



TROLLEYBUS

**MOTAS**



# UITP TROLLEYBUS WORKSHOP

The amazing birth of the trolleybus system in  
Riyadh in Saudi Arabia

Erik Lenz Vossloh Kiepe Oct 2nd 2015

# Modern e-bus propulsion systems Kiepe in the Vossloh group

## Vossloh AG

### Rail Infrastructure



- ▶ Vossloh Fastening Systems GmbH
- ▶ Vossloh Cogifer SA
- ▶ Vossloh Rail Services GmbH

### Transportation



- ▶ Vossloh Locomotives GmbH, Kiel
- ▶ Vossloh España S.A., Valencia
- ▶ Vossloh Kiepe GmbH, Düsseldorf

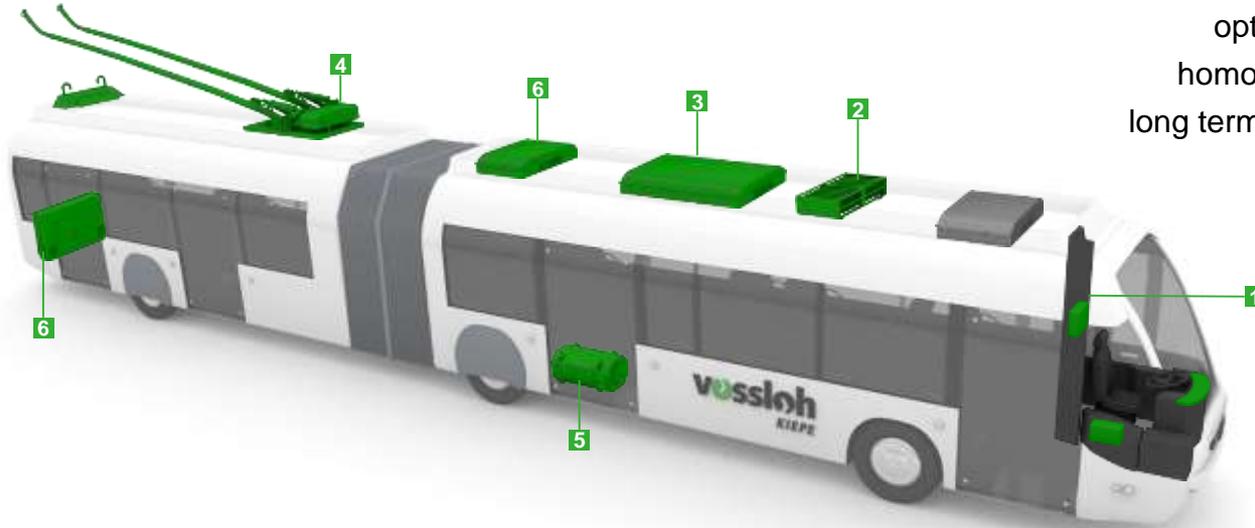
100 companies in 30 countries with approx. 5.700 Employees

# Modern e-bus propulsion systems

## Trolley Bus Propulsion System

### System Integrator

make it work reliable  
optimize  
homologation  
long term availability



#### 1 Energy Management

Controlling Units, Diagnostics



#### 2 Brake Resistor



#### 3 Power Electronics



#### 4 Current Collector



#### 5 Traction Motor



#### 6 Auxiliary Power Unit (APU)



# Modern e-bus propulsion systems

## New Campus People Mover transportation service



جامعة الملك سعود بن عبدالعزيز للعلوم الصحية  
KING SAUD BIN ABDULAZIZ UNIVERSITY FOR HEALTH SCIENCES  
RIYADH • JEDDAH • AL-AHSA



[www.youtube.com/watch?v=EpiOIPw0onw](http://www.youtube.com/watch?v=EpiOIPw0onw) (trolley bus after 4 min 52 sec)

# Advantages electrical BRT Solution

People Mover Systems (PMS)  
for King Saud Bin Abdulaziz Universities



## For the Passenger:

- ❑ Lower noise levels
  - Light Rail Tram 65 dB
  - Gasoline Bus 75 dB
  - Guided Tram 60 dB
  - Electrical PMS 50-60 dB
- ❑ More power, acceleration, and controlled deceleration
- ❑ Excellent and stable performance in hilly terrain
- ❑ Sensation of permanent service
- ❑ Improved trip quality
- ❑ Reduced travel times





## Transport Solutions

### OPERATIONAL CHARACTERISTICS OF LINE:

- ❑ City : Riyadh
- ❑ Number of Stations: 10
- ❑ Length 9km in total
- ❑ Average Passenger Demand: 20.000 daily passengers
- ❑ Headway : 4 minutes
- ❑ Average Speed: 20 Km/h
- ❑ Travel time: 30 minutes
- ❑ Number of electrical vehicles: 12
- ❑ Articulated vehicle 19,5 m
- ❑ Capacity of 120 passengers
- ❑ Start of passengers operation in May 2013



## Campus Transit System

– K.S.A.U.PROJECT جامعة الملك سعود



# Over all plan

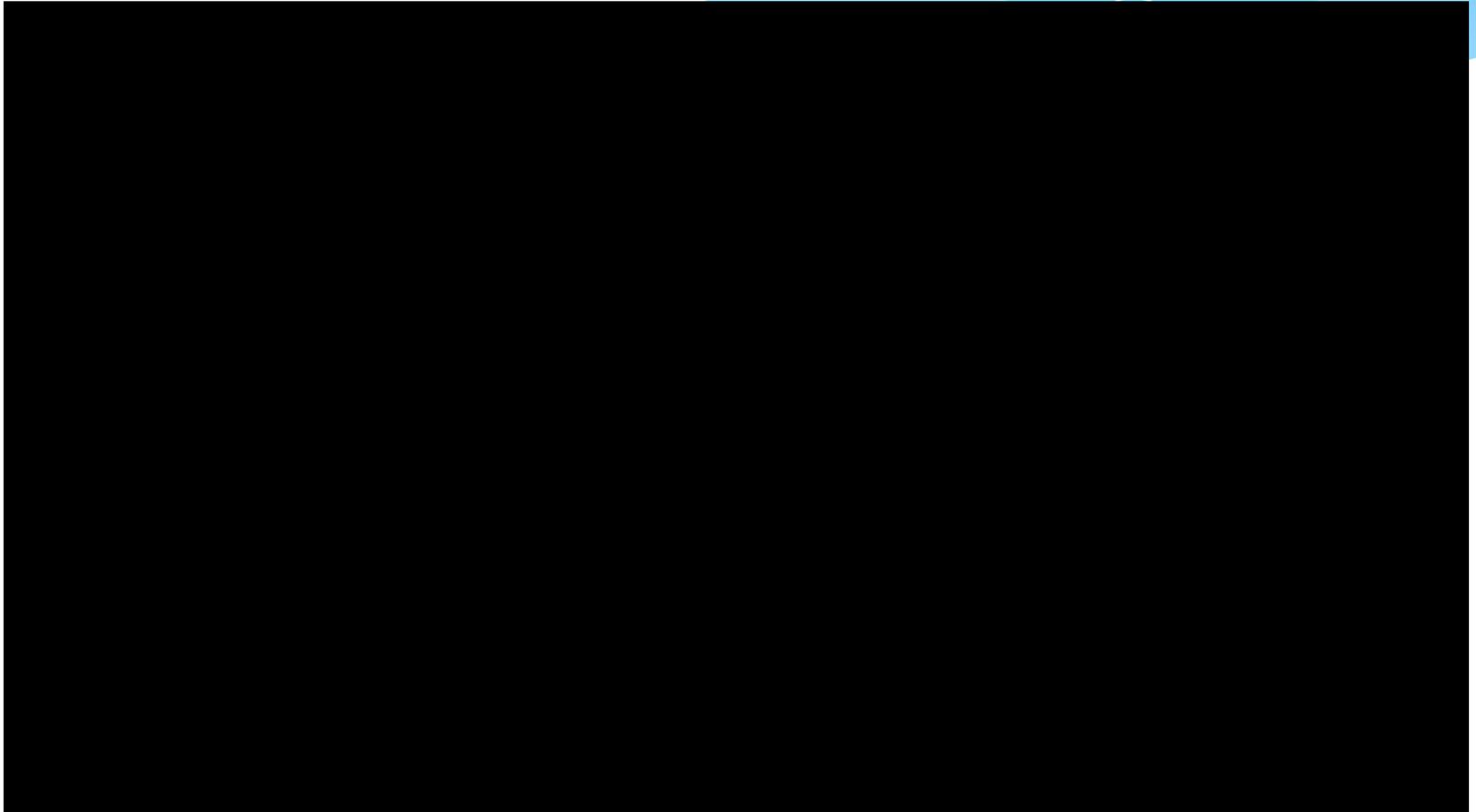


# Acknowledge of the KSU transport requirement

PMS KSU Project Consist of:

- 1- Catenary Installations.
- 2- Electrical Sub stations.
- 3- Depot Installations.
- 4- Telecommunication Systems.
- 5- Rolling Stock, 12 Vehicles.

# Acknowledge of the KSU transport requirement



## 1- Catenary Installations

- Aprox.9 km. powered and connected to the electrical substations
- Pure copper cable with silver
- Divided by 4 independent sections



## 2- Electrical Substations:

- 3 electrical substations for the power supplied to contact wires
- distributed along the line
- with High Redundancy
- Traction power supplied at 750 V d.c



### 3- Depot Installations:

- Fleet management and Control Area
- Repair and maintenance workshop areas
  - ✓ Interior and exterior washing systems
- 5 repair and maintenance lines
  - ✓ Inspection Line
  - ✓ Quick Repair Line
  - ✓ Slow Repair Line
  - ✓ Electric repair line
  - ✓ Water treatment for washing / 70% of water will be reused
- Trolley parking

#### **Depot and Workshop Equipment**

Vehicle washing Bridge, Water supply and sewage water treatment station, Mechanical Brake Test Meter, Travel crane, Compressed Air system, Exhaust Gas extraction, Systems for grease, oil and other liquids, Handling and lifting equipment, Special ladders and working stands basic equipment, Washing machine for industrial pieces, High pressure water cleaner, Rubber Repair Equipment...

# Depot

## Depot and Workshop Equipment





Parking Building



Depot Building

## 4- Telecommunication Systems

OPERATION CONTROL CENTRE (OCC) →

Ensures the capacity of **centralized monitoring** and control throughout the PMS

TRANSPORT MANAGEMENT AND OPERATION SYSTEM (TOMS) →

A software **to manage the whole system**. The operator can verify the CCTV, the positioning of each trolley by GPS and see and modify the state of the traffic and control the traffic lights.

SCADA →

**Monitors, oversees and acts** over different electric substations

TRAFFIC LIGHT CENTRALIZATION →

10 crossroads regulated by traffic lights which will **give absolute priority to the passage of electrical vehicles** by the means of specific loops in the Asphalt

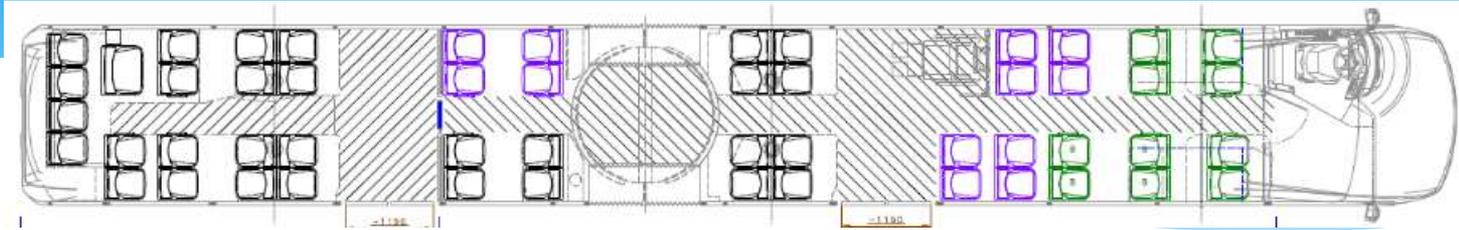
## 5- Rolling Stock, 12 Vehicles:

The Rapid Transit System (RTS) is fully equipped with 12 vehicles.

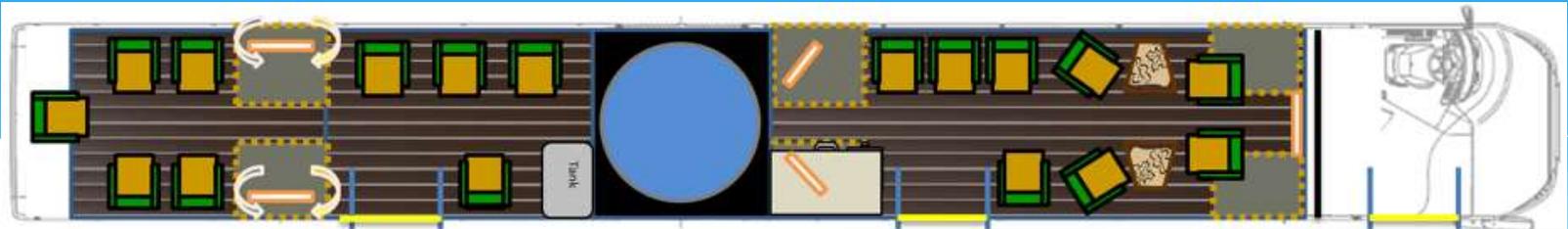
- Articulated
- Capacity of 120 passengers  
(of which 53 seated + 1 Handicapped position)
- 19.5m in length.
- Electric traction (main) and Diesel traction (auxiliary).
- Exclusive On-Board Display

# Interior Design

## Basic



# VIP Interior Design



# Operation

## **High Frequency Service between the stations**

- \* 10 hours service – from 7:00 to 17:00
- \* 5 days a week – from Saturday to Wednesday
- \* All year round

## **Maximum availability of electrical vehicles**

- \* A minimum of 4 and a maximum of 8 during rush hours
- \* Alternate use of the vehicles

## **Equilibrated work time schedule for drivers**

- \* 12 drivers
- \* 1 shift per day
- \* 5 days a week



# Modern e-bus propulsion systems

## Catenary system – Malatya / Turkey



## In Motion Charging

How to plan an IMC overhead wire system

**Take care about time**



### Wireless Section(s)

- Up to 50% of line
- Up to 50% of time
- ca 4km per section (max 15km)

### Charging Sections

Charging time

- Slow roads
- End stations

Energy consumption

- Steep roads

Inexpensive installation

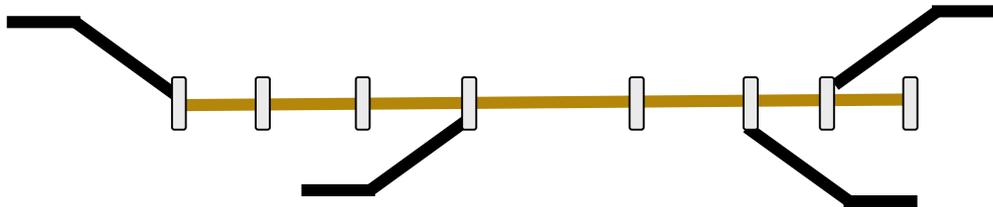
- Straight roads

# The future of Electro-Mobility with Vossloh Kiepe

## New electric Bus Rapid Transit (e-BRT) system with IMC bus feeders

Feeder lines  
with diesel bus

e-BRT Line  
with overhead wires

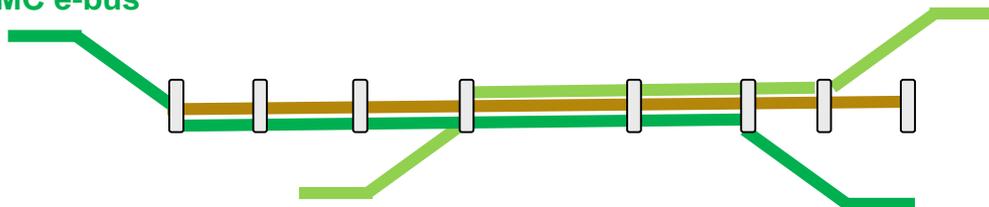


Passengers change bus from feeder bus to e-BRT bus

IMC feeder buses arrive at e-BRT destinations → less bus exchanges needed

Wireless feeder lines  
could merge with e-BRT  
by IMC e-bus

e-BRT Line  
with overhead wires



# Vossloh Kiepe – One Source for Your eBus System

## Trolley IMC: The Future is Present



**2014/2015** Seattle (141)



**2014** Lucerne (9)



Zürich (35) **2012**



**2005** Vancouver (262)



**2015** Cagliari (4)

**2015** Esslingen (4)

**2014/2015** San Francisco (60)



**2015** Dayton (2)

**2013/2014** Geneva (33)



# Modern e-bus propulsion systems

## Key References - Trolleybus

### References – a selection

- ▶ **Turkey:** Malatya
- ▶ **Germany:** Esslingen, Solingen, Eberswalde
- ▶ **Ecuador:** Quito
- ▶ **Greece:** Athens
- ▶ **Italy:** Bologna, Avelino, Bari, Modena, Parma, Genua, Lecce, Milan, Rimini, La Spezia, Cagliari ...
- ▶ **Canada:** Vancouver
- ▶ **Austria:** Linz, Salzburg
- ▶ **Switzerland:** Fribourg, Geneva, Biel, Lucerne, Zurich, Bern, St.Gallen, Lausanne, Montreux, Winterthur, Neuchatel
- ▶ **Venezuela:** Mérida
- ▶ **Belarus:** Minsk
- ▶ **Norway:** Bergen
- ▶ **USA:** Philadelphia
- ▶ **Hungary:** Budapest
- ▶ **Saudi Arabia:** Riyadh



# Modern e-bus propulsion systems

## Diesel-Hybrid bus References

- ▶ **Netherlands:** Enschede, Groningen
- ▶ **Luxembourg:** Luxembourg
- ▶ **Switzerland:** Basel
- ▶ **Germany:** Dortmund, Dresden, Düsseldorf, Ennepetal, Hagen, Leipzig, Hagen, Leipzig, Lübeck, Luxembourg, Wuppertal, Hamburg
- ▶ **Poland:** Co. Solaris



# Modern e-bus propulsion systems

## Fuel-Cell & Battery Bus References

- ▶ **Netherlands:** Amsterdam (Fuel Cell)
- ▶ **Austria:** Klagenfurt (connector)
- ▶ **Poland:** Krakow, Co. Solaris (connector)
- ▶ **Germany:** Berlin, Braunschweig (inductive)  
Hamburg, Hürth/Cologne (Fuel Cell)  
Düsseldorf (connector)  
Frauenhofer IVI (pantograph)



## Vossloh Kiepe

How can we help you?

Tell us your needs ...

... and we can advise you the right e-bus concept:

- Trolleybus
- Trolleybus with battery backup
- Trolleybus with battery for wireless operation



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EUROPE  
16-21 OCT 2015



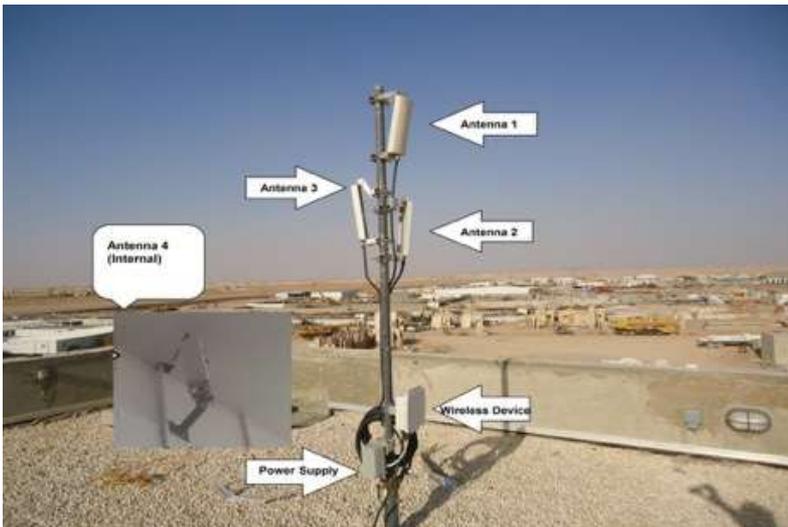
Booth R45



## Video Wall system



## Scada system



- Fiber Optic Ring Gigabit Ethernet Network
- Wireless Network
- Radio Trunking



