

**Legislative Council Panel on Transport
Subcommittee on matters relating to railways**

West Rail Signalling System

Purpose

In response to Members' request at the meeting of the Subcommittee on matters relating to railways held on 3 October 2005, this paper sets out for Members' information the earthing arrangements of the West Rail signalling system, requirements of the earthing arrangements as stipulated in the West Rail signalling system contract, and a comparison between the earthing arrangements of West Rail and East Rail.

Background

2. The alignment of West Rail between Tuen Mun and Nam Cheong is 30.5km in length, of which an elevated section of 13.4 km between Tuen Mun and Kam Sheung Road is situated on viaduct. The viaduct comprises 44% of the total track length. Another 2.4 km long section of at-grade track is located at Kam Sheung Road. The section of track between Tai Lam Tunnel and Nam Cheong runs in an underground enclosed tunnel.

3. The elevated track on the West Rail viaduct is comparatively long with an above-ground height higher than the viaducts of other railway systems in Hong Kong and is relatively exposed. Between June and August 2005, the number of lightning strikes was greater than normal in Hong Kong. During this period, there were signalling incidents on West Rail, which were mainly caused by the inclement weather and lightning strikes. In these incidents, some of the electronic components of the signalling system were damaged, which led to disruptions to West Rail service.

4. To minimise the impact of lightning strikes on the West Rail signalling system, Kowloon-Canton Railway Corporation ("KCRC") has engaged consultants to undertake comprehensive review of the earthing arrangements and the lightning protection system of West Rail. The reports are expected to be completed in early 2006.

Earthing Arrangements of West Rail Signalling System

5. The design of railway systems worldwide takes into account their respective geographical environment and operational needs. The earthing arrangements of the signalling system aim at providing a stable operational environment for railway systems by reducing external electro-magnetic interferences so as to protect the railway systems and ensure their normal operation.

6. The earthing arrangements of West Rail are designed to fit in with the unique operating environment of its alignment. A section of the West Rail alignment is situated on the viaduct. To effectively discharge surged voltage, earthing facilities which are connected to the earth underneath the viaduct by means of low resistance wires, called the earth wires, are installed at a regular distance on the West Rail viaduct. These facilities discharge any sudden increase in voltage to the earth.

7. The main purpose in the design of the earthing arrangements is to completely earth all railway facilities (including overhead line, rail track and signalling system etc). In times of lightning strikes, the earthing arrangements will perform its function and discharge upsurge voltage to the earth so as to minimise the impact of current caused to railway facilities and ensure safe operation of the railway system.

Earthing Arrangements of East Rail Signalling System

8. The alignment of East Rail is mostly at-grade with tracks on ballasts. Since the tracks are laid on the ground, the tracks and their earthing components can form an efficient network to discharge the surged voltage away from the railway system.

9. Since East Rail is mostly on ballast tracks and the alignment of West Rail is mostly built on viaduct and inside tunnels. The trackforms and installation arrangements of the railway equipment including earthing arrangements of the two railways are also different. It is therefore not feasible to draw a direct comparison between them¹.

¹ *There was a request from a Member for a comparison of the design of the West Rail and the Mass Transit Railway. However, most of the MTR network is underground with a small portion of viaduct spanned over the Tsuen Wan Line and Kwun Tong Line, whereas for the West Rail system, a large section is built on viaduct and therefore much more exposed. Besides, the power systems of the MTR and KCR are different. Therefore, the West Rail and the MTR cannot be directly compared.*

West Rail Signalling System Contract

10. KCRC's procurement policy is established according to the Agreement on Government Procurement under the World Trade Organisation. It ensures local and overseas suppliers can openly and fairly tender for works contracts. The tender assessment includes a technical evaluation to ensure the bidders can attain the required technical standards. KCRC clearly spells out all specification details in the tendering documents when inviting tenders.

11. In the design stage of the West Rail project, KCRC has conducted a comprehensive assessment on the functions and specifications of the earthing arrangements. On the design aspect, the earthing arrangements of the West Rail signalling system must meet the international standards and the requirements as set out in the Hong Kong Electricity Ordinance. All standards and requirements were clearly spelt out in the tender documents of the related systems of West Rail.

12. The contract for the design and provision of the West Rail signalling system was awarded to Alcatel in March 1999. According to the contract, the contractor had to comply fully with the relevant standards and requirements for the electro-magnetic component and earthing arrangements in the provision of the signalling system. The standards and requirements cover areas including electronic magnetic compatibility, earthing, wiring, lightning protection and power supply. The *Annex* lists out the reference number of the relevant standards and the organisations setting out the standards.

13. The earthing and lightning protection systems provided by Alcatel are widely adopted in the industry. The standards and provisions set out in the contract are international standards adopted by railway systems worldwide and the best practices. They are also common international standards. West Rail's signalling system was designed to meet the required specifications and Alcatel has fulfilled their obligations and requirements under the contract. On the other hand, the Corporation has exercised due diligence in ensuring that Alcatel has met the relevant standards.

Conclusion

14. KCRC is of the opinion that the design of the earthing arrangements for the West Rail and East Rail signalling system meets the international standards and requirements set out in the Hong Kong Electricity Ordinance.

The design adopting the international standards is able to cope with lightning in general cases.

15. The main cause for the West Rail incidents in mid-2005 was the increase in frequency of lightning strikes and the inclement weather.

16. The review reports by the consultants are expected to be completed in early 2006. Based on the consultants' recommendations, KCRC will carry out improvement works. The works will be completed before the rainy season in 2006. The Corporation believes that the improvement measures can effectively reduce the number of incidents to the minimum.

Kowloon-Canton Railway Corporation
January 2006

**International Standards and Local Ordinances applied to
West Rail Signalling System Contracts on
Electro Magnetic Compatability and Earthing Arrangements**

International Standards

Subject	Standard	Organisation setting out the standard
Electro-magnetic compatibility	89/336/EEC	European Economic Commission
Electro-magnetic compatibility	EN 50081-2	European Committee for Electrotechnical Standardization
Conducted immunity level	EN 50082-2	European Committee for Electrotechnical Standardization
Electrostatic discharge (ESD)	IEC 61000-4-2	International Electrotechnical Commission
Fast transient burst	IEC 61000-4-4	International Electrotechnical Commission
Power surge	IEC 61000-4-5	International Electrotechnical Commission
Recommended Practice for Grounding of Industrial and Commercial Power Systems	Std 142-1991	Institution of Electrical Electronics Engineers
Recommended Practice for Powering and Grounding Sensitive Electronic Equipment	Std 1100-1992	Institution of Electrical Electronics Engineers
Guide for Safety in AC Substation Grounding	Std 80-1986	Institution of Electrical Electronics Engineers
Code of Practice for Earthing	BS 7430	British Standards
Wiring Regulations for Electrical Installations for Buildings	BS 7671	British Standards

Code of Practice for Protection of Structures Against Lightning	BS 6651	British Standards
Distribution of Electricity on Construction and Building Sites	BS 7375	British Standards
Distribution Assemblies for Electricity Supplies for Construction and Building Sites	BS 4363	British Standards
Safety in Tunnelling in the Construction Industry	BS 6164	British Standards
Wiring Regulations	Wiring Regulations (16th Edition)	Institution of Electrical Engineers

Local Ordinances

- Hong Kong Factories and Industrial Electrical Regulations
- The Power Companies' Supply Rules
- Electricity Ordinance and its subsidiary Regulations
- Code of Practice for the Electricity (Wiring) Regulations, EMSD, Hong Kong