



ANNEX F

INVESTIGATION REPORT

Investigation Report of CEMS Exceedances	
Date	1 – 30 June 2024
Time	Continuous Monitoring throughout June 2024
Monitoring Location	Continuous Environmental Monitoring Systems (CEMS)
Parameter	Various emission parameters of the Cogeneration Units (CHPs) and Ammonia Stripping Plant (ASP)
Exceedance Description	<ul style="list-style-type: none"> • Continuous monitoring was carried out at the CAPCS, CHPs, and ASP throughout the reporting period using the CEMS. According to the EM&A Manual, an exceedance is considered if the emission concentration of the concerned pollutants is higher than the emission limits stated in Tables 2.2, 2.3, 2.4, and 2.5 of the EM&A Manual (Version F) for the CAPCS, CHPs, Standby Flare, and ASP respectively. The concentrations of the concerned air pollutants were monitored on-line by the CEMS. Exceedances of various emission parameters were recorded on the CEMS including: <ul style="list-style-type: none"> ○ NO_x and SO₂ from CHP1; ○ NO_x from CHP2; ○ NO_x from CHP3; ○ NO_x, SO₂, and NH₃, from the ASP. • The Contractor has investigated the cause of the exceedances and identified that: • The exceedances of NO_x and SO₂ and from the CHPs; NO_x, SO₂, and NH₃ from the ASP occurred due to system instability. • Regarding the NO_x exceedances from CHP1, the Contractor has identified that the exceedances may be attributed to the frequent stopping/ starting of the system. • Regarding the NO_x exceedances from CHP2, the Contractor has identified that the exceedances may be attributed to the frequent stopping/ starting of the system. • Regarding the NO_x exceedances from CHP3, the Contractor has identified that the exceedances may be reduced by various fine-tuning measures. • Regarding the SO₂ exceedances from the CHPs, SO₂ sampling and testing was completed by a third-party laboratory that showed lower SO₂ values than those reported by the CEMS. The lower values measured by the laboratory was attributed to methane gas interference. Based on this study, it was proposed to implement a correction factor in the CEMS to adjust for the methane gas interference. After review by MT and IEC, the correction factor was implemented on 17 May 2024.

Investigation Report of CEMS Exceedances

	<ul style="list-style-type: none"> The various exceedances from the ASP can be attributed to the frequent starting and stopping of the system which has been causing unstable process conditions during operation.
Action Taken / Action to be Taken	The Contractor investigated the reason for the exceedances and arranged Remedial Works and Follow-up Actions (see below).
Remedial Works and Follow-up Actions	The Remedial Works and Follow-up Actions to be implemented by the Contractor to address the above exceedances (as well as updates on any exceedances from recent months) are detailed in the following table below.

Monitoring Location	Measures/ Actions to Address any Exceedances	Implementation Timeline & Status
Centralised Air Pollution Unit (CAPCS)	<ul style="list-style-type: none"> To address the exceedances for Total Odour (ou/Nm³) recorded in January 2024 and February 2024, the Contractor ordered a new H₂S / ORP sensor to replace the faulty one which was installed on 23 May 2024. The cleaning of the ventilation pumps was conducted in April 2024. 	<ul style="list-style-type: none"> All measures have been implemented.
Cogeneration Unit 1 (CHP 1)	<ul style="list-style-type: none"> To address the ongoing NO_x exceedances recorded from October 2023 – June 2024, the Contractor ordered 3 new cylinder heads from the supplier to replace the old ones and improve performance which were installed in May 2024. To address the SO₂ exceedances recorded from October 2023 – June 2024, SO₂ sampling and testing was completed by a third-party laboratory that showed lower SO₂ values than those reported by the CEMS. The lower values measured by the laboratory was attributed to methane gas interference. Based on this study, it was proposed to implement a correction factor in the CEMS to adjust for the methane gas interference. After review by MT and IEC, the correction factor was implemented in May 2024. To address the HCl exceedances recorded from October 2023 – April 2024, the Contractor implemented in May 2024 fine tuning measures such as reviewing the ignition temperature curve, spark plug condition check and adjusting the intake & exhaust valves on the cylinder to reduce the fluctuations in HCl emissions and keep within the permissible limit. A CHP expert from Europe visited the ORRC1 facility from 20-24 May to review the performance of the CHPs. The Contractor will receive additional advanced training from the manufacturer for the operation and maintenance of the equipment. 	<ul style="list-style-type: none"> The new cylinder heads were installed in May 2024, and further works are ongoing. The updated SO₂ correction factor was implemented on 17 May 2024. The fine-tuning measures were implemented during May 2024. The CHP expert visited in from 20-24 May 2024 and report submitted in June; Contractor will begin reviewing the report in July. The Contractor will receive additional training in December 2024.
Cogeneration Unit 2 (CHP 2)	<ul style="list-style-type: none"> To address the ongoing NO_x exceedances recorded from October 2023 – June 2024, fine tuning of CHP 2 such as reviewing the ignition temperature curve, spark plug condition check and adjusting 	<ul style="list-style-type: none"> The fine-tuning measures were implemented in May 2024, and further works are ongoing.

Monitoring Location	Measures/ Actions to Address any Exceedances	Implementation Timeline & Status
	<p>the intake & exhaust valves on the cylinder was conducted to reduce the fluctuations in NO_x emissions and to keep within the permissible limit.</p> <ul style="list-style-type: none"> To address the SO₂ exceedances recorded from October 2023 – April 2024, SO₂ sampling and testing was completed by a third-party laboratory that showed lower SO₂ values than those reported by the CEMS. The lower values measured by the laboratory was attributed to methane gas interference. Based on this study, it was proposed to implement a correction factor in the CEMS to adjust for the methane gas interference. After review by MT and IEC, the correction factor was implemented in May 2024. To address the HCl exceedances recorded from November 2023 and April 2024, the Contractor implemented fine tuning measures such as reviewing the ignition temperature curve, spark plug condition check and adjusting the intake & exhaust valves on the cylinder to reduce the fluctuations in HCl emissions and keep within the permissible limit. A CHP expert from Europe visited the ORRC1 facility in May 2024 to review the performance of the CHPs. The Contractor will receive additional advanced training from the manufacturer for the operation and maintenance of the equipment. 	<ul style="list-style-type: none"> The updated SO₂ correction factor was implemented on 17 May 2024. The CHP expert visited in from 20-24 May 2024 and report submitted in June; Contractor will begin reviewing the report in July. The Contractor will receive additional training in December 2024.
Cogeneration Unit 3 (CHP 3)	<ul style="list-style-type: none"> To address the ongoing NO_x exceedances, fine tuning measures of CHP 3 were implemented such as reviewing the ignition temperature curve, spark plug condition check and adjusting the intake & exhaust valves on the cylinder is being conducted to reduce the fluctuations in NO_x emissions and to keep within the permissible limit. To address the SO₂ exceedances recorded from October 2023 – April 2024, SO₂ sampling and testing was completed by a third-party laboratory that showed lower SO₂ values than those reported by the CEMS. The lower values measured by the laboratory was attributed to methane gas interference. Based on this study, it was proposed to implement a correction factor in the CEMS to adjust for the methane gas interference. After review by MT and IEC, the correction factor was implemented in May 2024. A CHP expert from Europe visited the ORRC1 facility in May 2024 to review the performance of the CHPs. The Contractor will receive additional advanced training from the manufacturer for the operation and maintenance of the equipment. 	<ul style="list-style-type: none"> The fine-tuning measures were implemented in May 2024, and further works are ongoing. The updated SO₂ correction factor was implemented on 17 May 2024. The CHP expert visited in from 20-24 May 2024 and report submitted in June; Contractor will begin reviewing the report in July. The Contractor will receive additional training in December 2024.
Ammonia Stripping Plant (ASP)	<ul style="list-style-type: none"> To address the ongoing NO_x exceedances recorded from October 2023 – June 2024, the Contractor conducted an overhaul of the ASP and arranged for a visit by the supplier to improve the reliability and performance of the system. To address the ongoing SO₂ exceedances recorded from October 2023 – June 2024, SO₂ sampling and 	<ul style="list-style-type: none"> The overhaul of the ASP was completed 6 May 2024 The supplier could not visit in June 2024 as planned and will be rescheduled.

Monitoring Location	Measures/ Actions to Address any Exceedances	Implementation Timeline & Status
	<p>testing was completed by a third-party laboratory that showed lower SO₂ values than those reported by the CEMS. The lower values measured by the laboratory was attributed to methane gas interference. Based on this study, it was proposed to implement a correction factor in the CEMS to adjust for the methane gas interference. After review by MT and IEC, the correction factor was implemented in May 2024.</p> <ul style="list-style-type: none"> • To address the ongoing NH₃ exceedances recorded from October 2023 – June 2024, the Contractor conducted an overhaul of the ASP and arranged for a visit by the supplier. • To address the HCl exceedances recorded from October 2023 – May 2024, the Contractor conducted an overhaul of the ASP and arranged for a visit by the supplier. 	<ul style="list-style-type: none"> • The updated SO₂ correction factor was implemented on 17 May 2024.

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