

10 Inbetriebnahmebegleitende gutachterliche Tätigkeit der ARGE TÜV Transrapid beim Projekt Maglev Shanghai

(Assessment activities of joint task group TÜV Transrapid during commissioning of the Shanghai Maglev line)

Wolfgang Otto ¹⁷

10.1 Abstract

The paper describes the assessment tasks carried out by the joint task group of TÜVs for the Shanghai Maglev Project to ensure safety during the commissioning phase and prior to the Revenue Service starting in 2004.

10.2 Introduction


The construction of a magnetic levitation train route between the international airport of Pudong and the city of Shanghai is the first commercial application of the Transrapid magnetic levitation train.

TÜV InterTraffic as a company of TÜV Rheinland, Berlin - Brandenburg and member of work group ATT (Arbeitsgemeinschaft TÜV Transrapid) is a global specialist for all safety - critical issues of the Transrapid maglev train (see slides 10.1...10.5). The Company has accompanied the design, test and introduction of this innovative technology over a period of 25 years. Due to this outstanding expert knowledge and long practical experience ATT has been selected to support

- the German suppliers Siemens, ThyssenKrupp, Transrapid International in verifying the Transrapid safety concept and realisation of the technical components to be applied in Shanghai,
- the Chinese Shanghai Maglev Transport Development Company (SMTDC) to assure safe operation during the VIP Runs scheduled in December 2002 and provide expert opinions with regard to the Revenue Service starting in 2004.

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■ **TÜV InterTraffic GmbH**
ISA – Independent Safety Assessment




Assessment activities of joint task group TÜV Transrapid during commissioning of the Shanghai Maglev Line

Contribution to the third Transrapid conference held at TU Dresden on 2003-10-07

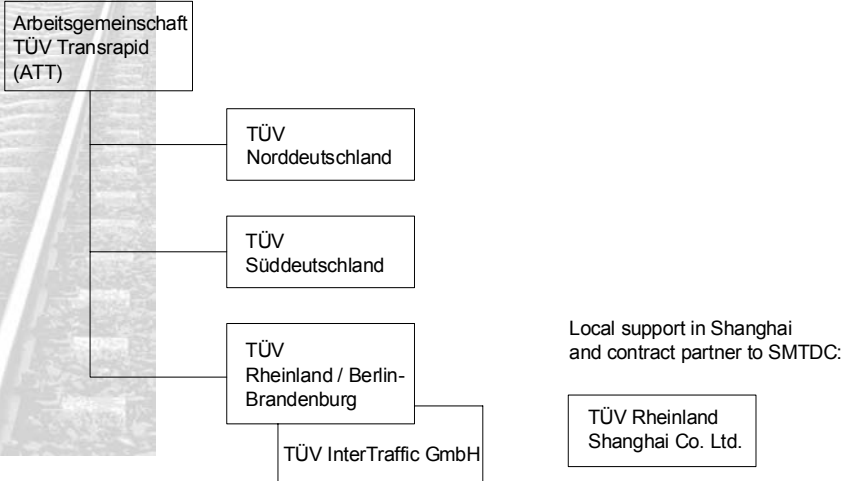
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■ **Members of joint task group**
Overview



Arbeitsgemeinschaft
TÜV Transrapid
(ATT)

TÜV
Norddeutschland

TÜV
Süddeutschland


TÜV
Rheinland / Berlin-
Brandenburg

TÜV InterTraffic GmbH

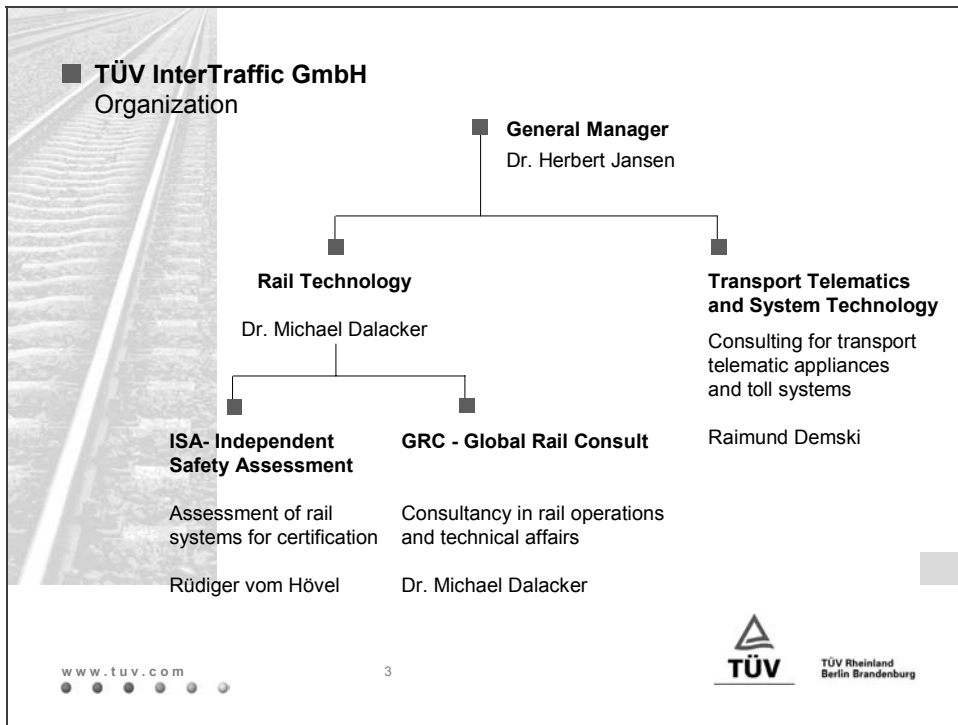
Local support in Shanghai
and contract partner to SMTDC:

TÜV Rheinland
Shanghai Co. Ltd.

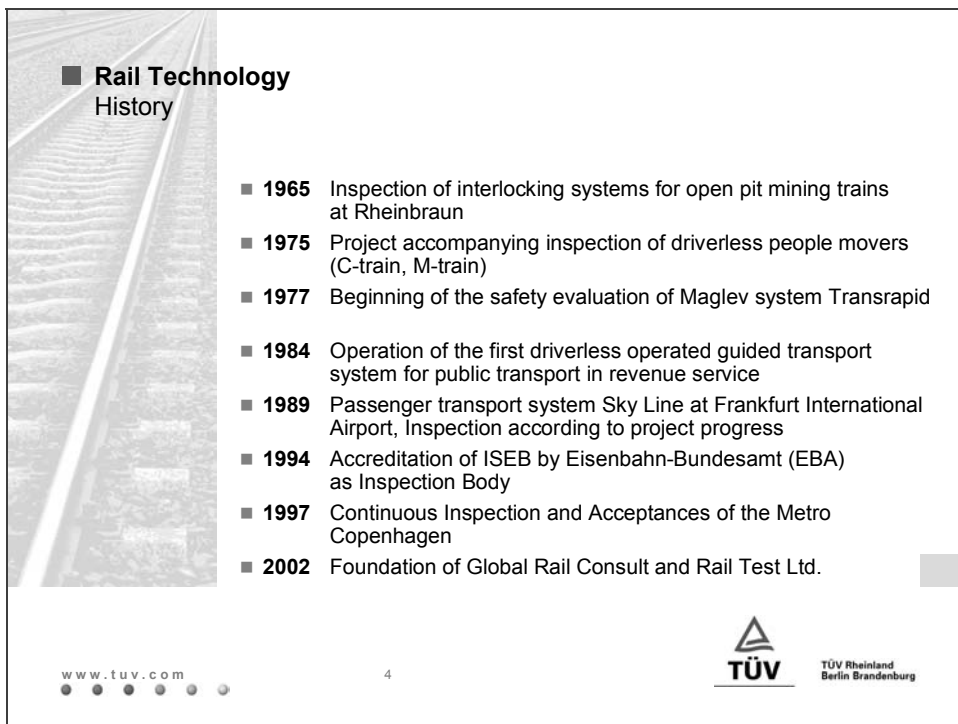
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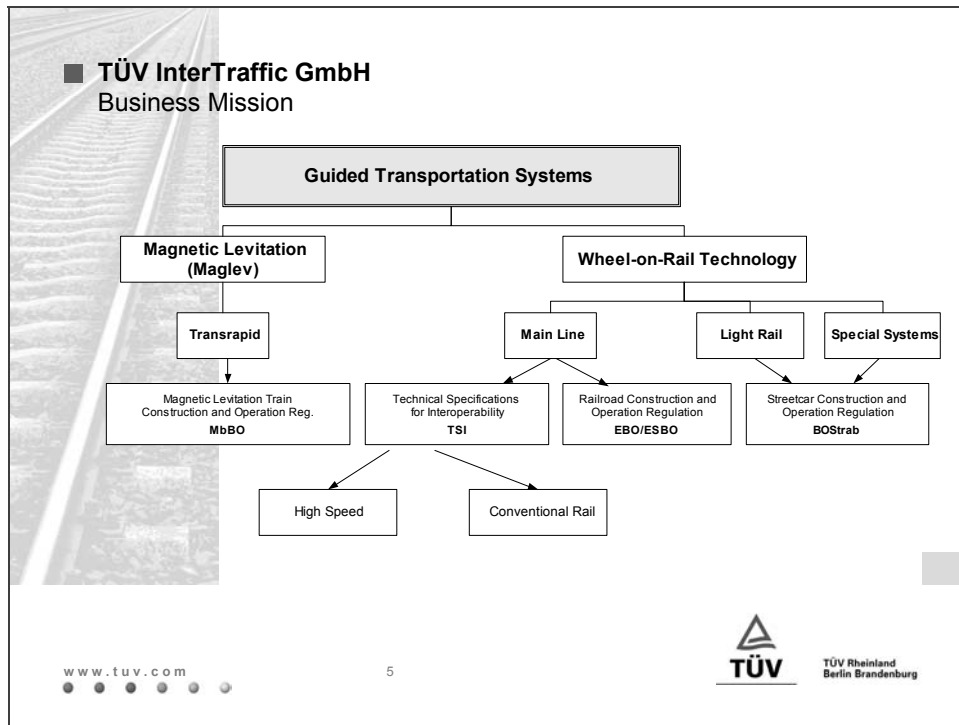
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Slide 10.3



Slide 10.4



Slide 10.5

Most assessment tasks were carried out by TÜV InterTraffic. This comprises the assessment of:

- **Operations Control System (OCS)**
 - High - level system documents,
 - Requirement Specifications,
 - Interfaces to other sub – systems,
 - Speed Profile Monitoring and Locating System.

- **Passenger Vehicle**
 - Mechanical structure,
 - Electrical equipment,
 - Interface to Evacuation and Rescue Concept,
 - Interface to Guideway (gap balances).

- **Guideway Switches**
 - Electrical part including OCS installations,
 - Interface to Operation and Maintenance,
 - Handling during commissioning.

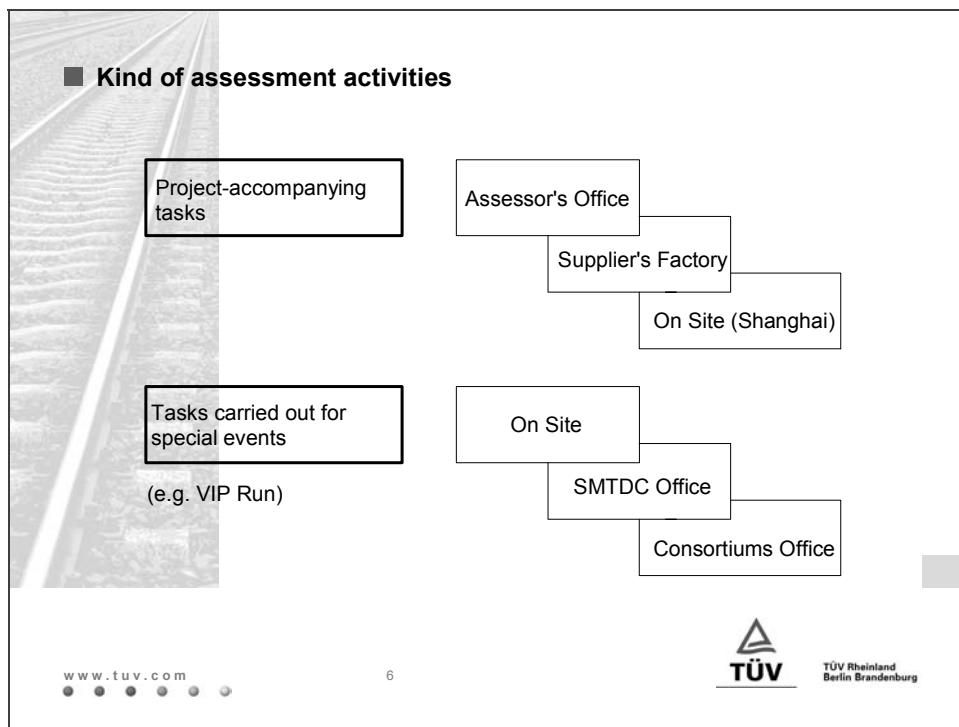
- **Rules & Regulations**
 - for Commissioning and Demonstration Test Runs,

- for Operations during Revenue Service,
- for Maintenance during Revenue Service.

TÜV Süddeutschland as other member of ATT carries out the assessment on the

- OCS, part vehicle safety computers,
- Longstator-packs (construction and mounting).

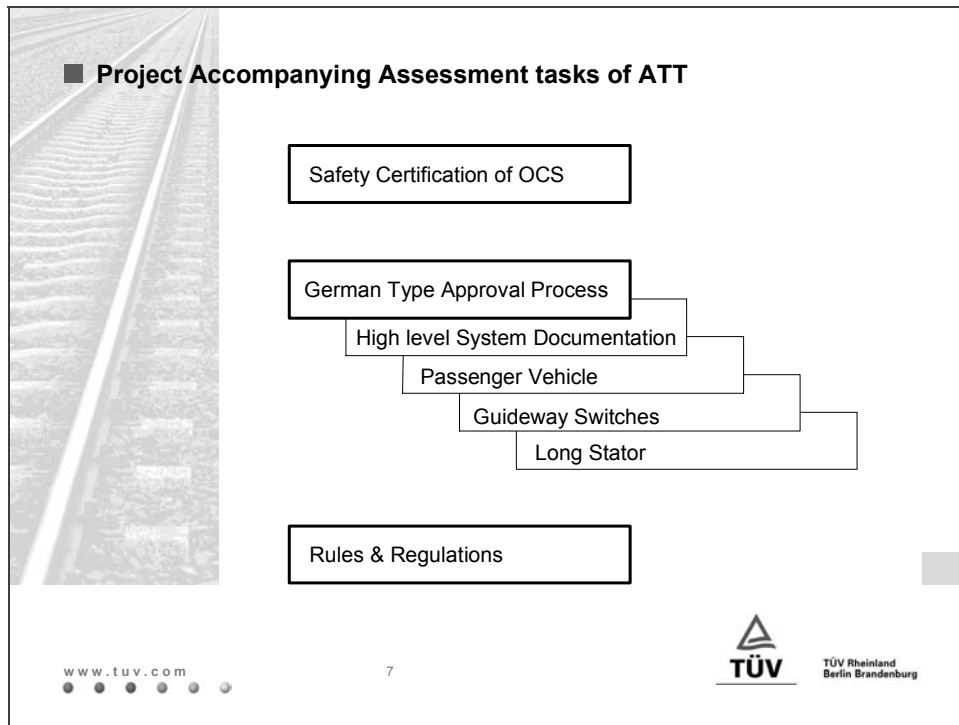
The above mentioned tasks are carried out on behalf of the system suppliers according to the development stages of the concept, plans and deliveries. Due to the early involvement of ATT and direct reporting to the suppliers, this so called Project Accompanying Safety Certification (PASC) - which has been applied successfully on several other projects - has been proven as time and cost efficient. For special events, assessment tasks will be performed on site (see slide 10.6).



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10.3 Project accompanying Assessment tasks

The tasks carried out by ATT concerning the technical subsystems of the Shanghai Maglev line comprise the following assessment activities (see slide 10.7):



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▪ **Safety Certification of OCS**

- Inspection of requirement specification, functional and interface descriptions, test cases;
- witnessing of factory acceptance tests.

The documents issued have been checked by using criteria checklists drawn up by ATT agreed with the customer. Findings are reported to him.

▪ **German Type Approval Process**

- Document inspection (especially validity of high-level system documentation),
- witnessing of factory acceptance tests during the development process,
- providing quality assurance during manufacturing,
- witnessing / performing of on site functional tests (for the supplier).

Activities carried out here are reported to the respective suppliers and to the Federal Railway Office (Eisenbahn - Bundesamt, EBA).

▪ **Rules & Regulations**

Concerning Rules & Regulations for commissioning, document inspections were performed. The outcome was reported to the supplier and was considered in the next revision of the documents.

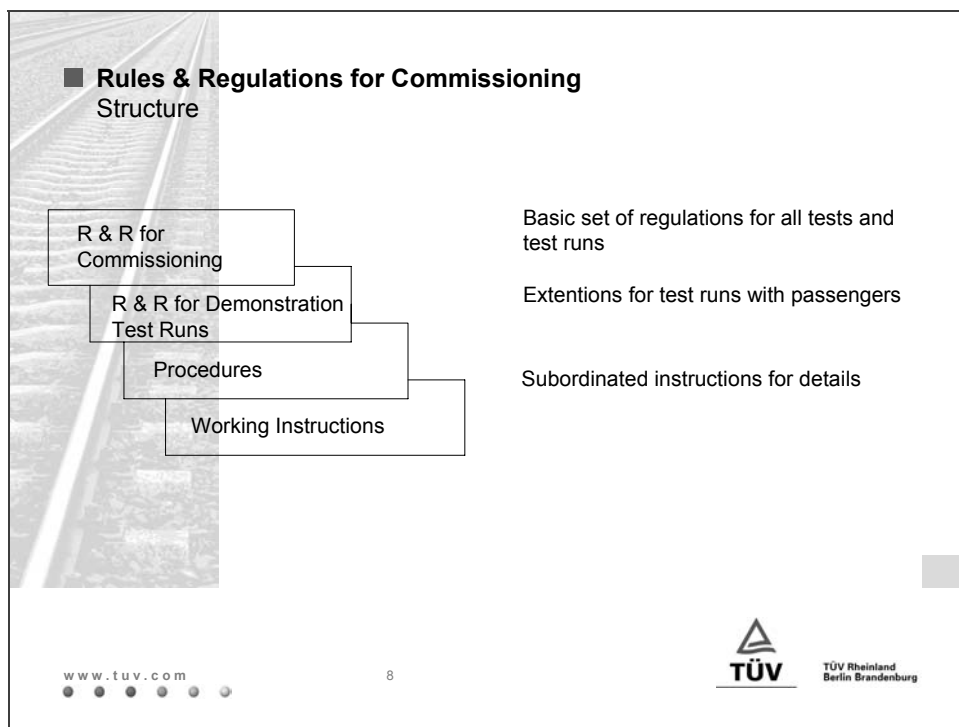
The first document contains general rules for performing test runs without passengers under personal responsibility:

- Tasks and communication of staff,
- organisation and qualification of staff,
- conducting of train runs,
- movement of service vehicles,
- handling of access requests,
- system releases, inspection and maintenance tasks.

The second document provides extensions for train runs with passengers including the VIP Run on 2002-12-31:

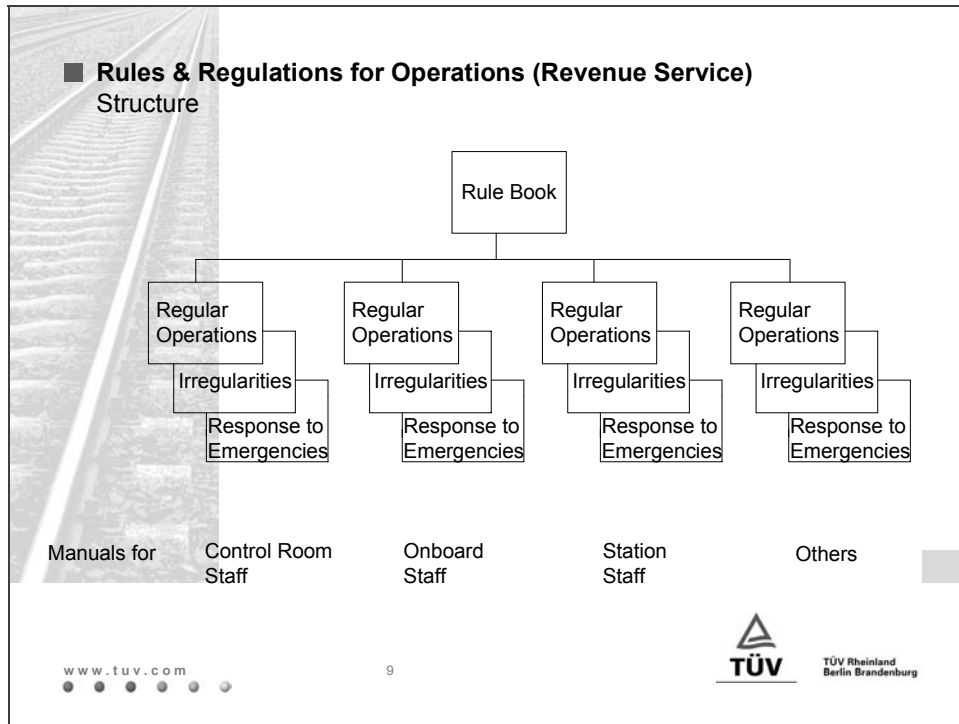
- passenger assistance,
- platform supervising, security aspects,
- consideration of vehicle passenger payload,
- Evacuation and Rescue Concept.

These papers are accompanied by subordinated papers dealing with detail issues, split into Procedures and Work Instructions. With the exception of the multi-vehicle operation carried out in Shanghai, content and structure of the documents are similar to those applied on the German Maglev test facility Transrapid Versuchsanlage Emsland (TVE) in Germany, which were also checked by TÜV InterTraffic (see slide 10.8).



Slide 10.8

For Revenue Service, the documents are structured regarding the acting people and possible operational scenarios (see slide 10.9). This approach is known from operating of public transport systems in different countries. Since the Maglev Shanghai is the first commercial application of the Maglev technology, the assessment performed by TÜV InterTraffic within 2003 is a challenging task currently in progress.



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Precondition for applying these rules is a fully installed and safety proven system, which is accepted and approved by the Chinese customer. The transition of the Rules & Regulations from commissioning to revenue service is also part of works.

10.4 Assessors' duties concerning the VIP Run

Under a contract with the Chinese company SMTDC, a safety engineering evaluation of the entire facility was carried out on site in November / December of 2002. The background was the demonstration run with high-ranking Chinese and German government representatives which was carried out on December 31, 2002. The system safety had to be independently certified for this event.

Since the safety of the Operation Control System (OCS) components intended for commercial use had not yet been proven, the safety-related reactions of additional safety

systems („Auxiliary Operation Control System“, AOCS) installed for the start-up was examined.

Furthermore, the acting staff, who also ensures safe operation, was topic of the assessment carried out in Shanghai.

The duties of ATT according the contract are listed as follows:

- The assessment of the technical systems installed with emphasis on safety-related functions and interfaces,
- the assessment of operational rules and operation methods to be applied during test runs with passengers,
- a judgement on staff qualification and skills to handle the Maglev system.

The assessment was carried out in collaboration with the Chinese customer SMTDC and the German suppliers. The approach selected by ATT was based on German and European Frameworks (e.g. MbBO, BOStrab), railway signalling standards (e.g. Mü8004, EN5012x) and rules and instructions existing for the operation of the Emsland Maglev Test Facility (TVE) in Germany.

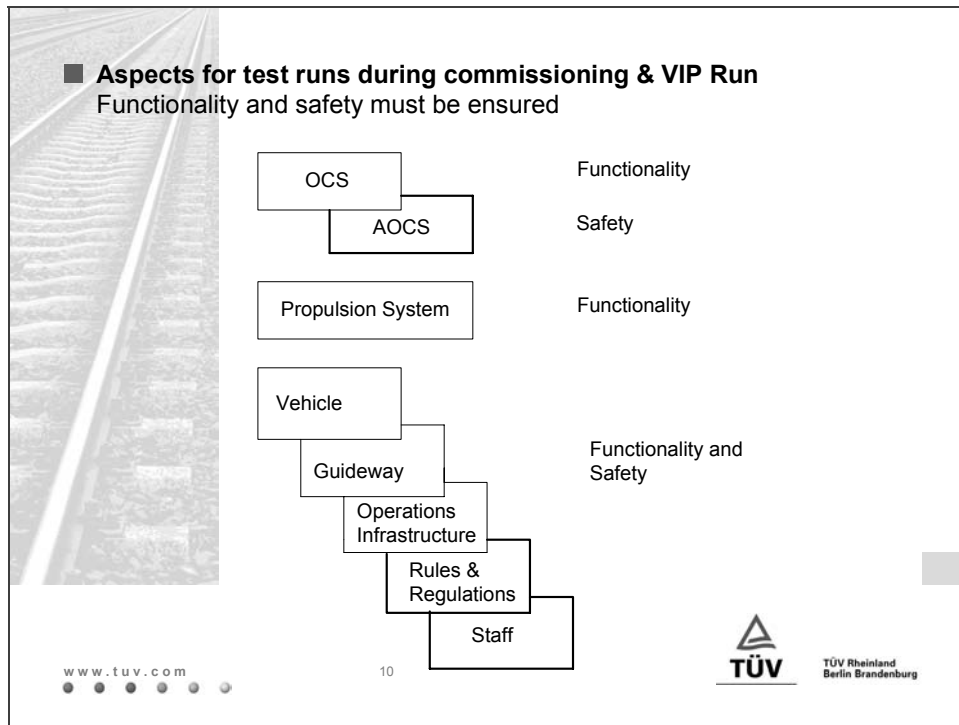
A joined task group of ATT, consisting of TÜV InterTraffic and TÜV Süddeutschland with local support of TÜV Rheinland (Shanghai) conducted an assessment on the maglev site in Shanghai during November / December 2002. To provide for an expert opinion on behalf of SMTDC, the whole systems functionality and commissioning organisation was verified. The following issues were checked:

- Compliance of installed sub-systems with safety requirements,
- compliance of civil works infrastructure with safety requirements,
- ability of staff to act according the verified Rules & Regulations.

The frames listed in slide no. 10.10 show the necessary parts for performing test runs. They will be tested and changed / extended during the various commissioning steps by the German suppliers. But safety for staff and passengers on the train and other persons must be granted from the beginning . This led to the introduction of further measures like AOCS and a set of instructions to be observed by operational staff.

The AOCS is an additional system working independently from OCS for:

- Initiating a safe shut-off of propulsion energy in the sub-stations,
- applying the emergency brakes in the vehicle (immediate forced stop).



Slide 10.10

It must be handled manually. It is no back-up for OCS and will be removed after OCS has been certified finally safety-proven. During the commissioning phases it ensures safe operation in conjunction with the acting staff (personal responsibility).

Therefore checking **AOCS functions** and **staff abilities** have been essential **key parts** checked by the assessor.

The assessment of the technical parts

- AOCS (with power switches in the sub-stations),
- Passenger Vehicle,
- guideway equipment,
- guideway switches,
- operation facilities (civil works infrastructure necessary for operation)

was split into the main tasks (see slide 10.11):

1. Document Inspection,
2. visual inspection of installations,
3. performing / witnessing of functional tests.

■ **Assessors' duties concerning VIP Run**
Assessment of technical Systems

Document Inspections

Visual Inspections

Functional Tests

Focus on safety functions /
interfaces

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The **document inspection** comprises:

- Verification of validity and adherence to specific Shanghai boundary conditions of all safety related interfaces,
- comparison with characteristics known from the German Type Approval process granted by EBA,
- looking up of already existing assessment reports from other experts involved in the project.

The **visual inspections** comprises:

- Looking up the installation of AOCS components (in the control room, sub-stations and vehicle),
- looking up of control room (access, work places), stations (access, construction and equipment of platforms), vehicle (construction, equipment), Maintenance Area (maintenance hall, stabling tracks, work infrastructure) , track layout (power rails; location, access and equipment of Auxiliary Stopping Areas; fencing in of at- grade tracks; securing of street crossings,...).

The following tests have been demonstrated to the assessor (named as **functional tests**) to demonstrate the safety functions:

- Applying of vehicle forced stop with safe shut-off of propulsion energy (several times under different conditions) initiated via OCS and AOCS,

- demonstrating the movement of guideway switches with manual supervision,
- monitoring test runs in normal situations and with provoked failures (e.g. sliding skid of the passenger vehicle),
- participating in a train evacuation (stop on the line, using the rescue slides, grounding power rail, transfer passengers back,...),
- handling of AOCS, train doors (in normal and emergency situations).

The **Assessment of Rules & Regulations** was based on the formerly document inspection. It was checked, whether

- the R & R laid down are feasible and reasonable,
- are followed during operation,
- how changes are managed.

This was done by witnessing test runs in the control room or in the cockpit of the passenger vehicle and participating in an evacuation & rescue drill. In detail the assessor watched handling and communications regarding:

- System releases of all involved sub-systems,
- allocation of guideway sections to be used by the vehicle,
- exchanging messages regarding velocity and location of the vehicle,
- access to control room, stations and vehicles,
- looking up of logbooks and duty rosters.

■ **Assessors' duties concerning VIP Run**
Assessment of staff

- Watching Test Runs
- Looking-up of Records
- Performing Audits
- Participating in Trainings and Drills

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Slide 10.12

To evaluate the staff ability to handle to system safely and as evidence of qualification, it was looked up (see slide no. 10.12):

- The organisation during commissioning and test runs with passengers,
- the existing training plans and already performed training activities (records),
- if certificates were handed over to appointed staff members (authorization of staff),
- if standby positions for all staff positions were available.

Furthermore, audits were performed on a qualified spot-check basis to support the assessors impression got during observing the activities.

The Assessment Report containing the findings was discussed with EBA and handed over to SMTDC. It states the readiness of staff and technical systems for commissioning purposes and concludes with:

- Conditions to be fulfilled prior to the first Demonstration Test Run,
- restrictions to be observed during the Demonstration Test Runs,
- recommendations for further improvements.

The actions taken on by SMTDC and German suppliers before and during the presence of ATT experts on the site led to a safe and successfully VIP Run in December 2002 and in future times.

10.5 Outlook

The comprehensive systems knowledge and outstanding experience of ATT made it possible to carry out the necessary works under a very tight time schedule.

Experts of ATT will accompany the ongoing process to put the first commercial Maglev application into safe operation for revenue service.