Power Engineers Collaborative, L.L.C.

Harbor Island Redevelopment

PROGRAM STATEMENT

MEET OUR TEAM

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PROGRESSIVE AE

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VICE PRESIDENT

POWER ENGINEERS COLLABORATIVE, L.L.C

TODAY'S AGENDA

1. Project Introduction
2. Planning Principles
3. Systems Operation and Technology Center
4. Power Generation Concept
5. Site Concepts

PROJECT INTRODUCTION

GOAL

Redefine the use of Harbor Island accommodating GHBLP and community priorities

STATUS

Preliminary concepts identified, 50% report out to board

NEXT STEPS

Costs budgets and designs

COMPLETION

August 2020

PLANNING PRINCIPLES

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PLANNING PRINCIPLES

Highest and Best Use

- Make a long-term investment in GHBLP and community
- Secure land for advanced energy options
- Effectively manages the complexity of historical past uses of site
- Offers the community recreational and utility opportunities that benefit both current and future generations

PLANNING PRINCIPLES

Operational Excellence

- Build and implement a mindset of proactive scenario planning, anticipation, and resolution by interaction with data and knowledge on demand in this new technology driven utility

- Cross-disciplinary growth and development encouraging resiliency in operations and career satisfaction

PLANNING PRINCIPLES

Talent Attraction & Succession Planning

- Shifting from task-oriented to mission-oriented empowerment
- Nimble and progressive operators with defined pathways to development & growth
- Adaptable and responsive to emerging technologies

PLANNING PRINCIPLES

Community Presence

- Enhance the opportunity to develop a new community experience in a familiar place
- Make the work of the utility visibly accessible to and within this community asset, Harbor Island
- This operations center is embedded within the community's culture, flow, and life

PLANNING PRINCIPLES

Integrated Generation

- Power generation will be integrated within this project development in a way that benefits current and future energy services to end users
- Snowmelt systems will be integrated within this project development in a way that benefits current and future snowmelt customers and community
- Diversified power supply portfolio will offer benefits of greater reliability and long-term sustainable rate structures

SYSTEMS OPERATION & TECHNOLOGY CENTER

SYSTEMS OPERATION & TECHNOLOGY CENTER

FORMER SIMS SITE

- Home of “What’s Next?” for GHBLP and community collaboration
- New GHBLP facilities use half of the site, rest of land is available for community use
- Substation serving downtown and other critical infrastructure will remain
- Enable new energy technologies (renewables, distributed generation, energy storage)
- Balance of the site can be re-developed for public use

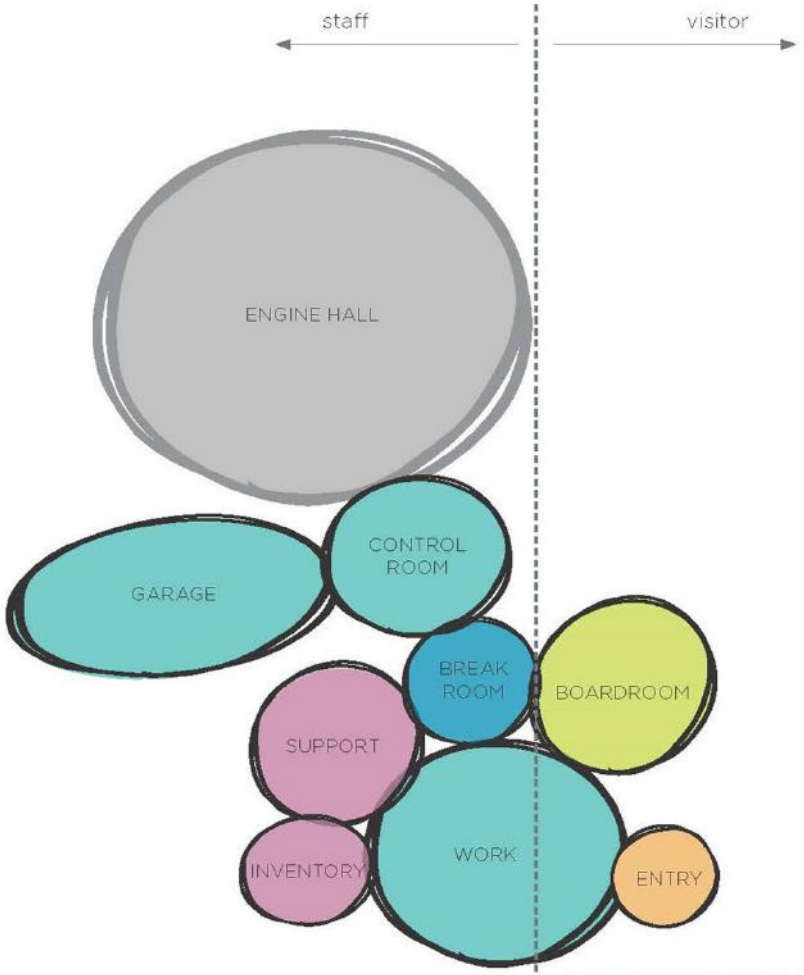
SYSTEM OPERATIONS AND TECHNOLOGY CENTER

- New facility for utility operations
- Planning
- System control
- Outage management
- Data infrastructure and records
- Training
- Plant supervision
- Snowmelt

POWER GENERATION

- 12 MegaWatt combined heat and power
- 5 Engine/generators
- Maximizes use of existing gas supply
- Connected for downtown distribution
- Conservatively justified on capacity
- Snowmelt heat and kW-Hr are bonus

SYSTEMS OPERATION & TECHNOLOGY CENTER



ADJACENCY DIAGRAM

Adjacency Diagrams use scaled bubbles to illustra scale and relationships between spaces. Spaces th are touching have a critical relationship. The diagr does not indicate a floor plan.

		PEOPLE	SQ. FT. PER PERSON / SPACE	SPACE QUANTITY	AREA - NET SQUARE FEET	COMMENTS
ARRIVE 320 SF	ENTRY					
	Vestibule	-	-	1	100	
	Lobby / Reception	1	220	1	220	plan for a person here, or at a minimum have someone available to greet/service (could
ENGAGE 1,575 SF	MEET					
	Board Room / Large Conference	70	20	1	1,400	capacity for [70] ppl for monthly board meetings
	Small Conference	6-8	25	-	175	near board room, screenings, training, on-boarding, vendors
WORK 2,770 SF	WORK					
	Offices	4	140	4	560	additional offices for growth
	Open Office	6	75	10	750	additional hoteling (GM, HR)
	SUPPORT					
	Control Room	2	200	1	400	secured area; 24/7 operation
	Meter Room	4	200	1	800	[4] work stations within, counter/bench for eqpt. testing
	Records Room	-	125	1	125	
	Server	-	135	1	135	
AMENITIES 7,600 SF	RELAX					
	Break Room	20	25	1	500	adjacency to board room for meetings; adjacent to control room for accessibility
	Kitchenette	-	100	1	100	
	Bike Storage	-	100	1	100	
	Wellness / Mothers Room	1	100	1	100	
	Office Patio	-	1,400	-	1,400	
	Roof Deck	-	3,000	-	3,000	
	Garage	-	2,400	-	2,400	[4] at-grade overhead doors, radiant slab heat, connection to meter room
SUPPORT 1,840 SF	SUPPORT					
	Toilet / Locker Room	-	180	2	360	possible unisex?
	Shower Room	-	100	2	200	possible unisex?
	Janitor's Closet	-	50	1	50	
	Chair / Table Storage	-	200	1	200	support functions of board room
	Inventory Storage	-	500	1	500	climate controlled
	Common Print Area / Plotter / Storage	-	100	1	100	
	Elevator	-	50	1	50	sqaure footage dependant on system; may need to increase
	Egress Stairs	-	200	2	400	

Functional Program Area	14,105 Net Square Feet
Circulation/Construction Factor	25% of functional program area
Overall Building Program	**17,630 Gross Square Feet**
Parking	10 automobile spaces

POWER GENERATION CONCEPT

AGENDA

1. Introduction
2. Prime Mover Review
3. Economic Evaluation
4. Conclusions
5. Recommended Facility Conceptual Design
6. Path Forward

INTRODUCTION TO PEC

- Engineering firm specializing in combined heat and power (CHP), power and distributed generation both fueled and renewable.
- Owned by Juhl Energy Inc.
- Offices in Chicago, IL. and Brookfield, WI.
- Typical Clients: Utilities, Municipalities, Industrial Facilities, Campus Central Plants.
- Recent Michigan Experience
  - Ford – DTE Energy Dearborn CHP
  - Sebewaing Light & Water CHP
  - Wolverine Alpine / Hersey CC

INTRODUCTION – TECHNOLOGY STUDY

Background

- Total cost to redevelop the J.B. Sims Generating Station site with 36MW of power generation and community enhancements is too costly. (2019 PDR Conclusion)
- Primary fatal flaws identified in the PDR are related to the high cost of gas supply upgrades and overall construction complexities related to the 9MW engines selected as prime movers for the proposed project.
- PDR recommendation to focus on critical path steps – Sims decommissioning, site remediation, temporary snowmelt. (Underway)
- Evaluate other power generation designs that may be a better fit for Harbor Island redevelopment. (Technology Study)
- PEC reviewed the PDR in detail and agrees with Burns & McDonnell's conclusions.

Technology Study Scope

- Focus on scaled generating assets capable of being supported by existing gas infrastructure available – i.e. 'Distribution Energy Resource'.
- Evaluate proper technology for pairing with City of Grand Haven snowmelt system.
- Reduce overall scale to a manageable capital cost level that makes economic sense for GHBLP.

PRIME MOVER REVIEW

- RICE Gensets [2.5MW – 4.0MW]
- Heat Rejection ~ 4 mmbtu/hr
- High Efficiency / Continuous Duty
- Low Gas Supply Pressure Required
- 100 mcfh Gas Supply Available
- Local Maintenance Support
- OEMs:
  - Caterpillar
  - Jenbacher
  - MTU-Rolls Royce

PRIME MOVER EVALUATION TABLE

	Unit	CAT G3520H	CAT CG260	MTU 20V4000	JENBACHER J620
SITE DESIGN DATA					
Ambient Temp	°F	59	59	59	59
Relative Humidity	%	60	60	60	60
Site Elevation	ft	587	587	587	587
GENSET DATA					
Genset Power Output - EA	kW	2491	4000	2454	3329
Fuel Consumption (LHV) - OEM, ISO 3046	Btu/ekW-hr	7672	7792	8083	7693
Fuel Consumption (LHV) - OEM, ISO 3046	MBtu/hr	19.11	31.17	19.83	25.61
Efficiency (LHV) - OEM, ISO 3046	%	44.5%	43.8%	42.2%	44.4%
Fuel Flow (LHV) - OEM, ISO 3046	cfm	352	574	367	472
Fuel Consumption (HHV), OEM, ISO 3046	MBtu/hr	21.88	35.68	22.83	29.32
Fuel Cost	$/Mbtu	$4.59	$4.59	$4.59	$4.59
Heat Rec. - Jacket + Oil Cooler + 1 AC	Mbtu/hr	3.92	7.08	5.01	5.29
Heat Rec. - 2 AC	Mbtu/hr	1.02	1.21	0.53	0.71
Heat Rec. - Exhaust	Mbtu/hr	3.36	7.34	4.34	4.44
Heat Rec Potential - Total	Mbtu/hr	8.30	15.63	9.88	10.44
CONFIGURATION A: EXISTING AVAILABLE GAS - HARBOR ISLAND: NOMINAL 10MW FACILITY					
	Unit	G3520H	CAT CG260	MTU 20V4000	JENBACHER J620
CONFIGURATION DESIGN INPUT					
Fuel Quantity Available	mcfh	100	100	100	100
Fuel Quantity Available	Mbtu/hr	103.6	103.6	103.6	103.6
Fuel Heating Value (HHV)	Btu/cf	1036	1036	1036	1036
Fuel Quantity Available (HHV)	cfm	1667	1667	1667	1667
Fuel Pressure Available	psig	75	75	75	75
CONFIGURATION					
Quantity of Units based on Available Fuel - Coincident Operation @ 100% Load	No.	4	2	4	3
Facility Power Generating Capacity - Gross	kW	9964	8000	9816	9987
Aux Load Allowance @ 1.5%	kW	149	120	147	150
Facility Power Generating Capacity - Net	kW	9815	7880	9669	9837
Potential Additional Generation Capability - Additional Unit / Max Fuel Avail.	kW	1649	3253	1187	1599

PRIME MOVER EVALUATION TABLE

FACILITY COST					
Total Facility Installed Cost PRELIM	$	$13,202,300	$11,400,000	$13,006,200	$13,232,775
Total Facility Installed Cost PRELIM	$/kW	$1,325	$1,425	$1,325	$1,325
GHBLP ELECTRICITY COST COMPARISON					
Capacity Charge - Long Term	$/kW-mo	$6.00	$6.00	$6.00	$6.00
Generating Facility Capacity	kW	9,815	7,880	9,669	9,837
Capacity Charge for Generating Facility Net Output - Annual	$	$706,647	$567,360	$696,151	$708,278
Winter Snow Melt Mode					
Winter Generation Snowmelt Operating Hours - Single Engine Operation	Hrs	2,800	2,800	2,800	2,800
Winter Generation - Snowmelt Coupled	kWh	6,870,178	11,032,000	6,768,132	9,181,382
Purchased Energy Charge	$/MWh	$30	$30	$30	$30
Purchased Energy Charge	$/kWh	$0.030	$0.030	$0.030	$0.030
Equivalent Purchased Energy Charge	$	$206,105	$330,960	$203,044	$275,441
Total Equivalent Purchased Energy + Interpolated Capacity Charge	$	$770,778	$897,672	$759,329	$841,417
Peak Shaving Mode					
Peak Shaving Generation Facility Operating Hours	Hrs	176	2	176	235
Peak Shaving Generation Facility Electrical Output	kW	9,815	7,880	9,669	9,837
Peak Shaving Generation	kWh	1,727,359	12,608	1,701,702	2,308,462
Purchased Energy Charge	$/MWh	$50	$50	$50	$50
Purchased Energy Charge	$/kWh	$0.050	$0.050	$0.050	$0.050
Equivalent Purchased Energy Charge	$	$86,368	$630	$85,085	$115,423
Total Equivalent Purchased Energy + Interpolated Capacity Charge	$	$228,343	$1,278	$224,951	$257,726
Generating Facility vs. Market Purchased Electric Comparison					
Total Generation Facility Annual Equivalet Engine Operating Hours	Hrs	3,504	2,803	3,504	3,504
Total Generation Facility Annual Equivalent Generation	kWh	8,597,537	11,044,608	8,469,834	11,489,844
Capacity Charge for Generating Facility Net Output - Annual	$	$706,647	$567,360	$696,151	$708,278
Energy Charge for Generating Facility Net Output - Annual	$	$292,473	$331,590	$288,129	$390,865
Total Projected Purchased Annual Electrical Cost	$	$999,120	$898,950	$984,280	$1,099,143
Total Projected Purchased Annual Electrical Rate	$/kWh	$0.116	$0.081	$0.116	$0.096
Generating Facility Annual Fuel + Genset O&M Cost	$	$350,540	$527,823	$435,980	$516,477
Staffing & General O&M Annual Allowance	$	$0	$0	$0	$0
Generating Facility Annual Equivalent Electric Rate	$/kWh	$0.041	$0.048	$0.051	$0.045
Potential Year 1 Pre-Capital Recovery Annual Savings	$	$648,580	$371,128	$548,300	$582,665

PRIME MOVER EVALUATION DISCUSSION

Nominal Recommended RICE Unit Size

- 2.5MW is a standard high efficiency building block RICE size competitive in terms of capital and operating cost.
- Pairs well w/ City of Grand Haven snowmelt system.
- Recovered heat from Jacket + OC + AC only to meet anticipated demand. Exhaust heat recovery not economical or required, but could be added in the future.
- Operate (1) Genset during the winter to support snowmelt eliminating the need to run a condensing boiler for idle mode.

(4) Units vs (5) Units

- Incremental gas availability on the island confirmed up to 110 mcfh with Mich. Gas.
- Supports (5) – 2.5MW nominal Gensets and ~12MW of capacity.
- Additional incremental capacity reducing $/kW installed cost and maximizing use of available gas makes economic sense depending on value of electrical capacity.

Technology Study Genset Conceptual Basis of Design

- Caterpillar G3520H selected.
- Future detailed evaluation of 2.5MW Gensets recommended.

ECONOMIC EVALUATION

Purpose

- Economic feasibility for the generating facility was evaluated for the 4-unit and 5-unit options using the recommended 2.5MW Gensets.
- Screening is intended to compare purchased capacity at varying costs along with energy at a set rate to the self-generation option.

Basis and Methodology:

- 4% cost of capital, 30 year term.
- Year 1 capacity at intervals of $5/kW-mo to $8/kW-mo.
- Year 1 natural gas cost at $4.59/mmBtu.
- Energy at $30/MWh in Winter and $50/MWh for Summer Peak.
- Genset O&M @ $20/Op-hr.
- Escalation at 2% for capacity charge, energy charge, fuel cost and Genset O&M.
- Capex $1325/kW for 4-unit option, $1300/kW for 5-unit option, which includes 15% contingency.

ECONOMIC EVALUATION

Present Value Expense Analysis – 2% Escalation

- Present value of the power purchase option was compared to that of the installed capacity option over a 30-year evaluation period considering a 30-year debt term.
- The 4-Unit facility would be considered economically beneficial at a year 1 capacity charge of $5.46/kW-mo or higher.
- The 5-Unit facility would be considered economically beneficial at a year 1 capacity charge of $5.16/kW-mo or higher.

(4) G3520H Gensets			
Year 1	PV of Total Evaluation Period Expenditures		Delta
Capacity Charge	Power Purchase Option	Installed Capacity Option	(Savings)
$5.00/kW-mo	$19,457,000	$20,648,000	-$1,191,000
$5.46/kW-mo	$20,653,000	$20,648,000	$5,000
$6.00/kW-mo	$22,057,000	$20,648,000	$1,409,000

(5) G3520H Gensets			
	PV of Expenditures		Delta
Capacity Charge	Power Purchase Option	Self-Generation Option	(Savings)
$5.00/kW-mo	$25,079,000	$25,579,000	-$500,000
$5.16/kW-mo	$25,599,000	$25,579,000	$20,000
$6.00/kW-mo	$28,329,000	$25,579,000	$2,750,000

ECONOMIC EVALUATION

Present Value Expense Analysis – 3% Escalation

- Present value of the power purchase option was compared to that of the installed capacity option over a 30-year evaluation period considering a 30-year debt term.
- The 4-Unit facility would be considered economically beneficial at a year 1 capacity charge of $4.84/kW-mo or higher.
- The 5-Unit facility would be considered economically beneficial at a year 1 capacity charge of $4.55/kW-mo or higher.

(4) G3520H Gensets			
Year 1	PV of Total Evaluation Period Expenditures		Delta
Capacity Charge	Power Purchase Option	Installed Capacity Option	(Savings)
$4.84/kW-mo	$21,703,000	$21,689,000	$14,000
$5.00/kW-mo	$22,177,000	$21,689,000	$488,000
$6.00/kW-mo	$25,141,000	$21,689,000	$3,452,000

(5) G3520H Gensets			
	PV of Expenditures		Delta
Capacity Charge	Power Purchase Option	Self-Generation Option	(Savings)
$4.55/kW-mo	$26,919,000	$26,892,000	$27,000
$5.00/kW-mo	$28,586,000	$26,892,000	$1,694,000
$6.00/kW-mo	$32,290,000	$26,892,000	$5,398,000

ECONOMIC EVALUATION

MISO - CONE

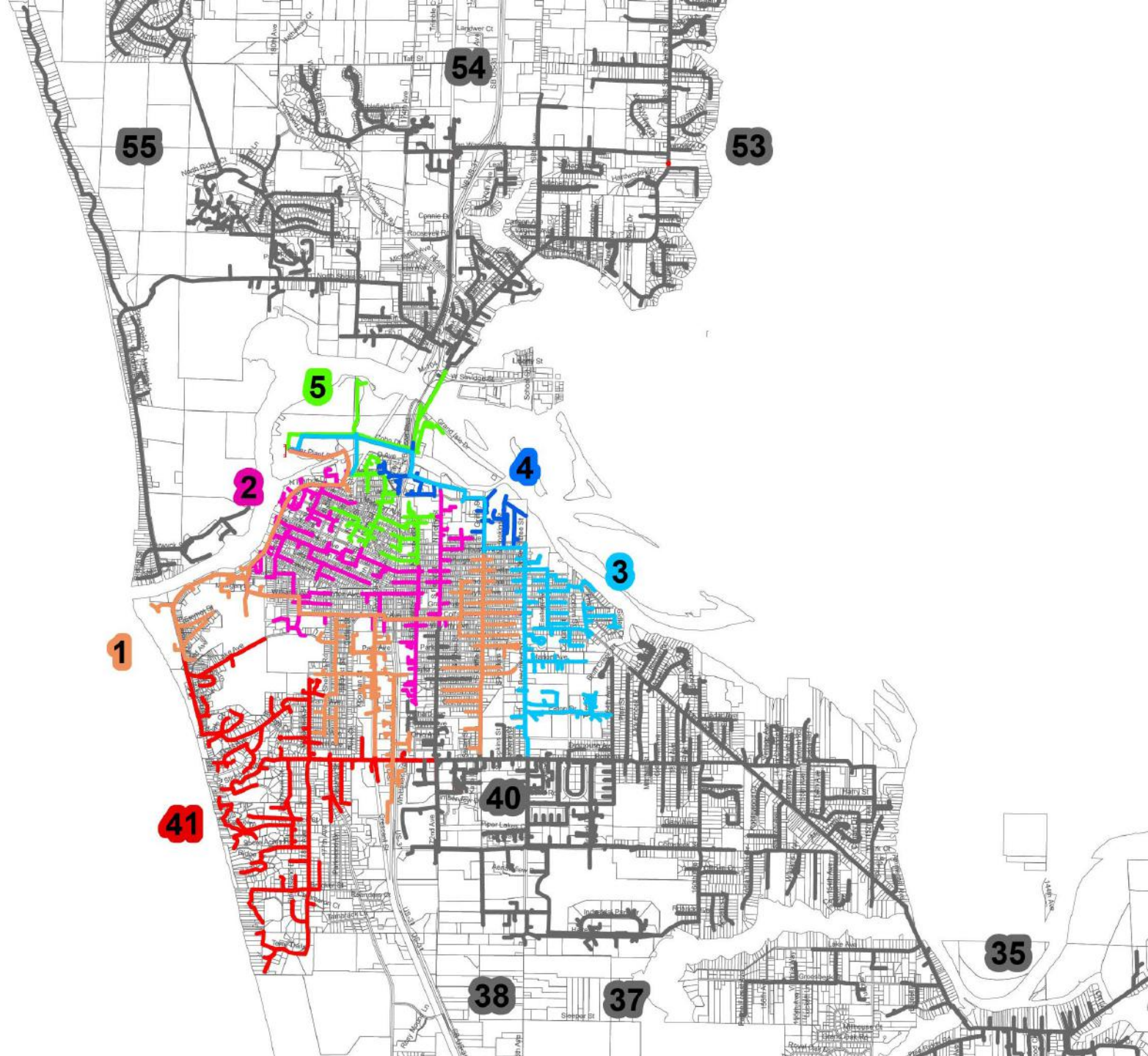
- The current cost of new entry (CONE) in Michigan Zone 7 based on 2020/2021 PRA auction results is $7.85/kW-mo. This cost will fluctuate based on generation projects in the region and has not historically been at this level for long term capacity purchases but is an indicator of the lack capacity in the region.
- CONE is based on a capacity asset for a plant that is to be used infrequently, generally a peaking plant.
- Used by MISO as a maximum offer and maximum clearing price.
- Financial analysis based on market cost of debt and normalized after tax return on equity.

ECONOMIC EVALUATION SUMMARY

- Installation of either a 4-unit facility or a 5-unit facility will provide a hedge against future capacity charges.
- The 5-unit facility is more beneficial than the 4-unit facility.
- A larger scale plant was evaluated using smaller engines, including scaling to 27MW factoring in the estimated $1.5M in required natural gas line upgrade costs. This additional gas line cost generally eliminated any benefit due to scale and is not justifiable in PEC's opinion.
- Building anything greater than the existing infrastructure on Harbor Island can support and that can be paired with snowmelt for a CHP efficiency benefit is not economical due to the cost of delivered fuel, heat rate of the proposed units and complexities of construction on the island. GHBLP would be better served to evaluate other capacity options and potentially partner through their Joint Action Agency with other municipalities to achieve better economies of scale.

GRAND HAVEN BOARD OF LIGHT AND POWER

Distribution Circuit Map

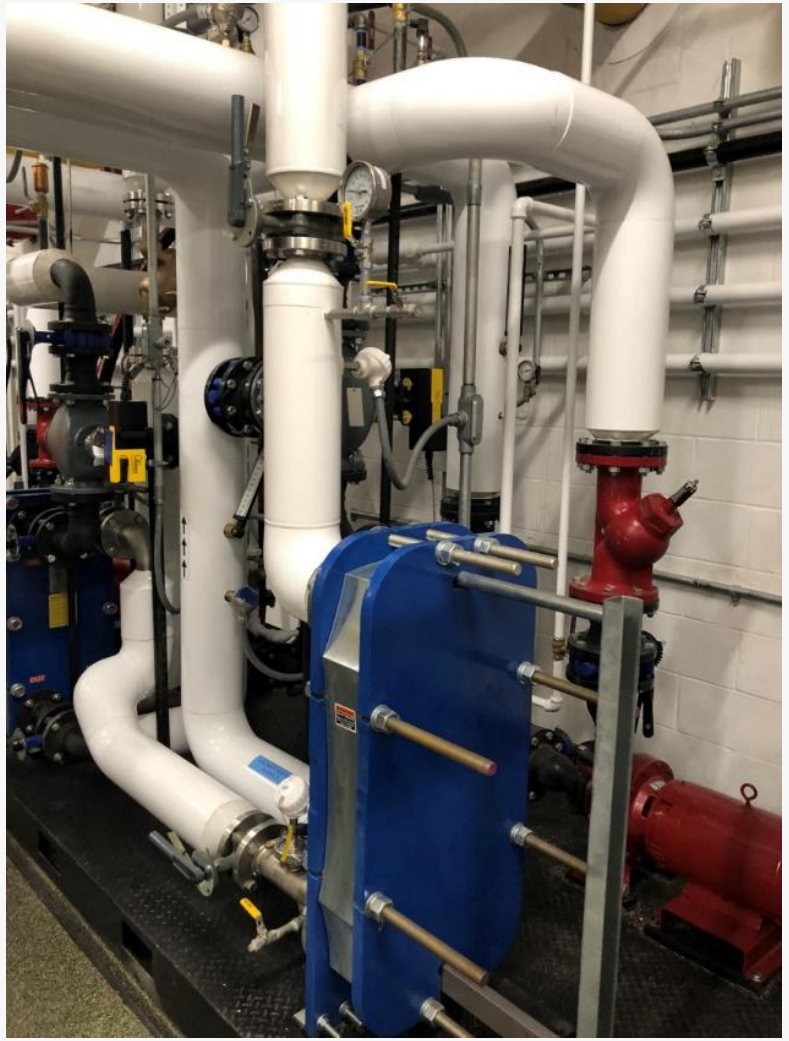


CONCLUSIONS

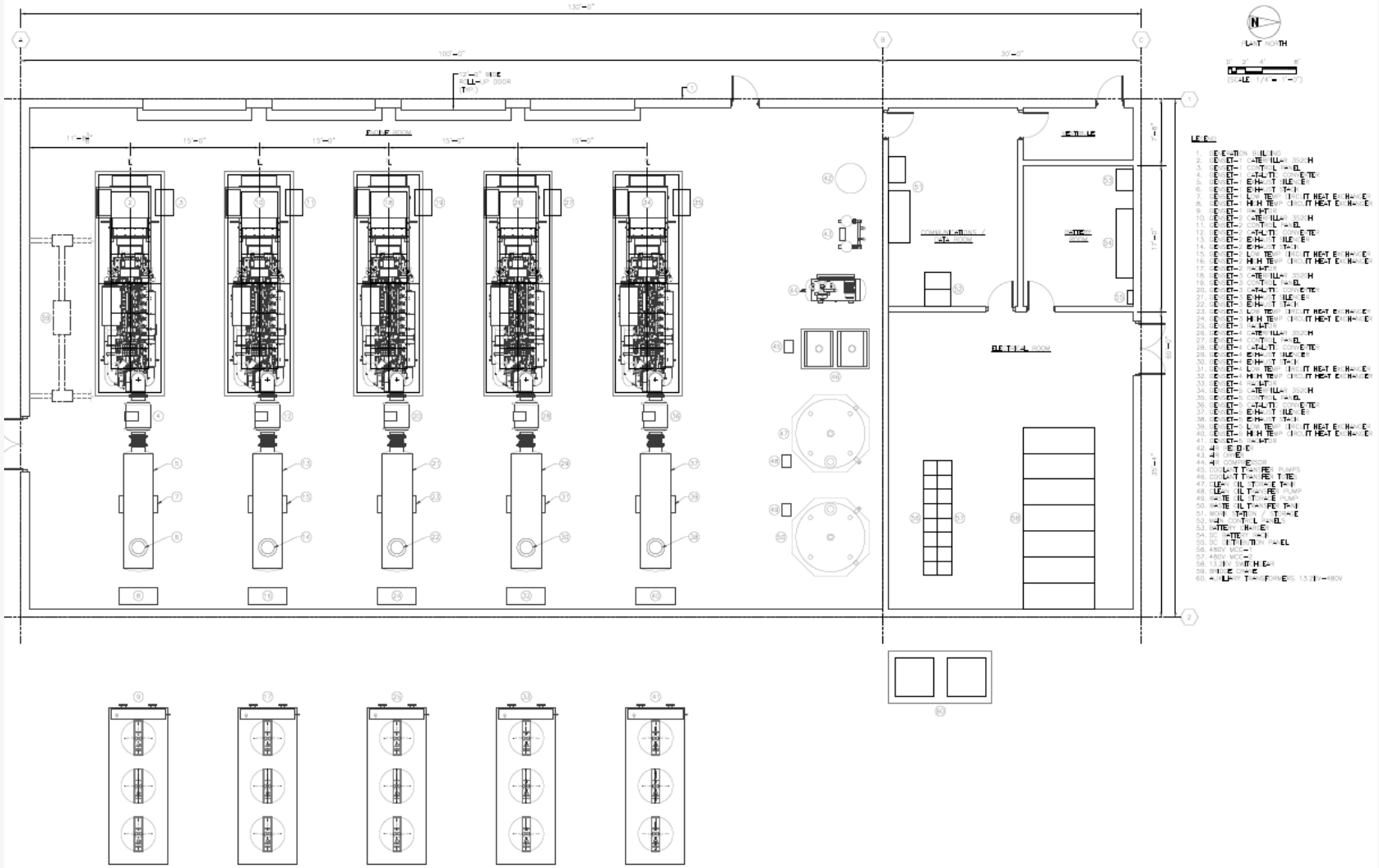
- Maximizing use of available gas on the island for a nominal capacity of 12MW makes the best economic sense.
- 2.5MW Genset pairs well with Snowmelt.
- 12MW of dispatchable capacity provides a hedge against long term capacity and peak energy pricing allowing for peak shaving, if market conditions warrant.
- Provides additional flexibility in how bi-lateral power purchase agreements are structured in the future offering a benefit to future power rates.
- Existing GHBLP staff available to operate and maintain the facility.
- Allows GHBLP to retain flexibility for future generation projects or capacity purchases dedicating ~17% of the peak electrical load to the proposed Harbor Island Generating Facility.
- Complies with the Board's direction to develop a sustainable, economical, and diversified power supply portfolio as outline in their 2017-2021 Strategic Plan.

GENERATING FACILITY CONCEPTUAL DESIGN

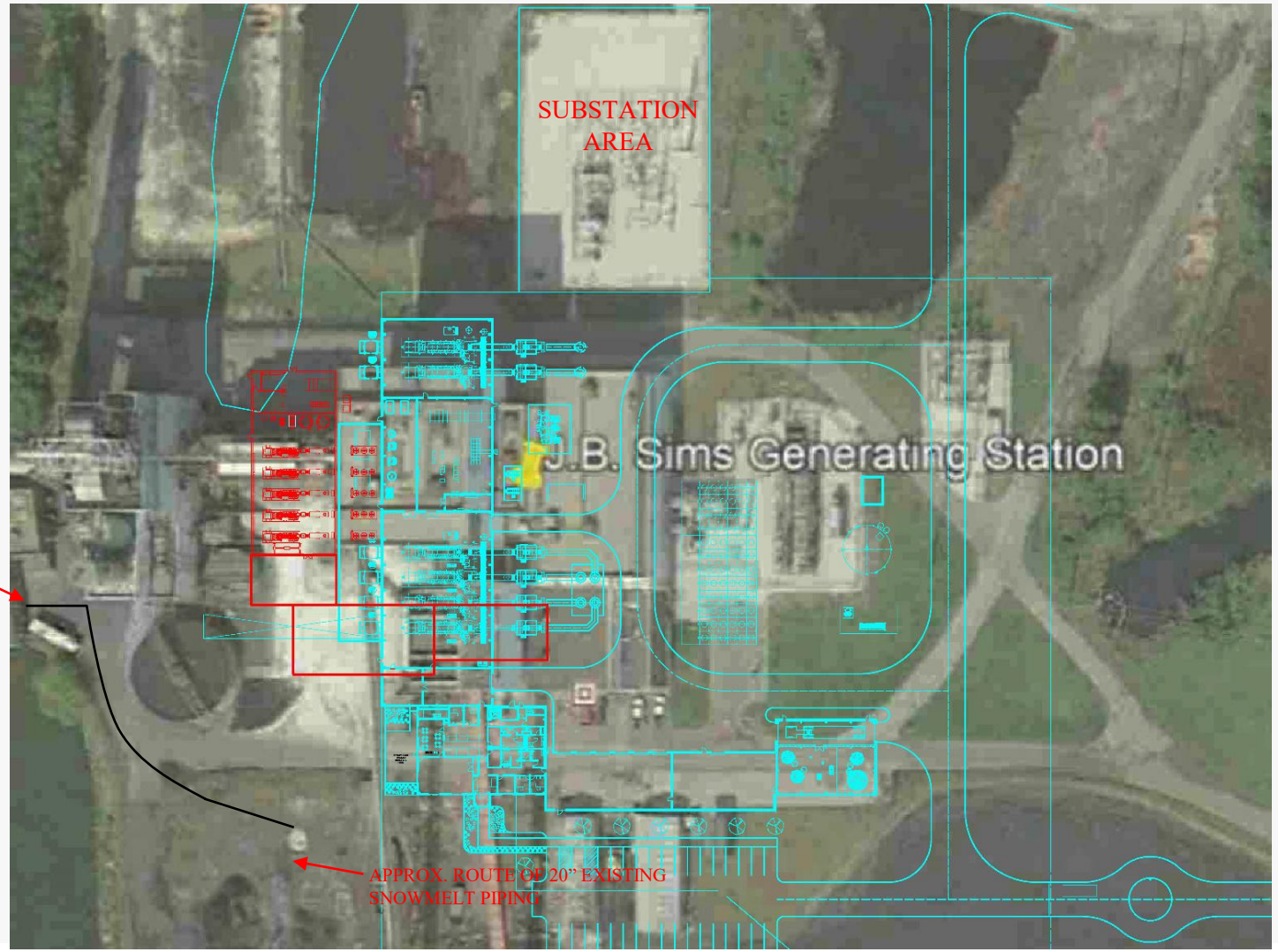
- New medium voltage paralleling switchgear - Electrical interconnection to 13.2kV substation.
- Plate and frame exchangers to reject heat to snowmelt system. Snowmelt condensing boilers and primary pumps to be located in adjacent space to the engine hall.
- Dedicated radiators for operation without snowmelt heat exchangers.
- Mufflers within engine hall / roof mounted stacks.
- Auxiliary Systems – Lube Oil, Coolant, Compressed Air.
- Emissions Controls beyond CO Catalyst not anticipated to be required.
- Building envelope to match master plan for GHBLP Operations Center.



GENERATING FACILITY CONCEPTUAL ARRANGEMENT



SCALE VS. 36MW FACILITY STUDIED IN PDR



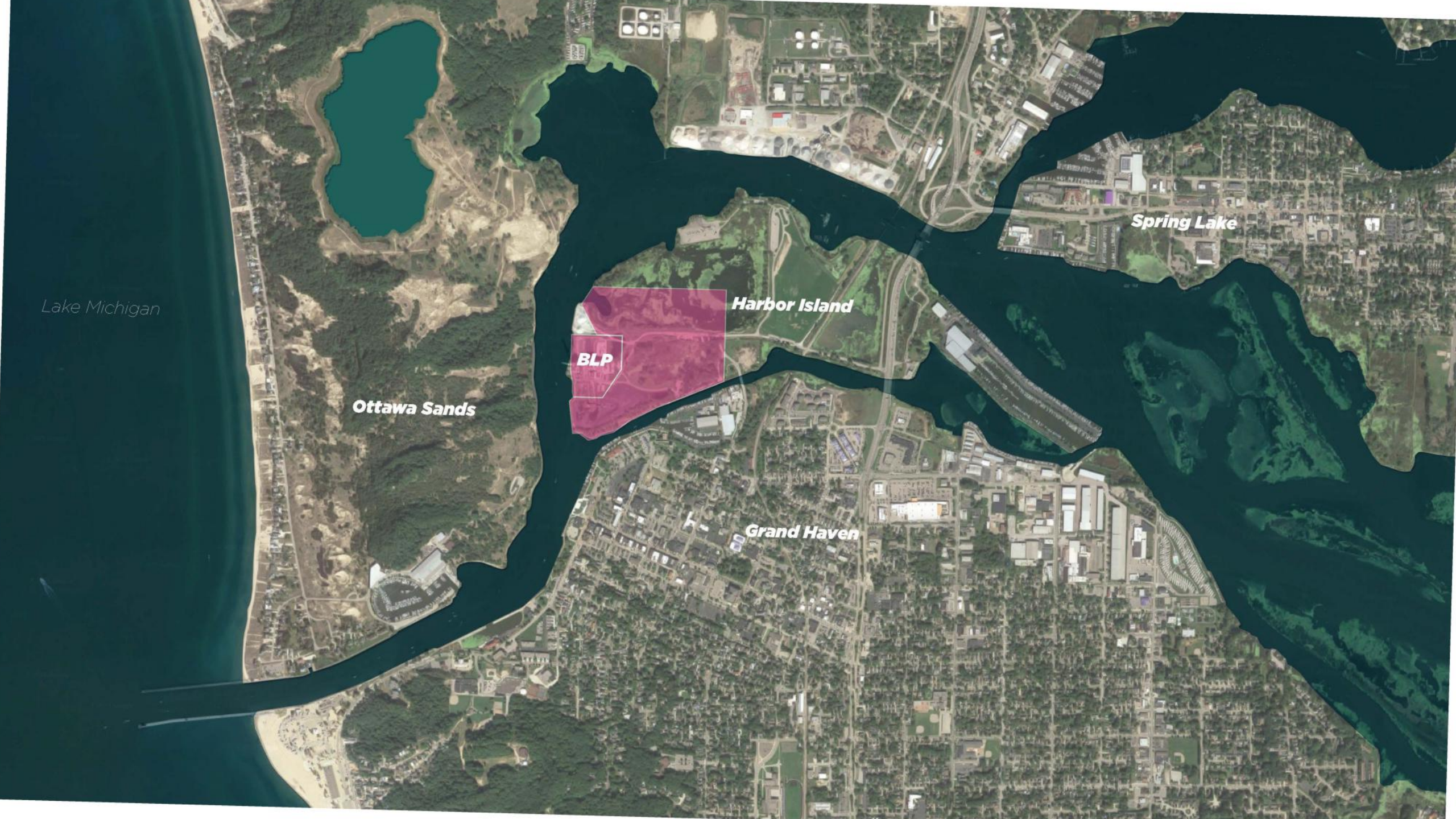
SCALE VS. J.B. SIMS GENERATING STATION

SIMILAR FACILITY – ZEELAND, MI

PATH FORWARD

- Finalize master plan for Harbor Island Redevelopment including civil design and utility interfaces.
- Develop project execution schedule and project execution approach.
- Refine site specific design criteria (foundation design, noise abatement requirements, aesthetics).
- Finalize RICE selection based on discussions with proposed equipment suppliers (OEMs).
- Advance conceptual engineering to schematic design stage to allow for development of +/- 10% grade cost estimate. Refine the design based on cost estimates.
- Determine path forward for snowmelt system interface design and relocation.
- Confirm air permitting requirements.
- Finalize electrical interconnection design concept and studies or agreements necessary.

SITE CONCEPTS


Lake Michigan
Ottawa Sands
BLP
Harbor Island
Grand Haven
Spring Lake

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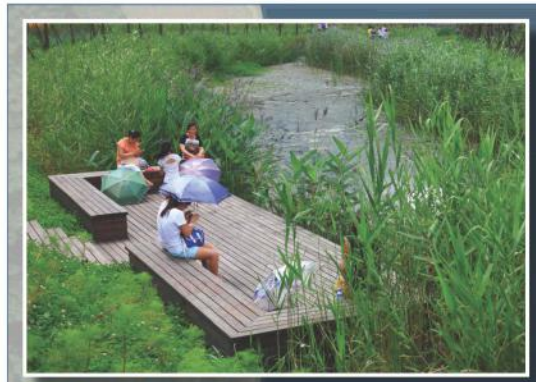
KEY
1 Ex. Public Parking
2 Prop. Public Parking
3 Power Plant Parking
4 Engine Hall
5 Administration Building
6 Garage
7 Prop. Snowmelt/Boiler Rm
8 Ex. Substation
9 Ex. Wetland
10 Prop. Wetland
11 Observatory Tower
12 Boardwalk Promenade
13 Boat Dock/Seawall + Plaza
14 Solar Farm
15 Boardwalk
16 Terrace Access to River
17 Kayak Launch
18 Meadow
19 100 YR Floodplain
20 500 YR Floodplain
21 Wetland Docks
22 Outdoor Patio
23 Fence/Wall + Gate Access
24 Berm Screen
25 Future Potential Energy Storage
Harbor Island



THANK YOU

We welcome your feedback, insights and inquiries.

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