APPENDIX BD
BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION (BACT)

Marathon Generation Plant Unit No. 8
Florida Keys Electric Cooperative Association
PSD-FL-237 and 0870004-002-AC
Marathon, Monroe County

The Florida Keys Electric Cooperative Association (FKEC) plans to install a new Diesel Engine Generator at its existing Marathon Generation Plant (MGP) in Marathon, Monroe County. The unit is a General Motors Electro-Motive Diesel generator model 20-710G4B with a nominal base load rating of 3.58 megawatts (MW) at 32°C and 718 mm Hg. The facility currently consists of seven (7) diesel engine generators used for peaking power. Units 1 & 2 are each rated at 2.0 MW. Units 3, 4 and 5 are each rated at 3.0 MW, and Units 6 & 7 are 2.5 MW each. The existing Units 1-7 are allowed to burn No. 2 fuel oil with a sulfur content of 0.5 percent or less, by weight. The new Unit 8 will be fired with No. 2 low sulfur fuel oil with a sulfur content not to exceed 0.05 percent, by weight, and a fuel oil consumption limit of 2.015 million gallons per year. The facility also has four fuel oil storage tanks and other electrical generating support equipment.

FKEC has indicated that the maximum annual air pollutant emission rates in tons per year for the Unit 8 diesel generator, based on consumption of 2.015 million gallons of No. 2 fuel oil, with a maximum sulfur content of 0.05 percent, by weight, will be:

Pollutant	PSD Significance Levels[1]	Uncontrolled Emissions[2]	Controlled Emissions[3]	Expected Emissions[4]	Subject to PSD Review?
NO_x	40	423	271	24.2	Yes
CO	100	111	<100	6.4	No
PM	25	9.5	9.1	0.6	No
PM_{10}	15	7.9		0.5	No
SO_2	40	7.2		0.5	No

[1] Florida Administrative Code 212.400-2
[2] Based on firing No. 2 fuel oil (0.05% sulfur by weight) at a maximum of 2.015 million gals/yr at full load with no emission controls.
[3] Based on firing No. 2 fuel oil (0.05% sulfur by weight) at a maximum of 2.015 million gals/yr at full load with emissions control of timing retardation.
[4] Based on FKEC's historical and projected actual operating hours of 500 or less.

Following is the BACT determination proposed by the applicant:

BACT DETERMINATION REQUESTED BY THE APPLICANT:

POLLUTANT	EMISSION LIMIT
Nitrogen Oxides	62 lbs/hr by timing retardation and aftercoolers

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The Marathon Generation Power Plant is a major source of air pollution or Title V source. Because emissions of nitrogen oxides are greater than 250 tons per year, it is a major facility with respect to the Prevention of Significant Deterioration (Rule 62-212.400). Because the project will result in a significant increase in nitrogen oxides emissions per Table 62-212.400-2, F.A.C., "Regulated Air Pollutants - Significant Emissions Rates," a BACT determination is required pursuant to Rule 62-212.410, F.A.C.

DATE OF RECEIPT OF A BACT APPLICATION:

January 27, 1997

REVIEW GROUP MEMBERS:

Syed Arif (Permit Engineer, prepared BACT) and A. A. Linero (Administrator, reviewed BACT) New Source Review Section.

BACT DETERMINATION PROCEDURE:

In accordance with Chapter 62-212, F.A.C., this BACT determination is based on the maximum degree of reduction of each pollutant emitted which the Department of Environmental Protection (Department), on a case by case basis, taking into account energy, environmental and economic impacts, and other costs, determines is achievable through application of production processes and available methods, systems, and techniques. In addition, the regulations state that, in making the BACT determination, the Department shall give consideration to:

- Any Environmental Protection Agency determination of BACT pursuant to Section 169, and any emission limitation contained in 40 CFR Part 60 - Standards of Performance for New Stationary Sources or 40 CFR Part 61 - National Emission Standards for Hazardous Air Pollutants.

- All scientific, engineering, and technical material and other information available to the Department.

  The emission limiting standards or BACT determination of any other state.

- The social and economic impact of the application of such technology.

The EPA currently stresses that BACT should be determined using the "top-down" approach. The first step in this approach is to determine, for the emission unit in question, the most stringent control available for a similar or identical emission unit or emission unit category. If it is shown that this level of control is technically or economically unfeasible for the emission unit in question, then the next most stringent level of control is determined and similarly evaluated. This process

continues until the BACT level under consideration cannot be eliminated by any substantial or unique technical, environmental, or economic objections.

The air pollutant emissions from this facility can be grouped into categories based upon the control equipment and techniques that are available to control emissions from these emission units. Using this approach, the emissions can be classified as follows:

Combustion Products (e.g., SO_2, NO_X, PM). Controlled generally by good combustion of clean fuels, removal in add-on control equipment.

- ***Products of Incomplete Combustion*** (e.g., CO, VOC). Control is largely achieved by proper combustion techniques.

Grouping the pollutants in this manner facilitates the BACT analysis because it enables the equipment available to control the type or group of pollutants emitted and the corresponding energy, economic, and environmental impacts to be examined on a common basis. Although all of the pollutants addressed in the BACT analysis may be subject to a specific emission limiting standard as a result of PSD review, the control of "non-regulated" air pollutants is considered in imposing a more stringent BACT limit on a "regulated" pollutant (i.e., PM, SO_2, H_2SO_4, fluorides, etc.), if a reduction in "non-regulated" air pollutants can be directly attributed to the control device selected as BACT for the abatement of the "regulated" pollutants.

BACT POLLUTANT ANALYSIS

NITROGEN OXIDES (NO_X)

Oxides of nitrogen (NO_x) are generated during fuel combustion by oxidation of chemically bound nitrogen in the fuel (fuel NO_x) and by thermal fixation of nitrogen in the combustion air (thermal NO_x). As flame temperature increases, the amount of thermally generated NO_x increases. Fuel type affects the quantity and type of NO_x generated. Generally, natural gas is low in nitrogen. However it causes higher flame temperatures and generates more thermal NO_x than oil or coal, which have higher fuel nitrogen content, but exhibit lower flame temperatures.

NO_x emissions represent a significant portion of the total emissions generated by this project, and must be minimized using BACT. A review of EPA BACT/LAER Clearinghouse (BACT Clearinghouse) information indicates that NO_x emissions at most small facilities are minimized by process control and good combustion practices.

The applicant has proposed modification of the combustion process through a combination of fuel injection timing retardation and cooling of combustion air resulting in exhaust temperature reduction. The design specific to FKEC's 20-710G4B includes a 4° injection timing retardation and a 4-pass aftercooler circuit with the addition of a separately cooled aftercooler circuit. The

combination of retarded injection timing and lowered combustion air temperature results in less NO_x formation.

Vendors data indicate that retarding injection timing will reduce NO_x formation by about 20 percent, but will increase PM emissions by about 10 percent and fuel consumption by 1.5 percent. The 4-pass aftercooler will reduce both NO_x and PM emissions by about 10 percent while reducing fuel consumption by about 0.7 percent. The separately cooled aftercooling circuit will decrease both NO_x and PM by another 10 percent and fuel consumption by 0.5 percent. The net result will be a 40 percent reduction in NO_x, a 5 percent increase in PM and about 0.3 percent increase in fuel consumption. The use of low sulfur fuel oil will minimize PM emissions thus reducing or eliminating the increase in PM caused by NO_x controls. **This combination of NO_x controls, proper engine design, good combustion practices, and the use of low sulfur fuel should provide effective emissions control.**

BACT DETERMINATION BY DEP:

Based on the information provided by the applicant and the information searches conducted by the Department, lower emissions limits can be obtained employing the top-down BACT approach for NO_x.

NO_x DETERMINATION

The top-down BACT approach for diesel fired internal combustion engines listed in order from most stringent control to least:

1. Selective Catalytic Reduction (SCR)
2. Combined technologies of injection timing retardation, turbocharger with aftercoolers
3. Good combustion design/practices

The following table summarizes the feasibility of using these control technologies with the EMD 20-710G4B as designed for installation in FKEC's Marathon Generation Plant.

Control Technology	Emission Reduction (%)	Technically Feasible	Cost Effective	Adverse Environ. Impacts	Adverse Energy Impacts
SCR with ammonia	60-90	No	N/A	N/A	N/A
SCR with urea	80	No	N/A	N/A	N/A
Timing retard; turbo charger aftercoolers	40	Yes	Yes	No	0.3%
Dry/Low NO_x	18	No	N/A	N/A	N/A

SCR is more widely used in Japan and Germany than it is in the United States and the technology is being improved such that the hazards and costs have been reduced. It remains, however, a costly technology for small applications and has hazards associated with the use and storage of ammonia. SCR is not generally used with diesel engines of this size. The BACT/LAER database lists only a single facility which uses SCR on diesel engines. SCR was selected in that instance because a local ordinance mandated strict limits on emissions without regards to cost. SCR is not technically feasible for this diesel engine because the exhaust back pressure maximum allowance for the EMD 20-710G4B is 5 inches H_2O. An SCR system will add 5 to 6 inches H_2O back pressure, exceeding the manufacturers specifications and recommendations.

For NO_x emissions, the Department accepts the applicants proposed use of injection timing retardation and cooling of combustion air as BACT for this project.

The BACT emission levels established by the Department are as follows:

POLLUTANT	EMISSION LIMIT
Nitrogen Oxides (NO_x)	62 lbs/hr (271 TPY)
Visible Emissions	20%

COMPLIANCE

Compliance with the visible emission limitations shall be in accordance with the EPA Reference Method 9 as contained in 40 CFR 60, Appendix A.

Compliance with the NO_x limitations shall be in accordance with the EPA Reference Method 7E as contained in 40 CFR 60, Appendix A.

DETAILS OF THE ANALYSIS MAY BE OBTAINED BY CONTACTING:

Syed Arif, Review Engineer (prepared BACT)
A. A. Linero, Administrator, New Source Review Section (reviewed BACT)
Department of Environmental Protection
Bureau of Air Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

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Recommended By:

C. H. Fancy, P.E., Chief
Bureau of Air Regulation

9/11/97
Date:

Approved By:

for Howard L. Rhodes, Director
Division of Air Resources Management

9/11/97
Date: