

Off-Wire Applications on Streetcar Projects

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13th National Light Rail & Streetcar Conference

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This presentation will . . .

- Focus on the Dallas and Seattle First Hill streetcar projects
- Discuss their wireless battery systems
- Review Operator interfaces
- Review switching from OCS to wireless
- List a few maintenance nuances
- Discuss first responder interfaces

Dallas Streetcar



**Brookville Equipment Corp (BEC)
Liberty Streetcar**

Dallas System



- DART, City of Dallas, and the North Central Texas Council of Governments (NCTCOG)
- Construction May 2013
- Service started April 2015
- 1.6 miles (3.2-mile round trip)
- 1 mile wireless over bridge
- 2.5 miles over LRT to the EMF
- Base fleet of 2 cars
- 2 option cars ordered for line extension
- ABB CC400 propulsion

Dallas ESS System



- Energy Storage System (ESS)
- Underfloor location (under cabs)
- Lithium Ion batteries
- 2 units per car, 1 per truck
- 15 sub-packs per unit
- Computer monitoring
- 1,760 lbs (800 kg) each unit (3,520/car)
- ESS “chiller” on roof - temp range
- State-of-Charge (SOC)
 - Maintain between 30% and 70%
 - Go / No-Go level \approx 50%
 - Load shed \approx 40% - shut down \approx 30%
 - Uses \approx 7% over bridge

Seattle First Hill Streetcar



Inekon Group (IG)



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Seattle First Hill System



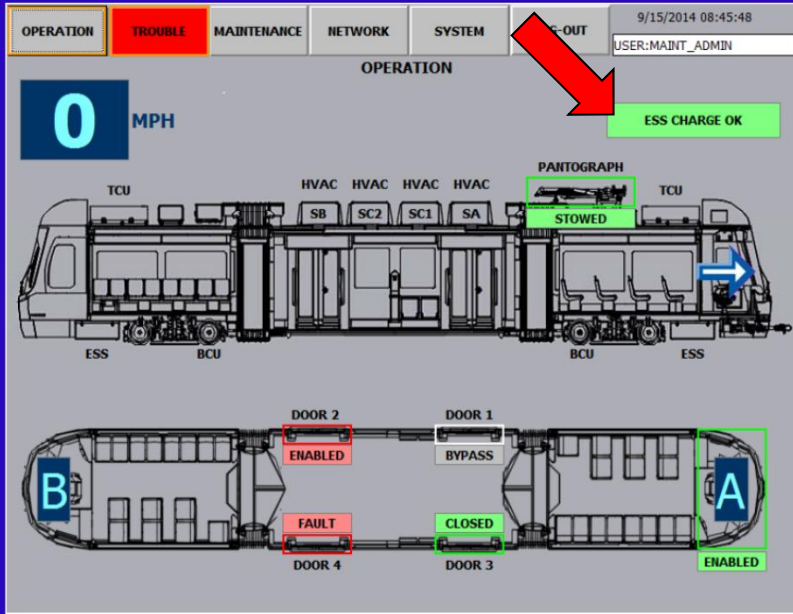
- Seattle DOT project, funding by Sound Transit
- Construction June 2012
- Revenue service is imminent
- 2.5 miles (5-mile round trip)
- 2.5 mile wireless “down hill”
- Short non-revenue line to EMF
- Base fleet of 6 cars
- ABB CC400 propulsion
- SAFT wireless batteries

Seattle OESS System

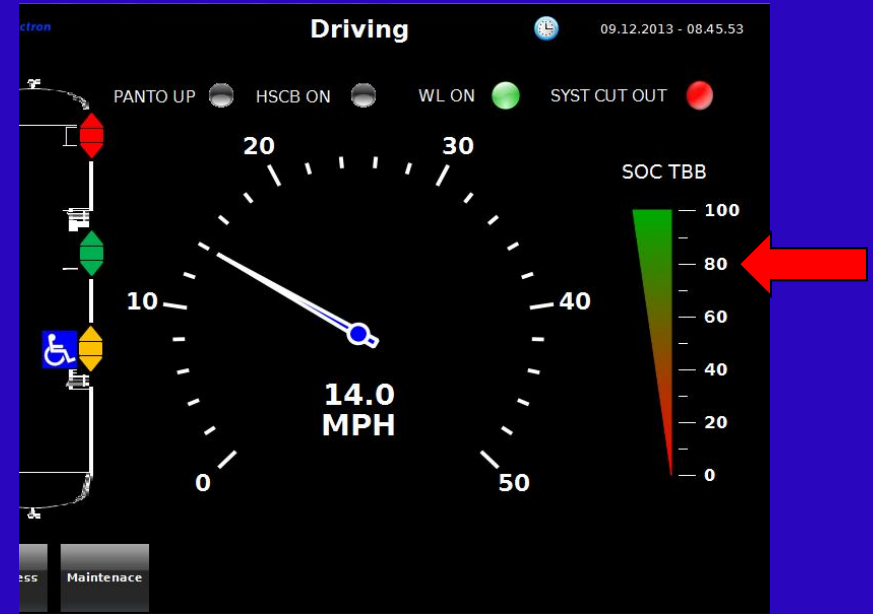


- On-Board Energy System Storage (OESS)
- Rooftop location
- Lithium Ion batteries
- 1 “double” unit per car
- Computer monitoring
- 3,300 lbs (1,500 kg)
- OESS “chiller” on roof - temp range
- State-of-Charge (SOC)
 - Maintain between 40% and 80%
 - Go / No-Go level at 80%
 - Load shed \approx 50% - shut down \approx 20%

Operator Interface



Dallas Streetcar

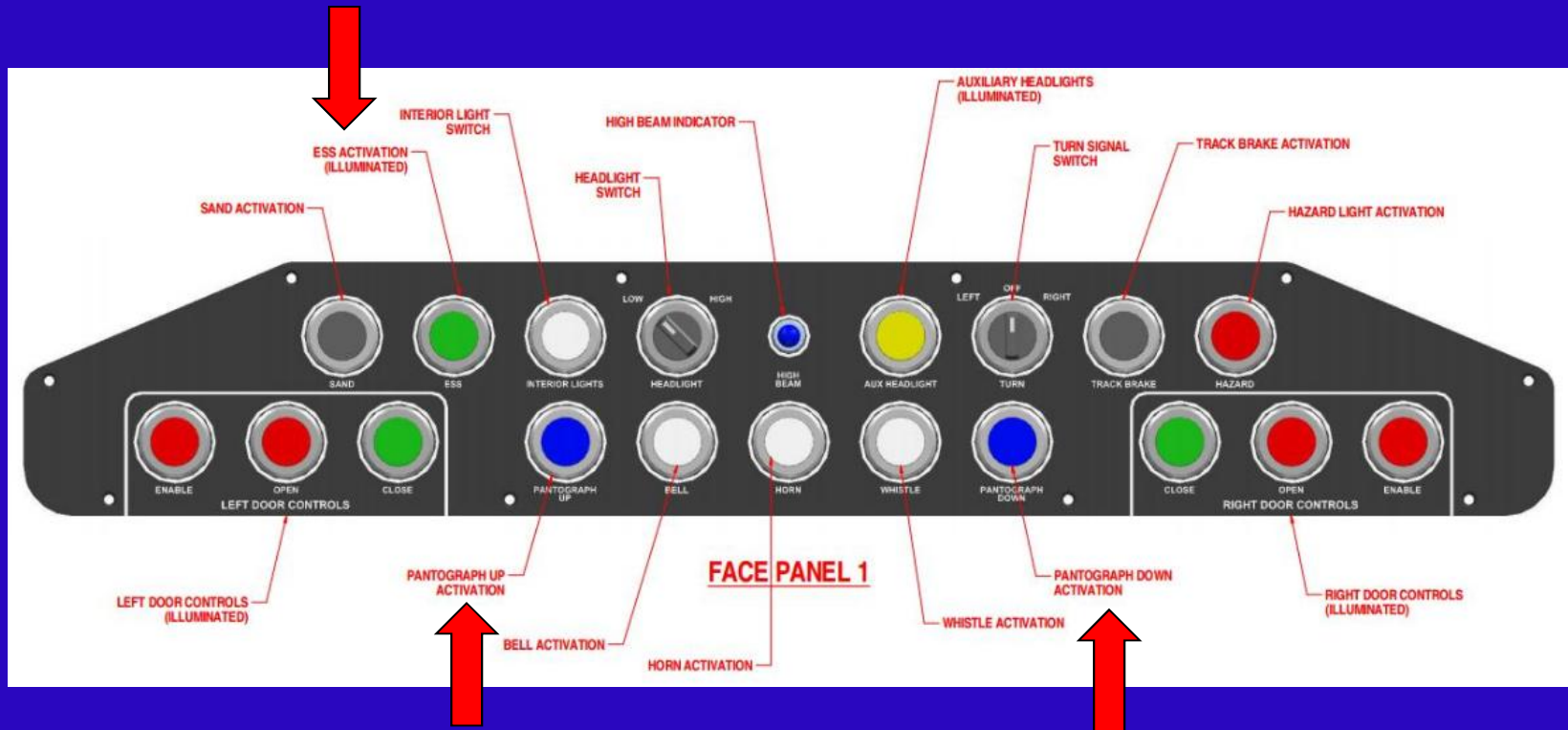


Seattle FHSC

Switching from OCS to Wireless

- Wireless region should start at a station
- Use dwell time for switching modes:
 - Lowering pantograph
 - Checking OESS system status (gauge or go/no-go)
- Signalized?
 - Seattle TWC signal with pantograph state
 - Dallas uses Operator protocols
 - Could use TWC for automatic transfer of operating modes

Switching from OCS to Wireless



Switching from OCS to Wireless



If you enter wireless with panto up . . .



Maintenance

- Spares:
 - How many?
 - Dallas has 2 battery packs (1 car set)
 - Seattle has 1 double stack unit (1 car set)
- Keeping spares ready-to-go:
 - Dallas uses a charging/monitor station for both spare units
 - Every 30 days, each spare runs through a 24 hour test
 - Balance, SOC and fault
 - Seattle charging system in the works
- Removing and installing

First Responder Interface



What's coming?

Location	Project	Route Length (mi/km)	Off-wire Segment (mi/km)	Car Builder	OESS Tech.	Fleet Size	In-Service Date	Reasons for Off-wire Segment
Dallas	Oak Cliff Streetcar	1.6/2.6	1.0/1.6	Brookville	Lithium Ion Batteries	2+2	April 2015	Historic bridge
Seattle	First Hill Streetcar	2.5/4.0	2.5/4.0	Inekon	Lithium Ion Batteries	7	Fall 2015	Trolleybus O/H wire interference, aesthetics, emergency recovery
Detroit	M-1 Rail	3.3/5.3	~50% of the line in total	Brookville	Lithium Ion Batteries	6	Late 2016	Aesthetics, parade route, signature downtown park
Oklahoma City	MAPS 3 Modern Streetcar	4.5/7.2	TBD	Brookville	Lithium Ion Batteries	5	Late 2017	Low clearance under overhead RR structures
Fort Lauderdale	The Wave	2.7/4.3	0.6/0.9	TBD	TBD	4	Late 2017	Bascule lift bridge
Charlotte	CityLYNX Gold Line Phase 2	4.0/6.4	0.3/0.5	TBD	TBD	6-8	Late 2019	Aesthetics; signature downtown intersection
Washington DC	DC Streetcar	TBD	TBD	TBD	TBD	TBD	TBD	Restriction on overhead wire in areas of the District

A Workable Solution to Conflicting Crashworthiness Requirements

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