

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 –**  
**Environmental Team Services for Construction Phase (2020-2021)**  
**Proposal for Changes of the Environmental Monitoring Audit Requirements (Operation phase**  
**of odour monitoring)**

We are pleased 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  
Black & Veatch Hong Kong Limited  
ANEWR Consulting Limited  
ANEWR Consulting Limited  
ANEWR Consulting Limited

H C Yeung (hcyung@dsd.gov.hk)  
Anthony Leung (re\_em2@dc1803.com.hk)  
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Adi Lee (aymlee@anewr.com)  
Hazel Chan (hyychan@anewr.com)



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/lhnh

cc DSD – Ms Roxana Yeung (email: hcyung@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)  
AECOM – Mr YW Fung (email: yw.fung@aecom.com)  
AECOM – Ms Lemon Lam (email: lemon.lam@aecom.com)

**ANewR Consulting Limited**  
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Web: www.anewr.com



**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.

Reference in EM&A Manual	Original Monitoring Requirement	Reason for Proposed Changes	Proposed Alternative Method																																																																																																											
Section 3.3.1	<p>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&amp;A Manual are extracted below)</p> <p><b>Table 3.1 – Design Parameter of Exhaust Stack and Odour Emission Rates of TSTP and STKSTW</b></p> <table border="1"> <thead> <tr> <th rowspan="2">Design Parameter</th> <th rowspan="2">Unit</th> <th colspan="2">STKSTW</th> <th colspan="2">TSTP</th> </tr> <tr> <th>STKSTW No.1</th> <th>STKSTW No.2</th> <th>TSTP No.1</th> <th>TSTP No.2</th> </tr> </thead> <tbody> <tr> <td>Location</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> </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">1.69</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<sup>3</sup>hr<sup>-1</sup></td> <td>70,279</td> <td>46,722</td> <td>3,952</td> <td>9,293</td> </tr> <tr> <td></td> <td>m<sup>3</sup>s<sup>-1</sup></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<sup>-1</sup></td> <td colspan="2">14.44</td> <td>15.53</td> <td>13.15</td> </tr> <tr> <td>Maximum H<sub>2</sub>S 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<sub>2</sub>S 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<sup>-3</sup></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>OU s<sup>-1</sup></td> <td colspan="2">4840.4 (b)</td> <td>116.8</td> <td>549.2</td> </tr> </tbody> </table> <p><b>Notes:</b>                      (a) Same emission point for STKSTW No.1 and STKSTW No.2.                      (b) Combined emission rate for STKSTW No.1 and STKSTW No.2.</p> <p><b>Table 3.2 – Odour Monitoring Methodology</b></p> <table border="1"> <thead> <tr> <th>Monitoring Location</th> <th>Parameter</th> <th>Recommended Method</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Stack of TSTP or STKSTW</td> <td>Exhaust air flow rate</td> <td><b>Air sampling:</b></td> </tr> <tr> <td>Temperature of exhaust</td> <td>• grab sampling using Teflon bag</td> </tr> <tr> <td>Odour</td> <td><b>Physical parameter:</b> • flow meter</td> </tr> <tr> <td></td> <td></td> <td><b>Laboratory analysis:</b> • Forced-choice Dynamic Olfactometer according to European Standard Method (EN 13725)</td> </tr> </tbody> </table>	Design Parameter	Unit	STKSTW		TSTP		STKSTW No.1	STKSTW No.2	TSTP No.1	TSTP No.2	Location	-					No. of emission points	-	1 (a)		2		Building height	m above ground	15.65		14.3	14.3	Stack height	m above ground	17.65		16.3	16.3	Equivalent stack diameter	m	1.69		0.15	0.25	Exit temperature	-	ambient		ambient	ambient	Total flowrate @ exit temp.	m <sup>3</sup> hr <sup>-1</sup>	70,279	46,722	3,952	9,293		m <sup>3</sup> s <sup>-1</sup>	19.52	12.98	1.10	2.58	Exit velocity	ms <sup>-1</sup>	14.44		15.53	13.15	Maximum H <sub>2</sub> S emission concentration at inlet	ppm	10	10	10	50	% of odour removal	%	99.3	99.3	99.5	99.8	Mitigated H <sub>2</sub> S emission concentration at exhaust	ppm	0.07	0.07	0.05	0.1	Mitigated odour emission concentration at exhaust	OUm <sup>-3</sup>	148.9	148.9	106.4	212.8	Mitigated odour emission rate	OU s <sup>-1</sup>	4840.4 (b)		116.8	549.2	Monitoring Location	Parameter	Recommended Method	Stack of TSTP or STKSTW	Exhaust air flow rate	<b>Air sampling:</b>	Temperature of exhaust	• grab sampling using Teflon bag	Odour	<b>Physical parameter:</b> • flow meter			<b>Laboratory analysis:</b> • Forced-choice Dynamic Olfactometer according to European Standard Method (EN 13725)	<p>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.</p> <p>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.</p> <p>Due to the health and safety concerns, the odour monitoring methodology (by forced-choice dynamic olfactometer*) recommended in the Table 3.2 EM&amp;A Manual seems to be not suitable.</p> <p><i>*The dynamic olfactometry is a standardized way of measuring odour concentrations using the human sense of smell by panelists.</i></p>	<p>H<sub>2</sub>S 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].</p> <p>With reference to the mitigated odour emission concentration at exhaust and mitigated H<sub>2</sub>S emission concentration at exhaust are equivalent based on 1OU= 0.00047ppm of H<sub>2</sub>S. It is proposed to adopt measurement of H<sub>2</sub>S as an alternative method.</p> <p>The measured H<sub>2</sub>S at the exhausts will be checked against with the requirements of mitigated H<sub>2</sub>S 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&amp;A Manual to assess the effectiveness of the deodorization units.</p> <p>Note: As stated in Table 3.1, while in maximum inlet emission, the mitigated H<sub>2</sub>S 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.</p> <p><i>Reference:</i>                      [1] Peter J. and Simon A. P., <i>Hydrogen sulphide measurement, in Odours in Wastewater Treatment Measurement, Modelling and Control</i>, R. Stuetz and F.B. Frenchen (eds), IWA Publishing, London, 2001, ISBN 1 900222 46 9, p.120-129.</p>
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Reference in EM&A Manual	Original Monitoring Requirement	Reason for Proposed Changes	Proposed Alternative Method
Section 3.3.2	<p>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&amp;A Manual are presented in above)</p>	<p>The TSTP will be operated in July 2020.</p> <p>Regular odour monitoring will be performed in the first-year operation of TSTP as below:</p> <ul style="list-style-type: none"> <li>• Weekly basis in the first two months</li> <li>• Monthly basis in the subsequent four months (if no non-compliance is found)</li> <li>• Quarterly in the remaining six months (if no non-compliance is found)</li> </ul> <p>In view of the latest development of COVID-19 which might transmit through aerosols and might not be settled in the upcoming few months.</p> <p>Due to the health and safety concerns, the odour monitoring methodology (by forced-choice dynamic olfactometer*) recommended in the Table 3.2 EM&amp;A Manual seems to be not suitable.</p> <p><i>*The dynamic olfactometry is a standardized way of measuring odour concentrations using the human sense of smell by panelists.</i></p>	<p>It is proposed to adopt measurement of H<sub>2</sub>S as an alternative method.</p> <p>The measured H<sub>2</sub>S at the exhausts will be checked against with the requirement of mitigated H<sub>2</sub>S 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&amp;A Manual to monitor the performance of deodorization units at the first-year operation of TSTP.</p> <p>Note: As stated in Table 3.1, while in maximum inlet emission, the mitigated H<sub>2</sub>S 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.</p>

# 1 METHODOLOGY FOR PROPOSED ODOUR MONITORING

## 1.1 Monitoring Parameter and Duration

- 1.1.1 15-minute Hydrogen Sulphide (H<sub>2</sub>S) concentration (in parts per million) will be measured by portable H<sub>2</sub>S 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<sub>2</sub>S measurement is presented in below table:

**Table 1.1 Details of H<sub>2</sub>S Measurement**

Measurement Locations	Measurement Parameters
At the Exhaust of TSTP No.1 and TSTP No.2	15-minute H <sub>2</sub> S 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<sub>2</sub>S analyzer equipment is presented in **Table 1**. The specification of the H<sub>2</sub>S analyzer is presented in **Annex A**. The verification test report of H<sub>2</sub>S analyzer is presented in **Annex B**.

**Table 1.2 Details of H<sub>2</sub>S Analyzer Equipment**

H <sub>2</sub> S Analyzer Model	Capable Range of measuring H <sub>2</sub> S concentration
Jerome 631X	3ppb to 50ppm

# Jerome 631-X<sup>®</sup>

## 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:

<b>Resolution</b>	0.001 at Range 0 to 1 ppm at Range 3
<b>Detection Range</b>	0.003-50 ppm
<b>Precision</b>	5% Relative Standard Deviation
<b>Accuracy</b>	Range 0: $\pm 0.003$ ppm at 0.050 ppm Range 1: $\pm 0.03$ ppm at 0.50 ppm Range 2: $\pm 0.3$ ppm at 5.0 ppm Range 3: $\pm 2$ ppm at 25 ppm
<b>Response Time</b>	Sample Mode: 10-50 ppm in 13 seconds 1.0-10.0 ppm in 16 seconds 0.10-1.00 ppm in 25 seconds 0.001-0.100 ppm in 30 seconds Survey Mode: 10-50 ppm in 3 seconds 1.0-10.0 ppm in 6 seconds 0.10-1.00 ppm in 15 seconds 0.001-0.100 ppm in 20 seconds
<b>Flow Rate</b>	150 cc/min or 0.15 l/min
<b>Power Requirements</b>	100-120 V~, 50/60 Hz, 1 A or 220-240 V~, 50/60 Hz, 1 A
<b>Internal Battery Pack</b>	Rechargeable nickel-cadmium
<b>Environmental Range</b>	0-40°C, noncondensing, nonexplosive
<b>Interfaces</b>	RS-232 PC using Jerome Communications Software
<b>Dimensions</b>	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
<b>Weight</b>	631-X: 7 lbs / 3 kg 631-XE: 8 lbs / 3.5 kg
<b>Warranty</b>	1 year, factory parts and labor
<b>Marks</b>	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	Applied Research Projects
Quality Control	Scrubber Efficiency Testing
Ambient Air Analysis	Hydrogen Sulfide Source Detection
Regulatory Compliance	Control Room Corrosion Monitoring
Nuisance Odor Monitoring	Accuracy Check for other Hydrogen Sulfide Monitors and Control Systems



## Calibration Certificate

**Certificate No.: CC0071910**

1. Description

Calibration item :	a) Hydrogen Sulfide (H <sub>2</sub> S)
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

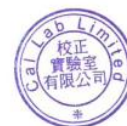
Date of calibration :	10 October 2019
-----------------------	-----------------

Approved Signatory

WM Ling

Company Chop:

Certificate issue date: 11 October 2019



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Page 1 of 3  
cc0071910

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](mailto:info@callab.com.hk) Website: [callab.com.hk](http://callab.com.hk)





4. Result of Calibration

a) Hydrogen Sulfide (H<sub>2</sub>S)

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:  $\pm 5$  ppm

Hydrogen Sulfide (H<sub>2</sub>S) - Repeatability

Reference reading ; ppm	RSD ; %
10.0	1.6

Technical Requirement:  $\pm 2$  %

Hydrogen Sulfide (H<sub>2</sub>S) – Response Time

Reference reading ; ppm	Response time ; second
10.0	13

Technical Requirement:

$\leq 30$  seconds (Pump)

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

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CT-006-04

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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](mailto:info@callab.com.hk) Website: [callab.com.hk](http://callab.com.hk)





5. Reference method for calibration

Hydrogen Sulfide	JJG 695-2003
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6. Environment condition of calibration

Temperature ; °C	24.5 °C
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 internal 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: *Francis Yung*

Date: 10 October 2019

Checked by: *William*

Date: 10 October 2019

\*\*\* End of Certificate \*\*\*

CT-END-02

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