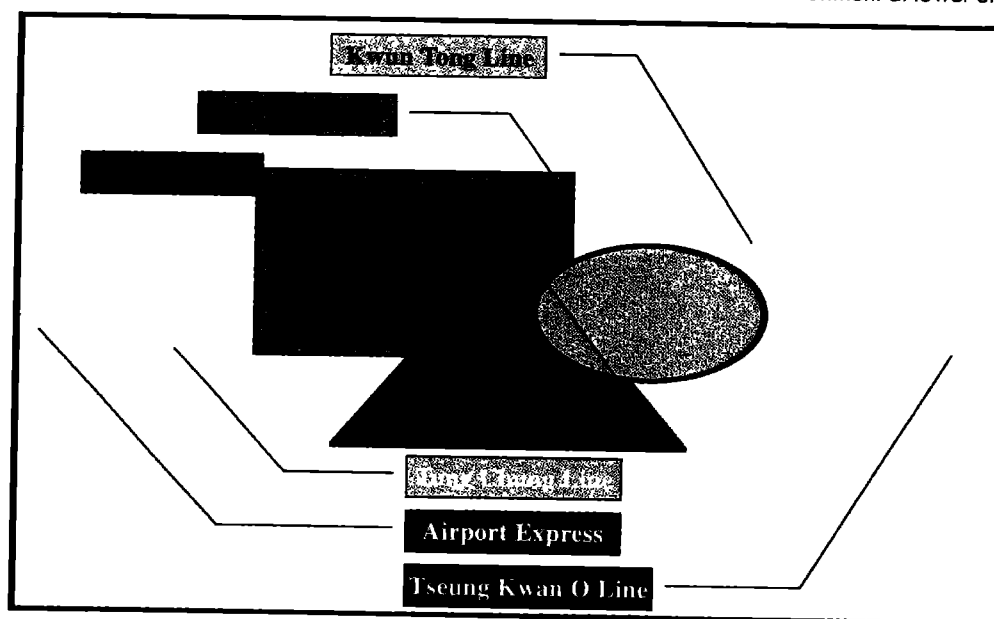


# PLATFORM SCREEN DOORS PROGRAMME OF MTR CORPORATION BETTER ENVIRONMENT FOR LESS ENERGY

*Dono Tong*  
*Project Manager (PSD)*  
*MTR Corporation*  
*Hong Kong SAR, China*

## ABSTRACT

The first of the MTR Corporation Urban Lines have been serving the Hong Kong public since 1 October 1979, and was the first public transport system in Hong Kong to have air conditioning. The average daily patronage was 100,000 in the first month of opening and the current average weekday patronage has increased to over 2.3 million. On top of the need to replace the first-generation Environmental Control System, demand on cooling has continued to rise due to new kiosks and new station facilities to meet passenger demands. Retrofitting Platform Screen Doors is considered to be the most cost-effective means to improve the air-conditioning performance and station environment for enhanced passenger comfort, and at the same time to reduce energy consumption. This project is the industry's first attempt to retrofit PSDs to an operating metro, which was not designed to have PSDs. The Retrofit PSD Project Team has overcome many challenges and is progressing well according to plan. The project has demonstrated that apart from improvement to temperature, noise and air quality, saving on air conditioning energy consumption could also be achieved. This project is a unique successful example of "Partnering" between passengers, train service operators, and the relevant suppliers and contractors working as an integrated team to achieve a better station environment at lower energy consumption.



## 1. Introduction

The concept of Platform Screen Door (PSD) is not new to the metro railway industry nor to the Hong Kong public. The MTR Corporation has adopted PSD as a standard provision for all new railways, and currently PSDs are in operation on the Tung Chung Line, Airport Express and the Tseung Kwan O Line. However, the MTR PSD Retrofit Project is the industry's first attempt to retrofit PSDs to an operating metro which was not designed to have PSDs, and also the largest project of its kind in the world. This paper first presents the project's scope of works and the challenges experienced during design and construction, and then it goes on to describe the impact of the project to the station environment and energy consumption.

## 2. Project Objectives

Although still relatively new comparing with the metro systems in cities like New York and London, the MTR's Kwun Tong Line - the earliest of the original three MTR urban lines, namely Kwun Tong Line, Tsuen Wan Line and Island Line - has been serving the Hong Kong public since 1 October 1979. The average daily patronage was 100,000 in the first month of opening. Today, our average weekday patronage is over 2.3 million. As part of the ongoing upgrading initiatives the Corporation has embarked on a programme to retrofit PSDs to 30 air-conditioned underground stations, the first railway in the world to undertake the complex task of retrofitting platform screen doors on a passenger railway in operation.

The primary objectives of the project are to improve the air-conditioning performance and station environment for enhanced passenger comfort, and at the same time to reduce energy consumption. Retrofitting PSDs and modify the Environmental Control System (ECS) is considered to be the most cost-effective means to achieve these objectives. The project will also address the following issues arising from current and future operations:

- Passenger opinions about high station temperatures
- Air quality and environment improvement at platform levels
- Heat load increase in stations from new commercial activities
- Air-conditioning energy consumption increase
- Crowding on platforms and public concern about platform safety

### 3. Project Scope

The project scope consists of modification to the Environmental Control Systems and retrofitting PSDs. These include:

- Installation of 13.5 km of PSDs at 74 platforms plus the associated monitoring, control and power supply equipment
- Modification of air-conditioning and tunnel ventilation equipment in 94 plant rooms
- Modification of many kilometres of air ducts and installation of linear diffusers at 74 platforms and 94 back of house plant rooms
- Replacement of 170 air handling units of capacities from 400kW to 1.5MW
- Installation of over-track PSD civil support structure to existing tunnel lining at 74 platforms

### 4. Design Challenges

The primary design challenge is to meet the project objectives of energy saving and environmental improvement, and to allow rapid, safe installation that can be reliably achieved in the short working time of about 2.5 hours within the Non-Traffic-Hours (NTH) every day.

Significant revenues are generated from the illuminated trackside advertising panels. There was concern that the PSDs may provide advertisers an opportunity to demand lower rates. The PSD design was substantially revised to maximise its transparency and provide clear views of advertising panels, and to retain the feel of open space at platform level.

To minimise service disruption due to PSD failures, extensive System Assurance validation had been carried out before on-site installation was allowed. 5 sets of platform screen doors were put to a gruelling test of endurance and reliability between December 2000 and April 2001. The doors were operated continuously at 10 seconds interval for 24 hours a day, 7 days a week until 1 million non disrupted successful operations were recorded for each door. The test result represents a total of 37.5 door operating years without failure. In addition 100,000 pre-installation commissioning test runs and 5000 in-situ test runs are also required for every door control unit before panel installation is permitted. On top of the system assurance and reliability tests, a fully workable prototype of sets of PSDs was erected in Hong Kong to validate required design functions and to develop emergency recovery procedure during construction period.

As Mr Phil Gaffney, Operations Director of MTR Corporation said, "We will be retrofitting the platform screen doors into stations that are already in operation. We must make sure that once the doors are put in, they work perfectly and are absolutely reliable so that they do not disrupt train service or cause inconvenience to passengers. The endurance and reliability test will allow us to identify any bugs in the design and make all the necessary adjustments before the doors are installed on the operational platforms."

### 5. Implementation Challenges

In order to ensure that millions of passengers carried per day by MTR are not affected and normal service are not interrupted during the installation period, works can only be carried out during non-passenger service hours between 2 am and 5 am every day.

All the works must be completed within NTH without interruption to the daily train services. Implementation poses a major challenge and constitutes approximately 70% of the project risk. Works at the platform and above the tracks impose risks of causing damage to the overhead power line and/or failure to clear the line, which would cause delay to railway service start-up.

In addition, during the period of ECS modifications 100% emergency ventilation and smoke extraction, and 50% air conditioning must be maintained at each station at all time. To accomplish these requirements, implementation studies by potential suppliers were commissioned by the Corporation, so that the contractors and MTR can jointly develop and refine the design requirements and implementation methodologies to minimise implementation and operational risks. The objectives of these studies were to:

- Review and confirm design requirements.
- Examine in detail the proposed installation methodologies, hazards and mitigation methods.
- Determine the feasibility of each potential tenderer's proposed installation process.
- Confirm the details of the project programme and ensure that the programme is realistic.
- Ensure that each potential tenderer fully appreciates the project scope, demands and implementation constraints prior to tender submission.

While each platform set of PSDs and ECS will require about 8 months to complete, passengers will see no installation works in progress, no materials left on platforms, no hoardings and find no inconvenience to their journey experience. The only visual intrusion will be caused by the temporary removal of suspended ceilings and installation of temporary platform lighting and signage as the works progress along each platform.

### 6. Project Management Challenges

The Corporation recognises that the implementation of this project may place railway operations at risk for the six-year duration of the works. A dedicated project management team was set up to ensure a clear focus in planning, design and implementation. Challenges faced by the project team are:

- The planning and logistic for demolition, removal and delivery of bulky equipment.
- Installation without any impact to daily services and being totally transparent to passengers.
- Live interface with the many improvements, new equipment, new systems and facilities added to the railway during the 6-year construction period.
- Changes due to as-built conditions, operational requirements or interfacing requirements.
- No suppliers, contractors and operators have previous work experience of similar nature
- Contractors' limited knowledge of the Railway's operations, control systems, hardware and upgrade and changes in the past 23 years.

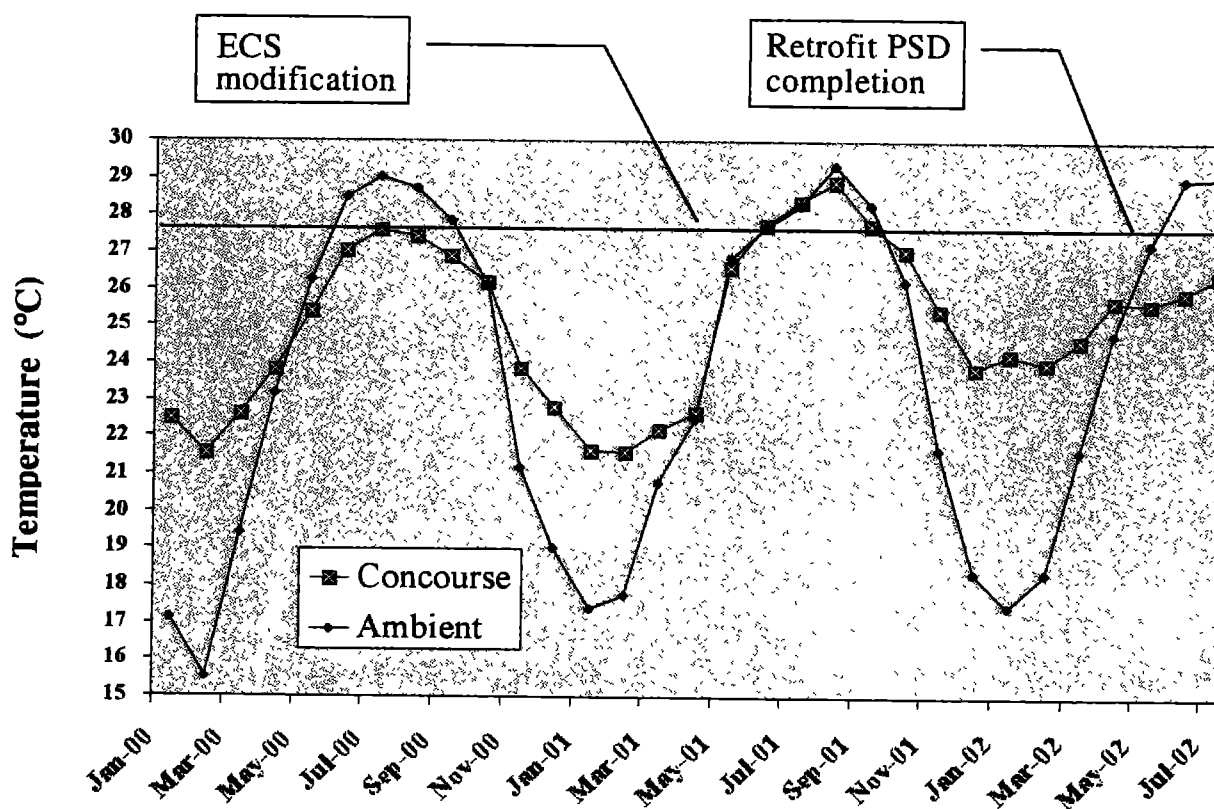
There are 4 major contracts, 3 awarded and the 4<sup>th</sup> to be awarded in mid 2003

Contract	Scope of Work	Status
Platform Screen Doors (design, supply & build)	30 stations (74 platforms)	Awarded in January 2000
Phase 1 ECS modifications (design, supply & build)	12 stations	Awarded in June 2000
Phase 2 ECS modifications (design, supply & build)	2 <sup>nd</sup> batch of 6 stations	Awarded in August 2002
Phase 3 ECS modifications (design, supply & build)	3 <sup>rd</sup> batch of 12 stations	To be awarded in 2003

To meet the challenges, a Partnering approach has been adopted to enhance co-operation among the contractors and the project team. The contractors' project management teams shared the same office as the MTR Project Team. MTR designers are seconded to work side-by-side with the contractor to form an Integrated Design Team to ensure that all elements of requirements, details of particular sites, design features, operational concerns and equipment specification are resolved and agreed efficiently. It is most satisfactory to report here that such approach has been extremely successful in keeping the cost, programme and the final product in line with the original project plan, and at the same time avoided unnecessary waste of time on variations, claims and contractual litigation.

### 7. Impact to Station Environment and Energy Consumption

As mentioned earlier, the primary objectives of the project are to improve the air-conditioning performance and station environment for enhanced passenger comfort, and at the same time to reduce energy consumption. Currently the target air temperatures for MTR underground stations are 29°C at concourse level and 27°C at platform level. Following the retrofit of PSDs, the respective new target temperatures will be 26°C and 25°C. The graph below shows the impact to Tsim Sha Tsui station temperatures at up-end concourse before, during and after ECS improvement and PSDs works. Apart from temperature, noise level and measured air quality at platform have improved, there was also saving on air conditioning energy consumption.



Tsim Sha Tsui Station Up-End Concourse Temperatures

## 8. Justification of the Project

Why retrofit PSDs to existing railways? When the first MTR line was introduced back in 1979, it was the first public transport system in Hong Kong to have air conditioning and received much praise from passengers. Nowadays nearly all modes of public transport have air conditioning, and air conditioning performance during hot summer days in MTR is the most persistent and prominent service attributes receiving comments from our passengers. On top of the need to replace the first-generation Environmental Control System (ECS), demand on cooling has continued to rise due to new kiosks and new facilities to meet passenger demands.

In 1997, it was predicted that if nothing is done by year 2006, station temperature might exceed 30°C even with the ECS running at full blast. Without PSDs, improvement and upgrade of the existing ECS will be limited by the available space and will only provide marginal temperature improvement at the expense of energy cost. A feasibility study to retrofit PSDs was put together taking in to account the following factors.

PSD Benefits	PSD Downside
+\$ Reduce energy consumption.	-\$ High capital cost.
+\$ Spare cooling capacity to improve station temperature, air quality and to expand commercial activity at stations.	-\$ Additional running and maintenance cost of PSDs.
+\$ A more secure, comfortable and relaxed station environment for passengers.	-\$ High project risk and potential service disruption during construction and PSD failures

The study concluded that the Retrofit PSD Project was not viable. Extensive passenger surveys were then carried out by MTR and independent body, which indicated sufficient positive feedback from passengers to support retrofit PSDs especially with the perceived enhancement to safety. In 1999 executive approval to proceed with the project was obtained.

## 9. Programme and Current Status

In spite of the many challenges and complications, current progress is on target to meet the Engineer's Programme.

Year	Planned No. of Completed Station	Actual No. of Station Completed
2002	4	4
2003	6	
2004	9	
2005	9	
2006	2	
Total	30	4

## 10. Conclusion

The Retrofit PSD Project Team has overcome many challenges and is progressing well according to plan. Although there will be many more challenges in the way ahead, the team is confident that the world's first retrofit platform screen doors will be successfully implemented to the benefit of the Hong Kong public. This project is a unique successful example of "Partnering" between passengers, train service operators, and the relevant suppliers and contractors working as an integrated team to achieve a better station environment at lower energy consumption.