE.
4) PLATFORM FOR CABLE MANAGERS SHOULD BE ABLE TO TRAVEL ALONG WHARF, TO ALIGN THE CABLES WITH TANKER'S INLET CONNECTORS ON THE TANKER VESSEL.
5) A CRANE ON SITE WILL BE REQUIRED TO LIFT THE CABLES FROM WHARF TO THE TANKER'S DECK. OR, TANKER VESSEL MUST BE FITTED WITH CRANE TO LIFT CABLES FROM WHARF.
6) TANKER VESSEL THAT IS FITTED FOR "COLD IRONING" AT A PORT FACILITY IN ACCORDANCE WITH IEC/IEEE 80005-1 STANDARD.
7) PERSONNEL WHO ARE FAMILIAR WITH THE INSTALLED FACILITIES AND ARE TRAINED IN THE CIRCUIT BREAKER SETTINGS, AS WELL AS THE CONTROLLERS.

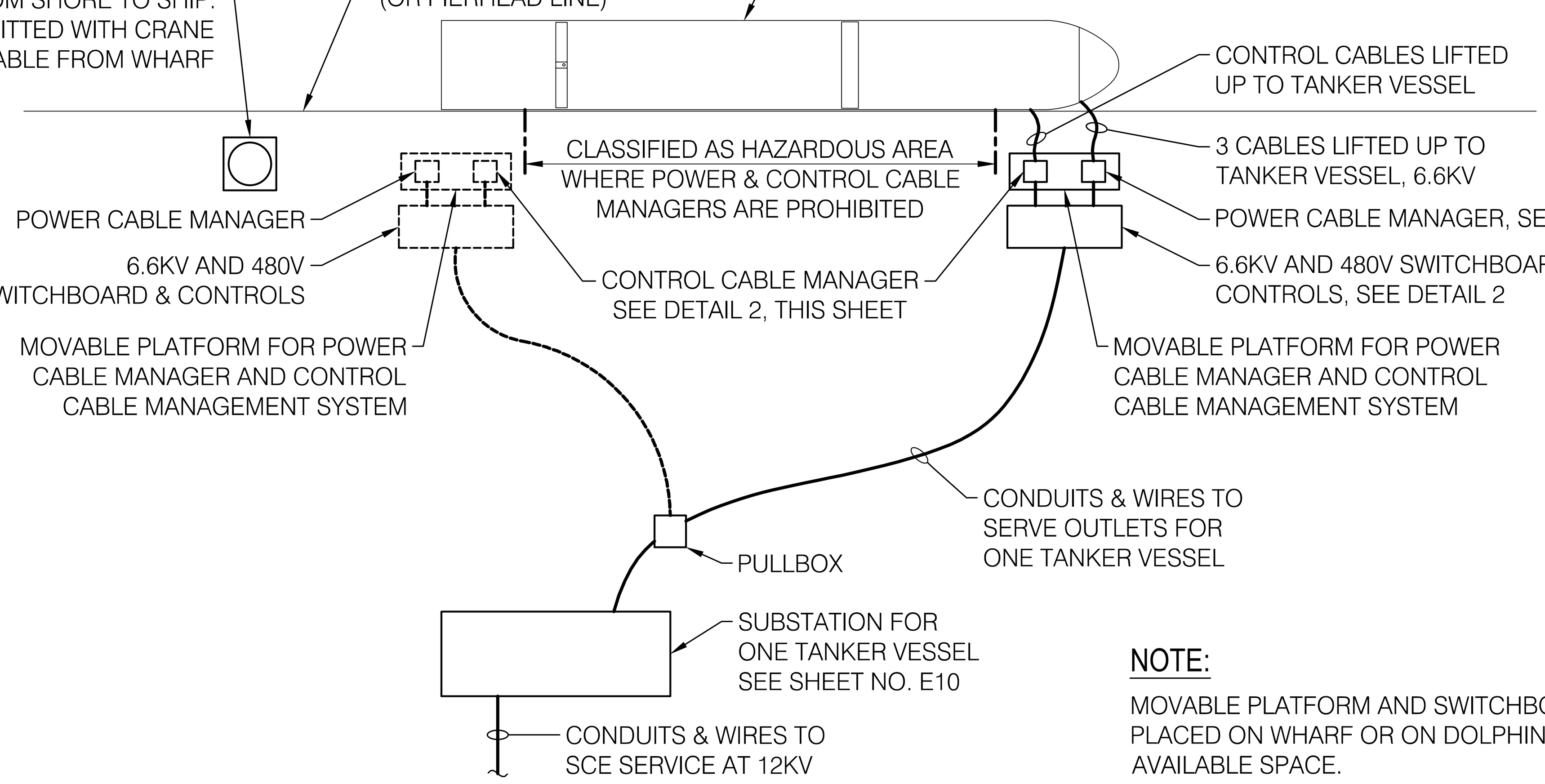
NOTE:

CONTROL CABLE MANAGER, SWITCHBOARD AND POWER CABLE MANAGER ARE SHOWN IN PICTURE, AS INSTALLED ON A DOLPHIN. MOVABLE PLATFORM IS NOT SHOWN.

TANKER VESSEL - SHORE POWER (TYP.)

NOT TO SCALE

2
E4



NOTE:

MOVABLE PLATFORM AND SWITCHBOARD CAN BE PLACED ON WHARF OR ON DOLPHIN, BASED ON AVAILABLE SPACE.

SHORE POWER TO TANKER VESSEL - SITE PLAN (TYP.)

NOT TO SCALE

1
E4

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Non-Container Terminals

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Date

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Scale: None

Sheet Title

POLB Shore Power Details For Tanker Vessel

Sheet Number

E4

P2S No. 21-0320

FILE PATH & NAME: R:\J21-0320\ELECTRICAL\E004_P18-1699_SHOREPOWERDETS.DWG JOHN VOSO
PLOT: Tuesday, August 10, 2021 10:31:59 AM

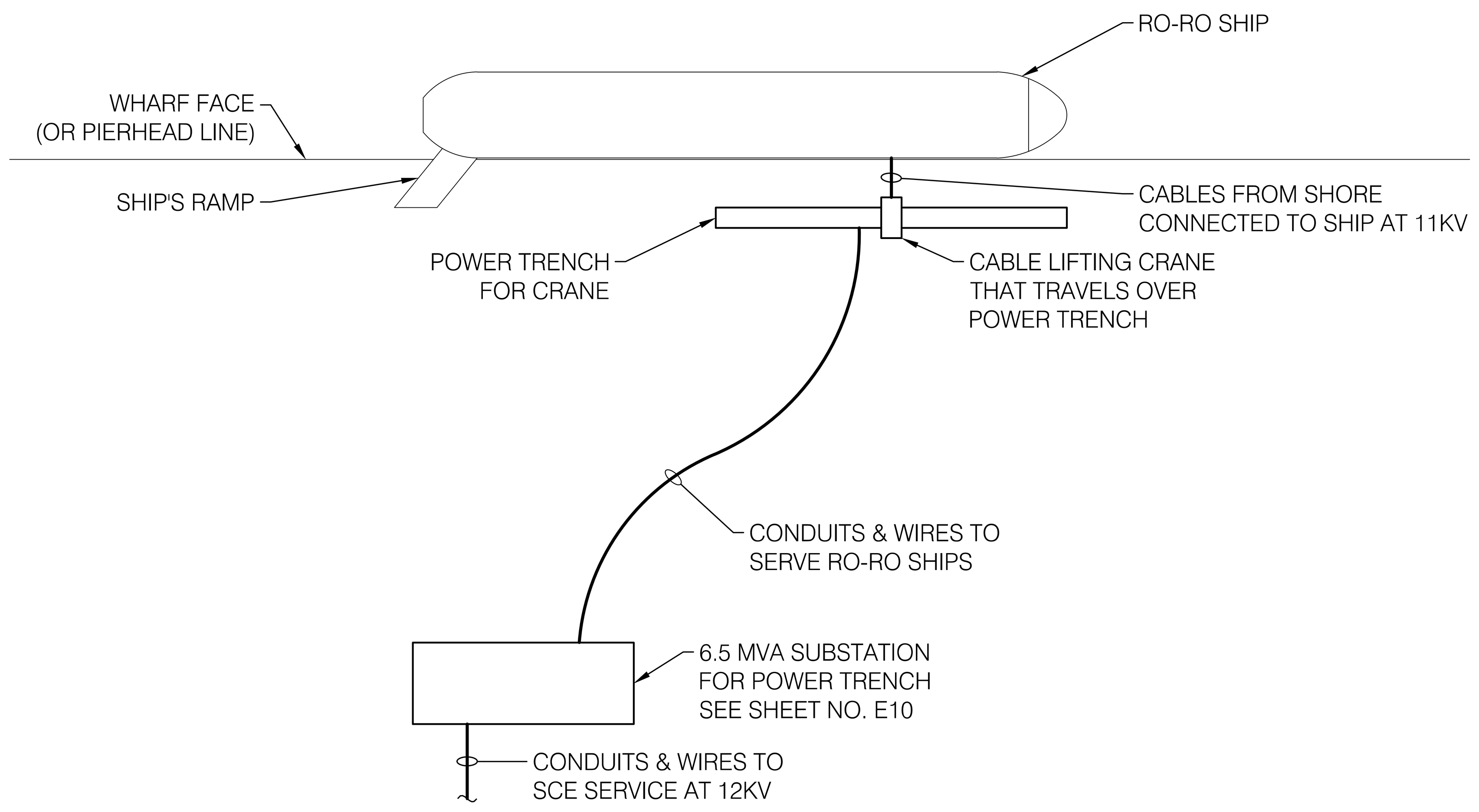
GENERAL NOTES

1) THIS DRAWING ILLUSTRATES HOW SHORE POWER CAN BE MADE AVAILABLE TO SHIPS AT WHARVES.
2) EXACT LOCATIONS AND QUANTITIES OF EQUIPMENT REQUIRED FOR SHORE POWER INSTALLATIONS CAN ONLY BE DETERMINED IF VESSEL PARTICULARS ARE DEFINED, SUCH AS; WHAT VESSEL SIZE IS IN KVA, WHAT TYPE OF VESSEL IT IS (TANKER, RO-RO, DRY BULK), WHERE THE VESSEL INLET IS LOCATED AND SIMILAR DATA.
3) SCE SERVICES AND SUBSTATION LOCATIONS ARE DIAGRAMMATIC. FOR EXACT SERVICE LOCATIONS FROM SCE, AND SUBSTATION LOCATIONS, IT IS NECESSARY TO DETERMINE AVAILABLE PROPERTY SITE FOR SUBSTATION AND A RESPONSIBLE PARTY THAT WILL SIGN TO THE SCE METER FOR ELECTRICAL POWER BILLING, AMONG OTHER DATA NEEDED.

MAJOR COMPONENTS - RO-RO SHIP

TO "COLD IRON" A RO-RO SHIP AT A TYPICAL POLB FACILITY, THE FOLLOWING MAJOR COMPONENTS ARE NEEDED ON SHORE, IN COMPLIANCE WITH IEC/IEEE 80005-1 STANDARD:

1) ELECTRICAL SERVICE AT 12.47KV FROM UTILITY COMPANY (SCE AT POLB).
2) AN ELECTRICAL SUBSTATION WITH 6.5 MVA CAPACITY AT 11KV.
3) A CRANE ON WHARF TO LIFT CABLES FROM WHARF TO THE DECK OF RO-RO SHIP.
4) A POWER TRENCH (OR A CRANE ON WHEELS) TO SET CABLES ON DECK OF RO-RO SHIP, WHERE THE SHIP'S INLET CONNECTORS ARE LOCATED.
5) A RO-RO SHIP THAT IS FITTED FOR "COLD IRONING" AT A PORT FACILITY IN ACCORDANCE WITH IEC/IEEE 80005-1 STANDARD.
6) PERSONNEL WHO ARE FAMILIAR WITH THE INSTALLED FACILITIES AND ARE TRAINED IN THE CIRCUIT BREAKER SETTINGS FOR RO-RO SHIP "COLD IRONING".



RO-RO - GENERAL SITE PLAN
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E5

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CARB - POLB
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Approved	MC

Date

Submittal

Scale None

Sheet Title
POLB
Ro-Ro Details

Sheet Number
E5

P2S No. 21-0320

FILE PATH & NAME: P:\21-0320\ELECTRICAL\E005_P18-1699_RO-RODETS.DWG JOHN VOSO
PLOT: Tuesday, August 10, 2021 10:32:02 AM

GENERAL NOTES

1) THIS DRAWING ILLUSTRATES HOW SHORE POWER CAN BE MADE AVAILABLE TO SHIPS AT WHARVES.
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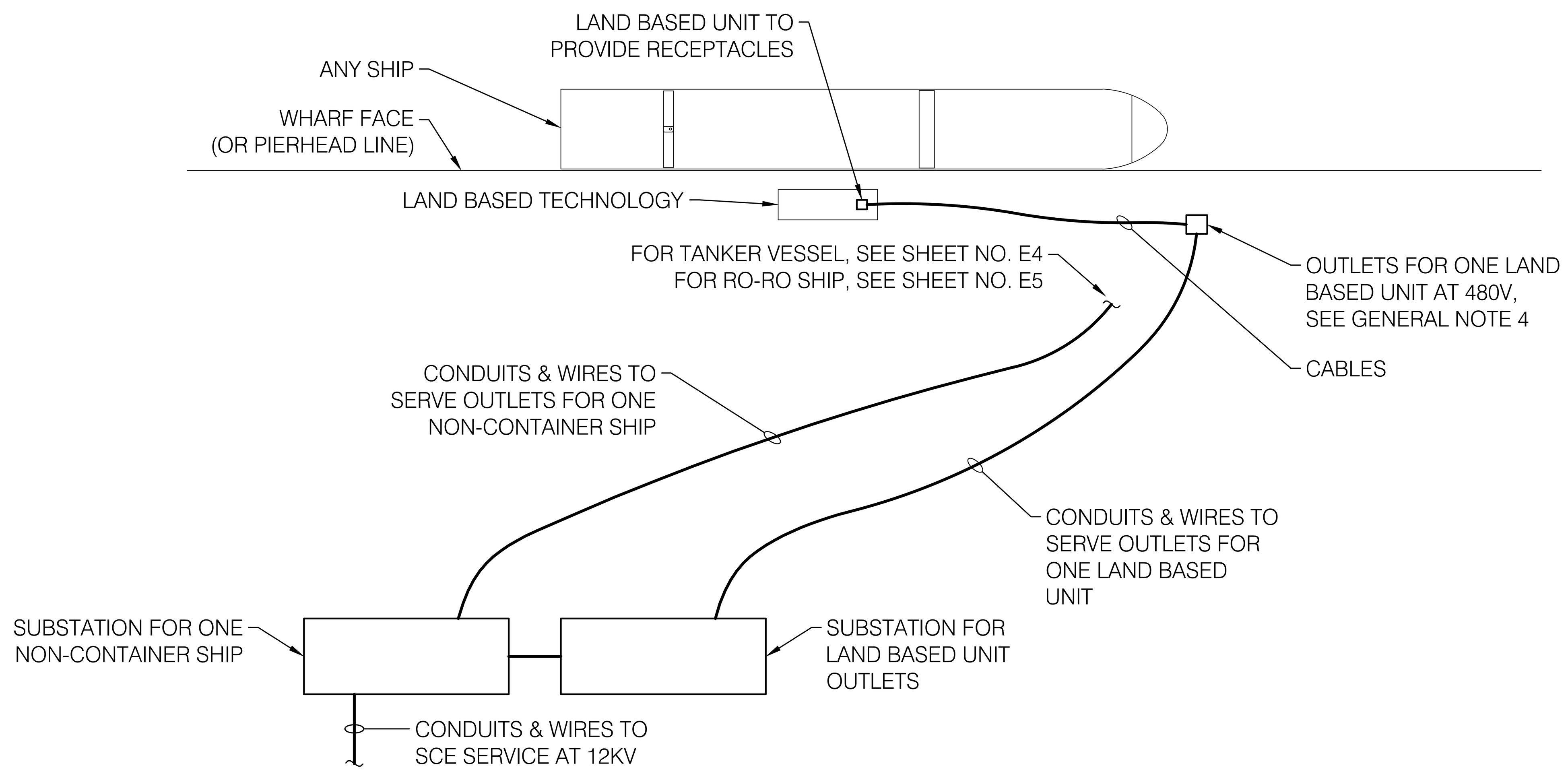
3) SCE SERVICES AND SUBSTATION LOCATIONS ARE DIAGRAMMATIC. FOR EXACT SERVICE LOCATIONS FROM SCE, AND SUBSTATION LOCATIONS, IT IS NECESSARY TO DETERMINE AVAILABLE PROPERTY SITE FOR SUBSTATION AND A RESPONSIBLE PARTY THAT WILL SIGN TO THE SCE METER FOR ELECTRICAL POWER BILLING, AMONG OTHER DATA NEEDED.
4) IN A NON-CONTAINER TERMINAL, AN ELECTRICAL OUTLET WILL BE REQUIRED AT EACH BERTH, WHERE LAND BASED UNIT WILL BE UTILIZED FOR ALTERNATE EMISSION CONTROL.



SHORE POWER TO LAND BASED UNIT - SITE PLAN (TYP.)

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E6

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Non-Container Terminals

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Sheet Title

POLB Shore Power
Land Based Unit Site Plan

Sheet Number

E6

P2S No. 21-0320

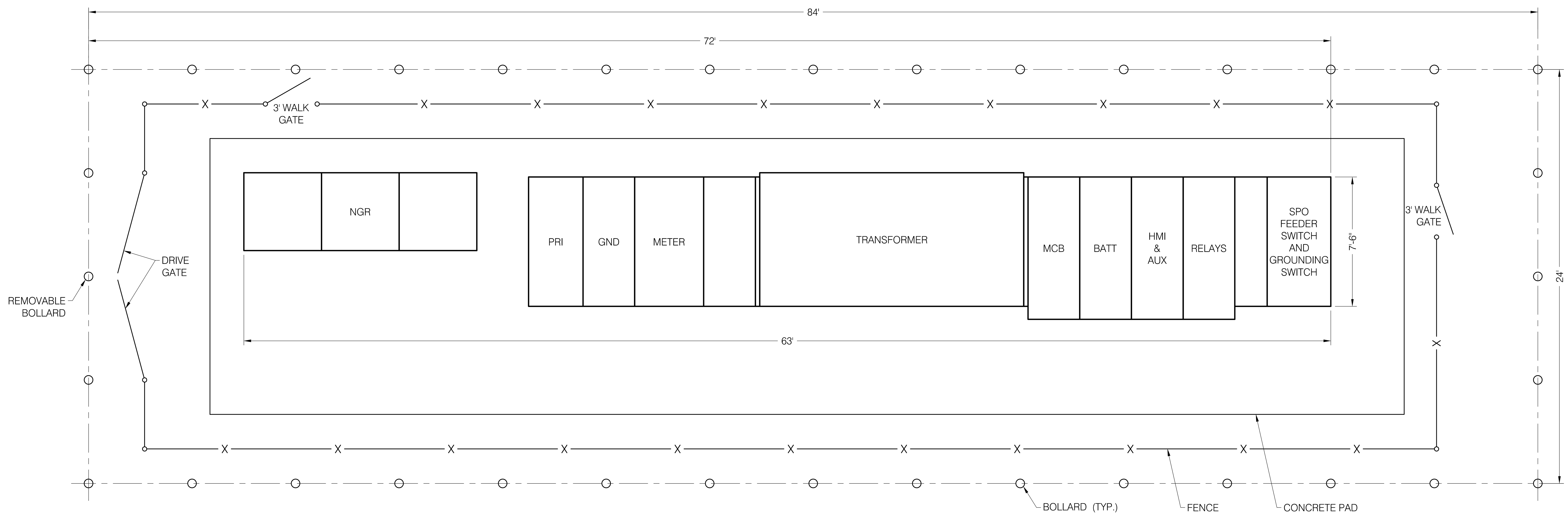
FILE PATH & NAME: R:\J21-0320\ELECTRICAL\E006_P18-1699_SHOREPOWERBARGE.DWG JOHN VOSO
PLOT: Tuesday, August 10, 2021 10:32:05 AM

SYMBOL

SPO - SHORE POWER OUTLET.

NOTES:

1) THIS SET UP IS FOR ONE BERTH, WHERE ONE SPO LOCATION IS PROVIDED FOR BERTH.
2) THIS SUBSTATION IS REQUIRED IN TANKER VESSEL APPLICATION, OR RO-RO SHIP.



SHORE POWER SUBSTATION PLAN - ONE SPO HIGH VOLTAGE
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1 / E10

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Scale: None

Sheet Title

Shore Power
Substation Plan
High Voltage - 1SPO

Sheet Number

E10

P2S No. 21-0320

APPENDIX

SHORE POWER NON CONTAINER TERMINAL EXAPANSION SUPPORT - COST ESTIMATE FOR TANKER VESSEL Per SPO

Estimated by: DI
Checked by: BC
Approved by: BC
Date: 08/02/2021

Item	Description	Quan	Unit	Material Unit $	Material Total	Labor MH/Unit	Labor MH	Labor Total	Total Cost
	Cables/Splice/Manholes								
1	15KV, 350kcmil Copper Cable	12000	LF	$12.67	$152,040	0.06	738.5	$66463.	$218,503.
2	15KV Terminations	8	EA	$525.	$4,200	3.00	24.0	$2160.	$6,360.
3	15KV Splice	8	EA	$1,050.	$8,400	4.00	32.0	$2880.	$11,280.
4	Ductbank (4) 5"	1000	LF	$135.	$135,000	0.72	720.0	$64800.	$199,800.
5	Electrical Manhole	2	EA	$80,000.	$160,000	120.00	240.0	$21600.	$181,600.
6	Testing and Commisioning	1	LS						$80,000.
Subtotal Electrical					$459,640.			$157,903.	$617,543.
	Sales Tax	9.25%			$42,517.				$42,517.
	Contractor Indirect Costs	20.0%							$123,509.
	Contractor OH & P	20.0%							$123,509.
Total Construction Cost									**$907,077.18.**
	Construction Contingency	15.0%							$136,062.
	Design Contingency	15.0%							$136,062.
OPINION OF TOTAL BID COST									**$1,179,200.00.**

This opinion of probable cost is approximate. Actual contruction bids may vary significantly from this statement of probable costs due to timing of construction, changed conditions, labor rate changes or other factors beyond the control of P2S Engineering, Inc.

SHORE POWER NON CONTAINER TERMINAL EXAPANSION SUPPORT - COST ESTIMATE FOR RO-RO VESSEL

Estimated by: DI
Checked by: BC
Approved by: BC
Date: 08/02/2021

Item	Description	Quan	Unit	Material Unit $	Material Total	Labor MH/Unit	Labor MH	Labor Total	Total Cost
	Cables/Splice/Manholes								
1	15KV, 350kcmil Copper Cable	4000	LF	$12.67	$50,680	0.06	246.2	$22154.	$72,834.
2	15KV Terminations	4	EA	$525.	$2,100	3.00	12.0	$1080.	$3,180.
3	15KV Splice	4	EA	$1,050.	$4,200	4.00	16.0	$1440.	$5,640.
4	Ductbank (2) 5"	1000	LF	$80.	$80,000	0.53	533.0	$47970.	$127,970.
5	Electrical Manhole	2	EA	$80,000.	$160,000	120.00	240.0	$21600.	$181,600.
6	Testing and Commisioning								$50,000.

Subtotal Electrical		$296,980.	$94,244.	$391,224.
Sales Tax	9.25%	$27,471.		$27,471.
Contractor Indirect Costs	20.0%			$78,245.
Contractor OH & P	20.0%			$78,245.
Total Construction Cost				**$575,184.81.**
Construction Contingency	15.0%			$86,278.
Design Contingency	15.0%			$86,278.
OPINION OF TOTAL BID COST				**$747,740.00.**

This opinion of probable cost is approximate. Actual contruction bids may vary significantly from this statement of probable costs due to timing of construction, changed conditions, labor rate changes or other factors beyond the control of P2S Engineering, Inc.

SHORE POWER NON CONTAINER TERMINAL EXAPANSION SUPPORT - COST ESTIMATE FOR SWGR -1_SPO_HV

Estimated by: DI
Checked by: BC
Approved by: BC
Date: 08/02/2021

Item	Description	Quan	Unit	Material Unit $	Material Total	Labor MH/Unit	Labor MH	Labor Total	Total Cost
	Cables/Splice/Manholes								
1	1200A, 480/277V, 35KAIC,Switchboard	1	LF	$18,000.	$18,000	46.00	46.0	$4140.	$22,140.
2	1200Amp Circuit Breaker	1	EA	$8,800.	$8,800	20.00	20.0	$1800.	$10,600.
2	MV Transfromer AND Accessories	1	MVA	$70,000.	$70,000	80.00	80.0	$7200.	$77,200.
3	HMI and Controls	1	EA	$240,000.	$240,000	40.00	40.0	$3600.	$243,600.
4	1 SPO RO-RO Load (Labor Included)	1	LF	$348,133.	$348,133	1.00	1.0	$90.	$348,223.
5	Grounding Switch	1	EA	$12,000.	$12,000	2.00	2.0	$180.	$12,180.
6	Equipment Pad	363	SF	$28.	$10,164	0.20	72.6	$6534.	$16,698.
7	Bollards	26	SF	$1,064.	$27,664	1.60	41.6	$3744.	$31,408.
8	Fence and Gate	373	LF	$44.8	$16,710	0.13	49.6	$4465.	$21,175.
8	Neutral Ground Resistor 75Ohms	3	LF	$15,000.	$45,000	10.00	30.0	$2700.	$47,700.
9	Testing and Commisioning	1	LS						$100,000.
Subtotal Electrical					$796,471.			$34,453.	$713,943.
	Sales Tax	9.25%			$73,674.				$73,674.
	Contractor Indirect Costs	20.0%							$142,789.
	Contractor OH & P	20.0%							$142,789.
Total Construction Cost									**$1,073,193.80.**
	Construction Contingency	15.0%							$160,979.
	Design Contingency	15.0%							$160,979.
OPINION OF TOTAL BID COST									**$1,395,152.00.**

This opinion of probable cost is approximate. Actual contruction bids may vary significantly from this statement of probable costs due to timing of construction, changed conditions, labor rate changes or other factors beyond the control of P2S Engineering, Inc.

Total Costs Calculations for 1 SPO Per Berth

Tanker Terminal	
Description	Costs
From Tanker Vessel Sheet	$ 1,179,200.00
Crane	$ 100,000.00
Movable Platform/Cable Mgr	$ 1,000,000.00
Dolphin	$ 15,000,000.00
From 1 SPO HV, Swgr.	$ 1,395,152.00
Total-Tanker Terminal	$ 18,674,352.00

Ro-Ro Terminal	
Description	Costs
From Ro-Ro Vessel Sheet	$ 747,740.00
Crane	$ 100,000.00
Movable	$ 1,000,000.00
Dolphin-Not Required	$ -
From 1 SPO HV, Swgr.	$ 1,395,152.00
Total-RoRo Terminal	$ 3,242,892.00

Land Based-480 Volt	
Description	Costs
From Barge Sheet of 10/29/2018	$ 1,067,461.00
Crane-Not Required	$ -
Movable-No. Fixed Location	$ -
Dolphin-Not Required	$ -
From 1 SPO HV, Swgr.	$ 1,395,152.00
Total-Land Based	$ 2,462,613.00

Total Costs Calculations for 2 SPOs per Berth

Tanker Terminal			
Description	Costs For 1 SPO	Additional Costs For Second SPO	Costs For 2 SPOs
From Tanker Vessel Sheet	$ 1,179,200.00	$ 884,400.00	$ 2,063,600.00
Crane	$ 100,000.00	$ -	$ 100,000.00
Movable Platform/Cable Mgr	$ 1,000,000.00	$ 750,000.00	$ 1,750,000.00
Dolphin	$ 15,000,000.00	$ 11,250,000.00	$ 26,250,000.00
From 1 SPO HV, Swgr.	$ 1,395,152.00	$ 4,000.00	$ 1,399,152.00
Total-Tanker Vessel			$ 31,562,752.00

Ro-Ro Terminal			
Description	Costs For 1 SPO	Additional Costs For Second SPO	Costs For 2 SPOs
From Ro-Ro Vessel Sheet	$ 747,740.00	$ 560,805.00	$ 1,308,545.00
Crane	$ 100,000.00	$ -	$ 100,000.00
Movable	$ 1,000,000.00	$ 750,000.00	$ 1,750,000.00
Dolphin-Not Required	$ -		
From 1 SPO HV, Swgr.	$ 1,395,152.00	$ 4,000.00	$ 1,399,152.00
Total-RoRo Terminal			$ 4,557,697.00