MAINTENING SAFETY IN AUTOMATED TRANSIT, THE VAL EXPERIENCE :

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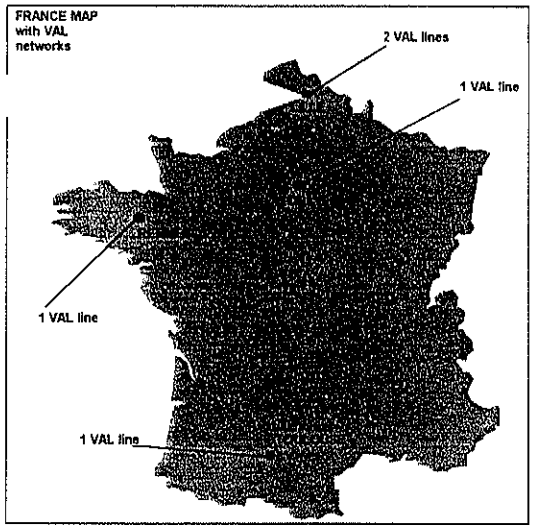
ABSTRACT :This paper describes the methodology used for the safety analysis of the second line extension. An important part of this analysis is the impact of new rolling stock equipment, vehicles used on line 2 are compatible with those used on line 1.This paper will also present the role and the operation of the safety group which, for twenty three years, has dealt with the safety of the automated transport system VAL in Lille and a few words about the impact of vandalism.

The lines:

Line 1 opened in 1983/84 between Calmette and Quatre Cantons via Gare Lille Flandres (Central Station) (13.5 km long, 8.5 km underground).

Line 2 opened in 1989 as Line 1b between St.Philibert and Gares, later renamed Gare Lille Flandres (15.5 km, 7 km underground). In 1994, there was a one-station extension to the new TGV station Gare Lille Europe, and in 1995 the line reached Fort de Mons. On 18 Aug. 1999, this line was extended to Tourcoing-Centre (12.5 km - 16 stations) and it reached C.H. Dron near the Belgian border on 27 Oct. 2000 (3.6 km). The entire Line 2 is now 32 km long.

The average distance between the stations is 738 m, station platforms are 52 m long, enough space for two trains, although currently only 26 m long single units are used. Trains run between 5 a.m. and midnight with a train every 3-6 minutes (90-s rush hour). As trains run totally automated without a driver there is a special security equipment in the train. Stations have doors between the platform and the train.



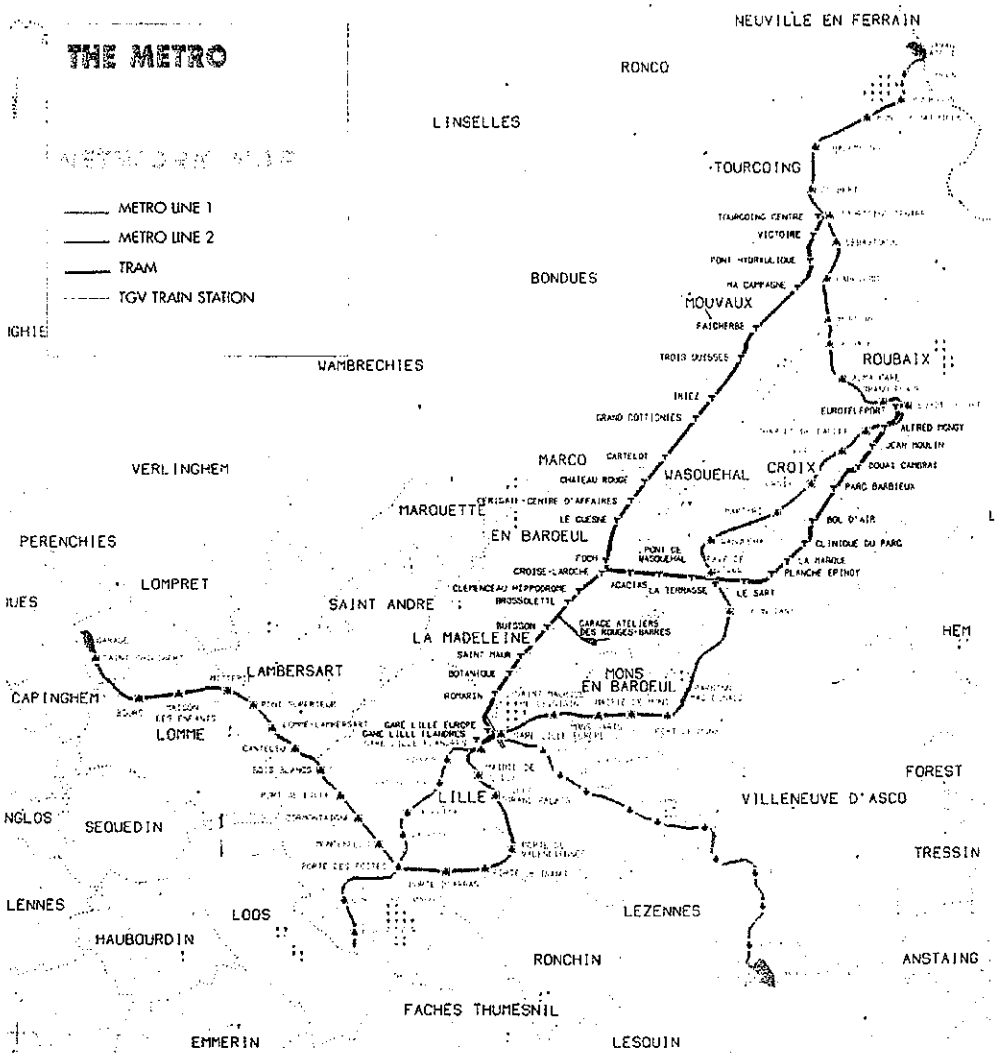


Figure 1: MAP of the VAL lines in LILLE (doc CUDL).

The VAL in Lille (France)

The VAL (short for Light Automated Vehicle).metro system in Lille, developed by MATRA TRANSPORT INTERNATIONAL is the first fully automatic transportation system put into service in the world

Before evoking the safety level of the Lille's val network, a summary presentation is done on the VAL automatisms and the devices used to make sure this system of transport.

The VAL system is a "manless" metro – one with no staff on board. .Everything is controlled remotely, even in disturbance situations.
The VAL system is designed for a high operation speed (34km/h) and headway as short as 60 seconds (with a 25s dwell time).
The VAL track in Lille is divided into several sections, each one independently managed by its own ground equipment. The occultation of an infrared beam detects any train entering and leaving a section. A section is also divided into several blocks.
These functions are carried out by the ATC (Automatic Train Control)system. The design of Automatic Train Protection is oriented to apply analog or discrete electronic components for key functions such as vital transmission and logics :

Train detection :

The system uses a fixed block concept. The train detection in a block is provided by a loop on the ground which receives a signal emitted by each train, which is re-emitted towards the section ground equipment.
When the entrance of a train in a section is detected by the infrared sensor, the section ground equipment makes sure that this train is always detected in a block and check the progress of the train from block to block until it leaves the section.
The state of the next block is transmitted by the wayside equipment by the existence of a low frequency subcarrier.

Speed control :

On the track are set out two wiggle wire transmission lines. The crossing of each line materialize the running programs, one of them corresponding to the service speed, the other to the stopping at the end of the block. The selection of either program in a block depends upon the occupancy of the following block and is done through the section ground equipment.

Overspeed safety :

A train in normal running should detect a crossing of the transmission line every 0.3 seconds. If this interval is less than 0.27 seconds, there is overspeed and therefore emergency braking.

The objective of the designers, constructors, operators and regulators of a transport system must be to ensure that it provides an acceptable level of safety for the staff and users of the system. Such a level of safety depends upon well-designed, reliable equipment operated in accordance with clear and effective procedures, particularly in the management of emergencies. But no transport system can made completely safe, involving as it does a complex interaction between engineering, technology and people.

The Control Center :

Installed at Gare Lille Flandres, the Control Center sees, hears and observes everything.
The operators remotely monitor the running of the trains and control al the essential functions of the network.


Figure 2 : The PCC (photo CUDL Max LEROUGE)

At the heart of the setup, there is the optical Track Diagram, a vast led diagram which provides a very detailed display of the track routes and indicates the position of all the trains.

Video monitors show pictures of what is going on on the platforms.

In this way, the operators can constantly check the operating programs pre-established for each day.

At any time, the operators can contact the intervention teams and ask them to go to a given point in the network.

On Val, a passenger never feels alone. All the cars are equipped with easily accessible intercoms. This means that, at any time the passenger can contact an operator at the Control Center.

This also works the other way round, since if there is an incident, the intercom comes on automatically.

The Control Center can then listen to what is going on in the car

Lille is now operating side-by-side the two generations of VAL trains which have been developed by the French Company Matra.

The latest vehicles also offer more passenger space, thanks largely to technological advances, and 30 per cent more of their area is glazed, making them airier and more pleasant to travel in.

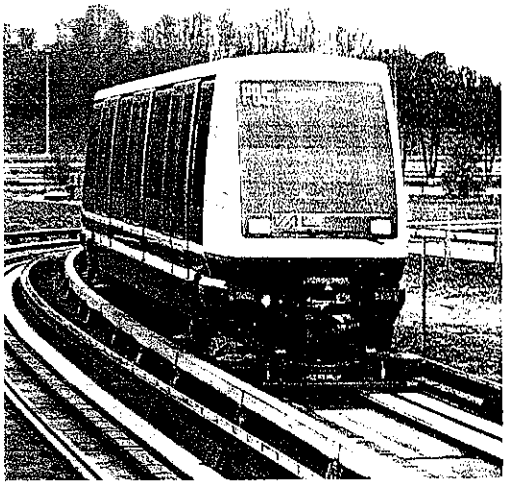


Figure 3 : The VAL208 photo INRETS

With improvements in braking, propulsion, the guidance mechanism and body structure, the weight of the new vehicles is 14 tons, compared to 15.5 tons for their predecessors. The trains operate 19 hours a day, and have established an excellent reliability record, given such an intensive use.

figure 4 : Interior of VAL208 photo INRETS

The latest version of vehicle, the VAL208 adds to the quality of the subway system with a larger interior, flexible arrangement of the interior space.

A prototype after authorizing to start in carroussel without passengers crossed more than 120000 km.

This prototype allowed to improve the settling of the new rolling stock and to validate some technical points of design.

The platform facades or platform doors "an impassable glass barrier"

Travelers are protected by a totally impassable glass screen between the platform and the track. Nobody can fall onto the track, whether on purpose or accidentally, even if there is a scrimmage.

On the facades, only the platform doors open in synchronization with the train doors when the subway arrives at the platform. They only open when the train has stopped.

Passenger safety is ensured at stations, as each is segregated from the running tracks by a series of transparent sliding doors. These are opened automatically as a train draws to a halt alongside them.

The "safety group"

This opening is subjected to a local authority authorization. Since the creation of the Lille's network, a "Safety Group" such as a safety commission is in charge of assessing the safety of the system and advising the local authority in order to open new or extension of lines. After following the examination of the documents constituting the safety case of the extension of this line, this group relates an opinion.

The RAMS requirements :

A recall of the safety targets of the others lines of subway can be made: theses targets were obtained starting from statistics the RATP on the subway of Paris, it is expressed in a number of collective and individual accidents per billion passengers. Following these values, allocations of individual accidents were fixed by sub system.

The safety targets for the extension of line 2 must at least be equal to those of the existing line, the formulation was modified for conformity to standards CENELEC (EN 50126)
These standards define procedures and technical requirements for the development of programmable safety critical system for use in railway control. They are based on the state of the art and best practices in safety technology. Thus, conformity to these standards can be used to substantiate safety evidence.

In France, the widely used principle is the « GAMAB », « Globalement Au Moins Aussi Bon ». The complete formulation of this principle is as following: All new guided transport system must offer a level of risk globally at least as good as the one offered by any equivalent existing system. The formulation takes into account what has been done and requires implicitly a progress to be made in the projected system, by the requirement "at least"

Impact of vandalism on the Lille network

Vandalism is common on most of the developed world's urban railway and transit system.

In Lille's network, we have reported a significant and sustained increase over the past several years in the number of train seats slashed or emergency evacuation handle action and otherwise damaged.

Normally, in case of emergency, passengers may pull an emergency handle that breaks the power supply of on-board antennas. The situation is detected by wayside equipment that releases the emergency braking of all trains on the section and opens traction power breakers in the power substations.

By play , a lot of teenagers pull the emergency handle and the VAL system is stopped.

The cost of vandalism in both human and financial terms has been considerable. In 1995-2000 there were more 50% incidents due to the vandalism.

Vandals are typically male aged between 12 and 15, generally originate from poorer geographical areas of the city, have relatively low levels of education and belong to large families.

The vandalism is a kind of "play vandalism": damage inflicted incidentally or deliberately as part of a game or competition , for example : who can break the most windows who can pull the most emergency handle ?

In order to increase passengers safety, and improve protection against vandalism, the VAL had several evolutions, the most significant against vandalism is :

The evolution of emergency evacuation :

The International Public Transit Union (UITP) gives recommendation for processing emergency evacuation in metro tunnels. The basis of these recommendations is ,that in case of fire with production of smoke, the worst place for leaving passengers is the tunnel. Indeed, there are life hazards due to suffocation, while the visibility is very low.

UITP recommends, in case an emergency stop handle is pulled by a passenger, to try to continue the trip until the next station. Two restrictive conditions have been defined in Lille application case :

The train speed has to be maintained over 1m/s
The maximum delay is 3 minutes
The availability of car's intercoms

If these three conditions are satisfied, the emergency handle action is differed and can be rearmed at distance by the PCC.

This evolution called " UITP emergency against vandalism" has decreased the delays.

In 1997 without this evolution, the delays due to emergency handle action were 500 minutes. In 1999 with this evolution the delays were 200 minutes.

After ministerial authorization, on October 28, 2000, the entire line 2 was opened to the public. The safety level of this 16 km extension is maintened.
The demonstration of safety was done, according to a method "by distance". The passenger of the year 2000 does not take more risk by taking VAL today that the passenger of the year 1984. At the beginning of the new millenium, Lille has the longest automatic line subway in the world.

REFERENCES :

VAL Automated Guided Transit Characteristics and Evolutions by Regis Lardennois in the Journal of Advanced Transportation, Vol.27,N°1, pp. 103 –120.

Research brief : Graffiti and vandalism on public transport July 1987 by Paul Wilson and Patricia Healy ISBN 0 642 11868 X

Metro,ligne 2 mise en service le 28 octobre 2000 Lignes info LILLE LMCU

Compte-rendu du groupe sécurité de 1977 à 2000.

Description of the VAL automated guideway transit system, march 10, 1978 , by U.S Department of Transportation and Ministère de l'Equipement.