REPORT

Report: Maritime Power Capacity Study for Terminal Electrification. **(Engineering)**

MEETING DATE: 12/12/2019

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APPROVED BY: Danny Wan, Acting Executive Director

SUMMARY

The Board of Port Commissioners approved the Seaport Air Quality 2020 and Beyond Plan (the Plan) at its regularly-scheduled meeting held June 13, 2019. The Plan is a Master Plan that guides Port maritime air quality policy, programs and projects to support a pathway to a zero-emissions Seaport. During Plan development, it became clear that future significant expansion of shore power and electrification of drayage trucks and container handling equipment will create a demand for more electricity that may be constrained by the capacity of the Port's existing electrical infrastructure.

SCOPE

Port staff contracted with energy consulting firm Burns and McDonnell to conduct a Maritime Power Capacity Study for Terminal Electrification (Study). The purpose of the Study was to quantify electrical grid infrastructure capacity limitations on the anticipated demand for more electricity to serve a zero-emissions Port operation. The Study evaluated the Port's existing electrical infrastructure at the Port of Oakland Maritime facilities. The Study is intended to identify electrical infrastructure upgrades for the Port utility distribution system needed to serve future anticipated power demands resulting from larger equipment, additional industrial facilities, and increased electrification of drayage trucks and terminal container handling equipment. The goals of the Study were to:

- Evaluate the Port's existing electrical infrastructure
- Develop estimates of existing loads located within the Seaport
- Develop projections of electric loads from future developments in the Seaport
- Conduct an analysis of electrical demand from future cargo handling equipment and drayage truck electrification
- Prepare conceptual plans and cost estimates for vehicle/equipment charging depots

- Evaluate capacities and limitations on the distribution infrastructure to meet future electrical loads
- Provide cost estimates and implementation schedules for infrastructure development

Electricity in the Seaport is provided by both PG&E and the Port in its role as a municipal utility. The Study focused on the primary feed to the Port's system which consists of a shared 115kV line that provides power to the port's primary seaport electrical substations Davis and Cuthbertson. This represents most of the Port's electrical power supply in the Seaport.

The Study evaluated demand on the 115kV system resulting from maritime growth, planned terminal improvements and electrification of Container Handling Equipment (CHE) and drayage trucks. The demand includes:

- Cold Storage Facilities
- Outer Harbor Crane Consolidation
- OAB Redevelopment
- Crane Upgrades
- New Shore Power Substations
- Shore Power Usage Growth
- Growth of Containerized Refrigerated Cargo (Reefers)
- LED Lighting Upgrades
- Drayage Truck Charging Stations
- Electrification of Container Handling Equipment

The growth projections for electricity demand are predicated on complete electrification of the terminals including additional reefers, additional shore power plugs and increased usage of shore power as well as electrification of drayage trucks and CHE. Capacity of the electrical system is limited by peak power (measured in Mega-Watts) demands on the system, not overall energy consumption (measured in Mega-Watt-Hours). In other words, the capacity of the system is limited by its ability to deliver a peak load, which is determined by the characteristics of the equipment and the number of equipment that may be operating simultaneously, but not limited by the number of hours that the equipment is operating (which is tied to terminal growth).

The 115kV system can handle around 50 MW. Currently, the system peaks at 15 MW. The Study suggests the peak could grow to 100 MW if full electrification is implemented. Staff is exploring options to mitigate this growth to around 50-70 MW through energy efficiency, sustainability, and technology incorporation.

RECOMMENDATION

The Study concludes the Port may see demand for electricity at the Seaport grow from its current level to nearly 100 MW through full buildout of the electrification of the Seaport; assumed by 2038.

The Study therefore outlines a number of initiatives for infrastructure upgrades to address:

- Port substation age and capacity limitations (Davis and Cuthbertson)
- Port distribution line capacity limitations
- New substations and connection plugs for expanded shore-power
- Conversion of Seaport lighting to LED
- Substations, distribution and charging stations for CHE and drayage trucks

  PG&E distribution (transmission from substation C to Port substations) line capacity limitations

The Study presumed a very aggressive schedule for availability and deployment of electrical CHE and drayage trucks, which are not yet commercially available. Figure 1 shows the 2010-today actual demand (MW) use, and the estimated forecasted increase to 2038. This demand was projected to exponentially grow starting in 2021 to accommodate complete electrification of the Port including charging stations for drayage trucks and Container Handling Equipment (Figure 1). Also, the study assumed EV chargers that draw an extremely high capacity only would be used, and that the chargers would often be fully active all at once, thereby creating the extreme demand increase triggering large infrastructure improvement requirements. The Study estimates approximately $222M will have to be invested to electrify the Seaport. This includes approximately $58M in substation improvements, $127M in CHE electrification (including trucks), and $37M in additional shore power. However, the actual electrical usage in the Seaport is less than the forecast and the demand is driven by high peak loads, especially from cranes and shore power. Figure 2 illustrates this variable peak demand load in 2018. Although peak demand was nearly 18 MW in 2018 (Cuthbertson, Davis, and main 12kV substations), the usage reflects that average demand is closer to 10 MW. Staff are exploring an approach to meet these peak demands with technology, including batteries, optimized EV charging, Port grid connected solar, demand response, wireless charging, advanced time of use rates, and system controls to meet the peak without building major capacity upgrades.

The sequence of potential improvement and triggers for implementation that the Study suggests provides a general roadmap for potential infrastructure improvements to meet the future needs. However, the timing and cost for implementing the full suite of improvements is uncertain. Therefore, the infrastructure improvements program will initially

emphasize and prioritize projects that are triggered by the end of the life of the asset as well as capacity improvements that have the most immediate need. For example, the Davis and Cuthbertson substations are nearing the end of their service life and have limited capacity to grow to meet the future needs outlined in the Study. The replacement of these substations is therefore our top priority.

In addition to the 115kV electrical service, the Seaport is also fed by PG&E through two 12kV lines, from two different substations located in downtown Oakland, and near Jack London Square. The Study evaluated the PG&E transmission system and concluded that no upgrades will be needed for that system. However, the PG&E and the Port 12kV distribution systems warrant more investigation to identify the potential capacity of those systems to accommodate growth of electrification in the Seaport because optimizing the 12kV system will reduce the need to expand the 115kV system. Port staff are currently conducting a study to evaluate opportunities to utilize the 12kV systems to expand electrification.

Therefore, as a result of the Study and other ongoing evaluations of the Port's infrastructure, Port staff intend to:

1. Prioritize substation improvements to address their age and condition as well as expand capacity.
2. Develop on or near-site power generating capacity including roof top solar. This will need to include energy storage (e.g., batteries) to meet power needs after dark, which presents a unique set of challenges including but not limited to the need for land.
3. Evaluate the Port and the PG&E 12kV systems and identify underutilized capacity to dedicate to CHE and drayage truck charging.
4. Identify capacity improvements on the 12kV system if necessary.
5. Convert lighting in the Seaport to LED.
6. Implement a "smart charging" system to reduce capital costs.
7. Create a flexible EV rate to incentivize conversion.

Figure 1: Port Utility Peak Demand Increase

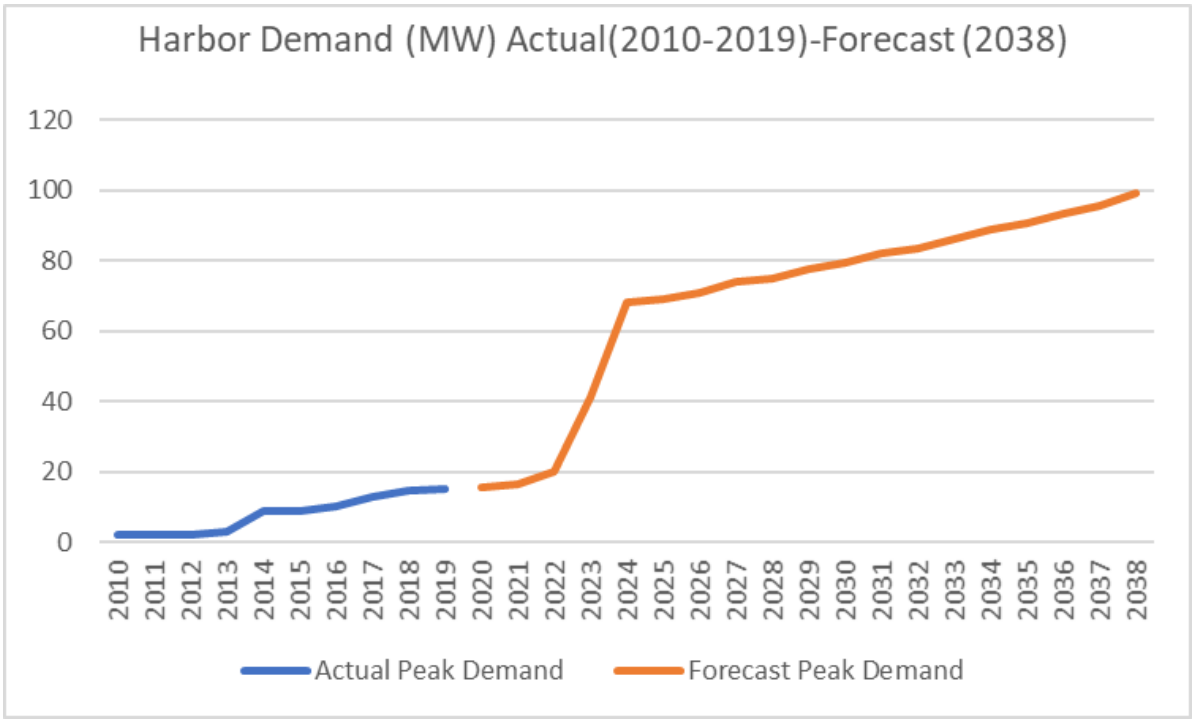

Figure 2: Entire Harbor Use (MW)