

Technical Evaluation
and
Preliminary Determination

Virginia Key Sewage Treatment Plant
Miami - Dade Water and Sewer Authority
Dade County
Virginia Key, Key Biscayne, Florida

Permit Number:
AC 13-81284

Florida Department of Environmental Regulation
Bureau of Air Quality Management
Central Air Permitting

January 25, 1985

I. Applicant and Source Location

A. Applicant

Virginia Key Sewage Treatment Plant
Miami - Dade Water and Sewer Authority
3575 South LeJeune Road
Miami, Florida 33133

B. Project and Location

The applicant proposes to modify an existing facility by constructing/installing 4 new 1200 KW methane gas fueled internal combustion engines (prime movers) and associated electrical generators. Each prime mover will have 16 cylinders and will be turbocharged.

Virginia Key Sewage Treatment Plant is located at Virginia Key, Key Biscayne, Florida, with UTM coordinates of Zone 17, 582.2 km East and 2848.1 km North. The facility is also located in an area designated nonattainment for the pollutant ozone.

C. Process and Controls

Methane gas is generated from the digesting of sewage sludge. The collected gas is scrubbed, using chlorinated effluent water to remove hydrogen sulfide (H₂S) gas, which is a contaminant in digester methane gas. Carbon dioxide (CO₂) is also partially removed when the digester gas is scrubbed. Scrubbed digester gas is approximately 72% methane, 28% CO₂, with some traces of H₂S.

After scrubbing the gas, it is stored in two 40-foot diameter and one 32-foot diameter storage spheres. Total storage capacity is estimated to be 313,230 scf at 40 psig.

The gas is then transferred from the storage tanks to the prime movers for combustion. Of the combustion products, nitrogen oxides (NO_x) will be the pollutant of most concern. Since NO_x emission control techniques are essentially designed modifications and not add-on equipment, the applicant will be requiring that all contractor's bids for the proposed project include engine design that will at least meet the NO_x emission limit as presented in the proposed new source performance standard (NSPS), 40 CFR 60, Subpart FF.

Of the four proposed new sources, the applicant proposes to operate only three of the new sources at a maximum of 8,400 hours each per year, while the other new source will be placed on a stand-by basis. The total annual hours of operation, all units, shall not exceed 27,200.

II. Rule Applicability

The proposed project is subject to preconstruction review under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code (FAC) Rule 17-2. The application was complete November 16, 1984.

The existing facility is a major facility in accordance with FAC Rule 17-2.100(98), because the potential emissions of the pollutant NO_x (nitrogen oxides) are greater than 100 tons per year (TPY).

The existing facility does not belong to any of the facility categories listed in Table 500-1, Major Facility Categories, and the sum of the potential emissions of all the pollutants emitted from all of the existing sources are not equal to or greater than 250 TPY. The proposed modification to the existing facility does not belong to any of the facility categories listed in Table 500-1, Major Facility Categories, and the sum of the potential emissions (see Table 1) of all the pollutants projected to be emitted from the proposed sources are not equal to or greater than 250 TPY. Therefore, the proposed modification is not subject to new source review requirements pursuant to FAC Rule 17-2.500, Prevention of Significant Deterioration, in accordance with FAC Rule 17-2.500(2).

The existing facility to be modified is located in Dade County, which is an area designated nonattainment for the pollutant ozone, pursuant to FAC Rule 17-2.410(1)(d). VOC, which is defined in FAC Rule 17-2.100(179), are precursors to ozone and are therefore reviewed in accordance with FAC Rule 17-2.510, New Source Review for Nonattainment Areas.

The existing facility is estimated to emit 7.1 TPY of the affected pollutant VOC, which will be reduced by an estimated 0.8 TPY through the retirement and dismantling of two existing digester gas/diesel fueled electrical generating units (a 1953, 410 hp and a 1953, 480 hp).

Both the existing facility and the proposed modification emit less than 100 TPY potential emissions of the nonattainment affected pollutant VOC. Therefore, the projected potential VOC emissions for the proposed modification are subject to the provisions of FAC Rule 17-2.510(2)(d)3., pursuant to FAC Rule 17-2.510(2)(d)4.b., which exempts the proposed modification from new source review in accordance with FAC Rule 17-2.510(4). Consequently, the proposed modification is subject to the provisions of FAC Rule 17-2.520, Sources Not Subject to Prevention of Significant Deterioration of Nonattainment Requirements.

Table 1

Source	Projected Potential Pollutant Emissions							
	NO _x		SO ₂		CO		VOC	
	lbs/hr	TPY	lbs/hr	TPY	lbs/hr	TPY	lbs/hr	TPY
1 Unit	18.3	76.9	1.5	6.3	5.2	21.9	1.6	6.9
All Units		248.9		20.4		70.7		22.3

Note:

- Unit: An internal combustion engine with an associated generator.
- SO₂ - sulfur dioxide CO - carbon monoxide
- Based on 8,400 hours of operation per source, with a maximum total hours of operation, all units, of 27,200.
- One of the four proposed new sources is on a stand-by basis.
- NO_x potential emissions are based on 700 ppm by volume, at 15 percent O₂ on a dry basis.
- SO₂ emissions are based on the projected H₂S input, assuming that 100% of the H₂S is converted to SO₂-SO₃ upon combustion.
- CO emission estimated from AP-42 Emission Factors, Table 3.3.2-1.
- VOC emissions estimated at 10% of the total HC (hydrocarbon) found in AP-42 Emission Factors, Table 3.3.2-1.

For these proposed new sources, there is not an emission limiting and performance standard contained in FAC Rule 17-2.600, Specific Source Emission Limiting Standards, nor in FAC Rule 17-2.650(1), Reasonably Available Control Technology - Volatile Organic Compounds. Therefore, the proposed modification shall be permitted in accordance with FAC Rule 17-2.610(2), General Visible Emissions Standard, and FAC Rule 17-2.620(2), General Pollutant Emission Limiting Standards - Objectionable Odors Prohibited.

In accordance with FAC Rule 17-2.610(2), no person shall cause, let, permit, suffer or allow to be discharged into the atmosphere any air pollutants from new, or existing sources, the density of which is equal to or greater than that designated as Number 1 on the Ringelmann Chart, the opacity of which is equal to or greater than 20 percent.

In accordance with FAC Rule 17-2.620(2), no person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor. Therefore, objectionable odors, related to the proposed modification, shall not be allowed on off-plant property.

The applicant requested a NO_x emission limit of 700 ppm by volume, at 15% oxygen on a dry basis, which is the same limit for NO_x as presented in the proposed new source performance standard, 40 CFR 60, Subpart FF. With this emission limit and by placing a cap on the total annual hours of operations, all units, the proposed modification is not subject to new source review pursuant to FAC Rule 17-2.500, Prevention of Significant Deterioration. The bureau finds the request acceptable and will adopt the emission limiting standard in the attached draft permit.

Compliance tests for visible emissions and NO_x shall be required and shall be performed in accordance with FAC Rule 17-2.700, Stationary Point Source Emissions Test Procedure. Visible Emissions tests shall be performed using EPA Method 9. NO_x emissions tests shall be performed using EPA Method 7. Frequency of tests, reporting, notification, etc. shall be in accordance with FAC Rule 17-2.700.

III. SUMMARY OF EMISSIONS AND AIR QUALITY ANALYSIS

A. Emission Limitations

The regulated pollutant emissions from this facility are NO_x and visible emissions, in accordance with the emission limiting standard established at the request of the applicant and FAC Rule 17-2.610(2), respectively. Table 2 will display the pollutants, their emission limiting standards, and the allowable emission limits for the proposed new sources:

Table 2

Source	Pollutant	Emission Limiting Standard	Allowable Emission Limit	
			lbs/hr	TPY
1 Unit	NO _x	700 ppm by volume, at 15% oxygen on a dry basis	18.3	76.9
All Units	NO _x			248.9
All Units	Visible Emissions		Less than 20% Opacity	

Note:

- ° Allowable emission limit is based on 8,400 hours per unit, with a maximum total hours of operation, all units, of 27,200.
- ° One of the four proposed new sources is on a stand-by basis.

The permitted emissions are in compliance with all applicable requirements of FAC Chapter 17-2.

B. Air Quality Impacts

From a technical review of the applications, the construction and operation of the proposed new sources will not have a significant impact on the ambient air quality standards.

IV. CONCLUSIONS

The emission limits for NO_x proposed by the applicant of 700 ppm by volume, at 15% oxygen on a dry basis, have been determined to be acceptable and shall become a condition in the proposed construction permit.

The permitted emissions should not have a significant impact on the ambient air quality standards.

The General and Specific Conditions listed in the proposed construction permit (attached) will assure compliance with all applicable requirements of FAC Chapter 17-2.

New or Used
Complete operating schedule

digester gas composition by volume

CH ₄	66%	H ₂ , H ₂ S, N ₂	very small
CO ₂	28.3%		
H ₂ O	5.7%		

1 Ft³ combusted → 619 Btu
619 Btu/SCF

1200 kW methane gas fired

IC Engine

cubic inch displacement per cylinder

TOTAL TO DIGESTERS - lbs/day (dry wt)

PERCENT VOLATILES

DIGESTER GAS COMPOSITION

BTU/CF (STD) - sludge heating value

cu" displacement / cylinder and the # of cylinders

Will each engine be the same type of engine? If not, describe

will the units be sized when not enough digester gas

digester gas simultaneously - is operating schedule

If gas for

natural gas/engine
diesel/engine

single

repetitive

combined

manufacturer etc

Ultimate Analysis of the

constituents on a % by wt. basis

if volatile solids & H₂ concentrations

See subject 200

NOx emissions / hour

18-15

treatment to remove
 H_2S , CO_2 , H_2O

particulates - sedimentation traps
and cyclonic separators.



Stack $250^\circ - 400^\circ F$

not used in intermittent service due to
condensation

Reciprocating
dual-fuel (compression ignited) ^{blend diesel} + digester gas
Spark ignited engines

naturally aspirated or turbocharged

brake mean effective pressure

700 - 1000 RPM

Heavy duty

Gasturbines - Possible
reciprocating - BACT catalytic denitrification
low pressure ratio turbines - staged ignition

Electric Output 1200 kW 1609

$$\frac{(1.2 \text{ MW})}{(1.2931 \text{ MW}/10^6 \text{ Btu})} = 4 \times 10^6 \text{ Btu/hr out generator}$$

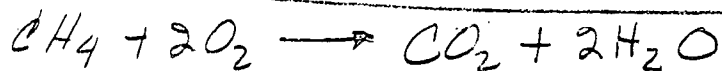
95% conversion to elect - then

$$\frac{4 \times 10^6}{.95} = 4,210,526 \text{ Btu/hr to Generator}$$

28% Conversion Prime mover

$$\frac{4,210,526 \text{ Btu/hr}}{.28} = 15,037,604 \text{ Btu/hr}$$
$$(15,037,604) \left(\frac{1}{60}\right) (0.2356) = \frac{5904.7}{\text{HP}} = 5905 \text{ hp}$$

$$\frac{15,037,604 \text{ Btu/hr}}{600 \text{ Btu/SCF}} = 25,063 \text{ SCF/hr}$$



1. $(.28 \text{ CO}_2)(25,063) = 7093 \text{ SCF/hr CO}_2$

2. $(.66 \text{ CH}_4)(25,063) = \frac{16542 \text{ SCF/hr}}{23635} \text{ CO}_2$
TOTAL CO₂

3. $(2 \text{ FT}^3/\text{FT}^3 \text{CH}_4)(10 \text{ excess air}) \left(\frac{.66 \text{ FT}^3 \text{CH}_4}{\text{FT}^3 \text{di gas}}\right) (25,063)$
 $= 3308 \text{ SCF/hr O}_2$

$$4. (25,063) (.66) \left(\frac{[1.10 \times 2] \text{ Ft}^3 \text{ O}_2 \text{ delivered}}{\text{Ft}^3 \text{ CH}_4} \right) \left(\frac{.79}{.21} \right) \text{ air ratio}$$

$$= 136,901 \text{ SCF/hr N}_2$$

$$5. (.057)(25,063) = 1429 \text{ SCF/hr H}_2\text{O in di gas}$$

$$\text{CH}_4 + 2\text{O}_2 = \text{CO}_2 + 2\text{H}_2\text{O}$$

$$(25063)(.66) \left(\frac{2 \text{ Ft}^3 \text{ H}_2\text{O}}{\text{Ft}^3 \text{ CH}_4} \right) = 33,083 \text{ SCF/hr}$$

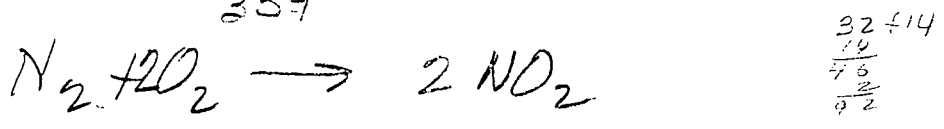
TOTAL WATER 34,512 SCF/hr H₂O

TOTAL GAS FLOW

CO ₂	23,635			
O ₂	3,308			
N ₂	136,901	.84		
H ₂ O	34,512		163,240 dry	
<u>198,356</u>		TOTAL EXHAUST SCF/hr		

$$\frac{44}{359} \text{ CO}_2 (23635) = 2897 \text{ Lb/hr}$$

$$\frac{28}{359} \text{ N}_2 (136,901) = 10,677 \text{ Lb/hr}$$



$$\frac{10677}{28} = \frac{X}{92} \quad 35,082 \text{ Lb/hr}$$