Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP-42 Section Number: 1.8

Reference Number: 64

Title: Okeelanta Corporation Particulate Emissions Test Reprot Boiler #15

February 1991

Eastmount Engineering

Environmental Consultants — Air Quality Specialists

OSW1-.0K1

OKEELANTA CORPORATION

COMPLIANCE PARTICULATE EMISSIONS TEST REPORT

BOILER #15

PREPARED FOR:

Okeelanta Corporation
Okeelanta Sugar Division
South Bay, Florida 33493

CONCERNING:

Particulate Emissions Testing
Okeelanta Corporation
Boiler #15
South Bay Florida Facility
February 8, 1991

PREPARED BY:

Sean MacKay
Project Director
Eastmount Engineering, Inc.
420 Main Street
Walpole, MA 02081

Sean MacKay
Project Director

28 FEB 91
Date

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1.0 COMPENDIUM

Eastmount Engineering Inc., conducted a Compliance Particulate Emissions Test Program on Unit #15 at Okeelanta Corporation's South Bay, Florida facility on February 8, 1991. The test program consisted of a series of three EPA Method 5 test runs.

All testing was conducted in strict accordance with the Environmental Protection Agency's Reference Methods 1 through 5 as found in the Federal Register (40 CFR 60) as amended and were consistent with the State of Florida Department of Environmental Regulation's guidelines.

The purpose of this test was to determine compliance with the rules of the Department of Environmental Regulation (DER), Chapter 17-2.600 Air Pollution, Section 2.05 Prohibitive Acts, Subsection 6, Stationary Sources, Table II, Emission Limiting Standards.

During testing the boiler was burning bagasse as fuel. Boiler No. 15 is rated at 125,000 pounds of steam per hour. Results of the test program indicate Boiler No. 15 to be in compliance with the Florida DER emission standards. The following table summarizes the emission results, emission standards and boiler operating conditions.

RUN#	DATE	EMISSION RATE #/MMBtu	EMISSION RATE #/HR	ALLOWABLE #MMBtu	ALLOWABLE #/HR	LOAD #/HR	% OF 125 KPH
1	02-08-91	.138	25.30	.200	36.78	91662	73.3%
2	02-08-91	.156	29.42	.200	37.70	93969	75.2%
3	02-08-91	.153	28.52	.200	37.40	93375	74.7%
3 RUN AVG.		.149	27.75	.200	37.29	93002	74.4%

Based on plant instrumentation and the measured feedwater flow rate to Boiler No. 15 it appeared that the steam flow indicator for Boiler No. 15 was reading considerably lower than the actual steam flow. After a complete check of all instrumentation in the steam flow measurement system it was determined that the only possible cause for the low steam flow indication must be a problem with the orifice plate located in Boiler No. 15's superheater outlet piping. This is all speculation at this time because the orifice plate cannot be inspected unless the plant is shutdown. A complete explanation and hypothesis for the determination of the actual steam flow was made by Mr. Leonard Triggs of Alshain Associates, Inc. and can be found in Appendix X of this report.

1.0 COMPENDIUM (cont.)

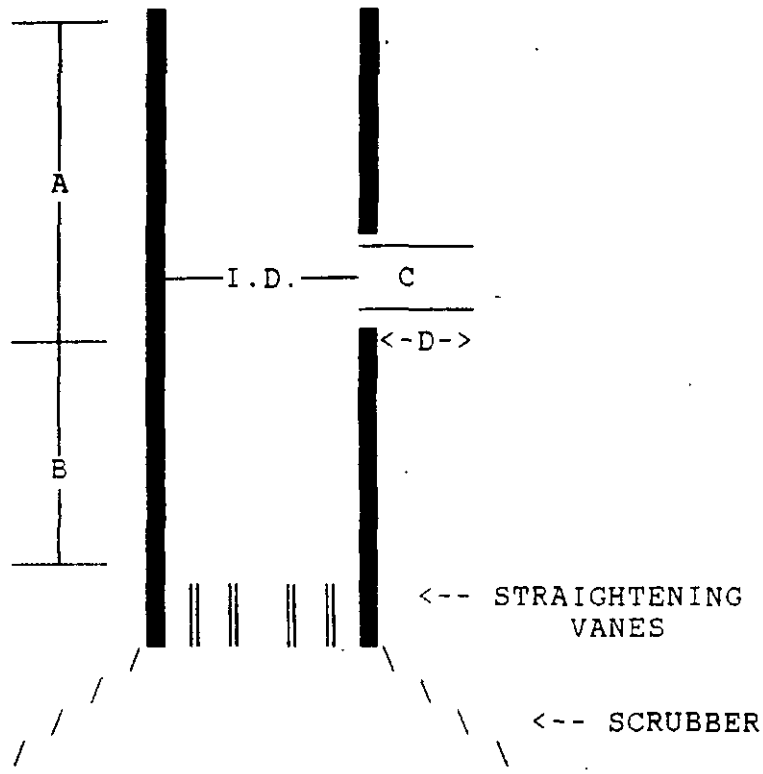
Sean MacKay, Project Director, was in charge of and responsible for all stack testing, conducted all calculations and maintained chain of custody of all samples. Mark Wescott operated the meter box and performed the field laboratory aspects of the program. Jim Jardin located the probe at the proper traverse point locations and assisted where required. Mr. Ken Tucker of the Florida Department of Environmental Regulation observed the stack testing and boiler operations. Mr. Alberto Padrone was the boiler room superintendent. Mr. George Devane was responsible for boiler operation and acquisition of all pertinent process data. Mr. Leonard Triggs, P.E. of Alshain Associates, Inc. assisted Mr. Devane and Mr. Padrone in boiler operations.

2.0 STACK SCHEMATIC

OKEELANTA CORPORATION
UNIT # 15
SOUTH BAY, FLORIDA FACILITY

The following is a schematic of the stack which services Boiler #15 at Okeelanta Corporation's South Bay, Florida facility.

Defined are the sampling port locations, interior stack dimensions and distances from the ports to the nearest upstream and downstream interferences.

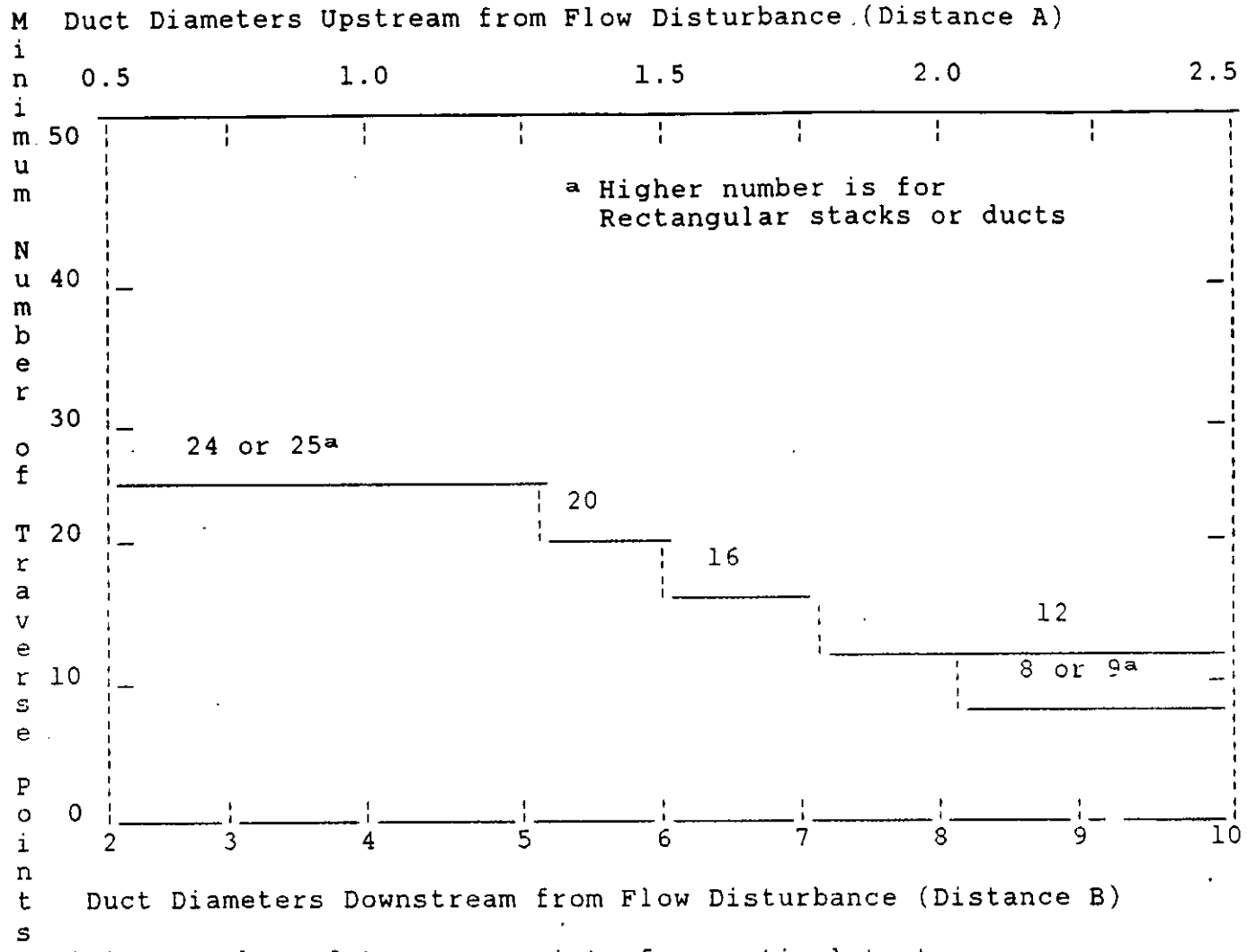


DISTANCE UPSTREAM FROM FLOW DISTURBANCE (A)	4'
DISTANCE DOWNSTREAM FROM FLOW DISTURBANCE (B)	16'
DIAMETER OF PORT SLEEVE (C)	4"
LENGTH OF PORT SLEEVE (D)	3.5"
NUMBER OF PORTS	2
INTERNAL DIAMETER OF STACK AT SAMPLING PORTS	7.5'

Drawing not to scale

3.0 NUMBER OF TRAVERSE POINTS AND SAMPLING TIME PER POINT

OKEELANTA CORPORATION
UNIT # 15
SOUTH BAY, FLORIDA FACILITY



Minimum number of traverse points for particulate traverses.

Distance A = 4' or 0.5 diameters.

Distance B = 16' or 2.1 diameters.

In accordance with Method 1, 24 traverse points are needed.

In order to sample for a minimum of one hour and draw at least 30 cubic feet, each traverse point was sampled for 2.5 minutes.

3.0 NUMBER OF TRAVERSE POINTS AND SAMPLING TIME PER POINT

OKEELANTA CORPORATION
UNIT # 15
SOUTH BAY, FLORIDA FACILITY

DIAMETER OF STACK: 7.5 FEET
PORT SLEEVE LENGTH: 3 INCHES

TRAVERSE POINT	DISTANCE % OF DIAMETER	DISTANCE (INCHES)	PROBE MARK (INCHES)
1	2.1	1.9	5.4
2	6.7	6.0	9.5
3	11.8	10.6	14.1
4	17.7	15.9	19.4
5	25.0	22.5	26.0
6	35.6	32.0	35.5
7	64.4	57.9	61.5
8	75.0	67.5	71.0
9	82.3	74.1	77.6
10	88.2	79.4	82.9
11	93.3	84.0	87.5
12	97.9	88.1	91.6

4.0 SAMPLING TRAIN AND ANALYTICAL TEST PROCEDURES

The following is a description of the sampling train and specifications of particulate collection media used in the tests.

1. EMISSION SAMPLING EQUIPMENT

The specific train used during this test is one manufactured by Research Appliance Company (RAC). The design specifications of this train meets all the requirements of Environmental Protection Agency's Method 5 as found in the Federal Regulations under Section 40 CFR 60 as amended. The following is a description of the individual pieces of equipment used:

Nozzle - The nozzle was of seamless stainless steel tubing construction of the button hook design. A range of sizes suitable for isokinetic sampling was available. All nozzles were calibrated before testing. A nozzle calibration sheet may be found in the calibration section of this report.

Probe - An 10 foot steel probe with a stainless steel liner was used.

Heating System - The filter temperature was maintained by enclosing the filter in a hot box capable of maintaining the temperature at 248 `F ±25`F. This temperature was monitored by use of a thermocouple in the hot box.

Pitot Tube - A type S pitot tube attached to the probe was used to monitor the stack gas velocity. Since the pitot tube meets all the dimensional criteria set forth in Method 2 of 40 CFR 60, a coefficient of 0.84 has been used.

Filter Holder - A borosilicate glass type filter holder with frit support was used.

Condenser - Four impingers connected in series, with ground glass leak-free fittings were used as the condenser. The first, third and fourth impingers were of the Greenburg-Smith design, modified by replacing the tip with a 1/2" glass tube extending to about 1/2" from the bottom of the flask. The second impinger was of the Greenburg-Smith design with the standard tip.

Metering System - A vacuum gauge, micromanometer, inclined manometer, leak-free pump, calibrated thermocouples and a calibrated dry gas meter were the basic components used to meter the dry gas through the system.

4.0 SAMPLING TRAIN AND ANALYTICAL TEST PROCEDURES (cont.)

Gas Density Determination - An ORSAT type combustion analyzer, capable of measuring CO_2, O_2 and CO was used to determine the molecular weight of the flue gas. An integrated proportional sample was taken at each of the traverse points in order to assure that the total test span was covered. The ORSAT analysis was conducted immediately following each test run.

2. SAMPLING AND ANALYTICAL PROCEDURES

All sampling and analytical procedures were conducted in strict accordance with the methods prescribed in Methods 1 through 5 of the Code of Federal Regulations as found in 40 CFR 60 as amended. The following is the sequence of events that occur both prior to and during the actual stack test.

Traverse Points - The traverse points were calculated in accordance with Method 1 and the probe was marked accordingly.

Static Pressure - The static pressure was checked and recorded.

Preliminary Traverse - A preliminary traverse was conducted. Readings included the pressure drops and stack gas temperatures.

Nomograph - Once all of the above information had been obtained, the nomograph was set up for the actual test to correlate the isokinetic relation ships.

Barometric Pressure - Barometric pressure was obtained by use of an aneroid barometer at the test site.

Sampling Train Set-Up

(a) The pre-weighed filter was placed in the filter holder and visually checked.
(b) 100 ml of water was placed in the first two impingers.
(c) Approximately 200 grams of silica gel was placed in the fourth impinger. (Exact weights were logged on the field data sheets).
(d) Crushed ice was placed around the impingers.
(e) Once assembly of the entire train was completed, the probe and heater box were turned on.

Pre-test Leak Check - Once the heater box was at the desired temperature for testing, the system was leak checked at 15 inches of vacuum. A leakage rate of less than 0.02 CFM had to be achieved before testing commenced.

Final Check - Once everything was ready to go, the plant was checked to assure that it was running at desired capacity.

4.0 SAMPLING TRAIN AND ANALYTICAL TEST PROCEDURES (cont.)

Sampling - Isokinetic sampling as described in Method 5 then took place.

Post-test Leak Check - Upon completion of each test run, the system was leak checked at the highest vacuum recorded during that run. All leak checks were less than 0.02 CFM and considered acceptable.

Sample Recovery - Because of the importance of proper sample recovery procedures, details of the sample recovery can be found in the Quality Control Procedures Section of this report.

Isokinetics - Once all sample recovery was completed and the amount of moisture collected had been determined, calculations were conducted to determine the percent isokinetics of the test run.

Operating Data Sheets - All pertinent operating data were logged throughout the testing period by plant personnel.

5.0 QUALITY CONTROL PROCEDURES

The following is a description of the procedures used for maintaining the integrity of samples collected, including the chain of custody and quality control assurance of filters and acetone wash.

Pre-test preparation consisted of the filters being desiccated at 68`± 10`F at ambient pressure for at least twenty four (24) hours. At intervals of at least six (6) hours, the filters were re-weighed until a constant weight was achieved ± 0.5 mg change from the previous weighing. These pre-marked filters were then put into petri dishes and sealed. All filters used during testing were put into a carrying case for transport to the job site. A list of the filters and tare weights was available prior to testing.

After each test run, the filter and any particles which may have adhered to the filter holder gasket were carefully removed from the filter holder and placed into its identified petri dish container. This container was then labeled with the run number and date.

Taking care to see that particulate on the outside of the probe or other exterior surface did not get into the sample, particulate matter from the probe liner, nozzle, probe fittings, and front half of the filter holder were acetone washed into a sample container. This container was then sealed. The run number, date, and a mark indicating the level of the acetone wash in the bottle was recorded on the bottle.

Both the petri dish containing the filter and the bottle containing the acetone wash were transported to Eastmount Engineering's laboratory.

Once at the laboratory, each filter was weighed and then put back into its individual container. The container was then placed in a desiccator for at least twenty four (24) hours and then weighed. At intervals of at least six (6) hours, the filters were re-weighed until a constant weight was achieved ± 0.5 mg change from the previous weighing.

The levels marked on the bottles containing the acetone wash were checked to confirm that no leakage occurred during transport. The contents were then transferred into a pre-tared beaker and evaporated to dryness. Once this had been accomplished, the beaker was placed in a desiccator for at least twenty four (24) hours and then weighed. At intervals of at least six (6) hours, the beaker was re-weighed until a constant weight of ± 0.5 mg change from the previous weighing was achieved.

All calculations were conducted in strict accordance with 40 CFR 60 (See Calculation Sheets in report).

APPENDIX I

COMPUTER INPUT SHEETS

INPUT DATA SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-1
DATE : 02-08-91

Ds (FT)	7.5
Dn (IN)	.305
FILTER#	3746
PIT COEFF	.84
IMP-1 (INT)	100
IMP-2 (INT)	100
IMP-3 (INT)	0
IMP-4 (INT)	500.0
IMP-1 (FIN)	293
IMP-2 (FIN)	137
IMP-3 (FIN)	3
IMP-4 (FIN)	517.0
% CO2	11.4
% O2	8.8
% CO	0
P BAR	30.08
P STK	.20
NO. PTS	24
TEST LNGTH	60
END METER	1008.46
	.321
INT METER	963.157
BEGIN TIME:	08:40
END TIME:	09:45

TRAV PT	VEL HEAD	SQ ROOT	DELTA H	DRYGAS IN	DRYGAS OUT	STACK TEMP
A1	.05	.22	.31	76	75	142
2	.07	.26	.43	77	76	141
3	.10	.32	.61	78	76	144
4	.11	.33	.67	79	77	145
5	.14	.37	.85	79	77	144
6	.15	.39	.92	80	77	145
7	.42	.65	3.18	83	78	144
8	.58	.76	3.54	85	78	144
9	.67	.82	4.10	87	79	144
10	.78	.88	4.76	89	80	144
11	.82	.91	5.00	90	80	143
12	.80	.89	4.90	92	81	143
B1	.83	.91	5.10	87	81	144
2	.93	.96	5.70	93	83	144
3	.93	.96	5.70	94	84	144
4	.86	.93	5.25	95	84	144
5	.69	.83	4.21	95	85	144
6	.55	.74	3.36	95	86	143
7	.20	.45	1.22	93	86	144
8	.14	.37	.85	91	86	145
9	.13	.36	.79	89	85	144
10	.13	.36	.79	97	85	144
11	.14	.37	.85	86	84	144
12	.14	.37	.85	86	84	144
AVERAGE	.43	.60	2.66	87.3	81.1	143.8

INPUT DATA SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-2
DATE : 02-08-91

Ds (FT)	7.5
Dn (IN)	.257
FILTER#	3748
PIT COEFF	.84
IMP-1 (INT)	100
IMP-2 (INT)	100
IMP-3 (INT)	0
IMP-4 (INT)	500.0
IMP-1 (FIN)	255
IMP-2 (FIN)	121
IMP-3 (FIN)	1
IMP-4 (FIN)	509.7
% CO2	11.2
% O2	9.0
% CO	0
P BAR	30.08
P STK	.20
NO. PTS	24
TEST LNGTH	60
END METER	41.415
	.140
INT METER	8.854
BEGIN TIME:	11:40
END TIME:	12:45

TRAV PT	VEL HEAD	SQ ROOT	DELTA H	DRYGAS IN	DRYGAS OUT	STACK TEMP
A1	.06	.24	.20	71	71	141
2	.08	.28	.26	72	71	143
3	.09	.30	.30	72	71	146
4	.12	.35	.39	73	71	145
5	.14	.37	.46	73	71	146
6	.20	.45	.66	75	72	145
7	.44	.66	1.45	76	73	145
8	.59	.77	1.95	78	73	146
9	.69	.83	2.27	80	74	145
10	.82	.91	2.71	82	74	145
11	.80	.89	2.64	83	75	145
12	.79	.89	2.61	84	76	146
B1	.73	.85	2.41	83	77	140
2	.93	.96	3.07	84	78	143
3	.98	.99	3.23	86	79	146
4	.91	.95	3.00	87	79	138
5	.77	.88	2.54	88	80	141
6	.52	.72	1.72	88	81	143
7	.19	.44	.63	86	81	143
8	.15	.39	.50	86	82	142
9	.13	.36	.43	84	81	142
10	.14	.37	.46	84	81	143
11	.13	.36	.43	84	82	142
12	.14	.37	.46	83	82	141
AVERAGE	.44	.61	1.45	80.9	76.5	143.4

INPUT DATA SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-3
DATE : 02-08-91

Ds (FT)	7.5
Dn (IN)	.257
FILTER#	3749
PIT COEFF	.84
IMP-1 (INT)	100
IMP-2 (INT)	100
IMP-3 (INT)	0
IMP-4 (INT)	500.0
IMP-1 (FIN)	245
IMP-2 (FIN)	130
IMP-3 (FIN)	2
IMP-4 (FIN)	511.0
% CO2	11.1
% O2	9.1
% CO	0
P BAR	30.08
P STK	.20
NO. PTS	24
TEST LNGTH	60
END METER	73.105
	.149
INT METER	41.665
BEGIN TIME:	13:25
END TIME:	14:40

TRAV PT	VEL HEAD	SQ ROOT	DELTA H	DRYGAS IN	DRYGAS OUT	STACK TEMP
A1	.04	.20	.14	77	77	141
2	.06	.24	.21	77	77	140
3	.07	.26	.25	78	77	142
4	.10	.32	.35	78	77	141
5	.10	.32	.35	79	78	142
6	.12	.35	.42	79	78	141
7	.15	.39	.53	80	78	142
8	.40	.63	1.40	81	78	141
9	.55	.74	1.93	83	79	142
10	.70	.84	2.47	85	79	141
11	.78	.88	2.73	86	80	142
12	.78	.88	2.73	87	80	142
B1	.85	.92	2.98	85	85	142
2	.92	.96	3.22	88	81	143
3	.91	.95	3.20	89	82	145
4	.88	.94	3.10	90	82	144
5	.70	.84	2.45	91	83	144
6	.51	.71	1.79	90	83	144
7	.19	.44	.67	88	83	143
8	.13	.36	.46	87	83	143
9	.14	.37	.50	85	83	143
10	.14	.37	.50	86	83	142
11	.14	.37	.50	85	83	143
12	.13	.36	.46	85	83	143
AVERAGE	.40	.57	1.39	84.1	80.5	142.3

Eastmount Engineering Inc., • 420 Main Street • Walpole, MA 02981 • (508) 668-9005 • FAX (508) 668-4989

APPENDIX II

ISOKINETIC CALCULATION SHEETS

ISOKINETIC CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-1
DATE : 02-08-91

TS (`F)=	143.8	% CO2=	11.4	VM (CF) =	44.986
TS (`R)=	603.8	% O2=	8.8	DELTA H (ABS)=	30.28
TM (`F)=	84.2	% CO=	0	PS (ABS) =	30.09
TM (`R)=	544.2	% N2=	79.8	SQRT DELTA P =	.601629
VI(TOT)=	250.0	CP=	.84	AREA NOZZLE =	.000507

Y = 1.001

VM STD	=	17.64 (VM)(Y)(DELTA H ABS) / (TM)	=	44.19	DSCF
VW STD	=	.04707 (VI TOT)	=	11.77	CF
BWO	=	VW STD / (VW STD + VM STD)	=	.210	
BWO	=	MOISTURE FROM STEAM TABLES	=	.215	
VI TOT	=	ADJUSTED TO SATURATION VOLUME	=	N/A	ML
1-BWO	=	1 - BWO	=	.790	
Md (DRY)	=	.44 (% CO2) +.32 (% O2) +.28 (% CO) +.28 (% N2)	=	30.18	LBS/LB MOLE
Ms (WET)	=	MD (1-BWO) + 18 (BWO)	=	27.62	LBS/LB MOLE
G	=	SQRT (TS / PS / MS)	=	.85	
VS	=	85.49(CP)(G)(SQRT DELTA P)	=	36.8	FPS
H	=	0.002669 (VI TOT)	=	.67	
J	=	(DELTA H ABS)(VM)(Y) /(TM)	=	2.51	
K	=	(H) + (J)	=	3.17	
% ISO	=	(TS) (K) (1.667) / (TIME) (VS) (PS) (AN)	=	94.6	

ISOKINETIC CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-2
DATE : 02-08-91

TS (`F)=	143.4	% CO2=	11.2	VM (CF) =	32.421
TS (`R)=	603.4	% O2=	9.0	DELTA H (ABS)=	30.19
TM (`F)=	78.7	% CO=	0	PS (ABS) =	30.09
TM (`R)=	538.7	% N2=	79.8	SQRT DELTA P =	.608348
VI(TOT)=	186.7	CP=	.84	AREA NOZZLE =	.000360

Y = 1.001

VM STD	=	$\frac{(VM)(Y)(DELTA\ H\ ABS)}{(TM)}$	= 32.08	DSCF
VW STD	=	.04707 (VI TOT)	= 8.79	CF
BWO	=	$\frac{VW\ STD}{VW\ STD + VM\ STD}$	= .215	
BWO	=	MOISTURE FROM STEAM TABLES	= .213	
VI TOT	=	ADJUSTED TO SATURATION VOLUME	= 185.0	ML
1-BWO	=	1 - BWO	= .787	
Md (DRY)	=	.44 (% CO2) +.32 (% O2) +.28 (% CO) +.28 (% N2)	= 30.15	LBS/LB MOLE
Ms (WET)	=	MD (1-BWO) + 18 (BWO)	= 27.60	LBS/LB MOLE
G	=	SQRT (TS / PS / MS)	= .85	
VS	=	85.49(CP)(G)(SQRT DELTA P)	= 37.2	FPS
H	=	0.002669 (VI TOT)	= .49	
J	=	(DELTA H ABS)(VM)(Y) /(TM)	= 1.82	
K	=	(H) + (J)	= 2.31	
% ISO	=	$\frac{(TS)\ (K)\ (1.667)}{(TIME)\ (VS)\ (PS)\ (AN)}$	= 96.0	

ISOKINETIC CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-3
DATE : 02-08-91

Avg = 143 Avg = 9.0

TS (`F)=	142.3	% CO2=	11.1	VM (CF) =	31.291
TS (`R)=	602.3	% O2=	9.1	DELTA H (ABS)=	30.18
TM (`F)=	82.3	% CO=	0	PS (ABS) =	30.09
TM (`R)=	542.3	% N2=	79.8	SQRT DELTA P =	.569009
VI(TOT)=	188.0	CP=	.84	AREA NOZZLE =	.000360

Y = 1.001

VM STD = $17.64 \dfrac{(VM)(Y)(DELTA\ H\ ABS)}{(TM)}$ = 30.75 DSCF

VW STD = .04707 (VI TOT) = 8.85 CF

BWO = $\dfrac{VW\ STD}{VW\ STD + VM\ STD}$ = .223

BWO = MOISTURE FROM STEAM TABLES = .207

VI TOT = ADJUSTED TO SATURATION VOLUME= 174.3 ML

1-BWO = 1 - BWO = .793

Md (DRY) = .44 (% CO2) +.32 (% O2) +.28 (% CO) +.28 (% N2) = 30.14 LBS/LB MOLE

Ms (WET) = MD (1-BWO) + 18 (BWO) = 27.92 LBS/LB MOLE

G = SQRT (TS / PS / MS) = .85

VS = 85.49(CP)(G)(SQRT DELTA P) = 34.6 FPS

H = 0.002669 (VI TOT) = .46

J = (DELTA H ABS)(VM)(Y) /(TM) = 1.74

K = (H) + (J) = 2.21

% ISO = $\dfrac{(TS)\ (K)\ (1.667)}{(TIME)\ (VS)\ (PS)\ (AN)}$ = 98.5

APPENDIX III

ENTHALPY CALCULATION SHEETS

ENTHALPY CALCULATION SHEET

PLANT : OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-1
DATE : 02-08-91

	STEAM PRESSURE	STEAM TEMPERATURE	FEED WATER TEMPERATURE
	355	640	260
	350	650	
	355	640	
	355	640	
	353	640	
AVERAGE	353.6 PSIG	642.0	260.0

P ABS = 368.3 PSIA

ENTHALPY @	700	'F AND	370	PSIA =	1363.6
ENTHALPY @	600	'F AND	370	PSIA =	1309.1
ENTHALPY @	642.0	'F AND	370	PSIA =	1332.0

ENTHALPY OF FEED WATER = 228.65

AVERAGE ENTHALPY = 1103.3 BTU/LB OF STEAM

ENTHALPY CALCULATION SHEET

PLANT : OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-2
DATE : 02-08-91

	STEAM PRESSURE	STEAM TEMPERATURE	FEED WATER TEMPERATURE
	356	640	260
	359	640	
	347	640	
	356	650	
	346	640	
AVERAGE	352.8 PSIG	642.0	260.0

P ABS = 367.5 PSIA

ENTHALPY @	700	'F AND	370	PSIA =	1363.6
ENTHALPY @	600	'F AND	370	PSIA =	1309.1
ENTHALPY @	642.0	'F AND	370	PSIA =	1332.0

ENTHALPY OF FEED WATER = 228.65

AVERAGE ENTHALPY = 1103.3 BTU/LB OF STEAM

ENTHALPY CALCULATION SHEET

PLANT : OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-3
DATE : 02-08-91

	STEAM PRESSURE	STEAM TEMPERATURE	FEED WATER TEMPERATURE
	353	650	260
	356	640	
	352	640	
	348	630	
	356	640	
	356	630	
AVERAGE	353.5 PSIG	638.3	260.0

P ABS = 368.2 PSIA

ENTHALPY @	700	'F AND	370	PSIA =	1363.6
ENTHALPY @	600	'F AND	370	PSIA =	1309.1
ENTHALPY @	638.3	'F AND	370	PSIA =	1330.0

ENTHALPY OF FEED WATER = 228.65

AVERAGE ENTHALPY = 1101.3 BTU/LB OF STEAM

APPENDIX IV

HEAT INPUT CALCULATION SHEETS

HEAT INPUT CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-1
DATE : 02-08-91

	STEAM INTEGRATOR READINGS						TIME		INTEGRATOR FACTOR	
									100	
END	805914						9: 45			
									LBS/HR STEAM	
BEGIN	804921						8: 40			
NET	993	X	100	/	65	MINS		=	91662	

91662 LBS/HR STEAM / 55% EFF. = 166657 EQUIV.

166657 LBS/HR STEAM X 1103 BTU/LB = 183.9 BTU(e6)/HR

	OIL INTEGRATOR READINGS						GALS/HR	
END	0				9: 45			
BEGIN	0				8: 40			
NET	0	GALLONS			65	MINS =	0	GPH

0 GPH X 150,000 BTU/GAL (EST) = 0 BTU(e6)/HR

ALLOWABLE EMISSIONS

BAGASSE	183.9	-	0	X	.2	=	36.8	LBS/HR
OIL			0	X	.1	=	.0	LBS/HR
TOTAL						=	36.8	LBS/HR

HEAT INPUT CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-2
DATE : 02-08-91

	STEAM INTEGRATOR READINGS	TIME	INTEGRATOR FACTOR
END	808680	12: 45	100
BEGIN	807662	11: 40	LBS/HR STEAM
NET	1018 X 100 / 65 MINS =		93969

93969 LBS/HR STEAM / 55% EFF. = 170853 EQUIV.

170853 LBS/HR STEAM X 1103 BTU/LB = 188.5 BTU(e6)/HR

	OIL INTEGRATOR READINGS	TIME	GALS/HR
END	0	12: 45	
BEGIN	0	11: 40	
NET	0 GALLONS	65 MINS =	0 GPH

0 GPH X 150,000 BTU/GAL (EST) = 0 BTU(e6)/HR

ALLOWABLE EMISSIONS

BAGASSE	188.5	-	0	X	.2	=	37.7 LBS/HR
OIL			0	X	.1	=	.0 LBS/HR
TOTAL						=	37.7 LBS/HR

HEAT INPUT CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-3
DATE : 02-08-91

	STEAM INTEGRATOR READINGS		TIME		INTEGRATOR FACTOR
					100
END	809348	810475	12:25	13: 40	
					LBS/HR STEAM
BEGIN	809299	809528	12:29	14: 40	
NET	49	947	X 100	/ 64	MINS = 93375

93375 LBS/HR STEAM / 55% EFF. = 169773 EQUIV.

169773 LBS/HR STEAM X 1101 BTU/LB = 187.0 BTU(e6)/HR

	OIL INTEGRATOR READINGS		TIME		GALS/HR
END	0		14: 40		
BEGIN	0		13: 25		
NET	0	GALLONS	64	MINS =	0 GPH

0 GPH X 150,000 BTU/GAL (EST) = 0 BTU(e6)/HR

ALLOWABLE EMISSIONS

BAGASSE	187.0	-	0	X	.2	=	37.4	LBS/HR
OIL			0	X	.1	=	.0	LBS/HR
TOTAL						=	37.4	LBS/HR

APPENDIX V

EMISSION CALCULATION SHEETS

EMISSION CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-1
DATE : 02-08-91

	SAMPLES		BLANKS	
	FILTER	BEAKER	FILTER	ACETONE
NO. :	3746	214	3750	209
FINAL:	.7663	74.9212	.6420	76.3019
TARE :	.6462	74.9151	.6418	76.3009
NET :	.1201	.0061	.0002	.0010/200ML

VOLUME OF RINSE 300

WEIGHT = 126.20
RESIDUE = - 1.50

Mn = 124.70 Mg AS = 44.2 SQ FT

Qs = 3600(1-BWO)(VS)(AS)(17.64)(PS)/(TS) = 4066570 DSCFH

CS = (2.205 X 10-6) (Mn) / (VM STD) = 6.222e-6 LBS/SCF

CS' = 0.0154 (Mn) / (VM STD) = .04 GRAINS /SCF

PMR = (QS) (CS) = 25.30 LBS/HR

LOAD= MILLIONS OF BTU / HOUR INPUT = 183.9 BTU e6 / HR

CS = LBS / MILLION BTu = .138 LBS/ BTu e6

ALLOWABLE = 36.78 LBS/HR

= .200 LBS/ BTu e6

EMISSION CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-2
DATE : 02-08-91

	SAMPLES		BLANKS	
	FILTER	BEAKER	FILTER	ACETONE
NO. :	3748	216	3750	209
FINAL:	.7412	75.3141	.6420	76.3019
TARE :	.6415	75.308	.6418	76.3009
NET :	.0997	.0061	.0002	.0010/200ML

VOLUME OF RINSE 280

WEIGHT = 105.80
RESIDUE = - 1.40

Mn = 104.40 Mg AS = 44.2 SQ FT

Qs = 3600(1-BWO)(VS)(AS)(17.64)(PS)/(TS) = 4099939 DSCFH

CS = (2.205 X 10-6) (Mn) / (VM STD) = 7.176e-6 LBS/SCF

CS' = 0.0154 (Mn) / (VM STD) = .05 GRAINS /SCF

PMR = (QS) (CS) = 29.42 LBS/HR

LOAD= MILLIONS OF BTU / HOUR INPUT = 188.5 BTU e6 / HR

CS = LBS / MILLION BTu = .156 LBS/ BTu e6

ALLOWABLE = 37.70 LBS/HR

= .200 LBS/ BTu e6

EMISSION CALCULATION SHEET

PLANT: OKEELANTA
LOCATION: UNIT 15

RUN #: COMP-3
DATE : 02-08-91

	SAMPLES		BLANKS	
	FILTER	BEAKER	FILTER	ACETONE
NO. :	3749	217	3750	209
FINAL:	.7377	76.5974	.6420	76.3019
TARE :	.6400	76.5901	.6418	76.3009
NET :	.0977	.0073	.0002	.0010/200ML

VOLUME OF RINSE 310

WEIGHT = 105.00
RESIDUE = - 1.55

Mn = 103.45 Mg AS = 44.2 SQ FT

Qs = 3600(1-BWO)(VS)(AS)(17.64)(PS)/(TS) = 3844860 DSCFH

Avg = 4,003,790

CS = (2.205 X 10-6) (Mn) / (VM STD) = 7.418e-6 LBS/SCF

CS' = 0.0154 (Mn) / (VM STD) = .05 GRAINS /SCF

PMR = (QS) (CS) = 28.52 LBS/HR

LOAD= MILLIONS OF BTU / HOUR INPUT = 187.0 BTU e6 / HR

Avg = 186.47

CS = LBS / MILLION BTu = .153 LBS/ BTu e6

ALLOWABLE = 37.40 LBS/HR

= .200 LBS/ BTu e6

APPENDIX VI

NOMENCLATURE SHEETS

NOMENCLATURE SHEET

PARTICULATE EMISSION TEST

Ar	Acetone residue - result of Blank evaporation.
AREA NOZZLE	Area of the nozzle in square feet.
AS	Area of the stack in square feet.
BDL	Below detectable limits
BWO	The amount of moisture in the flue gas.
% CO	Percent of carbon monoxide in the flue gas.
% CO2	Percent of carbon dioxide in the flue gas.
Cp	Pitot tube coefficient.
CS	The concentration in the stack in pounds per standard cubic foot.
Cs'	The concentration in the stack in grains per standard cubic foot.
DELTA H	The meter orifice differential.
DELTA H(ABS)	The meter orifice differential, absolute conditions in inches of mercury.
Dn (IN)	Diameter of the nozzle in inches.
DRY GAS IN	Temperature of the dry gas meter inlet degrees Farenheight.
DRY GAS OUT	Temperature of the dry gas meter outlet degrees Farenheight.
Ds (FT)	Diameter of the stack in feet.
E	The emission rate in pounds per million Btu derived by using F-Factor.
E (Heat Input)	The emission rate in pounds per million Btu derived by use of calculated heat input.
END METER	The dry gas meter reading at the end of the test.
F factor	The theoretical amount of air in dry standard cubic feet (DSCF) needed to combust a million Btu's worth of fuel.

NOMENCLATURE (cont'd)

Filter Catch	The amount of particulate captured on the filter during testing.
INT METER	The dry gas meter reading at the beginning of the test.
Md (DRY)	The dry molecular weight of the flue gas in pounds per pound mole.
MN	The amount of particulate collected by washing the nozzle, probe, and front half of the glassware, reported in milligrams.
MN'	The milligrams of particulate collected minus the blank.
Ms (WET)	Wet or actual molecular weight of the flue gas in pounds per pound mole.
% N2	The percent of nitrogen in the flue gas.
NO PTS	Number of traverse points.
% O2	Percent of oxygen in the flue gas.
P BAR	Barometric pressure at test location.
P STK	Static pressure of the stack in inches of water.
PMR	The emission rate in pounds per hour.
PS (ABS)	Absolute pressure conditions in the stack in inches of mercury.
Qs	The volumetric flow rate of the flue gas in dry standard cubic feet per hour.
SQ ROOT	The square root of each velocity head measurement.
SQRT DELTA P	The average of the square roots of the measured pressure drops.
Stack Temp or TS (`F)	The temperature of the stack in degrees Farenheight.
TS (`R)	The temperature of the stack in degrees Rankine.
T (Hot Box)	Temperature around the filter box, degrees Farenheight.
TM (`F)	Average temperature of the dry gas meter in degrees Farenheight.

NOMENCLATURE (cont'd)

TM (`R)	Average temperature of the dry gas meter in degrees Rankine.
VEL HEAD	The pressure drop measured across the pitot tubes.
VI (TOT)	The amount of water collected in the impingers in milliliters.
VM (CF)	The volume sampled through the dry gas meter in cubic feet.
VM STD	Volume sampled through the dry gas meter corrected to standard conditions.
VS	Velocity of the stack gas in feet per second.
VW STD	The amount of moisture collected, converted to standard cubic feet.
Y	Meter box calibration factor.
o	Sampling time in minutes.

APPENDIX VII

FIELD DATA SHEETS - UNIT OPERATING CONDITIONS

CAPACITY 125,000
INT. FACTOR 100
RUN # 15-1

BOILER # 15

POLLUTION COMPLIANCE TESTING
DATE: 2-8-91
TESTED BY: Eastmount Eng

TIME	STEAM INTERGRATOR	OIL METER NORTH	OIL METER SOUTH	STEAM PRESS.	STEAM TEMP.	CHART READING LBS/HR.	FEED WATER PRESS.	FEED WATER TEMP.
AM 8:40	804921	25353	493800	355	640	88,000	600	260°
8:55	805154			350	650	85,000	680	"
9:10	805384			355	640	88,000	700	"
9:25	805604			355	640	85,000	700	"
9:45	805914	25353	493800	353	640	88,000	700	"
		None	None					

BOILER PRESSURE DROP

OVERFIRE AIR PRESS.	29	29	29	29	28
AIR HEATER AIR OUT	3.5	3.8	3.5	3.8	3.5
UNDERGRATE AIR PRESS.	.20	.20	.20	.20	.20
WIND BOX PRESSURE	[illegible]	0	.10	.10	.10
FURNACE PRESSURE	.20	.20	.20	.20	.20
BLR. OUTLET PRESSURE	—	—	—	—	—
DUST COLLECTOR OUT.	—	—	—	—	—
SCRUBBER DIFF.	17"	17	17	17	17

BOILER TEMPERATURE

BOILER OUTLET					
AIR HEATER GAS OUT	410	410	410	400	
AIR HEATER AIR OUT					
I.D. FAN					
S.H. STEAM TEMP.	640	650	640	640	

PANEL SETTINGS

FURNACE PRESSURE	90
F.D. FAN PRESSURE	100
BAGASSE FEED	30
UNDERGRATE AIR	22
OVERFIRE AIR	Elec

TEST RESULTS

OIL USED	None	GALS.
TOTAL TEST TIME	65	MINS.
INTERGATOR TIME	995	COUNT
INTERGRATOR STEAM	91,662	P.P.H
CHART READING	434,000	TOTAL
CHART AVERAGE	86,800	P.P.H.
I.D. FAN TURBINE	4800	RPM
STACK TEMPERATURE	144	°F
GRATE TEMPERATURE	690	°F
SCRUBBER WATER	800	G.P.M.

COMMENTS:

	"A"	"B"	
(1) Mill speed	80	80	F.P.M.

(2) using no oil burner

Allowed =

Actual =

PLANT READINGS BY [signature]

% OF CAPACITY

CAPACITY 125,000
INT. FACTOR 100
RUN # 15-2

BOILER # 15

POLLUTION COMPLIANCE TESTING
DATE: 2-8-91
TESTED BY: Eastmount EAS

TIME	STEAM INTERGRATOR	OIL METER North	OIL METER South	STEAM PRESS.	STEAM TEMP.	CHART READING LBS/HR.	FEED WATER PRESS.	FEED WATER TEMP.
AM 11:40	807662	25353	493808	356	640	85,000	690	260
11:55	807895			359	640	85,000	700	"
PM 12:10	808136			347	640	90,000	660	"
12:25	808357			356	650	85,000	700	"
12:45	808680	25353	493808	346	640	88,000	660	"
		None	None					

BOILER PRESSURE DROP

OVERFIRE AIR PRESS.	29	29	28	29	28
AIR HEATER AIR OUT	3.8	3.8	3.5	3.8	3.5
UNDERGRATE AIR PRESS.	.10	.10	.10	.10	.15
WIND BOX PRESSURE	.05	0	0	0	.10
FURNACE PRESSURE	.20	.20	.20	.25	.20
BLR. OUTLET PRESSURE	—	—	—	—	—
DUST COLLECTOR OUT.	—	—	—	—	—
SCRUBBER DIFF.	17	17	17	17	17

BOILER TEMPERATURE

BOILER OUTLET					
AIR HEATER GAS OUT	410	410	410	400	
AIR HEATER AIR OUT					
I.D. FAN					
S.H. STEAM TEMP.	640	640	640	650	

PANEL SETTINGS

FURNACE PRESSURE	90
F.D. FAN PRESSURE	100
BAGASSE FEED	30
UNDERGRATE AIR	22
OVERFIRE AIR	Elec.

TEST RESULTS

OIL USED	None	GALS.
TOTAL TEST TIME	65	MINS.
INTERGATOR TIME	1018	COUNT
INTERGRATOR STEAM	93,969	P.P.H.
CHART READING	433,000	TOTAL
CHART AVERAGE	86,600	P.P.H.
I.D. FAN TURBINE	4800	RPM
STACK TEMPERATURE	145	°F
GRATE TEMPERATURE	650	°F
SCRUBBER WATER	800	G.P.M.

COMMENTS:

"A" "B"
(1) Mill speed 80 80 F.P.M.
(2) using no oil burner
(3) calibrated S.H. & drum press on chart

SH	Drum
356	389
359	399
347	353
356	390
346	360

Allowed =

Actual =

PLANT READINGS BY [illegible]

% OF CAPACITY

CAPACITY 125,000
INT. FACTOR 100
RUN # 15-3

BOILER # 15

POLLUTION COMPLIANCE TESTING
DATE: 2-8-91
TESTED BY: Eastmount Eng

TIME	STEAM INTERGRATOR	OIL METER North	OIL METER South	STEAM PRESS.	STEAM TEMP.	CHART READING LBS/HR.	FEED WATER PRESS.	FEED WATER TEMP.
1:25	809299	49	25353 / 493808	353	650	88,000	680	260°
Stop 1:29	809348	"B"	Mill	Stop-				
Start 1:40	809528	25353	493808	356	640	85,000	700	"
1:55	809771			352	640	85,000	680	"
2:10	810009	947		348	630	88,000	700	"
2:25	810243			356	640	85,000	690	"
2:40	810475	25353	493808	356	630	88,000	690	"

BOILER PRESSURE DROP

OVERFIRE AIR PRESS.	29	28	28	28	28
AIR HEATER AIR OUT	3.8	3.5	3.5	3.5	3.5
UNDERGRATE AIR PRESS.	.15	.15	.15	.15	.15
WIND BOX PRESSURE	.10	0	.05	.05	0
FURNACE PRESSURE	.25	.20	.20	.25	.20
BLR. OUTLET PRESSURE	—	—	—	—	—
DUST COLLECTOR OUT.	—	—	—	—	—
SCRUBBER DIFF.	17	17	17	17	17

BOILER TEMPERATURE

BOILER OUTLET					
AIR HEATER GAS OUT	400	410	410	410	400
AIR HEATER AIR OUT					
I.D. FAN					
S.H. STEAM TEMP.	640	640	630	640	630

PANEL SETTINGS

FURNACE PRESSURE	90
F.D. FAN PRESSURE	100
BAGASSE FEED	30
UNDERGRATE AIR	22
OVERFIRE AIR	Elec

TEST RESULTS

OIL USED	None	GALS.
TOTAL TEST TIME	64	MINS.
INTERGATOR TIME	996	COUNT
INTERGRATOR STEAM	93,375	P.P.H
CHART READING	431,000	TOTAL
CHART AVERAGE	86,800	P.P.H.
I.D. FAN TURBINE	4806	RPM
STACK TEMPERATURE	144	°F
GRATE TEMPERATURE	650	°F
SCRUBBER WATER	800	G.P.M.

COMMENTS:

	"A"	"B"	
(1) Mill speed	80	80	F.P.M.

(2) Using no oil burner
(3) Restart test with B Mill down.
(4) B Mill started @ 2:00 PM

Drum	SHOP	
385	365	20
380	355	25
382	358	24
375	350	25
370	340	30
362	340	22
365	343	18

Allowed =

Actual =

PLANT READINGS BY George Delaro

% OF CAPACITY

BAILEY RECORDER
Integrator
Off
On
Meter No.
Date
FEB 8 - 1991
BAILEY METER COMPANY
CLEVELAND, OHIO
Chart No.
30
PRESSURE
RATE OF FLOW
LEVEL
NOON
6 AM

APPENDIX VIII

FIELD DATA SHEETS - STACK TESTING

FIELD DATA SHEET

GENERAL INFORMATION

Plant:	OKEELANTA	Run #:	COMP-1
Location:	UNIT 15	Date:	8 FEB 91
Ds (ft):	7.5	No. Points:	24
Dn (in):	.305	Test Length:	60 min
Filter #:	3746	End Meter Reading:	008.464
Cp:	.84	Int Meter Reading:	963.157
P bar:	30.08	Begin Time:	08:40
P stack:	.2	End Time:	09:45
IMP-1 (INT)	100 ML	IMP-1 (FINAL)	293
IMP-2 (INT)	100 ML	IMP-2 (FINAL)	137
IMP-3 (INT)	0 ML	IMP-3 (FINAL)	3.0
IMP-4 (INT)	500.0g	IMP-4 (FINAL)	517.0

	TEST 1	TEST 2	TEST 3
% CO2	11.4		
% O2	8.8		
% CO	0		

Project Director:	S. MacKay	Field Laboratory:	MacKay/Wescott
Meter Box Operator:	M. Wescott	Chain of Custody:	S. MacKay
Probe Operator:	J. Jardin	Plant Coordinator:	G. Devane
Orsat Analyst:	S. MacKay	Agency Rep:	

Comments:

Eastmount Engineering, Inc. 420 Main Street, Walpole, MA 02081

FIELD DATA SHEET

TRAVERSE POINT INFORMATION

Page 1 of 2 | Sampling time per point: 2.5

Plant: OKEE/ANTA | Run #: COMP-1

Location: UNIT 15 | Date: 8 FEB 91

O_2%	Trav. No.	Delta P	Delta H	Meter Reading	DGM In	DGM Out	Hot Box	Impg Temp	Stack Temp	Vac
				963.157						
	A1	.05	.305	963.875	76	75	267	63	142	1.0
9.0	2	.07	.43	964.68	77	76	267	59	141	1.0
	3	.10	.61	965.62	78	76	266	58	144	1.0
8.6	4	.11	.67	966.635	79	77	267	57	145	1.0
	5	.14	.85	967.725	79	77	265	57	144	1.0
8.2	6	.15	.92	968.90	80	77	270	57	145	1.0
	7	.42	3.18	970.92	83	78	270	57	144	2.5
8.8	8	.55	3.54	973.19	85	78	269	58	144	3.0
	9	.67	4.1	975.67	87	79	269	60	144	5.5
8.8	10	.78	4.76	978.41	89	80	269	61	144	8.0
	11	.82	5.00	981.29	90	80	269	59	143	9.5
9.4	12	.80	4.9	984.121	92	81	270	59	143	9.5

Comments: DELTA P * 6.1 = DELTA H
BOX # 4 ; Y = 1.001 , DELTA H @ 2.03
START TIME : 08:40
STOP TIME : 09:45
INITIAL LEAK CHECK Dead AT 15 INCHES HG
FINAL LEAK CHECK .0 AT 10.5 INCHES HG
Mid Leak Check: Dead at 9.5 inches HG
Pitot Leak check: Dead at 7.7 inches H_2O

FIELD DATA SHEET

TRAVERSE POINT INFORMATION

Page 2 of 2 | Sampling time per point: 2.5

Plant: OKEELANTA | Run #: comp-1

Location: UNIT 15 | Date: 8 FEB 91

O_2%	Trav. No.	Delta P	Delta H	Meter Reading	DGM In	DGM Out	Hot Box	Impg Temp	Stack Temp	Vac
				984.442						
	1	.88	5.1	987.225	87	81	266	57	144	9.0
9.0	2	.93	5.7	990.105	93	83	267	59	144	10.5
	3	.93	5.7	992.915	94	84	265	61	144	10.5
8.8	4	.86	5.25	995.715	95	84	264	63	144	10.5
	5	.69	4.21	998.38	95	85	265	64	144	9.5
9.0	6	.55	3.36	000.05	95	86	266	66	143	9.0
	7	.20	1.22	002.82	93	86	266	61	144	3.0
8.4	8	.14	.85	004.04	91	86	265	57	145	1.0
	9	.13	.79	005.145	89	85	267	57	144	1.0
8.8	10	.13	.79	006.225	87	85	264	56	144	1.0
	11	.14	.85	007.355	86	84	264	57	144	1.0
9.0	12	.14	.85	008.464	86	84	263	56	144	1.0

Comments: DELTA P = .61 = DELTA H
BOX # 4 ; Y = 1.001 , DELTA H @ = 2.03
START TIME : _____
STOP TIME : _____
INITIAL LEAK CHECK Dead AT 15 INCHES HG
FINAL LEAK CHECK Dead AT 10.5 INCHES HG
Midpt Leak check Dead at 10.5 inches HG
Pitot Leak check dead at

FIELD DATA SHEET

GENERAL INFORMATION

Plant:	OKEELANTA	Run #:	COMP-2
Location:	UNIT 15	Date:	8 FEB 91
Ds (ft):	7.5	No. Points:	24
Dn (in):	.257	Test Length:	60 MIN
Filter #:	3748	End Meter Reading:	41.46
Cp:	.84	Int Meter Reading:	8.854
P bar:	30.08	Begin Time:	11:40
P stack:	.2	End Time:	12:45
IMP-1 (INT)	100 ML	IMP-1 (FINAL)	255
IMP-2 (INT)	100 ML	IMP-2 (FINAL)	121
IMP-3 (INT)	0 ML	IMP-3 (FINAL)	1.0
IMP-4 (INT)	500.00	IMP-4 (FINAL)	509.7

	TEST 1	TEST 2	TEST 3
% CO2	11.2		
% O2	9.0		
% CO	0		

Project Director:	S. MACKAY	Field Laboratory:	MACKAY / WESCOTT
Meter Box Operator:	M. WESCOTT	Chain of Custody:	S. MACKAY
Probe Operator:	J. JARDIN	Plant Coordinator:	G. DEVANE
Orsat Analyst:	S. MACKAY	Agency Rep:	K. TUCKER

Comments:

Eastmount Engineering, Inc. 420 Main Street, Walpole, MA 02081

FIELD DATA SHEET

TRAVERSE POINT INFORMATION

Page 2 of 2 | Sampling time per point: 2.5 min/pt

Plant: Okeelanta | Run #: Comp-2

Location: Unit #15 | Date:

	Trav. No.	Delta P	Delta H	Meter Reading	DGM In	DGM Out	Hot Box	Impg Temp	Stack Temp	Vac
				024.652						
	1	.73	2.41	026.30	83	77	264	63	140	2.5
8.8	2	.93	3.07	028.445	84	78	263	62	143	3.0
	3	.98	3.23	030.55	86	79	264	63	146	3.5
	4	.91	3.00	032.635	87	79	267	63	138	3.5
8.4	5	.77	2.54	034.615	88	80	265	65	141	3.0
	6	.52	1.72	036.285	88	81	263	65	143	2.0
9.3	7	.19	0.63	037.335	86	81	261	63	143	1.0
	8	.15	0.50	038.185	86	82	261	56	142	1.0
9.0	9	.13	0.43	038.880	84	81	258	53	142	1.0
	10	.14	0.46	039.795	84	81	260	50	143	1.0
	11	.13	0.43	040.595	84	82	259	50	142	1.0
8.4	12	.14	0.46	041.415	83	82	258	50	141	1.0

Comments: DELTA P * 3.3 = DELTA H
BOX # _____ ; Y = _____ , DELTA H @ _____
START TIME : _____
STOP TIME : _____
INITIAL LEAK CHECK _____ AT _____ INCHES HG
FINAL LEAK CHECK _____ AT _____ INCHES HG

FIELD DATA SHEET

TRAVERSE POINT INFORMATION

Page 1 of 2 — Sampling time per point: 2.5 min/pt

Plant: Okaloosa — Run #: Comp-2

Location: Unit #15 — Date: 8 FEB 91

	Trav. No.	Delta P	Delta H	Meter Reading	DGM In	DGM Out	Hot Box	Impg Temp	Stack Temp	Vac
H				008.854						
	1	.06	.398	009.615	71	71	265	68	141	1.0
9.4	2	.08	.26	010.29	72	71	264	61	143	1.0
	3	.09	.30	010.965	72	71	265	62	146	1.0
9.4	4	.12	.39	011.745	73	71	266	62	145	1.0
	5	.14	.46	012.59	73	71	267	62	146	1.0
9.0	6	.20	.66	013.565	75	72	267	62	145	1.0
	7	.44	1.45	015.035	76	73	270	60	145	1.0
9.2	8	.59	1.95	016.775	78	73	265	60	146	1.5
	9	.69	2.27	018.595	80	74	265	60	145	1.5
9.2	10	.82	2.71	020.58	82	74	270	61	145	2.5
	11	.80	2.64	022.555	83	75	268	62	145	2.5
9.3	12	.79	2.61	024.512	84	76	263	62	146	2.5

Comments: DELTA P = 3.3 = DELTA H
BOX # 4 ; Y = 1.001 , DELTA H @ = 2.03
START TIME : 11:40
STOP TIME : 12:45
INITIAL LEAK CHECK dead AT 15.0 INCHES HG
FINAL LEAK CHECK 0 AT 4 INCHES HG
Midpt Leak check dead at 2.5" Hg.
Pitot Leak check dead at 6.5" H_2O

FIELD DATA SHEET

GENERAL INFORMATION

Plant:	OKEELANTA	Run #:	comp-3
Location:	UNIT 5	Date:	8 FEB 91
Ds (ft):	7.5	No. Points:	24
Dn (in):	.257	Test Length:	60 min
Filter #:	3749	End Meter Reading:	73,105
Cp:	.84	Int Meter Reading:	41.665
P bar:	30.08	Begin Time:	13:25
P stack:	.2	End Time:	14:40
IMP-1 (INT)	100 ml	IMP-1 (FINAL)	245
IMP-2 (INT)	100 ml	IMP-2 (FINAL)	130
IMP-3 (INT)	0 ml	IMP-3 (FINAL)	2.0
IMP-4 (INT)	500.00	IMP-4 (FINAL)	511

	TEST 1	TEST 2	TEST 3
% CO2	11.1		
% O2	9.1		
% CO	0		

Project Director:	S. MacKay	Field Laboratory:	MacKay/Wescott
Meter Box Operator:	M. Wescott	Chain of Custody:	S. MacKay
Probe Operator:	J. Jardin	Plant Coordinator:	G. Devane
Orsat Analyst:	S. MacKay	Agency Rep:	K. Tucker

Comments:

FIELD DATA SHEET

TRAVERSE POINT INFORMATION

Page 1 of 2 | Sampling time per point: 2.5 min/pt

Plant: Okeelanta | Run #: Comp-3

Location: Unit #15 | Date:

	Trav. No.	Delta P	Delta H	Meter Reading	DGM In	DGM Out	Hot Box	Impg Temp	Stack Temp	Vac
				41.665						
	1	.04	.14	42.145	77	77	264	68	141	1.0
Stopped Test at 1329 Resumed 1340	2	.06	.21	42.722	77	77	265	67	140	1.0
9.8	3	.07	.25	43.352	78	77	264	66	142	1.0
	4	.10	.35	44.07	78	77	262	65	141	1.0
9.6	5	.10	.35	44.812	79	78	265	64	142	1.0
	6	.12	.42	45.615	79	79	266	63	141	1.0
8.7	7	.15	.53	46.495	80	78	264	63	142	1.0
	8	.40	1.41	47.955	81	79	266	62	141	1.5
9.2	9	.55	1.93	49.645	83	79	269	62	142	2.5
	10	.70	2.47	51.555	85	79	269	63	141	3.5
	11	.75	2.73	53.582	86	80	270	63	142	4.5
9.6	12	.78	2.73	55.566	87	80	268	64	142	4.5

Comments: DELTA P = 5.5 = DELTA H
BOX # 4 ; Y = 1.001 , DELTA H @ = 2.03
START TIME : 1325
STOP TIME : 1440
INITIAL LEAK CHECK dead AT 15 INCHES HG
FINAL LEAK CHECK _____ AT _____ INCHES HG
Pitot leak check : dead at 7.5 inches H_2O

B mill down 5 minutes into Test

FIELD DATA SHEET

TRAVERSE POINT INFORMATION

Page 2 of 2 | Sampling time per point: 2.5

Plant: OKEELANTA | Run #: COMP-3

Location: UNIT 15 | Date: 8 FEB 91

	Trav. No.	Delta P	Delta H	Meter Reading	DGM In	DGM Out	Hot Box	Impg Temp	Stack Temp	Vac
				55.715						
	1	.85	2.98	57.775	85	80	245	64	142	5.0
8.6	2	.92	3.22	59.88	81	88	270	64	143	6.0
	3	.91	3.2	62.01	82	89	269	64	145	6.0
8.8	4	.88	3.1	64.0	82	90	263	64	144	6.0
	5	.70	2.45	66.045	83	91	252	65	144	5.0
8.8	6	.51	1.79	67.765	83	90	250	65	144	3.5
	7	.19	.67	69.545	83	88	260	64	143	1.0
9.2	8	.13	.46	69.675	83	87	264	60	143	1.0
	9	.14	.50	70.535	83	85	269	55	143	1.0
8.8	10	.14	.50	71.40	86	83	270	54	142	1.0
	11	.14	.50	72.27	85	83	270	55	143	1.0
	12	.13	.46	73.105	85	83	270	55	143	1.0

Comments: DELTA P = 3.5 = DELTA H
BOX # _____ ; Y = _____ , DELTA H @ _____
START TIME : _____
STOP TIME : _____
INITIAL LEAK CHECK _____ AT _____ INCHES HG
FINAL LEAK CHECK _____ AT _____ INCHES HG
Midpt leak check dead at 4.5" HG.

APPENDIX IX

EQUIPMENT CALIBRATION SHEETS

POST
METER BOX CALIBRATION SHEET

BOX #: 4 DATE: 2-11-91
PRES BAR: 30.02 VACUUM: 10IN HG

RUN #	VOLUME WET	VOLUME DRY	DELTA H	DELTA H /13.6	PRES BAR (ABS)	TIME (MINS)
1	10.00	10.089	1.95	.143	30.16	13.39
2	10.00	10.353	1.95	.143	30.16	13.73
3	10.00	10.333	1.95	.143	30.16	13.73

RUN #	TEMP WET (`F)	TEMP DRY INLET	TEMP DRY OUT	TEMP DRY (AVG)	Y	DELTA H @
1	65.0	85.7	80.0	82.8	1.020	1.87
2	65.0	87.7	81.7	84.7	.9973	1.96
3	65.0	88.7	82.3	85.5	1.001	1.96
				AVERAGE	1.006	1.93

PRE CAL Y = 1.0010 % DIFFERENCE = .50 %

ALLOWABLE = 5.00 %

FORMULAS:

Y=

$$\frac{(V\ w)\ (P\ b)\ (T\ d)}{(V\ d)\ (P\ b\ \ ABS)\ (T\ w)}$$

DELTA H @=

$$\frac{0.0317\ (DELTA\ H)}{(P\ b)\ (T\ d)} * \left[\frac{(T\ w)\ (TIME)}{(V\ w)}\right]^2$$

CALIBRATION BY: S. MacKAY

METER BOX CALIBRATION SHEET

BOX NUMBER: 4
PRESS BAR : 30.04

DATE: 10 SEPT 1990
DUE: 10 MAR 1991

RUN #	VOLUME WET	VOLUME DRY	DELTA H	DELTA H /13.6	PRES BAR (ABS)	TIME (MINS)
1	5	5.037	.50	.0368	30.08	13.80
2	5	5.043	1.00	.0735	30.11	9.55
3	10	10.190	1.50	.1103	30.15	15.34
4	10	10.273	2.00	.1471	30.19	13.46
5	10	10.330	3.00	.2206	30.26	11.69
6	10	10.400	4.00	.2941	30.33	9.64

RUN #	TEMP WET (°F)	TEMP DRY INLET	TEMP DRY OUT	TEMP DRY (AVG)	Y	DELTA H @
1	69.3	82.3	77.3	79.8	1.011	2.09
2	69.7	83.7	78.3	81.0	1.010	2.00
3	70.0	86.7	80.3	83.5	1.003	1.93
4	70.0	89.3	82.7	86.0	.9979	1.97
5	69.3	91.7	83.3	87.5	.9940	2.21
6	69.0	94.7	85.3	90.0	.9900	1.99
				AVERAGE	1.001	2.03

MAX % DEVIATION 1.10
ALLOWABLE % DEV 2.00

FORMULAS:

Y=

$$\frac{(V\ w)(P\ b)(T\ d)}{(V\ d)(P\ b\ \ ABS)(T\ w)}$$

DELTA H @=

$$\frac{0.0317\ (DELTA\ H)}{(P\ b)(T\ d)} * \left[\frac{(T\ w)(TIME)}{(V\ w)}\right]^2$$

CALIBRATION BY: From Computer Disk BCH 12-Feb-90

SCOTT LAWTON

THERMOCOUPLE CALIBRATION SHEET

SET #: METER BOX #4 - IN DATE: 9/11/85

STANDARD ('F)	THERMOCOUPLE ('F)	% DIFFERENCE
32	27	1.02
63	57	1.15
204	201	.45
	MAXIMUM	1.15
	ALLOWABLE	1.50

SET #: METER BOX #4 - OUT DATE: 9/11/85

STANDARD ('F)	THERMOCOUPLE ('F)	% DIFFERENCE
32	27	1.02
63	57	1.15
204	202	.30
	MAXIMUM	1.15
	ALLOWABLE	1.50

CALIBRATION BY: C. LODI

CARL POE CO., INC. 99 REINERMAN ST. • HOUSTON, TEXAS 77007 • 713-861-3816

February 19, 1990

Eastmount Engineering
420 Main
Walpole, MA 02081

Dear Sirs:

This is to certify that your AL-19 American Wet Test Meter, serial no.P-468, has been calibrated with an American five foot bell prover, serial no. 2260. It is traceable to the Bureau of Standards, reference no. 106870, PI-TAPE.

Test Results are as follows:

FLOW RATE	% OF ERROR
60 CFH	+0.3%
30 CFH	0.0%
15 CFH	0.0%

Sincerely,

CARL POE CO., INC.

Carl W. Poe
CWP/mp

THERMOCOUPLE CALIBRATION SHEET

SET #: 8'-1 DATE: 10-25-85

REFERENCE MERCURY/GLASS

STANDARD ('F)	THERMOCOUPLE ('F)	ABSOLUTE OF % DEVIATION
74	72	.37
210	205	.75
400	409	1.05
	MAXIMUM DEVIATION	1.05
	ALLOWABLE	1.50

SET #: 8.5'-1 DATE: 11-15-85

STANDARD ('F)	THERMOCOUPLE ('F)	ABSOLUTE OF % DEVIATION
66	63	.57
170	170	0
211.5	215	.52
	MAXIMUM DEVIATION	.57
	ALLOWABLE	1.50

CALIBRATION BY: G. ZWILLING

NOZZLE CALIBRATION SHEET

PROJECT NAME: OKEELANTA PROJECT NUMBER: 90 102

POINT#	NOZZLE# 1/64-1	NOZZLE # 1/4-2	NOZZLE# ____	NOZZLE # ____
1	.305	.256	____	____
2	.305	.258	____	____
3	.305	.257	____	____
AVG.	.305	.257	____	____

SEAN MACKAY 3 DEC 90

CALIBRATED BY: DATE:

NOZZLE CALIBRATION SHEET

PROJECT NAME: OKEELANTA PROJECT NUMBER: 90-102

POINT#	NOZZLE# 5/16-3	NOZZLE # 5/16-14	NOZZLE# 1/4-3	NOZZLE # 1/4-1
1	.316	.313	.251	.250
2	.314	.312	.249	.251
3	.315	.311	.250	.251
AVG.	.315	.312	.250	.251

Sean MacKay 3 DEC 90

CALIBRATED BY: DATE:

APPENDIX X

BOILER NO. 15 STEAM FLOW HYPOTHESIS

ALSHAIN
ASSOCIATES, INC.
ENGINEERS, CONSULTANTS

February 18, 1991

Mr. Sean M. MacKay
Environmental Engineer
Eastmount Engineering, Inc.
420 Main Street
Walpole, MA 02081

Dear Mr. MacKay:

The engineering calculations handed to you on Friday, February 8, were made in an effort to independently determine the actual steam flow from Okeelanta's Boiler Unit No. 15 during the stack emisssions test conducted on that date.

Based on plant instrumentation, the measured feedwater flow to Unit No. 15, and the bagasse feeder settings it appeared that the plant's steam flow indicator for Unit No. 15 was reading considerably lower than the actual steam flow. After a complete on-line check of all of the instrumentation in the steam flow measurement system determined that there was nothing wrong with the operation or calibration of any of this equipment, it was judged that the only possible cause for the low steam flow indication must be a problem with the orifice plate located in Unit 15's superheater outlet piping. We were advised that this orifice plate had been installed approximately 10 years ago. It is conceivable that during this decade of operation normal erosion has increased the area of the hole in the orifice plate, and this change in area has caused the erroneous flow measurement. This, of course, is conjecture at this time, since the orifice plate cannot be inspected without a plant shutdown.

We suggested the possibility of using the boiler's superheater pressure drop as a direct indication of steam flow. It is a standard requirement when designing superheaters to calculate the steamside pressure drop using empirical formulas that are based on extensive test data obtained over many years of testing. All boiler designer/manufacturers have developed their own unique empirical calculating methods to determine superheater pressure drop as a function of steam flow. Notwithstanding different formula constants and exponents, all of these empirical calculations accurately

P.O. Box 73
Reading, Pa. 19603 • 0073
(215) 926 • 6322

ALSHAIN
ASSOCIATES, INC.
ENGINEERS, CONSULTANTS

predict, within very close agreement, the same pressure drop for a certain steam flow. In other words, after many years of testing and the development of these empirical formulas, there is really no significant difference in the prediction of superheater pressure drop when using any of the empirical formulas independently developed by the boiler manufacturers.

In evaluating the superheater pressure drop for Unit No. 15, we selected an empirical formula used for many years by Combustion Engineering, Inc. to predict superheater pressure drop in marine boiler superheaters. We used this formula primarily because the superheater arrangement in Unit No. 15 very closely resembles a drainable marine boiler superheater of a vertical design using 3 intermeshed hairpin loops with 4 steam passes.

From our calculations and the actual indicated superheater pressure drop during the emissions testing it appears that the boiler's actual steam flow was above that indicated on the plant's steam flow chart and was in very close agreement with the plant's feedwater flow indicator for Unit No. 15. We thus concluded that the orifice plate must have deteriorated and we recommended to Okeelanta that it be checked and replaced if necessary during the off season.

Very truly yours,

Leonard E. Triggs, P.E.

LET:mb

cc: Mr. Frank Fernandez

SUPERHEATER PRESSURE DROP

$$\Delta P = \frac{(1.2)(4.11)(F^{1.85})(L)(v)}{D^{4.97} \times 10^4}$$

WHERE: F = LB STEAM PER MIN. PER ELEMENT

L = TOTAL LENGTH (ACTUAL + EQUIV) (FT)

v = AVERAGE SPECIFIC VOLUME

D = INTERNAL DIAM (IN)

UNIT Nº 15

2" OD × 0.150 MWT D = 1.7"

$D^{4.97} = 13.974$

$L = [15.3 + 12.229 + 0.401 + 1.0 + 0.401 + 13.729] \times 4$

$L = 172.24'$

33 TUBE HOLES PER PASS

4 PASSES

30 TUBES NOT IN SERVICE

$$\frac{(4)(33) - 30}{4} = 25.5 \text{ TUBES/PASS}$$

AT 120,000 PPH $F^{1.85} = \left(\frac{120{,}000}{60 \times 25.5}\right)^{1.85} = 4030$

DRUM @ 415 PSIG $v = 1.0554$

SHTR @ 380 PSIG / 650°F $v = 1.5646$

$$v_{AVG} = \frac{2.72}{2} = 1.36$$

$$\Delta p = \frac{(1.2)(4.11)(4030)(172)(1.36)}{(13.97)(10^4)} = 33.3 \text{ PSI}$$

$$\Delta p \text{ @ } 95{,}000 \text{ PPH} = \left(\frac{95}{120}\right)^{1.85} \times 33.3 = 21.6 \text{ PSI}$$

$$\Delta p \text{ @ } 110{,}000 \text{ PPH} \left(\frac{110}{120}\right)^{1.85} \times 33.3 = 28.35$$

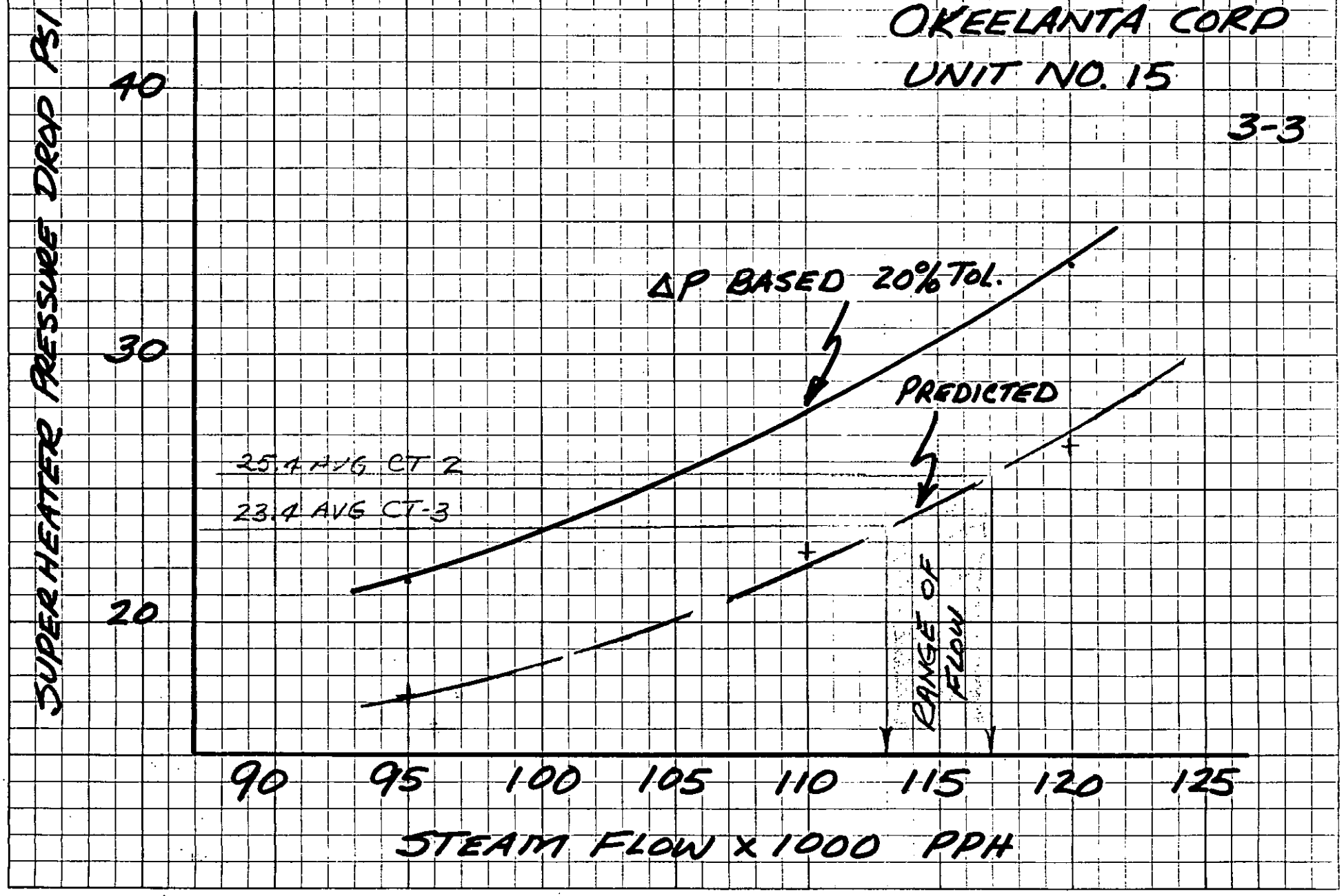
Δp WITHOUT 20% TOL. FACTOR ie 1.2

Δp @ 120,000 = 33.3 × 0.8 = 26.6 PSI

Δp @ 110,000 = 28.35 × 0.8 = 22.7 PSI

Δp @ 95,000 = 21.6 × 0.8 = 17.3 PSI

(LET) FEB 8 1991

OKEELANTA CORP
UNIT NO. 15

3-3