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COMPONENTS FOR WAYSIDE TRAIN OBSERVATION IN AUSTRIA

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Abstract *– Due to the ongoing remote control in signalling technology train observation by employees is reduced at traditional locations e.g. place of a station manager. The Austrian Federal Railways (ÖBB) Infrastructure Operation Company has recognised this trend very early. Several years ago, they started the construction of a wayside detection system to control the temperature of passing trains because of the increasing discontinuation of station managers doing the observation of boxes and brakes. Outcome of this research and development activities is the hot box detection system TK 99 of the HOA-group at Infrastructure Service in the Infrastructure Operation Company of ÖBB which is used in the railway network of Austria over one hundred times at the moment. Moreover new developments on dynamic weighting and derailment detection are yet in a field-test on the Eastern Line between Vienna and the Hungarian border.*

Keywords – Automated train observation, hot boxes, dynamic weighting, derailment detection

1. INTRODUCTION

The ongoing withdrawal of station inspectors from the field means a drawback on the organizational and technical level for the system of railway operation. The original function of a station inspector was being the safety part of the operation, i.e. setting routes. For this task, there were aids since the very beginning of the railway: as the first design of a signal box the dependencies between signals and points were shown by means of mechanical obligations. The development led via push-button signal boxes to the electronic signal boxes which are common practice nowadays in most European countries.

Over the years more tasks for the station inspector were added, that led even up to ticket sales. A significant function has always been the monitoring of the passing trains. This important task was also fulfilled by other personnel working along the track, e.g. block posts and so on. These functions became replaced over the years by the evolving signal box technology. With the passage of a train primarily the presence of the train-conclusion-board is examined, as well as apparently recognizable irregularities, as for instance overheated axles.

Particularly experienced station inspectors can recognize by the sound of the rolling wheels out-of-roundnesses or flat spots. Moreover, loose tarpaulins, exceeding the vehicle circumscription profile, can be seen by a station inspector. But there are also train-characteristics, which are impossible to be examined on an optical and/or acoustic basis. Similar problems arise when wheel loads and/or wheel pressures have to be evaluated. Only substantial overload conditions can lead to visible deformations of the car construction. Unfortunately, loading conditions can already lead to derailing and/or tearing up the lead to derailing and/or tearing up the train before they become visible. Due to the restructuring of operating structure also checking of the passing trains at the commercial stations is decreased, and a call for action exists, since these functions must be taken over now by technical systems to guarantee at least same safety as usual before.

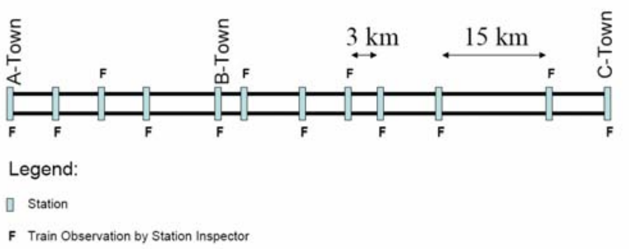

Fig.1. Trainobservation on an existing line

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On an existing line the locations of station inspectors are as a traditional rule distributed on both sides of a track (Figure 1). Due to the restructuring process in signaling technology the even distribution is sometimes disturbed. Also the distance between two observation points can vary from 3 to almost 15 or more kilometres. One of the first irregularity if train observation is reduced, is an increase of derailments caused by hot boxes. So, therefore, it is necessary to develop a technical solution to control temperature of boxes of passing trains.

Possibilities for trainobservation are wayside, vehicleside and combined approaches. For an infrastrcture manager according to european legislation 2001/14 only possibility remaining is the wayside because the vehicleside is not in his sphere of influence.

2. WAYSIDE TRAINOBSERVATION

The Hot Box Detection System used in Austria by ÖBB Infrastruktur Betrieb AG consists of a track-side equipment (scanners), an evaluation and control unit, a data transmission equipment and a visual display unit. The track-side equipment includes a control and evaluation electronics accommodated within a cabinet and a rail fastened measurement equipment with infrared sensors to record axle box and wheel temperatures and axle counters.

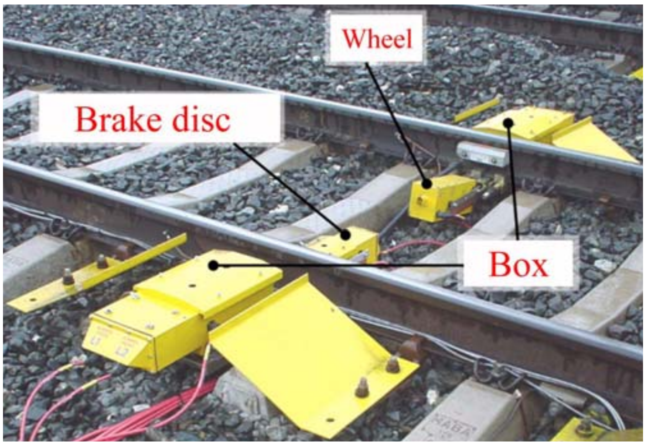

Fig.2. Combined hot box, wheel and brake disc plant

In most locations, where a hot box detection system is positioned, there is also a hot wheel detection system and a hot disk detection system. The main reason for this accumulation of sensors are the installation costs for a single system . The shared use of power supply and a connection to the railway data network results in synergies.

The technical solution is able to check the temperature even in a temperature array which cannot be seen by a station inspector. The visual check of boxes leads only to an alarm if the box is already glowing but in the beginning phase a box doesn't glow. So, a technical solution will recognise an initial hot box earlier than one station inspector ever can. Moreover, the technical plant controls both sides of a train even if most glowing boxes can be seen from both sides of a train. This also leads back to the basic argument in Chapter 1 why station inspectors where positioned on alternate sides on an existing line.

After the general decision to use a technical support for checking temperature of boxes, wheels and brakes, the question of locations for these systems and the maximum distance between two plants appear. For the choice of location the operational handling has to be taken into account because the alarm message has to be verified and afterwards the wagon has to be isolated from the train. The maximum distance can be calculated by a risk-analysis where the increase of the temperature has to be specified. In case of having no data from realtime operation it is possible to ask experts for their judgment how fast the temperature can increase.

Observations of occurred hot box alarms have shown that there are two differential cases of temperature increase: linear and exponential. So, an additional advantage of a continuous wayside train observation is the early recognition of linear temperature increases, which allow to plan the operation handling in a more efficient way [1].

A further component for automated trainobservation is a plant for dynamic weighting. Before inviting companies to present their products Austrian Railways designed a prototype plant called G 2000. For an infrastructure manager it is important to check the axle load and wheel load to prevent derailments. Moreover the axle load is important for the calculation of infrastructure fee.

Fig.3. Dynamic weighting plant

Because of the costs for dynamic weighting plants another idea to reduce derailment costs was the development of a wayside derailment detector which is so cheap that it can be located at every block signal. Derailments can be caused by many facts and therefore a combination of wayside and vehicleside influences have to coincide. The simple principle of the detector is the opening in case of deformation of the cabinet and shall guarantee a high relieability.

Fig.4. Wayside derailment detector

All of these wayside trainobservation plants can be used as stand-alone-solutions for railway operation, but there is a new development in Austria called Checkpoint. One of the aims of this project is the integration of high available and relieable wayside plants into solid interlocking system.

3. CHECKPOINT

Checkpoints can be defined as trackside locations containing an accumulation of technical systems, which are required to enable the substitution of the traditional train supervision. From today's point of view, seven sensors are needed for this task. They can be divided into two groups: Damage-reducing and/or event-avoiding systems. For both groups, all environmental requirements have to be met taking into consideration that these systems will be passed by trains with a speed of up to 250 km/h. Even under harsh environmental conditions, these systems have to supply reliable information regarding the train state. In addition to that, all data collected must be processed in the shortest time possible by using appropriate tools for analysis.

The implementation of this project, which is supported by various R&D-programmes of the Austrian Federal Ministry of Transport, Innovation and Technology (bmvit), was started in February 2003. The project team comprises employees of Alcatel Austria AG, the ÖBB Infrastruktur Betrieb AG, the Institute of Electrical Measurement and Circuit Design and the Institute of Railway Engineering, Traffic Management and Ropeways. Both institutes are located at the Vienna University of Technologoy. In autumn 2004, the Checkpoint prototype was put into operation between Vienna and the Austrian-Hungarian-border. All sensor components are subject to a 12 months test programme. The emphasis is put on the interaction of the various sensors and their reactions under a wide range of different climatic conditions [2].

All used sensor components have to meet the requirements set by the infrastructure operator. This is a prerequisite for a successful integration of Checkpoints into the control system and/or into solid state interlockings. Problems with railway operators have to be expected in case the number of failures is too high or alarms not being registered correctly lead to accidents. Events like these will result in a critical analysis of the investment. Therefore, as a first step, all alarms are to be displayed on the operational level. The development of the data concentrator is clearly orientated to the integration of Checkpoints into the control system and/or into solid state interlocking.

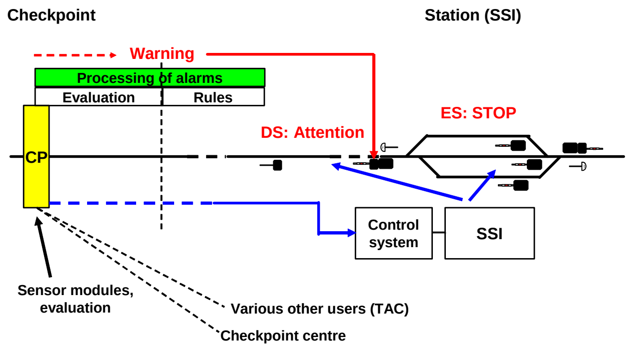

Fig.5. Functionality of a Checkpoint

4. CONCLUSIONS

According to new european legislation as a boundary condition for infrastructure manager the number of railway undertakings using time slots on his network have increased. From point of view of an infrastructure manager there is only the possibility to check passing trains at some wayside trainobservation plants to be sure that the vehicles will not destroy the superstructure. Additionally to the safety arguement data collected at a wayside plant can be used for optimising maintenance of vehicles if data is provided to railway undertakings. So the reduction of personal checking trains along lines is only acceptabel for safety reasons if plants for automated trainobservation are used.

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