How can you tell if the train operator is stealing your rails?

By Wim Coenraad

Report on a Technical Visit by the IRSE Swiss Section

Swiss IRSE members now know the answer to that question. It was revealed during the technical visit on 14 March, on the occasion of the Swiss section AGM. The visit's theme was an introduction to SBB's ZugKontrollEinrichtungen (ZKE), or Wayside Train Monitoring Systems (WTMS), developed and operated by SBB's Installations and Technology department in Lucerne.

Urs Nietlispach and his team were kind enough to receive the Swiss section members and demonstrate the many technologies and installations they have developed and operate from an Intervention Centre located in Erstfeld. The systems help detect any errors or defects on trains running on the network, before they cause accidents or damage.

WHY USE THE WTMS?

The Swiss network not only is one of the most densely used in Europe, it also sees a fair amount of cargo trains in transit. Owing to it mountainous terrain and many curves, it is more sensitive to a number of hazards caused by train defects, so the need to detect these potential incidents before they happen and intervene promptly, is perhaps felt more strongly there than elsewhere.

There are at present 147 detection sites on the network, that are networked to the Intervention Centre in Erstfeld and that number is to increase to some 200 sites by 2016.

One of the most important decisions to make, once an alarm has been generated by a detection system, is whether to intervene immediately or wait. The operator in Erstfeld has about 90 seconds to decide whether the alarm requires a train to be stopped immediately or if it can be allowed to continue on to a station or siding where it can be put aside for further investigation. Getting it wrong can of course have serious consequences, either in unnecessary delays caused, or in loss of trains, infrastructure or worse.

Figure 1: Some examples of incidents SBB is looking to prevent or catch early

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NETWORKING AND DATA ENHANCEMENT

Networking the WTSMs is part of the answer, it allows SBB to use train data in conjunction with the pure measurement data. Knowing a train's consist, origin, destination and even the driver's cell phone number, helps to optimise the intervention strategy and schedule interventions more intelligently:

- does the next detector confirm the previous alarms?
- what is the trend?
- can we schedule the train stop to have a lower impact on subsequent trains' delay?
- Set alarm values corresponding to car or train specific values.

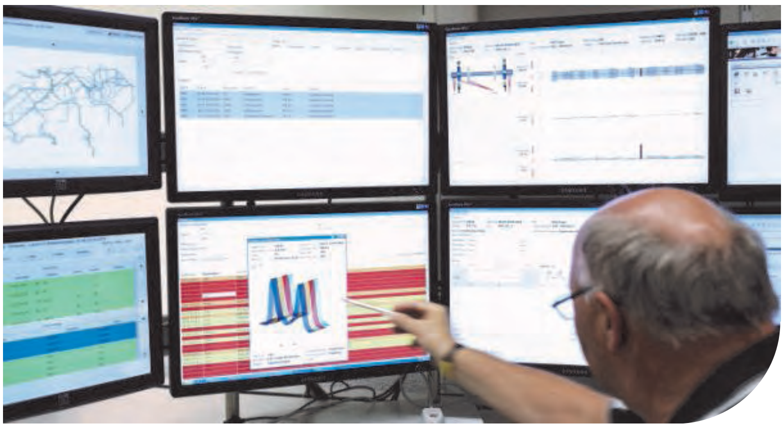
It also allows the intervention operator to direct a driver to the car or axle that set off the alarm.

Having staff in the Intervention Centre with knowledge of the detection systems and rolling stock a signaller would not have, allows SBB to 'triage' alarms and deciding which train to stop immediately, to weed out false alarms and evaluate the severity of the remaining ones. As a result, not only has SBB not experienced any derailments caused by hot axle boxes, locked brakes or shifted cargo since the intervention centre came online in 2005, SBB estimate that in 2010, for a set of 5000 train alarms, instead of 390 000 train delay minutes only 91 750 delay minutes were caused. In other words, they not only avoid some 300 000 delay minutes yearly by not stopping every train that sets off a detector, they have also reduced the number of delay minutes caused by false alarms from 700 min/year in 2005 to 20 min/year in 2012.

INTERNATIONAL COOPERATION

International cooperation and exchange of measurement data across borders is something SBB would like to see more of. An international exchange of WTMS data enhances corridor availability. Stopping a train at a border where a marshalling yard, stabling tracks and cranes are usually available to set out an incorrectly loaded car or correct the issue, speeds up incident response and avoids delays on the line. And finally, waiting to have a train with shifted cargo rejected at the Swiss border and then return it to a 'faraway' point of origin in the full knowledge that

Figure 2: Intervention Centre workstation in Erstfeld



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the risk remains but will not be detected, because on those legs of its journey WTSMs are not in place, may not be the optimum safety strategy.

As an aside for us signal engineers, stopping trains does not require a direct interface to the interlocking or ATP, but is achieved by stopping a route being cleared ahead of the train through the operational control centre. This allows for both flexibility and an 'affordable interface'.

The ZKE network has been developed, but not certified, to SIL 0 standards and is located in two redundant sites, whilst the operations from the Erstfeld Intervention centre can be relocated to Luzern.

DETECTION SYSTEMS

The detection systems vary in function and in numbers employed, corresponding to the type of hazard to be detected.

Hot Axle Boxes and Locked Brakes

It all started with hotbox and locked brake equipment detectors, which are now in their third generation. The latest versions use arrays of eight detectors to sense the temperature of the axle box as well as of the wheel rim and the brake disc(s) as shown in picture 6. Overheating of axle boxes can cause the grease in the bearing to deteriorate, leading to a bearing failure, which can cause a derailment. Likewise hot brake discs and wheel rims can indicate a locked brake, leading to wheel failures. Some 6000 alarms are generated yearly by 95 detection stations, located mainly at marshalling yards, before long tunnels and on important corridors.

Wheel Load Check Points

At least as important are wheel load and impact detectors. Not just to single out trains with axle loads exceeding the limit, but integrating measured loads also flag up the occasional train carrying more than the reported load in the manifest. Up to double the declared loads have been measured. As permitted speed is based on the declared loading and brake capacity, such overloading would make it unlikely that such a train could brake meeting the brake curves associated with its maximum allowed speed. Even higher risks are presented by trains that are unevenly loaded, or where cargo has shifted. A classic case involved a train travelling from Italy into Brig. The axle load checkpoint detected an axle with a load of 5.6 tonnes on the left wheel and 13.9 tonnes on the right hand one. On inspection a 25 tonne steel coil had broken loose and was leaning into the side of the car body. In these cases a derailment could be imminent.

Wheel defects such as flats are also detected. The high impasct forces of such wheels not only cause noise pollution but can lead to irreversible damage to track installations and bridges. Without early detection and intervention, the resultant bearing damage is a certain precursor to an overheated axle box.

In total 26 installations deal with 600 alarms each year.

Fire and Chemicals Detectors

Some distance inside tunnels, such as the Simplon tunnel, SBB employs gas and chemicals detectors, detecting CO, CO_2, CH_4 and C_xH_y. Incidentally, these detection stations need to be far enough from the tunnel portal for them not to be triggered by wafts of smoke caused by the Swiss hikers traditionally frying their sausages, we were told.

Fire and chemical detectors detect trains or cargo on fire, as well as spilled or leaking chemicals. These could cause an explosion if concentrations build up around a leaky car in a train that is held at a signal. These vapours might subsequently ignite if something produces a spark.

Fires we were told, are not only characterised by a rise in CO and CO_2 levels, but as fires are characterised by an incomplete combustion, they cause the rate of CO to CO_2 gasses in the detected gas mix to go "off" as well. Looking for the combination of these two indications prevents false alarms. A simple rise in the levels of these two gasses without the rate of CO to CO_2 changing, could be caused by steam loco passing through the tunnel, as was illustrated with a printout of signals actually recorded in March 2011. On the other hand coal fired passenger heating in Orient Express cars presents signatures very similar to a real fire.

On average 17 detection stations generate some 10 alarm per year.

Out-of-Profile and Antenna Detection

Other issues again are presented by objects on the train that exceed the clearance profile. Members that attended the 2006 convention may remember a seeing similar BLS installation at Spiez, an example of 'high and wide' detectors, checking that lorries entering tunnels do not have cargo, or covers violating the profile. This can cause a hazard to passengers on platforms as such trains pass, as well as to or in tunnels. An array of radar detectors mounted on a portal produces 3D images showing these protruding items, as well as things such as CB and other antennae in risk of coming into contact with the catenary.

In this type of installations 8 stations detect 200 hazardous situations yearly.

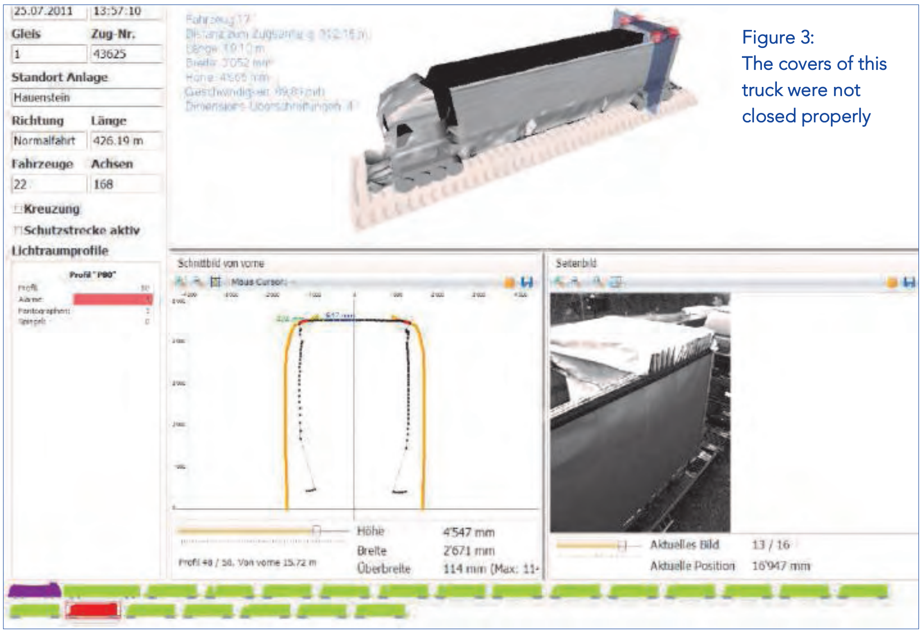

Figure 3: The covers of this truck were not closed properly

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