Tolly Graves
Director, Richmond Refinery

Submitted via shorepower@arb.ca.gov

March 8, 2023

Chief, Transportation and Toxics Division
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Chevron Richmond Refinery, Comments on Interim Evaluation Report

Chevron Richmond Refinery ("Chevron") is providing these comments on the California Air Resources Board ("CARB") Interim Evaluation Report ("Interim Report") for the Control Measure for Ocean-Going Vessels At Berth ("At-Berth Regulation"). Since passage of the At-Berth Regulation, Chevron has been diligently evaluating compliance options for Chevron's Richmond Long Wharf ("RLW"). These evaluations have consistently indicated that it is not feasible for RLW to comply with the At-Berth Regulation within the regulatory timeframe using shore power or capture and control technology. Moreover, CARB's delay in considering Chevron's Innovative Concept ("IC") Application and CARB's interpretation of the regulatory provisions concerning banking credits for IC projects, are impairing the viability of IC as a compliance option.

This letter is intended to present a detailed description of Chevron's evaluation to date of the feasibility of various compliance options for RLW and to express concern about CARB's actions that are compromising the viability of Chevron's proposed IC projects as a means of interim compliance for RLW. This comment letter includes and builds upon information conveyed to CARB staff over the course of multiple engagements during the latter half of 2022, and adds to the feasibility and safety concerns raised during the rulemaking process and in DNV-GL's *California Air Resources Board's Ocean-going Vessels At Berth Regulation Emissions Control Technology Assessment for Tankers Report* ("Technical Assessment").[1]

Based on the information in this letter, Chevron urges CARB to take several actions concerning the Interim Report and Chevron's IC Application.

- Make a recommendation in the Interim Report to extend the compliance deadline for terminals in northern California to at least 2034, subject to future assessment on the progress made in adopting control technologies for use with tankers.
- Revise the Interim report to reflect the substantial feasibility hurdles to meeting the compliance deadlines in the At-Berth Regulation using CAECS or ICs for tanker vessels and tanker terminals, in particular RLW.

[1] DNV-GL. California Air Resources Board's Ocean-going Vessels At Berth Regulation Emissions Control Technology Assessment for Tankers Report. DNV-GL, November 30, 2021.

- Revise the Interim Report to address the feasibility and safety concerns of implementing shore power or capture and control for tanker vessels as described in this letter and the DNV-GL Technical Assessment.
- Clarify that the At-Berth Regulation permits banking of credits from approved IC's retroactively starting from the date of implementation, regardless of when the IC is approved.
- Recommend revisions to the At-Berth Regulation to exempt inert gas systems and direct diesel drive hydraulic cargo pumping systems from emission reduction requirements of the At-Berth Regulation.
- Expedite processing of Chevron's IC Application.
- Retain a consulting naval architect/marine engineer, with expertise in sailing on large international ocean-going tankers, to advise CARB staff on the risks and concerns being expressed by industry regarding capture and control and shore power risks to tanker operation, including inert gas system issues.

Chevron appreciates this opportunity to comment on the Interim Report. If you have any questions regarding this submittal, please contact Anna Morgan at 510-242-1181 or via email at amorgan@chevron.com.

Sincerely,

For Tolly Graves

Tolly Graves

cc: shorepower@arb.ca.gov, CARB, via e-mail
Bonnie.Soriano@arb.ca.gov, CARB, via e-mail
Jeff.Jacobs@arb.ca.gov, CARB, via e-mail
Steve.Cliff@arb.ca.gov, CARB, via e-mail

Executive Summary

The At-Berth Regulation provides two principal methods of compliance[2]. Section 93130.5 of the At-Berth Regulation sets forth a CARB Approved Emissions Control Strategies (CAECS) as the primary compliance option. During the rulemaking process for the At-Berth Regulation, CARB identified shore power and capture and control technologies as potential CAECS. Section 93130.17 of the At-Berth Regulation sets forth an alternative, but transitional compliance option to implement an IC to reduce emissions in and around the port terminal. As set forth in Chevron's Terminal and Port Plans for the RLW ("Terminal Plan"), because Chevron determined compliance with the At-Berth Regulation by the initial compliance deadline using CAECS was not possible, Chevron had no choice but to propose meeting the initial compliance deadline using IC projects. To this end, Chevron convened an extensive team of experts across the company to develop a robust package of ICs, which could meet the initial compliance deadline of January 2027, provided timely processing and approval of applications and reasonable permitting conditions. Chevron submitted the IC Application to CARB on December 1, 2021, over one year ago, detailing a suite of fourteen projects to achieve the required offsets for oxides of nitrogen (NOx), reactive organic gases (ROG), particulate matter (PM), and diesel particulate matter (DPM) emissions from ocean-going vessels while docked at berth at the RLW, while not increasing greenhouse (GHG) emissions.

In the 15 months since submitting the Terminal Plan, Chevron has taken steps to facilitate implementation of its proposed ICs, while simultaneously expending significant engineering resources on further evaluating site-specific implementation of a CAECS (shore power and capture and control) at the RLW, despite feasibility issues already identified in the Terminal Plan and the tanker-specific DNV-GL Technical Assessment. To this end, Chevron has entered into service contracts with engineering and design firms, ship builders, equipment manufacturers, utility companies, technology vendors and CARB approved CAECS providers (Clear Air Engineering – Maritime or CAEM). Chevron is also actively engaging in industry initiatives to study challenges, to seek to develop feasible solutions and align the tanker maritime industry on safely implementing Shore Power and Capture & Control technologies (e.g. Environmental Committee section of Oil Companies International Marine Forum Issue 115[3]).

Based on its ongoing evaluations, Chevron continues to find implementation of a CAECS at the RLW is not feasible within the timelines specified by the At-Berth Regulation. CARB's delay in approving the ICs is further impairing the viability of complying with the At-Berth Regulation using ICs, because a number of the proposed projects require extended lead times for engineering, permitting and construction. Chevron has proactively communicated with and informed CARB staff on a number of these learnings during five meetings throughout 2022[4]. Other topics build upon themes covered in rulemaking comments or in the DNV-GL Technical Assessment. The DNV-GL Technical Assessment, while not specific to a port or terminal, was specific to tanker vessels—a unique category of ocean-going vessels—and therefore is

[2] The At-Berth Regulation also provides Terminal Incident Event, Vessel Incident Event, and Remediation Fund, but they can only be used in limited circumstances
[3] OCIMF Issue 15, https://www.ocimf.org/news-and-events/news/newsletter/issue-115
[4] Teleconference meetings between Chevron and CARB staff occurred on June 20, 2022, July 19, 2022, September 21, 2022, November 14, 2022, November 28, 2022

applicable to any port or terminal receiving tanker vessels and should be treated as material to the Interim Report.

As it relates to RLW, Chevron respectfully disagrees with CARB's assessment in its Interim Report that "in some cases, CARB staff have not seen sufficient site-specific information to indicate that compliance with the emissions reductions deadlines are not achievable, such as with many of the tanker terminals who provided only general, non-site-specific studies indicating an inability to comply with the emissions reductions deadlines in the Regulation but offered little evidence of attempts to explore compliance pathways". The Terminal Plan, Chevron's other comments during rulemaking, and engagements with CARB provide this information, but there is no indication it was considered as part of CARB's Interim Report.

Nonetheless, to the extent CARB feels additional information is necessary, this letter provides significant detail regarding the challenges in designing, procuring, permitting, and constructing projects on tanker vessels and the RLW to comply with the At-Berth Regulation in the required timeframes. Based on the information in this letter, Chevron urges CARB to take several actions concerning the Interim Report and Chevron's IC Application:

- Make a recommendation in the Interim Report to extend the compliance deadline for terminals in northern California to at least 2034, subject to future assessment on the progress made in adopting control technologies for use with tankers.
- Revise the Interim report to reflect the substantial feasibility hurdles to meeting the compliance deadlines in the At-Berth Regulation using CAECS or ICs for tanker vessels and tanker terminals, in particular RLW.
- Revise the Interim Report to address the feasibility and safety concerns of implementing shore power or capture and control for tanker vessels as described in this letter and the DNV-GL Technical Assessment.
- Clarify that the At-Berth Regulation permits banking of credits from approved IC's retroactively starting from the date of implementation, regardless of when the IC is approved.
- Recommend revisions to the At-Berth Regulation to exempt inert gas systems and direct diesel drive hydraulic cargo pumping systems from emission reduction requirements of the At-Berth Regulation
- Expedite processing of Chevron's IC Application.
- Retain a consulting naval architect/marine engineer, with expertise in sailing on large international ocean-going tankers, to advise CARB staff on the risks and concerns being expressed by industry regarding capture and control and shore power risks to tanker operation, including inert gas system issues.

I. Shore Power CAECS

Chevron has been actively assessing the feasibility of implementing shore power at RLW, as a potential CAECS to comply with the At-Berth Regulation. Chevron has determined the following concerning implementation of shore power at the RLW:

- Consistent with the Terminal Plan, Chevron finds the timing for implementing shore power to comply with the At-Berth Regulation is highly uncertain and dependent on multiple external factors over which ship owners and terminal operators have little or no control, including the time for the tanker maritime industry to align on a standardized design for ship shore interface, establishing and gaining global endorsement on the aligned standard, lead time to develop new technology that does not presently exist with electrical vendors, California Environmental Quality Act (CEQA) permitting for in-water and on shore equipment given the environmental impacts of construction, timeline to receive ordered equipment, plus time for construction on shore and at four berths.

- Under any scenario, it will not be possible to complete all of these tasks in the timeframe imposed by the regulations, and at this point it is not possible to determine when compliance with the At-Berth Regulation using shore power will be possible.

a. Vessel-side Retrofits

The following describes Chevron's latest key learnings, developments, and ongoing challenges with retrofitting tanker vessels with shore power capabilities. Chevron may find additional learnings and challenges as engineering and feasibility studies continue.

1. **The lack of internationally accepted maritime standards for the location and design of the shore power connection and interface for tankers is a major barrier, not within Chevron's control, to designing a safe, reliable and effective shore power CAECS that can comply with the At-Berth Regulation.**

   Safety in Design, Construction and operation of vessels are governed by requirements set forth by the International Maritime Organization (IMO). Although IMO MEPC.1/Circ. 794 provides some guidance on shore power, this circular primarily points to an International Electrotechnical Commission (IEC) standard for technical details. Marine classification society guides are also key resources for details on shore power design. Presently, there is no IEC international standard for high voltage shore power for tanker vessels. The applicable international standard, IEC 8005-1 sets requirements for Ro-Ro, cruise ships, and container ships. While the appendices provide some information for LNG carriers and tankers, they are not mandated requirements and lack critical details to form a stable foundation for safe and incident free design that the global shipbuilding industry can rely on. Importantly, one critical detail that is lacking is a standard design associated with the position of the ship-shore interface. This relates to whether the ship-shore connection should be placed at the aft end of the ship (outside the ship's hazardous area), or mid-ship near the manifold (within the hazardous zone). Each location has potential hazards and feasibility trade-offs.

   The inadequacies of IEC 80005-1 for tanker vessels are well-recognized, and the IEC committee is awaiting further guidance from LNG and tanker shipbuilders and ship operators prior to updating the IEC 80005-1 standard. Updating the IEC standard is a methodical process done in consultation with numerous industry stakeholders, organizations, and member countries.

In 2Q2022, the Oil Companies International Marine Forum (OCIMF) set up a working group consisting of members from different industry organizations, including OCIMF, INTERTANKO, International Association of Classification Societies (IACS), International Electrotechnical Commission (IEC), European Ports & Terminals, Engineering Companies, Equipment manufacturers etc. to attempt to align and develop a feasible design for shore power. Considering the complexity of design, hazards associated with handling and connecting and disconnecting of high voltage cable on tankers and terminals, it has taken over six months (and the study is still on-going) to comprehensively study the pros and cons associated with each location of ship shore interface for shore power. Moreover, even after OCIMF issues guidance, revisions to the IEC- 80005-1 standard is a lengthy process, involving approval by IMO member countries, and is expected to take years more. This highlights the additional complexity associated with designing shore power for tankers, versus container or other non-hydrocarbon carrying vessels. The lack of a shore power IEC standard creates a high degree of uncertainty for tanker and terminal operators on the design, engineering and modifications for their asset to ensure that any modifications made will allow for universal application of shore power across the global tanker fleet and ports and terminals in California and globally.

Even if only Chevron-operated vessels were retrofitted, they would represent only approximately 10% of vessels calling at RLW. Achieving 100% shore power compliance on all vessels visiting RLW is not currently possible. Without a global industry standard, tanker modifications may be incompatible with terminal modifications and vice-versa, resulting in very limited emissions control. Additionally, when a global industry standard is available, the existing global tanker fleet calling at RLW would need to be retrofitted or be replaced with shore-power enabled tanker vessels that meet the new global industry standard.

b. Shore-side (RLW) Retrofits

The following describes Chevron's key learnings, developments, and ongoing challenges with retrofitting the RLW and Chevron Richmond Refinery to supply shore power to at-berth vessels. Chevron has successfully completed some of the preliminary steps for design of a shore power system, but many hurdles remain. Chevron may find additional learnings and challenges as engineering and feasibility studies continue.

1. **PG&E has confirmed it can serve Chevron 12 MW of power through Chevron's existing interconnect.**

   Chevron filed an application on January 6, 2022 for our local utility, Pacific Gas and Electric to complete a Preliminary Engineering Study (PES). PG&E began the analysis in June 2022, and Chevron received a draft report for the transmission-level portion of PG&E's study in September 2022. PG&E completed a draft of its distribution-level study on December 17, 2022. On February 3, 2023, Chevron received the final PES. In the PES, PG&E has explicitly stated its preference for Chevron to supply the incremental 12MW, for the shore power facility, from its existing refinery interconnect with PG&E rather than serve the new 12MW load from a new connection. Chevron concurs with PG&E's preferred method for supplying power to the substation because it will result in the least amount of overall ground disturbance, reduce the amount of long-lead equipment that must be purchased, and provide the greatest reliability overall to the shore-power substation. For this solution, the electricity to the shore power substation must travel through refinery distribution lines and cannot be wholly segregated from the internal refinery grid. Chevron discussed this issue with CARB on September 21, 2022, and at that time, CARB staff agreed that, with sufficient metering to demonstrate shore power is a net import from PG&E's grid, the design would be compliant with the At-Berth Regulation.

2. **Conceptual designs for shore power equipment still need to resolve space constraints, vehicle access needs, and infrastructure needs at RLW.**

   Installation of shore power pedestal cranes at RLW2-RLW4 may adversely impact emergency vehicle access to berths. Further equipment design, including equipment development, must occur with vendors to resolve footprint conflicts with the 17-ft wide vehicle travel lane for emergency access to RLW2-4. This will take time to resolve by working with shore power electrical vendors, and their crane suppliers, to develop a crane design that works for tankers and specifically fits within the space constraints of RLW. There is no timeframe for how long this could take, as the equipment does not presently exist and would be a new product development.

   In May 2022, Chevron retained its marine engineering contractor to evaluate and develop a conceptual design for terminal-based shore power equipment at each of our four berths (RLW1, RLW2, RLW3, and RLW4). The marine engineering contractor provided a conceptual design in July 2022 and prepared a Basis of Design document for all of the CAECS alternatives Chevron is evaluating, including shore power. Upon further study of the shore power conceptual design, Chevron has identified several issues with shore power equipment and our limited plot space, particularly at berths RLW2, RLW3 and RLW4.

   i. Cable Management Systems and Pedestal Cranes.

      To provide shore power to tankers calling at RLW, Chevron will need to provide two cable management systems (CMS) integrated with pedestal-mount cranes. These cranes and cable management systems do not presently exist, and the technology for providing the cable feeds to tankers, which can self-adjust with changes in vessel draft, need to be designed and developed by specialized electrical equipment manufacturers. Feasible designs are uncertain and require individual study and technology development.

ii. Size and Placement of New Pedestal Cranes.

To provide shore power to vessels berthing both starboard and port-side, two pedestal cranes per berth will be necessary (eight total) at RLW 1, RLW2, RLW3 and RLW4 to lift the shore power connection (plugs) and cables from the terminal to the vessel at berth. Given the unique design for RLW, the crane reach would need to be long – up to 148 feet, resulting in the need for a large size pedestal to support the crane load, and resist seismic demand, each crane supported by four 48-in diameter steel piles and pile cap. The placement of such large pedestal cranes at each berth is limited by vessel mooring line arrangements, and existing operating equipment, such as loading arms and gangways. Consequently, there are very limited areas at the berths where these cranes may be placed, and some new dolphin structures must be built to support new cranes at Berths 1 and 4. The pedestal cranes are expected to be quite large at the base, and their placement must coincide with the optimal position for reaching the shore power reception point for the wide range of vessels that call each berth.

iii. RLW2 and Emergency Vehicle Access

Placement of the southern crane at RLW2 appears to restrict the turn radius for emergency response vehicles (fire trucks) accessing RLW2, RLW3, RLW4 from the Causeway at the RLW "tee". This area of the wharf cannot be expanded to improve the turn radius. Further vehicle turn radius study will be necessary as the pedestal crane design is further developed.

The cranes will impinge upon the available vehicle travel lane along the pipe rack on the east side of the RLW. Chevron must maintain a minimum 17 feet travel lane for ingress/egress of fire trucks and emergency vehicles, so that the emergency vehicles can set their outriggers to stabilize the fire truck when responding to fires. The overhead crane platform must be tall enough to not conflict with emergency response vehicles when they need to deploy equipment. Consequently, the height of the platform may be 20 feet tall, necessitating stairs to access the crane platform, and increasing overall weight and size of the crane, and seismic loads. Again, there is no equipment that currently exists for this type of service in hazardous classified areas, which we would need to develop with the electrical equipment manufacturer and their suppliers. This is likely a one-off design specific to RLW.

iv. RLW1 and Infrastructure Needs

To enable berthing starboard-side at RLW1 and port-side at RLW4, new dolphin structures are needed for the cable management system and pedestal crane. Progressing the design of those structures depends on having the structural loads and moments associated with the crane design. As mentioned earlier, this information does not exist and hence requires more engineering, involving more time, to be completed before progressing the work.

3. **Electrical Equipment procurement lead times are significantly longer than expected**

   i. Power Control Center.

   Chevron has recently obtained quotes from vendors for a Power Control Center (PCC), which is an electrical substation building. This PCC would need to house 6.6kV switchgear and would be installed on shore near the base of the RLW causeway. The lead time for a PCC from multiple vendors is 70-90 weeks currently. This is from point of purchase order, through vendor design, to "ready for delivery" and does not include delivery, installation, cable pulling, commissioning or any other site-related construction and commissioning. Vendors have confirmed there is no way to expedite this process – their plants are working weekends, and their suppliers also have long lead times. The problem is the demand for this equipment is increasing due to electrification projects worldwide.

   ii. Transformers

   Similarly, Chevron will need to purchase two transformers with a lead of 70-130 weeks. There is no improvement in turnaround expected for the same reasons mentioned above. Some vendors do not even respond to bids because they know they cannot deliver due to their backlog.

4. **In-water terminal construction takes substantially more time than port-based projects.**

   In-water work windows for San Francisco Bay are limited to 6 months (June 1-November 30) of any given year. This means that pile driving to add new equipment foundations can only be done in that 6-month window, substantially reducing the pace of construction work that occurs over water, resulting in longer project construction schedules compared with port-based projects. Consequently, construction at RLW is expected to take at least 3 years for the four berths, given the number of new pile-supported structures that must be built.

c. Regulating DDDHCPS Emissions Precludes a Shore Power Only Control Strategy

Based on meetings with CARB staff, Chevron understands CARB staff have interpreted "auxiliary engines", as defined in the At-Berth Regulation, to encompass diesel engines used in DDDHCPS, which in turn subjects the exhaust from DDDHCPS to control under the At-Berth Regulation. Under this interpretation, a CAECS comprised of shore power only would be infeasible because DDDHCPS cannot use shore power.

1. Adoption of DDDHCPS is expected to grow

Tanker vessels are increasingly adopting DDDHCPS, mostly manufactured by Framo, to improve energy efficiency and reduce emissions during cargo and ballast operations. This trend is expected to continue across the worldwide fleet not only because of the fuel savings, but also because the DDDHCPS systems provide a pathway for vessels to improve their performance and deliver on IMO's decarbonization goals for 2030 and 2050[5]. Large tankers, such as Aframax and Suezmax tankers, fitted with Framo DDDHCPS, can significantly reduce fuel consumption for cargo offloading operations, relative to conventional tankers. Vessels fitted with DDDHCPS systems have been operating in California, and Chevron expects to see an increase of such tankers calling at their ports and terminals as older vessels are retired.

2. Understanding DDDHCPS

Tankers are designed to load and offload cargo and ballast using common or dedicated in-tank submerged cargo pumping systems. Tankers designed with in-tank cargo pumps mostly use HCPS to power the cargo pumps by providing pressurized hydraulic fluid, provided by the hydraulic power pack (Figure 1), to operate the prime mover of the pumps.

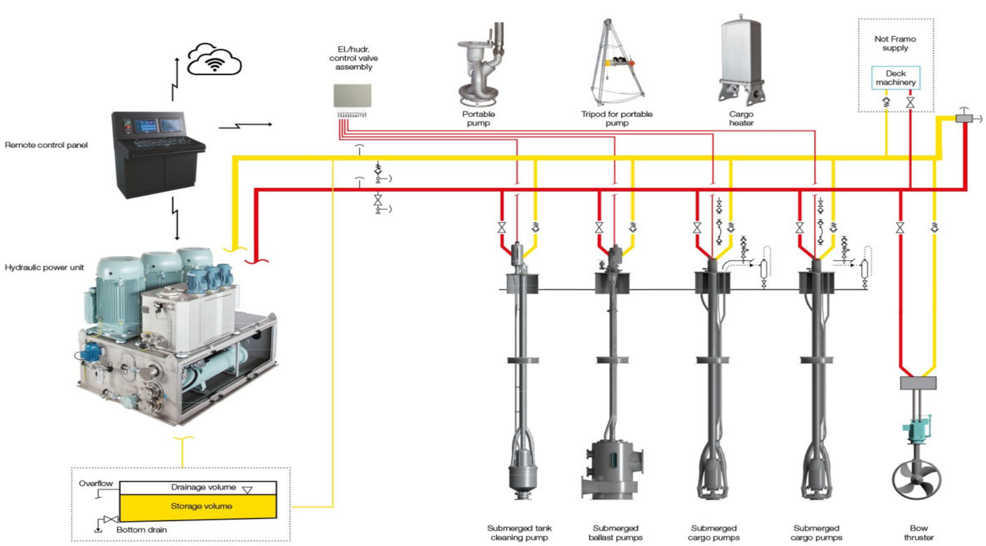


Figure 1: Framo Cargo Pumping Systems (source: Framo website)

Conventional HCPS systems are powered using electric power from a ship's main switchboard. Newer and more modern vessels are increasingly employing (more than

---

[5] IMO 2018, April 18. UN body adopts climate change strategy for shipping. https://www.imo.org/en/MediaCentre/PressBriefings/Pages/06GHGinitialstrategy.aspx

90% of new Framo systems) a hybrid HCPS in which the hydraulic pumps are driven by a combination of electric motors, powered by electric power from the main switchboard, and dedicated auxiliary diesel engines directly driving the hydraulic pumps without any intermediate electrical motor (Figure 2). These dedicated direct drive auxiliary diesel engines are much smaller than auxiliary diesel generators powering the main switchboard and hence these newer designed hybrid systems allow for improved vessel performance through lower overall fuel consumption.

Hybrid HCPS operate sequentially based on cargo throughput and pump loads. During cargo and ballast operations, the system starts off by first utilizing electric motor driven hydraulic pumps (powered by the tanker auxiliary diesel generators) and then starting the HCPS diesel engines to power direct drive hydraulic pumps. Typically, when operating at cargo loads of approximately 50% or more, the HCPS requires hydraulic power from both sources; electric motor driven hydraulic pumps and dedicated auxiliary engine driven hydraulic pumps. Tanker vessels at-berth in CA ports and terminals almost always off-load cargo at rates that require operating both the HCPS electric motors and HCPS diesel engines.

1. DDDHCPS Saves Fuels and Reduces Emissions

The HCPS significantly reduces tanker fuel consumption and emissions for three principal reasons. First, the use of the hydraulic power pack eliminates the need for auxiliary boilers which are less fuel efficient (auxiliary boilers are required in tankers designed with steam-driven common cargo pumping systems). Second, the HCPS diesel engines directly drive the hydraulic pump without the need for converting thermal energy to electrical energy to power a motor. This allows the diesel engine driven hydraulic pumps to achieve the same pumping rates as electric motor driven hydraulic pumps, but with smaller engines compared to ships using auxiliary diesel generators. Lastly, this cargo pumping system configuration allows the design of the auxiliary diesel generators to be optimized for the majority of the tanker vessel's operations, normally at-sea loads.

2. DDDHCPS cannot be connected to shore power

While the diesel direct-drive feature of the configuration of a hybrid HCPS significantly reduces cargo pumping emissions, it also precludes using shore power because there is no intermediate electrical motor. With new tanker vessels continuing to be built with this DDDHCPS, a control strategy comprised only of shore power will not be a viable means to achieve the emission reductions contemplated by the regulations, as interpreted by CARB.

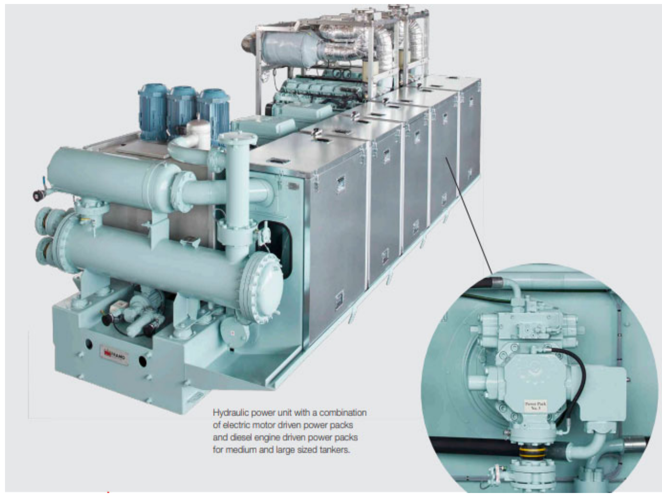


Figure 2: Framo System Using a Combination of Electric and Diesel Driven Power Pack
(Source: Framo website)

II. Capture and Control CAECS

Chevron has continued to actively assess the feasibility of implementing capture and control at RLW, as a potential CAECS to comply with the At-Berth Regulation. Currently there are only two vendors of capture and control technologies, and only one (CAEM) has approved CARB Executive Orders for its technologies. Chevron has been working closely with CAEM to evaluate feasibility of adapting their technology for a workable capture and control solution for large ocean-going tankers at RLW. Based on evaluation to date, Chevron does not anticipate that it will be feasible to implement capture and control technologies within the regulatory time-frames due to impediments posed by the following:

- Qualifying a new capture and control technology capable of safely and reliably capturing all in-scope emissions from tankers installed with steam or electric driven cargo and ballast pumps.
- Completing detailed safety, design and operational reviews of barge capture and control systems to ensure that barge design and operations meets all USCG and RLW safety requirements.
- CEQA permitting for barge fenders and barge mooring structures at all RLW berths.

a. Existing barge-based capture and control technologies are inadequate for tanker vessel application and a new barge- or shore-based design needs to be qualified.

1. Chevron toured the CAEM and STAX barges, while they were servicing container vessels in the Port of Los Angeles and Port of Long Beach, and learned the following:

- Current capture and control systems are capable of only processing emissions from one auxiliary engine.

- No technology has been demonstrated to capture emissions from auxiliary boilers, which are higher than auxiliary engines due to significantly greater fuel consumption.
- To date, no technology has been developed and piloted or demonstrated with the ability to simultaneously capture emissions from multiple stacks.
- Large bonnets, which capture emissions from multiple stack outlets into one big opening, have not been successfully deployed. Previous attempts to deploy large bonnets to cover multiple stacks have failed.
- Most large tankers, with steam turbine driven cargo and ballast pumps, have in-port exhaust emissions from multiple sources. For example, emissions from at least two auxiliary engines and one or two auxiliary boilers (to enable reliable, safe and timely operations, especially during cargo discharge) depending on rate of discharge. Due to the requirement to capture these emissions from multiple stacks from tankers, a bonnet larger and heavier than any existing or multiple hoods to capture emissions from each stack, will be needed.
- Safety standards and manning of existing designed barges, are not adequate for working in and around flammable hazardous zones. The design of these barges do not appear to meet U.S. Coast Guard requirements. These challenges are being discussed and still need to be addressed by the capture and control service providers.
- There are significant challenges associated with connecting, disconnecting and release of multiple hoods or bonnets in an emergency. This could present significant hazards to barge technicians or ship staff who may need to be in-situ, on top of the funnel stack, work in cramped and heated zones, at any hour or time of the day, under any weather conditions, operate tag lines while potentially being beneath very heavy loads to connect and disconnect the hoods/ bonnet. Also, an emergency disconnect option to meet the requirement to disconnect and leave a terminal within 30 minutes hasn't been considered in any barge design. This will need to be designed and proven to ensure safe ship and terminal operations.

2. **Regulating the Inert Gas System (IGS) significantly complicates designing capture and control solutions**

   Chevron began technical engagements with CAEM in November 2021. After developing conceptual designs for RLW in early 2022, we learned that CAEM was not yet familiar with tanker Inert Gas Systems (IGS) or Inert Gas Generators (IGG), as those safety systems are not required for non-hydrocarbon carrying vessels, such as container ships and passenger vessels, which are the only ships for which capture and control technology has been applied. Once Chevron and CAEM had a common understanding of the feasibility issues surrounding tanker IGS/IGG systems, we raised the issue to CARB in a June 2022 meeting and had several follow-up meetings.

   Based on these meetings with CARB staff, Chevron understands that CARB staff have interpreted that exhaust from IGS is subject to control under the At-Berth Regulation. Controlling exhaust from IGS increasingly complicates the development of a capture and control solution for tankers and will push the implementation timeline further than the timeline identified in DNV-GL's Technical Assessment.

i. Tanker exhaust gases and the Inert Gas System

Most tankers at-berth typically operate two or three auxiliary diesel generators and one or two main auxiliary boilers, each of which emit exhaust through an independent vent. Additionally, all tankers are required to generate inert gas, either using a dedicated Inert Gas Generator (IGG) or utilizing flue gases from the auxiliary boilers, to ensure an inert atmosphere for safe cargo operations. The excess inert gas is vented through an independent vent.

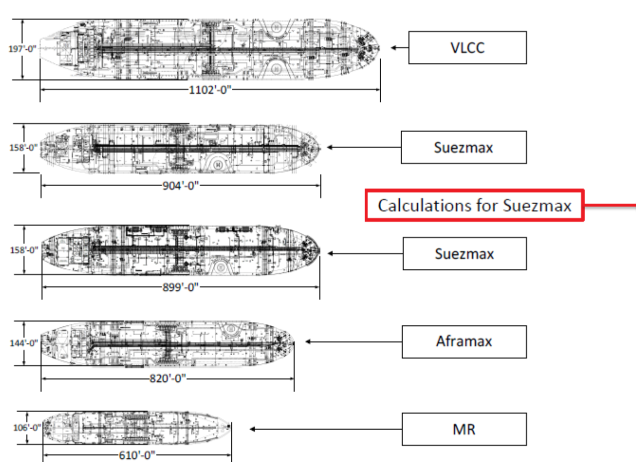
International Association of Classification Society (IACS) rules dictate the design requirements of IGS onboard tankers. The rules require that IGS are designed to generate at least 125% inert gas compared to the maximum discharge pumping capacity expressed as a volume. Oil Companies International Marine Forum (OCIMF) provides best practices and guidelines for safe operation of tankers. OCIMF guidelines require that cargo tanks be maintained under positive pressure[6], during cargo operations, to prevent inadvertent ingress of atmospheric air into the cargo tanks, which could lead to an explosion. To comply with IACS requirements and OCIMF best practices, IGS are designed and operated in a manner such that some amount of inert gas is continuously released from the exhaust outlet at the funnel. The inert gas going into the cargo tanks and released to the funnel is processed and treated using the ships IGS. As a part of the treatment, the inert gas is passed through a wet scrubber system. The scrubber removes particulate matter from the flue gas and cools the gas stream significantly to ensure compliance with safety requirements of IGS.

ii. Capturing inert gas from the IGS requires existing capture and control technologies to emit significant diesel emissions

The cooling of inert gas, described above, presents significant challenges to a capture and control solution, because the low temperature of inert gas is considerably cooler than exhaust gas temperature from the other exhaust vents. When the inert gas is comingled with all other exhaust emissions from tankers, it lowers the overall temperature of exhaust gases going into the capture and control CAECS.

[6] Inert gas systems, the use of inert gas for the carriage of flammable oil cargoes (First edition 2017) https://www.ocimf.org/document-libary/96-inert-gas-systems-the-use-of-inert-gas-for-the-carriage-of-flammable-oil-cargoes/file

Current capture and control systems require the combined exhaust stream to be at a minimum temperature to be effectively treated. With a cooler comingled exhaust gas stream, diesel heaters will be required to re-heat the stream. The energy needed to re-heat the expected combined exhaust volume of a middle-sized tanker will be on the order of running a 620 kW generator, resulting in a significant increase in overall emissions compared to ship emissions at berth (Figure 3). This amount of emissions presents a significant challenge for a capture and control system to satisfy the grid neutral greenhouse gas emissions requirement for CAECS under the At-Berth Regulation and would offset the air quality benefits from tanker vessel emission reductions. Additionally, the barges themselves will have difficulty storing sufficient diesel on board due to the consumption rate of 20 gallons of diesel per hour and the fact that vessel calls can be multi-day calls with maximum sustained pumping durations well over 10 hours per day.



Pump Number		3
Pump Capacity	m3/hr	3,800
Total Pumping	m3/hr	11,400
	bbl/hr	71,706
IGS Data		
ISG Design Factor		1.25
ISG Design Flow	Nm3/hr	14,250
	kg/hr	18,000
ISG Steam Flow	kg/hr	13,500
Minimum Stack Flow Design Factor		1.50
Minimum Stack Gas Flow	kg/hr	27,000
Temp	F	150
Vessel Pumping Data		
Desired Pumping Rate	bbl/hr	15,000
	m3/hr	2,385
Required Steam Rate	kg/hr	9,200
Required Fuel Rate	kg/hr	690
Required Flue Gas Flow	Nm3/hr	11,000
	kg/hr	14,500
Summary Calculations		
Steam to Condenser	kg/hr	4,300
ISG Percentage to Vent	%	83
ISG Vent Flow	kg/hr	14,988
	Nm3/hr	11,865
Diesel Consumed for Reheat	gph	39.6

Figure 3: Inert Gas Emissions for Suezmax

iii. Controlling inert gas systems increases safety risk

As described above, having to control the IGS exhaust adds another emissions capture point to the other three to five exhaust gas vents. In contrast, container vessels typically only have one emissions source at-berth. Capturing the exhaust gases from multiple exhaust outlets is challenging because it requires a very large and heavy bonnet to be hoisted high into the air to provide adequate coverage at the top of the stack for all potential stack configurations across the world-wide tanker fleet. The larger bonnet will be more susceptible to wind loads and will likely allow more air into the uptake that will dilute and further cool the combined exhaust stream to be controlled. The heavier weight increases the load on the suspension system and the hazard from any potential collision or falling bonnet. The capture hoods would need to be roughly 20-30-ft diameter hoods. Each lift of the hood will be a “critical lift” – one in which if the load drops, it has the potential to damage piping on board the vessel, or the terminal, cause a release to water, or injure or kill a person underneath. This results in a larger crane, barge tonnage, re-heat loads and processing plant footprint compared to existing capture and control equipment being used today on container vessels (Figure 4). This also adds complexity to connecting, keeping in-place during operation, and meeting requirements to disconnect in an emergency.

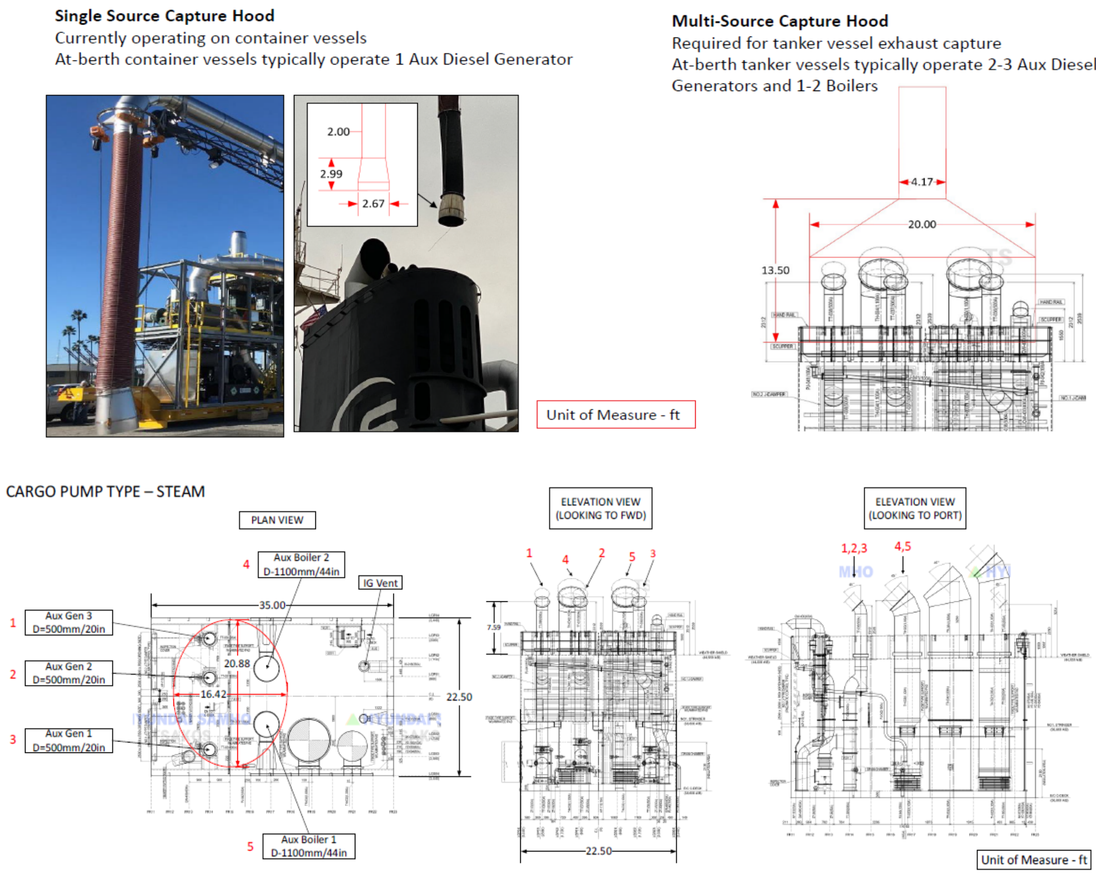


Figure 4: Funnel Casing Arrangement for Tankers

Lastly, the IGS is a critical safety system on tankers. Comingling exhaust gases from critical safety system with other systems, could have potential impact on safe cargo operations of tankers at berth. A common large bonnet could lead to cross contamination and inadvertent cross flow of exhaust gases to other exhaust outlets at lower pressure. The risk and impact of this needs to be studied. Addressing these safety risks may well require modifications to tanker vessels, which would need to be approved by IACS and other regulatory entities.

iv. CARB questions about discharge rates.

CARB questioned the flow rate calculations presented by CAEM in September and November 2022, stating that the flow rates shown by CAEM were peak pumping rates, and that vessels do not operate at peak pumping rates. This is not accurate. Vessels do operate at peak pumping rates, however, over the course of any given vessel call there is a ramp up and ramp down process for pumping product from a vessel, plus there is time at berth that is "non-pumping" time associated with the mooring, unmooring, and tank-switching procedures.

All vessels will operate at the maximum pumping capacity for the shore-side receiving equipment or the vessel's own maximum pumping capacity if the shore-side is not limiting. In this case at RLW, the typical maximum pumping rates will occur between 12,000-55,000 barrels per hour (BPH). Averaged over the entire duration of the vessel call at berth, the call-specific pumping rate will appear lower because of episodes of idle time, plus vessel mooring time, set up time, and tank or product switching and line flushing time. The data CARB focuses on are the average calculated pumping rates and time at berth from arrival to departure, not the specific hours of peak pumping activity for each vessel call. Consequently, this IGS issue is significant, particularly at peak pumping rates, and has a profound effect on the ability of barge-based systems to feasibly operate to control tanker emissions in a GHG-neutral manner given the process reheat requirements for the capture and control technology.

b. Barge-Based Capture and Control Feasibility

1. Barges with two capture and control booms are not feasible to operate simultaneously on two adjacent berthed vessels.

As of February 26, 2023, CAEM has provided Chevron a concept design for barges. Due to space limitations between vessels simultaneously berthed at adjacent berths, Chevron evaluated whether a single capture and control barge with two capture booms on board could service two tankers simultaneously in adjacent berths. Chevron and CAEM have determined operating one barge (with two booms) simultaneously on two different adjacent berthed tankers is not feasible because of the differential movement (draft, surge, sway) of ships at berth relative to the barge. Operationally it would be too complex for several reasons: simultaneous contact between two vessels at berth could lead to liability issues; safe ship management practices might not allow this configuration; visibility is necessary for manual monitoring of hood connection over vessel stacks; relative movement of three point system (two vessels, one barge), crane reach issues, and vessel departure maneuvering conflicts. Based on our evaluation to date, this alternative very likely is not practicable or feasible. This means barge-based capture and control will not be able to be applied to all potential vessel berthing scenarios because there will be situations when two individual single-boom barges, side by side, cannot fit between two adjacent berthed vessels.

2. Barge mooring and berthing issues at RLW are significant

CAEM, Moffatt and Nichol (a marine engineering firm), and Chevron have determined that mooring feasibility is a significant concern for capture and control barges at RLW. Chevron is evaluating non-motorized barges to limit the complexity of the capture and control system and barge operations. Further, we have determined that dynamic position systems (DPS) would result in very substantial fuel consumption over the 3-4 day duration of a typical tanker call, and would require significant redundancy in propulsion system equipment. As a result, Chevron and CAEM have focused on evaluation of tug-positioned barges for RLW. The mooring feasibility issue cannot be resolved in a simple manner, however, and is discussed further below.

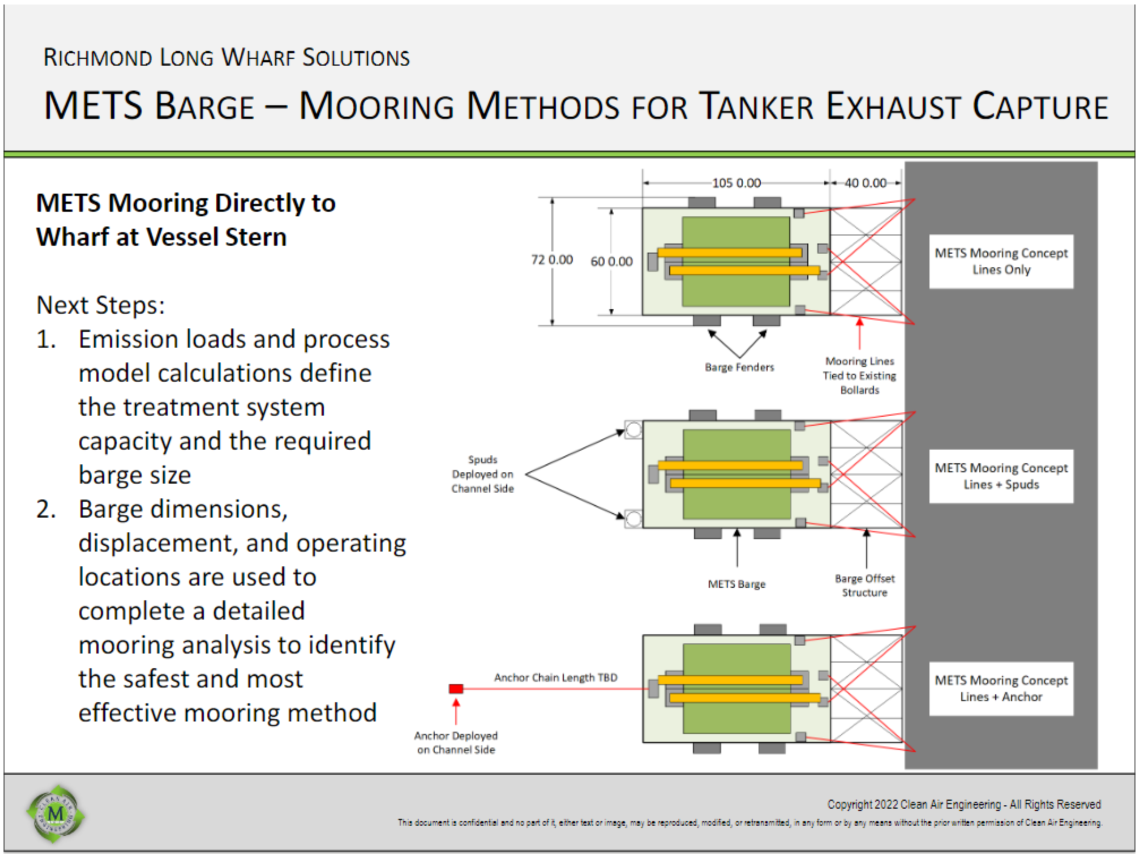


Figure 5: CAEM Diagram of Mooring Methods

i. Mooring geotechnical constraints

RLW is located in the San Francisco Bay, the uppermost stratigraphic layer of which is Young Bay Mud (YBM). According to the 2009-2020 RLW MOTEMS Audits, the RLW site consists of over 45 feet of soft Young Bay Mud deposit with an average undrained shear strength less than 500 psf with a plasticity index, PI > 20, and water content over 40%. Consequently, it will not be possible to rely solely on spud piles to station keep the barge throughout the duration of a vessel call.

Mooring a capture and control barge will require a combination mooring method that relies on spuds (temporarily driven piles to hold a barge in place), tie-off to RLW and possibly an anchor solution, given the terminal met-ocean conditions (combination of winds, waves and currents). Further, because the berth depth at RLW ranges from 40-50 ft, combined with the low shear strength of the Bay Mud, spud-based mooring would require greater than 100 ft-length spuds, penetrating greater than 50-ft into the sediment, to safely moor the barge. Motion studies are planned for 2023, but the combination of open water exposures to wind, waves and currents, precludes solely relying upon spud piles for barge station-keeping.

ii. Spacing Constraints

Chevron evaluated operations from 2016-2022 and found that the minimum vessel clearance between vessels occurs between Berths 2 and 3, with a spacing of 43 feet. The most common clearance between vessels and the minimum clearances between vessels at berth are:

RLW Berth	Most Common Approx Clearance Between Vessels +/- 20 ft	Largest LOA Vessels - Approx Clearance Between Vessels +/- 20 ft
1-2	271	118
2-3	204	43
3-4	208	174

Table 1. Clearances Between Vessels by Berths

Consequently, there is very little room to fit a barge between vessels, and in some cases, it will not be possible to place a capture and control barge in between two adjacent berthed vessels. Furthermore, Chevron will need to engage with the Bar Pilots to confirm whether they are willing to maneuver in and out of berth with such narrow clearances when a C&C barge is present and servicing an adjacent vessel.

iii. Berthing orientation

Because of the constrained clearances between vessels simultaneously berthed at RLW, Chevron is evaluating the feasibility of a fendering system between each berth (1-4) to enable barges to breast against the RLW structure, to provide a predictable mooring location from which barge-based C&C systems can deploy their boom cranes to the sterns of adjacent vessels for improved access to the vessel stack. Developing a fixed mooring location also would provide predictability to vessel pilots who must moor and depart from RLW berths where adjacent vessels may be actively serviced by C&C barges.

However, the perpendicular mooring to the face of RLW presents additional challenges for relative motion between the barge and ship movements, potentially causing greater relative motion between the capture and control boom and vessel stack, at the top of the stack. CAEM's naval architect will be studying this issue in the first half of 2023 to identify relative motion concerns, recommended hull shape and ballasting design changes (versus the METS-3/-4 ABS-certified design) and mooring forces based on site-specific metocean data for RLW.

3. **CEQA Permitting is critical path, particularly for in-water construction**

   To enable the perpendicular mooring, a fender system would need to be installed along the face of RLW at the interface of RLW1/RLW2, RLW2/RLW3 and RLW3/RLW4, plus mooring dolphins would need to be installed at RLW1S and RLW4N. As the barge fender systems would require in-water pile driving, the project wouldl need to permitted through a CEQA environmental review process, likely lead by the California State Lands Commission, which leases the submerged lands to Chevron under a 30-year lease agreement. The expected timeframe for CEQA review and approval is likely 18 to 24 months, and must occur prior to any construction starting, and after 60% engineering is complete. This same regulatory approval process applies to the foundation piles that support shore-based capture and control cranes, platform structures to support the 300,000 lbs of shore-based capture and control equipment, and for piles that support the boom crane and cable management system for shore power. Whether it is barge-based CAECS or shore-based CAECS, the project must undergo CEQA permitting due to in-water construction impacts, and that permitting process will take 18-24 months or longer.

4. **Lead time for barge manufacturing is long**

   On February 9, 2023, CAEM presented Chevron with its most recent manufacturing schedule for the METS-3 and METS-4 barges, which are intended for use in Southern California and are presently under construction. At a high level, CAEM's recent experience with their METS-3 and 4 barges are approximately 10 months for engineering, 18 months for equipment fabrication and 6 months for system assembly and delivery, or approximately 34 months from start to finish. This does not account for design, modeling and testing of different hull and capture hood designs relative to site-specific conditions at RLW. It also does not account for the time needed to change any process-related technologies to accommodate capturing the low-temperature IGS/IGG exhaust, if CARB requires IGS/IGG to be captured. Nor does it account for possible supply chain impacts caused by possible increasing demand for barges and electrical equipment, as discussed previously.

c. Shore-based capture and control feasibility

1. **Shore-Based Capture and Control poses unique challenges for design, construction and will result approximately 0.5 acre of permanent impacts to the marine environment, and construction will require several years due to in-water work restrictions in San Francisco Bay.**

i. The infrastructure necessary to support shore-based capture and control are massive in scope and would take more than 3 years to construct.

For shore-based capture and control at RLW, five new pile-supported concrete platforms would need to be installed along the back side of the wharf to support five (5) gas processing treatment systems, with dimensions of up to approximately 40 x 100 ft (4000 sf), and heights up to 36-ft above the deck, to support nearly 300,000 lbs of processing equipment. In addition, two new crane dolphins 30 ft x 24 ft (720 sf) would be needed at RLW1 and RLW4. To maintain a distance not greater than 400 ft from the vessel stacks, five (5) gas processing platforms are required to service the four (4) berths (see Figure 6). Consequently, these gas processing platforms would be exceptionally large and visible installations to the adjacent communities and would need to operate 24 hours per day when a vessel is connected.

The infrastructure required to transport the wide range of exhaust gas flow rates from vessel stacks to gas processing platforms would require routing approximately 1,360 feet of 34 to 62-in diameter steel ducts on the RLW, likely on elevated steel structures 20 feet (or more) above the existing pipe racks. Where the ducts must cross vehicle travel lanes on the Main Wharf, the duct rack elevation must be sufficient to enable large emergency vehicles (fire trucks) and mobile cranes (cherry pickers) to move unimpeded along the wharf deck.

The capture and control gas processing equipment employs Selective Catalytic Reduction (SCR) technology, which injects aqueous ammonia into the vessel exhaust gas to reduce NOx to N_2 gas and water vapor. Given the volumes of aqueous ammonia required for the exhaust gas throughput, CAEM estimates that a new 7,500-10,000 gal (~11,000-14,680 pounds NH_3) shore tank will be necessary to store the 19% aqueous ammonia solution. The aqueous ammonia would need to be pumped from the shore tank and conveyed via pipeline to the five shore-based gas processing platforms distributed along the shore side of the RLW. Aqueous ammonia is not presently handled at RLW and would introduce a new chemical to be managed at the marine terminal. Ammonia stored in quantities greater than 500 pounds will trigger CalARP requirements.

ii. CEQA Permitting is critical path, particularly for in-water construction

Permitting remains on the critical path for the shore-based capture and control CAECS as well. This CAECS is expected to trigger an Environmental Impact Report (EIR), which will take 24 months or more to complete. In addition, the expected duration of construction for the shore-based capture and control would likely be longer than barge-based capture and control and on par with shore power due to the extensive amount of new over-water platforms, cranes, crane dolphins, and structural work necessary to support the duct routing and design. This alternative will have additional permitting challenges due to the new structure creating permanent over-water shading (nearly 21,000 sq. ft, excluding the ducting), in-water fill due to added piles to support the new structure, potential dredging for construction access, disturbance to eelgrass habitat, and permanent visual/aesthetic impacts that would likely be created by the added structures, ducting and mechanical equipment. Potential noise impacts have not yet been studied associated with this technology. All in-water construction must be completed within the June 1-November 30th in the water work window permitted by resource agencies to protect endangered and threatened species, thus necessitating long construction durations for new terminal platforms. Finally, adding 0.5 acre of new structure to RLW would constitute the largest structural addition to RLW since the 1940s.

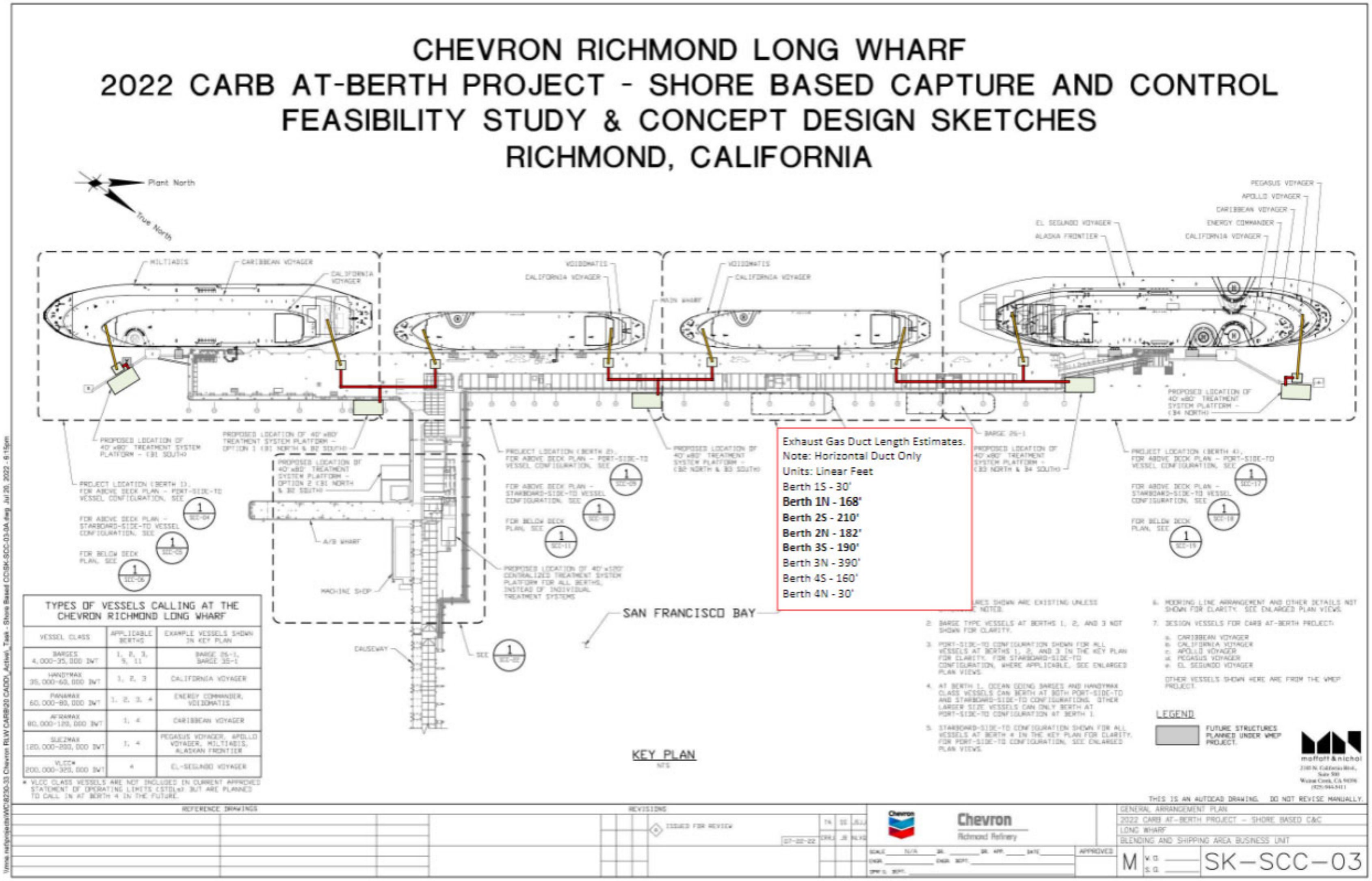


Figure 6: Schematic of Gas Processing Platforms, Boom Cranes and Exhaust Ducts for Shore-based Capture and Control

III. INNOVATIVE CONCEPTS

While Chevron has already implemented and submitted environmental review applications for several IC projects, we are finding that CARB's actions are impairing the viability of this compliance approach for two reasons.

First, CARB's failure to act on Chevron's Application in a timely fashion is impairing the viability of this compliance option. Given the lengthy and uncertain amount of time required to design, obtain government approvals, and construct some of the IC projects, CARB's delay in acting on Chevron's Application threatens to make it impossible to complete the projects in a timely fashion.

Unfortunately, during Chevron's September 21, 2022 discussions with CARB, CARB indicated that Chevron's IC application will not be prioritized for review and approval due to earlier compliance dates for other regulated industries when compared to Chevron's compliance date of 2027.

Second, CARB is advancing an interpretation of the IC provisions concerning banking of credits that, if upheld, would prevent Chevron from relying on IC projects to meet the first compliance deadline. Section 93130.17(a)(11) of the At-Berth Regulation states the following:

> *Early reductions achieved through an innovative concept that occur **before** a vessel or terminal's first compliance period can be used towards compliance during the **first compliance period of up to five years**. However, early reductions are only applicable for the initial compliance period and **will expire when the initial compliance period ends**.* (Emphasis added.)

On its face, this language permits Chevron to bank emissions credits generated by IC projects at any time prior to the first compliance period, regardless of when CARB approves such projects. Chevron's compliance strategy has been to implement IC projects as soon as possible to be able to accrue early emissions reductions, starting from the date of implementation, for the benefit of nearby communities, in advance of the 2027 regulatory compliance deadline. Chevron's IC proposal relies on banking of these early emission reductions, starting from the date of implementation, to achieve the required emissions reductions to comply with the At-Berth Regulation.

During the engagement held between CARB and Chevron on September 21, 2022, Chevron requested CARB's confirmation that it could "bank" early emission reductions for approved ICs. CARB stated that it interpreted the IC Compliance Option to only allow accrual on a go-forward basis from the date an IC is approved with an executive order. Not only is this interpretation contrary to the language of the At-Berth Regulation, but it would also prevent Chevron from achieving compliance with its proposed IC projects in light of CARB's delay in acting on Chevron's Application.

Simply put, if CARB cannot review and approve Chevron's Application and allow for retroactive accrual of emission reduction credits, the IC Compliance Option is not a viable means of compliance for Chevron at the RLW.

IV. CONCLUSION

Chevron appreciates the opportunity to comment on the Interim Report. The Interim Report represents an important update to the leadership of CARB concerning implementation of the At-Berth Regulation. The Interim Report needs to accurately reflect the on-the-ground reality of achieving compliance with regulation. This comment letter provides very detailed information concerning the reality of implementing the At-Berth Regulation at RLW and reflects Chevron's aggressive efforts to comply. CARB should take the information in this comment letter seriously and take actions concerning the Interim Report and Chevron's IC application, as described in the Executive Summary.