RISK MANAGEMENT APPLIED TO CIRCUIT SHUNTING

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- The four main causes of de-shunting
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- Introduction of a project mode based on a risk assessment process
- The three types of actions implemented
The **TRACK CIRCUIT**: a train detection device.

The train’s axles **SHUNT** the track circuit running between the two rails.

The functions performed by the **TRACK CIRCUIT** and by **SHUNTING** of traffic on the track facilitate the signalling functions that prevent rear-end and head-on collisions, derailments and collisions at level crossings.

Countries using such devices for traffic detection include: France, Germany, Belgium, the Netherlands and Japan.
SHUNTING - THE BASICS

HOW A TRACK CIRCUIT WORKS

If no train: all **current** reaches the receiver

If train: **circuit shunted**. Most **current** passes through train’s axle. Only a **residual current** reaches the receiver.
THE UNDESIRED EVENT: DE-SHUNTING

- **DE-SHUNTING** is the undesired event associated with operating a **TRACK CIRCUIT**.

- **DE-SHUNTING** is the term used to describe a high level of impedance in the contact between rail and wheel, which generates electrical behaviour in the **TRACK CIRCUIT** so that the circuit believes that there is no contact between the rail and the wheel when traffic is in fact physically present in the area.

- Hence, **DE-SHUNTING** can cause safety-critical incidents if its **CAUSES** and **CONSEQUENCES** are not managed.
THE FOUR MAIN CAUSES OF DE-SHUNTING

- **OXIDATION OF RAIL/WHEEL CONTACT**
- **EXCESSIVE SANDING**
- **AUTUMNAL CONTAMINATION**
- **INADEQUATE VEHICLE RESPONSE**

![Diagram showing causes of de-shunting 2016]
INCIDENT ANALYSIS

- 45 de-shunting incidents on average each year
- 80% of de-shunting incidents occur in the autumn
- 3 critical de-shunting incidents in 2016

![Graph showing de-shunting incidents per month in 2015 and 2016](image)

![Map of France with marked locations](image)
DE-SHUNTING TRENDS 2015-2017

- **2015**
  - Total: 65
  - Covered and protected by technical measures: 31
  - Covered and protected by operational measures: 28
  - Critical: 6

- **2016**
  - Total: 47
  - Covered and protected by technical measures: 36
  - Covered and protected by operational measures: 8
  - Critical: 3

- **2017**
  - Total: 6
  - Covered and protected by technical measures: 2
  - Covered and protected by operational measures: 2
  - Critical: 2

*End of September*

Legend:
- Green: Covered and protected by technical measures
- Blue: Covered and protected by operational measures
- Red: Critical
- Classification pending
The following are involved in the detection of de-shunting or suspected de-shunting:

- **operators:**
  - the train dispatcher (e.g. failure to release route, distance indicator light turning off or turning to white, etc.)
  - the controller
  - the driver (e.g. signalling interval)
  - electrical service or other staff (e.g. seeing a barrier at a level crossing being raised too early)

- the maintenance support computer system (remote monitoring)
- recordings from computerised switching stations
- the recorders put in place by Infrastructure Management to monitor signalling systems
- the track circuits’ residual voltage recorders
THE SAINTE-PAZANNE ACCIDENT: A TRIGGER EVENT FOR EFFORTS TO ERADICATE DE-SHUNTING

- Track spread following de-shunting on a switching zone
- Highlighted the impact of autumnal contamination
- Two immediate measures:
  - Introduction of a shunting safety protocol
    - Circulation of X73500 trains forbidden in interlockings with route recording if operating as single units; verification of a minimum of 2 trains on the route
    - Verification of cleanliness of the tyre treads of certain stock
  - Introduction of a shunting system taskforce (project mode)
A PROJECT MODE BASED ON A RISK ASSESSMENT PROCESS (1/2)

Prevention barriers

Root cause
Root cause
Root cause

Direct cause

Risk event

Immediate result

Potential severity

Final result

Protective barriers

Root cause
Root cause
Root cause

Direct cause

Immediate result

Final result

Frequency
A PROJECT MODE BASED ON A RISK ASSESSMENT PROCESS (2/2)
SHUNTING ACTION PLAN

I. Preventive actions to prevent shunt failure

II. Corrective actions of the consequences of shunt failure

III. Prospective actions for knowledge of the rail/wheel contact system
PREVENTIVE ACTIONS/INADEQUATE RESPONSE FROM VEHICLE

Inductive loop shunt assisting device

Scrubber

Bogie
Axle
Inductive loop
Shunt
Rail
PREVENTIVE ACTIONS/OXIDATION

High voltage impulse track circuit

Rail grinding

Rustproof rails
Cleaning of certain vehicles’ wheels
Cleaning of rails and track

Cleaning with high-pressure water

Cleaning by brushing
MITIGATING ACTIONS/RISK OF COLLISION AT LEVEL CROSSINGS

Treadles for level crossings with track circuit warnings
Delay of 45 seconds for route release mechanism
PROSPECTIVE ACTIONS/ANTICIPATING DE-SHUNTING

- Safety studies: mitigating actions are required for around 30 sections of line identified as critical by safety studies.

- Methodology for de-shunting analysis and risk management

- Development and testing of a residual voltage measurement instrument
PROSPECTIVE ACTIONS/PREVENTING DE-SHUNTING

Development and testing of a next generation inductive loop shunt assisting device

Development and testing of a wheel brush

Development and testing of an on-board anti-contamination device

UIC device (Marc Antoni): Research on improving track circuit receivers
IN ADDITION TO RISK ANALYSES

- A local criticality analysis methodology
- See presentation by Jean-Luc Wybo