

# The role of the safety concept within the approval process

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**ABSTRACT:** The safety concept is a debit-representation of the safety condition of a concrete maglev train line based on a system analysis which considers the complex operational, technical, constructional and organisational structures and installations in their totality. The applicable maglev train construction and operation order (Magnetschwebbahn-Bau- und Betriebsordnung) (MbBO) [1] for the building and operation of a maglev train envisages the schedule of a safety concept for a maglev train line through the operator and its authorisation through the Federal Railway Authority. Before a maglev train can be placed into operation further approval procedures are required. The article at hand would like to point out in which complex and comprehensive connection the safety concept is with the other elements of the total authorisation process up to the beginning of operation.

## 1 INTRODUCTION AND BASICS

Before we dwell on the connections to other approval procedures and to emphasise the importance of the safety concept the general conditions and contents of the safety concept are explained more closely.

To come to a debit-representation of a desired safety condition a structured process is required to guarantee on the one hand a systematic consideration of a multitude of parameters and on the other hand that a comprehensive system analysis can be performed.

The MbBO prescribes in § 23 the following approach for this which has to be respected with the issue of a safety concept: "The safety concept has to describe the identification and evaluation of all recognisable safety risks according to the type of risk, frequency and consequences and it has to determine the hence derived constructional, technical, operational and organisational safety measures." Legal, psychological and personal measures shall be assigned to operational and organisational measures. Due to the requirements of the maglev train construction and operation order the following fundamental steps with the issue of a safety concept have to be considered:

- Definition and/or compilation of all safety-relevant system parameter
- Identification of all relevant internal and external dangers, which can affect a maglev train installation
- Identification of risks to each single danger; thereby the occurrence probability as well as the extent of damages has to be determined

- Evaluation of risks by means of risk acceptance criteria
- Derivation of safety measures

These fundamental steps are to be found in the DIN EN 50126 [2]. Thus, it is reasonable to look about the approach of this standard with the interpretation and definition of the safety concept according to § 23 MbBO.

To sum up we can say that the safety concept serves for determination of the safety requirements for a maglev train line on the total system level. Thereby the immediately applicable legal requirements and requirements after decree law and/or the accepted engineering standards shall be considered.

## 2 INTERACTIONS BETWEEN THE SAFETY CONCEPT AND THE REMAINING ADMINISTRATIVE PROCEDURES

The requirements resulting from the safety concept have effects on all system components and for this reason on the whole planning- and approval process. This was also shown by the experiences from the projects Hamburg-Berlin and Metrorapid.

### *2.1 Connection between safety concept and planning approval*

Certain internal and external dangers, which affect a maglev train installation, may only be limited regarding their risk potential through constructional measures. The following examples shall make this clear.

### *2.1.1 Protection against going astray*

Due to parallel tracks and crossings of maglev trains and other carriers there is a risk that because of technical defects and/or human failures straying road vehicles come into the clearance gauge of a maglev train installation. Therefore the maglev line has to be protected against straying road vehicles. Type and extent of constructional safety measures against going astray result at least from the risk considerations which shall be executed in the safety concept. At first the question how detailed the safety measures shall be described in the safety concept is of interest. The safety measures deviated from the risk analysis shall be formulated functionally on the one side to leave scope for development of concrete buildings, but on the other side they shall be clear and detailed enough that the remaining risk can be evaluated. From secondary meaning is herewith if the safety measure existed in the initial state or if it is defined as additional measure. Decisive is only the parameter of the remaining risk under consideration of all safety requirements. Regarding the protection against going astray the following conclusions arise: type and extent of the safety measures against going astray are dependend from various parameters as e.g. distance, altitude differences of traffic routes, volume of road traffic, maximum speeds, type and composition of the road traffic. The decision-making for the detailed plan design – that means if the required protection is reached through an earth wall or a concrete wall or through an appropriate distance between the traffic routes – is made through the responsible body for the project on the basis of economic criteria.

The requirements for the protection against going astray may cause an essential floor space required and/or costs, also if they are firstly formulated functionally in the safety concept. Through this an immediate influence on the route guidance arises as well as on the type and extent of the necessary real estate acquisition and also on the rights of third parties. Thus, the consequences for the planning approval procedure are given immediately.

### *2.1.2 Rescue concept*

An essential component of the safety concept is the rescue concept. The maglev train operator has to explain in this concept with which measures self- and/or external rescue shall be guaranteed. Depending on conception self- and/or external rescue measures require different sizes of escape routes, places for emergency stops and/or accessibilities. Therefore the rescue concept influences the extent of the required properties so that the effects on the planning approval procedure are given immediately.

The examples “protection against going off” and “rescue concept” show very clearly how safety concept and planning approval are intimately connected

to each other. This means that the development of a safety concept must be at the beginning of the planning process of a maglev train line. However, changes of the route course may occur because of others than for safety reasons, so that corresponding customizations of the safety concept can become necessary at a later date.

### *2.2 Connection between safety concept and approval procedures according to § 6 Maglev construction and operation order (Magnetschwebebahn-Bau- und Betriebsordnung)*

A large part of risks basing on internal dangers can only be limited to an acceptable size by technical safety measures within the system or differently expressed by safety requirements on the subsystems and their components. Running over a peril point e.g. belongs to the internal dangers. Here the safety concept has the task to assign risk quotients to the subsystems and their functions based on the fact of one or several risk acceptance criteria, so that the risk acceptance criteria are satisfied and met durably. With this it is important – as already shown with the protection against going astray – that the derived safety requirements are formulated functionally on one side, i.e. without specification of a certain solution. But on the other side they shall be clear so that the risk quotient of the appropriate function is fixed quantitatively. For those safety technical functions of a maglev-train which is realized by electronic, electric or electromagnetic facilities especially the application of the SIL-phase concept [5] makes sense, i.e. the description of the safety measure through a SIL-phase. The advantage of the SIL concept consists primarily in the comprehensive description of the safety requirements without a concrete solution being defined. The SIL phase specification has then to be taken into account with the transfer into a concrete technical solution. The transfer suitable to standards of the SIL requirements is examined by the Federal Railway Authority in the acceptance and/or approval procedures in accordance with § 6 MbBO.

The derivation of SIL-phases from the risk analysis is described in [6]. Thereby it shall be considered that a SIL-phase integrates different safety requirements. These are especially protection against random failure behaviour through demand of a maximum allowable failure rate as well as protection against systematic failures through requirements to the system architecture (e.g. redundancy). Beyond the propabilistic procedure and the methods basing on this a fail-safe procedure, means a deterministic procedure, can be relevant for parts of the system. This is for example relevant if this is necessary through a direct legal provision.

### *3.3 Connection between the safety concept and the maintenance program according to § 8 MbBO*

§ 8 MbBO concretises the duty of the maglev-train operator for safe maintenance according to his in § 3 AmbG [7] standardised obligation, to operate safe and to construct the installations, vehicles and equipment safe and to keep them in a safe condition. Before a maintenance program can be scheduled the maglev-train operator has to define the principles and procedures for the schedule of the maintenance program and to subject it to the Federal Railway Authority. The principles and procedures include amongst others to define the maintenance- and inspection periods so that the described risk acceptance criteria in the safety concept are observed. The direct context between maintenance and safety concept is given.

#### SUMMARY

The existing legislation prescribes as essential precondition to grant a license for a maglev train the schedule of a safety concept through the maglev-train operator. The safety concept is of main importance for the whole approval process with far-reaching effects on the planning, system development, operation and maintenance of the total system. Particularly the fact that because of the partly complex connections and partly innovative approaches, with that we have less experiences at the time being, requires from all parties involved that the legal framework is constructively fulfilled. The main task of the maglev-train operator as responsible person for the safe operation of the installation is to initiate

and to control the necessary processes. This includes the updating of the safety concept in the later phase of the life cycle of the installation and to introduce new conclusions.

#### REFERENCES

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