

CARB Staff Analysis of Potential Emission Reduction Strategies by Port/Terminal/Berth For Container and Refrigerated Cargo (Reefer) Vessels

May 2019

The berth analysis is an assessment made by California Air Resources Board (CARB) staff to characterize what additional shore power infrastructure improvements and potential emission control technologies (land- or barge-based alternative capture and control systems) may be necessary for container and refrigerated cargo (reefer) vessels to support the new draft At Berth Regulation. For the development of the analysis CARB staff relied on port maps, Google Earth maps, and vessel visit information from Wharfinger, San Francisco Marine Exchange, and California State Lands Commission data. CARB staff's assessment was based on comment letters received from industry stakeholders in response to the new draft At Berth Regulation, numerous port/terminal site visits and tours, extensive discussions with terminal operators, Port staff throughout the state, and harbor pilots servicing the Northern and Southern California Ports.

The assessment is also intended to assist CARB staff to estimate the potential cost impacts that could be incurred due to infrastructure and/or equipment upgrades as a result of the requirements of the new draft At Berth Regulation.

If you have any comments, feedback and/or updated information we would welcome additional information to further refine this analysis. Please submit your feedback to CARB via email to Nicole Light (nicole.light@arb.ca.gov) or Lynsay Carmichael (lynsay.carmichael@arb.ca.gov).

Legend:

C+C= capture and control system

SP= shore power

Prop 1B = In 2006, California voters approved Proposition 1B (Prop 1B) which authorizes \$1 billion in bond funding to CARB to reduce freight related emissions in the State's trade corridor. The program focuses on funding cleaner equipment or related infrastructure for various emission sources, including port-related equipment such as shore power and emissions capture and control systems.

* Prop 1B Funding, Performance Option 1 - Plug in requirement is a percentage of all visits to the berth by vessels regulated under the existing At-Berth Regulation

** Prop 1B Funding, Performance Option 2 - Plug in requirement is a percentage of all visits to the berth by all vessels visiting the berth

*** Prop 1B Funding for these berths were an early grant prior to the Performance Options; requirement is for a percentage of all ship visits. This grant required the installation of 3 vaults at berths 60-63 (grantee chose which berths)

Subject Headers:

- **Prop 1B Berth?** = Indicates which specific berth at a port/terminal was funded through Prop 1B for shore power infrastructure and plug in performance requirements

- **Total # Container & Reefer Visits in 2017** = Total number of container and reefer vessel visits by berth based on 2017 visit information

(visit information includes vessel visits made by vessels subject to the existing At-Berth Regulation and unregulated vessels)

- **# of Anticipated Newly Regulated Vessel Visits** = Number of visits made by container and reefer vessels currently not subject to the existing At-Berth Regulation

- **# of Visits from Infrequent Vessels Not Anticipated To Install SP** = Total number of infrequently visiting container and reefer vessels that are expected to use capture and control to reduce emissions, instead of retrofitting for shore power. Infrequently visiting vessels is defined as a vessel making fewer than three visits to the Ports of Los Angeles and Long Beach; no use of capture and control technology was assumed for Ports outside of Los Angeles and Long Beach.

- **# of Existing Vaults** = Number of existing land-side vaults installed (to connect vessel-based shore power to land-side shore power)

- **Additional SP Infrastructure Assumed?** = Staff's estimates of potential infrastructure needs based on number of vessels that are currently not subject to the existing At-Berth Regulation and vessels that are currently subject to the regulation but will be required to meet vessel visit requirements once the new At Berth Regulation becomes effective
- **Estimated # of Additional C+C Systems Needed** = Number of emission capture and control system (land- or barge-based) that CARB staff's analysis indicates may be most feasible for use per port
- **Reasoning** = Basis for CARB staff analysis and assumptions

Berth Level CARB Staff Analysis of Potential Emission Reduction Strategies
May 2019

Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
Hueneme	3	155	0	0	6	No	0	Hueneme will continue to rely on SP for compliance, as all reefer berths are SP capable. Port already owns a cable reel management system.
Wharf 1	3	155	0	0	6	No	0	Wharf 1 has SP at all three berths. Port staff advised CARB staff that they have already purchased a cable reel management system, but are unable to use it at this time due to design flaws. Due to space and navigation constraints, barge-based C+C systems are not feasible at Wharf 1. Berths are all Prop 1B berths; not assuming any additional infrastructure needed.
Berth B1	Yes, Option 1*	1			2			
Berth B2	Yes, Option 1*	117	0	0	2	No	0	All berths have SP; up to three vessels can use SP at the same time.
Berth B3	Yes, Option 1*	37			2			

One berth used 190 days of the year, two berths used at same time 67 days of the year (in 2017)

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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
Long Beach	11	909	89	34	70	No	1 additional C+C (shared across POLB/POLA) - Terminals need access to an estimated 1 additional barge-based C+C system	POLB will continue to primarily rely on SP for compliance.
SSA - Pier A	3	225	36	14	9	No	1 (shared access across Port)	Terminal staff advised CARB staff that this terminal will continue to rely on SP for compliance. Terminal staff advised that Pier A sees limited vessel sizes due to bridge and channel restrictions; no purchase of a cable reel management system is anticipated. Vessels berth only Port side due to Pilots preference for safe navigation. Terminal may need occasional access to barge-based C+C system for vessels with SP connection only on starboard side, but no dedicated system. Terminal staff confirmed a barge-based C+C system will fit alongside vessels if needed. No additional vaults assumed due to low frequency of all berths being used at the same time, and because all berths are Prop 1B berths; not assuming any additional infrastructure needed.
A92	Yes, Option 2**	43			3	No		
A94	Yes, Option 2**	104	36	14	3	No	0	All berths have SP; up to three vessels can use SP at the same time.
A96	Yes, Option 2**	78			3	No		
One berth used 176 days of the year, two berths used at same time 114 days of the year, three berths used at same time 17 days of the year (in 2017)								
SSA - Pier C	0	82	9	0	8	No	0	Pier C staff advised CARB staff this is a dedicated terminal that will continue to rely solely on SP for compliance. No purchase of additional cable reel management systems are anticipated. No additional vaults assumed as terminal staff indicates they primarily only use one berth and one vault.
C60	No	1			4	No	0	
C62	No	81	9	0	4	No	0	The terminal has two SP-capable berths, but typically uses only one; the terminal also has 8 vaults in total.
One berth used 316 days of the year, two berths used at same time 19 days of the year (in 2017) - includes both container and con-ro vessel visits								

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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
Long Beach Container Terminal - Pier E	0	83	5	3	10	No	0	Lease with POLB already requires 100% controls (either SP or barge-based bonnet C+C system is currently used for compliance), so CARB staff not assuming any additional infrastructure needed. Per conversation with terminal staff, LBCT can plug in 2 vessels at a time - one at each berth. Terminal already owns two cable reel management systems. Third berth (E22) is currently under construction, and should be finished by early 2022 at the latest. Berth E22 will also be SP capable and terminal will have enough power for all vessels to plug in at all three berths at the same time.
E22	No	Under Construction	Under Construction	Under Construction	5	Under Construction	0	Pier E will be installing 5 SPOs as part of Phase 3 of the Middle Harbor Project at Long Beach Container Terminal. Both existing berths have SP. Terminal has enough power to supply SP to both berths at the same time.
E24	No	34	5	3	5	No		
E26	No	49			5			
One berth used 231 days of the year, two berths used at same time 78 days of the year (in 2017)								
International Transportation Service - Pier G	1	146	14	2	12	No	1 (shared access across Port)	Per CARB staff information Berths G232 and G236 have SP. Have not been able to confirm with Terminal about how many vessels can plug into SP at the Terminal at the same time; assuming no additional power needed at this time. SP infrastructure, operational changes, or access to a barge-based C+C system may be needed at berth G235, but no dedicated system (to be confirmed with Terminal). No additional vaults assumed at this terminal.
G232	No	53			5	No		Berth has SP - Port of LB installed Berth has limited SP usage; built for a specific vessel design. Vessel must be a certain size (5500 TEU and smaller), can only use AMP box if located at aft end. Berth has SP - Port of LB installed
G235	No	25	14	2	1	No	1 (shared across Port)	
G236	Yes, Option 2**	68			6	No		
One berth used 117 days of the year, two berths used at same time 160 days of the year, three berths used at same time 27 days of the year (in 2017)								

Berth Level CARB Staff Analysis of Potential Emission Reduction Strategies
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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
Pacific Container Terminal - Pier J	4	138	18	11	20	No	1 (shared access across Port)	Pier J staff confirmed terminal will continue to rely on SP for compliance. Terminal staff informed CARB staff that vessels berth port-side at berths J245-J247 (north berths) and starboard-side at J266-J270 (south berths) due to safety of terminal container yard operations. North berths have 1 substation, south berths have 2 substations. Can energize up to four vessels at a time, but only three vessels fit due to vessel size constraints at this time. Terminal staff advised no cable reel needed unless there is a significant change to the types of vessels calling this terminal. Terminal may need occasional access to barge-based C+C system for vessels with SP connection only on one side, but no dedicated system. No additional vaults assumed due to low frequency of all berths being used at the same time, and because berths are all Prop 1B berths; not assuming any additional infrastructure needed.
J245	Yes, Option 2**	52				No		Berth has SP; vessels calling this berth will be positioned on port-side. This is the main berth used on the north side of the terminal.
J246	No	0			9	No		Berth has SP; vessels calling this berth will be positioned on port-side. Typically only used when berth J245 is not available.
J247	Yes, Option 2**	0	18	11		No	1 (shared across Port)	Berth has SP; vessels calling this berth will be positioned on port-side. Low number of visits to this berth, as the size of the berth makes it only useable for smaller vessels.
J266	Yes, Option 2**	65			11	No		Berth has SP; vessels calling this berth will be positioned on starboard-side. This is the main berth used on the south side of the terminal.
J270	Yes, Option 2**	21				No		Berth has SP; vessels calling this berth will be positioned on starboard-side. This berth is typically used when berth J266 is not available.
One berth used 147 days of the year, two berths used at same time 153 days of the year, three berths used at same time 30 days of the year (in 2017)								
Total Terminals Inc. - Pier T	3	235	7	4	11	No	0	Pier T can energize four vessels at a time, but due to current vessel size and alignment constraints, can plug in a maximum of three vessels at a time. Terminal already owns one 100 foot cable reel management system, but can only use on vessels with aft AMP connection due to wharf space constraints. Vessels can berth port or starboard side due to location next to large turning basin. Terminal recently completed vault relocation; no additional vault installation assumed at this time.
T132	No	1						
T134	No	124			4	No		Berth has SP
T136	Yes, Option 2**	55	7	4	2	No		Berth has SP
T138	Yes, Option 2**	12			3	No	0	Berth has SP
T140	Yes, Option 2**	43			2	No		Berth has SP
One berth used 83 days of the year, two berths used at same time 138 days of the year, three berths used at same time 117 days of the year (in 2017)								
¹ Per POLB, the port has 78 total vaults; confirming location of 8 additional vaults								

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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
Los Angeles	10	1029	123	21	70	Yes - additional 2 vaults at WBCT Berths 121 and 126	1 additional C+C (shared across POLA/POLB) - Terminals need access to an estimated 1 additional barge-based C+C system	POLA will continue to primarily rely on SP for compliance, with some use of the barge-based system for non-SP capable vessels or for situations where the terminal is unable to connect a SP-capable vessel to SP for operational reasons.
APM	5	202	10	3	20	No	0	All of APM's active berths from 2017 are SP capable; up to 6 vessels can be connected to SP at the same time. Vessels can berth port or starboard side, with starboard-side being typical. Terminal has a large turning basin nearby that allows access for turning vessels. Terminal has a high number of existing vaults and all are Prop 1B berths; not assuming any additional infrastructure needed.
Berth 401	Yes, Option 2**	1			4			Berth has SP and a low # of visits
Berth 402	Yes, Option 2**	54			4			Berth has SP
Berth 403	Yes, Option 2**	60	10	3	4	No	0	Berth has SP
Berth 404	Yes, Option 2**	62			4			Berth has SP
Berth 405****	Yes, Option 2**	25			4			Berth has SP, but no visits in 2017
One berth used 108 days of the year, two berths used at same time 148 days of the year, three berths used at same time 70 days of the year, four berths used at same time 28 days of the year (in 2017)								
Everport	1	142	5	2	3	No	0	All of Terminal's active berths from 2017 are SP capable, with no visits recorded from unregulated vessels. Terminal staff confirmed they can plug in 2 vessels at the same time. Port is adding an additional 5 total vaults in the 2019-2021 timeframe. No cable reel considered for this terminal due to installation of new vaults occurring in 2019-2021.
Berth 227	Yes, Option 2**	82	5	2	2	No	0	Berth has SP; port adding 2 additional vaults
Berth 230	No	60			1			Berth has SP; port adding 3 additional vaults
One berth used 143 days of the year, two berths used at same time 202 days of the year (in 2017)								
Fenix Marine	0	132	19	10	15	No	0	All of Terminal's active berths from 2017 are SP capable per CARB staff information. Confirming with Terminal about how many vessels can plug into SP at the same time.
Berth 302	No	68			4			Berth has SP
Berth 303	No	43			4			Berth has SP
Berth 304	No	19	19	10	4	No	0	Berth has SP
Berth 305	No	2			3			Berth has SP
One berth used 123 days of the year, two berths used at same time 180 days of the year, three berths used at same time 51 days of the year (in 2017)								

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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
TraPac	0	99	3	1	10	No	0	Terminal only uses berths 139, 144, and 147; all three have SP and can energize three vessels at a time. No need for a cable reel management system is anticipated, as terminal staff advised CARB staff that they plan vessel berthing positions around where vessel AMP connections are located. Terminal staff advised CARB staff the terminal has an existing mitigation requirement to control 100% of emissions (SP or C+C system), so no additional infrastructure assumed at this terminal.
Berth 136	No	0			2			Berth has SP
Berth 139	No	45	3	1	2	No	0	Berth has SP
Berth 144	No	46			2			Berth has SP
Berth 147	No	8			4			Berth has SP
One berth used 247 days of the year, two berths used at same time 99 days of the year, three berths used at same time 3 days of the year (in 2017)								
WBCT - China Shipping	0	118	2	0	8	No	0	WBCT consists of the China Shipping dock and the Yang Ming dock. The terminal has four total SP capable berths, and can energize a maximum of four vessels at a time. Three vessels is maximum that will fit at the berths at any one time due to space and alignment constraints. China Shipping berths have an existing mitigation requirement to control 100% (+/- 5%) of all vessels calling berths 100 and 102, so no additional infrastructure is assumed for these berths. Per terminal staff, terminal is considering a cable reel for the China Shipping berths to increase plug ins.
China Shipping - Berth 100	No	67	2	0	4	No	0	Berth has SP
China Shipping - Berth 102	No	51			4			Berth has SP
One berth used 167 days of the year, two berths used at same time 150 days of the year (in 2017)								
WBCT - Yang Ming	2	115	78	3	4	Yes - Additional 2 vaults at Berths 121 and 126	1 (shared across Port)	WBCT consists of the China vesseling dock and the Yang Ming dock. The terminal has four total SP capable berths, and can energize a maximum of four vessels at a time. Three vessels is maximum that will fit at the berths at any one time due to space and alignment constraints. Per Terminal staff, vessels calling Yang Ming berths can only plug in if SP connection is in the middle of the vessel (near the house), and cannot plug in if connection is at the stern. Terminal staff advised that cable reel management system will not work at Berths 121 and 126, as there is not a cable reel long enough to correct alignment issues; Berths 121 and 126 need additional vaults to plug in 100% of vessels. Normal operations are to berth port side-to; terminal can berth starboard side-to also, but ability to do so depends on alignment of vessels at the berth.
Yang Ming - Berth 121	Yes, Option 2**	74	78	3	2	Additional 1 vault	1 (shared across Port)	Berths have SP; these berths see a high number of visits from currently unregulated steam ship vessels.
Yang Ming - Berth 126	Yes, Option 2**	41			2	Additional 1 vault		
One berth used 179 days of the year, two berths used at same time 100 days of the year (in 2017)								

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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
Yusen	2	221	6	2	10	No	0	All of Terminal's active berths from 2017 are SP capable per CARB staff information. No information received from Terminal about how many vessels can plug into SP at the same time. Terminal has a high number of existing vaults and 2 of 3 are Prop 1B berths; not assuming any additional infrastructure needed.
Berth 212	Yes, Option 2**	106			2			Berth has SP
Berth 214	No	46	6	2	4	No	0	Berth has SP
Berth 218	Yes, Option 2**	69			4			Berth has SP
One berth used 78 days of the year, two berths used at same time 205 days of the year, three berths used at same time 75 day of the year (in 2017)								

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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
Oakland	6 berths, plus 3 vaults at Matson Terminal	1597	191	0	31	Yes - additional 3 vaults at OICT	0	Port of Oakland will continue to rely on SP for compliance with the expanded regulation. Each berth has its own substation, so no additional power is needed. Barge-based C+C looks to be an option for TraPac terminals, but not Nutter, Matson or OICT due to concerns expressed from SF Bar Pilots about wave interaction from passing vessels and channel space and navigational constraints.
Everport (Nutter)	2	153	6	0	4	No	0	Nutter Terminal will continue to rely on SP for compliance with the regulation; both berths are SP capable and can plug two vessels in at the same time. Berths are all Prop 1B berths; not assuming any additional infrastructure needed.
Berth 35	Yes, Option 2**	99	6	0	2	No	0	Berth has SP
Berth 37	Yes, Option 2**	54		0	2	No	0	Berth has SP
* One berth used 260 days of the year, two berths used at same time 0 days of the year (in 2017)								
Matson	3 vaults	107	59	0	0	No	0	This terminal has SP and will continue to rely on SP for compliance with SP capable vessels. Terminal installed 3 vaults with Prop 1B funding; not assuming any additional infrastructure needed.
Berth 61	Yes***	0			3	No		This berth has SP and a low number of visits, so compliance is expected to be met with SP-capable vessels.
Berth 62	Yes***	99	59	0		No	0	This berth has SP, and receives a high number of both SP and non-SP vessels.
Berth 63	Yes***	8			0	No		This berth has SP and a low number of visits, so compliance is expected to be met with SP-capable vessels.
One berth used 240 days of the year, two berths used at same time 13 days of the year, three berths used at same time 1 day of the year (in 2017) - includes both container and con-ro vessel visits								
OICT	2	1072	113	0	18	Yes - additional 3 vaults	0	OICT will continue to rely on SP for compliance with SP capable vessels. This terminal has SP at every berth, with enough power capacity to plug in a vessel at every berth, but terminal staff has advised CARB staff that 3 additional vaults are needed. OICT has a cable reel management system, but labor has red-tagged the equipment and they are unable to use it at this time.
Berth 55	Yes, Option 2**	212			3			SP will continue to be primary pathway to compliance. Can energize five vessels at the same time, but only four vessels will fit plugged in at a time due to vessel size and positioning issues. Terminal already owns cable reel management system, but unable to use due to labor safety concerns.
Berth 56	No	255			4			
Berth 57	No	236	113	0	4	3 additional vaults	0	
Berth 58	No	224			4			
Berth 59	Yes, Option 2**	145			3			
One berth used 4 days of the year, two berths used at same time 35 days of the year, three berths were used at same time 103 days of the year, four berths were used at same time 166 times of the year, five berths were used at same								
TraPac	2	265	13	0	6	No	0	TraPac Terminal will continue to rely on SP for compliance with the regulation; both berths are SP capable and can plug two vessels in at the same time. Berths are all Prop 1B berths; not assuming any additional infrastructure needed.
Berth 30	Yes, Option 2**	101	13	0	3	No	0	Berth has SP
Berth 32	Yes, Option 2**	164			3			Berth has SP
One berth used 246 days of the year, two berths used at same time 100 days of the year (in 2017)								

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Port/Terminal/Berth	Prop 1B Berth?	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	# of Existing Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed	Reasoning
San Diego	0	52	0	0	3	No	0	Reefers visiting Port of San Diego will rely on SP for compliance. Port can plug in one reefer vessel at a time, but since only one vessel typically calls berth at a time, no additional power or infrastructure assumed necessary.
Tenth Avenue Terminal	0	52	0	0	3	No	0	Reefer terminal will continue to rely on SP for compliance with the regulation. All berths are SP capable, and only one berth typically used at a time, so no additional infrastructure assumed necessary at this terminal. Terminal has a cable management system available for use.
Berth 10-2	No	6			1			All reefer vessels calling San Diego were regulated as of 2017, with no major concerns about vessels plugging in.
Berth 10-3	No	31	0	0	1	No	0	
Berth 10-4	No	15			1			
One berth used 173 days of the year, two berths used at same time 0 days of the year (in 2017)								

Port/Terminal/Berth	# of Prop 1B Berths	Total # of Container & Reefer Visits in 2017	# of Anticipated Newly Regulated Vessel Visits	# of Visits from Infrequent Vessels Not Anticipated To Install SP	Total # of Vaults	Additional SP Infrastructure Assumed?	Estimated # of Additional C+C Systems Needed
Statewide #'s	30 individual berths, plus 3 vaults at Matson - Oakland	3742	403	55	189	5 vault installations	1 additional Barge-based C+C

* Prop 1B Funding, Performance Option 1 - Plug in requirement is a percentage of all visits to the berth by vessels regulated under the existing At-Berth Regulation

** Prop 1B Funding, Performance Option 2 - Plug in requirement is a percentage of all visits to the berth by all vessels visiting the berth

*** Prop 1B Funding for these berths were an early grant prior to the Performance Options; requirement is for a percentage of all vessel visits.

This grant required the installation of 3 vaults at berths 60-63 (grantee chose which berths)

****These 25 visits were previously under Berth 406, but Port of LA advised us Berth 406 is not in use; reassigned visits to Berth 405