Background Report Reference

AP-42 Section Number: 1.4

Background Chapter: 2

Reference Number: 11

Title: SCE Etiwanda Units 1 and 2 Urea Compliance Source Test Report, Final Report, Volumne I of II

Radian Corp.

Radian Corp.

March 1994

AP-42 Sec# 11
Section 1.4
(BID Ch. 2)

RADIAN
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DCN: 94-290-088-07
RCN: 290-088-03-03

SCE ETIWANDA UNITS 1 AND 2
UREA COMPLIANCE SOURCE TEST REPORT

FINAL REPORT

Volume I of II

Test Procedures and Results

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2 March 1994

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EXECUTIVE SUMMARY

Source testing was performed on Southern California Edison (SCE) Etiwanda Units 1 and 2 to quantify the effect of urea injection on various stack emissions. These tests are required by the South Coast Air Quality Management District (SCAQMD) Permits to Construct (Applications No. 248385 and 248386). The objective of the source test program was to satisfy requirements of Sections 13(B) and 13(C)(b) of the Permits. Emissions measured were NO_x, CO, total gaseous non-methane organics (TGNMO), ammonia (NH_3), and particulates. The test program was conducted according to a test protocol approved by the SCAQMD. The procedures used to conduct the emission tests and the test data, calculations, and results are reported in this document. A summary of the test results are presented in Table 1.

Per verbal agreement with Mr. Darren Stroud of the SCAQMD, it was agreed that particulate emissions would be measured on one unit of each unit class because of the low potential for urea having an impact on particulate emissions. Therefore, particulates were only measured on Etiwanda Unit 2, but not Unit 1.

Table E-1

Summary of SCE Etiwanda Unit 1 and 2 Test Results[a]

Unit No.	Load, MW	Urea	Urea Injection Rate, gal/min	O_2	NO_x		CO		TGNMO[c]		NH3[b]	Particulate[d]	
				%	ppm	ppmc[b]	ppm	ppmc[b]	ppm	ppmc[b]	ppm	gr/dscf	lb/hr
1	130	Off		8.02	48.3	67.1	2.1	2.8	41.4	57.5			
		On	0.46	7.88	46.9	64.5	2.2	3.0	57.0	78.4	1.7		
	65	Off		9.25	28.5	43.8	<1	<2	38.7	58.1			
		On	0.28	9.29	25.1	38.7	1.4	2.2	40.4	62.3	5.5		
	40	Off		11.86	29.2	57.9	<1	<2	87.4	173.1			
		On	0.20	11.78	25.5	50.0	<1	<2	45.0	88.3	18.4		
2	130	Off		7.92	49.0	132.5	6.7	9.2	25.1	34.6		0.0032	10.18
		On	0.37	8.03	44.4	61.8	5.1	7.1	38.2	53.1	4.1	0.0037	11.64
	65	Off		10.85	33.5	59.7	<1	<2	--[e]	--[e]		0.0025	5.62
		On	0.34	10.84	27.1	48.2	1.0	1.8	13.9	24.7	15.3	0.0029	6.82
	40	Off		12.06	34.7	70.2	<1	<2	46.8	94.8		0.0019	3.28
		On	0.20	12.00	29.5	59.4	<1	<2	--[e]	--[e]	18.4	0.0010	1.74

[a]Average values reported when duplicate tests were performed.
[b]Concentrations corrected to 3% O_2.
[c]TGNMO reported as methane.
[d]Total particulate (filterable and condensible particulate matter).
[e]Results invalid. See discussion in Section 4.3.

SECTION 1.0 INTRODUCTION

Radian Corporation (Radian) was contracted by Southern California Edison (SCE) to conduct source testing of Units 1 and 2 at the Etiwanda Generating Station, Etiwanda, California to quantify the effect of urea-injection on various emissions. These tests are required by the South Coast Air Quality Management District (SCAQMD) Permits to Construct, Applications No. 248385 and 248386 (see Appendix H). The objective of the source test program was to satisfy requirements of Sections 13(B) and 13(C)(b) of the Permits with respect to NO_x, CO, total gaseous non-methane organic (TGNMO), NH_3, and particulate emissions. The test schedule and unit operating conditions are shown in Tables 1-1 and 1-2, respectively.

Mr. Mike Escarcega, SCE, coordinated the overall testing activities. Mr. Don Prodan, Radian Corporation, was Project Director of the testing program. Unit 1 testing was performed during the period of October 6-9, 1993 and Unit 2 during November 2-5, 1993. Mr. Darren Stroud, South Coast Air Quality Management District (SCAQMD), conducted an on-site inspection on 4 November 1993 during testing activities on Unit No. 2.

A description of the SCE Etiwanda Units 1 and 2 is provided in Section 2.0. Section 3.0 presents the source test methods and procedures used for the test program. Source test results are provided in Section 4.0. The quality assurance/quality control procedures employed in the test program are discussed in Section 5.0. Test records, analytical results, test calculations, and quality assurance data are included in the appendices.

Table 1-1

SCE Etiwanda Unit 1 Test Schedule

Date	Nom. Load	Urea Injection	Measurement	Test No.	Start Time	End Time
10/6/93	40 MW	Off	Stratification	1	0340	0800
			Cyclonic Flow	2	0815	0920
	65 MW	Off	Stratification	3	1128	1603
			Cyclonic Flow	4	1620	1720
10/7/93	130 MW	Off	$NO_x/CO/O_2$	5	1110	1210
			TGNMO	5	1106	1206
		On	$NO_x/CO/O_2$	6	1427	1527
			TGMNO	6	1427	1527
			Ammonia	6	1427	1527
			$NO_x/CO/O_2$	7	1617	1717
			TGMNO	7	1617	1717
			Ammonia	7	1617	1717
		Off	$NO_x/CO/O_2$	8	1747	1847
			TGMNO	8	1747	1847
10/8/93	65 MW	On	$NO_x/CO/O_2$	9	0915	1015
			TGMNO	9	0916	1016
			Ammonia	9	0916	1016
		Off	$NO_x/CO/O_2$	10	1130	1230
			TGMNO	10	1131	1231
10/9/93	40 MW	On	$NO_x/CO/O_2$	11	0930	1030
			TGMNO	11	0930	1030
			Ammonia	11	0930	1030
		Off	$NO_x/CO/O_2$	12	1200	1300
			TGMNO	12	1200	1300
		On	$NO_x/CO/O_2$	13	1402	1502
			TGMNO	13	1400	1500
			Ammonia	13	1400	1500

Table 1-2

SCE Etiwanda Unit 2 Test Schedule

Date	Nom. Load	Urea Injection	Measurement	Test No.	Start Time	End Time
11/2/93	40 MW	Off	Stratification	1	0625	1005
			Cyclonic Flow	1	0715	0815
	65 MW	Off	Stratification	2	1218	1536
			Cyclonic Flow	2	1245	1345
11/3/93	130 MW	On	$NO_x/CO/O_2$	3	0820	0920
			Ammonia	3	0820	0920
			TGNMO	3	1142	1242
			Particulate	3A 3B	0820 1350	1231 1606
		Off	$NO_x/CO/O_2$	4	1645	1745
			TGNMO	4	1645	1745
			Particulate	4	1645	1901
11/4/93	65 MW	On	TGNMO	5	0830	0930
			Ammonia	5	0830	0930
			$NO_x/CO/O_2$	5	0830	0930
			Particulate	5A 5B	0818 1128	1047 1344
		Off	TGNMO	6	1433	1533
			$NO_x/CO/O_2$	6	1430	1530
			Particulate	6A 6B	1424 1712	1636 1918
11/5/93	40 MW	On	TGMNO	7	0830	0930
			Ammonia	7	0830	0930
			$NO_x/CO/O_2$	7	0830	0930
			Particulate	7A 7B	0818 1119	1040 1333
		Off	TGNMO	8	1410	1510
			$NO_x/CO/O_2$	8	1415	1515
			Particulate	8A 8B	1405 1709	1624 1925

SECTION 2.0 PROCESS DESCRIPTION AND OPERATING CONDITIONS

2.1 Process Description

SCE Etiwanda Units 1 and 2, constructed in 1952 and 1953, are two similar Combustion Engineering, tangentially-fired, controlled circulation boilers. The boilers each have a rated capacity of 920,000 pounds per hour of steam flow at a nominal pressure of 1950 psig and superheat design steam temperatures of 1000°F. Maximum net load of each unit is rated at 132 MW. Each unit comprises twin furnaces with four tiers of burners per furnace. The burners are numbered from top to bottom, with a total of eight burners in each tier. For oil firing, only the top three tiers of burners are employed, whereas for gas firing, only the bottom two tiers are used. Urea injection systems have been installed on both Units 1 and 2 to reduce NO_x emissions. The emission limits for these units, under gas firing, as indicated by the Permit to Construct, are:

NO_x:	175 ppmvd @ 3% O_2
CO:	500 ppmvd @ 3% O_2
NH_3:	20 ppmvd @ 3% O_2

2.2 Unit Operating Conditions During Source Testing

The operating data for Units 1 and 2 recorded during each of the emission test periods are provided in Appendix A. All tests were performed while the units were being fired with natural gas. The operating data in the Appendix A provides the power generation load, the fuel feed rate, fan settings, urea injection rate (where applicable), and various boiler operation parameters.

SECTION 3.0 TEST METHODS AND PROCEDURES

The equipment, methods, and procedures used to conduct the SCE Etiwanda Units 1 and 2 emission test program are discussed in the following sections.

3.1 Sampling Locations

Both Unit 1 and 2 stacks have four 6-inch orthogonal sampling ports located approximately 30 feet (2 1/2 stack diameters) downstream from the nearest disturbance, and approximately 49 feet (4 stack diameters) from the stack exit. Figure 3-1 shows a schematic of the sampling port location. The inside diameter of the Unit 1 stack is 11.8 feet. The Unit 2 stack inside diameter is 12.0 feet. By agreement between SCE and the SCAQMD, no full load stratification and cyclonic flow tests were performed, as full 48-point Chapter X tests were recently performed as part of the Rule 1135 compliance test program. Instead, this testing was performed at low- and mid-loads only as discussed below.

3.2 Gas Stratification Tests

Gas stratification tests were performed at the Unit 1 and 2 stack sampling locations using the procedure described in Chapter X, Section 13 of the SCAQMD Source Test Manual. The stratification tests were performed during operation of each unit at low- and mid-loads of 40 and 65 MW. The tests on each unit were performed by measuring pollutant gas concentrations (NO_x) at 48 points in the stacks. Gas concentrations were measured for five minute-periods at each traverse point and at the reference points. The location of the traverse and reference points used for the stratification tests of Units 1 and 2 are shown in Appendix B, Tables B-1 and B-5. The gas concentrations were measured using the equipment and procedure described in SCAQMD Method 100.1 (see Section 3.3). By agreement between SCAQMD and SCE, fixed reference point measurements were performed after every fourth traverse point measurement instead of after every traverse point measurement as specified in the SCAQMD procedure.

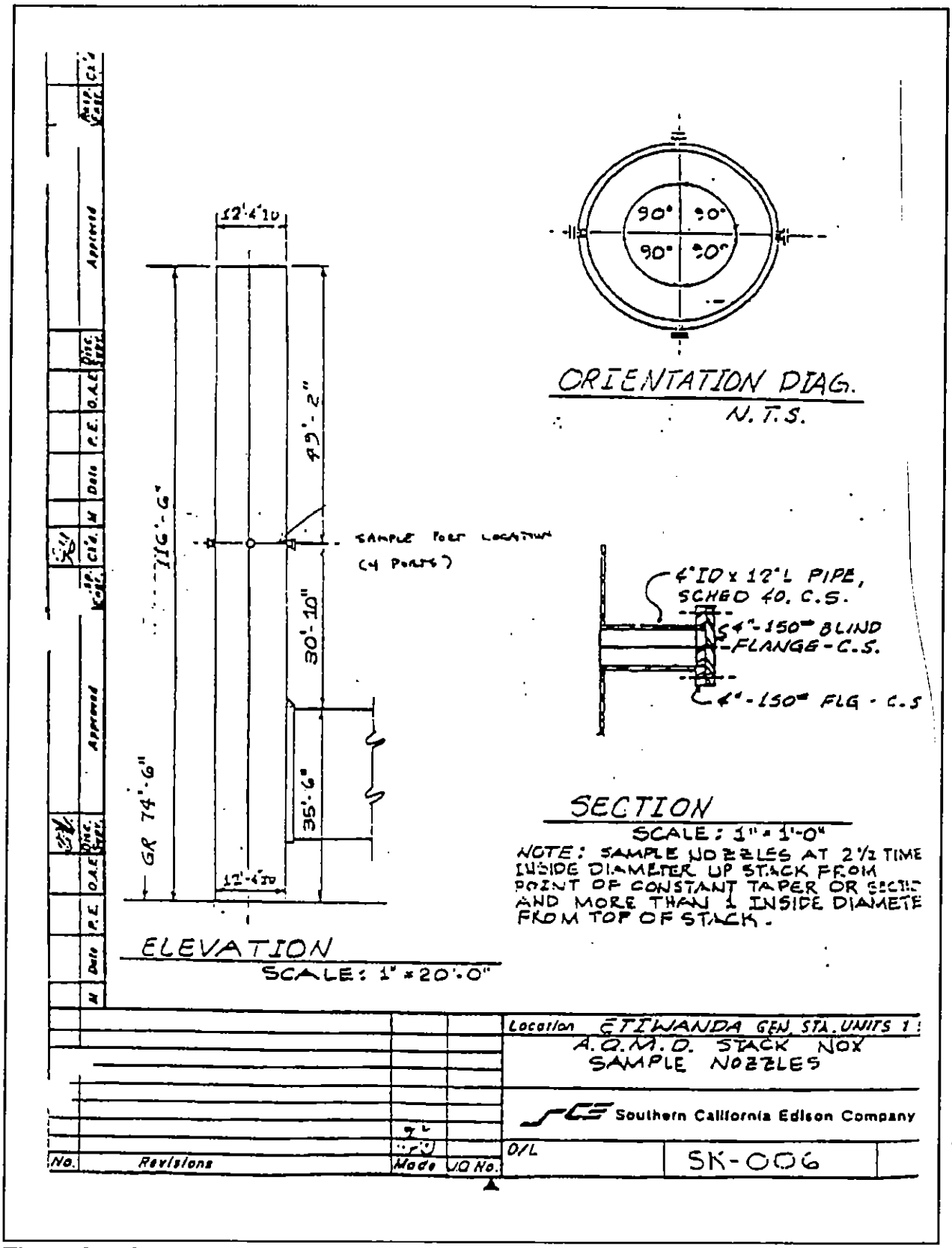

Figure 3-1. Stack Configuration Diagram

3.3 Cyclonic Flow Tests

Cyclonic flow tests were conducted at the Unit 1 and 2 stack sampling locations using the procedure described in SCAQMD Method 1.1, Section 2.4. The cyclonic flow tests were performed during operation of each of the units at low- and mid-loads of 40 and 65 MW. In each test, the Type S pitot tube rotation angle required to obtain a null manometer reading was determined at 24 traverse points in the stacks. The locations of the Unit 1 and 2 cyclonic flow test points are shown in Appendix B, Tables B-4 and B-8. For Unit 2, the same traverse points were used to conduct the particulate emission tests described in Section 3.7.

3.4 Gaseous Emission Measurements

The emission tests for NO_X, CO, and O_2 were performed using the continuous emission monitoring (CEM) equipment and procedure described in SCAQMD Method 100.1. The monitoring system consisted of a stainless steel probe, a heated Teflon sample line, a gas conditioner, and the following gas analysis instrumentation:

- Thermo Environmental Model 10S chemiluminescent NO_x analyzer equipped with a molybdenum NO_2 to NO converter;
- Automated Custom Systems Model 3400 Analyzer non-dispersive infrared (NDIR) CO/CO_2 analyzer; and
- Teledyne Model 320 AX electrochemical cell O_2 analyzer.

The compliance tests for NO_x, CO, and O_2 were conducted by collecting CEM emission data over 60-minute periods. Tests on both Units 1 and 2 were performed at three nominal load conditions: 130, 65, and 40 MW. Emission data were collected at each load condition both with and without urea injection. Although not required, duplicate 60-minute CEM emission tests were performed at some of the test conditions during Unit 1 testing at 40 and 130 MW. Results for these tests are based on the average of the two 60-minute runs.

Radian Corporation is certified by the California Air Resources Board (CARB) for performance of CARB Method 100 (Continuous Gas Emission Sampling). A copy of Radian's CARB certification is provided in Appendix C.

3.5 TGNMO Emission Measurements

TGNMO emission measurements were performed using the equipment and procedure described in SCAQMD Method 25.1. The TGNMO sampling was conducted by extracting a stack gas sample through a stainless steel probe (positioned at a point in the stack approximately 50 inches from the wall), collecting of condensible organics in a dry ice-cooled trap, and collecting of the non-condensible, gaseous organics in an evacuated stainless steel tank. During each test, duplicate samples were collected by sampling concurrently with two separate trap/tank systems. Sampling during each test was conducted for a 60-minute period. The gas sample was extracted from the stack at a constant rate such that the tanks were filled to atmospheric pressure at the end of the sampling period. Since prior tests showed an absence of gas stratification at both the Unit 1 and 2 sampling locations, TGNMO sampling was performed at a single point in the stacks.

TGNMO emission tests on Units 1 and 2 were performed at three nominal load conditions: 130, 65, and 40 MW. At each condition, tests were performed both with and without urea injection. As explained in Section 3.4, duplicate TGNMO tests were performed on Unit 1 at the 40 and 130 MW load conditions. Results presented are based on the average of all samples taken at each test condition.

The samples collected during the tests were analyzed for condensible TGNMOs, non-condensible TGNMOs, CH_4, CO, and CO_2 using the procedure described in SCAQMD Method 25.1. Unit 1 tests were performed with equipment provided by Horizon Air Measurement Services, Inc, Newbury Park, CA. The analysis of the Unit 1 test samples was performed by Atmospheric Analysis Associates, Inc., Chatsworth, CA. Equipment

provided by Clean Air Engineering (CAE), Palatine, IL, was used for the Unit 2 tests. CAE also performed the analysis of the Unit 2 test samples.

3.6 Ammonia Emission Measurements

Ammonia (NH_3) emission measurements were performed in accordance with SCAQMD Method 207.1 (3/93 draft). The NH_3 sampling system consisted of a heated stainless steel probe, a short Teflon line connecting the probe outlet and the impinger train, four serially-connected impingers, and a sample line connected to the metering system. The sample gas metering system consisted of a leak-free vacuum pump, a vacuum gauge, a dry gas meter, a sample flow orifice, and a manometer. The first two impingers in the sampling train each contained 100 ml of 0.1N H_2SO_4, the third impinger was empty, and the fourth contained indicating-type silica gel.

Sampling during each NH_3 test was conducted for a 60-minute period. The gas sample was extracted from the stack at a constant rate of approximately 0.5 cfm. Since prior tests showed an absence of gas stratification at both the Unit 1 and 2 sampling locations, the NH_3 sampling was performed at a single point in the stacks ($\sim$ 50 inches from the stack wall).

Ammonia emission tests on both Units 1 and 2 were performed at three nominal load conditions: 130, 65, and 40 MW. At each load condition, tests were performed only during urea injection. As explained in Section 3.4, duplicate NH_3 tests were performed on Unit 1 at the 130 and 40 MW load conditions, and the results presented are based on the average of the duplicate tests.

The analysis of NH_3 test samples was performed by West Coast Analytical Services, Santa Fe Springs, CA. The Unit 1 test samples were analyzed by the direct Nesslerization technique as described in SCAQMD Method 207.1. The Unit 2 test samples were analyzed by ion chromatography as described in EPA Method 300.7. Ion

chromatography was used for analysis of the Unit 2 test samples because interferences in the samples precluded using the direct Nesslerization method. This alternate procedure was approved by Joan Niertit of the SCAQMD.

3.7 Particulate Emission Measurements

Per verbal agreement with Mr. Darren Stroud of the SCAQMD, particulate testing was performed on one unit only (Unit 2). Particulate tests were not performed on Unit 1. Particulate emission measurements were conducted in accordance with SCAQMD Method 5.3 (in-stack filtration). The sampling train consisted of a nozzle, an in-stack filter, a heated stainless steel probe, four impingers arranged in series, and a sample line connected to the metering system. The sample gas metering system consisted of a leak-free vacuum pump, a vacuum gauge, a dry gas meter, a sample flow orifice, and a manometer. The first and second impingers each contained 100 milliliters of distilled water; the third impinger was empty, and the fourth impinger contained indicating-type silica gel.

A Type S pitot tube and thermocouple attached to the gas sampling probe were used to determine the stack gas velocity and volumetric flow rate as described in SCAQMD Method 2.1, Section 3. Stack gas moisture content was determined from the water gain in the impingers and in the silica gel trap of each SCAQMD Method 5.3 test. CO_2 and O_2 concentrations required to calculate the molecular weight of stack gas were determined with the continuous gas emission monitoring system described in Section 3.4.

Sampling was performed isokinetically using 24-point traverses established in accordance with SCAQMD Method 1.1 specifications. The locations of the Unit 2 traverse points at which sampling was performed are shown in Appendix B, Table B-8. Sampling was performed for 120-minute test durations (i.e., 5 minutes per traverse point).

Particulate emission tests were performed on Unit 2 at three nominal load conditions: 130, 65, and 40 MW. At each load condition, tests were performed both with

and without urea injection. Duplicate particulate emission tests were performed during urea injection at the nominal 130, 65, and 40 MW load conditions and without urea injection at the nominal 65 and 40 MW load conditions. However, one of the 40 MW tests without urea injection was invalidated due to a sampling system leak that occurred during the test. A single particulate emission test was performed on Unit 2 without urea injection at the 130 MW load condition.

Samples were recovered from the sampling train as described in SCAQMD Methods 5.1 and 5.3. The analysis of the test samples was performed by West Coast Analytical Services (WCAS), Santa Fe Springs, CA, using the procedures described in SCAQMD Methods 5.1 and 5.3.

Radian Corporation is certified by the California Air Resources Board (CARB) for performance of CARB Methods 1,2,3,4 and 5. A copy of Radian's CARB certification is provided in Appendix F.

SECTION 4.0 EMISSION TESTS RESULTS

4.1 Gas Stratification and Cyclonic Flow Test Results

The results of the stratification tests based on the continuous NO_x measurements and cyclonic flow angles are summarized in Table 4-1.

The strip chart records of NO_x data obtained during the Unit 1 and 2 stratification tests are provided in Appendix B. Appendix B-1, Tables B-2 and B-3 give the average measured and normalized NO_x concentrations for the Unit 1 stratification tests at 40 MW and 65 MW, respectively. Appendix B-2, Tables B-6 and B-7 provide similar data for the Unit 2 stratification test at 40 MW and 65 MW. Calculation of the percent stratification was performed as described in Chapter X, Section 13 of the SCAQMD Source Test Manual. The test results show that the stack gases were not stratified at either the Unit 1 or Unit 2 test locations (i.e., all stratification test values were less than 10 percent).

Unit 1 and Unit 2 cyclonic flow test field data records are provided in Appendix B-1 and Appendix B-2, respectively.

4.2 Gaseous Emissions Test Results

Results of the gas emission measurements performed on Units 1 and 2 are summarized in Table 4-2. The table presents the average measured and 3% O_2-corrected NO_x, CO, and the actual O_2 concentrations measured during the one-hour emission test periods.

The strip charts containing the gas concentration data collected for each of the Unit 1 and 2 emission tests are provided in Appendix C. All sampling system bias, analyzer calibration, and zero drift check data are provided in Appendix C. Copies of calibration gas certification sheets are also presented in Appendix C.

Table 4-1

NO_x Stratification and Cyclonic Flow Test Results Summary

Unit No.	Load Condition (MW)	Statification (%)	Cyclonic Flow (deg)
1	40	6.5	8
	65	2.6	8
2	40	2.1	14
	65	2.9	13

Table 4-2

Gaseous Emissions Results Summary

Unit No.	Nominal Power	Urea	Test No.	NO_x Emissions[a]		CO Emissions[a]		O_2, %
				Measured	@3% O_2	Measured	3% O_2	
1	130 MW	Off	SCE-1-GAS-5	48.0	66.9	1.6	2.2	8.1
		On	SCE-1-GAS-6	46.8	64.4	1.7	2.4	7.9
		On	SCE-1-GAS-7	47.0	64.6	2.6	3.6	7.9
		Off	SCE-1-GAS-8	48.6	67.2	2.5	3.4	8.0
	65 MW	On	SCE-1-GAS-9	25.1	38.7	1.4	2.2	9.3
		Off	SCE-1-GAS-10	28.5	43.8	<1	<2	9.3
	40 MW	On	SCE-1-GAS-11	25.3	49.7	<1	<2	11.8
		Off	SCE-1-GAS-12	29.2	57.9	<1	<2	11.9
		On	SCE-1-GAS-13	25.6	50.2	<1	<2	11.8
2	130 MW	On	SCE-2-GAS-3	44.4	61.8	5.1	7.1	8.0
		Off	SCE-2-GAS-4	49.0	67.6	6.7	9.2	7.9
	65 MW	On	SCE-2-GAS-5	27.1	48.2	1.0	1.8	10.8
		Off	SCE-2-GAS-6	33.5	59.7	<1	<1.8	10.9
	40 MW	On	SCE-2-GAS-7	29.5	59.4	<1	<2	12.0
		Off	SCE-2-GAS-8	34.7	70.2	<1	<2	12.1

[a]Measured and @3% O_2 values are reported in ppm.

The average gas concentrations over the 60-minute test durations were determined from 5-minute averaged concentration values taken from the strip charts. Appendix C-1, Table C-1 provides a summary of the five-minute and test average gas concentration values determined from the strip charts. Table C-2 presents a summary of the data used to adjust the measured NO_x concentrations for zero and high range calibration drift. A summary of the Unit 1 adjusted and 3% O_2-corrected CEM gas measurements is provided in Table C-3. Appendix C-2, Tables C-4 through C-6 provide similar data for the Unit 2 CEM gas measurements. Oxygen values obtained with the Radian CEM system were used to make the oxygen correction.

4.3 TGNMO Emissions Test Results

Table 4-3 presents the average TGNMO emission data for Unit 1 and Unit 2 obtained from the tests. Field data sheets and laboratory analysis data for the Unit 1 and Unit 2 TGNMO measurements are presented in Appendix D-1 and D-2, respectively. The results obtained for Unit 2 TGNMO Tests 6 (205.4 ppm) without urea injection and Test 7 (281.1 ppm) with urea injection appear unreasonably high considering that operating conditions of Unit 2 appear normal based on the concentrations of other combustion products. Carbon monoxide levels measured concurrently during these tests by SCAQMD 100.1 were less than the detection limit of 1 ppm. CO concentrations measured in the TGNMO samples from these tests are comparable to the CEM results. Concurrent oxygen and CO_2 concentrations were also typical for 40 and 65 MW load operation. There were no spikes in the CEM combustion or diluent gas concentrations during the test periods that would indicate an upset in combustion conditions.

A review of the trap and tank blanking and the analysis of the samples was performed by the analytical laboratory. Blank levels of tanks used for these tests were <0.5 ppmC NMHC and trap blank level were less than 15.9 ppmC NMHC (see Appendix C-2).

Table 4-3

TGNMO Emissions Results Summary

Unit No.	Load, MW	Urea	Test No.	TGNMO[a,b]		O_2 (%)	CO_2 (%)	CO (ppm)
				ppm	ppmc[c]			
1	130	Off	SCE-1-TGNMO-5	33.0	46.0	8.1	7.1	<1
		On	SCE-1-TGNMO-6	82.0	112.7	7.9	7.1	<1
		On	SCE-1-TGNMO-7	32.0	44.0	7.9	7.1	<1
		Off	SCE-1-TGNMO-8	49.8	68.9	8.0	6.9	<1
	65	On	SCE-1-TGNMO-9	40.4	62.3	9.3	6.2	<1
		Off	SCE-1-TGNMO-10	37.8	58.1	9.3	6.5	<1
	40	On	SCE-1-TGNMO-11	37.8	74.2	11.8	4.8	<1
		Off	SCE-1-TGNMO-12	87.4	173.1	11.9	4.9	<1
		On	SCE-1-TGNMO-13	52.1	102.3	11.8	5.0	<1
2	130	On	SCE-2-TGNMO-3	38.2	53.1	8.0	3.8	6.3
		Off	SCE-2-TGNMO-4	25.1	34.6	7.9	4.0	6.9
	65	On	SCE-2-TGNMO-5	13.9	24.7	10.8	2.6	1.4
		Off	SCE-2-TGNMO-6	205.4[d]	365.8[d]	10.9	2.6	0.7
	40	On	SCE-2-TGNMO-7	281.1[d]	565.3[d]	12.0	2.3	2.2
		Off	SCE-2-TGNMO-8	46.8	94.8	12.1	2.3	0.1

[a]TGNMO values reported as CH_4.
[b]Average of duplicate measurements.
[c]Corrected to 3% O_2.
[d]Results invalid. See discussion in Section 4.3.

The laboratory found no calculational errors or unusual analytical conditions that would yield the high TGNMO values.

Since other combustion conditions do not indicate that abnormally high TGNMO emissions should have occurred during Unit 2 Tests 6 and 7, we conclude that these results are not typical and are invalid due to some undeterminable cause. In addition, the high TGNMO values were obtained for one test without urea injection (Test 6) and one test with urea injection (Test 7). Therefore, the high TGNMO values obtained for the two tests do not appear to result from urea injection. Since Units 1 and 2 are similar in design, we feel the results obtained for Unit 1 provide more typical TGNMO emissions data. In addition, the goal of the test program was to determine the effect of urea injection on various gaseous emissions and to demonstrate compliance with applicable emission limits. Since TGNMO is not a regulated pollutant, the purpose of its testing was to demonstrate the effect of urea injection only. From that standpoint, the program goal was achieved, and it was demonstrated that urea had no affect on TGNMO.

4.4 Ammonia Emissions Test Results

The results of the NH_3 emission tests on Units 1 and 2 are summarized in Table 4-4. Measured and 3% O_2-corrected ammonia concentrations are presented in the table. Oxygen values obtained with the Radian CEM system were used to make the oxygen correction.

The sampling and analytical data for the Unit 1 and Unit 2 ammonia emission tests are provided in Appendix E-1 and E-2, respectively.

Table 4-4

Ammonia Emissions Results Summary

Unit No.	Nominal Load	Test No.	NH_3 Emission Concentration (ppmv)	
			Measured	@ 3% O_2
1	130 MW	SCE-1-NH3-6	1.4	1.9
		SCE-1-NH3-7	1.1	1.5
	65 MW	SCE-1-NH3-9	3.6	5.5
	40 MW	SCE-1-NH3-11	8.9	17.7
		SCE-1-NH3-13	9.8	19.1
2	130 MW	SCE-2-NH3-3	3.0	4.1
	65 MW	SCE-2-NH3-5	8.7	15.3
	40 MW	SCE-2-NH3-7	9.1	18.4

4.5 Particulate Emissions Results

The results of the particulate emission testing are summarized in Table 4-5. Particulate concentrations (grains/dscf) and mass emission rates (lb/hr) are given in the table. A summary of the test results are presented in Tables F-1, F-2, and F-3 of Appendix F. Copies of the field sampling forms, sample recovery forms, test calculations and a summary of the CO_2 and O_2 measurements performed during the particulate tests is provided in Appendix F.

The Test 8A was invalidated due to failure to obtain an acceptable leak check at the conclusion of the test. Inspection of the sampling train revealed that one of the glass connectors between the probe and first impinger had cracked during the test. Results of Test 8A were calculated and are reported in Appendix F. However, the results are not reported in the test results tables.

Gravimetric data on the in-stack filters for the tests conducted at the 65 and 40 MW load conditions yielded slightly negative particulate catch weights. For purposes of calculating emission rates, the filter catch weights for the 40 and 65 MW tests were assumed to be zero (i.e., the negative residue weights were not used in the calculations).

Table 4-5

Particulate Emission Test Results Summary

Nominal Load	Urea Injection	Test No.	Emission Concentration, gr/dscf		Emission Rate, lb/hr	
			Solids	Total	Solids	Total
130 MW	On	SCE-2-PART-3A	0.0041	0.0046	12.84	14.46
		SCE-2-PART-3B	0.0022	0.0028	7.09	8.81
	Off	SCE-2-PART-4	0.0026	0.0032	8.41	10.18
65 MW	On	SCE-2-PART-5A	0.0026	0.0031	6.22	7.31
		SCE-2-PART-5B	0.0024	0.0027	5.58	6.32
	Off	SCE-2-PART-6A	0.0028	0.0032	6.36	7.33
		SCE-2-PART-6B	0.0015	0.0017	3.43	3.91
40 MW	On	SCE-2-PART-7A	0.0009	0.0012	1.69	2.16
		SCE-2-PART-7B	0.0007	0.0008	1.22	1.32
	Off	SCE-2-PART-8B	0.0016	0.0019	2.76	3.28

SECTION 5.0 QUALITY ASSURANCE/QUALITY CONTROL

All quality assurance and quality control (QA/QC) procedures specified in the respective test methods were implemented during the source testing program. The QA/QC activities included:

Sampling Location

- Statification and cyclonic flow checks were performed to determine the suitability of the sampling locations. Stratification test procedures and results are provided in Sections 3.2, 3.3, 4.1, and 4.2 and Appendix B.

Sampling Systems

- Sampling system components were calibrated as described in Chapter III of the SCAQMD Source Test Manual. The calibration records are presented in Appendix G.
- All equipment was inspected for malfunctions and physical damage before initiating sampling, after completing sampling, and between tests.
- All components of the sampling trains that contacted the gas sample stream were pre-cleaned prior to use as directed in the respective test methods.
- Pre-and post-test leak checks were performed on the pitot tube/manometer assemblies and the sampling trains. Leak check data are included on the field sampling forms shown in Appendices D, E, and F.
- Field checks of the dry gas meter calibration were performed during the testing.
- Isokinetic sampling conditions were maintained within 100 $\pm$ 10 percent for all SCAQMD Method 5.3 tests. Isokinetic variation calculations are provided in Appendix F.

Test Sample Recovery

- Test samples were recovered in a clean area on the SCE Etiwanda Plant site.
- Field blank samples were obtained using the same equipment, reagents, and procedures used for the actual test samples.
- After recovery, all samples were placed in the type of container specified in the test method. All samples were stored and shipped to the analytical laboratories as specified in the test methods. The TGNMO traps were stored and shipped to the laboratories in an insulated chest filled with dry ice. Liquid samples bottles were weighed after sample collection to permit checking for leakage after storage and transit to the laboratory.

Radian CEM System

- Leak checks of the CEM system were performed at the beginning and end of each test day.
- The CEM system was calibrated with EPA Protocol Gas Mixtures and zero gas immediately before and after each test period as prescribed in SCAQMD Method 100.1. The calibration data for the protocol gases are provided in Appendix C.
- Bias checks were performed immediately before and after each test period as prescribed in SCAQMD Method 100.1. The bias check data are provided in Appendix C.

Data Accuracy and Completeness

- All field sampling data were collected on standardized forms. (See field data forms in Appendices A through F).
- A two-party independent review and check of all test data and calculations were performed.

Chain-of-custody procedures were employed in handling all samples generated during the test program. Upon recovery, each sample was assigned a unique identification number which was entered on the sample container label along with the collection date, initials of person responsible for the sample recovery, and, for liquids, the tare and gross

weight of the sample bottle. At the same time, the sample type, identification number, and weight data (if applicable) were entered on a chain-of-custody form. Copies of the completed chain-of-custody forms accompanied all samples when they were submitted to the analytical laboratories. All ammonia and particulate test samples and the Unit 1 TGNMO samples were hand delivered to West Coast Analytical Services and Horizon Air Measurements Services, respectively. The Unit 2 TGNMO samples were shipped next-day air express to Clean Air Engineering. Copies of the chain-of-custody forms are provided in Appendix G.