Port of Los Angeles
ALTERNATIVE MARITIME POWER – AMP™
Connecting Ships to Shore Power
San Pedro Bay Port Complex

- Harbor Department founded in 1907
- State Tidelands Trust granted 1911
- Non-Taxpayer Supported
- Hybrid Port Model
- Handles Cargo to & from every corner of the U.S.

By the Numbers:
- 4,300 acres land
- 3,200 acres water
- 43 miles of waterfront
- 270 berths, 27 terminals

9,337,632 TEU CY - 2019
## Global Ranking (2017)

1. Shanghai, China 40.2
2. Singapore 33.7
3. Shenzhen, China 25.2
4. Ningbo, China 24.6
5. Hong Kong 20.8
6. Busan, South Korea 20.5
7. Guangzhou, China 20.4
8. Qingdao, China 18.3
9. LA & LB (as of 2018) 17.5

## North American Ranking (2018)

1. Los Angeles 9.4
2. Long Beach 8.1
3. NY/NJ 7.2
4. Panama (AMP) 7.0
5. Savannah 4.4
6. Tacoma/Seattle 3.8
7. Vancouver 3.4
8. Manzanillo 3.1
9. Hampton Roads 2.9
10. Houston 2.7

## PORT OF LOS ANGELES - TEU COUNT

<table>
<thead>
<tr>
<th>Year</th>
<th>TEU Count</th>
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<tbody>
<tr>
<td>1981</td>
<td>476,249</td>
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<td>1985</td>
<td>1,103,722</td>
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<td>1990</td>
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<td>1995</td>
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<td>2000</td>
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<td>2010</td>
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<td>2015</td>
<td>8,160,458</td>
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<td>2018</td>
<td>9,458,749</td>
</tr>
<tr>
<td>2019</td>
<td>9,337,632</td>
</tr>
</tbody>
</table>
OTHER LINES OF BUSINESS

VEHICLES: 156,091 Units

LIQUID BULK: 90,624,559 Barrels

STEEL: 2,101,856 MT

VISITORS: 3.14 Million People

CRUISES: 111 Calls

FRUIT: 80,892 MT

SCRAP METAL: 905,886 MT

STEEL: 2,101,856 MT

CRUISES: 111 Calls

OTHER LINES OF BUSINESS

34%

8.4%

1.1%

4.6%

8%

26%

1.8%
Air Quality – South Coast Air Basin

- The “100” Year War
- Diesel Emissions
- Identified as Air Toxic by the California Air Resources Board (CARB)
Connecting vessels to Shore Power while at berth.
AMP: The Challenge
Container Ship Particulars
On-Board Electrical Systems

- Newer larger container vessel’s on-board voltage is 6.6 kV
- Balance are 440 Volt vessels
- Ship’s power demand is widely variable:
  - Average 1.5 MW
- Power Demand Examples:
  - 2 MW at 6.6 kV = 1 power cable
  - 2 MW at 440 V = 9 power cables
High Voltage in Tight Locations
Conduits and Wires
AMP - Power Vault
Vault and Receptacle
Fiber Optics Wiring
AMP – Switchgear & Transformer
AMP – First Generation – Berth 100

Barge Power Transfer:
- 440 Volt to 6.6 kV
- Barge based cable management system, transformer and switchgear
Container Vessel Cable Management
Moveable Ship Board Cable Management
Moveable Ship Board Cable Management
Container- AMP Vessel Connection
On-Board AMP Equipment
Port of Los Angeles Cruise Terminal

- 11 kV System construction 100% complete
- 6.6 kV construction 100% complete
- Both systems @ 60 Hertz - 20 MVA
- Synchronized Power Transfer
- Four Connectors + 1 Isolated Neutral
- Flexible Shore Based Cable Management
- Total cost $30 million
The “AMPMobile”

DWP Industrial Station

POLA Switch Gear

[Images of AMPMobile setup]
AMP Power Vault – Cruise Vessel Connection
AMP - System Features

- Container: 7.5 MVA xfmr
- Cruise: 18.0 MVA xfmr with automatic load tap change
- 6.6 or 11 KV, 3-ph, 60 Hz
- One transformer per berth
- Neutral Gnd resistor connection
- Auto sync and power transfer
- Fiber optic connection (optional)
- PLC controller (optional)
- Vacuum circuit breakers on main and feeder circuits
• Ground check double loop
• Connect/Disconnect procedures
• Earthing switch
• On-board vessel cable management systems
• On-board vessel xfmr
• Digital relay with protection functions:
  • Reverse power
  • Under/Over voltage
  • Under/Over frequency
  • Over current
New Challenge: Moveable Connection Points