MTR Corporation Ltd.

SCL – NEX/2206 EIA Study for Tai Wai to Hung Hom Section

SEL Source Term Verification

FINAL

Contents

1 Introduction

The Shatin to Central Link SCL (TAW-HUH) is one of the railway projects recommended for implementation in Railway Development Strategy 2000. It is an integral component of the expanded rail network, which will be required to support the economic, social and population growth of the HKSAR in the coming years. In particular, it will support the urban renewal of the existing Kowloon City District, planned Kai Tak Development (KTD) and further developments in North East New Territories (including Ma On Shan) by providing direct and efficient rail service between Shatin and the Central Business District of the Hong Kong Island via KTD.

In order to assess the potential noise impact with the operation of SCL, A train noise model has been developed. The modelling methodology for propagation is based on the prediction procedures in Calculation of Railway Noise 1995 (CRN)[1] and validated against the examples listed in CRN handbooks.

Whilst the propagation model would be based on CRN, the train noise source term would need to be evaluated. The source term for SP1900 trains had been evaluated and presented with the commissioning test in 2003[2]. This report presents the recent measurement and comparison of the source term evaluation.

2 Noise Measurement Methodology

2.1 Measurement Parameters

Trains currently operating within West Rail are mainly SP1900 trains. With the current train fleet, trains are formed from 7 train cars. Noise level measurements were taken in terms of A-weighted equivalent sound pressure level (L_{eq}) at 1 second intervals for a train pass-by event. Noise measurements were omitted in the presence of rain or wind with a steady speed exceeding 5m/s, or wind with gusts exceeding 10m/s. The wind speed was checked with a portable meter capable of measurement in m/s.

2.2 Measurement Locations and Schedule

Noise levels measurements were taken by MTRC at Pat Heung Depot of MTRC. **Figure 2-1** shows the measurement location. The sound level meter was set on tripod and the microphone was set at 1.2m above ground.

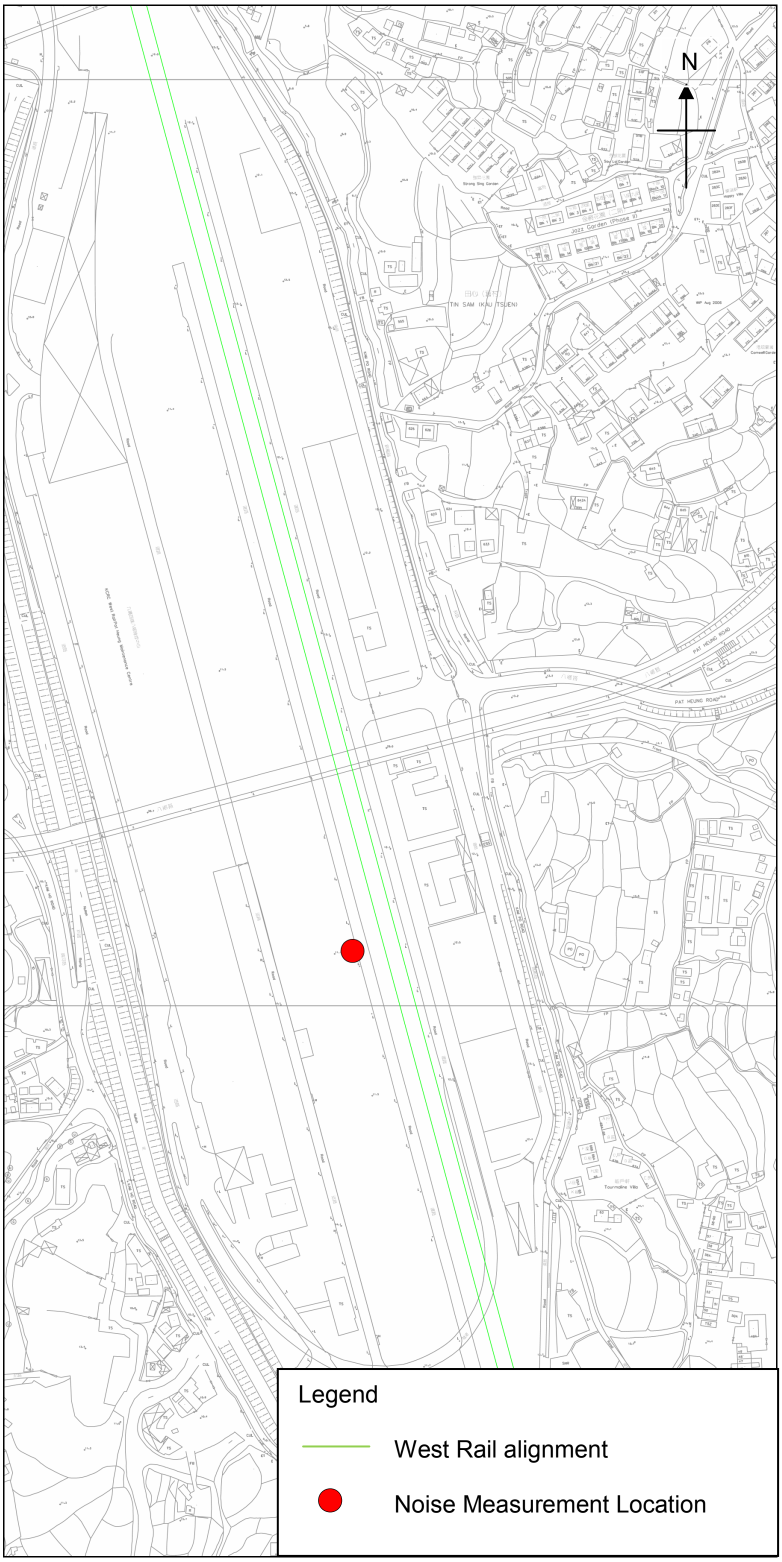
The noise measurement schedule is presented in **Table 2-2**.

Table 2-2: Noise Measurement schedule

Date	Noise Measurement Period	Measurements
31-July-2009 (Fri)	7:20am – 7:25am	Ambient
31-July-2009 (Fri)	7:25am – 9:55am	Train Pass-by Events

Reference ambient noise levels for the above corresponding periods were taken at the beginning of the measurement period when there were no train pass-by events.

Figure 2-1: Noise measurement location



2.3 Noise Monitoring Procedures

All field measurements have been conducted according to the following procedures:

- The sound level meters and batteries were checked to ensure that they were in proper condition.
- The sound level meter was set on tripod and the microphone was set at 1.2m above floor.
- Before conducting the measurement, the sound level meter was calibrated by an acoustical calibrator.
- The measurement parameter was set to A-weighted sound pressure level. The time weighting was set in fast response and measurements were logged automatically at 1 second intervals over each train pass-be event.
- The wind speed was checked during noise measurement to ensure the steady wind speed did not exceed 5m/s, or wind with gusts did not exceed 10m/s.
- With each train pass-by event together with train direction were logged manually. For each event, train speed was evaluated with a stop watch.
- Any abnormal conditions that may affect the measurement were recorded on the field record sheet.
- The averaged sound pressure levels (L_{Aeq}) for each train pass-by event were recorded on the field record sheet.
- The sound level meter was re-calibrated by the acoustical calibrator to confirm that there was no significant drift of reading.

3 Noise Measurement Results

Reference ambient noise levels were taken at the beginning of the measurement period when there were no train pass-by events. The averaged ambient noise level for a period of approximately 3 minutes was 46.7 dB(A).

Noise measurement results taken during train pass-by events are presented in **Tables 3-1** below. Double pass-by events, events with noticeable wheel-flat and trains other than SP1900 are excluded. The maximum noise level with an event (L_{max}) is identified from the 1 second time history of the event.

Table 3-1: Summary of noise level measurements taken during train pass-by events

Event	Direction[1]	Estimated Speed (kph)	Distance from Track (m)	L_{max}, dB(A)
1	S	110	28	67.3
2	N	110	25	71.0
3	S	110	28	68.2
4	S	110	28	68.4
5	S	110	28	66.7
6	S	110	28	67.9
7	N	100	25	71.3
8	S	110	28	69.4
9	S	110	28	66.8
10	N	100	25	68.9

Event	Direction[1]	Estimated Speed (kph)	Distance from Track (m)	L_{max}, dB(A)
11	S	110	28	66.9
12	S	110	28	68.4
13	S	110	28	66.9
14	N	100	25	70.8
15	S	100	28	67.1
16	N	100	25	68.9
17	S	100	28	66.5
18	S	100	28	67.1
19	N	100	25	71.0
20	S	100	28	66.4
21	N	100	25	70.0
22	N	100	25	71.8
23	S	100	28	68.3

Note: [1] S – Southbound train, N – Northbound train.

4 Results Analysis

Since the noise levels during a train pass-by event is significantly higher than the averaged ambient noise level of 46.7 dB(A), no correction to the measured noise level is applied. For each train pass-by event, measurements up to 15 seconds before and after the maximum noise level L_{max} identified are extracted from the recorded time history. These measurements are integrated for evaluation of Sound Exposure Level (SEL) for the train pass event.

For comparison purpose, the L_{max} and SEL measurements are adjusted to the reference condition using CRN methodology.

Reference conditions are:

Ballast track

Setback distance – 25m

Train speed – 130kph

Number of train cars - 8

Free field condition

Correction factors (C_S) for speed changes are:

For L_{max}: $$C_{SL} = 30\log\left(\frac{V_R}{V}\right)$$

where V_R is the reference speed.

V is the measured speed

For SEL: $$C_{SS} = 20\log\left(\frac{V_R}{V}\right)$$

Correction factor (C_D) for distance variation is:

$$C_D = 10\log\left(\frac{D_R}{D}\right)$$

where D_R is the reference distance (25m).

D is the distance with measurement.

Correction factor (C_N) for number of cars is:

$$C_N = 10\log\left(\frac{N_R}{N}\right)$$

where N_R is the number of train cars with reference condition.

N is the number of cars during measurement.

A comparison of measurement results are presented in **Table 4.1** below:

Table 4-1: Comparison of measurement results

Event	Dir'n	Estimated Speed (kph)	Dist. fm Track (m)	L_{max}	SEL	Correction (dB(A)) Speed			Corrected Values (dB(A))		SEL (8-Cars) (dB(A))
						L_{max}	SEL	Dist	L_{max}	SEL (7-Cars)	
1	S	110	28	67.3	73.9	2.2	1.5	0.5	70.0	75.9	76.5
2	N	110	25	71.0	77.3	2.2	1.5	0.0	73.2	78.7	79.3
3	S	110	28	68.2	75.0	2.2	1.5	0.5	70.9	76.9	77.5
4	S	110	28	68.4	74.9	2.2	1.5	0.5	71.1	76.9	77.5
5	S	110	28	66.7	73.4	2.2	1.5	0.5	69.4	75.4	76.0
6	S	110	28	67.9	75.2	2.2	1.5	0.5	70.6	77.2	77.8
7	N	100	25	71.3	77.8	3.4	2.3	0.0	74.7	80.1	80.6
8	S	110	28	69.4	75.9	2.2	1.5	0.5	72.1	77.8	78.4
9	S	110	28	66.8	74.0	2.2	1.5	0.5	69.5	76.0	76.5
10	N	100	25	68.9	75.9	3.4	2.3	0.0	72.3	78.2	78.8
11	S	110	28	66.9	74.1	2.2	1.5	0.5	69.6	76.0	76.6
12	S	110	28	68.4	75.1	2.2	1.5	0.5	71.1	77.0	77.6
13	S	110	28	66.9	74.3	2.2	1.5	0.5	69.6	76.2	76.8
14	N	100	25	70.8	78.2	3.4	2.3	0.0	74.2	80.5	81.0
15	S	100	28	67.1	74.9	3.4	2.3	0.5	71.0	77.6	78.2
16	N	100	25	68.9	76.0	3.4	2.3	0.0	72.3	78.2	78.8
17	S	100	28	66.5	74.3	3.4	2.3	0.5	70.4	77.1	77.7
18	S	100	28	67.1	75.2	3.4	2.3	0.5	71.0	78.0	78.6
19	N	100	25	71.0	78.0	3.4	2.3	0.0	74.4	80.3	80.8
20	S	100	28	66.4	74.4	3.4	2.3	0.5	70.3	77.2	77.8
21	N	100	25	70.0	76.4	3.4	2.3	0.0	73.4	78.7	79.2
22	N	100	25	71.8	78.3	3.4	2.3	0.0	75.2	80.6	81.2
23	S	100	28	68.3	75.8	3.4	2.3	0.5	72.2	78.5	79.1
								Averaged :	**72.0**	**78.0**	**78.6**

5 Conclusions

When corrected to the same reference condition, averaged L_{max} (72.0dB(A)) and SEL values (78.6dB(A)) with the present measurement are approximately 3 ~ 4 dB(A) lower than that with commissioning tests of SP1900. To compare the results of the present measurement to the reference source terms, it indicates using the source terms in the commissioning test would be more conservative than the present measurement

The source term (L_{max} of 75.3 dB(A)) at reference condition of 130kph and 25m setback,for the Electric Multiple Unit (model SP1900) in the commissioning test is considered successfully validated by the in-situ measurements, and appropriate to be used for noise modeling for operational airborne railway noise assessment.

6 References

[1] Calculation of Railway Noise 1995, the Department of Transport, UK

[2] Wayside Noise Levels For The SP1900 EMU Operating on West Rail Ballast and Sleeper Track (2003), KCR, Document Reference SGS-8120017