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A-89-08

II-I-091

Conference Proceedings

April 11 14, 1989
The Diplomat Hotel
Hollywood Florida
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AIR EMISSIONS TEST RESULTS FROM THE STANISLAUS
COUNTY, CALIFORNIA RESOURCE RECOVERY FACILITY

By: Jeffrey L. Mahn, P.E.
Donna S. Sofaer
Ogden Projects, Inc.
Emeryville, California 94608

ABSTRACT

Ogden Martin Systems, Inc.'s Stanislaus County, California resource recovery facility began construction in August 1986. Commercial operation began in February 1989. This waste-to-energy plant uses Thermal DeNOx to reduce nitrogen oxide emissions to help meet its emission offset requirements under the Clean Air Act. In addition, it is the first large-scale facility in California to pass a rigorous environmental and health risk assessment process with review by the California Air Resources Board (CARB) and the California Department of Health Services (DOHS).

The 800 tons-per-day (TPD) facility comprises two watervall boiler units (400 TPD each) with dry scrubbers and fabric filter baghouses to reduce acid gases and particulates, respectively. This facility generates approximately 20 megawatts of electricity, 15 of which are sold to Pacific Gas & Electric. Approximately 400,000 residents of the City of Modesto and parts of rural San Joaquin Valley are served by this facility.

Results of the testing for emissions of acid gases, nitrogen oxides, heavy metals, dioxins, and other trace organics are reported.

The original health risk assessment is re-evaluated for cancer risk based on these actual emissions and the revised cancer risk is presented. For the 30-year and 70-year scenarios, the risk level is 11 and 20 times lower, respectively, than levels originally reviewed by CARB and DOHS.

INTRODUCTION

The Stanislaus Waste Energy Company (SWEC), owned and operated by Ogen Martin Systems, Inc., is located in Cross Landing, CA, a rural San Joaquin Valley community near the city of Modesto, CA. This facility is Ogen Martin Systems, Inc.'s first resource recovery project located in California and its first facility using add-on nitrogen oxide emission control equipment. Construction began in August 1986 and was completed in late summer, 1988.

The technical specifications of this plant are shown in Table 1. This plant combusts 800 TPD of municipal solid waste (MSW) in two 400 TPD mass-burn units controlled by the Martin GMBH Stoker Combustion System. Emissions of acid gases, particulates, and nitrogen oxides are controlled with dry scrubbers, fabric filter/baghouses, and Exxon's Thermal DeNO_x, respectively.

RESULTS

Air emissions testing for criteria and non-criteria pollutants, heavy metals, dioxins and other trace organics was conducted November 29 through December 10, 1988 by Energy Systems Associates (ESA) of Tustin, CA, an independent testing firm approved by the California Air Resources Board. The schedule of compliance testing and the list of approved test methods are shown in Table 2. Results of the criteria and non-criteria pollutant emissions during the compliance testing program are presented in Tables 3, 4, 5, and 6, and are derived from the data contained in ESA's Report No. ESA 25910-1000 (1). Air emission control efficiencies for nitrogen oxides and sulfur dioxide are shown in Tables 7 and 8. These Thermal DeNO_x control efficiencies are approximate since simultaneous uncontrolled levels are not obtainable with accuracy similar to that of controlled levels, i.e., the uncontrolled levels were determined with the NH₃ shut off prior to the testing with NH₃. In addition, the measured uncontrolled levels are typical of normal fuel nitrogen and do not represent seasonal variation of normal levels (2). Based on NO_x removal data shown in Table 7, which reflect a short-term test during only one season with average fuel nitrogen, and on unabated NO_x levels measured at other OMS facilities (2), OMS will not guarantee a NO_x removal rate greater than 35-45%. In addition, there must be allowances for short-term (3-8 hr) NO_x levels up to 225 ppb_v at 12% CO₂ or 7% O₂.

The actual air emissions results are compared with the estimated air emissions used in the October 1986 final Health Risk Assessment done by Radian Corporation (3) for the SWEC facility. The cancer risk is recalculated on the basis of actual, rather than estimated, emission levels and the revised cancer risk is presented in Figures 1 and 2.

ACKNOWLEDGEMENTS

The authors acknowledge the excellent source test effort of Ogen Projects, Inc.'s independent contractor, Energy Systems Associates, and their key test personnel, M. D. McDannel, P.E., and A. C. Bell.

The work described in this paper was not funded by the U. S. Environmental Protection Agency and therefore the contents do not necessarily reflect the views of the Agency and no official endorsement should be inferred.

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1. McDannel, M. D., and A. C. Bell, Energy Systems Associates, "Test Report for Air Compliance Tests at Stanislaus Waste-to-Energy Company," ESR 25910-100, February 1989.
2. Hahn, J.L., and D. S. Sofer, Variability of NO_x Emissions From Modern Mass-Fired Resource Recovery Facilities. Paper presented at 81st Annual Meeting of Air Pollution Control Association, Dallas, Texas. June 19-24, 1988.
3. Radian Corporation, "Stanislaus Waste-to-Energy Facility Health Risk Assessment," DCN 86-243-079-14, October 1986.
4. U.S. EPA, Office of Air Quality Planning and Standards, "Municipal Waste Combustion Multipollutant Study, Summary Report," EMB Report No. 86-MIN-03A, September 1988.

TABLE 1. TECHNICAL SPECIFICATIONS OF THE STANISLAUS COUNTY RESOURCE RECOVERY FACILITY

Plant Capacity:	
Guaranteed Throughput:	292,000 Tons Per Year
Guaranteed Delivery:	243,300 Tons Per Year
System Description:	
Furnace:	Mass-burning with Watervall Boilers
Process Units:	Two, 400 TPD per Unit
Stoker Grate:	Martin GmbH, Inclined, Reverse-Reciprocating
Steam Pressure:	865 psig
Steam Temperature:	830°F
Condenser Cooling Medium:	Well Water
Energy Products:	
Net Electricity Generated:	Approximately 15 MW
Customer:	Pacific Gas & Electric Co.
Air Quality Controls:	
Nitrogen Oxide Control:	Exxon's Thermal DeNO _x System
Acid Gas Removal:	Dry Flue Gas Scrubbers
Particulate Removal:	Fabric Filter Baghouses

TABLE 2. SCHEDULE OF EMISSIONS TESTING AT STANISLAUS COUNTY
RESOURCE RECOVERY FACILITY

Test No.	1988 Date	Time	Test Method	Unit	Location	Run
01	12/01	0928-1258	U.S. EPA 104	1	Outlet	1
02	12/01	1355-1730	U.S. EPA 104	1	Outlet	2
03	12/01	1850-2225	U.S. EPA 104	1	Outlet	3
04	12/02	0846-1003	U.S. EPA 5, CARB 5	1	Outlet	1
05	12/02	0845-0945	U.S. EPA 8, Modified	1	Outlet	1
06	12/02	0845-0945	U.S. EPA 8, Modified	1	Inlet	1
07	12/02	1130-1247	U.S. EPA 5, CARB 5	1	Outlet	2
08	12/02	1130-1230	U.S. EPA 8, Modified	1	Outlet	2
09	12/02	1130-1230	U.S. EPA 8, Modified	1	Outlet	2
10	12/02	1415-1528	U.S. EPA 5, CARB 5	1	Inlet	2
11	12/02	1415-1515	U.S. EPA 8, Modified	1	Outlet	3
12	12/02	1415-1515	U.S. EPA 8, Modified	1	Inlet	3
13	12/02	1620-1725	U.S. EPA 13B	1	Outlet	1
14	12/03	0825-1055	U.S. EPA 12/101A, CARB 423 & 424	1	Outlet	1
15	12/03	1550-1805	U.S. EPA 12/101A, CARB 423 & 424	1	Outlet	2
16	12/03	1245-1345	U.S. EPA 25A	1	Outlet	1
17	12/03	1443-1553	U.S. EPA 25A	1	Outlet	2
18	12/03	1604-1704	U.S. EPA 25A	1	Outlet	3
19	12/03	1755-1910	U.S. EPA 13B	1	Outlet	2
20	12/04	0903-1536	U.S. EPA Mod. 5, CARB 428	1	Outlet	1
21	12/04	1503-1737	U.S. EPA 12/101A	1	Outlet	3
22	12/04	1655-1837	U.S. EPA 13B	1	Outlet	3
23	12/05	0800-1115	U.S. EPA Mod. 5, CARB 428	1	Outlet	2
24	12/05	1345-1700	CARB 428	1	Outlet	3
25	12/05	1521-1621	U.S. EPA 9, CARB 9	1	Outlet	1
26	12/05-12/07	2025-1035	Particle Size	2	Outlet	1

Continued...

TABLE 2. SCHEDULE OF EMISSIONS TESTING AT STANISLAUS COUNTY
RESOURCE RECOVERY FACILITY (Continued)

Test No.	1988 Date	Time	Test Method	Unit	Location	Run
27	12/06	0934-1112	U.S. EPA 5, CARB 5	2	Outlet	1
28	12/06	0935-1112	U.S. EPA 8, Modified	2	Outlet	1
29	12/06	0938-1055	U.S. EPA 8, Modified	2	Inlet	1
30	12/06	1217-1334	U.S. EPA 5, CARB 5	2	Outlet	2
31	12/06	1217-1334	U.S. EPA 8, Modified	2	Outlet	2
32	12/06	1220-1335	U.S. EPA 8, Modified	2	Inlet	2
33	12/06	1500-1617	U.S. EPA 5, CARB 5	2	Outlet	3
34	12/06	1500-1617	U.S. EPA 8, Modified	2	Outlet	3
35	12/06	1502-1618	U.S. EPA 8, Modified	2	Inlet	3
36	12/06	1731-1848	U.S. EPA 13B	2	Outlet	1
37	12/07	1353-1633	U.S. EPA 7E, CARB 100	2	Outlet	1*
38	12/07	1647-1927	U.S. EPA 7E, CARB 100	2	Outlet	2*
39	12/07	2000-2240	U.S. EPA 7E, CARB 100	2	Outlet	3*
40	12/08	0020-0300	U.S. EPA 7E, CARB 100	1	Outlet	1*
41	12/08	0410-0800	U.S. EPA 104	2	Outlet	1
42	12/08	0830-1150	U.S. EPA 104	2	Outlet	2
43	12/08	0641-0741	U.S. EPA 7E, 10, CARB 100	2	Outlet	1
44	12/08	0754-0854	U.S. EPA 7E, 10, CARB 100	2	Outlet	2
45	12/08	0904-1004	U.S. EPA 7E, 10, CARB 100	2	Outlet	3
46	12/08	1148-1248	U.S. EPA 25A, CARB 100	2	Outlet	1
47	12/08	1319-1410	U.S. EPA 25A, CARB 100	2	Outlet	2
48	12/08	1534-1634	U.S. EPA 25A, CARB 100	2	Outlet	3
49	12/08	1035-1355	U.S. EPA Mod. 5, CARB 428	2	Outlet	1
50	12/08	1730-2045	U.S. EPA Mod. 5, CARB 428	2	Outlet	2
51	12/08	1325-1545	U.S. EPA 12/101A	2	Outlet	1
52	12/08	2200-0025	U.S. EPA 12/101A	2	Outlet	2
53	12/08	2347-0110	U.S. EPA 13B	2	Outlet	2
54	12/09	0250-0524	U.S. EPA 12/101A	2	Outlet	3
55	12/09	3350-0500	U.S. EPA 13B	2	Outlet	3
56	12/09	0625-0950	U.S. EPA 104	2	Outlet	3
57	12/09	0925-1323	U.S. EPA Mod. 5, CARB 428	2	Outlet	3
58	12/09	1703-1803	U.S. EPA 7E, 10, CARB 100	1	Outlet	1
59	12/09	1811-1911	U.S. EPA 7E, 10, CARB 100	1	Outlet	2
60	12/09	1921-2021	U.S. EPA 7E, 10, CARB 100	1	Outlet	3
61	12/09	2037-2317	U.S. EPA 7E, 10, CARB 100	1	Outlet	2*
62	12/09	2345-0225	U.S. EPA 7E, 10, CARB 100	1	Outlet	3*

*NH₃ off

TABLE 3. RESULTS OF EMISSION TESTS FOR CRITERIA AND SELECTED NON-CRITERIA POLLUTANT CONCENTRATIONS FROM THE STANISLAUS COUNTY RESOURCE RECOVERY FACILITY

Parameter	Concentrations at 12± CO ₂			Permitted Concentration
	Unit 1	Unit 2	Average	
Criteria Pollutants				
NO _x (ppm _{dv})	93	113	103	200
SO ₂ (ppm _{dv})	2.8	5.3	4.1	30
CO (ppm _{dv})	43	42	43	400
THC (as CH ₄ , ppm _{dv})	3	4	4	70
Particulate (gr/dscf)				
Total Particulate (including condensible fraction)	0.0108	0.0112	0.0110	0.0275
Solid Particulate	0.0055	0.0022	0.0039	0.011
Solid Particulate of <2 microns	---	0.0000	0.0000	0.008
Selected Non-Criteria Pollutants				
HCl (ppm _{dv})	0.7	2.5	1.6	50
Fluoride (ppm _{dv})	0.24	0.07	0.16	3
NH ₃ (ppm _{dv})	3.7	5.0	4.4	50

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TABLE 4. RESULTS OF EMISSION TESTS FOR CRITERIA POLLUTANT MASS EMISSION RATES FROM THE STANISLAUS COUNTY RESOURCE RECOVERY FACILITY

Parameter	Permitted Mass Emission Rate for Both Units		
	Unit 1 lbs/day	Unit 2 lbs/day	Both Units lbs/day
NO _x	674	864	1538
SO ₂	29.21	59.21	88.42
CO	185	197	382
THC (as CH ₄)	7	10	17
Total Particulate (including condensible fraction)	97	102	199
	102	47	475

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TABLE 5. RESULTS OF EMISSION TESTS FOR CANCER RISK POLLUTANTS FROM THE STANISLAUS COUNTY RESOURCE RECOVERY FACILITY

Parameter	Concentrations at 12 $\pm$ CO $_2$		
	Unit 1	Unit 2	Average
Total PCDD/PCDF (ng/Nm 3)	6.70	7.13	6.92
Total PAH (μ g/Nm 3)	3.90	2.62	3.26
Total PCB (μ g/Nm 3)	<0.20	<0.18	<0.19
Heavy Metals (μ g/Nm 3)			
Arsenic	1.744	0.93	1.34
Beryllium	0.60	<0.00052	0.77
Cadmium	<0.00055	2.35	<0.00054
Chromium	1.84	10.9	2.10
Nickel	13.1	21.9	12.0
	22.5		22.2

TABLE 6. EMISSIONS OF DIOXINS AND FURANS FROM THE STANISLAUS COUNTY RESOURCE RECOVERY FACILITY IN U.S. EPA TOXIC EQUIVALENTS

Parameter	Unit 1		Unit 2	
	ng/Nm 3 @ 12 $\pm$ CO $_2$ Equivalents	U.S. EPA Toxic Equivalents	ng/Nm 3 @ 12 $\pm$ CO $_2$ Equivalents	U.S. EPA Toxic Equivalents
1278 TCDD	[0.010]	0.000	[0.009]	0.000
other TCDD	0.386	0.004	0.509	0.005
12378 PCDD	[0.009]	0.000	[0.008]	0.000
other PCDD	[0.052]	0.000	0.088	0.000
123478 HxCDD	[0.022]	0.000	[0.017]	0.000
123678 HxCDD	[0.018]	0.000	[0.018]	0.000
123789 HxCDD	[0.021]	0.000	[0.018]	0.000
other HxCDD	0.115	0.000	0.279	0.000
1234678 HpCDD	0.088	0.000	0.087	0.000
other HpCDD	0.133	0.000	0.065	0.000
OCDD	0.092	0.000	0.068	0.000
1278 TCDF	0.146	0.015	0.152	0.015
other TCDF	3.186	0.003	3.317	0.003
12378 PCDF	0.165	0.017	0.196	0.020
12478 PCDF	0.091	0.009	0.097	0.010
other PCDF	1.679	0.002	1.708	0.002
123478 HxCDF	0.176	0.002	0.179	0.002
123678 HxCDF	0.091	0.001	0.076	0.001
124678 HxCDF	[0.013]	0.000	[0.020]	0.000
123789 HxCDF	[0.015]	0.000	[0.012]	0.000
other HxCDF	0.096	0.000	0.032	0.000
1234678 HpCDF	0.186	0.000	0.154	0.000
124789 HpCDF	[0.020]	0.000	[0.018]	0.000
other HpCDF	0.011	0.000	0.014	0.000
OCDF	[0.020]	0.000	[0.018]	0.000
Total Toxic Equivalents		0.053		0.058

Note: Values in brackets are minimum detection limits of not-detectable congeners and are considered as zeroes in calculating averages and toxic equivalencies (4).

TABLE 7. EFFECTIVENESS OF THERMAL DEMO_x IN CONTROLLING EMISSIONS OF NO_x AT THE STANISLAUS COUNTY RESOURCE RECOVERY FACILITY

	Uncontrolled		Controlled		Reduction Efficiency %
	NO _x ppmv @ 12% CO ₂	NH ₃ lb/hr	NO _x ppmv @ 12% CO ₂	NH ₃ lb/hr	
Unit 1					
Run 1	304	0	85	29	72
Run 2	290	0	99	29	66
Run 3	298	0	95	29	68
Average	297	0	93	29	69
Unit 2					
Run 1	308	0	110	25	64
Run 2	306	0	110	26	64
Run 3	297	0	119	23	60
Average	304	0	113	25	63

December tests.
Not yet seen what summer record NO_x values are.

TABLE 8. EFFECTIVENESS OF DRY SCRUBBER/FABRIC FILTERS IN CONTROLLING EMISSIONS OF SO₂ AT THE STANISLAUS COUNTY RESOURCE RECOVERY FACILITY

	SO ₂		CaO lbs per ton MSW	SO ₂		Removal Efficiency %
	Inlet ppmv @ 12% CO ₂	Outlet ppmv @ 12% CO ₂		Inlet ppmv @ 12% CO ₂	Outlet ppmv @ 12% CO ₂	
Unit 1						
Run 1	56.2	0.7	18.2	56.2	0.7	99.5
Run 2	70.2	0.8	18.2	70.2	0.8	98.9
Run 3	63.8	1.3	16.6	63.8	1.3	88.6
Average	63.4	2.6	17.6	63.4	2.6	95.7
Unit 2						
Run 1	87.0	2.6	19.0	87.0	2.6	80.3
Run 2	61.7	5.6	17.5	61.7	5.6	91.2
Run 3	21.4	7.4	15.0	21.4	7.4	65.4
Average	56.7	4.1	17.2	56.7	4.1	84.0

Figure 1. Original and Revised 30-Year Cancer Risk

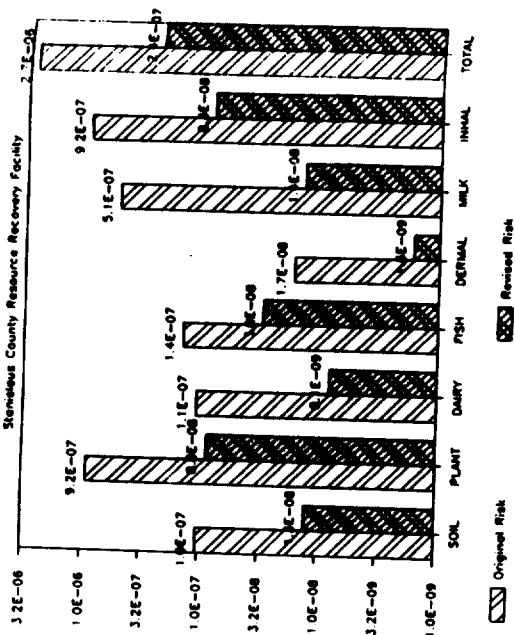
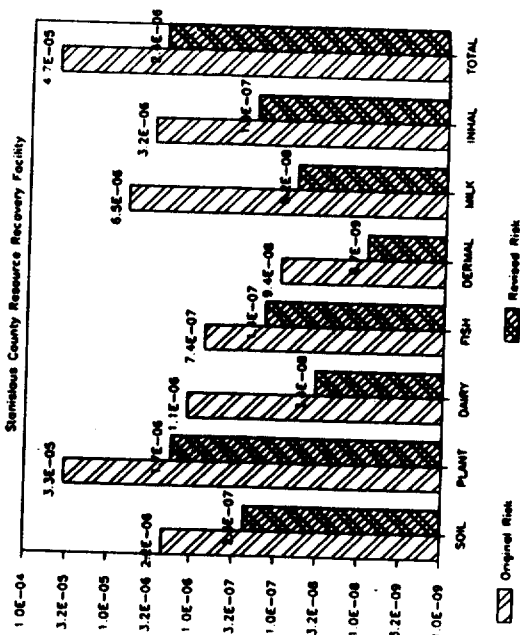


Figure 2. Original and Revised 70-Year Cancer Risk



JACKSON COUNTY (MICHIGAN) RESOURCE RECOVERY FACILITY

by: Stuart J. Hand
Riley Energy Systems Corporation
Worcester, MA 01606

and: P.R. Bhargalkar
Research-Cottrell Inc.
Somerville, NJ 08076

ABSTRACT

The Jackson County waste-to-energy facility has a capacity rating of 200 tons per day (TPD) of municipal solid waste, (MSW). Each of the two 100 TPD unit streams represent current modern day design and operating principles that are directly associated with environmental control.

Each of the unit streams incorporate the Riley-Takuma stoker, combustion and boiler technology. The air quality control system being a dry scrubber and fabric filter supplied by Research-Cottrell.

Included in the facility's performance is compliance with the emission levels imposed by the State of Michigan. Performance trials having been conducted include the trials for environmental control from which the test results show that all emissions were below state limits.

The following text therefrom describes the facility installation and emission control performance.

INTRODUCTION BACKGROUND

Following a comprehensive study the recommendation for the Jackson County facility was initiated in August 1984 by approval of a bond issue by the Jackson County electorate. Subsequent construction began in July 1986 and commercial operation in November 1987. The performance - compliance trials were conducted during April of 1988.