Voith Turbo GmbH, St. Pölten

Requirements on modern electrical traction systems and its implementations by Voith

Ankara, 2012-03-28
# Facts & Figures

<table>
<thead>
<tr>
<th>Voith Group</th>
<th>Voith in Austria</th>
</tr>
</thead>
</table>
| • Founded in 1867  
• 40,000 employees  
• Sales: EUR 5.600 million* | • Founded in 1903  
• 1,500 employees  
• Sales: EUR 550 million* |

* as of fiscal year 2010/11
Our Markets

Voith in Austria

Energy  Mobility  Paper  Service
Voith Turbo GmbH

Voith in Austria - Mobility Divisions

Road

Rail

Marine

Industry
# Voith Turbo GmbH

## Rail Division - Products and Systems

<table>
<thead>
<tr>
<th>Locomotive Technology</th>
<th>Diesel Driveline Systems</th>
<th>Electro-Mechanical Drive Systems</th>
<th>Cooling Systems</th>
<th>Scharfenberg Couplers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Development</td>
<td>• Turbo and Turbo reversing transmissions</td>
<td>• Final drives</td>
<td>• Complete cooling systems</td>
<td>• Complete front-end modules</td>
</tr>
<tr>
<td>• Engineering</td>
<td>• System technology</td>
<td>• Complete wheelsets</td>
<td>• Cooling networks</td>
<td>• Front-end energy absorption</td>
</tr>
<tr>
<td>• Prototype Construction</td>
<td>• Systems engineering and control</td>
<td>• Motor-gear units</td>
<td>• Fan technology</td>
<td>• Automatic couplers</td>
</tr>
<tr>
<td>• Locomotive production</td>
<td>• Automatic transmissions</td>
<td>• Traction converter</td>
<td>• Accessories</td>
<td>• Articulations</td>
</tr>
<tr>
<td>• Locomotive Service</td>
<td>• Engine technology</td>
<td>• Vehicle control technology</td>
<td>• Service</td>
<td>• Coupler service</td>
</tr>
</tbody>
</table>
Projects in Turkey

Final drives, Turbo Transmissions Cooling Systems Cardan Shafts

Railcar, TCDD Tüvlasas / Rotem
LRV B80D, Bursa Siemens
HST, TCDD CAF
Railcar MT5700, TCDD Fiat Ferroviaria
Railcar “Sakarya”, TCDD Tüvlasas

DH 7000, TCDD Tüvlasas
DH 7000B Irakish Ind., Tüvlasas
DH 10000 Turkish Ind. Tüvlasas

Local presence:
Voith Turbo Güç Aktarma Tekniği Ltd. Şti.
Birlik Mah. 415.Cad. 9/5
06610 Çankaya / ANKARA
Worldwide center of competence for electrical traction systems

- Voith Turbo in Austria is well known as most preferred partner for hydrodynamic transmissions in Turkey. Numerous vehicles have been equipped and serviced by our professionals from St. Pölten.

- Over the time, Voith Turbo has evolved from a component manufacturer to a system supplier for final drives, couplings, cooling systems or power packs.

- As a logical consequence, a new stage has been entered by foundation of Voith Turbo “Electrical Traction Systems” in 2006. Since that days, the entire R&D activities including the traction converter production are centered in St. Pölten.
Design aspects for optimized electric propulsion systems

Requirements

- Acceleration (max, mean, ...)
- Run time ($v_{\text{max}}$, duty cycle, line operation, ...)
- Braking (max, min, distance, ...)

Traction / Braking effort

- Drive configuration
  - Line parameter
  - Gear ratio
  - Motor performance
  - Traction converter performance
- Vehicle mass (empty, AW1, AW2, ...)
- Vehicle resistance

Line operation

- Run time
- Energy efficiency
- Life cycle cost
- Noise
- EMC
- etc.
Key requirements

- Driving performance is really adapted to operation demands
- Performance of traction converter, motor and gearbox are well balanced; component losses are minimized for typical duty cycles
- Energy recuperation is maximized acc. to operation profile and line conditions
- Using or storage of losses and braking energy for other sub-systems
Further aspects concerning system and service integration

Optimized traction means more than just putting parts together:

**Integration of all components to a technically and economically optimized service-friendly system!**
Benefits

System Know How ensures optimally coordinated components
Recuperation of braking energy
High dynamic slip-slide control
Line friendly traction control
Light-weight roof, under frame or cabinet housing
Modular design

Safety
Energy Efficiency
Availability
Maintainability
Reliability
EMC Interference

Life Cycle Costs
Environmental benefits
The Teams’ competence in Propulsion Systems
EmTrac –
Safety and Efficiency through system competence

Conception  Simulation  Realization  Integration
EmCon  Power Electronics Technologies (I)

Compact Power Unit with *Infineon PrimePack™* Modules for LRV/Metro

*Infineon PrimePACK™*

IGBT modules:
- FF650R17IE4D
- FF1000R17IE4D
EmCon  Power Electronics Technologies (II)

Power Stack Core for Metro/EMU/Loco with Standard Modules

*Infineon IHM-B modules*:  
- FZ1000R33HE3
- FZ1500R33HE3

1) Second source available from other IGBT supplier
## EmCon Traction Converter - Product Range

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Continuous Output Power</th>
<th>Voltage</th>
<th>Cooling Method</th>
<th>Mounting Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRV Tram</td>
<td>180 - 300 kW 1)</td>
<td>DC 600 / 750 V</td>
<td>Air Cooled</td>
<td>Roof Mounting - Single or Double Inverter</td>
</tr>
<tr>
<td>Metro DEMU</td>
<td>300 - 900 kW</td>
<td>DC 750 - 1500 V</td>
<td>Air/Water Cooled</td>
<td>Roof Mounting - Under Frame Mounting</td>
</tr>
<tr>
<td>EMU Loco</td>
<td>600 - 1200 kW</td>
<td>DC 1500 V AC 15 / 25 kV</td>
<td>Water Cooled</td>
<td>Cabinet Mounting - Under Frame Mounting</td>
</tr>
</tbody>
</table>

1) Continuous output power
An example for the implementation – Helsinki City Transport Tram
Helsinki City Transport Tram

- Pantograph, HV equipment
- Traction Inverter
- Motor-Gear Unit
- Axles, Wheels, Bearings
- Master Controller, Vehicle Control
- Diagnostic System

### Technical Data Vehicle

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>26.5 - 30 m</td>
</tr>
<tr>
<td>Total height</td>
<td>3.46 m</td>
</tr>
<tr>
<td>Maximum width</td>
<td>2.4 m</td>
</tr>
<tr>
<td>Track gauge</td>
<td>1000 mm</td>
</tr>
<tr>
<td>Number of seats</td>
<td>88</td>
</tr>
<tr>
<td>Number of standing spaces</td>
<td>125 (5 pers./m²)</td>
</tr>
<tr>
<td>Tara weight</td>
<td>41.0 t</td>
</tr>
<tr>
<td>Maximum speed</td>
<td>80 km/h</td>
</tr>
<tr>
<td>Max. power on wheel (driving)</td>
<td>520 kW</td>
</tr>
</tbody>
</table>
Electric Traction Design

Example LRV Helsinki - System Arrangement
Thank you for your attention!

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