GOVERNMENT OF PUERTO RICO
DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

PUERTO RICO 1-HOUR SO_2 STATE IMPLEMENTATION PLAN

BASELINE EMISSION INVENTORY 2014

DNER
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Contents

1.0 Introduction

In June 2010, the Environmental Protection Agency (EPA), promulgated the new 1-hour primary sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS) of 75 parts per billion (ppb), which is met at an ambient air quality monitoring site, when the 3-year average of the 99th percentile of 1-hour daily maximum concentrations does not exceed 75 ppb.

On January 2018, the EPA published in the Federal Register (83 FR 1098) the Air Quality Designations for the 2010 Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard-Round 3. This final rule established non-attainment designation for the 1-Hour SO_2 NAAQS, of two areas in Puerto Rico, including several wards in different counties. The Clean Air Act (CAA) directs areas designated as non-attainment to submit the Non-Attainment Sulfur Dioxide State Implementation Plan (SO_2 non-attainment SIP) within 18 months of the effective date of the designation (September 9, 2018).

The designated SO_2 non-attainment areas in PR are San Juan and Guayama-Salinas. Air quality modeling in each area, demonstrate that 1-hour SO_2 emissions are over the NAAQS. The Department of Environmental and Natural Resources (DNER) is required to submit a SO_2 non-attainment SIP for each designated area. Along with the SO_2 non-attainment SIP, the State, Local and Tribal agencies are required to submit, a baseline emission inventory that presents the current actual emissions data in the non-attainment areas.

The base year inventory should be accurate and comprehensive; and should include emission estimates for stationary point and nonpoint sources, onroad mobile sources, nonroad mobile sources and events (prescribed fires, agricultural burning and wildfires). DNER prepared the baseline emission inventory 2014 for the SO_2 non-attainment SIP, in the areas of San Juan and Guayama-Salinas. The principal SO_2 emitters in each area are: PREPA San Juan and Palo Seco in San Juan, and PREPA Aguirre, in Guayama-Salinas, see Figures 3 and 4.

DNER in consultation with the EPA, agree to use the 2014 as the baseline year for the emission inventory, due to the completeness and accuracy of the SO_2 emission data. The SO_2 emission data for the year 2017 was incomplete, because during this time the island was affected by Hurricanes Irma and María. Both hurricanes destroyed the electric distribution grid of the island, leaving inoperative all PREPA's electric power plants for several months.

At least, the last quarter of the year, the average electric power generation of the island was below 50%. PREPA reached 64.7% generation on December 15, 2017. Besides, when PREPA start-up the grid, they used portable electric power generators, provided by the Federal Emergency Management Agency (FEMA), to support energy distribution operations at the north side. Meanwhile in the south, the main power plants where shutdown or their operation was significantly reduced, since the electric power lines that connect both sides of the island where damaged.

This situation caused that actual SO_2 emissions for year 2017 were not representative, along with the lack of data for other emission inventory sectors. Since year 2017 is not representative of the island fuel consumption of the PREPA generation units, EPA and DNER concur to use, the 2014 emission inventory as the baseline year, for the SO_2 non-attainment SIP.

The SO_2 actual emissions for 2014 were used during the designation air quality modeling, and the SO_2 emissions for other inventory sectors are from the EPA 2014 National Emission Inventory (2014 NEI)[1]. DNER do not have complete SO_2 emissions data for other emission inventory sectors and agree with EPA to use the data of the 2014 NEI.

2.0 Baseline Emission Inventory Areas

The nonattainment San Juan area includes the following municipalities and wards; within Cataño (Palmas and Barrio Pueblo Wards), in Toa Baja (Palo Seco and Sabana Seca Wards), within Guaynabo (Pueblo Viejo Ward), in Bayamón (Juan Sánchez Ward) and in San Juan (San Juan Antiguo, Santurce, Hato Rey Norte and Gobernador Piñero Wards). The rest of the wards in each municipality were classified as attainment/unclassified.

The San Juan non-attainment area is located to the north of the island and part of the municipalities and the wards are near the coastline. The non-attainment area is shown in Figure 1.

The non-attainment designation for the Guayama-Salinas area was as following; the Guayama municipality was classified as attainment/unclassified and for Salinas municipality, the areas classified as nonattainment are, Aguirre and Lapa Wards. The remaining wards of Salinas municipality, were classified as attainment/unclassified.

The Guayama-Salinas non-attainment area, is located to the south of the island along the coastline. The non-attainment area is shown in Figure 2.

The significant SO_2 emitters in San Juan are PREPA San Juan and PREPA Palo Seco. PREPA San Juan is located in San Juan municipality and PREPA Palo Seco in Toa Baja. In Guayama-Salinas area, the significant SO_2 emissions comes from PREPA Aguirre, and this plant is located in Salinas municipality.

[1] National Emission Inventory. https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data

3.0 Stationary Point Sources

The baseline actual emission inventory includes the SO_2 emissions for PREPA San Juan and Palo Seco, in San Juan area, and PREPA Aguirre in Guayama-Salinas area. All sources emit more than 2000 tpy of SO_2 (DDR)[2] and the air quality modeling analysis demonstrated their major contribution, to the violations of the 1-hour SO2 NAAQS.

The baseline emission inventory has the 2014 SO_2 actual emissions for these emission sources. The emissions are from PREPA certified actual annual emission report; submitted to DNER, as permit and the RECAP[3] requirement, according to the Rule 410 (Maximum Sulfur Content in Fuels).

The actual SO_2 emissions for 2014 are presented in the Table 1: Stationary Point Sources Emission Inventory. The emissions calculations and QA revision are included in the Appendix.

[2] Data Requirements Rule for 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS). 40 CFR Part 51.

[3] Regulation for the Control of atmospheric Pollution. Puerto Rico Environmental Quality Board, July 1995.

Table1: Stationary Point Sources Emission Inventory

Industry	**Unit**	**Sector**	**SO_2 Emissions 2014 (tpy)**
PREPA Palo Seco	Boiler 1	External Combustion Boilers	809.45
PREPA Palo Seco	Boiler 2	External Combustion Boilers	889.15
PREPA Palo Seco	Boiler 3	External Combustion Boilers	0.00
PREPA Palo Seco	Boiler 4	External Combustion Boilers	1418.8
PREPA Palo Seco	Power Block 1	Stationary Gas Turbines	1.90
PREPA Palo Seco	Power Block 2	Stationary Gas Turbines	4.32
PREPA Palo Seco	Power Block 3	Stationary Gas Turbines	4.40
PREPA San Juan	HRSG 5& 6	Stationary Gas Turbines	250.2
PREPA San Juan	Boiler 7	External Combustion Boilers	1446.8
PREPA San Juan	Boiler 8	External Combustion Boilers	1657.0
PREPA San Juan	Boiler 9	External Combustion Boilers	1333.78
PREPA San Juan	Boiler 10	External Combustion Boilers	448.0
	San Juan Area Sub-Total	**External Combustion Boilers**	**8002.98**
		Stationary Gas Turbines	**260.82**
PREPA Aguirre	Boiler AG1	External Combustion Boilers	3353.0
PREPA Aguirre	Boiler AG2	External Combustion Boilers	5865.0
PREPA Aguirre	Gas Turbine CC1-1 to 1-4	Stationary Gas Turbines	16.5
PREPA Aguirre	Gas Turbine CC2-1 to 2-4	Stationary Gas Turbines	26.3
PREPA Aguirre	Gas Turbine AGGT2-1, 2-2	Stationary Gas Turbines	0.354
	Guayama-Salinas Area Sub-Total	**External Combustion Boilers**	**9218**
		Stationary Gas Turbines	**43.15**

Note: Information from PREPA Actual Annual Emission Report 2014.

4.0 Stationary Nonpoint Sources, Onroad and Nonroad Mobile Sources, and Events

The SO_2 emissions data for these categories are from the EPA 2014 NEI. DNER do not have a complete SO_2 emission data for these emission sources and agree with EPA to use the estimates from the National Emission Inventory.

The 2014 NEI includes emission sources for both types of pollutants, criteria and hazardous air pollutants. Data is available for many facilities and county totals. EPA create this inventory using data from states, local and tribal agencies; and with the help of the Emission Inventory System (EIS). The following sections presents the SO_2 emissions according to the emission source category, for each non-attainment area. Some sectors are not shown because there are not emissions available for the 2014 NEI.

4.1 Stationary Nonpoint Sources

Sector	County	SO_2 Emissions (TON)
Residential Fuel Combustion	San Juan	0
	Guayama-Salinas	0
Waste Disposal	San Juan	36.16
	Guayama-Salinas	3.82
Miscellaneous Non-Industrial NEC	San Juan	0.47
	Guayama-Salinas	0.045
Agriculture	San Juan	0
	Guayama-Salinas	0

Note: San Juan SO_2 emissions includes data from Guaynabo, Cataño, Bayamon and Toa Baja.

4.2 Stationary Nonpoint Events

Sector	County	SO_2 Emissions (TON)
Fires		
Prescribed Fires	San Juan	0.30
	Guayama-Salinas	7.31
Wildfires	San Juan	0
	Guayama-Salinas	0
Agricultural Field Burning	San Juan	0
	Guayama-Salinas	0

Note: San Juan SO_2 emissions includes data from Guaynabo, Cataño, Bayamon and Toa Baja.

4.3 Fuel Combustion

Sector	County	SO_2 Emissions (TON)
Commercial Institutional Oil	San Juan	3.85
	Guayama-Salinas	0.48
Commercial Institutional Other		
	San Juan	0
	Guayama-Salinas	0.021
Industrial Boilers Oil	San Juan	35.31
	Guayama-Salinas	0.0377
Industrial Boilers Other	San Juan	0
	Guayama-Salinas	0.026

Note: San Juan SO_2 emissions includes data from Guaynabo, Bayamon, Cataño and Toa Baja.

4.4 Onroad Mobile Sources

Sector	County	SO_2 Emissions (TON)
On-Road Diesel Heavy Duty Vehicles	San Juan	1.19
	Guayama-Salinas	0.10
On-Road Diesel Light Duty Vehicles	San Juan	0.334
	Guayama-Salinas	0.029
On-Road Gasoline Heavy Duty Vehicles	San Juan	0.46
	Guayama-Salinas	0.038
On-Road Gasoline Light Duty Vehicles	San Juan	30.69
	Guayama-Salinas	2.7

Note: San Juan SO_2 emissions includes data from Guaynabo, Bayamon, Cataño and Toa Baja.

4.5 Nonroad Mobile Sources

Sector	County	SO_2 Emissions (TON)
Aircraft	San Juan	7.22
	Guayama-Salinas	0
Marine Vessels	San Juan	422.27
	Guayama-Salinas	11.87
Non-Road Equipment Diesel	San Juan	5.04
	Guayama-Salinas	0.153
Non-Road Equipment Gasoline	San Juan	2.68
	Guayama-Salinas	0.298
Non-Road Equipment Other	San Juan	0.115
	Guayama-Salinas	0.016

Note: San Juan SO_2 emissions includes data from Guaynabo, Bayamon, Cataño and Toa Baja.

Figure 1: San Juan Non-Attainment Area

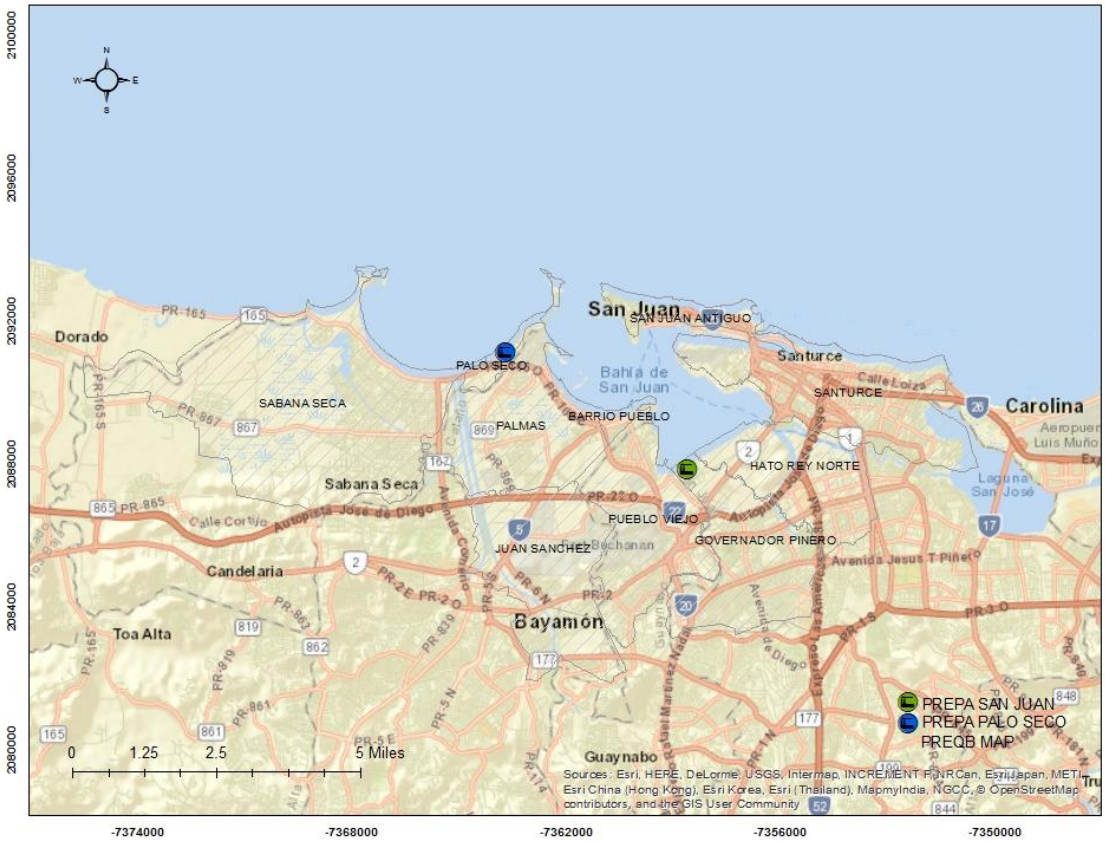

Figure 1. Includes the non-attainment area municipalities and wards. Also presents the site location for PREPA San Juan and PREPA Palo Seco.

Figure 2: Guayama-Salinas Non-Attainment Area

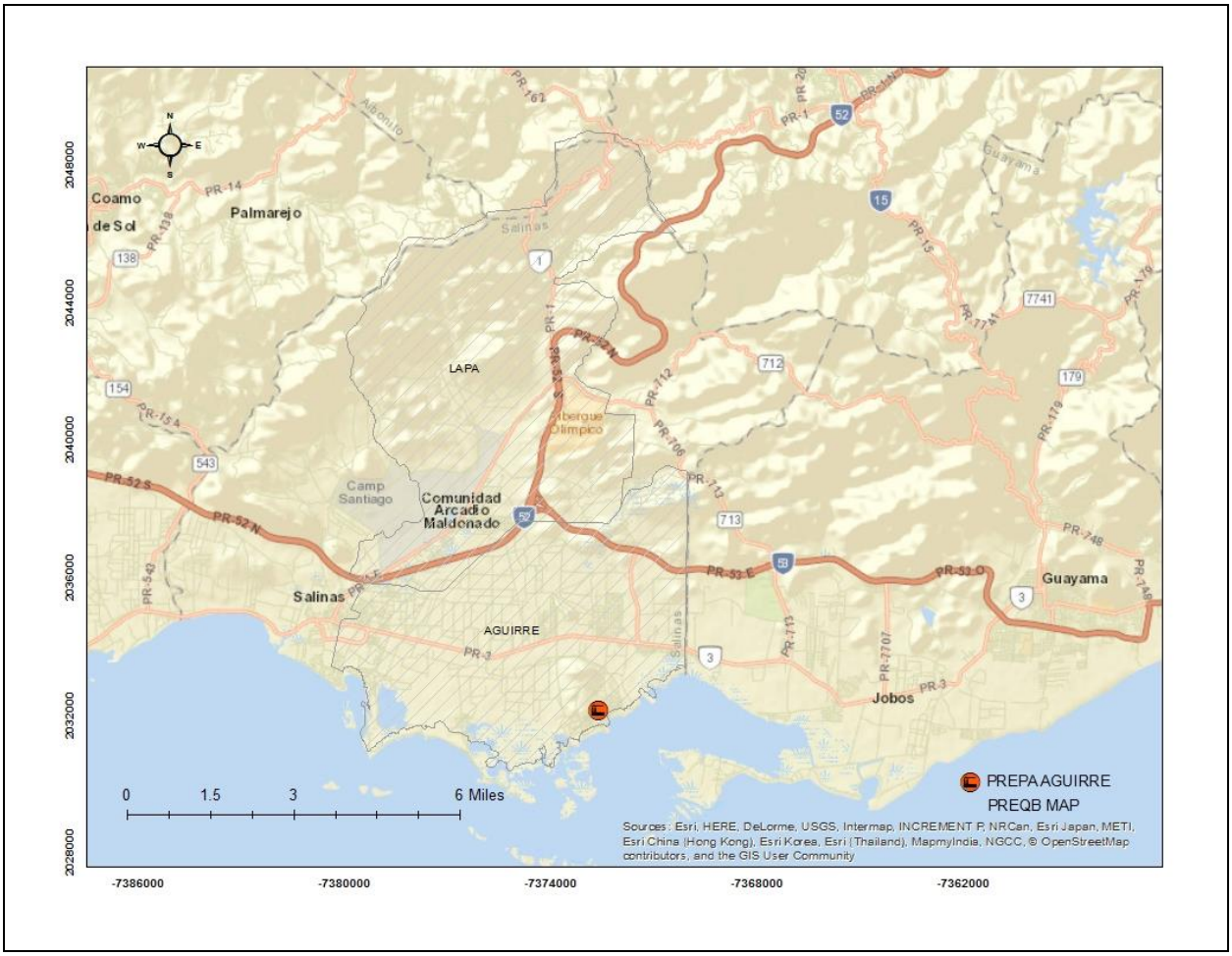

Figure 2. Includes the non-attainment area municipality and wards. Also presents the site location for PREPA Aguirre.

Figure 3: 2014 National Emission Inventory- San Juan Area

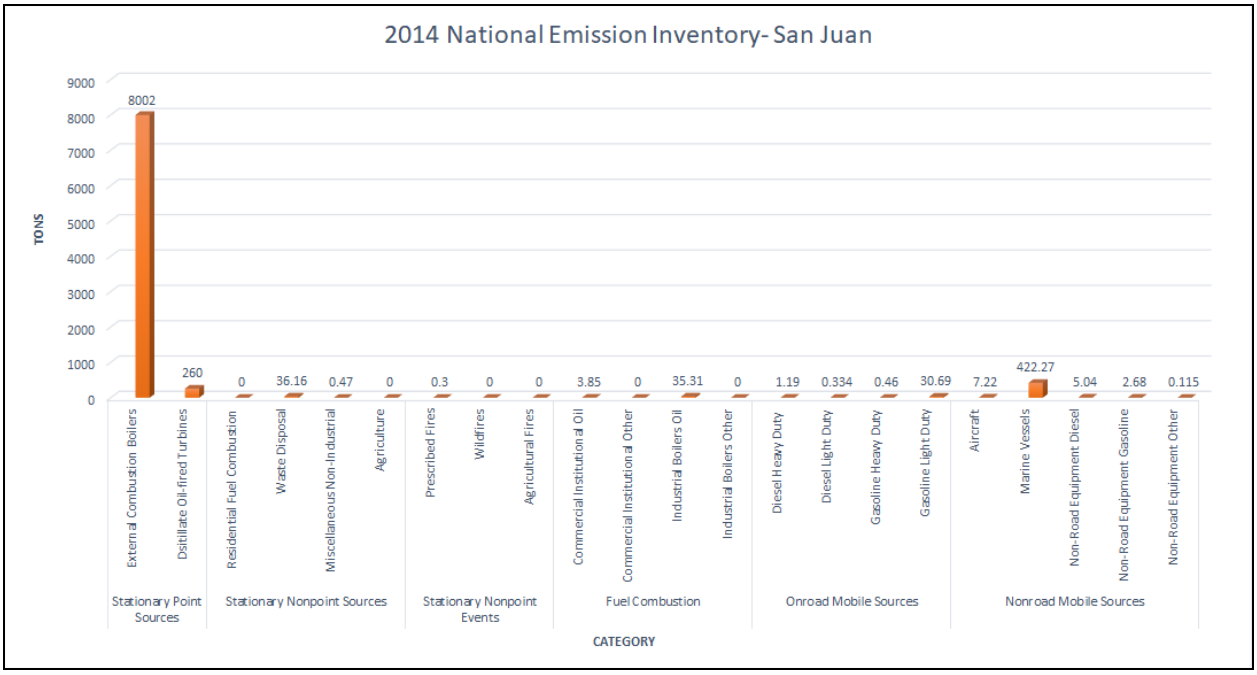

Figure 3: Shows the SO_2 emissions by sector in San Juan Area for year 2014.

Figure 4: 2014 National Emission Inventory- Guayama-Salinas Area

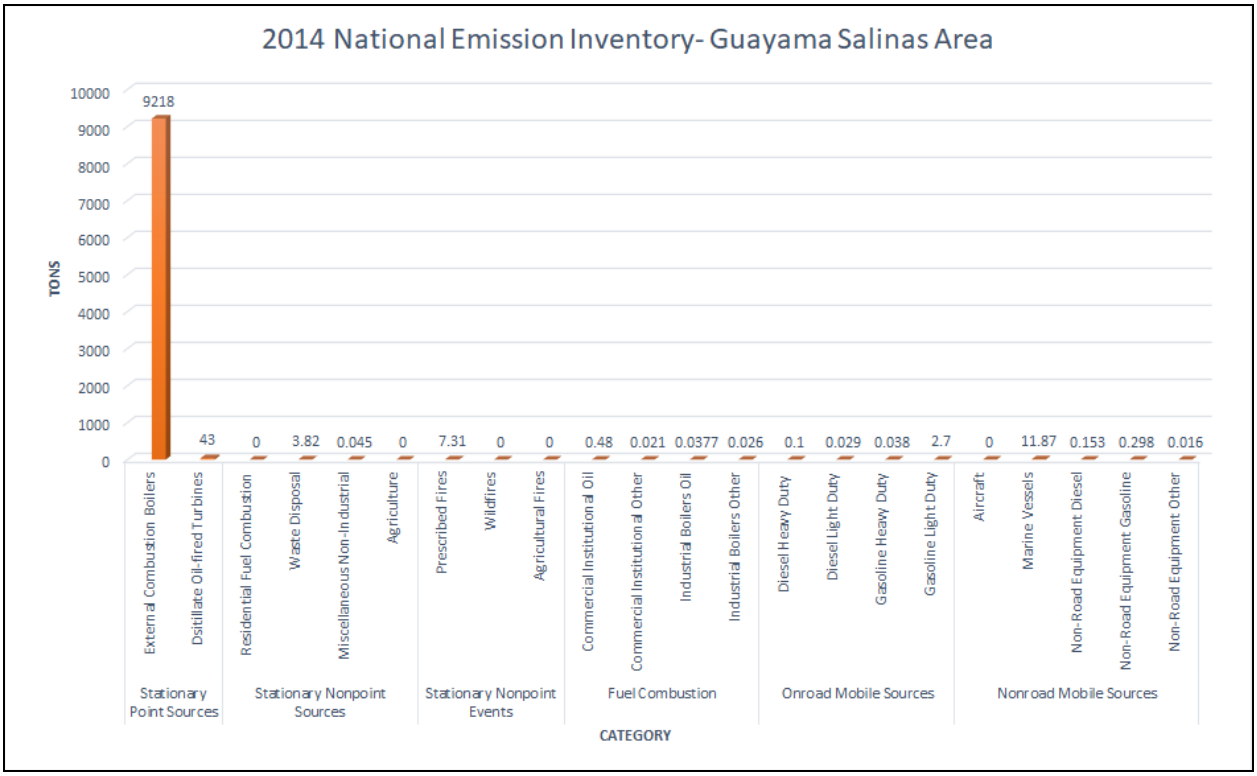

Figure 4: Shows the SO_2 emissions by sector in Guayama-Salinas Area for year 2014.

References

Actual Annual Emission Report 2014. Puerto Rico Electric Power Authority.

Data Requirements Rule for 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS). 40 CFR Part 51.

EPA, 2014 National Emission Inventory. https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data

Rule 410: Maximum Sulfur Content in Fuels. Regulation for the Control of atmospheric Pollution. Puerto Rico Environmental Quality Board, July 1995.

APPENDIX

Emissions Calculations

PREPA PRCU SCCO 2014 EMISSIONS %S 0.4T Ef 157 x %S

PS1

$\frac{75.36\ lb}{1000\ gal} \times \frac{21482141\ gal}{yr} \times \frac{1\ ton}{2000\ lb} = 809.4\ ton/yr$

PS2

$\frac{75.36\ lb}{1000\ gal} \times \frac{23597406\ gal}{yr} \times \frac{1\ ton}{2000\ lb} = 889.15\ ton/yr$

PS3

No fuel usage during 2014

PS4

$\frac{75.36\ lb}{1000\ gal} \times \frac{37653969\ gal}{yr} \times \frac{1\ ton}{2000\ lb} = 1418.8\ ton/yr$

- Power Block 1 %S = 0.02 Ef = 1.01 x %S

$= \frac{0.02021\ lb}{MMBtu} \times \frac{1398965\ gal}{yr} \times \frac{0.135\ MMBtu}{gal} \times \frac{1\ ton}{2000\ lb} = 1.90\ ton/yr$

- Power Block 2

$= \frac{0.02021\ lb}{MMBtu} \times \frac{3172861\ gal}{yr} \times \frac{0.135\ MMBtu}{gal} \times \frac{1\ ton}{2000\ lb} = 4.32\ ton/yr$

- Power Blocks

$= \frac{0.02021\ lb}{MMBtu} \times \frac{3227367\ gal}{yr} \times \frac{0.135\ MMBtu}{gal} \times \frac{1\ ton}{2000\ lb} = 4.40\ ton/yr$

① PREPA SAN JUAN

- Units 5/6 - Guarantee Ef ton SO_2 85.34 lb/hr

$= \frac{85.34\ lb}{hr} \times \frac{5864.60\ hrs}{yr} \times \frac{1\ ton}{2000\ lbs} = 250.2\ ton/yr$

- Boiler 7

$= \frac{8.06\ lbs}{gal} \times \frac{64\ lbs\ S}{32\ lbs\ SO_2} \times \frac{37397679\ gal}{yr} \times \frac{0.48}{100} \times \frac{1\ ton}{2000\ lbs} = 1446.8\ ton/yr$

- Boiler 8

$= \frac{8.06\ lbs}{gal} \times \frac{64\ lbs\ S}{32\ lbs\ SO_2} \times \frac{42830835\ gal}{yr} \times \frac{0.48}{100} \times \frac{1\ ton}{2000\ lbs} = 1657\ ton/yr$

- Boiler 9

$= \frac{8.06\ lbs}{gal} \times \frac{64\ lbs\ S}{32\ lbs\ SO_2} \times \frac{34475410\ gal}{yr} \times \frac{0.48}{100} \times \frac{1\ ton}{2000\ lbs} = 1333.76\ ton/yr$

- Boiler 10

$= \frac{8.06\ lbs}{gal} \times \frac{64\ lbs\ S}{32\ lbs\ SO_2} \times \frac{11579970\ gal}{yr} \times \frac{0.48}{100} \times \frac{1\ ton}{2000\ lbs} = 448\ \frac{ton}{yr}$

③ PREPA Aguirre

Boiler AG1 0/05 0.476 Ef = 157 x 0/05 = 74.73 lb/1000 scf

$= \frac{74.73}{1000\,scf} \times \frac{89734336\,scf}{yr} \times \frac{1\,ton}{2000\,lbs} = \boxed{3353\ ton/yr}$

Boiler AG2 $= \frac{74.73\,lbs}{1000\,scf} \times \frac{156967326\,scf}{yr} \times \frac{1\,ton}{2000\,lb} = \boxed{5865\ ton/yr}$

- Gas turbine CC1-1, 1-4 0/05 0.012 Ef 1.01 x 0/05 = 0.01212 lb/MMBtu

$= \frac{0.01212\,lbs}{MMBtu} \times \frac{20235143\,scf}{yr} \times \frac{0.135\,MMBtu}{scf} \times \frac{1\,ton}{2000\,lbs} = \boxed{16.5\ ton/yr}$

- Gas turbine CC2-1, 2-4

$= \frac{0.01212\,lbs}{MMBtu} \times \frac{3217585}{yr} \times \frac{0.135\,MMBtu}{scf} \times \frac{1\,ton}{2000\,lbs} = \boxed{26.3\ ton/yr}$

- Gas turbine AGGT 1, 2

$= \frac{0.01212\,lbs}{MMBtu} \times \frac{433105\,scf}{yr} \times \frac{0.135\,MMBtu}{scf} \times \frac{1\,ton}{2000\,lbs} = \boxed{0.354\ ton/yr}$