APPENDIX B

Florida Department of Environmental Protection
Division of Air Resource Management

Regional Haze Supplemental SIP – Four Factor Analyses and Documentation

Table A-1c

Fuel Switching Cost (No Solid Fuel) - WestRock Fernandina Beach No. 7 Power Boiler

CAPITAL COSTS			
Total Capital Investment for New ULSD Burners and required infrastructure:	(a)	***TCI***	***$18,750,000***

ANNUALIZED COSTS

	COST ITEM	COST FACTOR		UNIT COST		COST ($)
Annual Operating Costs - Direct Annual Costs						
(b)	Maintenance Costs	2.75%	of TCI			***$515,625***
(c)	Bark ash landfill disposal	[redacted]	tpy	[redacted]	/ton	***$295,466***
Fuel						
(d)	Additional natural gas cost - Tier 3 usage rate	[redacted]	MMBtu	[redacted]	/MMBtu	***$6,328,829***
(e)	Additional natural gas cost - elevated price days		MMBtu		/MMBtu	***$5,572,800***
(f)	ULSD cost		thousand gal		/gal	***$1,052,414***
(g)	Coal cost savings		tons		/ton	***-$6,683,215***
	Total Direct Annual Costs:			***DAC***		***$7,081,919***
Annual Operating Costs - Indirect Annual Costs						
(h)	Overhead	0%	of TCI			***$0***
(i)	Administrative Charges	2%	of TCI			***$375,000***
(i)	Property Taxes	0%	of TCI			***$0***
(i)	Insurance	1%	of TCI			***$187,500***
	Total Indirect Annual Costs:			***IDAC***		***$562,500***
	Total Annual Costs:			***TAC***		***$7,644,419***
Cost Effectiveness						
(i)	Expected lifetime of equipment, years	30				
(i)	Interest rate, %/yr	3.25%				
(i)	Capital recovery factor	0.053				
(i)	Total Capital Investment Cost	$18,750,000				
	Annualized Capital Investment Cost:					***$987,782***
	Total Annualized Cost:					***$8,632,201***
(j)	SO_2 Reduction	97.3%				
	Pre-retrofit SO_2	1,203	tons SO_2/yr			
	Post-retrofit SO_2 Using Burner System	32.8	tons SO_2/yr			
	SO_2 Removed	1,171	tons SO_2/yr			
	Annual Cost/Ton Removed:					***$7,374***

(a) Based on project estimate performed by WestRock.

(b) Maintenance costs were estimated based on the U.S. EPA OAQPS Alternative Control Techniques Document - NOX Emissions from Process Heaters (Revised), Document No. EPA-453/R-93-034 (September 1993).

(c) 2019 WestRock Fernandina Beach cost to dispose of bark ash.

(d) Projected WestRock Fernandina Beach fuel costs.

(e) Projected WestRock Fernandina Beach fuel costs. Projecting that natural gas costs will be elevated (but less than ULSD) at least 24 days/year (518,400 MMBtu of heat input for 20 days of operation).

(f) Projected 2022 WestRock Fernandina Beach fuel costs. WestRock expects that natural gas costs will spike and exceed ULSD costs at least 3 days/year, so that WestRock will fire ULSD instead of natural gas on those days (479 thousand gallons of ULSD for 2 days of operation).

(g) 2019 WestRock Fernandina Beach coal cost.

(h) No charge taken here due to operational cost savings from removing coal.

(i) U.S. EPA Air Pollution Control Cost Manual, Section 1, Chapter 2. Yellow-highlighted values were selected in order to conform to the values used by Florida DEP in their Regional Haze SIP submittal. WestRock believes the expected useful life of the equipment is no more than 20 years, but has utilized 30 years in this set of calculations to conform to Florida DEP's Regional Haze SIP submittal. WestRock believes that the appropriate interest rate is 4.75%, which was the rate prior to the COVID-19 pandemic, but has utilized 3.25% to conform to Florida DEP's Regional Haze SIP submittal. Any potential property tax costs have been excluded.

(j) Pre-retrofilt SO2 emissions estimated based on projected 2028 actual throughput/fuel usage. Post-retrofit SO2 emissions estimated based on equivalent heat input and replacment of coal and bark ash with natural gas and as noted in footnote (f), ULSD. See Table A-1d for emission factors and calculations.

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(c)	Bark ash landfill disposal	[redacted]	tpy	[redacted]	/ton	***$295,466***
Fuel						
(d)	Additional natural gas cost - Tier 3 usage rate	[redacted]	MMBtu	[redacted]	/MMBtu	***$6,328,829***
(e)	Additional natural gas cost - elevated price days		MMBtu		/MMBtu	***$5,572,800***
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	Total Direct Annual Costs:			***DAC***		***$7,081,919***
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(i)	Administrative Charges	2%	of TCI			***$375,000***
(i)	Property Taxes	0%	of TCI			***$0***
(i)	Insurance	1%	of TCI			***$187,500***
	Total Indirect Annual Costs:			***IDAC***		***$562,500***
	Total Annual Costs:			***TAC***		***$7,644,419***
Cost Effectiveness						
(i)	Expected lifetime of equipment, years	20				
(i)	Interest rate, %/yr	4.75%				
(i)	Capital recovery factor	0.079				
(i)	Total Capital Investment Cost	$18,750,000				
	Annualized Capital Investment Cost:					***$1,472,821***
	Total Annualized Cost:					***$9,117,240***
(j)	SO_2 Reduction	97.3%				
	Pre-retrofit SO_2	1,203	tons SO_2/yr			
	Post-retrofit SO_2 Using Burner System	32.8	tons SO_2/yr			
	SO_2 Removed	1,171	tons SO_2/yr			
	Annual Cost/Ton Removed:					***$7,788***

(a) Based on project estimate performed by WestRock.
(b) Maintenance costs were estimated based on the U.S. EPA OAQPS Alternative Control Techniques Document - NOX Emissions from Process Heaters (Revised), Document No. EPA-453/R-93-034 (September 1993).
(c) 2019 WestRock Fernandina Beach cost to dispose of bark ash.
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(j) Pre-retrofilt SO2 emissions estimated based on projected 2028 actual throughput/fuel usage. Post-retrofit SO2 emissions estimated based on equivalent heat input and replacment of coal and bark ash with natural gas and as noted in footnote (f), ULSD. See Table A-1d for emission factors and calculations.

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Fuel						
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	Annual Cost/Ton Removed:					***$7,374***

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(j) Pre-retrofilt SO2 emissions estimated based on projected 2028 actual throughput/fuel usage. Post-retrofit SO2 emissions estimated based on equivalent heat input and replacment of coal and bark ash with natural gas and as noted in footnote (f), ULSD. See Table A-1d for emission factors and calculations.

Table A-1d

SO_2 Fuel Switching Emissions Calculations - WestRock Fernandina Beach No. 7 Power Boiler

Projected 2028 Actual Throughput/Fuel Usage			Projected 2028 Actual SO_2 Emissions	
Current SO_2 (No Change to Current Fuel Mix)				
Bark Ash	14,591	tpy	387	tpy
	265,554	MMBtu/yr		
Coal	51,572	tpy	784	tpy
	1,340,872	MMBtu/yr		
Natural Gas	5,810	MMscf/yr	1.7	tpy
	6,082,548	MMBtu/yr		
LVHC NCG	41,818	ADTUBP	31	tpy
Total Emissions			1,203	tpy
Total Heat Input	7,688,974	MMBtu/yr		
Post-change SO_2 (No Solid Fuel)				
Natural Gas	7,328	MMscf/yr	2.20	tpy
	7,672,367	MMBtu/yr		
ULSD (est. 3 days at 900 MMBtu/hr)	478,370	gal/yr	0.05	tpy
	64,800	MMBtu/yr		
LVHC NCG	41,818	ADTUBP	31	tpy
Total Emissions			33	tpy
Total Heat Input	7,737,167	MMBtu/yr		
SO_2 Removed			1,171	tpy

Heat Content		
Bark Ash[1]	9,100	Btu/lb
Coal[1]	13,000	Btu/lb
Natural Gas[1]	1,047	Btu/scf
ULSD	135,460	BTU/gal

1 - Mill Specific Information

Bark Ash Emissions Factor[2]		
Bark Ash Emission Factor	2.92	lb/MMBtu

2 - Calculated from 2019 SO2 CEMS data:
(total SO2 emissions measured by the CEMS minus the SO2 emissions attributable to coal, natural gas and NCG) / (heat input from bark ash)

Coal Emissions Factor[3]		
Coal Sulfur Content	0.8	% weight max expected
Coal Emissions Factor	30.4	lb/ton

3 - AP-42 Section 1.1

Natural Gas Emissions Factor[4]		
Natural Gas Emissions Factor	0.6	lb/MMscf

4 - AP-42 Section 1.4

No. 2 Fuel Oil (ULSD) Emissions Factor[5]		
No. 2 Fuel Oil (ULSD) Emissions Factor	0.213	lb/10^3 gal

5 - AP-42 Section 1.4

NCG Emisions Factor[6]		
Emission factor for combustion of scrubbed NCG	1.46	lb/ADTUBP

6 - Calculated from the amount of TRS in LVHC NCG per NCASI Technical Bulletin 1050, Section 4.2.5 and white liquor scrubber control efficiency of 99% for H2S and 80% for methyl mercaptan (NCG passes through the white liquor scrubber prior to combustion in No. 7 Power Boiler).

No.	Good / Best	Pollutant	Equipment	Units	Type of chemical	Maintenance labor & materials, % of TIC	Energy, kw/feed rate at design rate	units	Usage Factor	Manpower hr/dy	Testing	Water, gpm at design rate	wastewater, gpm at design rate	Steam at steam rate	units	Compress air at design rate	units	Fuel cost	units	Natural gas usage	units	General Utilities	Units	Incremental Solid Waste Disposal	Units	Downtime Net downtime assumes that outage can be coordinated with scheduled equipment downtime: net downtime is additional downtime beyond the normal scheduled outage - days
1	Good	PM	NDCE Kraft Recovery Furnace	NA	NA	3.50%	546.63983	kw/Mmlb BLS	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
2	Best	PM	NDCE Kraft Recovery Furnace	NA	NA	3.50%	683.29978	kw/Mmlb BLS	80%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
3	Good	SO2	NDCE Kraft Recovery Furnace	NA	NA	3.50%	440.92377	kw/Mmlb BLS	70%	3.00	$ 5,000	148.00	14.80	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
4	Best	SO2	NDCE Kraft Recovery Furnace	NA	NA	3.50%	440.92377	kw/Mmlb BLS	80%	3.00	$ 5,000	148.00	14.80	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
5	Good	NOx	NDCE Kraft Recovery Furnace	NA	NA	1.00%	20.14061	kw/Mmlb BLS	70%	0.75	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
6	Best	NOx	NDCE Kraft Recovery Furnace	NA	NA	3.50%	4.26257	kw/Mmlb BLS	70%	3.00	$ 5,000	3.00	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
7	Best	VOC	NDCE Kraft Recovery Furnace	NA	NA	2.00%	4.03243	kw/Mmlb BLS	70%	1.50	$ 5,000	-	-	$ -	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
8	Good	PM	DCE Kraft Recovery Furnace	NA	NA	3.50%	746.10919	kw/Mmlb BLS	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
9	Best	PM	DCE Kraft Recovery Furnace	NA	NA	3.50%	932.63649	kw/Mmlb BLS	80%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
10	Good	SO2	DCE Kraft Recovery Furnace	NA	NA	3.50%	601.81726	kw/Mmlb BLS	70%	3.00	$ 5,000	68.00	6.80	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
11	Best	SO2	DCE Kraft Recovery Furnace	NA	NA	3.50%	601.81726	kw/Mmlb BLS	80%	3.00	$ 5,000	68.00	6.80	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
12	Best	NOx	DCE Kraft Recovery Furnace	NA	NA	3.50%	9.27736	kw/Mmlb BLS	70%	3.00	$ 5,000	3.00	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
13	Good	VOC	DCE Kraft Recovery Furnace	NA	NA	3.00%	88.64235	kw/Mmlb BLS	70%	3.00	$ 5,000	-	-	294.12	lb/hr/Mmlb BLS/day	-	NA	$ -	NA	-	NA	-	NA	-	NA	4
14	Best	VOC	DCE Kraft Recovery Furnace	NA	NA	3.00%	264.96165	kw/Mmlb BLS	70%	3.00	$ 5,000	-	-	(15,873)	lb/hr/Mmlb BLS/day	-	NA	$ -	NA	-	NA	-	NA	-	NA	20
15	Good	PM	Smelt Dissolving tank	NA	NA	2.00%	77.47584	kw/Mmlb BLS	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
16	Best	PM	Smelt Dissolving tank	NA	NA	2.00%	85.22343	kw/Mmlb BLS	80%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
17	Good	PM	Lime Kilns	NA	NA	3.00%	0.77961	kw/tpd CaO	70%	2.25	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
18	Best	PM	Lime Kilns	NA	NA	3.00%	0.97451	kw/tpd CaO	80%	2.25	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
19	Best	NOx	Lime Kilns	NA	NA	3.50%	0.31083	kw/tpd CaO	70%	3.00	$ 5,000	35.00	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
20	Best	NOx	Lime Kilns	NA	NA	2.00%	0.68643	kw/tpd CaO	70%	28.57	$ 5,000	1.97	-	2.30	lb/hr/tpd CaO	0.05	cfm/tpd CaO	$ -	NA	-	NA	-	NA	-	NA	5
21	Good	PM	Coal Boiler	NA	NA	3.00%	0.00444	hp/lb/hr stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	39.00	tpy of ash	3
22	Best	PM	Coal Boiler	NA	NA	3.00%	0.00555	kw/lb/hr/stm	80%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	77.00	tpy of ash	3
23	Good	HCl	Coal Boiler	NA	NA	5.00%	0.00270	kw/lb/hr/stm	70%	3.00	$ 5,000	64.00	20.00	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
24	Best	HCl	Coal Boiler	NA	NA	5.00%	0.00270	kw/lb/hr/stm	80%	3.00	$ 5,000	64.00	20.00	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
25	Good	PM	Coal/Wood Boiler (50/50)	NA	NA	3.00%	0.00444	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	94.00	tpy of ash	3
26	Best	PM	Coal/Wood Boiler (50/50)	NA	NA	3.00%	0.00555	kw/lb/hr/stm	80%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	137.00	tpy of ash	3
27	Good	SO2	Coal or Coal/Wood boiler (50/50)	NA	NA	3.50%	0.00381	kw/lb/hr/stm	70%	3.00	$ 5,000	142.86	14.29	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
28	Best	SO2	Coal or Coal/Wood boiler (50/50)	NA	NA	3.50%	0.00508	kw/lb/hr/stm	80%	3.00	$ 5,000	142.86	14.29	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
29	Good	NOx	Coal or Coal/Wood boiler (50/50)	NA	NA	2.00%	0.00081	kw/lb/hr/stm	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
30	Best	NOx	Coal or Coal/Wood boiler (50/50)	NA	NA	2.00%	0.00207	kw/lb/hr/stm	70%	28.57	$ 5,000	7.43	-	0.006939	lb/hr/lb/hr stm	0.00015	cfm/lb/hr stm	$ -	NA	-	NA	-	NA	-	NA	5
31	Best	NOx	Coal or Coal/Wood boiler (50/50)	NA	NA	1.00%	-	NA	0%	1.50	$ 5,000	-	-	-	-	-	-	$ -	NA	0.00120	Mmbtu/hr /Mlb/hr steam	-	NA	-	NA	3
32	Best	Hg	Coal or Coal/Wood boiler (50/50)	lb/hr	lime	5.00%	0.00109	kw/lb/hr/stm	70%	3.00	$ 5,000	64.00	20.00	-	-	-	-	$ -	NA	-	NA	-	NA	15,779.65	tpy of lime & carbon	5
33	Best	CO	Coal or Coal/Wood boiler (50/50)	NA	NA	3.00%	0.00099	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
34	Good	NOx	Gas boiler	NA	NA	3.00%	0.00147	kw/lb/hr/stm	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
35	Best	NOx	Gas boiler	NA	NA	2.00%	0.00197	kw/lb/hr/stm	70%	28.57	$ 5,000	2.83	-	0.00660	lb/hr/lb/hr stm	0.000142	cfm/lb/hr stm	$ -	NA	-	NA	-	NA	-	NA	5
36a	Good	NOx	Gas turbine	NA	NA	2.00%	0.06667	kw/MW	70%	1.50	$ 5,000	10.00	-	-	-	-	-	$ -	NA	-	NA	-	NA	-	NA	5
36b	Good	NOx	Gas turbine	NA	NA	2.00%	0.06667	kw/MW	70%	1.50	$ 5,000	4.76	-	79.3800	lb/hr/MW	-	-	$ -	NA	-	NA	-	NA	-	NA	5
37	Best	NOx	Gas turbine	NA	NA	2.00%	13.93333	kw/MW	70%	3.00	$ 5,000	5.00	-	46.67	lb/hr/MW	1.00	cfm/MW	$ -	NA	-	NA	-	NA	-	NA	5
38	Good	PM	Oil boiler	NA	NA	3.00%	-	NA	0%	-	$ 5,000	-	-	-	-	-	-	$ 21.21	$/yr/lb/hr st	-	NA	-	NA	-	NA	3
39	Best	PM	Oil boiler	NA	NA	3.00%	0.00813	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	99.00	tpy of ash	3
40	Good	SO2	Oil boiler	NA	NA	3.00%	0.00411	kw/lb/hr/stm	70%	3.00	$ 5,000	42.86	4.29	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
41	Best	SO2	Oil boiler	NA	NA	3.00%	0.00548	kw/lb/hr/stm	80%	3.00	$ 5,000	42.86	4.29	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
42	Good	NOx	Oil boiler	NA	NA	3.00%	0.00112	kw/lb/hr/stm	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
43	Best	NOx	Oil boiler	NA	NA	2.00%	0.00256	kw/lb/hr/stm	70%	28.57	$ 5,000	4.14	-	0.00858	lb/hr/lb/hr stm	0.00018	cfm/lb/hr stm	$ -	NA	-	NA	-	NA	-	NA	5
44	Good	PM	Wood boiler	NA	NA	3.50%	0.00304	kw/lb/hr/stm	70%	3.00	$ 5,000	(200.00)	(20.00)	-	NA	-	NA	$ -	NA	-	NA	-	NA	551.00	tpy of ash	5
45	Best	PM	Wood boiler	NA	NA	3.50%	0.00659	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	599.00	tpy of ash	3
46	Best	PM	Wood boiler	NA	NA	2.00%	0.00083	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	116.00	tpy of ash	5
47	Good	NOx	Wood boiler	NA	NA	3.00%	0.00099	kw/lb/hr/stm	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
48	Best	NOx	Wood boiler	NA	NA	3.50%	0.00004	kw/lb/hr/stm	80%	3.00	$ 5,000	3.00	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
49	Best	NOx	Wood boiler	NA	NA	2.00%	0.00140	kw/lb/hr/stm	75%	28.57	$ 5,000	5.00	-	0.004676	lb/hr/lb/hr stm	0.00010	cfm/lb/hr stm	$ -	NA	-	NA	-	NA	-	NA	5
50	Best	Hg	Wood boiler	lb/hr	pebble lime	5.00%	0.00087	kw/lb/hr/stm	70%	3.00	$ 5,000	89.60	28.00	-	NA	-	NA	$ -	NA	-	NA	-	NA	1,576.39	tpy of lime & carbon	5
51	Best	CO	Wood boiler	NA	NA	3.00%	0.00099	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
52	Good	VOC	Paper machines	NA	NA	3.00%	0.86089	kw/tpd	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	5
53	Best	VOC	Paper machines	NA	NA	3.00%	0.31160	kw/tpd	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	0.00471	Mmbtu/hr/tpd	-	NA	-	NA	5
54	Best	VOC	Paper machines	NA	NA	3.00%	0.37975	kw/tpd	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	0.00810	Mmbtu/hr/tpd	-	NA	-	NA	5
55	Good	VOC	Mechanical pulping	NA	NA	3.00%	0.32912	kw/tpd	70%	1.50	$ 5,000	192.00	194.00	(188.51)	lb/hr/tpd pulp	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
56	Best	VOC	Mechanical pulping	NA	NA	3.50%	0.04476	kw/tpd	70%	2.25	$ 5,000	10.00	10.00	-	NA	-	NA	$ -	NA	0.00371	Mmbtu/hr/tpd	-	NA	-	NA	3
57	Best	Various	Recovery Furnace	NA	NA	3.00%	###################	kW/Mmlb BLS	70%	-	$ 5,000	-	650.00	########	lb/hr/Mmlb BLS/day	-	NA	$ -	NA	-	NA	0.10%	Of TIC	12.32	tons/day/Mm lb BLS	NA
58	Best	PM	NDCE Kraft Recovery Furnace	NA	NA	2.00%	81.08108	kw/Mmlb BLS	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
59	Good	PM	NDCE Kraft Recovery Furnace	NA	NA	2.00%	74.32432	kw/Mmlb BLS	70%	1.50	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
60	Best	PM	Lime Kilns	NA	NA	1.00%	0.41667	kw/tpd CaO	70%	2.25	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
61	Best	PM	Coal Boiler	NA	NA	1.00%	0.00183	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	38.00	NA	3
62	Best	PM	Coal/Wood Boiler (50/50)	NA	NA	1.00%	0.00167	kw/lb/hr/stm	70%	3.00	$ 5,000	-	-	-	NA	-	NA	$ -	NA	-	NA	-	NA	43.00	NA	3
63	Best	NOx	NDCE Kraft Recovery Furnace	NA	NA	2.00%	147.71161	kw/Mmlb BLS	70%	28.57	$ 5,000	6.54	-	494.73	lb/hr/Mmlb BLS/day	10.60	cfm/Mmlb BLS/day	$ -	NA	-	NA	-	NA	-	NA	5
64	Best	NOx	DCE Kraft Recovery Furnace	NA	NA	2.00%	209.03447	kw/Mmlb BLS	70%	28.57	$ 5,000	4.25	-	700.12	lb/hr/Mmlb BLS/day	25.50	cfm/Mmlb BLS/day	$ -	NA	-	NA	-	NA	-	NA	5
65	Best	VOC	Mechanical pulping	NA	NA	3.50%	0.37388	kw/tpd	70%	2.25	$ 5,000	202.00	204.00	(188.51)	lb/hr/tpd pulp	-	NA	$ -	NA	-	NA	-	NA	-	NA	3
66	Good	VOC	Mechanical pulping	NA	NA	3.00%	0.32912	kw/tpd	70%	1.50	$ 5,000	192.00	38.80	(37.70)	lb/hr/tpd pulp	-	NA	$ -	NA	-	NA	-	NA	-	NA	
67	Best	VOC	Mechanical pulping	NA	NA	3.50%	0.39696	kw/tpd	70%	2.25	$ 5,000	202.00	48.80	(37.70)	lb/hr/tpd/pulp	-	NA	$ -	NA	0.00742	Mmbtu/hr/tpd	-	NA	-	NA	
68	Best	VOC	Mechanical pulping	NA	NA	3.50%	0.34847	kw/tpd	70%	2.25	$ 5,000	10.00	20.00	-	NA	-	NA	$ -	NA	0.03021	Mmbtu/hr/tpd	-	NA	-	NA	

Mosaic Fertilizer, LLC
South Pierce Facility
13830 Circa Crossing Drive
Lithia, FL 33547

February 28, 2023

ELECTRONIC SUBMITTAL

Mr. Hastings Read
Florida Department of Environmental Protection
Division of Air Resources Management
2600 Blairstone Road
Tallahassee, FL 32399

RE: **Response to February 1, 2023 Regional Haze Rule Reasonable Progress Analysis Request Letter**
Mosaic South Pierce Facility
Permit Nos. 1050055-035-AV

Dear Mr. Read:

This submittal serves as the Regional Haze Rule Reasonable Progress Analysis for the Mosaic Fertilizer, LLC (Mosaic) South Pierce facility in response to the February 1, 2023 request letter to complete and submit to the Florida Department of Environmental Protection (Department) an analysis regarding the availability of emission controls needed to ensure reasonable progress to visibility goals at Class I areas in and around the State of Florida. The February 1, 2023 Regional Haze Rule Reasonable Progress Analysis request letter includes background on the U.S. Environmental Protection Agency's (U.S. EPA's) Regional Haze Rule, the second implementation period (2018-2028), and the Department's SIP development process.

The South Pierce facility is located in South Pierce, Polk County, Florida and is currently operating under Title V Air Operation Permit No. 1050055-035-AV. The South Pierce facility is classified as a phosphate fertilizer manufacturing facility consisting of two sulfuric acid plants (SAPs). The SAPs manufacture sulfuric acid (H_2SO_4) that is then reacted with phosphate rock (P_2O_5) at nearby Mosaic phosphate fertilizer manufacturing facilities to produce phosphoric acid, which is then ammoniated and granulated to produce fertilizers and animal feed ingredients.

The units listed below are projected to emit more than 5 tons per year of SO_2 in 2028, and the Department requested that Mosaic provide either a reasonable progress four-factor technical analysis or an analysis demonstrating that the unit meets the "effectively controlled unit" exemption at the facility:

- EU 004 – Sulfuric Acid Plant No. 10
- EU 005 – Sulfuric Acid Plant No. 11

Mosaic has determined that a full four-factor technical analysis would likely result in the conclusion that no further controls are necessary, and this response provides the analysis demonstrating that the SAPs at the South Pierce facility meet the "effectively controlled unit" exemption.

Regional Haze Rule Reasonable Progress Analysis Subject Emission Units

Within the SAP process at the South Pierce facility, molten sulfur is combusted (oxidized) with dry air in the sulfur furnace. The resulting SO_2 gas is catalytically converted (further oxidized) to sulfur trioxide (SO_3) over a catalyst bed in a converter tower. The SO_3 is then absorbed in sulfuric acid. The remaining SO_2, not previously oxidized, is passed over a final converter bed of catalyst and the SO_3 produced is then absorbed in H_2SO_4. The remaining gases exit to the atmosphere through a high-efficiency mist eliminator. The current permit production capacities and SO_2 emission limits are presented in Table 1.

Table 1: South Pierce SAP Production Capacities & SO_2 Emission Limits

	SAP # 10 (EU 004)	SAP # 11 (EU 005)
Maximum Production Rate - TPD of 100% H_2SO_4	3,000	3,000
SO_2 Emission Limit - lb/ton of 100% H_2SO_4	4	4
SO_2 Emission Limit - lb/hr of 100% H_2SO_4	500	500
SO_2 Emission Limit - ton/year	2,190	2,190
SO_2 Emission Limit- lb/hr CAP	750[a] CAP, 24-hour block average (6:00 a.m. to 6:00 a.m.)	

[a]SO_2 CAP effective April 1, 2023 (Construction Permit No. 1050055-037-AC)

Effectively Controlled Units

Mosaic has determined that the South Pierce SAPs are effectively controlled with respect to SO_2 emissions and, therefore, they are not subject to a reasonable progress four-factor technical analysis. As outlined below, Mosaic has recently made significant expenditures to effectively control SO_2 emissions at each unit.

The South Pierce SAPs are double absorption sulfuric acid systems equipped with two absorption towers in series to react sulfur trioxide (SO_3) with water to generate sulfuric acid. The SO_2 generated in a double absorption system's sulfur furnace is catalytically oxidized to SO_3 over catalyst beds at a very high rate of 99.7% or greater, resulting in relatively low SO_2 emissions when compared to a single absorption system. A design feature that limits the overall SO_2-to-SO_3 conversion in a single absorption system is the fact that the reaction of SO_2 to SO_3 becomes less favorable as the SO_3 concentration in the system increases with SO_2 conversion efficiencies ranging from only 95% to 98%. The double absorption design improves SO_2-to-SO_3 conversion by using the first absorption tower, a heat recovery system (HRS) absorption tower, to remove SO_3, thereby bringing about a considerable shift in the SO_2-to-SO_3 reaction equilibrium towards the formation of SO_3 in the converter bed(s) located after the first absorption tower, which results in a very high overall SO_2-to-SO_3 conversion efficiency.

Permit No. 1050055-037-AC added a voluntary SO_2 lb/hr 24-hour block average facility cap that will assist towards the goal of the Regional Haze Rule during the second implementation period, the goal of the EPA's June 12, 2015 Startup, Shutdown, and Malfunction (SSM) SIP Call, and the continued assurance of the National Ambient Air Quality Standards (NAAQS) attainment. The standard catalysts used in sulfuric acid unit SO_2-to-SO_3 converter beds are comprised of potassium and vanadium salts supported on a silica carrier. Cesium-promoted catalysts are like these standard potassium-promoted catalysts, but the potassium promoter is replaced with cesium. The cesium helps to promote SO_2-to-SO_3 conversion at lower temperatures. In the South Pierce SAPs, a cesium-promoted catalyst is used in the SO_2-to-SO_3 converter bed located between each unit's two absorption columns because it promotes a high SO_2-to-SO_3 conversion rate at the lower inlet temperature that may occur at this converter bed. By using a cesium-promoted catalyst in the last converter bed, the overall SO_2-to-SO_3 conversion rate is increased, resulting in lower SO_2 emissions from the plant. Appendix 1 provides a summary per SAP of the amount, manufacturer, and type of catalyst installed.

A search of sulfuric acid plant (Process Code 62.015) entries dating back to January 1, 2000 in EPA's RACT/BACT/LAER Clearinghouse (RBLC) database indicates that the combination of dual absorption design and cesium-promoted catalysts represents the BACT for sulfur burning, non-single absorption column sulfuric acid plants. Appendix 2 is a compilation of the results of our search of the RBLC database for sulfur burning, non-single absorption column sulfuric acid plants. BACT determinations have been in the range of 3.0 to 4.0 lb/ton for SO_2 emissions.

Additionally, Mosaic has replaced several major components within the South Pierce SAPs during the last decade. These comprehensive replacement activities reduced the SAPs' SO_2 emissions by renovating the units with gastight, more efficient components which improved its overall SO_2-to-SO_3 conversion efficiency. The construction permits authorizing improvements to overall SO_2-to-SO_3 conversion efficiency are presented in Table 2.

Table 2. Construction Permits Authorizing Overall SO_2-to-SO_3 Conversion Efficiency Improvements

Emission Unit	Construction Permit
SAP # 10 (EU 004)	1050055-030-AC
	1050055-037-AC
SAP # 11 (EU 005)	1050055-026-AC & 1050055-027-AC
	1050055-036-AC

In summary, sulfur dioxide emissions from the South Pierce SAPs are effectively controlled by the 750 lb SO_2/hour, 24-hour block average (6:00 a.m. to 6:00 a.m.) cap, double absorption system technologies with vanadium catalyst for the 1st, 2nd, and 3rd beds and cesium catalyst for the 4th bed in the converters, the use of good combustion practices, and best operational practices to minimize excess emissions during startup and shutdown.

If you have any questions regarding this correspondence please do not hesitate to contact me at 863-800-9283, or email me at Veronica.Figueroa@Mosaicco.com.

Sincerely,

Veronica Figueroa

Veronica K. Figueroa, PE
Engineer Lead, Air Permitting & Compliance

enc.

cc:

P. Kane
S. Provenzano
S. Sorenson
J. Hilderman
B. Koplin
D. Ford
M. Wozniak
SWD_AIR@dep.state.fl.us

Appendix 1
Catalyst Improvement Summary

No. 10 SAP (EU 004) Catalyst Conversion Completion Date: March 2019

No. 10 SAP (EU 004) Bed	Catalyst Amount (Liters)	Manufacturer and Type
A	127,000	GR-330
B	154,000	XLP-110
C	167,000	XLP-110
D	207,000	VK-69

No. 11 SAP (EU 005) Catalyst Conversion Completion Date: December 2021

No. 11 SAP (EU 005) Bed	Catalyst Amount (Liters)	Manufacturer and Type
A	105,600	GR-330
B	96,000	GR-310
C	114,000	XLP-310
D	164,400	SCX-2000

Appendix 2
EPA RBLC Table for Sulfuric Acid Plants (Process Code 62.015)

RBLC Search Results - Process 62.015; Sulfuric Acid Plants; Sulfur Burning Double Absorption Sulfuric Acid Trains
Sulfur Dioxide

RBLCID	FACILITY NAME	CORPORATE OR COMPANY NAME	PERMIT ISSUANCE DATE	PROCESS NAME	PRIMARY FUEL	THROUGHPUT		POLLUTANT	CONTROL METHOD DESCRIPTION	EMISSION LIMIT		CASE-BY-CASE BASIS	POLLUTANT COMPLIANCE NOTES
FL-0253	NEW WALES PLANT/MULBERRY	IMC PHOSPHATES MP, INC	7/12/2002	ABSORBER		3,400	T/D	Sulfur Dioxide (SO2)	DOUBLE ABSORPTION PROCESS	3.5	LB/T	BACT-PSD	
FL-0260	PLANT CITY PHOSPHATE COMPLEX	CF INDUSTRIES, INC.	6/1/2004	ABSORBER		3,000	T/D	Sulfur Dioxide (SO2)	DOUBLE ABSORPTION PROCESS IS CONSIDERED AN INHERENT CONTROL TECHNOLOGY SINCE IT CONTROLS EMISSIONS OF SO2.	401	LB/H	BACT-PSD	3.2 LB/T
ID-0015	J R SIMPLOT COMPANY - DON SIDING PLANT	J R SIMPLOT COMPANY	4/5/2004	400 SULFURIC ACID PLANT		2,500	T/D	Sulfur Dioxide (SO2)	DOUBLE-CONTACT PROCESS	999	LB/3 H PERIOD	RACT	3.2 LB/T
MS-0090	MISSISSIPPI PHOSPHATES CORPORATION	MISSISSIPPI PHOSPHATES CORPORATION	11/9/2010	No. 2 Sulfuric Acid Plant (Emission Point AA-001)	sulfur and air	1,800	T/D	Sulfur Dioxide (SO2)	This is a dual absorption plant with a 2-2 converter design. MPC will replace the vanadium catalyst with cesium catalyst in the 3rd and 4th passes of the converter.	3	LB/T OF 100% H2SO4	BACT-PSD	
MS-0090	MISSISSIPPI PHOSPHATES CORPORATION	MISSISSIPPI PHOSPHATES CORPORATION	11/9/2010	No. 3 Sulfuric Acid Plant (Emission Point AA-017)	sulfur and air	1,800	T/D	Sulfur Dioxide (SO2)	Dual absorption. Replacing vanadium catalyst with cesium catalyst in 3rd and 4th passes of the 2/2 converter.	3	LB/T OF 100% H2SO4	BACT-PSD	
NC-0088	PCS PHOSPHATE COMPANY	PCS PHOSPHATE COMPANY	9/24/2003	SULFURIC ACID PLANT NO. 4		1,850	T/D	Sulfur Dioxide (SO2)	DUAL ABSORPTION CATALYST	3.7	LB/T	BACT-PSD	
NC-0099	PCS PHOSPHATE	PCS PHOSPHATE	7/14/2000	SULFURIC ACID PLANT NO. 3		2,000	T/D	Sulfur Dioxide (SO2)	Double-absorption sulfuric acid plant	4	LB/T	BACT-PSD	
TX-0519	AGRIFOS SULFURIC ACID PLANT	AGRIFOS FERTILIZER	11/10/2005	H2SO4 PLANT STACK (INCLUDING MSS)				Sulfur Dioxide (SO2)		525	LB/H	BACT-PSD	