NAFLIC

National Association For Leisure Industry Certification

Standards & Related Documents Committee

TECHNICAL BULLETIN - FEBRUARY 2000

199. Electrical Fault on Juvenile Train Ride

The Health and Safety Executive have provided us with some additional details of an accident which resulted from an electrical fault on a juvenile train ride. One of the passengers received minor injuries.

The incident involved a Winnards juvenile train ride which was probably about 20 years old. The type of ride is relatively unimportant, the fault being with the electrical control equipment.

The ride was powered by a mobile 110V d.c. generator which was placed about 20 metres from the ride and supplied it by two multi-strand rubber sheathed cables terminated at two brass bolts mounted on an insulated plate attached to a lower support of the ride.

The speed controller consisted of a rheostat with six fixed resistor coils attached to a bakelite board inside a control box fitted with a hinged lid. At the left hand side of the box was a 20 amp isolator switch and a GEC chassis-mounted red spot fuse holder. The fuse(s) had been replaced by two strands of wire. Flexible conductors between electrical components did not have adequate mechanical protection against wear as they passed through the hole in the metal control box.

The negative electrical supply was connected directly to the traction motor and also to the chassis of the ride. The positive supply was connected to the fuse, then to a 3 pole isolator switch (which was being used as a single pole isolator rather than also isolating the negative side) and thence to the traction motor. This modification, the addition of fuse and isolator, was carried out about 15 years ago because the original design was unsafe.

We are informed that the incident occurred because the incoming positive supply cable, including the wires themselves, completely wore through as a result of mechanical wear and tear and subsequent short circuit to earth on the edge of the hole in the box through which the cable passed. It is possible that proper circuit protection or fusing at the generator would have properly disconnected the circuit at this stage. The now free-floating wire fell on to a terminal (a brass bolt) resulting in full voltage being applied to a feed to the motor, thus bypassing all control elements including the isolator, fuse and rheostat. With full voltage the

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achievable speed was higher than the normal maximum operating speed and overspeed was the outcome. As a result of this overspeeding the train derailed.

This accident reminds us of several matters that may need to be considered in similar circumstances :-

1. It is normal, in mains electrical circuits, to provide double insulation for all conductors that are not protected by an enclosure or trunking.

2. Protect connectors and cables against mechanical wear and tear where they may be abraded by contact with other parts by securing, providing grommets, glands, etc., as appropriate.

3. Provide overcurrent protection. In simplest terms this means making sure there is a fuse or overcurrent device of the correct rating suitably placed to protect all cables in the system. It is particularly important to remember the distribution cables at the generator.

4. Provide isolation in both supply conductors. (This would be a definite requirement for floating d.c. supplies).

5. If the maximum achievable speed is greater than the maximum operational speed, additional means may be necessary (e.g. circuitry to force a safety stop in the case of overspeeding) to ensure that the maximum operational speed is not exceeded. Designs which avoid this possibility, by for instance providing correct gearing ratios to make the maximum operational and achievable speeds the same, are much preferred.

6. Electrical equipment and modifications should only be designed by persons with the appropriate competence. The design safety of all electrical equipment or modifications brought into use in Great Britain after September 1997 should be checked by an inspection body registered for design review. Paragraph 15 of HSG175 requires the design safety risks of older equipment to be assessed by controllers.