Die Bahn DB

FIRE AND DISASTER CONTROL

ON THE

COLOGNE-FRANKFURT

NEW-BUILD LINE

Publishing Details

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Cover photo: Montabaur station on the Cologne-Frankfurt new-build line

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1 Introduction

This publication sets out the fire and disaster control measures adopted for both tunnels and open line on the Cologne-to-Frankfurt new-build line with the exception of stations.

2 Averting hazards on the Cologne-Frankfurt new-build line

2.1 Open line

Railway lines are traffic routes like roads and waterways. Operating conditions for outside rescue services do not differ significantly from those that apply for other types of traffic route.

As there is not as yet any legal basis in the form of a directive from the EBA (Federal Railway Office) in which measures for open line are defined, it was agreed with the EBA that means of access be established for use by outside rescue forces at max. intervals of 1.000 m along the track. This may also be effected by making use of woodland tracks. The whole of the Cologne-Frankfurt new-build line (NBL) is served in this way. Access routes have additionally been provided up to the entrances to the long viaducts along the line. Further measures are being put to effect by DB AG's Emergency Management. This is gone into in greater detail in Section 4.

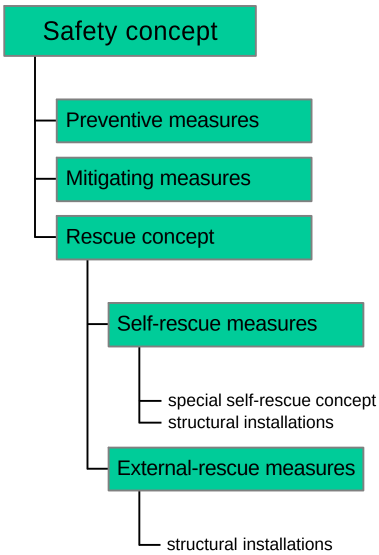

Table 1: Safety concept architecture

There are no measures in the form of special structural facilities.

2.2 Railway tunnels

2.2.1 Legal basis

Railway tunnels are items of railway infrastructure as set forth in Annex 1 of EEC Regulation 2598 of 1970 (EEC REG 2598/70). Project and building approval and measures attendant thereupon are the domain for the purposes of German federal railways of the EBA.

The applicable legal basis is thus in the first instance the General Railway Act (AEG) and, to an extent, the Railway Construction and Operating Regulations (EBO)[1].

Given that a railway tunnel is not an area of public access[2], the respective federal-state legislation governing fire safety in rising structures does not apply.

2.2.2 The safety concept for tunnels

The safety concept for railway tunnels has four tiers (cf. Table 1). It comprises

- preventive measures
- mitigating measures
- self-rescue measures
- external-rescue measures.

The key focus is on preventive and mitigating measures.

Depending on the length of a given tunnel, its location and construction date, the safety concept is supported by a variety of measures in DB AG areas. The tunnels along the Cologne-Frankfurt NBL meet the requirements set forth in the EBA Directive entitled "Fire and disaster control requirements for the construction and operation of railway tunnels"[3].

[1] Railway Construction and Operating Regulations (EBO) of 8 May 1967, last amended 27 Dec 1993.

[2] Trespassing on trackage systems constitutes an offence under Paragraph 64b EBO.

[3] EBA Directive "Fire and disaster-control requirements for the construction and operation of railway tunnels" of 1 July 1997

2.2.2.1 Preventive measures

Preventive measures are designed to minimise the probability of an incident occurring. The operating schedule for the Cologne-Frankfurt NBL does not provide for freight workings. Measures to prohibit trains crossing are not, therefore, considered here.

Figure 1: Hectometre board with EBOD sign

To avoid fires on board vehicles, the ICE 3 category rolling stock used on the NBL conforms to fire protection class 2 in the German DIN 5510 standard. Fitments are either hardly inflammable or else non-combustible. The guaranteed operability of rolling stock under full fire conditions is 15 minutes.

2.2.2.2 Mitigating measures

Mitigating measures are intended to prevent an incident that has already arisen from spreading. That would be the case, for instance, if a passenger train that has caught fire comes to a halt in a tunnel. The “fire” event would spread through the unfavourable “tunnel” location.

As a means of ruling this out as far as possible, trains worked on the Cologne-Frankfurt NBL are fitted with an emergency brake override device (EBOD). The requisite EBOD sections have been suitably marked along the line with the aid of specially labelled kilometre and hectometre boards (cf. Figure 1).

2.2.2.3 Rescue concept

The rescue constituent of the safety concept takes effect should preventive and mitigating measures be unsuccessful.

The rescue concept subdivides into self-rescue and external-rescue measures. Both types of measure are supported on the Cologne-Frankfurt NBL by structural installations and organisational measures. These measures are covered in detail in Section 3.

2.2.3 Incident probability

The rescue concept is designed to enable outside rescue forces as well as endangered persons themselves to deal with a potential scenario. This inevitably raises the question as to the form such a scenario might take and what effects it would have. A crucial point alongside the possible extent of damage is the probability of an incident occurring.

It is not worthwhile here considering a “worst case” that has very little likelihood of occurring in a tunnel and would cause so much damage if it did that it would be virtually impossible to tackle anyway. A rescue concept needs to be geared towards probable and controllable scenarios so as to be able to guarantee the optimum sequence of events if an incident does occur.

In conjunction with Unit 5 (Fire-Fighting) at fire-safety specialists “Vereinigung zur Förderung des Deutschen Brandschutzes e. V. (vfdb)”, the EBA and the STUVA study group for subterranean transport systems, DB AG’s Emergency Management unit drew up recommendations[4] taking as their point of departure two defined scenarios within a tunnel. These scenarios cover both a “hot” incident in which fire breaks out and a “cold” incident requiring technical assistance.

The same pattern has been applied for the deployment of equipment and for structural

[4] Final Report of the “Fighting Tunnel Fires” Working Group in Unit 5 at vfdb dated December 2000.

precautions. It is necessary here to consider not only incident probability but also the issue of commensurability. In the final analysis, complete safety can never be delivered. Thus, it is necessary to determine how great the acceptable residual risk really is.

For the purpose of the German federal railways, this residual risk is defined in the EBA Directive[3].

2.2.4 Comparison with road tunnels

Like roads, rail is a mode of transport. The respective federal states in Germany (Länder) have responsibility for averting hazards and to this end have adopted laws governing fire safety and the assistance to be rendered. These laws transfer jurisdiction over the measures required to local authorities (municipalities, districts and parishes). Local authorities are required to establish fire brigades and to equip these in compliance with regional requirements for the purpose of fire-fighting and providing assistance in the event of accidents.

Rescue operations in tunnels are nevertheless an uncommon undertaking for a fire brigade. Just how true this is has been repeatedly attested to lately, notably by major accidents in the Tauern and Mont-Blanc tunnels in 1999, the disaster in the Kitzsteinhorn tunnel at Kaprun in Austria in 2000 and, most recently, by the fire in 2001 in the Gotthard road tunnel in Switzerland. Rescue services have difficulty getting to the scenes of such calamities owing to the enclosed nature of tunnel systems, the intense heat and smoke generated, and in some instances access routes being blocked. The latter in particular is an even greater problem for road tunnels than for railway tunnels. The fire brigade arrived at the Gotthard tunnel portal within five minutes, for instance, but was unable to reach the scene of the accident until the next day owing to the intense heat produced. Given the lack of experience gained with incidents in railway tunnels and the experience that has by contrast been gained from the road sector, operating conditions for fire brigades in road tunnels are invariably applied to railway tunnels without any adjustment. This gives rise to demands that cannot be regarded as realistic for railway tunnels.

Albeit railway lines and roads are both transport routes, their different operating systems alone mean that they cannot be compared. The main cause of accidents in road traffic relates to errors made by motorists. The operating system for road traffic is conducive to the high risks of accidents brought about by such errors. Running at sight, a lack of technical safety equipment on board vehicles, the existence of a multitude of ignition sources and combustible substances - none of these play a part in the operating system for rail. Likewise, the danger of subjective and hence unpredictable responses by a large number of individual persons is a typical characteristic of road traffic. The attempt to transfer the insights and findings from the calamities mentioned one to one to a railway tunnel and hence to compare the two safety concepts with one another is accordingly doomed to failure.

The operating system for the railway with its guided motion, its practice of running at space intervals, its technical safety installations, advance command-control technology and the existence of trained staff enable the emphasis to be placed from the outset upon measures that reduce the likelihood of an incident occurring as far as possible and contain it if it does.

In road tunnels, by contrast, the emphasis has to be on self-rescue and external-rescue measures. It is effectively impossible to prevent subsequent vehicles from entering a tunnel in which an accident has happened. Road vehicles constitute a considerable fire hazard through the fuel they carry moreover. The probability of an accident leading to a fire or vice versa and a tunnel subsequently becoming blocked is significantly greater than with rail. Very few vehicles carry fire extinguishers and the owners of those that do are frequently unversed in their use.

A further point is that the average European citizen nowadays is accustomed to receiving rapid, comprehensive and expert aid in the event of any incident and takes such provision for granted, with the upshot that virtually no one acts of their own accord anymore.

Findings from studies conducted to date on the accidents adumbrated above show that the vast majority of vehicle occupants remain in their vehicles in the event of an incident and wait for the rescue services to arrive instead of making any effort to rescue themselves.

The key focus in a road tunnel accordingly needs to be on external-rescue measures.

3 Putting the rescue concept into practice

The safety concept set out in Section 2 is adopted in tunnels owing to their specific structural properties. The following describes how it is put into practice.

The EBA Directive[3] defines requirements, as do other statutory provisions and laws, without addressing the respective means of meeting them; this is the task of the operator of the system. There may well be different ways of carrying out the measure called for and, in individual cases, its effectuation may be beset by problems. Details of the respective approaches to be adopted initially needed to be clarified whilst the Cologne-Frankfurt NBL was still being built. The arrangements arrived at set standards regarding the structural design of fitments in tunnels that to a large extent are being, or already have been, incorporated into the DB AG Rulebook.

Described below is the extent to which stipulations contained in the EBA Directive[3] have been heeded in tunnels on the Cologne-Frankfurt NBL.

3.1 Structural design

3.1.1 Principles

The tunnels inclusive of their emergency exits are stable and built of non-combustible materials in line with the laws of engineering and their envisaged use. To prevent persons being hit by disintegrating sections of tunnel lining, the depth of potential chips of concrete was estimated having account to the composition of the concrete and its structural engineering (form of reinforcement). The behaviour through time of conflagration gases as shown in Table 2 was taken as a point of departure. The values in the Table relate to a reference fire with a rate of release of energy of 20 MW.

Duration of fire [min]	0	5	60	170
Temperature [°C]	0	1,200	1,200	0

Table 2: Behaviour through time of conflagration gases

3.1.2 Maintaining fitness for function

To protect supply lines for emergency lighting, the power supply and communication from possible damage in the event of a fire or as a result of a derailment, and to guarantee they fail safe, these lines are required to be laid in concrete beneath the escape route.

Where outer doors are concerned, the demand is exclusively confined to technical devices for remote release. The actual doors are in a defined safe area and conform to Class T 30.

Excluded from the demand for fail-safe status is the emitter cable to ensure a BOS radio capability. Laying the cable to F 90 specifications would impede its functioning. It is accordingly fed in sections. Should the cable be damaged by, for instance, fire, it will still be fed from two sides, resulting at most in locally confined as opposed to total failure.

The cabling needed to run operations such as signalling and telecommunications does not have to be laid to fire-safety standards.

3.1.3 Gradient

As a means of creating a slight flue effect that causes smoke to be naturally removed, tunnels have been given a gradient of at least 1 in 500. This generally leads to flow rates of between 1 and 2 m/s being achieved, depending on the

Figure 2: Handrail

underlying flow of air within the tunnel[5].

It was not possible to meet this specification in the 627m-long Troisdorf tunnel. As a means of compensating for this and ensuring the same degree of safety, therefore, an emergency exit fitted with a rescue shaft was provided for and the max. escape-route length drastically reduced.

3.1.4 Structural installations

3.1.4.1 Safe areas, escape routes

Emergency exits with rescue shafts up to the surface as defined safe areas were designed in such a way that the escape-route distance from a safe area does not exceed 500 m.

Leading to each safe area on both sides of the tunnel is a hard-surface, level escape route at least 1.20 m wide. This width is determined by the distance between the widest railway vehicle with doors open and the handrail. In the area of items such as catenary bracing equipment, switch cabinets or rail trolleys, escape routes may be up to 30 cm narrower for a distance of no more than 2.00 m.

3.1.4.1.1 Handrails

Handrails are fitted as tactile means of guidance at a height of 1.00 m above the escape route's finished floor level. Handrails are to be taken round fitments in the tunnel at an angle of 30° (cf. Figure 2).

3.1.4.2 Emergency exits

Reflecting the escape-route spacing demanded, emergency exits have been installed in longer tunnels. These give on to rescue shafts. All rescue shafts have been fitted with both stairs and lifts (cf. Figure 3). The latter are meant to facilitate the

Figure 3: Lift in emergency exit

conveyance of rescue gear into the tunnel and are hence for material only. The conveyance of persons is not envisaged, and such an intention would not in any case be worth entertaining. Since it can be assumed that a large number of people would be involved in such an incident, a lift's capacity would soon be exhausted. The officer in charge may in isolated instances allow handicapped persons etc. to be conveyed by lift by the rescue staff.

As the lift is located in a defined safe area and is initially only conceived for the conveyance of material, it does not need to be designed as a

[5] Depending on the direction of the wind, the outside temperature and other factors, both the direction and rate of flow can change several times a day. Experts posit, however, that flow rates in excess of 2.5 m/s give rise to considerable turbulence.

fire-safety lift and neither is this stipulated by law (cf. also Section 2.2.1).

The emergency exit is a defined safe area within the meaning of the EBA Directive[3]. This

Figure 4: Duct between running tunnel and rescue shaft

is achieved by means of connecting ducts arranged between the running tunnel and the rescue shaft. These ducts are at least 12 m long (cf. Figure 4). Two independent-action self-latching door systems seal the running tunnel off from the rescue shaft.

The doors separating the connecting duct from the running tunnel are at least fire-retardant and smokeproof (T 30 quality). The doors inside the connecting ducts are smokeproof.

To prevent crushing hazards arising from congestion as people approach stairs, circulating space of at least 25 sq. m is stipulated at such points. This also accommodates the needs of handicapped persons awaiting the arrival of outside rescue staff.

It is also possible to access the tunnel layout and hence the danger area of the track via the emergency exits. To prevent trespassing and also for monitoring purposes, outer doors to emergency exits are fitted with burglar alarms. It is sufficient here to route messages generated by the alarm system to the operations monitoring centre so operative measures can be initiated.

The outer doors to emergency exits are locked to keep trespassers out. To enable the fire brigade to get in, key safes have been installed outside the emergency exits that are electronically monitored by the operations control (cf. Figure 5). Key safes are fitted with a unitary locking system used by the fire brigade. They contain the key for the emergency exit.

Figure 5: Key safe

On the inside, doors are fitted with panic furniture.

3.1.4.3 Emergency lighting

The emergency lighting system has the primary function of aiding self-rescue. On the other hand, it can obviously also be used to aid outside rescue efforts, e.g. as a means of illuminating the scene of the incident. The individual fittings for the emergency lighting are mounted on both tunnel walls, even if the bore is single-track, at a height of at least 2.50 m. This accords with the provision in the EBA Directive[3] that lighting intensity should be uniform; at such a height, moreover, the light fittings are unlikely to suffer mechanical damage or destruction in the course of any incident.

The emergency lighting is exclusively confined to the tunnel bore and the emergency exits. Troughing areas adjacent to the tunnel are not illuminated, since by this point the defined safe area of the tunnel portal has already been reached. Connecting routes between the portal and the refuge site are likewise not illuminated as a rule.

3.1.4.4 Escape-route signage

The required distance of 25 m between directional arrows is derived from the fact that passenger carriages generally measure 26.40 m over buffers. This guarantees that the escape-route signage can be seen regardless of where a person alights from a train.

Rescue signs and directional arrows are identifiable as green information signs conforming to Trade Association Health & Safety at Work Provision (BGV) A8 that are luminescent and retroreflective and are

Figure 6: Emergency lighting and escape-route signage

attached to the tunnel wall (cf. Figure 6). Illumination or backlighting of these signs is not foreseen.

By contrast, emergency exits are marked by illuminated rescue signs mounted at right angles to the track. These signs are blue (cf. Figure 7).

The choice of blue instead of green rules out the possibility of a train driver mistaking the sign for a proceed signal. Blue is the colour legally stipulated for light-rail and underground-railway tunnels[6]; it has been specified here in the interests of uniformity.

[6] Operating Regulations for Tramway and Underground Railway Systems (BOStrab).

3.1.4.5 Refuge sites and access roads

Refuge sites each covering an area of 1,500 sq. m have been sited at each tunnel portal and emergency exit. In instances in

Figure 7: Emergency exit sign

which it was not possible to site the refuge sites at portals level with the top of the rail, additional means of access have been constructed up to the portal. These access routes are exclusively designed to enable heavy gear to be carried by vehicle up to the portal in the context of a rescue operation, where it is then loaded onto rail trolleys. It is not designed for shuttling accident victims in rescue vehicles. The road is accordingly 3 m across in conformance with DIN 14090 and does not need to be suitable for two-way traffic. There is a rudimentary means of turning at the end of the access road in the form of a hammer-shaped reversing bay.

Refuge sites are illuminated using equipment carried by fire brigades and disaster-control units. Most LF[7] or RW[8] vehicles used by fire brigades dispose over a lighting mast these days. Where major incidents are concerned, use is also made in Germany of Technisches Hilfswerk (THW), a nationwide technical support service. THW has at its disposal an

[7] German initials for “fire-fighting vehicle”: carries equipment to deal with fires and render technical assistance.

[8] German initials for “vehicle for tools and gear”: carries further equipment for technical assistance.

extremely powerful lighting assembly that can very effectively light up large areas (cf. Figure 8)

Special helicopter landing pads are not foreseen. Where a refuge site is not suitable for landing a helicopter, other sites are envisaged for such an operation. In the event of an incident, helicopters will land wherever they reasonably can, be it at a road junction, in a field, on a main road etc. - just as is the case for any similar incident occurring on non-

Figure 8: THW lighting equipment

railway premises.

3.1.4.6 Overhead lifeline

To be able to carry out external-rescue measures in a tunnel, it is essential first that the overhead line be quickly switched off and rail-earthed. Any overhead line equipment and feeder lines need to be de-energised and rail-earthed by the time the rescue services arrive.

This is achieved with the aid of an overhead line voltage detector (OHL-VD) that is generally remote-controlled from the applicable central control station. The OHL-VD acts to automatically rail-earth both the overhead line and any line feeders via an earthing switch. The de-energised and earthed state is displayed to the rescue services by an indicator lamp on the local control panel (cf. Figure 10). There is an OHL-VD local control

Figure 10: Local OHL-VD control panel

panel at each tunnel portal as well at each emergency exit with a refuge site.

Should the remote control on the OHL-VD malfunction there is also a means of activating the earthing switches in situ via a switch on the local control panel (cf. Figure 10). A precondition for in situ operation is that the appropriate sections of line have previously been deactivated.

At tunnel portals and emergency exits, mobile earthing devices are provided in addition with the aid of which the overhead line can be rail-earthed independently of the OHL-VD.

3.1.4.7 Power supply

The power feeders to be installed in tunnels feature connections for operating electrical apparatus running on 220 and 380 volts. They are required to have a power rating of at least 8 kW (cf. Figure 9).

Connections are suitable for standard fire-

Figure 9: Power supply in the tunnel

brigade equipment.

3.1.4.8 Water supply for fire-fighting

Ninety-six cubic metres of water is provided for fire-fighting purposes at each tunnel portal with a refuge site and at each emergency exit. In most cases, water tanks holding this amount have been recessed beneath refuge sites. The water in them merely acts as a bridging source until the fire brigade has established its regular supply, should this be required, guaranteeing a supply of 800 l/min for a period of two hours[9].

There is an end-to-end dry water main within the tunnel with a dimension of DN 80. To protect the main as far as possible against the effects of accidents, it is laid in steel at a height of at least 3.40 m above the escape-route floor[10].

Figure 12: Connectors for pipes

There are tapping points at 125 m intervals fitted with connectors for B and C-dimension pipes (cf. Figure 12). Depending on whether the main has been laid above or beneath the escape route, tapping points are situated at a height of either 1.40 m or 0.80 m above the escape-route floor. The difference is due to a handrail being fitted at a height of 1.00 m above the escape-route floor as a means of tactile guidance. Tapping points are equipped with a B-coupling as well as a B/C-adaptor, enabling B- or C-pipes to be used as required by the circumstances.

If so required, the fire brigade will establish a connection between the in situ water tanks and the feeders for their own fire-fighting main. The main is filled in sections, i.e. at the tapping points every 125 m there is, in addition to the tapping valve, a further shut-off valve in the main (cf. Figure 11) which is normally in the closed position. The first fire-fighters entering the tunnel open the shut-off valve as they pass, thus causing the main to be filled section by section. This ensures that, should any one section of the water main be damaged during an accident, water is not unnecessarily wasted.

Figure 11: Shut valve in the main

Having a fixed water supply in place avoids critical time being lost getting hosepipes ready. The amount of water available provides enough time for the fire brigade to access their own regular supply, if need be using hosepipes. It is not intended as an exclusive means of supply.

The fire brigade uses portable motor engines to generate a feeder supply at the required pressure (cf. Figure 13). Emergency exits are

[9] Demands for 3,200 l/min or 2,800 l/min that are sometimes made derive from the statutory provisions for industrial facilities. For the purposes of railway infrastructure assets they are neither applicable, reasonable nor legally stipulated.

[10] In newer systems, the water main is laid beneath the escape route.

sited at 1,000 m intervals. Water tanks and feeder points are likewise to be found here.

3.1.4.9 Auxiliary means of transport

Two rail trolleys are available at each tunnel

Figure 13: Generating a feeder supply by fire brigade

portal and at emergency exits as an auxiliary means of transporting rescue and salvage gear as well as persons needing to be stretchered out (cf. Figure 15).

Figure 15: Rail trolley

Trolleys weigh 85 kg and can carry 1,000 kg. They are fitted with both a locking device and a dynamic brake ("dead man's brake" principle).

3.1.4.10 Emergency telephones

Emergency telephones allow both persons escaping and fire-fighting staff to get in contact with the operations control centre. Emergency telephones have been installed at tunnel portals, at emergency exits or cross headings within the running tunnel, and also within the covered area beyond the outer doors of emergency exits.

Emergency telephones are engineered in such a way that they can be used as a telephone link between the line and the operations control centre ("F" box) whilst also enabling anyone unfamiliar with their use to establish immediate contact by operating a special key (cf. Figure 14).

Figure 14: Emergency telephone

Unlike standard "F" boxes on the railway, emergency telephones are required to be openable without a special key, via a thumbturn for instance. Where telephones beyond the covered area at emergency exits are provided for, these do not constitute emergency telephones under the EBA Directive[3] and have to be locked to avoid abuse, the lock being operated by the likes of a Berne key.

3.1.4.11 "BOS" radio equipment

To ensure "BOS" radio[11] within a tunnel, an emitter cable is fitted to the tunnel ceiling. The function of this cable means it cannot be installed to F90 quality. It may, therefore, be damaged in the course of a fire. As a means of nevertheless maintaining radio contact to the fullest possible extent, the cable is fed at several points, thus ruling complete failure out. Limited "dead spots" are the worst that can occur.

Projection by “BOS” radio equipment is effected within a radius of at least 200 m around the tunnel and also, therefore, includes the emergency exits.

3.1.4.12 Line communication facilities

The line-communication network is a degraded-mode link-up between section control centres. To this end, telephone sockets such as the German TAE analog-line type are fitted at tunnel portals, emergency exits and refuge sites (cf. arrow in Figure 16). Sockets are exclusively interconnected to produce a ring network. It is neither possible nor necessary to contact the operations control centre via this network.

Figure 16: Telephone socket alongside help-alarm pillar

3.2 Operational requirements

The operating schedule for the Cologne-Frankfurt NBL provides exclusively for passenger-train traffic. There are hence no operational requirements regarding the separation of traffic types (inadmissibility of trains crossing).

3.2.1 Requirements for rolling stock

The trains worked on the Cologne-Frankfurt NBL are equipped with an emergency-brake override device (EBOD). EBOD constitutes a mitigating measure in that it prevents a train being forced to come to a halt inside a tunnel in the event of an incident such as a fire.

Besides the preventive measure involving the EBOD already set out, it is also possible to support self-rescue as an element of the rescue concept by means of loudspeaker announcements throughout the train with the aim, for example, of initiating evacuation. Every passenger train additionally carries an emergency case containing a megaphone and torches as a means of backing up action by the train crew in respect of self-rescue measures (cf. Figure 17).

Figure 17: Emergency case

Vehicles that work long and very long tunnels, to conclude, carry two fire extinguishers to enable fires to be tackled as they break out.

3.2.2 Organisational measures

Organisational measures relate both to train operators whose vehicles negotiate long and very long tunnels and to managers of such infrastructure.

3.2.2.1 Train Operating Companies (TOCs)

There is a special self-rescue concept (SRC) conforming to Corporate Guidelines 423.0130 for existing high-speed lines that forms part of the Safety Concept (cf. Table 1 on Page 2). Within the framework of this SRC, train attendants are given instruction on the use of fire extinguishers and tackling fires as they break out. Instruction also covers how to proceed in the event of the emergency brake

[11] BOS: German abbreviation for Authorities and Organisations with Safety Functions; BOS radio a federally standardised system for rescue services.

being activated or of a possible evacuation of the train in a tunnel.

This self-rescue concept has also been adopted on the Cologne-Frankfurt NBL.

3.2.2.1.1 DB AG's special self-rescue concept

The special self-rescue concept (SRC) was drawn up to guarantee the acknowledged high level of safety on the railway under the altered conditions of the existing high-speed lines (HSLs) from Hanover to Würzburg and from Mannheim to Stuttgart. Application of the procedure has remained unchanged with the commissioning of the Cologne-Frankfurt NBL.

Besides the structural installations already mentioned, there are also staff-related preconditions. These concern

- a minimum proportion of train crews being cognisant with the SRC. Staffing levels depend on the number of carriages.
- special training for attendants and drivers on trains working HSLs.

Given that the activities involved in putting the SRC into practice hardly figure at all in day-to-day operating routines, there is a need for systematic repetition as a means of memorising its contents and, to an equal extent, it is necessary to engender and nurture an awareness of safety on the part of staff out of which a personal interest in the SRC can take shape.

The psychological influence that on-train staff can have on passengers in the event of an incident is in itself of great significance. It is they who explain the nature of the situation to passengers in straightforward terms whilst simultaneously initiating the necessary steps for rapid and circumspect action without spreading panic in the process.

Building upon these general principles covering action in the safety sphere, a binding sequence of actions has now been developed in the form of a CBT learning programme[12]. This is conducive for instance to

- running local training schemes
- setting up schemes for new staff at short notice
- making the SRC an integral part of duties on HSLs
- delivering coordinated learning material for all target groups
- defined announcement texts that can be called up at any time.

Currently being incorporated into the CBT learning programme are the new emergency-exit arrangements on the Cologne-Frankfurt NBL. There are emergency exits on this line at intervals not exceeding 1,000 m for instance, obviating the need for airflow detection devices in tunnels.

This fundamental task of ongoing adaptation rests with the respective TOC.

3.2.2.2 Railway Infrastructure Managers

The assistance measures required need to be initiated without delay. This is ensured by Emergency Management. Measures are set out in Section 4.

[12] CBT = Computer-Based Training

3.2.3 Other Measures

3.2.3.1 Operational alert and hazard-prevention plan

Operational alert and hazard-prevention plans set out the rescue concept for a tunnel. Plans are drawn up in liaison with the appropriate fire-safety service centres taking account of DB AG's Emergency Management system and regionally specific features. Plans include descriptions of structural installations for fire and disaster control together with the relevant operations control centres and the responsible emergency coordination point plus their telephone numbers.

Appended to the respective alert and hazard-prevention plans are layout maps which, as with fire-fighting plans conforming to DIN 14095, depict access routes to refuge sites, tunnel portals and emergency exits. Figure 18 shows a specimen layout plan for the southern portal of Idstein tunnel.

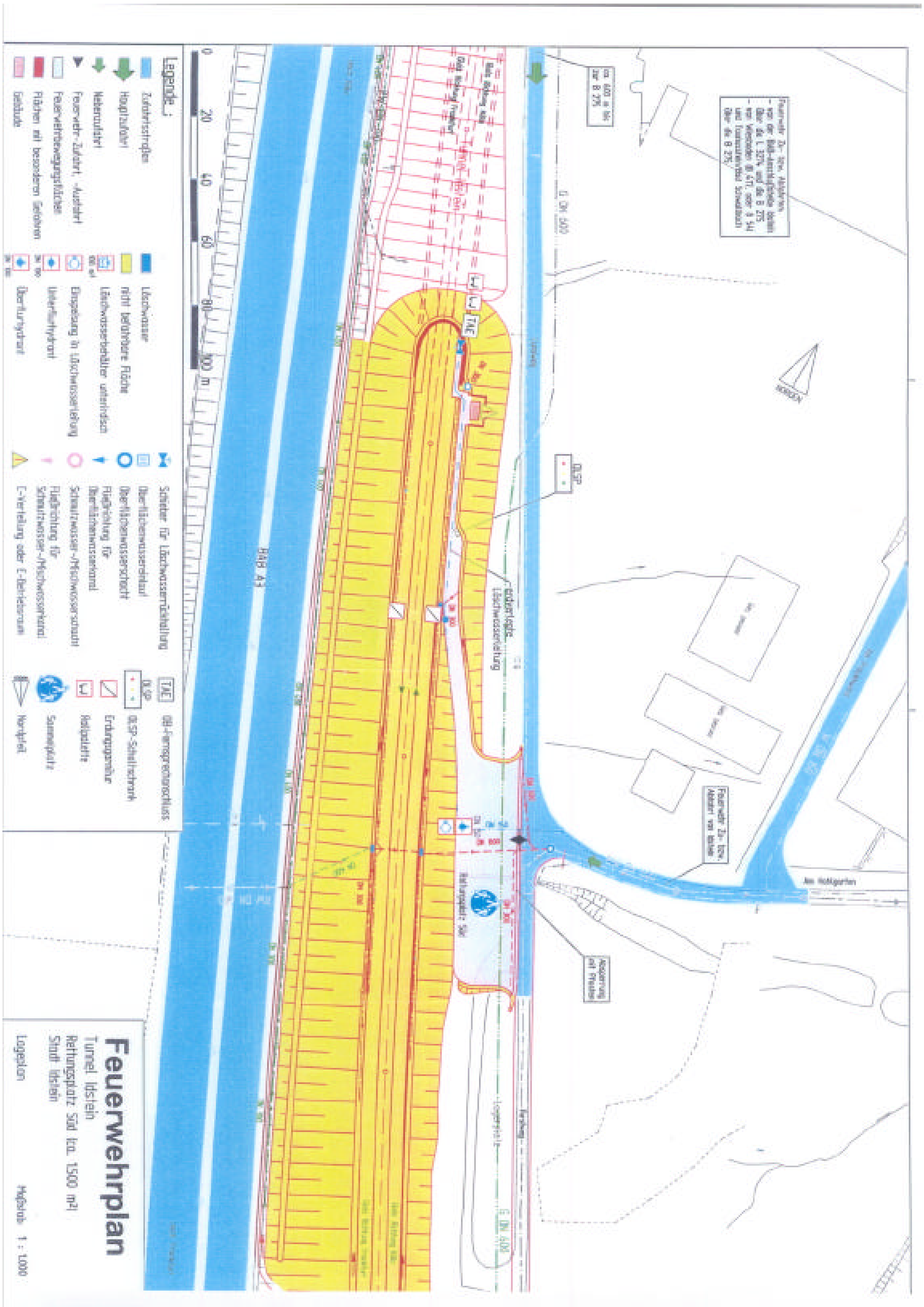

Figure 18: Fire-fighting plan for Idstein South Portal

3.2.3.2 Layout maps

DB AG has produced federally standardised fire-brigade access-point maps (cf. Figure 19) for rail installations on the basis of 1:25.000 survey maps (TK 25 maps). These have been coordinated with the federal states.

Maps showing means of access on the Cologne-Frankfurt NBL have been passed to the respective district authorities. They are also available at the DB Netz emergency district and in digital form at the Emergency Control Center.

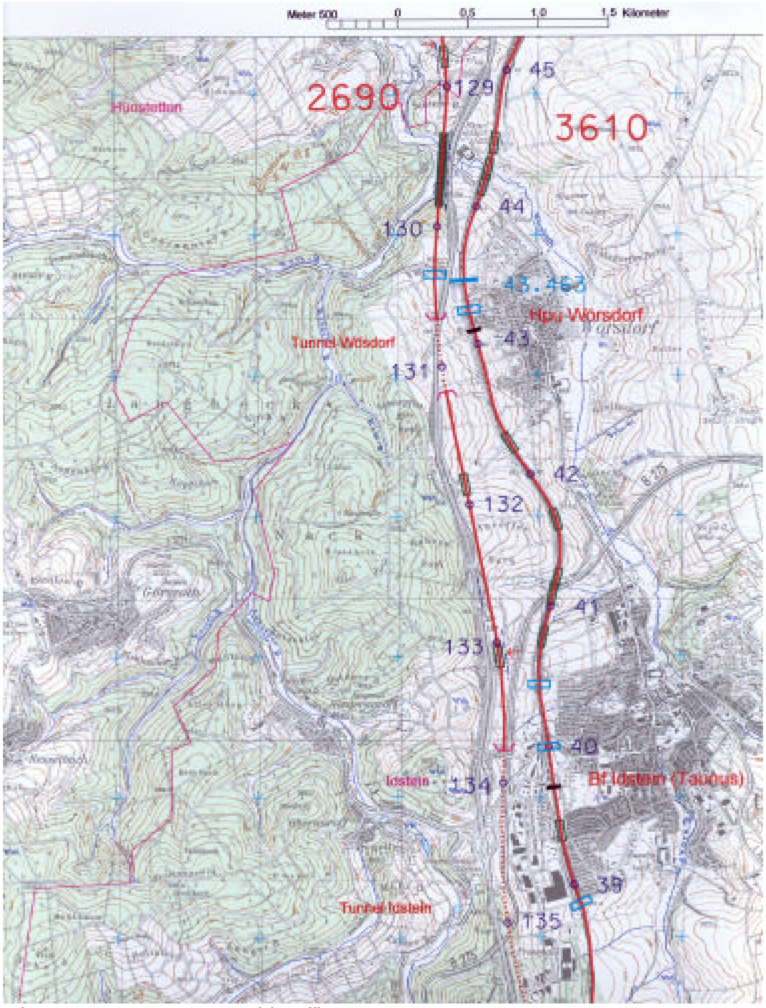

Figure 19: Layout map (detail)

3.2.3.3 Agreements on additional requirements

Local-authority fire-brigades and rescue services are equipped to extinguish fires and provide technical assistance. Operations on railway premises do not differ greatly from those on, say, motorways in this respect. Any incident inside a tunnel on the Cologne-Frankfurt NBL, however, would make demands on fire brigades that far exceed anything associated with a standard major-fire scenario. Talks were thus held with fire brigades to determine what additional items of equipment would be needed in such a scenario. Consideration was given in the process to apparatus already available, with the upshot that unitary procurement was not possible.

There has primarily been procurement of handheld transmitters with helmet mouthpieces and of smoke hoods for personal rescue. There have also been isolated instances of lump sums to pump-prime the procurement of diverse smaller items.

Where tunnel operations are concerned, there is an additional need for long-life breathing equipment. Such equipment is not generally required by fire brigades in the course of their normal duties and hence is not stocked. Clarification has been reached here on how DB AG would involve itself in the procurement of such gear in individual instances.

Long-time breathing equipment comes in a variety of forms. One variant involves adding a second bottle to the compressed-air breathing apparatus used by fire brigades, effectively doubling the supply of oxygen. This twin-bottle equipment remains effective for between

45 minutes and an hour, depending on the physical exertion required of the wearer.

Recirculation devices chemically cleanse used oxygen, permitting deployment for up to four hours. Using such equipment requires special training, however, as well as a degree of physical fitness. Such devices have only therefore been used by professional fire brigades for the most part.

Along the Cologne-Frankfurt NBL, equipment of this type has been procured for the operational staff of the professional fire brigade at the Hessian capital Wiesbaden. With the federal state of Hesse having developed a special Respiratory Protection deployment concept, however, these staff can be deployed over the entire line on Hessian territory. Deployment in bordering federal states is also possible under certain circumstances on the basis of cross-border accords.

It needs to be borne in mind with regard to the procurement of long-life compressed-air breathing apparatus that, regardless of the reasons for its purchase, this equipment can and will also be used in the service of the respective local authority. There will therefore be dual usage, a fact that needs to be taken into account in the form of local-authority participation in, for instance, procuring and servicing the equipment. In DB AG's opinion, therefore, the local authority needs to assume the maintenance costs for such equipment.

By contrast, DB Netz AG is shouldering part of the cost of maintaining and servicing the recirculation equipment. This takes the form of annual lump-sum payments. The special training operative staff have to undergo also entails added costs for local authorities, a proportion of which DB Netz AG is likewise assuming.

3.2.3.4 Familiarising rescue staff

Rescue forces need to be cognisant with the scene of possible operations. To obtain such topographical knowledge, they have to acquire access to the premises, specifically for initial familiarisation and subsequent briefings.

At their request, furthermore, the rescue forces were also provided with all the requisite documentation.

The structural features and specifics of the rolling stock needed to be known. To this end, DB AG produced leaflets setting out how to enter vehicles and providing details such as how to disconnect the battery. Leaflets for traction units include details on the type and quantity of running materials such as transformer oil and fuel carried.

There was cooperation with the applicable fire brigades, in tandem with preparations for a hazardous event, from the construction phase. In liaison with the central and operative Emergency Management units, the fire brigades prepared and set down in writing possible sequences of operations. Emergency forces undergo training at irregular intervals that ranges from general information through tours of ICE 3-category trains and on-foot inspections of tunnels to familiarisation with the equipment there, including the OHL-VD.

3.2.3.5 Exercises

Before a new tunnel enters service, exercises involving the fire brigades have to be carried out. These do not generally have the purpose of testing and running the rescue concept or of testing the functioning of equipment but rather of familiarising emergency forces with the locality as well as of trialling channels of communication and operational procedures for rescue measures. The functioning of structural installations is established during acceptance testing.

Figure 20: Exercise at the Himmelberg tunnel

The provisions of the EBA Directive[3] and, with them, the safety concept defined therein have been put to effect for the first time in the tunnels on the Cologne-Frankfurt NBL. For this reason, it was determined in consultation with the EBA and the authorities responsible for hazard prevention that self-rescue measures should likewise be practised in the course of exercises.

Owing to the large number of tunnels on the Cologne-Frankfurt NBL, neither the fire brigade nor DB AG were able to comply with the requirement set forth in the EBA Directive for exercises to be conducted in every tunnel prior to their being commissioned. It was thus agreed that one large-scale exercise should be carried out in a long tunnel in each federal state.

3.2.3.5.1 Exercise scenarios

All exercise scenarios draw on the Final Report of the “Fighting Tunnel Fires” Working Group at vfdb[4]. The only exception relates to the exercise in the Limburg tunnel, which was confined to practising the external-rescue concept given an incident in the tunnel that does not lead to a fire.

The other scenarios foresee an ICE 3 carrying 300 passengers derailing inside a tunnel for reasons unknown or due to an act of malice. The accident results in 30 passengers being so badly injured that they have to be rescued by external-rescue services. The remaining passengers are able to reach safety of their own accord or with assistance from others.

Shortly after the derailment, it is discovered that a fire has broken out in the restaurant car; attempts by the train crew to tackle the fire are unsuccessful and the fire spreads. The train manager therefore decides to evacuate the train. Those who on account of the severity of their injuries are unable to rescue themselves are helped out of the burning restaurant car by the train crew and fellow passengers. The smoke-control doors between cars are closed.

3.2.3.5.2 Conclusions from exercises

Exercise findings were evaluated in a joint effort by all participants.

The railside findings concerned vehicle fitments, tunnel construction features and also organisational factors.

With regard to the fire brigades, shortcomings in deployment strategy were pinpointed that are being remedied in the course of initial/ further training of personnel.

There were problems on both sides as regards reporting channels and internal communications.

Listed below are the main findings from the exercises:

- The ladders and other auxiliary means of alighting carried on the ICE 3 train (cf. Figure 21) are not ideal in tunnels on the Cologne-Frankfurt NBL owing to the Slab Track in use and its very pronounced cant in places. Appropriate measures to alter the concept have already been set in train by Emergency Management.
- There are trenches up to 60 cm deep between tracks in the tunnels. Until such time as these are filled in, passage in the vicinity of emergency exits is being assisted by the fitting of gridirons.
- Communication between the Emergency Control Centerand the attendant console for "112" emergency calls (dialled to reach the rescue/fire services in Germany) was so flawed in part that there were delays in alerting external-rescue services. This was almost exclusively the fault of staff on either side. DB AG has already responded by acting on staffing and intensifying training. The respective local authorities had their attention drawn to the mistakes made by their staff in concluding discussions[13].
- The rescue service did not look after people very well once they had left the tunnel. In almost all exercises persons were encountered who were not being attended to at all.

All exercises have shown that the self-rescue concept can work on the Cologne-Frankfurt NBL. Evacuation of the train was concluded within ten minutes; the last person to escape unaided left the tunnel within 20 minutes of evacuation commencing. These figures have been corroborated by the EBA.

Figure 21: Ladder on the ICE 3 train

Demands for more extensive equipment made in the light of the exercises were rejected by DB AG since none of them have a railway-related grounding and, given the degree of probability of an incident occurring, cannot be regarded as reasonable.

[13] In one instance, an operative at the ECC spent 13 minutes in the emergency-call attendant console's wait loop because the latter had not reported promptly to the ECC as agreed.

4 Managing Emergencies

4.1 Operative emergency management

DB AG meets its statutory obligation under Paragraph 4 (1) General Railway Act (AEG) through the agency of Emergency Management. The company's network of railway lines is divided up amongst 170 emergency districts. In each, an emergency manager can be reached at all times who, in the event of an incident, would provide the emergency services with specialist advice at the scene.

Emergency districts are of such a size that the Emergency Manager would be able, given normal road and traffic conditions, to travel from their district office to the scene of an incident within 30 minutes. The boundaries of emergency districts along the Cologne-Frankfurt NBL have been drawn in such a way that this time limit can be adhered to under the conditions described.

Figure 22: Service vehicle

The Cologne-Frankfurt NBL passes through the

- Mainz
- Frankfurt
- Limburg and
- Troisdorf emergency districts.

One of the Emergency Manager's tasks involves protecting emergency staff at the scene of an incident from train-running hazards. This primarily concerns rail-earthing the overhead line. To be able to perform this task as rapidly as possible, the Emergency Manager is equipped with a service vehicle fitted with special identifying equipment as provided for under Paragraph 52 (3) Road Traffic Licensing Regulations (StVZO) (blue flashing light and siren) (cf. Figure 22). The vehicle also carries rail-earthing gear.

Further tasks of the Emergency Manager include:

- giving specialist advice at the operations control centre
- requirement for emergency systems at DB Netz AG,
- submitting the requisite messages.

Emergency management along the Cologne-Frankfurt NBL does not differ from that along other areas of line. Staff employed in local emergency management units have been familiarised with the locality of the line and with structural installations inside tunnels that play a part in the rescue concept. In addition, Emergency Managers also have up-to-date emergency documentation at their disposal, as do traffic controllers and Emergency Control Centers for the Operating Centres at Frankfurt and Duisburg.

4.2 Reporting and alerting procedures; Emergency Control Centers

The job of receiving and forwarding reports and of alerting railway or external-rescue staff is performed along the Cologne-Frankfurt NBL by the Central and Western Emergency Control Center.

Emergency Control Centers are equipped with the latest command technology including facilities for logging all key call numbers. With the aid of a special routing procedure, the Emergency Control Center operative is able to directly contact the Contact Center for a district or county borough by dialling 112[14].

The channels involved in alerting external-rescue services depend on how a given hazardous event is reported. Where the railway's own lines of communication, e.g. train crews, are used, the responsible Emergency Control Center is notified by the duty traffic controller. In such an instance, the Emergency Control Center informs the emergency-call attendant console[15] by dialling 112.

Where a hazardous event is reported by a third party, over a mobile telephone for instance, it is generally the emergency-call attendant console that is notified first. As well as informing the rescue services via a single national number (0180 3 xxxx)[16], this then also notifies the applicable DB AG Emergency Control Center. This in turn alerts its own railway services, e.g. the Emergency Manager.

In all instances, operating measures are initiated at once, i.e. affected train movements on adjacent tracks are sent an emergency call and affected tracks are immediately closed to traffic by the duty traffic controller. If an incident has occurred inside a tunnel, furthermore, the overhead line is switched off and rail-earthed by means of the overhead line voltage detector (OHL-VD).

The emergency-call attendant console receives confirmation of a track having been closed to traffic[17] by fax from the Emergency Control Center, which generally passes this information on to the emergency services by radio as they make their way to the scene, where they can then safely enter the track area.

Indicator lamps on the OHL-VD light up to confirm that the overhead line inside the tunnel has been switched off and rail-earthed. Where manual rail-earthing is required, this is seen to and carried out by either the Emergency Manager or, if so briefed, fire-fighting staff.

[14] With the increasing availability and use of mobile phones, more and more incidents are being reported directly to local-authority coordination points by third parties dialling the emergency fire/rescue service number 112. The federally uniform call number 0 18 03 xxxxx enables coordination points to get directly in touch with the responsible Emergency Coordination Point.

[15] This is the rescue coordination point for the district or coordination point for the county borough. There is no single term with nationwide application.

[16] Rural districts are cognisant with the call number.

[17] Form 423.0141V01

5 Concluding Remarks

The safety concept along the Cologne-Frankfurt NBL complies with the current provisions specified by the Federal Railway Office and has been enhanced by experience gained in the course of exercises as well as by proposals that emerged in discussions with fire brigades.

Notwithstanding sceptical utterances made by the media and to an extent also by holders of local office, the safety concept in place along this line sets benchmarks. This is evidenced amongst other things in discussions held with representatives of neighbouring railways. Suffice it to cite the visiting report by representatives of AlpTransit Gotthard AG, with whom we have been busily interchanging know-how for quite some time now.