



**Kowloon-Canton Railway Corporation**  
**East Rail Extensions**

**Sheung Shui to Lok Ma Chau Spur Line**  
**- Sheung Shui to Chau Tau Tunnels**

*LegCo Panel on Transport*  
*Subcommittee on matters relating to railways*

*Supplementary Information on Risk Assessment*

February 2003

**KCRC East Rail Extensions**  
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**LEGCO PANEL ON TRANSPORT SUBCOMMITTEE**  
**on matters relating to railway**

**Supplementary Information on Risk Assessment**

**Introduction**

1. At the meeting of the Subcommittee on matters relating to railways held on 27 November 2002, in response to Members' request, the Kowloon-Canton Railway Corporation (KCRC) agreed to provide details about the findings of the risk assessment in relation to the tunnelling works of the Spur Line.
2. As part of the Tunnels Feasibility Study carried out in August 2001 for the Sheung Shui to Chau Tau Tunnels, a risk assessment has been performed to identify tunnelling hazards, quantify the associated risks and develop methods to mitigate and manage these risks. The results of the assessment have been documented in a Risk Management Plan which details the approach to risk management and procedures to be followed during the design, procurement, construction and operation stages. This paper summarises the findings of the risk assessment process and the strategy adopted to manage risks of the tunnelling works of the Spur Line Project.

**Risk Management**

3. Risk management for the tunnelling works is based on the following systematic process :-
  - (a) Identification of project-specific hazards during various stages of the works;
  - (b) Quantification of the risks in terms of *probability of occurrence* and *impacts*;
  - (c) Pro-active action plan to either eliminate or mitigate the *major risks*; and
  - (d) Allocation of responsibilities for risk management to the appropriate parties.
4. Tunnelling risks would be controlled by integrating risk management into the design and project management procedures. The risk management process would be continuously monitored and reviewed as the project progresses.

### **Results of Risk Assessment**

5. The results of the risk assessment show that *major risks* could be categorised under :
  - (a) Tunnel Design (3 nos.)
  - (b) Project Management (8 nos.)
  - (c) Tunnel Construction (19 nos.)
  - (d) Environmental Issues (6 nos.)
6. Mitigation measures and fallback actions for the *major risks* have been evaluated and are recorded in a *Risk Register* a summary of which is shown in Annex A.

### **Contractor's Responsibilities**

7. Risk management forms an essential part of the tunnelling contractor's project management procedures. Under the Contract, the contractor is required to maintain the *Risk Register*, monitor and report on the risks. More importantly, the contractor's responsibilities and liabilities have been clearly written down in the Contract and the contractor will be held liable for his default and mistakes, and will be required to implement all necessary mitigation measures and fallback actions.
8. The main contract provisions which specify the contractor's responsibilities in respect of tunnel design, project management and tunnel construction are clearly described under various parts of the General Conditions, General Specification and Particular Specification of the Contract. The Contract also requires the contractor to adopt an anticipatory approach to address all environmental requirements and constraints. When reaching various limits which are very stringent and have been clearly defined in the Environmental Permit, the contractor must stop that section of work and take all necessary actions at his own cost to correct the problem before he could proceed further.

### **Conclusion**

9. Based on the assessment of the impacts, mitigation measures and fallback actions of the 36 *major risks* identified, and the contract documentation that aims at preventing the contractor from evading its contractual responsibility, it is concluded that the identified risks are all within acceptable levels and that in the event of occurrence, the Corporation will ensure that all these will be adequately addressed and resolved by the contractor. During the execution of the works, the individual risks will be continuously and closely monitored by the Corporation's in-house construction team and Environmental Specialist as well as Independent Environmental Checker to ensure that adequate controls and mitigation measures are applied, and the risks properly managed.

## Annex A Risk Register (Sheet 1 of 4)

Risk ID	Description of Risk	Risk Mitigation	Fallback Plan
<b>(a) Tunnel Design</b>			
1	System safety requirements not completely included in design	System Safety Plan / System Safety procedures / Design Review Meeting / System Safety Team to attend design review	Assess with the designer and the contractor and take remedial action
2	Late start to Electrical & Mechanical design	Early procurement of Electrical & Mechanical designer / Early start to Electrical & Mechanical detailed design	Provide additional resources
3	Electrical & Mechanical Interface with civil design	Good coordination / Appoint Building Services Coordinator to check submissions/ early start to E & M design / Appoint competent contractor	Review with the designer and take remedial action
<b>(b) Project Management</b>			
1	Extreme weather conditions	Bad weather procedures / Method statements for work in rainy season to account for extreme weather / Temporary Drainage Plan	Emergency team on stand by
2	Fire	Consultation with Fire Services Department on fire procedure / Provision of fire fighting equipment / Fire drill / Site Inspections	Emergency Plan / Emergency Team available
3	Tree felling permit not approved in time / unable to fell trees.	Close attention by management / Close contact with Environmental Protection Department & Agriculture, Fisheries and Conservation Department / Assistance from the contractor	Revise construction programme
4	Material not acceptable	Procurement procedure / Inspection and Test Plan / QC audits	Remedial Action / Management Review
5	Workmanship not acceptable	All works covered by method statement / Procurement procedure for contractors / Preventive action meetings / Task launch meeting / Training / Inspection and Test Plan / Contractor supervision / QC audits	Remedial Action / Management Review
6	Damage to Works by others	Coordination / Handover procedures & inspection / Early reporting of incidents	Contractual provisions
7	Physical damage or injury	Physical monitoring / Pre-construction condition survey / Complaint handling procedure / Communication with the contractor	Assess with the contractor and take remedial action
8	Disturbance / nuisance to public	Meet with local organisations / Work closely with contractor and complainants to open good communication channels / 24 hr Hotline / Complaint procedure to avoid escalation of complaint / Interface plan and programme / Press officer	Assess with the contractor and take remedial action

## Annex A Risk Register (Sheet 2 of 4)

Risk ID	Description of Risk	Risk Mitigation	Fallback Plan
<b>(c) Tunnel Construction</b>			
1	Tunnel Boring Machine not delivered in time	Early identification of source of supply / Selection of experienced supplier / Full time supervision of Tunnel Boring Machine delivery	Revise construction programme
2	Poor machine performance	Experienced contractor / Selection of competent staff and good equipment / Good ground investigation / Analysis of daily monitoring results	Revise construction programme
3	Tunnel not watertight	Use of experienced contractor with proven experience in tunnel lining design and installation	Review with the designer and take remedial action / Emergency evacuation procedure / Key spare parts on site / Key standby plants on site
4	Construction tolerance exceeded / Ring ovality / Steps between lining segments and rings	Experienced contractor / Post erection monitoring / Use of packers / Selection of experienced and competent staff	Review with the designer and take remedial action / Emergency evacuation procedure / Key spare parts on site / Key standby plant on site
5	Lack of accuracy of drive	Use of experienced contractor with computerised navigation system / Selection of experienced and competent staff	Review with the designer / contractor / operation staff and take remedial action
6	Unacceptable water seepage through diaphragm wall	Pumping test / Remedial grouting	Ground water recharge / Remedial work as assessed by the designer
7	Diaphragm wall not adequate structurally	Independent Checking Engineer check of the design / Proof testing (sonic / coring) / Material testing	Remedial work assessed by the designer / contractor
8	Temporary works failure	Adequate design / Proper construction techniques / Adequate materials / Adequate supervision	Temporary works to maintain safety / Remedial works as assessed by the designer
9	Excessive ground movement	Adequate design of diversion / Monitoring of retaining walls and tracks	Emergency response plan
10	Ground collapse	Proper ground investigation / Geotechnical instrumentation to monitor ground movement / Proven ground treatment method / Use of appropriate excavation mode / Experienced contractor / Selection of experienced and competent staff	Review with the designer and take remedial action / Emergency evacuation procedure / Key spare parts on site / Key standby plant on site

## Annex A Risk Register (Sheet 3 of 4)

<b>Risk ID</b>	<b>Description of Risk</b>	<b>Risk Mitigation</b>	<b>Fallback Plan</b>
11	Grouting for cross passages do not provide sufficient ground support	Experienced contractor / Adequate design / Adequate supervision / Verification records / Continuous monitoring	Further grouting / Ensure safety of the tunnel as assessed by the designer
12	Utilities not adequately supported	Design check by Independent Checking Engineer / Adequate monitoring of the utilities	Remedial work as assessed by the designer / utility companies / contractor
13	Flooding of the shaft / tunnel by rainwater / river flooding	Adequate freeboard provided in the design / Weather and river level monitoring / Adequate pumps / Back-up power supply	Emergency evacuation procedure / Key spare parts on site / Key standby plant on site
14	Damage to large diameter Dongjiang watermains by construction plant	Construct access and protection platform over watermains / Settlement monitoring / Access control / Limit on plant access / Works controlled by method statement and movement procedures	Emergency response plan as agreed with WSD
15	Working adjacent to an operating railway system – damage to East Rail property / passengers	Erection of protective enclosure / Access procedure for plant and personnel / Provide special training / Real time settlement monitoring / Detailed risk studies with East Rail operations	Emergency Plan / Emergency Team
16	Removal of footbridge causes damage to railway infrastructure	Implementation of safe working procedures before operation	Emergency response plan
17	Damage to Drainages Services Department sewer pipes under San Wan Road due to temporary diverted tracks	Closed circuit television survey / Pre-construction condition survey / Monitor track levels / Check loading calculations and depth of sewer / Provide standby pumping / Liaise with Drainages Services Department	Emergency plan
18	Late diversion of 132 kV power line	Liaison with utilities / Early programming of activity	Revise construction programme
19	Mechanical breakdown e.g. ventilation system failure, breakdown in spoil disposal conveyor	Routine maintenance / Full-time maintenance team	Emergency evacuation procedure / Key spare parts on site / Key standby plant on site

## Annex A Risk Register (Sheet 4 of 4)

Risk ID	Description of Risk	Risk Mitigation	Fallback Plan
<b>(d) Environmental Issues</b>			
1	Environmental Impact Assessment Requirements not completely included in the design	Operational Phase procedure / Schedule of requirements / Traceability to design / Design Review Meeting	Assess with the designer and take remedial action
2	Unacceptable settlement in Long Valley	Experienced contractor / Use of Earth Pressure Balanced Machine / Selection of experienced and competent staff / Ground level monitoring	Consultation with farmers / Maintain existing channels and irrigation systems / Reinstatement channel bund heights to minimize impact on surface hydrology
3	Adverse effects on wells in Long Valley	Well location survey / Continuous monitoring	Review working pressure of tunnel drive and Implement the Action Plan for Long Valley
4	Flooding of the River Sutlej / nullah during the ground treatment and construction of the nullah crossing	Work in dry season / Standby pumps / Drainage layout management plan for Sutlej Channel	Emergency response plan as agreed with DSD
5	Disturbance of Long Valley at ground level as a result of loss of freeze for cross passages	Experienced contractor / Adequate design and monitoring of freeze / Monitoring of ground movement	Implement further ground freezing
6	Disturbance of groundwater/surface settlement monitoring devices in Long Valley by others	Adequate design and maintain sufficient number of replacement of the monitoring devices	Maintain sufficient neighbourhood relationship and liaison with the relevant parties including representatives from villages along the area of tunnel alignment