Centerm Expansion and South Shore Access Projects

Project Energy Study

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1 Executive Summary

PBX Engineering has conducted a Project Energy Study for the Port of Vancouver's Centerm facility operated by DPW Vancouver (DPWV) as part of the Centerm Expansion Project (CEP). The purpose of the study is to identify major electrical loads, potential power savings, and energy conservations measures to assist with determining equipment and operational practices for proposed works and activities. The energy study encompasses major existing electrical loads and major electrical loads planned to be added as a part of the expansion project. The energy study follows the Port of Vancouver Project and Environmental Review – Project Energy Study Guidelines.

Energy savings for the CEP may be implemented through the following two Energy Conservation Measures (ECMs):

- High Efficiency Terminal Lighting – energy savings through the installation of LED lighting in place of High Pressure Sodium (HPS) fixtures, specifically for the terminals outdoor highmast area lighting.
- High Efficiency Building Lighting – energy savings through the use of LED lighting and advanced lighting controls such as programmable dimming, daylight harvesting, and occupancy sensors for the terminal administration and operations buildings.

The anticipated annual energy savings associated with these ECMs is approximately 286kWh/year. A detailed analysis of the load estimates is contained within.

2 Background Information

Centerm Container Terminal (Centerm) is located on the south shore of the Port of Vancouver's inner harbour at 777 Centennial Road, Vancouver, BC. It is one of three primary container terminals in the Vancouver gateway and handles approximately one-fifth of the container goods shipped through Vancouver.

The proposed CEP is a series of on-terminal and off-terminal infrastructure improvements that will increase the number of containers that can be handled at the terminal by approximately two-thirds, from a current sustainable annual capacity of 750,000 TEUs to 1.3 Million TEUs. These improvements include an expansion of the terminal area, reconfiguration of the terminal, and upgrades of road and rail infrastructure.

Electric power is distributed to site infrastructure from the Container Main Substation (CMS) located on the south side of the terminal, just east of the Container Site Services Facility (CSSF). The CMS is fed from BC Hydro's (BCH) Murrin Substation, located at 721 Main Street via the following three 12.47kV feeders:

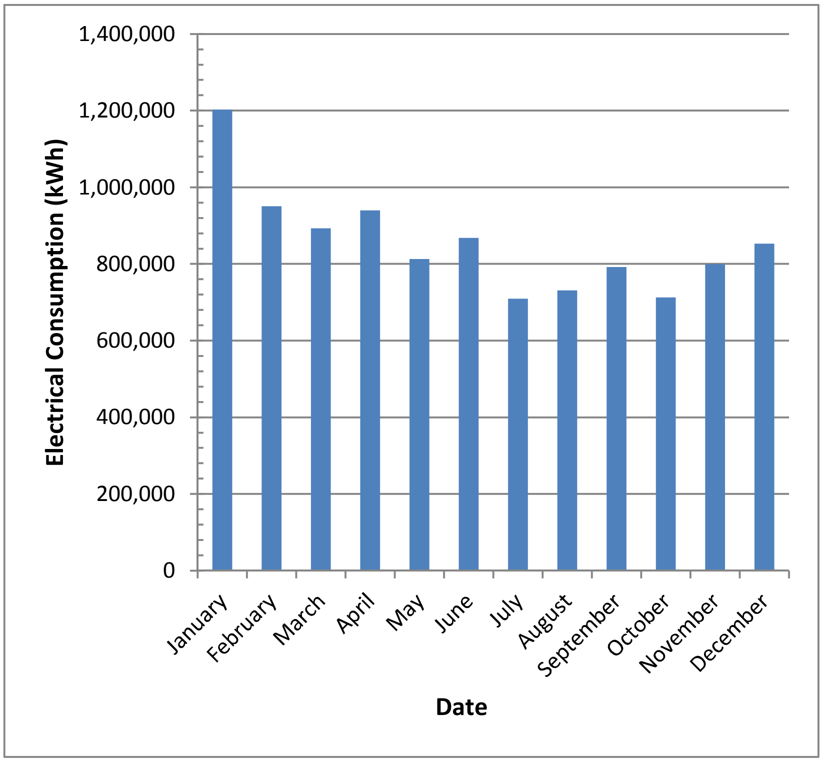
- **MUR 12F94** – this is a dedicated feeder (Centerm is the only connected customer) that currently provides power to the quay cranes.
- **MUR 12F80** (Primary) and **MUR 12F57Q UC-811** (Stand-by) – this is a dual radial shared feeder (there are multiple connected customers) that provides power to general site loads, such as yard lighting, refrigerated receptacles (reefer receptacles), and office and maintenance facilities.

3 Energy Supply

The 2015 electrical consumption data for Centerm is summarized *in Table 1 – Centerm Container Terminal 2015 Electrical Consumption*. The corresponding graph presented below highlights the months that saw an increase in energy consumption. This increase in energy consumption primarily occurs during the winter months, when reduced daylight hours require the highmast and general area lighting to be operated for longer periods of time and when cooler temperatures lead to increases in heating demand.

Table 1 – Centerm Container Terminal 2015 Electrical Consumption

Month	Electrical Consumption (kWh)
January	1,202,400
February	950,400
March	892,800
April	939,600
May	813,079
June	86,600
July	709,200
August	730,800
September	792,000
October	712,800
November	799,200
December	853,200
TOTAL	**10,263,079**



4 Description of Studied Systems

Major electrical loads at the Centerm facility include the following:

1. Terminal Lighting
2. Reefer Receptacles
3. Quay Cranes & Rail Mounted Gantries
4. Terminal Buildings

Terminal Lighting

Terminal lighting refers to the outdoor highmast light towers used to illuminate the facility during nighttime hours. A highmast light tower is a tall pole with lighting attached to the top pointing towards the ground to illuminate the area around the base of the pole. The pole that the lighting is mounted on is generally around 30-40m tall. Centerm standards dictate that operational areas must be illuminated with a lowest in-service maintained illumination of 50 lux at the pavement. There are currently 38 highmast light towers at the facility. After the expansion project, there will be approximately 60 highmast light towers. These additional towers are required to illuminate new terminal areas and parking lot areas.

A feasible ECM associated with the Terminal Lighting is ***"High Efficiency Terminal Lighting"***. That is, energy savings through the installation of LED lighting in place of High Pressure Sodium (HPS) fixtures.

It should be noted that DPWV is currently undertaking a major retrofit of the existing HPS fixtures on the highmast light towers to LED fixtures. These towers have been excluded from the study as no further savings can be identified. As a part of CEP, approximately 22 new highmast light towers will be added. These towers will form a part of the energy study.

Reefer Receptacles

A major source of energy consumption at the terminal is the refrigerated receptacles, or, 'reefer receptacles', that provide power to refrigerated containers used to transport perishable goods.

A total build-out of 630 reefer receptacles is proposed for the new terminal configuration. This is an increase of 84 plugs over the existing 546. Each receptacle draws a peak load of 10kW.

There is no opportunity for an ECM associated with the reefer receptacles. The reefer receptacles provide power to containers supplied by the users of the terminal. While energy conservation may be possible through better insulated containers or higher efficiency compressors, the containers used are industry standard and are beyond the control of the terminal operator and therefore are excluded from the energy study.

Quay Cranes & Rail Mounted Gantries

At Centerm, quay cranes are used to move cargo from ship to shore, while rail mounted gantry cranes (RMGs) are used to move cargo from shore to rail. After the terminal expansion, there will be a total of seven quay cranes and five RMGs. All RMGs will be 40LT units. Currently, not all quay cranes are 65LT rated, however, as they are replaced they will be upgraded to 65LT units. The forecasted peak electrical demand for each crane was obtained from manufacturer data and is as follows:

- Each 40LT RMG unit has an approximate peak load of 680kW.
- Each 65LT quay crane has an approximate peak load of 2,057kW.

RMGs and quay cranes are highly specialized equipment. Industry standards govern their energy usage and all new cranes include energy conservation measures such as four quadrant motors that allow energy to be regenerated back into the terminal distribution system while a load is being lowered. There is no opportunity to obtain a quay crane or RMG that is significantly less energy efficient than another. For this reason, the quay cranes and RMGs have been excluded from the energy study.

Terminal Buildings

The terminal operates a number of operational and administrative buildings across the terminal. The majority of these buildings will be consolidated into a new building as a part of CEP, the Container Operations Facility. Buildings to be consolidated in this new building include the Container Main Office, Container Foreman Facility, Container Berth Lunchroom, Container Yard Lunchroom, and Container Centennial Guardhouse. Apart from the main Container Operations Facility, a new Container Maintenance Warehouse will be constructed as a part of CEP.

Energy savings through the use of LED lighting and advanced lighting controls such as programmable dimming, daylight harvesting, and occupancy sensors can be achieved. This ECM is referred to as ***"High Efficiency Building Lighting"*** and is included in the energy study.

Based on ANSI/ASHRAE/IES Standard 90.1 (2010), high efficiency building design can attain an average of 10% energy savings. This is a preliminary approximation and realized reductions may change based on alterations to space planning, alternative control methods, and changing technologies.

Mechanical equipment, HVAC, pumps, and plug loads, computers, monitors, etc. are excluded from the study. It is assumed that mechanical equipment will be provided to meet the minimum energy efficiency requirements per ANSI/ASHRAE and applicable building codes. Plug loads are based on the function of the space. For the purpose of these calculations it is assumed the power consumption for these plug loads will be required for operators of the terminal.

5 Baseline Electrical Consumption

The following describes and summarizes the baseline conditions per ECM – that is, the approximate energy demand and annual consumption for the identified ECMs if conservation measures were not pursued. This is the base case from which the ECMs will be compared to determine the magnitude of potential energy savings.

Terminal Lighting

The **High Efficiency Terminal Lighting** ECM baseline will consider all new highmast light towers built-out with standard HPS light fixtures, similar to the existing highmast light towers that are currently being converted to LED fixtures. As a part of CEP, approximately 22 new highmast light towers will be added to the facility. On average, when using HPS fixtures, the power requirement for each highmast light tower is 12kW. Based on the National Research Council of Canada (NRCC) yearly data average for Vancouver, there are 10.15 hours a day when the highmast light towers should be operational.

Terminal Lighting Baseline

Electrical Demand: 22 highmast light towers x 12kW = 264kW

Annual Electrical Consumption: 264kW x 10.25 hr/day x 365 days = 987,000kWh/year

Terminal Buildings

The High Efficiency Building Lighting ECM baseline is derived from ANSI/ASREAH/IES Standard 90.1 (2010) for industrial buildings. The terminal buildings will be operated and staffed for the majority of a 24 hour period and will contain equipment and operations that are safety critical. Based on the square footage from the preliminary design and using Standard 90.1 for standard industrial buildings, the lighting power consumption for the baseline case is as follows.

Terminal Building Baseline

Electrical Demand: $4150m^2$ x $10.8W/m^2$ = 44.8kW

Annual Electrical Consumption: 44.8kW x 24 hr/day x 365 days = 392,000kWh/year

6 ECM Calculations

The following provides the approximate energy demand and annual consumption for each identified ECM, and compares this demand to the base case to determine the magnitude of the potential energy savings if the ECMs are pursued.

Terminal Lighting

Upgrading from HPS to LED fixtures lowers the average power requirement of each highmast light tower from 12kW to 9kW. Electrical demand and annual electrical consumption for the High Efficiency Terminal Lighting ECM is presented below.

High Efficiency Terminal Lighting

Electrical Demand: 22 highmast light towers x 9kW = 198kW

Annual Electrical Consumption: 198kW x 10.25 hr/day x 365 days = 740,000kWh/year

Terminal Buildings

Based on ANSI/ASHRAE/IES Standard 90.1 (2010), high efficiency building design can attain an average of 10% energy savings. This equates to 9.7W/m2 for industrial buildings. Electrical demand and annual electrical consumption for the High Efficiency Building Lighting ECM is presented below.

High Efficiency Building Lighting

Electrical Demand: 4150m^2 x 9.7W/m2 = 40.3kW

Annual Electrical Consumption: 44.3kW x 24 hr/day x 365 days = 353,000kWh/year

The ECMs and the anticipated electrical demand reduction and annual energy savings are summarized in *Table 2 – ECM Summary* below. All savings identified potentially qualify for BC Hydro incentives.

Table 2 – ECM Summary

ECM No.	ECM Description	Demand Reduction (kW)	Annual Energy Savings (kWh)
1	High Efficiency Terminal Lighting	66.0	247,000
2	High Efficiency Building Lighting	4.5	39,000
TOTAL		**70.5**	**286,000**

7 Implementation

The ECMs identified within this energy study can be successfully implemented into the CEP with some considerations. DPWV is currently converting all existing highmast light tower fixtures from HPS to LED. Any new highmast light towers must follow this convention, as it is now the site standard. Proposed highmast light towers for the CEP will be consistent with the terminals direction on LED lighting; this will ensure that common products are used and allowing for easy maintenance and replacement by the terminal operator. Best management practises developed by organizations such as the International Dark Sky Association to eliminate light pollution will be taken into account during the development of design requirements to minimize or eliminate lighting effects on neighbours and wildlife. These standards will dictate that LED lighting be used as HPS will not achieve the requirements. The proposed terminal building energy conservation measures can be obtained with the adoption of an independent, third-party verification such as LEED certification or another relevant Energy Rating Systems. Requirements for these certifications can be built-in to the project design specifications and requirements to ensure that they are captured in the system design and constructed as a part of CEP.

Concordance between the Port of Vancouver *Project & Environmental Review – Guidelines – Project Energy Study, May 2016* and the *Centerm Expansion and South Shore Access Projects – Project Energy Study.*

Project & Environmental Review – Guidelines – Project Energy Study	**Centerm Expansion and South Shore Access Projects – Project Energy Study**
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