OTIF/RID/CE/GTDD/2015/9

10 December 2015

(English only)

RID: **4th Session of the RID Committee of Experts' working group on derailment detection**
(Paris, 16 and 17 December 2015)

Subject: **Initial review of ERA's 2012 conclusions[1] on the derailment detection in the light of Dr Bing dissertation**

Transmitted by ERA

Introduction

At the 3rd meeting of the RID working group on derailment detection the participants were asked to analyse the recent findings Dr Bing dissertation in order to see if it could bring some facts helping solving remaining controversial viewpoint on the specific use of mechanical derailment detectors.

For facilitating the task of the workgroup, ERA kindly offered an official translation of this dissertation from German to English which was performed by the European Commission translation service. On the 27/10/2015 ERA was confirmed by the OTIF that the author, Dr.-Ing Daniel Bing, was satisfied and agreed with the translation. OTIF forwarded the document all participants on the same day.

As any other participants to the working group, ERA carefully read Dr Bing's dissertation and is reporting hereinafter a review of its 2012 conclusions in the light of Dr Bing's findings. This review is arranged per topic, as follows:

1) Scope of ERA's 2012 report versus Dr Bing's dissertation,
2) Legal framework for the admission/authorisation of vehicles,
3) Situation of the freight train derailment in EU,

[1] ERA report 2012

4) 'Braking' from the locomotive/by the driver versus 'Automatic braking' by a mechanical derailment detector of UIC leaflet type:
    a) Effect on compressive longitudinal forces on straight lines,
    b) Effect on compressive longitudinal forces in curves,
    c) Possibility to trigger a derailment under unfavourable circumstances,
    d) Frequency of "automatic braking" with risk of derailment triggered by a mechanical detector,
    e) Use of mechanical detectors in tunnel environment,
5) Possibility to use other measures than the Mechanical Derailment Detectors,

Detailed analysis

<table>
<tr><td colspan="2">1) Scope of ERA's 2012 report versus Dr Bing's dissertation</td></tr>
<tr><td>ERA 2012</td><td>Dr Bing dissertation</td></tr>
<tr><td>ERA's 2012 report is concerning the use of derailment detection in the European Union.</td><td>Dr Bing clearly indicated that "only UIC freight wagon brakes are evaluated"</td></tr>
<tr><td colspan="2">Update of ERA conclusions following Dr Bing dissertation</td></tr>
<tr><td colspan="2">Within EU the railway system is mainly defined both by the TSIs and the Railway Safety Directive, as well as recognised EN/ISO norms.

In this context it must be noted that UIC brake and coupling systems are not mandatory according to the Wagon TSI.
From this perspective, Dr Bing dissertation brings a limited contribution to the debate, focussing on the use of mechanical derailment detectors, as they exist today, within the existing framework of the UIC brake system.

In the coming years, it is expected to see big evolutions in freight train braking systems market that are currently under development, notably with the Joint Undertaking Shift2Rail.

In its role, which will be reinforced by the adoption of the 4th Railway Package, ERA is required to take into account both current and future railway systems when recommending the European Commission on the sustainable use of the derailment detection. In other words, EU legislation shall allow innovative solutions.</td></tr>
</table>

2) Legal framework for the admission/authorisation of vehicles	
ERA 2012	Dr Bing dissertation
In its 2012 report (see section xxx) ERA explained in detail the process which should be followed by applicants who would like to use derailment detectors.	Concerning the process of authorisation for placing into service a vehicle, Dr Bing uses the word '*permit (English version)*'. The dissertation indicate that '*the COTIF was revised as an addition to the actual transport laws, so that it also contains technical requirements and admission rules*' and also considers that '*Comprehensive functional and technical data are specified in UIC data sheet 541-08[34] describing the standard requirements for derailment detectors in rail freight transport . Compliance with these is mandatory in order to obtain a UIC permit for a derailment detector*'.

Update of ERA conclusions following Dr Bing dissertation

Within the European Union the vehicles placed into service shall be authorised.

In its 2012 report, ERA explained that the use of mechanical derailment detector is a change to the current railway system which must be risk assessed, both in case of new vehicle or retrofitting. The Agency recalled the applicable legal framework:

"…/

c) In EU Member States the SMS requires every change to be risk assessed and that a procedure is in place to apply the CSM on Risk Evaluation and Assessment (Regulation 2009/352/EC) when the change is deemed to be significant under the terms of this CSM.

d) This CSM states: "Where hazards arise from failures of technical systems not covered by codes of practice or the use of a reference system, the following risk acceptance criterion shall apply for the design of the technical system: For technical systems where a functional failure has a credible direct potential for a catastrophic consequence, the associated risk does not have to be reduced further if the rate of that failure is less than or equal to 10^{-9} per operating hour.

/…"

According to EU law it is to the applicant (proposer) to apply the process described in Regulation 2009/352/EC. It is not foreseen by this regulation that it is addressed to authorities, even if safe integration of changes should be ensured, in anycase, for obvious safety reason.

The CSM on Risk Evaluation and Assessment as also been transposed in the ATMF (Appendix F APTU – GEN-G) and therefore it is the same process in the COTIF region despite an 'Authorisation' is called 'Admission' in this context.

In its 2013 edition, a note was introduced in RID section 7.1.1, to clarify the fact that if a derailment detection is used it must be used in accordance with the applicable legislation. The note says:

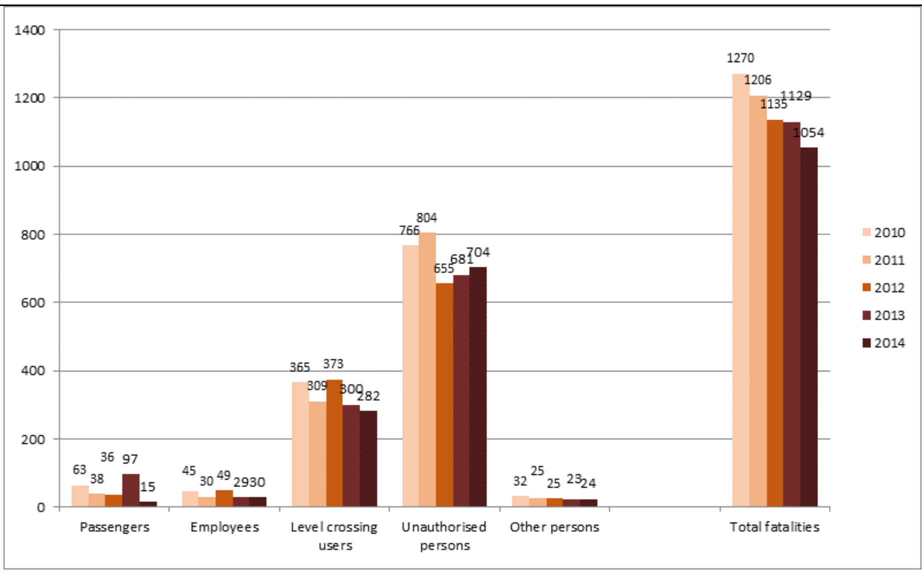
"*NOTE: Wagons are allowed to be equipped with detection devices which indicate or react to the occurrence of a derailment, <u>provided that the requirements for the authorisation for placing into service of such</u>*

wagons are met.
The requirements for placing into service of wagons cannot prohibit or impose the use of such detection devices. The circulation of wagons shall not be restricted on the grounds of the presence or lack of such devices."

From this point of view, Dr Bing's dissertation mixes the applicable legal framework with the railway industry know-how described in UIC leaflets.

According to EU legal framework the UIC leaflet 541-08 has the status of a voluntary process which can be applied by the railway manufacturer in order to obtain a UIC label for their detectors. However, limits and conditions of use of the vehicle have to be clearly identified by the manufacturer to ensure that no new risks are introduced (e.g. use of G braking mode only), and followed by the user of the vehicle.
Within the European Union, the UIC leaflets have no legal validity for the process of authorisation and the placing into service of vehicles equipped with derailment detectors. In other words, the notion of '*UIC permit*' used by Dr Bing does not exist in EU legal environment.

3) Situation of the freight train derailment in EU	
ERA 2012	Dr Bing dissertation
ERA has considered the evolution of the freight train derailments in EU both in its 2009 and 2012 reports. At this time CER considered that ERA had overestimated the derailment risks (reference number of derailments per year) in taking a too conservative approach. However the same conservative approach was also adopted in the study procured to DNV by ERA in order to allow for comparability of the results.	Dr Bing dissertation does not bring any information on this aspect.
Update of ERA conclusions following Dr Bing dissertation	
Considering the last available figures from UIC and from the Common Safety Indicators (CSI) reported by the EU Member States to ERA, one can conclude the following. In general, the EU railway system is safe and its safety records do not deteriorate. Travelling by train means using the safest mode of land transport. There were only 4 fatal train collisions and derailments in 2014, while the traffic volume was 4.1 billion train kilometres and 400 billion passenger kilometres.	



Number of fatalities per victim category (Source: Safety performance report – ERA)

Within EU the railway safety levels and their developments is in good position compared to other regions in the world.

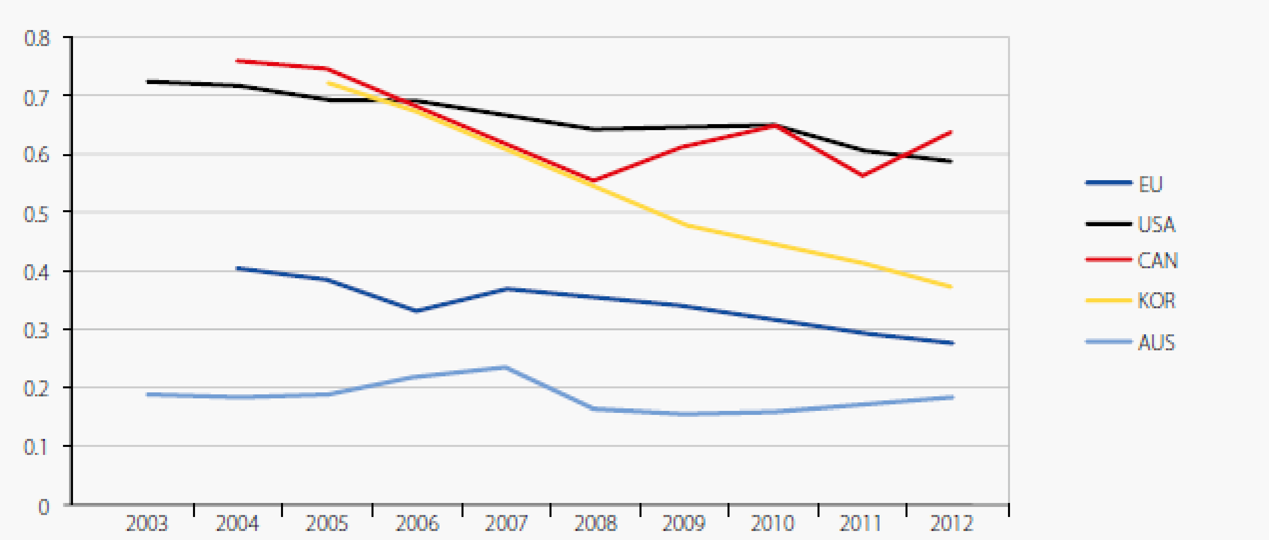
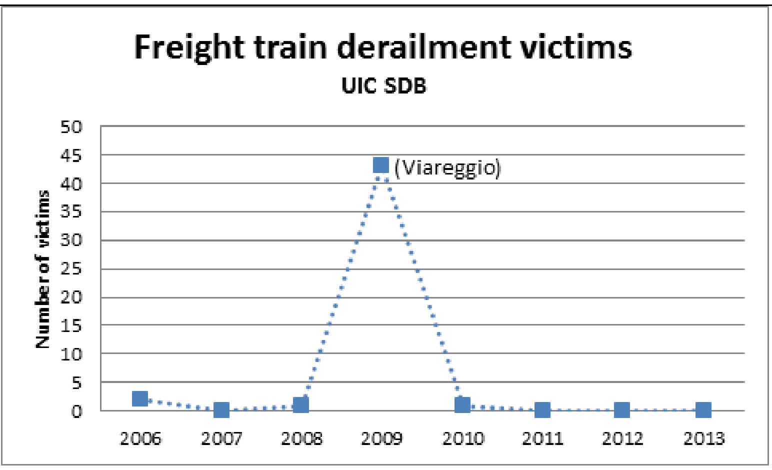


Figure 5: Railway fatalities (excluding suicides) per million train-kilometres in 2003–2012 for the EU-28, USA, Canada, South Korea and Australia ([6])

[5] All EU countries, Norway and Switzerland, excluding Romania and Croatia for the period 1980–1989. Accidents on railway lines not covered by the RSD are also included.

[6] Source of data: USA: Federal Railroad Administration, Safety statistics; Canada: Transportation Safety Board Canada, Statistical summary on railway occurrences 2012; Korea: National Statistical Office; Australia: Australian Transport Safety Bureau, ATSB Transport Safety Reports on rail statistics.

The problem of the derailment of freight train, in general, remains in a large extent an economic issue due to the impacts on the service disruption and to the damages caused to the railway infrastructure and the rolling stock. This is confirmed by the figures reported in UIC performance reports concerning freight train accidents victims.



When analysing specific information on freight train derailments, the information reported by UIC shows a very limited number of significant events; some years even indicate 0 victims.

Concerning dangerous goods the information reported by UIC shows also clearly that when dangerous goods are involved severe accidents can also occur. However, despite some recent events: Godinne (0 fatality), Wetteren (1 fatality) and Dailens (0 fatality), the Agency has no indication that derailments of dangerous goods wagons show real critical trends as reported by EU member states to the Agency in the following table:

Accidents involving transport of dangerous goods	2010	2011	2012	2013	2014
Number of accidents involving at least one railway vehicle transporting dangerous goods in which dangerous goods are NOT released	17	19	17	13	24
Number of accidents involving at least one railway vehicle transporting dangerous goods in which dangerous goods ARE released	37	9	10	11	16
Total number of accidents involving at least one railway vehicle transporting dangerous goods	54	28	27	24	40

(Source: ERA – Safety performance report 2014 – updated with 2013 and 2014 figures)

Freight train derailments have a limited (statistical) impact on safety, even when considering dangerous goods accidents, and even if, as in any other more of transport, catastrophic events are possible when involving dangerous goods substances.

A common approach to very rare but potentially catastrophic events is being developed in the framework of the multimodal TDG Roadmap initiated by the Agency in 2013. The deliverables of this roadmap should take the form of guidelines which will be applicable to all inland transport modes. These guidelines should be issued by the end of 2017.

4) 'Braking' from the locomotive/by the driver versus 'Automatic braking' by a mechanical derailment detector of UIC leaflet type

a) <u>Effect on compressive longitudinal forces on straight lines</u>

ERA 2012	Dr Bing dissertation
ERA's report 2012 highlighted the fact that an 'automatic braking' triggered by a derailment detector does not have the same characteristics than an 'emergency braking' activated by the driver from the locomotive cabin. In particular ERA indicated the following: " …/ *a) As it is explained previously the automatic application of brake by a derailment detector is something different than an 'emergency braking' invoked by a locomotive driver.* *b) In this respect, the automatic brake application triggered by a derailment detector must be considered as a change (new technical system) in the railway system.* */… "*	Dr Bing dissertation shows clearly that braking from the locomotive driver does not always result in the same longitudinal compressive forces than a braking initiate by the venting of the main brake pipe by a derailment detector at any position within the train composition. Clear differences are shown, for example by the figures 39, 88 and 93. In fact it is the main topic of the dissertation to show the differences between these two types of braking with regards to compressive forces.

Update of ERA conclusions following Dr Bing dissertation

The general influence of the train weight when braking from the locomotive at 40km/h is reported in the Figure 68 of the dissertation, reported below:

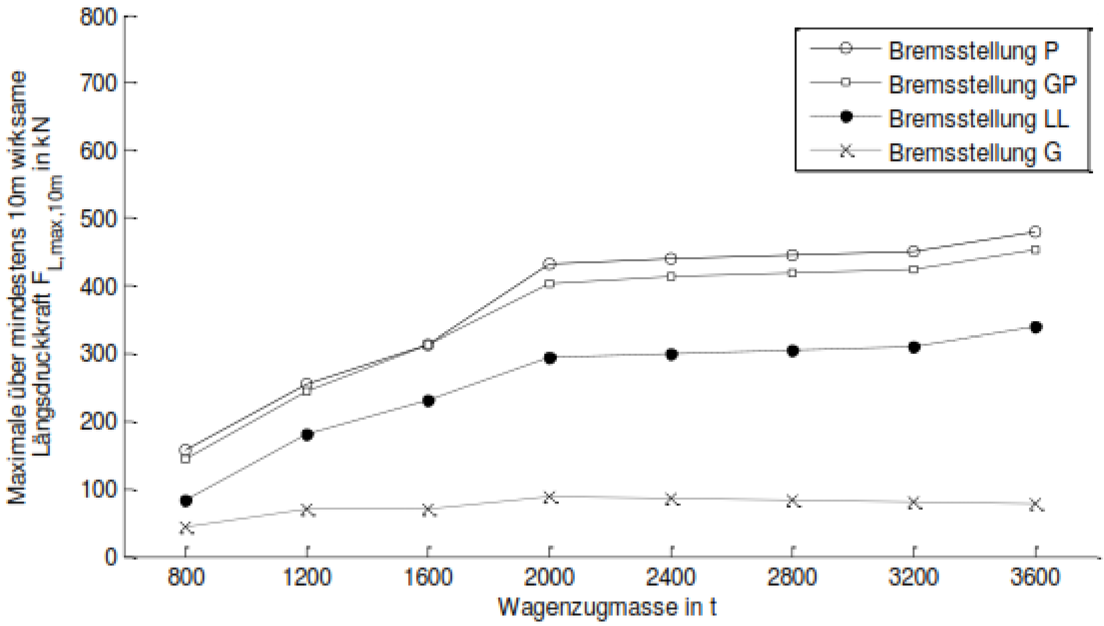


Figure 68: Dependency of the longitudinal compressive force on the train's brake setting

With the Figure 39 Dr Bing shows that "*in the case of a brake activation on the first vehicle, the brakes on this vehicle and on the adjacent vehicles build up their full brake force extremely quickly, while the brake force build-ups significantly more slowly on the rear vehicles*" while in the case of a braking initiated by a derailment detector in the middle of the train "*the braking force is already almost completely developed on a higher number of brakes according to the proper time and to the respective penetration time*".

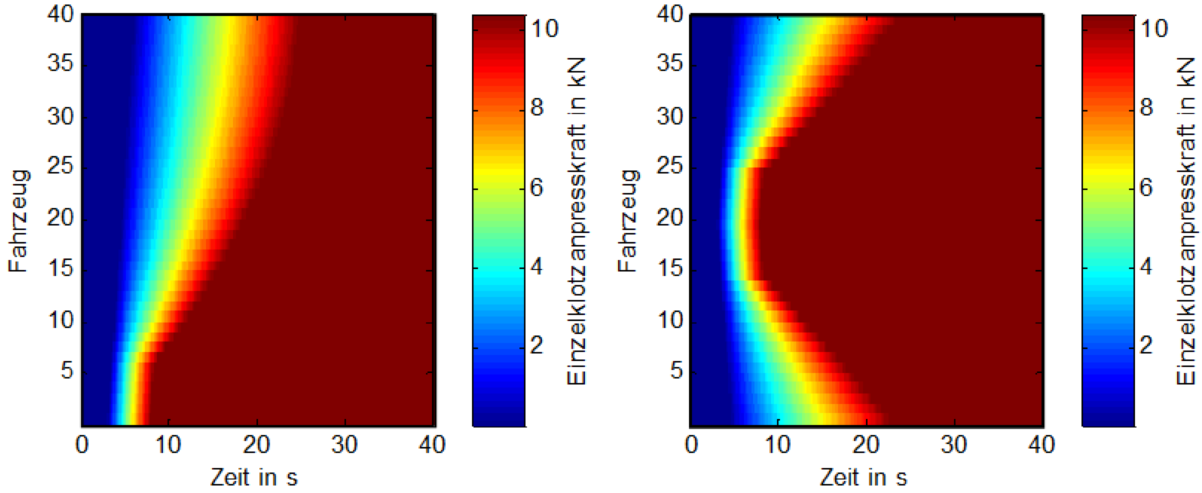


Figure 39: Progression of the individual brake contact forces following brake activation via the first or middle vehicle in the train, brake setting P

This behaviour explains why the longitudinal compressive forces are different when a braking is initiated by a mechanical derailment detector within the train than when triggered by a driver from the first vehicle. Figure 88 shows clearly that compressive forces are higher, in the mode P, GP and LL when the braking is triggered in the zones highlighted in yellow.

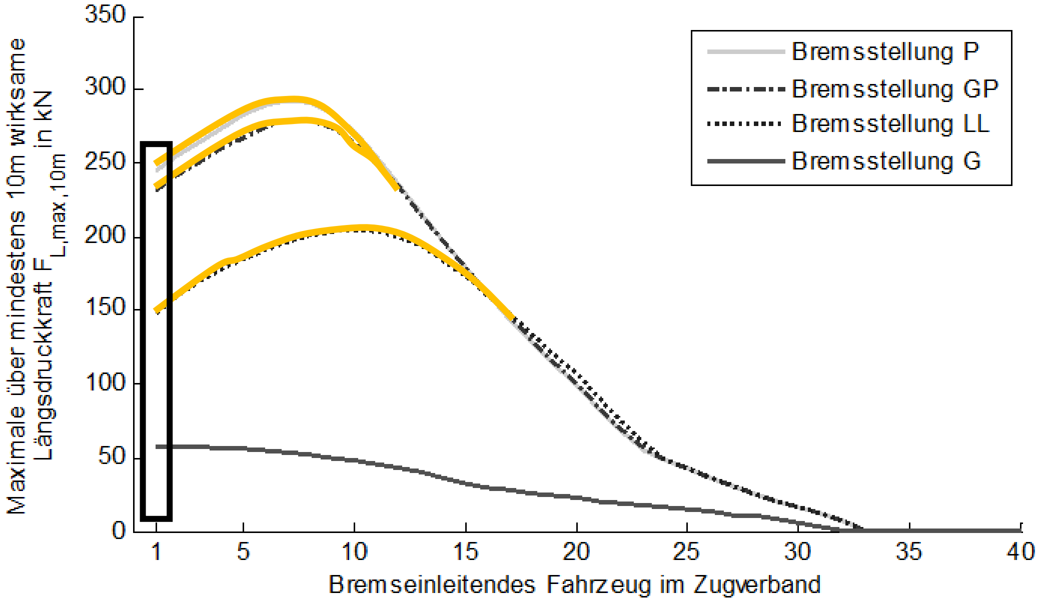


Figure 88: Influence of the position of the brake activating vehicle on the longitudinal forces at a brake output speed of 40 km/h

Figure 93 shows the same general influence of the position of braking in the train but with a different loading weight.

As a conclusion the Agency believes that these clear differences allow to confirm its 2012 statement as it clearly shows that a braking initiated by a driver (from the first vehicle - see area in the black box) is different, at least for some of the possible braking modes, in terms of compressive forces than a braking initiated by a derailment detector elsewhere in the train (area on x_axle outside the black box).

<table>
<tr><td colspan="2">4) ‘Braking’ from the locomotive/by the driver versus ‘Automatic braking’ by a mechanical derailment detector of UIC leaflet type
b) <u>Effect on compressive longitudinal forces in curves</u></td></tr>
<tr><td>ERA 2012</td><td>Dr Bing dissertation</td></tr>
<tr><td>ERA’s report 2012 does not studied the specific case of braking in curves but noted that in 2011 DNV found “over 238 analysed derailments there were 6 derailments where strong braking (applied to the whole train) has led to the derailments or has been a contributory cause” and noted that some derailments in the past where related to a combination of causes including braking under unfavourable circumstances.</td><td>Dr Bing’s dissertation explains the phenomena which are encountered with longitudinal compressive forces in curves and the notable differences in the behaviour of screw couplings with side buffers and automatic coupling without side buffers.</td></tr>
<tr><td colspan="2">Update of ERA conclusions following Dr Bing dissertation</td></tr>
<tr><td colspan="2">In studying the behaviour of compressive forces in curves Dr Bing allows to better understand why curves are part of some of the unfavourable circumstances mentioned by the Agency in 2012.

In analysing <u>lateral</u> compressive forces in curves, Dr Bing confirms ERA’s general statement on maintenance of buffers in explaining that “it is essential for the buffer to always be in a lubricated condition.” Dr Bing concludes “As described, it is particularly important that the buffer plates are lubricated in order to attain the lowest possible friction value. Alternatively, the use of plastic intermediate layers can reduce the need for costly and frequent maintenance and simultaneously ensure that the friction value is low.”

Dr Bing also study the positive impact of automatic central couplings and explains that studies around central couplings “was developed as a potential workaround in the mid-1960s because to the increasing risk of derailment caused by longitudinal forces, in particular for double-axled freight wagons”
Dr Bing concludes that “Braking a train that is composed of vehicles that are fitted with automatic central buffer couplings, is therefore considered as not being as critical as in the use of conventional screw coupling with side buffers. In particular, the lateral forces are reduced due to the absence of buffer plate friction.”

These findings support 2012 Agency’s conclusions concerning the importance of the maintenance in general and of buffers, in particular, and the possibility to use automatic central coupling for reducing the risk of derailments.

Finally, concerning the findings on the behaviour of a train with one wheel derailed in conjunction with the activation of a derailment detector, it is unclear in which extent the model used by Dr Bing really integrates (in full) lateral dynamics effects in addition to purely longitudinal dynamics modelling, therefore it is unclear if Dr Bing findings can be used to conclude on the potential worsening -or not- of a starting derailment (one wheel derailment) with the consecutive activation of a mechanical derailment detection. It is worth to mention that this scenario is also different from the scenario of triggering a derailment with a false-alarm.</td></tr>
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<table>
<tr><td colspan="2">4) 'Braking' from the locomotive/by the driver versus 'Automatic braking' by a mechanical derailment detector of UIC leaflet type
c) <u>Possibility to trigger a derailment under unfavourable circumstances</u></td></tr>
<tr><td>ERA 2012</td><td>Dr Bing dissertation</td></tr>
<tr><td>In 2012, the Agency concluded that "…the mechanical derailment detectors… have the potential to directly provoke a derailment under unfavourable circumstances. Concerning …the mechanical derailment detectors… the identified unfavourable circumstances are, for example if a false-alarm occurs where tracks are underperforming, or/and if it occurs at a curve, or/and if it is combined with an unsuitable composition/loading of the train."</td><td>Dr Bing recognise in the introductory part of the dissertation that "false activations also lead to emergency braking of the entire train, so that depending on the route there is a risk of derailment due to exceeding the permitted longitudinal compressive forces".

Dr Bing did not study thoroughly the "unfavourable circumstances" mentioned in 2012 Agency's report.

To the exception of the analysis of typical longitudinal and lateral forces in curves, the dissertation do not report on the influence of:
- Under-performing tracks,
- Unsuitable loading/composition of the train.</td></tr>
<tr><td colspan="2">Update of ERA conclusions following Dr Bing dissertation</td></tr>
<tr><td colspan="2">It is clear that Dr Bing recognises the possibility identified by the Agency concerning the triggering of a derailment via a false alarm activation. However Dr Bing does not report results concerning simulations combining the unfavourable circumstances identified by DNV and the Agency. Therefore the dissertation findings cannot be used to quantify this risk.

As an update to this specific risk, and taking into account the other findings of Dr Bing, the Agency consider that such specific risk of derailment provoked by a false activation of a mechanical detector:
- was confirmed by DNV in 2011 when they analysed past accidents: "over 238 analysed derailments there were 6 derailments where strong braking (applied to the whole train) has led to the derailments or has been a contributory cause" and noted that some derailments in the past where related to a combination of causes including braking under unfavourable circumstances."
- is recognised by Dr Bing but is not quantified.

In addition to the knowledge at the time the Agency drew conclusions in 2012, Dr Bing show now that compressive forces are higher, in a certain number of cases (e.g. in braking mode P), when braking is activated by a mechanical derailment detector within the train than in a standard automatic braking from the front of the train.

This new findings reinforce the argument of the Agency concerning this risk which is higher than expected in 2012.</td></tr>
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Also, during the first meeting of the RID DDD working group, Switzerland confirmed that the issue of false alarms was not totally solved as they identified, on average, 1 to 2 false alarms per year with the fleet equipped in Switzerland.

4) d) Frequency of "automatic braking" with risk of derailment triggered by a mechanical detector

ERA 2012	Dr Bing dissertation
In its 2012 report, the Agency indicated that "*because the derailment detectors of M1-a type represents a change in the current railway system, and because a functional failure of the derailment detector has a credible direct potential for a catastrophic consequence, the Agency considers that the above mentioned CSM is applicable to the M1-a type derailment detectors*." Note: In the above statement: - 'M1-a type' is referring to UIC type mechanical derailment detectors, - The referred 'CSM' was the Regulation 2009/352/EC on risk evaluation and assessment, - The 'functional failure' referred to the situation of false-alarms	Dr Bing brought information on the number of automatic braking in Germany with standard UIC trains braking systems. Dr Bing starts section 3.5 in saying "*As evidenced later, even rapid and automatic braking at low speeds should be classified as potentially critical with regards to the development of high longitudinal compressive forces*". Based on year 2010 assumptions, the author estimates that 17000 automatic braking would occur each year in Germany and that few more automatic braking added from derailment detectors would not change the risk significantly. However the general conclusions of the dissertation concerning the risk of mechanical detectors seem to go in another direction.

Update of ERA conclusions following Dr Bing dissertation

Here it is very important to clarify that in the meaning of Dr Bing dissertation the term 'automatic braking' is used both 1) for the activation of braking efforts from the locomotive and 2) for the activation from a mechanical detector within the train composition.

Also concerning the number of automatic braking (from the locomotive) in Germany it would be interesting to know the % of cases that occurred in braking mode G.

As demonstrated with Dr Bing findings, it is now clear that the two types of automatic braking are different (excepted in braking mode G), a large part of the dissertation describes these differences and, at least, we now know that compressive forces do not build-up in the same way and do not have the same level in many situations.

This is also confirmed by Dr Bing in the conclusions of his dissertation.

While the dissertation does not really allow to quantify in which extent the risk is increased, Dr Bing however concludes that
"*The maximum longitudinal compressive force is increased by up to 50 kN or 20%. This shows that the*

initial thesis: *'The automatic activation of a rapid brake would [...] not be the best solution, as this would cause events such as overriding of buffers or derailments of additional vehicles […]'* [1], *is justified*.". Dr Bing confirms also that "*the derailment detectors when an automatic braking is activated can produce higher longitudinal compressive forces than when the braking is activated by the traction unit driver. This occurs especially when driving in brake setting P.",* *and that* "*<u>in order to increase the safety</u> of on-vehicle derailment detection and to simultaneously reduce the longitudinal compressive forces, implementation of <u>one of the following actions would be advisable</u>.* – *Targeted decrease in the main air braking pipe pressure upon detection* – *Introduction of electronic derailment detection* – *Use of the ep brake in rail freight transport* *Update of the train composition guidelines with regard to the use of double-axled wagons*". All these conclusions support 2012 Agency conclusions on the risk of using mechanical derailment detectors. For these reasons, the Agency still considers that: - Its 2012 statement concerning the need to carefully assess the risks related to mechanical detectors is still valid, - The risk identified in 2012 on the possibility of triggering a derailment is confirmed, - This risk is even expected to be higher than envisaged in 2012 due to the higher compressive forces found by Dr Bing (for other braking mode than G), - This risk has still not been quantified today. It should also be noted that the implementation of the UIC leaflet and the labelling of products by UIC is not equivalent to the use of the CSM on risk assessment, and cannot be considered as a risk assessment in itself.

4) e) Use of mechanical detectors in tunnel environment	
ERA 2012	Dr Bing dissertation
In 2012, the Agency explained that "*The section 4.4.2 mentioned above is currently re-discussed by the Working Party on SRT TSI which proposed to align the requirement with the general requirement of the OPE TSI on managing emergency situations*" and that "*the 'DDD' is not fully in line with the SRT TSI safety principle and is not in line with the requirements of some other TSIs*"	Section 2.5 of Dr Bing's dissertation is devoted to this topic and concludes that the 2009 Agency statement saying "*The automatic function which is impossible to override from the driver's cabin might be inconsistent with the existing emergency procedures within the EU Member States, for example in tunnel contexts, and might introduce new risks not sufficiently well assessed and managed*" was questionable.

Update of ERA conclusions following Dr Bing dissertation
First of all it must be noted that Dr Bing used the 2007 version of the SRT TSI which was revised by the SRT TSI working party from 2010 until 2013. As indicated in the Agency report 2012, the topic concerning stopping derailed trains immediately in a tunnel was re-discussed, clarified and aligned with general principles concerning the emergency rules of the OPE TSI. The working party composed of tunnel safety experts officially nominated by their States concluded that the applicable emergency rules are the following, independently from the type of the train: 4.4. **Operating rules** (a) Operating rules are developed within the procedures described in the Infrastructure Manager safety management system. These rules take into account the documentation related to operation which forms a part of the technical file as required in Article 18(3) and set out in Annex VI of Directive 2008/57/EC. The following operating rules do not form any part of the assessment of the structural subsystems. 4.4.1. *Emergency rule* These rules apply to all tunnels. In light of the essential requirements in Chapter 3, the operating rules specific to tunnel safety are: (a) The operational rule is to monitor the train condition before entering a tunnel in order to detect any defect detrimental to its running behaviour and to take appropriate action. (b) In the case of an incident outside the tunnel, the operational rule is to stop a train with a defect that could be detrimental to its running behaviour before entering a tunnel. (c) In the case of an incident inside the tunnel the operational rule is to drive the train out of a tunnel, or to the next fire fighting point. 4.4.2. *Tunnel emergency plan* These rules apply to tunnels of > 1 km. (a) An emergency plan shall be developed under the direction of the Infrastructure Manager(s), in cooperation with the emergency response services and the relevant authorities for each tunnel. Railway Undertakings intending to use the tunnel shall be involved in the development or adaptation of the Emergency Plan. Station managers shall be equally involved if one or more stations in a tunnel are used as a safe area or a fire fighting point. (b) The emergency plan shall be consistent with the self-rescue, evacuation, fire-fighting and rescue facilities available. (c) Detailed tunnel-specific incident scenarios adapted to the local tunnel conditions shall be developed for the emergency plan. (Source: SRT TSI in force) These requirements are applicable to freight trains, including dangerous goods trains. The new version of the SRT TSI was published in the official journal of the European Union on the 12/12/2014. This explains also why Dr Bing did not use, as reference, the legal framework which is applicable today. Concerning the application of the SRT TSI on the situation of trains equipped with mechanical derailment detectors the Agency remarks that such trains will not always allow to implement emergency procedures that are defined under the direction of the Infrastructure Managers. According to the SRT TSI, Infrastructure Managers have the right to forbid the use of systems applying the brakes automatically in tunnels,

even for dangerous goods trains, if it is not a rule justified and retained in the emergency plan. However, the Agency notes also that there are still diverging experts' views concerning the appropriate management of freight and TDG trains in derailments in tunnels.	
5) Possibility to use other measures than the Mechanical Derailment Detectors	
ERA 2012	Dr Bing dissertation
ERA's report 2012 highlighted the possibility to use prevention measures that would have a better impact on the reduction of the transport of dangerous goods risks and in the same time on a drastic reduction of economic impacts.	Dr Bing considers also the possibility to use other measures which would have more impact on the reduction of freight train derailments.
ERA highlighted the possibility to use the following measures, from short to long term perspectives:	Notably Dr Bing has identified some measures which would have a significant (better) impact on the reduction of derailments risks:
- High quality performance of staff (ST)	- (not in the dissertation scope)
- Wheel load impact detectors & Weighting in Motion (MT)	- Impact of the wagon weight is only partly assessed, the dissertation assumes the use of automatic load brakes
- Wheel Profile Detectors (MT)	- (not in the dissertation scope)
- Bearing Acoustic Monitoring (MT)	- (not in the dissertation scope)
- Bogie Hunting Detectors (MT)	
- Track Geometry Maintenance (ST)	- (not in the dissertation scope)
- Under-performance of wagons, maintenance, informed decision (ST)	- Maintenance of buffer's surface needs to be ensured
- Supervision (of authorities) Targeted on Maintenance (ST)	- (not in the dissertation scope)
- Polyamide Roller Cages (MT)	- (not in the dissertation scope)
- European Visual Inspection Catalogue (EVIC) (MT)	- (not in the dissertation scope)
- Wheel/Rail interactions (LT)	- (not in the dissertation scope)
- Revision of intervention limits concerning track quality (LT)	- (not in the dissertation scope)
- Harmonised real-time monitoring of tracks/wagons/train composition quality (LT), including Electronic derailment detection	- Electronic detection is seen as a far more effective measure which could mitigate the issues found with mechanical detection
- Harmonised safety data exchange between IMs, RUs and ECMs (LT)	- Partly mentioned in the conclusion as important improvement for the future
- Increase the use of central couplings (LT)	- Use of central coupling, possibly with the combination of the installation of power and data bus.
Legend: Topics that are common or partly in common between ERA's 2012 report and Dr Bing dissertation	

(ST)=Short term; (MT)=Medium term, (LT)=Long term	
Update of ERA conclusions following Dr Bing dissertation	
A large part of the possible measures described in ERA 2012 report to reduce the risk of derailments are not covered in the dissertation of Mr Bing. This is normal and in accordance with the dissertation scope. For the measures discussed both by ERA 2012 report and by Dr Bing Dissertation, one can notice that: 1) Dr Bing confirms the opportunities and the advantages identified by ERA in 2012 concerning the use, in the long term, of both central couplings and electronic detection. 2) Dr Bing confirms also the importance of the maintenance of the buffers' surface.	

Preliminary updated ERA's conclusions in the light of Dr Bing's findings

The Agency recognise that Dr Bing dissertation is useful and has followed a scientific process which allow to use the results with a certain level of confidence. Dr Bing's dissertation give the opportunity to better understand UIC brake systems and coupling and identifies a certain number of consequences regarding the different possible braking modes of the 'standard' brake system and the impact of connecting mechanical derailment detectors on the main brake pipe.

Because of the nature of the exercise itself – it is a scientific dissertation – the Agency would like to stress that some of the results needs to be put in perspective before using them, potentially, for modifying the railway legislation.

In particular, the dissertation exercise did not study, for example, the influence of the track quality, track geometry (twist, slopes…) and real-life situations of train composition on the risk of derailment when a braking is triggered by mechanical derailment detectors.

It should be also noted that the dissertation does not explicitly address the currently applicable legal framework, and for some aspects focusses on practices sometimes only representative of the situation in Germany (e.g. braking mode LL).

As a general conclusion, the Agency understand that the of the findings of Dr Bing confirm or reinforce the conclusions drawn by the Agency in 2009 and in 2012 concerning the issues raised for the mechanical derailment detectors of UIC type, for the following reasons:

- Dr Bing findings show that compressive forces are higher, in some well identified cases, with the use of mechanical derailment detectors of UIC labelled type, which in itself is a new risk compared to the standard behaviour of trains equipped with UIC brake systems,

- The unfavourable circumstances mentioned in 2012 by the Agency, under which a mechanical derailment detector could trigger a derailment are not thoroughly studied by Dr Bing, however the specific situation of braking in curves is analysed, and it is confirmed that curves are part of the circumstance mentioned by the Agency,

- There is no new information on the level of false alarms[2] brought by Dr Bing, however the concerns of the Agency are clearly expressed also by the author,

- When combining the findings related to the previous points, the conclusion is that the use of mechanical derailment detection increases the risk of derailments in some circumstances; this risk must be clearly assessed by the applicants,

- Concerning the proportion of the risk increase, the Agency considers that it cannot be estimated on the basis of the information reported by Dr Bing on the situation of 'standard' automatic braking from the locomotive in Germany because the scenario of an automatic braking triggered within the train composition by a mechanical derailment detector is of a different nature than automatic braking triggered from the locomotive,

- Considering the above, and because the dissertation does not specifically study the situation in tunnels, the Agency believe that no specific conclusions can be derived from the dissertation on this specific aspect, and in addition the dissertation does not refer to the applicable legal framework but to a framework repealed in 2014,

- The dissertation does not takes into account the legal framework applicable in the EU (or in OTIF CSs) concerning the authorisation for placing into service (or admission) of wagons equipped with mechanical derailment detectors; it only refers to the UIC leaflet.

- Finally, the Agency has also noticed - and this is important for the development of the existing railway system - that **the scope of Dr Bing dissertation is limited to UIC brake systems and cannot be extrapolated for general conclusions concerning the future use the of derailment detection in Europe.**

According to the findings, the Agency considers it is necessary to study the measures to put in place for preventing the operational risks posed by the use of the mechanical derailment detectors of UIC type. The use of the mechanical detectors of UIC type constitutes a change of the system in use which needs to be risk assessed in accordance with the applicable CSM. The results of the risk assessment need to be integrated in the form of risk control measures in the Safety Management Systems of RUs, IMs and possibly ECMs.

A more general consequence of Dr Bing findings when mechanical derailment detectors are used in a train composition should be a revision of braking mode settings – for example, increased use of G mode - which may lead to a general impact on the operation of the EU railway system, as follows:

- **Limitation of use certain train compositions including two-axles wagons,**
- **Possible increase of braking distance for train compositions with bogie wagons,**
- **Possible more restrictive braking mode when mixing two axles wagons with bogie wagons,**
- **Reduction of train operating speed, with negative global influence on the capacity of lines.**

These possible impacts should be analysed carefully and quantified before deciding on a potential amendment of the relevant legal framework for the use of mechanical detectors.

[2] On this aspect the most up-to-date information is the one reported by Switzerland to the RID DDD Working group during its first meeting, which indicated 1 to 2 false alarms per year for the fleet equipped in Switzerland.

Concerning possible alternative measures to mechanical detectors, Dr Bing's dissertation globally support the proposal made by the Agency in 2012, in particular:

- It is confirmed that very simple measures taken at the level of the safety management and maintenance systems, for example the regular maintenance of the buffer's surfaces (e.g. greasing), could significantly reduce the risk of derailments,

- It is confirmed that the use of electronic detection would be an effective solutions for "mitigating the problems identified with the use of mechanical detectors",

- It is confirmed that both the use of central coupling, with energy supply and on-board monitoring, including electronic derailment detection as part of a general condition monitoring systems, would be an effective package for the reduction of Dangerous Goods risks.

These conclusions should be considered for the definition of the future railway freight system.

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