

SUMMARY IN ENGLISH

An accident occurred in the Sundsvall marshalling yard on 20 September 2012, where a shunter was killed.

The shunter was in the process of moving a multiple-unit (MU) arrangement of two Z70-class diesel locomotives from one track to another in order to collect a set of cars. The MU was remotely controlled through a radio control box, that the shunter carried in a harness and she was standing on the locomotive's outside, on a "shunters' footstep" in the usual manner for this type of activity. The movement was halted just outside the marshalling tower and the switch 430 was thrown by the signalman in the tower to set the route in the correct direction. Then the movement of the MU was reversed and as it entered switch 430, the leading locomotive (no. 738) in the MU derailed.

The shunter, standing on the footstep at the front left position of the MU, was thrown off by the violent jumping of the leading locomotive and was fatally injured getting caught between the left side cab ladder of locomotive 738 and the ground.

The derailment was caused by the leading wheel axle on no 738 being broken off, just inside the wheel hub seat on the right-hand side. The right-hand wheel of the leading axle is believed to have taken the wrong way in the switch common crossing (frog). As the left-hand wheel left the guardrail, the locomotive made a violent movement to the right which made the shunter fall off while the MU was still moving.

The Z70 is a diesel-hydraulic unit with two axles, both of which are driven off the central gearbox through propeller shafts.

The break in the wheel axle was caused by material fatigue, which had led to a crack forming in the area just inside the wheel hub seat. The crack has propagated until very little (< 10%) undamaged material was left and then the axle broke. Crack propagation has been caused by rotational bending forces in conjunction with torsional stress, which can appear when wheel slip give rise to torsional vibrations. The crack had remained unnoticed, since no regular checks for cracks were performed on locomotives of this class.

Wheel sets from this class of locomotive were taken into shop for "rebuilding" after 28.800 service hours. This operation included fitting of new or restored wheels and thorough inspection of the axle and gearbox, including a search for cracks using the "magnaflux" method. In cases where cracks were found, the axles were discarded and new ones fitted into the wheel sets. The fact that axles indeed had to be discarded was a deviation from the expected service life of this component, which was supposed to be equal to the service life of the locomotive itself, but no proper analysis of these occurrences was carried out.

The crack that caused the wheel axle to break would have been noticed, if a search for cracks had been carried out regularly, with a reasonable interval. The very small undamaged part that finally broke suggests that the crack had been growing for a long time. The premature failure of wheel axles hasn't been caught and processed by the Railway Undertaking's system for finding, recognising and analysing incidents and deviances from norm.

Recommendations

The Swedish Transport Authority is recommended to check how Railway Undertakings are working with continuous improvements in respect to deficiencies in safety-critical designs where deviations previously have been noted but not taken care of, for example when a component's expected life cycle is not achieved.

The Swedish Transport Authority is recommended to encourage owners / users of locomotives of a similar type and similar uses as Z70, to ensure that safety-critical assemblies and components of these vehicles are subject to periodic examinations in order to find incipient hazardous deficiencies.