SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
PLANNING, RULE DEVELOPMENT & AREA SOURCES

Draft Staff Report
SOx RECLAIM
Part III

BARCT Assessment & RTC Reductions

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Chapter 17 – BARCT Assessment Process

17.1 Best Available Retrofit Control Technology (BARCT) Definition

Best Available Retrofit Control Technology (BARCT) is defined in California Health and Safety (H&S) Code §40406 as:

> *"… an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, & economic impacts by each class or category of source."*

The BARCT analysis procedure for RECLAIM is identical to any BARCT analysis procedure used in developing a command-and-control rule. In RECLAIM, however, the BARCT levels are mainly used for assessing programmatic RECLAIM Trading Credit (RTC) reductions. Unlike other facilities that are subject to a command-and-control rule, RECLAIM facilities are not required to meet the BARCT levels at all times. RECLAIM facilities are provided the flexibility to meet the programmatic reductions by various means, such as installing control devices or buying RTCs.

It should be noted that California H&S Code §39616 requires a market incentive program to achieve an equivalent or greater level of emission reductions at an equivalent or lower cost as would have been achieved under a command-and-control rule. Since the adoption of RECLAIM in 1993, staff has not conducted any BARCT analysis for SOx. Starting with the 2003 AQMP, staff committed to conduct a BARCT analysis for RECLAIM facilities every three years to assure that RECLAIM and non-RECLAIM facilities are subject to the same BARCT standards based on state-of-the-art control technologies.

17.2 BARCT Selection Procedure

In order to identify BARCT meeting the definition of California Health and Safety (H&S) Code §40406, staff conducted the following five-step procedure:

Step 1 - Identify technology that can achieve maximum degree of reduction

In order to identify technology that can achieve maximum degree of reduction for this project, staff conducted a thorough and extensive research of the:

1. Control technology (both existing technology and potential future technology) from literature research, consultations with manufacturers/vendors, and expert consultants;

2. Federal, state, or other air pollution control district or agency rules/regulations; and

3. U.S. EPA RACT/BARCT/LAER Clearinghouse, CARB database, and other state and local district permitting database to search for recent BACT or BARCT implementation.

It should be noted that in the rule making process staff is not obligated or limited to look at fully commercialized available technologies. Sometimes staff is called upon to develop technology forcing rules. In this situation, staff can consider technology that has not been applied to full scale operations, and provide sufficient time in the rule language to assist the technology to reach maturity. In addition, staff can develop alternative compliance provisions to handle situations where the technology cannot be fully developed.

Staff will consider feasible retrofit control technology, which is a technology that has been previously installed and operated successfully at a similar type of source, or has practical potential for application to the source (i.e. has been successfully applied to similar sources with similar gas stream characteristics).

Staff will also consider currently available retrofit control technology, which is a control technology that 1) is being offered commercially by vendors, or 2) is in commercial demonstration or licensing. Technologies that are in development and testing stages are generally classified as not currently available, but if available in the future, will be considered in the BARCT determination as well.

The results of staff's work in this step are presented in Part I of the Staff Report. A summary of staff's review on federal, state or other air pollution control districts' regulatory requirements is shown in Appendix III-C of this report. [1]

As discussed in Part II of the Staff Report, in July 2008, staff awarded two contracts to two individual contractors and a sub-contractor to conduct an independent analysis on feasible/available control technologies and assess costs and cost effectiveness of control technologies. The contractors were required to identify at least two available control technology manufacturers/vendors for each of the top seven categories of emitting sources that staff identified in Part I. The contractors were asked to collect the manufacturers' performance guaranteed letters. All of the performance guaranteed letters and the contractors' final reports were sent to the refineries and affected facilities.

The contractors' work in this step is summarized in Part II of the Staff Report.

Regarding the feasible and available SOx control technologies, staff and the contractors reached the same conclusion that dry and wet gas scrubbers are technologically feasible and abundantly available for the top seven categories of emitting identified by staff in Part I. SOx reducing catalysts was also identified by staff and the consultants as of the feasible and available control technology for FCCUs.

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[1] While developing the 2007 AQMP, staff conducted a thorough review of regulatory requirements shown in Appendix VI of the 2007 AQMP – RACM Demonstration.

Step 2 - Evaluate control effectiveness

After the technically feasible and available control technologies were identified in Step 1, staff evaluated the control effectiveness of the control technology using the control efficiency, or the outlet SOx concentration, or the emission factor reported for each control technology. These control effectiveness information was obtained by considering data available through permitting, source testing, engineering estimates, or performance guarantees by the control manufacturers/vendors.

As part of the contracts, the contractors were required to assess the levels of emission reductions that could be achieved from at least two different types of control technology.

The results of staff's work in this step are presented in Part I of the Staff Report, and the results of the contractors' work are summarized in Part II of the Staff Report.

Regarding the control effectiveness, staff and the contractors are in agreement that wet and dry gas scrubbers are very effective in reducing SOx. Their control efficiencies are reported in a range of 95% - 99% for most applications. The consultants received several manufacturers' guaranteed letters for FCCUs' and SRU/TGTUs' wet gas scrubbers, and absorption/oxidation catalysts technology used for SRU/TGTUs. The consultants have provided the District, as well as the refineries, copies of these guaranteed letters.

In addition, one refinery in the District conducted a short-term testing with SOx reducing catalysts, and their data (CEMS and source test results) indicated that SOx reducing catalysts had the potential to reduce SOx to a level of 10 ppmv or less.

Step 3 - Conduct a top-down cost effectiveness analysis

After the control effectiveness is established in Step 2, a top-down cost effectiveness analysis starting with the most effective control technology was conducted to provide information on emission reductions and cost effectiveness associated with different control technologies and different levels of control.

The top-down cost effectiveness analysis must consider site-specific, physical limitation, as well as operational characteristics of the equipment at the facilities. Equipment costs, installation costs, annual operating costs, the useful life of the control equipment are all captured in this analysis to generate a cost-effectiveness factor in dollars per ton of pollutants reduced.

Staff did not conduct a cost effectiveness analysis for this project but selected to contract this important project to two contractors and a subcontractor. Their extensive and detailed cost analyses are summarized and referenced in Part II of the Staff Report. In most parts, staff was in agreement with the contractors' analyses and used their costs and cost effectiveness in the scenario studies discussed in Chapter 18. However, in some few scenarios, staff adjusted the consultants' estimate to reflect the actual conditions at the facilities.

Establishing a cost-effectiveness factor allows a comparison of control technologies. Using the contractors' costs information, staff estimated the following four types of cost-effectiveness:

1) Individual cost effectiveness for a specific emitting source (e.g. cost effectiveness for each FCCU);
2) Average cost effectiveness for the category of source (e.g. average cost effectiveness for five FCCUs in the Basin);
3) Average cost effectiveness for the entire project; and
4) Incremental cost-effectiveness for the entire project.

The individual cost-effectiveness is defined as the present worth value of the control technology divided by the total quantity of pollutants removed during the life time of a control technology. The average cost effectiveness is an average of all control technologies, or an average of all control technologies for all sources in the project. The incremental cost-effectiveness is a comparison of the cost and performance level of a control technology to a next more stringent option.

There is no bright line cut-off of what cost effectiveness in dollars per ton should be considered as cost effective. The cost-effectiveness factor remains a relative measurement factor.

The top down analysis conducted by the contractors and their results are summarized in Part II of the Staff Report.

In addition to the top down analysis conducted by the contractors, staff conducted a scenario analysis presented in Chapter 18. In Chapter 18, staff estimated the emission reductions and cost effectiveness for four scenarios of control ranging from the most stringent set of control to the least stringent set of control. From this analysis, staff selected a scenario that best reflected BARCT, "*… maximum degree of reduction achievable, taking into account of ….economic impacts by each class or category of source.*"

Step 4 - Conduct an impact analysis for environmental, energy & economic

CEQA and Socioeconomic staff will conduct full CEQA and Socioeconomic analyses to address and analyze the impacts to environmental, energy and economic for this rule making process.

The energy impact of each evaluated control technology is the energy penalty or benefit resulting from the operation of the control technology at the source. An example of the energy impact includes the increase (or decrease) in energy consumption at the source.

The environmental impacts are evaluated to determine whether a particular control technology has any impacts, either positive or negative, to the environment. An example of the environmental impact is the generation of wastewater discharge and solid waste.

The economic impacts are evaluated to determine the impacts of staff proposal to the economy of the basin as a whole.

As a part of the contracts, the contractors were asked to conduct an analysis on concurrent effect on other air pollutants, and made comments and recommendations if there were technologies capable of reducing SOx, and concurrently reducing (or increasing) PM2.5, and/or CO2. The contractors indicated that wet gas scrubbers should have a positive effect on particulate emissions and minimal impact on NOx, ammonia, and volatile organic compound. Fine particulate impact will be lessened by reducing SO2 emissions which is PM2.5 precursor.

The contractor were also asked to identify and quantify, as appropriate, the environmental effects or impacts (water demand, wastewater treatment, solid waste, energy consumption) and provide information on any hazardous materials and hazardous waste, if known for each SOx reduction technique or technology evaluated.

The contractors' results for this analysis are in their final reports. Further, data derived by the contractors will be used in the CEQA and socioeconomic analyses that will be conducted in the future and will supplement the rule development analysis.

Step 5 – Select Best Available Retrofit Control Technology (BARCT)

The contractors were asked to propose the BARCT levels based on their independent analysis from Step 1 to Step 4. The consultants recommended BARCT levels are shown in Table 17.1.

Table 17.1
BARCT Levels Recommended by the Consultants

Basic Equipment	Consultants' Recommendation
Fluid Catalytic Cracking Units	5 ppmv
SRUs/TGs	Incinerated tail gas: 5 ppmv; Non incinerated tail gas: 10 ppmv H2S & 300 ppmv non H2S
Refinery Boilers/Heaters	40 ppmv
Calciner, Petroleum Coke	10 ppmv
Sulfuric Acid Mfg	10 ppmv
Container Glass Melting Furnace	1-2 ppmv (99% control)
Cement Kiln & Coal-Fired Boiler	1-2 ppmv (95% control)

Staff is in agreement with the consultants' recommendation for FCCUs, SRUs/TGs, refinery boilers/heaters, coke calciner, and sulfuric acid manufacturing. Based on the results of the scenario analysis presented in Chapter 18, staff proposed to set the BARCT limits for glass melting furnace and cement kilns/coal-fired boiler at 5 ppmv.

Staff believed that BARCT for FCCUs should be kept at 5 ppmv because it was the level achieved in practice at one refinery in the District. This refinery installed and operated a wet gas scrubber since September of 2008 and consistently achieved a level less than 5 ppmv. The initial source test conducted in October 2008 indicated SOx concentration was about 1 ppmv. The initial source test results and the emissions reported by this refinery for their FCCU in the past eight months were presented in Appendix III-D. Estimated SOx concentrations were about 3 ppmv – 4 ppmv during this 8-month period.

Table 17.2
Preliminary BARCT Levels Recommended by AQMD

Basic Equipment	AQMD's Recommendation
Fluid Catalytic Cracking Units	5 ppmv
SRUs/TGs	Incinerated tail gas: 5 ppmv; Non incinerated tail gas: 10 ppmv H2S & 300 ppmv non H2S
Refinery Boilers/Heaters	40 ppmv
Calciner, Petroleum Coke	10 ppmv
Sulfuric Acid Mfg	10 ppmv
Container Glass Melting Furnace	5 ppmv
Cement Kiln & Coal-Fired Boiler	5 ppmv

Additional CEQA and Socioeconomic analyses will be conducted and staff will continue its evaluation/re-evaluation to set the final BARCT levels.

Chapter 18 – Scenario Analysis

18.1 Scenario Analysis

Staff conducted the following four scenario analysis to estimate overall emission reductions for the project, costs, cost effectiveness, control factors, and RTC reductions.

Scenario 1 – Most Stringent
- 1 ppmv for FCCUs (98% control),
- 1 ppmv for SRU/TGTUs
- Tier I level for boilers/heaters (40 ppmv, or to appropriate sensible levels)
- 5 ppmv for coke calciner
- 5 ppmv for sulfuric acid
- 1 - 2 ppmv (99% control) for glass furnace
- 1 - 2 ppmv (99% control) for cement plant

Scenario 2 – Consultants' Recommendations
- 5 ppmv for FCCUs,
- 5 ppmv for SRU/TGTUs
- Tier I level for boilers/heaters (40 ppmv, or to appropriate sensible levels)
- 10 ppmv for coke calciner
- 10 ppmv for sulfuric acid
- 1 – 2 ppmv (99% control) for glass furnace
- 1 - 2 ppmv (99% control) for cement plant

Scenario 3 – Staff's Recommendations
- 5 ppmv for FCCUs
- 5 ppmv for SRU/TGTUs (only WGS at reasonable level of cost effectiveness)
- Tier I level for boilers/heaters (40 ppmv, or to appropriate sensible levels)
- 10 ppmv for coke calciner
- 10 ppmv for sulfuric acid
- 5 ppmv for glass furnace
- 5 ppmv for cement plant

Scenario 4 – No additional control beyond Tier 1 control level

The emission reductions and cost effectiveness of these scenarios are shown in Table 18-1 and the full analyses are shown in Appendix III-A.

TABLE 18-1
Scenario Analysis

	PWV	Emission Reductions from 2005 Baseline	Cost Effectiveness
Scenario 1 - Most Stringent	$1.03 billion	7.5 tpd	$15K/ton
Scenario 2- Consultants' Proposal	$1.01 billion	6.5 tpd	$17K/ton
Scenario 3 – Staff's Proposal	$883 - 944 million*	6.1 – 6.4 tpd*	$16K/ton

*Staff is in the process of verifying the numbers for Scenario 3.

There is not much difference in the cost effectiveness between the most stringent proposal, consultants' proposal and staff proposal. The consultants' proposal would alleviate several process/measurement control problems such as accuracy in CEMS measurements, repeatability in source testing, and excessive use of caustic solution. The BARCT levels suggested by the consultants can be considered as *"emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy,…. impacts by each class or category of source."*

Comparing the consultants' proposal and staff's proposal, the costs to get to an additional of 0.4 tpd incremental emission reductions were $126 million, which translated to **an incremental cost effectiveness of $300 million per incremental ton SOx reduced per day**. This significant high level of incremental cost between the two options was the driving force leading staff to select the BARCT levels in Scenario 3. Staff believed that the BARCT levels in Scenario 3 reflect a balancing act between requiring additional control for SOx RECLAIM versus being sensible to the economic impacts. The BARCT levels in Scenario 3 finally reflect "*… emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source."* as required by California Health and Safety (H&S) Code §40406.

18.2 Comparison of Cost Effectiveness

The weighted average cost effectiveness of staff's proposal is approximately $16K per ton of SOx reduced, or equivalent to $1K per ton NOx reduced, or $10K per ton PM2.5 reduced. [2]

As discussed in Section 17.2, the cost effectiveness factors should only be used as a relative measurement for comparison. Table 18-1 shows a comparison between the cost effectiveness derived for the 2009 SOx RECLAIM to the cost effectiveness of the 2005 NOx RECLAIM and other command-and-control rules.

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[2] Staff used the following equivalency factor: 1 ton of SOx reduced will have the same effect as 15 tons of NOx reduced, or 1.5 tons of PM2.5 reduced (Appendix C of CARB's 2007 SIP Submittal.)

As shown in this table, controlling SOx to the BARCT levels proposed by staff would result in cost effectiveness mostly falls within, or lower than, the range of the rule cost effectiveness approved by the Governing Board in the past.

TABLE 18-1
Cost Effectiveness Comparison

2009 SOx RECLAIM	**Command-Control SOx Rule**
Sulfuric acid plant: $2K per ton SOx reduced Glass melting furnace: $5K per ton SOx reduced Coke calciner: $10K per ton SOx reduced FCCUs: $25K per ton of SOx reduced Cement kilns: $37K per ton SOx reduced SRU/TGTUs: $42K per ton of SOx reduced Project Overall: $16K per ton SOx	Flares: $5K - $9K per ton of SOx reduced (Rule 1118 amended 11/4/05)
2009 SOx RECLAIM (1)	**2005 NOx RECLAIM**
Sulfuric acid plant: $133 per ton NOx reduced Glass melting furnace: $333 per ton NOx reduced Coke calciner: $700 per ton NOx reduced FCCUs: $2K per ton NOx reduced Cement kilns: $2K per ton NOx reduced SRU/TGTUs: $3K per ton NOx reduced Project Overall: $1K per ton NOx reduced	Metal melting/heat treating and miscellaneous combustion: $4K – $11K per ton of NOx reduced Industrial boilers: $9K - $10K per ton FCCUs, refinery boilers/heaters: $11K-$17K per ton
2009 SOx RECLAIM (1)	**Command-Control PM Rules**
Sulfuric acid plant: $1K per ton PM2.5 reduced Glass melting furnace: $3K per ton PM2.5 reduced Coke calciner: $6.5 K per ton PM2.5 reduced FCCUs: $16K per ton PM2.5 reduced Cement kilns: $25K per ton PM2.5 reduced SRU/TGTUs: $28K per ton PM2.5 reduced Project Overall: $10K per ton PM2.5 reduced	FCCUs: $13K-$23K per ton filterable PM, $3-$5K per ton filterable and condensable (Rule 1105.1, adopted 11/7/03) Coke/Coal/Sulfur Handling: $3-$30K per ton PM10 (Rule 1158, amended 6/11/99)

1) The comparison in this table uses the following equivalency: of 1 ton of SOx reduced has an equivalent effect to 15 tons of NOx reduced, or 1.5 tons of PM2.5 reduced provided in Appendix C to CARB’s 2007 SIP Submittal.

Chapter 19 – RTC Reductions

Staff applied the same methodology used for NOx RECLAIM to estimate the projected year 2014 SOx emissions for the entire SOx RECLAIM universe as follows:

Projected Emissions = 1997 Baseline x Growth Factor x New BARCT Adjustment Factor

Where:

Projected Emissions = Emissions in year 2014 at new BARCT levels.
1997 Baseline =Actual emissions from July 1, 1997 – June 30, 1998. [3]
Growth Factor = Growth factor from 1997 – 2014 for each facility
New BARCT Adjustment Factor = New BARCT / Starting Emission Factor

Staff applied the 10% upward adjustment factor to the 2014 projected emissions, and estimated the projected year 2014 RTC reductions for each of the four scenarios described in Chapter 18 as follows:

RTC Reductions = Current RTC Holdings - [Projected Emissions x 10% Compliance Margin]

Where:

Current RTC Holding = 11.76 tons per day for year 2003 and beyond
Projected Emissions = Remaining emissions of the entire SOx universe in year 2014

The entire SOx RECLAIM universe was captured in this approach. In this approach, it was assumed that the year 1997 emission rates were similar to the starting emission factors. Staff estimated the projected remaining 2014 emissions, the RTC reductions and the percent reductions for the four scenarios outlined in Chapter 18: Scenario 1 represented the impacts of the most stringent control measures, Scenario 2 represented the impacts on the consultants' recommendations, Scenario 3 reflected staff's recommendations, and Scenario 4 reflected the scenario with no additional control beyond Tier I control. The results are listed in Appendix III-B and are summarized in Table 19-1.

[3] In this analysis, staff used the actual CEMS reported emissions from July 1, 1997 – June 30, 1998. The period used in the 2003 AQMP is from July 1, 1996 – June 30, 1997. According to the RECLAIM Annual Audit Reports based on the CEMS data, the inventory for the compliance year 1996 was 6,484 lbs (17.76 tpd), and the inventory for the compliance year 1997 was 6,464 lbs (17.71 tpd). Since there is very little difference between the two inventories, staff believes that the results presented here, even for the 1997-1998 period, would reflect the 1996-1997 period as well.

TABLE 19-1
Projected Year 2014 RTC Reductions Estimated Based on 1997 Baseline

Equipment Type	97-98 Inventory (tpd)	Projected 2014 Inventory (tpd)	Year 2014 Emissions Reductions (tpd)			
			Scenario 1 Most Stringent Control	Scenario 2 Consultants' Proposal	Scenario 3 Staff's Proposal	Scenario 4 No Additional Control Beyond Tier I
FCCUs	5.26	5.26	5.21	5.05	5.05	3.89
SRUs/TGTU	1.54	1.54	1.00	0.83	0.10 - 0.70*	0.00
Boilers/Heaters	7.08	7.08	5.66	5.66	5.66	5.66
Coke Calciner	1.22	1.22	1.21	1.19	1.19	0.00
Sulfuric Acid	0.75	0.81	0.80	0.78	0.78	0.00
Glass Furnace	1.13	1.55	1.55	1.55	1.52	0.00
Cement Kilns	0.53	1.24	0.49	0.49	0.37	0.00
Others	0.21	0.21	0.00	0.00	0.00	0.00
Total	**17.71**	**18.91**	15.92	15.55	**14.66 - 15.20***	9.55
Year 2014 Remaining (tpd)			2.99	3.36	**4.25 - 3.71***	9.36
Yr 2014 RTC Reductions (tpd) = 11.76 tpd – (1.1 x Yr 2014 Remaining)			8.47	8.07	**7.09 - 7.68***	1.47
% RTC Reductions			72%	69%	**60% - 65%***	12%

***Staff is in the process of verifying the numbers for Scenario 3.**

As shown in Table 19-1:

1) For the most stringent control scenario (Scenario 1), staff estimated about 8.5 tons per day reduction in year 2014 from the current RTC holdings (72% reduction);

2) At the BARCT levels recommended by the consultants (Scenario 2), the RTC reductions would be 8 tons per day in year 2014 (70% reductions);

3) To merely get to Tier I with no additional control beyond Tier I (Scenario 4), the current RTC holdings must be reduced by 1.5 tons per day in year 2014 (12% reductions);

4) Staff's current recommendation is Scenario 3, about 7 tons per day RTC reductions (60% reductions).

As a result of the current BARCT analyses in Part I, II and III, staff proposal is to reduce the RTC holdings by 7 tons per day (60% reduction of the current 11.76 tons per day RTC holdings) to ensure that the SOx market incentive program will *"achieve an equivalent or greater level of emission reductions at an equivalent or lower cost as would have been achieved under a command-and-control rule"* as required by California H&S Code §39616.

Because the proposed reduction of 60% RTC holdings will significantly alter the SOx RECLAIM program, staff needs to conduct additional analyses, CEQA and Socioeconomic to fully study the environmental, energy, and economic impacts of the proposed amendment, as well as impacts on the market stability.

In addition, staff proposes a six-year implementation program:

- 1.5 tons per day reductions in Compliance Year 2012
- 1.5 tons per day reductions in Compliance Year 2013
- 1.5 tons per day reductions in Compliance Year 2014
- 1.0 tons per day reductions in Compliance Year 2015
- 1.0 tons per day reductions in Compliance Year 2016
- 0.5-1.2 tons per day reductions in Compliance Year 2017

The first 4.5 tons per day reduction will meet and surpass the commitment under the 2007 AQMP, to help the Basin achieve the federal annual average PM2.5 standard by 2014. The remaining reductions will help the Basin to achieve the federal 24-hour average standard by 2020.

It should be noted that the first 1.5 tons per day reductions in Compliance Year 2012 can be seen as the "over allocated" RTCs, the difference between the RTC holdings of 11.76 tons per day and the actual emissions of 10 tons per day in year 2005.

The remaining tons per day actual emission reductions in compliance year 2014 and beyond must be generated by implementing additional control measures. Assuming the rule is adopted in 2009, staff believes that a 4 to 5-year window is needed to implement all control measures recommended by staff and the consultants. The consultants estimated about 2 - 3 years for implementation. An additional 2 years may be needed to reconcile the turn-around for some refineries in the District. To ease the implementation of this large project, especially to ease some environmental/energy impacts that may occur, staff recommends spreading the remaining tons per day reductions into 5 years, from 2013 to 2017.

Appendix III-A – Scenario Analysis

Equipment	**Fluid Catalytic Cracking Units**						
Facility	**Refinery 1**	**Refinery 2**	**Refinery 3**	**Refinery 4**	**Refinery 5**	**Refinery 6**	**Total**
Control Technology /Vendor	WGS - BELCO						
Present Worth Value ($ million)	76	133	95	78		110	**493**
Scenario 1 - most stringent							
Performance Level	98%	98%	98%	98%	*98%*	98%	
Emission Reductions (tpd)	0.60	0.30	0.35	0.24	*0.94*	1.01	**2.50**
Cost Effectiveness ($/ton)	14,000	48,000	29,500	35,200	*10,700*	11,900	**21,592**
BARCT	0.36 lbs/Mbarrels						
BARCT/Start EF	0.01 (=0.36/52.06)						
Scenario 2 - consultants							
Performance Level	5 ppmv	5 ppmv	5 ppmv	5 ppmv	5 ppmv	5 ppmv	
Emission Reductions (tpd)	0.58	0.19	0.28	0.20	0.87	0.94	**2.20**
Cost Effectiveness ($/ton)	14,437	76,211	36,636	42,103	11,600	12,849	**24,573**
BARCT	2.32 lbs/Mbarrels						
BARCT/Start EF	0.04 (=2.32/52.06)						
Scenario 3 - staff's							
Performance Level	5 ppmv	5 ppmv	5 ppmv	5 ppmv	5 ppmv	5 ppmv	
Emission Reductions (tpd)	0.58	0.19	0.28	0.20	0.87	0.94	**2.20**
Cost Effectiveness ($/ton)	14,437	76,211	36,636	42,103	11,600	12,849	**24,573**
BARCT	2.32 lbs/Mbarrels						
BARCT/Start EF	0.04 (=2.32/52.06)						
Scenario 4 - least stringent							
	No additional control						
BARCT/Start EF	0.26 (=13.7/52.06)						

Appendix III-A (Cont.)

Equipment	Sulfur Recovery Units/Tail Gas						
Facility	Refinery 1	Refinery 2	Refinery 3	Refinery 4	Refinery 5	Refinery 6	Total
Control Technology /Vendor	Emerachem	WGS-TriMer	Emerachem	Emerachem	WGS-TriMer	WGS-TriMer	
Present Worth Value ($ million)	26	60	17	19	64	97	**282**
Scenario 2 - consultants							
Performance Level	5 ppmv	5 ppmv	5 ppmv	5 ppmv	5 ppmv	5 ppmv	
Emission Reductions (tpd)	0.13	0.17	0.15	0.04	0.06	0.29	**0.83**
Cost Effectiveness ($/ton)	22,410	39,000	12,881	54,686	123,186	36,359	**37,411**
BARCT	3.89 lbs/hr						
BARCT/Start EF			0.46 (=3.89/8.39)				
Scenario 3 - staff's							
Performance Level	5 ppmv	5 ppmv	5 ppmv	5 ppmv		5 ppmv	
Emission Reductions (tpd)	0.13	0.17	0.15	0.04		0.29	**0.77**
Cost Effectiveness ($/ton)	22,410	39,000	12,881	54,686		36,359	**31,082**
BARCT	4.72 lbs/hr						
BARCT/Start EF			0.56 (=4.72/8.39)				
Scenario 4 - least stringent							
	No additional control						
BARCT/Start EF							

***Staff is in the process of verifying the (BARCT/Start EF) for Scenario 3.**

Appendix III-A (Cont.)

Equipment	Refinery Boilers/Heaters			Refinery Boilers/Heaters			
Facility	**Refinery 1**	**Refinery 2**	**Refinery 3**	**Refinery 4**	**Refinery 5**	**Refinery 6**	**Total**
Control Technology /Vendor	FGT	FGT	FGT	FGT	FGT	FGT	
Present Worth Value ($ million)	1.4	20	15	16	64	21	**136**
Scenario 1 - most stringent							
Performance Level							
Emission Reductions (tpd)	0.06	0.07	0.04	0.35	0.33	0.04	**0.89**
Cost Effectiveness ($/ton)	2,395	30,948	46,906	4,903	21,071	57,416	**16,823**
BARCT	40 ppmv = 6.76 lbs/mmscft						
BARCT/Start EF	0.2 (=6.76/33)						
Scenario 2 - consultants							
Performance Level							
Emission Reductions (tpd)	0.06	0.07	0.04	0.35	0.33	0.04	**0.89**
Cost Effectiveness ($/ton)	2,395	30,948	46,906	4,903	21,071	57,416	**16,823**
BARCT	40 ppmv = 6.76 lbs/mmscft						
BARCT/Start EF	0.2 (=6.76/33)						
Scenario 3 - staff's							
Performance Level							
Emission Reductions (tpd)	0.06	0.07	0.04	0.35	0.33	0.04	***0.89***
Cost Effectiveness ($/ton)	2,395	30,948	46,906	4,903	21,071	57,416	***16,823***
BARCT	40 ppmv = 6.76 lbs/mmscft						
BARCT/Start EF	0.2 (=6.76/33)						
Scenario 4 - least stringent							
	No additional control						
BARCT/Start EF							

Appendix III-A (Cont.)

Equipment	Coke Calciner		Sulfuric Acid Plant			
Facility	Fac C	Total Costs for Calciner	Fac A	Fac A	Fac B	Total Costs for SAP
Control Technology /Vendor	WGS-BELCO (1,2,3)		Equip Mod-Cansolv (4)	WGS-BELCO (5)	WGS-BELCO (5)	
Present Worth Value ($ million)	25.3	**25.3**	1.7	8.0	17.3	**25.3**
Scenario 1 - most stringent						
Performance Level	5 ppmv (90%)			5 ppmv (>95%)	5 ppmv (>95%)	
Emission Reductions (tpd)	0.32	**0.32**		0.04	1.1	**1.14**
Cost Effectiveness ($/ton)	8,642	**8,642**	not applicable	17,596	1,594	**2,432**
BARCT	0.03 lbs/ton coke			0.07 lbs/ton acid		
BARCT/Start EF	0.01 (=0.03/2.47)			0.02 (=0.07/3.93)		
Scenario 2 - consultants						
Performance Level	10 ppmv		10 ppmv		10 ppmv	
Emission Reductions (tpd)	0.28	**0.28**	0.033		1	**1.03**
Cost Effectiveness ($/ton)	9,902	**9,902**	5,556	not applicable	1,896	**2,016**
BARCT	0.07 lbs/ton coke		0.14 lbs/ton acid		0.14 lbs/ton acid	
BARCT/Start EF	0.03 (=0.07/2.47)		0.04 (=0.14/3.93)		0.04 (=0.14/3.93)	
Scenario 3 - staff's						
Performance Level	10 ppmv		10 ppmv		10 ppmv	
Emission Reductions (tpd)	0.28	**0.28**	0.033		1	**1.03**
Cost Effectiveness ($/ton)	9,902	**9,902**	5,556	not applicable	1,896	**2,016**
BARCT	0.07 lbs/ton coke		0.14 lbs/ton acid		0.14 lbs/ton acid	
BARCT/Start EF	0.03 (=0.07/2.47)		0.04 (=0.14/3.93)		0.04 (=0.14/3.93)	
Scenario 4 - least stringent						
	No additional control		No additional control			
BARCT/Start EF						

Appendix III-A (Cont.)

Equipment	Glass Plant		Cement Plant				
Facility		Total Costs for Glass	Kilns	Coal Fired Boiler	Total Costs for Cement	OVERALL COSTS AND COST EFFECTIVENESS	COSTS AND COST EFFECTIVENESS (including emission reductions from all 6 FCCUs)
Control Technology /Vendor	WGS-TriMer		Limestone Absorber-BoldEco	DGS or Limestone Absorber - BoldEco			
Present Worth Value ($ million)	8.8	**8.8**	43.7	12.6	**56.3**	**1,027**	**1,027**
Scenario 2 - consultants							
Performance Level	99% (1ppmv)		95% (1-2 ppmv)	Not use in 2005		**PWV ($mil)=**	**1,008**
Emission Reductions (tpd)	0.19	**0.19**	0.25		**0.25**	**5.7**	**6.5**
Cost Effectiveness ($/ton)	4,988	**5,201**	18,893		**18,893**	**19,517**	**16,916**
BARCT	0.0058 lbs/ton glass		0.03 lbs/ton clinker				
BARCT/Start EF	0.002 (=0.0058/2.51)		0.6 (=0.03/0.05)				
Scenario 3 - staff's							
Performance Level	95% (5 ppmv)		92% (5 ppmv)	Not use in 2005		**PWV ($mil)=**	**944**
Emission Reductions (tpd)	0.18	**0.18**	0.15		**0.15**	**5.5**	**6.4**
Cost Effectiveness ($/ton)	5,377	**5,377**	31,947		**31,947**	**18,821**	**16,249**
BARCT	0.03 lbs/ton glass		0.035 lbs/ton clinker				
BARCT/Start EF	0.01 (=0.03/2.51)		0.7 (=0.035/0.05)				
Scenario 4 - least stringent							
	No additional control		No additional control				
BARCT/Start EF							

***Staff is in the process of verifying the costs/cost effectiveness numbers for Scenario 3.**

Appendix III-B – RTC Reductions Estimated from 1997 Baseline

				Most Stringent			Consultants' Proposal			Staff's Proposal			No Additional Control Beyond Tier I		
	97-98 Fiscal tpd	Growth Factor 1997-2014	2014 with growth	BARCT Adj Factor F1	Remaining R1	Reduction Rd1	BARCT Adj Factor F2	Remaining R2	Reduction Rd2	BARCT Adj Factor F3	Remaining R3	Reduction Rd3	BARCT Adj Factor F4	Remaining R4	Reduction Rd4
FCCUs	5.26	1.00	5.26	0.01	0.053	5.21	0.04	0.21	5.05	0.04	0.21	5.05	0.26	1.37	3.89
SRUs	1.54	1.00	1.54	0.35	0.54	1.00	0.46	0.71	0.83	0.94	1.45	0.09	1.00	1.54	0.00
COKE CALC	1.22	1.00	1.22	0.01	0.01	1.21	0.03	0.04	1.19	0.03	0.04	1.19	1.00	1.22	0.00
SULFACID	0.75	1.00-1.17	0.81	0.02	0.02	0.80	0.04	0.03	0.78	0.04	0.03	0.78	1.00	0.81	0.00
GLASS	1.13	1.37 - 1.38	1.55	0.002	0.003	1.550	0.002	0.003	1.550	0.01	0.03	1.52	1.00	1.55	0.00
CEMENT	0.53	2.26-2.65	1.24	0.60	0.74	0.49	0.60	0.74	0.49	0.70	0.86	0.37	1.00	1.24	0.00
BOILERS/H	7.08	1.00	7.08	0.20	1.42	5.66	0.20	1.42	5.66	0.20	1.42	5.66	0.20	1.42	5.66
TOTAL MAJOR EQUIP	17.50	1.07	18.70		2.78	15.92		3.15	15.55		4.04	14.66		9.15	9.55
OTHERS	0.21	1.00	0.21		0.21			0.21			0.21			0.21	
TOTAL	17.71	1.07	18.91		2.99			3.36			4.25			9.36	
1.1 REMAINING					3.29			3.69			4.67			10.29	
RTC REDUCT					8.47			8.07			7.09			1.47	
% REDUCT					72%			69%			60%			12%	

NOTE: STAFF IS IN THE PROCESS OF VERIFYING THE VALUES ESTIMATED FOR SCENARIO #3. THE RTC REDUCTIONS CAN BE AS HIGH AS 7.7 TPD (65% REDUCTION)

Appendix III-C – Summary of Federal, State and Local SOx Rule Requirements

Fluid Catalytic Cracking Units

Rule/Regulation	**Applicability ***	**Emission Limits**	**Compliance Date**	**Monitoring ** **
SCAQMD R1105	FCCU	132 lbs SO_2 per 1000 bbl feed (60-minute average)	1/1/1987	
BAAQMD 9-1	FCCU	1000 ppmv SO_2	3/15/1995	CEMS
San Diego County APCD R53	Other sources of gaseous sulfur emissions where sulfur compounds emitted are not products of fuel combustion	0.05 % by volume dry, sulfur as SO_2	1/22/1997	
NSPS 40 CFR Part 60 Subpart Ja	FCCU	25 ppmv SO_2 dry basis, 365-day rolling average	5/14/2007	CEMS

Sulfur Recovery Units/Tail Gas Units

Rule/Regulation	**Applicability ***	**Emission Limits**	**Compliance Date**	**Monitoring ** **
SCAQMD R468	SRU	500 ppm sulfur compounds (calculated as SO_2 dry) over 15 minute average; and 10ppm H_2S over 15-minutes (dry); and 198.5 lbs./hr sulfur compounds as SO_2	10/8/1976	
BAAQMD 9-1	SRU	250 ppmv SO_2 dry @ 0% O_2	3/15/1995	CEMS
San Diego County APCD R53	Sulfur recovery plants	0.05% by volume dry, sulfur as SO_2	1/22/1997	
NSPS 40 CFR Part 60 Subpart Ja	SRU with capacity >20 long tons/day, followed by incineration	250 ppmv SO_2 dry @ 0% O_2	5/14/2007	CEMS
NSPS 40 CFR Part 60 Subpart Ja	SRU with capacity >20 long tons/day, followed by incineration, with multiple trains or release points	250 ppmv SO_2 dry @ 0% O_2 for each process train or release point; or comply with a flow-weighted average of 250 ppmv for all release points	5/14/2007	CEMS
NSPS 40 CFR Part 60 Subpart Ja	SRU with capacity >20 long tons/day, not followed by incineration	10 ppmv H_2S and 300 ppmv of reduced sulfur compounds (H_2S, COS, and CS_2), each calculated as ppmv of SO_2 dry @ 0% O_2	5/14/2007	CEMS

Refinery Boilers/Heaters

Rule/Regulation	Applicability *	Emission Limits	Compliance Date	Monitoring **
NSPS 40 CFR Part 60 Subpart Ja	Fuel gas combustion devices	162 ppmv H_2S in fuel gas determined hourly on a 3-hour rolling average basis or 60 ppmv in fuel gas determined daily on a 365 successive calendar day rolling average basis	5/14/2007	CFGMS
NSPS 40 CFR Part 60 Subpart Ja	Fuel gas combustion devices	20 ppmv flue gas SO_2 (dry @ 0% O_2) determined hourly on a 3-hour rolling average basis, and 8 ppmv flue gas SO2 (dry @0% O2) determined daily on a 365 successive calendar day rolling average basis	5/14/2007	CEMS
SCAQMD R431.1	Fuel gas combustion devices	40 ppmv averaged over 4 hours, calculated as H_2S	5/4/1994	CFGMS or CEMS
SJVUAPCD R4301	Fuel burning equipment	200 lb/hr sulfur compounds, calculated as SO_2	12/17/1992	

Coke Calciners

Rule/Regulation	Applicability *	Emission Limits	Compliance Date	Monitoring **
SCAQMD R1119	Coke Calcining	At least 80% reduction of uncontrolled SOx emissions	7/1/1983	
BAAQMD 9-1	Coke Calcining kilns	400 ppmv or 250 lb/hr SO_2	3/15/1995	
San Diego County APCD R53	Other sources of gaseous sulfur emissions where sulfur compounds emitted are not products of fuel combustion	0.05 % by volume dry, sulfur as SO_2	1/22/1997	

Sulfuric Acid Plants

Rule/Regulation	Applicability *	Emission Limits	Compliance Date	Monitoring **
SCAQMD R469	Sulfuric Acid	500 ppm sulfur compounds (calculated as SO_2 dry) over 15 minute average; 198.5 lbs./hr sulfur compounds as SO_2	2/13/1981	
BAAQMD 9-1	Sulfuric acid plant equipment	300 ppmv SO_2 @12% O_2	3/15/1995	CEMS
San Diego County APCD R53	Other sources of gaseous sulfur emissions where sulfur compounds emitted are not products of fuel combustion	0.05 % by volume dry, sulfur as SO_2	1/22/1997	
NSPS 40 CFR Part 60 Subpart H	Sulfuric Acid production units	4 lb SO_2 per ton of acid produced (as 100% H_2SO_4)	6/14/1974	CEMS

Cement Kilns

Rule/Regulation	Applicability *	Emission Limits	Compliance Date	Monitoring **
San Diego County APCD R53	Other sources of gaseous sulfur emissions where sulfur compounds emitted are not products of fuel combustion	0.05 % by volume dry, sulfur as SO_2	1/22/1997	
SJVUAPCD R4801	Any equipment that discharges gaseous sulfur compounds	0.2% by volume SO_2 dry, over 15 min-average	12/17/1992	

Glass Manufacturing

Rule/Regulation	Applicability *	Emission Limits	Compliance Date	Monitoring **
San Diego County APCD R53	Other sources of gaseous sulfur emissions where sulfur compounds emitted are not products of fuel combustion	0.05 % by volume dry, sulfur as SO_2	1/22/1997	
SJVUAPCD R4354	Glass melting furnaces	0.90 lb SOx per ton glass produced (rolling 30-day average)	1/1/2011	CEMS

Appendix III-D – CEMS Information & Source Test Data

Table III-D-1: CEMS Data from a Refinery in the District – FCCU with Wet Gas Scrubber

SOx Emissions lbs/day	Day	SOx Emissions lbs/day	Day	SOx Emissions lbs/day	Day	SOx Emissions lbs/day	Day	SOx Emissions lbs/day	Day	SOx Emissions lbs/day	Day	SOx Emissions lbs/day	Day
111.09	9/13/08	145.23	10/21/08	122.9	11/30/08	150.46	1/10/09	144.16	2/19/09	134.63	3/31/09	149.71	5/11/09
111.02	9/14/08	143.99	10/22/08	125.16	12/1/08	150.58	1/11/09	143.64	2/20/09	136.42	4/1/09	149.85	5/12/09
110.09	9/15/08	143.19	10/23/08	124.33	12/2/08	153.81	1/12/09	144.62	2/21/09	136.65	4/2/09	149.85	5/13/09
109.51	9/16/08	143.22	10/24/08	123.61	12/3/08	155.46	1/13/09	145.55	2/22/09	138.37	4/3/09	149.82	5/14/09
110.36	9/17/08	143.55	10/25/08	123.43	12/4/08	157.15	1/14/09	149.61	2/23/09		4/5/09	149.47	5/15/09
119.47	9/18/08	143.89	10/26/08	123.25	12/5/08	157.49	1/15/09	155.25	2/24/09	181.74	4/6/09	149.11	5/16/09
129.49	9/19/08	143.61	10/27/08	122.44	12/6/08	157.24	1/16/09	156.9	2/25/09	182.97	4/7/09	149.16	5/17/09
130.41	9/20/08	143.3	10/28/08	123.13	12/7/08	158	1/17/09	153.88	2/26/09	174.53	4/8/09	149	5/18/09
130.88	9/21/08	143.92	10/29/08	125	12/8/08	149.89	1/18/09	156.03	2/27/09	152.39	4/9/09		5/19/09
130.75	9/22/08	143.73	10/30/08	123.15	12/9/08	147.05	1/19/09	155.04	2/28/09	127.02	4/10/09	150.05	5/20/09
130.93	9/23/08	139.91	10/31/08	122.73	12/10/08	145.6	1/20/09	143.39	3/1/09	126.22	4/11/09	150.46	5/21/09
131.86	9/24/08	130.97	11/1/08	122.37	12/11/08	146.31	1/21/09	139.42	3/2/09	130.46	4/12/09	150.32	5/22/09
130.62	9/25/08	131.45	11/2/08	123.49	12/12/08	145.74	1/22/09	141.21	3/3/09	149.2	4/13/09	149.93	5/23/09
130.69	9/26/08	133.77	11/3/08	123.68	12/13/08	150.03	1/23/09	141.9	3/4/09	152.12	4/14/09	149.89	5/24/09
125.6	9/27/08	131.73	11/4/08	135.92	12/15/08	158.61	1/24/09	141.2	3/5/09	150.03	4/15/09	150.07	5/25/09
132.65	9/28/08	131.32	11/5/08	139.17	12/16/08	157.7	1/25/09	142.64	3/6/09	150.28	4/16/09	149.87	5/26/09
131.76	9/29/08	130.27	11/6/08	134.89	12/17/08	158.07	1/26/09	143	3/7/09	148.51	4/17/09	149.28	5/27/09
128.53	9/30/08	132.76	11/7/08	135.66	12/18/08	158.49	1/27/09	142.89	3/8/09	147.04	4/18/09	149.69	5/28/09
127.41	10/1/08	137.1	11/8/08	129.8	12/19/08	157.81	1/28/09	142.7	3/9/09	145.98	4/19/09	149.55	5/29/09
129.48	10/2/08	138.25	11/9/08	130.95	12/20/08	154.73	1/29/09	141.86	3/10/09	146.36	4/20/09	149.49	5/30/09
131.67	10/3/08	138.12	11/10/08	138	12/21/08	153.98	1/30/09	111.54	3/11/09	147.47	4/21/09	148.77	5/31/09
132.49	10/4/08	137.22	11/11/08	132.16	12/22/08	155.43	1/31/09	48.03	3/12/09	148.87	4/22/09	147.92	6/1/09
131.92	10/5/08	137.09	11/12/08	125.81	12/23/08	157.58	2/1/09	118.74	3/13/09	148.24	4/23/09	148.77	6/2/09
131.33	10/6/08	137.11	11/13/08	134.23	12/24/08	155.16	2/2/09	36.04	3/14/09	149.37	4/24/09	148.87	6/3/09
131.02	10/7/08	136.91	11/14/08	155.32	12/25/08	156.07	2/3/09	136.91	3/15/09	143.4	4/25/09	148.31	6/4/09
119.64	10/8/08	135.62	11/15/08	156.05	12/26/08	155.67	2/4/09	143.78	3/16/09	125.06	4/26/09	148.7	6/5/09
154.21	10/9/08	135.75	11/16/08	156.06	12/27/08	156.76	2/5/09	142.9	3/17/09	125.5	4/27/09	149.28	6/6/09
154.71	10/10/08	135.71	11/17/08	157.29	12/28/08	156.1	2/6/09	125.63	3/18/09	131.39	4/28/09		
155.74	10/11/08	136.19	11/18/08	157.07	12/29/08	158.64	2/7/09	118.51	3/19/09	138.27	4/29/09		
156.58	10/12/08	137.07	11/19/08	155.95	12/30/08	159.41	2/8/09	119	3/20/09	138.9	4/30/09		
146.18	10/13/08	137.4	11/20/08	157.3	12/31/08	155.14	2/9/09	122.27	3/21/09	147.53	5/1/09		
128.23	10/14/08	137.14	11/21/08	160.33	1/1/09	160.87	2/10/09	130.06	3/22/09	148.7	5/2/09		
132.85	10/15/08	137.25	11/22/08	155.22	1/2/09	157.97	2/11/09	133.4	3/23/09	149.37	5/3/09		
140.19	10/16/08	137.81	11/23/08	141.5	1/3/09	151.77	2/12/09	134.39	3/24/09	149.34	5/4/09		
139.43	10/17/08	134.1	11/24/08	144	1/4/09	148.28	2/13/09	136.13	3/25/09	148.97	5/5/09		
140.03	10/18/08	125.09	11/25/08	147.65	1/5/09	143.42	2/14/09	136.69	3/26/09	148.51	5/6/09		
140.16	10/19/08	122.53	11/26/08	143.59	1/6/09	145.05	2/15/09	136.46	3/27/09	148.66	5/7/09		
143.02	10/20/08	122.32	11/27/08	141.79	1/7/09	150.44	2/16/09	136.49	3/28/09	149.02	5/8/09		
		122.14	11/28/08	154.11	1/8/09	149.17	2/17/09	138.11	3/29/09	149.51	5/9/09		
		122.55	11/29/08	156.96	1/9/09	145.34	2/18/09	136.85	3/30/09	149.32	5/10/09		

The concentration during 265 days (8.83 months) is 3.80 ppmv

Table III-D-2: Source Test from a Refinery in the District - FCCU with Wet Gas Scrubber

Test/Run ID		1	2	3	Average	
Date Tested	NA	10/8/2008	10/9/2009	10/9/2008		
Stack Oxygen	%	1.30	1.28	1.27	1.28	
Stack Carbon Dioxide	%	17.8	17.7	17.9	17.82	
Average Stack Volumetric Flow (Methods 5 and 6)	dscfm	128,982	128,276	124,384	127214	
Stack Temperature (Methods 5 and 6)	oF	134	132	132	132.88	
Stack Moisture Concentration (Methods 5 and 6)	%	15.29	14.53	14.39	14.73	
FCC Feed	MBPD	49.19	48.93	48.93	49.02	
FCC Feed	MBPH	2.05	2.04	2.04	2.04	
Coke Make (Burn)	lb/hr	39,274	39,389	39,389	39,351	
Coke Make (Burn)	Mlb/hr	39.27	39.39	39.39	39.35	
Catalyst Circulation Rate	ton/min	45.41	46.25	46.25	45.97	
Gas Flow to Scrubber/Circulation Ratio	gal/MACF	26.23	25.94	25.94	26.04	
Total WESP Power	KW	7.49	8.06	8.06	7.87	
#2 Lower WESP Spark Rate	spk/min	1.34	1.30	1.30	1.31	
#1 Lower WESP Spark Rate	spk/min	2.37	4.08	4.08	3.51	
#2 Upper WESP Spark Rate	spk/min	0.00	0.00	0.00	0.00	
#1 Upper WESP Spark Rate	spk/min	0.00	0.00	0.00	0.00	
Oxides of Nitrogen as NO_2 - Method 100.1						LIMIT(S)
as found	ppmv	12.1	18.4	17.8	16.08	
at 3% O_2	ppmv	11.0	16.8	16.2	14.7	
at 0% O_2%	ppmv	12.9	19.6	18.9	17.1	20
emission rate	ppmv	11.3	17.2	16.1	14.9	
Carbon Monoxide – Method 100.1						
as found	ppmv	40.9	39.6	43.5	41.3	
at 3% O_2	ppmv	37.4	36.1	39.7	37.7	
emission rate	lbs/hr	23.4	22.5	24.0	23.3	
VOC as Total Gaseous Non-Methane Organic – Method 25.3						
VOC as TOC in Impinger Vial - Sample A	ppmv	0.63				
VOC as TGNMO in Canister - Sample A	ppmv	50.1				
Combined Vial and Canister Conc. - Sample A	ppmv	50.73				
VOC as TOC in Impinger Vial - Sample B	ppmv	0.28				
VOC as TGNMO in Canister - Sample B	ppmv	65.9				
Combined Vial and Canister Conc. - Sample B	ppmv	66.18				
as found-Average	ppmv	58.46				
at 3% O_2	ppmv	53.39				
emission rate	lbs/hr	19.07				
Sulfur Oxides as SO_2 – SCAQMD Method 6.1						
Stack Volumetric Flow	dscfm	128.071	123.830	121.962	124.621	
Isokinetic Sampling Rate (I)	%	98	93	92	94	90<=I<=110
Stack Moisture Concentration	%	15.97	15.44	15.18	15.53	
Stack Temperature oF	ºF	135	132	132	133	
Corrected Gas Volume Collected	dscf	68.622	52.361	50.731	57.238	
SOx Conc. in Gas Sample	ppmv	1.270	0.810	0.706	0.929	
SOx Conc. in Gas Sample at 3% O_2	ppmv	1.160	0.739	0.644	0.848	
SOx Conc. in Gas Sample at 0% O_2	**ppmv**	**1.354**	**0.863**	**0.752**	**0.990**	**25**
SOx Emission Rate	lb/hr	1.65	1.02	0.87	1.18	
SOx Emission (lb/1000 coke burn)	lb/MB	0.04	0.03	0.02	0.03	9.80
Stack Particulate Matter (PM) – EPA Method 5 (Front ½)SCAQMD Method 5.2 (Back ½)						
Stack Volumetric Flow	dscfm	129,892	132,722	126,806	129,807	
Isokinetic Sampling Rate (I)	%	103	104	102	103	90<=I<=110
Stack Moisture Concentration	%	14.60	13.61	13.59	13.93	
Stack Temperature oF	ºF	134	132	133	133	
Corrected Gas Volume Collected	dscf	183.457	189.314	177.602	183.458	
Stack Total PM Mass	mg	42.60	34.55	34.45	37.20	
Stack Total PM - as found	gr/dscf	0.00358	0.00282	0.00299	0.00313	
Stack Total PM at 3% O_2	gr/dscf	0.00327	0.00257	0.00273	0.00286	
Stack Total PM emission rate	lb/hr	3.99	3.20	3.25	3.48	
Stack Solid PM Mass	mg	42.60	31.80	31.95	35.45	
Stack Solid PM - at found	gr/dscf	0.00358	0.00259	0.00278	0.00298	
Stack Solid PM at 3% O_2	gr/dscf	0.00327	0.00236	0.00253	0.00272	
Stack Solid PM Emission Rate	lb/hr	3.99	2.95	3.02	3.32	
Stack PM Emission (lb/1000 bbl of feed)	lb/MB	1.96	1.57	1.60	1.70	2.80
Stack PM Emission (lb/1000 coke burn)	lb/MB	0.10	0.08	0.08	0.09	1.00

Inlet Particulate Matter (PM) – EPA Method 5						
Inlet Volumetric Flow	dscf	102,640	108,052	116,160	108,951	
Isokinetic Sampling Rate (I)	%	92	103	92	96	90<=I<=110
Inlet Moisture Concentration	%	16.39	16.10	10.20	14.23	
Inlet Temperature	ºF	561	570	567	566	
Corrected Gas Volume Collected	dscf	27.307	32.356	30.980	30.214	
Inlet Total PM Mass	mg	169.90	229.75	330.30	243.32	
Inlet Total PM - as found	gr/dscf	0.09602	0.10958	0.16454	0.12338	
Inlet Total PM at 3% O_2	gr/dscf	0.08770	0.09996	0.15006	0.11257	
Inlet PM emission rate	lb/hr	84.47	101.49	163.82	116.59	