August 29, 2012

TO:               Board of Directors
THROUGH:         Arthur T. Leahy
                   Chief Executive Officer
FROM:            Krishniah N. Murthy
                   Executive Director, Transit Project Delivery
SUBJECT:         Platform Screen Door (PSD) System Report

ISSUE

Use of Platform Screen Door (PSD) system for Metrorail Stations

DISCUSSION

This brief report is in response to an inquiry received from a board office concerning the use of Platform Screen Doors (PSDs) on our rail system.

Platform Screen Doors have been implemented in transit systems for the following reasons: 1) for automated operations or driverless systems as in most of the airport people movers in the world; 2) specific transit lines where the very high ridership and short operational headway requirements require a full automated operation (Europe and Asia); and 3) to have air conditioned stations (Singapore).

Metro has previously considered use of the PSDs but has found that the ridership and operational requirements of our Metrorail system would not justify the large investment in such a system. Further, Metro stations are not air conditioned thereby negating one of the apparent benefits of PSDs; in fact, airflow in our stations depends on the piston action of trains which PSDs would remove from station platforms.
The attached summary report “Platform/Track Protection Systems Report” was issued in October 2009 by the International Association of Public Transport (UITP), the international network of public transportation authorities and operators. It compares several protection devices to detect or prevent passengers from falling into the track and concludes that most operators consider the installation of PSDs as normally associated with fully automatic operations. None of the lines operated by Metro have the capability of fully automatic operation. Exceptionally a few agencies, mostly outside the USA, have installed platform doors for specific lines where the capacity requirements required a short operational headway of 90 seconds or less, resulting in a full automation of the line. This is the case in Paris Metro Line 1 and Line 13; Barcelona; London’s Jubilee Line; and 3 lines in Hong Kong.

There is no precedent for PSDs being installed in any major U.S. rail transit station in operation today.

The UITP report also looks at PSDs from a safety perspective. While the implementation of PSDs offers benefits, they are not immediately realizable because of the time frame involved in implementing the PSDs on an existing system. Instead, Metro has already begun implementing alternative systems such as fiber-optic based intrusion detection. We are evaluating video based analytics to detect persons or objects that may intrude into the right-of-way and alert control center staff who can intervene and take immediate actions. In the near future we also plan on testing and evaluating similar systems that will alert an approaching train operator, by providing an alarm in the train cab, when an intrusion occurs on the right-of-way.

Staff’s evaluation of the installation of PSDs has included the significant costs to retrofit existing stations and include PSDs in new stations, life-cycle operational and maintenance costs, possible legal claims when doors malfunction, additional ventilation to supplement lack of piston action air, and additional costs for enhanced train control and interlocking system functionality to work with PSD operation.

NEXT STEPS

Staff does not recommend any further studies on this issue.

Attachment: International Association of Public Transport Report (UITP)
Platform/Track Protection Systems

Introduction

The purpose of this study on Platform/Track Protection systems (PTP systems) was to understand the practice of deploying devices for platform/track protection in metro systems and identify the technical, operational and financial considerations when deploying these devices. To this end, the Electrical Installations and Safety Systems Metro Subcommittee conducted a survey in order to assess and compare different PTP systems with respect to:

- Ensuring passengers' protection;
- Preventing intrusions onto the track, limiting the number of suicides, protecting against pollution, reducing the occurrence of fire in tunnels;
- Improving traffic flow, allowing trains to enter platforms at a higher speed;
- Improving operational Quality of Service;
- Making better use of the available platform areas;
- Optimising the air conditioning system, delimiting air circulation, reducing energy consumption.

Twelve networks responded to the survey: TMB Barcelona, STIB Brussels, Metrorex Bucharest, MTR & KCRC Hong Kong, TL Lausanne, Metropolitano de Lisboa, London Underground, NYCT New York, RATP Paris, LTA Singapore and Metro Warszawskie. This Core Brief presents the consolidated results of the survey; the full detailed study is available to UITP members in Mobi+.

Platform/track protection systems

Survey results show that 58% of respondent networks deploy Platform Screen Doors (PSDs) [this is inclusive of full-height and half-height PSDs and Automatic Platform Gates (APGs)]. PSDs are the single dominant type of system used for platform/track protection. However, some operators have tried or are considering the use of alternative solutions.
Benchmarking technologies and applications

Video

The principle behind this technology is based on comparing successive pictures, or the current picture and a reference picture. Many automatic incident detection systems relying on this technology are already in use for roads. The algorithms used depend on the type of detection required. None of the existing applications are safety critical, although some of them considerably improve overall safety as well as the perception of it. The limitation of this technology is related to its excessive sensitivity to ambient luminosity and contrast, and to climatic conditions.

The intelligent video system (IVS) technology, sometimes referred to as a behavioural video system, is one of the most promising emerging technologies. One of the reasons why IVS is regarded as so promising is that it can be configured to detect a variety of real-world anomalies. Unlike traditional video detection systems, these systems can be programmed so that alarms are not triggered unless specific behavioural patterns are exhibited. This technology can also be applied to PTP in railway networks.

Active infrared beam

This system is derived from a device developed for automatic-start escalators. It detects the on and off states of a modulated infrared beam transmitted perpendicularly to the axis of the tracks below the level of the platforms. The combination of transmitting and receiving diodes ensures a high enough level of security, as all intrusions prevent the signal from reaching the receiving diode. The system is nevertheless vulnerable to false alarms, caused in particular by free newspapers, plastic bags, etc.

Weight sensors

Weight sensors use pressure-sensitive mats arranged on the tracks and on the platform edge along the whole length of the platform. Applying pressure on the mat triggers an alarm. Detection is based on the variation of the electric capacity of the mats. These mats are made up of two metallic plates that make a capacitor, whose capacitance varies with the pressure applied to it. However, this device is often inappropriate for existing stations due to the configuration of the tracks, dirty environment and cluttering of the rails.

Laser scanner

A laser distance meter measures the total travel time of a laser light pulse between an emitter, an object in the environment and a receiver. A laser scanner takes a set of measurements in accordance with the required resolution with various compositions of angular positions and distances. A rotating mirror causes the laser light to revolve at the rate of 78 cycles per second. The resolution of the system depends on the distance between the object and the laser. Although the technology is sensitive to extreme climatic conditions and to the colour of the object, appropriate dimensioning (e.g. four units per platform) can free the system of these constraints.

Active radar beam

The technology of an active radar beam system is similar to that of the infrared beam but operates in the 25GHz-frequency spectrum. Its main advantage is that it is insensitive to interception of the signal by newspapers, plastic bags, etc. It is sensitive to the mass and density of objects, which makes it appropriate for the detection of intrusions. Sensitivity depends on the spacing between beams and on the chosen threshold (adjustable threshold).

Platform Screen Doors (PSD)

PSD is the most widely used PTP system. It covers more needs than the other systems: preventing falls onto tracks (not merely detecting them); preventing heat exchange between platform and tracks; allowing trains to enter stations at a higher speed; etc. Two types are in use: the full-height PSDs and the half-height PSDs. The latter have the advantage of being lighter and less onerous with respect to civil engineering but their disadvantage is that it is possible to jump over them. They also do not provide thermal or sound insulation, which some operators require. While PSD is the most expensive of the various systems used for platform/track protection, it also offers the highest level of safety.
Choice of PTP systems and PSDs

Ensuring the safety of the tracks on driverless lines is essential, very often for legal reasons. Most operators, in agreement with their respective Authority, require the installation of a PTP system or of PSDs on driverless lines.

The choice of using PSDs rather than another PTP system should be based on identified needs and associated constraints. The table below summarises the constraints and the performance of each type of system. Given these data, operators still have to make the choice between inexpensive and easy-to-implement solutions that only offer a few functionalities, and a multi-purpose but expensive solution.

Most operators consider that installing a PTP system is a prerequisite for fully automatic operations and, in the majority of cases, PSDs are adopted. However, the study also shows that there are different solutions in place that meet different needs and also differ in terms of their constraints, performance and cost. The choice, therefore, has to be made on a case-by-case basis. The table below also illustrates a possible method of assessment.

PSDs: design and functionalities

The main design features and functional requirements for PSDs are as follows:

- Modular design
- Provides a barrier for conditioned air and smoke between platform and track
- Automatic operation based on train movements
- Use of large glass panel to minimise the impact on trackside advertising
- Computerised fault log with door address
- Adjustable opening and closing force
- Obstacle detection on closing
- Manual override operations
- Detection of open doors (when doors should be closed)

In the above list, 'modular design' and 'manual override operations' are two universal design

Criteria for selecting PTP systems

<table>
<thead>
<tr>
<th>PTP system</th>
<th>Beam barrier</th>
<th>Laser scanner</th>
<th>Radar beam</th>
<th>Video sensors</th>
<th>Weight sensor</th>
<th>PSD/APG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full-height</td>
<td>Half-height</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interferences</td>
<td>Snow, rain, sun</td>
<td>Snow, rain, sun</td>
<td>Null</td>
<td>Light</td>
<td>Heavy snow</td>
<td>Wind</td>
</tr>
<tr>
<td>Rolling stock</td>
<td>No specific interface</td>
<td>No specific interface</td>
<td>No specific interface</td>
<td>No specific interface</td>
<td>No specific interface</td>
<td>Doors must coincide</td>
</tr>
<tr>
<td>Duration</td>
<td>Quick</td>
<td>Quickest</td>
<td>Quick</td>
<td>Quickest</td>
<td>Quick</td>
<td>Long</td>
</tr>
<tr>
<td>Location</td>
<td>Along the platform and between tracks for double tracks</td>
<td>Different spots along the tracks</td>
<td>Along the platform and between tracks for double tracks</td>
<td>Different spots on top of the tracks</td>
<td>On the tracks</td>
<td>On the platform</td>
</tr>
<tr>
<td>Impact on operations</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Maintenance pit</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Curved stations</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Gap between train and PSD for safety reasons</td>
</tr>
<tr>
<td>False detection rate</td>
<td>Highest</td>
<td>High but could be lowered using specific algorithm</td>
<td>Null</td>
<td>Medium</td>
<td>Null</td>
<td>Null</td>
</tr>
<tr>
<td>Safety Integrity Level (SIL) currently achieved</td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 0</td>
<td>SIL 2</td>
<td>SIL 4</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Lowest</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

June 2011
features required for all systems. 'Computerised fault log with door address' is also applicable to all installations except for small installations where only the platform address is shown with an individual fault log. The 'platform gap hazard detector' is not as common and it is only required in Hong Kong and Lausanne.

Most PSDs are installed for new lines or new extensions. This is due to the difficulties in justifying the additional cost of retrofitting on a brownfield site. On existing lines, a large part of retrofitting work has to be limited to a very narrow time window of no more than 4 non-traffic hours per day. Hence, of the 14 lines with PSDs, 10 are new lines or extensions. Experience in retrofitting is relatively rare, as only two operators (Hong Kong MTR & Transports Metropolitans de Barcelona) have installed PSDs on their existing lines (three lines in Hong Kong, one in Barcelona).

Comparison before/after retrofit of PSDs based on the urban lines of MTR

The use of PSDs has a positive effect on operations and the availability of train service. This is supported by the following data from Hong Kong.

<table>
<thead>
<tr>
<th>Impact on operations and the availability of train service</th>
<th>Before</th>
<th>After retrofit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger fatal accidents (including suicides)</td>
<td>12 (year 2000)</td>
<td>0</td>
</tr>
<tr>
<td>Lost operational time due to passenger intrusion</td>
<td>0.75 minutes/day</td>
<td>0</td>
</tr>
<tr>
<td>Lost operational time due to objects falling on tracks</td>
<td>0.075 minutes/day</td>
<td>0</td>
</tr>
<tr>
<td>Drivers' sick days due to psychological shock after collision with persons on tracks</td>
<td>4 days/year (2005)</td>
<td>0</td>
</tr>
</tbody>
</table>

Installation constraints

The constraints when installing PSDs seem to be a barrier to the development of PSDs on existing lines (retrofit) and, at present, PSDs are mainly required for new lines. It is also interesting to note that, from one country to another, there is significant variation in the interpretation of safety requirements, which results in having systems ranging from SIL 0 to SIL 4 for apparently similar functions.

Conclusion

PSDs, compared with other PTP devices, are more effective in preventing passengers from intruding on railway tracks. However, operators should consider their own specific needs when selecting the appropriate PTP system. It is recommended that they go through an assessment process.

Based on the experience of operators who have implemented PSDs, it must be noted that train service is interrupted when PSDs do not work properly because PSD operation is interlocked with the train service. In the event that a PSD system is chosen, it is recommended that special attention be given to the design of the system. In particular, the design should include the following:

- Redundancy and fall-back mechanism (e.g. manual release of PSD doors);
- Fault monitoring system (e.g. alarm indication for individual doors);
- Safety aspects (e.g. limited door closing force, obstacle detection mechanism, etc.).

In the event that an operator chooses a PTP system only providing intrusion detection, additional measures should be taken to achieve the overall objectives of preventing intrusions in protected zones and recovering train service following an intrusion.

This is an information sheet of UITP, the International Association of Public Transport, has over 3,400 members in 92 countries throughout the world and represents the interests of key players in this sector. Its membership includes transport authorities, operators, both private and public, in all modes of collective passenger transport, and the industry. UITP addresses the economic, technical, organisation and management aspects of passenger transport, as well as the development of policy for mobility and public transport world-wide.

This Core Brief has been prepared by the Metro Committee and specifically the Electrical Installations & Safety Systems Subcommittee.