Richmond Long Wharf (RLW) is located near the eastern terminus of the Richmond-San Rafael Bridge.

RLW is the largest marine oil terminal in California, and its operations are regulated primarily by CSLC through State Lands lease, Article 5 of their regulations and MOTEEMS (CBC Chapter 31F).

2008-2010 volume transfers – averaged 145 MMbbl/yr in 720 vessel calls.

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Wharf Volume</td>
<td>MM bbl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>151.9</td>
<td>143.6</td>
<td>138.7</td>
<td>144.7</td>
</tr>
<tr>
<td>Total Transfers</td>
<td>#</td>
<td>1,930</td>
<td>1,738</td>
<td>1,790</td>
</tr>
<tr>
<td>Total Vessel Calls</td>
<td>#</td>
<td>783</td>
<td>736</td>
<td>641</td>
</tr>
</tbody>
</table>

Richmond Long Wharf has six berths for receiving raw materials and shipping final products. Two berths (9, 11) are limited to 5K DWT barges. Largest vessels accommodated are 193K DWT ships at Berth 4.

Total vessel calls are split approximately 55% ships and 45% barges.
Richmond Refinery’s first marine oil terminal was located at Pt. Orient in San Pablo Bay, and was used until Richmond Long Wharf was built in the 1940s. Pt. Orient remained active until the 1980s and is now in caretaker status.
The structure you see below, which comprises the majority of the modern RLW structure, was constructed in 1945-1947.
Richmond Long Wharf Today

- 27 +/- feedstock and product pipelines, ranging in diameter from 6 to 36-inches totaling ~30 +/- miles of pipe.
- 23 mooring hooks (1970s and three recent vintage)
- Cleats, bollards and bits from 1947 construction.
- Per MOTEMS Sec. 3104F.1.1, Table 31F-4-1, >1200 bbl over water = High Risk Oil Spill Classification

Pipe trestle and LSFO Pipeway
Causesway (4,200')

Pile Summary
(2009 MOTEMS Audit Rev. 1, M&N)

<table>
<thead>
<tr>
<th>Summary</th>
<th>2000</th>
<th>1991</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Steel Pipe Piles</td>
<td>488</td>
<td>2000</td>
</tr>
<tr>
<td>Installed 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Concrete Piles</td>
<td>91</td>
<td>1991</td>
</tr>
<tr>
<td>Installed 1991</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Concrete Piles</td>
<td>3,281</td>
<td>Prior to 1980</td>
</tr>
<tr>
<td>Installed Prior to 1980</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Concrete-Sleeved</td>
<td>545</td>
<td>1947</td>
</tr>
<tr>
<td>Timber Piles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total H-Section Piles</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Total Timber Fender Piles</td>
<td>780</td>
<td></td>
</tr>
<tr>
<td>Total All Piles</td>
<td>5,246</td>
<td></td>
</tr>
</tbody>
</table>

# RLW Pre-MOTEEMS Construction

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Facilities Modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1945-47</td>
<td>Original construction</td>
<td>• Main Wharf and Causeway</td>
</tr>
<tr>
<td>1973</td>
<td>Long Wharf Modernization</td>
<td>• Construction of Berth 1, 3 and 4 Loading Platforms, dolphins and bump-outs, and two (of three total) fender units at Berth 3.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Installed 15 loading arms, and 23 mooring hooks.</td>
</tr>
<tr>
<td>1989</td>
<td>Berth 4 Mooring Dolphin Reconstruction</td>
<td>• A mooring hook and 60-ft of catwalk were rebuilt following vessel impact with the original dolphin.</td>
</tr>
<tr>
<td>1990</td>
<td>Long Wharf Emissions Reduction Project</td>
<td>• Vapor cranes installed at Berths 2, 3 and 4. The Berth 4 gangway tower was moved to accommodate new vapor recovery crane.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Between 1990 and 2000, the third fender and concrete bump-out were added in front of the Berth 3 Loading Platform</td>
</tr>
<tr>
<td>2000</td>
<td>Seismic Upgrade and Repairs</td>
<td>• 4-ft diameter steel piles and pilecaps inset into the Main Wharf.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Retrofit steel piles also added to the Causeway, A/B Berth and office building.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Replaced timber pipe trestle with steel structure.</td>
</tr>
<tr>
<td>2004</td>
<td>Long Wharf Electrical Upgrades</td>
<td>• Installed new cable tray, power distribution racks and cable for the 480V power system at Berths 1, 2, 3, 4, 9 and 11.</td>
</tr>
</tbody>
</table>
Richmond Long Wharf –
MOTEAMS Compliance Journey

- Chevron’s Initial Audit was submitted in 2008.

- In June 2009, CSLC MFD requested Chevron to resubmit its initial audit based on numerous comments, including:
  - Difference of opinion regarding some Remedial Action Priorities (RAPs) assigned to deficiencies.
  - As-built documentation
  - Seismic analysis documentation
  - Repair implementation schedule for RAPs vs. date of inspection
  - Underwater inspection: % of piles inspected less than 33% of 5,246 total to be completed in 3 inspection intervals.
  - Site-specific current data, among other issues.

- Chevron and CSLC MFD agreed that a revised Initial Audit (Rev. 1) would be submitted by December 2009, and it was.

- The second MOTEAMS Audit was submitted in 2012, on a 3-year cycle.
Audit-Identified Deficiencies

- **MOTEAMS Initial Audit Deficiencies**
  - **104 Deficiencies and Recommendations**
    - **48% Piping-related**, primarily coating and pipe supports.
    - **23% Electrical** - issues were focused on sealing conduits, exposed cables, and some equipment labels.
    - **11% Above-water** - Significant concrete deck repair, in addition to mooring hardware rehabilitation and fender repair/replacement.
    - Balance (19%) split between Mechanical, M&B, Seismic/Structural and Fire Protection.

- **MOTEAMS Audit 2012 Deficiencies**
  - **51 Deficiencies and Recommendations**
    - **65% Above-Water**—isolated concrete spalls, expansion joint repairs, guard rail corrosion. Concrete repairs was a factor of 10 reduced relative to 2009 audit.
    - **15% Electrical** – lighting levels, conduit.
    - Balance (20%) split nearly equally between UW, Mechanical, Piping and M&B
Audit Deficiencies and Recommendations

2009 vs. 2012 MOTEAMS Audit
Deficiencies and Recommendations

- No Priority 1 (P1) deficiencies were identified in the initial MOTEAMS audit (2008/2009), nor the second audit (2012). All P2 deficiencies (4 total) were electrical related.

- Implementation of four major projects from 2009-2014 closed all P2-P4 deficiencies but one (P3), and all but 15 recommendations. The Berth 2 fender system replacement is undergoing CEQA review, and would complete the remaining P3 deficiency.
<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
<th>Facilities Modified</th>
<th>TIC ($MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-2012</td>
<td>MOTEMS 1</td>
<td>Berth 1 and Berth 4 Fender Replacements</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Berth 1 &amp; 4 steel platform replacements</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mooring hardware and foundation(s), rehabilitation and repairs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recoated the pipe trestle along the causeway.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concrete repair, bull rail replacement near MK-408</td>
<td>$25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Wharf deck edge, curb and bull rail (800 ft.) along Berth 1 through Berth 4 were repaired.</td>
<td></td>
</tr>
<tr>
<td>2010-2013</td>
<td>Rockfill Project / Pipe Reliability</td>
<td>Raised the active pipes off of the rocks and re-leveled the pipe by replacing deteriorated pipe supports in Rockfill area. Also raised seven pipelines that were in the “splash zone” to reduce the corrosion rate.</td>
<td>$22</td>
</tr>
<tr>
<td>2013-2014</td>
<td>MOTEMS 2</td>
<td>Concrete deck repairs, expansion joint replacement and light pole foundation repairs.</td>
<td></td>
</tr>
<tr>
<td>2012-2013</td>
<td>Berth 9/11 Composite Piles</td>
<td>Replaced timber fender piles with composite piles at Berths 9 and 11 to make them MOTEMS compliant.</td>
<td>$2</td>
</tr>
</tbody>
</table>

**Completed MOTEMS Projects** $52
Berth 4 Breasting Dolphin Fender Replacement (Oct 2011) – P3 Deficiency

Drivers for replacement:
1. Seibu parts difficult to obtain.
2. Standardize fenders, larger panels.
Berth 1 South Mooring Dolphin
Mooring Hook Replacement (2013) – P3/P4 Deficiencies

Before (2007)

After Replacement (2013)

Reconditioned (2010)

30-year CSLC lease renewal required tension monitoring at Berth 1 so Chevron installed a quintuple hook.
Berth 4 Loading Platform
Steel Platform Replacement (Oct 2011) – P3 Deficiency

Before

Replaced two 40 year old steel platforms at Berth 4 loading platform and a similar platform at Berth 1.

After
Berth 9 and 11 Timber Fender Piles
MOTEAMS Compliant for M&B velocities – P3 Deficiency

Main Wharf, Berth 9 (before)
Approach velocity limitations, requiring AAS velocity monitoring.

Berth 9/11 - Composite piles with timber waler system, and new concrete curb.

Lessons learned: Composite piles (polyethylene sheath, concrete-filled) have >3-5x longer service life than untreated or exotic wood timber fender piles; they are a more cost effective fendering solution.
Pipe Trestle Repairs / Coating
2009 Audit vs. Post-Project (2011) – P3 Deficiency

Before (2007/8):
Coating system nearing end of life resulting in surficial corrosion.

After (2011)

Photograph 2: Pipeway Trestle W-section Girders with Pipe Bracing
Safety is the #1 priority.

All MOTEMS-related construction from 2009-2014 was completed incident and injury free.

Construction BMPs:
- Chevron required the contractor to build two types of secondary containment (primary and alternate) while rebuilding the wharf face to ensure no materials were released to the bay.
- Chevron also had the contractor build temporary mooring line guides to protect integrity of the lines and moorings.
1. Open communication with CSLC enabled innovative solutions to complex problems.

   - **Underwater Inspection** – CSLC and Chevron agreed to 3 audit cycle to complete inspecting the 5,246 piles at Richmond Long Wharf.
     - 2007 UW Inspection = 14% completed.
     - 2011 UW Inspection = 44% (58% total), completed.
     - 2016 UW Inspection = 42% (100% total), planned.

   - **Alternatives Requests:**
     - **Non-Linear Seismic and Structural Analysis** – CSLC approved Chevron’s Alternatives Request to apply the Chopra-Goel Method (1999) for the Berth 4 Loading Platform structure seismic and structural analysis.
     - **Current Study (2010-2012)** – site specific data obtained in 2009/2010, demonstrated that current velocities at RLW are less than 1.5 kts. Consistent with 1973 current survey; different from current-dominated Pt. Orient and other Bay Area terminals in Carquinez Straits.
     - **Wind vs. Current Mooring Line Forces** - RLW Mooring and Berthing forces in tidal marine environment are dominated by winds, not current.
       - AT RLW - Loads on mooring lines due to current are $\frac{1}{6}$th of the loads caused by wind. Therefore, a 3.5 kt current = the same mooring line force as a 40 kt wind at same heading (May 2013 M&N Analysis).
       - CSLC approved Chevron to reduce Berth 4 STOL wind speeds in lieu of a current meter.
Lessons Learned, continued

– **Equal or Better Protection Requests (3101F.2)**–
  
  • CSLC approved to use PIANC/BS 6349 curves instead of MOTEMS step-function for berthing velocities, at Berth 3.
  
  • Berths 9 and 11 - Alternative Berthing Method
    
    ▶ CSLC approved Chevron to use two tugs to bring in loaded barges, as temporary measure to mitigate Allision Avoidance System (AAS) below-deck limitations.
    
    ▶ Engineered solution - Composite piles vs. timber piles to eliminate berthing restrictions at B9/B11 – Chevron installed in 2012 (B9) and 2013 (B11).
    
    ▶ Long term transition from timber to composite fender piles will improve performance of the fender system, reduce pile replacement frequency and drive down overall operational costs.

2. Integrate marine engineering contractor and construction contractor into project planning and development early.

  • Ensure the correct people are actively engaged throughout planning, permitting and construction.
  
  • Develop detailed work plans, identify critical construction inspection/oversight activities.
  
  • *Detailed construction execution planning is essential for injury-free work.*
On behalf of Chevron, I’d like to thank the following individuals for their roles in supporting Chevron RLW’s past, present and upcoming MOTEAMS compliance efforts:

CSLC:
Gary Gregory, Martin Eskijian, Kendra Oliver, Chris Beckwith, Laura Kovary, Avi Nafday, Alex Augustin, Hosny Hakim, Mike Edwards, Helen Galope, Don Hermanson, Donn Oetzel (LMD), Sarah Mongano (EPMD).

Chevron:
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Power Engineering and Construction:
David Mik, Hilary Tigue, Jeff VanMeter, Lars Olsen, Freddy Herrmann, Bennett Clegg

References:
MOTEAMS Audits, prepared by Moffatt and Nichol on behalf of Chevron:
1. Richmond Long Wharf MOTEAMS Initial Audit, Rev. 1 (2009), ES-2 Rev. 2
2. Richmond Long Wharf MOTEAMS Audit (2012), ES-2, Rev. 8
RLW Construction for Pile Supported Foundation