Unit 50 Boiler Efficiency

(2 Oktober 2014)

STEAM GENERATOR PERFORMANCE TEST (INDIRECT METHOD) <u>Calculation</u>

HHV AF at constant pressure	TEST COAL	_ ANALYSIS	Symbol	Units	Calculation
ASH ANALYSIS	HHV AF at o	constant pressure	Hf	Btu/lb	9038.96
Unburned Combustible in Refuse	LHV AF at o	constant pressure	Hfnet	Btu/lb	8364.91
Unburned Combustible in Refuse					
Heating Value in Refuse Hdr' Btu/lb refuse 71.52995 Dry Refuse Wdr' Lb/Lb AF fuel 0.0400 Carbon Burned Cb Lb/Lb AF fuel 0.5434 AIR TEMPERATURE AH Inlet Air Temperature Primary Average Hallet Air Temperature Secondary Average Weighted Average AH Inlet Air Temperature Secondary Average Weighted Average AH Inlet Air Temperature Secondary Average L88 deg F 84.60 L88 deg F 88.65 R88.65	_		,		
Dry Refuse Wdr' Cb Lb/Lb AF fuel 0.0400 Carbon Burned Cb Lb/Lb AF fuel 0.5434 AIR TEMPERATURE Symbol Units Calculation AH Inlet Air Temperature Secondary Average tA8P deg F 84.60 Weighted Average AH Inlet Air Temperature Symbol Units Calculation AH Inlet Gas Temperature Average tG14 deg F 759.15 AH Outlet Gas Temperature Average tG14 deg F 759.15 AH Outlet Gas Temperature Average tG14 deg F 759.15 AH Outlet Gas Temperature Average tG14 deg F 300.07 MOISTURE IN AIR AT FAN INLET Symbol Units Calculation Partial Pressure of Vapor in Wet Air Wma' Lb/Lb dry air 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average Q2 % dry-vol 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2, fg Cu, fg Cu, ft/Lb AF fuel 0.04	Unburned C	combustible in Refuse	Wcr'	% Combustible	0.49331
Carbon Burned Cb Lb/Lb AF fuel 0.5434 AIR TEMPERATURE Symbol Units Calculation AH Inlet Air Temperature Primary Average tA8P deg F 102.84 AH Inlet Air Temperature Secondary Average tA8 deg F 84.60 GAS TEMPERATURE Symbol Units Calculation AH INLET Gas Temperature Average tG14 deg F 300.07 MOISTURE IN AIR AT FAN INLET Symbol Units Calculation Partial Pressure of Vapor in Wet Air PmA in Hg 0.7477 Moisture in Dry Air Symbol Units Calculation Partial Pressure of Vapor in Wet Air Symbol Units Calculation Partial Pressure of Vapor in Wet Air Symbol Units Calculation Partial Pressure of Vapor in Wet Air Symbol Units Calculation Partial Pressure of Vapor in Wet Air Symbol Units Calculation O2 Average O2 % dry-vol 0 The gas anallysis (PTC 19.1) Symbol Units	Heating Val	ue in Refuse	Hdr'	Btu/lb refuse	71.52995
AIR TEMPERATURE AH Inlet Air Temperature Primary Average AH Inlet Air Temperature Secondary Average Weighted Average AH Inlet Air Temperature GAS TEMPERATURE AH Inlet Gas Temperature Average AH Inlet Gas Temperature Average AH Outlet Gas Analysis (PTC 19.1) AH Outlet Gas Analysis (PTC 19.1) ANA INLET GAS ANAL	Dry Refuse		Wdr'	Lb/Lb AF fuel	0.0400
AH Inlet Air Temperature Primary Average AH Inlet Air Temperature Secondary Average Weighted Average AH Inlet Air Temperature GAS TEMPERATURE AH Inlet Gas Temperature Average MOISTURE IN AIR AT FAN INLET Symbol Dunits Calculation PmA in Hg 0.7477 Wma' Lb/Lb dry air 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air Flue gas components O2, fg SO2, fg SO2, fg CO2, fg CO2, fg CO2, fg CU.ft/Lb AF fuel CO2, fg CO2, fg CU.ft/Lb AF fuel T.2878 AX 14 AH OUTLET GAS ANALYSIS (PTC 19.1) O2 Average O2 AV Gry-vol AV AV AH OUTLET GAS ANALYSIS (PTC 19.1) O2 Average O2, fg CO2, fg CO3, fg CU.ft/Lb AF fuel T.2878 AV 14 CAICULATION AND THE MERCE SANALYSIS (PTC 19.1) CA Average O2 CO2 CO2 CO2 CO2 CO2 CO2 CO3 CO4 CO3 CO4 CO4 CO5 CO5 CO5 CO5 CO5 CO5 CO5 CO5 CO6 CO7	Carbon Buri	ned	Cb	Lb/Lb AF fuel	0.5434
AH Inlet Air Temperature Primary Average AH Inlet Air Temperature Secondary Average Weighted Average AH Inlet Air Temperature GAS TEMPERATURE AH Inlet Gas Temperature Average MOISTURE IN AIR AT FAN INLET Symbol Dunits Calculation PmA in Hg 0.7477 Wma' Lb/Lb dry air 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air Flue gas components O2, fg SO2, fg SO2, fg CO2, fg CO2, fg CO2, fg CU.ft/Lb AF fuel CO3, fg CO4, fg CU.ft/Lb AF fuel CO4 CO5 CO5 CO5 CO5 CO5 CO5 CO5 CO6 CO7					
AH Inlet Air Temperature Secondary Average Weighted Average AH Inlet Air Temperature		·····			
Weighted Average AH Inlet Air Temperature tA8 deg F 88.65 GAS TEMPERATURE Symbol Units Calculation AH Inlet Gas Temperature Average tG14 deg F 759.15 AH Outlet Gas Temperature Average tG15 deg F 300.07 MOISTURE IN AIR AT FAN INLET Symbol Units Calculation AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average O2 % dry-vol 0 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 0.000 SO2, fg Cu, fg cu, ft/Lb AF fuel 0.000 SO2, fg CO2, fg cu, ft/Lb AF fuel 0.000 N2, fg N2, fg cu, ft/Lb AF fuel 75.388 Total, fg tot, fg cu, ft/Lb AF fuel 75.388 Total, fg tot, fg cu, ft/Lb AF fuel 92.451 O2 % dry-vol 0.004					
GAS TEMPERATURE Symbol Units Calculation AH Inlet Gas Temperature Average tG14 deg F 759.15 AH Outlet Gas Temperature Average tG15 deg F 300.07 MOISTURE IN AIR AT FAN INLET Symbol Units Calculation Partial Pressure of Vapor in Wet Air PmA in Hg 0.7477 Moisture in Dry Air Symbol Units Calculation AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average O2 % dry-vol 0 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 0.000 SO2, fg CO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg CO2, fg cu.ft/Lb AF fuel 7.2878 N2, fg N2, fg cu.ft/Lb AF fuel 75.388 Total, fg tot, fg cu.ft/Lb AF fuel 75.388 Total, fg tot, fg cu.ft/Lb AF fuel 72.878 AH OUTLET GAS ANALYSIS (PTC 19.1) Symbol				•	
AH Inlet Gas Temperature Average AH Outlet Gas Temperature Average MOISTURE IN AIR AT FAN INLET Partial Pressure of Vapor in Wet Air Moisture in Dry Air AH INLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air Flue gas components O2, fg SO2, fg SO2 SO2 SO2 SO2 SO2 N2 (by difference) N2 (by difference) N2 (by difference) N2 (by difference) N2, fg SO2, fg SO2	Weighted A	verage AH Inlet Air Temperature	tA8	deg F	88.65
AH Inlet Gas Temperature Average AH Outlet Gas Temperature Average MOISTURE IN AIR AT FAN INLET Partial Pressure of Vapor in Wet Air Moisture in Dry Air AH INLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air Flue gas components O2, fg SO2, fg SO2 SO2 SO2 SO2 SO2 N2 (by difference) N2 (by difference) N2 (by difference) N2 (by difference) N2, fg SO2, fg SO2	GAS TEMP	FRATURE	Symbol	Units	Calculation
AH Outlet Gas Temperature Average tG15 deg F 300.07 MOISTURE IN AIR AT FAN INLET Partial Pressure of Vapor in Wet Air PmA in Hg Moisture in Dry Air Symbol Wma' Units Lb/Lb dry air Calculation 0.7477 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) Symbol O2 Werage Units O2 Average Calculation 0.00157 Flue gas components O2, fg O2, fg Cu.ft/Lb AF fuel Ax'14 % 0.000 Flue gas components O2, fg Cu.ft/Lb AF fuel CO2, fg CO2 Mory-vol CO2, fg Cu.ft/Lb AF fuel CO2,		_	,		
MOISTURE IN AIR AT FAN INLET Symbol Units in Hg Calculation Partial Pressure of Vapor in Wet Air Moisture in Dry Air Wma' Lb/Lb dry air 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average Q. % dry-vol 0 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 0.000 Flue gas components O2, fg cu.ft/Lb AF fuel 0.000 SO2, fg CO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg CU.ft/Lb AF fuel 0.046 CO2, fg cu.ft/Lb AF fuel 75.388 Total, fg tot, fg cu.ft/Lb AF fuel 92.451 O2 % dry-vol 0.000 SO2 % dry-vol 0.000 SO2 % dry-vol 0.049 CO2 % dry-vol 18.407 N2 (by difference) N2 % dry-vol 41.543 AH OUTLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation <td></td> <td></td> <td></td> <td></td> <td></td>					
Partial Pressure of Vapor in Wet Air PmA Wma' in Hg Lb/Lb dry air 0.7477 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average O2 % dry-vol 0 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 0.000 Flue gas components O2, fg C02, fg cu.ft/Lb AF fuel 0.000 SO2, fg C02, fg cu.ft/Lb AF fuel 0.046 CO2, fg C02, fg cu.ft/Lb AF fuel 17.018 N2, fg N2, fg cu.ft/Lb AF fuel 75.388 Total, fg tot, fg cu.ft/Lb AF fuel 92.451 O2 % dry-vol 0.000 0.000 SO2 SO2 % dry-vol 0.049 CO2 % dry-vol 18.407 N2 (by difference) N2 % dry-vol 81.543 AH OUTLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average O2, fg cu.ft/Lb AF fuel 7.2878	An Ouliel G	as remperature Average	1015	ueg r	300.07
Partial Pressure of Vapor in Wet Air PmA Wma' in Hg Lb/Lb dry air 0.7477 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average O2 % dry-vol 0 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 0.000 Flue gas components O2, fg C02, fg cu.ft/Lb AF fuel 0.000 SO2, fg C02, fg cu.ft/Lb AF fuel 0.046 CO2, fg C02, fg cu.ft/Lb AF fuel 17.018 N2, fg N2, fg cu.ft/Lb AF fuel 75.388 Total, fg tot, fg cu.ft/Lb AF fuel 92.451 O2 % dry-vol 0.000 0.000 SO2 SO2 % dry-vol 0.049 CO2 % dry-vol 18.407 N2 (by difference) N2 % dry-vol 81.543 AH OUTLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average O2, fg cu.ft/Lb AF fuel 7.2878	MOISTURE	IN AIR AT FAN INLET	Symbol	Units	Calculation
Moisture in Dry Air Wma' Lb/Lb dry air 0.0157 AH INLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation 02 Average 02 % dry-vol 0 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 0.000 Flue gas components O2, fg Cu, ft/Lb AF fuel 0.000 SO2, fg Cu, ft/Lb AF fuel 0.046 CO2, fg Cu, ft/Lb AF fuel 17.018 N2, fg N2, fg cu, ft/Lb AF fuel 75.388 Total, fg tot, fg cu, ft/Lb AF fuel 92.451 O2 % dry-vol 0.000 SO2 % dry-vol 0.000 SO2 % dry-vol 0.000 SO2 % dry-vol 0.000 SO2 % dry-vol 18.407 N2 (by difference) N2 % dry-vol 81.543 AH OUTLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average O2, fg cu, ft			-		
AH INLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air Flue gas components O2, fg SO2, fg CO2, fg CO3, fg CO4, fg CO4, fg CO5, fg CO5, fg CO5, fg CO6, fg CO7, fg CO7, fg CO7, fg CO7, fg CO8, fg CO9, fg CO9, fg CO9, fg CO9, fg CO9, fg CO1, fg CO1, fg CO1, fg CO2, fg CO3, fg CO4, fg CO5, fg CO5, fg CO5, fg CO6, fg CO7, fg CO7, fg CO8, fg CO8, fg CO9 CO9 CO9 CO9 CO9 CO9 CO9 CO		•	Wma'	•	0.0157
O2 Average		•		,	
Theoretical dry air Ao'	AH INLET O	GAS ANALYSIS (PTC 19.1)	Symbol		Calculation
Ax'14	O2 Average	ı	O2	,	0
Flue gas components O2, fg Cu.ft/Lb AF fuel O.000 SO2, fg SO2, fg Cu.ft/Lb AF fuel O.046 CO2, fg CO2, fg Cu.ft/Lb AF fuel T7.018 N2, fg N2, fg Cu.ft/Lb AF fuel T5.388 Total, fg CO2 O2 % dry-vol O.000 SO2 SO2 % dry-vol O.049 CO2 % dry-vol M2 W dry-vol M2 W dry-vol M3.543 W dry-vo	Theoretical	dry air	Ao'	Lb/Lb AF fuel	7.2878
O2, fg O2, fg cu.ft/Lb AF fuel 0.000 SO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg cu.ft/Lb AF fuel 17.018 N2, fg cu.ft/Lb AF fuel 75.388 Total, fg tot, fg cu.ft/Lb AF fuel 92.451 O2 02 % dry-vol 0.000 SO2 502 % dry-vol 18.407 N2 (by difference) N2 % dry-vol 81.543 AH OUTLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air Symbol Units Calculation O2 % dry-vol 4.7855 7.2878 Ac' Lb/Lb AF fuel Ax'14 Calculation O2, fg cu.ft/Lb AF fuel Ax'14 5.739 SO2, fg cu.ft/Lb AF fuel CO2, fg 0.046 CO2, fg cu.ft/Lb AF fuel Total, fg 0.046 CO2, fg cu.ft/Lb AF fuel Total, fg 119.907 O2 % dry-vol 4.786 SO2 % dry-vol 0.038 CO Average co % dry-vol 0.038 CO Average co % dry-vol <td>Excees air</td> <td></td> <td>Ax'14</td> <td>%</td> <td>0.000</td>	Excees air		Ax'14	%	0.000
SO2, fg		Flue gas components			
CO2, fg N2, fg N2, fg N2, fg CO2, fg CU.ft/Lb AF fuel Total, fg CO2		O2, fg	O2, fg	cu.ft/Lb AF fuel	0.000
N2, fg		SO2, fg	SO2, fg	cu.ft/Lb AF fuel	0.046
N2, fg		CO2, fg	CO2, fg	cu.ft/Lb AF fuel	17.018
Total, fg O2 O2 W dry-vol O00 SO2 SO2 SO2 SO2 CO2 N2 (by difference) N2 Symbol O2 W dry-vol A.7855 Theoretical dry air Excees air Av'14 W Sexess air Av'14 Sexes			N2, fg	cu.ft/Lb AF fuel	75.388
O2 % dry-vol 0.000 SO2 SO2 % dry-vol 0.049 CO2 CO2 % dry-vol 18.407 N2 (by difference) N2 % dry-vol 81.543 AH OUTLET GAS ANALYSIS (PTC 19.1) Symbol Units Calculation O2 Average 02 % dry-vol 4.7855 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 28.845 Flue gas components O2, fg cu.ft/Lb AF fuel 5.739 SO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg cu.ft/Lb AF fuel 17.018 N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 % dry-vol 4.786 SO2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 % dry-vol 14.192		Total, fg	tot, fg	cu.ft/Lb AF fuel	92.451
CO2 N2 (by difference) AH OUTLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air O2, fg SO2, fg SO2, fg SO2, fg CO2, fg N2 (by difference) N2 W dry-vol At 7855 Ac' Ac' Lb/Lb AF fuel Ax'14 W CAICUIAtion 7.2878 Ax'14 W CAICUIAtion 7.2878 Ax'14 W CAICUIAtion 7.2878 CAICUIATION 6.00 7.2878 CAICUIATION			O2	% dry-vol	0.000
CO2 N2 (by difference) AH OUTLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air O2, fg SO2, fg SO2, fg SO2, fg CO2, fg N2 (by difference) CO3 N2 (by dry-vol Ac' Lb/Lb AF fuel Ax'14 N2 (by Cu.ft/Lb AF fuel CO2, fg CO2, fg CO3 CO4 CO5		SO2	SO2	•	0.049
N2 (by difference) N2 % dry-vol 81.543 AH OUTLET GAS ANALYSIS (PTC 19.1) Symbol o2 Units Calculation O2 Average 02 % dry-vol 4.7855 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 28.845 Flue gas components O2, fg cu.ft/Lb AF fuel 5.739 SO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg co2, fg cu.ft/Lb AF fuel 17.018 N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 % dry-vol 14.192		CO2	CO2	•	18.407
AH OUTLET GAS ANALYSIS (PTC 19.1) O2 Average Theoretical dry air Excees air O2, fg SO2, fg SO2, fg SO2, fg SO2, fg CO2, fg CO2, fg CO2, fg CO3, fg CO4 CO5		N2 (by difference)	N2	•	
O2 Average 02 % dry-vol 4.7855 Theoretical dry air Ao' Lb/Lb AF fuel 7.2878 Excees air Ax'14 % 28.845 Flue gas components O2, fg cu.ft/Lb AF fuel 5.739 SO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg co2, fg cu.ft/Lb AF fuel 17.018 N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 % dry-vol 14.192			<u>.</u> .		
Theoretical dry air Excees air Plue gas components O2, fg SO2, fg CO2, fg N2,			-		
Ax'14					
Flue gas components O2, fg o2, fg cu.ft/Lb AF fuel 5.739 SO2, fg so2, fg cu.ft/Lb AF fuel 0.046 CO2, fg co2, fg cu.ft/Lb AF fuel 17.018 N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192		ary air	-		
O2, fg cu.ft/Lb AF fuel 5.739 SO2, fg cu.ft/Lb AF fuel 0.046 CO2, fg co2, fg cu.ft/Lb AF fuel 17.018 N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192	Excees air	Flue was same secrets	Ax'14	%	28.845
SO2, fg so2, fg cu.ft/Lb AF fuel 0.046 CO2, fg co2, fg cu.ft/Lb AF fuel 17.018 N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192		•	-0.6	6/11 25 6	F 700
CO2, fg co2, fg cu.ft/Lb AF fuel 17.018 N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192		000 (
N2, fg n2, fg cu.ft/Lb AF fuel 97.105 Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192					
Total, fg tot, fg cu.ft/Lb AF fuel 119.907 O2 o2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192					
O2 % dry-vol 4.786 SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192					
SO2 so2 % dry-vol 0.038 CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192		. •	_		
CO Average co % dry-vol 0.001 CO2 co2 % dry-vol 14.192					
CO2 co2 % dry-vol 14.192			so2	•	0.038
		CO Average	со	% dry-vol	0.001
N2 (by difference) n2 % dry-vol 80.982			co2		14.192
		N2 (by difference)	n2	% dry-vol	80.982

Cont'd Page 2/2

GAS AND AIR WEIGHTS	Symbol	Units	Calculation
Dry Gas Entering Air Heater	Wg'14	Lb/Lb AF fuel	7.6275
Dry Gas Leaving Air Heater	Wg'15	Lb/Lb AF fuel	9.7386
Dry Air for Combustion	Wa'	Lb/Lb AF fuel	7.3178
Moisture in Gas Entering Air Heater	Wmg	Lb/Lb AF fuel	0.7570

Wet Gas Entering Air Heater	Wg14	Lb/Lb AF fuel	8.3845	
Wet Gas Leaving Air Heater	Wg15	Lb/Lb AF fuel	10.5288	
Wet Gas for Combustion	Wa	Lb/Lb AF fuel	7.4328	
SPECIFIED HEAT LOSSES				
Radiation loss per PTC4.1, figure 8, page 67	IB	% eff. loss	0.1700	
Unmeasured losses per specification	lum	% eff. loss	0.1700	
HEAT LOSS CALCULATION	Symbol	Units	Calculation	Losses (%)
Dry Gas	LG	Btu/Lb AF fuel	497.6708	5.51
Moisture in Fuel	Lmf	Btu/Lb AF fuel	271.6485	3.01
Combustion of H2 in Fuel	LH	Btu/Lb AF fuel	464.3134	5.14
Moisture in Air	LmA	Btu/Lb AF fuel	11.1478	0.12
Combustible in Refuse	Luc	Btu/Lb AF fuel	2.8646	0.03
Formation of CO	Lco	Btu/Lb AF fuel	0.3716	0.00
Radiation	LB	Btu/Lb AF fuel	15.3662	0.17
Unmeasured losses	Lum	Btu/Lb AF fuel	15.3662	0.17
Total	L	Btu/Lb AF fuel	1278.7492	14.15
MEASURED EFFICIENCY	Symbol	Units	Calculation	
Measured efficiency (HHV)	Eb-hhv	%	85.8529	
Measured efficiency (LHV)	Eb-lhv	%	92.7710	

Unit 60 Boiler Efficiency

(18 Februari 2014)

STEAM GENERATOR PERFORMANCE TEST (INDIRECT METHOD) <u>Calculation</u>

TEST COAL	L ANALYSIS	Symbol	Units	Calculation
HHV AF at	constant pressure	Hf	Btu/lb	8955.74
LHV AF at o	constant pressure	Hfnet	Btu/lb	8299.21
	·			
ASH ANAL	YSIS	Symbol	Units	Calculation
Unburned C	Combustible in Refuse	Wcr'	% Combustible	0.2987
Heating Val	ue in Refuse	Hdr'	Btu/lb refuse	43.3115
Dry Refuse		Wdr'	Lb/Lb AF fuel	0.0236
Carbon Bur	ned	Cb	Lb/Lb AF fuel	0.5240
04.2024		0.2		0.02.0
AIR TEMPE	RATURE	Symbol	Units	Calculation
	Temperature Primary Average	tA8P	deg F	102.61
	Temperature Secondary Average	tA8S	deg F	83.80
	verage AH Inlet Air Temperature	tA8	deg F	88.28
vvoiginou / i	verage / ii / iiilet / iii / emperature	0.10	dog i	00.20
GAS TEMP	FRATURE	Symbol	Units	Calculation
	s Temperature Average	tG14	deg F	757.67
	Sas Temperature Average	tG15	deg F	290.53
Air Ouliet C	as remperature Average	1013	deg i	290.00
MOISTLIDE	IN AIR AT FAN INLET	Symbol	Units	Calculation
	sure of Vapor in Wet Air	PmA	in Hg	0.8487
Moisture in	•	Wma'	•	0.0182
Moisture III	DIY All	vviiia	Lb/Lb dry air	0.0162
AH INI ET (GAS ANALYSIS (PTC 19.1)	Symbol	Units	Calculation
O2 Average		O2	% dry-vol	4.195
Theoretical		Ao'	Lb/Lb AF fuel	6.8354
Excees air	ury an	Ax'14	%	24.515
Excees all	Elua das components	AX 14	70	24.515
	Flue gas components	02 60	ou ft/l b A T fuol	1 575
	O2, fg	O2, fg	cu.ft/Lb AF fuel	4.575
	SO2, fg	SO2, fg	cu.ft/Lb AF fuel	0.039
	CO2, fg	CO2, fg	cu.ft/Lb AF fuel	16.411
	N2, fg	N2, fg	cu.ft/Lb AF fuel	88.014
	Total, fg	tot, fg	cu.ft/Lb AF fuel	109.039
	02	02	% dry-vol	4.196
	SO2	SO2	% dry-vol	0.036
	CO2	CO2	% dry-vol	15.051
	N2 (by difference)	N2	% dry-vol	80.718
ALL CUT! T	T CAS ANALYSIS (DTC 40.4)	Cumak - I	Lleite	Calaulatian
	T GAS ANALYSIS (PTC 19.1)	Symbol	Units	Calculation
O2 Average		02	% dry-vol	4.915
Theoretical	ary air	Ao'	Lb/Lb AF fuel	6.8354
Excees air		Ax'14	%	30.018
	Flue gas components			
	O2, fg	o2, fg	cu.ft/Lb AF fuel	5.602
	SO2, fg	so2, fg	cu.ft/Lb AF fuel	0.039
	CO2, fg	co2, fg	cu.ft/Lb AF fuel	16.411
	N2, fg	n2, fg	cu.ft/Lb AF fuel	91.900
	Total, fg	tot, fg	cu.ft/Lb AF fuel	113.952
	O2	o2	% dry-vol	4.916
	SO2	so2	% dry-vol	0.034
	CO Average	со	% dry-vol	0.002
	CO2	co2	% dry-vol	14.402
	N2 (by difference)	n2	% dry-vol	80.646
-	/	•	•	

Cont'd Page 2/2

GAS AND AIR WEIGHTS	Symbol	Units	Calculation
Dry Gas Entering Air Heater	Wg'14	Lb/Lb AF fuel	8.8871
Dry Gas Leaving Air Heater	Wg'15	Lb/Lb AF fuel	9.2636
Dry Air for Combustion	Wa'	Lb/Lb AF fuel	8.5436
Moisture in Gas Entering Air Heater	Wmg	Lb/Lb AF fuel	0.7805

Wet Gas Entering Air Heater	Wg14	Lb/Lb AF fuel	9.6676	
Wet Gas Leaving Air Heater	Wg15	Lb/Lb AF fuel	10.0509	
Wet Gas for Combustion	Wa	Lb/Lb AF fuel	8.6989	
SPECIFIED HEAT LOSSES				
Radiation loss per PTC4.1, figure 8, page 67	IB	% eff. loss	0.1700	
Unmeasured losses per specification	lum	% eff. loss	0.1700	
HEAT LOSS CALCULATION	Symbol	Units	Calculation	Losses (%)
Dry Gas	LG	Btu/Lb AF fuel	453.5157	5.06
Moisture in Fuel	Lmf	Btu/Lb AF fuel	302.6314	3.38
Combustion of H2 in Fuel	LH	Btu/Lb AF fuel	411.6242	4.60
Moisture in Air	LmA	Btu/Lb AF fuel	14.4081	0.16
Combustible in Refuse	Luc	Btu/Lb AF fuel	1.0209	0.01
Formation of CO	Lco	Btu/Lb AF fuel	0.7222	0.01
Radiation	LB	Btu/Lb AF fuel	15.2248	0.17
Unmeasured losses	Lum	Btu/Lb AF fuel	15.2248	0.17
Total	L	Btu/Lb AF fuel	1214.3720	13.56
MEASURED EFFICIENCY	Symbol	Units	Calculation	
Measured efficiency (HHV)	Eb-hhv	%	86.4403	
Measured efficiency (LHV)	Eb-lhv	%	93.2784	