EXTENDED SUMMARY IN ENGLISH

On May 20, 2014 an overspeed incident took place in Hallstahammar, as empty train 18294 entered a curve at a significantly higher speed (96 km/h) than the curve allowed (80 km/h for the type of vehicle concerned, otherwise 75 km/h; notation is: 75/80). The driver had applied service brake before the train entered the curve, and as the train passed the speed sign at the beginning point of the speed restriction of the curve, the ATC also engaged the service brakes. ATC is the Swedish system for automated train protection.

The incident occurred because the ATC transponders, the balises, at the ahead information point for the curve speed restriction, 1100 m before the restriction start point, were both destroyed, so the in-vehicle ATC equipment did not receive any ahead information about the speed restriction as would have been the case in normal circumstances. The vehicle ATC showed 140 km/h as the permissible speed, instead of the pending 75/80 km/h that would have been the correct ahead info about the upcoming curve. First the driver increased speed according to ATC info, but then he acted on his knowledge of the line and engaged the brakes to negotiate the curve, which he in fact knew to have a speed restriction. If he had not acted thus, the train would have entered the curve at 140 km/h. The vehicle ATC would have engaged emergency brakes as the train passed the starting point of the speed restriction, but that point is where the curve starts and with the reaction time of the brake system taken into account, the train would have gone into the circular curve at a severe overspeed and a derailment might have occurred.

The Swedish ATC is a system based on discrete information points. The system has in-track equipment, *balises*, that communicate with equipment in the active vehicles (locomotives, motor-coaches, cab cars etc.); *vehicle-ATC*. Balises are normally related to permanent optical information points, such as signs and signals (including distant signals). Balises in conjunction with static information points (e.g. signs) are not adjustable and give only one preset message, while balises connected to signals give different messages depending on the signal aspect shown to the train.

Balises are read by vehicle-ATC as the leading vehicle passes over them, the information being conveyed in the form of coded binary telegrams. Information from the balises is then evaluated by the on-board equipment and the correct actions of the driver are monitored. Failure to react on restrictive information (e.g. ahead info about a signal at Danger), will eventually trigger service or emergency brake application.

The system is fail-safe in itself. All information points require at least two balises (a "group") to be able to give all pertinent information and to allow the vehicle ATC to determine the direction of travel. All balises are read by all trains, but

information that is intended for trains in opposite direction is discarded. If a telegram is incomplete, or a balise in a group is missing, the vehicle equipment will alert the driver.

The dangerous situation described in this report could appear, because both balises, in the ahead information group regarding the speed restriction, were inoperable. No errors could then be detected and, accordingly, no alert given to the driver. Balise groups related to *signals* are all linked together with the information that they send to the vehicle ATC (the distance to the next signal and its balise group is included in the telegram; if the next group is not found, the driver will be alerted), but that is not the case for static information points, such as speed restrictions. The complete loss of a static ahead information balise group will not be detected by vehicle ATC.

The balises in the ahead information point for the speed restriction were most probably destroyed by a ballast plough. The inspection procedure that should be executed after track adjustment and ballast forming does not include checking signalling equipment in the track.

The restrictive ahead information from the balise group in question is normally masked by a restrictive ahead information from the distant signal balise group for Hallstahammar home signal 122, as was the case in this particular situation. The distant signal balise group lies before the speed restriction ahead information balise group, for trains in the direction dealt with here. The vehicle ATC showed "70, pending" from the distant signal, and the information "80, pending", that would be recorded for the curve, would not have shown until the signal speed information was altered to a higher value, when the train passed Hallstahammar 122. The ahead information sign, which the driver is supposed to notice, is, of course, situated at the information point that the train passed before signal 122 and can not be expected to have been of any substantial help to the driver in this particular situation.

Recommendations

The Swedish Transport Authority (Transportstyrelsen) is recommended to take action, with the purpose of ensuring that Infrastructure Managers, in their safety management systems, have included rules and procedures that aim to ascertain that damage to signalling equipment, that might occur in the course of works on the permanent way, is identified and properly noted for need of repair.