Conveying Dangerous Goods by Freight Train

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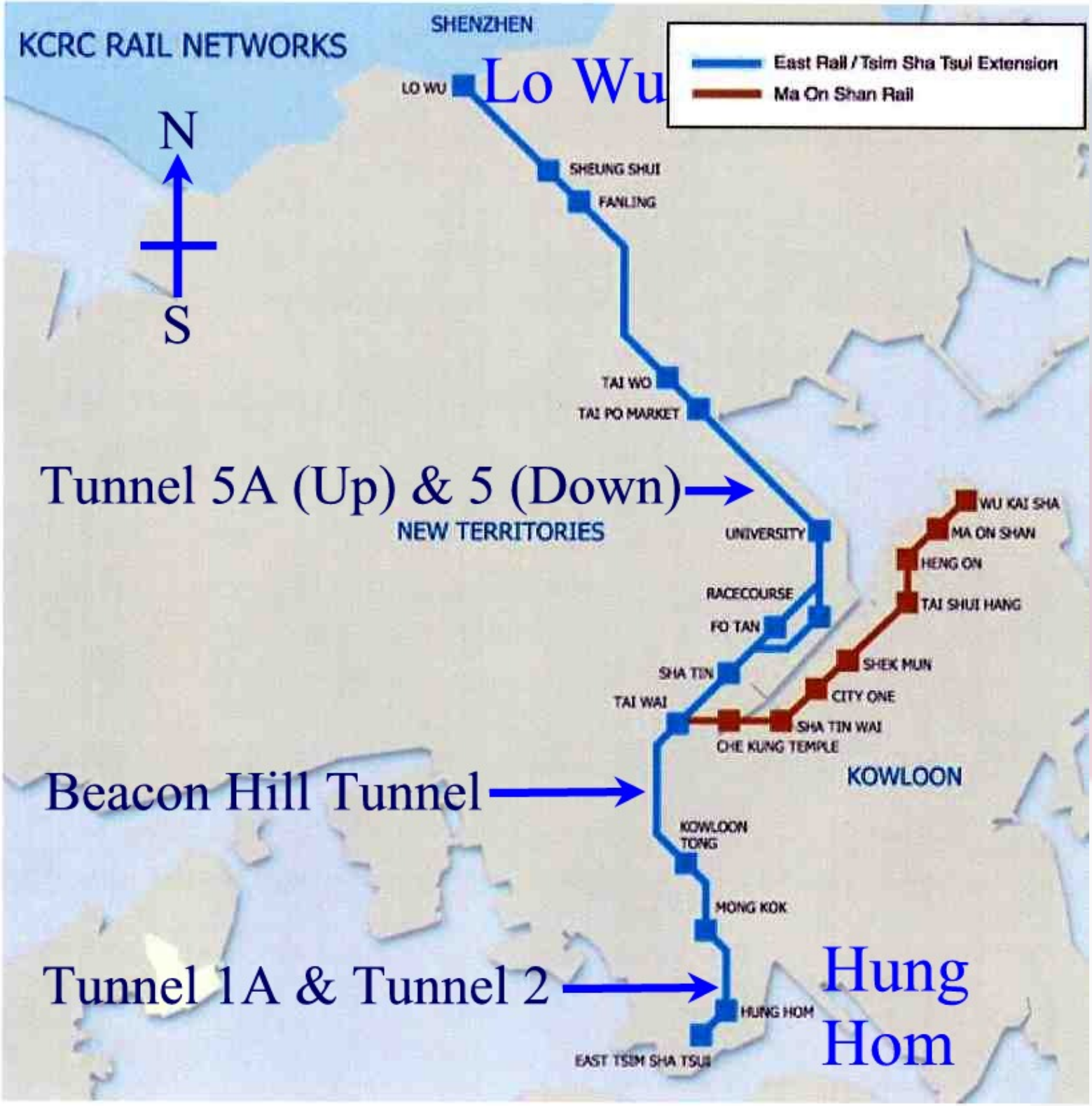
KCR 九廣鐵路

Background

- ER is a multimodal mass transit passenger and freight system and passes through densely populated areas.
- ER line covers a distance of 35.3 km with 14 stations.
- In year 2004, patronage of 207 million from ETS to SHS and 85 million use LOW cross boundary.


KCRC RAIL NETWORKS
SHENZHEN
East Rail / Tsim Sha Tsui Extension
Ma On Shan Rail
N
S
LO WU
Lo Wu
SHEUNG SHUI
FANLING
TAI WO
TAI PO MARKET
Tunnel 5A (Up) & 5 (Down)
NEW TERRITORIES
UNIVERSITY
RACECOURSE
FO TAN
SHA TIN
TAI WAI
CHE KUNG TEMPLE
SHA TIN WAI
CITY ONE
SHEK MUN
TAI SHUI HANG
HENG ON
MA ON SHAN
WU KAI SHA
KOWLOON
Beacon Hill Tunnel
KOWLOON TONG
MONG KOK
Tunnel 1A & Tunnel 2
HUNG HOM
Hung Hom
EAST TSIM SHA TSUI

Background

- KCRC conveys goods, including PVC (raw material), and Potable Spirits (alcoholic beverage 可飲用酒精) to and from Hong Kong and Mainland by Freight Trains.
- Two flight yards, Hung Hom & Fo Tan.
- Definition of DG is referred to Dangerous Goods Ordinance (DGO).
- In-house procedure to assess chemical cargoes and suspected items for safety and suitability to be conveyed by railway.

Scope of Risk Assessment

- Identify and review the hazards associated with the conveyance process of the Cat. 9A substances and Potable Spirits (Cat. 5) in ER.
- Cat. 9A substances are classified into:
  - Cotton
  - Petroleum by-products, e.g. PVC, Polystyrene
  - Rubber, e.g raw materials, rubber tyres

Methodology

1. Identify the risk associated with conveyance of DGs – train on fire
2. Evaluate the properties of DGs being conveying, especially under fire conditions
3. Assess the frequency and consequence of the different locations/ scenarios by using Event Tree Analysis
4. Determine the risk ranking in accordance with Risk Matrix

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Evaluation of DG

- Evaluation of properties of Chemicals based on the Material Safety Date Sheet (MSDS) collected.
- The following properties of Goods were studied:
  - Flash Point/ Ignition Temperature
  - Auto-flammability
  - Nature in case of fire, e.g. burning rate and smoke generation

Evaluation of DG

Type of Goods	Potable Spirit	Cotton	Petroleum by-products	Rubber
Ignition Temp(℃)	<100	250	360 - 488	300
Burning rate	High	Medium	Medium	High
Smoke produced	Dust	Irritating	Dust, Toxic & Irritating	Toxic & Flammable

Scenarios

- Generic hazards such as train collision, derailment are not included in the study as their frequency would not be affected except the consequence may become worse.
- Scenarios were developed in case of freight train on fire in 3 types of locations along ER:
  - At grade and station in open area;
  - Tunnel sections (1-tunnel-2-track system in Beacon Hill Tunnel (BHT) 1-tunnel-1-track tunnel system
  - Semi-enclosed Station underneath podium;

Risk Assessment – Scenario 1

Freight Train with Cat. 9A and Potable Spirit on fire in ***at grade section***

- 2 sequences of event were studies:
  - Presence of fire source but not ignite the goods;
  - Train movement is not affected and train could travel to safe place

Risk Assessment – Scenario 1

	Presence of fire source but not ignite the goods	Train movement is not affected and train could travel to safe place		
	9.99E-01		9.99E-01	No consequence
Yes	1.00E-03	9.90E-01	9.90E-04	No consequence
		1.00E-02	1.00E-05	Serious
No				

Risk Assessment – Scenario 2

Freight Train with Cat. 9A and Potable Spirit on fire in ***tunnel section***

- 3 sequences of event were studies:
  - Presence of fire source but not ignite the goods;
  - Train movement is not affected and train could travel to safe place
  - Other train movement stalled and not entering the affected tunnel section
- Scenario: 2a: BHT North & 2b:BHT South

Risk Assessment – Scenario 2a

Presence of fire source but not ignite the goods	Train movement is not affected and train could travel to safe place	Other train movement stalled and not entering the affected tunnel section		
9.99E-01			9.99E-01	No consequence
1.00E-03	9.00E-01		9.00E-04	No consequence
	1.00E-01	8.00E-01	8.00E-05	No consequence
		2.00E-01	2.00E-05	Serious
Yes				
No				

Risk Assessment – Scenario 2b

Presence of fire source but not ignite the goods	Train movement is not affected and train could travel to safe place	Other train movement stalled and not entering the affected tunnel section	
9.99E-01			9.99E-01 No consequence
1.00E-03	9.00E-01		9.00E-04 No consequence
	1.00E-01	6.00E-01	6.00E-05 No consequence
		4.00E-01	**4.00E-05 Disastrous**
Yes			
No			

Risk Assessment – Scenario 3

Freight Train with Cat. 9A and Potable Spirit on fire in ***enclosed station areas***

- 4 sequences of event were studies:
  - Presence of fire source but not ignite the goods;
  - Train movement is not affected and train could travel to safe place
  - Other train movement are stopped and trains did not enter the incident station
  - Passengers in the station evacuation on time

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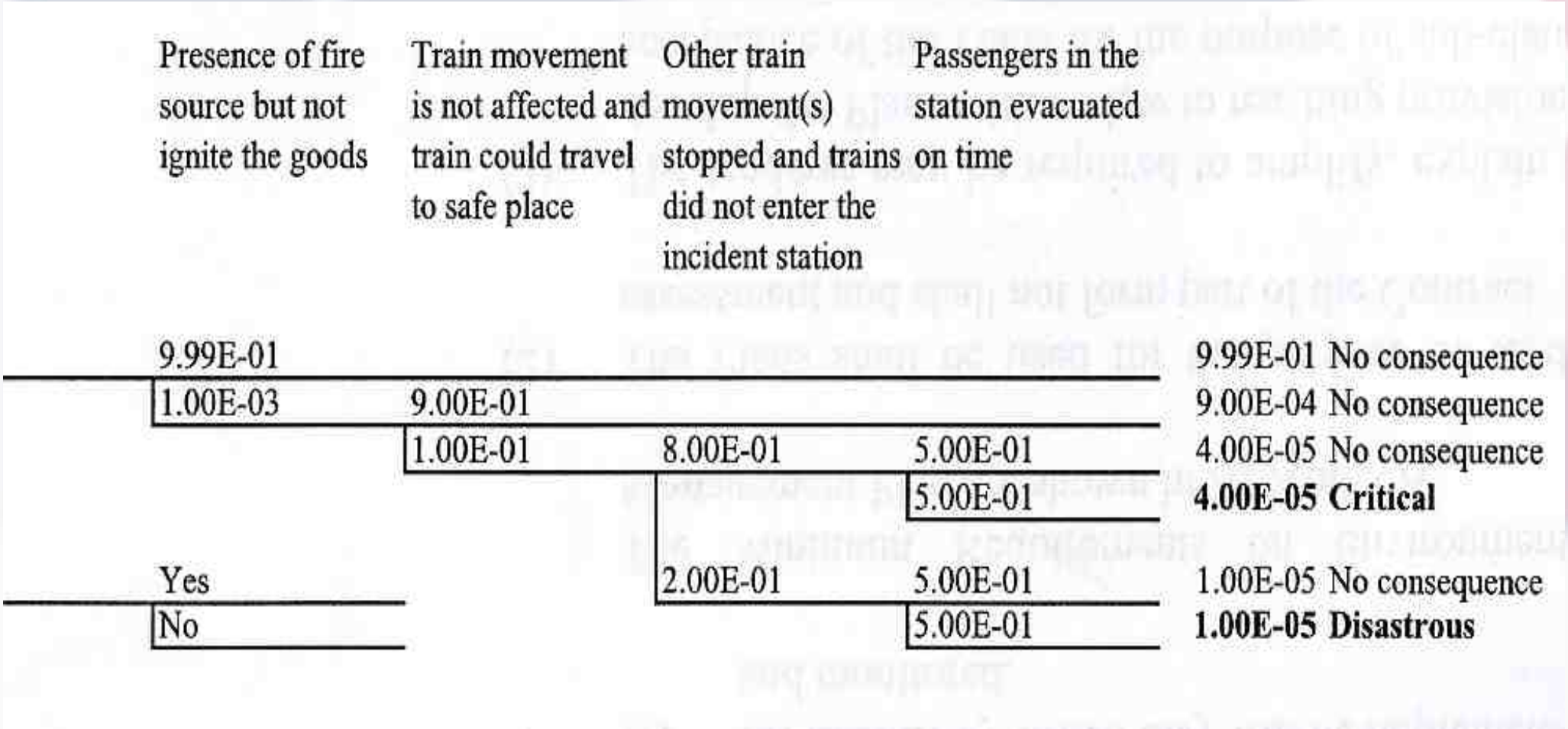
Risk Assessment – Scenario 3



Risk Ranking

Frequency Class	Consequence Class					
	R – Service-Related	C1 – Trivial	C2 – Minor	C3 – Serious	C4 – Critical	C5 – Disastrous
F1 – Frequent (>10/yr)	R	B	A	A	A	A
F2 – Common (1/yr to 10/yr)	R	B	B	A	A	A
F3 – Likely (0.1/yr to 1/yr)	R	C	B	A	A	A
F4 – Rare (0.01/yr to 0.1/yr)	R	C	C	B	A	A
F5 – Unlikely (10^{-3}/yr to 0.01/yr)	R	D	C	C	B	A
F6 – Improbable (10^{-4}/yr to 10^{-3}/yr)	R	D	D	C	C	B
F7 – Incredible (<10^{-4}/yr)	R	D	D	D	C	C

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Risk Ranking

Scenario	1: At-grade section	2: Tunnel section	3: Station in enclosed area
Frequency	1.00E-05, Incredible (F7)	2.00E-05/ 4.00E-05, Incredible (F7)	4.00E-05/ 1.00E-05, Incredible (F7)
Consequence	Serious (C3)	Serious (C3)/ Disastrous (C5)	Critical (C4)/ Disastrous (C5)
Risk Ranking	Negligible (D)	Negligible (D)/ Low (C)	Low (C)

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Conclusion

- The risk of conveyance of potable spirit and Cat. 9A substances, excluding matches, by freight train is Low, and fall into the As Low As Reasonably Practicable (ALARP) region.
- Cost effective control measures may be implemented to further mitigate the risk.

Thank You

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