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Consulting Engineers

Petersburg Municipal Light and Power
Load and Generation Study

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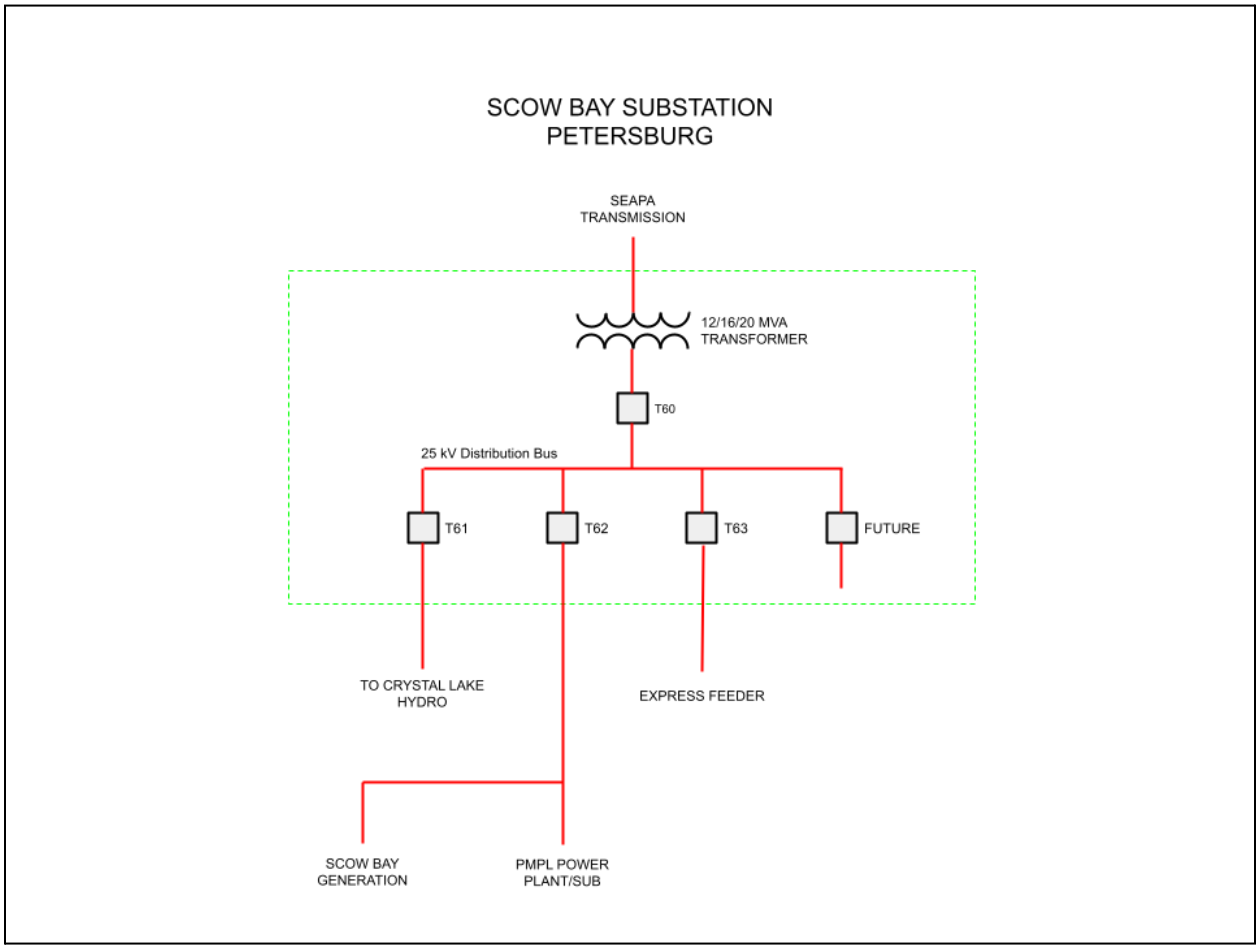
Introduction and Background

Petersburg Municipal Power and Light (PMPL) receives a majority of its electrical energy from the SEAPA hydroelectric system. SEAPA is interconnected to the PMPL grid at the Scow Bay Substation via a 12/16/20 MVA 69kV to 24.9kV transformer. It enters the substation via the main breaker T60. The PMPL loads are fed via the feeder breakers T61, T62 and T63. See below simplified Scow Bay Substation one-line.



Analysis

The purpose of this analysis is to identify the backup generation needs for PMPL. This includes identifying the existing generation capabilities, system loads and energy received from SEAPA.

For this study, EPS will include two generation scenarios:

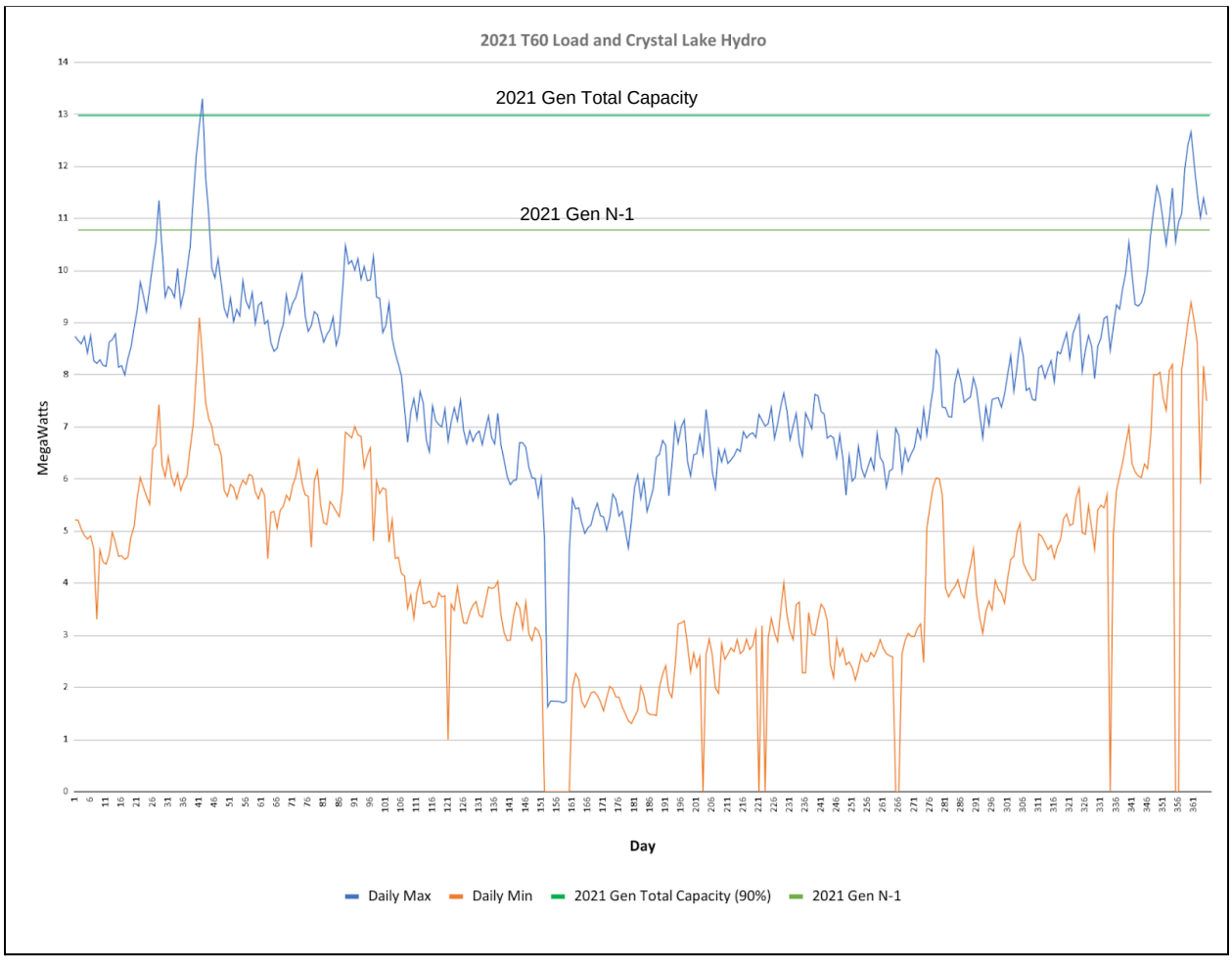
- All generators available loaded to 90% capacity. (90% capacity was used for all scenarios to allow for some spinning reserve in the system to account for cyclical loads.)
- "N minus 1" (N-1) - All generators minus the largest unit. The N-1 scenario is used to evaluate risk of a generator being out of service during a SEAPA outage. The exposure to this scenario will be higher during extended SEAPA outages that require generator maintenance during all diesel operations.

Petersburg's existing generation capabilities have been identified in the table below:

EXISTING GENERATION			
UNIT	**KW RATING**	**90%**	**N-1**
EMD 20-1	2500	2250	2250
EMD 20-2	2500	2250	0
EMD 16	2100	1890	1890
CAT 399	900	810	810
CAT 398	600	540	540
MTU (Scow Bay)	2500	2250	2250
MTU 350 Station Service	350	315	315
Superior	1250	1125	1125
Hydro (Crystal Lake)	1755	1755	1755
Total (kW)	**14455**	**13185**	**10935**

Table 1 - Existing Generation Capacity

The chart below represents the 2021 T60 daily maximum and minimum loads. Included on the chart is the existing PMPL generation for both all generators and N-1 scenarios.



2021 Daily Max/Min Load - The above chart plots the daily maximum and minimum loads recorded. The values are based on the energy from SEAPA plus the energy produced at Crystal Lake. Note that between days 151 and 161 there was a planned outage such that the only energy graphed is that of Crystal Lake. The chart includes the 2021 total generator capacity at 90% along with the 2021 N-1 total generation scenario. The daily maximum load exceeds the N-1 scenario for several days in December, January and February. The daily maximum load exceeds the 2021 total generation capacity in early February.

PMPL has experienced aggressive electrical growth recently and anticipates that growth to continue. For the purpose of this study, EPS used a 3% annual growth through 2032.

Projecting future PMPL diesel generation, EPS assumes the Caterpillar 398 (600 kW rated) will be retired in the near future, therefore, available generation projections did not include the 540 kW provided by this unit. The Superior (1250kw rated, 1125kw at 90%) was included in all generation totals.

With a peak load of 13.3 MW in 2021, the system load has exceeded total existing generation capacity with all units available at 90% rated. In the N-1 scenario, the load exceeds the total available backup generation for several days out of the year.

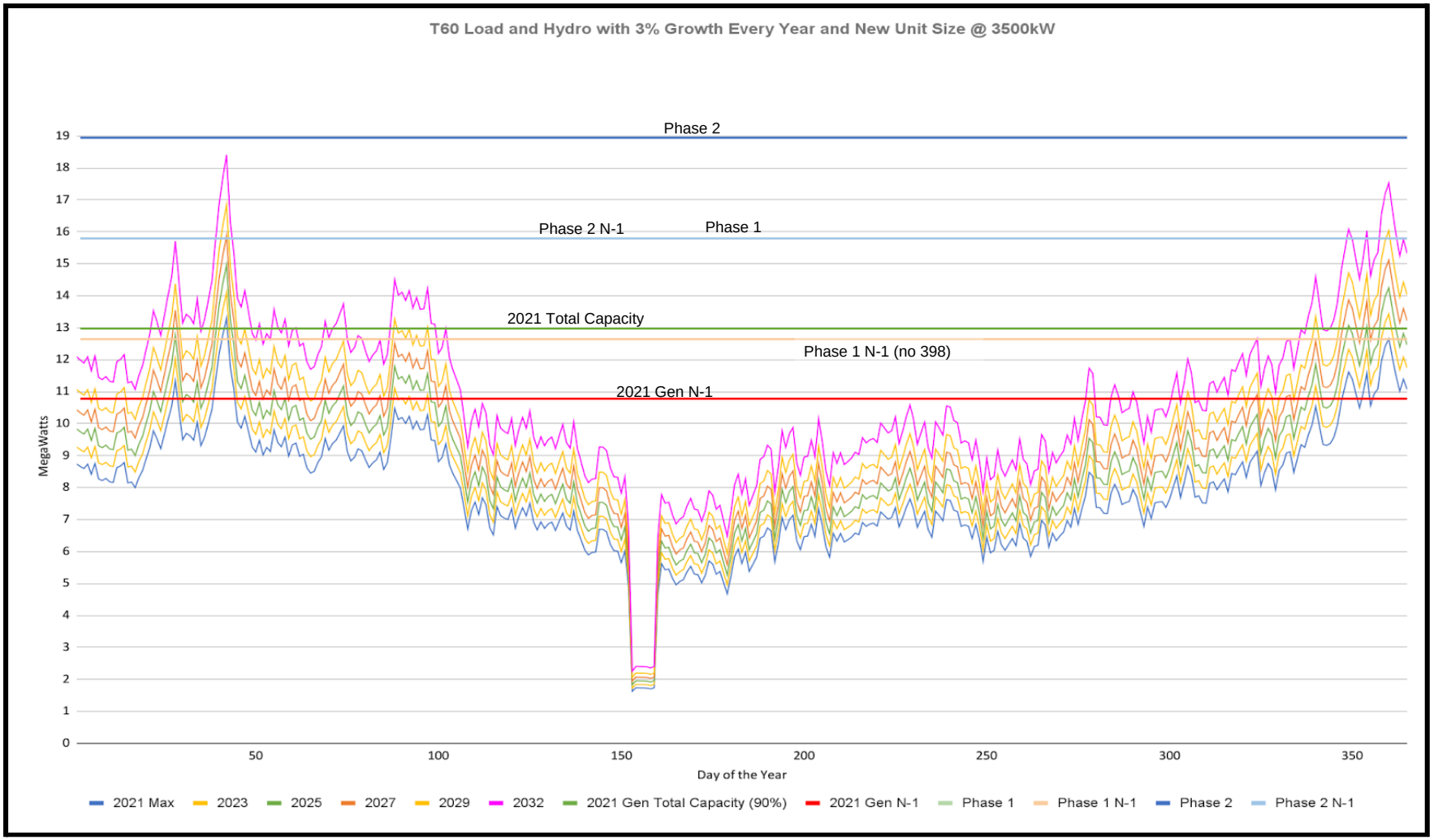
EPS looked at typical unit sizes for future expansion. Typical unit sizes range from 1000 kW to 4000 kW with several iterations in between. PMPL has existing EMD and MTU units. For the sake of consistency in spare parts and engine familiarity, EPS used typical sizes from these suppliers. Analyzing the data and load projections, EPS inserted different units into the load projection and found that using two 3500 kW units would meet the needs for load growth of 3% over the next 10 years. The following table and charts are a reflection of using two 3500 kW installed in a phased approach, phase-1 and phase-2.

A 3500 kW rated unit was used to illustrate the need for future backup generation expansion over the next 10 years. The two charts below show growth for select years between 2021 and 2032. The charts include the addition of two new 3500 generators installed in phases, with one new generator installed at each phase. The total generation for each of the phases, including the N-1 for each, is summarized in the table below.

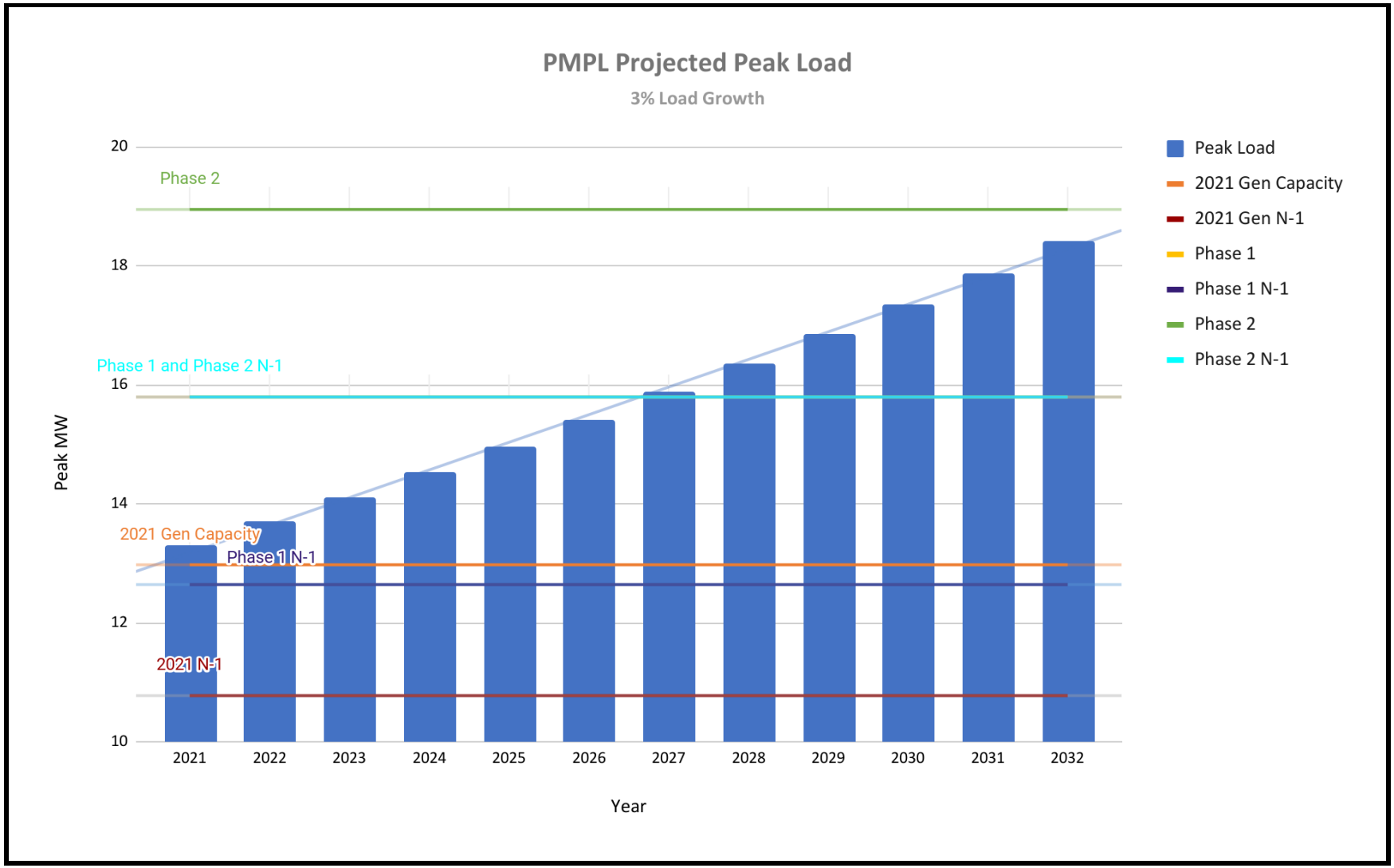
BACKUP GENERATION							
		EXISTING		PHASE-1		PHASE-2	
UNIT	KW RATING	90%	N-1	90%	N-1	90%	N-1
EMD 20-1	2500	2250	2250	2250	2250	2250	2250
EMD 20-2	2500	2250	0	2250	2250	2250	2250
EMD 16	2100	1890	1890	1890	1890	1890	1890
CAT 399	900	810	810	810	810	810	810
CAT 398	600	540	540	0	0	0	0
MTU (Scow Bay)	2500	2250	2250	2250	2250	2250	2250
MTU 350 Station Service	350	315	315	315	315	315	315
Superior	1250	1125	1125	1125	1125	1125	1125
Hydro (Crystal Lake)	1755	1755	1755	1755	1755	1755	1755
Phase 1 Gen (New)	3500			3150	0	3150	3150
Phase 2 Gen (New)	3500					3150	0
Total		**13185**	**10935**	**15795**	**12645**	**18945**	**15795**

* Note Phase-1 and Phase-2 N-1 total generation values are equal.

Table 2 - Backup Generation Scenarios with Additional Diesel



Projected Load 3% Annual Growth - Annual load growth set at 3% with 2021, Phase 1 and Phase 2 generation scenarios (see Table 2). The load growth will exceed the Phase 1 and Phase 2 N-1 generation capacity in 2027.



Annual Peak Load with 3% Load Growth- The chart highlights the lack of generation during peak loading.

Using 3% growth results in a peak of 15.8 MW in 2027, exceeding the total generation available with the addition of one 3500 kW unit (phase I). The peak will be 18.4 MW in 2032. That is within 500 kW of all generation after adding two 3.5 MW generators.

Based on the 2021 load and 3% projected load growth, EPS recommends installing a unit in the range of 2.5 WM to 3.5 MW as Phase I of the generation expansion as soon as possible. If a unit in the lower end of the range (2.5 MW) is chosen for Phase I it will accelerate the need for Phase II to be implemented. For example, adding a 2.5 MW unit in Phase I would see the all generation scenario exceeded by load in 2025 with 3% load growth. The design of Phase I should include provisions for a second unit to be installed in the future. EPS recommends planning for a 3.5 MW unit in Phase II, although that size should be re-evaluated based on actual load growth leading up to the implementation of Phase II.

The PMPL property adjacent to the Scow Bay substation has been identified as the preferred location for future generation. PMPL installed a containerized diesel generator in this location in 2010. This unit is a self-contained MTU rated at 2500 kW. It is connected to the T62 distribution system via a 4.16kV to 24.9kV transformer. Space has been allocated at this site for expansion of the generation capabilities and is well suited for the addition of multiple units. The new generation can be installed in a new powerhouse building or as standalone units in arctic enclosures, similar to the existing MTU.

EPS reached out to two manufactures for the purpose of this study; MTU and EMD. PMPL has units from both suppliers in their fleet of generators. Both can supply appropriately sized units either as a stand alone unit to be installed in a building or a unit integrated into an enclosure.

The EMD supplier, MSI, has indicated they have surplus 3500 kW units available at a discounted price. Estimated cost for one of the surplus units is $1.65 million. The units are supplied with 11 kV generators which would need to be changed to 4.16 kV generators to match the PMPL system. The surplus unit will require other minor modifications to meet air permitting requirements along with a new remote radiator. The unit does not include an enclosure. An estimated cost for an arctic enclosure for this unit is $400,000.

A 3MW EMD package with enclosure was recently delivered to another Alaskan utility for $4.1 million, not installed. Lead time on a new unit is approximately 20 months.

MTU offers new units in the size range required. The budgetary cost of a MTU 3250 kW unit in an enclosure is $2,106,001. Delivery time for this unit is estimated to be 60-65 weeks.

Based on the needs of PMPL and the availability of the surplus EMD, EPS recommends PMPL pursue purchase of one of the surplus EMDs with modifications to the unit for air emissions, 4160 volt alternator and an integrated drop over enclosure.

If Petersburg would like to pursue the option of building a plant that could accommodate two units at Scow Bay, EPS estimates the building cost to be $1,800,000 based on previous projects recently completed by EPS. This estimate is for the site development, foundations for building, building package and installation of the building. It would not include the electrical or mechanical requirements for installation of the units. A building will provide the advantages of a second bay for the phase II unit and ease of maintenance with room for spare parts. PMPL staff have indicated the drop over enclosure on the existing unit has been adequate for the application and therefore EPS recommends pursuing units with drop over enclosures and not a building.

Below is a rough order of magnitude (ROM) cost estimate for engineering, materials and installation of a single EMD unit at Scow Bay. This estimate is based on prior EPS experience and budgetary numbers from EMD. The overall cost is variable and would be refined upon performing a 35% design and based on negotiations with MSI on purchase of the surplus units.

PMPL Scow Bay ROM Estimate Single Generator	
Surplus EMD	$ 1,650,000
Drop Over Enclosure	$ 400,000
Unit Subtotal	**$ 2,050,000**
Engineering and PM Oversight	$ 200,000
Shipping	$ 200,000
Electrical Infrastructure	$ 600,000
Mechanical/Fuel System	$ 750,000
Site Prep	$ 250,000
Installation	$ 350,000
Controls and Commissioning	$ 200,000
Subtotal	**$ 2,550,000**
Total	**$ 4,600,000**