Best practices for maintaining critical Traction Components over the lifetime of a vehicle

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Agenda

Maintenance through the ages

Drivers for Mid-Life Overhaul

Refurbishment solutions
Maintenance through the ages

Past
- High demand for preventive maintenance
- Low complexity
- High portion of mechanical components
- Continuous maintenance without major changes in design over very long time
- Maintenance fully realized by the operator

Today
- Reduced preventive maintenance
- High complexity
- Components as “Black Boxes” from suppliers
- Obsolescence issues on electronic components
- Cost and time pressure in workshops
Drivers for Vehicle Refurbishment

Life Cycle Costs Reduction

Obsolescence and maintenance issues

Reliability

System Improvement

Energy savings
Drivers for Vehicle Refurbishment

Obsolescence – Solve Spare Parts availability issues

Standardized building blocks

Simplified Maintenance

Increased availability

Water cooled IGBT phase leg.
Standardized building blocks provide long term availability of spare parts
Drivers for Vehicle Refurbishment

Reliability – Don’t miss the right time to start!

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Operation Analysis

<table>
<thead>
<tr>
<th></th>
<th>Specification</th>
<th>Bid phase</th>
<th>Prototype Upgrade</th>
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Time

Failures
Drivers for Vehicle Refurbishment

System Improvement – Seize the Opportunity

Elimination of weak spots

Remote Diagnosis

Multisystem/Hybrid operation

Component failure causes stopping
Component failure causes power reduction
Component failure has no impact to performance due to redundancy

MTA LRV 5004 (Baltimore – USA)

ABB Computer (Turgi - CH)
Drivers for Vehicle Refurbishment

Energy Savings – State of the Art technology for an optimized energy efficiency

State of the Art Technology

System optimization
### Refurbishment Solutions

Find the right scope and project setup

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**On-Site**
- Less cost
- Quicker execution
- Operator- and Supplier-Staff work hand in hand

**Off-Site**
- Integrated Solution
- Longer duration
- Train needs to be transported off premise (Logistic Risks)
# Refurbishment Solutions

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**Execution**

- **Commuter train, Germany**
  - 2015, 70 Vehicles

- **SBB Re460**
  - 2015 – 2021, > 100 Locomotives

- **Alstom, MTA, Baltimore**
  - 2014 – 2015, 53 Light Rail Vehicles

- **SJ X2**
  - 2015 – 2018, (1+) 35 HST

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| APTA Rail Conference 2017 | Slide 10 |
Refurbishment Solutions

Traction Converter Integrated in Existing Commuter Train Cabinet

Box in the box integration

Keeping vehicles interfaces untouched

Very high level of integration

“Plug – Play” Installation, performed directly by the train operator
Refurbishment Solutions

Adaptation to the existing vehicle interfaces

Vehicle Control Unit (VCU) Interface

Existing VCU

VCU - TCU adapter

Converter TCU, ABB standard controller

Vehicle control unit

- v reference of the train

RS232

- Reference values
  - Train-/Braking power
  - v_Train

- Actual values
  - Train-/Braking power
  - v_Axle

TCU

- Wheel track adhesion control
- Axle-Speed

Axles speed

- v_Axle

Speed of other axles

Driven axles

Rail
Refurbishment Solutions

Adaptation to the existing vehicle interfaces

Mechanical Interface
Recuperation of braking energy

Driving Modes
- Diesel Only
- Diesel + Battery
- Catenary
- Catenary + Battery
- Battery only

Hybridization of a Diesel Train