

A black and white photograph showing the interior of a modern tram or light rail vehicle. The view is from the front of the vehicle looking back, showing rows of seats and the front windshield area. The lighting is bright, and the interior appears clean and spacious.

## *Lierenfeld Depo & Atölye*

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***Günaydın, Hoşgeldiniz !***

# Maintenance Procedures



for

**BUGSAS Ankara Metro**

**Marc Herkenrath, LRTC GmbH**

Düsseldorf, 30th October 2008

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# *Laws and Regulations (1)*

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## Overview

- **PBefG** (Federal Law)
- **BOStrab** (Regulation)
- **EN** and **DIN** (Norms)
- **VDV Documents**  
(Guidelines made by Association of German Public Transport Operators)



## ***Laws and Regulations (2)***

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### **PBefG**

- In Germany LRT Systems are being operated according to the „Personenbeförderungsgesetz“ (PBefG).
- PBefG is a German federal law governing the licensing, construction and operation of light rail systems and other public transport modes.

# ***Laws and Regulations (3)***

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## **BOStrab**

- The main regulations concerning operational and technical issues within PBefG are the  
*„German Federal Regulations on the construction and operation of light rail transit systems“* (BOStrab)
- BOStrab has several supplements (e.g. guidelines regarding quality and design).

# ***Laws and Regulations (4)***

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## **BOStrab**

- It is to be noted that BOStrab is strictly on a functional level.
  
- BOStrab
  - demands general safety,
  - allocates responsibilities,
  - defines corresponding procedures and
  - may refer to guidelines regarding quality, design and standards
  
- BOStrab does not demand the observance of exact dimensions or figures.

# Laws and Regulations (5)

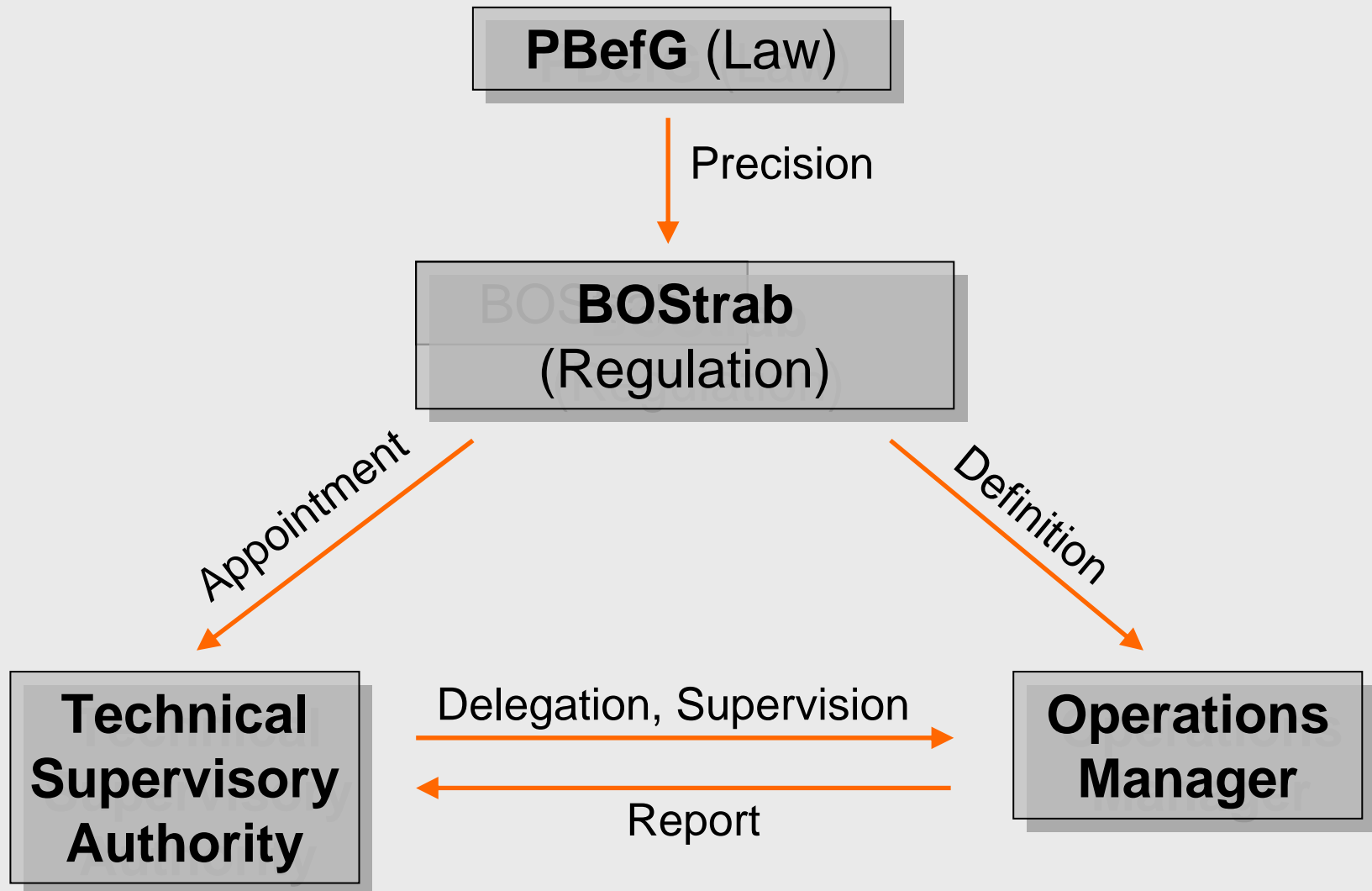
## BOStrab

- BOStrab says:

*„Operational installations and vehicles must be so constructed that in normal use they can injure nobody, and endanger or hinder nobody more than is unavoidable.“*



# External and Internal Responsibilities (1)



## ***External and Internal Responsibilities (2)***

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### **Technical Supervisory Authority**

- Supervision of compliance with legal requirements in Germany is being carried out by a regulating agency called *Technische Aufsichtsbehörde (TAB)* („Safety Authority“ or „Technical Supervisory Authority“) which is appointed by the government.

# ***External and Internal Responsibilities (3)***

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## **Technical Supervisory Authority**

- The „Technical Supervisory Authority“ (TAB) is in the name of the Ministry of Transportation responsible for safety checking and safety assurance of light rail transit systems according to BOStrab and its potential supplements (e.g. guidelines regarding quality and design).

# External and Internal Responsibilities (5)

## Technical Supervisory Authority

- The TAB investigates safety of
  - infrastructure,
  - rolling stock and
  - operating procedures & personnelas well as the
  - inspection / maintenance intervals of **rolling stock** and **fixed installations.**



# ***External and Internal Responsibilities (6)***

## **Technical Supervisory Authority**

- The TAB's responsibilities are limited to the LRT system.
- A new road built in conjunction with the light rail system will need to be assessed by the authority responsible for the road, and not the TAB.



# ***External and Internal Responsibilities (7)***

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## **Operations Manager**

- The appointment of the Operations Manager requires the confirmation of the Technical Supervisory Authority.
- On application by the Public Transport Operator (PTO), the TAB will confirm the appointment of the Operations Manager provided that:
  - he has passed the examination for Operations Manager (comparable to the Major State Examination for the higher technical public service)
  - has had at least three years experience as an engineer in a department of a PTO concerned with construction and operations

# ***External and Internal Responsibilities (8)***

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## **Operations Manager...**

- is responsible for the safe and orderly operation of the system as a whole.
- must produce instructions (e.g. Rule book) for operational staff which will ensure that the requirements of the BOStrab are observed, and must ensure that they are fulfilled.
- must bring such instructions (Rule book) to the notice of the TAB.
- is also responsible for the maintenance of Fixed Installations and Rolling Stock ...

# ***Elements of Maintenance (1)***

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## **■ Examinations**

- Daily Preparation  
(Washing, cleaning, refilling, sight checks)
- Regular Examinations  
(Extended checks, replacement of wearing parts, ...  
every 15', 30', 60', 120', ... km or equivalent)

## **■ Inspections**

Works according to BOStrab requirements

## **■ Repairs**

Corrective works following defects and accidents

# Maintenance Requirements (1)

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## General BOStrab Requirements

- BOStrab defines the maintenance of Fixed Installations and Rolling Stock:
- „Maintenance of fixed installations and vehicles comprises **examination, inspection and repairs**.

*These operations must cover, at the minimum, all those parts which may affect operational safety. The manner and scope of examination and inspection, must relate to the construction and severity of use of the installations and vehicles.“*

## ***Maintenance Requirements (2)***

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### **General BOStrab Requirements**

- According to BOStrab, **inspections** must be carried out on a scheduled basis, and within maximum intervals, e.g.:
  - Power Supply: 5 years
  - Trackwork: 5 years
  - Rolling Stock: 500,000 km, but not exceeding 8 years
  
- Without regard to the **inspection intervals**, fixed installations and vehicles are subject to inspection after serious accidents in which damaged parts may affect safety.

# Maintenance Requirements (3)

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## General BOStrab Requirements

- The Safety Authority may in certain cases extend the inspection intervals.
- They may also, on systems with peculiar features, set shorter intervals.
- *„Inspection is an examination for the purpose of ensuring compliance with rules and regulations (e.g. BOStrab) or other requirements. It is the critical examination of a product to determine that it conforms with applicable standards and specifications.“*

A black and white photograph showing a railway track with a train in the distance, partially obscured by a grey vertical bar on the left side of the slide.

## ***Maintenance Requirements (4)***

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### **BOStrab Requirements for Inspections**

- Inspections must be recorded.
- The records must be filed with the documentation which is essential for the structures and maintenance.
- In particular, the acceptance certificates for rolling stock and for fixed installations, the supporting documents which formed the basis for the building consent.
- Records for inspections must be retained until the next inspection or a minimum of 3 years.

# Maintenance Principles (1)

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## Overview

- Rolling Stock Maintenance can generally be divided in:
  - routine (regular) maintenance > *light maintenance*
  - overhaul > *heavy maintenance*
  
- Rolling Stock Maintenance will be carried out in workshops:
  - light maintenance workshop
  - heavy maintenance workshop

# ***Maintenance Principles (2)***

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## **Light Maintenance**

- Light maintenance includes
  - preparation for the next duty,
  - sand refilling,
  - interior and exterior cleaning,
  - inspection / fault diagnostic, and
  - small repairs which can be executed during one shift.
  
- Light maintenance will be carried out in the light maintenance workshop

# ***Maintenance Principles (3)***

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## **Heavy Maintenance**

- Heavy maintenance includes all maintenance activities which can not be executed during light maintenance.
- These activities are in most cases
  - major overhaul,
  - bogie repair,
  - vehicle body repair,
  - painting and
  - wheel lathing.
- Heavy maintenance will be carried out in the heavy maintenance workshop.

# *Modern Approach (1)*

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## **Situation**

- The required inspection works due to BOStrab every 500,000 km or 8 years (which comes first) lead to regular unavailabilities of rolling stock for several weeks.
- Compensation by additional vehicles necessary
- In the meantime regular examination works do not last for one complete shift (8 hours).
  
- **→ The available fleet is not used with maximum efficiency.**

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## *Modern Approach (2)*

### **Objective**

- Avoiding of unavailability for long periods and need for operational compensation
- Equalization of durations of regular maintenance works in order to utilize working shifts to full capacity
  
- → **Considerable reductions of costs and improvements of fleet availability**

## ***Modern Approach (3)***

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### **Measurements**

- Splitting of inspection works into suitable fractions
- Integration of these fractions into the volume of one working shift (8 hours) by adding them to regular examination works
- Adaptation of inspection frequencies to actual wear and tear of parts
  
- **→ Equal work loads for each shift and no exceptional unavailabilities of fleet**

# ***Modern Approach (4)***

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## **Conditions**

- This approach leads to splitting up a work package („inspection“) that is under supervision of TAB and that had formerly been performed „en bloc“.
- For that reason, a working method has to be established, that ensures
  - high qualification of involved staff
  - consistent and durable documentation
  - exclusion of later manipulation

# *Modern Approach (5)*

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## Conditions

- This approach leads from a safety-driven philosophy to an economically driven philosophy with higher risk of unexpected defects.
- This risk can be managed and be kept justifiable by an adapted maintenance concept with focus on data quality and regular surveillance to improve empirical knowledge.
- This approach has to be strictly limited to components that are not safety relevant!
- The gained results continuously have to be considered for constant improvement of the process.
- → „**Inspective Maintenance Procedure**“

**THANK YOU FOR YOUR ATTENTION**

**Questions?**

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**Düsseldorf, 30th October 2008**