AECOM

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Your Ref: -
Our Ref: 60627779/C/FYW2005271

By Email (kkleung04@dsd.gov.hk)

Drainage Services Department
44/F, Revenue Tower,
5 Gloucester Road,
Wan Chai, Hong Kong

Attn: Mr. K K Leung

27 May 2020

Dear Sir,

Contract No. CM 12/2019
Expansion of Sha Tau Kok Sewage Treatment Works –
Environmnntal Team Services for Construction Phase (2020-2021)
Proposal for Changes of the Environmental Monitoring Audit Requirements (Operation phase of odour monitoring)

We are pleaesed to submit the revised Proposal for Changes of the Environmental Monitoring Audit Requirements (Operation phase of odour monitoring) which is certified by the Environmental Team Leader and verified by Independent Environmental Checker for your onward submission.

Should you have any queries, please feel free to contact the undersigned at 3922 9366.

Yours faithfully,
AECOM Asia Co. Ltd.

Y W Fung
Environmental Team Leader

Encl.

cc DSD H C Yeung (hcyeung@dsd.gov.hk)
Black & Veatch Hong Kong Limited Anthony Leung (re_em2@dc1803.com.hk)
ANEWR Consulting Limited James Choi (jpschoi@anewr.com)
ANEWR Consulting Limited Adi Lee(aymlee@anewr.com)
ANEWR Consulting Limited Hazel Chan (hyychan@anewr.com)

ANEWR

Drainage Services Department
42/F, Revenue Tower
5 Gloucester Road
Wan Chai
Hong Kong

Your reference:

Our reference: HKDSD206/50/106518

Date: 27 May 2020

Attention: Mr K K Leung

BY EMAIL & POST
(email: kkleung04@dsd.gov.hk)

Dear Sirs

Agreement No.: CM 14/2018
Independent Environmental Checker Services for
Expansion of Sha Tau Kok Sewage Treatment Works
Proposal for Changes of the Environmental Monitoring
Audit Requirements (Operation phase of odour monitoring)

We refer to emails of 26 and 27 May 2020 from AECOM Asia Co. Ltd attaching the revised Proposal for Changes of the Environmental Monitoring Audit Requirements (Operation phase of odour monitoring).

We have no further comment and hereby verify the captioned Proposal in accordance with Clause 3.1 of the Environmental Permit no. EP-517/2017/A.

Should you have any queries, please do not hesitate to contact the undersigned or our Mr Adi Lee at 2618 2831.

Yours faithfully
ANEWR CONSULTING LIMITED

James Choi
Independent Environmental Checker

CPSJ/LYMA/CYYH/lhmh

cc DSD – Ms Roxana Yeung (email: hcyeung@dsd.gov.hk)
Black & Veatch Hong Kong Limited – Mr Anthony Leung (email: re_em2@dc1803.com.hk)
Black & Veatch Hong Kong Limited – Mr Alaster Chan (email: are_em2@dc1803.com.hk)
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ISO 9001 : 2015
Certificate No.: QC 3988

Proposal for Changes of the Environmental Monitoring Audit Requirements (Operation phase of odour monitoring)

In accordance with Section 3.3.1 and 3.3.2 of the EM&A Manual for the Expansion of Sha Tau Kok Sewage Treatment Works (AEIAR-207/2017), the following changes for the Odour monitoring during operation phase are proposed for health and safety concerns.

<table>
<tr><th>Reference in EM&A Manual</th><th>Original Monitoring Requirement</th><th>Reason for Proposed Changes</th><th>Proposed Alternative Method</th></tr>
<tr>
<td>Section 3.3.1</td>
<td>In accordance with EIA recommendations, commissioning test for the TSTP and STKSTW is recommended to be performed prior to their operation to ascertain the effectiveness of the deodorization systems at the TSTP and STKSTW during the operation phase. Exhaust air flow rate, temperature of exhaust, odour concentration at the outlet of the deodorization systems should be monitoring during the commissioning test. The exhaust air flow rate, temperature of exhaust odour concentrations presented in Table 3.1 should be maintained. The recommended method for the odour monitoring is presented in Table 3.2. (Table 3.1 and 3.2 of EM&A Manual are extracted below)

Table 3.1 – Design Parameter of Exhaust Stack and Odour Emission Rates of TSTP and STKSTW
<table>
<tr><th>Design Parameter</th><th>Unit</th><th colspan="2">STKSTW</th><th colspan="2">TSTP</th></tr>
<tr><th>Location</th><th>-</th><th>STKSTW No.1</th><th>STKSTW No.2</th><th>TSTP No.1</th><th>TSTP No.2</th></tr>
<tr><td>No. of emission points</td><td>-</td><td colspan="2">1 (a)</td><td colspan="2">2</td></tr>
<tr><td>Building height</td><td>m above ground</td><td colspan="2">15.65</td><td>14.3</td><td>14.3</td></tr>
<tr><td>Stack height</td><td>m above ground</td><td colspan="2">17.65</td><td>16.3</td><td>16.3</td></tr>
<tr><td>Equivalent stack diameter</td><td>m</td><td colspan="2">1.40</td><td>0.15</td><td>0.25</td></tr>
<tr><td>Exit temperature</td><td>-</td><td colspan="2">ambient</td><td>ambient</td><td>ambient</td></tr>
<tr><td>Total flowrate @ exit temp.</td><td>m^3hr^{-1}</td><td>70,279</td><td>46,722</td><td>3,952</td><td>9,293</td></tr>
<tr><td></td><td>m^3s^{-1}</td><td>19.52</td><td>12.98</td><td>1.10</td><td>2.58</td></tr>
<tr><td>Exit velocity</td><td>ms^{-1}</td><td colspan="2">14.44</td><td>15.53</td><td>13.15</td></tr>
<tr><td>Maximum H_2S emission concentration at inlet</td><td>ppm</td><td>10</td><td>10</td><td>10</td><td>50</td></tr>
<tr><td>% of odour removal</td><td>%</td><td>99.3</td><td>99.3</td><td>99.5</td><td>99.8</td></tr>
<tr><td>Mitigated H_2S emission concentration at exhaust</td><td>ppm</td><td>0.07</td><td>0.07</td><td>0.05</td><td>0.1</td></tr>
<tr><td>Mitigated odour emission concentration at exhaust</td><td>OUm^{-3}</td><td>148.9</td><td>148.9</td><td>106.4</td><td>212.8</td></tr>
<tr><td>Mitigated odour emission rate</td><td>OUs^{-1}</td><td colspan="2">4840.4 (b)</td><td>116.8</td><td>549.2</td></tr>
</table>
Notes:
(a) Same emission point for STKSTW No.1 and STKSTW No.2.
(b) Combined emission rate for STKSTW No.1 and STKSTW No.2.

Table 3.2 – Odour Monitoring Methodology
<table>
<tr><th>Monitoring Location</th><th>Parameter</th><th>Recommended Method</th></tr>
<tr><td>Stack of TSTP or STKSTW</td><td>• Exhaust air flow rate
• Temperature of exhaust
• Odour</td><td><u>Air sampling:</u>
• grab sampling using Teflon bag

<u>Physical parameter:</u>
• flow meter

<u>Laboratory analysis:</u>
• Forced-choice Dynamic Olfactometer according to European Standard Method (EN 13725)</td></tr>
</table>
</td>
<td>As refer to the latest construction programme, the operation of TSTP will be commissioned in July 2020. The odour commissioning test shall be performed in May 2020.

In view of the latest development of Coronavirus Disease 2019 (COVID-19) which might transmit through aerosols and might not be settled in the upcoming few months.

Due to the health and safety concerns, the odour monitoring methodology (by forced-choice dynamic olfactometer*) recommended in the Table 3.2 EM&A Manual seems to be not suitable.

*The dynamic olfactometry is a standardized way of measuring odour concentrations using the human sense of smell by panelists.</td>
<td>H_2S is the dominant odorant (often present in higher concentrations than other odorants from sewage treatment works) and can provide an indication of the overall odour concentration [1].

With reference to the mitigated odour emission concentration at exhaust and mitigated H_2S emission concentration at exhaust are equivalent based on 1OU= 0.00047ppm of H_2S. It is proposed to adopt measurement of H_2S as an alternative method.

The measured H_2S at the exhausts will be checked against with the requirements of mitigated H_2S emission concentration at exhaust (i.e. 0.05ppm at TSTP No.1 and 0.1ppm at TSTP No.2) as stated in Table 3.1 of EM&A Manual to assess the effectiveness of the deodorization units.

Note: As stated in Table 3.1, while in maximum inlet emission, the mitigated H_2S emission concentration measured at exhausts (i.e. 0.05ppm at TSTP No.1 and 0.1ppm at TSTP No.2) are equivalent to achieve the corresponding 99.5% and 99.8% of odour removal efficiency.

Reference:
[1] Peter J. and Simon A. P., Hydrogen sulphide measurement, in Odours in Wastewater Treatment Measurement, Modelling and Control, R. Stuetz and F.B. Frenchen (eds), IWA Publishing, London, 2001, ISBN 1 900222 46 9, p.120-129.</td>
</tr>
</table>

Reference in EM&A Manual	Original Monitoring Requirement	Reason for Proposed Changes	Proposed Alternative Method
Section 3.3.2	Weekly monitoring of odour emission at the exhausts at TSTP and STKSTW by taking odour samples is recommended to be conducted in the first two months of the first year of the operation. The monitoring parameter will include exhaust flow rate, temperature of exhaust and odour concentrations, following the recommended monitoring method as presented in Table 3.2. The monitoring results should be compared with that presented in Table 3.1. Provided that the monitoring results show no non-compliance on a weekly basis during the first two months, it is recommended to reduce the frequency to monthly in the subsequent four months and further reduce to quarterly in the remaining six months of the first year if no non-compliance is found. (Extracted Table 3.1 and 3.2 of EM&A Manual are presented in above)	The TSTP will be operated in July 2020. Regular odour monitoring will be performed in the first-year operation of TSTP as below: • Weekly basis in the first two months • Monthly basis in the subsequent four months (if no non-compliance is found) • Quarterly in the remaining six months (if no non-compliance is found) In view of the latest development of COVID-19 which might transmit through aerosols and might not be settled in the upcoming few months. Due to the health and safety concerns, the odour monitoring methodology (by forced-choice dynamic olfactometer*) recommended in the Table 3.2 EM&A Manual seems to be not suitable. **The dynamic olfactometry is a standardized way of measuring odour concentrations using the human sense of smell by panelists.*	It is proposed to adopt measurement of H_2S as an alternative method. The measured H_2S at the exhausts will be checked against with the requirement of mitigated H_2S emission concentration at exhaust (i.e. 0.05ppm at TSTP No.1 and 0.1ppm at TSTP No.2) as stated in Table 3.1 of EM&A Manual to monitor the performance of deodorization units at the first-year operation of TSTP. Note: As stated in Table 3.1, while in maximum inlet emission, the mitigated H_2S emission concentration measured at exhausts (i.e. 0.05ppm at TSTP No.1 and 0.1ppm at TSTP No.2) are equivalent to achieve the corresponding 99.5% and 99.8% of odour removal efficiency.

1 METHODOLOGY FOR PROPOSED ODOUR MONITORING

1.1 Monitoring Parameter and Duration

1.1.1 15-minute Hydrogen Sulphide (H_2S) concentration (in parts per million) will be measured by portable H_2S analyzer at the exhaust of TSTP No.1 and TSTP No.2. The exhaust air flow rate, ambient temperature, temperature of exhaust, weather conditions and wind speed will be recorded during the measurement. The details of H_2S measurement is presented in below table:

Table 1.1 Details of H_2S Measurement

Measurement Locations	Measurement Parameters
At the Exhaust of TSTP No.1 and TSTP No.2	15-minute H_2S Measurement (every 5 minutes measure one reading) - Average value of the three 5-minute readings will be used to justify the compliance. Exhaust air flow rate, ambient temperature, temperature of exhaust, weather conditions and wind speed will be recorded.

1.2 Monitoring Equipment

1.2.1 The details of H_2S analyzer equipment is presented in **Table 1.** The specification of the H_2S analyzer is presented in **Annex A.** The verification test report of H_2S analyzer is presented in **Annex B.**

Table 1.2 Details of H_2S Analyzer Equipment

H2S Analyzer Model	Capable Range of measuring H_2S concentration
Jerome 631X	3ppb to 50ppm

Annex A

Jerome 631-X
Hydrogen Sulfide Analyzer

Features:
Rugged and easy to operate
Inherently stable gold film sensor
Pressure sensitive membrane switch operation
Rechargeable internal battery pack for portability
Wide detection range allows for multiple applications
Automatic LCD backlight during low light conditions
Survey mode for rapid source detection of hydrogen sulfide concentrations
Microprocessor ensures a linear response throughout the entire range of the sensor

Specifications:

Resolution	0.001 at Range 0 to 1 ppm at Range 3	
Detection Range	0.003-50 ppm	
Precision	5% Relative Standard Deviation	
Accuracy	Range 0: ±0.003 ppm at 0.050 ppm	
	Range 1: ±0.03 ppm at 0.50 ppm	
	Range 2: ±0.3 ppm at 5.0 ppm	
	Range 3: ±2 ppm at 25 ppm	
Response Time	Sample Mode:	Survey Mode:
	10-50 ppm in 13 seconds	10-50 ppm in 3 seconds
	1.0-10.0 ppm in 16 seconds	1.0-10.0 ppm in 6 seconds
	0.10-1.00 ppm in 25 seconds	0.10-1.00 ppm in 15 seconds
	0.001-0.100 ppm in 30 seconds	0.001-0.100 ppm in 20 seconds
Flow Rate	150 cc/min or 0.15 l/min	
Power Requirements	100-120 V~, 50/60 Hz, 1 A or 220-240 V~, 50/60 Hz, 1 A	
Internal Battery Pack	Rechargeable nickel-cadmium	
Environmental Range	0-40°C, noncondensing, nonexplosive	
Interfaces	RS-232 PC using Jerome Communications Software	
Dimensions	631-X: 6" W x 13" L x 4" H / 16 cm W x 33 cm L x 10 cm H	
	631-XE: 7" W x 14" L x 7" H / 18 cm W x 35 cm L x 18 cm H	
Weight	631-X: 7 lbs / 3 kg	
	631-XE: 8 lbs / 3.5 kg	
Warranty	1 year, factory parts and labor	
Marks	European Communities (CE) for 220-240 V~ model only	

Options:
Functional Test Module for sensor operation verification in the field (30 or 250 ppb)
Data Logger to record field monitoring information
Maintenance Kit for routine maintenance and upkeep
Hard or Soft Field Carrying Case for versatile handling and additional storage
Jerome Communications Software Kit for downloading information from the data logger to a PC or for unattended, fixed-point sampling
Option Board for external fresh air solenoid support, auto-zeroing, DC power operation, timed regeneration, 4-20 mA or 0-2 V analog output, and timed sampling

Applications:
Leak Detection
Quality Control
Ambient Air Analysis
Regulatory Compliance
Nuisance Odor Monitoring
Applied Research Projects
Scrubber Efficiency Testing
Hydrogren Sulfide Source Detection
Control Room Corrosion Monitoring
Accuracy Check for other Hydrogen Sulfide Monitors and Control Systems

Annex B

CALIBRATION

ACCREDITED
Certificate #3815.01

Calibration Certificate

Certificate No.: CC0071910

1. Description

Calibration item :	a) Hydrogen Sulfide (H_2S)
Equipment description :	Gold Film Hydrogen Sulfide Analyzer
Manufacturer :	ARIZONA INSTRUMENT LLC
Type / Model No. :	Jerome® 631X
Serial No. :	1914
Assigned equipment no. :	N/A
Adjustment :	N/A
Remark :	Received with good condition

2. Customer information

Customer :	AECOM
Address :	8/F, Tower 2, Grand Central Plaza, 138 Shatin Rural Committee Road, Shatin, N.T. HK
Date of receipt :	4 October 2019

3. Date of performance of the calibration

Date of calibration :	10 October 2019

Approved Signatory
WM Ling

Company Chop:

Certificate issue date: 11 October 2019

Cal Lab Limited
Address: Room 2103, Technology Plaza, 29-35 Sha Tsui Road, Tsuen Wan, NT, Hong Kong
Tel : (852)25680106 Fax(852)30116194 Email: info@callab.com.hk Website:callab.com.hk

CALIBRATION

4. Result of Calibration

a) Hydrogen Sulfide (H_2S)

Reference Setting ; ppm	Measured reading ; ppm	Error of indication ; % FS
0	0.000	0.0
0.5	0.46	-0.1
1.0	0.96	-0.1
5.0	4.2	-1.6
10.0	9.1	-1.8

Estimated expanded uncertainty: 2.1 % FS Technical Requirement: ± 5 ppm

Hydrogen Sulfide (H_2S) - Repeatability

Reference reading ; ppm	RSD ; %
10.0	1.6

Technical Requirement: ± 2 %

Hydrogen Sulfide (H_2S) – Response Time

Reference reading ; ppm	Response time ; second
10.0	13

Technical Requirement:
≤ 30 seconds (Pump)

Note: The technical requirement is refer to JJG 695-2003

Cal Lab Limited
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CALIBRATION

5. Reference method for calibration

Hydrogen Sulfide	JJG 695-2003

6. Environment condition of calibration

Temperature ; ℃	24.5 ℃
Relative humidity ; %RH	43 %RH

7. Reference equipment used in the calibration

Item	Model	Serial No.	Expiry date	Traceable to
Hydrogen Sulfide	N/A	L193414080	28 Jan 2020	NIM

Note1: The estimated expanded uncertainties have been calculated in "Evaluation and expression of uncertainty in measurement" and give an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

Note2: The standard (s) and instrument used in the calibration are traceable to national or international recognized standard and are calibrated on a schedule to maintain the accuracy and good condition.

Note3: The result reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long term stability of the instrument.

Note4: The result shows in this calibration certificate relate only to the item calibrated, and the result only applies to the calibration item as received.

Calibrated by: Date: 10 October 2019

Checked by: Date: 10 October 2019

*** End of Certificate ***

CT-END-02

Cal Lab Limited
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