NAFLIC

National Association For Leisure Industry Certification

Standards & Related Documents Committee

TECHNICAL BULLETIN - JANUARY 1998

161. Roller Coaster Anti-Rollback Failure

We have received a copy of a "Ride Safety Alert" issued in November 1997 by the Oklahoma Department of Labor (4001 N. Lincoln Boulevard, Oklahoma City, Oklahoma 73105-5212). This concerns an incident on 20 April 1997 in Tulsa involving a "Wildcat" roller coaster manufactured by Schwarzkopf. A premature release of a single car from the lift chain (i.e. while still ascending the lift) and the subsequent failure of the anti-rollback device allowed the car to accelerate backwards, colliding with another car that had just been dispatched from the loading station. It is thought that the collision resulted in 1 fatality and 5 injuries.

The Committee wish to draw to your attention several points concerning this incident and anti-rollback devices. Firstly, in this incident, there was a failure of the primary system the cause of which was not described. However, it is known that such primary failures occur with sufficient frequency to require a secondary device (i.e. anti-rollback). Typically anti-rollback devices are rack and pawl so that, in the worst case, the car or train rolls back by the distance of the rack pitch, resulting in an impact load.

Perhaps the most frequent cause of failure of the primary system is loss of power to the lift drive, but chain breakage from excessive wear is not unknown although it is infrequent. In the case of power failure the inertia of chain and drive components restricts the rollback impact velocities to some extent, but chain breakage can result in a more serious impact. In general the probability of primary system failure is high enough, and the potential for injury serious enough, to require a secondary, anti-rollback, system although there are a few roller coasters where there is no significant hazard associated with the rollback direction.

In the case of the Tulsa incident, the secondary system also failed - brittle fracture of an "anti-rollback stop" made from a Nylatron type material was said to have occurred. It is our experience that many anti-rollback systems are not designed so as to be able to absorb the full impact energy within the elastic range. In these circumstances part of the energy is converted into plastic deformation of one or more components. This implies that the relevant components of the system should be inspected after a rollback. It is clearly an important design matter to ensure that the dimensions etc. are selected according to the material properties in

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relation to the calculated or measured impact loading. If properly designed, inspected and maintained there should be no need for a tertiary safety system!

It is possible that the original Schwarzkopf anti-rollback dog had worn and been replaced by a modified component manufactured by the park. We are aware that anti-rollback components are sometimes repaired, replaced or modified and it is important to ensure that such parts are properly designed, manufactured and maintained by persons having appropriate competence. In the UK's Guidance, *Fairgrounds and Amusement Parks - Guidance on Safe Practice*, paragraphs 120, 167 - 169 and 178 should help in checking that suitable procedures have been followed.

Roller coasters operated with multiple cars or trains generally have blockzone systems with several sets of brakes around the circuit to ensure that the vehicles are kept apart. These systems are unlikely to be helpful, in the event of a rollback, even with modified zone spacing, since the car or train is likely to continue for some way back around the track. Brake control systems are not normally designed to detect and halt motion in the reverse direction.

The Oklahoma Department of Labor will make copies of the engineer's preliminary report available upon request and will issue additional reports when tests are finalised. You may wish to check the DOL website: http:/www.state.ok.us/~okdol/