

The wrong kind of SNOW?

When ice, snow and frost start, British Rail stops — or so it seems. Rodger Bradley looks at the problems that severe weather presents for electric railways, and how other countries have come to grips with keeping the winter trains on time.

About a year ago, a British Rail spokesman made his famous comment that the reason for the poor performance of train services during a period of bad weather was the "wrong kind of snow".

The tabloid press, of course, made much of this remark. But is it really fair to berate BR for the problems presented by the weather? What exactly has it done to counter the impact of snow and ice on electric traction equipment and train services?

Some components on electric trains are clearly at risk in bad weather, particularly snow and ice. The multiple unit trains which dominate Network SouthEast carry a great deal of underfloor electrical equipment, including switchgear, traction motors, control apparatus and contact systems.

On London's suburban lines and

on the Underground, the contact system consists of side-mounted traction current pick-up shoes. On more modern, 25kV AC electrified lines, the current is carried by an overhead catenary, and a pantograph and HT equipment are mounted on the roof of the train. However, these trains still carry underfloor equipment in pannier cases which are exposed to the elements.

The bad weather of a year ago that caused delays and cancellations in the south has not so far been repeated in 1993. Scotland, however, has seen its worst weather for many years, causing not only train cancellations and disruptions, but physical damage to lines.

BR has taken action on electrified routes throughout the UK to minimise the impact of severe winter weather on power and control systems. But it has not made any significant design changes to its traction

Sub-zero success story

ABB Traction, one of the main suppliers of traction equipment to Scandinavia, has long experience of designing and building vehicles for Arctic or sub-Arctic operations. Vehicles from the ABB stable usually include the following measures:

- increased creepage distance on electrical machines with double insulation;
- careful sealing and draining of equipment cases;
- water and oil separation in the compressed air system;
- overpressure and electric heating of equipment cases;
- encapsulation of electronic and con-

trol equipment boxes;

- encapsulation with internal closed air circulation or with air-to-air heat exchanger;
- electric heating of automatic couplings;
- careful selection of grease for electrical contacts in couplings;
- mechanical protection and unloading of cables in the underframe, and between closely coupled vehicles;
- armoured cable hoses;
- cable ducts and piping within underframe designed to minimise snow collection;
- reinforced mechanical fittings for

underframe assemblies;

- forced ventilation of traction motors;
- ventilation air intakes at high level — on the roof, for example — to prevent ingress of powder snow and snow smoke;
- mechanical snow and dust separation filters for air intakes;
- careful sealing of air ducts and bellows between underframe and traction motors;
- draining of traction motors to avoid water collection in severe weather;
- tightening and selection of insulation to avoid water pockets and absorption of moisture;

equipment, and there are lessons to be learnt from other countries which face weather much more severe than it is here.

Electric traction is more widespread in Sweden, Norway, Finland, Switzerland, Austria and Germany than it is in the UK. In these countries, winter weather is an important consideration in equipment design and operation.

A typical drive system consists of axle-mounted traction motors, cooling systems, switching systems — usually mounted under the vehicle floor — and contact systems.

Control systems

Control systems, including on-board computers, are more easily protected from low ambient temperatures than, say, an axle-mounted DC motor. Electropneumatic control systems, carrying air under pressure, are vulnerable on multiple-unit trains because they are mounted under the vehicle floor in pannier cases exposed to snow and ice.

For the ventilation systems of traction motors, designers must consider the position of filtered air intakes and ducting, and the filtration system must be able to cope with not only dust, leaves and dirt, but with powdered snow and snow smoke.

So winter weather precautions must ensure that there is a supply of clean air to the electropneumatic control system. If the on-board systems are charged with air at a depot, it must be dry and oil-free. Under-floor equipment must be sealed and drained — a common fault in bad weather is insulation leakage in the traction motor and other exposed components.

During the past year, BR has improved its winter maintenance schedules. Its main measure is the exten-

- elimination of stagnation areas in the underframe, particularly for air flows;
- locating equipment properly in equipment cases and protection against condensation;
- creep control systems built into the vehicle control system to avoid wheelslip/slide.

There are aspects of locomotive or multiple unit vehicle design which would not be suitable for UK operations. In some cases, these features will add to the capital cost and this may be more difficult to justify in the temperate UK climate.



sive use of de-icing chemicals to melt snow and ice. Reportedly, the chemicals result from ten years' research.

De-icing and snow melting agents are applied to contact systems and the underfloor areas where the electrical equipment is carried. A non-stick coating has been developed which prevents the build-up of snow and ice on the train's underframe. The disadvantage of this method is that it takes a lot of time and money.

Weatherproofing could cure the problem permanently, however. BR has conducted experiments with blanking plates over air intake ducts to keep snow out of the traction motors. Air can still get round the plate to cool the motor and BR has improved the air filtration on its trains. Leaving the heating systems on when the trains are in the depot can also help prevent snow and ice building up.

It is not only the trains themselves that are affected by severe weather. Ice can build up on conductor rails, causing problems for the traction current pick-up shoes. Chemical de-icers, modified shoes and strip heating have all been brought to bear on this problem. London Underground has conducted trials with strip heating near Stanmore, but the technique has yet to see widespread application.

Trains damaged by bad weather can make severe dents in railway timetables. In Sweden, the rail authorities recognise this and run reduced services. This creates a reserve of rolling stock to replace damaged vehicles, and leaves the tracks clear for snow clearance and maintenance. Unfortunately, a string of mild winters in Sweden since the measure was introduced means that it has yet to be proved effective. BR has toyed with the idea of reduced timetables in its "ten-point plan" announced a year ago.

The European connection

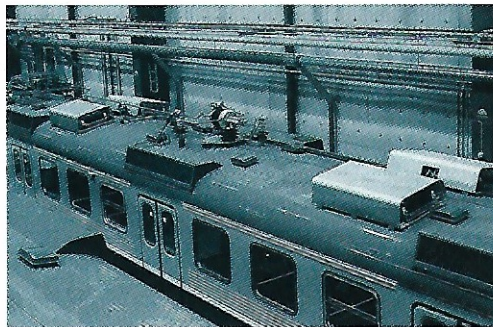
The countries of central Europe and Scandinavia have run trains in severe winter weather since the dawn of rail traction. Ironically, these countries have chosen to develop electric traction, mainly because of the scarcity of alternative fuels. Their experiences could point the way for BR.

During this year, Denmark, Finland, Norway and Sweden are preparing a joint study of the effectiveness of measures and designs to protect equipment from the effects of winter weather. Nordic locomotives and stock already have a range of design features that allow them to operate in bad weather. Major suppliers are obliged to include features — not common in the UK — demanded by the railway operators.

When Swedish Railways and Nor-

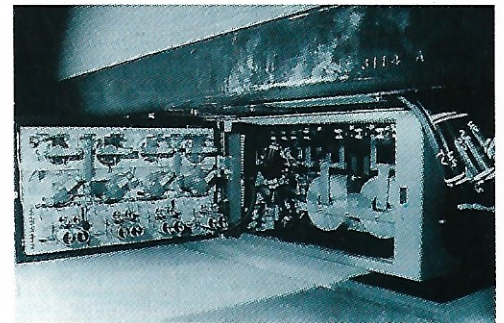


Above: Snowbound but running — Swiss railways



Left: Roof mounted ABB Traction equipment in Scandinavia

Below: Interior view of equipment case with air-to-air heat exchanger



wegian State Railways order new trains, they set out the winter service conditions in the purchasing specification. They also carry out type testing on the notorious Kiruna to Narvik line — a severe winter test for any equipment. This kind of type testing will soon be required for new BR vehicle designs (for a list of typical design modification for winter operation, see the box on page 26).

Austrian State Railways currently has electric multiple units under construction. Their winter protection features include:

- pressurised circulation systems incorporating effective drainage and heating;
- air intakes at roof level and filtering of cooling air;
- overpressure in electrical cubicles and equipment cases;
- avoiding stagnant and low pressure areas in equipment;
- liquid cooling of high performance electronic systems and components, where possible;
- liquid cooling of traction motors in extreme circumstances.

Temporary measures for winter only include fine mesh filters in cooling air systems, more frequent servicing of brakes to prevent seizure, and electric heating of automatic couplers.

Other maintenance procedures include:

- snow clearance of tracks with rotary and conventional snow ploughs;

- removal of snow and ice from the underframe before any train leaves the workshop;
- hot air flushing facilities where bad weather is frequent;
- reduced ventilation of some components during winter;
- use of dried and oil-separated air from shore systems when charging the trains' air systems.

Maintenance procedures are similar throughout Europe. While some of the worst effects of freezing winter weather can be designed out of electric traction systems, there are many operational and maintenance measures that can minimise the impact on the on-board equipment. Snow clearance is compulsory on many mountain railways, and de-icing agents are used throughout Europe.

The design and placement of electric traction equipment, and its protection and cooling, have combined with more frequent servicing of trains and their drive, control and braking systems to keep Continental rail systems running in winter. BR take note. ■