Annex J

Investigation Report

Investigation Report of CEMS Exceedances

Date	1 – 31 June 2019
Time	Continuous monitoring throughout May 2019
Monitoring Location	Continuous Environmental Monitoring System (CEMS)
Parameter	Various emission parameters of the Cogeneration Units (CHP) and Ammonia Stripping Plan (ASP)
Exceedance Description	1. Continuous monitoring was carried out for CAPCS, CHP and ASP throughout the reporting period using the CEMS. According to the EM&A Manual, exceedance is considered if the emission concentration of the concerned pollutants is higher than the emission limits stated in Tables 2.2, 2.3 and 2.5 of the EM&A Manual (Version E) for CAPCS, CHP and ASP respectively. The concentration of the concerned air pollutants were monitored on-line by the CEMS. Exceedances of various emission parameters were recorded on the CEMS including: • NO_x and VOC (including methane) in the CHP; and • Dust, NO_x, VOCs and NH_3 in the ASP. 2. According to the Contractor, the plant was receiving around 100 tonnes of SSOW daily and was operated normally. 3. CHP setting was undergoing fine-tuning for performance optimisation which leads to the ineffective removal of NO_x and VOC (including methane) at a certain period of time. 4. The Contractor explained that the exceedances recorded in Dust, NO_x, SO_2 and NH_3 in the ASP was because the thermal combustion unit of the ASP still require tuning to optimise the combustion efficiency. In addition, the Contractor reported that the tuning of the thermal combustion unit took longer than anticipated resulting in the many exceedances recorded during the reporting period.
Action Taken / Action to be Taken	• The number of exceedances in CHP has drastically decreased since the beginning of the operation period. Only 1 exceedance on NO_x and 1 exceedance on VOC (including methane) were recorded from the 3 CHP stacks during this reporting period. Continuous optimisation of CHP and re-adjustment of NO_x and VOC (including methane) control for CHP has been carried out to further reduce the exceedance. The re-adjustment is expected to be completed in the next reporting period. • Tuning of the thermal combustion unit of the ASP was carried out by the ASP suuplier to optimise the combustion efficiency in order to remove the

	pollutants in the biogas. The ASP supplier gave the Contractor a set of procedures for the fine-tuning of the ASP. By having the procedure guidelines, the Contractor can perform the ASP fine tuning in-house without relying on the ASP supplier which can minimise the extent of exceedances. The fine tuning is expected to be completed in the next reporting period.
Remedial Works and Follow-up Actions	The Contractor is recommended to closely monitor the processes, including the combustion of biogas in the ASP to avoid the reoccurrence of similar problems. MT will carry out follow-up audit regarding the progress next month.

Prepared by: Bonia Leung, MT Representative
Date 10 July 2019

Investigation Report of Biogas Leakage

Date	18 June 2019
Time	17:30
Monitoring Location	Biogas system
Parameter	Biogas pressure
Description	Biogas release as a result of unstable power supply by CLP on 18 June 2019.
Action Taken / Action to be Taken	The Contractor closed the biogas holder inlet valve to safeguard the biogas system as per emergency response procedures. The biogas pressure began to build up in the biogas system (before the biogas holder) resulting in the biogas being released through one of the pressure relief valves as per designed scenario to safeguard the biogas tanks.
Remedial Works and Follow-up Actions	The Contractor resumed the power supply from CLP and the biogas booster set. A thorough check was conducted to confirm the situation was under control with stable performance.

Prepared by: Bonia Leung, MT Representative
Date 10 October 2019

Extract of the Incident Notification Form on Release of Biogas to the Environment Prepared by the Contractor

Description of the Process

The purpose of Organic Resources Recovery Centre Phase 1 (ORRC1 or the facility) is to convert source-separated organic waste into compost and biogas through proven biological treatment technologies. The biogas generated, after post-treatment including sulphur and water removal, would be in the on-site Combined Heat and Power (CHP) generators to generate hot water and electricity to be used on site and exported to the China Light and Power (CLP) power grid network.

The major equipment involving biogas includes:

- Anaerobic Digesters (AD)
- Suspension Buffer Tank (SBT)
- Desulphurisation Column
- Gasholder (GH)
- Dehumidifier
- Biogas booster system

The biogas consumers include:

- Emergency Flare
- Combined Heat and Power (CHP) Unit
- Ammonia Stripping Plant (ASP)

Description of the Incident

Time	Event
18 June 2019	High biogas production rate was observed in the afternoon. Three (3) Combined Heat and Power (CHPs) Units were in operation to consume the biogas. The Ammonia Stripping plant (ASP) was offline due to planned maintenance works. Due to the high biogas production rate, the biogas holder was observed to be high (>90%).
16:30	Seeing the biogas holder was reaching to high level, team members attended to the Standby Flare System on site to check if the standby flare can be ready to start. It resulted in identifying that the air compressor has overheated, and the cabinet was also found to be hot to the touch. The compressed air was not available for the pneumatic actuation valve Standby flare not able to be activated.
16:45	Preparation and installation work for the addition a standby pneumatic line to be attached the plant-wide compressed air system. During the repair of the standby flare, the biogas booster set was tripped resulted in the CHPs to shut down due to the lack of fuel. The booster set was immediately reset and restarted. CHPs in turn were then restarted to resume to reduce the level in the Biogas holder. Three CHPs were back into operation.
17:30	The electrical connections Q1 and Q2 opened. Later all CHPs tripped and loss of electrical power to the entire facility. The status electrical connections status of H1 and H2 were not changed.
17:48	After immediate diagnosis at the HV switch room and clearing the fault of Q1, the Q1 connection was closed allowing electricity back into the facility from CLP. After the power was

	resumed to the plant, an attempt to restart the Booster Set was conducted. However, the Booster Set failed to start due to the lack of compressed air. Immediate review of the system was undertaken to resolve this issue. A temporary pneumatic line was laid from the AD Area to the Booster Set to provide compressed air to the system. During the course of repairing, the biogas pressure was observed to building up and biogas started to release from the pressure safety valve of the biogas holder (@25 mbar). All repair team members were evacuated away from the booster area until the working condition was able to the secured safely. According to the emergency response procedure, the biogas valves (3040-V-105 & 3040-V-205) at the exit of the each of the Desulphurization columns were manually closed to prevent further biogas from flowing to the Biogas Holder. The arrangement discontinued the pressure build up at the biogas holder.
18:55	Once the valves were closed, the PSV of the Biogas Holder was allowed to release biogas until the pressure was reduced below 25 mbar. After the pressure stabilized below the release set point of the biogas holder, the biogas stopped releasing from the PSV of biogas holder and site monitoring results confirmed the booster area is free from biogas. The team members returned to complete the repair of the booster set and temporary compressed airline for the Booster Set system. The Booster Set system was then repaired and restarted to allow biogas to be fed to the CHPS. One (1) CHP was then restarted to attempt to reduce the level in the Biogas Holder. Later the ASP was also operated. After the biogas holder feeding line was isolated from 3040-V105 & 3040-V-205, the biogas pressure before the isolation was built up in the AD and SBT tanks resulting in the biogas being released through the pressure relief valves (33 mbar) as per designed scenario. The gas concentration was closely monitored at ground level. The monitoring results were consistent to the modelling results from Quantitative Risk Analysis report that he biogas released from pressure safety valves was able to dispersed to a safe level on ground.
19:15	Standby Flare repair works were also completed to allow the unit to begin flaring the biogas.
19:45	In conjunction with the start-up of the Standby Flare, the Desulphurization System's exit valves were opened slowly in incremental amounts to resume flow of the biogas from Ads to the Biogas Holder. At this time, one (1) CHP, the ASP and the Standby Flare were operating to consume the gas.
20:00	The biogas Holder level was reduced to approximately 45%. The facility resumed to normal operations using the CHP and ASP to control the biogas consumption.

Immediate Corrective Actions

- The Contractor immediately arranged onsite personnel for evacuation except the Emergency Response Team (including Maintenance Team, Operation Team and QHSE).
- The Contractor maintained close monitoring the gas concentration around the site.
- The Contractor arranged to resume all essential plant equipment in safe condition.
- The Contractor arranged to conduct a thorough check to confirm the situation was under control with stable performance at around 20:00.
- The Contractor also carried out indoor ambient air monitoring at all RCV bays to confirm the condition was safe to resume waste reception.
- Food waste reception was suspended for about 2 hours. 4 trucks were arranged to wait at a safe location (outside the main gate of the plant).
- Food waste reception resumed to normal at around 20:30.

Root Cause Analysis

1. Biogas production rate was higher (1,200 m^3/h) than normal because of the Organic Loading Rate was not calculated precisely enough. The OLR was higher by 50% that

precise day (approx.. 14 tons of VS fed to the Ads on 17 June 2019, compared to an average feeding fo 9 tons of VS fed to the Ads on the previous days):

   a. Variation on nature of SSOW could result fluctuation of organic loading.
   b. The SBT Jet Mixing efficiency is unstable (based on the SBT level) and produces suspension of variable moisture content
   c. In these conditions, due to improper Jet Mixing, sampling the SBT three times a week appeared to be not frequent enough.

2. Flare not able to be activated due to loss of compressed air to actuation valves. The air compressor of the flare system found defective. The root cause of the system was due to the overheating of the air compressor in the standby flare system. This was the primary source of compressed air to the system. At the time of the incident, there was no redundant supply of compressed air installed and maintenance works were started to provide redundant compressed air to the system.
3. HV switch gears Q1 and Q2 tripped and later resulted all CHPs tripped. (HV contractor collected plant data to study the cause of Q1 & Q2 trip).
   a. No biogas pressure from the booster set – because the flare system was switched from remote to local to conduct the repair works which caused the biogas booster set to enter a controlled shutdown the CHPs to Tip.
   b. CHPs could not run due to Q1 & Q2 tripped – from the investigation report, it was found that a voltage drop occurred, and the relays tripped to protect the system. However the report is inconclusive as to why a voltage drop occurred on that day. So further investigation will be carried out by subcontractor to provide a more thorough report to see if they can determine the root cause of Q1 & Q2.
4. The plant black out period accelerated the accumulation of biogas and eventually biogas pressure reached the release pressure set point. Standby flare could not function because lack of compressed air and electricity to power the control panel to allow the ignition of the flare.

Description of Corrective Actions (1)

1. To install a temporary pneumatic line to emergency flare system
2. To replace defective air compressor of emergency flare
3. To keep close monitoring the biogas production rate and its content
4. To arrange to test run the Emergency flare regularly (at least weekly to ensure the flare is well functioning
5. To inspect and diagnosis the function of Q1 and Q2

Description of Preventive Actions (2)

1. Monitoring & Prediction of Biogas Production:
   a. To define a target OLR per day with/without Asp in operation
   b. To measure the suspension moisture content of the SBT during Monday to Friday.

(1) The corrective actions have been closed on 30 June 2019
(2) The preventive actions have been closed on 30 June 2019.

   c. To give updated Ads feeding guidelines every day based on the actual SBT moisture content and OLR.
2. Monitoring & Inspection of standby fare system
   a. Implement regular testing flare (weekly)
   b. Install redundant compressed air source
   c. Air compressor will automatically start to maintain a set pressure if there is a failure in the plant compressed air system
   d. Implemented daily visual check for air compressor.
3. Training & Inspection of relays
   a. Addition training provided to the MT and operation staff
   b. Routine Maintenance: Regular visual inspection of the relays to ensure they are running normally. Additionally the sub-contractor for the high voltage system can come in on a regular basis to do a software diagnostic on the relays to ensure they are operation normally.
   c. Annually: a "WR2" (as required by the EMSD) is conducted on an annual basis for the high voltage system which does a complete power down of the relays. This allows the relays' hardware to be inspected more thoroughly to ensure they are functioning normally.
4. Emergency response during black out period
   a. Supply power from UPS to the control panel of the standby flare and control panel for duty standby compressor.
   b. Establish SOP to resume plant after blackout.