NMAR

Ocean Park Corporation, Hong Kong

Repositioning and Long Term Operation Plan of Ocean Park: *Noise Mitigation and Audit Report for Phase 2*

September 2014

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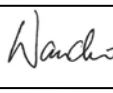
Ocean Park Corporation, Hong Kong

Repositioning and Long Term Operation Plan of Ocean Park: *Noise Mitigation and Audit Report for Phase 2*

September 2014

Reference 0238176

For and on behalf of ERM-Hong Kong, Limited	
Approved by:	Frank Wan
Signed:	
Position:	Partner
Date:	4 September 2014

Ocean Park Master Redevelopment Project

Environmental Permit No. EP-249/2006/D - Condition 2.26

Noise Mitigation and Audit Report for the Operation of the Project outside 0900 to 2300 hours

Submitted by ERM-Hong Kong, Limited dated 04-09-2014

This is to verify that

Noise Mitigation and Audit Report for the Operation of the Project outside 0900 to 2300 hours

Submitted by ERM-Hong Kong, Limited

dated 04-09-2014

Has been verified by the undersigned.

Signed _____

Ir Eric Ching
Independent Environmental Checker (IEC)
Retained by Ocean Park Corporation
pursuant to Environmental Permit No. EP-249/2006/D

Date 5 September 2014

Ocean Park Master Redevelopment Project

EP-249/2006/D – Condition 2.26

Noise Mitigation and Audit Report for the Operation of the Project outside 0900 to 2300 hours

September 2014

Certified by _____ on 5-September-2014
Winnie Ko (ETL)

Verified by Independent Environmental Checker on 5 September 2014
IEC Certificate attached in the submission? Yes

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LIST OF ANNEXES

1 INTRODUCTION

1.1 BACKGROUND

Following the approval of the Repositioning and Long Term Operation Plan of Ocean Park (the Project) Environmental Impact Assessment (EIA) report (Register No.: AEIAR-101/2006) (hereafter referred to as the approved EIA Report), an Environmental Permit (EP) (EP-249/2006) was granted for the Project in July 2006 and amendments to the EP were approved in October 2006, November 2010 and December 2013. To update the opening hours of the Ocean Park (the Park) and the layout plans for the Waterfront and Summit, an application for Variation of EP (VEP) was submitted to the EPD and new EP (EP-249/2006/D) was issued on 02 July 2014.

In accordance with Condition 2.26 of the EP-249/2006/D, the Permit Holder shall deposit with the Director four hard copies and one electric copy of Noise Mitigation and Audit Report (NMAR), no later than two weeks after the completion of noise measurement and audit works are carried out. The Permit Holder shall carry out noise measurement and audit works according to the Noise Mitigation and Audit Plan(s) (NMAP) and submit a *Report on Commissioning Test Results* to the Director for approval, prior to the implementation of the specified periods of the proposed extension of opening hours.

1.2 PURPOSES OF THIS REPORT

If the results of the commissioning test demonstrate that the mitigation measures have achieved the required Sound Power Levels (SWLs), the extension of the opening hours will be implemented in three phases, as follows:

- Phase 1 – extension of the opening hours of the Park from 10:00 to 09:00 hours and from 22:00 to 23:00 hours (excluding the Sky Fair Plaza Performance Venue and attractions for special events);

- Phase 2 - extension of the opening hours of the Park during Special Events to 01:00 hours and extension of opening hours of Restaurants and Retail Shops from 09:00 to 08:00 hours and from 23:00 to 02:00 hours of the next day (excluding the Sky Fair Plaza Performance Venue); and

- Phase 3 – operation of the Sky Fair Plaza Performance Venue.

This *NMAR* presents the noise measurement results for the commissioning test for Phase 2 in accordance with Condition 2.28, 2.29 and 2.30 of the EP-249/2006/D.

2 MEASUREMENT METHODOLOGY

2.1 FIXED PLANT AND PA SYSTEM

A-weighted equivalent continuous noise level (L_{Aeq}) was measured at specified distances from the plant items and compared with the commissioning requirements given in *Table 2.1* of the approved NMAP for Phase 2. For fixed plant items that generate relatively continuous and steady noise, such as the split-type AC unit, AC plant, chiller, fan room, and ventilation fan, the noise measurement was over a 1-minute period. For the PA system at Aqua City and Entry Plaza, the measurement was over a 5-minute period. For each items, three sets of measurement data was taken.

The background (B/G) noise was measured in terms of $L_{Aeq,\ (1\ min)}$ at the same measurement point when the concerned plant item is switched off. At each location, one set of background noise data was taken. If any abnormal intrusive noise exists during background noise measurement, further measurement should be made until having a measurement with no abnormal intrusive noise. The measured noise levels are subject to background noise correction in accordance with standard acoustical principles.

The measurement locations are presented in *Annex A*.

The commissioning requirements, mitigation measures, details of measurement parameters and measurement distances for each of the fixed plant items and PA system for Phase 2 are summarised in *Table 2.1* of the approved NMAP.

If no further noise mitigation measure is provided for the fixed plant items or the PA systems after the commissioning test for Phase 1, sound power levels obtained from Phase 1 have been adopted for Phase 2 and re-measurement for the same item is considered not necessary. *Table 2.1* summarized the commissioning requirements for the fixed plant items and PA system in Phases 1 and 2. The locations of the fixed plant items are shown in *Annex A1*.

Table 2.1 Commissioning Requirements for Fixed Plant Items and PA System in Phases 1 and 2

Fixed Plant Item	Phase 1 (max. allowable SWL)	Phase 2 (max. allowable SWL)	Mitigation measures for Phase 2	Commissioning test for Phase 2 required? (Yes/No)
Sea Life Carousel (LNR7)	-	85dB(A)	Turn off	No
PA system at Entry Plaza (WF04)	-	85dB(A)	Volume control	Yes (*Section 4.1*).

Fixed Plant Item	Phase 1 (max. allowable SWL)	Phase 2 (max. allowable SWL)	Mitigation measures for Phase 2	Commissioning test for Phase 2 required? (Yes/No)
PA system at Aqua City (WF05)	90dB(A)	90dB(A)	Further reduce the number of operation PA cluster from 53 to 40	No.
Split-type A/C unit at Coral Building (WF06)	84dB(A)	81dB(A)	10 out of the 20 split type AC units measured in Phase 1 will be operated in Phase 2.	Adopt measurement result from Phase 1 (*Section 4.2*)
Split-type A/C unit at West Retail (WF08)	-	84dB(A)	-	Yes (*Section 4.3*)
Split-type A/C unit at Administration Building (WF17)	Under Renovation. NMAR will be submitted to EPD for approval upon the completion of the renovation and will be operated during Phase 2.			
A/C plant at West Retail (WF19)	-	82dB(A)	Turn off	No
A/C Plant at East Retail (WF20)	82dB(A)	82dB(A)	Turn off	No
Cooling Towers at Old Hong Kong (WF23)	84dB(A)	84dB(A)	-	No (Adopt measurement result from Phase 1)
A/C plant at Panda Café (WF24)	90dB(A)	80dB(A)	Turn off during Phase 2	No
Cooling Tower at The Grand Aquarium (WF26)	87dB(A)	87dB(A)	Turn off in Phase 2	No.
Compressors Cluster at West Retail (WF27)	85dB(A)	85dB(A)	Compressors cluster has been relocated, same as Phase 1	No
Fan Room at West Retail (WF30)	86dB(A)	86dB(A)	-	No (Adopt measurement result from Phase 1)

Fixed Plant Item	Phase 1 (max. allowable SWL)	Phase 2 (max. allowable SWL)	Mitigation measures for Phase 2	Commissioning test for Phase 2 required? (Yes/No)
Ventilation Fan at West Retail (WF32)	-	82dB(A)	Turn off	No
Ventilation Fan at Panda Café (WF35)	90dB(A)	80dB(A)	Turn off	No
Chiller at Giant Panda Adventure (WF29)	90dB(A)	86dB(A)	Reduce the operation quantity from 2 to 1	Adopt measurement result from Phase 1 (*Section 4.4*)

All noise measurement was supervised and endorsed by a qualified person possessing at least seven years of noise control experience and a corporate membership of Hong Kong Institute of Acoustics or equivalent.

2.2 TEMPORARY INDOOR ATTRACTIONS AND OPEN AIR SHOW

As per the design information provided by Ocean Park Corporation (OPC), there is a total of 7 temporary indoor attractions and 1 open air show at the Park for the coming special event, as summarized in *Table 2.2* of the approved NMAP for Phase 2.

Simulated sound track (including background music and noise from visitors, eg chatting, screaming, etc) was played during noise measurements for temporary indoor attractions and open air show. For the five temporary indoor attractions at the Summit, simulated sound track was being played with all A/C operating during the noise measurement.

2.2.1 Movie Studio

Simulated sound track (including background music and noise from visitors, eg chatting, screaming, etc) was played during the commissioning test. Three sets of 5 minutes A-weighted equivalent continuous noise level ($L_{Aeq, 5min}$) was measured at the potential leakage locations of the temporary indoor attraction (ie entrance and exit). Sound Power Level (SWL) of the AC plant was determined individually. Three sets of 1 minute A-weighted equivalent continuous noise level ($L_{Aeq, 1min}$) was measured at 16m from the AC plant area.

2.2.2 Doraemon Attraction

During the commissioning test measurement, simulated sound track (including background music and noise from visitors, eg chatting, screaming, etc) was being played and all air conditioners and outdoor units were turned on. The measurement method is in accordance with the latest edition of ISO

3746. $L_{eq\ (1min)}$ was measured at all of the measurement points and the measurement distance is 2m from the reference box.

2.2.3 Temporary Indoor Attractions at the Summit

There are 5 temporary indoor attractions at the Summit. Three sets of 5 minutes A-weighted equivalent continuous noise level (L_{Aeq}) was measured at twice of the largest dimension of each of the attraction. During the noise measurement, simulated sound track (including background music and noise from visitors, eg chatting, screaming, etc) was being played and all A/C were operating.

The direct lines of sight between the all temporary indoor attractions at the Summit and the nearest NSR Broadview Court are screened by the terrain of Nam Long Shan (See *Annexes B2* and *B2a* of the approved NMAP). A barrier effect of 10dB(A) has been included, such that the maximum allowable SWL is increased by 10 dB(A).

2.2.4 Open Air Show at the Summit

For the open air show, there are four sets of loudspeakers provided for the show, three sets of 5 minutes A-weighted equivalent continuous noise level (L_{Aeq}) was measured at 3m from each set of the loudspeaker. During the noise measurement, simulated sound track (including background music and noise from visitors, eg chatting, screaming, etc) was played. The SWL of each set of loudspeaker was determined individually.

2.2.5 Background Noise Measurement

The background noise was measured in terms of $L_{Aeq,\ (1\ min)}$ at the same measurement point when all noise sources from the temporary indoor attraction and A/C units were switched off. At each location, one set of background noise data was taken. If any abnormal intrusive noise exists during background noise measurement, further measurement should be made until having a measurement with no abnormal intrusive noise. The measured noise levels are subject to background noise correction in accordance with standard acoustical principles.

The instruments that were used for the noise measurements shall comply with International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1).

Before and after each series of measurements, a sound calibrator was applied to each microphone to verify the calibration of the measuring system. The difference between the readings made before and after each series of measurements shall be less than or equal to 0.5 dB. If this value is exceeded, the results of this series of measurements shall be discarded.

Sound level meters and calibrator used are listed in the *Table 3.1*. The equipment calibration certificates are shown in *Annex B*.

Table 3.1 Noise Measurement Equipment

Equipment	Model	Serial Number
Sound Level Meter	01dB – Solo	65225
	01dB – Solo	65226
Calibrator	Svantek SV30A	No.7971
	01dB – CAL 21	No.34113609(2011)

The measurement parameter was set to A-weighted sound pressure level and the time weighting was set in fast response.

4 MEASUREMENT RESULTS

Noise measurement was carried out by Isaac Chu, Chris Hoi, Alvina Chau, Samuel Lee, Ian Yuen and supervised by Mandy To from ERM-Hong Kong Limited from 11 to 17, 25 and 26 August 2014. Noise measurement results for the fixed plant items and temporary indoor attractions are summarized in the below sections. Measurement parameter and measurement distance for each fixed plant item follows the approved NMAP for Phase 2.

4.1 PA SYSTEM AT ENTRY PLAZA (WF04)

Before the commissioning measurement carried out, a screening noise measurement was conducted for two different sound tracks (ie announcement and background music) to determine the worst case scenario (ie to find out which sound track generates higher noise level). Under same volume setting (output as "-18dB"), the background music sound track was found to be generated a higher sound level. Sound track of background music was then used for the commissioning test. The microphone was pointed toward the principle axis of the loudspeaker. The test was conducted under the output setting of "-18dB". The location of the PA cluster is shown in *Annex A2*.

Table 4.1a Noise Measurement Detail for PA system at Entry Plaza (WF04)

Fixed Plant Item	Dimension (L x W x H),m	Measurement distance	Before Calibration, dB(A)	After Calibration, dB(A)
PA system at Entry Plaza (WF05)	0.65 x 0.3 x 0.4	3m from a PA cluster	93.9	93.9

Table 4.1b Screening Noise Measurement Result for PA system at Entry Plaza (WF04)

Scenario	Measured Noise Levels, $L_{eq, 1 min}$, dB(A)			Highest Level, dB(A)	B/G noise level, dB(A)	B/G corrected noise level, dB(A)
	1	2	3			
Leq (1 min) for loudspeaker playing announcement sound track	52.7	52.1	53.0	53.0	49.9	50.1
Leq (1 min) for loudspeaker playing background music sound track	55.3	53.2	53.4	55.3	49.9	53.8

Table 4.1c Noise measurement result for PA system at Entry Plaza (WF04)

Scenario	Measured Noise Levels, $L_{eq, 5\ min}$, dB(A)			Highest Level, dB(A)	B/G noise level, dB(A)	B/G corrected noise level, dB(A)
	1	2	3			
Leq (5 min) for Background music sound track	55.4	54.8	54.7	55.4	49.9	54.0

Table 4.1d Sound Power Level of PA system at Entry Plaza (WF04)

Fixed Plant Item	B/G corrected noise level, dB(A)	Measurement distance to the center of the fixed plant, m	SWL per PA cluster, dB(A)	No of PA cluster to be used during Phase 2	Total SWL , dB(A)	Maximum allowable SWL
PA system at Entry Plaza (WF05)	54.0	3	71.5	15	83	85

OPC confirmed that a computerized volume control system will be used to adjust the volume of loudspeaker to the output of "-18dB" during Phase 2 which same as the setting in the commissioning test. The SWL of PA system at Entry Plaza of volume setting of "-18dB" complies with its maximum allowable SWL for Phase 2.

4.2 SPLIT-TYPE A/C UNIT AT CORAL BUILDING (WF06)

Total of 20 split-type A/C units at Coral Building were measured for commissioning test for Phase 1. 10 out of the 20 will be operated during Phase 2 which are shown in *Table 4.2a*. The locations of the 10 split –type AC units are shown in *Annex A3*. The identification numbers and the sound power levels of the 10 split type A/C units measured in Phase 1 are extracted from NMAR of Phase 1 and presented in *Table 4.2a*.

Table 4.2a Sound Power Levels of split-type A/C units at Coral Building (WF06)

Identification number of split type A/C unit	B/G corrected noise level, dB(A)	Measurement distance to the center of the fixed plant, m	SWL, dB(A)
Ground level split type A/C unit			
AC10	50.8	2.5	66.8
AC11	49.7	2.5	65.7
Rooftop level split type A/C unit			
RAC1	53.0	2.5	69.0
RAC2	53.8	2.5	69.8
RAC3	55.1	2.5	71.1
RAC4	52.2	2.5	68.2
RAC5	56.5	2.5	72.5
RAC6	54.4	2.5	70.4

Identification number of split type A/C unit	B/G corrected noise level, dB(A)	Measurement distance to the center of the fixed plant, m	SWL, dB(A)
RAC7	54.4	2.5	70.4
RAC8	55.6	2.5	71.6
		Total SWL	**80**
		Maximum allowable SWL	**81**
		Compliance	**Yes**

OPC confirmed that only the above-mentioned 10 split-type A/C units will be operated during Phase 2, other split-type A/C units at Coral Building will be turn off by a timer system during Phase 2.

4.3 SPLIT-TYPE A/C UNIT AT WEST RETAIL (WF08)

A total of 5 split-type A/C units at roof level of the West Retail that will be operated during Phase 2 were identified for the commissioning test. The locations of the 5 split –type AC units are shown in *Annex A4*. The split–type A/C units were measured individually during the commissioning test. The identification numbers of each split-type A/C unit and the measurement result are presented in *Tables 4.3a* to *4.3c*.

Table 4.3a Noise Measurement Details for the 5 split-type A/C units at West Retail (WF08)

Fixed Plant Item	Dimension	Measurement distance	Before Calibration, dB(A)	After Calibration, dB(A)
Split-type A/C units at West Retail (WF08)	1.2m x 0.8m x 1.5m	3m from the split type AC unit	93.9	93.9

Table 4.3b Noise Measurement Results for the 5 split-type A/C units at West Retail (WF08)

Identification number of split type AC unit	Measured Noise Levels, $L_{eq,\,1\,min}$, dB(A)			Highest level, dB(A)	B/G noise level, dB(A)	B/G corrected noise level, dB(A)
	1	2	3			
VOU-AC-RF-06-02	56.9	55.8	56.2	56.9	48.2	56.3
VOU-AC-RF-07-01	56.5	55.3	54.6	56.5	46.8	56.0
VOU-AC-RF-06-01	55.9	55.2	56.0	56.0	47.5	55.3
VOU-AC-RF-13-02	55.8	54.8	53.5	55.8	45.6	55.4
VOU-AC-RF-13-01	54.9	54.7	55.8	55.8	46.8	55.2

Table 4.3c Sound Power Levels of the 5 split-type A/C units at West Retail (WF08)

Identification number of split type AC unit	B/G corrected noise level, dB(A)	Measurement distance to the center of the fixed plant, m	SWL, dB(A)
VOU-AC-RF-06-02	56.3	3	73.8
VOU-AC-RF-07-01	56.0	3	73.6
VOU-AC-RF-06-01	55.3	3	72.8

Identification number of split type AC unit	B/G corrected noise level, dB(A)	Measurement distance to the center of the fixed plant, m	SWL, dB(A)
VOU-AC-RF-13-02	55.4	3	72.9
VOU-AC-RF-13-02	55.2	3	72.7
		Total SWL	**80**
		Maximum allowable SWL	**84**
		Compliance	**Yes**

OPC confirmed that only the measured 5 split-type A/C units will be operated during Phase 2, other split-type A/C units at West Retail will be turned off by a timer system during Phase 2.

4.4 CHILLER AT GIANT PANDA ADVENTURE (WF29)

The SWL of the chillers were measured during the commissioning test for Phase 1 and the results are presented in *Table 4.4a*. Only 1 chiller will be operated during Phase 2. The locations of the chillers are shown in *Annex A5*.

Table 4.4a Sound Power Level of Chillers at Giant Panda Adventure (WF29)

Fixed Plant Item	B/G corrected noise level, dB(A)	Measurement distance to the center of the fixed plant item, m	SWL, dB(A)
Chiller 1	55.6	11	84.4
Chiller 2	55.7	11	84.5
Chiller 3	55.6	11	84.4
Chiller 4	55.7	11	84.5
		Worst case SWL of only one chiller will be operated during Phase 2	**85**
		Maximum allowable SWL	**86**
		Compliance	**Yes**

4.5 TEMPORARY INDOOR ATTRACTION AT WATERFRONT (MOVIE STUDIO)

The locations of the measurement point are shown in *Annex A6*. The simulated sound tracks (including background music and noise from visitors) and A/C plants were measured individually during the commissioning test. The measurement results are presented in *Tables 4.5a* to *4.5c*.

Table 4.5a Noise Measurement Details for Movie Studio

Noise leakage area/ Fixed plant item	Dimension (L x W x H),m	Measurement distance	Before Calibration, dB(A)	After Calibration, dB(A)
Entrance	1.2 x 2 (H)	4	93.9	93.9
Exit	1.2 x 2 (H)	4		
AC plants	8 x 5 x 2.5(H)	16		

Table 4.5b Noise Measurement Results for the Movie Studio

Noise Leakage Area	Measured Noise Levels, $L_{eq, 5\ min}$, dB(A)			Highest Level, dB(A)	B/G noise level, dB(A)	B/G corrected noise level, dB(A)
	1	2	3			
Entrance	53.0	53.0	52.8	53.0	49.7	50.3
Exit	54.8	54.9	55.3	55.3	51.2	53.2
AC plants	55.6	55.8	55.7	55.8	52.4	53.1

Table 4.5c Sound Power Level of the Movie Studio

Noise Leakage Area/ Fixed plant item	B/G corrected noise level, dB(A)	Measurement distance to the center of the noise leakage area/ fixed plant, m	Barrier Effect, dB(A)	SWL, dB(A)
Entrance	50.3	4	0	70.3
Exit	53.2	4	0	73.2
AC plants	53.1	20	-10(a)	77.1
			Total:	**79**
			Maximum allowable SWL, dB(A):	**80**
			Compliance:	**Yes**

Note:

(a) The direct lines of sight between the AC plant area and NSRs in the north-east are screened by the temporary indoor attraction itself, the cable car station, the Sky Fair Plaza Performance Venue and the Giant Panda Adventure (See *Annex B1* of the approved NMAP). The direct line of sight between the AC plant area and the nearest NSR Manly Villa is totally screened by the Ocean Express Station (See Annex B1a of the approved NMAP).

OPC confirm that the computerised volume control will be capped at show level which is the same as that adopted in the noise commissioning test.

4.6 *TEMPORARY INDOOR ATTRACTION AT WATERFRONT (DORAEMON ATTRACTION)*

During the commissioning test measurement, simulated sound track including background music and noise from visitors was being played and all air conditioners and outdoor units were turned on.

The measurement method is in accordance with the latest edition of ISO 3746. $L_{eq\ (1min)}$ was measured at all measurement points and the measurement distance was 2m from the reference box.

The SWL measurement was conducted in open area (ie. Environmental correction K_{2A} =0). The dimension of the attraction is 21m x 18m x 4m (H) and noise levels were measured at 32 points over a parallelepiped measurement surface 25m (L) x 22m (W) x 6m (H) of the attraction. The locations of the measurement point are shown in *Annex A7*. The measurement results are presented in *Tables 4.6a* to *4.6c*.

Table 4.6a Noise measurement detail for the Doraemon Attraction

TIA	Dimension (L x W x H),m	Measurement distance	Before Calibration, dB(A)	After Calibration, dB(A)
Doraemon Attraction	21x 18x 4 (H)	2	93.9	93.9

Table 4.6b Measured Sound Pressure Levels

Measurement Point	Measured SPL, $L_{eq,1min}$,dB(A)	Background noise level, $L_{eq,1min}$,dB(A)
1	45.6	40.1
2	46.8	39.4
3	49.4	40.7
4	47.3	40.8
5	46.9	39.8
6	46.1	39.9
7	52.7	40.6
8	45.8	43.1
9	44.7	42.9
10	45.7	42.2
11	45.8	42.7
12	45.4	39.6
13	45.6	39.9
14	45.8	39.9
15	44.7	41.1
16	44.3	42.4
17	45.2	42.4
18	48.5	42.5
19	46.9	42.3
20	46.5	42.3
21	47.8	42.4
22	48.2	43.7
23	48.7	45.3
24	48.3	39.7
25	48.2	41.1
26	49.7	43.3
27	48.6	43.8
28	46.6	42.9
29	47.3	40.4
30	46.8	40.4
31	44.9	40.4
32	46.5	43.1
Mean A-weighted time-averaged SPL	47.3	41.9

Table 4.6c ***Calculation of K_{1A} (Background noise corrections)***

Quantity	SPL, dB(A)
$\overline{L'pA(ST)}$ =	47.3
$\overline{LpA(B)}$ =	41.9
$\triangle L_{pA} = \overline{L'pA(ST)} - \overline{LpA(B)}$ =	5.4
$K_{1A} = -10\ log\ (1 - 10^{-0.1\Delta LpA})$	1.45

In accordance with the ISO 3746: 2010, the A-weighted SWL of the TIA was calculated based on the following *Equation 1*:

SWL = Mean A-weighted SPL – K_{1A} – K_{2A} + 10 log (S/S_0)dB ---------Equation 1

where

S is the area of the measurement surface, ie (21+4) m (L) x (18+4) m (W) x (4+2) m (H) = 1,114m², with measurement box at 2m from the reference box

S_0 = 1 m²

The SWL of the Doraemon Attraction = 47.3 – 1.45 - 0 + 30.5

= 76dB(A)

The commissioning requirement = the maximum allowable SWL should not exceed 80dB(A)

The SWL of the Doraemon Attraction is found to be 76dB(A), which complies with the commissioning requirement of 80dB(A). OPC confirm that the computerised volume control will be capped at this level which is the same as that adopted in the noise commissioning test.

4.7 TEMPORARY INDOOR ATTRACTIONS AT THE SUMMIT

The locations of measurement are shown in *Annexes A8 and A9*. The measurement results are presented in *Tables 4.7a* to *4.7c*.

Table 4.7a ***Noise Measurement Details for TIAs at the Summit***

TIA	Dimension (L x W x H),m	Measurement distance from the edge of the TIA	Before Calibration, dB(A)	After Calibration, dB(A)
Chinese Forest	21x 18 x 4	42		
Ultimate	23 x 17 x 4	46		
Rigor Mortis	26 x 18 x 4	52	93.9	93.9
Japanese Evil	20 x 18 x 4	40		
Chinese Medical	18 x 16 x 4	36		

Table 4.7b Noise Measurement Results for TIAs at the Summit

TIA	Measured Noise Levels, $L_{eq, 5\ min}$, dB(A)			Highest Level, dB(A)	B/G noise level, dB(A)	B/G corrected noise level, dB(A)
	1	2	3			
Chinese Forest	54.0	54.0	53.8	54.0	48.3	52.6
Ultimate	53.3	53.3	53.2	53.3	47.6	51.9
Rigor Mortis	48.9	49.2	48.2	49.2	43.0	48.0
Japanese Evil	53.9	54.9	53.9	54.9	49.5	53.4
Chinese Medical	55.2	55.5	55.5	55.5	47.2	54.8

Table 4.7c Sound Power Level of TIAs at the Summit

TIA	B/G corrected noise level, dB(A)	Measurement distance to the center of the TIA	Barrier Effect, dB(A)	SWL, dB(A)
Chinese Forest	52.6	55	-10[(a)]	85.4
Ultimate	51.9	59	-10[(a)]	85.3
Rigor Mortis	48.0	65	-10[(a)]	82.3
Japanese Evil	53.4	54	-10[(a)]	86.0
Chinese Medical	54.8	49	-10[(a)]	86.6
			Maximum allowable SWL, dB(A):	**88 for each TIA**
			Compliance:	**Yes**

Note:

(a) The direct line of sight between the temporary indoor attraction and the nearest NSR Broadview Court is screened by the terrain of Nam Long Shan (See *Annex B2a* of the approved NMAP for Phase 2).

OPC confirm that the computerised volume control will be capped at this level which is the same as that adopted in the noise commissioning test.

4.8 OPEN AIR SHOW AT SUMMIT

During the commissioning test, sound track including show music and noise from visitors was being played and the volume output of each loudspeaker was set to the show level equivalent to future operation. The SWL of each set of loudspeaker was determined individually. The location of the open air show is shown in *Annex A10*. The measurement results are presented in *Tables 4.8a* to *4.8c.*

Table 4.8a Noise Measurement Details for the Open Air Show

Noise Source	Dimension (L x W x H),m	Measurement distance from the loudspeaker	Before Calibration, dB(A)	After Calibration, dB(A)
Loudspeaker used for open air show	0.2 x 0.2 x 1.2 each	3	93.9	93.9

Table 4.8b Noise Measurement Results for the Open Air Show

Loudspeaker	Measured Noise Levels, $L_{eq, 5\ min}$, dB(A)			Highest Level, dB(A)	B/G noise level, dB(A)	B/G corrected noise level, dB(A)
	1	2	3			
Loudspeaker 1	84.0	84.2	84.0	84.2	41.9	84.2
Loudspeaker 2	83.4	83.6	83.7	83.7	43.1	83.7
Loudspeaker 3	82.3	83.5	83.2	83.5	43.9	83.5
Loudspeaker 4	84.0	83.9	83.8	84.0	44.5	84.0

Table 4.8c Sound Power Level of the Open Air Show

TIA	B/G corrected noise level, dB(A)	Measurement distance to the center of loudspeaker	SWL, dB(A)
Loudspeaker 1	84.2	3	101.7
Loudspeaker 2	83.7	3	101.2
Loudspeaker 3	83.5	3	101.0
Loudspeaker 4	84.0	3	101.5
		Total:	**107**
		Maximum allowable SWL, dB(A):	**110**
		Compliance:	**Yes**

OPC confirm that the computerised volume control will be capped at show level which is the same as that adopted in the noise commissioning test.

5 CONCLUSION

Noise measurements have been conducted based on the commissioning requirements given in *Tables 2.1* and *2.3* of the NMAP for Phase 2 deposited in accordance with Condition 2.25 of the EP-249/2006/D. Results of noise measurements indicated that the design and performance of the noise mitigation measures implemented complies with the maximum SWL determined in the VEP application document (VEP-438/2014). All measures implemented will be properly operated and maintained during the operation for Phase 2.

Annex A

Figures

Fixed Plant List (The Waterfront)

ID	Fixed Plant Type
WF04	PA system
WF05	PA system
WF06	Split-type A/C unit
WF08	Split-type A/C unit
WF17	Split-type A/C unit
WF19	AC plant
WF20	AC plant
WF23	AC plant
WF24	AC plant
WF26	Cooling Tower
WF27	Compressors Cluster
WF29	Chiller
WF30	Fan Room
WF32	Ventilation Fan
WF35	Ventilation Fan
LNR7	Sea Life Carousel

Annex A1

Location for Fixed Plant Items (Phase 2 commissioning test)

FILE: 0238176d
DATE: 31/07/2014

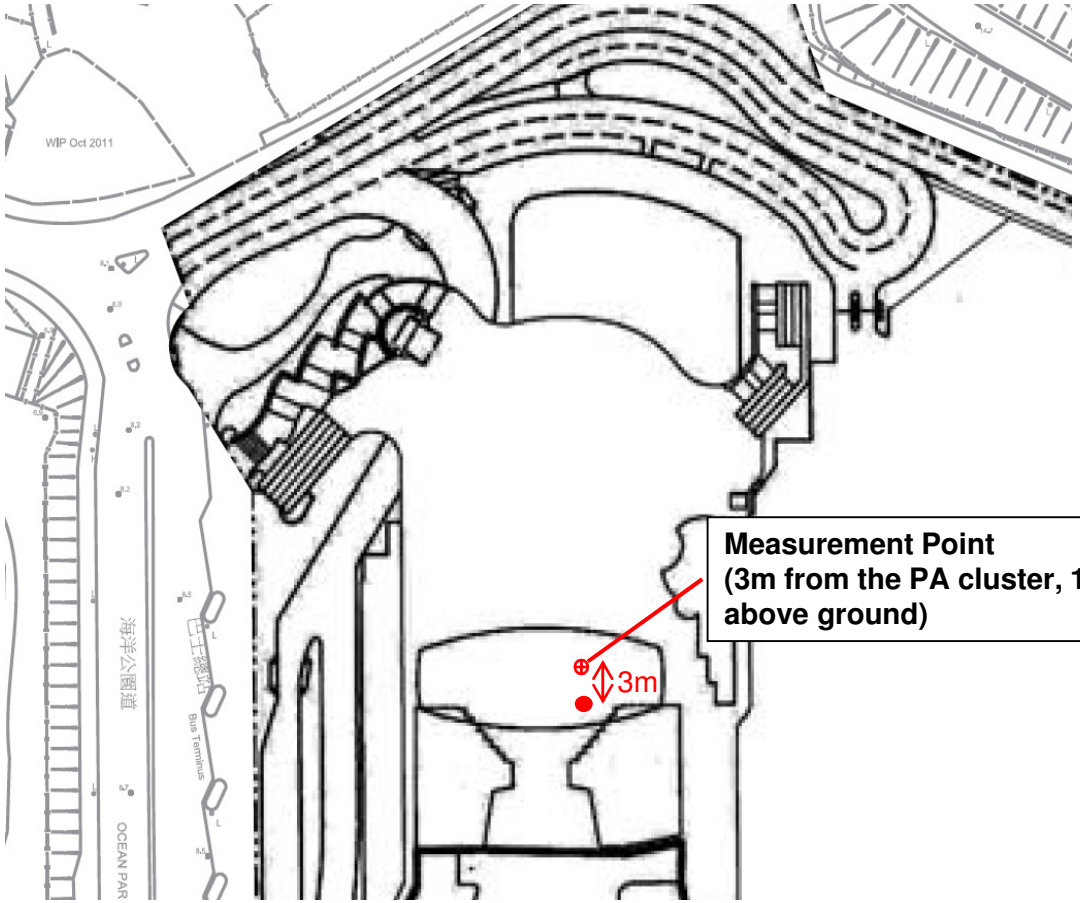
Environmental Resources Management

ERM

Key

- PA Cluster
- Noise Measurement Point

N



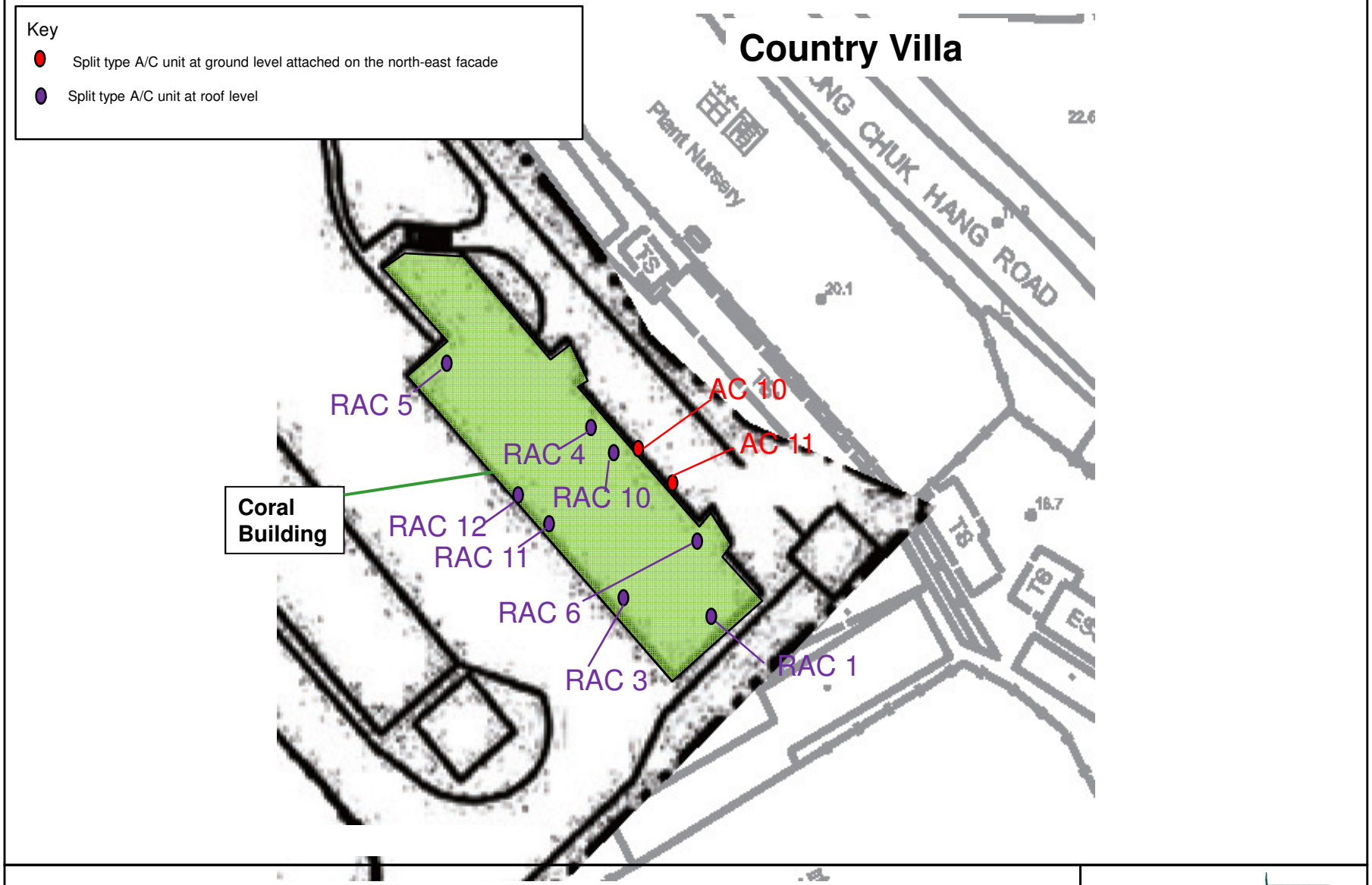
Annex A2

Measurement location for PA system at Entry Plaza (WF04)

DATE: 26/08/2014

Environmental Resources Management

ERM



Annex A3

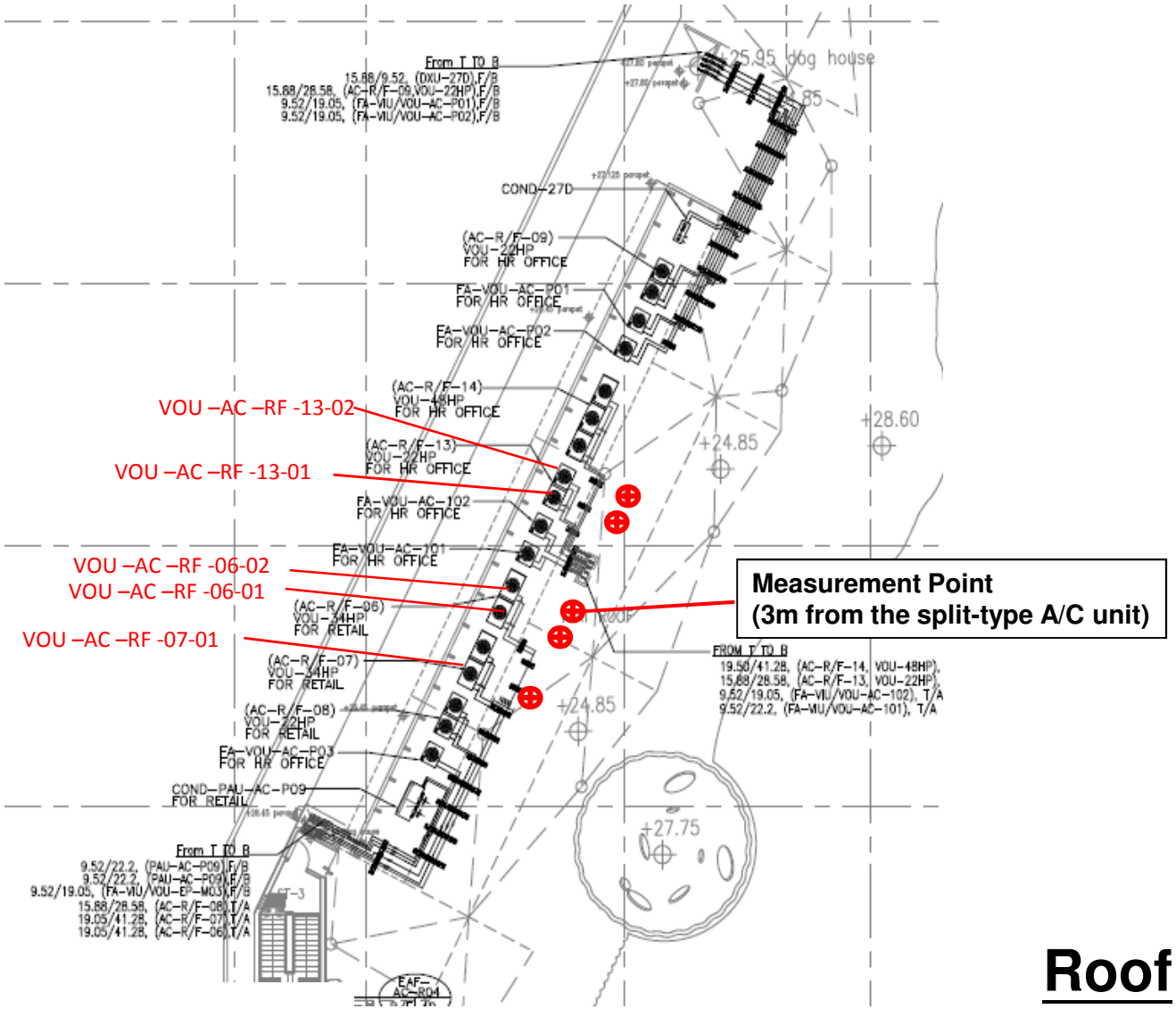
Location of 10 measured split-type A/C unit at Coral Building (WF06)

DATE: 26/08/2014

Environmental Resources Management

ERM

N



Roof Level

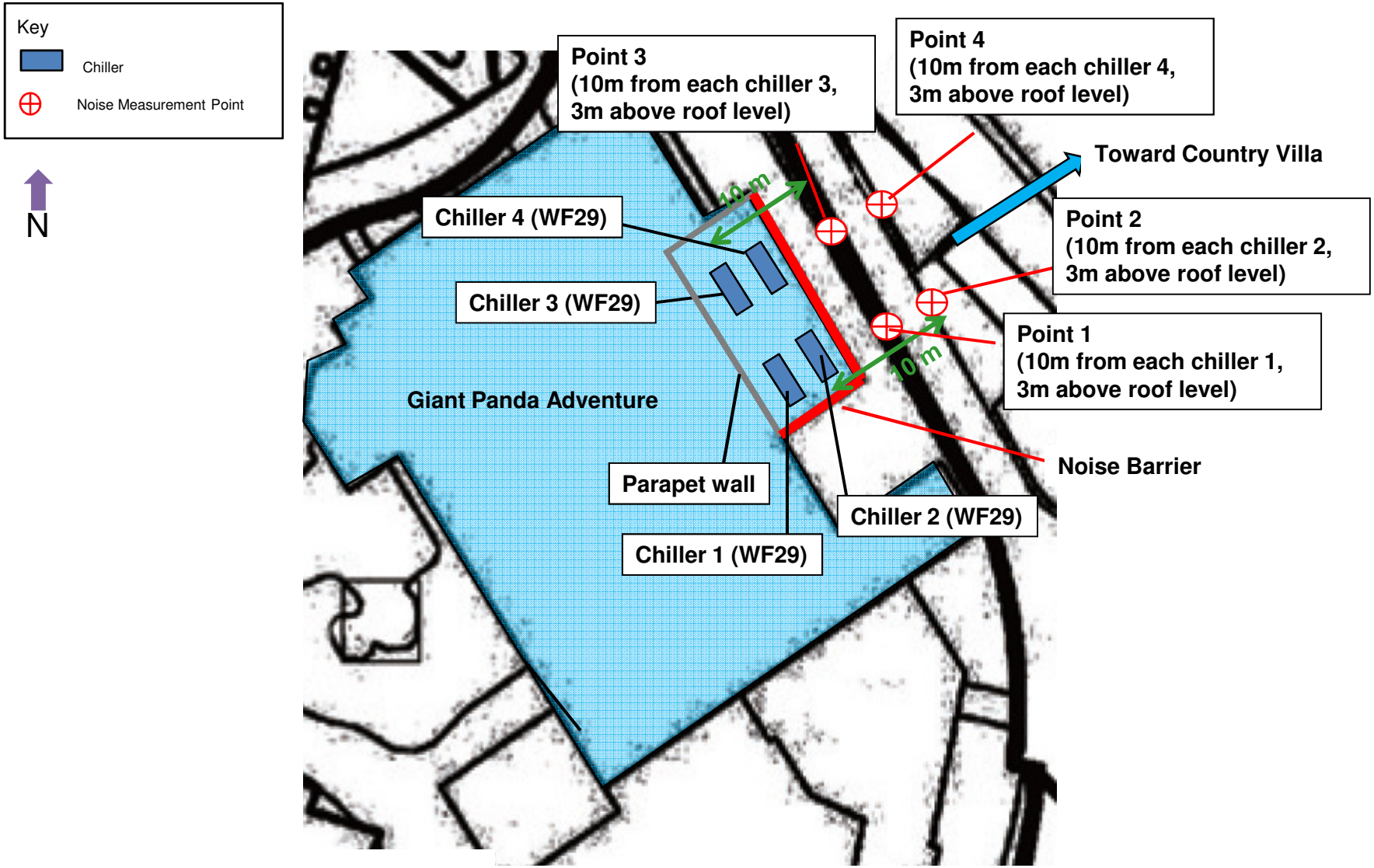
Annex A4

Measurement Location for split-type AC unit at West Retail (WF08)

DATE: 26/08/2014

Environmental Resources Management

ERM



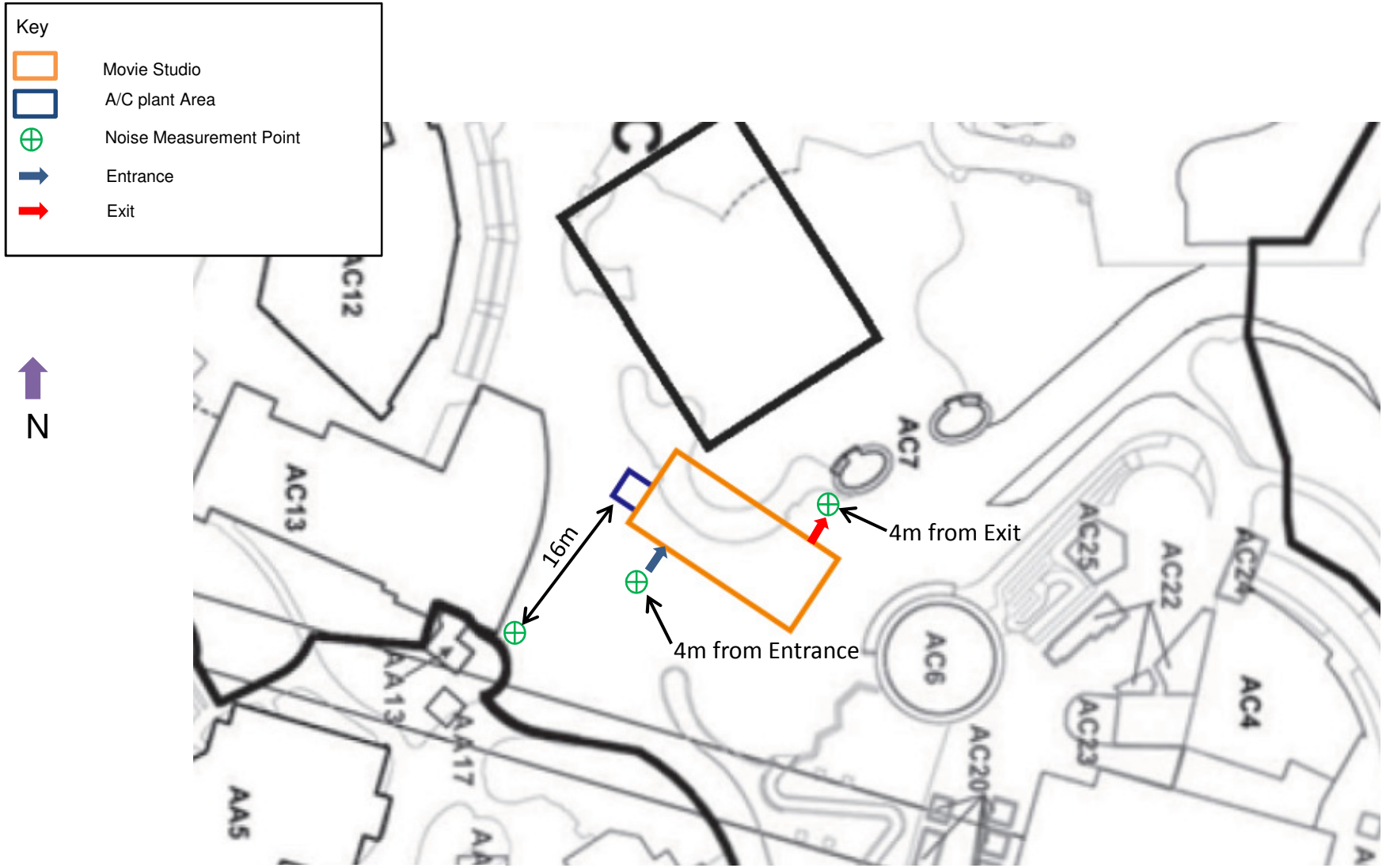
Annex A5

Measurement Location for Chiller at Giant Panda Adventure (WF29)

DATE: 26/08/2014

Environmental Resources Management

ERM



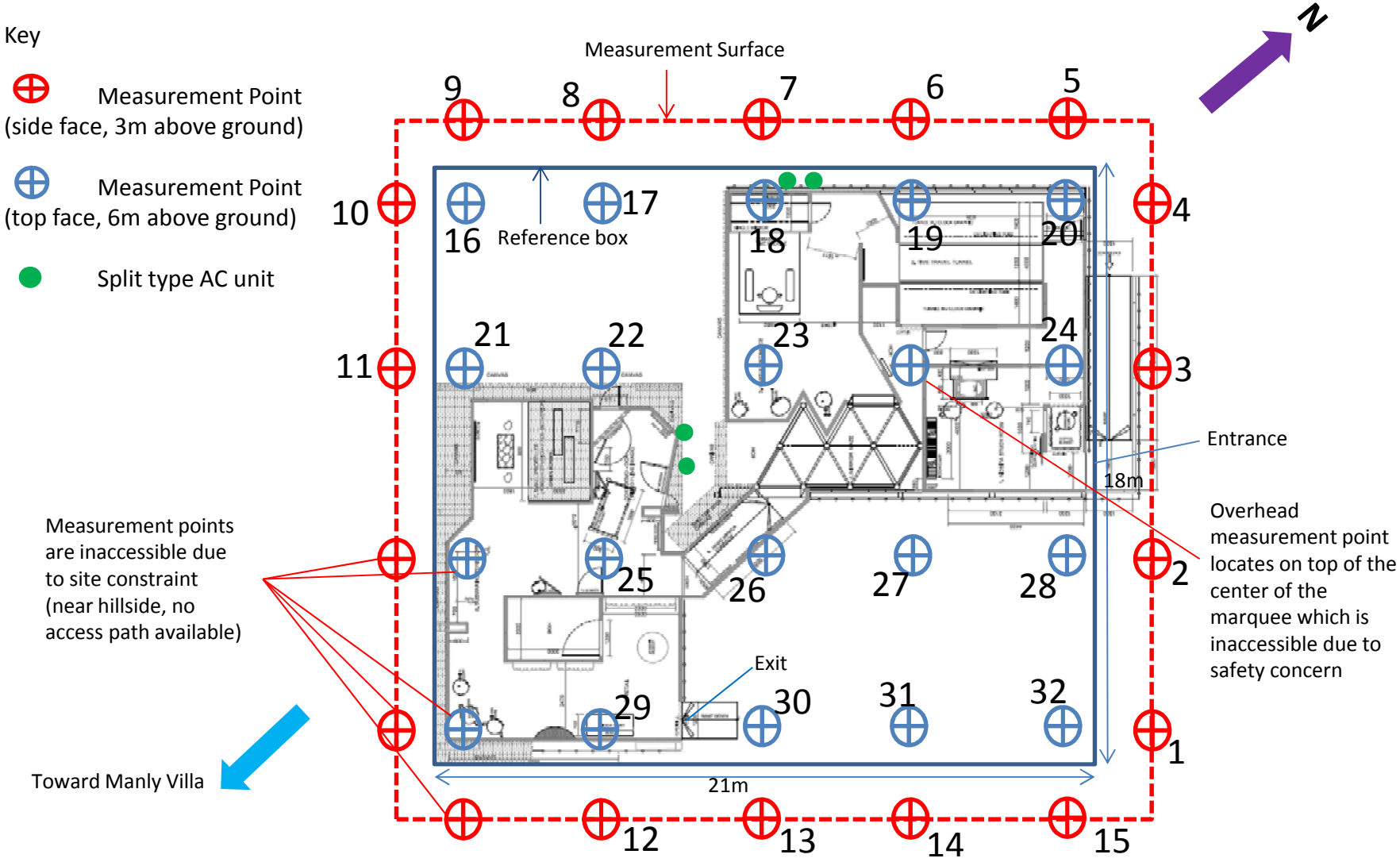
Annex A6

Measurement Locations for the Movie Studio

DATE: 26/08/2014

Environmental Resources Management

ERM



* Remark: If measurement point is inaccessible due to site constraint or safety reason, such measurement can be omitted.

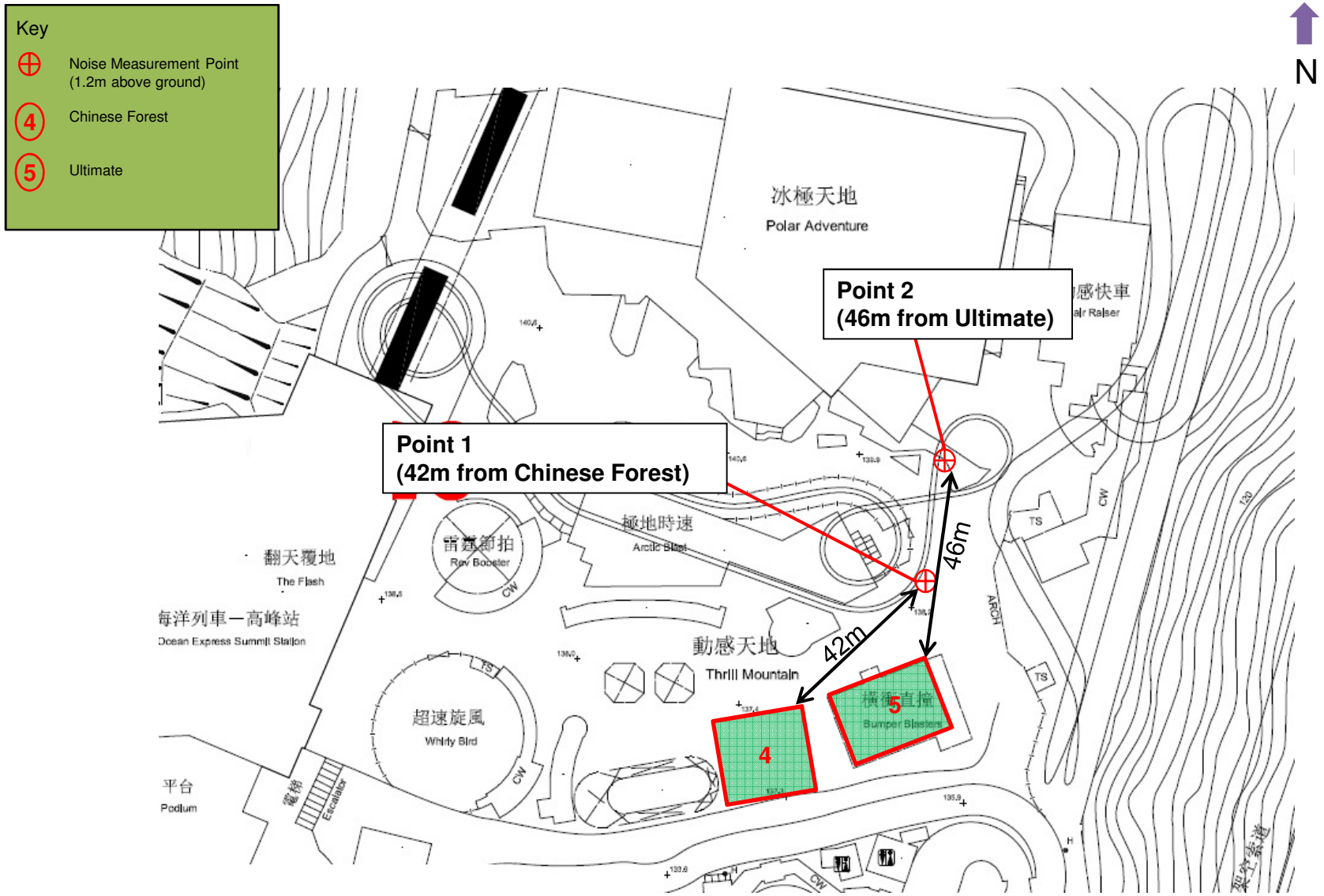
Annex A7

Measurement Location for Doraemon Attraction (Plan View)

DATE: 19/08/2014

Environmental Resources Management

ERM



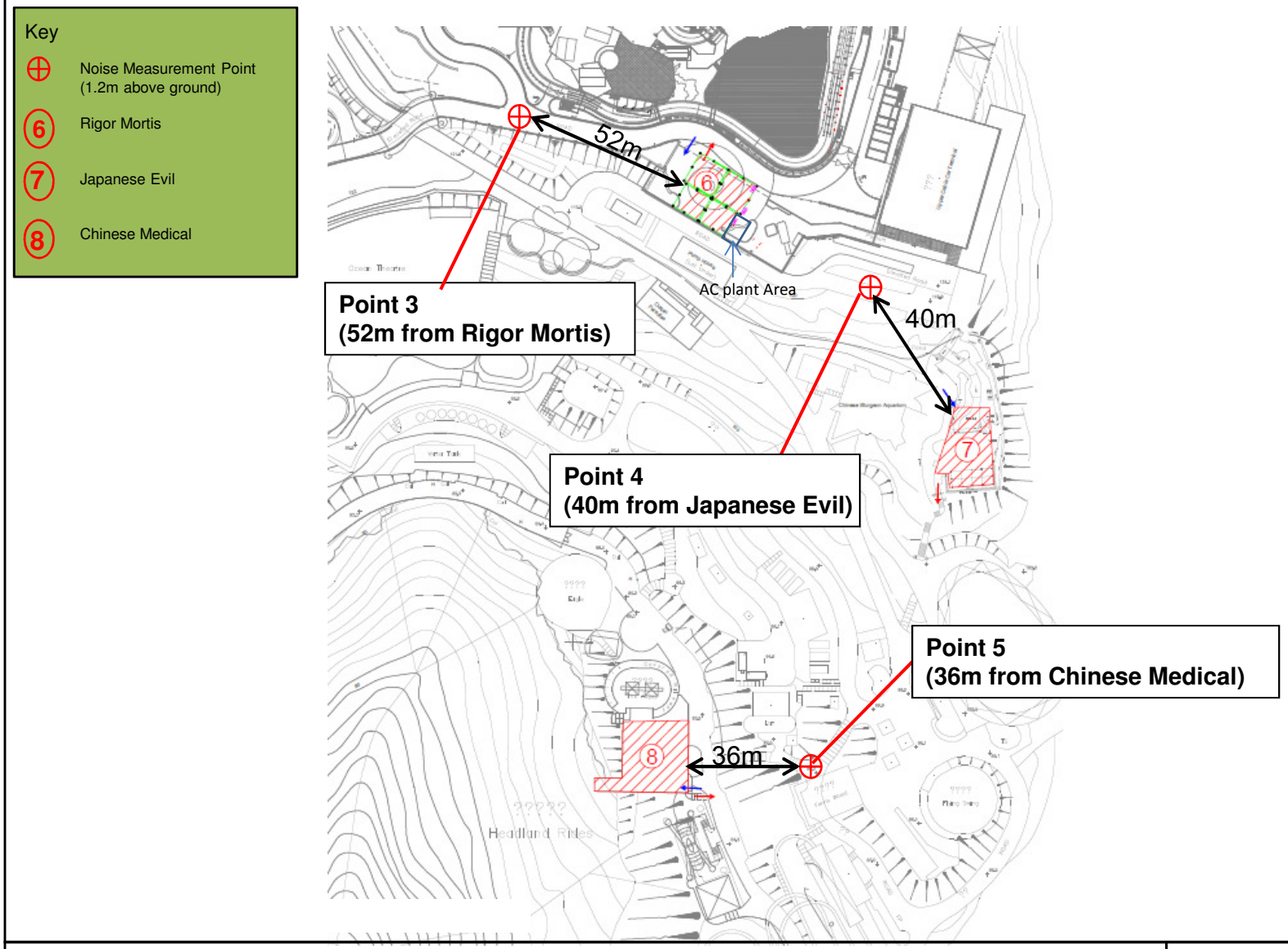
Annex A8

Measurement Locations for Chinese Forest and Ultimate at the Summit

DATE: 26/08/2014

Environmental Resources Management

ERM



Annex A9

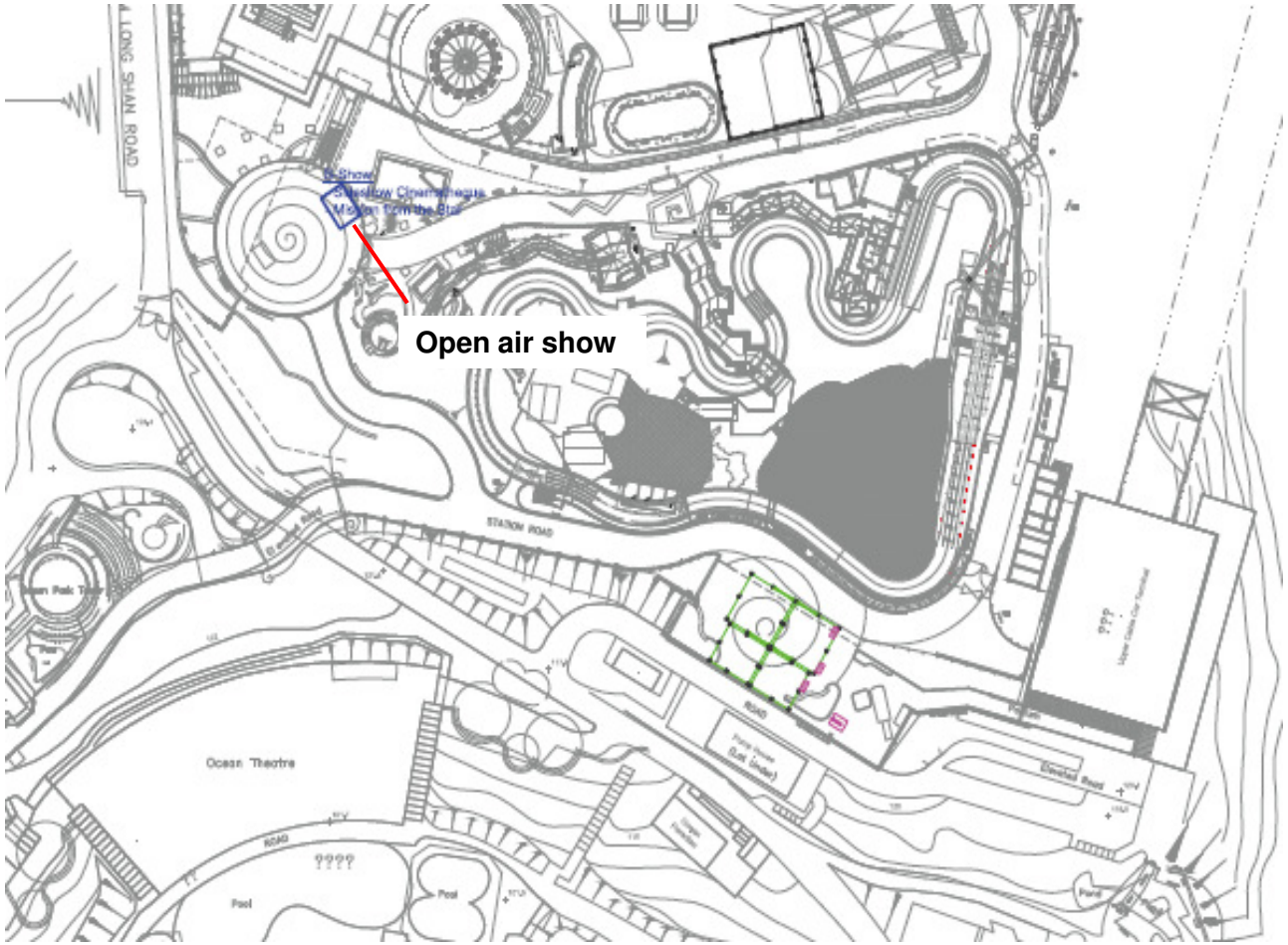
Measurement Locations for Rigor Mortis, Japanese Evil and Chinese Medical at the Summit

DATE: 26/08/2014

Environmental Resources Management

ERM

N



Annex A10

Location for the open air show in Summit

DATE: 23/06/2014

Environmental Resources Management

ERM

Annex B

Calibration Certificates

Hong Kong Calibration Ltd.
香 港 校 正 有限公司

Calibration Certificate

Certificate No. **34249** Page 1 of 3 Pages

Customer : Environmental Resources Management

Address : 21/F, Lincoln House, 979 King's Road, Taikoo Place, Island East, Hong Kong.

Order No. : Q31652 **Date of receipt :** 24-Jun-13

Item Tested

Description : Sound Level Meter

Manufacturer : Solo

Model : 01dB **Serial No. :** 65225

Test Conditions

Date of Test : 5-Jul-13 **Supply Voltage :** --

Ambient Temperature : (23 ± 3)°C **Relative Humidity :** (50 ± 25) %

Test Specifications

Calibration check.

Calibration procedure : Z01.

Test Results

All results were within the IEC 651 Type1, IEC 804 Type1 and IEC 1260 Class1 specification.

The results are shown in the attached page(s).

Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S017	Multi-Function Generator	C127181	SCL-HKSAR
S024	Sound Level Calibrator	30620	NIM-PRC & SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).
The test results apply to the above Unit-Under-Test only

Calibrated by : Liam Wong

Approved by : Dorothy Cheuk

Date: 5-Jul-13

This Certificate is issued by:
Hong Kong Calibration Ltd.
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street,Kwai Chung, NT,Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

Calibration Certificate

Results :

1. SPL Accuracy

UUT Setting				Applied Value (dB)	UUT Reading (dB)
Level Range	Octave Filter	Weight	Time Const.		
20 – 140 dB	OFF	A	Fast	94.0	93.7
			Slow		93.7
		C	Fast		93.7
	ON (1/1)	--	Fast		93.7
	ON (1/3)	--	Fast		93.7
	OFF	A	Fast	114.0	113.7
			Slow		113.7
		C	Fast		113.7
	ON (1/1)	--	Fast		113.7
	ON (1/3)	--	Fast		113.7

IEC 651 Type 1 Spec. : ± 0.7 dB
Uncertainty : ± 0.2 dB

2. Level Stability : 0.0 dB

IEC 651 Type 1 Spec. : ± 0.3 dB
Uncertainty : ± 0.1 dB

3. Linearity

UUT Range (dB)	Applied Value (dB)	UUT Reading (dB)	Variation (dB)	IEC 651 Type 1 Spec.
20 – 140 dB	84.0	83.8	+0.1	± 0.4 dB
	94.0	93.7 (Ref.)	--	
	95.0	94.7	0.0	± 0.2 dB

Calibration Certificate

4. Frequency Weighting

A weighting

Frequency	Attenuation (dB)	IEC 651 Type 1 Spec.
31.5 Hz	-39.2	- 39.4 dB, ± 1.5 dB
63 Hz	-25.9	- 26.2 dB, ± 1.5 dB
125 Hz	-16.0	- 16.1 dB, ± 1 dB
250 Hz	-8.5	- 8.6 dB, ± 1 dB
500 Hz	-3.1	- 3.2 dB, ± 1 dB
1 kHz	0.0 (Ref.)	0 dB, ± 1 dB
2 kHz	+1.2	+ 1.2 dB, ± 1 dB
4 kHz	+0.9	+ 1.0 dB ,± 1 dB
8 kHz	-1.7	- 1.1 dB, + 1.5 dB ~ - 3 dB
16 kHz	-12.1	- 6.6 dB, + 3 dB ~- ∞

Uncertainty : ± 0.1 dB

5. Time Averaging

Applied Burst duty Factor	Applied Leq Value (dB)	UUT Reading (dB)	IEC 804 Type 1 Spec.
continuous	40.0	40.0	--
1/10	40.0	40.0	± 0.5 dB
$1/10^2$	40.0	40.0	
$1/10^3$	40.0	40.0	± 1.0 dB
$1/10^4$	40.0	40.0	

Uncertainty : ± 0.1 dB

Calibration Certificate

6. Filter Characteristics

6.1 1/1 – Octave Filter

Frequency	Attenuation (dB)	IEC 1260 Class 1 (dB)
125 Hz	-74.4	< - 61
250 Hz	-55.0	< - 42
500 Hz	-24.4	< - 17.5
707 Hz	-3.0	- 2 ~ - 5
1 kHz (Ref)	--	--
1.414 kHz	-2.8	- 2 ~ - 5
2 kHz	-18.3	< - 17.5
4 kHz	-83.6	< - 42
8 kHz	-84.5	< - 61

Uncertainty : ± 0.25 dB

6.2 1/3 – Octave Filter

Frequency	Attenuation (dB)	IEC 1260 Class 1 (dB)
326 Hz	-69.1	< - 61
530 Hz	-59.8	< - 42
772 Hz	-28.4	< - 17.5
891 Hz	-3.4	+ 0.3 ~ - 5.0
1 kHz (Ref)	--	--
1.122 kHz	-3.7	+ 0.3 ~ - 5.0
1.296 kHz	-31.5	< - 17.5
1.887 kHz	-66.8	< - 42
3.070 kHz	-80.7	< - 61

Uncertainty : ± 0.25 dB

Remark : 1. UUT : Unit-Under-Test
2. The uncertainty claimed is for a confidence probability of not less than 95%.
3. Atmospheric Pressure : 1001 hPa.

---------- END ----------

Hong Kong Calibration Ltd.
香 港 校 正 有限公司

Calibration Certificate

Certificate No. **32987** Page 1 of 3 Pages

Customer : Environmental Resources Management

Address : 21/F, Lincoln House, 979 King's Road, Taikoo Place, Island East, Hong Kong.

Order No. : Q31162 **Date of receipt :** 3-May-13

Item Tested

Description : Sound Level Meter

Manufacturer : Solo

Model : 01dB **Serial No. :** 65226

Test Conditions

Date of Test : 21-May-13 **Supply Voltage :** --

Ambient Temperature : (23 ± 3)°C **Relative Humidity :** (50 ± 25) %

Test Specifications

Calibration check.

Calibration procedure : Z01.

Test Results

All results were within the IEC 651 Type1, IEC 804 Type1 and IEC 1260 Class1 specification.

The results are shown in the attached page(s).

Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S017	Multi-Function Generator	C127181	SCL-HKSAR
S024	Sound Level Calibrator	30620	NIM-PRC & SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).
The test results apply to the above Unit-Under-Test only

Calibrated by : Liam Wong

Approved by : Dorothy Cheuk

Date: 21-May-13

This Certificate is issued by:
Hong Kong Calibration Ltd.
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street,Kwai Chung, NT,Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

Calibration Certificate

Results :

1. Accuracy Check

UUT Setting			Applied Value (dB)	UUT Reading (dB)
Range (dB)	Response	Weighting		
20 - 140	Fast	L_A	94.0	93.8
	Slow			93.8
	Fast	L_C		93.9
	Slow			93.9
	Fast	L_A	114.0	113.9
	Slow			113.9
	Fast	L_C		113.9
	Slow			113.9

IEC 651 Type 1 Spec. : ± 0.7 dB
Uncertainty : ± 0.1 dB

2. Level Stability : 0.0 dB

IEC 651 Type 1 Spec. : ± 0.3 dB
Uncertainty : ± 0.1 dB

3. Linearity

Differential level linearity

UUT Range	Applied Value (dB)	UUT Reading (dB)	Variation (dB)	IEC 651 Type 1 Spec.
140	84.0	83.8	0.0	± 0.4 dB
	94.0	93.8 (Ref.)	- -	
	95.0	94.8	0.0	± 0.2 dB

Uncertainty : ± 0.1 dB

Calibration Certificate

4. Frequency Weighting

A weighting

Frequency	Attenuation (dB)	IEC 651 Type 1 Spec.
31.5 Hz	-39.5	- 39.4 dB, ± 1.5 dB
63 Hz	-26.1	- 26.2 dB, ± 1.5 dB
125 Hz	-16.1	- 16.1 dB, ± 1 dB
250 Hz	-8.6	- 8.6 dB, ± 1 dB
500 Hz	-3.3	- 3.2 dB, ± 1 dB
1 kHz	0.0 (Ref.)	0 dB, ± 1 dB
2 kHz	+1.2	+ 1.2 dB, ± 1 dB
4 kHz	+0.8	+ 1.0 dB ,± 1 dB
8 kHz	-1.8	- 1.1 dB, + 1.5 dB ~ - 3 dB
16 kHz	-12.1	- 6.6 dB, + 3 dB ~- ∞

Uncertainty : ± 0.1 dB

5. Time Averaging

Applied Burst duty Factor	Applied Leq Value (dB)	UUT Reading (dB)	IEC 804 Type 1 Spec.
continuous	40.0	- -	--
1/10	40.0	40.0	± 0.5 dB
$1/10^2$	40.0	39.9	
$1/10^3$	40.0	39.9	± 1.0 dB
$1/10^4$	40.0	39.9	

Uncertainty : ± 0.1 dB

Calibration Certificate

6. Filter Characteristics

6.1 1/1 – Octave Filter

Frequency	Attenuation (dB)	IEC 1260 Class 1 (dB)
125 Hz	-74.8	< - 61
250 Hz	-55.0	< - 42
500 Hz	-24.4	< - 17.5
707 Hz	-3.0	- 2 ~ - 5
1 kHz (Ref)	--	--
1.414 kHz	-2.8	- 2 ~ - 5
2 kHz	-48.3	< - 17.5
4 kHz	-88.6	< - 42
8 kHz	-89.0	< - 61

Uncertainty : ± 0.25 dB

6.2 1/3 – Octave Filter

Frequency	Attenuation (dB)	IEC 1260 Class 1 (dB)
326 Hz	-68.4	< - 61
530 Hz	-58.4	< - 42
772 Hz	-28.4	< - 17.5
891 Hz	-3.5	+ 0.3 ~ - 5.0
1 kHz (Ref)	--	--
1.122 kHz	-3.7	+ 0.3 ~ - 5.0
1.296 kHz	-31.5	< - 17.5
1.887 kHz	-66.5	< - 42
3.070 kHz	-90.0	< - 61

Uncertainty : ± 0.25 dB

Remarks : 1. UUT : Unit-Under-Test
2. The uncertainty claimed is for a confidence probability of not less than 95%.
3. Atmospheric Pressure : 996 hPa.

---------- END ----------

Hong Kong Calibration Ltd.
香港校正有限公司

Calibration Certificate

Certificate No. 404228

Customer : Environmental Resources Management

Address : 16/F DCH Commercial Centre 25 Westlands Road Quarry Bay Hong Kong

Order No. : Q41594 **Date of receipt :** 20-Jun-14

Item Tested

Description : Sound Level Calibrator
Manufacturer : 01dB-Stell
Model : CAL21 **Serial No. :** 34113609(2011)

Test Conditions

Date of Test : 23-Jun-14 **Supply Voltage :** --
Ambient Temperature : (23 ± 3)°C **Relative Humidity :** (50 ± 25) %

Test Specifications

Calibration check.
Calibration procedure : Z02, IEC 942.

Test Results

All results were within the IEC 942 Class 2 specification.
The results are shown in the attached page(s).

Main Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S205	Ref. Sound Level Calibrator	PHCO40002	SCL-HKSAR
S041	Universal Counter	34621	SCL-HKSAR
S206	Sound Level Meter	36203	SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).
The test results apply to the above Unit-Under-Test only

Calibrated by : Dorothy Cheuk

Approved by : Steve Kwan

Date: 23-Jun-14

This Certificate is issued by:
Hong Kong Calibration Ltd.
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street,Kwai Chung, NT,Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

Calibration Certificate

Results :

1. Level Accuracy

UUT Nominal Value (dB)	Measured Value (dB)	IEC 942 Class 1 Spec.
94	93.98	± 0.3 dB

Uncertainty : ± 0.2 dB

2. Frequency

UUT Nominal Value	Measured Value	IEC 942 Class 1 Spec.
1 kHz	1.008 kHz	± 2 %

Uncertainty : $\pm 3.6 \times 10^{-6}$

3. Level Stability : 0.0 dB
IEC 942 Class 1 Spec. : ± 0.1 dB
Uncertainty : ± 0.1 dB

4. Total Harmonic Distortion : < 1.6 %
IEC 942 Class 1 Spec. : < 3 %
Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test
2. The above measured values are the mean of 3 measurement.
3. The uncertainty claimed is for a confidence probability of not less than 95%.
4. Atmospheric Pressure : 991 hPa.

---------- END ----------

Hong Kong Calibration Ltd.
香 港 校 正 有限公司

Calibration Certificate

Certificate No. 404229 Page 1 of 2 Pages

Customer : Environmental Resources Management

Address : 16/F DCH Commercial Centre 25 Westlands Road Quarry Bay Hong Kong

Order No. : Q41594 **Date of receipt :** 20-Jun-14

Item Tested

Description : Sound Level Calibrator

Manufacturer : Svantek

Model : SV30A **Serial No. :** 7971

Test Conditions

Date of Test : 23-Jun-14 **Supply Voltage :** --

Ambient Temperature : (23 ± 3)°C **Relative Humidity :** (50 ± 25) %

Test Specifications

Calibration check.

Ref. Document/Procedure : F21, Z02.

Test Results

All results were within the IEC 942 Class 1 specification.

The results are shown in the attached page(s).

Main Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S014	Spectrum Analyzer	35730	NIM-PRC & SCL-HKSAR
S205	Ref. Sound Level Calibrator	PHCO40002	SCL-HKSAR
S041	Universal Counter	34621	SCL-HKSAR
S206	Sound Level Meter	36203	SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).
The test results apply to the above Unit-Under-Test only

Calibrated by : Dorothy Cheuk

Approved by : Steve Kwan

Date: 23-Jun-14

This Certificate is issued by:
Hong Kong Calibration Ltd
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street,Kwai Chung, NT,Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

E

Calibration Certificate

Results :

1. Level Accuracy

UUT Nominal Value (dB)	Measured Value (dB)	IEC 942 Class 1 Spec.
94	94.15	± 0.3 dB
114	114.17	

Uncertainty : ± 0.2 dB

2. Frequency

UUT Nominal Value	Measured Value	IEC 942 Class 1 Spec.
1 kHz	1.000 kHz	± 2 %

Uncertainty : $\pm 3.6 \times 10^{-6}$

3. Level Stability : 0.0 dB
IEC 942 Class 1 Spec. : ± 0.1 dB
Uncertainty : ± 0.01 dB

4. Total Harmonic Distortion : < 0.8 %
IEC 942 Class 1 Spec. : < 3 %
Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test
2. The above measured values are the mean of 3 measurements.
3. The uncertainty claimed is for a confidence probability of not less than 95%.
4. Atmospheric Pressure : 991 hPa.

---------- END ----------