



**TUEN MUN**

# LRT



**A BUILDING & CONSTRUCTION NEWS  
COMMEMORATIVE PUBLICATION**

AUGUST 8, 1988



MINISTER FOR INDUSTRY,  
TECHNOLOGY AND COMMERCE  
PARLIAMENT HOUSE  
CANBERRA, A.C.T. 2600

**CONGRATULATORY MESSAGE  
FROM SENATOR JOHN BUTTON  
AUSTRALIAN MINISTER FOR INDUSTRY, TECHNOLOGY AND COMMERCE**

I am delighted to extend the Australian Government's congratulations to the communities of Tuen Mun and Yuen Long, the KCRC, the Leighton-Victorian Metropolitan Transit Authority consortium and their subcontractors, on the completion and opening of the first truly modern light rail system on the mainland of Asia.

The end result which I have been privileged to watch growing through the construction stages - is impressive: an efficient, comfortable, high-capacity electric rapid transit link that is safe and pollution free.

The infrastructure represents the experience of nearly a century's operation of street railways in Melbourne, whose Metropolitan Transit Authority now runs the most extensive unified light rail network in the world. The Comeng built vehicles combine MTA's experience with that of the Australian car building industry while profiting from state of the art development in Europe. The total system is a transport showcase, of which Hong Kong will be proud for many decades to come.

Such results are achieved only after a great deal of hard work by all concerned - community leaders, Governments, KCRC, the contractors and the people who built the system.

Australians are proud to have been a part of this great Light Rail project.

*John N Button*



Photo: Neil Farnin

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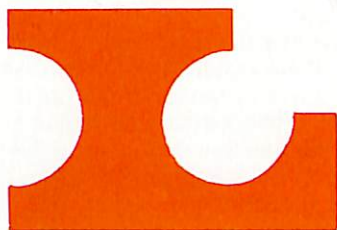
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Edited by: Richard Northcote  
 Design: Armando Recio Sr  
 Typesetting and Production:  
 Crescent Publishing Services Ltd  
 Colour separations:  
 CPS Colour Separations Services  
 Printed in Hong Kong

Building and Construction News would like to extend special thanks to Leighton Contractors (Asia) Ltd, the Metropolitan Transit Authority of Victoria and the Kowloon-Canton Railway Corporation for their help in the production of this supplement.

# The force behind the LRT



**L**eighton Contractors (Asia) Ltd is a subsidiary of the diversified construction and property group Leighton Holdings Ltd. Identifying Asia as one of three target areas to concentrate its construction activities, Leighton Contractors (Asia) has played a major role in the the parent group's strategy.

In Asia Leighton operates in Hong Kong, Singapore, Malaysia, Brunei, Thailand and Indonesia and it is through projects such as the Tuen Mun LRT, the North West Shelf LNG tanks project in Australia and Teluk Intan hospital in Malaysia, that Leighton divisions are becoming involved in large joint venture and turnkey projects with major Asian and European partners.

All group operations in Asia are controlled from Hong Kong by Leighton Asia, which is involved in civil engineering, building, foundation engineering, pipelines, infrastructure development and land reclamation, as well as the Light Rail Transit.

The company's achievement in winning multi-million dollar building and civil engineering projects reflects an increasing emphasis on penetrating the Asian market.

**The three main forces behind the Tuen Mun Light Rail Transit System are the Kowloon-Canton Railway Corporation, Leighton Contractors (Asia) and the Metropolitan Transport Authority of Victoria. Here, we provide a brief description of each of these organisations.**

By implementing a five-year plan initiated in 1982, Leighton Holdings has established a significant involvement in building and property development to balance its traditional strength in civil engineering.

This five-year plan has been successful in establishing a strong presence in building as this aspect of its operation now accounts for 60 per cent of the total value of work, compared to 39 per cent in 1984.

The group has also extended its construction capabilities to include project management, construction management and the arrangement of project financing, all of which were offered for the Tuen Mun Light Rail Transit System.

An emerging trend is total project involvement, in which Leighton companies participate in all stages of a project, from initial feasibility studies through, site acquisition, design development and construction to finished product operation and marketing.

Leighton's philosophy is to place particular emphasis on the performance and skills of people while complementing

these by the development and application of advanced technology

From its origins in the 1950's as a small, privately owned civil engineering company in the Australian state of Victoria, the Group:

- Obtained stock exchange listing in 1962;
- established Leighton Holdings in 1971 to facilitate further business and geographic expansion; and
- became one of the first Australian construction groups diversify into international markets, initially in Asia during the early 1970s.



**T**he charter of the Metropolitan Transit Authority (MTA) of Victoria states that it was formed "to provide, manage and operate an integrated, efficient, effective, reliable and safe public transport network in Melbourne by means of regular scheduled services, within policy and financial guidelines set by Government and having regard to the interest of employees and the broad community."

Given this chartered objective, and the fact that the MTA has vast experience in the management of the Light Rail System, it was an invaluable asset to the consortium building the Tuen Mun LRT.

The goals and objectives of the MTA include:

- The development of a market-oriented approach supplying quality, integrated services where they will best satisfy travel needs;
- the development of new modes of transport to meet changing conditions; and
- to ensure passenger and staff safety in all areas.

These three objectives have played a major role in the development of this LRT system.

The backbone of the MTA's experience in Light Rail is Melbourne's public transport system which is becoming a show-piece for the development of efficient transport systems overseas.

Initially, the MTA was formed to integrate three modes of transport — trains, trams and buses — into one safe, effective service. More importantly, however, the services had to be made responsive to the needs of the communities in which they operated. This meant moves to increase patronage, to offer routes and timetables which operate efficiently and to achieve a realistic cost recovery rate.

The high-tech approach adopted for the Tuen Mun LRT System was no obstacle for the MTA, as it already uses such a system in Melbourne to monitor the transport system.

The MTA's sophisticated Automatic Vehicle Monitoring (AVM) System is a computer-based control system that automatically determines the location and status of every vehicle in real time. Currently, 200 light rail vehicles and almost the entire fleet of 315 Government buses are being tracked in this way. When fully operational, the system can monitor up to 2,000 vehicles and trips over 450 bus and tram routes.

The system allows the MTA to initiate immediate action to keep vehicles on schedule and thereby to enhance efficiency of operation. It provides a quick response to emergency calls relating to crew and passenger safety.

In Melbourne, the MTA is meeting the challenge of keeping 400,000 people a day on the move. This is the same as the forecast early 1990s figure for the Tuen Mun Light Rail Phase 1 System.

In 1986/87 the MTA's combined tram, train and bus network clocked up 150 million vehicle kilometres and serviced an area of more than 6,000 square kilometres.



The Kowloon-Canton Railway Corporation was set up in February 1983 to operate the railway system between Kowloon and Lo Wu, on the border with mainland China, which carries approximately 400,000 passengers a day.

In 1984 the company commissioned a feasibility study on the construction of a Light Rail Transit System (LRT) to service the western New Territories. By 1986 substantial progress was already made on the phase one contract of the LRT, which was scheduled for operation in August this year. In the second half of the same year worksites began to be handed over to the corporation's contractor, Leighton MTA Consortium.

Towards the end of 1986, track-laying, erection of overhead line poles and construction of stops, substations and rectifier stations commenced in Tuen Mun. The LRT administration building at the depot also began to take shape.

Having established a small project team to supervise the various aspects of the contract, the corporation set up the framework for operation and training, in preparation for the commissioning and opening of the LRT System for public use.

Legislation empowering the company to build and operate the system was enacted in the same year, which provides for the setting up of a Transit Service area in Tuen Mun and Yuen Long and empowers the company to operate a public bus system within the area.

In April 1986, consultants were appointed to undertake studies for the extension of the LRT, both within the region as well as to the urban area through connection with either the Kowloon-Canton Railway (KCRC) or the Mass Transit Railway.

As a result of developments outside the sphere of the KCRC, a major organisational review took place in May 1987 to expand the scope of the KCRC's activities. A deci-

sion to change the corporate organisational structure from one based on functions to one related to profit centres resulted in the formation of five new business divisions: bus, freight, heavy rail, light rail, and property.

In step with the construction of the LRT system, KCRC's employment of staff for the Light Rail Division grew rapidly in 1987. The division is to have more than 400 staff when the system is commissioned.

Financial and personnel systems, as well as project management system for the LRT project started in 1985 and were successfully computerised at the beginning of 1986.

The second phase of computerisation, which includes applications in freight administration, train time-table and crew-scheduling, progressed on schedule. Owing to the rapid increase in transactions, the IBM4331 system was upgraded to the IBM4361 system, providing a threefold expansion in capacity.

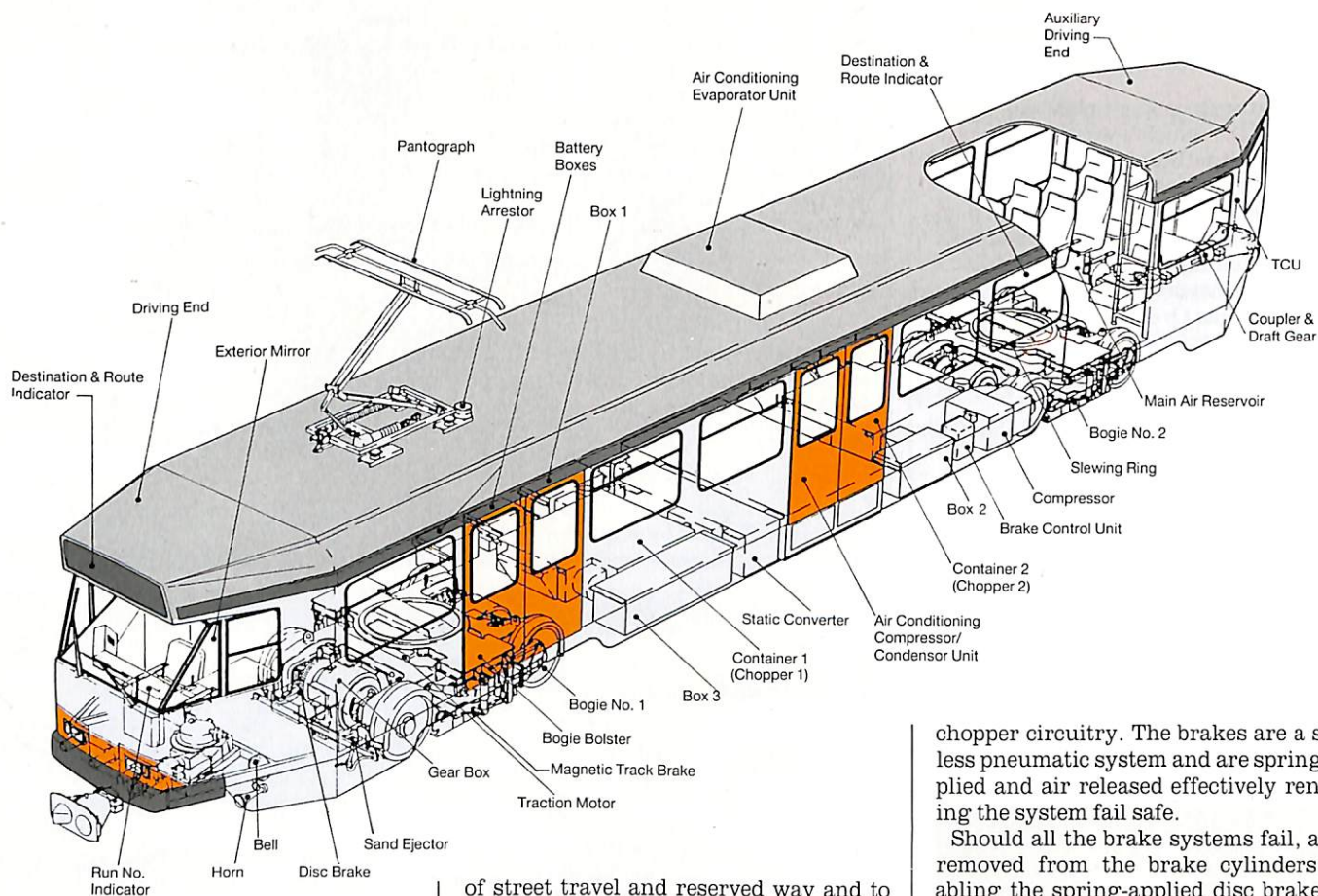
The arrival of the first Light Rail Vehicle from Australia in October last year marked a significant step towards the completion of the three-year contract for phase one of the LRT system. To facilitate the test run, the overhead line system from the LRT Depot in Lung Mun Road to Shan King estate was energised, and the energisation programme was extended to Leung Tin in January this year.

With the completion of the Regional System, the corporation has already commenced design of six additional regional links, including Tuen Mun Pierhead to Yau Oi; Yau Oi to Sam Shing and Town Centre to Tuen Mun (northwest), which are planned for completion by 1991 or 1992.

Apart from involvement in the design and construction of the system, the KCRC is also responsible for property developments along the route.

The company signed a joint agreement with New World Development for property development above the Tuen Mun LRT terminus in 1985, and two other agreements with Sun Hung Kai Properties for commercial and residential developments above the LRT depot in Tuen Mun and the terminus in Yuen Long.

# World rail standards apply



**T**he specification for rolling stock for an entirely new railway system in Hong Kong was released in 1985 to international competitive tendering.

Termed the Tuen Mun Light Rail Vehicles, the rolling stock was needed for the new Light Rail Transit System to be built in the New Territories.

After lengthy negotiations, a contract for 70 light rail vehicles, which had to conform to the latest world standards for light rail vehicles, was awarded to Comeng (Victoria), a Division of the ANI Corporation Limited, by the Leighton-MTA Consortium.

The track system specified is a 750 V D.C. standard gauge arrangement.

The system has included a combination

of street travel and reserved way and to cope with this, the vehicle must conform to the local design regulations whilst still being capable of effective running on the reserved way section, as coupled light rail vehicles.

The vehicles are designed to accommodate automatic couplers and can run effectively as three vehicle units.

The specification stated that the vehicles would be for single-ended operation, where doors are situated on one side of the vehicle only. Using this design, more seated passengers can be accommodated, while also demanding an off-centre bogie mounting due to the weight difference on either side of the vehicle.

The latest traction design and brake technology has been incorporated into the vehicle construction with the traction package including the microprocessor control of gate turn off (GTO) thyristor

chopper circuitry. The brakes are a stepless pneumatic system and are spring-applied and air released effectively rendering the system fail safe.

Should all the brake systems fail, air is removed from the brake cylinders enabling the spring-applied disc brakes to operate. The bogies are also fitted with magnetic track brakes and sanding equipment, for added safety.

The bogies are a monomotor configuration driven through right angle gear boxes with hollow shafts. The secondary suspension on the bogies utilises air bags, effectively providing a uniform floor height, for platform loading.

The vehicles are designed for a life of at least 30 years, with the average distance covered each year anticipated at a minimum of 120,000 km.

The vehicle structure is made from stainless steel in order to minimise maintenance and the effects of corrosion. The ends of the vehicle are clad with fibreglass sections which allow quick and simple replacement, if necessary.

The following are the parameters of the vehicle showing its design features, per-

formance and unique operating conditions.

The major design criteria of the vehicle encompasses stress analysis, engineering calculations, comparative analysis and comprehensive testing. To this end, detailed design parameters were prepared during the design process before being formally approved.

Load assumptions and safety margins used in the vehicle design were calculated in accordance with "Load assumptions and Safety Margins for Rail Vehicles" published in 1970 by the German Association for Lightweight Design for Transit Vehicles.

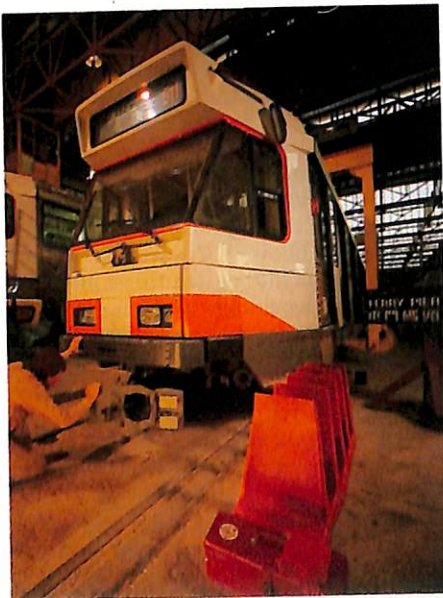
A weight management plan was established and the vehicle's weight was monitored by a monthly weight report until the first vehicle was commissioned.

A safety analysis was undertaken to cover all the critical aspects of vehicle operation including:

- Safety against derailment;
- safety against Overturning;
- electrical safety;
- crashworthiness; and
- passenger safety.

This safety analyses became a regular part of the vehicle design operation and monthly reports were painstakingly prepared. The safety report covered:

- Four axle rigid body;
- unidirectional operation: auxiliary operator's console in rear of vehicle (shunting controls);
- left hand line operation;
- single or multiple operation of up to three vehicles;
- platform loading;
- outside sliding doors;
- low interior and exterior noise levels;



Comeng vehicles during manufacture

## CARBODY

- Designed and built by Comeng (Victoria), Australia
- Natural decorative finished stainless steel structure
- Crashworthy design
- Single split roof and underfloor airconditioner units also designed and built in Australia
- Modular design, utilising identical components and sub-assemblies

## BOGIES

- Design by Comeng (Victoria) and Duewag of West Germany
- Mono-motor design
- Inside frame design
- Resilient wheels
- Chevron primary suspension
- Air secondary suspension
- Frame-hung motor
- Low unsprung mass and good wheel-load equalisation

## PROPULSION

- Manufactured by AEG of West Germany
- DC GTO Chopper control traction package
- Electrodynamic and regenerative brake system

## BRAKES

- Manufactured by Knort of West Germany
- Electrodynamic brake, with electropneumatic disc brake
- Parking brake
- Magnetic track brake

## OPERATIVE ENVIRONMENT

Considerable design was necessary to cater for the unique conditions which are evident in Hong Kong, such as:

- Operating under typhoon conditions, vehicles must stay fully operational to signal 8.
- Under typhoon condition encountered during signals 9 and 10, all vehicles are to be parked at the storage area or at the system loops. They must be safe with respect to overturning under these conditions.
- Fordability — with fully worn wheels, the vehicles must be able to operate on flooded tracks without water entering into any compartment, component or device.

## ENVIRONMENT IMPACT

- Noise
- The external noise of the vehicle is reduced by the use of:
  - resilient wheels
  - flange lubrication which also helps to minimise flange wear
- The external noise of the vehicle does not exceed 75 dB(A) when empty (except for the operator) with new or machined wheels on a level ballasted track with all systems operating at a speed of 60 km/h.
- Radio frequency interference
- The vehicle which will be designed to reduce radio frequency interference, both inside and outside, which is set at very low limits.
- Interference will not be caused to the communication and public address systems on the vehicles and platforms.



## What Melbourne Transit Consulting Service can do for you.



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### Feasibility studies for new Transport System

- Patronage estimation.
- Financial and economic evaluation.
- Fare and ticketing design.
- System network design.
- Comparative mode evaluations comprising heavy rail, light rail, bus and mini bus.

### Operations Specifications

- Detailed network design.
- Vehicle and crew scheduling.
- Traffic operations procedure development.
- Fare and ticketing systems.
- Passenger information and facilities.

### Engineering Specifications

Specifications prepared for the following areas:

- Vehicles.
- Electrical supply and distribution.
- Communication and signalling systems.
- Depots and workshop.
- Workshop equipment.
- Track work.
- Public transport priority systems.

### Project Management

- Control, supervision of system element production, installation, commissioning and complete system implementation.

### Manufacture of Specialist Equipment

- Design and manufacture of specialist workshops and depot equipment.

### Traffic Operation Procedures Development

- Development of operation systems tailored to the particular operation system design based on MTA operating experience.

### Training

- Training of operations and engineering staff both in Melbourne or on site.

### Management Assistance

- Management assistance to operators during start-up and early operational phases of new systems.



**The Met.**  
AN AUTHORITY OF VICTORIA TRANSPORT





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## Light Rail

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## Technology

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Australia's Metropolitan Transit Authority in the city of Melbourne is a world leader in light rail technology.

Backed by over 100 years experience in tramcar operation, it now operates the biggest tram network in the Western World, using over 600 vehicles to transport 110 million passengers a year over 24 million vehicle kilometres.

Together with its consulting wing, Melbourne Transit Consulting Service, it has already won lucrative contracts in South East Asia, for both construction of light rail systems and consulting services.

Since its formation, the MTA has introduced major improvements to its own system.

A special Automatic Fleet Monitoring System has been installed to keep track of the system's trams and buses. This system monitors the location and schedule adherence of vehicles, and with direct contact between the driver and the control centre, vehicle running can be readily adapted to cater for specific demands or events occurring during operation. The system has the added advantage of greatly improving passenger and staff safety.

In Melbourne the light rail operates on converted heavy rail reserve, on special median strip road reserve, and on carriageways shared with motor vehicles.

The MTA's sister transport authority, the Road Traffic Authority, operates a special dynamic computer traffic control system which, apart from greatly improving traffic flow, gives tram/light rail vehicles and buses priority at traffic signals.

All these innovations result in a flexible and cost-effective public transport system.





As an operator of a fully-integrated multi-modal transit system, the MTA is continually involved in the planning and evaluation of system improvements. In almost all cases this involves the comparative assessment of options involving different modes, using computer-based costs and models.

This practical experience has enabled the MTA to develop strong costing, financial and operational analysis capabilities.

Through its extensive capital investment activities, the MTA has developed considerable expertise in design and specification of major transport projects in all areas — vehicle, electrical, signalling, track and depot construction, mode conversions, vehicle control systems, rostering, timetabling, ticketing and all training programs.

When competing for construction or consultation contracts, the MTA's big advantage over many competitors is that it can demonstrate a working integrated public multi-modal system.

Interested parties can visit Melbourne and experience the system for themselves. **It is not just theory but an operational reality.**

It was just such experience coupled with Melbourne Transit Consulting Service's expertise that won MTA, in partnership with Leightons, a \$200 million contract to build a light rail system in Hong Kong. This involved consultancy, construction of the system, training of staff, supply of light rail vehicles and commissioning of the system. In Malaysia, the Melbourne Transit Consulting Service has won a contract as consultant for the construction of a new light rail system for Kuala Lumpur.

The Metropolitan Transit Authority is the complete transit authority. Together with the Melbourne Transit Consulting Service, it combines over 100 years practical experience with up-to-the-minute expertise on light rail, trams, buses and heavy rail.

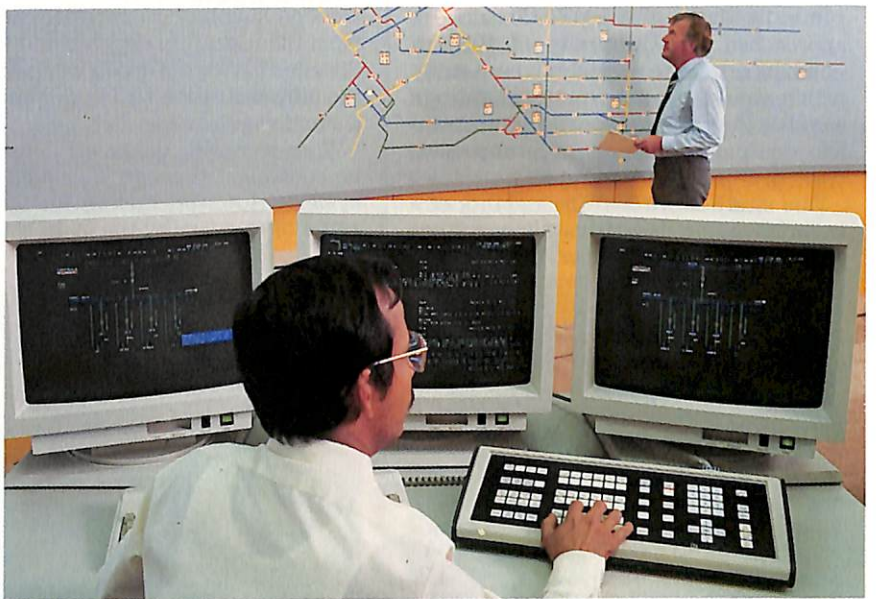
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## MTA-MTCS.

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### A Winning Team

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*T*ravel

# Right on time.



*Exactly 3 years ago, 8 August, 1988 was chosen as the day to handover phase I of the Tuen Mun LRT system.*

*When the big day came, Leighton-MTA was ready.*

*Tuen Mun LRT in Hong Kong is the first light rail transit system of its type in Asia. It can carry 25,000 pas-*

*sengers per hour over 23 km of track.*

*Under a turnkey contract, it was designed, built and commissioned*

*by Leighton-MTA for the Kowloon Canton Railway Corporation in less than 3 years and ahead of schedule.*



**LEIGHTON MTA  
CONSORTIUM**

**MAIN TURNKEY CONTRACTOR FOR THE TUEN MUN LRT.**