BERMUDA ELECTRIC LIGHT COMPANY LIMITED

ANNUAL OPACITY MONITORING REPORT

For the period

JANUARY 1ST, 2021 – DECEMBER 31ST, 2021

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Prepared by:

OHSE Coordinator
Occupational Health, Safety & Environment (OHSE) Business Centre

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(January 1st, 2021 through December 31st, 2021)

Introduction

This report summarizes BELCO's Continuous Opacity Monitoring System for the period **January 1st, 2021 to December 31st, 2021** as required under Conditions 5.3 and 6.3 of BELCO's Operating Licence (OL-114). The report presents information related to BELCO's Opacity Monitoring program previously reported in 2021 Quarterly Reports to the Environmental Authority and includes: summary data collected from the in-stack opacity instruments on the E7, E8, N1, N2, N3 and N4 engines; availability statistics and maintenance performed on all operating opacity instruments; the results for monthly visible emissions (VE); as well as a Non-Compliant Engine (NCE) summary for the year.

In-Stack Opacity Monitor Exceedances

Bermuda Clean Air Regulations 1993 limits emissions to a standard of 20 percent opacity over a six-minute average. However, BELCO's Operating Licence OL-114, limits emissions to a regulatory standard of 15 percent opacity over a six-minute block average as described in Section 5.3.2. Opacity emissions are presently measured using in- stack Continuous Opacity Monitoring Systems (COMS) on six (6) of BELCO's diesel engines (E7, E8, N1, N2, N3 and N4).

The COMS utilized in all installations consist of Teledyne Monitor Labs' Lighthawk Model 560 Compliance Opacity Monitors. It is noted that diesel engines E5 and E6 were not fitted with in-stack opacity meters and therefore BELCO's opacity emissions from these diesel engines were monitored in 2021 using monthly visual opacity observations as per EPA Alternative Method 9 & ALT-082.

During the 2021 monitoring period there were zero (0) exceedances of the regulatory standard recorded by the in-stack opacity monitors.

Since 2010, there has been a significant reduction in the number of opacity exceedances reported (**Figure 1**). Year to year opacity exceedance records have decreased by approximately 97% since 2010 which is an example of BELCO's continued effort to improve our Standard Operating Procedures (SOP's) and operate more efficiently. All remaining exceedances recorded by the in-stack opacity monitors presented in the quarterly reports are permitted under Section 5.3.2. of BELCO's Operating Licence.

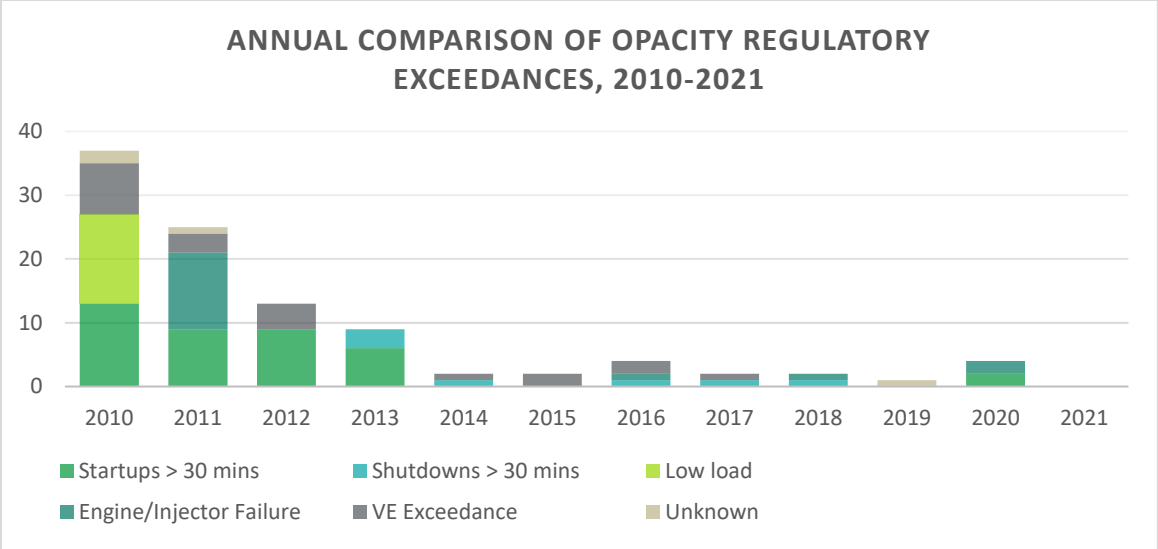

Figure 1: Comparison of Opacity Monitor Regulatory Exceedances 2010-2021

Data Availability

Data availability throughout the reporting period was considered generally high on all in-stack opacity units in 2021. The 2021 annual cumulative availability average for each unit was 95.44%, 99.27%, 98.42%, 98.75%, 95.28% and 96.46% for opacity monitors on E7, E8, N1, N2, N3 and N4 respectively. (**Figure 2**). As such, all COMS yearly average values met the 95% data availability target for 2021.

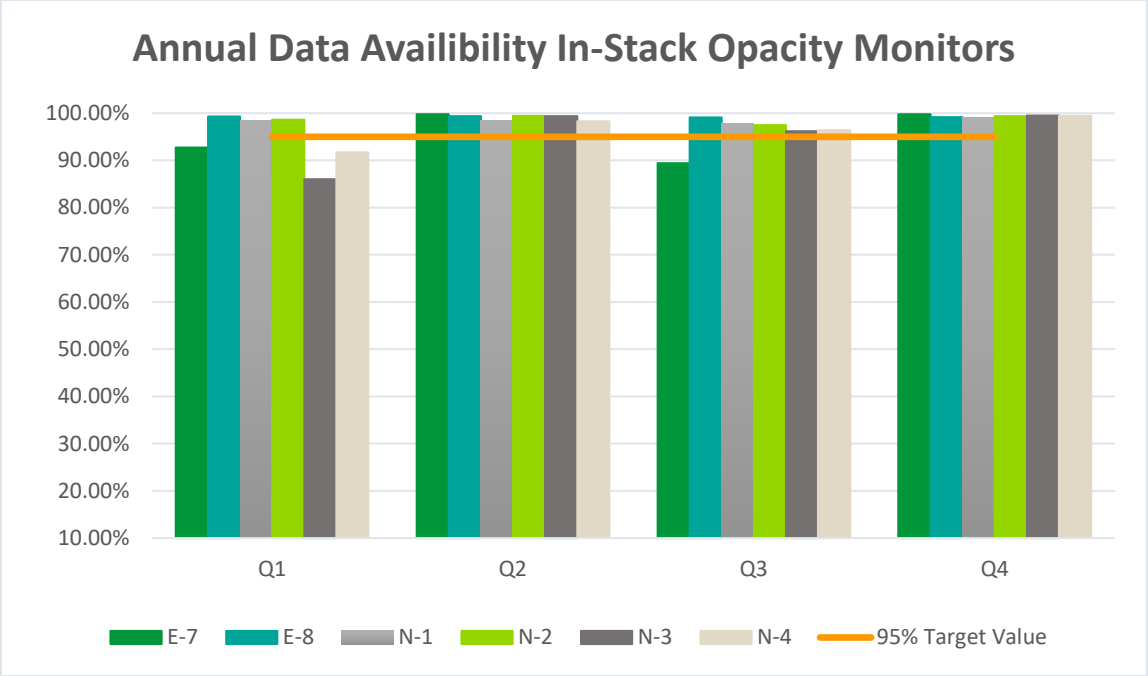

Figure 2: Annual Data Availability of In-Stack Opacity Monitors 2021

Opacity System Calibration and Maintenance

Each COMS instrument is challenged daily and is required to pass a zero (0%) and span calibration (25-28%). Annual calibration drift data indicated that for the six active opacity monitors, 24 daily calibrations of a possible 2,190 total daily calibrations in 2021 failed. It is noted that Q1 had a total of 15 days of instrument drift above 4% for N1, N2, and N4 (i.e., either a zero, span or both), Q2 had 6 total days, Q3 had 3 total failure days while Q4 2021 had zero instances of calibration drift above 4%. All reported opacity data that followed a failed calibration was flagged as invalid in CEMLink6 until such time a successful calibration was achieved. In many cases, the COMS instrument self-corrected while for more serious failures a maintenance visit was required for instruments that did not self-correct. In accordance with BELCO's Operating License #OL-114, DENR was notified of all issues that resulted in significant data loss.

Regular bi-monthly maintenance was scheduled and executed by BELCO Bulk Generation Electrical Instrumentation & Control personnel on all operating COMS throughout the 2021 period. The Semi-annual maintenance of the opacity monitoring system and software was performed in September 2021 by VIM Technologies. During the service visit, VIM Technologies performed all maintenance and inspections required by the Teledyne Monitor Labs Lighthawk Opacity monitors installed on Engines E7, E8, N1, N2, N3 and N4 and the associated VIM CEMLink 6 Data Acquisition System (DAS). A summary of VIM's maintenance visit is provided in **Appendix I**. Due to COVID-19 travel restrictions; VIM personnel were unable to travel to Bermuda for the service visit originally scheduled for Q1 2021.

Visible Emissions Monitoring

Visible Emissions (VE) monitoring was completed monthly throughout 2021 for all active engines without dedicated COMS (i.e. E5 and E6) as well as the NPS engines for which there were no exceedances of the 15% regulatory standard recorded. Details of all visible emissions monitoring activities can be found in the quarterly reports previously submitted to the Environmental Authority.

BELCO maintained at least one certified visual opacity reader on staff at all times during 2021 as required under Conditions 5.3.4 of BELCO's Operating Licence #OL-114. All readers were certified by Eastern Technical Associates (ETA) in the case of U.S.E.P.A. Federal Reference Method 9, and Virtual Technology LLC in the case of U.S.E.P.A. Alternative Method 082 and utilizing ASTM D-7520-09 (ALT-082).

During the 2021 period BELCO held the following VE certifications:

Method 9: OHSE Coordinator, Date of Certification September 29, 2021
Certification Expiration March 31, 2022

ALT-082: OHSE Coordinator Date of Certification September 12, 2018
OHSE Coordinator, Refresher Training September 12, 2018
OHSE Coordinator, Date of Certification October 4, 2017
Environmental Engineer, Date of Certification August 18, 2018

The ALT-082 certification from Virtual Technology LLC is maintained by the submission of a valid observation on a quarterly basis. **Appendix II** contains copies of all Visible Emissions Evaluator and Digital Still Camera Operator Certificates.

Operation of Non-Compliant Engines (NCEs)

The Environmental Authority's approval for NCE operation shall be requested on a case by case basis by BELCO as per the Appendix of BELCO's Operating License by the Department of Environment & Natural Resources' Environmental Authority. There were no engines assigned NCE status by BELCO for this reporting period. Therefore, there was no NCE operation in 2021.

Conclusion

During the 2021 monitoring period there were zero (0) exceedances of the regulatory standard for opacity recorded by the in-stack opacity monitors. All six continuous opacity monitors passed daily calibration drift tests in 2021 with the exception of N1, N2 and N4 in Q1, N4 in Q2 and N3 in Q3 2021. There was a total of twenty-four (24) failed daily calibration drift tests for all opacity monitors in 2021. Data availability throughout the period was high on all monitoring units. Each unit's data availability met US EPA data

availability requirements and had a combined average of 97.27% at the end of 2021. Visible Emissions Monitoring was completed monthly throughout the period for which there were no exceedances of the 15% regulatory standard recorded. BELCO maintained a certified VE reader in both EPA Method 9 and/ or Alternative Method 082 specifications on staff at all times during 2021. Maintenance of the opacity monitoring system was routinely performed; bi-monthly by BELCO Instrumentation and Control personnel and semi-annually by VIM personnel that performed detailed on and off-stack calibrations for COMS in September 2021. There were no engines assigned NCE status in 2021 and therefore no NCE operations in 2021.