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No. SD.DFM.A.4.7 Dated: 13.12.2016

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Sub : Emergency brake application on train leading to derailment - A Misconceptions of Zonal Railways.

Different departments of Zonal Railways have been expressing doubts on use of emergency brake application of a train formation and its contribution to derailments. It is also observed that the following unfounded assumptions give rise to such doubts.

- Bunching of formation on emergency brake application leading to off loading of wheels.
- Excessive brake forces on emergency brake application compared to service brake application leading to derailment.

(A) Bunching of formation on emergency brake application:

There are doubts about the application of brakes in the front portion of train formation much before the brakes get applied in the rear of the train formation, as the brake pipe (BP) pressure gets discharged from the locomotive leading to bunching of formation.

Two important factors need to be considered to clear any doubts:

(i) The time difference between brake initiation between the 1st vehicle and last vehicle (i.e. the time difference between charging of air in to brake cylinder of 1st vehicle to charging of air in to the brake cylinder of last vehicle).

(ii) The time difference between the time the brake cylinder of 1st vehicle is fully charged and the time the last vehicle brake cylinder is fully charged.

Field trials conducted by Testing Directorate of RDSO substantiate that the time difference between brake initiation as well as full brake application between adjacent vehicles is highly negligible indicating that the brake application is almost simultaneous leaving no scope for bunching. The details of trials of Testing Directorate of RDSO are given below:

The time difference between brake initiation between the 1st vehicle and last vehicle:

Table-1

RDSO Testing Dte field trial report reference	Brake Propagation rate* in emergency application (a)	Calculation for a full length passenger and goods train			
		No. of trailing stock (b)	Length of a single vehicle (m) (c)	Approx. time lag (in Seconds) in start of filling of brake cylinder of last vehicle from the time of emergency application (b*c/a) (d)	Approx. time lag (in seconds) in brake propagation in two adjacent vehicle (d/b) (e)
MT-1371/F, September 2014 with 21 LHB coach	233 m/Sec	26	22	2.5	0.096
MT-244, August 2000 with 58 BOXN	251 m/Sec	58	10.5	2.5	0.043

* Brake propagation rate is the ratio of train length (length of brake pipe from first vehicle to last vehicle) to the transmission time (time elapsed from the moment the air starts entering in to the brake cylinder of first vehicle to the moment air start to enter the brake cylinder of last vehicle)

As seen from the Table-1, brake wave reaches last vehicle in approx. 2.5 seconds for a full length passenger/ goods train i.e. brake initiation starts in 2.5 seconds even in the last vehicle of a passenger/ goods train once the emergency brake is initiated from the locomotive. The difference between initiation of brake in two adjacent vehicles will be a fraction of second, in the order of 0.043 seconds in goods and 0.096 seconds in passenger train.

The time difference between the time, the brake cylinder of 1st vehicle is fully charged and the time the last vehicle brake cylinder is fully charged:

Testing Dte of RDSO conducted a detailed field study on brake application time in different modes of brake application and published report vide Report No.MT-73, February 1997 for Passenger train and MT-244, August 2000 for Goods train. Brake application time in emergency application is tabulated below for passenger and goods train.

Table-2

Type of trailing stock	No. of trailing stock (a)	Type of brake application	Brake application time* (In seconds)		Approx. Time lag (In seconds) in brake application time in two adjacent vehicles ((c-b)/a)
			I st Coach/ Wagon (b)	26th coach/ 58th Wagon (c)	
ICF coach	26	Emergency Application	7	24	0.65
BOXN Wagon	58	Emergency Application	30	34	0.07

* Brake application time is the time to develop full brakes on the vehicle from the instant brake application is initiated from the locomotive.

During the brake development time, the brakes on each vehicle start applying progressively and the full brakes are applied on each vehicle with a time lag of 0.65 seconds (Passenger train) and 0.07 seconds (Goods train) between each vehicle till the rear most vehicle.

As would be seen from the discussions above, brakes initiation in two adjacent vehicles of a passenger train takes place within 0.096 seconds and fully developed within 0.65 seconds indicating that the brake initiation is almost simultaneous and leaves no scope for bunching of the train.

(B) Excessive brake forces on emergency brake application:

Brakes on Indian railway rolling stock vehicle are applied by physical contact of the brake block/ disc with the wheel and axle assembly. The wheel & axle assembly and brake blocks/disc come in contact once the brake cylinders starts getting filled with air. The movement of the brake cylinder piston is transmitted to the brake block via brake rigging and a normal force acts on the wheel (Product of Brake Cylinder pressure x cross sectional area of brake cylinder x Mechanical advantage of brake rigging x No. of brake cylinder in vehicle). All the parameters are constant for the given vehicle except the brake cylinder pressure. The normal force is maximum, when the brake cylinder is filled with the maximum designed air pressure.

The maximum brake cylinder pressure is the same in full service brake application as well the emergency brake application, which indicates that the brake force both in emergency and full service application is the same, except for the fact that in emergency condition, the brake force is applied at a faster rate. Accordingly, it is submitted that there are no additional forces acting during emergency application, thus the occurrence of excessive force during emergency brake application is ruled out.

2.0 While clearing every new rolling stock for regular service (as per policy circular no. 6), emergency braking distance trials (apart from oscillation trials) are conducted by RDSO to judge the braking capabilities of the rolling stock and a specific mention of such trials is included in the final speed certificate issued by RDSO for regular operations.

3.0 In addition to above, It may be noted that emergency application (Automatic brake valve & Asst. Pilot Brake valve) is a standard design feature of the brake system and provided to stop the train in the shortest possible distance from the given speed in case of emergency situations. Emergency features used on IR locomotive brake system are also in line with UIC guidelines. This is a standard feature of the brake system used worldwide on locomotives.

As submitted above, emergency brake application is an essential safety feature of the brake system of railway rolling stock for faster application of brakes in case of emergencies this does not contribute to any derailment under any circumstance.

Encl: Nil.

13/12/2016

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