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# Training Technicians for an Electric Bus Fleet

October 22, 2019

# Welcome

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APTA
Washington, DC

*Staff Advisor*
APTA Bus Technical Maintenance Committee

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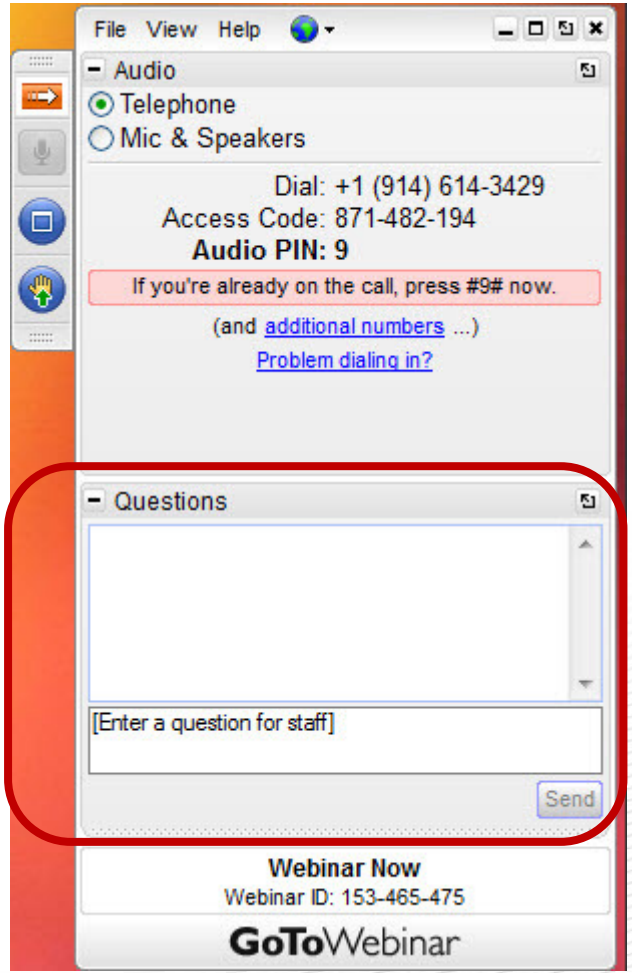
# Housekeeping

- This webinar will be **recorded** and made available on APTA's website next week
- All attendee phone lines are **muted**
- To ask a question, use the **Questions panel; questions will be answered at the end** of the presentations

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# Moderator

**Obed Mejia**

*Senior Bus Equipment Maintenance Instructor*

LA Metro

Los Angeles, CA

*Vice Chair-Webinars*

APTA Bus Technical Maintenance Committee

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# Presenters

**Michael Flocchini**
*Training and Education Manager*
AC Transit
Hayward, CA

**Jose Vega**
*Maintenance Trainer*
AC Transit
Hayward, CA

**Michael Joyce**
*Assistant Director Technical Support*
Metro Transit
St. Paul, MN

**Daniel Ramirez**
*Bus Maintenance Superintendent*
LA Metro
Los Angeles, CA

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# Objectives

At the completion of this this webinar, participants will:

1. *Devise a plan for ZEB training*
2. *Learn best practices and key challenges in implementing your own training program*
3. *Understand considerations related to high voltage maintenance training*

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# AC Transit

# AC Transit - Service and Fleet Facts

- Third largest bus only transit agency in California
- TED:  Train 70% of Operations
- 28 ZEB buses: 23 FCEB and 5 BEB; 45 additional next few years
- Two Hydrogen stations in two locations
- BEB Electric Charging
- ZEB bus comparison:  Determine the best fleet mix; running BEB and FCEB on same routes/same time


**FCEB – > 32,000 in-service hours**

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# AC Transit ZEB Training Plan

- Coordinate with internal stakeholders
- Identify/prioritize target audience
- Plan training with OEMs/Sub-component Suppliers
- Schedule all logistics - LMS (MyACT - Intranet)
- Ensure pre-requisites are first scheduled prior to other courses

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# Training Plan Timeline

**TRAINING IMPLEMENTATION PLAN**

| Categories | Training Session | Description | Hrs per Course | Days | Total Hrs | Attende | Start | End | Location |
|---|---|---|---|---|---|---|---|---|---|
| **NF Vehicle Innovation Center** | New Flyer Fuel Cell Bus Intro | Safety and Familiarization of major systems | 8 | 3 | 24 | 8 | 12/18/2018 | 12/20/2018 | NF VIC - Anniston, AL |
| | | | | | | | | | |
| **Fuel Cell** | Ballard Fuel Cell (Tier 1) | Safety and Familiarization | 8 | 1 | 8 | 10 | 4/9/2019 | 4th Q 18/19 | ACT TEC |
| | Ballard Maintenance (Tier 2) | Maintenance and repair | 8 | 2 | 16 | 20 | 4/10/2019 | 4th Q 18/19 | ACT TEC |
| | Ballard Maintenance | Maintenance and repair | 8 | 4 | 32 | 10 | 5/28/2019 | 5/29/2019 | ACT TEC |
| | | | | | | | | | |
| **Siemens Hybrid Drive** | Siemens ELFA Intro | Safety and Familiarization | 8 | 1 | 8 | 20 | 6/11/2019 | 8/13/2019 | ACT TEC |
| | Siemens ELFA Maintenance | ELFA maintenance and repair | 8 | 1 | 8 | 20 | 6/12/2019 | 10/14/2019 | ACT TEC |
| | | | | | | | | | |
| **A123 Batteries** | A123 Battery Intro | ESS Safety and Familiarization | 8 | 6 | 48 | 60 | 6/5/2019 | 6/5/2019 | ACT TEC |
| | | | | | | | | | |
| **Connect Data System** | Vansco Multiplex | Basics/Diagnostics of Vansco Multiplex | 8 | 12 | 96 | 40 | 3rd Q 18/19 | 1st Q 19/20 | ACT TEC |

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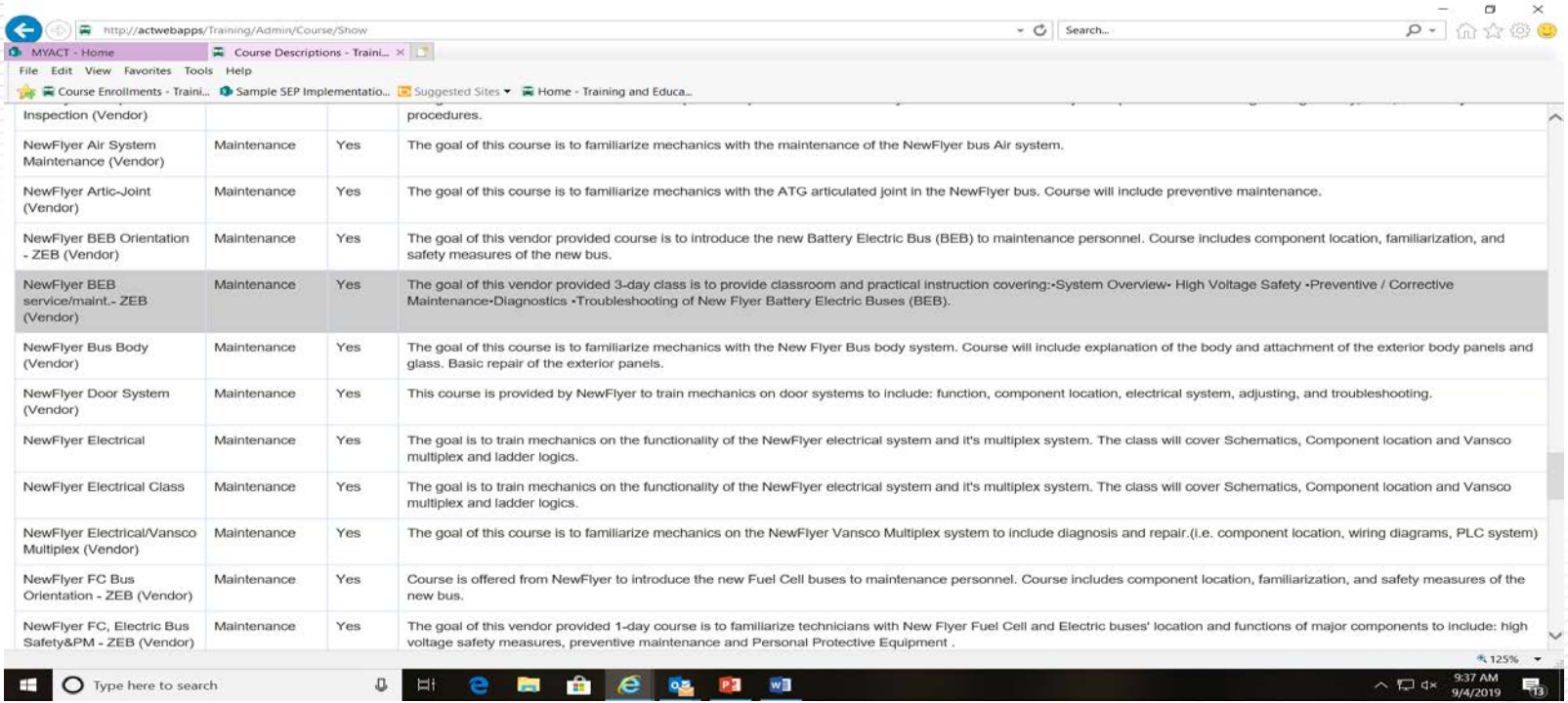
# MyACT - Course Description



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MYACT - Home | Course Descriptions - Traini...

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Course Enrollments - Traini... | Sample SEP Implementatio... | Suggested Sites | Home - Training and Educa...

| | | | |
|---|---|---|---|
| Inspection (Vendor) | | | procedures. |
| NewFlyer Air System Maintenance (Vendor) | Maintenance | Yes | The goal of this course is to familiarize mechanics with the maintenance of the NewFlyer bus Air system. |
| NewFlyer Artic-Joint (Vendor) | Maintenance | Yes | The goal of this course is to familiarize mechanics with the ATG articulated joint in the NewFlyer bus. Course will include preventive maintenance. |
| NewFlyer BEB Orientation - ZEB (Vendor) | Maintenance | Yes | The goal of this vendor provided course is to introduce the new Battery Electric Bus (BEB) to maintenance personnel. Course includes component location, familiarization, and safety measures of the new bus. |
| NewFlyer BEB service/maint.- ZEB (Vendor) | Maintenance | Yes | The goal of this vendor provided 3-day class is to provide classroom and practical instruction covering:•System Overview• High Voltage Safety •Preventive / Corrective Maintenance•Diagnostics •Troubleshooting of New Flyer Battery Electric Buses (BEB). |
| NewFlyer Bus Body (Vendor) | Maintenance | Yes | The goal of this course is to familiarize mechanics with the New Flyer Bus body system. Course will include explanation of the body and attachment of the exterior body panels and glass. Basic repair of the exterior panels. |
| NewFlyer Door System (Vendor) | Maintenance | Yes | This course is provided by NewFlyer to train mechanics on door systems to include: function, component location, electrical system, adjusting, and troubleshooting. |
| NewFlyer Electrical | Maintenance | Yes | The goal is to train mechanics on the functionality of the NewFlyer electrical system and it's multiplex system. The class will cover Schematics, Component location and Vansco multiplex and ladder logics. |
| NewFlyer Electrical Class | Maintenance | Yes | The goal is to train mechanics on the functionality of the NewFlyer electrical system and it's multiplex system. The class will cover Schematics, Component location and Vansco multiplex and ladder logics. |
| NewFlyer Electrical/Vansco Multiplex (Vendor) | Maintenance | Yes | The goal of this course is to familiarize mechanics on the NewFlyer Vansco Multiplex system to include diagnosis and repair.(i.e. component location, wiring diagrams, PLC system) |
| NewFlyer FC Bus Orientation - ZEB (Vendor) | Maintenance | Yes | Course is offered from NewFlyer to introduce the new Fuel Cell buses to maintenance personnel. Course includes component location, familiarization, and safety measures of the new bus. |
| NewFlyer FC, Electric Bus Safety&PM - ZEB (Vendor) | Maintenance | Yes | The goal of this vendor provided 1-day course is to familiarize technicians with New Flyer Fuel Cell and Electric buses' location and functions of major components to include: high voltage safety measures, preventive maintenance and Personal Protective Equipment . |

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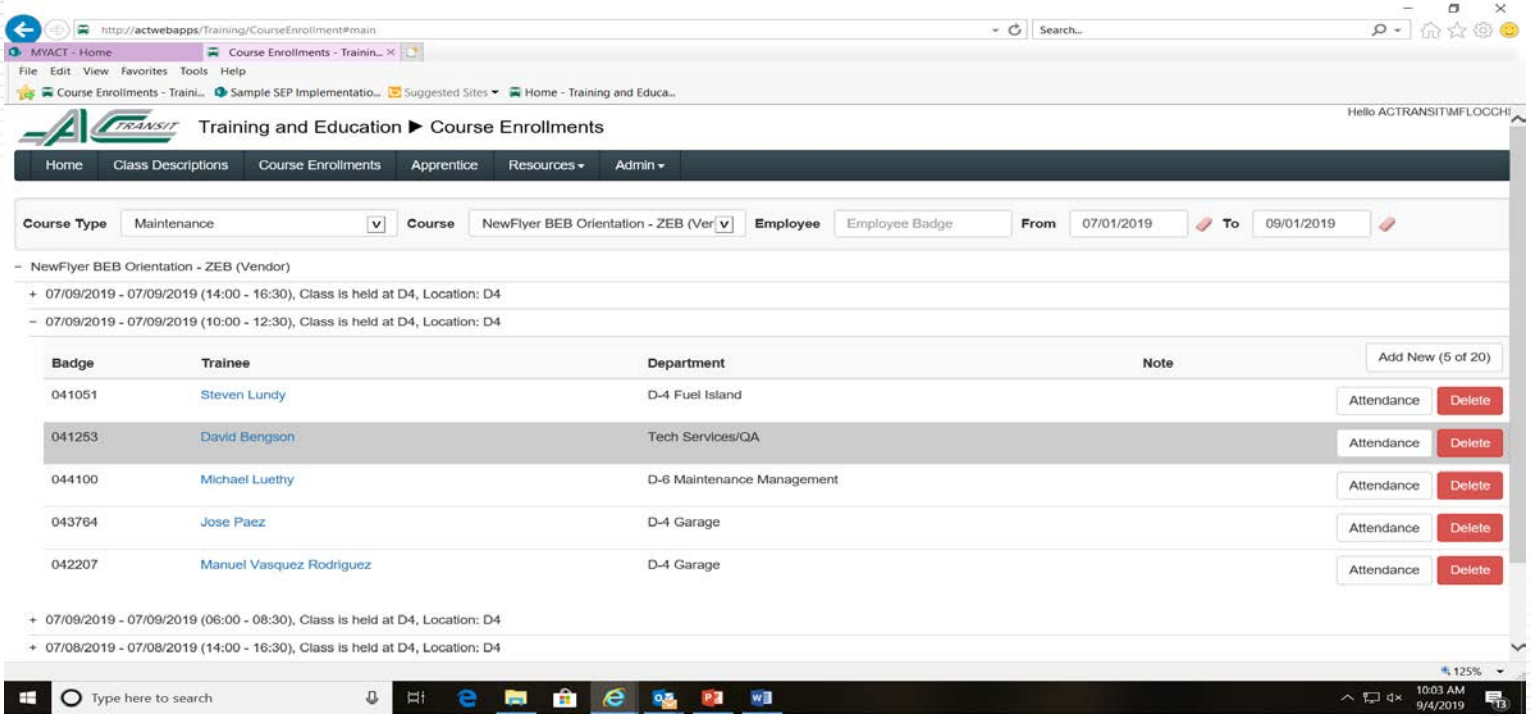
# MyACT – Schedule/Course Enrollment

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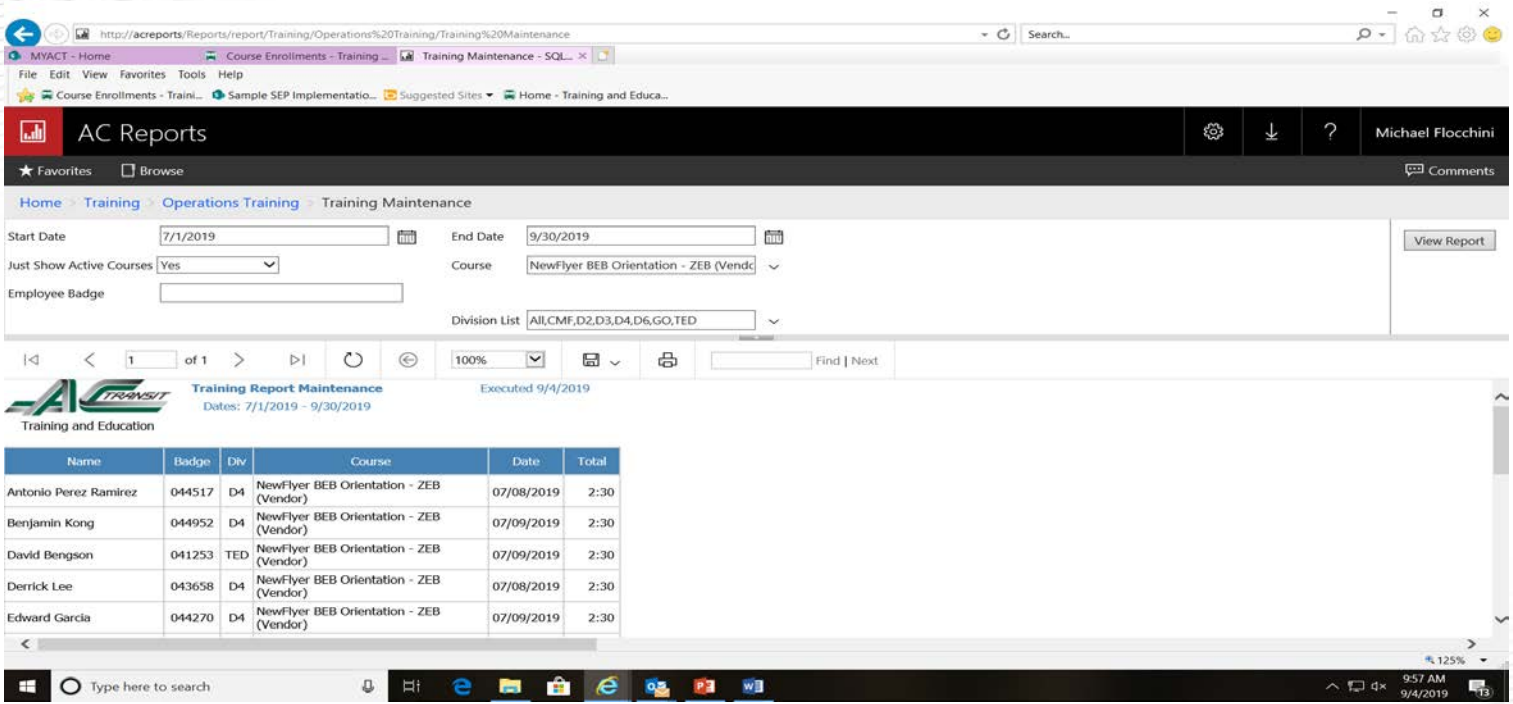
# MyACT - Query

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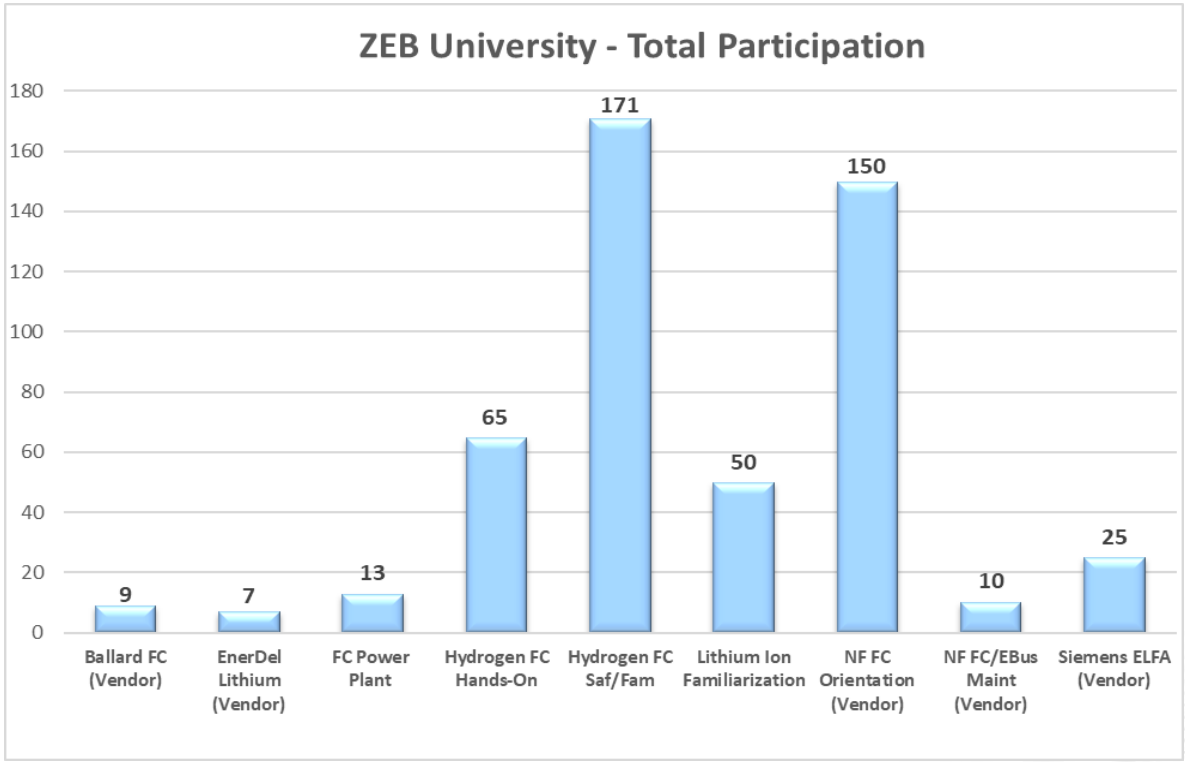
# Evaluation and Assessment

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# Training Challenges

**Staffing to maintain other required products**

**Technician enrollments**

**Heavy reliance on OEM/Vendors**

**Specific diagnostic tools and related training**

# Partnerships in Action


**Ballard (Fuel Cell) Power Plant Maintenance training**

- April 2019: 3-day course
- Mock-up: Ballard FC, air and water cooling system, diagnostic software.
- Perform more complex FC system maintenance.

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# Minneapolis Metro

# Metro Transit Fleets and Facilities

- 900+ buses
  - 130 hybrid
  - 8 battery electric
- 91 light rail vehicles
- 6 locomotives and 18 commuter rail cars
- 14 support facilities
  - 5 bus service garages

Proposed fleet plan: Future solicitation for nine forty-foot transit buses

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# Metro's Training Plan

- Form electric mechanic-technician bus project team
- Deliver High Voltage Awareness and Electric Bus Safety for staff
- Ensure technicians have specialty tools and adequate personal protective equipment
- Leveraged New Flyer's Vehicle Innovation Center (VIC) for Maintenance / Operations Staff
- Developed agency specific standard operation procedures, maintenance practices in conjunction with OEMs and CALSTART
- Train technicians to meet industry performance standards

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# Training Timeline

| Course Title | Date | Primary Audience |
|---|---|---|
| Temporary Battery Charger | February 7 | e-Bus Team, Fleet, Facilities |
| Permanent Battery Charger | April 25 | e-Bus Team, Fleet, Facilities |
| Charger Training | May 22 | Helpers |
| Thermo King System Update | May 29 - 30 | e-Bus Team & HVAC |
| High Voltage Awareness | Week of June 3 | All Staff |
| High Voltage Safety & E-Bus Familiarization | June 18 - 20 | e-Bus Team |
| Vansco Multiplexing system for E-Bus | July 9 - 11 | e-Bus Team |
| Towing Recovery & electric Axle for E-Bus | July 30 | e-Bus Team |
| ABS Brakes & Air Systems for E-Bus | August 1 | e-Bus Team |
| High Powered Core Charger | Pending | e-Bus Team, Fleet, Facilities |
| Suspension & Steering | September 10 | e-Bus Team |
| Troubleshooting & PM for E-Bus | September 10 | e-Bus Team |
| Articulated Joint for E-Bus | September 11 | e-Bus Team |
| Duration & Cooling for E-bus | September 12 | e-Bus Team |

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# Training Challenges

- Safety
- Employee engagement
- Employee skill gap
- New technology
- Maintaining depot and on route chargers

# LA Metro

# LA Metro Electric Bus Training Plan

- Identify Service and Maintenance requirements for Electric Bus High Voltage Components & Systems
- Schedule & complete OEM training for applicable Electric Fleets and HV systems
- Develop Training content for Fleet Specific / Task Specific safety procedures for HV activities
- Develop SOP's to document policies, procedures and practices related to training requirements, PPE usage, and job planning
- Schedule and complete training for HV Level I and Level II personnel
- Implement, monitor and course correct as technology and experience dictates

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# Fleets with High Voltage Systems

- 900 NFA Xcelsior with Electric HVAC (In-Service)
- 229 ENC El Dorado with Electric HVAC (In-Service)
- 65 NFA articulated buses with Electric HVAC (Pre-Delivery)
- 40 NFA Electric buses (Pre-Delivery)
- 259 ENC El Dorado with Electric HVAC (On order)
- 70 NFA articulated buses with Electric HVAC (On Order)
- 105 BYD Electric buses (On order)

1,668 Buses Battery Electric or HV components and sub-systems (2021)

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# High Voltage Systems and Components

- The general servicing and maintenance tasks related to buses with High Voltage systems are similar in scope to Diesel or CNG buses when the bus is de-energized.
- Bus mechanics trained in conventional operating systems can perform most of the routine maintenance work on these systems.
- There are specific tasks that require additional training, knowledge and skill:
  - Use of HV Personal Protection Equipment (PPE) and tools
  - Zero Voltage Verification Procedures (de-energizing the system)
  - Servicing battery packs, generators, inverters, and motors

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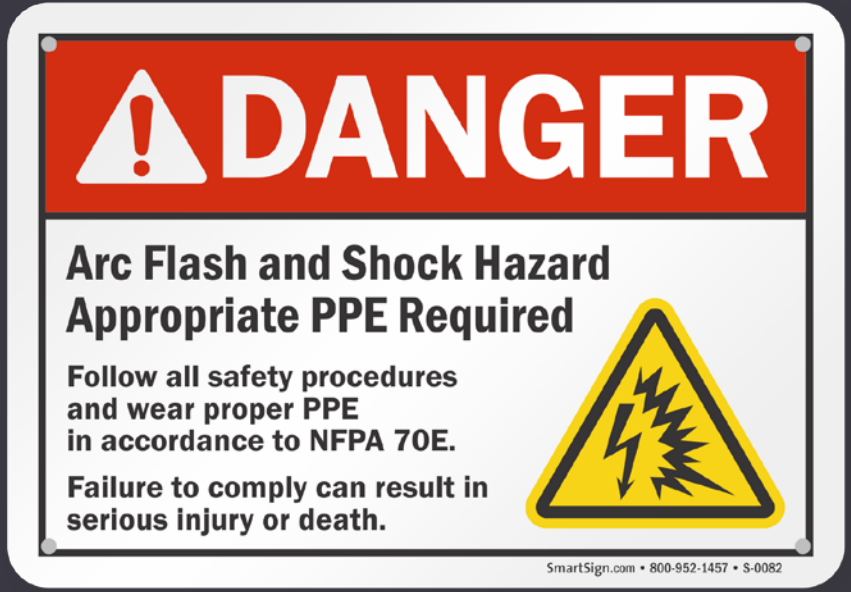
# High Voltage

High-voltage (HV) electrical systems on buses typically range from 50 to 1000 Vac/Vdc.

- These systems are designed with safety features that deactivate the electrical system when a fault is detected
- Additionally, exposure can be minimized when regulatory and manufacturer recommended safety procedures are followed.

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# Personnel Designations

Level I – No to Low Exposure

- Service Personnel
- Maintenance Personnel
- Supervision and Management Staff
- Bus Operators
- First Responders

Level II – Moderate to High Exposure

- Maintenance Instruction Staff
- Select Mechanic Classifications
  - Master
  - Warranty
  - HVAC Technicians
- Maint. Mgmt. & Supervision
- OEM Technicians

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# Designated Personnel Training Requirements

Level I

- General High Voltage Safety Awareness
- OEM High Voltage Safety Training
- OEM Maintenance Bus Orientation
- OEM Operator Bus Orientation
- Bus Systems Training

Level II

- High Voltage Electrical Systems
- Battery Electric Propulsion System
- Energy Storage Systems
- Lockout / Tagout
- HV Personal Protective Equipment
- Contact Release
- First Aid

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# High Voltage Systems Tasks

There are service and maintenance task that require the use of Level 2 PPE.

- Zero Voltage Verification
- Live / Hot Work


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# Safety First: Managing Exposure

- Monitor adherence to safety policies, procedures and practices. Emphasize safety.
- Collaborate with OEMs for configuration improvements; safety features, component accessibility, placement, etc.
- Right size personnel assigned to HV tasks and support functions
- Course correct as technology advances and experience dictates

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# Questions???