EV Charging Site Considerations for AC and DC Infrastructure

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Solutions Growth Lead, EV Charging and Distributed Energy Resources

Topics to cover today:

- B&V EV Charging Background
- 480 V Distribution HD Fleet DCFC
- 12.47 KV Distribution HD Fleet DCFC
- DC-Coupled DER Integration Opportunities

Black & Veatch Today

120+ Offices

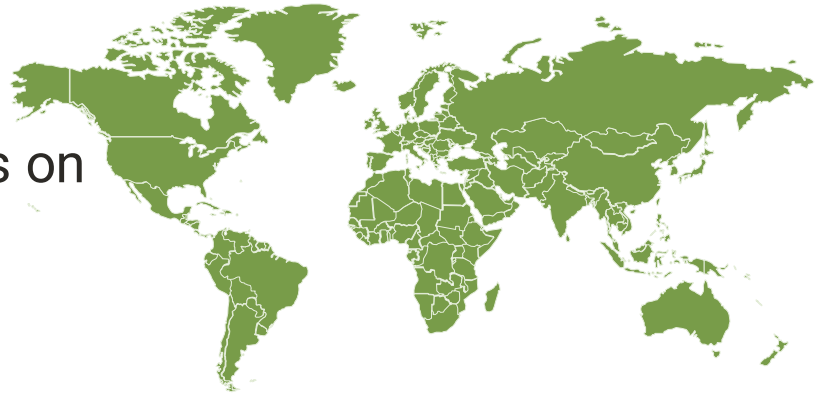
and

12,000+ Professionals

$4.7B Revenue in 2023

Founded in **1915**

Projects on **6** Continents



8th Largest 100% Employee-Owned Company in the U.S.

voted

2022 Best Places to Work for LGBTQ+ Equality

7,000 Active Projects Worldwide

Rank	ENR 2024 Top Design Firms
3	Power
8	Water
10	Telecommunications
14	Top 500 Design Firms

Black & Veatch North American Electric Vehicle & Distributed Energy Deployment

- 2.14 GW connected EV charging capacity across public, fleet and transit
- 30,600 L2 and L3 dispensers
- 156 EV sites deployed with BESS and/or Solar PV
- 32 MW of connected solar & storage for EV peak shaving
- 90 stand-alone BESS sites totaling 48 MW of storage
- 63 Microgrids

Fleet Sites | Public Sites | EV Charging Sites with BESS | Stand-alone BESS Sites | EV Charging Sites with Solar PV | Transit Sites

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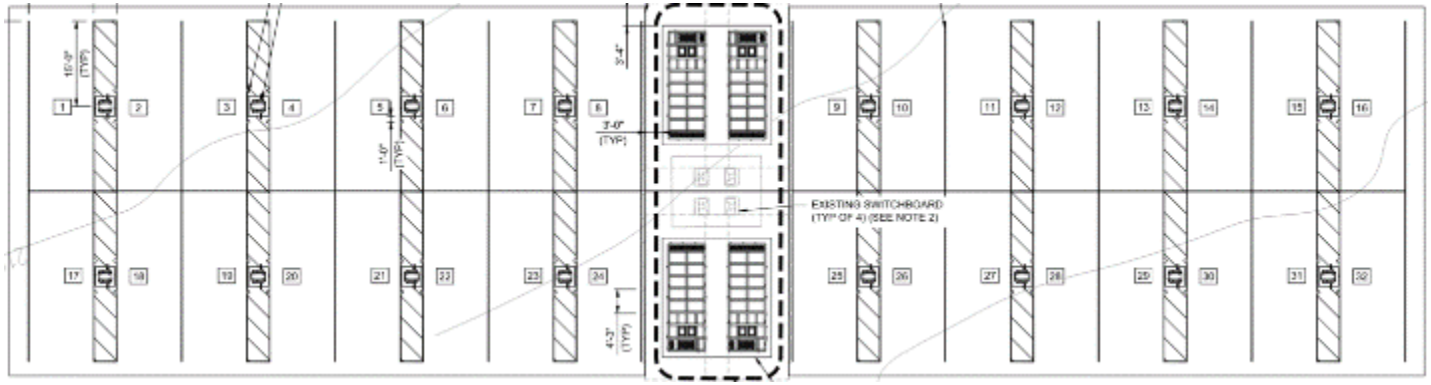
480 Volt Power Distribution

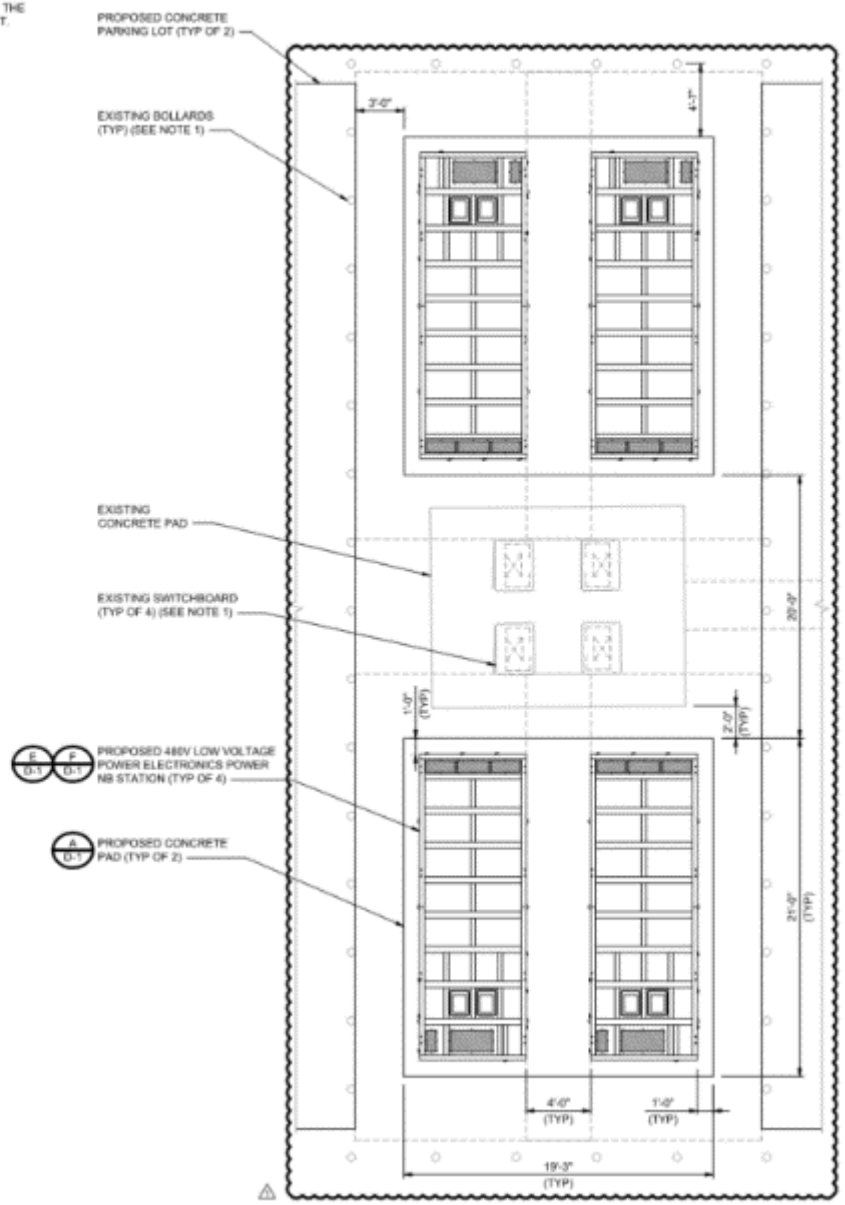
The NBSK Station offers the following standard characteristics. For other configurations, consult Power Electronics.

REFERENCE		NBSK075000U NBSK07500SU	NBSK082500U	NBSK090000U NBSK09000SU	NBSK 097500U	NBSK105000U NBSK10500SU	NBSK112500U NBSK11250SU	NBSK120000U NBSK12000SU	NBSK127500U	NBSK135000U NBSK13500SU	NBSK142500U	NBSK150000U NBSK15000SU
DC OUTPUT	Maximum power [kW]	750	825	900	975	1050	1125	1200	1275	1350	1425	1500
	Number of power stages	10	11	12	13	14	15	16	17	18	19	20
	Charging dispenser power [kW]	75 / 150 / 225 / 375										
	Charging Pantograph power [kW]	75 / 150 / 225 / 375 / 450 / 600 / 750										
	Voltage range [V]	150 - 1000[1]										
	Voltage range full power [V]	320 – 1000										
AC INPUT	Voltage [V]	480 ± 10%										
	Power factor	> 0.99										
	Frequency [Hz]	60										
	Efficiency	94%										

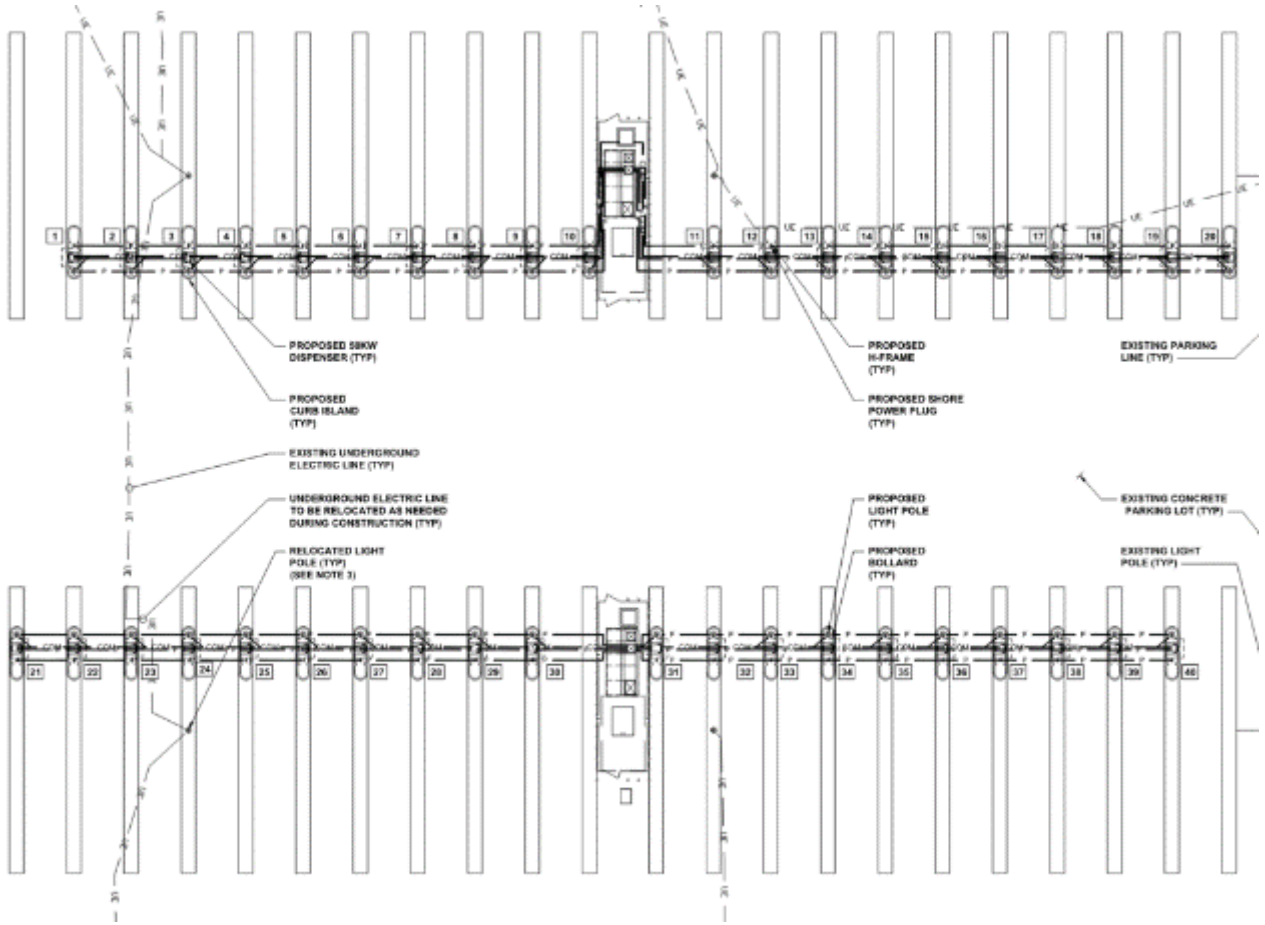


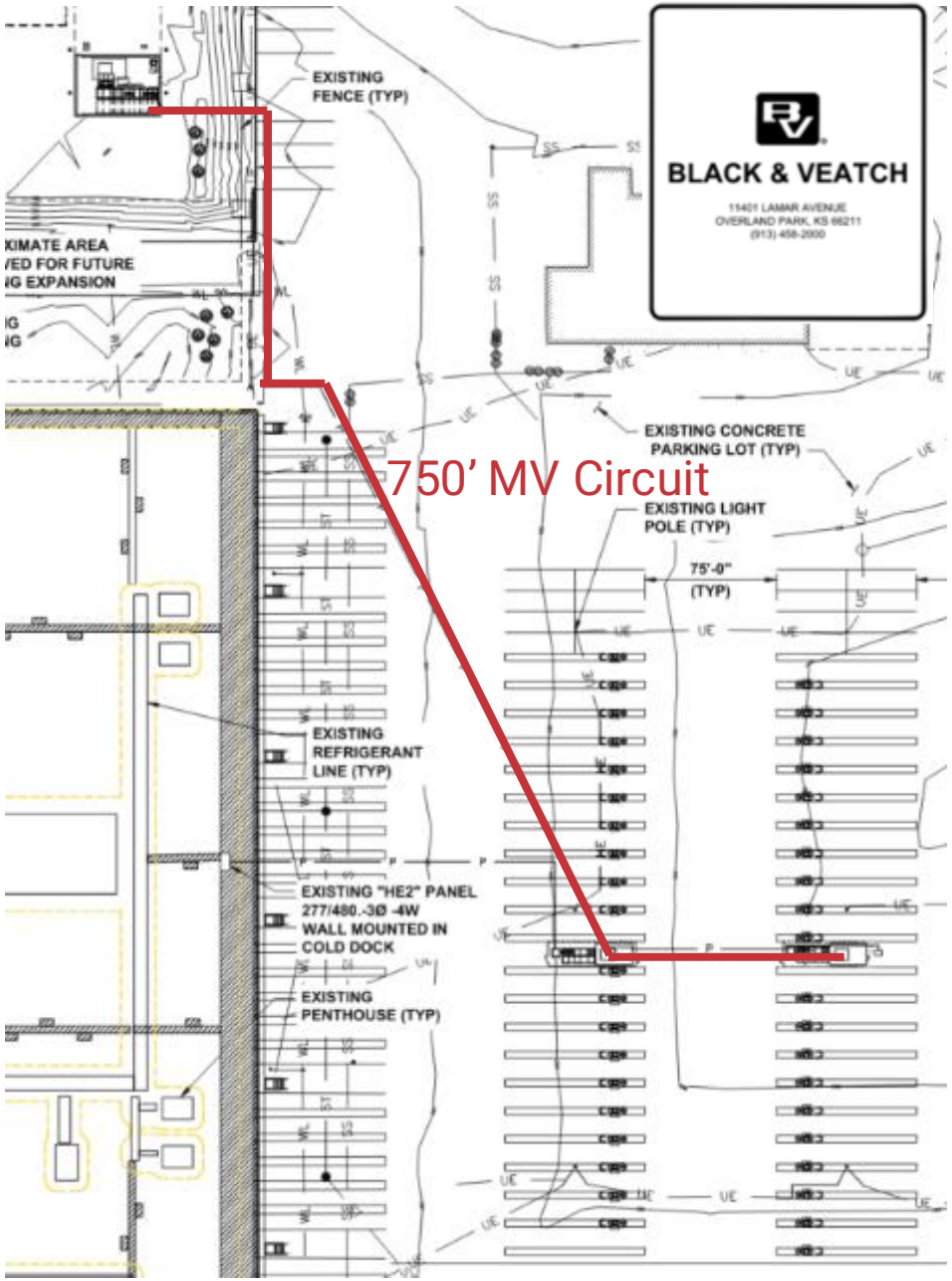
NOTE

1. EXISTING SWITCHBOARDS AND CONCRETE PAD WILL BE INSTALLED PER THE SCE CHARGE READY DESIGN SET. ONLY SHOWN ON DRAWINGS AS INTERCONNECTION LOCATION. EXISTING BOLLARDS SHOWN AROUND THE EQUIPMENT AREA ARE ALSO PART OF THE SCE CHARGE READY DESIGN SET. UNDER SEPARATE PERMIT.

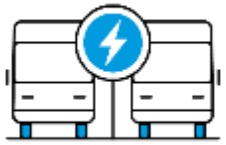


Medium Voltage Distribution





Solutions for Mitigating Capacity Limitations And Optimizing Total Cost of Ownership (TCO)

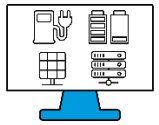


Shared/"Smart" Charging

- Managed at the charger level without external control
- Simplest method of load management
- Limited overall site flexibility

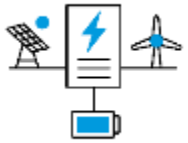
Charge Station Management Systems (CSMS)

- Charging typically managed via Open Charge Point Protocol (OCPP)
  - Local or Cloud-based solutions vary in features and capabilities
  - Required to be a "Listed Device" in 2023 NEC 625.42



Site Energy Management Systems (EMS)

- NEC 705.13 and 750.30 allow for load/supply management
  - Required to be a "Listed Device" in 2023
- EMS manages overall site, including building loads, DER and CSMS
  - Local (MODBUS/LAN/RS-485) or Cloud (API) options
  - May include Demand Response (OpenADR, IEEE 2030.5) capability



On-Site Distributed Energy Resources

- Battery Energy Storage Systems (BESS)
  - Load-shifting, Peak Shaving, Resiliency, PV Storage (TOU Arbitrage)
  - Highly dependant on Demand and Time-of-Use rates)
- Photovoltaic Solar
  - Energy (kWh) generation (intermittent resource, not for demand reduction)
  - Dependant on energy rates, NEM policy, solar resource and installation costs
- Alternative/Conventional On-Site Generation
  - Internal Combustion, Fuel Cell, Wind, Hydro, Bio-gas, Thermal Storage

Temporary/First-Deployment

- Mobile charging and energy storage
- Operation/Schedule Adjustment
- Pre-fabricated, Modular Charging
- Dynamic Load Management
- Leased/Rented generation
- Off-Site/Opportunity Charging

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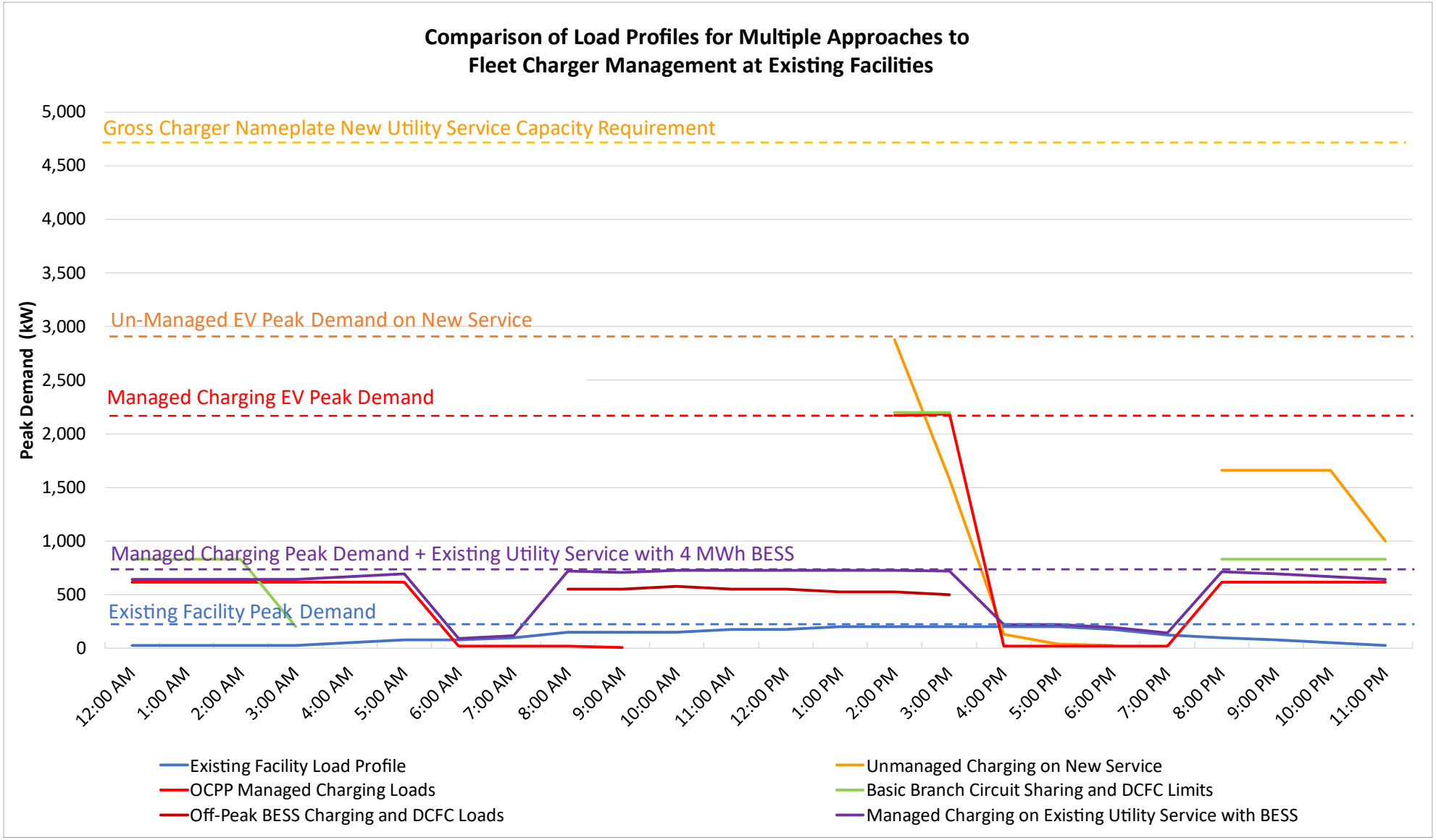
Orchistrated Solution for Fleet Electrification at Existing Facility



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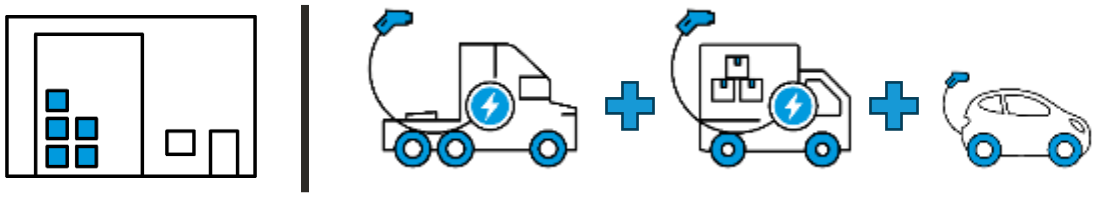
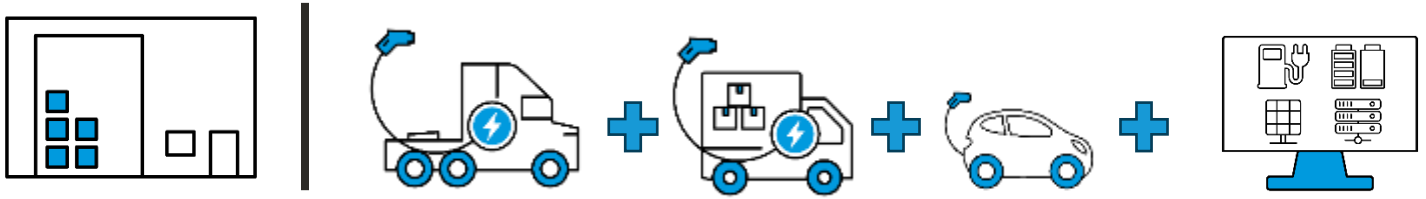
Demand Management Solutions for Facility and Fleet Example



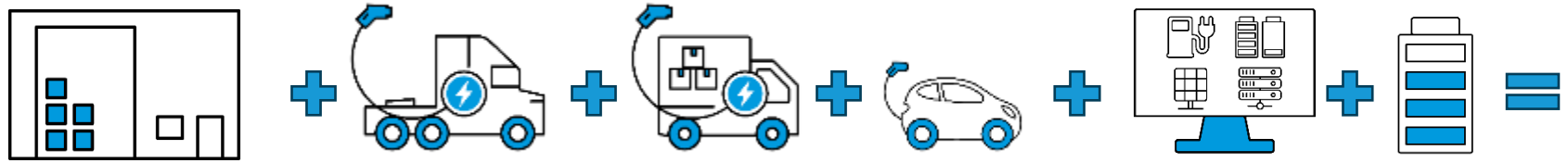
Facility and EV Fleet
2 Meters, 15,252 kWh

=

Peak Demand
3,080 kW



New Service Reduced to 2.5 MVA
Demand Reduced to 2,174 kW
Total Demand now 2,374 kW
Monthly Demand Charges = $83k



BESS sized to support DCFC Loads
No New Service Required
Total Demand now 725 kW
Monthly Demand Charges = $26k

Vehicle Type	Energy (kWh) per-mile	Miles per Day	kWh Required Per Vehicle*	Arrival (Plug-In)	Departure (Plug-Out)	Dwell Hours	Nameplate Charger kW	Minimum Charger kW	Vehicle and Charger Quantity	Gross Nameplate Charging kW	OCPP Managed Minimum Charging kW	Total Daily kWh
Last-Mile Van	1.1	50	60	8:00 PM	6:00 AM	10	16.6	6.0	100	1660	598	5,978
Class 7/8	2	250	543	2:00 PM	4:00 PM	2	360	272	8	2880	2,174	4,348
Light Truck	0.5	60	33	3:00 PM	9:00 AM	18	16.6	1.8	8	133	14	261
Passenger	0.3	50	16	5:00 PM	10:00 AM	17	10	1.0	4	40	4	65
* 8% Overall Charging Losses Included					EV Charging Load Totals				**120**	**4,713**	2,174	10,652
					Existing Facility Peak Demand and Daily Energy Usage						200	4,600
					Minimum Facility + Charging KVA Capacity with 4 MWh BESS for DCFC Support						750	
					Minimum Facility + Charging KVA Capacity With 8 MWh BESS for all Chargers						**636**	

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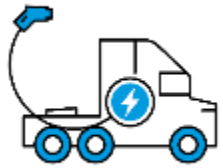
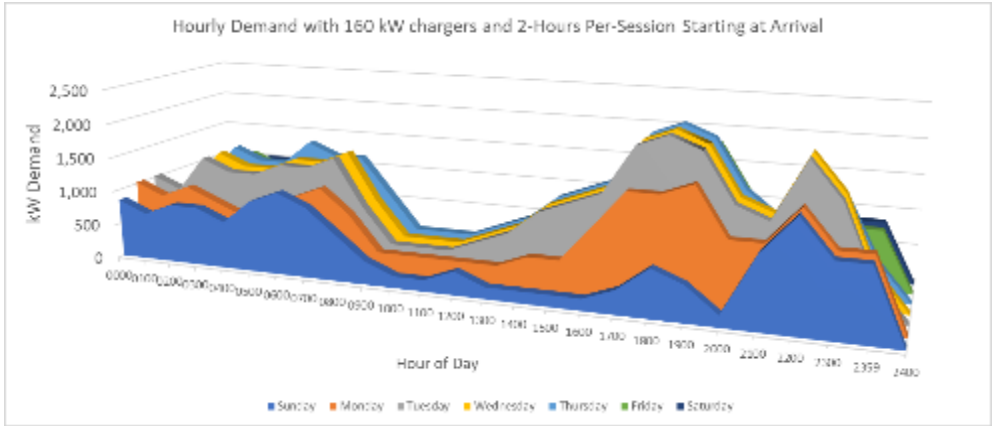
Load Shifting Solution Example for On-Peak Charging Needs

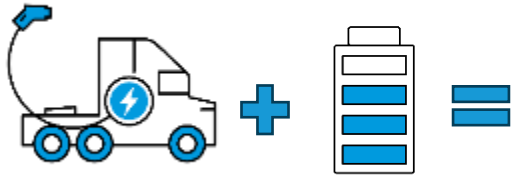
24-Hour Operation Example, Slip-Seating with 2-Hour Dwell
EV Rate with no Demand Charges (currently)



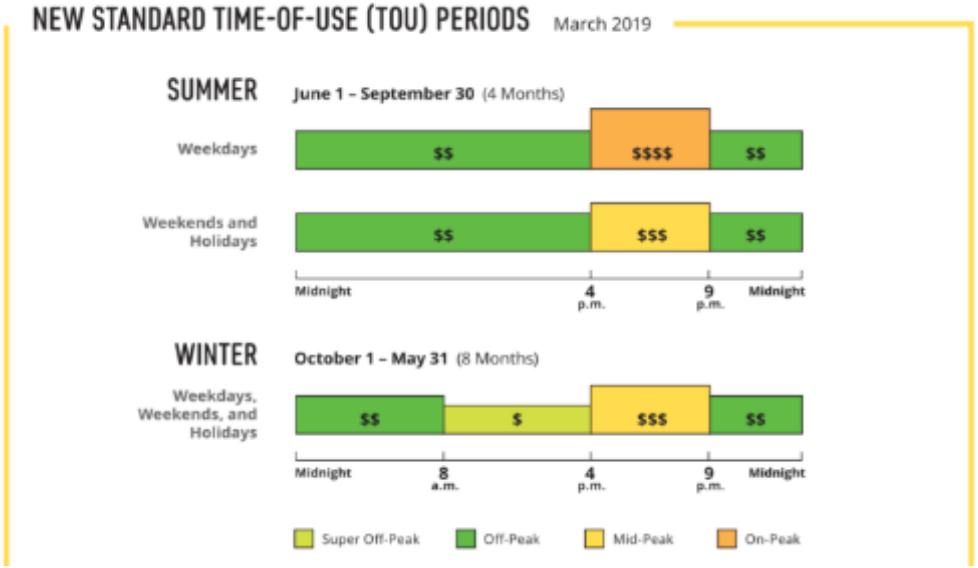
31 Trucks
24 Chargers

Energy Charges			
Season	Charge Type	Rate Type	TOU-EV-9
W	Mid Peak	Import	$0.38648
W	Off Peak	Import	$0.21043
W	Super Off Peak	Import	$0.11634
S	On Peak	Import	$0.57797
S	Mid Peak	Import	$0.3282
S	Off Peak	Import	$0.19571





Energy Toolbase (ETB) Summary:
2.5 MW, 4-Hour BESS (10 MWh)
Provides ~$900,000 Annual TOU Savings
$6M Cost – Incentives = 4 Year Payback
200+% ROI, $7M NPV



Today's Solutions for Early Deployment

Dynamic Load Management

- Include controls to meter existing loads and use remaining capacity for EV charging without overloading utility or panelboards

Black & Veatch Modular Solutions: Universal Framework for Installing EV Charging Equipment

- Pre-fabricated and assembled off-site with DC-Fast or Level 2 Charging hardware
- Fully above-ground mounting and capable of anchoring
- Integrated wireways and bollard protection
- ISO Shipping Container dimensions for simple logistics

Mobile Power Generation

- Power can be generated with traditional fuel sources like propane, natural gas, or diesel
  - Capstone
  - Pioneer Power
- Fuel Cell solutions, fueled by H2 or Methanol
  - Plug Power
  - Kaizen Clean Energy
- Portable energy storage solutions are emerging
  - Dannar
  - Moxion
  - Nomad

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DC-Coupling Voltage Approaches

Challenging Approaches

Droops Control

- Standards in-progress for several years through various working groups
- Wide range of working voltages for various applications
- Limited by battery-specific system voltage
  - **Difficult to adapt to various chemistries**
  - **BESS Augmentation/replacement challenges**

Fixed 1,250V DC

- Fewer solutions currently coming to market
- More applicable to MCS applications
- Could leverage utility-scale PV and BESS Solutions
- More difficult to permit with AHJ
- Likely limited to outdoor commercial use
  - **See 2023 NEC 690.7, 690.31(G) for 1,500V Commercial PV**
- Higher voltage, lower current, reduced cost and losses

Near-Term Approaches

Fixed 800V DC

- Multiple solutions already coming to market
- Easier to permit with AHJ
- More feasible for indoors use
- DCFC likely to require both Buck and Boost

Fixed 950V DC

- Multiple solutions already coming to market
- Pilot system operating at NREL
- Easier to permit with AHJ
- More feasible for indoors use
- DCFC likely to only require Buck

First Applications

- DC-"Slow" alternatives to large AC L2 sites
  - **Last-Mile Fleets, Workplace, ESB, Apartments**
- BESS-Coupled grid augmentation
  - **Load shifting, Peak Shaving, Capacity De-limiting**
- PV + BESS self-generation on-site
  - **Minimization of Grid-Interaction**

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Discussion

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