

GOVERNMENT OF THE DISTRICT OF COLUMBIA
Department of Energy and Environment

CHAPTER 2 TECHNICAL MEMORANDUM

TO: Stephen S. Ours, P.E. *SSO*
Chief, Permitting Branch

FROM: John C. Nwoke *JCN*
Engineer

SUBJECT: **District of Columbia Water and Sewer Authority (DC Water)
Permit No. 6372-C2/O to Construct and Operate Biosolids Management and
Handling Facilities at Blue Plains Wastewater Treatment Plant**

DATE: March 12, 2018

BACKGROUND INFORMATION

On October 27, 2014, the District of Columbia Water and Sewer Authority (DC Water) was issued a permit (Permit No. 6372-C-A2) to construct new biosolids handling facilities at Blue Plains advanced waste water treatment plant. The permit expired on March 15, 2015.

DC Water requested renewal of the permit, but due to delays the permit was not renewed. However, to enable the continued construction activities at the facility while being in compliance with the law, DC Water requested a series of 30-day permit extension, which were granted.

Furthermore, on June 2, 2016, August 4, 2016 June 30, 2017, and August 23, 2017, DC Water submitted various requests to modify the existing Permit No. 6372-C-A2. First, DC Water submitted a request for the removal of particulate matter (PM) and hazardous air pollutant (HAP) testing of the emergency flares from the permit on June 2, 2016. Second, on August 4, 2016, DC Water submitted additional requests for a resolution of contradictions in testing frequencies for the CHP facility in the permit and modifications to the Main Process Train odor scrubber (MPTOS) operation and monitoring requirements based on the measured concentrations of odorous pollutants entering the scrubber. Following the June 30, 2017 meeting, DC Water proposed modification of permit limits regarding auxiliary boiler operation. On August 23, 2017, DC Water submitted a technical justification for a proposed change to the emergency flare NOx limits, previously established as LAER, but not actually achieved.

Much of the equipment covered by the permit is now operational, but some remains under construction. Since construction of permitted equipment and processes is on-going at the facility, a combined construction and operation permit is proposed.

The discussion of this memo's technical information will be primarily focused on the requested changes to the existing permit requirements.

Additionally, this memo will discuss why the Air Quality Division (AQD) believes that certain

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emission limits included in this permit constitute Reasonably Available Control Technology (RACT). These limits are intended to be submitted to the U.S. Environmental Protection Agency (EPA) as case-by-case RACT determinations to address equipment not covered by existing RACT standards found in 20 DCMR 805, but subject to RACT requirements due to the 2008 and 2015 National Ambient Air Quality Standards (NAAQS) for ozone.

DC Water has not requested that any aspects of the applications be held confidential.

EVALUATION OF AMENDMENT REQUESTS

The requested modifications are discussed in detail below:

1. PM and HAP Testing for Emergency Flares:

- Condition III(d)(3)(A) required testing on the emergency flares for criteria pollutants and HAPs as listed in Condition III, Table 2. DC Water contends that performing PM testing on the flares at Blue Plains is not currently possible using the approved isokinetic EPA methods because the required apparatus for testing begins to soften at 1500 deg. F. DC Water notes that the temperature of the flare's flame is upwards of 2200 deg. F and that the temperature recorded at the sampling ports varied from 1400 deg. F to 1600 deg. F during the testing of the other permit parameters. To accommodate a monorail that would need to be installed to safely conduct the test, the sampling ports cannot be moved any further up the stack because that would jeopardize the required clearances for the samplers to safely perform the test. Any attempt to take measurements at a point where the temperature was reliably under the softening point of the sampling apparatus would be above the stack and outside of the flare.
- Additionally, calculations were performed using samples collected from the digester gas with the assumption that all of the silicon in the siloxane is converted to silicon dioxide (SiO₂). DC water determined that SiO₂ production in lb/MMBtu (HHV) of digester gas ranged from 7.91e-5 to 3.65 e-4 lb/MMBtu, as compared to natural gas particulate emission rates of 7.6 lb/MMBtu (filterable plus condensable). One can reasonably assume that due to the excessive heat of combustion in the flare, emissions of polycyclic aromatic hydrocarbons would be negligible and the largest potential PM emissions would be attributed to SiO₂.
- Because of DC Water's inability to safely perform the test, and the anticipated low production of SiO₂, *DC Water requested that the testing requirement of the emergency flares be waived. In lieu of testing, DC Water will perform digester gas sampling and calculate PM emissions based on siloxane content in the digester gas every five years. In addition, DC Water requested the removal of the HAP testing requirement.*

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- Testing for speciated HAPs was not possible for the emergency flares for the same reasons the PM could not be tested at the high temperatures of the flare exhaust. The HAP emission estimates in the existing permit for the emergency flares were based on the County of San Diego Air Pollution Control District's recommendation for digester gas-fired flares. *Thus, DC Water requested to demonstrate compliance with emission limits through calculations.*

AQD agrees that isokinetic sampling at the flare for PM will not work and agrees that the proposed alternative of periodically (once every five years, consistent with the emission testing schedule) sampling for siloxane in the digester gas is a reasonable alternative.

Additionally, AQD agrees that organic HAPs would be expected to be destroyed to a very high efficiency, given the temperatures of the flare, and that HAP speciation testing is not workable in this situation. However, in order to ensure that HAP metals (which would not be destroyed in the flare) are not being emitted in excessive levels, AQD believes that periodic testing of the digester gas for metals content is also appropriate.

These digester gas sampling requirements have been added to Condition III(d)(3)(A).

2. Testing Frequencies:

- Condition III(a)(3)(A) requires annual stack testing on the turbines for NO_x, while Condition III(a)(3)(G) requires stack testing for NO_x, CO, VOC, SO_x and HAPs every five years. As worded in the permit, this requirement could be construed as a redundant testing for NO_x. *To avoid this, DC Water requested language that specifies that a stack test for NO_x be performed on each turbine annually to comply with the requirements of 40 CFR 60.4400, and a stack test for the remaining pollutants be performed every five (5) years.*
- *DC Water requested that Condition III(c)(3)(A) for testing of the duct burners be modified to require the same testing frequency for each pollutant as in the case of the turbines.*
- Condition III(d)(3)(A) requires source testing of each flare at multiple loads every five years, while Condition III(d)(3)(B) requires this testing no sooner than 2 years and no later than 3 years after the previous test. DC Water found these terms to be inconsistent and they requested that the frequency of Condition III(d)(3)(B) be changed to require testing every five years to be consistent with Condition III(d)(3)(A) and testing frequency required for other units in the permit.

These comments reflect the intent of the previous language in the permit, but in the case of the first two bullet points, it was apparently not clear to the Permittee. In the case of the third

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bullet point, the language in the permit was clearly in error. In all three locations, AQD has revised the relevant language to clearly specify the intent of the conditions.

3. Main Process Train Odor Scrubber (MPTOS):

- DC Water contends that due to the low concentrations of H₂S, testing for the MPTOS was unable to show compliance with the removal efficiency of H₂S (a max. outlet concentration of 0.05 ppmv for inlet concentrations ≤ 1 ppm).
- The concentration of contaminants is not high enough to develop and support biological activity for the permitted removal of H₂S. DC Water demonstrated this observation when in June 29, 2016 DC Water collected a H₂S sample with the highest concentration of 0.2 ppm.
- Due to such low concentrations, DC Water requested a modification to limit MPTOS operation to when H₂S concentrations exceed 6 ppm. The H₂S concentration will be monitored quarterly through seasonal grab samplings at the inlet.
- In support of this request, DC Water performed air dispersion modeling of the H₂S odor at varying levels of H₂S concentrations and compared the impacts to H₂S odor threshold in published literature. According to DC Water, even at 10 ppm, the H₂S impacts from the MPTOS were below the literature's upper limits.

AQD agrees with DC Water that it is unreasonable to require proper operation of the MPTOS if it is impossible to maintain the biology required for biological treatment. Because this issue is a result of lower odor-emitting compound concentrations than originally expected, AQD has made revisions to the permit to only require seeded operation of the equipment if inlet concentrations of H₂S exceed 6.0 ppm. Quarterly monitoring is required to determine if the H₂S concentrations are exceeding this level. If the level were to be exceeded, procedures have been put in place to perform increased monitoring and to ultimately seed the system. These requirements are found primarily in Conditions III(g)(2)(A) and III(g)(3)(I).

4. Auxiliary Boiler Operation:

- DC Water contends that the current permit language requiring the operation of only one CT/HRSG train when the auxiliary boiler is in operation is restrictive. DC Water asked for a language change that would allow operation of two CT/HRSG trains without duct burners and with the auxiliary boiler. Basically, the modification will ensure that the auxiliary boiler will operate at times when at least two (2) duct burners are out of service.
- DC Water further requested clarification within Condition III(b)(2)(G) that the maintenance and testing referenced therein might also include the maintenance and testing of the CT/HRSG trains.

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- Effectively, because emissions from two duct burners exceeds emissions from the auxiliary boiler, the proposed change will allow DC Water more operational flexibility while still allowing them to meet the established emission limits.

AQD agrees that these changes are acceptable. They will not result in any change to emission limits, while providing further operational flexibility. As such, the requested changes have been made in the permit.

5. Reassessment of Lowest Achievable Emission Rate (LAER) for Emergency Flares

- The two emergency flares at the DC Water Blue Plains facility burn digester gas when other portions of the plant are unable to do so, such as when the combustion turbines trip off. Originally, the LAER level had been set at 0.042 lb/MMBTU based on manufacturer's documents, but it had later become known that the manufacturer would not guarantee a level below 0.06 lb/MMBTU. This 0.06 lb/MMBTU was similar to previously established LAER levels at other wastewater treatment plants where digester gas was burned in flares. As such, AQD had previously recognized that it may be necessary to reassess this LAER level.
- In December 2015, DC Water attempted to determine compliance with the established LAER level of 0.042 lb/MMBTU NO_x from the two emergency flares at the facility. Results showed levels well above that level, as well as well above the manufacturer's guaranteed level of 0.06 lb/MMBTU. Measured levels averaged approximately 0.09 lb/MMBTU. Further testing was attempted in June/July 2016 that showed similar levels, averaging approximately 0.08 lb/MMBTU.
- DC Water evaluated the root causes of the higher than expected levels. In a memorandum dated August 23, 2017, DC Water explained that they had determined that ammonia (NH₃) levels in the digester gas were found to be approximately three times higher than those at traditional wastewater treatment plants. This is an artifact of the fact that the thermally hydrolyzed sludge digestion process being implemented at DC Water was different than traditional sludge digestion processes. This thermal hydrolysis process is being implemented for the first time in the U.S. at DC Water and is therefore not fully demonstrated. Other facilities of this type in the U.S. are planned, but have not yet been constructed. Due to these high levels of ammonia, there is more fuel-bound nitrogen in the digester gas than found at other wastewater treatment plants. As a result, in the flare, there is more fuel-bound NO_x production than had been expected.
- DC Water proposed establishment of a new LAER level from the flares of 0.11 lb/MMBTU. They based this proposal on what they assert is a policy in the State of New Jersey to set emission limits 10% above the maximum individual test run result or 15% above the average stack test result, whichever is higher.

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AQD agrees that a new LAER level is appropriate, however AQD has determined that, because there is a fair amount of test results available from the two testing attempts, a better way to set the level is to set it equal to two times the standard deviation of the average test results ($\sigma = 0.00553$; $2\sigma = 0.011$) above the maximum average result (max. three-run average = 0.09). As a result, AQD has determined that an appropriate LAER level is 0.101 lb/MMBTU NO_x and will include this in the permit.

While the LAER level is being increased, there is no need to increase the number of offsets required. Originally, the full biosolids project was permitted to emit 84.36 tons per year of NO_x. 130 tons of NO_x offsets were originally obtained (to accommodate an additional combustion turbine that was dropped from plans before permitting was complete). Of those, 110 were used to cover the 84.36 tons per year permitted level ($1.3 \times 84.36 = 109.5$). However, in 2014, as the project developed, the allowable emissions were reduced to 77.07 tons per year of NO_x, but the offset requirement was not changed. The result of this change in LAER level will increase emissions by up to 3.47 tons per year of NO_x to increase the allowable NO_x emissions from the project to 80.54 tons per year. See Condition III, Table 1. As a result, sufficient offsets were already incorporated in the permit to address this increase in NO_x emissions.

Note that DC Water has verbally indicated that they are unsure if compliance with the new LAER limit for the emergency flares will be able to be demonstrated consistently over time as increased influent to the facility occurs over the years to approach the facility's design capacity. Currently average daily plant influent load is 290 million gallons per day. The plant is designed to accommodate 384 million gallons per day. It is possible that ammonia levels will increase as average daily load increases, causing a need to reconsider this level again in the future.

EVALUATION OF EMISSIONS

The changes in this permit will not increase allowable emissions except as discussed above reflecting increased NO_x emissions levels from the emergency flares. The allowable emissions from the equipment covered by the biosolids permit will now be set at the following:

Table 1: Total 12-Month Rolling Emission Limits from Permitted Equipment¹

Pollutant	12-Month Rolling Emissions Limit (tons/yr)
PM (Total) ²	18.45
SOx	25.04
NOx	80.54
VOC	11.84
CO	97.51
PM10	18.45

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Pollutant	12-Month Rolling Emissions Limit (tons/yr)
PM2.5	18.45
HAPs (Total)	1.75

1. The equipment covered consists of three Solar Mercury 50 gas turbines, three duct burners, one auxiliary steam boiler, one siloxane removal system, two emergency flares, space heating units as referenced in this permit, two odor scrubbers (MPTOS and EDFOS), and two lime silo baghouses.

2. Total PM is the sum of the filterable PM and condensable PM

Table 2- Maximum Hourly Emissions (lbs/hr)

Pollutants	Each Solar Mercury 50 Gas Turbine	Each Duct Burner	Auxiliary Boiler	Siloxane Removal System	Each Emergency Flare
PM (Total)	1.06	0.16	2.69	0.21	2.52
SOx	1.21	0.55	1.63	0.16	3.28
NOx	3.56	1.66	2.11	0.37	12.72
VOC	0.40	0.03	0.31	0.53	2.54
CO	4.34	2.31	2.22	1.25	2.52
PM10	1.06	0.16	2.69	0.21	2.52
PM2.5	1.06	0.16	2.69	0.21	2.52
Total HAPs	0.07	0.06	0.17	0.01	0.19

Table 3 – Start-Up Emissions for Two Temporary Boilers and One Emergency Flare

Pollutant	Temporary Sources During Construction	
	Temporary Steam Boilers⁽¹⁾ (Natural Gas) (lbs/hr)	Emergency Flare (Digester Gas) (lbs/hr)
PM (Total)	0.020	2.52
SOx	0.04	3.28
NOx	2.00	12.72
VOC	0.10	2.54
CO	0.72	2.52
PM10	0.20	2.52
PM2.5	0.20	2.52

⁽¹⁾ The emission rates listed in this column are informational only and may change without the amendment of the permit. The boilers are permitted under separate Permit Nos. 6809 and 6810, issued to Pepco Energy Services, Inc.

During a start-up period projected to have a duration of six to nine months after initial operation of portions of the equipment, natural gas will be the primary fuel, with supplemental digester gas as available.

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REGULATORY REVIEW

No changes to the regulatory evaluation are being implemented as compared to those evaluations performed related to the previous permit (6372-C-A2, dated October 27, 2014) except in regard to the following regulations.

20 DCMR 204: Permit Requirements for Major Sources Located in Non-Attainment Areas (New Source Review)

The previously determined LAER level for the emergency flares is being changed from 0.042 lb/MMBTU to 0.101 lb/MMBTU NO_x. The details of this change are discussed above in point 5 of the Evaluation of Amendment Requests section of this memorandum.

20 DCMR 805: Reasonably Available Control Technology for Major Stationary Sources of the Oxides of Nitrogen

AQD has determined that, because the Blue Plains Wastewater Treatment Plant is a major source of NO_x, reasonably available control technology (RACT) must be established for NO_x for the equipment burning digester gas pursuant to 20 DCMR 805. This was not previously considered in earlier regulatory analyses because the equipment was going through a LAER determination under 20 DCMR 204. The District considers LAER to be at least as stringent as RACT, at least at the time of original evaluation.

In this case this biosolids project, with its thermally hydrolyzed sludge digestion, is unique in the U.S. As noted above, the digester gas has different properties (higher ammonia levels) that means that previous RACT and LAER analyses for wastewater treatment plant flares are not relevant. The technology used, however, is one that, in other wastewater treatment applications, does meet those standards.

Other equipment involved in the process including the combustion turbines, heat recovery steam generators with duct burners, and auxiliary boiler are still among the best performing units in the RACT/BACT/LAER Clearinghouse for broadly similar applications.

AQD considers the NO_x limits in the permit for the digester gas fired equipment to represent RACT as a result. AQD expects to incorporate these standards into the District's State Implementation Plan (SIP) at 40 CFR 52, Subpart J. Noting, however, that these values have not yet been demonstrated at average daily plant influent flows approaching the design capacity of the facility (384 million gallons per day), AQD expects to establish RACT only for average flows of 290 million gallons per day and below with this process. In the future, as average influent flow rates increase at the facility it may be necessary to re-evaluate RACT since RACT has not been demonstrated at any facility in the U.S. for this technology at those levels at this time.

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RECOMMENDATIONS

The draft permits are scheduled for posting in the D.C. Register and on the Department's website on March 16, 2018 and will be available for public comment through April 16, 2018.

The proposed project and attached permit comply with all applicable federal and District air pollution control laws and regulations. Assuming no comments are received during the public review period, I recommend that the attached permit document be issued as drafted. If comments are received, they will be reviewed and addressed appropriately before the permit is issued.

SSO/JCN

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