HEAT RATE MEASUREMENTS THERMAL POWER PLANT NORGENER

Results Heat Rate Measurements Norgener Unit 2

By order of AES Gener Chile

Report no.: 16-0246
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1 EXECUTIVE SUMMARY

Project

In close operation and by order of AES Gener, maximum power test and performance tests at Norgener Unit 2, as per CDEC-SING requirement, have been conducted by DNV GL in the period from the 15th of December 2015 until the 17th of December 2015.

Test procedure, with reference 15-1235, final version Rev.2 dated the 16th of September 2015, which has been agreed by parties involved, has been used as a guideline.

Deviating from the test procedure, on site, parties agreed to minimize the test duration of the heat rate tests from four hours to two hours. The needed time for the traverse measurements of the emissions could be decreased, due to the application of interconnection and combining the installed sample tubes in the ducts upstream and downstream of the air heater. The test duration of two hours still complies with the minimum requirement as per ASME PTC4. The duration of the maximum power test remained to five hours. The result of the maximum power test is reported in a separate document, with reference 74108301 CES/PTM 15-3256.

Also deviating from the test procedure is the introduction of an additional mass and heat balance measurement around the deaerator, to determine the final feed water flow of the boiler. It appeared that the feed water flow measurement down streams the feed water pumps, which was foreseen for the evaluation, is affected by swirl and systematically showing a too high value. For that reason we have used the determined boiler feed water flow, based on the main condensate flow (including additional heat balances of the deaerator and HP heaters I and II), as decisive value for the final evaluation.

Purpose

The purpose of the heat rate test is to determine the variable operating costs for Northern Interconnected Grid (CDEC-SING) as per specification “Procedimiento DO: Informatión de Consumos Especificos” version 3.

Report

In this report the final results are presented of the conducted heat rate tests of Norgener Unit 2. The results are based on the final coal analyse results (100% Signal Peak) and unburned analysis of the fly-ash and bottom-ash. The analysis has been performed by PCM Santiago. As per comment of CDEC-SING during the preparation phase, the fuel properties of the coal have not been applied for correction of the heat rate of the plant.

Final Results

In Table 1 the main final results of the performance test of Unit 2 are presented and a graphical presentation of the net heat rate is given in Figure 1.

For more detail information of the results, we refer to chapter 9 and Appendix F and G.

Table 1 Summary Final Result of Norgener Unit#2 (HHV)

Point Number DNVGL	Performance Test Date Time begin Time end	Unit	100% 15-12-15 09:00 11:00	95% 16-12-15 09:00 11:00	90% 16-12-15 12:45 14:45	80% 17-12-15 09:30 11:30	70% 17-12-15 13:00 15:00	47%/Min 17-12-15 17:00 19:00
	Net Power Plant Corr.							
@0560	Pe Net Power Unit (kWh)	kW	125479	118877	112468	99499	86803	57998
@0561	Pe Aux.Corr.CDEC-SING	kW	128	128	128	128	128	128
@0957	Pe Add.Corr.Power Factor	kW	-361	-327	-295	-238	-184	-90
@0958	Pe Add.Corr.CW Temp.	kW	-191	-197	-65	-246	-235	-295
@0965	Pe Net Power Plant Corr.	kW	125055	118480	112236	99143	86512	57740
	Net Heat Rate Plant Corr.							
@0960	Qc Fuel Consumption Corr.	kJ/s	359445	342946	326338	287887	253696	182883
@0965	Pe Net Power Plant Corr.	kW	125055	118480	112236	99143	86512	57740
@0970	HR Net Heat Rate Plant Corr	kJ/kWh	10347	10420	10467	10454	10557	11402
	Net HR Plant @Standard HHV of 6000 kCal/kg							
@0976	M Coal Corr. HHV (6000)	kg/s	14.31	13.65	12.99	11.46	10.10	7.28
@0965	Pe Net Power Plant Corr.	kW	125055	118480	112236	99143	86512	57740
@0980	HR Net HR Plant (at 6000)	g/kWh	**411.9**	**414.8**	**416.7**	**416.1**	**420.2**	**453.9**

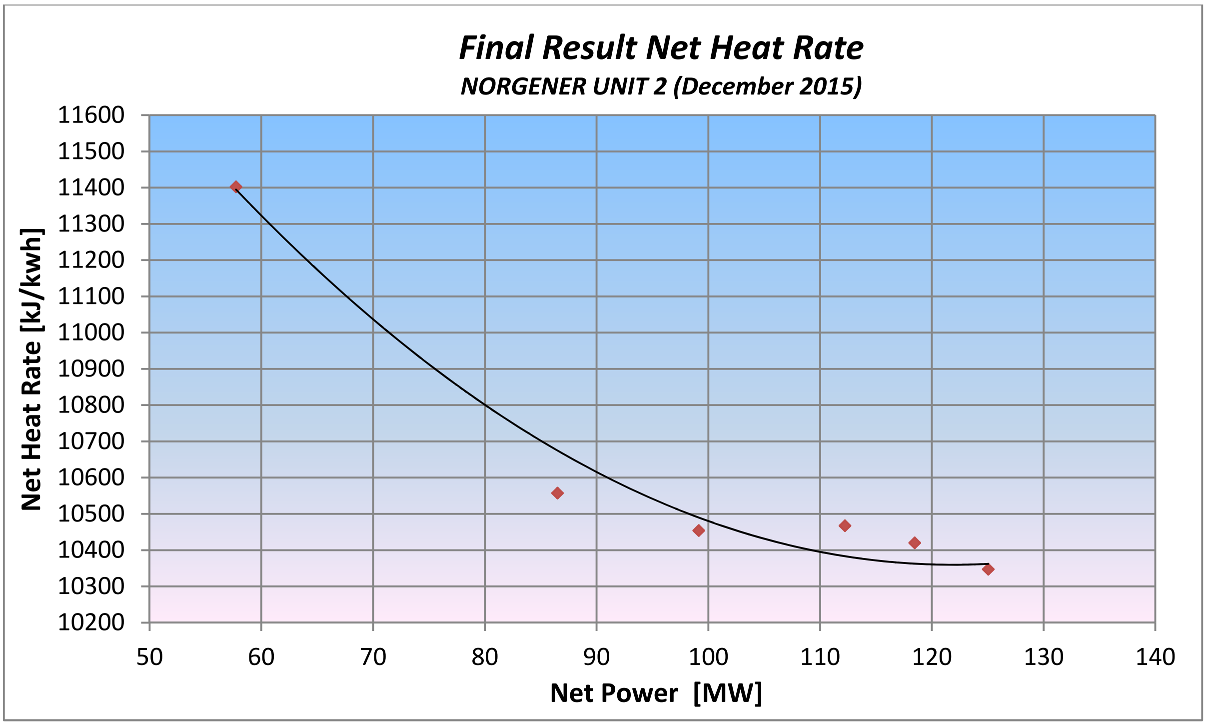


Figure 1 Final Result Net Heat Rate of Norgener Unit#2 (HHV)

2 INTRODUCTION

In close operation and by order of AES Gener, maximum power test and performance tests at Norgener Unit 2, as per CDEC-SING requirement, have been conducted by DNV GL in the period from the 15^{th} of December 2015 until the 17^{th} of December 2015. In total six heat rate tests has been performed.

Test procedure, with reference 15-1235, final version Rev.2 dated the 16^{th} of September 2015, which has been agreed by parties involved, has been used as a guideline.

Deviating from the test procedure, on site, parties agreed to minimize the test duration of the heat rate tests from four hours to two hours. The needed time for the traverse measurements of the emissions could be decreased, due to the application of interconnection and combining the installed sample tubes in the ducts upstream and downstream of the air heater. The test duration of two hours still complies with the minimum requirement as per ASME PTC4.

The duration of the maximum power test remained to five hours. The result of the maximum power test is reported in a separate document, with reference 74108301 CES/PTM 15-3255.

Also deviating from the test procedure is the introduction of an additional mass and heat balance measurement around the deaerator, to determine the final feed water flow of the boiler. It appeared that the feed water flow measurement down streams the feed water pumps, which was foreseen for the evaluation, is affected by swirl and systematically showing a too high value.

For that reason we have used the determined boiler feed water flow, based on the main condensate flow (including additional heat balances of the deaerator and HP heaters I and II), as decisive value for the final evaluation.

As per comment of CDEC-SING during the preparation phase, the fuel properties of the coal have not been applied for correction of the heat rate of the plant.

The following external representatives were present during the performance tests:

CDEC-SING : Mr. Sergio Pizarro

: Mr. José Flores (partly)

3 DESCRIPTION OF THE UNITS

The Norgener power plant (Unit 1 and Unit 2) is located at the coast in Tocopilla, Chile, in the Segunda Region about 175 km north to Antofagasta. Both units are type conventional coal-fired thermal units with a total installed gross power capacity of 264 MWe.

Each unit is foreseen with a conventional condenser, supplied by seawater from the pumping station. Recently both units are extended with a desulfurization plant.

The steam cycle is based on a conventional steam turbine with a nominal operating pressure of 160 bar(a) and a nominal HP and IP operating temperature equal to 537 °C, respectively 537.8°C.
Low pressure exhaust steam from the steam turbine is condensed in a condenser operating working under vacuum. The steam turbine system of unit 2 has no bypass system. Each steam turbine generator is connected to the local 220 kV system through a step-up transformer. The steam turbine generator is connected to the main transformer by means of an isolated phase bus. Each unit includes auxiliary transformers for service of all the plant’s own loads and common station loads.

4 STANDARDS

The following standards have been used as a guideline for the maximum power test and heat rate tests:

- ASME PTC 46 Performance Test Code on overall Plant Performance, 1996
- ASME PTC 4 Fired Steam Generators, October 2008
- ASME PTC 6 Steam Turbines, December 2004
- ASME PTC 12.2 Steam Surface Condensers, January 2010
- ASME PTC 19.1 Test uncertainty, November 2005
- ASME PTC 19.5 Flow Measurement, March 2004
- ISO 5167 Measurement of fluid flows by means of differential pressure devices inserted in circular cross-section conduits running
- IAPWS-IFC97 Properties of Water and Steam, The Industrial Standard
- NEN-ISO 18283 Hard coal and coke – manual sampling, September 2006
- NEN-ISO 13909 Mechanical sampling moving streams

5 TEST PROGRAM HEAT RATE TESTS

Six tests, as presented in table 5.1, have been evaluated.

Table 5.1 Test program

Test	**100 %**	**95 %**	**90 %**	**80 %**	**70 %**	**47 % / Min**
Date	15-12-15	16-12-15	16-12-15	17-12-15	17-12-15	17-12-15
Time begin	09:00	09:00	12:45	09:30	13:00	17:00
Time end	11:00	11:00	14:45	11:30	15:00	19:00

6 REFERENCE CONDITIONS

The reference conditions at the system boundary of the plant are defined as follow:

Table 6.1 Reference conditions

Description	**Unit**	**Reference Conditions**	
		Unit 1	**Unit 2**
Ambient temperature	°C	18.8	18.8
Ambient relative humidity	%	75	75
Water content in ambient air	kg/kg	0.0101	0.0101
Cooling water inlet temperature	°C	18	18
Power factor generator steam turbine	-	0.85	0.85

7 MEASUREMENTS

In Appendix A2 an overview is presented of the essential measurements (measuring point list). An overview of these main measurements is also presented in the diagram of Appendix A1.

Essential measurements, which have a significant influence on the accuracy of the net heat rate, have been measured by means of calibrated test instruments or calibrated plant instrumentation.

Measurements which have a minor or even negligible influence or which will be used for information has been measured by means of plant instruments.

The most essential measurements for the net heat rate tests are:

- net power of the unit
- auxiliary power, excluded for power generation as per CDEC-SING requirement
- feed water flow inlet boiler and/or main condensate flow to the deaerator
- attemperator spray water flow to boiler and re-heater line
- main steam pressure and temperature at the outlet of the boiler
- main steam pressure and temperature at the inlet and outlet of the re-heater
- auxiliary steam flow, pressure and temperature at the header
- feed water temperature at the inlet of the boiler
- attemperator spray water temperature boiler and re-heater
- exhaust gas temperature after the air heater
- O_2 and CO content in the exhaust gasses after the air heater
- HHV, LHV, Ash, H_2O and volatile of the hard coal (and ultimate analysis C, H, N, S, O)
- unburned carbon content bottom ash and fly ash
- ambient conditions
- pre-heating of air (if applicable).

8 CORRECTIONS TO REFERENCE CONDITIONS

As per test procedure the following corrections have been applied:

- correction for air temperature at the boundary of the steam generator
- correction for fuel properties of the coal
- correction for cooling water inlet temperature of the condenser
- correction for power factor of the generator
- correction for auxiliary power, as per CDEC-SING requirement

The applicable correction curves are presented in Appendix B.

The correction for Unit 2 as per CDEC-SING definition consists of:

- correction for administration building and lightning
- correction for common auxiliaries, which may be divided equally to both units (air compressors, potable water pump, make up water pump, diesel pump).

9 RESULTS

In the following Annexes the main detail results are presented:

Appendix C:	Results analysis coal, bottom ash and fly ash
Appendix D:	Measurement data DNV GL, Algorithm and AES
Appendix E:	Control panel screen dumps
Appendix F:	Results DNV GL calculation program
Appendix F1:	Measurement input for DNV GL calculation program condensate balance
Appendix F2:	Results DNV GL calculation program condensate balance (long results)
Appendix F3:	Measurement input for DNV GL main calculation program
Appendix F4:	Results DNV GL main calculation program (long results)
Appendix G:	Results ASME PTC 4 Heat Balance Method
Appendix H:	Uncertainty calculation

In the so-called long results output of Appendix F4, details of the calculations of the main program are presented step by step, so each calculated parameter can be easily checked. The numbers in the DNV GL main calculation program of Appendix F3 and F4 are:

- numbers @0001 till @0600: measured values, constants and flag setting
- numbers @0650 till @3054: calculated results.

In table 9.1 till table 9.3 the main results of the performance measurements are summarised.

Table 9.1 Ambient Conditions, Flow Measurements and HP Heater 6

Point		Performance Test	Unit	100 %	95 %	90 %	80 %	70 %	47 % / Min
Number		Date		15-12-15	16-12-15	16-12-15	17-12-15	17-12-15	17-12-15
DNVGL		Time begin		09:00	09:00	12:45	09:30	13:00	17:00
		Time end		11:00	11:00	14:45	11:30	15:00	19:00
		Ambient Conditions							
@3001	P	Ambient Pressure	mbar	1.0096	1.0095	1.0082	1.0082	1.0071	1.0051
@3002	T	Ambient Temperature	°C	20.81	21.49	21.23	20.84	21.37	20.65
@0082	X	Relative Humidity	%	64.82	68.98	63.98	61.61	64.47	74.84
@3004	X	Absolute Humidity	kg/kg	0.00998	0.01109	0.01012	0.00951	0.0103	0.01149
@3005	X	Wet Bulb Temperature	°C	16.50	17.65	16.75	16.09	16.94	17.64
		HP Flow Measurement							
@0100	dP	HP Feed Water Flow	mbar	440.88	401.04	357.92	277.85	206.07	98.96
@1751	P	HP Feed Water	bar(a)	213.5	218.8	222.8	232.6	243	246.8
@1752	T	HP Feed Water	°C	178.3	176.5	174.7	170.0	165.4	152.6
@1755	M	HP Feed Water Flow	kg/s	118.02	112.68	106.55	94.11	81.23	56.59
@1756	M	HP FW Cond.Method	kg/s	114.88	109.69	103.79	91.53	79.18	55.53
		HP Spray Water Flow 1							
@0105	dP	HP Spray Water Flow 1	mbar	0.00	0.00	0.00	0.00	0.00	0.00
@1761	P	HP Spray Water 1	bar(a)	168.7	215.8	219.9	229.7	240.1	243.9
@1762	T	HP Spray Water 1	°C	178.3	176.5	174.7	170	165.4	152.6
@1760	M	HP Spray Water Flow 1	kg/s	0.00	0.00	0.00	0.00	0.00	0.00
		HP Spray Water Flow 2							
@0115	dP	HP Spray Water Flow 2	mbar	0.00	18.85	63.47	8.20	39.95	18.16
@1771	P	HP Spray Water 2	bar(a)	168.7	215.7	219.7	229.6	240.0	243.8
@1772	T	HP Spray Water 2	°C	178.3	176.5	174.7	170.0	165.4	152.6
@1770	M	HP Spray Water Flow 2	kg/s	0.00	1.15	2.11	0.76	1.68	1.14
		RH Spray Water Flow							
@0110	dP	RH Spray Water Flow	mbar	78.06	30.91	19.83	0.00	0.00	3.90
@1801	P	RH Spray Water	bar(a)	73.86	75.95	77.22	80.41	83.11	82.98
@1802	T	RH Spray Water	°C	175.61	173.55	171.42	112.56	105.63	139.39
@1800	M	RH Spray Water Flow	kg/s	2.33	1.47	1.17	0.00	0.00	0.53
		Heat Balance HP Heater 6							
@1700	M	HP Feed Water Inlet	kg/s	114.9	108.5	101.7	90.8	77.5	54.4
@1701	P	HP Feed Water Inlet	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@1702	T	HP Feed Water Inlet	°C	215.6	213.3	210.9	204.5	198.3	182.2
@1703	H	Enthalpy FW Inlet	kJ/kg	928.9	918.6	907.7	878.8	851.4	780.7
@1711	P	HP Feed Water Outlet	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@1712	T	HP Feed Water Outlet	°C	249.1	246.4	243.7	236.3	229.0	210.2
@1713	H	Enthalpy FW Outlet	kJ/kg	1082.4	1069.5	1056.7	1022.6	989.0	903.8
@1721	P	Drain Outlet	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@1722	T	Drain Outlet	°C	221.1	218.6	215.9	209.1	202.0	184.3
@1723	H	Drain Outlet	kJ/kg	949.1	937.5	925	893.9	861.9	782.5
@1020	M	Extraction Flow HPH 6	kg/s	8.246	7.654	7.043	6.011	4.865	3.008

Table 9.2 Boiler Heat Production and Boiler Fuel Efficiency

Point Number DNVGL	Performance Test Date Time begin Time end	Unit	100 % 15-12-15 09:00 11:00	95 % 16-12-15 09:00 11:00	90 % 16-12-15 12:45 14:45	80 % 17-12-15 09:30 11:30	70 % 17-12-15 13:00 15:00	47 % / Min 17-12-15 17:00 19:00
	HP Steam Production							
@1750	M HP Feed Water Flow	kg/s	114.88	109.69	103.79	91.53	79.18	55.53
@0901	M Boiler Leakage	kg/s	0.268	0.268	0.268	0.268	0.268	0.268
@0902	M Blow Down Boiler	kg/s	0.00	0.00	0.00	0.00	0.00	0.00
@1000	M HP Steam Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26
	Cold RH Steam Production							
@1000	M HP Steam Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26
@1020	M Extraction Flow HPH 6	kg/s	8.246	7.654	7.043	6.011	4.865	3.008
@0900	M Leak HP Turb.&Gland St.	kg/s	2.534	2.436	2.323	2.088	1.851	1.393
@0490	M Ejector Steam Design	kg/s	0.18	0.18	0.18	0.18	0.18	0.18
@1035	M CRH Steam Inlet Boiler	kg/s	103.65	99.15	93.98	82.98	72.02	50.68
	Hot RH Steam Production							
@1035	M CRH Steam Inlet Boiler	kg/s	103.65	99.15	93.98	82.98	72.02	50.68
@1800	M RH Spray Water Flow	kg/s	2.33	1.47	1.17	0.00	0.00	0.53
@1040	M HRH Steam Outlet Boiler	kg/s	105.99	100.62	95.15	82.98	72.02	51.21
	Boiler Heat Production							
@1000	M HP Steam Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26
@1003	H HP Steam Outlet Boiler	kJ/kg	3406.9	3396.1	3398.2	3405.4	3406.7	3380.0
@1650	M Feed Water Inlet Boiler	kg/s	114.88	108.54	101.68	90.77	77.50	54.39
@1653	H Feed Water Inlet Boiler	kJ/kg	1117.7	1104.7	1091.5	1056.6	1022.1	932.4
@1040	M HRH Steam Outlet Boiler	kg/s	105.99	100.62	95.15	82.98	72.02	51.21
@1043	H HRH Steam Outlet Boiler	kJ/kg	3554.1	3554.3	3556.2	3555.6	3558.8	3497.5
@1035	M CRH Steam Inlet Boiler	kg/s	103.65	99.15	93.98	82.98	72.02	50.68
@1033	H CRH Steam Inlet Boiler	kJ/kg	3098.6	3089.2	3087.6	3077.3	3064.7	3021.3
@1760	M HP Spray Water Flow 1	kg/s	0.00	0.00	0.00	0.00	0.00	0.00
@1763	H HP Spray Water Flow 1	kJ/kg	764.0	758.8	751.3	731.6	712.7	658.2
@1770	M HP Spray Water Flow 2	kg/s	0.00	1.15	2.11	0.76	1.68	1.14
@1773	H HP Spray Water Flow 2	kJ/kg	764.0	758.8	751.3	731.6	712.7	658.2
@1800	M RH Spray Water Flow	kg/s	2.33	1.47	1.17	0.00	0.00	0.53
@1803	H RH Spray Water Flow	kJ/kg	747.2	738.4	729.2	477.9	448.9	591.8
@0830	Q Boiler Heat Production	kJ/s	315833	301067	286586	254021	223998	160985
	Boiler Fuel Efficiency							
@0520	Ym Fuel Efficiency Measured	%	87.90	87.82	87.86	88.27	88.33	88.04
@0952	Xc Corr.for Ambient Temp.	%	-0.035	-0.048	-0.043	-0.036	-0.045	-0.032
@0953	Xc Corr.for Humidity	%	-0.002	0.009	-0.001	-0.007	0.001	0.014
@0954	Xc Corr.for Hydrogen Coal	%	0.000	0.000	0.000	0.000	0.000	0.000
@0955	Xc Corr.for Moisture Coal	%	0.000	0.000	0.000	0.000	0.000	0.000
@0956	Xc Corr.for Theor.Dry Air	%	0.000	0.000	0.000	0.000	0.000	0.000
@0950	Ym Fuel Efficiency Corrected	%	87.87	87.79	87.82	88.24	88.29	88.03

Table 9.3 Fuel Consumption, Net Heat Rate and Net Heat Rate at Standard HHV of 6000 kCal/kg

Point Number DNVGL	**Performance Test** Date Time begin Time end	**Unit**	**100%** 15-12-15 09:00 11:00	**95%** 16-12-15 09:00 11:00	**90%** 16-12-15 12:45 14:45	**80%** 17-12-15 09:30 11:30	**70%** 17-12-15 13:00 15:00	**47% / Min** 17-12-15 17:00 19:00
	Fuel Consumption Corr.							
@0830	Q Boiler Heat Production	kJ/s	315833	301067	286586	254021	223998	160985
@0950	Yc Fuel Efficiency Corrected	%	87.87	87.79	87.82	88.24	88.29	88.03
@0960	Qc Fuel Consumption Corr.	kJ/s	359445	342946	326338	287887	253696	182883
	Net Power Plant Corr.							
@0560	Pe Net Power Unit (kWh)	kW	125479	118877	112468	99499	86803	57998
@0561	Pe Aux.Corr.CDEC-SING	kW	128	128	128	128	128	128
@0957	Pe Add.Corr.Power Factor	kW	-361	-327	-295	-238	-184	-90
@0958	Pe Add.Corr.CW Temp.	kW	-191	-197	-65	-246	-235	-295
@0965	Pe Net Power Plant Corr.	kW	125055	118480	112236	99143	86512	57740
	Net Heat Rate Plant Corr.							
@0960	Qc Fuel Consumption Corr.	kJ/s	359445	342946	326338	287887	253696	182883
@0965	Pe Net Power Plant Corr.	kW	125055	118480	112236	99143	86512	57740
@0970	HR Net Heat Rate Plant Corr	kJ/kWh	10347	10420	10467	10454	10557	11402
	Mass Coal HHV as Fired							
@0960	Qc Fuel Consumption Corr.	kJ/s	359445	342946	326338	287887	253696	182883
@0295	HHV Coal (as fired)	kJ/kg	23580	23614	23542	23777	23542	23505
@0975	M Coal Corr. HHV (fired)	kg/s	15.24	14.52	13.86	12.11	10.78	7.78
	Mass Coal @6000 kCal/kg							
@0975	M Coal Corr. HHV (fired)	kg/s	15.24	14.52	13.86	12.11	10.78	7.78
@0295	HHV Coal (as fired)	kJ/kg	23580	23614	23542	23777	23542	23505
@0511	HHV Coal (standard)	kCal/kg	6000	6000	6000	6000	6000	6000
@0976	M Coal Corr. HHV (6000)	kg/s	14.31	13.65	12.99	11.46	10.10	7.28
	Net HR Plant @Standard HHV of 6000 kCal/kg							
@0976	M Coal Corr. HHV (6000)	kg/s	14.31	13.65	12.99	11.46	10.10	7.28
@0965	Pe Net Power Plant Corr.	kW	125055	118480	112236	99143	86512	57740
@0980	HR Net HR Plant (at 6000)	g/kWh	**411.9**	**414.8**	**416.7**	**416.1**	**420.2**	**453.9**

10 UNCERTAINTY CALCULATION

Based on the uncertainties of the individual measurements, the total uncertainty of the net corrected heat rate of the plant has been calculated for the full load test (test 1). Detail results are presented in Appendix H.

The used systematically uncertainties (calibrated test equipment DNV GL and AES Gener Metering Systems, coal, fly-ash and bottom-ash analysis, etcetera) are presented in Table 10.1.

For the process variations during the tests, for each individual process value, the applicable fluctuation by means of the standard deviations (random error) has been used. The result of the 2k standard deviations (random errors at 95% confidence interval) is presented in the summary table of Appendix H.

Table 10.1 Used systematically uncertainties

Name	Unit	Uncertainty
Ambient Temperature	°C	± 0.2 K (abs.)
Ambient Pressure	mbar	± 1 mbar (abs.)
Ambient Humidity	%	± 2.5 %
Differential Transmitters	mbar	± 0.2 %
Water and Steam Pressures	bar(a)	± 0.1 %
Water and Steam Temperature (<50°C)	°C	± 0.2 K (abs.)
Water and Steam Temperature (50°C < T <400°C)	°C	± 0.5 K (abs.)
Water and Steam Temperature (> 400°C)	°C	± 1.2 K (abs.)
Net Power Metering	%	± 0.35 %
Gross Power Metering	%	± 0.35 %
Power Factor	%	± 0.35 %
HHV Analysis	kJ/kg	± 1.5 %
Water Content Analysis	%	± 1.0 %
Ash Content Analysis	%	± 1.0 %
C, H, O, N, S Analysis	%	± 1.0 %
Unburned Carbon	%	± 1.0 %
O2 in Exhaust Gas Inlet Air Heater (incl.grid)	%	± 5.0 %
O2 in Exhaust Gas Outlet Air Heater (incl.grid)	%	± 5.0 %
CO in Exhaust Gas Outlet Air Heater (incl.grid)	ppm	± 5.0 %
Temperature Exhaust Gas Inlet Air Heater (incl.grid)	°C	± 2.5 K (abs)
Temperature Exhaust Gas Outlet Air Heater (incl.grid)	°C	± 2.5 K (abs)
Temperature Primary Air Inlet Air Heater	°C	± 1.5 K (abs)
Temperature Secondary Air Inlet Air Heater	°C	± 1.5 K (abs)
Total Auxiliary Power within System Boundary	kW	± 5.0 %

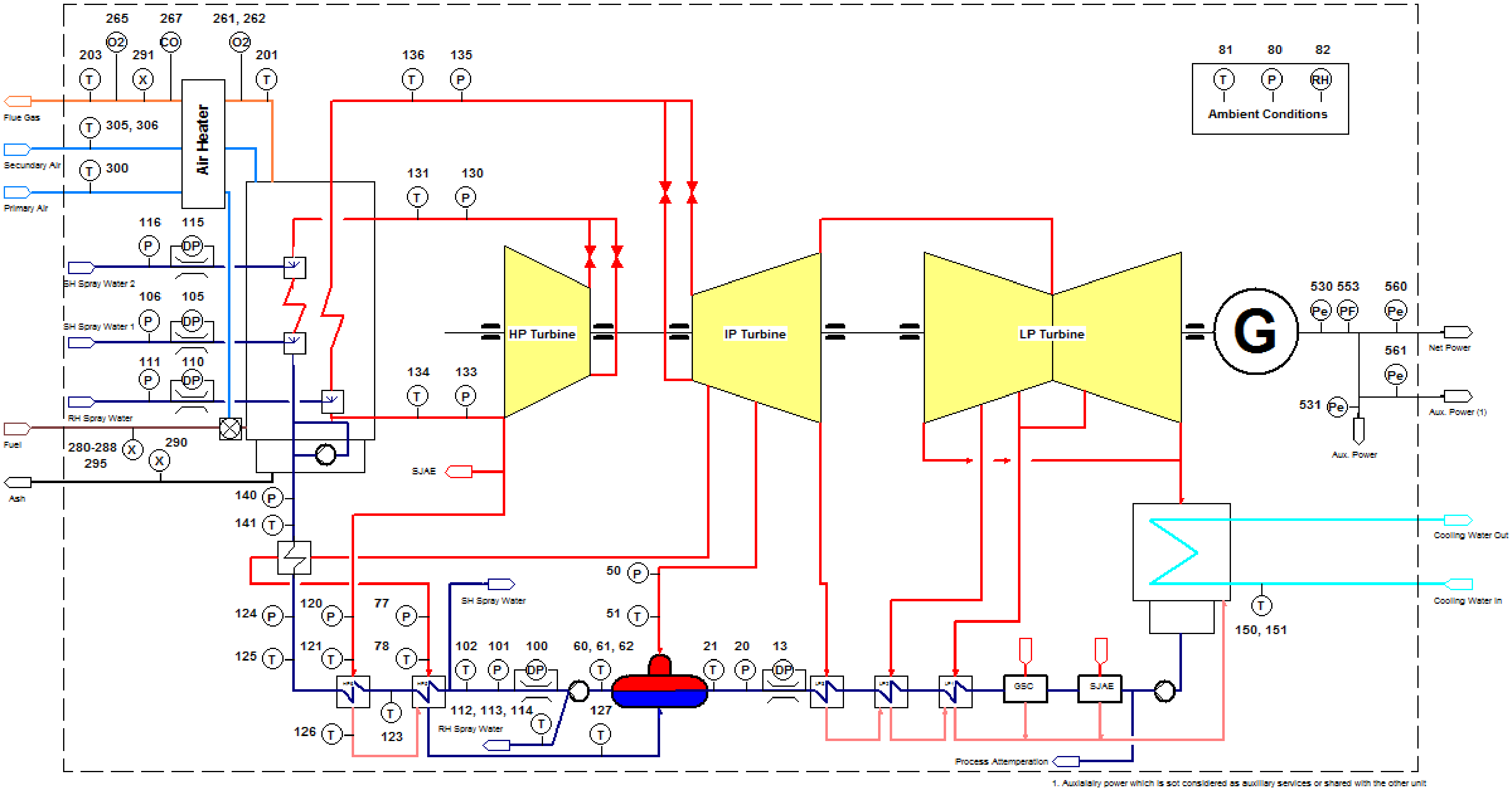
The summary result of the uncertainty calculation (Appendix H) is presented in Table 10.2.

Table 10.2 Uncertainty Net Heat Rate of Norgener Unit 2

Uncertainty Process Value	Unit	Uncertainty Test 1
σ Net Heat Rate Plant Corrected	%	**± 2.3 %**

APPENDIX A
Test Measurement List & Point

APPENDIX A1
Location of the Test Measurement Points


Flue Gas
Secondary Air
Primary Air
Fuel
Ash
Air Heater
SH Spray Water 2
SH Spray Water 1
RH Spray Water
SH Spray Water
HP Turbine
IP Turbine
LP Turbine
G
SJAE
GSC
Net Power
Aux. Power (1)
Aux. Power
Cooling Water Out
Cooling Water In
Process Attemperation
Ambient Conditions
1. Auxiliary power which is not considered as auxiliary services or shared with the other unit

APPENDIX A2
DNV GL Test Measuring Points List

Client	AES GENER						Date	11-dec-15
Location	Norgener						Revision	Rev 0
Unit	Unit 2							

TEST POINT			INSTRUMENT						REMARKS
DNVGL No.	Code	Description	Type	Test instr.	Unit	Reading	Ref. # Geod.H.	Supplier	
		Ambient Condition							
81	-	Ambient Temperature Dry	T	4701	ºC	-	-	DNV-GL	R15130
82	-	Ambient Relative Humidity	RH	0013	%	-	-	DNV-GL	
80	-	Ambient Pressure	P	8123	mbar	-	-	DNV-GL	
		Flow Measurements Water/Steam/Air							
100	1/2 F0001	Feedwater Differential Pressure	dP	2802	mbar	-	-	DNV-GL	In paralel to plant dP-transmitter (1/4"NPT)
105	1/2 F0002	SH Spray Differential Pressure No.1	dP	2803	mbar	-	-	DNV-GL	In paralel to plant dP-transmitter (1/4"NPT)
115	1/2 F0003	SH Spray Differential Pressure No.2	dP	2804	mbar	-	-	DNV-GL	In paralel to plant dP-transmitter (1/4"NPT)
110	1/2 F0004	RH Spray Differential Pressure	dP	2805	mbar	-	-	DNV-GL	In paralel to plant dP-transmitter (1/4"NPT)
13	1/2 F4003	Condensate Differential Pressure	dP	2806	mbar	-	-	DNV-GL	In paralel to plant dP-transmitter (1/4"NPT)
		Pressure Measurements Water/Steam							
20	1/2 F4003	Condensate to Deaerator Pressure	P	2360	bar(g)	-	-3.90M	DNV-GL	
50	1/2 P4831	Extraction Steam Pressure Deaerator	P	2358	bar(g)	-	-0.40M	DNV-GL	
77	1/2 P4869	Extraction Steam to HP Heater 1	P	2361	bar(g)	-	0.00M	DNV-GL	
101	1/2 F0001	Feedwater Mass Flow : Pressure + side	P	2391	bar(g)	-	-3.35M	DNV-GL	
106	1/2 F0002	SH Spray Water: Pressure + side No.1	P	2392	bar(g)	-	-4.70M	DNV-GL	
116	1/2 F0003	SH Spray Water: Pressure + side No.2	P	2393	bar(g)	-	-2.50M	DNV-GL	
111	1/2 F0004	Reheater Spray Water: Pressure + side	P	2352	bar(g)	-	-4.70M	DNV-GL	
130	1/2 P0803	HP Steam Pressure	P	2394	bar(g)	-	-20.95M	DNV-GL	
133	1/2 P0804	Cold Reheat Pressure inlet before RH	P	2353	bar(g)	-	+0.70M	DNV-GL	
135	1/2 P0805	Reheater Outlet Steam Pressure	P	2356	bar(g)	-	-21.25M	DNV-GL	
124	1/2 P4865	Feed Water HP Heater 2 Outlet	P	2395	bar(g)	-	0.00M	DNV-GL	
140	1/2 P0801	Feed Water Boiler Inlet	P	2399	bar(g)	-	+1.00M	DNV-GL	
120	1/2 P4870	Steam Extraction to HP Heater 2	P	2357	bar(g)	-	-0.75M	DNV-GL	

Client	AES GENER					Date	11-dec-15
Location	Norgener					Revision	Rev 0
Unit	Unit 2						

TEST POINT			INSTRUMENT						REMARKS
DNVGL No.	Code	Description	Type	Test instr.	Unit	Reading	Ref. # Geod.H.	Supplier	
		Temperatures Measurements Water/Steam							
21	1/2 T4903	Condensate to Deaerator	T	4702	°C	-	-	DNV-GL	R15131
51	1/2 T4820	Steam Extraction to Deaerator	T	4208	°C	-	-	DNV-GL	R15141
60	1/2 T4825	Feedwater Temperature inlet pump 1	T	4213	°C	-	-	DNV-GL	R15136
61	1/2 T4826	Feedwater Temperature inlet pump 2	T	--	°C	-	-	DNV-GL	pump was not running
62	1/2 T4827	Feedwater Temperature inlet pump 3	T	4207	°C	-	-	DNV-GL	R15142
78	1/2 T4925	Steam Extraction to HP Heater 1	T	4201	°C	-	-	DNV-GL	R15132
102	1/2 T4009	Feedwater Mass Flow : Temperature	T	4209	°C	-	-	DNV-GL	R15135
141	1/2 T0001	Feedwater Temperature inlet Boiler	T	4212	°C	-	-	DNV-GL	R15145
131	1/2 T0012	HP Steam Temperature	T	4202	°C	-	-	DNV-GL	R15140
134	1/2 T0041	Cold Reheat Temperature inlet before RH	T	4210	°C	-	-	DNV-GL	R15144
136	1/2 T0505	Reheater Outlet Steam Temp	T	4204	°C	-	-	DNV-GL	R15137A
112	1/2 T4911	RH Spray water temperature FW pump 1	T	4211	°C	-	-	DNV-GL	R15143
113	1/2 T4912	RH Spray water temperature FW pump 2	T	--	°C	-	-	DNV-GL	pump was not running
114	1/2 T4913	RH Spray water temperature FW pump 3	T	4214	°C	-	-	DNV-GL	R15139
123	1/2 T4832	Feed Water HP Heater 2 inlet	T	3241	°C	-	-	DNV-GL	R15169
125	1/2 T4833	Feed Water HP Heater 2 outlet	T	3301	°C	-	-	DNV-GL	R15169
121	1/2 T4926	Steam Extraction to HP Heater 2	T	4206	°C	-	-	DNV-GL	R15134
126	1/2 T4839	Drain Temp. HP Heater 2	T	3246	°C	-	-	DNV-GL	R15169
127	1/2 T4838	Drain Temp. HP Heater 1	T	4205	°C	-	-	DNV-GL	R15138
		Air and Flue Gas Temperatures							
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5401	°C	-	-	DNV-GL	Exhaust extraction probe 104, R15206-1
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5431	°C	-	-	DNV-GL	Exhaust extraction probe 104, R15207-1
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5461	°C	-	-	DNV-GL	Exhaust extraction probe 104, R15208-1
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5402	°C	-	-	DNV-GL	Exhaust extraction probe 105, R15206-2
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5432	°C	-	-	DNV-GL	Exhaust extraction probe 105, R15207-2
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5462	°C	-	-	DNV-GL	Exhaust extraction probe 105, R15208-2
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5403	°C	-	-	DNV-GL	Exhaust extraction probe 106, R15206-3
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5433	°C	-	-	DNV-GL	Exhaust extraction probe 106, R15207-3
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5463	°C	-	-	DNV-GL	Exhaust extraction probe 106, R15208-3

Client	AES GENER						Date	11-dec-15
Location	Norgener						Revision	Rev 0
Unit	Unit 2							

TEST POINT			INSTRUMENT						REMARKS
DNVGL No.	Code	Description	Type	Test instr.	Unit	Reading	Ref. # Geod.H.	Supplier	
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5404	ºC	-	-	DNV-GL	Exhaust extraction probe 107, R15206-4
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5434	ºC	-	-	DNV-GL	Exhaust extraction probe 107, R15207-4
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5464	ºC	-	-	DNV-GL	Exhaust extraction probe 107, R15208-4
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5405	ºC	-	-	DNV-GL	Exhaust extraction probe 108, R15206-5
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5435	ºC	-	-	DNV-GL	Exhaust extraction probe 108, R15207-5
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5465	ºC	-	-	DNV-GL	Exhaust extraction probe 108, R15208-5
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5406	ºC	-	-	DNV-GL	Exhaust extraction probe 109, R15206-6
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5436	ºC	-	-	DNV-GL	Exhaust extraction probe 109, R15207-6
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5466	ºC	-	-	DNV-GL	Exhaust extraction probe 109, R15208-6
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5407	ºC	-	-	DNV-GL	Exhaust extraction probe 110, R15206-7
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5437	ºC	-	-	DNV-GL	Exhaust extraction probe 110, R15207-7
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5467	ºC	-	-	DNV-GL	Exhaust extraction probe 110, R15208-7
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5408	ºC	-	-	DNV-GL	Exhaust extraction probe 113, R15206-8
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5438	ºC	-	-	DNV-GL	Exhaust extraction probe 113, R15207-8
201	1/2 Test Nozzles	GAH Inlet Exhaust Gas Temp, A	T	5468	ºC	-	-	DNV-GL	Exhaust extraction probe 113, R15208-8
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5501	ºC	-	-	DNV-GL	Exhaust extraction probe 117, R15166-1
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5531	ºC	-	-	DNV-GL	Exhaust extraction probe 117, R15167-2
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5561	ºC	-	-	DNV-GL	Exhaust extraction probe 117, R15168-2
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5502	ºC	-	-	DNV-GL	Exhaust extraction probe 118, R15166-2
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5532	ºC	-	-	DNV-GL	Exhaust extraction probe 118, R15167-3
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5562	ºC	-	-	DNV-GL	Exhaust extraction probe 118, R15168-3
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5503	ºC	-	-	DNV-GL	Exhaust extraction probe 119, R15166-3
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5533	ºC	-	-	DNV-GL	Exhaust extraction probe 119, R15167-5
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5563	ºC	-	-	DNV-GL	Exhaust extraction probe 119, R15168-4
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5506	ºC	-	-	DNV-GL	Exhaust extraction probe 122, R15166-6
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5536	ºC	-	-	DNV-GL	Exhaust extraction probe 122, R15167-9
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5566	ºC	-	-	DNV-GL	Exhaust extraction probe 122, R15168-8
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5505	ºC	-	-	DNV-GL	Exhaust extraction probe 121, R15166-5
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5535	ºC	-	-	DNV-GL	Exhaust extraction probe 121, R15167-8
203	1/2 Test Nozzles	GAH Outlet Exhaust Gas Temp, A	T	5565	ºC	-	-	DNV-GL	Exhaust extraction probe 121, R15168-6
		Internal Boundary Conditions for CT correction / ST correction							
150	1/2 T3091	Inlet temperature CW Left Side	T	4703	ºC	-	-	DNV-GL	R15129
151	1/2 T3092	Inlet temperature CW Rigth Side	T	4706	ºC	-	-	DNV-GL	R15127

APPENDIX A3

DNV GL Calibration Certificates

Tradinco Instruments

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

CALIBRATION RvA K 050

Certificate number : 21500262R1

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266MST
Serial number	3K650000006803
Service number	18065
Customer identification number	DP 2802
Calibration method	This calibration is carried out with : Deadweight tester type : T1100/1 S/N : 4275/86 Cal. Due : 11 July 2018 Deadweight tester type : T2300/1 S/N : 6612/91 Cal. Due : 18 July 2018 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	24 February 2015
Results	See following page(s)
Uncertainty	± 0.011 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.35
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	24 February 2015
Name	A.G. v.d. Berghe Deputy Head of TCL

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2651 BD Berkel en Rodenrijs
The Netherlands
Tel. : +31(0)105112911
Telefax : +31 (0)105115114

Tradinco Instruments
The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500262R1

	Standard 1	Standard 2	Instrument
Service number			18065
Type	T1100/1	T2300/1	266MST
Manufacturer	Tradinco Instruments	Tradinco Instruments	ABB
Description	Deadweight tester	Deadweight tester	Pressure transmitter
Serial number	4275/86	6612/91	3K650000006803
Range	(30 ÷ 2000) mbar	(0.2 ÷ 35) bar	(0 ÷ 2500) mbar
Medium	Air	Air	Air
Accuracy	±0.01 % R	±0.01 % R	±0.1 % R
Temperature	21.0°C ± 0.5°C	21.0°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP mbar	INPUT DOWN mbar	READING UP mbar	READING DOWN mbar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.0000	0.0000	0.01	0.01			± 0.10	± 0.10
2	29.9700	29.9700	29.97	29.98	0.00	0.03	± 0.10	± 0.10
3	49.9683	49.9683	49.98	49.98	0.02	0.02	± 0.10	± 0.10
4	99.9630	99.9630	99.97	99.97	0.01	0.01	± 0.10	± 0.10
5	199.960	199.960	199.96	199.96	0.00	0.00	± 0.10	± 0.10
6	299.957	299.957	299.96	299.95	0.00	0.00	± 0.10	± 0.10
7	449.955	449.955	449.96	449.94	0.00	0.00	± 0.10	± 0.10
8	599.947	599.947	599.95	599.94	0.00	0.00	± 0.10	± 0.10
9	799.937	799.937	799.94	799.93	0.00	0.00	± 0.10	± 0.10
10	999.933	999.933	999.92	999.93	0.00	0.00	± 0.10	± 0.10
11	1249.94	1249.94	1249.92	1249.92	0.00	0.00	± 0.10	± 0.10
12	1499.93	1499.93	1499.92	1499.90	0.00	0.00	± 0.10	± 0.10
13	1999.91	1999.91	1999.87	1999.88	0.00	0.00	± 0.10	± 0.10
14	2500.04		2500.09		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician
C. Martinus
Cal. date : 24 February 2015

Approved by
Deputy Head of TCL
A.G.v.d. Berghe
Date : 24 February 2015
Berkel en Rodenrijs

Customer ID. no. : DP 2802
Customer ref. : 1.099.74103420.400
Our ref. : 61402416
Customer : DNV GL

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500524

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266MST
Serial number	3K650000006804
Service number	18222
Customer identification number	DP 2803

Calibration method

This calibration is carried out with :

Deadweight tester	type : T1100/1	S/N : 4275/86	Cal. Due :	11 July 2018
Deadweight tester	type : T2300/1	S/N : 6612/91	Cal. Due :	18 July 2018

During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights

Environmental conditions

Temperature: 20.0°C ± 2°C

Humidity: 55 %rh ± 25 %rh

Date / period of calibration: 8 April 2015

Results: See following page(s)

Uncertainty: ± 0.012 % of reading with use of correction figures in the range of 20 - 100 % of full scale

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %.
The standard uncertainty has been determined in accordance with document EA-4/02.

Calculated by software revision: 2.7.6.6/2.33

Traceability: The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.

Date: 8 April 2015

Name: S. Baidjnath-Misier

Head of TCL

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Telefax : +31 (0)105115114

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500524

	Standard 1	Standard 2	Instrument
Service number			18222
Type	T1100/1	T2300/1	266MST
Manufacturer	Tradinco Instruments	Tradinco Instruments	ABB
Description	Deadweight tester	Deadweight tester	Pressure transmitter
Serial number	4275/86	6612/91	3K650000006804
Range	(30 ÷ 2000) mbar	(0.2 ÷ 35) bar	(0 ÷ 2500) mbar
Medium	Air	Air	Air
Accuracy	±0.01 % R	±0.01 % R	±0.1 % R
Temperature	21.1°C ± 0.5°C	21.1°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP mbar	INPUT DOWN mbar	READING UP mbar	READING DOWN mbar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.0000	0.0000	0.01	0.01			± 0.10	± 0.10
2	29.9699	29.9699	29.97	29.98	0.00	0.03	± 0.10	± 0.10
3	49.9682	49.9682	49.97	49.97	0.00	0.00	± 0.10	± 0.10
4	99.9627	99.9627	99.97	99.97	0.01	0.01	± 0.10	± 0.10
5	199.960	199.960	199.96	199.96	0.00	0.00	± 0.10	± 0.10
6	299.956	299.956	299.96	299.97	0.00	0.00	± 0.10	± 0.10
7	449.954	449.954	449.95	449.96	0.00	0.00	± 0.10	± 0.10
8	599.945	599.945	599.94	599.95	0.00	0.00	± 0.10	± 0.10
9	799.935	799.935	799.93	799.93	0.00	0.00	± 0.10	± 0.10
10	999.930	999.930	999.92	999.93	0.00	0.00	± 0.10	± 0.10
11	1249.94	1249.94	1249.92	1249.94	0.00	0.00	± 0.10	± 0.10
12	1499.92	1499.92	1499.91	1499.92	0.00	0.00	± 0.10	± 0.10
13	1999.90	1999.90	1999.90	1999.90	0.00	0.00	± 0.10	± 0.10
14	2500.04		2500.11		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 8 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 8 April 2015
Berkel en Rodenrijs

Customer ID. no. : DP 2803
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Tradinco Instruments®
The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500527

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266MST
Serial number	3K650000006805
Service number	18223
Customer identification number	DP 2804
Calibration method	This calibration is carried out with : Deadweight tester type : T1100/1 S/N : 4275/86 Cal. Due : 11 July 2018 Deadweight tester type : T2300/1 S/N : 6612/91 Cal. Due : 18 July 2018 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	9 April 2015
Results	See following page(s)
Uncertainty	± 0.012 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	9 April 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments
The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500527

	Standard 1	Standard 2	Instrument
Service number			18223
Type	T1100/1	T2300/1	266MST
Manufacturer	Tradinco Instruments	Tradinco Instruments	ABB
Description	Deadweight tester	Deadweight tester	Pressure transmitter
Serial number	4275/86	6612/91	3K650000006805
Range	(30 ÷ 2000) mbar	(0.2 ÷ 35) bar	(0 ÷ 2500) mbar
Medium	Air	Air	Air
Accuracy	±0.01 % R	±0.01 % R	±0.1 % R
Temperature	20.3°C ± 0.5°C	20.3°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP mbar	INPUT DOWN mbar	READING UP mbar	READING DOWN mbar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.0000	0.0000	0.00	-0.04	0.00		± 0.10	± 0.10
2	29.9705	29.9705	30.00	29.94	0.10	-0.10	± 0.10	± 0.10
3	49.9693	49.9693	50.00	49.95	0.06	-0.04	± 0.10	± 0.10
4	99.9649	99.9649	100.02	99.94	0.06	-0.02	± 0.10	± 0.10
5	199.964	199.964	200.07	199.98	0.05	0.01	± 0.10	± 0.10
6	299.963	299.963	300.08	300.00	0.04	0.01	± 0.10	± 0.10
7	449.964	449.964	450.13	450.04	0.04	0.02	± 0.10	± 0.10
8	599.958	599.958	600.15	600.07	0.03	0.02	± 0.10	± 0.10
9	799.952	799.952	800.26	800.14	0.04	0.02	± 0.10	± 0.10
10	999.952	999.952	1000.26	1000.26	0.03	0.03	± 0.10	± 0.10
11	1249.96	1249.96	1250.35	1250.34	0.03	0.03	± 0.10	± 0.10
12	1499.95	1499.95	1500.45	1500.49	0.03	0.04	± 0.10	± 0.10
13	1999.95	1999.95	2000.60	2000.58	0.03	0.03	± 0.10	± 0.10
14	2500.07		2501.01		0.04		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician
C. Martinus
Cal. date : 9 April 2015

Approved by
Head of TCL
S. Baidjnath-Misier
Date : 9 April 2015
Berkel en Rodenrijs

Customer ID. no. : DP 2804
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION RvA K 050

CALIBRATION CERTIFICATE

Certificate number : 21500528

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266MST
Serial number	3K650000006806
Service number	18224
Customer identification number	DP 2805

Calibration method

This calibration is carried out with :

Deadweight tester	type : T1100/1	S/N : 4275/86	Cal. Due :	11 July 2018
Deadweight tester	type : T2300/1	S/N : 6612/91	Cal. Due :	18 July 2018

During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights

Environmental conditions

Temperature: 20.0°C ± 2°C

Humidity: 55 %rh ± 25 %rh

Date / period of calibration: 9 April 2015

Results: See following page(s)

Uncertainty: ± 0.012 % of reading with use of correction figures in the range of 20 - 100 % of full scale

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %.
The standard uncertainty has been determined in accordance with document EA-4/02.

Calculated by software revision: 2.7.6.6/2.33

Traceability: The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.

Date: 9 April 2015

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Head of TCL

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Tradinco Instruments
The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500528

	Standard 1	Standard 2	Instrument
Service number			18224
Type	T1100/1	T2300/1	266MST
Manufacturer	Tradinco Instruments	Tradinco Instruments	ABB
Description	Deadweight tester	Deadweight tester	Pressure transmitter
Serial number	4275/86	6612/91	3K650000006806
Range	(30 ÷ 2000) mbar	(0.2 ÷ 35) bar	(0 ÷ 2500) mbar
Medium	Air	Air	Air
Accuracy	±0.01 % R	±0.01 % R	±0.1 % R
Temperature	20.9°C ± 0.5°C	20.9°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP mbar	INPUT DOWN mbar	READING UP mbar	READING DOWN mbar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.0000	0.0000	0.00	0.01	0.00		± 0.10	± 0.10
2	29.9701	29.9701	29.99	29.99	0.07	0.07	± 0.10	± 0.10
3	49.9684	49.9684	50.01	50.02	0.08	0.10	± 0.10	± 0.10
4	99.9633	99.9633	99.98	99.98	0.02	0.02	± 0.10	± 0.10
5	199.961	199.961	199.97	199.98	0.00	0.01	± 0.10	± 0.10
6	299.958	299.958	299.97	299.97	0.00	0.00	± 0.10	± 0.10
7	449.957	449.957	449.96	449.97	0.00	0.00	± 0.10	± 0.10
8	599.949	599.949	599.95	599.94	0.00	0.00	± 0.10	± 0.10
9	799.939	799.939	799.93	799.93	0.00	0.00	± 0.10	± 0.10
10	999.936	999.936	999.92	999.92	0.00	0.00	± 0.10	± 0.10
11	1249.94	1249.94	1249.91	1249.94	0.00	0.00	± 0.10	± 0.10
12	1499.93	1499.93	1499.89	1499.89	0.00	0.00	± 0.10	± 0.10
13	1999.91	1999.91	1999.87	1999.87	0.00	0.00	± 0.10	± 0.10
14	2500.05		2500.09		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 9 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 9 April 2015
Berkel en Rodenrijs

Customer ID. no. : DP 2805
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

ilac-MRA

RvA CALIBRATION RvA K 050

CALIBRATION CERTIFICATE

Certificate number : 21500528

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266MST
Serial number	3K650000006806
Service number	18224
Customer identification number	DP 2805

Calibration method

This calibration is carried out with :

Deadweight tester	type : T1100/1	S/N : 4275/86	Cal. Due : 11 July 2018
Deadweight tester	type : T2300/1	S/N : 6612/91	Cal. Due : 18 July 2018

During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights

Environmental conditions

Temperature: 20.0°C ± 2°C

Humidity: 55 %rh ± 25 %rh

Date / period of calibration: 9 April 2015

Results: See following page(s)

Uncertainty: ± 0.012 % of reading with use of correction figures in the range of 20 - 100 % of full scale

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %.
The standard uncertainty has been determined in accordance with document EA-4/02.

Calculated by software revision: 2.7.6.6/2.33

Traceability: The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.

Date: 9 April 2015

Name: S. Baidjnath-Misier

Head of TCL

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Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

ilac-MRA

RvA CALIBRATION RvA K 050

CALIBRATION CERTIFICATE

Certificate number : 21500528

	Standard 1	Standard 2	Instrument
Service number			18224
Type	T1100/1	T2300/1	266MST
Manufacturer	Tradinco Instruments	Tradinco Instruments	ABB
Description	Deadweight tester	Deadweight tester	Pressure transmitter
Serial number	4275/86	6612/91	3K650000006806
Range	(30 ÷ 2000) mbar	(0.2 ÷ 35) bar	(0 ÷ 2500) mbar
Medium	Air	Air	Air
Accuracy	±0.01 % R	±0.01 % R	±0.1 % R
Temperature	20.9°C ± 0.5°C	20.9°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP mbar	INPUT DOWN mbar	READING UP mbar	READING DOWN mbar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.0000	0.0000	0.00	0.01	0.00		± 0.10	± 0.10
2	29.9701	29.9701	29.99	29.99	0.07	0.07	± 0.10	± 0.10
3	49.9684	49.9684	50.01	50.02	0.08	0.10	± 0.10	± 0.10
4	99.9633	99.9633	99.98	99.98	0.02	0.02	± 0.10	± 0.10
5	199.961	199.961	199.97	199.98	0.00	0.01	± 0.10	± 0.10
6	299.958	299.958	299.97	299.97	0.00	0.00	± 0.10	± 0.10
7	449.957	449.957	449.96	449.97	0.00	0.00	± 0.10	± 0.10
8	599.949	599.949	599.95	599.94	0.00	0.00	± 0.10	± 0.10
9	799.939	799.939	799.93	799.93	0.00	0.00	± 0.10	± 0.10
10	999.936	999.936	999.92	999.92	0.00	0.00	± 0.10	± 0.10
11	1249.94	1249.94	1249.91	1249.94	0.00	0.00	± 0.10	± 0.10
12	1499.93	1499.93	1499.89	1499.89	0.00	0.00	± 0.10	± 0.10
13	1999.91	1999.91	1999.87	1999.87	0.00	0.00	± 0.10	± 0.10
14	2500.05		2500.09		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 9 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 9 April 2015
Berkel en Rodenrijs

Customer ID. no. : DP 2805
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

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The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500563

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266MST
Serial number	3K650000006807
Service number	18225
Customer identification number	DP 2806

Calibration method

This calibration is carried out with :

Deadweight tester	type : T1100/1	S/N : 4275/86	Cal. Due : 11 July 2018
Deadweight tester	type : T2300/1	S/N : 6612/91	Cal. Due : 18 July 2018

During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights

Environmental conditions

Temperature: 20.0°C ± 2°C

Humidity: 55 %rh ± 25 %rh

Date / period of calibration: 14 April 2015

Results: See following page(s)

Uncertainty: ± 0.012 % of reading with use of correction figures in the range of 20 - 100 % of full scale

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %.
The standard uncertainty has been determined in accordance with document EA-4/02.

Calculated by software revision: 2.7.6.6/2.33

Traceability: The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.

Date: 14 April 2015

Name: S. Baidjnath-Misier

Head of TCL

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The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500563

	Standard 1	Standard 2	Instrument
Service number			18225
Type	T1100/1	T2300/1	266MST
Manufacturer	Tradinco Instruments	Tradinco Instruments	ABB
Description	Deadweight tester	Deadweight tester	Pressure transmitter
Serial number	4275/86	6612/91	3K650000006807
Range	(30 ÷ 2000) mbar	(0.2 ÷ 35) bar	(0 ÷ 2500) mbar
Medium	Air	Air	Air
Accuracy	±0.01 % R	±0.01 % R	±0.1 % R
Temperature	20.0°C ± 0.5°C	20.0°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP mbar	INPUT DOWN mbar	READING UP mbar	READING DOWN mbar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.0000	0.0000	0.00	0.01			± 0.10	± 0.10
2	29.9708	29.9708	29.97	29.97	0.00	0.00	± 0.10	± 0.10
3	49.9697	49.9697	49.98	49.97	0.02	0.00	± 0.10	± 0.10
4	99.9657	99.9657	99.98	99.98	0.01	0.01	± 0.10	± 0.10
5	199.965	199.965	199.98	199.98	0.01	0.01	± 0.10	± 0.10
6	299.965	299.965	299.99	299.99	0.01	0.01	± 0.10	± 0.10
7	449.967	449.967	450.02	449.98	0.01	0.00	± 0.10	± 0.10
8	599.963	599.963	600.02	600.03	0.01	0.01	± 0.10	± 0.10
9	799.959	799.959	800.05	800.06	0.01	0.01	± 0.10	± 0.10
10	999.960	999.960	1000.09	1000.10	0.01	0.01	± 0.10	± 0.10
11	1249.97	1249.97	1250.12	1250.13	0.01	0.01	± 0.10	± 0.10
12	1499.97	1499.97	1500.14	1500.12	0.01	0.01	± 0.10	± 0.10
13	1999.96	1999.96	2000.20	2000.20	0.01	0.01	± 0.10	± 0.10
14	2500.09		2500.06		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Customer ID. no. : DP 2806
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Calibrated by
TCL Technician

C. Martinus
Cal. date : 14 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 14 April 2015
Berkel en Rodenrijs

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The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500272R1

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006847
Service number	18053
Customer identification number	P 2352
Calibration method	This calibration is carried out with : Deadweight tester type : M2200/1 S/N : 4792/87 Cal. Due : 24 April 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	25 February 2015
Results	See following page(s)
Uncertainty	± 0.017 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.35
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	25 February 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500272R1

	Standard	Instrument
Service number		18053
Type	M2200/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	4792/87	3K650000006847
Range	(2.7 ÷ 700) bar	(0 ÷ 100) bar
Medium	Oil	Air
Accuracy	±0.012 % R	±0.1 % R
Temperature	20.2°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	0.000	0.00	0.00	± 0.10	± 0.10
2	10.0001	10.0001	10.003	10.006	0.03	0.06	± 0.10	± 0.10
3	20.0049	20.0049	20.008	20.012	0.02	0.04	± 0.10	± 0.10
4	30.0083	30.0083	30.012	30.016	0.01	0.03	± 0.10	± 0.10
5	39.9853	39.9853	39.992	39.996	0.02	0.03	± 0.10	± 0.10
6	49.9800	49.9800	49.983	49.991	0.01	0.02	± 0.10	± 0.10
7	59.9865	59.9865	59.993	59.996	0.01	0.02	± 0.10	± 0.10
8	69.9814	69.9814	69.981	69.984	0.00	0.00	± 0.10	± 0.10
9	79.9779	79.9779	79.973	79.975	-0.01	0.00	± 0.10	± 0.10
10	89.9744	89.9744	89.977	89.978	0.00	0.00	± 0.10	± 0.10
11	99.9690		99.962		-0.01		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 25 February 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 25 February 2015
Berkel en Rodenrijs

Customer ID. no. : P 2352
Customer ref. : 1.099.74103420.400
Our ref. : 61402416
Customer : DNV GL

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500548

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006848
Service number	18209
Customer identification number	P 2353
Calibration method	This calibration is carried out with : Deadweight tester type : M2000/1 S/N : 7518/93 Cal. Due : 3 June 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	13 April 2015
Results	See following page(s)
Uncertainty	± 0.015 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	13 April 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500548

	Standard	Instrument
Service number		18209
Type	M2000/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	7518/93	3K650000006848
Range	(2.6 ÷ 350) bar	(0 ÷ 100) bar
Medium	Oil	Air
Accuracy	±0.011 % R	±0.1 % R
Temperature	19.6°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	0.002	0.00		± 0.10	± 0.10
2	9.99608	9.99608	9.998	10.001	0.02	0.05	± 0.10	± 0.10
3	19.9969	19.9969	20.001	20.003	0.02	0.03	± 0.10	± 0.10
4	29.9975	29.9975	30.002	30.004	0.01	0.02	± 0.10	± 0.10
5	39.9899	39.9899	39.993	39.997	0.01	0.02	± 0.10	± 0.10
6	49.9881	49.9881	49.990	49.993	0.00	0.01	± 0.10	± 0.10
7	59.9865	59.9865	59.987	59.990	0.00	0.01	± 0.10	± 0.10
8	69.9845	69.9845	69.986	69.990	0.00	0.01	± 0.10	± 0.10
9	79.9828	79.9828	79.985	79.982	0.00	0.00	± 0.10	± 0.10
10	89.9807	89.9807	89.980	89.978	0.00	0.00	± 0.10	± 0.10
11	99.9784		99.978		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 13 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 13 April 2015
Berkel en Rodenrijs

Customer ID. no. : P 2353
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500560

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006851
Service number	18207
Customer identification number	P 2356
Calibration method	This calibration is carried out with : Deadweight tester type : M2000/1 S/N : 7518/93 Cal. Due : 3 June 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	14 April 2015
Results	See following page(s)
Uncertainty	± 0.013 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of *k* = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	14 April 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments®
The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500560

	Standard	Instrument
Service number		18207
Type	M2000/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	7518/93	3K650000006851
Range	(2.6 ÷ 350) bar	(0 ÷ 100) bar
Medium	Oil	Air
Accuracy	±0.011 % R	±0.1 % R
Temperature	20.4°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	0.002	0.00		± 0.10	± 0.10
2	9.99595	9.99595	9.999	10.001	0.03	0.05	± 0.10	± 0.10
3	19.9966	19.9966	20.002	20.004	0.03	0.04	± 0.10	± 0.10
4	29.9971	29.9971	30.003	30.001	0.02	0.01	± 0.10	± 0.10
5	39.9894	39.9894	39.998	39.998	0.02	0.02	± 0.10	± 0.10
6	49.9875	49.9875	49.993	49.995	0.01	0.02	± 0.10	± 0.10
7	59.9857	59.9857	59.988	59.992	0.00	0.01	± 0.10	± 0.10
8	69.9836	69.9836	69.987	69.991	0.00	0.01	± 0.10	± 0.10
9	79.9817	79.9817	79.986	79.987	0.01	0.01	± 0.10	± 0.10
10	89.9795	89.9795	89.983	89.981	0.00	0.00	± 0.10	± 0.10
11	99.9771		99.978		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 14 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 14 April 2015
Berkel en Rodenrijs

Customer ID. no. : P 2356
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

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CALIBRATION RvA K 050

CALIBRATION CERTIFICATE

Certificate number : 21500459

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006852
Service number	18052
Customer identification number	P 2357
Calibration method	This calibration is carried out with : Deadweight tester type : M2000/1 S/N : 7518/93 Cal. Due : 3 June 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	26 March 2015
Results	See following page(s)
Uncertainty	± 0.015 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	26 March 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500459

	Standard	Instrument
Service number		18052
Type	M2000/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	7518/93	3K650000006852
Range	(2.6 ÷ 350) bar	(0 ÷ 100) bar
Medium	Oil	Air
Accuracy	±0.011 % R	±0.1 % R
Temperature	20.6°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	-0.011	-0.009			± 0.10	± 0.10
2	9.99591	9.99591	9.986	9.989	-0.10	-0.07	± 0.10	± 0.10
3	19.9965	19.9965	19.988	19.991	-0.04	-0.03	± 0.10	± 0.10
4	29.9970	29.9970	29.989	29.992	-0.03	-0.02	± 0.10	± 0.10
5	39.9893	39.9893	39.980	39.984	-0.02	-0.01	± 0.10	± 0.10
6	49.9873	49.9873	49.978	49.982	-0.02	-0.01	± 0.10	± 0.10
7	59.9855	59.9855	59.976	59.980	-0.02	-0.01	± 0.10	± 0.10
8	69.9834	69.9834	69.973	69.977	-0.01	-0.01	± 0.10	± 0.10
9	79.9815	79.9815	79.970	79.973	-0.01	-0.01	± 0.10	± 0.10
10	89.9792	89.9792	89.970	89.970	-0.01	-0.01	± 0.10	± 0.10
11	99.9767		99.964		-0.01		± 0.10	

Before calibration the transmitter has not been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Customer ID. no. : P 2357
Customer ref. : -
Our ref. : 61500730
Customer : DNV GL

Calibrated by
TCL Technician

P. Verhoef
Cal. date : 26 March 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 26 March 2015
Berkel en Rodenrijs

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CALIBRATION CERTIFICATE

Certificate number : 21500532

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006853
Service number	18201
Customer identification number	P 2358
Calibration method	This calibration is carried out with : Deadweight tester type : M2000/1 S/N : 7518/93 Cal. Due : 3 June 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	9 April 2015
Results	See following page(s)
Uncertainty	± 0.015 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of *k* = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	9 April 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500532

	Standard	Instrument
Service number		18201
Type	M2000/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	7518/93	3K650000006853
Range	(2.6 ÷ 350) bar	(0 ÷ 100) bar
Medium	Oil	Air
Accuracy	±0.011 % R	±0.1 % R
Temperature	20.5°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	-0.005	0.004			± 0.10	± 0.10
2	9.99593	9.99593	9.992	9.994	-0.04	-0.02	± 0.10	± 0.10
3	19.9966	19.9966	19.995	19.996	-0.01	0.00	± 0.10	± 0.10
4	29.9971	29.9971	29.996	29.999	0.00	0.01	± 0.10	± 0.10
5	39.9894	39.9894	39.985	39.993	-0.01	0.01	± 0.10	± 0.10
6	49.9874	49.9874	49.990	49.989	0.01	0.00	± 0.10	± 0.10
7	59.9856	59.9856	59.984	59.985	0.00	0.00	± 0.10	± 0.10
8	69.9835	69.9835	69.981	69.990	0.00	0.01	± 0.10	± 0.10
9	79.9816	79.9816	79.985	79.982	0.00	0.00	± 0.10	± 0.10
10	89.9793	89.9793	89.986	89.987	0.01	0.01	± 0.10	± 0.10
11	99.9769		99.981		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 9 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 9 April 2015
Berkel en Rodenrijs

Customer ID. no. : P 2358
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

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T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500547

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006855
Service number	18210
Customer identification number	P 2360
Calibration method	This calibration is carried out with : Deadweight tester type : M2000/1 S/N : 7518/93 Cal. Due : 3 June 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	13 April 2015
Results	See following page(s)
Uncertainty	± 0.015 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	13 April 2015
Name	S. Baidjnath-Misier Head of TCL

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RvA CALIBRATION RvA K 050

CALIBRATION CERTIFICATE

Certificate number : 21500547

	Standard	Instrument
Service number		18210
Type	M2000/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	7518/93	3K650000006855
Range	(2.6 ÷ 350) bar	(0 ÷ 100) bar
Medium	Oil	Air
Accuracy	±0.011 % R	±0.1 % R
Temperature	19.6°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	0.002	0.00		± 0.10	± 0.10
2	9.99608	9.99608	9.997	10.000	0.01	0.04	± 0.10	± 0.10
3	19.9969	19.9969	20.002	20.004	0.03	0.04	± 0.10	± 0.10
4	29.9975	29.9975	30.003	30.006	0.02	0.03	± 0.10	± 0.10
5	39.9899	39.9899	39.993	39.998	0.01	0.02	± 0.10	± 0.10
6	49.9881	49.9881	49.989	49.995	0.00	0.01	± 0.10	± 0.10
7	59.9865	59.9865	59.987	59.990	0.00	0.01	± 0.10	± 0.10
8	69.9845	69.9845	69.984	69.989	0.00	0.01	± 0.10	± 0.10
9	79.9828	79.9828	79.982	79.981	0.00	0.00	± 0.10	± 0.10
10	89.9807	89.9807	89.981	89.979	0.00	0.00	± 0.10	± 0.10
11	99.9784		99.978		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Customer ID. no. : P 2360
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Calibrated by
TCL Technician

C. Martinus
Cal. date : 13 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 13 April 2015
Berkel en Rodenrijs

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500549

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006856
Service number	18200
Customer identification number	P 2361
Calibration method	This calibration is carried out with : Deadweight tester type : M2000/1 S/N : 7518/93 Cal. Due : 3 June 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	13 April 2015
Results	See following page(s)
Uncertainty	± 0.020 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	13 April 2015
Name	S. Baidjnath-Misier Head of TCL

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T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500549

	Standard	Instrument
Service number		18200
Type	M2000/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	7518/93	3K650000006856
Range	(2.6 ÷ 350) bar	(0 ÷ 100) bar
Medium	Oil	Air
Accuracy	±0.011 % R	±0.1 % R
Temperature	20.3°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	0.001	0.00		± 0.10	± 0.10
2	9.99596	9.99596	9.998	10.002	0.02	0.06	± 0.10	± 0.10
3	19.9966	19.9966	20.001	20.004	0.02	0.04	± 0.10	± 0.10
4	29.9972	29.9972	30.003	30.005	0.02	0.03	± 0.10	± 0.10
5	39.9895	39.9895	39.994	39.997	0.01	0.02	± 0.10	± 0.10
6	49.9876	49.9876	49.993	49.996	0.01	0.02	± 0.10	± 0.10
7	59.9858	59.9858	59.989	59.994	0.01	0.01	± 0.10	± 0.10
8	69.9837	69.9837	69.989	69.992	0.01	0.01	± 0.10	± 0.10
9	79.9819	79.9819	79.987	79.994	0.01	0.02	± 0.10	± 0.10
10	89.9796	89.9796	89.982	89.990	0.00	0.01	± 0.10	± 0.10
11	99.9772		99.978		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 13 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 13 April 2015
Berkel en Rodenrijs

Customer ID. no. : P 2361
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500461

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006880
Service number	18060
Customer identification number	P 2391
Calibration method	This calibration is carried out with : Deadweight tester type : M2200/1 S/N : 4792/87 Cal. Due : 24 April 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	26 March 2015
Results	See following page(s)
Uncertainty	± 0.019 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of *k* = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	26 March 2015
Name	S. Baidjnath-Misier Head of TCL

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All quotations and deliveries are subject to the general delivery- and payment conditions of the "Cooperatieve Vereniging Het Instrument U.A." filed with the Registary of the District Court in Utrecht on 13-01-1993 and with the Chamber of Commerce and Industry in Amersfoort

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The Calibration Company

T.C.L. Tradinco Calibration Laboratory

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CALIBRATION RvA K 050

CALIBRATION CERTIFICATE

Certificate number : 21500461

	Standard	Instrument
Service number		18060
Type	M2200/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	4792/87	3K650000006880
Range	(2.7 ÷ 700) bar	(0 ÷ 400) bar
Medium	Oil	Air
Accuracy	±0.012 % R	±0.1 % R
Temperature	20.2°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	-0.012	-0.021			± 0.10	± 0.10
2	39.9853	39.9853	39.962	39.962	-0.06	-0.06	± 0.10	± 0.10
3	79.9779	79.9779	79.958	79.966	-0.02	-0.01	± 0.10	± 0.10
4	119.973	119.973	119.968	119.984	0.00	0.01	± 0.10	± 0.10
5	159.970	159.970	159.982	160.000	0.01	0.02	± 0.10	± 0.10
6	199.952	199.952	199.975	199.995	0.01	0.02	± 0.10	± 0.10
7	239.949	239.949	239.973	239.998	0.01	0.02	± 0.10	± 0.10
8	279.945	279.945	279.974	279.990	0.01	0.02	± 0.10	± 0.10
9	319.940	319.940	319.965	319.976	0.01	0.01	± 0.10	± 0.10
10	359.938	359.938	359.934	359.975	0.00	0.01	± 0.10	± 0.10
11	399.920		399.917		0.00		± 0.10	

Before calibration the transmitter has not been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Customer ID. no. : P 2391
Customer ref. : -
Our ref. : 61500730
Customer : DNV GL

Calibrated by
TCL Technician

P. Verhoef
Cal. date : 26 March 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 26 March 2015
Berkel en Rodenrijs

Tradinco Instruments

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500278R1

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006881
Service number	18061
Customer identification number	P 2392
Calibration method	This calibration is carried out with : Deadweight tester type : M2200/1 S/N : 4792/87 Cal. Due : 24 April 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	25 February 2015
Results	See following page(s)
Uncertainty	± 0.029 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.35
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	25 February 2015
Name	S. Baidjnath-Misier Head of TCL

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The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500278R1

	Standard	Instrument
Service number		18061
Type	M2200/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	4792/87	3K650000006881
Range	(2.7 ÷ 700) bar	(0 ÷ 400) bar
Medium	Oil	Air
Accuracy	±0.012 % R	±0.1 % R
Temperature	20.9°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	-0.002	0.00		± 0.10	± 0.10
2	39.9849	39.9849	39.985	39.988	0.00	0.01	± 0.10	± 0.10
3	79.9770	79.9770	79.982	79.992	0.01	0.02	± 0.10	± 0.10
4	119.972	119.972	119.974	119.981	0.00	0.01	± 0.10	± 0.10
5	159.968	159.968	159.964	159.982	0.00	0.01	± 0.10	± 0.10
6	199.950	199.950	199.970	199.943	0.01	0.00	± 0.10	± 0.10
7	239.946	239.946	239.916	239.948	-0.01	0.00	± 0.10	± 0.10
8	279.942	279.942	279.891	279.925	-0.02	-0.01	± 0.10	± 0.10
9	319.937	319.937	319.895	319.989	-0.01	0.02	± 0.10	± 0.10
10	359.934	359.934	359.922	359.989	0.00	0.02	± 0.10	± 0.10
11	399.916		399.861		-0.01		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Customer ID. no. : P 2392
Customer ref. : 1.099.74103420.400
Our ref. : 61402416
Customer : DNV GL

Calibrated by
TCL Technician

C. Martinus
Cal. date : 25 February 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 25 February 2015
Berkel en Rodenrijs

Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500579

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006882
Service number	18215
Customer identification number	P 2393
Calibration method	This calibration is carried out with : Deadweight tester type : M2200/1 S/N : 4792/87 Cal. Due : 24 April 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	16 April 2015
Results	See following page(s)
Uncertainty	± 0.015 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	16 April 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments
The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500579

	Standard	Instrument
Service number		18215
Type	M2200/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	4792/87	3K650000006882
Range	(2.7 ÷ 700) bar	(0 ÷ 400) bar
Medium	Oil	Air
Accuracy	±0.012 % R	±0.1 % R
Temperature	20.4°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	0.000	0.00	0.00	± 0.10	± 0.10
2	39.9852	39.9852	39.999	39.997	0.03	0.03	± 0.10	± 0.10
3	79.9777	79.9777	79.987	79.993	0.01	0.02	± 0.10	± 0.10
4	119.973	119.973	119.975	119.961	0.00	-0.01	± 0.10	± 0.10
5	159.969	159.969	159.951	159.938	-0.01	-0.02	± 0.10	± 0.10
6	199.952	199.952	199.942	199.952	0.00	0.00	± 0.10	± 0.10
7	239.948	239.948	239.954	239.966	0.00	0.01	± 0.10	± 0.10
8	279.944	279.944	279.946	279.929	0.00	-0.01	± 0.10	± 0.10
9	319.939	319.939	319.940	319.938	0.00	0.00	± 0.10	± 0.10
10	359.937	359.937	359.932	359.921	0.00	0.00	± 0.10	± 0.10
11	399.919		399.912		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 16 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 16 April 2015
Berkel en Rodenrijs

Customer ID. no. : P 2393
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

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T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500995

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006883
Service number	18216
Customer identification number	P 2394
Calibration method	This calibration is carried out with : Deadweight tester type : M2200/1 S/N : 4792/87 Cal. Due : 24 April 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	23 July 2015
Results	See following page(s)
Uncertainty	± 0.014 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of *k* = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.35
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	23 July 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500995

	Standard	Instrument
Service number		18216
Type	M2200/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	4792/87	3K650000006883
Range	(2.7 ÷ 700) bar	(0 ÷ 400) bar
Medium	Oil	Air
Accuracy	±0.012 % R	±0.1 % R
Temperature	20.5°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	-0.006	0.00		± 0.10	± 0.10
2	39.9851	39.9851	39.978	39.979	-0.02	-0.02	± 0.10	± 0.10
3	79.9775	79.9775	79.973	79.967	-0.01	-0.01	± 0.10	± 0.10
4	119.972	119.972	119.952	119.955	-0.02	-0.01	± 0.10	± 0.10
5	159.969	159.969	159.948	159.963	-0.01	0.00	± 0.10	± 0.10
6	199.951	199.951	199.940	199.955	-0.01	0.00	± 0.10	± 0.10
7	239.948	239.948	239.933	239.943	-0.01	0.00	± 0.10	± 0.10
8	279.943	279.943	279.918	279.927	-0.01	-0.01	± 0.10	± 0.10
9	319.939	319.939	319.911	319.921	-0.01	-0.01	± 0.10	± 0.10
10	359.936	359.936	359.909	359.907	-0.01	-0.01	± 0.10	± 0.10
11	399.918		399.910		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 23 July 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 23 July 2015
Berkel en Rodenrijs

Customer ID. no. : P 2394
Customer ref. : 17.099.74103420.400
Our ref. : 61501526
Customer : DNV GL

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T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500577

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006884
Service number	18214
Customer identification number	P 2395
Calibration method	This calibration is carried out with : Deadweight tester type : M2200/1 S/N : 4792/87 Cal. Due : 24 April 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	16 April 2015
Results	See following page(s)
Uncertainty	± 0.019 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	16 April 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments
The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500577

	Standard	Instrument
Service number		18214
Type	M2200/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	4792/87	3K650000006884
Range	(2.7 ÷ 700) bar	(0 ÷ 400) bar
Medium	Oil	Air
Accuracy	±0.012 % R	±0.1 % R
Temperature	20.2°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	-0.010	0.00		± 0.10	± 0.10
2	39.9853	39.9853	39.987	39.987	0.00	0.00	± 0.10	± 0.10
3	79.9779	79.9779	79.979	79.984	0.00	0.01	± 0.10	± 0.10
4	119.973	119.973	119.960	119.963	-0.01	-0.01	± 0.10	± 0.10
5	159.970	159.970	159.931	159.925	-0.02	-0.03	± 0.10	± 0.10
6	199.952	199.952	199.907	199.890	-0.02	-0.03	± 0.10	± 0.10
7	239.949	239.949	239.868	239.870	-0.03	-0.03	± 0.10	± 0.10
8	279.945	279.945	279.854	279.865	-0.03	-0.03	± 0.10	± 0.10
9	319.940	319.940	319.853	319.860	-0.03	-0.03	± 0.10	± 0.10
10	359.938	359.938	359.845	359.952	-0.03	0.00	± 0.10	± 0.10
11	399.920		399.799		-0.03		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Calibrated by
TCL Technician

C. Martinus
Cal. date : 16 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 16 April 2015
Berkel en Rodenrijs

Customer ID. no. : P 2395
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

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CALIBRATION CERTIFICATE

Certificate number : 21500569

Applicant	DNV GL Utrechtseweg 310 6812 AR Arnhem
Instrument	Pressure transmitter
Manufacturer	ABB
Type	266GST
Serial number	3K650000006888
Service number	18213
Customer identification number	P 2399
Calibration method	This calibration is carried out with : Deadweight tester type : M2200/1 S/N : 4792/87 Cal. Due : 24 April 2019 During calibration a testpressure is put under a calibrated measuring piston which is loaded with calibrated weights The instrument is calibrated in combination with oil/gas seperator type 8335.
Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	15 April 2015
Results	See following page(s)
Uncertainty	± 0.014 % of reading with use of correction figures in the range of 20 - 100 % of full scale The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of *k* = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	15 April 2015
Name	S. Baidjnath-Misier Head of TCL

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T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500569

	Standard	Instrument
Service number		18213
Type	M2200/1	266GST
Manufacturer	Tradinco Instruments	ABB
Description	Deadweight tester	Pressure transmitter
Serial number	4792/87	3K650000006888
Range	(2.7 ÷ 700) bar	(0 ÷ 400) bar
Medium	Oil	Air
Accuracy	±0.012 % R	±0.1 % R
Temperature	20.0°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP bar	INPUT DOWN bar	READING UP bar	READING DOWN bar	ERROR UP % R	ERROR DOWN % R	LIMIT UP % R	LIMIT DOWN % R
1	0.00000	0.00000	0.000	-0.001	0.00		± 0.10	± 0.10
2	39.9910	39.9910	39.980	39.977	-0.03	-0.03	± 0.10	± 0.10
3	79.9837	79.9837	79.960	79.968	-0.03	-0.02	± 0.10	± 0.10
4	119.979	119.979	119.953	119.957	-0.02	-0.02	± 0.10	± 0.10
5	159.976	159.976	159.945	159.947	-0.02	-0.02	± 0.10	± 0.10
6	199.958	199.958	199.934	199.936	-0.01	-0.01	± 0.10	± 0.10
7	239.955	239.955	239.925	239.932	-0.01	-0.01	± 0.10	± 0.10
8	279.951	279.951	279.932	279.951	-0.01	0.00	± 0.10	± 0.10
9	319.947	319.947	319.916	319.935	-0.01	0.00	± 0.10	± 0.10
10	359.945	359.945	359.922	359.918	-0.01	-0.01	± 0.10	± 0.10
11	399.927		399.917		0.00		± 0.10	

Before calibration the transmitter has been set to zero.
The transmitter is mounted in a frame and the whole is calibrated in the horizontal position.
The read-out of the transmitter was done using the software Studio302 / ThermoLyse on a laptop of the customer.

Customer ID. no. : P 2399
Customer ref. : 9.099.74103420.400
Our ref. : 61500533
Customer : DNV GL

Calibrated by
TCL Technician

C. Martinus
Cal. date : 15 April 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 15 April 2015
Berkel en Rodenrijs

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ilac-MRA

RvA CALIBRATION RvA K 050

CALIBRATION CERTIFICATE

Certificate number : 21500409

Applicant	Kema Nederland BV Utrechtseweg 310 6812 AR Arnhem
Instrument	Digital pressure indicator + Volt output
Manufacturer	Druck
Type	DPI 142
Serial number	2805148
Service number	18155
Customer identification number	KPS-TDM 8123
Calibration method	This calibration is carried out with :

Pressure Controller	type : DPI 515	S/N : 51500850	Cal. Due : 10 April 2015
Digital Multimeter	type : 1281	S/N : 43394	Cal. Due : 2 March 2016

Environmental conditions	Temperature: 20.0°C ± 2°C Humidity: 55 %rh ± 25 %rh
Date / period of calibration	18 March 2015
Results	See following page(s)
Uncertainty	± 0.015 % of full scale with use of correction figures in the range of (950 ÷ 1050) mbar (abs) The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with document EA-4/02. Calculated by software revision: 2.7.6.6/2.33
Traceability	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	18 March 2015
Name	S. Baidjnath-Misier Head of TCL

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Tradinco Instruments®

The Calibration Company

T.C.L. Tradinco Calibration Laboratory

CALIBRATION CERTIFICATE

Certificate number : 21500409

	Standard	Standard	Instrument
Service number			18155
Type	DPI 515	1281	DPI 142
Manufacturer	Druck	Wavetek	Druck
Description	Pressure Controller	Digital Multimeter	Digital pressure indicator + mV output
Serial number	51500850	43394	2805148
Range	(750 ÷ 1150) mbar (abs)	(0 ÷ 10000) mV	(750 ÷ 1150) mbar (abs)
Medium	Air		Air
Accuracy	±0.15 mbar	±0.002 % R	±0.05 % FS
Temperature	20.4°C ± 0.5°C	20.4°C ± 0.5°C	

	STANDARD		INSTRUMENT					
MP.	INPUT UP mbar (abs)	INPUT DOWN mbar (abs)	READING UP mV	READING DOWN mV	ERROR UP % FS	ERROR DOWN % FS	LIMIT UP % FS	LIMIT DOWN % FS
1	950.000	950.000	5008.6	5008.7	0.030	0.030	± 0.050	± 0.050
2	960.000	960.000	5258.5	5258.7	0.030	0.030	± 0.050	± 0.050
3	970.000	970.000	5508.6	5508.8	0.030	0.031	± 0.050	± 0.050
4	980.000	980.000	5758.6	5758.8	0.030	0.031	± 0.050	± 0.050
5	990.000	990.000	6008.8	6008.8	0.031	0.031	± 0.050	± 0.050
6	1000.000	1000.000	6258.6	6258.6	0.030	0.030	± 0.050	± 0.050
7	1010.000	1010.000	6508.6	6508.6	0.030	0.030	± 0.050	± 0.050
8	1020.000	1020.000	6758.6	6758.6	0.030	0.030	± 0.050	± 0.050
9	1030.000	1030.000	7008.6	7008.7	0.030	0.030	± 0.050	± 0.050
10	1040.000	1040.000	7258.7	7258.7	0.030	0.030	± 0.050	± 0.050
11	1050.000		7508.8		0.031		± 0.050	

The instrument has not been adjusted (As found is as left calibration).

Calibrated by
Deputy Head of TCL

A.G. v.d. Berghe
Cal. date : 18 March 2015

Approved by
Head of TCL

S. Baidjnath-Misier
Date : 18 March 2015
Berkel en Rodenrijs

Customer ID. no. : KPS-TDM 8123
Customer ref. : 1.099.74103420.200
Our ref. : 61500643
Customer : Kema Nederland BV

CIJ Borculo
Kalibraties & Energiemetingen
Zeker Meten!

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Internet www.cijborculo.nl

DNV-GL
Utrechtseweg 310
6812 AR Arnhem

Calibration certificate

Certificatenumber	:	**1503013**	page 1 of		2
Instrument	:	temp/Rv.-meter	Specifications	:	unknown
Manufacturer	:	E+E			
Type	:	EE31			
Serialnumber	:	324331502			
Identificationnumber	:	KPS-TDM 0013	Barcode	:	104169

Calibration method : The calibration is executed by comparing the readout of the unit under test with the value generated by the calibrator.

Results : see next pages

Remark : No adjustment was required

Calibration date : 19-Mar-2015

Due : 19-Mar-2016

Enviromental conditions : Temperature (23,0 ± 2,0) ° C ; humidity (55 ± 10) %

Traceability : The calibration has been executed using the standards, mentioned below, which are traceable to the (inter)national standards.

Uncertainty :

calibrationstandards:

Manufacturer	Type	Certificatenumber	Calibration date
Michell	DEWMET-01-TDH	10606.552	12-jun-2013

Executed by : Geert Veldink
Team Leader measuring instruments

CIJ Borculo
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7271 AZ Borculo
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Internet www.cijborculo.nl

Results:

Humidity					
Input		Reading		Equals	
30,70	%	1,557	V	31,14	%
40,48	%	2,050	V	41,01	%
59,47	%	2,973	V	59,47	%
84,45	%	4,215	V	84,29	%

Temperature			
Input		Reading	
24,60	°C	24,55	°C

THERMO ELECTRIC INSTRUMENTATION

CALIBRATION RvA K 065

Page 1 of 2

CERTIFICATE
Number: R15130

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. Pt100 /4W
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serialnr.	:	121407488
Resolution	:	0,01 °C
Calibration method	:	The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, by comparison with a standard thermometer. After the calibration at the highest temperature the thermometer calibration at 0 °C has been repeated.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Date of calibration	:	30-06-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 0,13 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

Spruit

J. Spruit
Sr. Calibration Engineer

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Certificate No. : R15130

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
0,00	-0,09	-0,09
50,00	49,99	-0,01
100,00	100,05	0,05
150,00	150,09	0,09
200,00	200,10	0,10

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15131

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. Pt100 /4W
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serialnr.	:	121407489
Resolution	:	0,01 °C
Calibration method	:	The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, by comparison with a standard thermometer. After the calibration at the highest temperature the thermometer calibration at 0 °C has been repeated.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Date of calibration	:	30-06-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 0,09 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

Spruit

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THERMO ELECTRIC INSTRUMENTATION

Calibration Certificate

 Certificate No. : R15131

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
0,00	-0,09	-0,09
50,00	49,98	-0,02
100,00	100,03	0,03
150,00	150,07	0,07
200,00	200,08	0,08

THERMO ELECTRIC INSTRUMENTATION

CALIBRATION RvA K 065

CERTIFICATE
Number: R15129

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. Pt100 /4W
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serialnr.	:	121407491
Resolution	:	0,01 °C
Calibration method	:	The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, by comparison with a standard thermometer. After the calibration at the highest temperature the thermometer calibration at 0 °C has been repeated.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Date of calibration	:	30-06-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 0,09 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO
ELECTRIC
INSTRUMENTATION

Calibration Certificate

Page : 2 of 2

Certificate No. : R15129

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
0,00	-0,00	-0,00
50,00	49,86	-0,14
100,00	99,66	-0,34
150,00	149,42	-0,58
200,00	199,12	-0,88

CERTIFICATE
Number: R15127

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. Pt100 /4W
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serialnr.	:	121407486
Resolution	:	0,01 °C
Calibration method	:	The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, by comparison with a standard thermometer. After the calibration at the highest temperature the thermometer calibration at 0 °C has been repeated.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Date of calibration	:	30-06-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 0,09 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Certificate No. : R15127

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
0,00	0,00	0,00
50,00	50,00	0,00
100,00	99,96	-0,04
150,00	149,89	-0,11
200,00	199,77	-0,23

THERMO ELECTRIC INSTRUMENTATION

CALIBRATION RvA K 065

CERTIFICATE
Number: R15132

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serialnr.	:	121407505
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 2,2 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Certificate No. : R15132

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,8	0,8
150,0	151,1	1,1
250,0	251,5	1,5
350,0	351,9	1,9
450,0	452,4	2,4
550,0	553,0	3,0
650,0	653,6	3,6

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15140

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407485
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,6 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Page : 2 of 2 Certificate No. : R15140

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,5	0,5
150,0	150,6	0,6
250,0	250,7	0,7
350,0	350,8	0,8
450,0	450,8	0,8
550,0	551,0	1,0
650,0	651,1	1,1

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15137A

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407487
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,6°C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	23 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Page : 1 of 2 Certificate No. : R15137A

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,000	50,603	0,603
150,000	150,680	0,680
250,000	250,827	0,827
350,000	350,999	0,999
450,000	451,153	1,153
550,000	551,248	1,248
650,000	651,240	1,240

THERMO ELECTRIC INSTRUMENTATION

CALIBRATION RvA K 065

CERTIFICATE
Number: R15138

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407502
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,7 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC INSTRUMENTATION

Calibration Certificate

Certificate No. : R15138

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,7	0,7
150,0	150,8	0,8
250,0	250,8	0,8
350,0	350,9	0,9
450,0	451,0	1,0
550,0	551,2	1,2
650,0	651,3	1,3

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15134

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407501
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,7 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Certificate No. : R15134

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,6	0,6
150,0	150,6	0,6
250,0	250,6	0,6
350,0	350,7	0,7
450,0	450,8	0,8
550,0	551,0	1,0
650,0	651,3	1,3

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15142

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407495
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,6 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Page : 2 of 2

Certificate No. : R15142

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,7	0,7
150,0	150,9	0,9
250,0	251,0	1,0
350,0	351,1	1,1
450,0	451,1	1,1
550,0	551,1	1,1
650,0	651,0	1,0

THERMO ELECTRIC INSTRUMENTATION

CALIBRATION RvA K 065

CERTIFICATE
Number: R15141

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407496
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,6 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Certificate No. : R15141

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,7	0,7
150,0	151,1	1,1
250,0	251,4	1,4
350,0	351,7	1,7
450,0	452,0	2,0
550,0	552,3	2,3
650,0	652,6	2,6

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15135

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407484
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,7 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

H.T.V. Do

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Sr. Calibration Engineer

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Page : 2 of 2 Certificate No. : R15135

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,6	0,6
150,0	150,6	0,6
250,0	250,7	0,7
350,0	350,8	0,8
450,0	450,9	0,9
550,0	551,2	1,2
650,0	651,4	1,4

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15144

Applicant :	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument :	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer :	DELL laptop
IDnr :	KEMA 350946
Type :	Modelnr PP18L
Controller box :	SMAR System Fieldbus Universal bridge
Type :	DFI 302 ME
ID. Nr ;	KPS-TDM-8397
Software for PC :	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter :	PR-electronics
Type :	5350B
Serial nr. :	121407494
Resolution :	0,1 °C
Calibration method :	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions :	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration :	02-07-2015 to 09-07-2015
Results :	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty :	The uncertainty is 1,7 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability :	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date :	9 July 2015

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THERMO ELECTRIC
INSTRUMENTATION

Calibration Certificate

Certificate No. : R15144

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,6	0,6
150,0	150,7	0,7
250,0	250,8	0,8
350,0	350,9	0,9
450,0	451,0	1,0
550,0	551,1	1,1
650,0	651,3	1,3

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15143

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407499
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,6 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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Calibration Certificate

Certificate No. : R15143

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,7	0,7
150,0	150,8	0,8
250,0	250,8	0,8
350,0	351,0	1,0
450,0	451,2	1,2
550,0	551,4	1,4
650,0	651,6	1,6

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15145

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407492
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,6 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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INSTRUMENTATION

Calibration Certificate

Certificate No. : R15145

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,5	0,5
150,0	150,6	0,6
250,0	250,7	0,7
350,0	350,8	0,8
450,0	450,9	0,9
550,0	551,1	1,1
650,0	651,3	1,3

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15136

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407497
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,7 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
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Calibration Certificate

 Certificate No. : R15136

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,7	0,7
150,0	150,7	0,7
250,0	250,8	0,8
350,0	350,9	0,9
450,0	451,1	1,1
550,0	551,2	1,2
650,0	651,4	1,4

Page 1 of 2

CERTIFICATE
Number: R15139

Applicant	:	KEMA NEDERLAND BV UTRECHTSEWEG 310 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	Temperature indicator which consists of computer & controller box + Fieldbus Foundation PR- topTransmitter incl. TC type K
Computer	:	DELL laptop
IDnr	:	KEMA 350946
Type	:	Modelnr PP18L
Controller box	:	SMAR System Fieldbus Universal bridge
Type	:	DFI 302 ME
ID. Nr	;	KPS-TDM-8397
Software for PC	:	Studio 302 version 1.11.0.7 & System 302 version 7.3.5
Transmitter	:	PR-electronics
Type	:	5350B
Serial nr.	:	121407498
Resolution	:	0,1 °C
Calibration method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C with an immersion depth of 400 mm. The thermometer has been calibrated in liquid bath's, with a minimum immersion of 200 mm, and in a tube furnace with a minimum immersion depth of 360 mm, by comparison with a standard thermometer.
Environmental conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of calibration	:	02-07-2015 to 09-07-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The calibration temperature t_{90} defined according the ITS-90; 2 The actual reading; 3 The deviation in °C.
Uncertainty	:	The uncertainty is 1,6 °C. The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which provides a confidence level of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	9 July 2015

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THERMO ELECTRIC
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Calibration Certificate

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Certificate No. : R15139

Calibration Temperature [°C]	Actual Reading [°C]	Deviation [°C]
50,0	50,7	0,7
150,0	150,8	0,8
250,0	250,9	0,9
350,0	351,0	1,0
450,0	451,1	1,1
550,0	551,3	1,3
650,0	651,4	1,4

CERTIFICATE
Number: R15166

Applicant	:	KEMA B.V. UTRECHTSEWEG 310 GEBOUW B08 – EXPEDITIE 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	22 pcs. Thermocouples type K
Manufacturer	:	Thermo Electric Instrumentation B.V.
Item no.	:	9297465
Serial number	:	R15166-1 to -22
Calibration Method	:	Prior to the calibration the thermocouple has been heat treated for a period of 12 hours at 500 °C. The thermocouple has been calibrated in liquid bath's, with an minimum immersion depth of 200 mm, by comparison with a standard thermometer. The cold junction has been realised by using an ice bath.
Environmental Conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of Calibration	:	10-08-2015 to 19-08-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The serial number / tag number; 2 The temperature t90 defined according the ITS-90; 3 The microvolt value Et as per the relevant tables at t90 according IEC 60584-1 (2013); 4 The actual measured microvolt value E; 5 The deviation in microvolt; 6 The deviation in °C; 7 The expanded uncertainty in °C.
Uncertainty	:	The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	24 August 2015

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Tag No.	Temperature [°C]	Tabel Value [μV]	Measured Value [μV]	Deviation [μV]	Deviation [°C]	Expanded Uncertainty [°C]
R15166-1	50,0	2023,08	2042,85	19,77	0,48	0,9
	150,0	6138,34	6180,40	42,06	1,04	
	250,0	10153,37	10226,58	73,21	1,80	
	350,0	14293,15	14406,37	113,22	2,70	
	450,0	18515,81	18677,90	162,10	3,81	
R15166-2	50,0	2023,08	2043,39	20,32	0,49	1
	150,0	6138,34	6181,88	43,54	1,08	
	250,0	10153,37	10228,44	75,07	1,84	
	350,0	14293,15	14408,07	114,92	2,74	
	450,0	18515,81	18678,89	163,08	3,84	
R15166-3	50,0	2023,08	2044,01	20,94	0,51	1
	150,0	6138,34	6183,73	45,39	1,13	
	250,0	10153,37	10230,82	77,45	1,90	
	350,0	14293,15	14410,27	117,12	2,79	
	450,0	18515,81	18680,21	164,40	3,87	
R15166-4	50,0	2023,08	2043,98	20,90	0,51	1,2
	150,0	6138,34	6183,30	44,96	1,12	
	250,0	10153,37	10231,06	77,69	1,91	
	350,0	14293,15	14412,24	119,09	2,84	
	450,0	18515,81	18684,97	169,17	3,98	
R15166-5	50,0	2023,08	2044,01	20,93	0,51	1
	150,0	6138,34	6183,26	44,92	1,12	
	250,0	10153,37	10229,81	76,44	1,88	
	350,0	14293,15	14408,64	115,49	2,76	
	450,0	18515,81	18677,87	162,06	3,81	
R15166-6	50,0	2023,08	2042,57	19,49	0,47	0,8
	150,0	6138,34	6179,60	41,26	1,02	
	250,0	10153,37	10225,51	72,15	1,77	
	350,0	14293,15	14405,29	112,14	2,68	
	450,0	18515,81	18677,06	161,25	3,80	
R15166-7	50,0	2023,08	2042,98	19,90	0,48	0,8
	150,0	6138,34	6181,97	43,63	1,08	
	250,0	10153,37	10230,33	76,96	1,89	
	350,0	14293,15	14413,05	119,90	2,86	
	450,0	18515,81	18688,26	172,45	4,06	
R15166-8	50,0	2023,08	2043,31	20,23	0,49	0,9
	150,0	6138,34	6182,23	43,89	1,09	
	250,0	10153,37	10229,60	76,23	1,87	
	350,0	14293,15	14410,40	117,25	2,80	
	450,0	18515,81	18682,77	166,97	3,93	
R15166-9	50,0	2023,08	2042,78	19,70	0,48	0,8
	150,0	6138,34	6180,16	41,81	1,04	
	250,0	10153,37	10226,75	73,38	1,80	
	350,0	14293,15	14407,56	114,41	2,73	
	450,0	18515,81	18680,69	164,89	3,88	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation [µV]	Deviation [°C]	Expanded Uncertainty [°C]
R15166-10	50,0	2023,08	2042,08	19,00	0,46	0,7
	150,0	6138,34	6179,47	41,13	1,02	
	250,0	10153,37	10226,42	73,05	1,79	
	350,0	14293,15	14407,91	114,77	2,74	
	450,0	18515,81	18682,08	166,27	3,91	
R15166-11	50,0	2023,08	2043,19	20,11	0,49	1
	150,0	6138,34	6180,55	42,21	1,05	
	250,0	10153,37	10226,72	73,35	1,80	
	350,0	14293,15	14406,67	113,52	2,71	
	450,0	18515,81	18678,54	162,73	3,83	
R15166-12	50,0	2023,08	2043,87	20,79	0,50	1
	150,0	6138,34	6181,11	42,76	1,06	
	250,0	10153,37	10226,59	73,23	1,80	
	350,0	14293,15	14405,32	112,17	2,68	
	450,0	18515,81	18675,41	159,60	3,76	
R15166-13	50,0	2023,08	2043,18	20,10	0,49	1,1
	150,0	6138,34	6180,09	41,74	1,04	
	250,0	10153,37	10225,63	72,26	1,78	
	350,0	14293,15	14404,80	111,65	2,66	
	450,0	18515,81	18675,72	159,91	3,76	
R15166-14	50,0	2023,08	2044,11	21,03	0,51	1,1
	150,0	6138,34	6182,03	43,68	1,08	
	250,0	10153,37	10227,95	74,58	1,83	
	350,0	14293,15	14406,87	113,72	2,71	
	450,0	18515,81	18676,91	161,11	3,79	
R15166-15	50,0	2023,08	2043,20	20,12	0,49	1,1
	150,0	6138,34	6180,73	42,39	1,05	
	250,0	10153,37	10226,97	73,60	1,81	
	350,0	14293,15	14406,91	113,76	2,71	
	450,0	18515,81	18678,68	162,87	3,83	
R15166-16	50,0	2023,08	2043,72	20,64	0,50	1,2
	150,0	6138,34	6180,34	42,00	1,04	
	250,0	10153,37	10225,89	72,52	1,78	
	350,0	14293,15	14405,34	112,19	2,68	
	450,0	18515,81	18676,84	161,03	3,79	
R15166-17	50,0	2023,08	2044,18	21,11	0,51	1,3
	150,0	6138,34	6180,56	42,21	1,05	
	250,0	10153,37	10225,37	72,00	1,77	
	350,0	14293,15	14403,62	110,47	2,64	
	450,0	18515,81	18673,42	157,61	3,71	
R15166-18	50,0	2023,08	2044,19	21,11	0,51	1,4
	150,0	6138,34	6181,24	42,89	1,06	
	250,0	10153,37	10227,16	73,79	1,81	
	350,0	14293,15	14406,97	113,82	2,72	
	450,0	18515,81	18678,78	162,97	3,84	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
R15166-19	50,0	2023,08	2045,15	22,07	0,54	1,3
	150,0	6138,34	6183,63	45,29	1,12	
	250,0	10153,37	10229,76	76,39	1,88	
	350,0	14293,15	14408,54	115,39	2,75	
	450,0	18515,81	18678,08	162,27	3,82	
R15166-20	50,0	2023,08	2044,46	21,38	0,52	1,4
	150,0	6138,34	6182,24	43,89	1,09	
	250,0	10153,37	10228,38	75,01	1,84	
	350,0	14293,15	14407,89	114,74	2,74	
	450,0	18515,81	18678,88	163,07	3,84	
R15166-21	50,0	2023,08	2044,47	21,39	0,52	1,5
	150,0	6138,34	6181,74	43,40	1,08	
	250,0	10153,37	10227,21	73,84	1,81	
	350,0	14293,15	14405,87	112,72	2,69	
	450,0	18515,81	18675,83	160,02	3,77	
R15166-22	50,0	2023,08	2044,00	20,93	0,51	1,4
	150,0	6138,34	6180,91	42,56	1,06	
	250,0	10153,37	10227,40	74,03	1,82	
	350,0	14293,15	14408,47	115,32	2,75	
	450,0	18515,81	18682,26	166,45	3,92	

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15167

Applicant	:	KEMA B.V. UTRECHTSEWEG 310 GEBOUW B08 – EXPEDITIE 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	22 pcs. Thermocouples type K
Manufacturer	:	Thermo Electric Instrumentation B.V.
Item no.	:	9413553
Serial number	:	R15167-1 to -22
Calibration Method	:	Prior to the calibration the thermocouple has been heat treated for a period of 12 hours at 500 °C. The thermocouple has been calibrated in liquid bath's, with an minimum immersion depth of 200 mm, by comparison with a standard thermometer. The cold junction has been realised by using an ice bath.
Environmental Conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of Calibration	:	10-08-2015 to 19-08-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The serial number / tag number; 2 The temperature t90 defined according the ITS-90; 3 The microvolt value Et as per the relevant tables at t90 according IEC 60584-1 (2013); 4 The actual measured microvolt value E; 5 The deviation in microvolt; 6 The deviation in °C; 7 The expanded uncertainty in °C.
Uncertainty	:	The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	24 August 2015

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Tag No.	Temperature [°C]	Tabel Value [μV]	Measured Value [μV]	Deviation		Expanded Uncertainty [°C]
				[μV]	[°C]	
R15167-1	50,0	2023,08	2056,99	33,91	0,82	1,3
	150,0	6138,34	6207,80	69,45	1,72	
	250,0	10153,37	10250,99	97,62	2,40	
	350,0	14293,15	14411,56	118,41	2,83	
	450,0	18515,81	18647,62	131,82	3,10	
R15167-2	50,0	2023,08	2057,87	34,79	0,84	1,1
	150,0	6138,34	6209,33	70,99	1,76	
	250,0	10153,37	10252,43	99,06	2,43	
	350,0	14293,15	14412,15	119,00	2,84	
	450,0	18515,81	18646,61	130,81	3,08	
R15167-3	50,0	2023,08	2056,05	32,98	0,80	1,2
	150,0	6138,34	6204,64	66,29	1,65	
	250,0	10153,37	10246,92	93,55	2,30	
	350,0	14293,15	14407,89	114,74	2,74	
	450,0	18515,81	18645,68	129,87	3,06	
R15167-4	50,0	2023,08	2058,08	35,00	0,85	1,3
	150,0	6138,34	6211,48	73,14	1,82	
	250,0	10153,37	10257,39	104,02	2,56	
	350,0	14293,15	14420,78	127,64	3,05	
	450,0	18515,81	18659,79	143,99	3,39	
R15167-5	50,0	2023,08	2058,06	34,98	0,85	1,1
	150,0	6138,34	6208,35	70,00	1,74	
	250,0	10153,37	10248,20	94,83	2,33	
	350,0	14293,15	14402,62	109,47	2,61	
	450,0	18515,81	18629,72	113,91	2,68	
R15167-6	50,0	2023,08	2056,61	33,53	0,81	1,2
	150,0	6138,34	6207,02	68,68	1,71	
	250,0	10153,37	10251,19	97,82	2,40	
	350,0	14293,15	14414,10	120,95	2,89	
	450,0	18515,81	18653,88	138,07	3,25	
R15167-7	50,0	2023,08	2057,34	34,26	0,83	1,4
	150,0	6138,34	6209,55	71,20	1,77	
	250,0	10153,37	10252,53	99,17	2,44	
	350,0	14293,15	14411,30	118,16	2,82	
	450,0	18515,81	18643,98	128,17	3,02	
R15167-8	50,0	2023,08	2058,27	35,19	0,85	1,1
	150,0	6138,34	6213,04	74,69	1,85	
	250,0	10153,37	10258,50	105,13	2,58	
	350,0	14293,15	14419,66	126,51	3,02	
	450,0	18515,81	18654,62	138,82	3,27	
R15167-9	50,0	2023,08	2057,90	34,82	0,84	1
	150,0	6138,34	6211,90	73,56	1,83	
	250,0	10153,37	10256,76	103,39	2,54	
	350,0	14293,15	14417,45	124,31	2,97	
	450,0	18515,81	18652,12	136,31	3,21	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
R15167-10	50,0	2023,08	2058,31	35,23	0,85	1,1
	150,0	6138,34	6212,21	73,86	1,83	
	250,0	10153,37	10255,21	101,84	2,50	
	350,0	14293,15	14412,32	119,17	2,84	
	450,0	18515,81	18641,66	125,85	2,96	
R15167-11	50,0	2023,08	2058,11	35,03	0,85	1,1
	150,0	6138,34	6211,40	73,06	1,81	
	250,0	10153,37	10254,68	101,31	2,49	
	350,0	14293,15	14412,94	119,79	2,86	
	450,0	18515,81	18644,31	128,50	3,02	
R15167-12	50,0	2023,08	2057,08	34,00	0,82	1,2
	150,0	6138,34	6209,67	71,33	1,77	
	250,0	10153,37	10252,83	99,46	2,44	
	350,0	14293,15	14411,55	118,40	2,83	
	450,0	18515,81	18643,94	128,13	3,02	
R15167-13	50,0	2023,08	2058,22	35,14	0,85	1,1
	150,0	6138,34	6209,62	71,28	1,77	
	250,0	10153,37	10250,63	97,26	2,39	
	350,0	14293,15	14406,25	113,11	2,70	
	450,0	18515,81	18634,61	118,80	2,80	
R15167-14	50,0	2023,08	2058,85	35,77	0,87	1,1
	150,0	6138,34	6212,04	73,70	1,83	
	250,0	10153,37	10253,36	99,99	2,46	
	350,0	14293,15	14407,80	114,66	2,74	
	450,0	18515,81	18633,49	117,68	2,77	
R15167-15	50,0	2023,08	2057,56	34,48	0,84	1,2
	150,0	6138,34	6210,95	72,61	1,80	
	250,0	10153,37	10253,95	100,58	2,47	
	350,0	14293,15	14411,54	118,40	2,83	
	450,0	18515,81	18641,86	126,05	2,97	
R15167-16	50,0	2023,08	2055,94	32,86	0,80	1,1
	150,0	6138,34	6205,09	66,75	1,66	
	250,0	10153,37	10244,97	91,60	2,25	
	350,0	14293,15	14400,58	107,43	2,56	
	450,0	18515,81	18630,03	114,22	2,69	
R15167-17	50,0	2023,08	2056,78	33,70	0,82	1,1
	150,0	6138,34	6207,69	69,34	1,72	
	250,0	10153,37	10248,15	94,78	2,33	
	350,0	14293,15	14403,16	110,01	2,63	
	450,0	18515,81	18630,84	115,03	2,71	
R15167-18	50,0	2023,08	2056,42	33,34	0,81	1,1
	150,0	6138,34	6205,57	67,22	1,67	
	250,0	10153,37	10245,44	92,08	2,26	
	350,0	14293,15	14401,05	107,90	2,57	
	450,0	18515,81	18630,50	114,69	2,70	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
R15167-19	50,0	2023,08	2058,15	35,08	0,85	1
	150,0	6138,34	6211,50	73,16	1,82	
	250,0	10153,37	10253,10	99,74	2,45	
	350,0	14293,15	14407,96	114,81	2,74	
	450,0	18515,81	18634,19	118,38	2,79	
R15167-20	50,0	2023,08	2056,01	32,93	0,80	1,1
	150,0	6138,34	6204,81	66,47	1,65	
	250,0	10153,37	10245,01	91,64	2,25	
	350,0	14293,15	14401,58	108,43	2,59	
	450,0	18515,81	18632,65	116,85	2,75	
R15167-21	50,0	2023,08	2059,14	36,06	0,87	1,1
	150,0	6138,34	6215,64	77,30	1,92	
	250,0	10153,37	10261,05	107,68	2,65	
	350,0	14293,15	14420,35	127,20	3,04	
	450,0	18515,81	18651,66	135,86	3,20	
R15167-22	50,0	2023,08	2056,55	33,48	0,81	1,1
	150,0	6138,34	6209,35	71,01	1,76	
	250,0	10153,37	10253,82	100,45	2,47	
	350,0	14293,15	14414,96	121,81	2,91	
	450,0	18515,81	18650,89	135,08	3,18	

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15168

Applicant	:	KEMA B.V. UTRECHTSEWEG 310 GEBOUW B08 – EXPEDITIE 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	22 pcs. Thermocouples type K
Manufacturer	:	Thermo Electric Instrumentation B.V.
Item no.	:	9260543
Serial number	:	R15168-1 to -22
Calibration Method	:	Prior to the calibration the thermocouple has been heat treated for a period of 12 hours at 500 °C. The thermocouple has been calibrated in liquid bath's, with an minimum immersion depth of 200 mm, by comparison with a standard thermometer. The cold junction has been realised by using an ice bath.
Environmental Conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of Calibration	:	10-08-2015 to 20-08-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The serial number / tag number; 2 The temperature t90 defined according the ITS-90; 3 The microvolt value Et as per the relevant tables at t90 according IEC 60584-1 (2013); 4 The actual measured microvolt value E; 5 The deviation in microvolt; 6 The deviation in °C; 7 The expanded uncertainty in °C.
Uncertainty	:	The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	24 August 2015

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Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation [µV]	Deviation [°C]	Expanded Uncertainty [°C]
R15168-1	50,0	2023,08	2058,90	35,83	0,87	1,6
	150,0	6138,34	6219,93	81,59	2,03	
	250,0	10153,37	10266,20	112,83	2,77	
	350,0	14293,15	14422,70	129,55	3,09	
	450,0	18515,81	18647,56	131,76	3,10	
R15168-2	50,0	2023,08	2059,33	36,25	0,88	1,6
	150,0	6138,34	6223,41	85,06	2,11	
	250,0	10153,37	10272,68	119,31	2,93	
	350,0	14293,15	14432,16	139,01	3,32	
	450,0	18515,81	18659,95	144,14	3,39	
R15168-3	50,0	2023,08	2057,10	34,03	0,82	1,5
	150,0	6138,34	6216,01	77,67	1,93	
	250,0	10153,37	10261,70	108,33	2,66	
	350,0	14293,15	14419,18	126,03	3,01	
	450,0	18515,81	18646,55	130,75	3,08	
R15168-4	50,0	2023,08	2058,95	35,87	0,87	1,5
	150,0	6138,34	6221,02	82,67	2,05	
	250,0	10153,37	10268,79	115,42	2,84	
	350,0	14293,15	14427,26	134,11	3,20	
	450,0	18515,81	18654,55	138,74	3,27	
R15168-5	50,0	2023,08	2059,04	35,96	0,87	1,5
	150,0	6138,34	6220,64	82,29	2,04	
	250,0	10153,37	10266,07	112,71	2,77	
	350,0	14293,15	14420,36	127,21	3,04	
	450,0	18515,81	18641,61	125,80	2,96	
R15168-6	50,0	2023,08	2059,73	36,65	0,89	1,9
	150,0	6138,34	6223,94	85,59	2,12	
	250,0	10153,37	10272,71	119,34	2,93	
	350,0	14293,15	14431,04	137,89	3,29	
	450,0	18515,81	18657,06	141,26	3,32	
R15168-7	50,0	2023,08	2058,96	35,88	0,87	1,5
	150,0	6138,34	6221,84	83,50	2,07	
	250,0	10153,37	10271,44	118,07	2,90	
	350,0	14293,15	14432,75	139,60	3,33	
	450,0	18515,81	18663,90	148,09	3,49	
R15168-8	50,0	2023,08	2060,52	37,45	0,91	1,5
	150,0	6138,34	6224,33	85,99	2,13	
	250,0	10153,37	10272,66	119,29	2,93	
	350,0	14293,15	14430,50	137,35	3,28	
	450,0	18515,81	18655,98	140,17	3,30	
R15168-9	50,0	2023,08	2060,09	37,02	0,90	1,3
	150,0	6138,34	6219,62	81,28	2,02	
	250,0	10153,37	10267,74	114,37	2,81	
	350,0	14293,15	14429,44	136,30	3,25	
	450,0	18515,81	18662,86	147,05	3,46	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation [µV]	Deviation [°C]	Expanded Uncertainty [°C]
R15168-10	50,0	2023,08	2058,78	35,70	0,87	1,2
	150,0	6138,34	6214,66	76,32	1,89	
	250,0	10153,37	10259,99	106,62	2,62	
	350,0	14293,15	14419,74	126,59	3,02	
	450,0	18515,81	18652,05	136,24	3,21	
R15168-11	50,0	2023,08	2060,76	37,68	0,91	1,3
	150,0	6138,34	6220,54	82,20	2,04	
	250,0	10153,37	10267,88	114,51	2,81	
	350,0	14293,15	14427,77	134,62	3,21	
	450,0	18515,81	18658,34	142,53	3,35	
R15168-12	50,0	2023,08	2061,90	38,82	0,94	1,3
	150,0	6138,34	6221,37	83,02	2,06	
	250,0	10153,37	10266,00	112,63	2,77	
	350,0	14293,15	14420,80	127,65	3,05	
	450,0	18515,81	18643,88	128,07	3,01	
R15168-13	50,0	2023,08	2067,88	44,80	1,09	1,9
	150,0	6138,34	6225,03	86,69	2,15	
	250,0	10153,37	10251,58	98,21	2,41	
	350,0	14293,15	14372,51	79,36	1,89	
	450,0	18515,81	18545,94	30,13	0,71	
R15168-14	50,0	2023,08	2059,95	36,87	0,89	1,4
	150,0	6138,34	6218,71	80,37	2,00	
	250,0	10153,37	10265,19	111,82	2,75	
	350,0	14293,15	14424,38	131,23	3,13	
	450,0	18515,81	18654,41	138,60	3,26	
R15168-15	50,0	2023,08	2059,58	36,50	0,88	1,2
	150,0	6138,34	6217,03	78,68	1,95	
	250,0	10153,37	10263,06	109,69	2,69	
	350,0	14293,15	14422,67	129,52	3,09	
	450,0	18515,81	18653,99	138,18	3,25	
R15168-16	50,0	2023,08	2061,03	37,95	0,92	1,4
	150,0	6138,34	6216,84	78,49	1,95	
	250,0	10153,37	10259,83	106,47	2,62	
	350,0	14293,15	14415,02	121,87	2,91	
	450,0	18515,81	18640,51	124,71	2,93	
R15168-17	50,0	2023,08	2061,06	37,99	0,92	1,5
	150,0	6138,34	6219,08	80,74	2,00	
	250,0	10153,37	10266,20	112,83	2,77	
	350,0	14293,15	14427,43	134,28	3,20	
	450,0	18515,81	18660,87	145,06	3,41	
R15168-18	50,0	2023,08	2061,80	38,73	0,94	1,5
	150,0	6138,34	6221,45	83,11	2,06	
	250,0	10153,37	10269,18	115,81	2,84	
	350,0	14293,15	14429,99	136,84	3,27	
	450,0	18515,81	18662,00	146,20	3,44	

THERMO ELECTRIC INSTRUMENTATION

Calibration Certificate

Number: R15168

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
R15168-19	50,0	2023,08	2059,67	36,60	0,89	1,3
	150,0	6138,34	6213,57	75,22	1,87	
	250,0	10153,37	10257,40	104,03	2,56	
	350,0	14293,15	14416,17	123,03	2,94	
	450,0	18515,81	18648,01	132,20	3,11	
R15168-20	50,0	2023,08	2062,99	39,91	0,97	1,6
	150,0	6138,34	6224,71	86,36	2,14	
	250,0	10153,37	10272,71	119,34	2,93	
	350,0	14293,15	14432,00	138,85	3,31	
	450,0	18515,81	18660,69	144,88	3,41	
R15168-21	50,0	2023,08	2060,82	37,75	0,92	1,3
	150,0	6138,34	6216,13	77,78	1,93	
	250,0	10153,37	10258,75	105,38	2,59	
	350,0	14293,15	14413,68	120,53	2,88	
	450,0	18515,81	18639,05	123,24	2,90	
R15168-22	50,0	2023,08	2061,50	38,42	0,93	1,4
	150,0	6138,34	6219,53	81,18	2,02	
	250,0	10153,37	10265,80	112,43	2,76	
	350,0	14293,15	14425,31	132,16	3,15	
	450,0	18515,81	18656,19	140,38	3,30	

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15169

Applicant	:	KEMA B.V. UTRECHTSEWEG 310 GEBOUW B08 – EXPEDITIE 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	30 pcs. Thermocouples type K
Manufacturer	:	Supplied by Customer (Used Thermocouples)
Item no.	:	----
Serial number	:	See Next Pages
Calibration Method	:	Prior to the calibration the thermocouple has been heat treated for a period of 5 hours at 650 °C. The thermocouple has been calibrated in liquid bath's, with an minimum immersion depth of 200 mm, by comparison with a standard thermometer. The cold junction has been realised by using an ice bath.
Environmental Conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of Calibration	:	11-08-2015 to 20-08-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The serial number / tag number; 2 The temperature t90 defined according the ITS-90; 3 The microvolt value Et as per the relevant tables at t90 according IEC 60584-1 (2013); 4 The actual measured microvolt value E; 5 The deviation in microvolt; 6 The deviation in °C; 7 The expanded uncertainty in °C.
Uncertainty	:	The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of *k* = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	24 August 2015

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Calibration Certificate

Number: R15169

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation [µV]	Deviation [°C]	Expanded Uncertainty [°C]
3221	50,0	2023,08	2042,78	19,70	0,48	4,9
	150,0	6138,34	6163,76	25,41	0,63	
	250,0	10153,37	10187,21	33,84	0,83	
	350,0	14293,15	14338,14	44,99	1,07	
	450,0	18515,81	18574,66	58,86	1,39	
	550,0	22776,43	22851,87	75,44	1,77	
3222	50,0	2023,08	2042,22	19,14	0,46	4,3
	150,0	6138,34	6163,01	24,67	0,61	
	250,0	10153,37	10186,27	32,90	0,81	
	350,0	14293,15	14337,00	43,85	1,05	
	450,0	18515,81	18573,32	57,51	1,35	
	550,0	22776,43	22850,31	73,89	1,73	
3224	50,0	2023,08	2042,75	19,67	0,48	4,8
	150,0	6138,34	6164,63	26,29	0,65	
	250,0	10153,37	10188,28	34,91	0,86	
	350,0	14293,15	14338,70	45,55	1,09	
	450,0	18515,81	18574,01	58,21	1,37	
	550,0	22776,43	22849,30	72,87	1,71	
3228	50,0	2023,08	2039,59	16,51	0,40	4,8
	150,0	6138,34	6153,65	15,31	0,38	
	250,0	10153,37	10173,07	19,70	0,48	
	350,0	14293,15	14322,84	29,70	0,71	
	450,0	18515,81	18561,09	45,29	1,07	
	550,0	22776,43	22842,90	66,48	1,56	
3235	50,0	2023,08	2042,36	19,28	0,47	4,5
	150,0	6138,34	6162,66	24,32	0,60	
	250,0	10153,37	10184,78	31,42	0,77	
	350,0	14293,15	14333,72	40,57	0,97	
	450,0	18515,81	18567,59	51,78	1,22	
	550,0	22776,43	22841,48	65,05	1,53	
3241	50,0	2023,08	2041,43	18,35	0,44	1
	150,0	6138,34	6164,74	26,39	0,66	
	250,0	10153,37	10189,27	35,90	0,88	
	350,0	14293,15	14340,04	46,89	1,12	
	450,0	18515,81	18575,15	59,34	1,40	
	550,0	22776,43	22849,70	73,27	1,72	
3246	50,0	2023,08	2040,67	17,60	0,43	0,9
	150,0	6138,34	6161,70	23,36	0,58	
	250,0	10153,37	10185,02	31,65	0,78	
	350,0	14293,15	14335,62	42,47	1,01	
	450,0	18515,81	18571,62	55,82	1,31	
	550,0	22776,43	22848,12	71,69	1,68	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation [µV]	Deviation [°C]	Expanded Uncertainty [°C]
3250	50,0	2023,08	2044,24	21,16	0,51	2,3
	150,0	6138,34	6171,44	33,09	0,82	
	250,0	10153,37	10197,83	44,46	1,09	
	350,0	14293,15	14348,43	55,28	1,32	
	450,0	18515,81	18581,35	65,54	1,54	
	550,0	22776,43	22851,67	75,24	1,76	
3253	50,0	2023,08	2040,70	17,62	0,43	1,1
	150,0	6138,34	6162,09	23,75	0,59	
	250,0	10153,37	10185,16	31,79	0,78	
	350,0	14293,15	14334,89	41,74	1,00	
	450,0	18515,81	18569,42	53,61	1,26	
	550,0	22776,43	22843,82	67,39	1,58	
3260	50,0	2023,08	2039,77	16,69	0,40	3,2
	150,0	6138,34	6158,90	20,55	0,51	
	250,0	10153,37	10181,29	27,92	0,69	
	350,0	14293,15	14331,94	38,79	0,93	
	450,0	18515,81	18568,98	53,17	1,25	
	550,0	22776,43	22847,48	71,05	1,67	
3267	50,0	2023,08	2040,40	17,32	0,42	1,6
	150,0	6138,34	6155,07	16,72	0,42	
	250,0	10153,37	10167,93	14,56	0,36	
	350,0	14293,15	14304,00	10,85	0,26	
	450,0	18515,81	18521,38	5,57	0,13	
	550,0	22776,43	22775,17	-1,26	-0,03	
3277	50,0	2023,08	2039,42	16,34	0,40	1,1
	150,0	6138,34	6153,17	14,82	0,37	
	250,0	10153,37	10165,58	12,21	0,30	
	350,0	14293,15	14301,66	8,51	0,20	
	450,0	18515,81	18519,52	3,71	0,09	
	550,0	22776,43	22774,25	-2,18	-0,05	
3280	50,0	2023,08	2046,68	23,60	0,57	2
	150,0	6138,34	6174,28	35,93	0,89	
	250,0	10153,37	10193,64	40,27	0,99	
	350,0	14293,15	14329,75	36,60	0,87	
	450,0	18515,81	18540,74	24,94	0,59	
	550,0	22776,43	22781,70	5,27	0,12	
3281	50,0	2023,08	2034,06	10,98	0,27	4,6
	150,0	6138,34	6133,22	-5,12	-0,13	
	250,0	10153,37	10139,58	-13,79	-0,34	
	350,0	14293,15	14278,13	-15,02	-0,36	
	450,0	18515,81	18507,00	-8,81	-0,21	
	550,0	22776,43	22781,27	4,85	0,11	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
3286	50,0	2023,08	2033,29	10,21	0,25	2
	150,0	6138,34	6134,93	-3,41	-0,08	
	250,0	10153,37	10141,99	-11,38	-0,28	
	350,0	14293,15	14279,47	-13,68	-0,33	
	450,0	18515,81	18505,49	-10,32	-0,24	
	550,0	22776,43	22775,13	-1,30	-0,03	
3288	50,0	2023,08	2036,31	13,23	0,32	2,8
	150,0	6138,34	6142,55	4,21	0,10	
	250,0	10153,37	10150,16	-3,21	-0,08	
	350,0	14293,15	14284,13	-9,02	-0,22	
	450,0	18515,81	18502,60	-13,21	-0,31	
	550,0	22776,43	22760,63	-15,79	-0,37	
3298	50,0	2023,08	2037,48	14,40	0,35	4,2
	150,0	6138,34	6140,46	2,12	0,05	
	250,0	10153,37	10146,90	-6,47	-0,16	
	350,0	14293,15	14281,81	-11,34	-0,27	
	450,0	18515,81	18503,30	-12,51	-0,29	
	550,0	22776,43	22766,46	-9,97	-0,23	
3300	50,0	2023,08	2031,02	7,94	0,19	2,8
	150,0	6138,34	6124,15	-14,19	-0,35	
	250,0	10153,37	10125,58	-27,79	-0,68	
	350,0	14293,15	14260,31	-32,84	-0,78	
	450,0	18515,81	18486,46	-29,35	-0,69	
	550,0	22776,43	22759,11	-17,32	-0,41	
3301	50,0	2023,08	2042,96	19,89	0,48	0,9
	150,0	6138,34	6163,23	24,88	0,62	
	250,0	10153,37	10177,64	24,27	0,60	
	350,0	14293,15	14311,19	18,04	0,43	
	450,0	18515,81	18522,01	6,20	0,15	
	550,0	22776,43	22765,18	-11,25	-0,26	
3302	50,0	2023,08	2037,74	14,66	0,36	0,8
	150,0	6138,34	6150,40	12,06	0,30	
	250,0	10153,37	10163,94	10,57	0,26	
	350,0	14293,15	14303,36	10,21	0,24	
	450,0	18515,81	18526,78	10,98	0,26	
	550,0	22776,43	22789,29	12,86	0,30	
3306	50,0	2023,08	2046,62	23,54	0,57	1,4
	150,0	6138,34	6172,92	34,58	0,86	
	250,0	10153,37	10191,02	37,65	0,92	
	350,0	14293,15	14325,92	32,77	0,78	
	450,0	18515,81	18535,74	19,93	0,47	
	550,0	22776,43	22775,57	-0,86	-0,02	

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
3309	50,0	2023,08	2043,40	20,32	0,49	1,1
	150,0	6138,34	6166,12	27,78	0,69	
	250,0	10153,37	10184,61	31,24	0,77	
	350,0	14293,15	14323,86	30,71	0,73	
	450,0	18515,81	18541,99	26,19	0,62	
	550,0	22776,43	22794,09	17,66	0,41	
3313	50,0	2023,08	2044,04	20,96	0,51	1
	150,0	6138,34	6167,91	29,57	0,73	
	250,0	10153,37	10187,17	33,80	0,83	
	350,0	14293,15	14326,80	33,65	0,80	
	450,0	18515,81	18544,94	29,13	0,69	
	550,0	22776,43	22796,67	20,24	0,47	
3314	50,0	2023,08	2044,73	21,65	0,52	1,6
	150,0	6138,34	6168,57	30,22	0,75	
	250,0	10153,37	10188,36	34,99	0,86	
	350,0	14293,15	14329,11	35,96	0,86	
	450,0	18515,81	18548,94	33,13	0,78	
	550,0	22776,43	22802,93	26,50	0,62	
3315	50,0	2023,08	2039,88	16,80	0,41	1,3
	150,0	6138,34	6157,80	19,46	0,48	
	250,0	10153,37	10176,10	22,73	0,56	
	350,0	14293,15	14319,78	26,63	0,64	
	450,0	18515,81	18546,96	31,15	0,73	
	550,0	22776,43	22812,72	36,29	0,85	
3316	50,0	2023,08	2040,69	17,61	0,43	0,8
	150,0	6138,34	6157,99	19,65	0,49	
	250,0	10153,37	10174,23	20,86	0,51	
	350,0	14293,15	14314,40	21,25	0,51	
	450,0	18515,81	18536,62	20,82	0,49	
	550,0	22776,43	22795,98	19,55	0,46	
3317	50,0	2023,08	2042,05	18,97	0,46	0,8
	150,0	6138,34	6161,06	22,72	0,56	
	250,0	10153,37	10177,60	24,24	0,60	
	350,0	14293,15	14316,67	23,52	0,56	
	450,0	18515,81	18536,39	20,59	0,48	
	550,0	22776,43	22791,85	15,42	0,36	
3318	50,0	2023,08	2040,27	17,20	0,42	0,8
	150,0	6138,34	6157,06	18,72	0,46	
	250,0	10153,37	10173,60	20,23	0,50	
	350,0	14293,15	14314,87	21,72	0,52	
	450,0	18515,81	18539,02	23,21	0,55	
	550,0	22776,43	22801,11	24,69	0,58	

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Calibration Certificate

Number: R15169

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
3319	50,0	2023,08	2041,43	18,36	0,45	0,8
	150,0	6138,34	6160,54	22,20	0,55	
	250,0	10153,37	10178,43	25,06	0,62	
	350,0	14293,15	14320,09	26,94	0,64	
	450,0	18515,81	18543,64	27,83	0,66	
	550,0	22776,43	22804,18	27,75	0,65	
3320	50,0	2023,08	2041,83	18,76	0,45	0,8
	150,0	6138,34	6162,57	24,22	0,60	
	250,0	10153,37	10181,58	28,21	0,69	
	350,0	14293,15	14323,88	30,73	0,73	
	450,0	18515,81	18547,58	31,77	0,75	
	550,0	22776,43	22807,77	31,34	0,74	

CERTIFICATE
Number: R15206

Applicant	:	KEMA B.V. UTRECHTSEWEG 310 GEBOUW B08 – EXPEDITIE 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	8 pcs. Thermocouples type K
Manufacturer	:	Thermo Electric Instrumentation B.V.
Item no.	:	9410268
Serial number	:	R15206-1 to -8
Calibration Method	:	Prior to the calibration the thermocouple has been heat treated for a period of 12 hours at 500 °C. The thermocouple has been calibrated in a tube type furnace, with an immersion depth of 360 mm by comparison with a standard thermometer. The cold junction has been realised by using an ice bath.
Environmental Conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of Calibration	:	15-10-2015 to 16-10-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The serial number / tag number; 2 The temperature t90 defined according the ITS-90; 3 The microvolt value Et as per the relevant tables at t90 according IEC 60584-1 (2013); 4 The actual measured microvolt value E; 5 The deviation in microvolt; 6 The deviation in °C; 7 The expanded uncertainty in °C.
Uncertainty	:	The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	19 October 2015

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Number: R15206

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
R15206-1	250,0	10153,37	10235,00	81,63	2,01	1,7
	350,0	14293,15	14379,97	86,83	2,07	
	450,0	18515,81	18596,36	80,55	1,90	
R15206-2	250,0	10153,37	10233,72	80,35	1,97	1,9
	350,0	14293,15	14372,39	79,24	1,89	
	450,0	18515,81	18579,07	63,26	1,49	
R15206-3	250,0	10153,37	10225,53	72,16	1,77	1,9
	350,0	14293,15	14367,28	74,13	1,77	
	450,0	18515,81	18580,62	64,81	1,53	
R15206-4	250,0	10153,37	10231,68	78,31	1,92	1,6
	350,0	14293,15	14371,11	77,96	1,86	
	450,0	18515,81	18579,67	63,87	1,50	
R15206-5	250,0	10153,37	10237,29	83,92	2,06	1,8
	350,0	14293,15	14375,41	82,27	1,96	
	450,0	18515,81	18580,36	64,55	1,52	
R15206-6	250,0	10153,37	10220,64	67,27	1,65	1,7
	350,0	14293,15	14357,52	64,37	1,54	
	450,0	18515,81	18564,31	48,50	1,14	
R15206-7	250,0	10153,37	10227,44	74,07	1,82	1,8
	350,0	14293,15	14367,30	74,16	1,77	
	450,0	18515,81	18577,24	61,44	1,45	
R15206-8	250,0	10153,37	10230,03	76,66	1,88	1,7
	350,0	14293,15	14372,45	79,30	1,89	
	450,0	18515,81	18585,75	69,94	1,65	

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

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CERTIFICATE
Number: R15207

Applicant	:	KEMA B.V. UTRECHTSEWEG 310 GEBOUW B08 – EXPEDITIE 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	8 pcs. Thermocouples type K
Manufacturer	:	Thermo Electric Instrumentation B.V.
Item no.	:	9215974
Serial number	:	R15207-1 to -8
Calibration Method	:	Prior to the calibration the thermocouple has been heat treated for a period of 12 hours at 500 °C. The thermocouple has been calibrated in a tube type furnace, with an immersion depth of 360 mm by comparison with a standard thermometer. The cold junction has been realised by using an ice bath.
Environmental Conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of Calibration	:	15-10-2015 to 16-10-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The serial number / tag number; 2 The temperature t90 defined according the ITS-90; 3 The microvolt value Et as per the relevant tables at t90 according IEC 60584-1 (2013); 4 The actual measured microvolt value E; 5 The deviation in microvolt; 6 The deviation in °C; 7 The expanded uncertainty in °C.
Uncertainty	:	The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of *k* = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	19 October 2015

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Calibration Certificate

Number: R15207

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation		Expanded Uncertainty [°C]
				[µV]	[°C]	
R15207-1	250,0	10153,37	10246,05	92,69	2,28	1,6
	350,0	14293,15	14392,80	99,65	2,38	
	450,0	18515,81	18609,54	93,73	2,21	
R15207-2	250,0	10153,37	10249,07	95,70	2,35	1,5
	350,0	14293,15	14392,72	99,57	2,38	
	450,0	18515,81	18603,80	88,00	2,07	
R15207-3	250,0	10153,37	10247,66	94,29	2,32	1,6
	350,0	14293,15	14391,59	98,44	2,35	
	450,0	18515,81	18603,37	87,56	2,06	
R15207-4	250,0	10153,37	10238,02	84,65	2,08	1,5
	350,0	14293,15	14382,25	89,10	2,13	
	450,0	18515,81	18596,95	81,14	1,91	
R15207-5	250,0	10153,37	10244,11	90,74	2,23	1,6
	350,0	14293,15	14388,96	95,81	2,29	
	450,0	18515,81	18603,06	87,25	2,05	
R15207-6	250,0	10153,37	10249,31	95,94	2,36	1,5
	350,0	14293,15	14396,40	103,25	2,46	
	450,0	18515,81	18612,92	97,12	2,29	
R15207-7	250,0	10153,37	10247,94	94,57	2,32	1,7
	350,0	14293,15	14394,13	100,98	2,41	
	450,0	18515,81	18609,41	93,60	2,20	
R15207-8	250,0	10153,37	10245,87	92,50	2,27	1,8
	350,0	14293,15	14393,00	99,85	2,38	
	450,0	18515,81	18610,17	94,36	2,22	

THERMO ELECTRIC
INSTRUMENTATION

CALIBRATION
RvA K 065

CERTIFICATE
Number: R15208

Applicant	:	KEMA B.V. UTRECHTSEWEG 310 GEBOUW B08 – EXPEDITIE 6812 AR ARNHEM THE NETHERLANDS
Instrument	:	8 pcs. Thermocouples type K
Manufacturer	:	Thermo Electric Instrumentation B.V.
Item no.	:	9222233
Serial number	:	R15208-1 to -8
Calibration Method	:	Prior to the calibration the thermocouple has been heat treated for a period of 12 hours at 500 °C. The thermocouple has been calibrated in a tube type furnace, with an immersion depth of 360 mm by comparison with a standard thermometer. The cold junction has been realised by using an ice bath.
Environmental Conditions	:	The laboratory temperature was conditioned at 23 °C ± 2 °C.
Period of Calibration	:	15-10-2015 to 16-10-2015
Results	:	The results are specified at the attached sheet(s) The table indicates : 1 The serial number / tag number; 2 The temperature t90 defined according the ITS-90; 3 The microvolt value Et as per the relevant tables at t90 according IEC 60584-1 (2013); 4 The actual measured microvolt value E; 5 The deviation in microvolt; 6 The deviation in °C; 7 The expanded uncertainty in °C.
Uncertainty	:	The reported uncertainty is based on the standard uncertainty multiplied by a coverage factor of k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty has been determined in accordance with EA-4/02.
Traceability	:	The measurements have been executed using standards for which the traceability to (inter)national standards has been demonstrated towards the RvA.
Date	:	19 October 2015

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Calibration Certificate

Number: R15208

Tag No.	Temperature [°C]	Tabel Value [µV]	Measured Value [µV]	Deviation [µV]	Deviation [°C]	Expanded Uncertainty [°C]
R15208-1	250,0	10153,37	10257,25	103,88	2,55	1,5
	350,0	14293,15	14400,71	107,56	2,57	
	450,0	18515,81	18609,49	93,69	2,20	
R15208-2	250,0	10153,37	10260,66	107,29	2,64	1,6
	350,0	14293,15	14409,37	116,22	2,77	
	450,0	18515,81	18625,54	109,74	2,58	
R15208-3	250,0	10153,37	10254,46	101,09	2,48	1,5
	350,0	14293,15	14400,66	107,51	2,57	
	450,0	18515,81	18614,34	98,53	2,32	
R15208-4	250,0	10153,37	10222,35	68,98	1,69	1,6
	350,0	14293,15	14357,96	64,81	1,55	
	450,0	18515,81	18562,51	46,70	1,10	
R15208-5	250,0	10153,37	10268,15	114,78	2,82	1,6
	350,0	14293,15	14418,83	125,68	3,00	
	450,0	18515,81	18636,29	120,48	2,84	
R15208-6	250,0	10153,37	10236,51	83,15	2,04	1,5
	350,0	14293,15	14380,89	87,74	2,09	
	450,0	18515,81	18595,83	80,02	1,88	
R15208-7	250,0	10153,37	10266,53	113,17	2,78	1,7
	350,0	14293,15	14420,68	127,53	3,04	
	450,0	18515,81	18644,09	128,29	3,02	
R15208-8	250,0	10153,37	10251,74	98,37	2,42	1,6
	350,0	14293,15	14395,70	102,55	2,45	
	450,0	18515,81	18606,37	90,56	2,13	

APPENDIX A4

AES Calibration Certificates

PowerLogic™

Certificate of Compliance and Calibration

Schneider Electric certifies that the PowerLogic product listed below meets the published specifications and has been calibrated and tested using equipment and standards traceable to the National Institute of Standards and Technology (NIST) in the US or the National Research Council of Canada (*NRC*).

Model	Part #	Serial #	Calibration Date
ION8600	**P8600B4C0H5E0B0B**	**PT-0807A565-01**	**01-Aug-2008**

AUTOMATED TESTING

- Power supply levels tested and adjusted on variable power supply units
- Communications verified
- Unit ID and serial number programmed
- Voltage and current inputs calibrated
- Aux I/O calibrated and tested (if applicable)
- Required software options programmed
- Calibration constants saved to external file (if applicable)

FINAL TESTING AND INSPECTION

- Serial number verified
- Firmware version verified
- LCD/Keypad functionality checked (if applicable)
- Memory checked
- Calibration verified
- Software options downloaded and verified (if applicable)
- Applicable counters and registers cleared
- Dielectric Withstand Test Passed

TEST EQUIPMENT USED TO CALIBRATE METER (If Applicable)

Model	Serial #	Test Equipment Calibration Due Date
HP 3458A	**2823A06876**	**21-Dec-2008**
Rotek 8000 BC	**133BC**	**23-Nov-2008**
Rotek 8000 A	**133**	**23-Nov-2008**

Alexander Stoettner
Quality Manager

Jennifer Jacques
Plant Manager

Quality System
Certified to ISO 9001

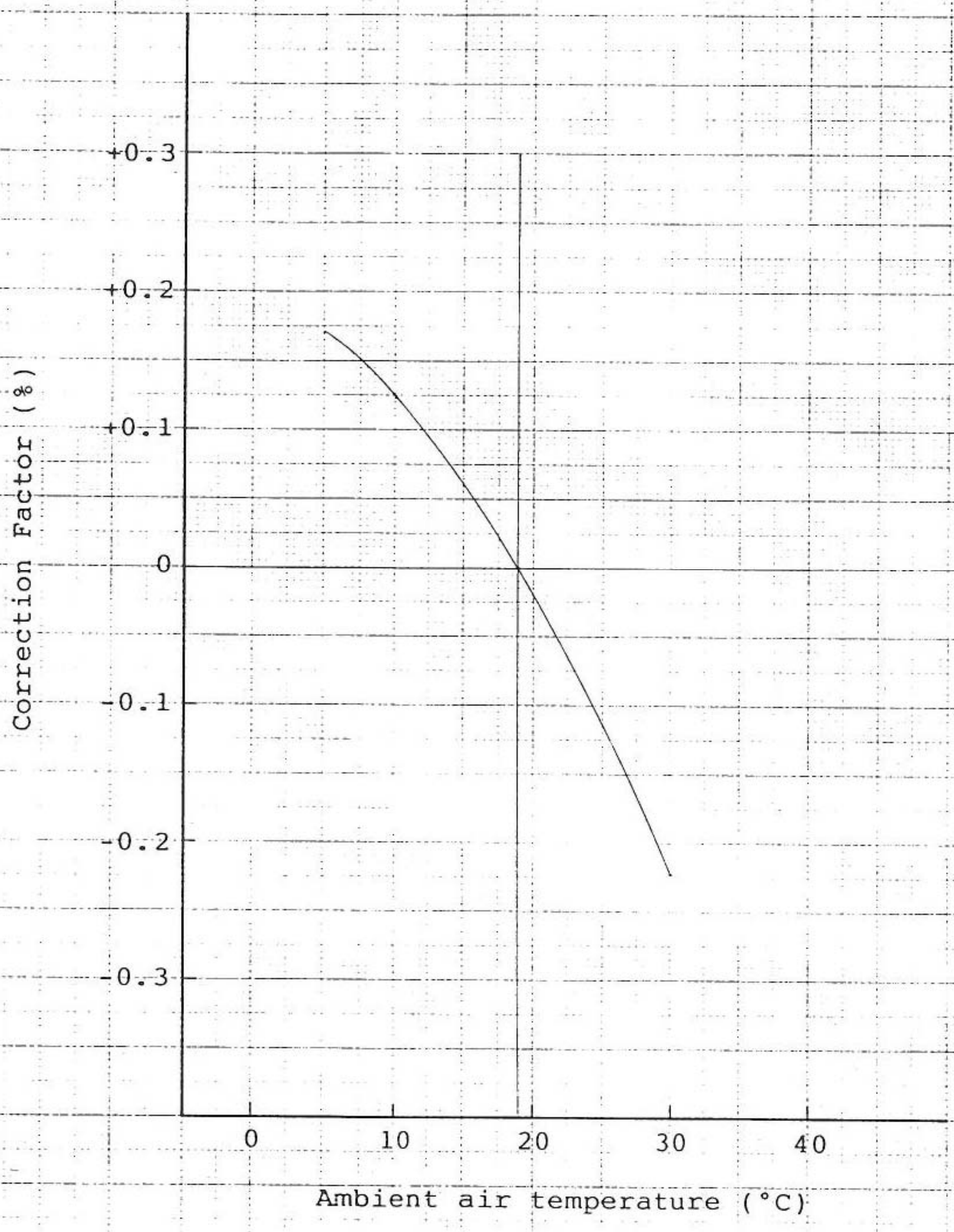
Schneider Electric

APPENDIX B
Correction Curves

AMBIENT AIR TEMPERATURE CORRECTION

FOR BOILER EFFICIENCY

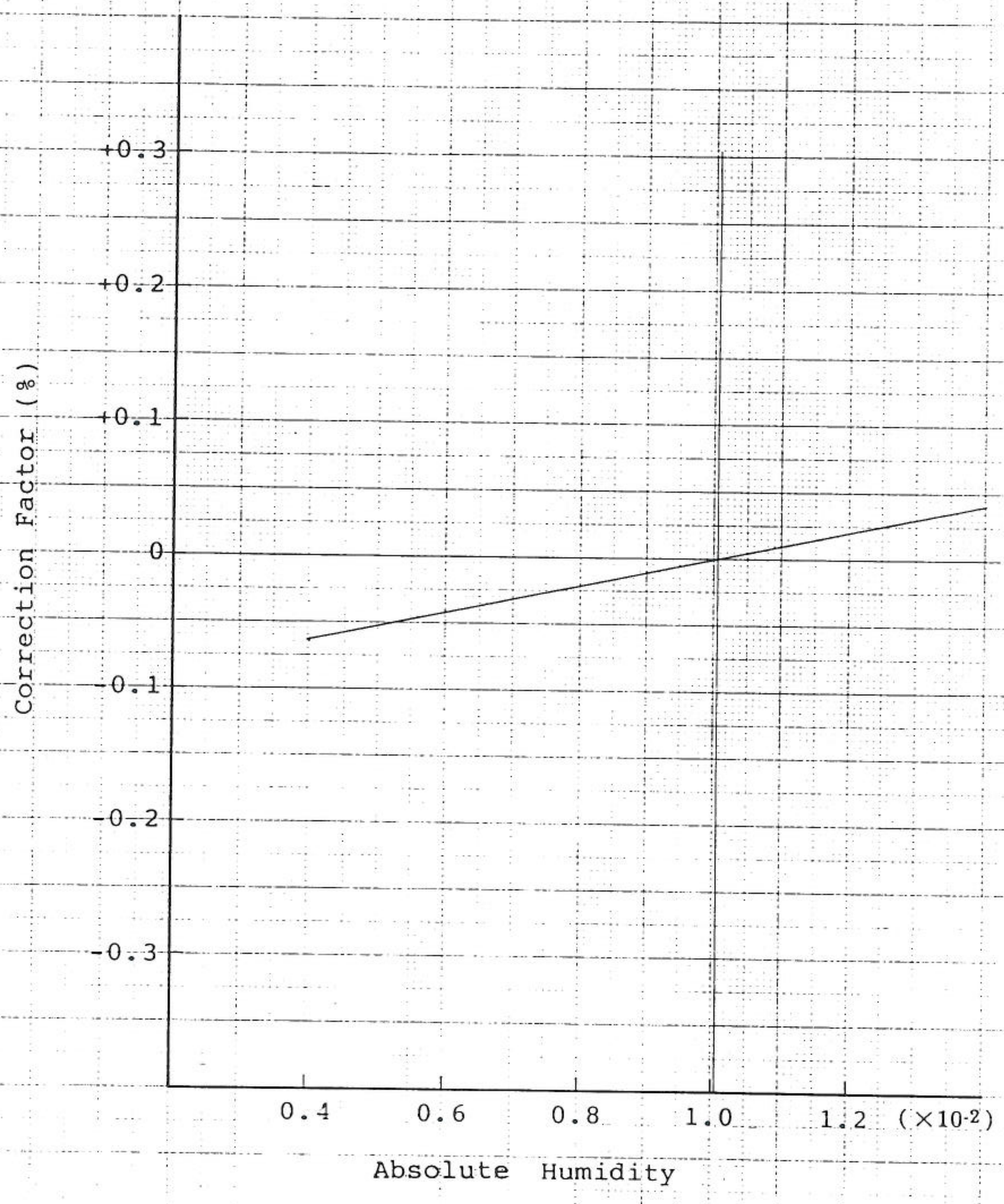
(COAL FIRING)

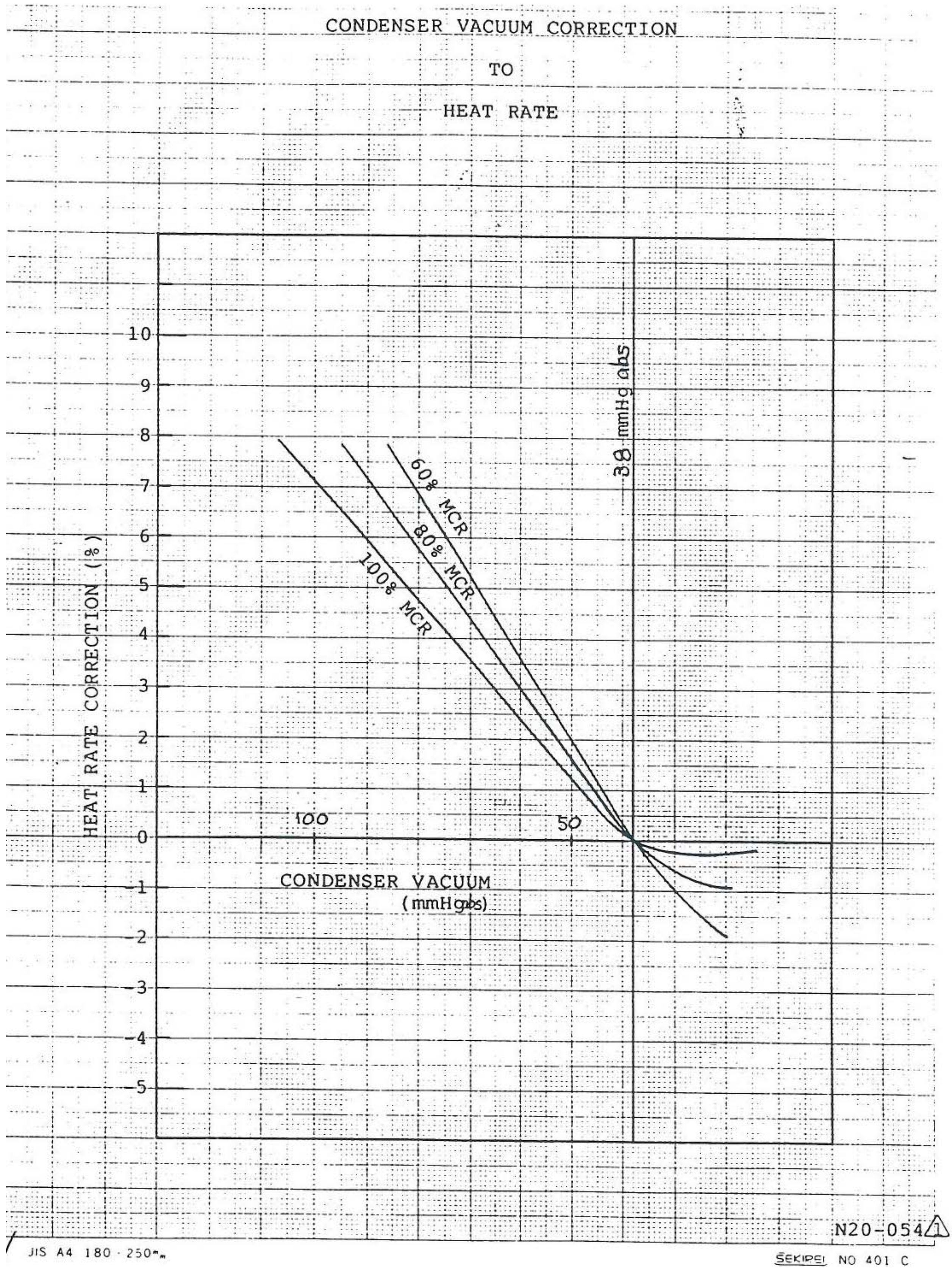


MOISTURE IN AIR CORRECTION

FOR BOILER EFFICIENCY

(COAL FIRING)




CONDENSER VACUUM CORRECTION
TO
HEAT RATE
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
HEAT RATE CORRECTION (%)
3.8 mmHg abs
60% MCR
80% MCR
100% MCR
100
50
CONDENSER VACUUM
(mmHg abs)
N20-054
1
JIS A4 180 · 250mm
SEKIPEI NO 401 C

NUEVA TOCOPILLA UNIT-1

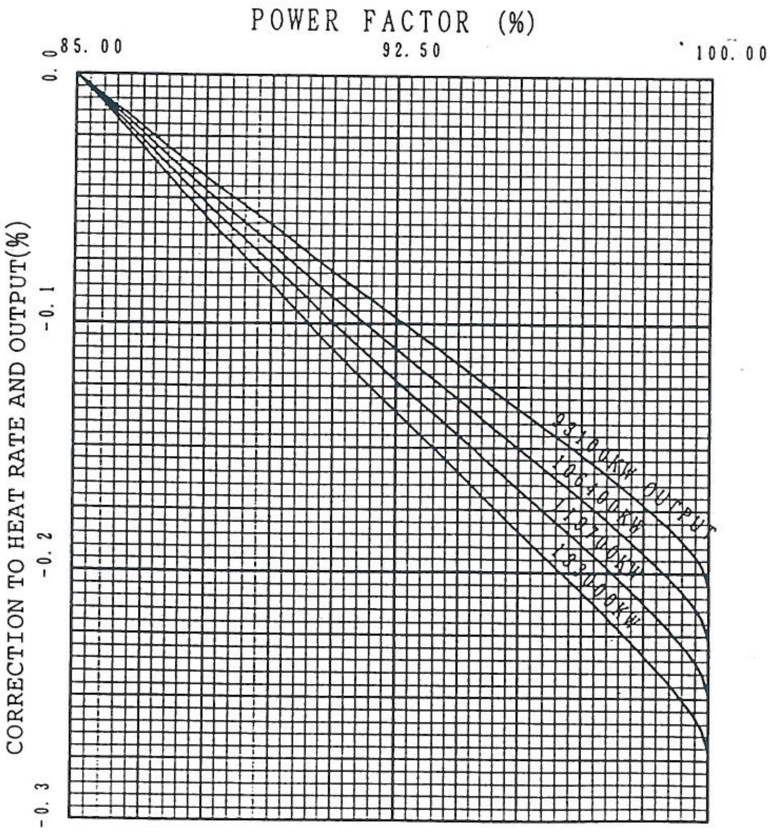
156500 KVA, 133025 KW, 85.00 % PF, 50 HZ, 3000 RPM

13.8 KV, 6547 A, 2 KG/CM^2 GAS PRESS., 295 V EXC.

HYDROGEN-COOLED TURBINE GENERATOR

EFFICIENCY CORRECTION CURVE

EFFICIENCY AT 85.00 % PF CAN BE ESTIMATED BY ADDING EFFICIENCY DIFFERENCE VALUE TO EFFICIENCY AT A CERTAIN POWER FACTOR.



105/

APPROVED	[illegible] M. Sakyama
CHECKED	H. Onishi
DESIGNED	'94-4-13 A. Yoshii

KC494985

APPENDIX C

Results Analysis Coal, Bottom Ash and Fly Ash

APPENDIX C1

Results Analysis Coal, Bottom and Fly Ash Test at 100% Load

PCM lab GESTIÓN ENERGÉTICA

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3837

Santiago, 20 de enero de 2016

# Documento	*36354*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	15 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36676	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 1; 136 MWe)	**Fecha Análisis**	20/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,62	
Humedad Residual (%)	ASTM D 3173 /7582	9,38	
Cenizas (%)	ASTM D 3174 /7582	5,77	7,10
Materia Volátil (%)	ASTM D 3175 /7582	32,96	40,50
Carbono Fijo (%)	ASTM D 3172	42,64	52,40
Azufre(%)	ASTM D 4239	0,41	0,50
Poder Calorífico Superior (kcal/kg)	ASTM D 5865	5.632	6.921
Poder Calorífico Inferior (kcal/kg)	ASTM D 5865	5.334	6.687
Carbono (%)	ASTM D 5373	59,08	72,61
Hidrógeno (%)	ASTM D 5373	3,70	4,54
Nitrógeno (%)	ASTM D 5373	0,94	1,15
Oxígeno (%)	ASTM D 3180	11,48	14,10

OBSERVACIONES :

La muestra fue preparada en PCM.
El Hidrógeno y Oxígeno reportados en base "Como Recibido" no incluyen el contenido de éstos elementos en el agua.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3831

Santiago, 19 de enero de 2016

# Documento	36348
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	15 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36670	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 1; 136 MWe) Humedad	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,88	
Humedad Residual (%)	ASTM D 3173 /7582	9,85	

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
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Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3849

Santiago, 19 de enero de 2016

# Documento	*36366*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	15 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36688	**Tipo de Muestra**	Escoria
ID Cliente	BOTTOM-ASH NT-02 C.E.N. (Prueba 1; 136MWe)	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	53,73	
Humedad Residual (%)	ASTM D 3173 /7582	1,13	
LOI (%)	ASTM D 7348	4,07	8,80

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
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ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3843

Santiago, 18 de enero de 2016

# Documento	*36360*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	15 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36682	**Tipo de Muestra**	Ceniza
ID Cliente	FLY-ASH NT-02 C.E.N. (Prueba 1; 136 MWe)	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	0,25	
Humedad Residual (%)	ASTM D 3173 /7582	< 0, 27	
LOI (%)	ASTM D 7348	2,58	2,59

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

Laboratorio de Combustibles * PCM Ltda. * Control de Calidad

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

APPENDIX C2

Results Analysis Coal, Bottom and Fly Ash Test at 95% Load

PCMlab GESTIÓN ENERGÉTICA

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3838

Santiago, 20 de enero de 2016

# Documento	*36355*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36677	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 1; 129,2 MWe)	**Fecha Análisis**	20/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,98	
Humedad Residual (%)	ASTM D 3173 /7582	9,70	
Cenizas (%)	ASTM D 3174 /7582	5,66	6,99
Materia Volátil (%)	ASTM D 3175 /7582	33,00	40,73
Carbono Fijo (%)	ASTM D 3172	42,36	52,28
Azufre(%)	ASTM D 4239	0,42	0,52
Poder Calorífico Superior (kcal/kg)	ASTM D 5865	5.640	6.962
Poder Calorífico Inferior (kcal/kg)	ASTM D 5865	5.340	6.726
Carbono (%)	ASTM D 5373	59,26	73,15
Hidrógeno (%)	ASTM D 5373	3,71	4,57
Nitrógeno (%)	ASTM D 5373	0,95	1,17
Oxígeno (%)	ASTM D 3180	11,02	13,60

OBSERVACIONES :

La muestra fue preparada en PCM.
El Hidrógeno y Oxígeno reportados en base "Como Recibido" no incluyen el contenido de éstos elementos en el agua.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
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INFORME DE ANÁLISIS Nº NG- 3832

Santiago, 19 de enero de 2016

# Documento	*36349*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36671	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 1; 129,2 MWe)Humedad	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	19,36	
Humedad Residual (%)	ASTM D 3173 /7582	9,68	

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3850

Santiago, 19 de enero de 2016

# Documento	36367
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36689	**Tipo de Muestra**	Escoria
ID Cliente	BOTTOM-ASH NT-02 C.E.N. (Prueba 1; 129,2 MWe)	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	54,63	
Humedad Residual (%)	ASTM D 3173 /7582	1,27	
LOI (%)	ASTM D 7348	4,83	10,66

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3844

Santiago, 18 de enero de 2016

# Documento	36361
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energia Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 09:00 Till 11:00 h
ID PCM	36683	**Tipo de Muestra**	Ceniza
ID Cliente	FLY-ASH NT-02 C.E.N. (Prueba 1; 129,2 MWe)	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	0,46	
Humedad Residual (%)	ASTM D 3173 /7582	0,46	
LOI (%)	ASTM D 7348	3,49	3,50

OBSERVACIONES :
La muestra fue preparada en PCM.

Laboratorio de Combustibles PCM Ltda. Control de Calidad

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorifico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

APPENDIX C3

Results Analysis Coal, Bottom and Fly Ash Test at 90% Load

PCM Ltda.
Laboratorio de Combustibles
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Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3839

Santiago, 20 de enero de 2016

# Documento	*36356*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 12:45 Till 14:45 h
ID PCM	36678	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 2; 122,4 MWe)	**Fecha Análisis**	20/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,97	
Humedad Residual (%)	ASTM D 3173 /7582	9,97	
Cenizas (%)	ASTM D 3174 /7582	5,70	7,04
Materia Volátil (%)	ASTM D 3175 /7582	32,82	40,50
Carbono Fijo (%)	ASTM D 3172	42,51	52,46
Azufre(%)	ASTM D 4239	0,46	0,56
Poder Calorífico Superior (kcal/kg)	ASTM D 5865	5.623	6.939
Poder Calorífico Inferior (kcal/kg)	ASTM D 5865	5.323	6.704
Carbono (%)	ASTM D 5373	59,24	73,11
Hidrógeno (%)	ASTM D 5373	3,71	4,57
Nitrógeno (%)	ASTM D 5373	0,94	1,16
Oxígeno (%)	ASTM D 3180	10,98	13,56

OBSERVACIONES :

La muestra fue preparada en PCM.
El Hidrógeno y Oxígeno reportados en base "Como Recibido" no incluyen el contenido de éstos elementos en el agua.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

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ISO 9001-2008
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INFORME DE ANÁLISIS Nº NG- 3833

Santiago, 19 de enero de 2016

# Documento	*36350*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 12:45 Till 14:45 h
ID PCM	36672	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 2; 122,4 MWe)Humedad	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	19,06	
Humedad Residual (%)	ASTM D 3173 /7582	10,97	

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

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ISO 9001-2008
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Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3851

Santiago, 19 de enero de 2016

# Documento	36368
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 12:45 Till 14:45 h
ID PCM	36690	**Tipo de Muestra**	Escoria
ID Cliente	BOTTOM-ASH NT-02 C.E.N. (Prueba 2; 122,4 MWe)	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	52,83	
Humedad Residual (%)	ASTM D 3173 /7582	1,15	
LOI (%)	ASTM D 7348	4,41	9,36

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

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En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3845

Santiago, 18 de enero de 2016

# Documento	*36362*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	16 de Diciembre 2015 12:45 Till 14:45 h
ID PCM	36684	**Tipo de Muestra**	Ceniza
ID Cliente	FLY-ASH NT-02 C.E.N. (Prueba 2; 122,4 MWe)	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	0,24	
Humedad Residual (%)	ASTM D 3173 /7582	< 0, 27	
LOI (%)	ASTM D 7348	2,30	2,30

OBSERVACIONES :

La muestra fue preparada en PCM.

Laboratorio de Combustibles PCM Ltda. Control de Calidad

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

APPENDIX C4

Results Analysis Coal, Bottom and Fly Ash Test at 80% Load

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
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INFORME DE ANÁLISIS Nº NG- 3840

Santiago, 20 de enero de 2016

# Documento	36357
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 09:30 Till 11:30 h
ID PCM	36679	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 1; 108 MWe)	**Fecha Análisis**	20/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,24	
Humedad Residual (%)	ASTM D 3173 /7582	9,67	
Cenizas (%)	ASTM D 3174 /7582	5,59	6,84
Materia Volátil (%)	ASTM D 3175 /7582	33,22	40,63
Carbono Fijo (%)	ASTM D 3172	42,94	52,53
Azufre(%)	ASTM D 4239	0,44	0,54
Poder Calorífico Superior (kcal/kg)	ASTM D 5865	5.679	6.946
Poder Calorífico Inferior (kcal/kg)	ASTM D 5865	5.381	6.711
Carbono (%)	ASTM D 5373	59,79	73,13
Hidrógeno (%)	ASTM D 5373	3,74	4,57
Nitrógeno (%)	ASTM D 5373	1,12	1,37
Oxígeno (%)	ASTM D 3180	11,08	13,56

OBSERVACIONES :

La muestra fue preparada en PCM.
El Hidrógeno y Oxígeno reportados en base "Como Recibido" no incluyen el contenido de éstos elementos en el agua.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
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En proceso de Implementación de la Norma Nch ISO 17025-2005

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Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS   Nº NG- 3834

Santiago, 19 de enero de 2016

# Documento	36351
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 09:30 Till 11:30 h
ID PCM	36673	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 1; 108 MWe)Humedad	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,25	
Humedad Residual (%)	ASTM D 3173 /7582	10,75	

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
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ISO 9001-2008
Nro Certificado: 3774 – Año 2008
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INFORME DE ANÁLISIS Nº NG- 3852

Santiago, 19 de enero de 2016

# Documento	36369
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 09:30 Till 11:30 h
ID PCM	36691	**Tipo de Muestra**	Escoria
ID Cliente	BOTTOM-ASH NT-02 C.E.N. (Prueba 1; 108 MWe)	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	54,90	
Humedad Residual (%)	ASTM D 3173 /7582	1,96	
LOI (%)	ASTM D 7348	10,09	22,36

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
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Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3846

Santiago, 18 de enero de 2016

# Documento	*36363*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 09:30 Till 11:30 h
ID PCM	36685	**Tipo de Muestra**	Ceniza
ID Cliente	FLY-ASH NT-02 C.E.N. (Prueba 1; 108 MWe)	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	**NORMA**	**Como Recibido**	**Base Seca**
Humedad Total (%)	ASTM D 3302	0,39	
Humedad Residual (%)	ASTM D 3173 /7582	0,39	
LOI (%)	ASTM D 7348	2,15	2,15

OBSERVACIONES :

La muestra fue preparada en PCM.

Laboratorio de Combustibles PCM Ltda. Control de Calidad

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

APPENDIX C5

Results Analysis Coal, Bottom and Fly Ash Test at 70% Load

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3841

Santiago, 20 de enero de 2016

# Documento	*36358*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 13:00 Till 15:00 h
ID PCM	36680	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 2; 95 MWe)	**Fecha Análisis**	20/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	19,08	
Humedad Residual (%)	ASTM D 3173 /7582	9,89	
Cenizas (%)	ASTM D 3174 /7582	5,55	6,86
Materia Volátil (%)	ASTM D 3175 /7582	33,41	41,29
Carbono Fijo (%)	ASTM D 3172	41,95	51,84
Azufre(%)	ASTM D 4239	0,43	0,53
Poder Calorífico Superior (kcal/kg)	ASTM D 5865	5.623	6.949
Poder Calorífico Inferior (kcal/kg)	ASTM D 5865	5.322	6.713
Carbono (%)	ASTM D 5373	59,01	72,93
Hidrógeno (%)	ASTM D 5373	3,70	4,58
Nitrógeno (%)	ASTM D 5373	1,18	1,45
Oxígeno (%)	ASTM D 3180	11,04	13,65

OBSERVACIONES :

La muestra fue preparada en PCM.
El Hidrógeno y Oxígeno reportados en base "Como Recibido" no incluyen el contenido de éstos elementos en el agua.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3835

Santiago, 19 de enero de 2016

# Documento	36352
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 13:00 Till 15:00 h
ID PCM	36674	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 2; 95 MWe)Humedad	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,91	
Humedad Residual (%)	ASTM D 3173 /7582	10,64	

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3853

Santiago, 19 de enero de 2016

# Documento	*36370*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 13:00 Till 15:00 h
ID PCM	36692	**Tipo de Muestra**	Escoria
ID Cliente	BOTTOM-ASH NT-02 C.E.N. (Prueba 1; 95 MWe)	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	52,78	
Humedad Residual (%)	ASTM D 3173 /7582	1,51	
LOI (%)	ASTM D 7348	7,29	15,44

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
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Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

PCMlab GESTION ENERGETICA

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS N° NG- 3847

Santiago, 18 de enero de 2016

# Documento	*36364*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energia Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 11:30 Till 15:00 h
ID PCM	36686	**Tipo de Muestra**	Ceniza
ID Cliente	FLY-ASH NT-02 C.E.N. (Prueba 2; 95 MWe)	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	< 0, 15	
Humedad Residual (%)	ASTM D 3173 /7582	< 0, 27	
LOI (%)	ASTM D 7348	0,55	0,55

OBSERVACIONES :

La muestra fue preparada en PCM.

Laboratorio de Combustibles PCM Ltda. Control de Calidad

Responsable Verificación	Responsable Aprobación
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

APPENDIX C6
Results Analysis Coal, Bottom and Fly Ash Test at 47% Load

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3842

Santiago, 20 de enero de 2016

# Documento	*36359*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 17:00 Till 19:00 h
ID PCM	36681	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 3; 65 MWe)	**Fecha Análisis**	20/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	18,99	
Humedad Residual (%)	ASTM D 3173 /7582	10,93	
Cenizas (%)	ASTM D 3174 /7582	5,62	6,94
Materia Volátil (%)	ASTM D 3175 /7582	33,50	41,36
Carbono Fijo (%)	ASTM D 3172	41,88	51,70
Azufre(%)	ASTM D 4239	0,43	0,53
Poder Calorífico Superior (kcal/kg)	ASTM D 5865	5.614	6.930
Poder Calorífico Inferior (kcal/kg)	ASTM D 5865	5.315	6.696
Carbono (%)	ASTM D 5373	59,11	72,97
Hidrógeno (%)	ASTM D 5373	3,67	4,54
Nitrógeno (%)	ASTM D 5373	1,18	1,46
Oxígeno (%)	ASTM D 3180	10,98	13,56

OBSERVACIONES :

La muestra fue preparada en PCM.
El Hidrógeno y Oxígeno reportados en base "Como Recibido" no incluyen el contenido de éstos elementos en el agua.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3836

Santiago, 19 de enero de 2016

# Documento	36353
# O.C. Cliente:	Pendiente

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 17:00 Till 19:00 h
ID PCM	36675	**Tipo de Muestra**	Carbón
ID Cliente	Carbón NT-02 C.E.N. (Prueba 3; 65 MWe)Humedad	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	19,03	
Humedad Residual (%)	ASTM D 3173 /7582	10,67	

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS Nº NG- 3854

Santiago, 19 de enero de 2016

# Documento	*36371*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener. Trans. y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 17:00 Till 19:00 h
ID PCM	36693	**Tipo de Muestra**	Escoria
ID Cliente	BOTTOM-ASH NT-02 C.E.N. (Prueba 2; 65 MWe)	**Fecha Análisis**	19/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	48,92	
Humedad Residual (%)	ASTM D 3173 /7582	1,79	
LOI (%)	ASTM D 7348	10,26	20,08

OBSERVACIONES :

La muestra fue preparada en PCM.

Responsable Verificación	**Responsable Aprobación**
Consuelo Araya C. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorífico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

PCM Ltda.
Laboratorio de Combustibles
Fono 551 69 83 - Fax 551 74 55 - e-mail laboratorio@pcmlab.tie.cl
Padre Orellana 1421 - Santiago
Certificada bajo los Estándares de la Norma ISO 9001-2008
En proceso de Implementación de la Norma Nch ISO 17025-2005

ISO 9001-2008
Nro Certificado: 3774 – Año 2008
Bureau Veritas

INFORME DE ANÁLISIS   Nº NG- 3848

Santiago, 18 de enero de 2016

# Documento	*36365*
# O.C. Cliente:	*Pendiente*

INFORMACIÓN DEL CLIENTE

Cliente	AES Gener - NORGENER	**Contacto Comercial**	Adolfo Rodriguez	**RUT**	94.272.000-9
Dirección	Rosario norte 532- Piso 19	**Teléfono**	6804882	**Fax**	6804895
Comuna	Las Condes	**Giro**	Gener, Trans, y Venta de Energía Eléctrica	**e-mail**	adolfo.rodriguez@aes.com

IDENTIFICACIÓN DE LA MUESTRA

Fecha Recepción	13/01/2016	**Fecha de Muestreo**	17 de Diciembre 2015 17:00 Till 19:00 h
ID PCM	36687	**Tipo de Muestra**	Ceniza
ID Cliente	FLY-ASH NT-02 C.E.N. (Prueba 3; 65 MWe)	**Fecha Análisis**	18/01/2016
Representatividad	ND	**Lugar de Muestreo**	Unidad 2

RESULTADOS DEL ANÁLISIS

Parámetro	NORMA	Como Recibido	Base Seca
Humedad Total (%)	ASTM D 3302	0,18	
Humedad Residual (%)	ASTM D 3173 /7582	< 0, 27	
LOI (%)	ASTM D 7348	0,46	0,46

OBSERVACIONES :
La muestra fue preparada en PCM.

Laboratorio de Combustibles PCM Ltda. Control de Calidad

Responsable Verificación	Responsable Aprobación
Consuelo Araya G. Jefe de Laboratorio	Ernesto Pérez de Arce G. Gerente General

NOTAS

1. Los resultados reportados son válidos para la muestra ensayada, la que fue proporcionada por el solicitante.
2. El certificado de análisis no se debe reproducir sin la aprobación escrita del Laboratorio de PCM Ltda.
3. Las opiniones e interpretaciones de los resultados se realizarán solo en el caso que el cliente lo solicite formalmente.
4.- En caso que PCM haya realizado el Servicio de Muestreo, se indicará en las observaciones del certificado la fecha de muestreo, el lugar de muestreo, las condiciones ambientales del muestreo y el procedimiento de muestreo.
5.- En el caso en que PCM Ltda. subcontrate servicios de análisis será informado al cliente previamente.
6.- El alcance de la Acreditación incluye: Preparación, Análisis Inmediato y Elemental, Poder Calorifico, Punto de Fusión de Cenizas y HGI para muestras de Carbón.

Hoja 1 de 1

APPENDIX D

Measurement Data, DNV GL, Algoritmos and AES

APPENDIX D1

Measurement Data Test at 100% Load

Tag	Performance Test 100% Unit Norgener #2 Date 15 december 2015 Time 09:00 hr. - 11:00 hr.	Unit	Average	Max	Min	Std	Origin
@0013	Condensate Inlet Deaerator Differential Pressure	mbar	180.72	187.65	175.45	2.602	DNV GL
@0020	Condensate Inlet Deaerator Pressure	bar(a)	10.205	10.247	10.145	0.019	DNV GL
@0021	Condensate Inlet Deaerator Temperature	°C	136.59	136.78	136.30	0.084	DNV GL
@0050	Extraction Steam Pressure Deaerator	bar(a)	8.710	8.747	8.652	0.018	DNV GL
@0051	Extraction Steam Temperature Deaerator	°C	356.56	357.47	354.04	0.490	DNV GL
@0060	Feed Water Inlet Temperature Pump#1	°C	173.83	173.97	173.61	0.073	DNV GL
@0061	Feed Water Inlet Temperature Pump#2	°C	0.00	0.00	0.00	0.000	DNV GL
@0062	Feed Water Inlet Temperature Pump#3	°C	173.69	173.87	173.47	0.081	DNV GL
@0077	Extraction Steam Pressure High Pressure Heater#5	bar(a)	21.73	21.82	21.59	0.045	DNV GL
@0078	Extraction Steam Temperature High Pressure Heater#5	°C	273.49	273.89	272.98	0.174	DNV GL
@0080	Barometer Pressure	bar(a)	1.00959	1.00985	1.00936	0.0002	DNV GL
@0081	Ambient Air Temperature	°C	20.814	21.440	20.350	0.235	DNV GL
@0082	Relative Humidity Ambient Air	%	64.824	66.979	62.367	0.989	DNV GL
@0100	HP Feed Water Inlet Boiler Differential Pressure	mbar	440.88	450.82	431.10	3.817	DNV GL
@0101	HP Feed Water Inlet Boiler Pressure	bar(a)	213.53	215.99	209.97	1.434	DNV GL
@0102	HP Feed Water Inlet Boiler Temperature	°C	178.29	178.52	178.02	0.100	DNV GL
@0105	HP Spray Water #1 Boiler Differential Pressure	mbar	0.000	0.000	0.000	0.169	DNV GL
@0106	HP Spray Water #1 Boiler Pressure	bar(a)	168.69	169.22	167.81	0.279	DNV GL
@0110	ReHeat Spray Water Boiler Differential Pressure	mbar	78.06	89.65	58.83	8.458	DNV GL
@0111	ReHeat Spray Water Boiler Pressure	bar(a)	73.857	74.560	72.640	0.51	DNV GL
@0112	ReHeat Spray Water#1 Boiler Temperature	°C	175.75	175.94	175.50	0.087	DNV GL
@0113	ReHeat Spray Water#2 Boiler Temperature	°C	0.00	0.00	0.00	0.000	DNV GL
@0114	ReHeat Spray Water#3 Boiler Temperature	°C	175.46	175.64	175.22	0.091	DNV GL
@0115	HP Spray Water #2 Boiler Differential Pressure	mbar	0.758	1.090	0.350	0.123	DNV GL
@0116	HP Spray Water #2Boiler Pressure	bar(a)	168.69	169.21	167.82	0.278	DNV GL
@0120	Extraction Steam Pressure High Pressure Heater#6	bar(a)	39.147	39.310	38.890	0.078	DNV GL
@0121	Extraction Steam Temperature High Pressure Heater#6	°C	351.01	352.85	349.10	0.715	DNV GL
@0123	Feed Water Inlet Temperature High Pressure Heater#6	°C	215.59	215.79	215.30	0.104	DNV GL
@0124	Feed Water Outlet Pressure High Pressure Heater#6	bar(a)	184.71	185.32	183.78	0.301	DNV GL
@0125	Feed Water Outlet Temperature High Pressure Heater#6	°C	249.14	249.36	248.76	0.119	DNV GL
@0126	Drain Temperature High Pressure Heater#6	°C	221.09	221.29	220.79	0.104	DNV GL
@0127	Drain Temperature High Pressure Heater#5	°C	192.25	192.43	191.93	0.100	DNV GL
@0130	HP Steam Pressure Outlet Boiler	bar(a)	165.59	166.22	164.73	0.278	DNV GL
@0131	HP Steam Temperature Outlet Boiler	°C	540.37	543.05	537.28	1.045	DNV GL
@0133	Cold ReHeat Pressure Inlet Boiler	bar(a)	39.078	39.240	38.830	0.079	DNV GL
@0134	Cold ReHeat Temperature Inlet Boiler	°C	351.26	353.06	349.38	0.710	DNV GL
@0135	Hot ReHeat Pressure Outlet Boiler	bar(a)	35.931	36.090	35.700	0.076	DNV GL
@0136	Hot ReHeat Temperature Outlet Boiler	°C	545.61	547.72	543.95	0.742	DNV GL
@0140	Feed Water Inlet Temperature Boiler	bar(a)	182.30	182.90	181.41	0.289	DNV GL
@0141	Feed Water Inlet Pressure Boiler	°C	256.62	257.00	256.30	0.139	DNV GL
@0150	Cool Water Temperature Inlet Condenser (a)	°C	16.450	16.880	15.990	0.276	DNV GL
@0151	Cool Water Temperature Inlet Condenser (b)	°C	16.383	16.810	15.930	0.276	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A1	°C	362.64	364.89	360.25	1.041	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A2	°C	364.47	366.79	361.82	1.171	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A3	°C	363.97	366.13	361.54	1.103	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A4	°C	366.78	369.06	364.14	1.170	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A5	°C	367.71	369.91	365.22	1.105	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A6	°C	368.38	370.67	365.92	1.157	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A7	°C	369.07	371.63	366.42	1.178	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A8	°C	369.18	371.67	366.49	1.178	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A9	°C	370.03	372.49	367.43	1.170	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A10	°C	372.36	374.34	370.01	0.912	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A11	°C	374.79	377.51	371.88	1.376	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A12	°C	371.31	374.00	368.56	1.342	DNV GL

Tag	Performance Test 100% Unit Norgener #2 Date 15 december 2015 Time 09:00 hr. - 11:00 hr.	Unit	Average	Max	Min	Std	Origin
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A13	°C	369.60	371.85	367.36	1.108	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A14	°C	373.04	375.47	370.41	1.182	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A15	°C	371.25	373.49	368.87	1.108	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A16	°C	369.09	371.20	366.89	0.947	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A17	°C	373.82	376.07	371.38	1.104	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A18	°C	371.34	373.41	369.15	1.001	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A19	°C	360.18	362.17	358.43	0.779	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A20	°C	373.06	375.24	370.92	0.927	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A21	°C	369.40	371.50	367.41	0.935	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A22	°C	358.17	360.32	356.17	0.847	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A23	°C	365.02	367.08	363.29	0.765	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A24	°C	362.46	364.37	360.66	0.795	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A1	°C	136.89	138.06	135.99	0.693	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A2	°C	147.38	148.75	146.48	0.748	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A3	°C	155.93	157.36	154.93	0.781	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A4	°C	135.85	137.05	134.98	0.676	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A5	°C	143.80	145.05	142.91	0.721	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A6	°C	153.85	155.23	152.86	0.752	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A7	°C	133.64	134.80	132.87	0.647	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A8	°C	142.51	143.61	141.32	0.639	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A9	°C	152.51	153.84	151.51	0.735	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A10	°C	132.75	133.84	131.90	0.646	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A11	°C	143.22	144.48	141.91	0.688	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A12	°C	151.38	152.68	150.48	0.704	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A13	°C	131.63	132.79	130.72	0.661	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A14	°C	140.67	141.93	139.80	0.707	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A15	°C	150.84	152.18	149.92	0.745	DNV GL
@0261	Oxigen (O2) Inlet Air Heater A	vol%	3.11	3.37	2.88	0.09	Algoritmos
@0262	Oxigen (O2) Inlet Air Heater B	vol%	2.96	3.21	2.67	0.09	Algoritmos
@0265	Oxigen (O2) Outlet Air Heater	vol%	6.55	7.38	5.41	0.57	Algoritmos
@0267	Carbon Monoxide Outlet Air Heater	ppm	0.1	2.1	0.0	0.2	Algoritmos

Tag	Performance Test 100% Unit Norgener #2 Date 15 december 2015 Time 09:00 hr. - 11:00 hr.	Unit	Average	Max	Min	Std	Origin
@0012	Condensate Inlet Deaerator Mass Flow	t/h	341.65	351.75	333.53	3.387	AES
@0021	Condensate Inlet Deaerator Temperature	°C	137.00	137.18	136.76	0.091	AES
@0040	Mass Flow Feed Water Pump#1	t/h	193.97	197.13	191.50	1.147	AES
@0041	Mass Flow Feed Water Pump#2	t/h	0.000	0.000	0.000	0.000	AES
@0042	Mass Flow Feed Water Pump#3	t/h	231.18	233.55	228.57	0.971	AES
@0050	Extraction Steam Pressure Deaerator	bar(a)	9.048	9.114	9.013	0.048	AES
@0051	Extraction Steam Temperature Deaerator	°C	367.10	367.89	366.36	0.369	AES
@0060	Feed Water Temperature Deaerator	°C	173.83	173.89	173.69	0.077	AES
@0095	Extraction Steam Pressure High Pressure Heater#5	bar(a)	22.427	22.592	22.240	0.058	AES
@0096	Extraction Steam Temperature High Pressure Heater#5	°C	490.28	491.17	489.35	0.433	AES
@0300	Cold Primair Air Temperature	°C	26.132	26.750	25.633	0.331	AES
@0305	Cold Secundair Air Temperature 201	°C	25.175	25.775	24.671	0.328	AES
@0306	Cold Secundair Air Temperature 202	°C	25.786	26.414	25.306	0.318	AES
@0310	Hot Primair Air Temperature	°C	342.35	344.03	340.78	0.922	AES
@0315	Hot Secundair Air Temperature 154	°C	327.02	328.41	325.70	0.869	AES
@0316	Hot Secundair Air Temperature 155	°C	334.78	336.35	333.32	0.894	AES
@0320	Airflow Hot Secundair 21	t/h	120.29	125.09	115.87	1.695	AES
@0321	Airflow Hot Secundair 22	t/h	131.48	135.14	127.30	1.497	AES
@0325	Mass Flow Coal Feeder A	t/h	10.507	10.584	10.477	0.045	AES
@0326	Mass Flow Coal Feeder B	t/h	10.622	10.716	10.510	0.044	AES
@0327	Mass Flow Coal Feeder C	t/h	14.384	14.521	14.271	0.060	AES
@0328	Mass Flow Coal Feeder D	t/h	14.423	14.519	14.289	0.047	AES
@0330	Mass Flow Primair Air Mill A	t/h	32.226	32.922	31.721	0.208	AES
@0331	Mass Flow Primair Air Mill D	t/h	25.934	27.467	24.711	0.400	AES
@0332	Mass Flow Primair Air Mill C	t/h	29.138	29.596	28.638	0.172	AES
@0333	Mass Flow Primair Air Mill D	t/h	29.653	30.180	29.169	0.159	AES
@0340	Oxigen (O2) Inlet Air Heater A	vol %	2.017	2.214	1.783	0.093	AES
@0341	Oxigen (O2) Inlet Air Heater B	vol %	2.619	2.741	2.404	0.075	AES
@0350	X Position HP Valves	%	82.328	84.609	79.055	2.278	AES
@0360	Make-Up Water Mass Flow	t/h	4.366	6.782	0.002	2.079	AES
@0500	Power Consumption Mill A	kW	295.22	303.29	290.56	2.464	AES
@0501	Power Consumption Mill B	kW	293.54	301.96	286.31	2.849	AES
@0502	Power Consumption Mill C	kW	303.82	310.20	298.25	2.377	AES
@0503	Power Consumption Mill D	kW	296.33	305.47	287.88	2.917	AES
@0530	Gross Power Genrator (kWh)	kW	136251.7	-	-	-	AES
@0531	Auxiliary Power Consumption (kWh)	kW	9868.4	-	-	-	AES
@0535	Generator Excitation Current	A	306.50	334.00	276.00	6.928	AES
@0550	Gross Power Generator	kW	136342.429	137163.000	135072.000	375.251	AES
@0551	Voltage Generator	kV	13.260	13.375	13.159	0.053	AES
@0552	Current Generator	kA	5.870	5.919	5.765	0.032	AES
@0553	Phi Power Factor	-	0.999	1.000	0.998	0.000	AES
@0554	Frequentie Generator	Hz	50.126	50.370	49.722	0.144	AES
@0555	Rotor Speed	rpm	3013.55	3028.05	2989.28	8.889	AES
@0556	Reactive Power Generator	MVar	-4.0	0.582	-9.059	1.854965	AES
@0560	Net Power Unit (kWh)	kW	125479.47	-	-	-	AES

APPENDIX D2

Measurement Data Test at 95% Load

Tag	Performance Test 95% Unit Norgener #2 Date 16 december 2015 Time 09:00 hr. - 11:00 hr.	Unit	Average	Max	Min	Std	Origin
@0013	Condensate Inlet Deaerator Differential Pressure	mbar	163.92	172.31	155.27	2.958	DNV GL
@0020	Condensate Inlet Deaerator Pressure	bar(a)	9.776	9.803	9.740	0.011	DNV GL
@0021	Condensate Inlet Deaerator Temperature	°C	135.18	135.33	135.03	0.061	DNV GL
@0050	Extraction Steam Pressure Deaerator	bar(a)	8.301	8.327	8.273	0.010	DNV GL
@0051	Extraction Steam Temperature Deaerator	°C	356.65	357.37	355.60	0.326	DNV GL
@0060	Feed Water Inlet Temperature Pump#1	°C	171.85	172.01	171.73	0.048	DNV GL
@0061	Feed Water Inlet Temperature Pump#2	°C	0.00	0.00	0.00	0.000	DNV GL
@0062	Feed Water Inlet Temperature Pump#3	°C	171.57	171.70	171.45	0.044	DNV GL
@0077	Extraction Steam Pressure High Pressure Heater#5	bar(a)	20.70	20.77	20.63	0.026	DNV GL
@0078	Extraction Steam Temperature High Pressure Heater#5	°C	270.07	270.22	269.88	0.065	DNV GL
@0080	Barometer Pressure	bar(a)	1.00947	1.00965	1.00920	0.0001	DNV GL
@0081	Ambient Air Temperature	°C	21.488	23.000	20.230	0.850	DNV GL
@0082	Relative Humidity Ambient Air	%	68.983	72.588	64.218	2.380	DNV GL
@0100	HP Feed Water Inlet Boiler Differential Pressure	mbar	401.04	417.87	389.28	5.427	DNV GL
@0101	HP Feed Water Inlet Boiler Pressure	bar(a)	218.77	222.35	214.97	1.457	DNV GL
@0102	HP Feed Water Inlet Boiler Temperature	°C	176.47	176.74	176.25	0.094	DNV GL
@0105	HP Spray Water #1 Boiler Differential Pressure	mbar	0.621	2.500	0.014	1.050	DNV GL
@0106	HP Spray Water #1 Boiler Pressure	bar(a)	215.81	219.25	211.96	1.466	DNV GL
@0110	ReHeat Spray Water Boiler Differential Pressure	mbar	30.91	47.91	19.12	5.170	DNV GL
@0111	ReHeat Spray Water Boiler Pressure	bar(a)	75.951	77.140	74.620	0.47	DNV GL
@0112	ReHeat Spray Water#1 Boiler Temperature	°C	173.74	173.90	173.56	0.058	DNV GL
@0113	ReHeat Spray Water#2 Boiler Temperature	°C	0.00	0.00	0.00	0.000	DNV GL
@0114	ReHeat Spray Water#3 Boiler Temperature	°C	173.35	173.51	173.10	0.075	DNV GL
@0115	HP Spray Water #2 Boiler Differential Pressure	mbar	18.854	29.390	12.620	3.165	DNV GL
@0116	HP Spray Water #2Boiler Pressure	bar(a)	215.71	219.20	211.92	1.463	DNV GL
@0120	Extraction Steam Pressure High Pressure Heater#6	bar(a)	37.211	37.350	37.050	0.047	DNV GL
@0121	Extraction Steam Temperature High Pressure Heater#6	°C	345.34	346.86	344.26	0.572	DNV GL
@0123	Feed Water Inlet Temperature High Pressure Heater#6	°C	213.32	213.48	213.18	0.055	DNV GL
@0124	Feed Water Outlet Pressure High Pressure Heater#6	bar(a)	179.83	180.54	178.75	0.354	DNV GL
@0125	Feed Water Outlet Temperature High Pressure Heater#6	°C	246.40	246.50	246.30	0.043	DNV GL
@0126	Drain Temperature High Pressure Heater#6	°C	218.58	218.71	218.47	0.048	DNV GL
@0127	Drain Temperature High Pressure Heater#5	°C	189.81	189.98	189.61	0.076	DNV GL
@0130	HP Steam Pressure Outlet Boiler	bar(a)	162.09	162.97	160.77	0.417	DNV GL
@0131	HP Steam Temperature Outlet Boiler	°C	535.12	538.04	532.92	1.050	DNV GL
@0133	Cold ReHeat Pressure Inlet Boiler	bar(a)	37.136	37.270	36.970	0.047	DNV GL
@0134	Cold ReHeat Temperature Inlet Boiler	°C	345.64	347.24	344.48	0.585	DNV GL
@0135	Hot ReHeat Pressure Outlet Boiler	bar(a)	34.124	34.250	33.990	0.045	DNV GL
@0136	Hot ReHeat Temperature Outlet Boiler	°C	544.95	548.51	542.17	1.278	DNV GL
@0140	Feed Water Inlet Temperature Boiler	bar(a)	177.65	178.35	176.59	0.353	DNV GL
@0141	Feed Water Inlet Pressure Boiler	°C	253.90	254.14	253.71	0.069	DNV GL
@0150	Cool Water Temperature Inlet Condenser (a)	°C	16.642	16.980	16.380	0.134	DNV GL
@0151	Cool Water Temperature Inlet Condenser (b)	°C	16.575	16.910	16.310	0.134	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A1	°C	357.91	360.04	356.00	0.783	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A2	°C	359.46	361.62	357.24	0.907	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A3	°C	359.02	361.16	357.09	0.864	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A4	°C	362.00	364.09	360.20	0.800	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A5	°C	362.86	365.22	360.77	0.886	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A6	°C	363.41	365.68	361.36	0.933	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A7	°C	364.49	367.03	362.30	1.004	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A8	°C	364.40	366.93	362.21	0.975	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A9	°C	365.15	367.61	362.92	1.008	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A10	°C	368.12	370.87	365.79	1.067	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A11	°C	369.59	372.11	367.41	1.014	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A12	°C	366.12	368.40	364.07	0.958	DNV GL

Tag	Performance Test 95% Unit Norgener #2 Date 16 december 2015 Time 09:00 hr. - 11:00 hr.	Unit	Average	Max	Min	Std	Origin
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A13	°C	365.24	367.72	363.39	0.909	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A14	°C	367.83	370.31	365.70	0.966	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A15	°C	366.22	368.36	364.28	0.906	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A16	°C	365.02	367.58	362.91	0.972	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A17	°C	369.12	371.69	366.91	0.987	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A18	°C	366.51	368.74	364.60	0.859	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A19	°C	356.71	359.18	354.89	0.927	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A20	°C	368.42	371.11	365.98	1.038	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A21	°C	364.54	366.78	362.55	0.879	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A22	°C	354.42	357.17	351.97	1.106	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A23	°C	360.60	363.07	358.53	0.899	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A24	°C	357.65	359.74	355.91	0.779	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A1	°C	133.40	134.33	132.59	0.480	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A2	°C	143.03	143.93	142.26	0.466	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A3	°C	151.26	152.35	150.26	0.501	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A4	°C	132.56	133.49	131.66	0.479	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A5	°C	139.94	140.87	139.16	0.485	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A6	°C	149.53	150.57	148.48	0.495	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A7	°C	130.48	131.32	129.65	0.428	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A8	°C	138.70	139.60	137.79	0.463	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A9	°C	148.37	149.32	147.28	0.509	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A10	°C	129.66	130.47	128.81	0.409	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A11	°C	139.34	140.30	138.51	0.424	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A12	°C	147.23	148.13	146.17	0.454	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A13	°C	128.55	129.30	127.73	0.384	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A14	°C	136.92	137.78	136.10	0.415	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A15	°C	146.64	147.50	145.66	0.445	DNV GL
@0261	Oxigen (O2) Inlet Air Heater A	vol%	3.73	4.20	3.10	0.28	Algoritmos
@0262	Oxigen (O2) Inlet Air Heater B	vol%	3.09	3.33	2.91	0.10	Algoritmos
@0265	Oxigen (O2) Outlet Air Heater	vol%	6.69	7.65	5.60	0.58	Algoritmos
@0267	Carbon Monoxide Outlet Air Heater	ppm	0.0	1.9	0.0	0.2	Algoritmos

Tag	Performance Test 95% Unit Norgener #2 Date 16 december 2015 Time 09:00 hr. - 11:00 hr.	Unit	Average	Max	Min	Std	Origin
@0012	Condensate Inlet Deaerator Mass Flow	t/h	324.88	337.05	313.93	3.341	AES
@0021	Condensate Inlet Deaerator Temperature	°C	135.59	135.72	135.40	0.069	AES
@0040	Mass Flow Feed Water Pump#1	t/h	186.79	190.16	183.46	1.378	AES
@0041	Mass Flow Feed Water Pump#2	t/h	0.000	0.000	0.000	0.000	AES
@0042	Mass Flow Feed Water Pump#3	t/h	219.66	224.47	214.50	1.629	AES
@0050	Extraction Steam Pressure Deaerator	bar(a)	8.599	8.599	8.599	0.000	AES
@0051	Extraction Steam Temperature Deaerator	°C	367.37	368.56	366.39	0.460	AES
@0060	Feed Water Temperature Deaerator	°C	171.87	171.88	171.78	0.038	AES
@0095	Extraction Steam Pressure High Pressure Heater#5	bar(a)	21.363	21.375	21.272	0.033	AES
@0096	Extraction Steam Temperature High Pressure Heater#5	°C	490.00	491.40	488.86	0.531	AES
@0300	Cold Primair Air Temperature	°C	23.773	24.414	23.297	0.322	AES
@0305	Cold Secundair Air Temperature 201	°C	22.839	23.466	22.364	0.327	AES
@0306	Cold Secundair Air Temperature 202	°C	23.488	24.111	23.003	0.314	AES
@0310	Hot Primair Air Temperature	°C	337.33	338.46	336.20	0.543	AES
@0315	Hot Secundair Air Temperature 154	°C	322.25	323.23	321.46	0.482	AES
@0316	Hot Secundair Air Temperature 155	°C	330.25	331.19	329.31	0.521	AES
@0320	Airflow Hot Secundair 21	t/h	112.20	118.70	107.11	2.219	AES
@0321	Airflow Hot Secundair 22	t/h	124.84	131.33	119.10	2.178	AES
@0325	Mass Flow Coal Feeder A	t/h	10.342	10.601	10.072	0.117	AES
@0326	Mass Flow Coal Feeder B	t/h	10.447	10.737	10.169	0.114	AES
@0327	Mass Flow Coal Feeder C	t/h	13.393	13.771	13.098	0.152	AES
@0328	Mass Flow Coal Feeder D	t/h	13.414	13.771	13.037	0.147	AES
@0330	Mass Flow Primair Air Mill A	t/h	32.137	32.802	31.680	0.203	AES
@0331	Mass Flow Primair Air Mill D	t/h	25.816	27.071	24.666	0.329	AES
@0332	Mass Flow Primair Air Mill C	t/h	28.532	29.074	27.897	0.218	AES
@0333	Mass Flow Primair Air Mill D	t/h	29.051	29.682	28.567	0.201	AES
@0340	Oxigen (O2) Inlet Air Heater A	vol %	2.017	2.328	1.712	0.103	AES
@0341	Oxigen (O2) Inlet Air Heater B	vol %	2.579	2.928	2.308	0.107	AES
@0350	X Position HP Valves	%	65.447	67.883	63.100	1.558	AES
@0360	Make-Up Water Mass Flow	t/h	4.912	9.394	0.001	2.157	AES
@0500	Power Consumption Mill A	kW	297.90	304.20	291.70	2.549	AES
@0501	Power Consumption Mill B	kW	294.67	303.40	286.34	3.152	AES
@0502	Power Consumption Mill C	kW	302.37	307.40	295.60	2.364	AES
@0503	Power Consumption Mill D	kW	298.23	304.59	290.81	2.866	AES
@0530	Gross Power Genrator (kWh)	kW	129267.4	-	-	-	AES
@0531	Auxiliary Power Consumption (kWh)	kW	9553.2	-	-	-	AES
@0535	Generator Excitation Current	A	276.55	309.00	239.00	7.331	AES
@0550	Gross Power Generator	kW	129320.850	130236.000	128582.000	288.234	AES
@0551	Voltage Generator	kV	13.330	13.484	13.185	0.047	AES
@0552	Current Generator	kA	5.518	5.622	5.490	0.017	AES
@0553	Phi Power Factor	-	1.000	1.000	1.000	0.000	AES
@0554	Frequentie Generator	Hz	50.160	50.472	49.777	0.139	AES
@0555	Rotor Speed	rpm	3015.51	3036.66	2990.08	8.476	AES
@0556	Reactive Power Generator	MVar	-0.2	3.352	-3.746	1.317535	AES
@0560	Net Power Unit (kWh)	kW	118877.32	-	-	-	AES

APPENDIX D3

Measurement Data Test at 90% Load

Tag	Performance Test 90% Unit Norgener #2 Date 16 december 2015 Time 12:45 hr. - 14:45 hr.	Unit	Average	Max	Min	Std	Origin
@0013	Condensate Inlet Deaerator Differential Pressure	mbar	147.54	160.85	140.00	3.079	DNV GL
@0020	Condensate Inlet Deaerator Pressure	bar(a)	9.339	9.381	9.303	0.012	DNV GL
@0021	Condensate Inlet Deaerator Temperature	°C	133.62	133.77	133.45	0.061	DNV GL
@0050	Extraction Steam Pressure Deaerator	bar(a)	7.888	7.912	7.863	0.010	DNV GL
@0051	Extraction Steam Temperature Deaerator	°C	357.02	357.58	355.93	0.260	DNV GL
@0060	Feed Water Inlet Temperature Pump#1	°C	169.75	169.86	169.62	0.042	DNV GL
@0061	Feed Water Inlet Temperature Pump#2	°C	0.00	0.00	0.00	0.000	DNV GL
@0062	Feed Water Inlet Temperature Pump#3	°C	169.62	169.76	169.48	0.057	DNV GL
@0077	Extraction Steam Pressure High Pressure Heater#5	bar(a)	19.66	19.73	19.58	0.029	DNV GL
@0078	Extraction Steam Temperature High Pressure Heater#5	°C	266.75	266.91	266.61	0.056	DNV GL
@0080	Barometer Pressure	bar(a)	1.00821	1.00872	1.00762	0.0003	DNV GL
@0081	Ambient Air Temperature	°C	21.230	21.830	20.840	0.241	DNV GL
@0082	Relative Humidity Ambient Air	%	63.975	67.902	60.560	1.659	DNV GL
@0100	HP Feed Water Inlet Boiler Differential Pressure	mbar	357.92	371.56	343.85	5.445	DNV GL
@0101	HP Feed Water Inlet Boiler Pressure	bar(a)	222.82	225.50	218.94	1.772	DNV GL
@0102	HP Feed Water Inlet Boiler Temperature	°C	174.69	174.96	174.45	0.100	DNV GL
@0105	HP Spray Water #1 Boiler Differential Pressure	mbar	0.585	4.450	0.006	1.028	DNV GL
@0106	HP Spray Water #1 Boiler Pressure	bar(a)	219.87	222.56	215.99	1.767	DNV GL
@0110	ReHeat Spray Water Boiler Differential Pressure	mbar	19.83	29.43	8.26	5.054	DNV GL
@0111	ReHeat Spray Water Boiler Pressure	bar(a)	77.217	78.070	75.880	0.56	DNV GL
@0112	ReHeat Spray Water#1 Boiler Temperature	°C	171.70	171.87	171.56	0.048	DNV GL
@0113	ReHeat Spray Water#2 Boiler Temperature	°C	0.00	0.00	0.00	0.000	DNV GL
@0114	ReHeat Spray Water#3 Boiler Temperature	°C	171.14	171.41	169.71	0.233	DNV GL
@0115	HP Spray Water #2 Boiler Differential Pressure	mbar	63.468	74.510	52.440	4.406	DNV GL
@0116	HP Spray Water #2Boiler Pressure	bar(a)	219.74	222.41	215.74	1.762	DNV GL
@0120	Extraction Steam Pressure High Pressure Heater#6	bar(a)	35.254	35.430	35.050	0.065	DNV GL
@0121	Extraction Steam Temperature High Pressure Heater#6	°C	342.94	344.01	342.23	0.387	DNV GL
@0123	Feed Water Inlet Temperature High Pressure Heater#6	°C	210.91	211.05	210.73	0.060	DNV GL
@0124	Feed Water Outlet Pressure High Pressure Heater#6	bar(a)	176.58	177.22	175.50	0.317	DNV GL
@0125	Feed Water Outlet Temperature High Pressure Heater#6	°C	243.67	243.81	243.53	0.044	DNV GL
@0126	Drain Temperature High Pressure Heater#6	°C	215.87	215.96	215.70	0.048	DNV GL
@0127	Drain Temperature High Pressure Heater#5	°C	186.95	187.21	186.72	0.084	DNV GL
@0130	HP Steam Pressure Outlet Boiler	bar(a)	160.40	161.36	159.13	0.377	DNV GL
@0131	HP Steam Temperature Outlet Boiler	°C	535.20	536.85	533.72	0.677	DNV GL
@0133	Cold ReHeat Pressure Inlet Boiler	bar(a)	35.169	35.360	34.960	0.067	DNV GL
@0134	Cold ReHeat Temperature Inlet Boiler	°C	343.07	344.15	342.31	0.430	DNV GL
@0135	Hot ReHeat Pressure Outlet Boiler	bar(a)	32.303	32.470	32.130	0.060	DNV GL
@0136	Hot ReHeat Temperature Outlet Boiler	°C	545.02	547.40	542.43	1.137	DNV GL
@0140	Feed Water Inlet Temperature Boiler	bar(a)	174.60	175.24	173.55	0.316	DNV GL
@0141	Feed Water Inlet Pressure Boiler	°C	251.10	251.28	250.93	0.062	DNV GL
@0150	Cool Water Temperature Inlet Condenser (a)	°C	17.642	17.880	17.430	0.110	DNV GL
@0151	Cool Water Temperature Inlet Condenser (b)	°C	17.576	17.820	17.360	0.110	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A1	°C	355.54	357.34	354.10	0.682	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A2	°C	357.67	359.72	355.70	0.937	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A3	°C	356.62	358.50	354.93	0.861	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A4	°C	359.25	361.19	357.64	0.784	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A5	°C	360.08	362.07	358.22	0.908	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A6	°C	360.66	362.54	358.90	0.941	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A7	°C	361.00	363.05	359.36	0.821	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A8	°C	361.61	363.74	359.64	1.042	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A9	°C	362.17	364.15	360.34	1.001	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A10	°C	363.77	365.83	362.32	0.681	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A11	°C	366.95	369.28	364.69	1.276	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A12	°C	363.62	365.79	361.53	1.193	DNV GL

Tag	Performance Test 90% Unit Norgener #2 Date 16 december 2015 Time 12:45 hr. - 14:45 hr.	Unit	Average	Max	Min	Std	Origin
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A13	°C	362.29	364.10	360.72	0.725	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A14	°C	365.27	367.09	363.55	0.798	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A15	°C	363.30	364.91	361.94	0.769	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A16	°C	361.29	363.13	359.85	0.674	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A17	°C	366.06	368.03	364.35	0.802	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A18	°C	363.23	364.74	361.95	0.688	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A19	°C	351.35	353.30	349.68	0.732	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A20	°C	364.88	367.04	363.29	0.808	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A21	°C	361.19	362.92	359.90	0.690	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A22	°C	348.99	350.97	347.41	0.715	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A23	°C	356.91	358.98	355.47	0.772	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A24	°C	354.27	356.07	352.98	0.712	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A1	°C	137.39	138.19	136.67	0.421	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A2	°C	146.28	147.17	145.55	0.427	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A3	°C	154.17	155.14	153.30	0.427	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A4	°C	136.51	137.32	135.80	0.413	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A5	°C	143.54	144.29	142.88	0.399	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A6	°C	152.60	153.48	151.83	0.415	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A7	°C	134.55	135.31	133.91	0.388	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A8	°C	142.22	142.98	141.39	0.447	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A9	°C	151.42	152.28	150.66	0.410	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A10	°C	133.80	134.63	133.20	0.404	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A11	°C	142.96	143.73	142.31	0.410	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A12	°C	150.42	151.26	149.69	0.409	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A13	°C	132.76	133.61	132.19	0.403	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A14	°C	140.69	141.42	140.06	0.402	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A15	°C	146.64	147.50	145.66	0.445	DNV GL
@0261	Oxigen (O2) Inlet Air Heater A	vol%	3.03	3.36	2.79	0.11	Algoritmos
@0262	Oxigen (O2) Inlet Air Heater B	vol%	4.04	4.65	3.87	0.13	Algoritmos
@0265	Oxigen (O2) Outlet Air Heater	vol%	6.73	7.81	5.68	0.55	Algoritmos
@0267	Carbon Monoxide Outlet Air Heater	ppm	0.8	2.7	0.0	0.9	Algoritmos

Tag	Performance Test 90% Unit Norgener #2 Date 16 december 2015 Time 12:45 hr. - 14:45 hr.	Unit	Average	Max	Min	Std	Origin
@0012	Condensate Inlet Deaerator Mass Flow	t/h	308.28	319.65	296.57	3.332	AES
@0021	Condensate Inlet Deaerator Temperature	°C	133.97	134.05	133.84	0.066	AES
@0040	Mass Flow Feed Water Pump#1	t/h	177.23	180.35	173.73	1.440	AES
@0041	Mass Flow Feed Water Pump#2	t/h	0.000	0.000	0.000	0.000	AES
@0042	Mass Flow Feed Water Pump#3	t/h	206.94	210.50	203.29	1.603	AES
@0050	Extraction Steam Pressure Deaerator	bar(a)	8.187	8.187	8.187	0.000	AES
@0051	Extraction Steam Temperature Deaerator	°C	367.81	368.65	366.98	0.413	AES
@0060	Feed Water Temperature Deaerator	°C	169.82	169.86	169.76	0.049	AES
@0095	Extraction Steam Pressure High Pressure Heater#5	bar(a)	20.240	20.340	20.139	0.015	AES
@0096	Extraction Steam Temperature High Pressure Heater#5	°C	490.00	490.92	489.07	0.457	AES
@0300	Cold Primair Air Temperature	°C	27.042	27.559	26.547	0.342	AES
@0305	Cold Secundair Air Temperature 201	°C	26.101	26.587	25.583	0.334	AES
@0306	Cold Secundair Air Temperature 202	°C	26.720	27.230	26.222	0.341	AES
@0310	Hot Primair Air Temperature	°C	335.83	336.70	334.66	0.569	AES
@0315	Hot Secundair Air Temperature 154	°C	321.76	322.52	320.65	0.539	AES
@0316	Hot Secundair Air Temperature 155	°C	329.40	330.14	328.37	0.506	AES
@0320	Airflow Hot Secundair 21	t/h	105.78	112.58	99.82	2.161	AES
@0321	Airflow Hot Secundair 22	t/h	117.50	121.97	111.91	1.824	AES
@0325	Mass Flow Coal Feeder A	t/h	9.783	10.107	9.479	0.115	AES
@0326	Mass Flow Coal Feeder B	t/h	9.856	10.345	9.478	0.135	AES
@0327	Mass Flow Coal Feeder C	t/h	12.656	13.203	12.122	0.169	AES
@0328	Mass Flow Coal Feeder D	t/h	12.674	13.126	12.265	0.149	AES
@0330	Mass Flow Primair Air Mill A	t/h	31.677	32.346	30.823	0.284	AES
@0331	Mass Flow Primair Air Mill D	t/h	25.380	26.171	24.641	0.231	AES
@0332	Mass Flow Primair Air Mill C	t/h	28.091	28.672	27.515	0.225	AES
@0333	Mass Flow Primair Air Mill D	t/h	28.600	29.342	28.130	0.205	AES
@0340	Oxigen (O2) Inlet Air Heater A	vol %	2.179	2.534	1.923	0.102	AES
@0341	Oxigen (O2) Inlet Air Heater B	vol %	2.654	2.854	2.433	0.094	AES
@0350	X Position HP Valves	%	63.732	66.178	61.369	1.909	AES
@0360	Make-Up Water Mass Flow	t/h	4.156	7.727	0.012	2.833	AES
@0500	Power Consumption Mill A	kW	299.47	306.17	290.91	2.647	AES
@0501	Power Consumption Mill B	kW	295.20	306.43	286.18	2.959	AES
@0502	Power Consumption Mill C	kW	303.70	310.18	295.69	2.455	AES
@0503	Power Consumption Mill D	kW	299.11	306.84	289.45	3.072	AES
@0530	Gross Power Genrator (kWh)	kW	122472.0	-	-	-	AES
@0531	Auxiliary Power Consumption (kWh)	kW	9228.1	-	-	-	AES
@0535	Generator Excitation Current	A	252.52	290.00	211.00	6.987	AES
@0550	Gross Power Generator	kW	122549.419	123405.457	121891.029	289.753	AES
@0551	Voltage Generator	kV	13.333	13.453	13.168	0.051	AES
@0552	Current Generator	kA	5.232	5.350	5.175	0.028	AES
@0553	Phi Power Factor	-	1.000	1.000	0.999	0.000	AES
@0554	Frequentie Generator	Hz	50.070	50.281	49.745	0.160	AES
@0555	Rotor Speed	rpm	3009.79	3023.14	2987.58	9.792	AES
@0556	Reactive Power Generator	MVar	0.5	4.390625	-4.9960938	1.779081	AES
@0560	Net Power Unit (kWh)	kW	112467.82	-	-	-	AES

APPENDIX D4

Measurement Data Test at 80% Load

Tag	Performance Test 80% Unit Norgener #2 Date 17 december 2015 Time 09:30 hr. - 11:30 hr.	Unit	Average	Max	Min	Std	Origin
@0013	Condensate Inlet Deaerator Differential Pressure	mbar	113.48	124.80	105.11	3.074	DNV GL
@0020	Condensate Inlet Deaerator Pressure	bar(a)	8.342	8.419	8.293	0.015	DNV GL
@0021	Condensate Inlet Deaerator Temperature	°C	129.62	129.75	129.48	0.053	DNV GL
@0050	Extraction Steam Pressure Deaerator	bar(a)	6.928	6.963	6.891	0.012	DNV GL
@0051	Extraction Steam Temperature Deaerator	°C	353.13	357.52	348.04	2.531	DNV GL
@0060	Feed Water Inlet Temperature Pump#1	°C	164.46	164.62	164.35	0.052	DNV GL
@0061	Feed Water Inlet Temperature Pump#2	°C	0.00	0.00	0.00	0.000	DNV GL
@0062	Feed Water Inlet Temperature Pump#3	°C	164.35	164.50	164.22	0.054	DNV GL
@0077	Extraction Steam Pressure High Pressure Heater#5	bar(a)	17.23	17.32	17.13	0.037	DNV GL
@0078	Extraction Steam Temperature High Pressure Heater#5	°C	257.90	258.09	257.58	0.113	DNV GL
@0080	Barometer Pressure	bar(a)	1.00824	1.00836	1.00813	0.0001	DNV GL
@0081	Ambient Air Temperature	°C	20.838	21.490	20.440	0.208	DNV GL
@0082	Relative Humidity Ambient Air	%	61.607	63.146	59.267	1.047	DNV GL
@0100	HP Feed Water Inlet Boiler Differential Pressure	mbar	277.85	292.76	264.40	6.466	DNV GL
@0101	HP Feed Water Inlet Boiler Pressure	bar(a)	232.55	237.72	226.86	2.110	DNV GL
@0102	HP Feed Water Inlet Boiler Temperature	°C	169.97	170.22	169.71	0.099	DNV GL
@0105	HP Spray Water #1 Boiler Differential Pressure	mbar	0.446	1.800	0.003	0.850	DNV GL
@0106	HP Spray Water #1 Boiler Pressure	bar(a)	229.65	234.75	223.97	2.125	DNV GL
@0110	ReHeat Spray Water Boiler Differential Pressure	mbar	0.19	0.75	0.01	0.299	DNV GL
@0111	ReHeat Spray Water Boiler Pressure	bar(a)	80.406	82.100	78.520	0.70	DNV GL
@0112	ReHeat Spray Water#1 Boiler Temperature	°C	127.30	165.20	119.22	14.589	DNV GL
@0113	ReHeat Spray Water#2 Boiler Temperature	°C	0.00	0.00	0.00	0.000	DNV GL
@0114	ReHeat Spray Water#3 Boiler Temperature	°C	97.81	101.68	96.14	1.425	DNV GL
@0115	HP Spray Water #2 Boiler Differential Pressure	mbar	8.202	22.580	0.003	6.607	DNV GL
@0116	HP Spray Water #2Boiler Pressure	bar(a)	229.57	234.69	223.83	2.120	DNV GL
@0120	Extraction Steam Pressure High Pressure Heater#6	bar(a)	30.825	31.030	30.590	0.080	DNV GL
@0121	Extraction Steam Temperature High Pressure Heater#6	°C	334.14	336.95	332.66	0.923	DNV GL
@0123	Feed Water Inlet Temperature High Pressure Heater#6	°C	204.46	204.63	204.26	0.078	DNV GL
@0124	Feed Water Outlet Pressure High Pressure Heater#6	bar(a)	170.85	172.04	169.89	0.403	DNV GL
@0125	Feed Water Outlet Temperature High Pressure Heater#6	°C	236.33	236.46	236.18	0.061	DNV GL
@0126	Drain Temperature High Pressure Heater#6	°C	209.06	209.20	208.85	0.072	DNV GL
@0127	Drain Temperature High Pressure Heater#5	°C	181.08	181.25	180.91	0.069	DNV GL
@0130	HP Steam Pressure Outlet Boiler	bar(a)	157.26	158.43	156.07	0.456	DNV GL
@0131	HP Steam Temperature Outlet Boiler	°C	536.49	541.17	534.16	1.472	DNV GL
@0133	Cold ReHeat Pressure Inlet Boiler	bar(a)	30.746	30.970	30.510	0.082	DNV GL
@0134	Cold ReHeat Temperature Inlet Boiler	°C	334.43	337.31	333.00	0.933	DNV GL
@0135	Hot ReHeat Pressure Outlet Boiler	bar(a)	28.208	28.410	27.990	0.076	DNV GL
@0136	Hot ReHeat Temperature Outlet Boiler	°C	543.05	546.83	537.27	2.060	DNV GL
@0140	Feed Water Inlet Temperature Boiler	bar(a)	169.20	170.36	168.18	0.401	DNV GL
@0141	Feed Water Inlet Pressure Boiler	°C	243.67	243.87	243.44	0.088	DNV GL
@0150	Cool Water Temperature Inlet Condenser (a)	°C	16.655	16.870	16.360	0.139	DNV GL
@0151	Cool Water Temperature Inlet Condenser (b)	°C	16.588	16.800	16.300	0.139	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A1	°C	339.24	341.15	336.60	0.989	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A2	°C	340.50	342.63	337.74	1.083	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A3	°C	339.85	342.01	337.17	1.024	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A4	°C	343.12	345.20	340.48	1.039	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A5	°C	343.98	346.09	341.22	1.060	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A6	°C	343.84	346.03	341.12	1.059	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A7	°C	344.64	346.93	341.74	1.107	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A8	°C	345.22	347.27	342.56	1.065	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A9	°C	345.65	347.76	343.01	1.047	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A10	°C	348.20	350.55	345.31	1.113	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A11	°C	349.74	352.05	346.89	1.125	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A12	°C	346.32	348.41	343.64	1.073	DNV GL

Tag	Performance Test 80% Unit Norgener #2 Date 17 december 2015 Time 09:30 hr. - 11:30 hr.	Unit	Average	Max	Min	Std	Origin
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A13	°C	346.77	348.77	344.04	1.058	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A14	°C	348.89	351.08	346.02	1.123	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A15	°C	346.81	348.78	344.14	1.064	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A16	°C	344.90	346.71	342.37	0.945	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A17	°C	350.05	352.19	347.01	1.146	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A18	°C	347.14	349.02	344.52	1.052	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A19	°C	335.76	337.89	333.26	1.014	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A20	°C	348.46	350.50	345.55	1.103	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A21	°C	344.88	346.73	342.34	1.015	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A22	°C	333.48	335.28	330.88	0.933	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A23	°C	341.11	343.26	338.29	1.128	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A24	°C	338.27	340.29	335.64	1.057	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A1	°C	127.55	128.71	126.07	0.665	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A2	°C	134.40	135.61	132.91	0.704	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A3	°C	141.38	142.71	139.79	0.711	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A4	°C	126.89	127.99	125.51	0.646	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A5	°C	132.56	133.74	131.16	0.666	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A6	°C	140.35	141.62	138.79	0.706	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A7	°C	125.12	126.17	123.80	0.644	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A8	°C	131.30	132.33	129.94	0.568	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A9	°C	139.63	140.81	138.08	0.667	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A10	°C	124.43	125.50	123.16	0.637	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A11	°C	131.82	132.93	130.44	0.666	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A12	°C	138.61	139.79	137.11	0.663	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A13	°C	123.56	124.68	122.28	0.645	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A14	°C	130.11	131.22	128.71	0.682	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A15	°C	138.19	139.33	136.62	0.703	DNV GL
@0261	Oxigen (O2) Inlet Air Heater A	vol%	3.58	4.28	3.06	0.32	Algoritmos
@0262	Oxigen (O2) Inlet Air Heater B	vol%	4.02	4.25	3.82	0.09	Algoritmos
@0265	Oxigen (O2) Outlet Air Heater	vol%	7.09	7.97	6.10	0.48	Algoritmos
@0267	Carbon Monoxide Outlet Air Heater	ppm	0.0	0.0	0.0	0.0	Algoritmos

Tag	Performance Test 80% Unit Norgener #2 Date 17 december 2015 Time 09:30 hr. - 11:30 hr.	Unit	Average	Max	Min	Std	Origin
@0012	Condensate Inlet Deaerator Mass Flow	t/h	270.88	286.54	259.42	4.257	AES
@0021	Condensate Inlet Deaerator Temperature	°C	129.91	130.03	129.75	0.048	AES
@0040	Mass Flow Feed Water Pump#1	t/h	157.00	161.35	151.71	2.078	AES
@0041	Mass Flow Feed Water Pump#2	t/h	0.000	0.000	0.000	0.000	AES
@0042	Mass Flow Feed Water Pump#3	t/h	183.01	187.12	178.54	1.971	AES
@0050	Extraction Steam Pressure Deaerator	bar(a)	7.250	7.250	7.250	0.000	AES
@0051	Extraction Steam Temperature Deaerator	°C	367.13	369.66	363.10	1.568	AES
@0060	Feed Water Temperature Deaerator	°C	164.58	164.66	164.56	0.044	AES
@0095	Extraction Steam Pressure High Pressure Heater#5	bar(a)	17.728	17.846	17.598	0.035	AES
@0096	Extraction Steam Temperature High Pressure Heater#5	°C	487.73	490.48	483.38	1.736	AES
@0300	Cold Primair Air Temperature	°C	26.049	26.863	25.637	0.266	AES
@0305	Cold Secundair Air Temperature 201	°C	25.084	25.885	24.581	0.268	AES
@0306	Cold Secundair Air Temperature 202	°C	25.703	26.430	25.222	0.255	AES
@0310	Hot Primair Air Temperature	°C	319.04	320.49	317.23	0.870	AES
@0315	Hot Secundair Air Temperature 154	°C	305.51	306.97	303.73	0.878	AES
@0316	Hot Secundair Air Temperature 155	°C	313.58	314.97	311.84	0.863	AES
@0320	Airflow Hot Secundair 21	t/h	97.62	103.53	92.10	2.179	AES
@0321	Airflow Hot Secundair 22	t/h	108.66	114.11	104.11	1.953	AES
@0325	Mass Flow Coal Feeder A	t/h	12.359	12.866	11.719	0.202	AES
@0326	Mass Flow Coal Feeder B	t/h	12.458	13.004	11.918	0.219	AES
@0327	Mass Flow Coal Feeder C	t/h	14.040	14.716	13.418	0.253	AES
@0328	Mass Flow Coal Feeder D	t/h	0.039	0.039	0.039	0.000	AES
@0330	Mass Flow Primair Air Mill A	t/h	32.961	33.846	32.365	0.231	AES
@0331	Mass Flow Primair Air Mill D	t/h	27.228	28.098	26.548	0.275	AES
@0332	Mass Flow Primair Air Mill C	t/h	28.912	29.602	28.148	0.237	AES
@0333	Mass Flow Primair Air Mill D	t/h	-0.002	-0.002	-0.002	0.000	AES
@0340	Oxigen (O2) Inlet Air Heater A	vol %	2.839	3.061	2.452	0.107	AES
@0341	Oxigen (O2) Inlet Air Heater B	vol %	2.630	2.845	2.330	0.101	AES
@0350	X Position HP Valves	%	61.104	63.602	58.697	1.806	AES
@0360	Make-Up Water Mass Flow	t/h	5.311	6.040	1.161	0.556	AES
@0500	Power Consumption Mill A	kW	295.56	302.26	288.00	2.914	AES
@0501	Power Consumption Mill B	kW	297.23	306.52	287.93	3.494	AES
@0502	Power Consumption Mill C	kW	301.36	307.52	294.27	2.504	AES
@0503	Power Consumption Mill D	kW	0.88	0.88	0.88	0.000	AES
@0530	Gross Power Genrator (kWh)	kW	108664.0	-	-	-	AES
@0531	Auxiliary Power Consumption (kWh)	kW	8551.6	-	-	-	AES
@0535	Generator Excitation Current	A	207.76	236.00	180.00	7.441	AES
@0550	Gross Power Generator	kW	108796.346	110128.000	107921.000	338.487	AES
@0551	Voltage Generator	kV	13.340	13.463	13.171	0.051	AES
@0552	Current Generator	kA	4.642	4.736	4.608	0.016	AES
@0553	Phi Power Factor	-	1.000	1.000	0.999	0.000	AES
@0554	Frequentie Generator	Hz	50.027	50.445	49.611	0.184	AES
@0555	Rotor Speed	rpm	3005.43	3030.55	2978.57	11.088	AES
@0556	Reactive Power Generator	MVar	1.1	4.734	-3.203	1.440289	AES
@0560	Net Power Unit (kWh)	kW	99499.161	-	-	-	AES

APPENDIX D5

Measurement Data Test at 70% Load

Tag	Performance Test 70% Unit Norgener #2 Date 17 december 2015 Time 13:00 hr. - 15:00 hr.	Unit	Average	Max	Min	Std	Origin
@0013	Condensate Inlet Deaerator Differential Pressure	mbar	86.77	95.92	81.19	2.749	DNV GL
@0020	Condensate Inlet Deaerator Pressure	bar(a)	7.445	7.476	7.413	0.013	DNV GL
@0021	Condensate Inlet Deaerator Temperature	°C	125.52	125.62	125.41	0.035	DNV GL
@0050	Extraction Steam Pressure Deaerator	bar(a)	6.075	6.099	6.052	0.009	DNV GL
@0051	Extraction Steam Temperature Deaerator	°C	352.64	356.12	350.34	1.298	DNV GL
@0060	Feed Water Inlet Temperature Pump#1	°C	159.25	159.38	159.14	0.039	DNV GL
@0061	Feed Water Inlet Temperature Pump#2	°C	0.00	0.00	0.00	0.000	DNV GL
@0062	Feed Water Inlet Temperature Pump#3	°C	159.16	159.33	159.04	0.051	DNV GL
@0077	Extraction Steam Pressure High Pressure Heater#5	bar(a)	15.09	15.17	15.01	0.033	DNV GL
@0078	Extraction Steam Temperature High Pressure Heater#5	°C	248.92	249.08	248.73	0.072	DNV GL
@0080	Barometer Pressure	bar(a)	1.00705	1.00768	1.00658	0.0003	DNV GL
@0081	Ambient Air Temperature	°C	21.368	21.870	20.740	0.301	DNV GL
@0082	Relative Humidity Ambient Air	%	64.474	68.103	61.055	1.827	DNV GL
@0100	HP Feed Water Inlet Boiler Differential Pressure	mbar	206.07	225.24	180.15	11.050	DNV GL
@0101	HP Feed Water Inlet Boiler Pressure	bar(a)	243.01	247.39	238.20	1.715	DNV GL
@0102	HP Feed Water Inlet Boiler Temperature	°C	165.42	165.62	165.18	0.078	DNV GL
@0105	HP Spray Water #1 Boiler Differential Pressure	mbar	0.663	3.800	0.006	1.160	DNV GL
@0106	HP Spray Water #1 Boiler Pressure	bar(a)	240.12	244.46	235.20	1.726	DNV GL
@0110	ReHeat Spray Water Boiler Differential Pressure	mbar	0.17	0.80	-1.01	0.273	DNV GL
@0111	ReHeat Spray Water Boiler Pressure	bar(a)	83.115	84.460	81.530	0.56	DNV GL
@0112	ReHeat Spray Water#1 Boiler Temperature	°C	97.28	104.81	93.15	3.057	DNV GL
@0113	ReHeat Spray Water#2 Boiler Temperature	°C	0.00	0.00	0.00	0.000	DNV GL
@0114	ReHeat Spray Water#3 Boiler Temperature	°C	113.97	159.81	110.29	8.045	DNV GL
@0115	HP Spray Water #2 Boiler Differential Pressure	mbar	39.949	57.730	25.330	7.556	DNV GL
@0116	HP Spray Water #2Boiler Pressure	bar(a)	240.02	244.30	235.11	1.723	DNV GL
@0120	Extraction Steam Pressure High Pressure Heater#6	bar(a)	26.813	26.930	26.660	0.053	DNV GL
@0121	Extraction Steam Temperature High Pressure Heater#6	°C	324.67	325.33	324.10	0.252	DNV GL
@0123	Feed Water Inlet Temperature High Pressure Heater#6	°C	198.33	198.46	198.23	0.045	DNV GL
@0124	Feed Water Outlet Pressure High Pressure Heater#6	bar(a)	165.32	166.23	164.17	0.378	DNV GL
@0125	Feed Water Outlet Temperature High Pressure Heater#6	°C	229.03	229.15	228.93	0.038	DNV GL
@0126	Drain Temperature High Pressure Heater#6	°C	202.01	202.17	201.86	0.058	DNV GL
@0127	Drain Temperature High Pressure Heater#5	°C	174.76	174.91	174.57	0.063	DNV GL
@0130	HP Steam Pressure Outlet Boiler	bar(a)	154.44	155.29	153.33	0.387	DNV GL
@0131	HP Steam Temperature Outlet Boiler	°C	535.79	537.16	534.75	0.579	DNV GL
@0133	Cold ReHeat Pressure Inlet Boiler	bar(a)	26.728	26.860	26.570	0.054	DNV GL
@0134	Cold ReHeat Temperature Inlet Boiler	°C	324.97	325.68	324.49	0.266	DNV GL
@0135	Hot ReHeat Pressure Outlet Boiler	bar(a)	24.519	24.650	24.370	0.051	DNV GL
@0136	Hot ReHeat Temperature Outlet Boiler	°C	542.88	546.90	540.02	1.688	DNV GL
@0140	Feed Water Inlet Temperature Boiler	bar(a)	163.99	164.95	162.95	0.376	DNV GL
@0141	Feed Water Inlet Pressure Boiler	°C	236.26	236.44	236.05	0.062	DNV GL
@0150	Cool Water Temperature Inlet Condenser (a)	°C	16.844	17.100	16.410	0.163	DNV GL
@0151	Cool Water Temperature Inlet Condenser (b)	°C	16.777	17.030	16.340	0.163	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A1	°C	331.65	333.43	330.37	0.719	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A2	°C	332.98	335.02	331.39	0.840	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A3	°C	331.96	333.70	330.35	0.797	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A4	°C	335.17	336.85	333.88	0.700	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A5	°C	336.23	338.42	334.63	0.912	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A6	°C	335.92	337.80	334.28	0.859	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A7	°C	336.41	338.11	335.00	0.730	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A8	°C	337.06	339.13	335.52	0.858	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A9	°C	337.41	339.30	335.93	0.825	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A10	°C	338.93	340.29	337.75	0.605	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A11	°C	341.91	344.19	339.93	1.071	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A12	°C	338.67	340.80	336.72	1.044	DNV GL

Tag	Performance Test 70% Unit Norgener #2 Date 17 december 2015 Time 13:00 hr. - 15:00 hr.	Unit	Average	Max	Min	Std	Origin
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A13	°C	338.55	340.22	336.94	0.768	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A14	°C	340.63	342.68	338.99	0.866	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A15	°C	338.58	340.41	336.94	0.828	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A16	°C	336.58	338.34	335.25	0.739	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A17	°C	341.32	343.50	339.79	0.895	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A18	°C	338.60	340.63	337.06	0.865	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A19	°C	326.64	328.00	325.56	0.588	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A20	°C	340.10	342.58	338.51	0.952	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A21	°C	336.43	338.60	334.93	0.878	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A22	°C	324.56	325.90	323.38	0.606	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A23	°C	332.61	335.10	331.05	0.938	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A24	°C	329.75	332.16	328.17	0.915	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A1	°C	127.20	127.60	126.62	0.212	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A2	°C	132.78	133.28	132.27	0.242	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A3	°C	138.95	139.58	138.33	0.272	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A4	°C	126.61	126.96	125.97	0.197	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A5	°C	131.30	131.67	130.75	0.204	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A6	°C	138.25	138.79	137.70	0.245	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A7	°C	124.98	125.33	124.41	0.185	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A8	°C	130.00	130.46	129.47	0.225	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A9	°C	137.58	138.10	137.02	0.240	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A10	°C	124.48	124.89	124.00	0.199	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A11	°C	130.67	131.09	130.25	0.204	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A12	°C	136.75	137.28	136.27	0.236	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A13	°C	123.68	124.10	123.20	0.209	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A14	°C	129.31	129.70	128.81	0.197	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A15	°C	136.35	136.85	135.87	0.217	DNV GL
@0261	Oxigen (O2) Inlet Air Heater A	vol%	4.40	4.70	4.22	0.09	Algoritmos
@0262	Oxigen (O2) Inlet Air Heater B	vol%	4.37	4.62	4.15	0.10	Algoritmos
@0265	Oxigen (O2) Outlet Air Heater	vol%	7.50	8.22	6.68	0.44	Algoritmos
@0267	Carbon Monoxide Outlet Air Heater	ppm	0.7	1.6	0.0	0.7	Algoritmos

Tag	Performance Test 70% Unit Norgener #2 Date 17 december 2015 Time 13:00 hr. - 15:00 hr.	Unit	Average	Max	Min	Std	Origin
@0012	Condensate Inlet Deaerator Mass Flow	t/h	236.59	251.43	228.28	3.706	AES
@0021	Condensate Inlet Deaerator Temperature	°C	125.73	125.74	125.63	0.026	AES
@0040	Mass Flow Feed Water Pump#1	t/h	133.09	139.60	123.81	3.863	AES
@0041	Mass Flow Feed Water Pump#2	t/h	0.000	0.000	0.000	0.000	AES
@0042	Mass Flow Feed Water Pump#3	t/h	160.48	166.77	152.18	3.615	AES
@0050	Extraction Steam Pressure Deaerator	bar(a)	6.337	6.337	6.337	0.000	AES
@0051	Extraction Steam Temperature Deaerator	°C	368.42	370.99	366.00	1.316	AES
@0060	Feed Water Temperature Deaerator	°C	159.44	159.44	159.44	0.000	AES
@0095	Extraction Steam Pressure High Pressure Heater#5	bar(a)	15.516	15.545	15.425	0.039	AES
@0096	Extraction Steam Temperature High Pressure Heater#5	°C	487.92	490.76	485.25	1.443	AES
@0300	Cold Primair Air Temperature	°C	27.448	27.773	27.160	0.201	AES
@0305	Cold Secundair Air Temperature 201	°C	26.466	26.793	26.088	0.211	AES
@0306	Cold Secundair Air Temperature 202	°C	27.109	27.436	26.833	0.198	AES
@0310	Hot Primair Air Temperature	°C	312.18	313.35	311.12	0.626	AES
@0315	Hot Secundair Air Temperature 154	°C	299.69	300.87	298.79	0.590	AES
@0316	Hot Secundair Air Temperature 155	°C	307.39	308.41	306.43	0.554	AES
@0320	Airflow Hot Secundair 21	t/h	87.47	91.26	82.81	1.897	AES
@0321	Airflow Hot Secundair 22	t/h	94.73	99.66	90.33	1.701	AES
@0325	Mass Flow Coal Feeder A	t/h	10.882	11.279	10.468	0.137	AES
@0326	Mass Flow Coal Feeder B	t/h	10.974	11.398	10.467	0.154	AES
@0327	Mass Flow Coal Feeder C	t/h	12.383	12.810	11.764	0.174	AES
@0328	Mass Flow Coal Feeder D	t/h	0.039	0.039	0.039	0.000	AES
@0330	Mass Flow Primair Air Mill A	t/h	32.351	33.003	31.790	0.224	AES
@0331	Mass Flow Primair Air Mill D	t/h	26.182	27.047	25.364	0.275	AES
@0332	Mass Flow Primair Air Mill C	t/h	27.926	28.602	26.889	0.266	AES
@0333	Mass Flow Primair Air Mill D	t/h	-0.002	-0.002	-0.002	0.000	AES
@0340	Oxigen (O2) Inlet Air Heater A	vol %	3.272	3.562	3.048	0.088	AES
@0341	Oxigen (O2) Inlet Air Heater B	vol %	2.967	3.156	2.731	0.092	AES
@0350	X Position HP Valves	%	52.692	53.512	51.795	0.423	AES
@0360	Make-Up Water Mass Flow	t/h	5.096	7.611	0.096	1.587	AES
@0500	Power Consumption Mill A	kW	294.94	300.53	288.32	2.270	AES
@0501	Power Consumption Mill B	kW	292.97	301.54	286.41	2.761	AES
@0502	Power Consumption Mill C	kW	300.05	307.31	294.34	2.210	AES
@0503	Power Consumption Mill D	kW	0.88	0.88	0.88	0.000	AES
@0530	Gross Power Genrator (kWh)	kW	95406.7	-	-	-	AES
@0531	Auxiliary Power Consumption (kWh)	kW	8082.5	-	-	-	AES
@0535	Generator Excitation Current	A	177.05	201.00	146.00	5.502	AES
@0550	Gross Power Generator	kW	95580.433	96282.000	94688.000	269.342	AES
@0551	Voltage Generator	kV	13.329	13.460	13.181	0.050	AES
@0552	Current Generator	kA	4.079	4.165	3.992	0.032	AES
@0553	Phi Power Factor	-	0.998	1.000	0.996	0.001	AES
@0554	Frequentie Generator	Hz	50.130	50.365	49.829	0.121	AES
@0555	Rotor Speed	rpm	3010.73	3029.85	2988.78	7.395	AES
@0556	Reactive Power Generator	MVar	-5.1	-0.965	-8.961	1.434886	AES
@0560	Net Power Unit (kWh)	kW	86802.95	-	-	-	AES

APPENDIX D6
Measurement Data Test at 47% Load

Tag	Performance Test 47% Unit Norgener #2 Date 17 december 2015 Time 17:00 hr. - 19:00 hr.	Unit	Average	Max	Min	Std	Origin
@0013	Condensate Inlet Deaerator Differential Pressure	mbar	45.08	50.28	40.29	2.317	DNV GL
@0020	Condensate Inlet Deaerator Pressure	bar(a)	5.625	5.682	5.573	0.017	DNV GL
@0021	Condensate Inlet Deaerator Temperature	°C	114.81	114.90	114.71	0.039	DNV GL
@0050	Extraction Steam Pressure Deaerator	bar(a)	4.306	4.329	4.280	0.010	DNV GL
@0051	Extraction Steam Temperature Deaerator	°C	334.51	335.16	334.06	0.242	DNV GL
@0060	Feed Water Inlet Temperature Pump#1	°C	146.22	146.31	146.10	0.039	DNV GL
@0061	Feed Water Inlet Temperature Pump#2	°C	0.00	0.00	0.00	0.000	DNV GL
@0062	Feed Water Inlet Temperature Pump#3	°C	146.14	146.28	146.04	0.051	DNV GL
@0077	Extraction Steam Pressure High Pressure Heater#5	bar(a)	10.62	10.71	10.53	0.036	DNV GL
@0078	Extraction Steam Temperature High Pressure Heater#5	°C	224.75	224.89	224.59	0.054	DNV GL
@0080	Barometer Pressure	bar(a)	1.00513	1.00578	1.00480	0.0003	DNV GL
@0081	Ambient Air Temperature	°C	20.651	21.090	20.180	0.247	DNV GL
@0082	Relative Humidity Ambient Air	%	74.842	77.501	70.638	1.909	DNV GL
@0100	HP Feed Water Inlet Boiler Differential Pressure	mbar	98.96	117.60	76.09	13.331	DNV GL
@0101	HP Feed Water Inlet Boiler Pressure	bar(a)	246.76	252.68	242.17	2.591	DNV GL
@0102	HP Feed Water Inlet Boiler Temperature	°C	152.56	152.78	152.28	0.084	DNV GL
@0105	HP Spray Water #1 Boiler Differential Pressure	mbar	0.907	3.870	0.028	0.947	DNV GL
@0106	HP Spray Water #1 Boiler Pressure	bar(a)	243.91	249.87	239.30	2.596	DNV GL
@0110	ReHeat Spray Water Boiler Differential Pressure	mbar	3.90	12.49	0.26	2.373	DNV GL
@0111	ReHeat Spray Water Boiler Pressure	bar(a)	82.985	84.930	81.410	0.89	DNV GL
@0112	ReHeat Spray Water#1 Boiler Temperature	°C	130.48	136.80	124.65	3.783	DNV GL
@0113	ReHeat Spray Water#2 Boiler Temperature	°C	0.00	0.00	0.00	0.000	DNV GL
@0114	ReHeat Spray Water#3 Boiler Temperature	°C	148.30	148.46	148.15	0.059	DNV GL
@0115	HP Spray Water #2 Boiler Differential Pressure	mbar	18.156	23.340	12.630	1.992	DNV GL
@0116	HP Spray Water #2Boiler Pressure	bar(a)	243.83	249.83	239.18	2.590	DNV GL
@0120	Extraction Steam Pressure High Pressure Heater#6	bar(a)	18.652	18.770	18.490	0.048	DNV GL
@0121	Extraction Steam Temperature High Pressure Heater#6	°C	296.41	296.78	296.05	0.168	DNV GL
@0123	Feed Water Inlet Temperature High Pressure Heater#6	°C	182.23	182.39	182.08	0.060	DNV GL
@0124	Feed Water Outlet Pressure High Pressure Heater#6	bar(a)	160.14	160.76	159.43	0.260	DNV GL
@0125	Feed Water Outlet Temperature High Pressure Heater#6	°C	210.19	210.31	210.07	0.048	DNV GL
@0126	Drain Temperature High Pressure Heater#6	°C	184.29	184.39	184.15	0.051	DNV GL
@0127	Drain Temperature High Pressure Heater#5	°C	159.45	159.70	159.26	0.074	DNV GL
@0130	HP Steam Pressure Outlet Boiler	bar(a)	153.56	154.13	152.90	0.237	DNV GL
@0131	HP Steam Temperature Outlet Boiler	°C	525.89	526.78	525.06	0.360	DNV GL
@0133	Cold ReHeat Pressure Inlet Boiler	bar(a)	18.588	18.710	18.420	0.048	DNV GL
@0134	Cold ReHeat Temperature Inlet Boiler	°C	296.96	297.37	296.50	0.189	DNV GL
@0135	Hot ReHeat Pressure Outlet Boiler	bar(a)	17.046	17.170	16.890	0.046	DNV GL
@0136	Hot ReHeat Temperature Outlet Boiler	°C	511.91	515.26	508.71	1.363	DNV GL
@0140	Feed Water Inlet Temperature Boiler	bar(a)	159.25	159.88	158.63	0.241	DNV GL
@0141	Feed Water Inlet Pressure Boiler	°C	216.58	216.80	216.35	0.069	DNV GL
@0150	Cool Water Temperature Inlet Condenser (a)	°C	16.521	16.770	16.350	0.096	DNV GL
@0151	Cool Water Temperature Inlet Condenser (b)	°C	16.455	16.710	16.280	0.096	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A1	°C	355.54	357.34	354.10	0.682	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A2	°C	357.67	359.72	355.70	0.937	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A3	°C	356.62	358.50	354.93	0.861	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A4	°C	359.25	361.19	357.64	0.784	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A5	°C	360.08	362.07	358.22	0.908	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A6	°C	360.66	362.54	358.90	0.941	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A7	°C	361.00	363.05	359.36	0.821	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A8	°C	361.61	363.74	359.64	1.042	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A9	°C	362.17	364.15	360.34	1.001	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A10	°C	363.77	365.83	362.32	0.681	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A11	°C	366.95	369.28	364.69	1.276	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A12	°C	363.62	365.79	361.53	1.193	DNV GL

Tag	Performance Test 47% Unit Norgener #2 Date 17 december 2015 Time 17:00 hr. - 19:00 hr.	Unit	Average	Max	Min	Std	Origin
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A13	°C	362.29	364.10	360.72	0.725	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A14	°C	365.27	367.09	363.55	0.798	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A15	°C	363.30	364.91	361.94	0.769	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A16	°C	361.29	363.13	359.85	0.674	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A17	°C	366.06	368.03	364.35	0.802	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A18	°C	363.23	364.74	361.95	0.688	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A19	°C	351.35	353.30	349.68	0.732	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A20	°C	364.88	367.04	363.29	0.808	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A21	°C	361.19	362.92	359.90	0.690	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A22	°C	348.99	350.97	347.41	0.715	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A23	°C	356.91	358.98	355.47	0.772	DNV GL
@0201	Exhaust Temperature Inlet Gas Air Heater Heat A24	°C	354.27	356.07	352.98	0.712	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A1	°C	137.39	138.19	136.67	0.421	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A2	°C	146.28	147.17	145.55	0.427	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A3	°C	154.17	155.14	153.30	0.427	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A4	°C	136.51	137.32	135.80	0.413	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A5	°C	143.54	144.29	142.88	0.399	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A6	°C	152.60	153.48	151.83	0.415	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A7	°C	134.55	135.31	133.91	0.388	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A8	°C	142.22	142.98	141.39	0.447	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A9	°C	151.42	152.28	150.66	0.410	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A10	°C	133.80	134.63	133.20	0.404	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A11	°C	142.96	143.73	142.31	0.410	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A12	°C	150.42	151.26	149.69	0.409	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A13	°C	132.76	133.61	132.19	0.403	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A14	°C	140.69	141.42	140.06	0.402	DNV GL
@0203	Exhaust Temperature Outlet Gas Air Heater Heat A15	°C	146.64	147.50	145.66	0.445	DNV GL
@0261	Oxigen (O2) Inlet Air Heater A	vol%	5.68	5.94	5.49	0.10	Algoritmos
@0262	Oxigen (O2) Inlet Air Heater B	vol%	5.87	6.16	5.56	0.12	Algoritmos
@0265	Oxigen (O2) Outlet Air Heater	vol%	8.90	9.46	8.19	0.30	Algoritmos
@0267	Carbon Monoxide Outlet Air Heater	ppm	10.6	16.2	0.7	4.1	Algoritmos

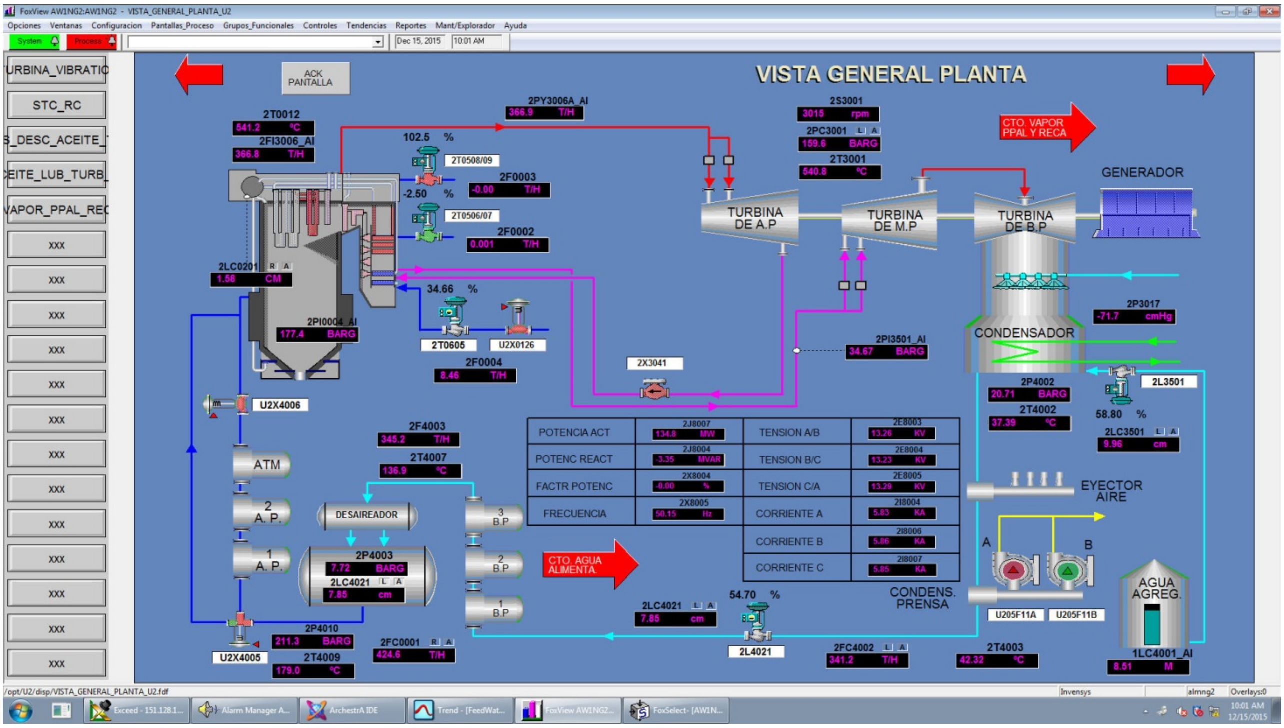
Tag	Performance Test 47% Unit Norgener #2 Date 17 december 2015 Time 17:00 hr. - 19:00 hr.	Unit	Average	Max	Min	Std	Origin
@0012	Condensate Inlet Deaerator Mass Flow	t/h	170.53	179.62	159.84	4.197	AES
@0021	Condensate Inlet Deaerator Temperature	°C	114.99	115.11	114.89	0.045	AES
@0040	Mass Flow Feed Water Pump#1	t/h	59.60	69.26	47.77	5.939	AES
@0041	Mass Flow Feed Water Pump#2	t/h	0.000	0.000	0.000	0.000	AES
@0042	Mass Flow Feed Water Pump#3	t/h	145.34	154.63	132.64	7.176	AES
@0050	Extraction Steam Pressure Deaerator	bar(a)	4.602	4.602	4.602	0.000	AES
@0051	Extraction Steam Temperature Deaerator	°C	347.47	348.09	346.73	0.380	AES
@0060	Feed Water Temperature Deaerator	°C	146.59	146.69	146.59	0.017	AES
@0095	Extraction Steam Pressure High Pressure Heater#5	bar(a)	10.865	10.941	10.818	0.048	AES
@0096	Extraction Steam Temperature High Pressure Heater#5	°C	459.08	459.63	458.14	0.390	AES
@0300	Cold Primair Air Temperature	°C	26.955	27.363	26.348	0.379	AES
@0305	Cold Secundair Air Temperature 201	°C	25.955	26.392	25.387	0.394	AES
@0306	Cold Secundair Air Temperature 202	°C	26.631	27.035	26.032	0.370	AES
@0310	Hot Primair Air Temperature	°C	289.59	290.23	289.11	0.302	AES
@0315	Hot Secundair Air Temperature 154	°C	279.62	280.02	279.29	0.187	AES
@0316	Hot Secundair Air Temperature 155	°C	285.61	286.07	285.24	0.209	AES
@0320	Airflow Hot Secundair 21	t/h	63.67	68.35	59.58	1.551	AES
@0321	Airflow Hot Secundair 22	t/h	61.77	67.52	57.18	1.643	AES
@0325	Mass Flow Coal Feeder A	t/h	7.825	8.150	7.570	0.105	AES
@0326	Mass Flow Coal Feeder B	t/h	7.876	8.156	7.553	0.109	AES
@0327	Mass Flow Coal Feeder C	t/h	8.983	9.384	8.610	0.127	AES
@0328	Mass Flow Coal Feeder D	t/h	0.039	0.039	0.039	0.000	AES
@0330	Mass Flow Primair Air Mill A	t/h	28.732	29.292	28.071	0.221	AES
@0331	Mass Flow Primair Air Mill D	t/h	24.028	24.816	23.309	0.274	AES
@0332	Mass Flow Primair Air Mill C	t/h	25.905	27.114	25.117	0.319	AES
@0333	Mass Flow Primair Air Mill D	t/h	-0.002	-0.002	-0.002	0.000	AES
@0340	Oxigen (O2) Inlet Air Heater A	vol %	4.786	5.057	4.498	0.114	AES
@0341	Oxigen (O2) Inlet Air Heater B	vol %	4.295	4.621	3.992	0.115	AES
@0350	X Position HP Valves	%	36.322	37.484	35.023	0.797	AES
@0360	Make-Up Water Mass Flow	t/h	4.320	6.854	0.013	2.242	AES
@0500	Power Consumption Mill A	kW	295.94	304.06	289.59	2.499	AES
@0501	Power Consumption Mill B	kW	289.43	296.65	281.53	2.633	AES
@0502	Power Consumption Mill C	kW	292.71	299.78	286.57	2.435	AES
@0503	Power Consumption Mill D	kW	0.88	0.88	0.88	0.000	AES
@0530	Gross Power Genrator (kWh)	kW	65945.8	-	-	-	AES
@0531	Auxiliary Power Consumption (kWh)	kW	7603.7	-	-	-	AES
@0535	Generator Excitation Current	A	153.13	180.00	128.00	5.313	AES
@0550	Gross Power Generator	kW	66131.815	66802.887	65220.360	303.658	AES
@0551	Voltage Generator	kV	13.329	13.465	13.176	0.058	AES
@0552	Current Generator	kA	2.818	2.892	2.768	0.023	AES
@0553	Phi Power Factor	-	0.997	1.000	0.989	0.002	AES
@0554	Frequentie Generator	Hz	49.967	50.271	49.721	0.147	AES
@0555	Rotor Speed	rpm	3001.83	3021.83	2984.78	9.169	AES
@0556	Reactive Power Generator	MVar	-4.6	0.2539063	-9.7304688	1.785886	AES
@0560	Net Power Unit (kWh)	kW	57997.559	-	-	-	AES

APPENDIX E

Control Panel Screen Dumps

APPENDIX E1

Control Panel Screen Dumps Test at 100% Load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ACK PANTALLA
CTO. VAPOR PPAL Y RECA
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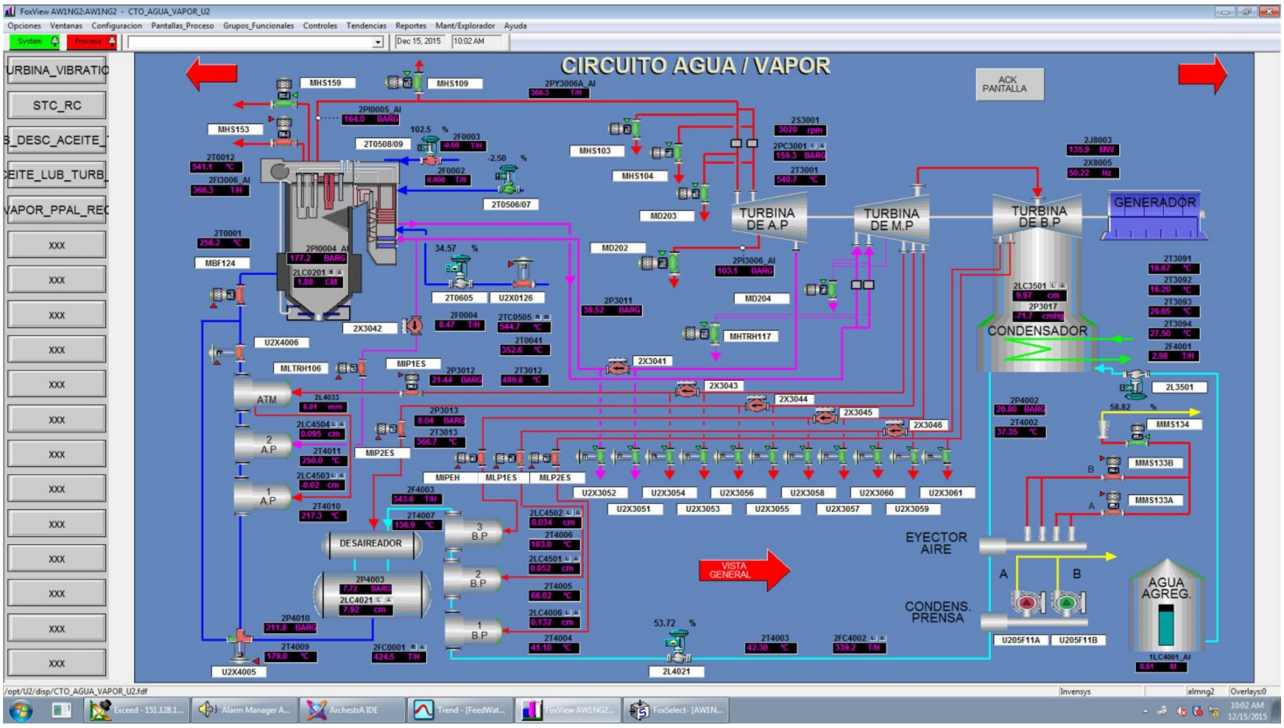
TURBINA DE M.P
TURBINA DE B.P
CONDENSADOR
EYECTOR AIRE
CONDENS. PRENSA
AGUA AGREG.
DESAIREADOR
CTO. AGUA ALIMENTA
ATM
POTENCIA ACT
POTENC REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C
STC_RC


CIRCUITO AGUA / VAPOR
ACK PANTALLA
GENERADOR
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
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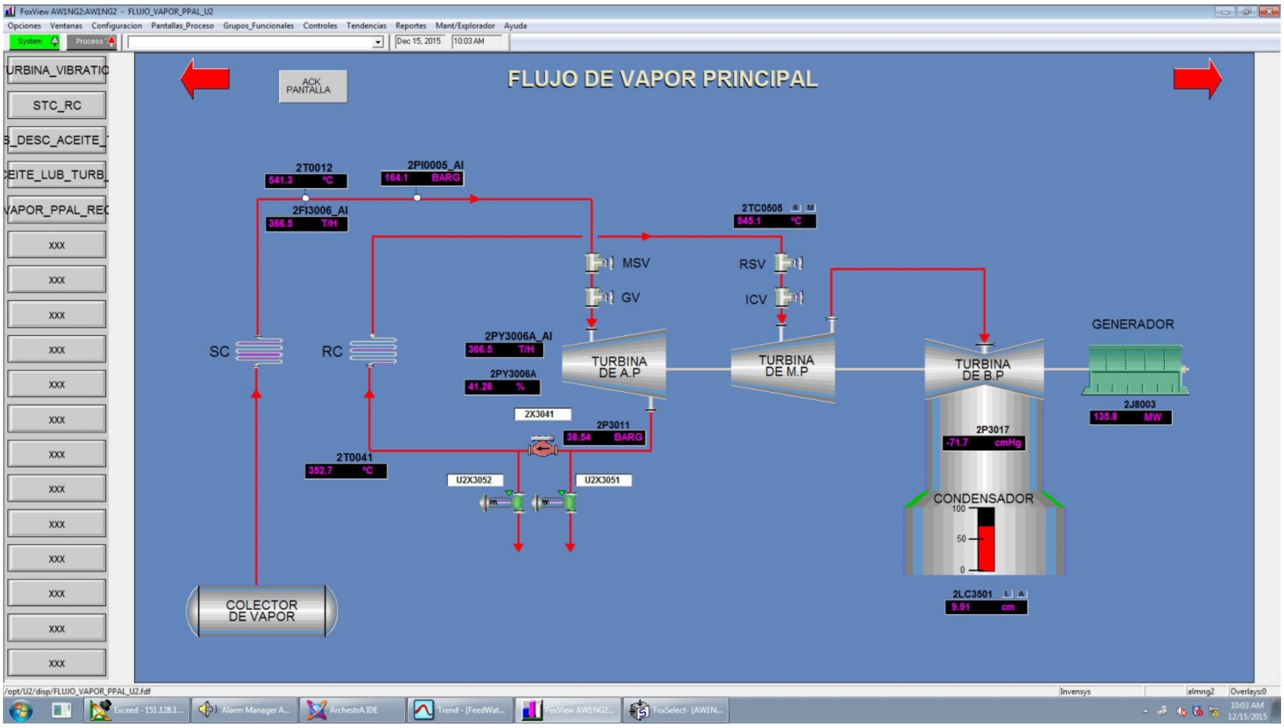
EYECTOR AIRE
CONDENS. PRENSA
AGUA AGREG.
DESAIREADOR
VISTA GENERAL
ATM
STC_RC


FLUJO DE VAPOR PRINCIPAL
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164.1 BARG
2FI3006_AI
366.5 T/H
2TC0505
545.1 °C
MSV
GV
RSV
ICV
SC
RC
2PY3006A_AI
366.5 T/H
2PY3006A
41.28 %
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
2J8003
135.8 MW
2X3041
2P3011
38.54 BARG
2T0041
352.7 °C
U2X3052
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CONDENSADOR
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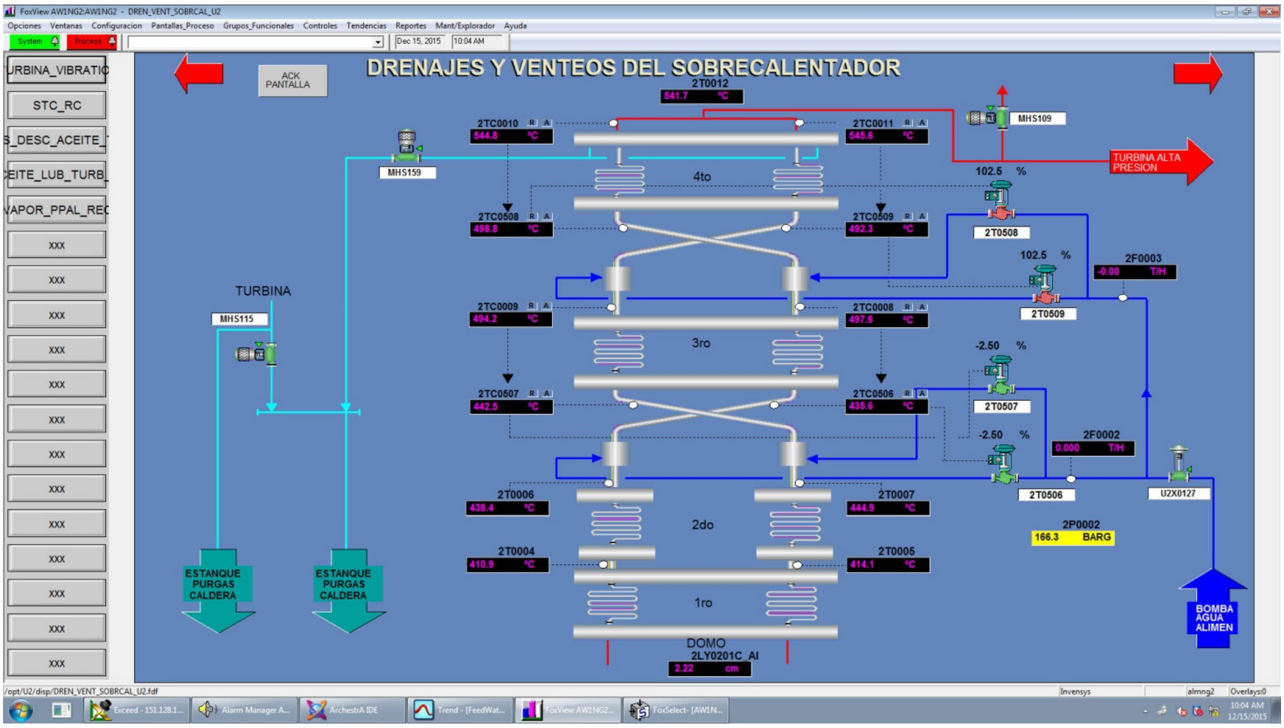
COLECTOR DE VAPOR
STC_RC


DRENAJES Y VENTEOS DEL SOBRECALENTADOR
ACK PANTALLA
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541.7 °C
MHS109
MHS159
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544.8 °C
2TC0011
545.6 °C
4to
TURBINA ALTA PRESION
102.5 %
2TC0508
498.8 °C
2TC0509
492.3 °C
2T0508
2F0003
-0.00 T/H
2T0509
TURBINA
MHS115
2TC0009
494.2 °C
2TC0008
497.6 °C
3ro
2TC0507
442.5 °C
2TC0506
435.6 °C
-2.50 %
2T0507
2F0002
0.000 T/H
2T0006
438.4 °C
2T0007
444.9 °C
2T0506
U2X0127
2do
2P0002
166.3 BARG
2T0004
410.9 °C
2T0005
414.1 °C
ESTANQUE PURGAS CALDERA
ESTANQUE PURGAS CALDERA
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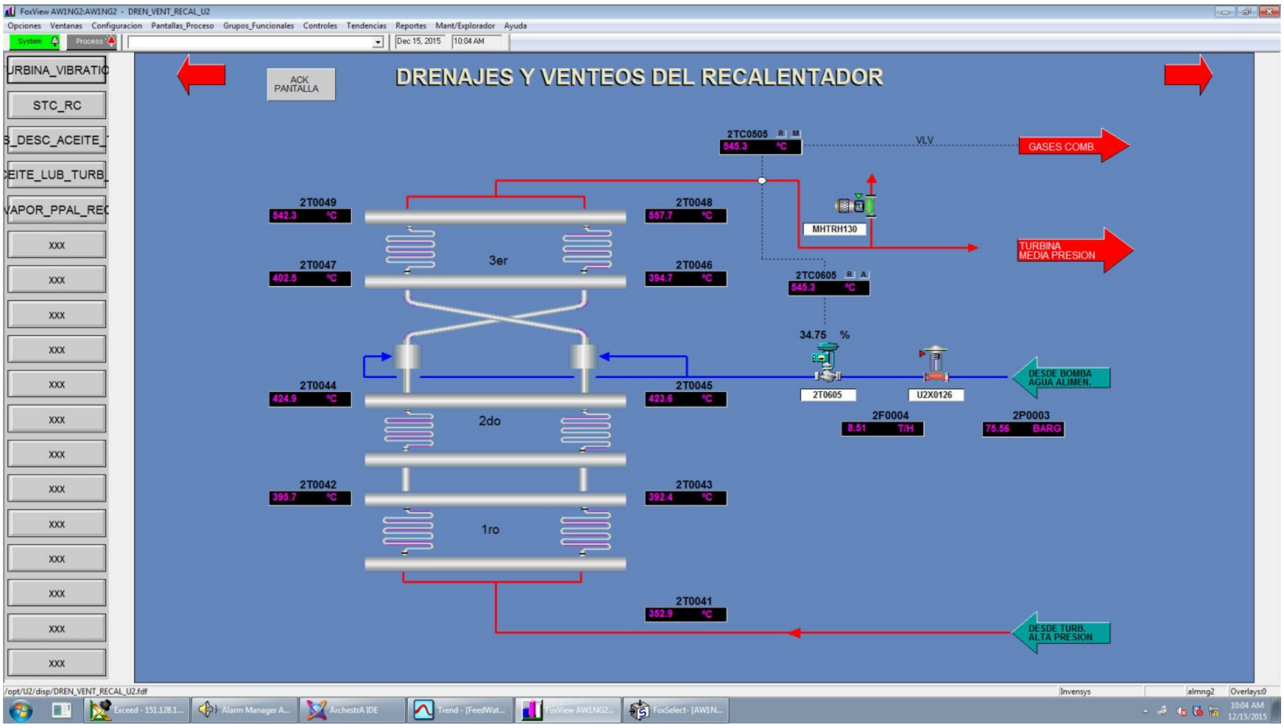
STC_RC


DRENAJES Y VENTEOS DEL RECALENTADOR
ACK PANTALLA
GASES COMB.
TURBINA MEDIA PRESION
DESDE BOMBA AGUA ALIMEN.
DESDE TURB. ALTA PRESION
3er
2do
1ro
2T0049
2T0048
2T0047
2T0046
2T0045
2T0044
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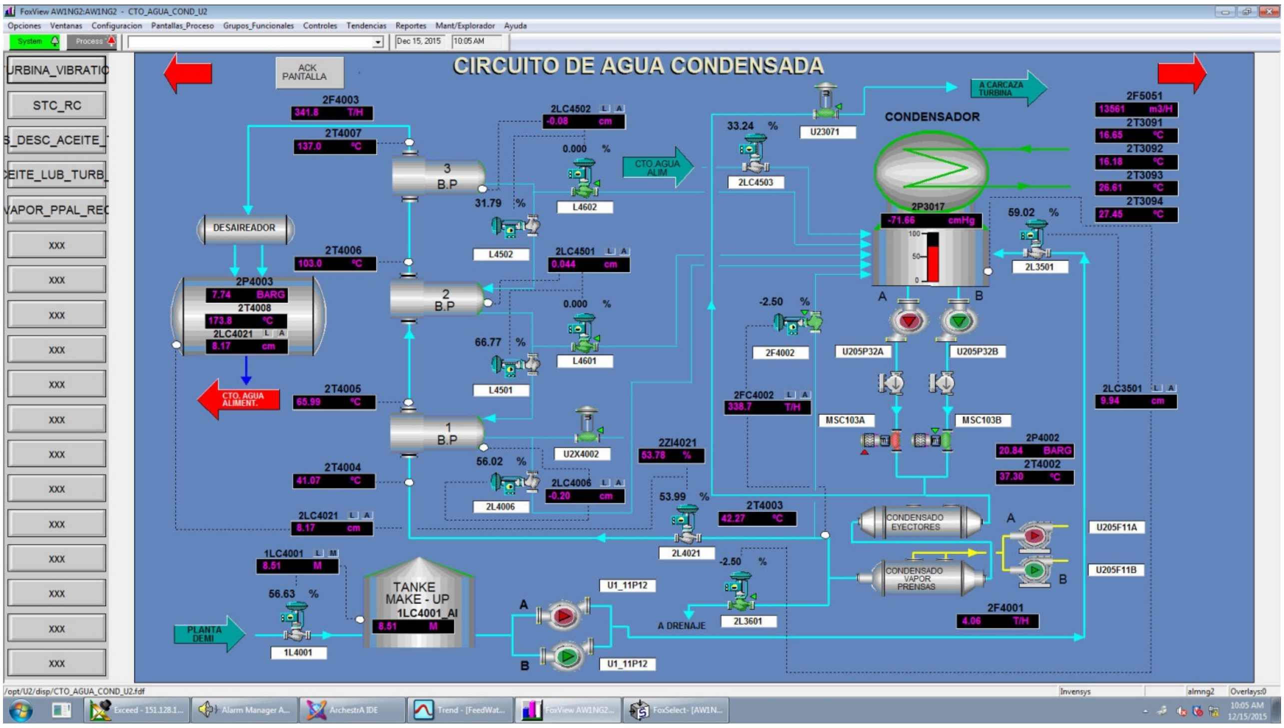
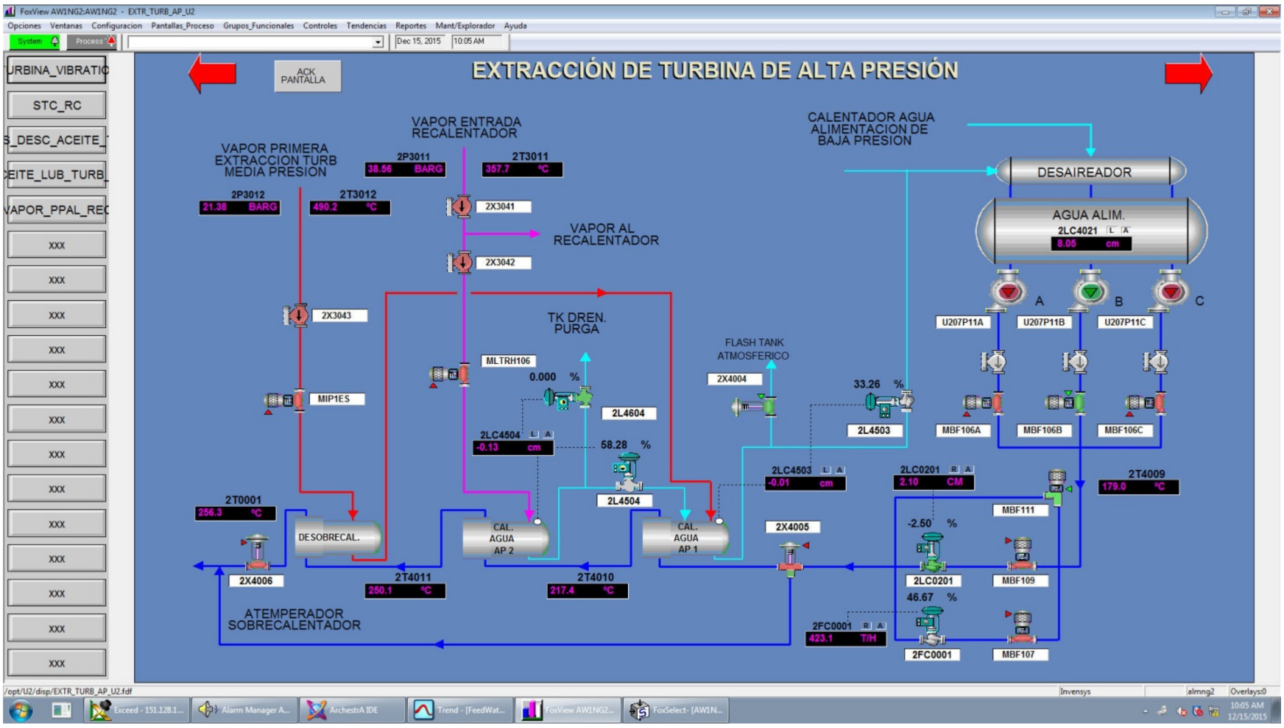
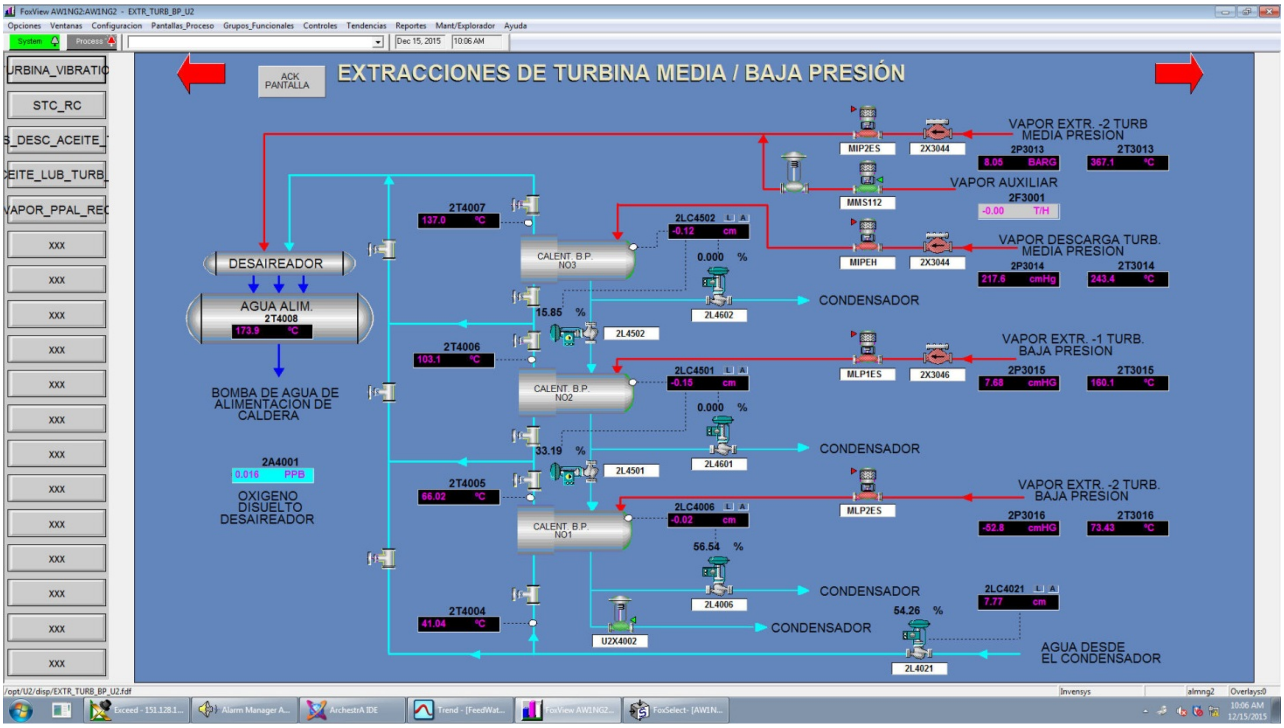
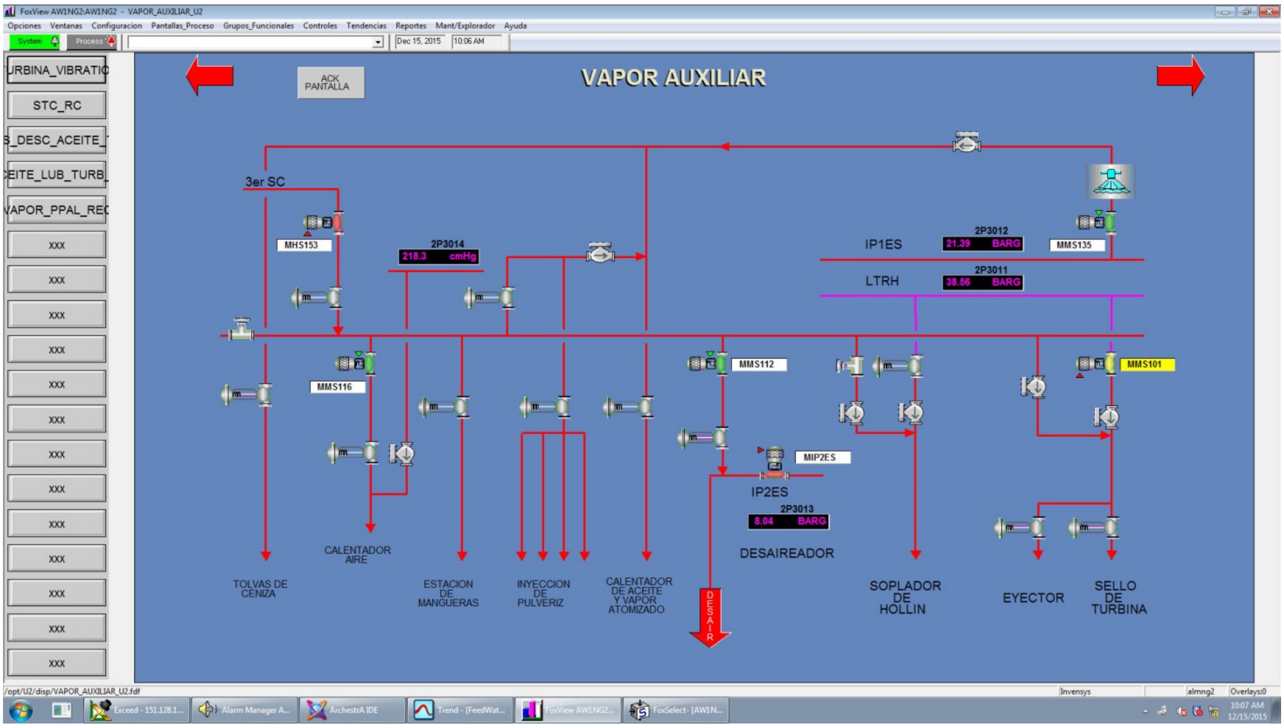
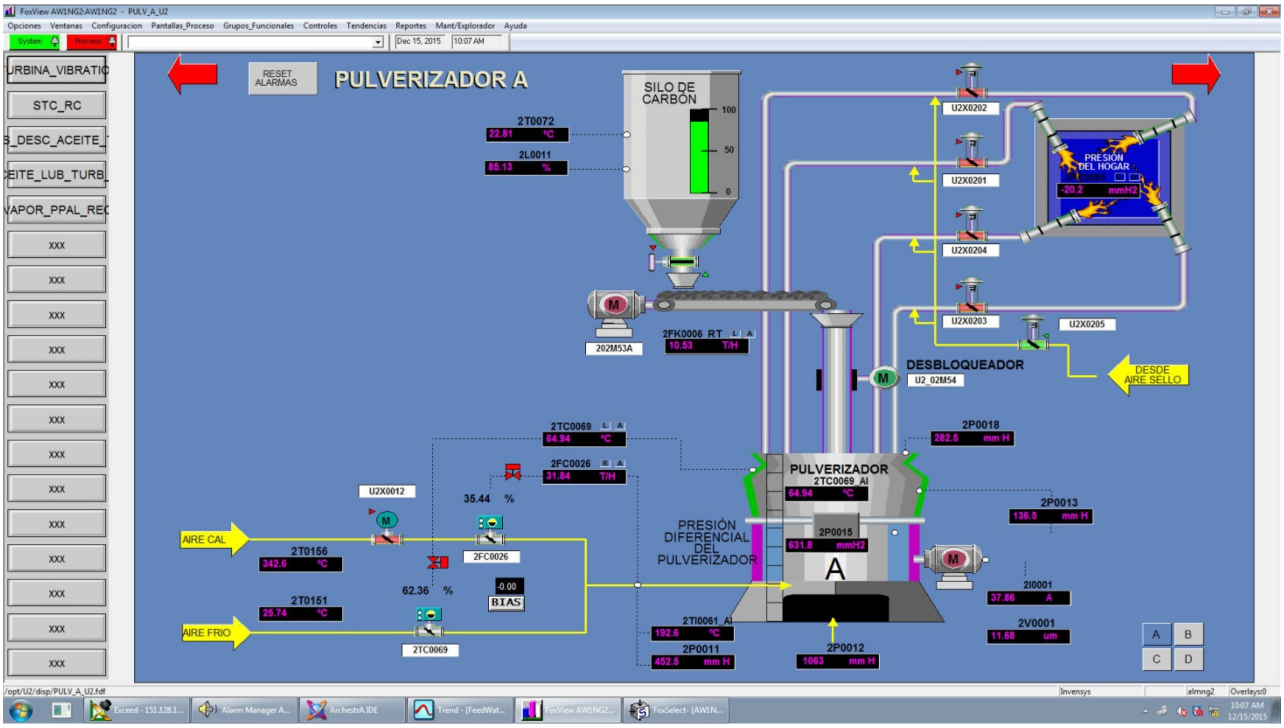
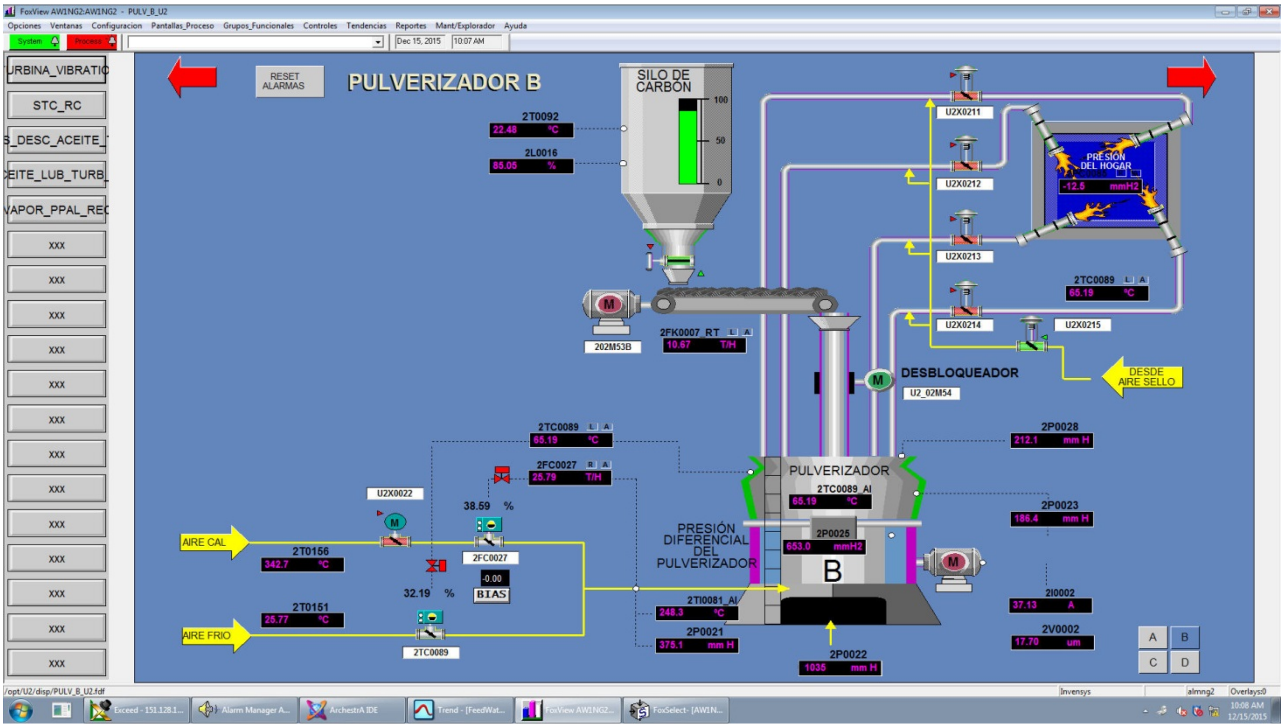

CIRCUITO DE AGUA CONDENSADA
ACK PANTALLA
CONDENSADOR
DESAIREADOR
A CARCAZA TURBINA
CTO AGUA ALIM
CTO. AGUA ALIMENT.
TANKE MAKE - UP
PLANTA DEMI
A DRENAJE
CONDENSADO EYECTORES
CONDENSADO VAPOR PRENSAS
2F4003
2T4007
2T4006
2P4003
2T4008
2LC4021
2T4005
2T4004
1LC4001
2LC4502
2LC4501
2LC4006
L4602
L4502
L4601
L4501
2L4006
U2X4002
2Z14021
2L4021
2T4003
2FC4002
2F4002
2LC4503
U23071
2P3017
2F5051
2T3091
2T3092
2T3093
2T3094
2L3501
2LC3501
U205P32A
U205P32B
MSC103A
MSC103B
2P4002
2T4002
U205F11A
U205F11B
2F4001
2L3601
U1_11P12
1L4001

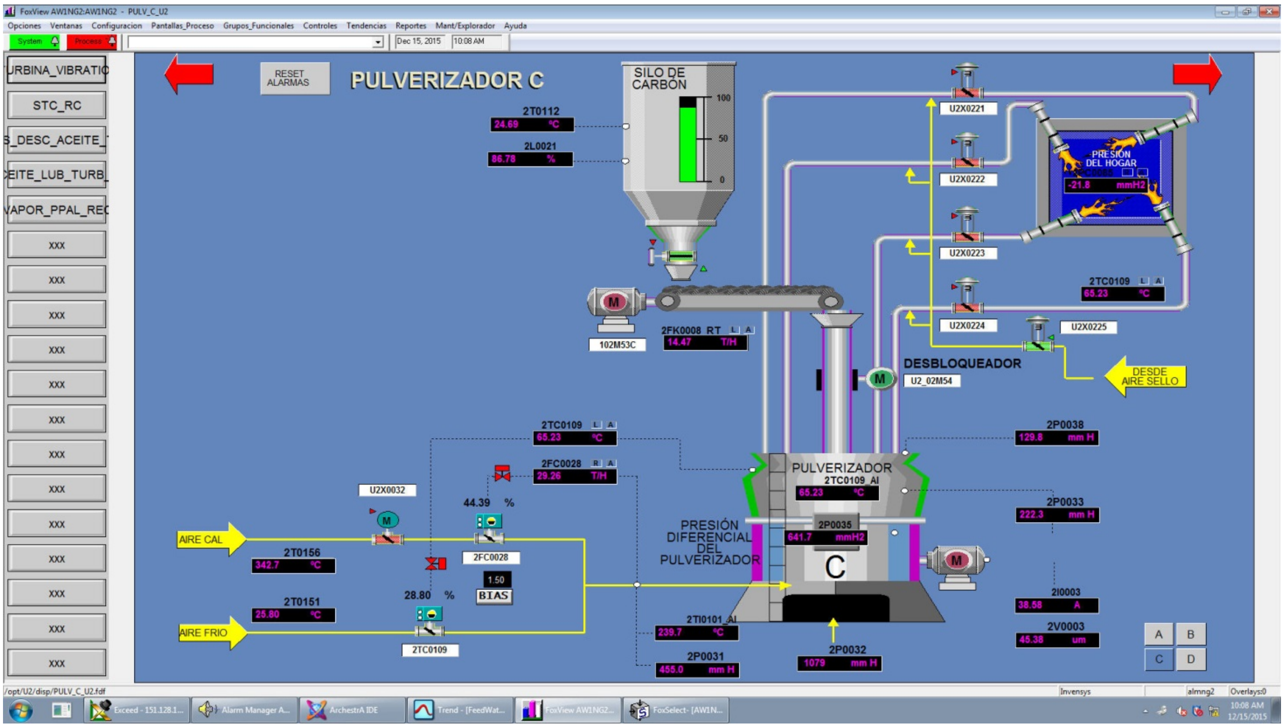

EXTRACCIÓN DE TURBINA DE ALTA PRESIÓN
ACK PANTALLA
VAPOR ENTRADA RECALENTADOR
VAPOR PRIMERA EXTRACCION TURB MEDIA PRESION
CALENTADOR AGUA ALIMENTACION DE BAJA PRESION
DESAIREADOR
AGUA ALIM.
VAPOR AL RECALENTADOR
TK DREN. PURGA
FLASH TANK ATMOSFERICO
DESOBRECAL.
CAL. AGUA AP 2
CAL. AGUA AP 1
ATEMPERADOR SOBRECALENTADOR

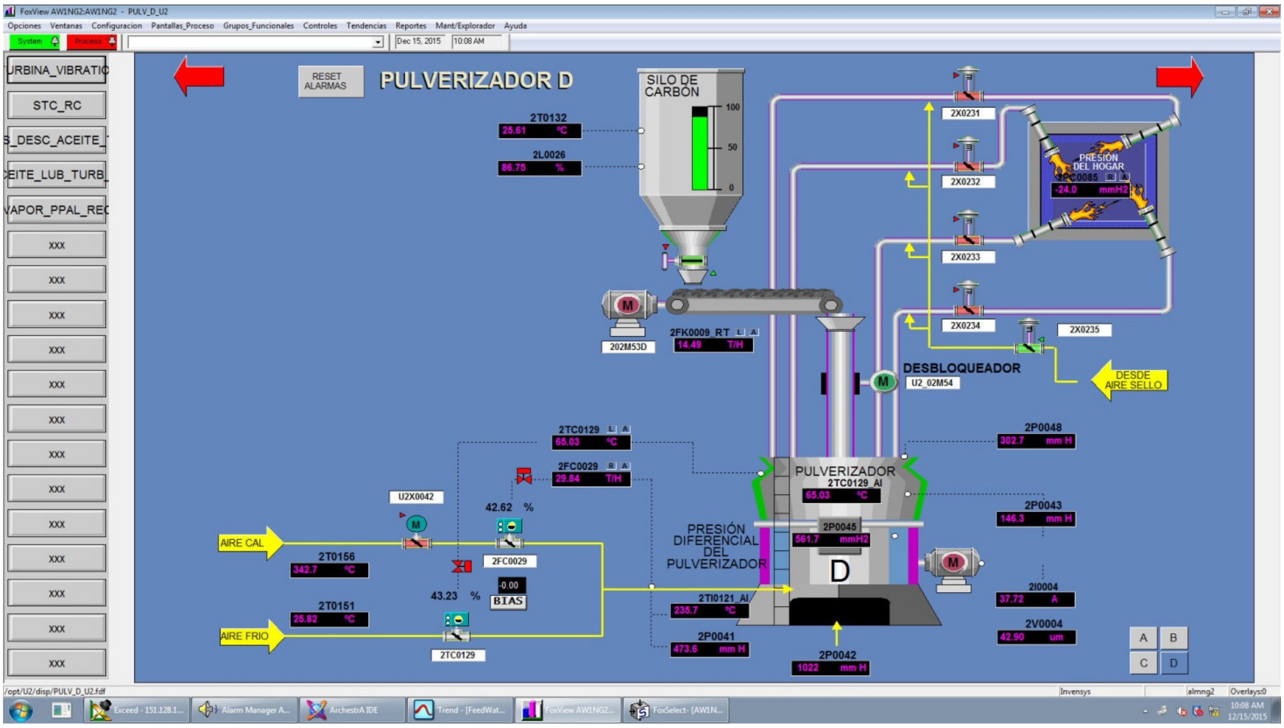

EXTRACCIONES DE TURBINA MEDIA / BAJA PRESIÓN
ACK PANTALLA
VAPOR EXTR. -2 TURB MEDIA PRESION
VAPOR AUXILIAR
VAPOR DESCARGA TURB. MEDIA PRESION
DESAIREADOR
AGUA ALIM.
CONDENSADOR
VAPOR EXTR. -1 TURB. BAJA PRESION
BOMBA DE AGUA DE ALIMENTACION DE CALDERA
VAPOR EXTR. -2 TURB. BAJA PRESION
OXIGENO DISUELTO DESAIREADOR
AGUA DESDE EL CONDENSADOR

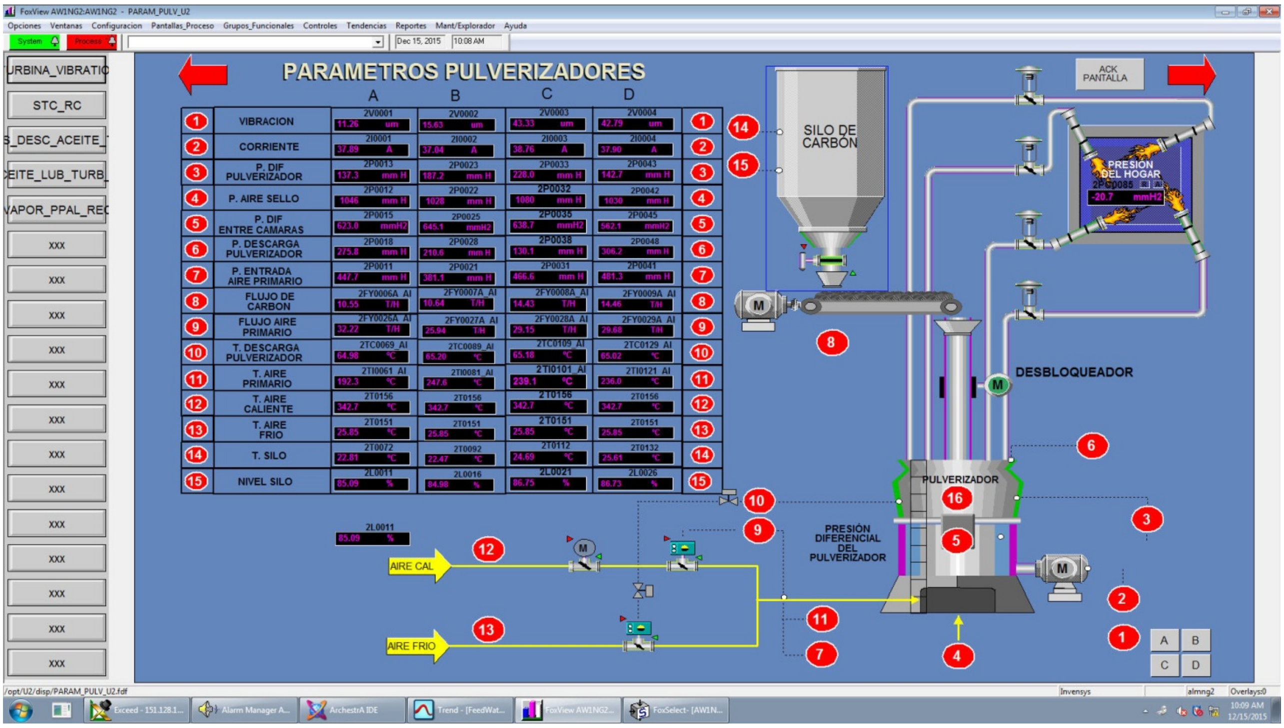

VAPOR AUXILIAR
ACK PANTALLA
3er SC
IP1ES
LTRH
IP2ES
DESAIREADOR
TOLVAS DE CENIZA
CALENTADOR AIRE
ESTACION DE MANGUERAS
INYECCION DE PULVERIZ
CALENTADOR DE ACEITE Y VAPOR ATOMIZADO
SOPLADOR DE HOLLIN
EYECTOR
SELLO DE TURBINA

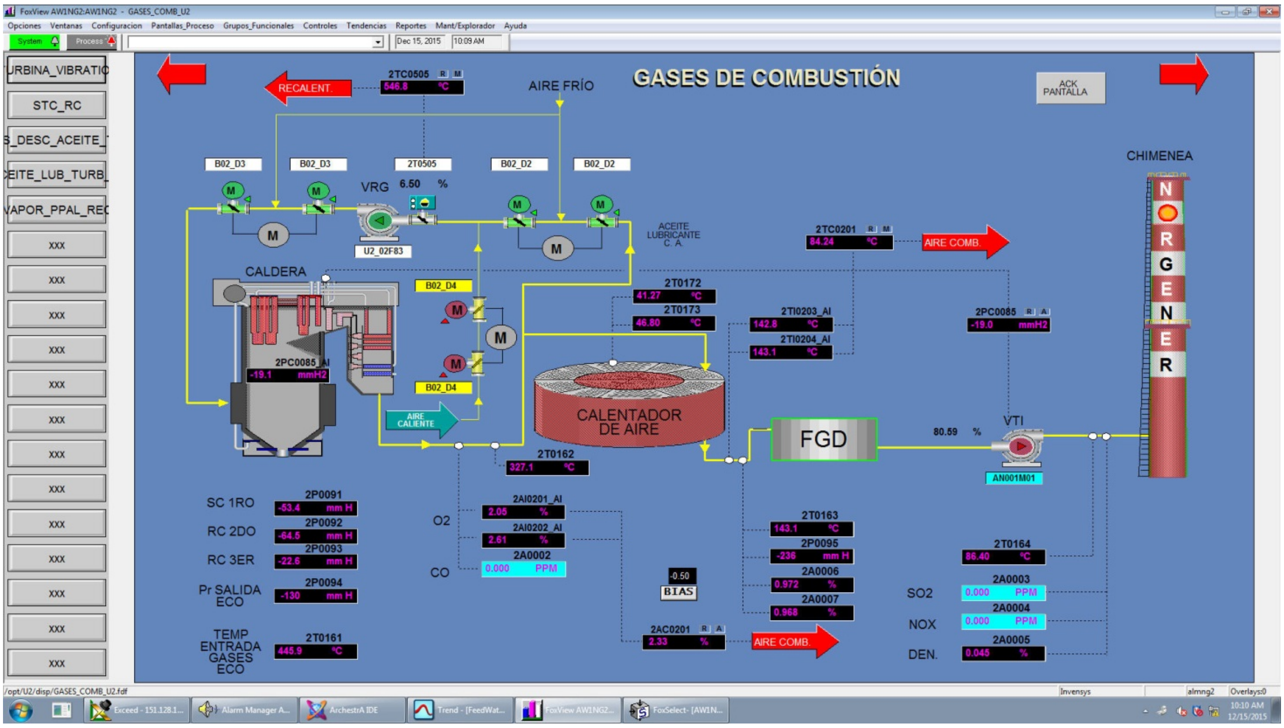

PULVERIZADOR A
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
PRESIÓN DEL HOGAR
BIAS

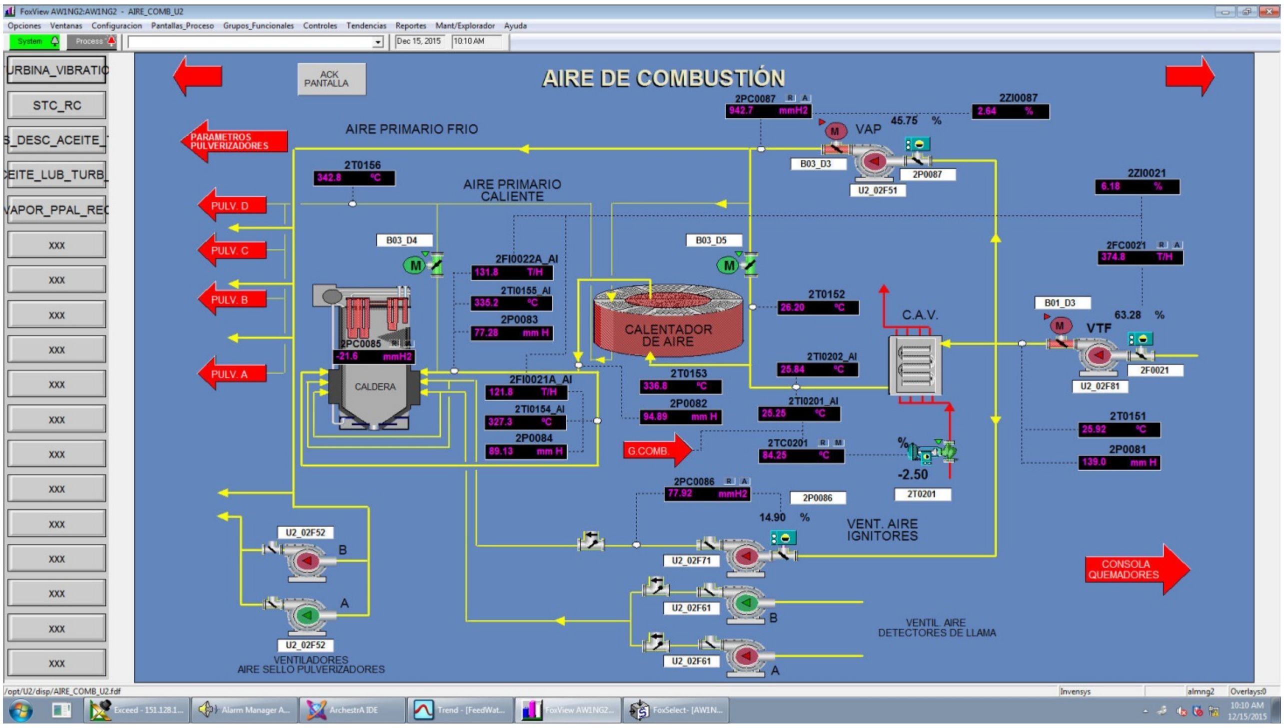

PULVERIZADOR B
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
PRESIÓN DEL HOGAR
AIRE CAL
AIRE FRIO
BIAS

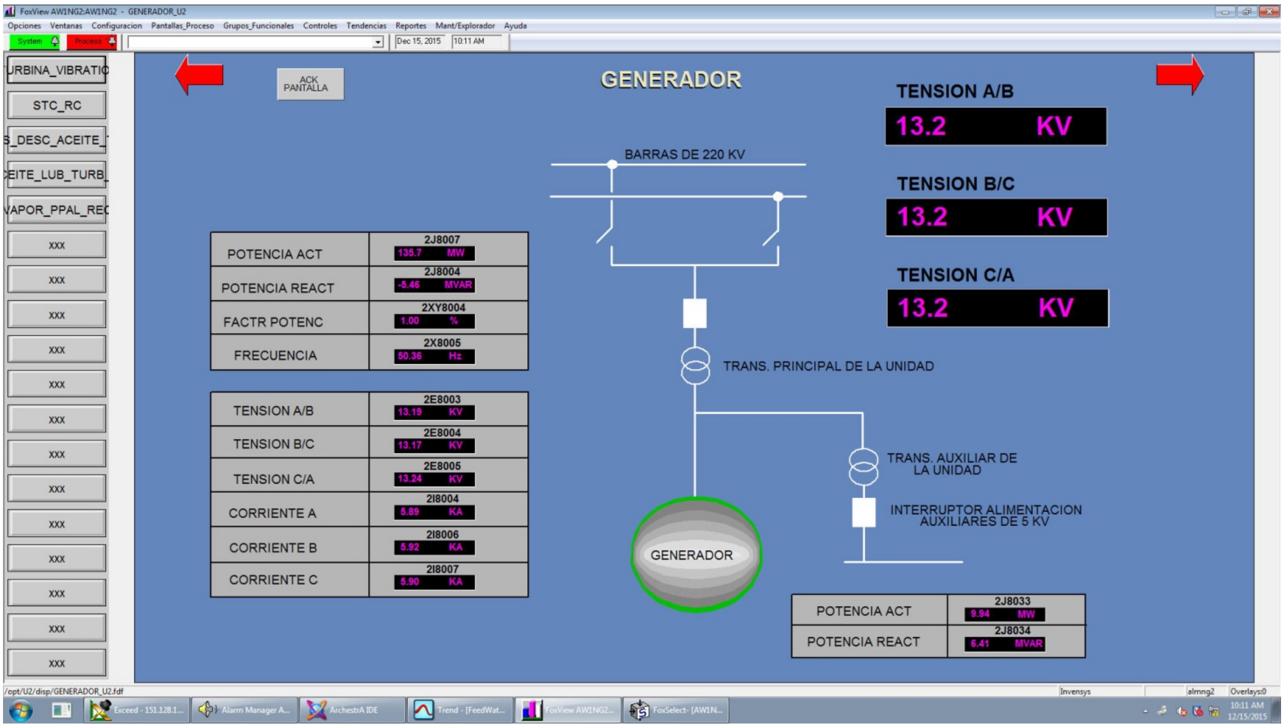

PULVERIZADOR C
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
PRESIÓN DEL HOGAR
AIRE CAL
AIRE FRIO
BIAS

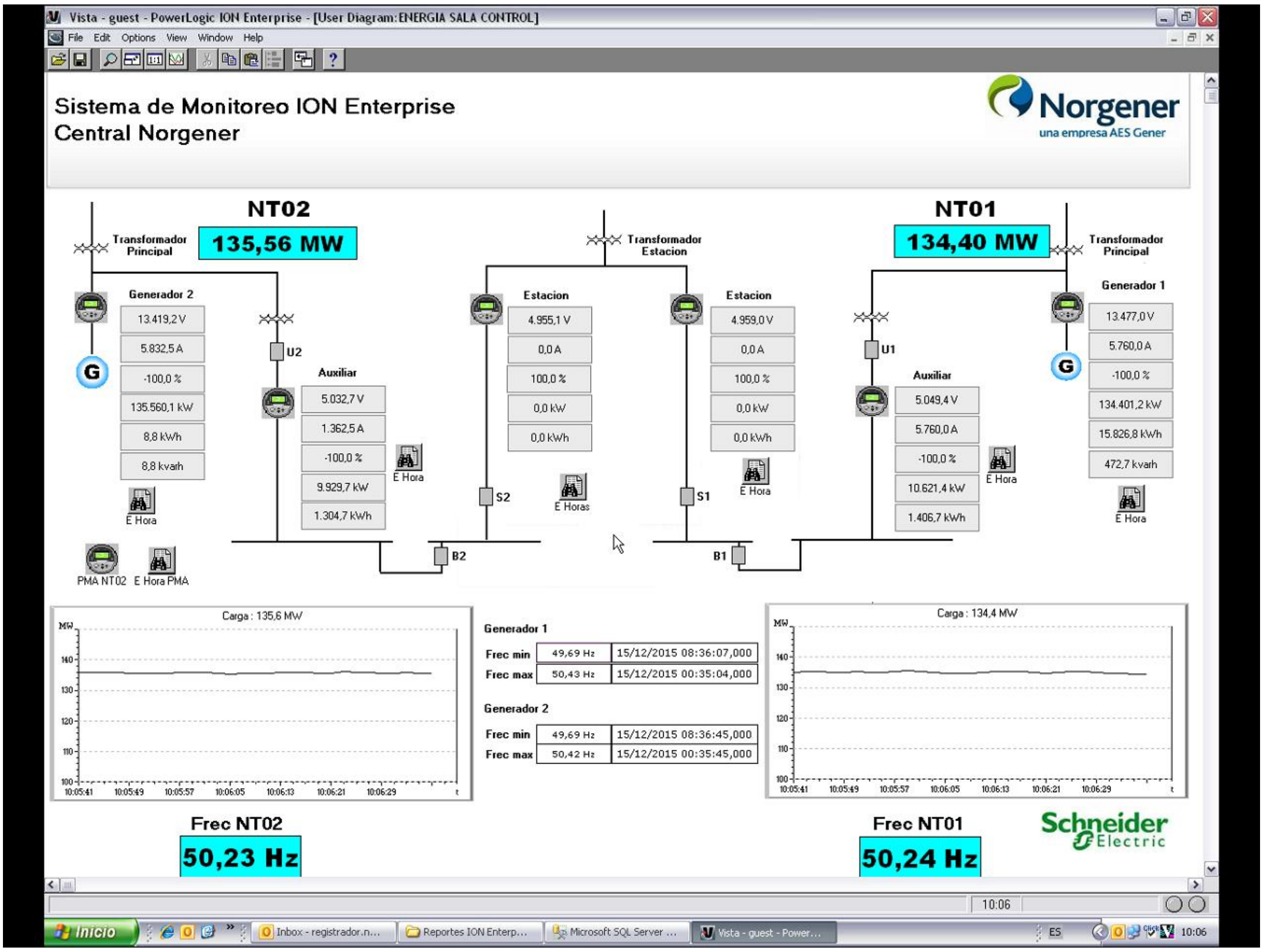

PULVERIZADOR D
RESET ALARMAS
SILO DE CARBÓN
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
PRESIÓN DEL HOGAR
AIRE CAL
AIRE FRIO
DESDE AIRE SELLO
BIAS


PARAMETROS PULVERIZADORES
A
B
C
D
VIBRACION
CORRIENTE
P. DIF PULVERIZADOR
P. AIRE SELLO
P. DIF ENTRE CAMARAS
P. DESCARGA PULVERIZADOR
P. ENTRADA AIRE PRIMARIO
FLUJO DE CARBON
FLUJO AIRE PRIMARIO
T. DESCARGA PULVERIZADOR
T. AIRE PRIMARIO
T. AIRE CALIENTE
T. AIRE FRIO
T. SILO
NIVEL SILO
ACK PANTALLA
SILO DE CARBÓN
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
PRESIÓN DEL HOGAR
AIRE CAL
AIRE FRIO


GASES DE COMBUSTIÓN
CALDERA
CALENTADOR DE AIRE
FGD
CHIMENEA
AIRE FRÍO

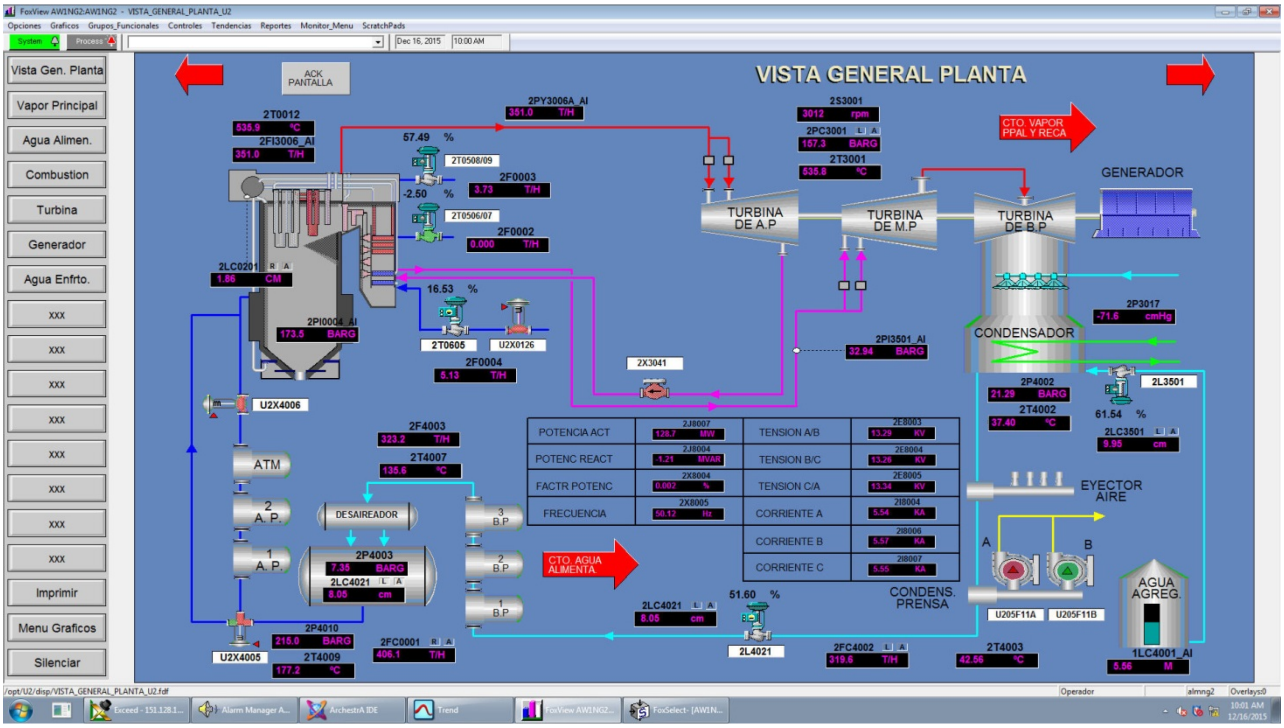

AIRE DE COMBUSTIÓN
AIRE PRIMARIO FRIO
AIRE PRIMARIO CALIENTE
CALENTADOR DE AIRE
VENT. AIRE IGNITORES

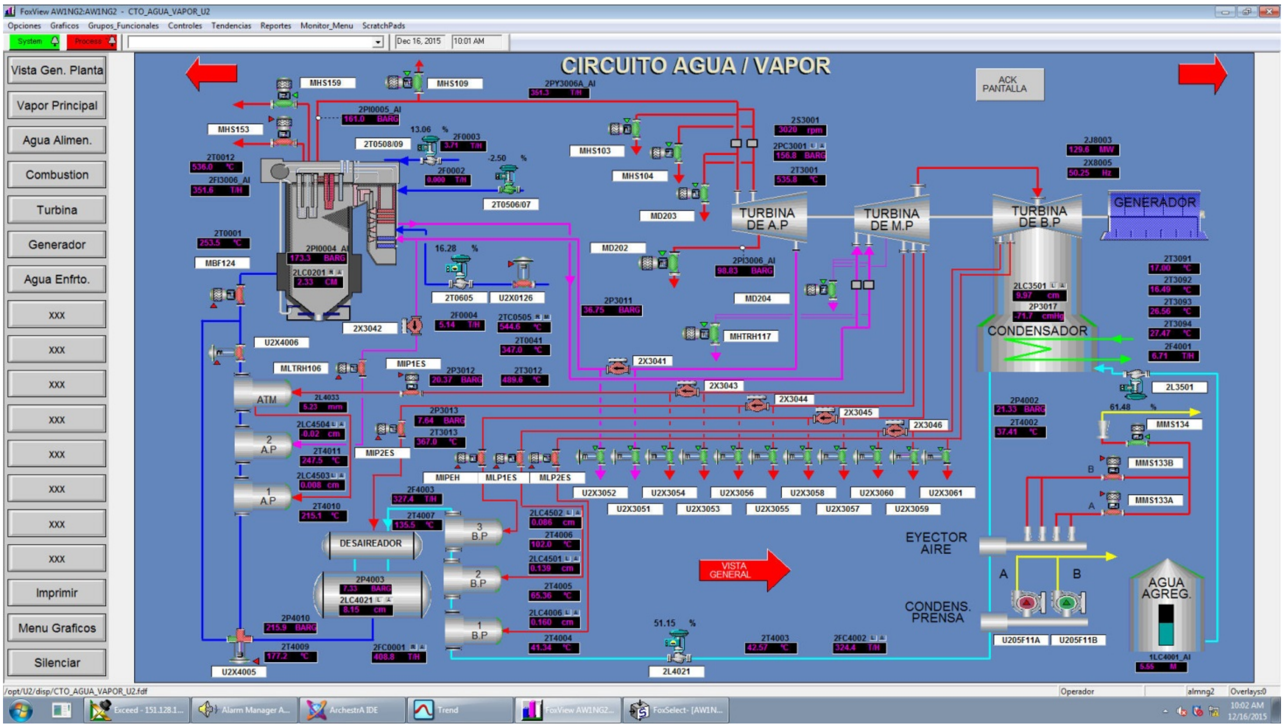

GENERADOR
ACK PANTALLA
TENSION A/B
13.2 KV
TENSION B/C
13.2 KV
TENSION C/A
13.2 KV
BARRAS DE 220 KV
TRANS. PRINCIPAL DE LA UNIDAD
TRANS. AUXILIAR DE LA UNIDAD
INTERRUPTOR ALIMENTACION AUXILIARES DE 5 KV
POTENCIA ACT
POTENCIA REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C
POTENCIA ACT
POTENCIA REACT

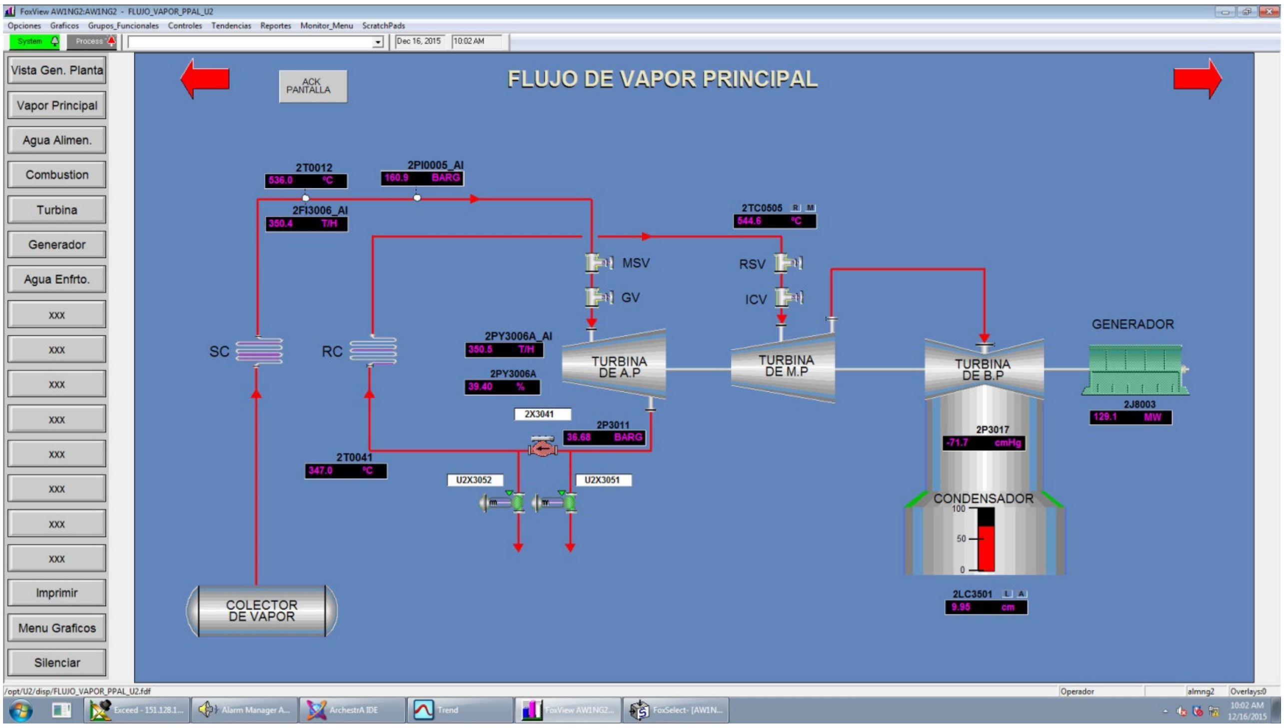

Sistema de Monitoreo ION Enterprise
Central Norgener
Norgener
una empresa AES Gener
NT02
135,56 MW
NT01
134,40 MW
Transformador Principal
Transformador Estacion
Generador 2
Generador 1
Auxiliar
Estacion
Carga : 135,6 MW
Carga : 134,4 MW
Generador 1
Frec min 49,69 Hz 15/12/2015 08:36:07,000
Frec max 50,43 Hz 15/12/2015 00:35:04,000
Generador 2
Frec min 49,69 Hz 15/12/2015 08:36:45,000
Frec max 50,42 Hz 15/12/2015 00:35:45,000
Frec NT02
50,23 Hz
Frec NT01
50,24 Hz
Schneider Electric

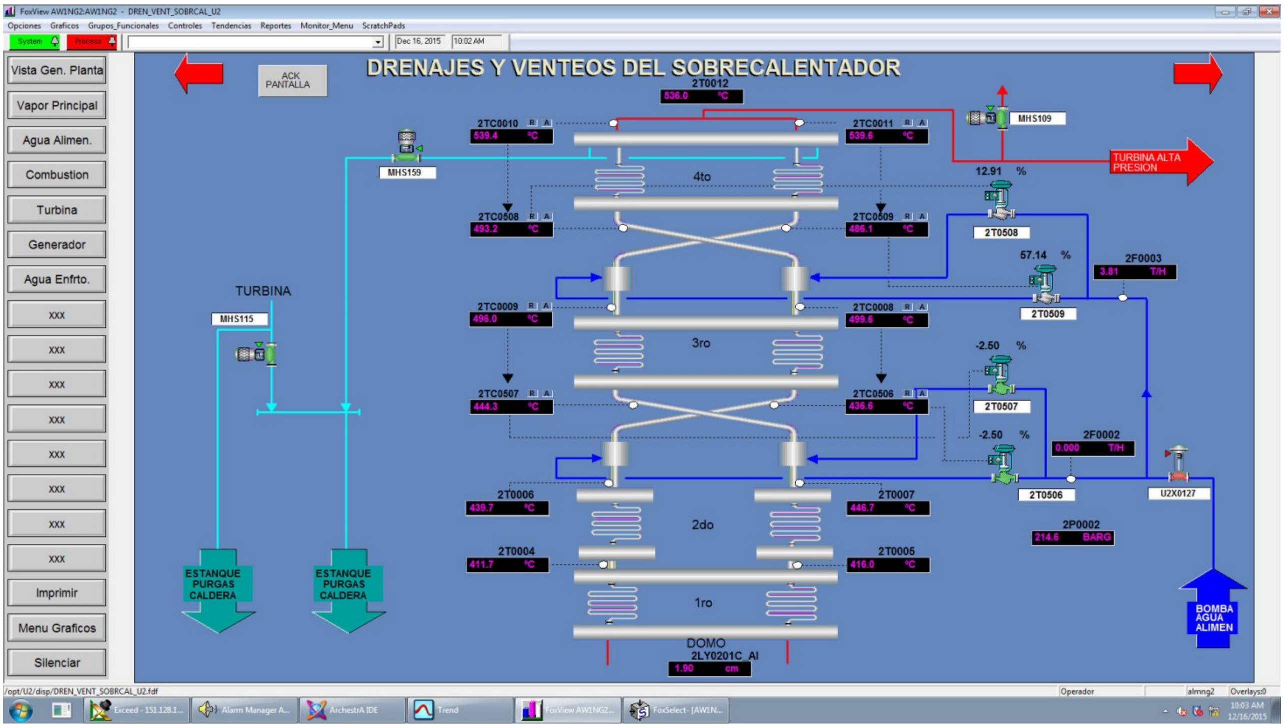
APPENDIX E2

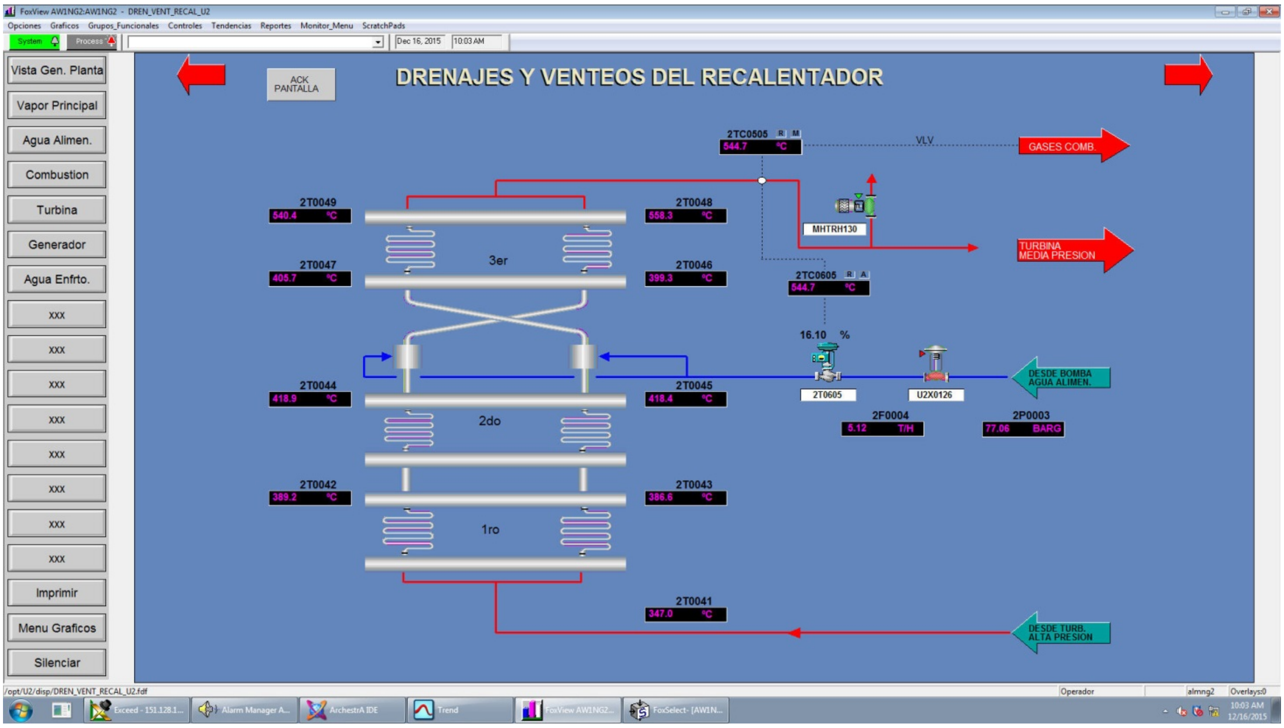
Control Panel Screen Dumps Test at 95% Load

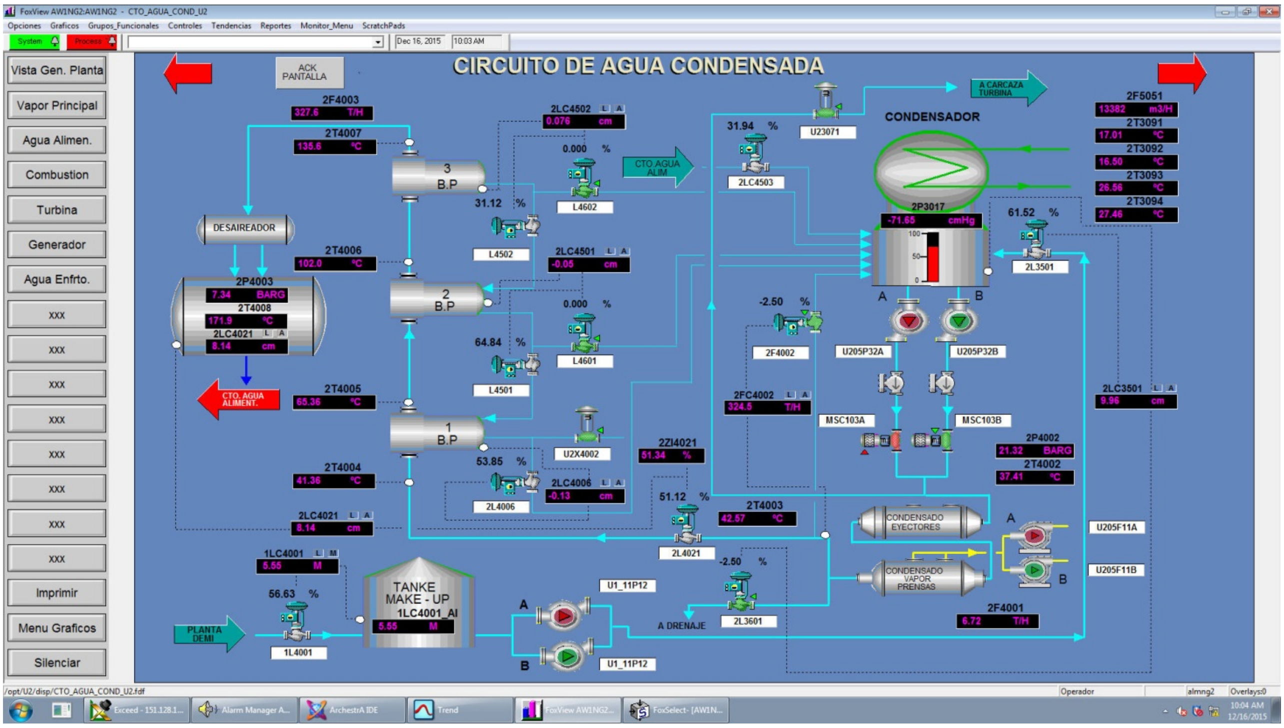

VISTA GENERAL PLANTA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
CTO. VAPOR PPAL Y RECA
DESAIREADOR
CTO. AGUA ALIMENTA
EYECTOR AIRE
CONDENS. PRENSA
AGUA AGREG.
POTENCIA ACT
POTENC REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C

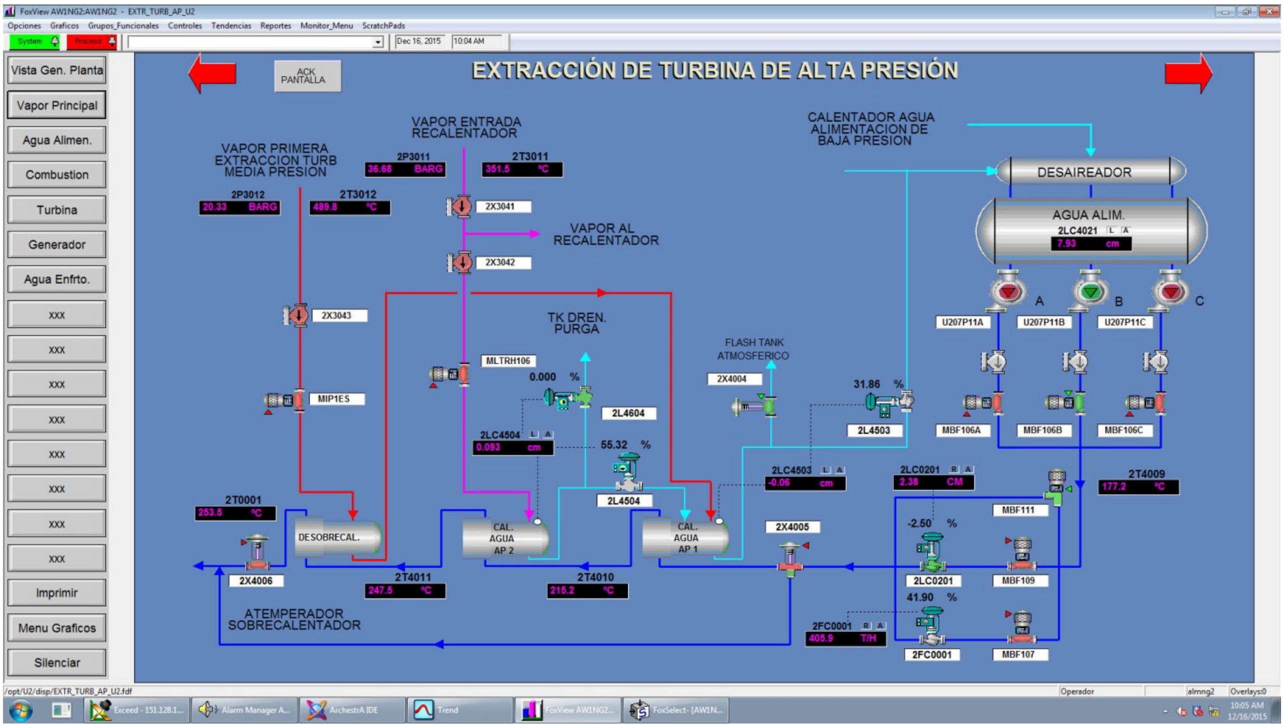

CIRCUITO AGUA / VAPOR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
DESAIREADOR
VISTA GENERAL
EYECTOR AIRE
CONDENS. PRENSA
AGUA AGREG.

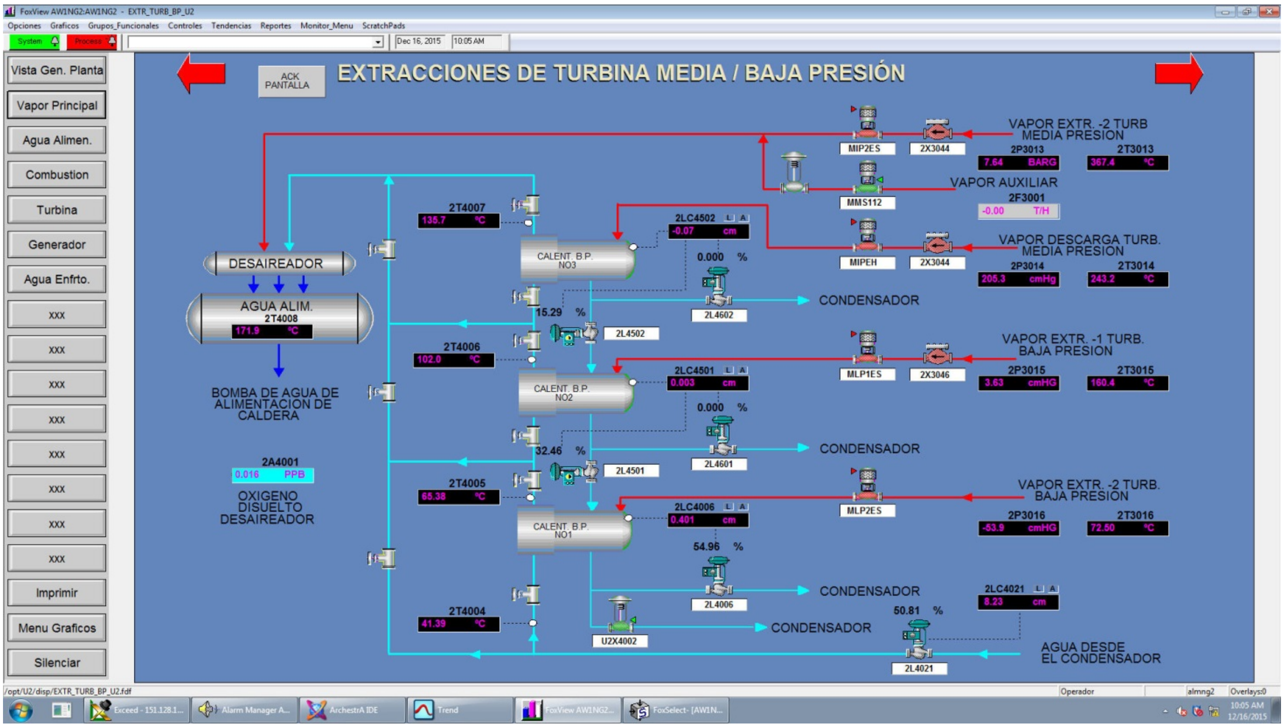

FLUJO DE VAPOR PRINCIPAL
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
2T0012
2PI0005_AI
2FI3006_AI
2TC0505
MSV
GV
RSV
ICV
SC
RC
2PY3006A_AI
2PY3006A
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
2J8003
2X3041
2P3011
2P3017
2T0041
U2X3052
U2X3051
CONDENSADOR
2LC3501
COLECTOR DE VAPOR

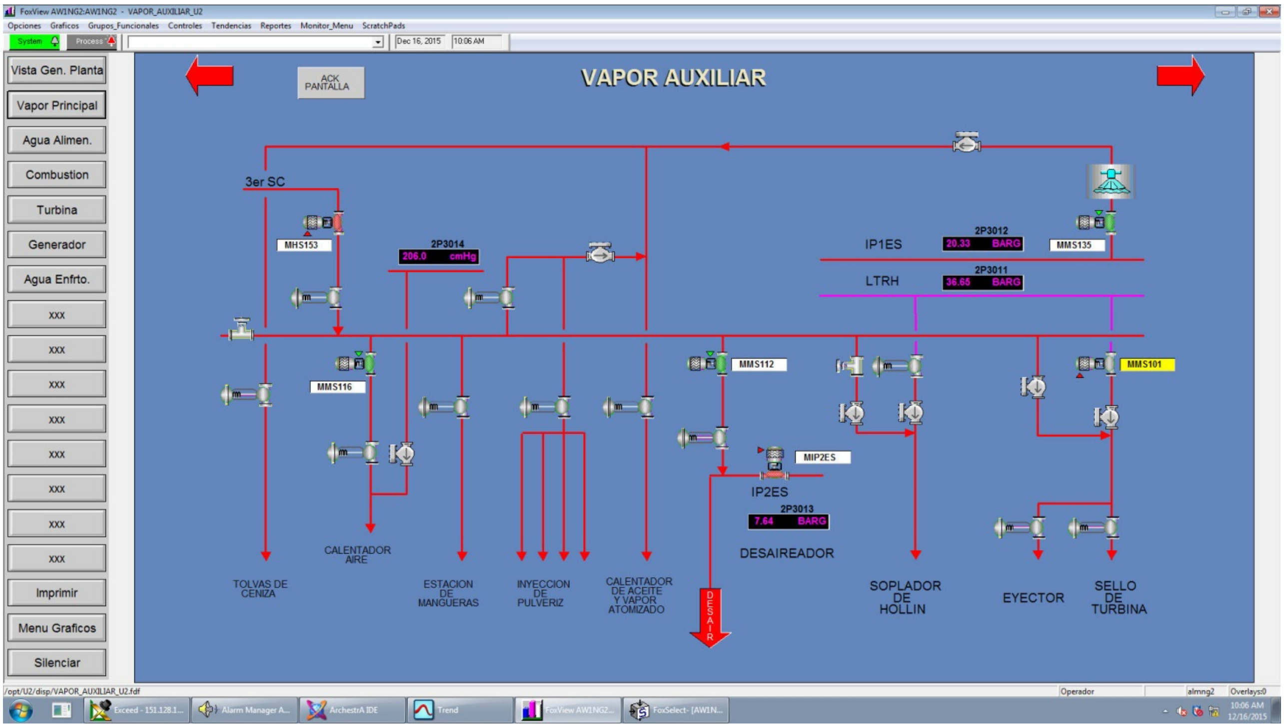

DRENAJES Y VENTEOS DEL SOBRECALENTADOR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
2T0012
2TC0010
2TC0011
MHS109
MHS159
4to
3ro
2do
1ro
TURBINA ALTA PRESION
TURBINA
MHS115
2TC0508
2TC0509
2T0508
2TC0009
2TC0008
2T0509
2F0003
2TC0507
2TC0506
2T0507
2F0002
2T0506
U2X0127
2T0006
2T0007
2P0002
2T0004
2T0005
ESTANQUE PURGAS CALDERA
ESTANQUE PURGAS CALDERA
DOMO
2LY0201C_AI
BOMBA AGUA ALIMEN

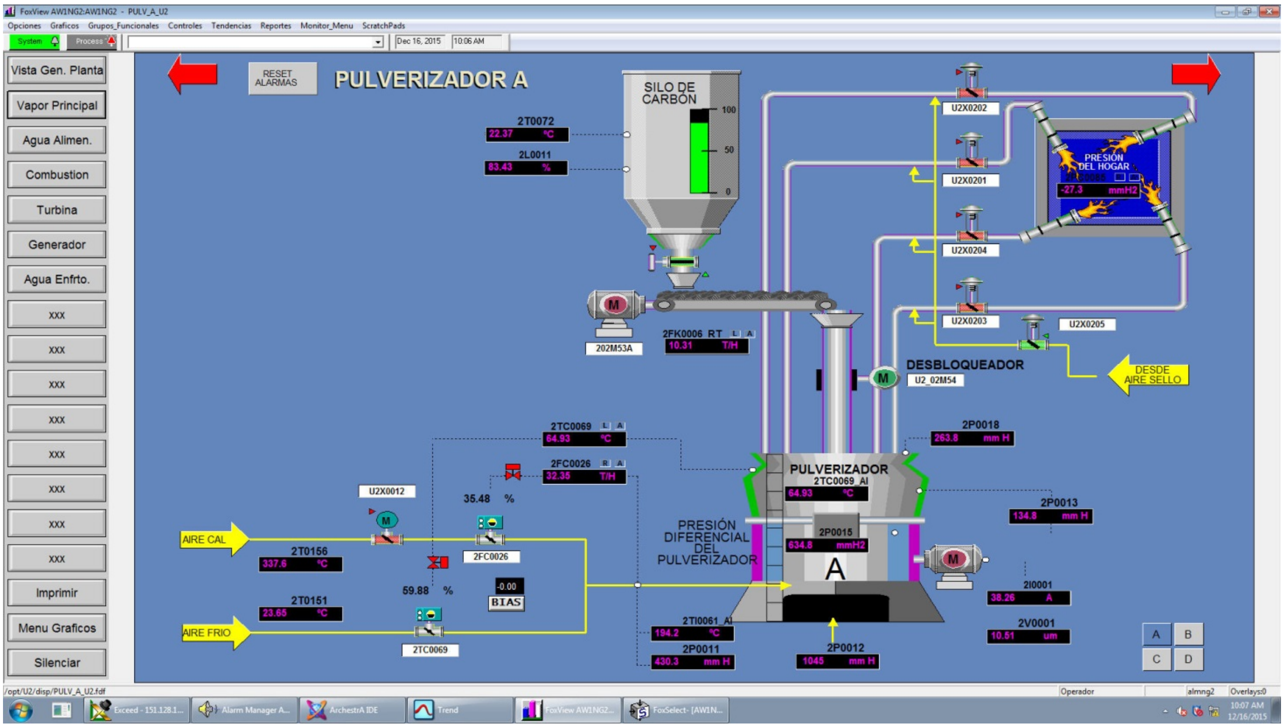

FoxView AW1NG2:AW1NG2 - DREN_VENT_RECAL_U2
Opciones Graficos Grupos_Funcionales Controles Tendencias Reportes Monitor_Menu ScratchPads
Dec 16, 2015
10:03 AM
DRENAJES Y VENTEOS DEL RECALENTADOR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
xxx
Imprimir
Menu Graficos
Silenciar
2TC0505
544.7 °C
VLV
GASES COMB.
MHTRH130
TURBINA MEDIA PRESION
2T0049
540.4 °C
2T0048
558.3 °C
3er
2T0047
405.7 °C
2T0046
399.3 °C
2TC0605
544.7 °C
16.10 %
2T0605
U2X0126
DESDE BOMBA AGUA ALIMEN.
2T0044
418.9 °C
2T0045
418.4 °C
2F0004
5.12 T/H
2P0003
77.06 BARG
2do
2T0042
389.2 °C
2T0043
386.6 °C
1ro
2T0041
347.0 °C
DESDE TURB. ALTA PRESION
/opt/U2/disp/DREN_VENT_RECAL_U2.fdf
Operador

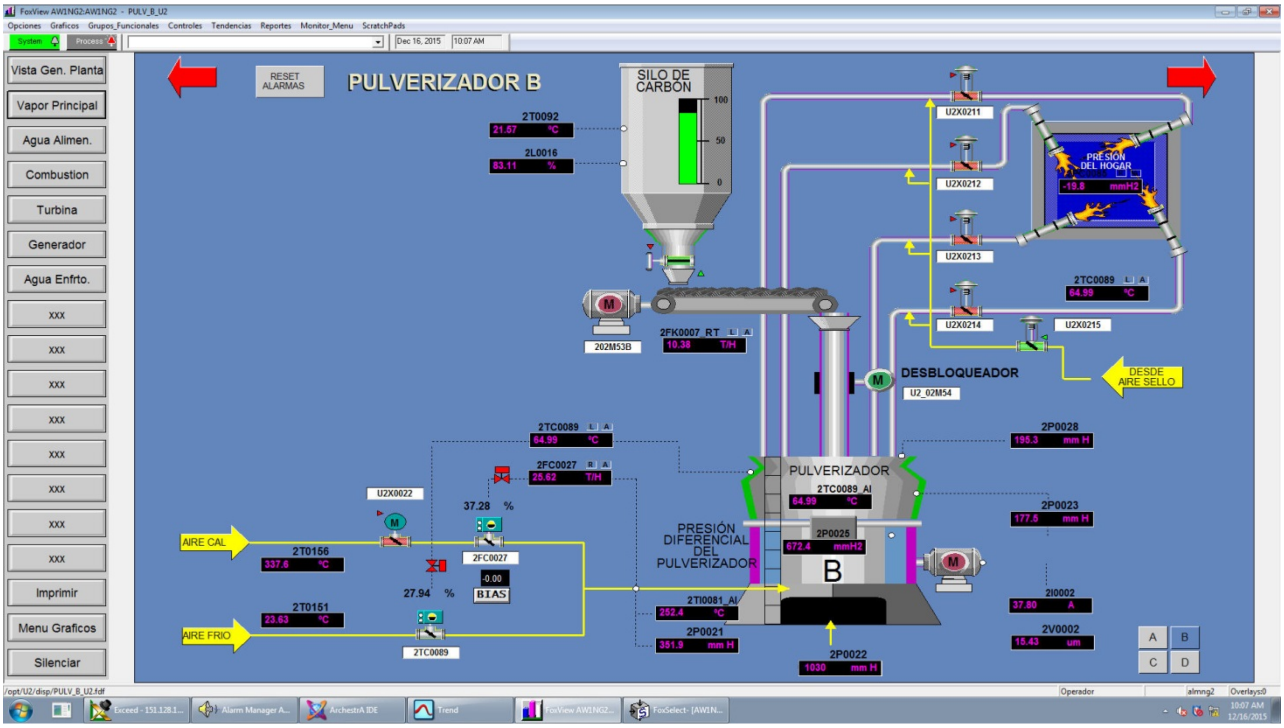

FoxView AW1NG2:AW1NG2 - CTO_AGUA_COND_U2
Opciones Graficos Grupos_Funcionales Controles Tendencias Reportes Monitor_Menu ScratchPads
Dec 16, 2015
10:03 AM
CIRCUITO DE AGUA CONDENSADA
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
xxx
Imprimir
Menu Graficos
Silenciar
2F4003
327.6 T/H
2T4007
135.6 °C
2LC4502
0.076 cm
0.000 %
CTO AGUA ALIM
L4602
31.12 %
L4502
3 B.P
2 B.P
1 B.P
DESAIREADOR
2T4006
102.0 °C
2LC4501
-0.05 cm
2P4003
7.34 BARG
2T4008
171.9 °C
2LC4021
8.14 cm
0.000 %
64.84 %
L4601
L4501
2T4005
65.36 °C
CTO. AGUA ALIMENT.
U2X4002
2ZI4021
51.34 %
53.85 %
2LC4006
-0.13 cm
2L4006
2T4004
41.36 °C
51.12 %
2L4021
2T4003
42.57 °C
1LC4001
5.55 M
56.63 %
TANKE MAKE - UP
1LC4001_AI
5.55 M
PLANTA DEMI
1L4001
U1_11P12
A DRENAJE
-2.50 %
2L3601
2F4001
6.72 T/H
U23071
A CARCAZA TURBINA
31.94 %
2LC4503
CONDENSADOR
2P3017
-71.65 cmHg
61.52 %
2L3501
2F5051
13382 m3/H
2T3091
17.01 °C
2T3092
16.50 °C
2T3093
26.56 °C
2T3094
27.46 °C
-2.50 %
2F4002
U205P32A
U205P32B
2FC4002
324.5 T/H
MSC103A
MSC103B
2LC3501
9.96 cm
2P4002
21.32 BARG
2T4002
37.41 °C
CONDENSADO EYECTORES
CONDENSADO VAPOR PRENSAS
U205F11A
U205F11B
/opt/U2/disp/CTO_AGUA_COND_U2.fdf
Operador

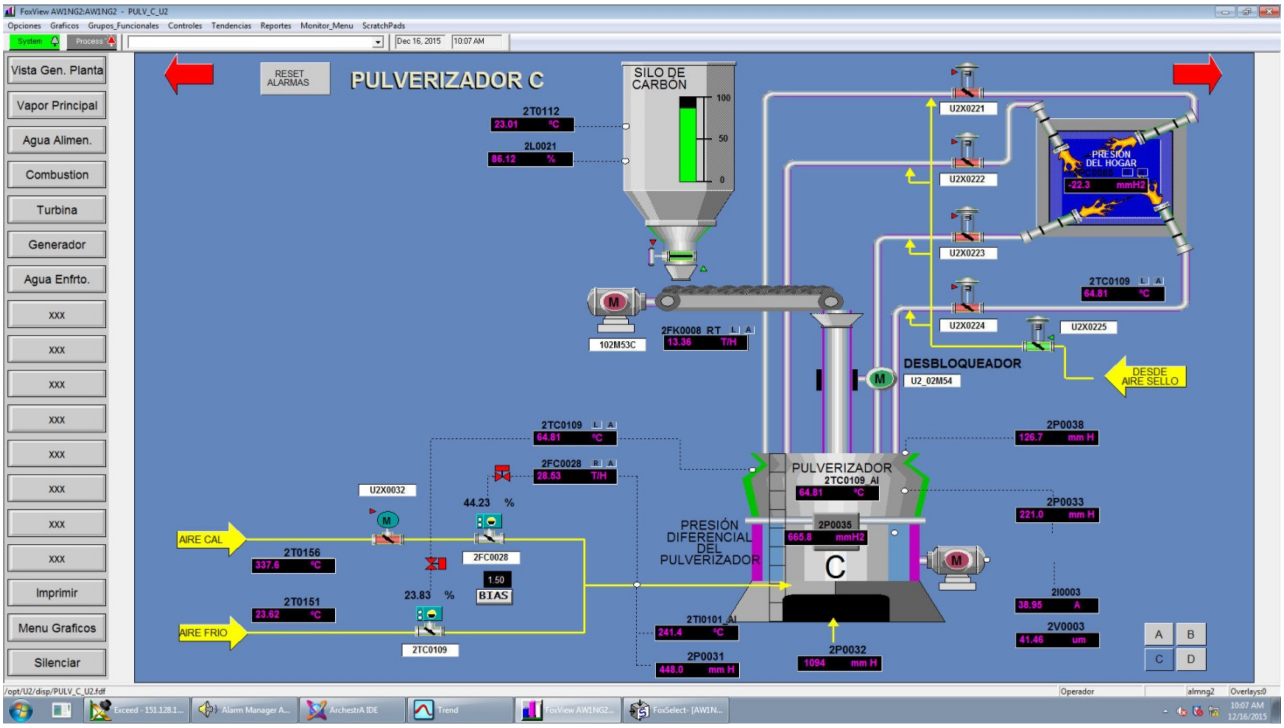

EXTRACCIÓN DE TURBINA DE ALTA PRESIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
VAPOR ENTRADA RECALENTADOR
VAPOR PRIMERA EXTRACCION TURB MEDIA PRESION
CALENTADOR AGUA ALIMENTACION DE BAJA PRESION
DESAIREADOR
AGUA ALIM.
VAPOR AL RECALENTADOR
TK DREN. PURGA
FLASH TANK ATMOSFERICO
DESOBRECAL.
CAL. AGUA AP 2
CAL. AGUA AP 1
ATEMPERADOR SOBRECALENTADOR

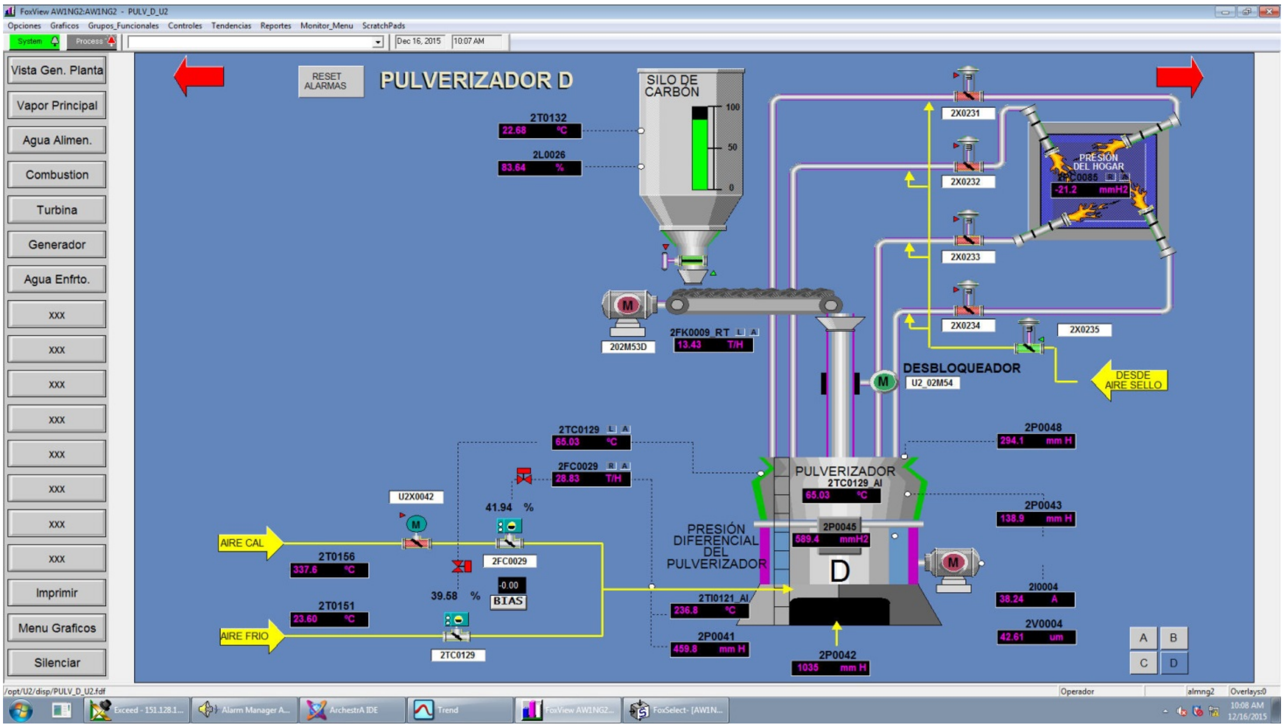

EXTRACCIONES DE TURBINA MEDIA / BAJA PRESIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
VAPOR EXTR. -2 TURB MEDIA PRESION
VAPOR AUXILIAR
VAPOR DESCARGA TURB. MEDIA PRESION
VAPOR EXTR. -1 TURB. BAJA PRESION
VAPOR EXTR. -2 TURB. BAJA PRESION
DESAIREADOR
AGUA ALIM.
BOMBA DE AGUA DE ALIMENTACION DE CALDERA
OXIGENO DISUELTO DESAIREADOR
CALENT. B.P. NO3
CALENT. B.P. NO2
CALENT. B.P. NO1
CONDENSADOR
AGUA DESDE EL CONDENSADOR


VAPOR AUXILIAR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
3er SC
MHS153
2P3014
206.0 cmHg
IP1ES
2P3012
20.33 BARG
MMS135
LTRH
2P3011
36.65 BARG
MMS116
MMS112
MMS101
MIP2ES
IP2ES
2P3013
7.64 BARG
DESAIREADOR
TOLVAS DE CENIZA
CALENTADOR AIRE
ESTACION DE MANGUERAS
INYECCION DE PULVERIZ
CALENTADOR DE ACEITE Y VAPOR ATOMIZADO
SOPLADOR DE HOLLIN
EYECTOR
SELLO DE TURBINA

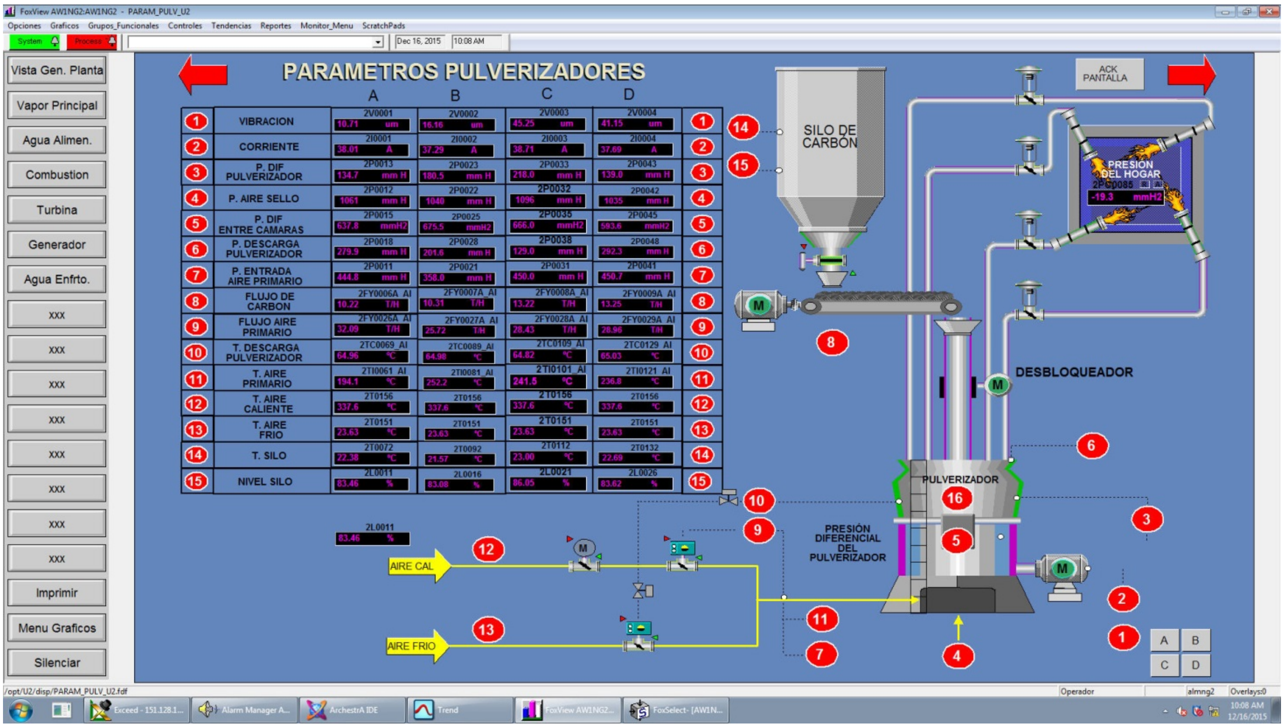

PULVERIZADOR A
RESET ALARMAS
SILO DE CARBON
2T0072
22.37 °C
2L0011
83.43 %
U2X0202
U2X0201
U2X0204
U2X0203
U2X0205
PRESION DEL HOGAR
-27.3 mmH2
202M53A
2FK0006 RT
10.31 T/H
DESBLOQUEADOR
U2_02M54
DESDE AIRE SELLO
2TC0069
64.93 °C
2FC0026
32.35 T/H
U2X0012
35.48 %
PULVERIZADOR
2TC0069_AI
64.93 °C
2P0018
263.8 mm H
2P0013
134.8 mm H
AIRE CAL
2T0156
337.6 °C
2FC0026
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
2P0015
634.8 mmH2
A
59.88 %
-0.00
BIAS
2I0001
38.26 A
AIRE FRIO
2T0151
23.65 °C
2TC0069
2TI0061_AI
194.2 °C
2P0011
430.3 mm H
2P0012
1045 mm H
2V0001
10.51 um
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar


PULVERIZADOR B
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
PRESIÓN DEL HOGAR
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
B
AIRE CAL
AIRE FRIO
BIAS

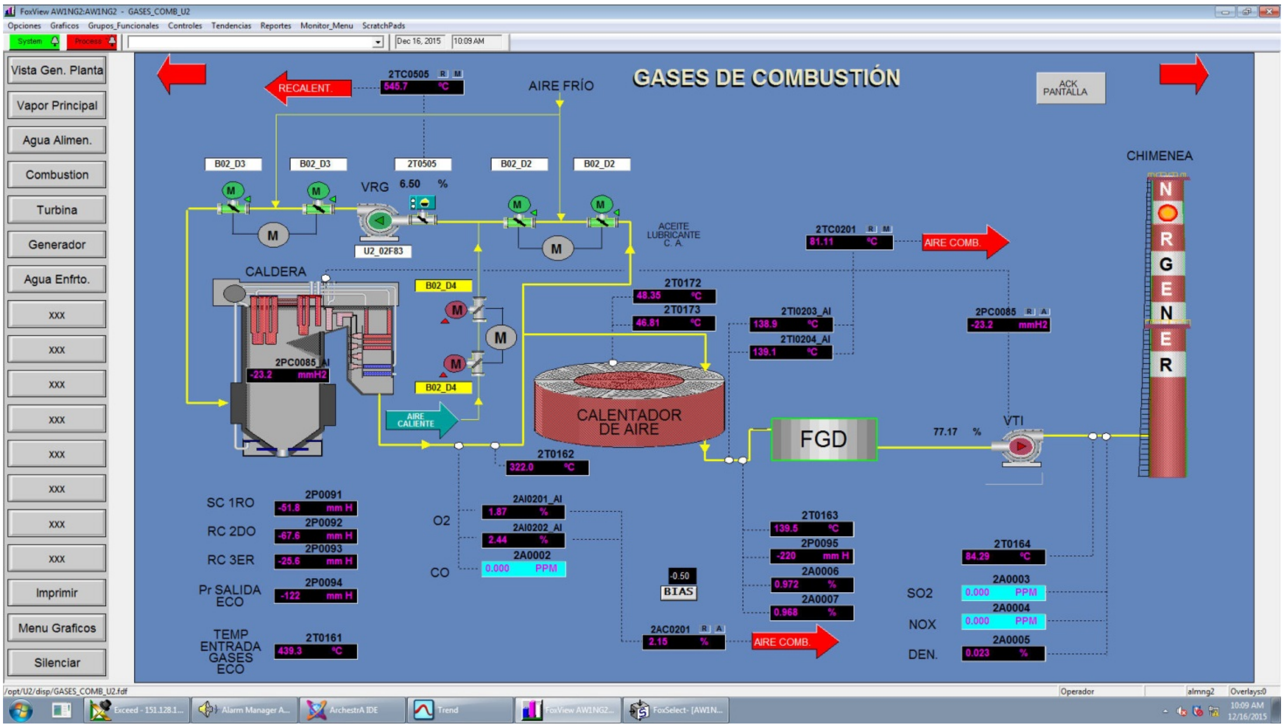

PULVERIZADOR C
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
PRESIÓN DEL HOGAR
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
C
AIRE CAL
AIRE FRIO
BIAS

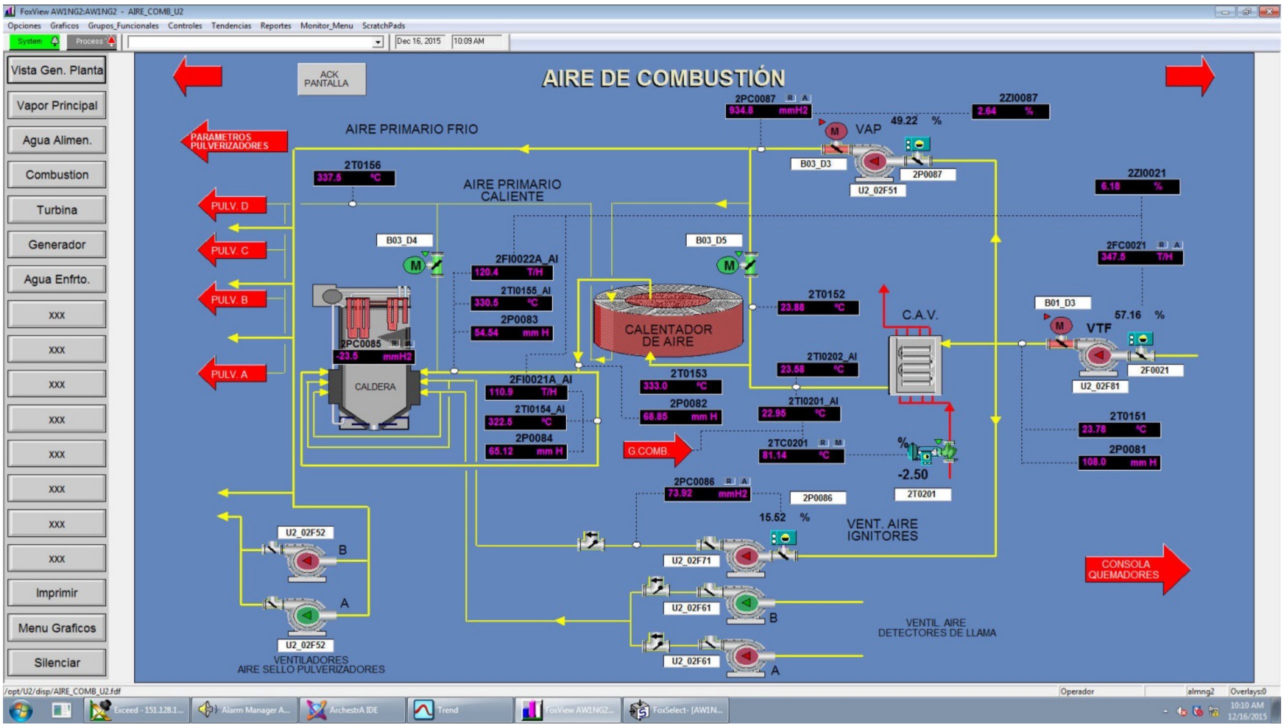


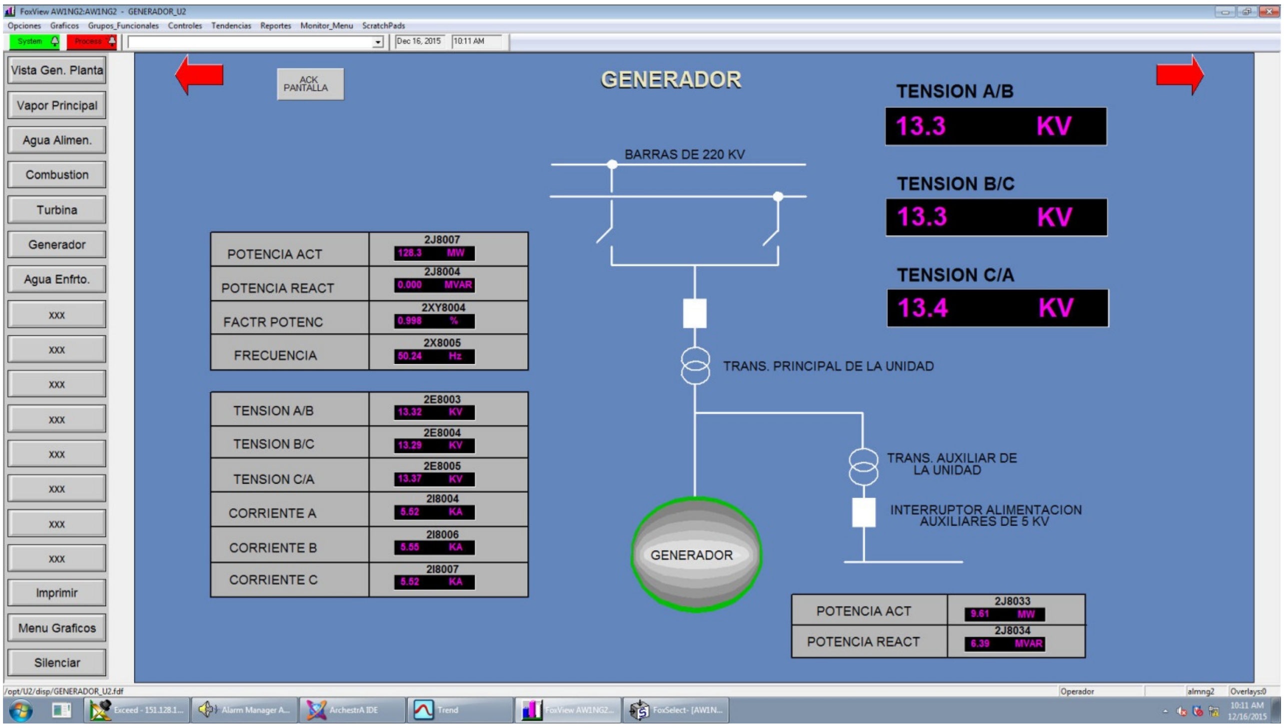
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
RESET ALARMAS
PULVERIZADOR D
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PRESIÓN DEL HOGAR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS

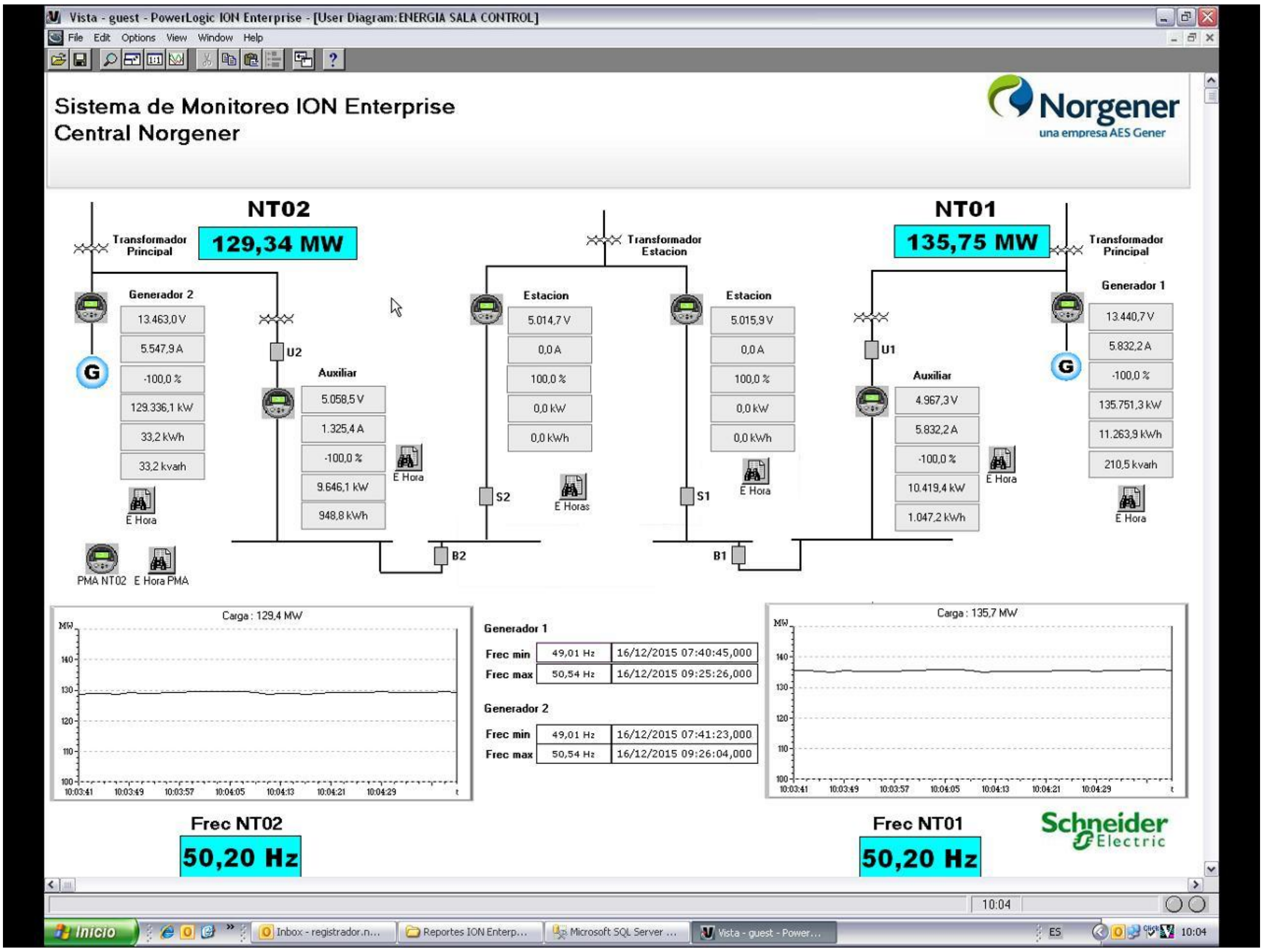


PARAMETROS PULVERIZADORES
ACK PANTALLA
A
B
C
D
VIBRACION
CORRIENTE
P. DIF PULVERIZADOR
P. AIRE SELLO
P. DIF ENTRE CAMARAS
P. DESCARGA PULVERIZADOR
P. ENTRADA AIRE PRIMARIO
FLUJO DE CARBON
FLUJO AIRE PRIMARIO
T. DESCARGA PULVERIZADOR
T. AIRE PRIMARIO
T. AIRE CALIENTE
T. AIRE FRIO
T. SILO
NIVEL SILO
SILO DE CARBON
PRESION DEL HOGAR
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO


GASES DE COMBUSTIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
RECALENT.
AIRE FRÍO
CALDERA
VRG
CALENTADOR DE AIRE
FGD
VTI
CHIMENEA
NORGENER
AIRE COMB.
AIRE CALIENTE
SC 1RO
RC 2DO
RC 3ER
Pr SALIDA ECO
TEMP ENTRADA GASES ECO
O2
CO
BIAS
SO2
NOX
DEN.

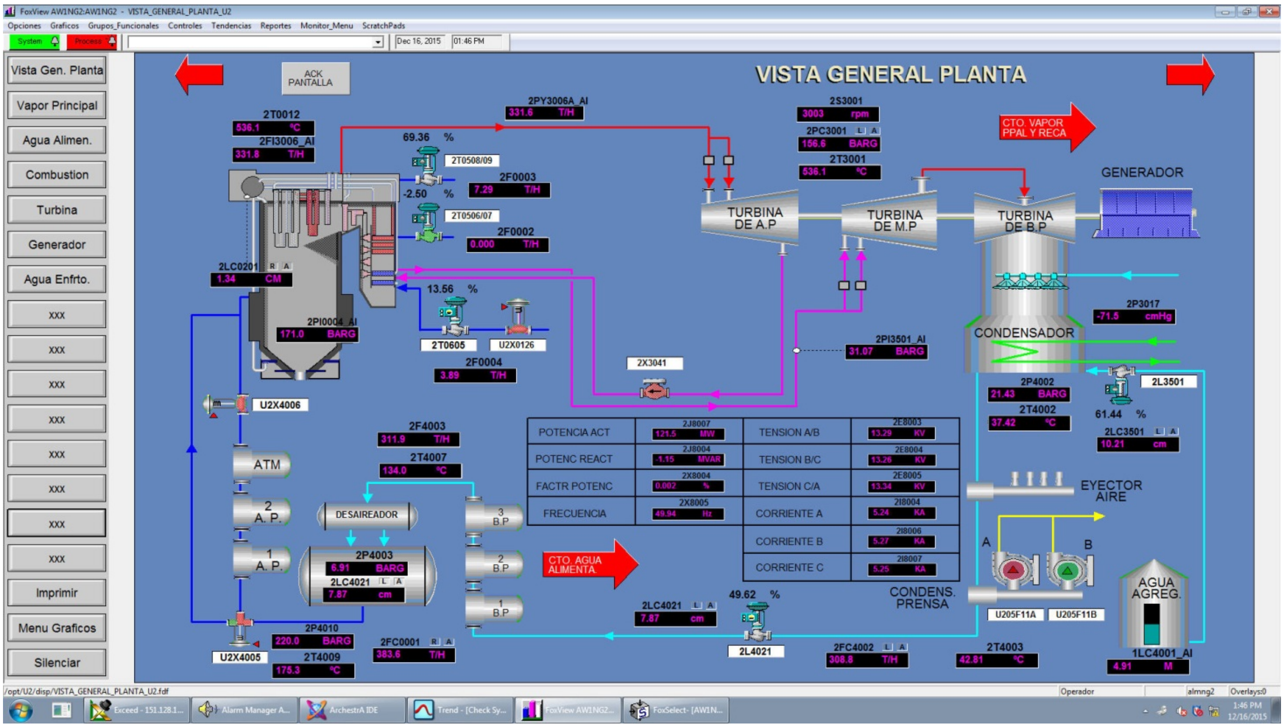

AIRE DE COMBUSTIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
PARAMETROS PULVERIZADORES
AIRE PRIMARIO FRIO
AIRE PRIMARIO CALIENTE
PULV. D
PULV. C
PULV. B
PULV. A
CALDERA
CALENTADOR DE AIRE
VAP
VTF
C.A.V.
G.COMB.
VENT. AIRE IGNITORES
VENTIL. AIRE DETECTORES DE LLAMA
VENTILADORES AIRE SELLO PULVERIZADORES
CONSOLA QUEMADORES

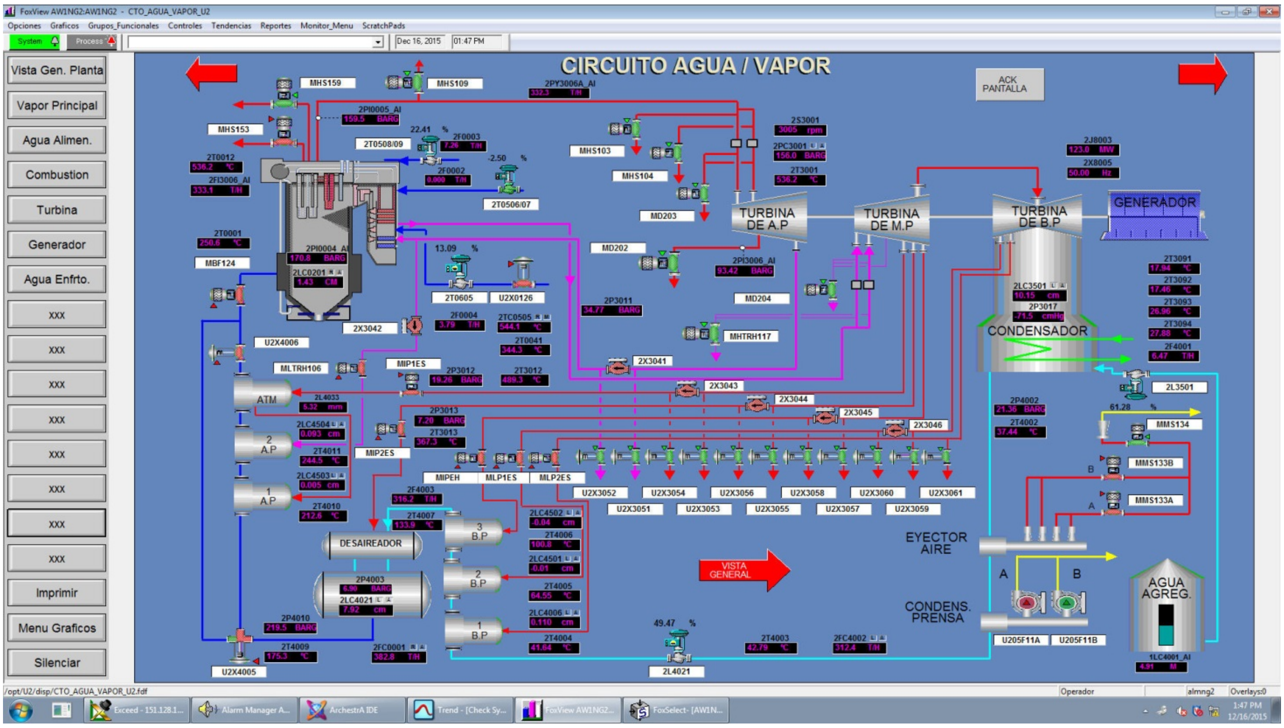

GENERADOR
ACK PANTALLA
TENSION A/B
13.3 KV
TENSION B/C
13.3 KV
TENSION C/A
13.4 KV
BARRAS DE 220 KV
POTENCIA ACT
POTENCIA REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C
TRANS. PRINCIPAL DE LA UNIDAD
TRANS. AUXILIAR DE LA UNIDAD
INTERRUPTOR ALIMENTACION AUXILIARES DE 5 KV
GENERADOR
POTENCIA ACT
POTENCIA REACT
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar

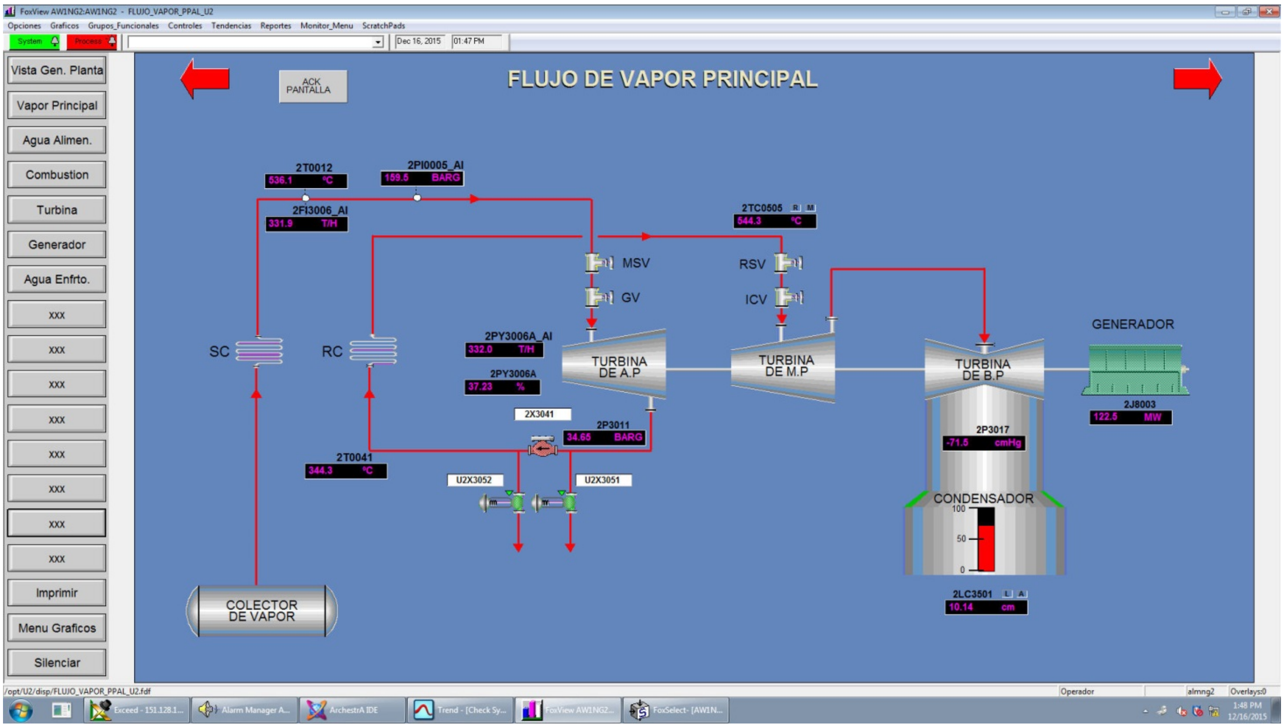

Sistema de Monitoreo ION Enterprise
Central Norgener
Norgener
una empresa AES Gener
NT02
129,34 MW
NT01
135,75 MW
Transformador Principal
Transformador Estacion
Generador 2
Generador 1
Auxiliar
Estacion
Generador 1
Frec min 49,01 Hz 16/12/2015 07:40:45,000
Frec max 50,54 Hz 16/12/2015 09:25:26,000
Generador 2
Frec min 49,01 Hz 16/12/2015 07:41:23,000
Frec max 50,54 Hz 16/12/2015 09:26:04,000
Carga : 129,4 MW
Carga : 135,7 MW
Frec NT02
50,20 Hz
Frec NT01
50,20 Hz
Schneider Electric

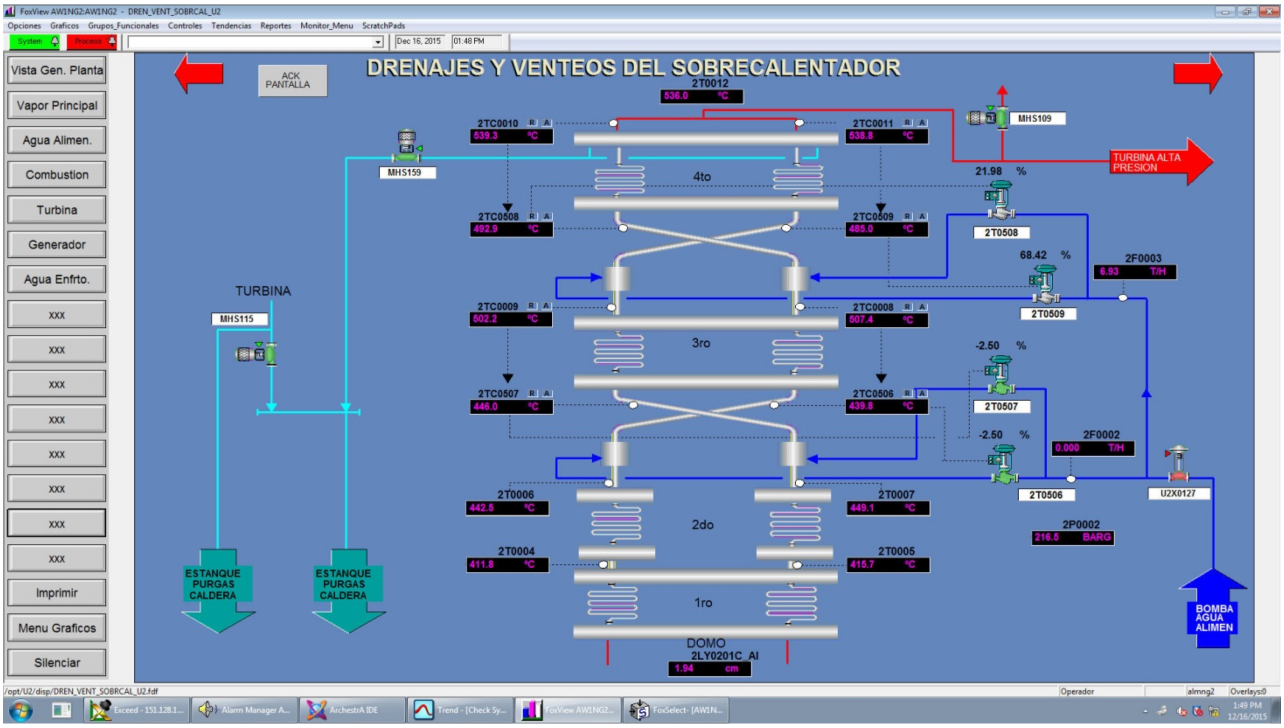
APPENDIX E3

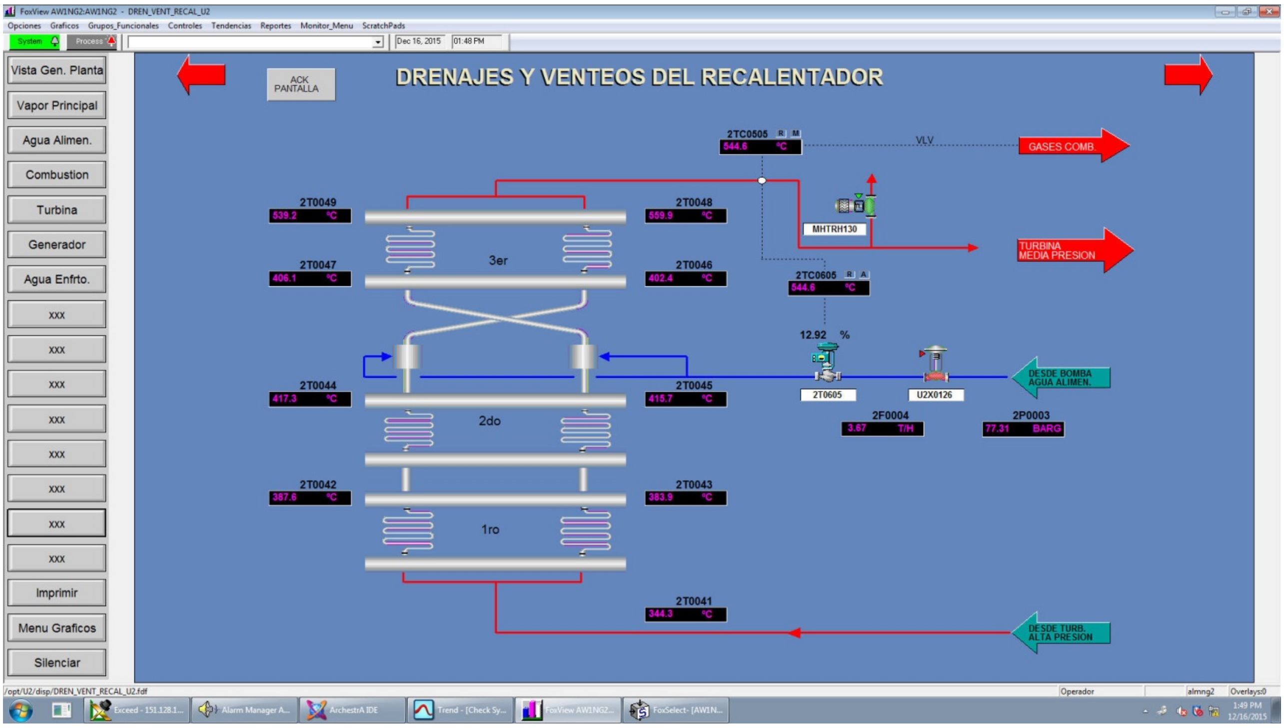
Control Panel Screen Dumps Test at 90% Load

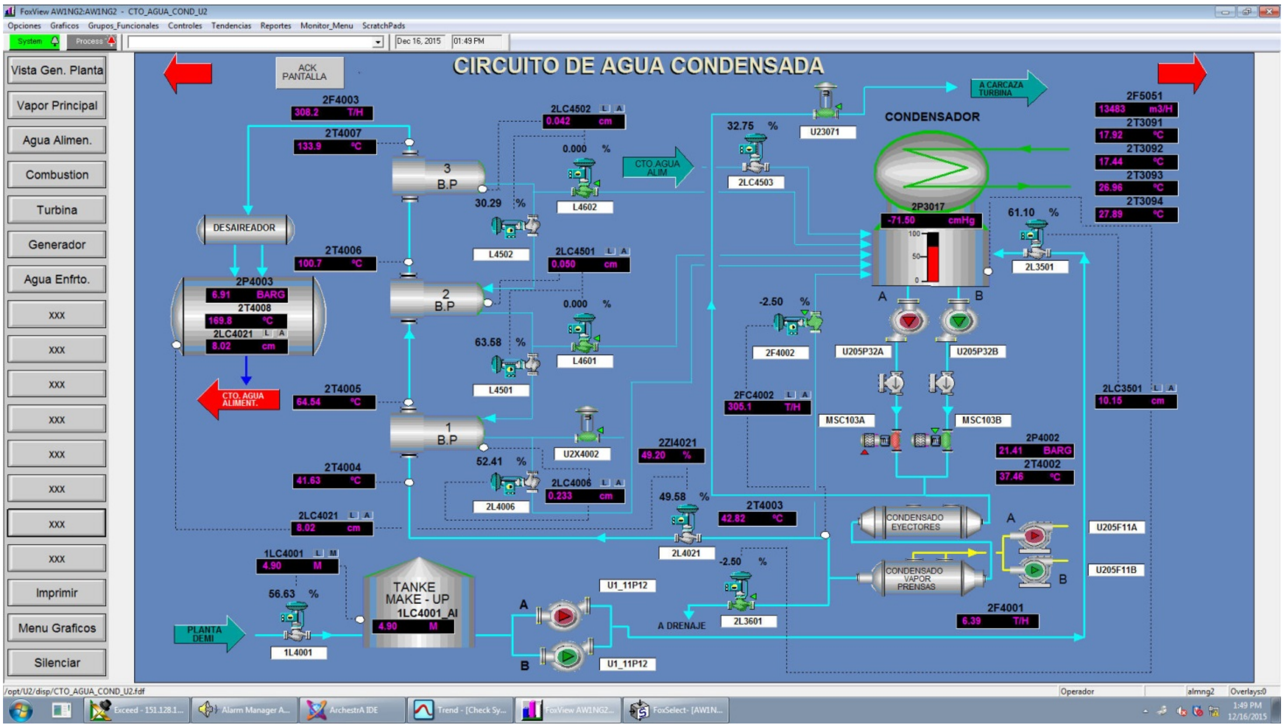

VISTA GENERAL PLANTA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
CTO. VAPOR PPAL Y RECA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
EYECTOR AIRE
CONDENS. PRENSA
AGUA AGREG.
DESAIREADOR
CTO. AGUA ALIMENTA
POTENCIA ACT
POTENC REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C

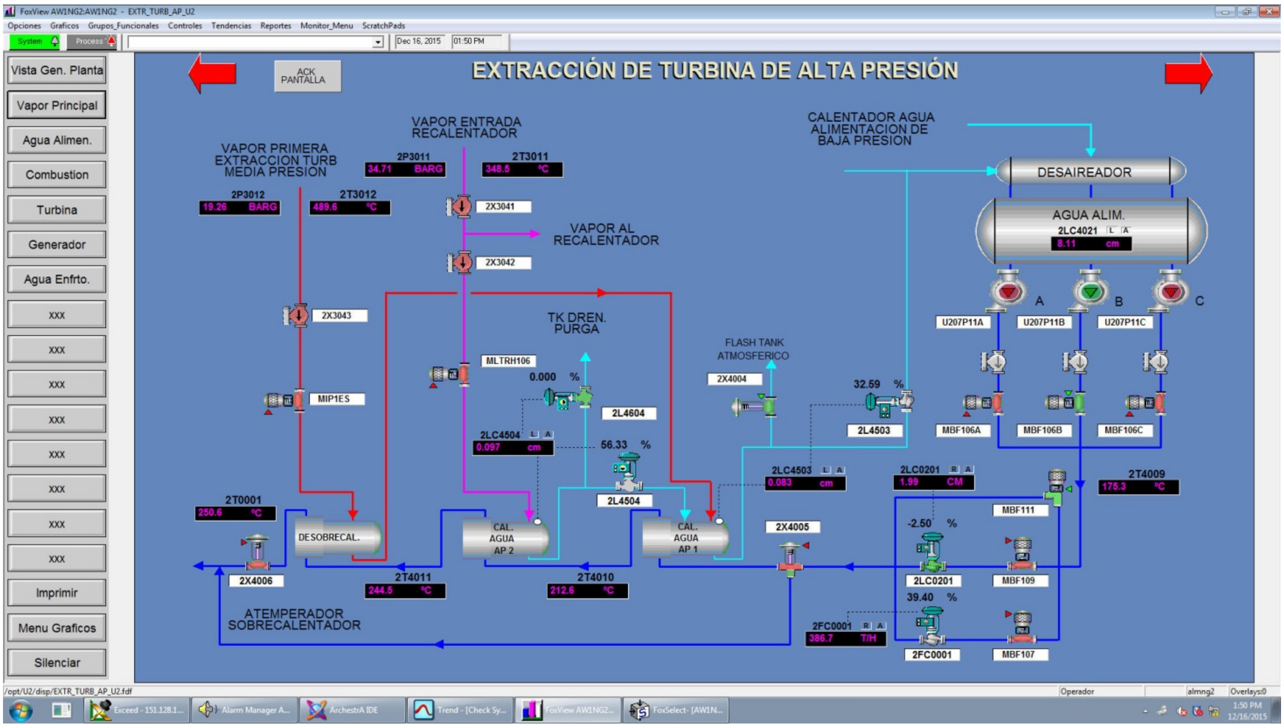
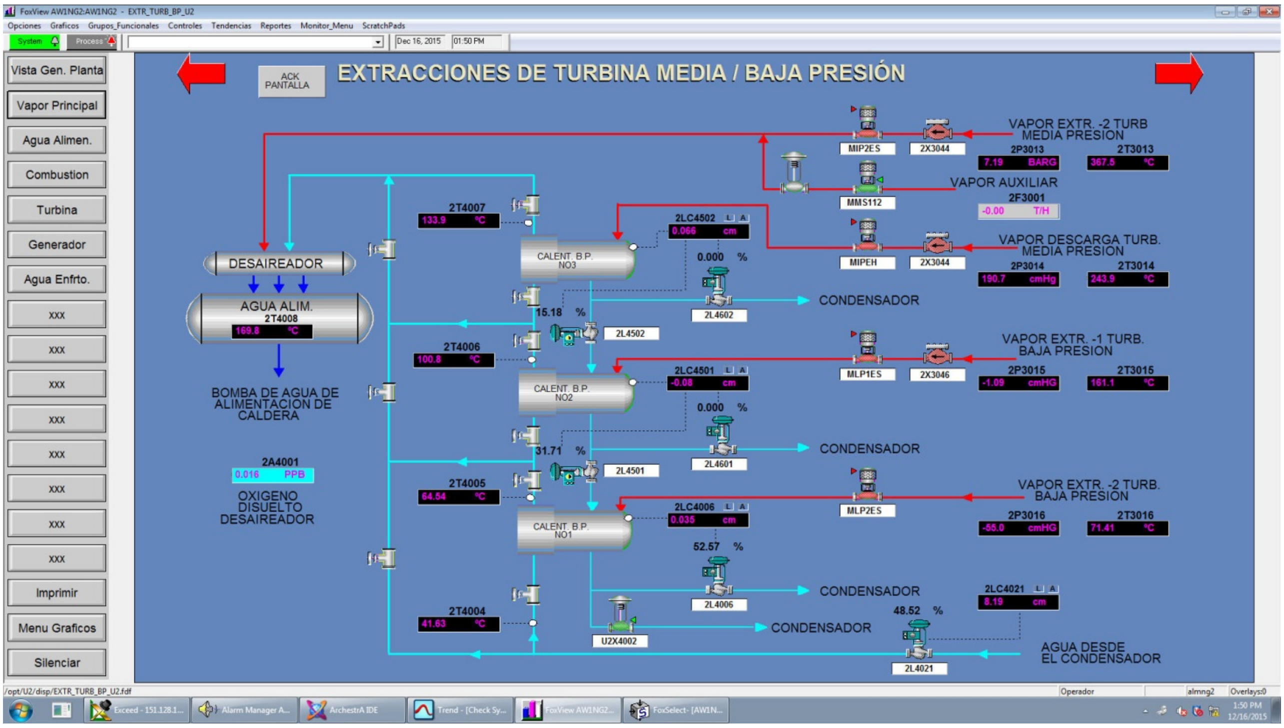

CIRCUITO AGUA / VAPOR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
EYECTOR AIRE
CONDENS. PRENSA
AGUA AGREG.
DESAIREADOR
VISTA GENERAL

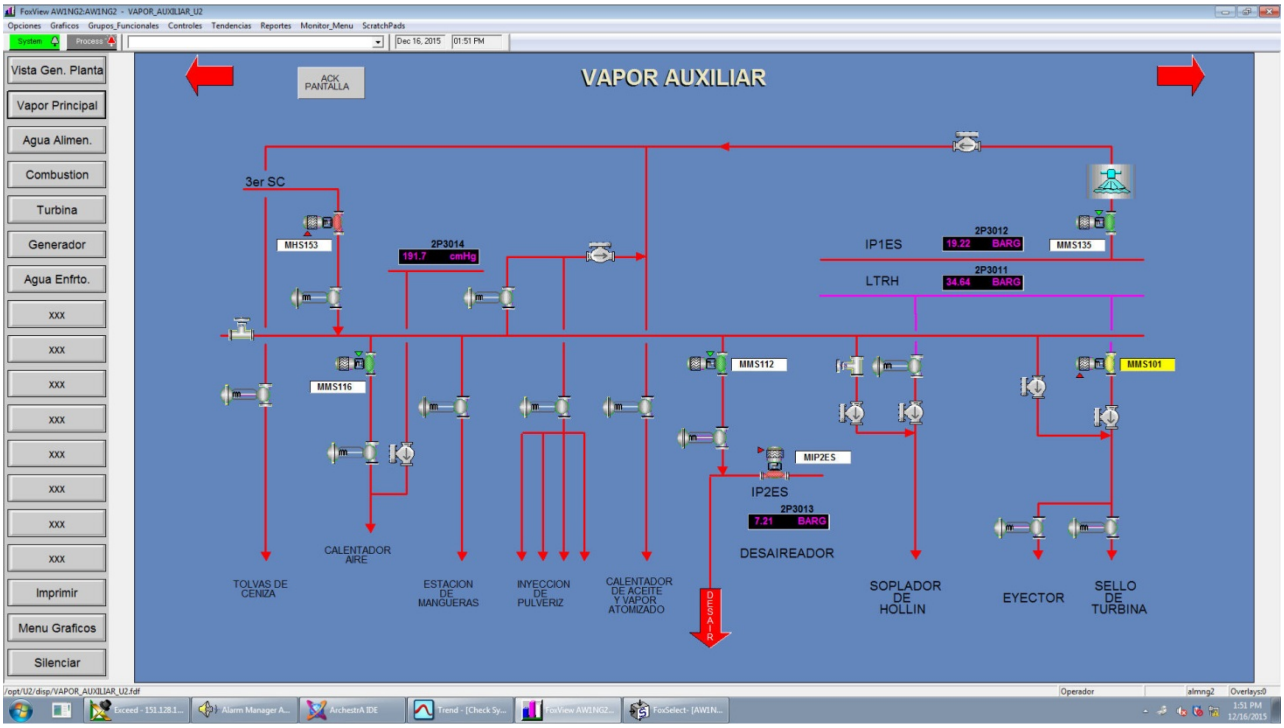

FLUJO DE VAPOR PRINCIPAL
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
SC
RC
MSV
GV
RSV
ICV
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
COLECTOR DE VAPOR
2T0012
2PI0005_AI
2FI3006_AI
2TC0505
2PY3006A_AI
2PY3006A
2X3041
2P3011
2T0041
U2X3052
U2X3051
2P3017
2J8003
2LC3501

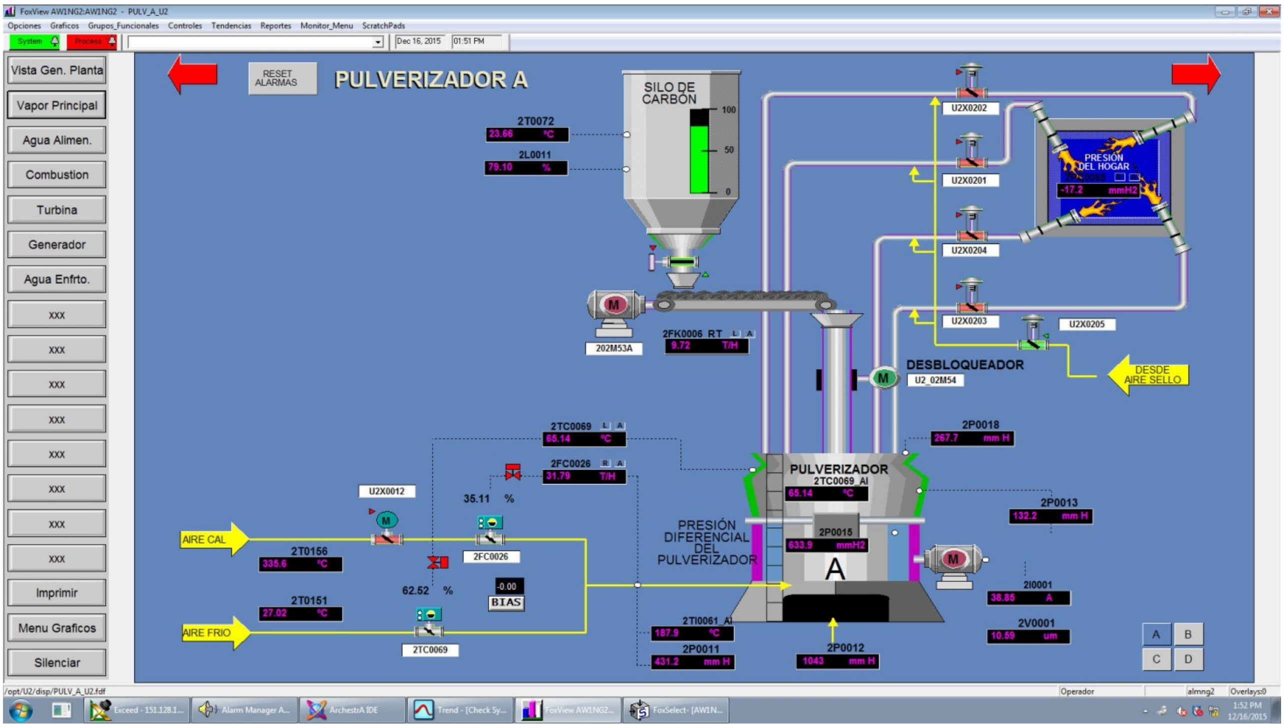

DRENAJES Y VENTEOS DEL SOBRECALENTADOR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA
MHS115
MHS159
MHS109
TURBINA ALTA PRESION
4to
3ro
2do
1ro
DOMO
2LY0201C_AI
ESTANQUE PURGAS CALDERA
ESTANQUE PURGAS CALDERA
BOMBA AGUA ALIMEN
2F0003
2F0002
2P0002
U2X0127

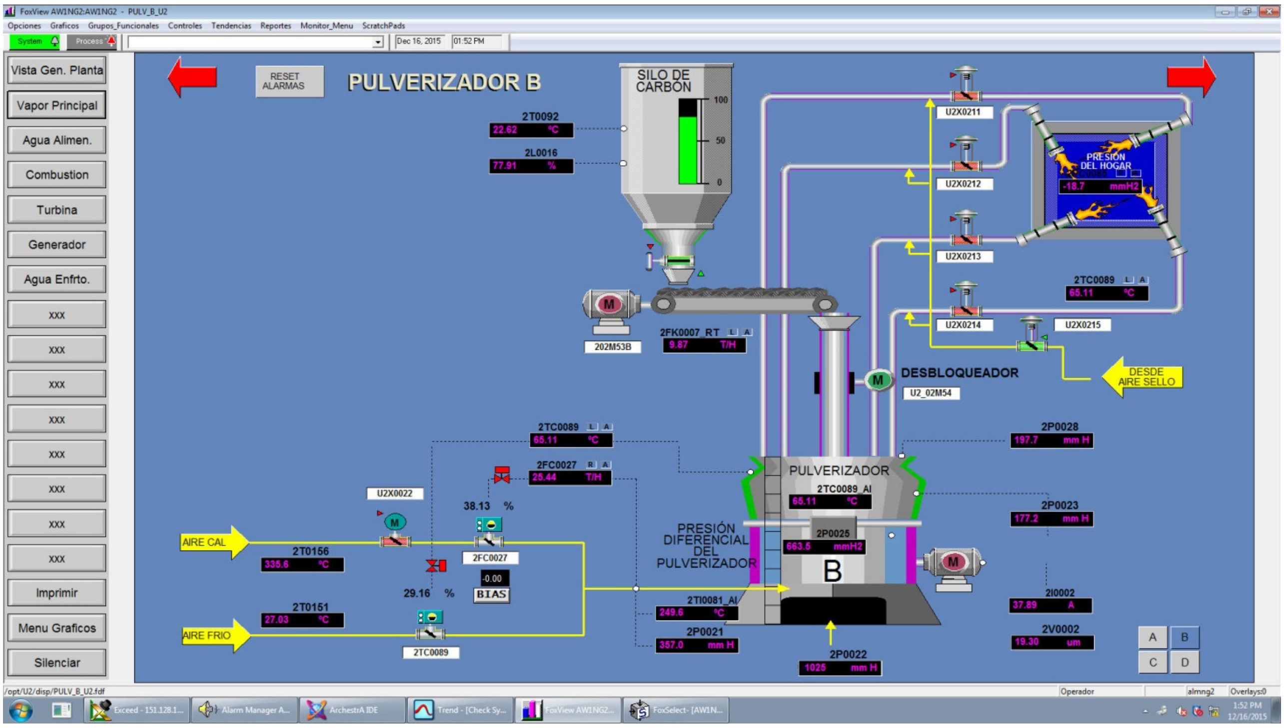

DRENAJES Y VENTEOS DEL RECALENTADOR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
GASES COMB.
TURBINA MEDIA PRESION
DESDE BOMBA AGUA ALIMEN.
DESDE TURB. ALTA PRESION
3er
2do
1ro

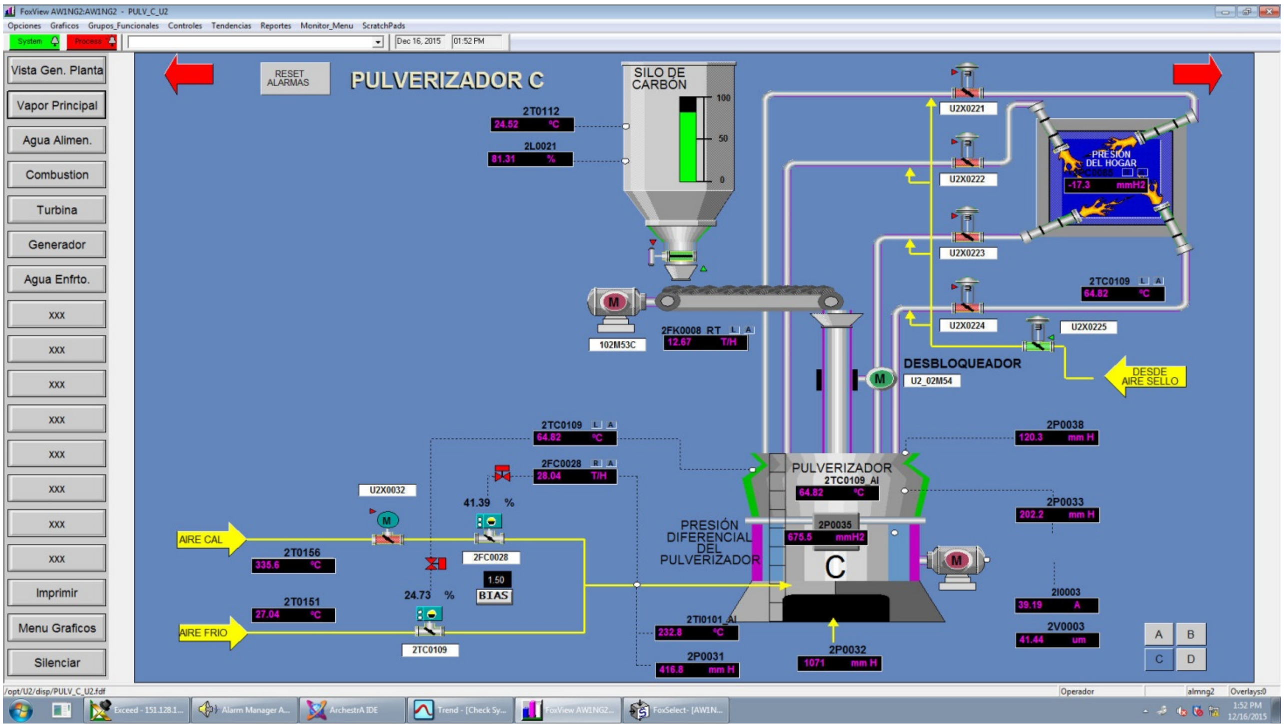

CIRCUITO DE AGUA CONDENSADA
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
DESAIREADOR
CONDENSADOR
CTO. AGUA ALIMENT.
TANKE MAKE - UP
PLANTA DEMI
CONDENSADO EYECTORES
CONDENSADO VAPOR PRENSAS
A DRENAJE

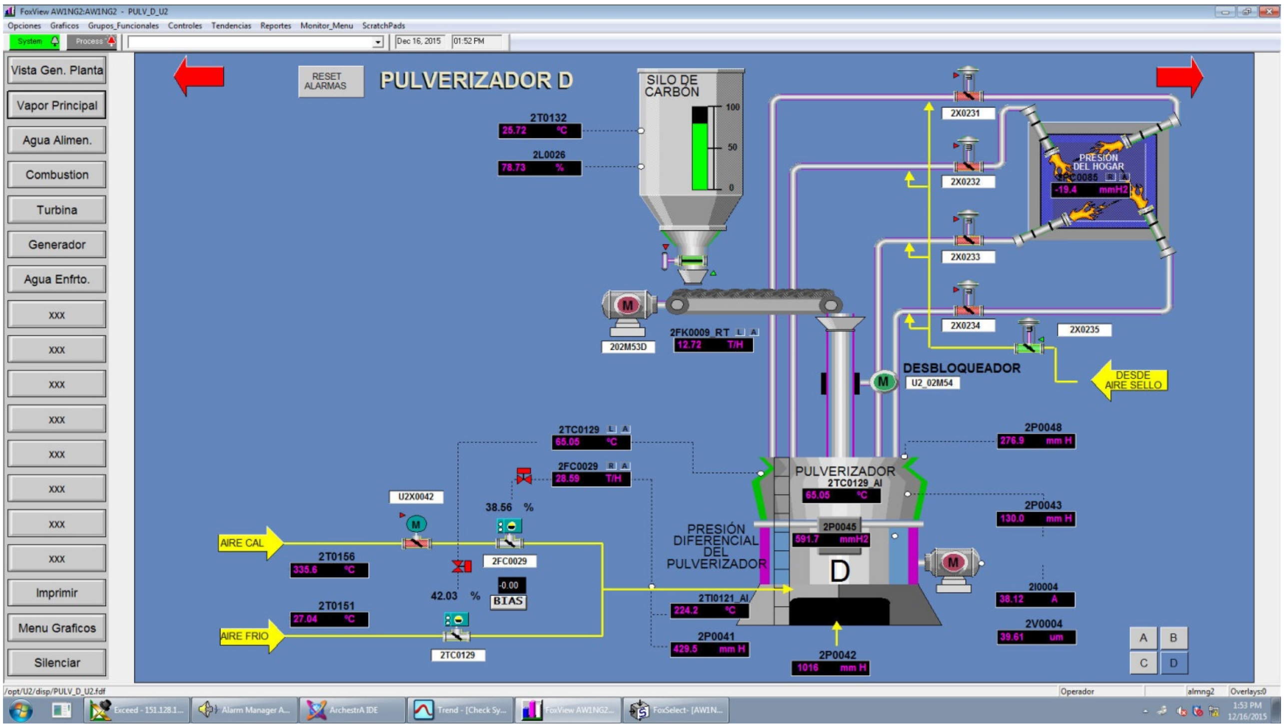

EXTRACCIÓN DE TURBINA DE ALTA PRESIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
VAPOR PRIMERA EXTRACCION TURB MEDIA PRESION
VAPOR ENTRADA RECALENTADOR
VAPOR AL RECALENTADOR
CALENTADOR AGUA ALIMENTACION DE BAJA PRESION
DESAIREADOR
AGUA ALIM.
TK DREN. PURGA
FLASH TANK ATMOSFERICO
DESOBRECAL.
CAL. AGUA AP 2
CAL. AGUA AP 1
ATEMPERADOR SOBRECALENTADOR

EXTRACCIONES DE TURBINA MEDIA / BAJA PRESIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
VAPOR EXTR. -2 TURB MEDIA PRESION
VAPOR AUXILIAR
VAPOR DESCARGA TURB. MEDIA PRESION
VAPOR EXTR. -1 TURB. BAJA PRESION
VAPOR EXTR. -2 TURB. BAJA PRESION
DESAIREADOR
AGUA ALIM.
BOMBA DE AGUA DE ALIMENTACION DE CALDERA
OXIGENO DISUELTO DESAIREADOR
CALENT. B.P. NO3
CALENT. B.P. NO2
CALENT. B.P. NO1
CONDENSADOR
AGUA DESDE EL CONDENSADOR

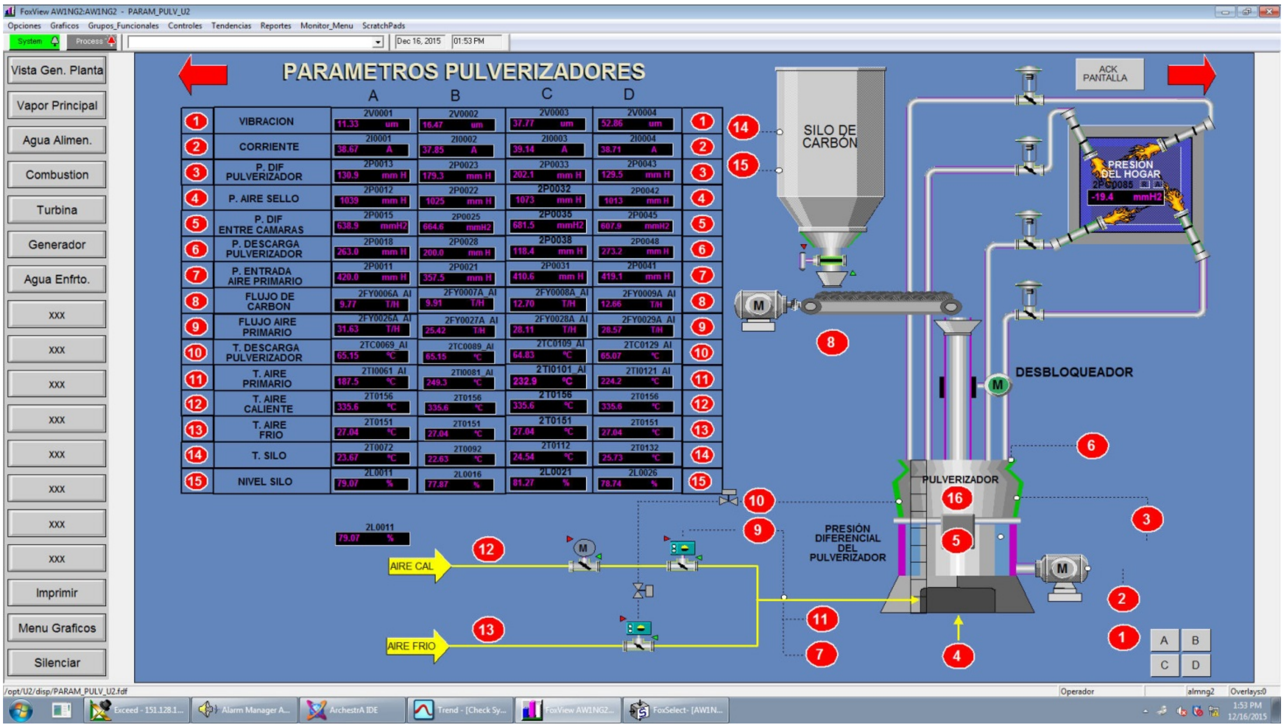

VAPOR AUXILIAR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
3er SC
IP1ES
LTRH
TOLVAS DE CENIZA
CALENTADOR AIRE
ESTACION DE MANGUERAS
INYECCION DE PULVERIZ
CALENTADOR DE ACEITE Y VAPOR ATOMIZADO
DESAIREADOR
SOPLADOR DE HOLLIN
EYECTOR
SELLO DE TURBINA
IP2ES

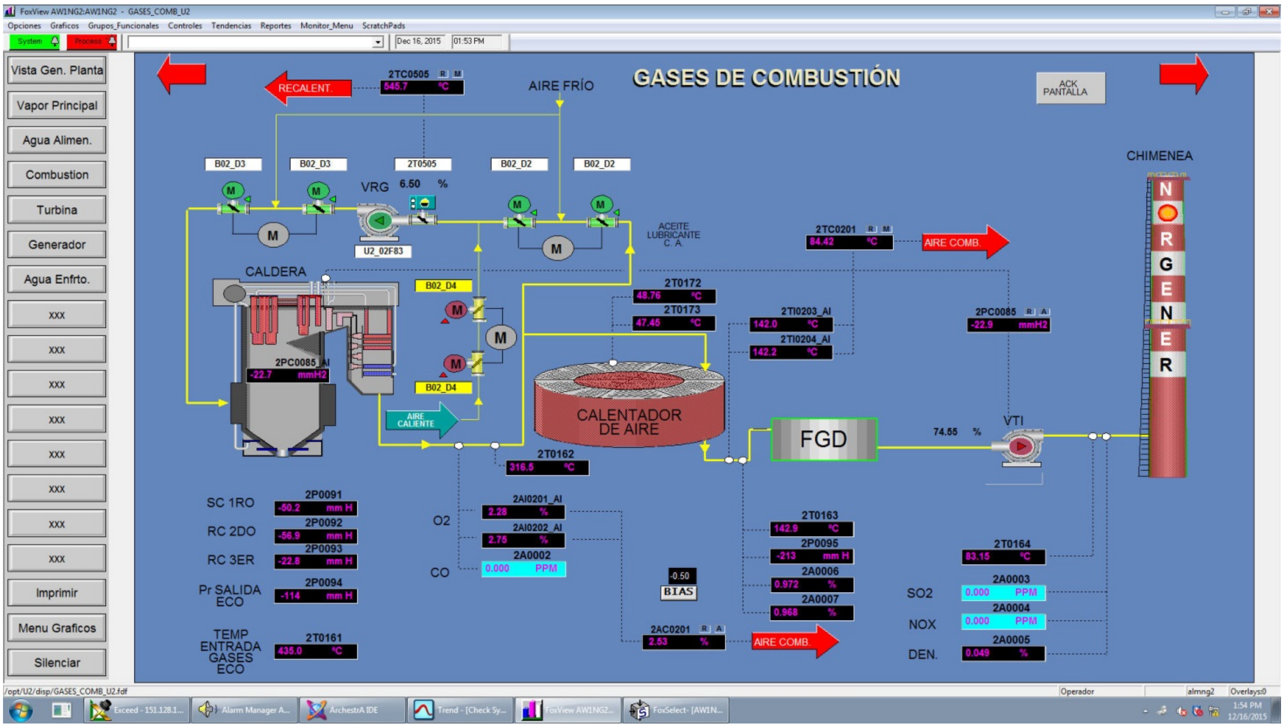

PULVERIZADOR A
RESET ALARMAS
SILO DE CARBÓN
PRESIÓN DEL HOGAR
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS

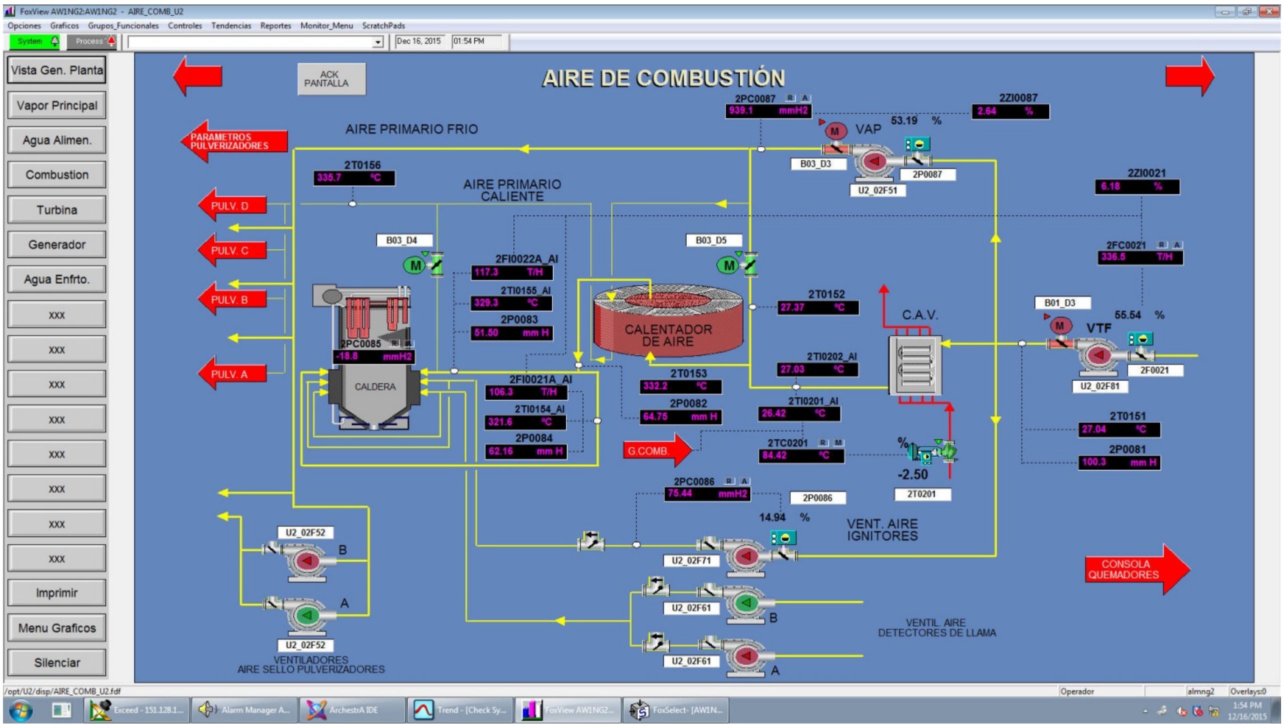

PULVERIZADOR B
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESION DIFERENCIAL DEL PULVERIZADOR
PRESION DEL HOGAR
AIRE CAL
AIRE FRIO
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar

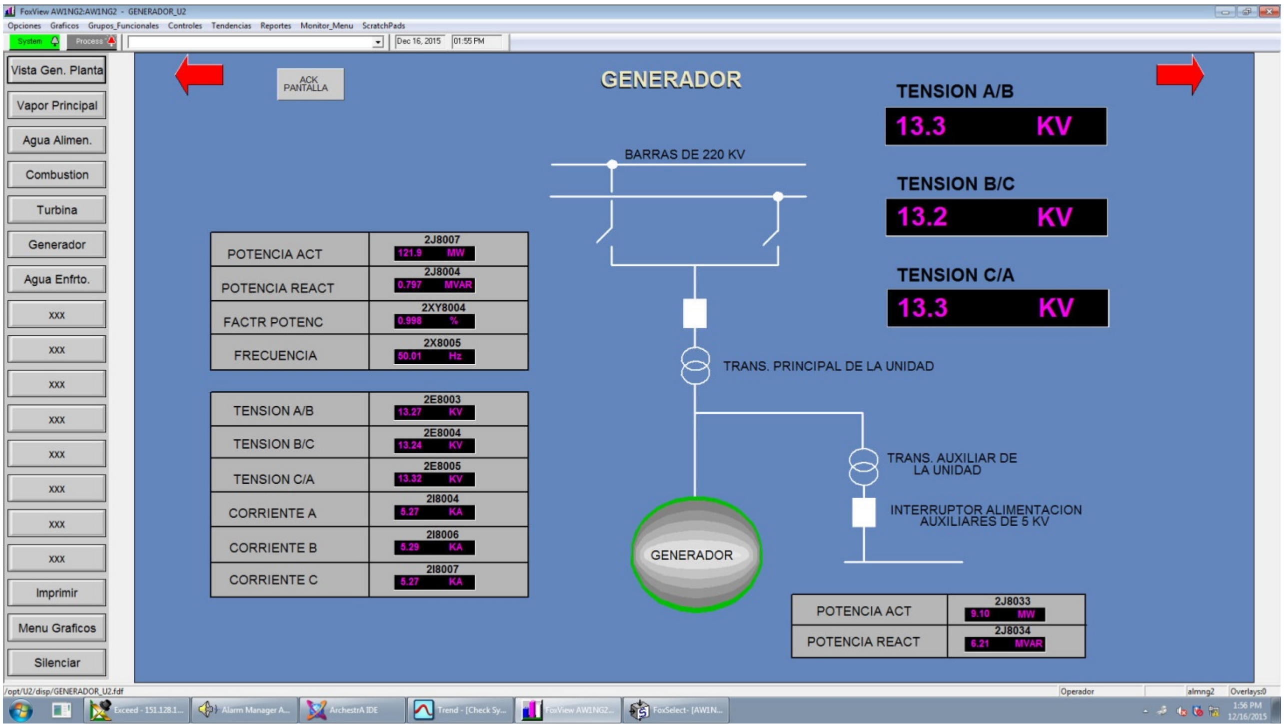

PULVERIZADOR C
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESION DIFERENCIAL DEL PULVERIZADOR
PRESION DEL HOGAR
AIRE CAL
AIRE FRIO
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar

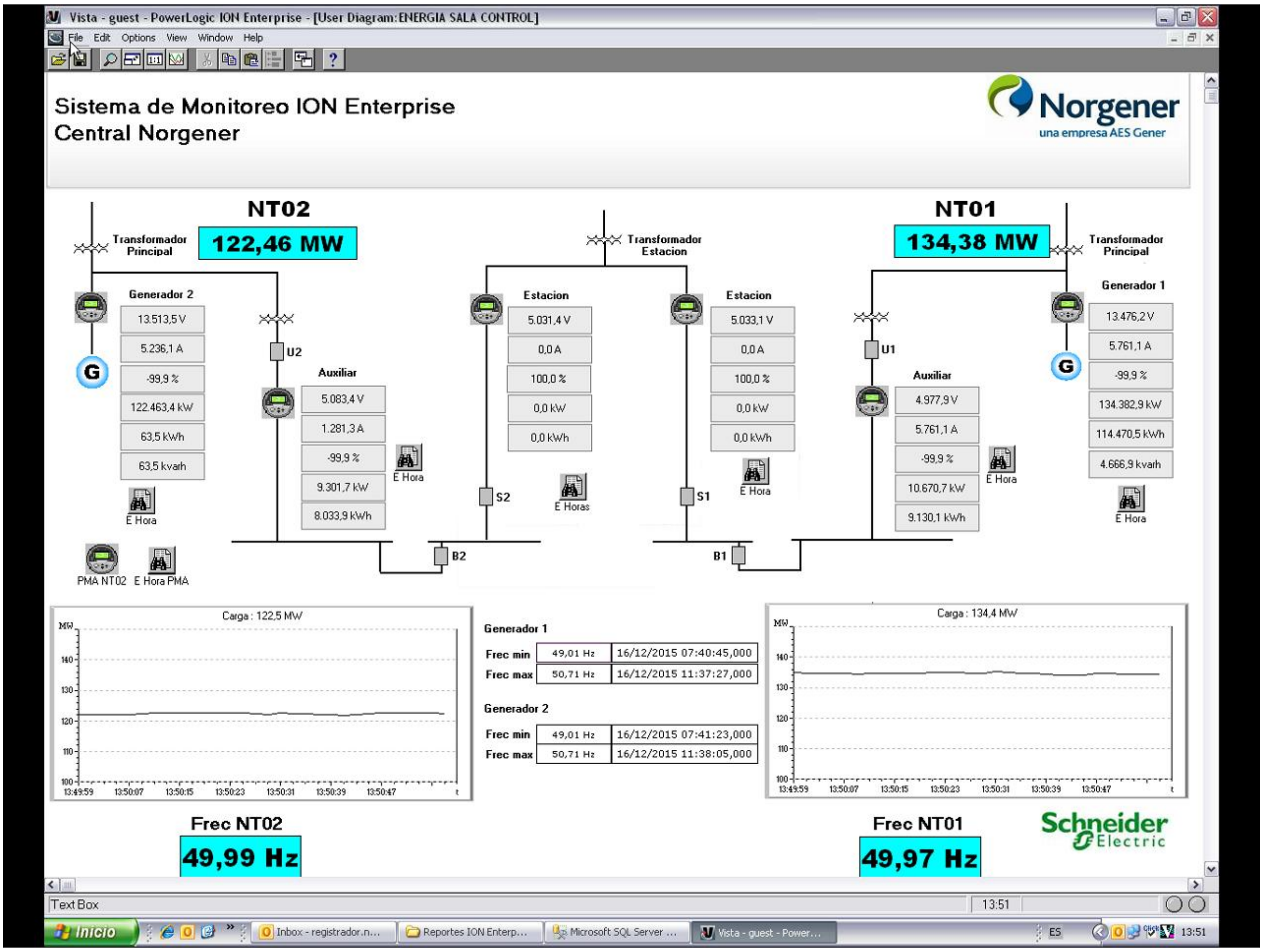

PULVERIZADOR D
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PRESIÓN DEL HOGAR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar


PARAMETROS PULVERIZADORES
A
B
C
D
VIBRACION
CORRIENTE
P. DIF PULVERIZADOR
P. AIRE SELLO
P. DIF ENTRE CAMARAS
P. DESCARGA PULVERIZADOR
P. ENTRADA AIRE PRIMARIO
FLUJO DE CARBON
FLUJO AIRE PRIMARIO
T. DESCARGA PULVERIZADOR
T. AIRE PRIMARIO
T. AIRE CALIENTE
T. AIRE FRIO
T. SILO
NIVEL SILO
ACK PANTALLA
SILO DE CARBON
PRESION DEL HOGAR
DESBLOQUEADOR
PULVERIZADOR
PRESION DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO


GASES DE COMBUSTIÓN
AIRE FRÍO
RECALENT.
CALDERA
CALENTADOR DE AIRE
FGD
VTI
CHIMENEA
AIRE COMB.
SC 1RO
RC 2DO
RC 3ER
Pr SALIDA ECO
TEMP ENTRADA GASES ECO
O2
CO
SO2
NOX
DEN.
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar

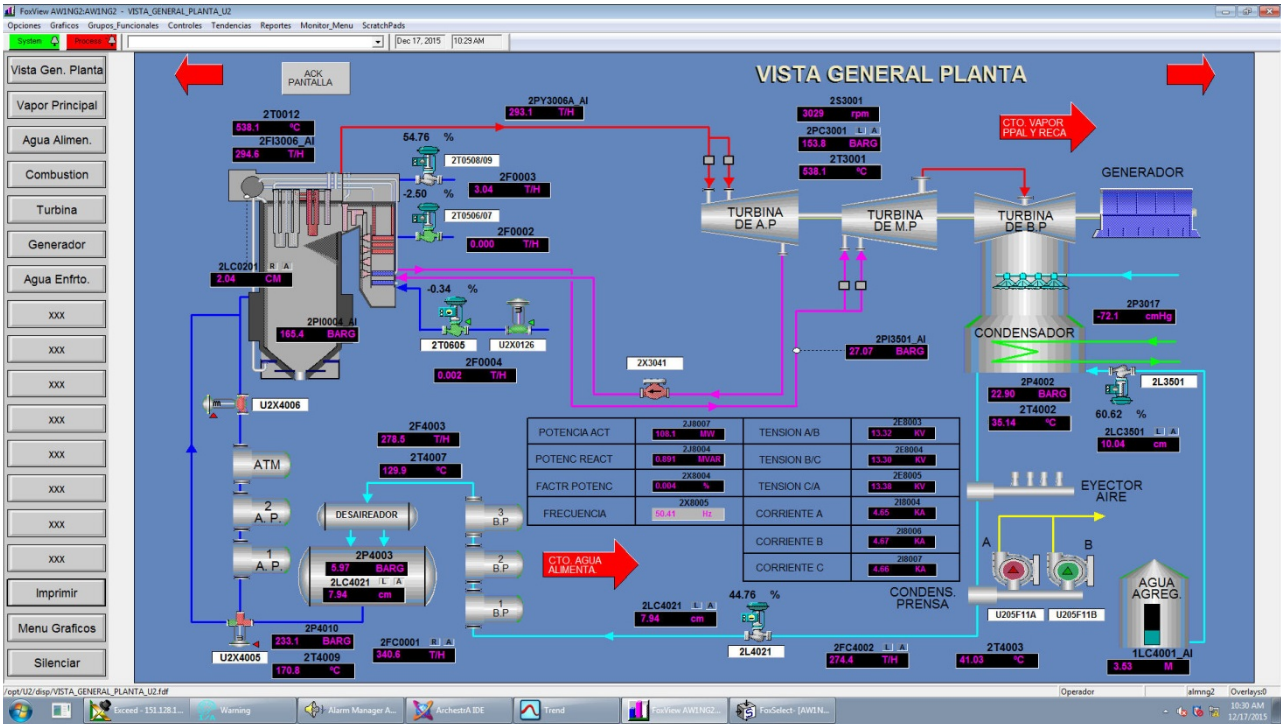

AIRE DE COMBUSTIÓN
AIRE PRIMARIO FRIO
AIRE PRIMARIO CALIENTE
PARAMETROS PULVERIZADORES
PULV. D
PULV. C
PULV. B
PULV. A
CALDERA
CALENTADOR DE AIRE
VAP
VTF
C.A.V.
G.COMB.
VENT. AIRE IGNITORES
VENTIL. AIRE DETECTORES DE LLAMA
VENTILADORES AIRE SELLO PULVERIZADORES
CONSOLA QUEMADORES
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar

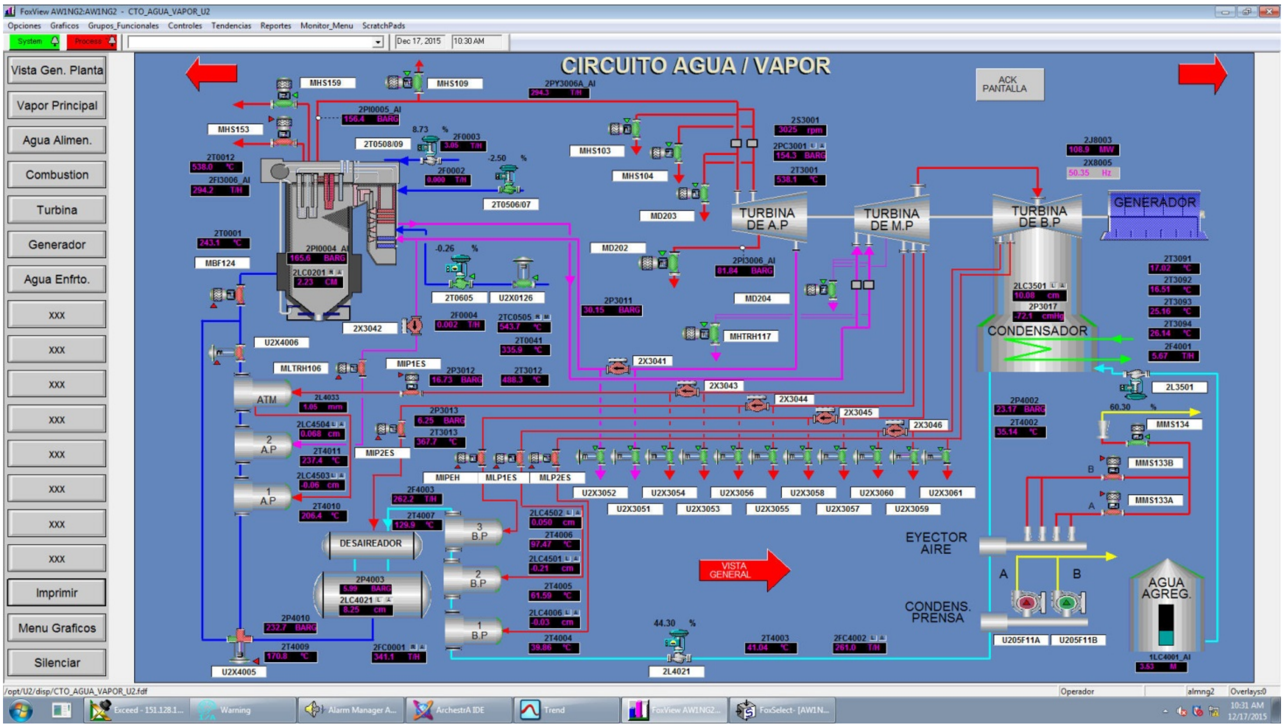

GENERADOR
TENSION A/B
13.3 KV
TENSION B/C
13.2 KV
TENSION C/A
13.3 KV
BARRAS DE 220 KV
TRANS. PRINCIPAL DE LA UNIDAD
TRANS. AUXILIAR DE LA UNIDAD
INTERRUPTOR ALIMENTACION AUXILIARES DE 5 KV
GENERADOR
POTENCIA ACT
POTENCIA REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar

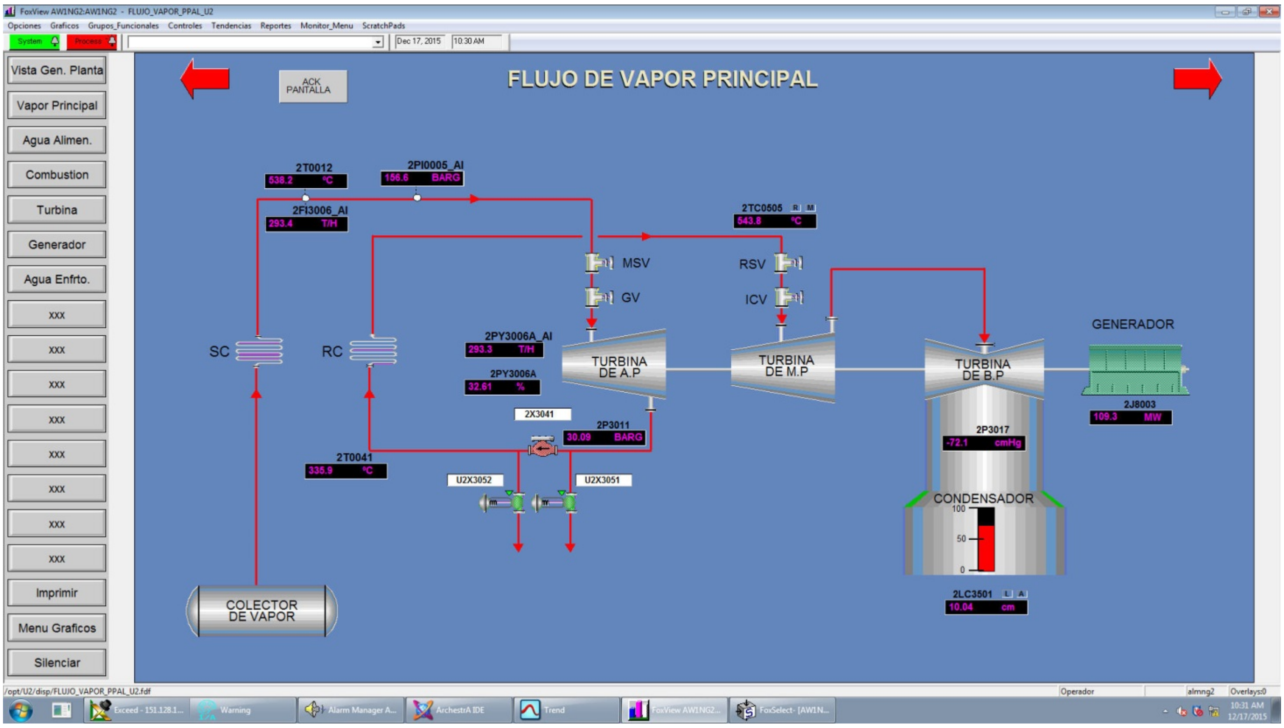

Sistema de Monitoreo ION Enterprise
Central Norgener
Norgener
una empresa AES Gener
NT02
122,46 MW
NT01
134,38 MW
Transformador Principal
Transformador Estacion
Generador 2
Generador 1
Auxiliar
Estacion
Carga : 122,5 MW
Carga : 134,4 MW
Generador 1
Frec min 49,01 Hz 16/12/2015 07:40:45,000
Frec max 50,71 Hz 16/12/2015 11:37:27,000
Generador 2
Frec min 49,01 Hz 16/12/2015 07:41:23,000
Frec max 50,71 Hz 16/12/2015 11:38:05,000
Frec NT02
49,99 Hz
Frec NT01
49,97 Hz
Schneider Electric

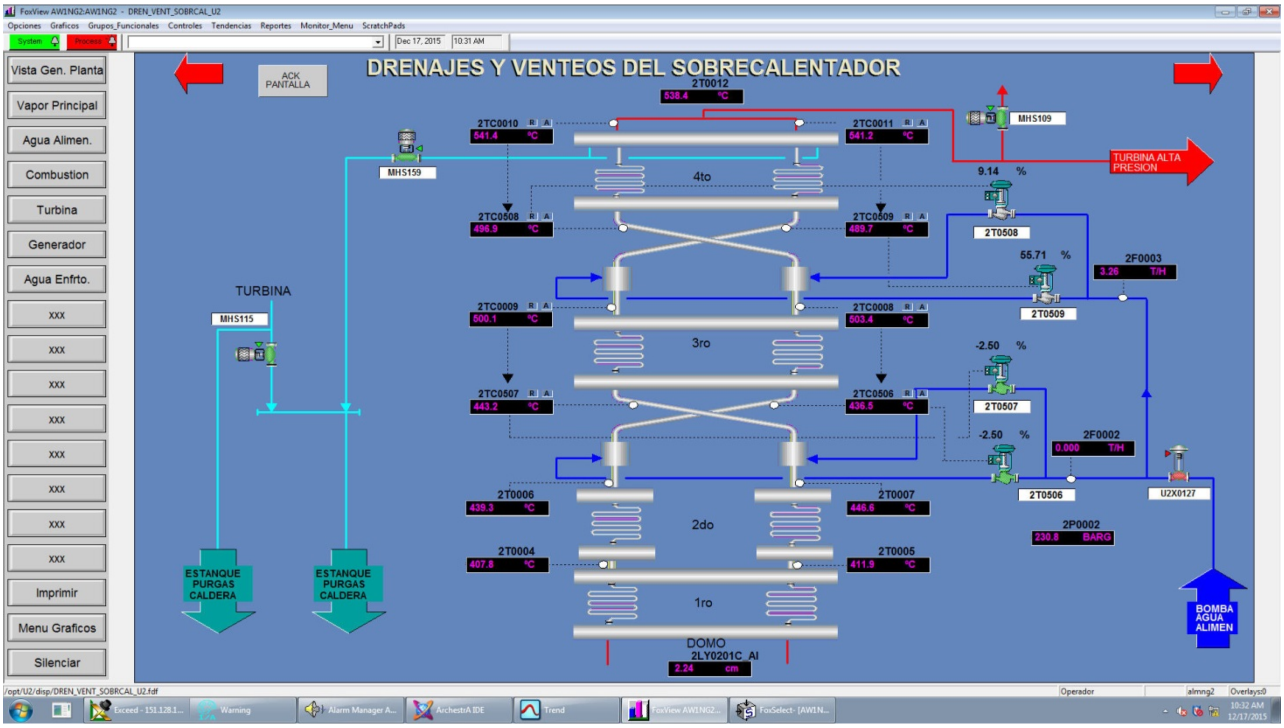
APPENDIX E4

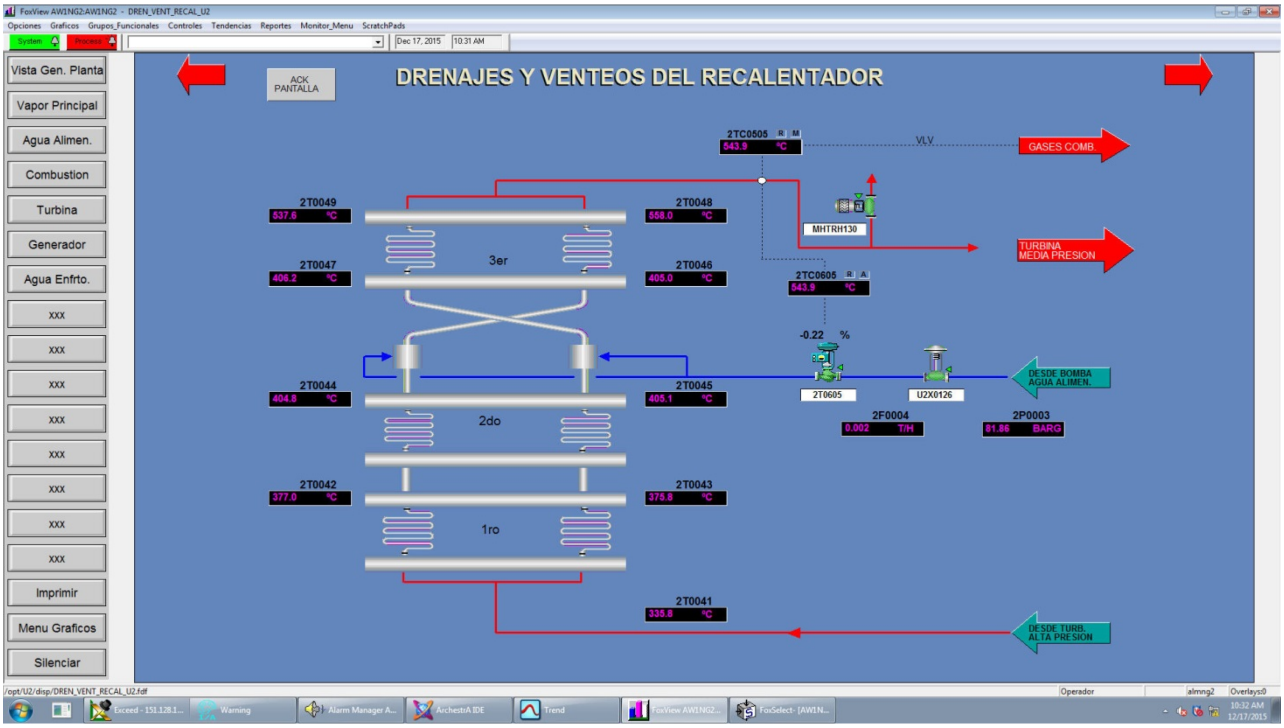
Control Panel Screen Dumps Test at 80% Load

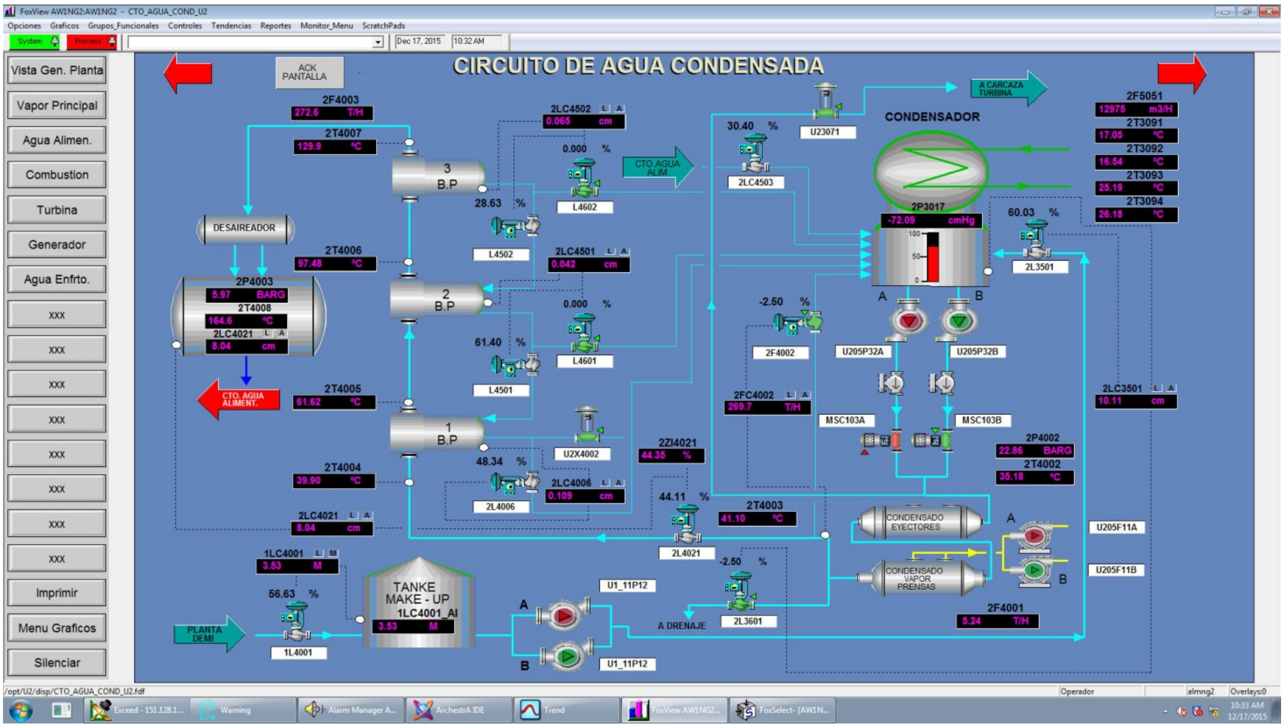

VISTA GENERAL PLANTA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
CTO. VAPOR PPAL Y RECA
EYECTOR AIRE
DESAIREADOR
ATM
CTO. AGUA ALIMENTA
CONDENS. PRENSA
AGUA AGREG.
POTENCIA ACT
POTENC REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C

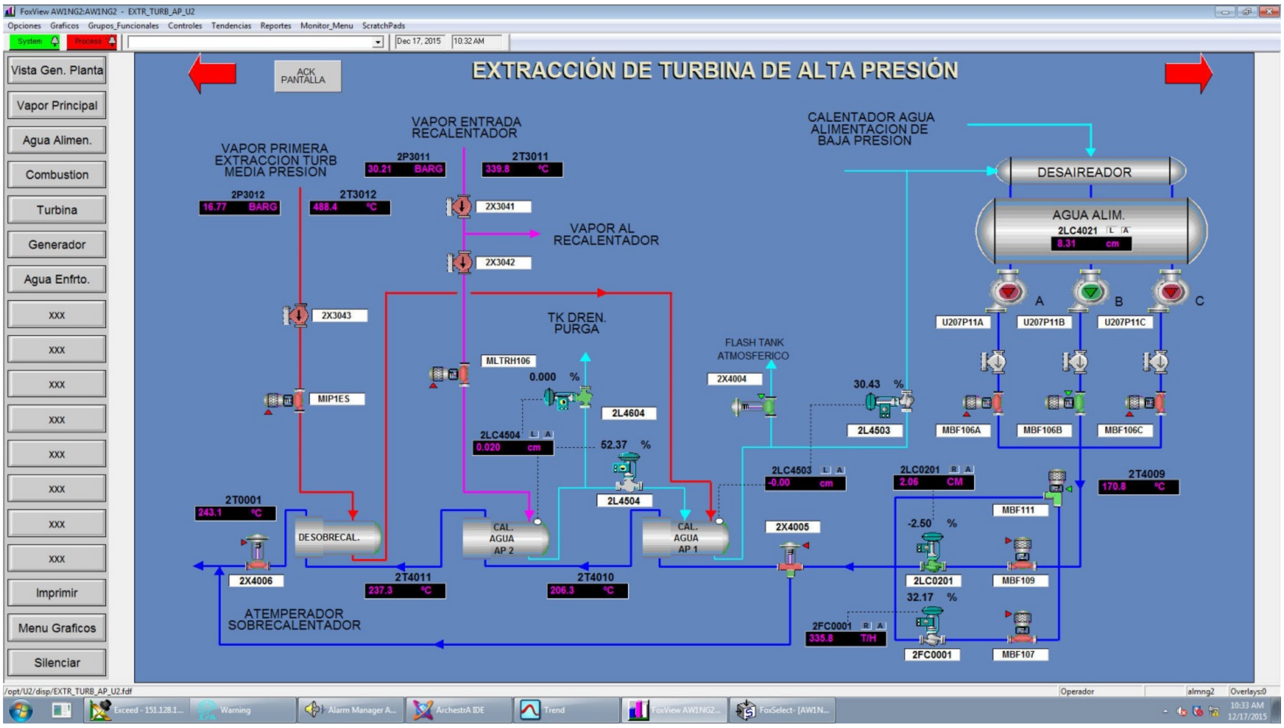

CIRCUITO AGUA / VAPOR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
DESAIREADOR
EYECTOR AIRE
VISTA GENERAL
CONDENS. PRENSA
AGUA AGREG.

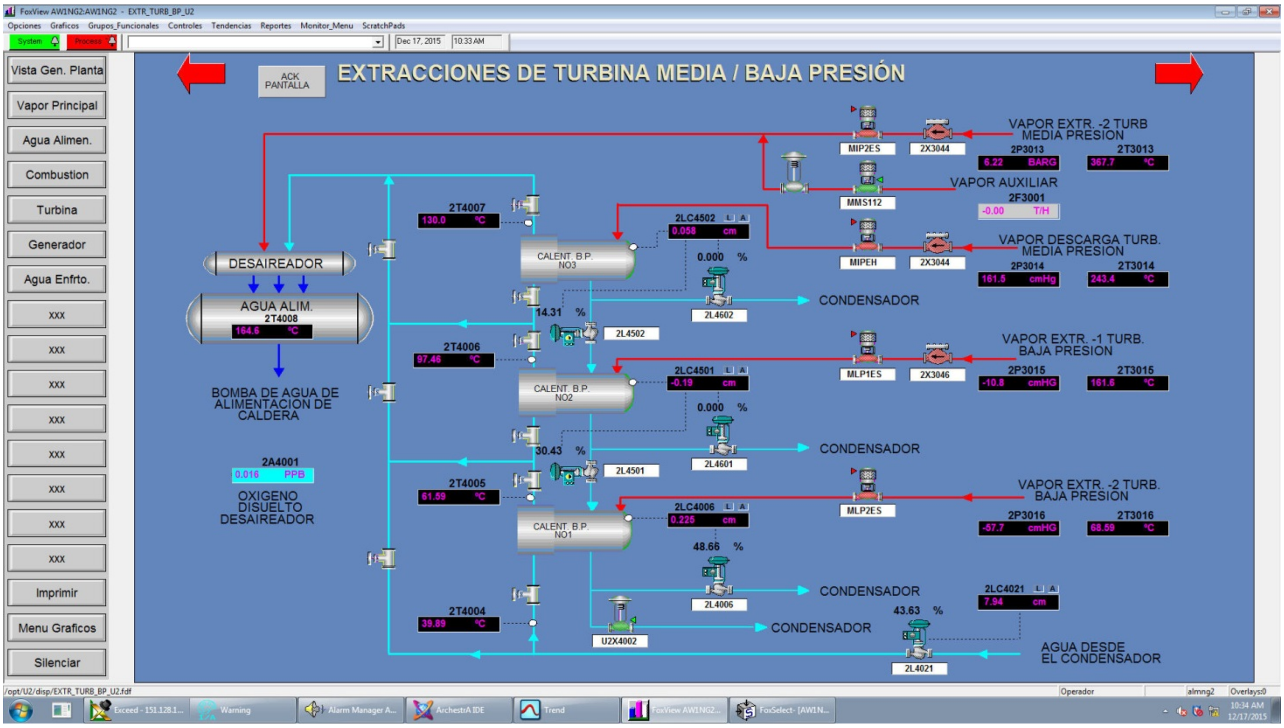

FoxView AW1NG2:AW1NG2 - FLUJO_VAPOR_PPAL_U2
Opciones Graficos Grupos_Funcionales Controles Tendencias Reportes Monitor_Menu ScratchPads
Dec 17, 2015 10:30 AM
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
FLUJO DE VAPOR PRINCIPAL
2T0012 538.2 °C
2PI0005_AI 156.6 BARG
2FI3006_AI 293.4 T/H
2TC0505 543.8 °C
MSV
GV
RSV
ICV
SC
RC
2PY3006A_AI 293.3 T/H
2PY3006A 32.61 %
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
2J8003 109.3 MW
2X3041
2P3011 30.09 BARG
2T0041 335.9 °C
U2X3052
U2X3051
2P3017 -72.1 cmHg
CONDENSADOR
100
50
0
2LC3501 10.04 cm
COLECTOR DE VAPOR
/opt/U2/disp/FLUJO_VAPOR_PPAL_U2.fdf
Operador

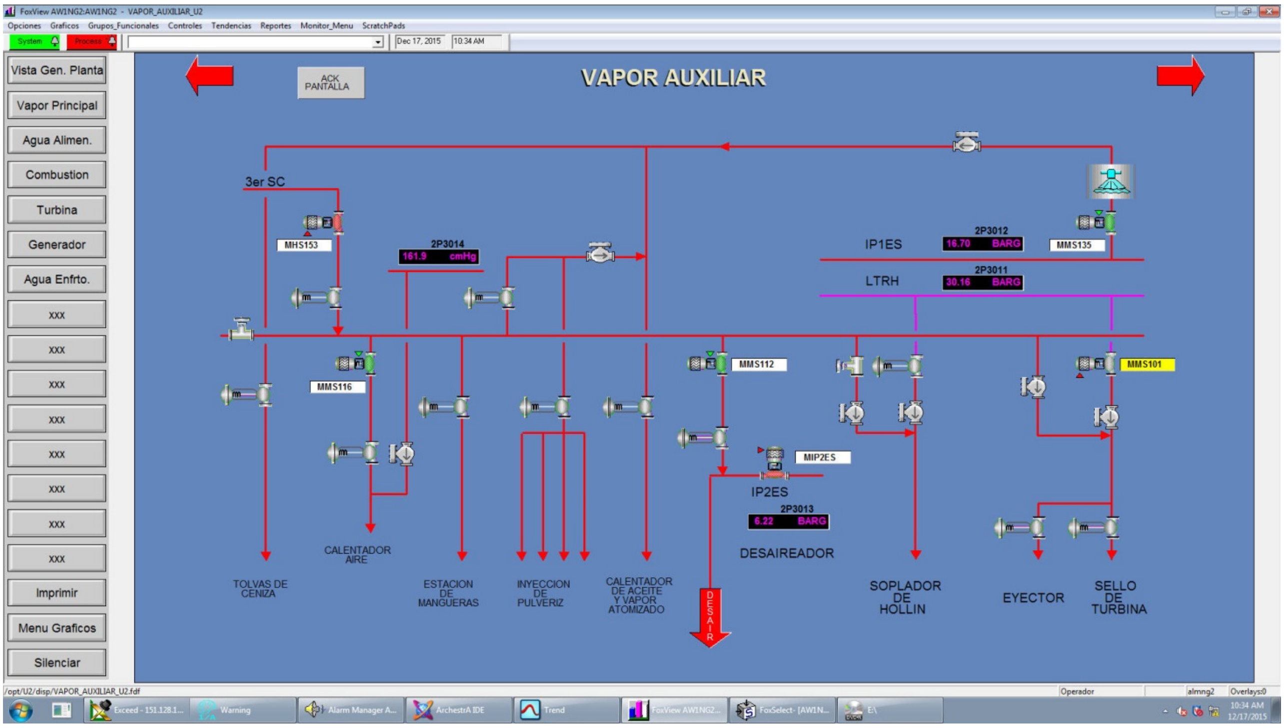

FoxView AW1NG2:AW1NG2 - DREN_VENT_SOBRCAL_U2
Opciones Graficos Grupos_Funcionales Controles Tendencias Reportes Monitor_Menu ScratchPads
Dec 17, 2015 10:31 AM
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
DRENAJES Y VENTEOS DEL SOBRECALENTADOR
2T0012 538.4 °C
2TC0010 541.4 °C
2TC0011 541.2 °C
MHS159
MHS109
TURBINA ALTA PRESION
9.14 %
4to
2TC0508 496.9 °C
2TC0509 489.7 °C
2T0508
55.71 %
2F0003 3.26 T/H
TURBINA
MHS115
2TC0009 500.1 °C
2TC0008 503.4 °C
2T0509
3ro
-2.50 %
2TC0507 443.2 °C
2TC0506 436.5 °C
2T0507
-2.50 %
2F0002 0.000 T/H
U2X0127
2T0506
2T0006 439.3 °C
2T0007 446.6 °C
2do
2P0002 230.8 BARG
2T0004 407.8 °C
2T0005 411.9 °C
1ro
ESTANQUE PURGAS CALDERA
ESTANQUE PURGAS CALDERA
BOMBA AGUA ALIMEN
DOMO
2LY0201C_AI 2.24 cm
/opt/U2/disp/DREN_VENT_SOBRCAL_U2.fdf
Operador

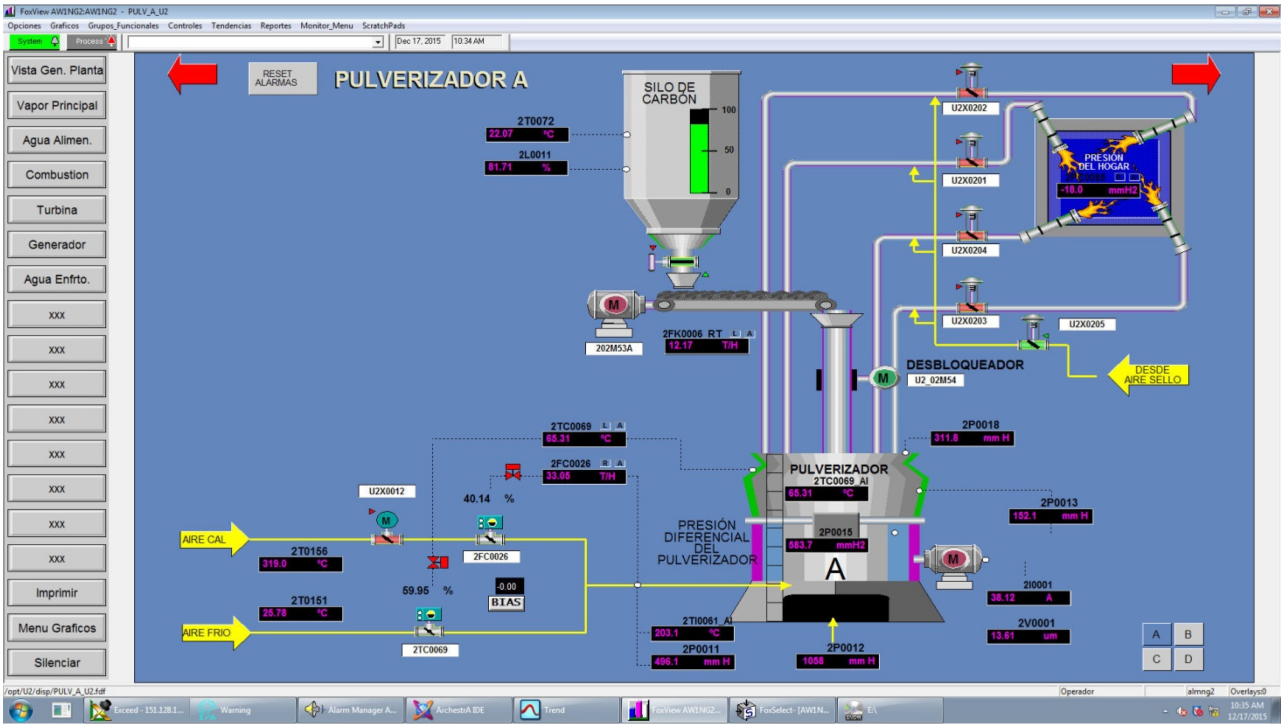

DRENAJES Y VENTEOS DEL RECALENTADOR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
GASES COMB.
TURBINA MEDIA PRESION
DESDE BOMBA AGUA ALIMEN.
DESDE TURB. ALTA PRESION
3er
2do
1ro

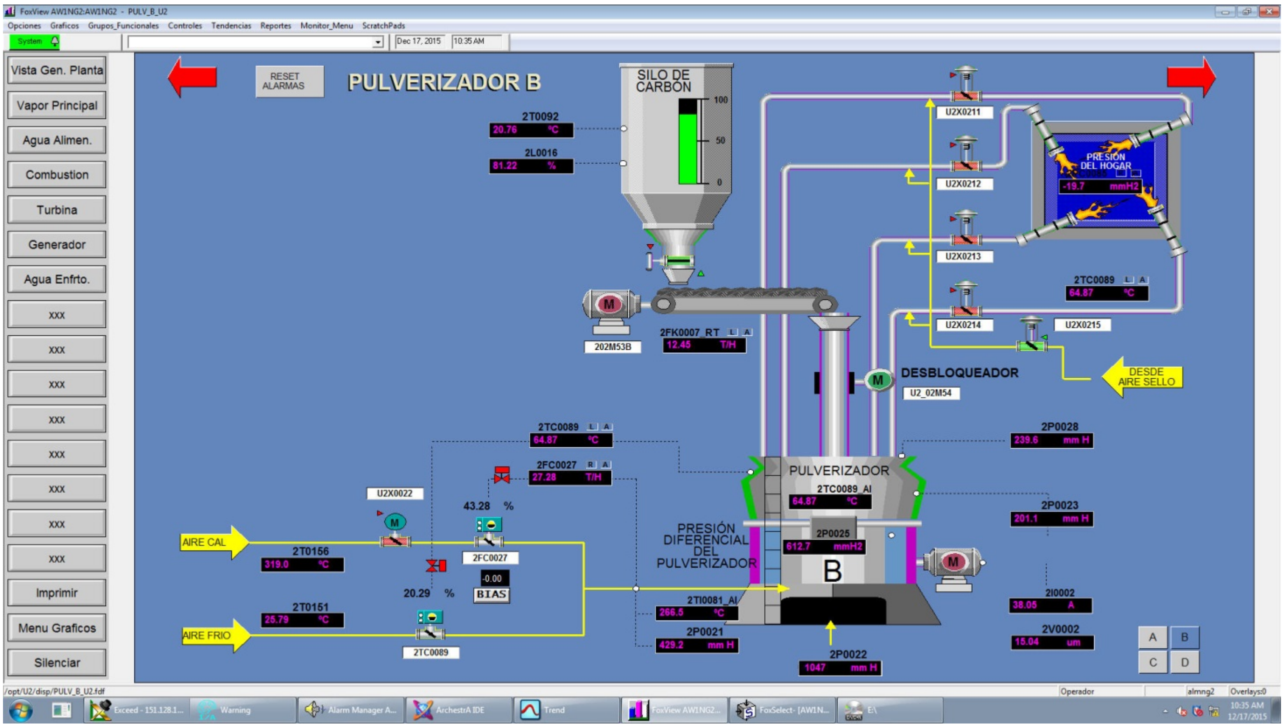

CIRCUITO DE AGUA CONDENSADA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
CONDENSADOR
DESAIREADOR
TANKE MAKE - UP
CONDENSADO EYECTORES
CONDENSADO VAPOR PRENSAS
A DRENAJE

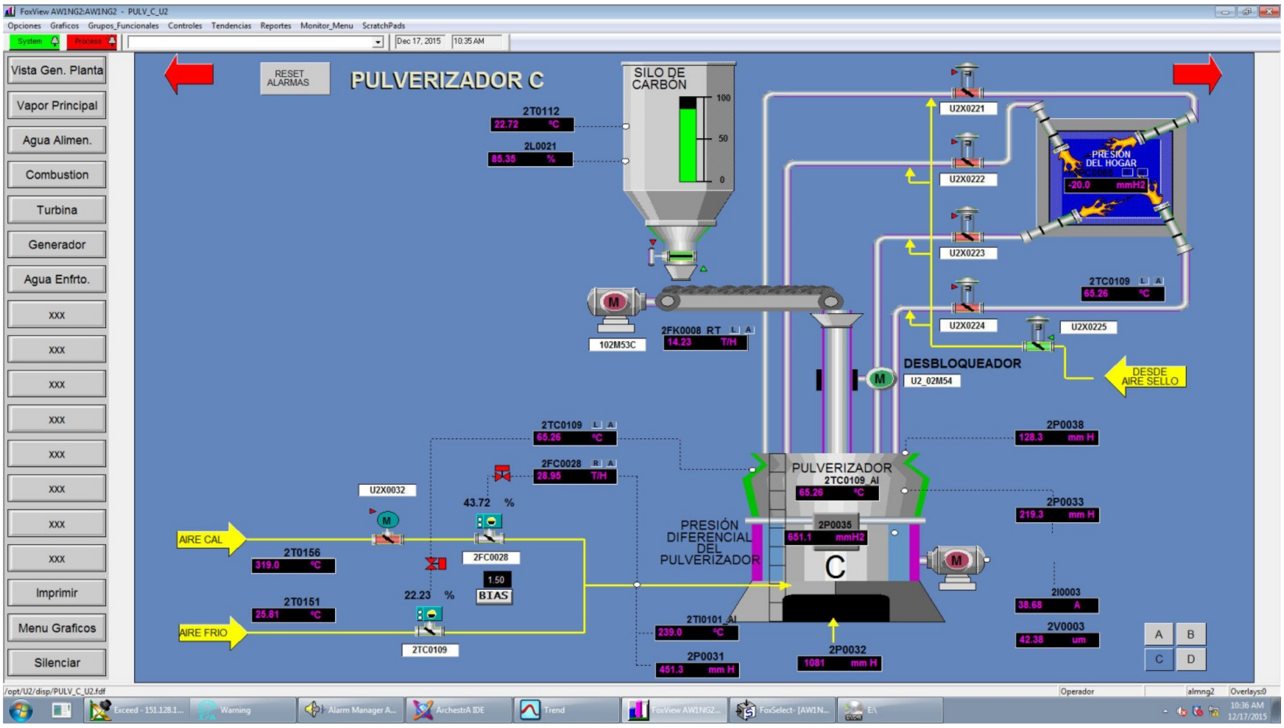

EXTRACCIÓN DE TURBINA DE ALTA PRESIÓN
VAPOR ENTRADA RECALENTADOR
VAPOR PRIMERA EXTRACCION TURB MEDIA PRESION
CALENTADOR AGUA ALIMENTACION DE BAJA PRESION
DESAIREADOR
AGUA ALIM.
VAPOR AL RECALENTADOR
TK DREN. PURGA
FLASH TANK ATMOSFERICO
DESOBRECAL.
CAL. AGUA AP 2
CAL. AGUA AP 1
ATEMPERADOR SOBRECALENTADOR

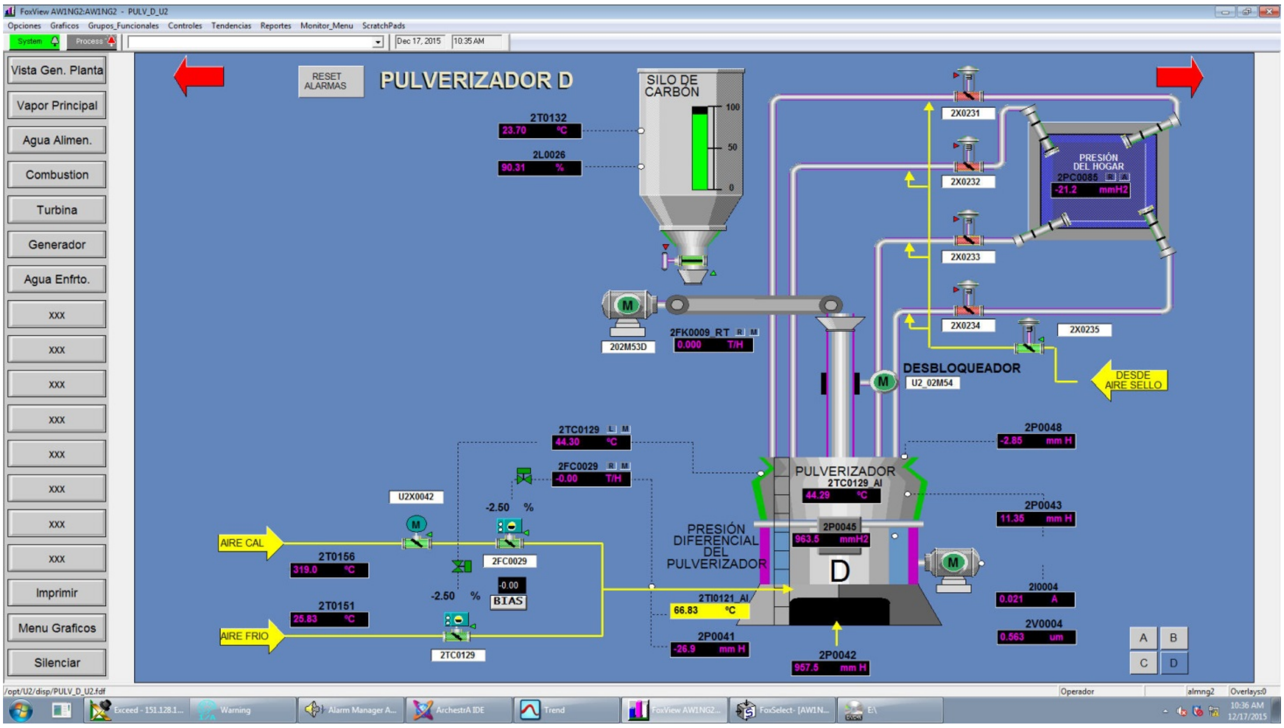

EXTRACCIONES DE TURBINA MEDIA / BAJA PRESIÓN
VAPOR EXTR. -2 TURB MEDIA PRESION
VAPOR AUXILIAR
VAPOR DESCARGA TURB. MEDIA PRESION
DESAIREADOR
AGUA ALIM.
CONDENSADOR
VAPOR EXTR. -1 TURB. BAJA PRESION
BOMBA DE AGUA DE ALIMENTACION DE CALDERA
OXIGENO DISUELTO DESAIREADOR
VAPOR EXTR. -2 TURB. BAJA PRESION
AGUA DESDE EL CONDENSADOR

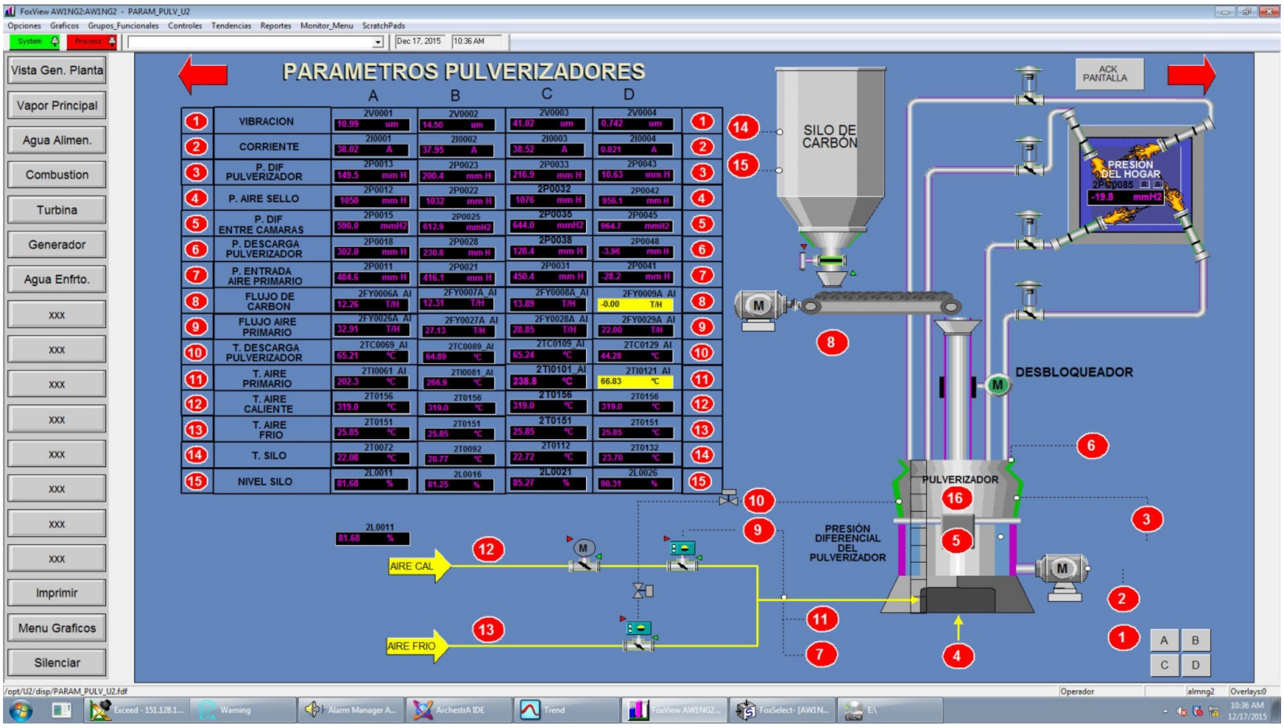

VAPOR AUXILIAR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
3er SC
MHS153
2P3014
161.9 cmHg
IP1ES
2P3012
16.70 BARG
MMS135
LTRH
2P3011
30.16 BARG
MMS116
MMS112
MMS101
MIP2ES
IP2ES
2P3013
6.22 BARG
DESAIREADOR
TOLVAS DE CENIZA
CALENTADOR AIRE
ESTACION DE MANGUERAS
INYECCION DE PULVERIZ
CALENTADOR DE ACEITE Y VAPOR ATOMIZADO
DESAIR
SOPLADOR DE HOLLIN
EYECTOR
SELLO DE TURBINA

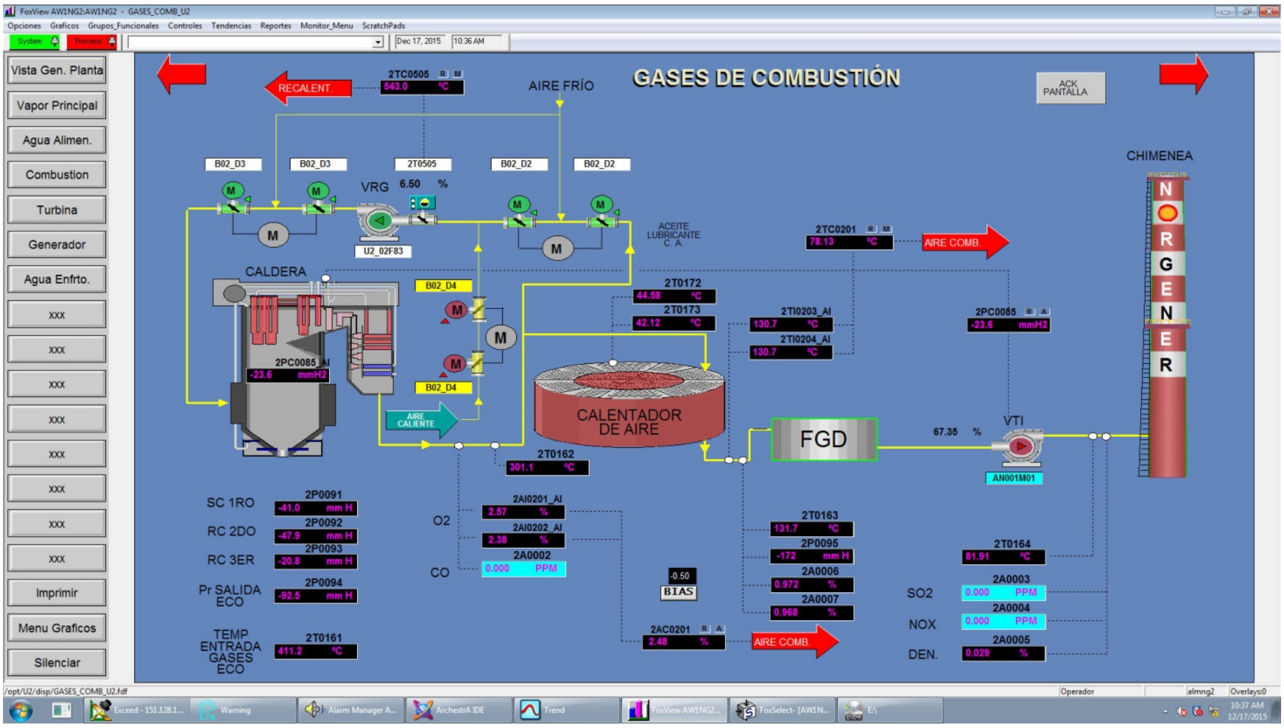

PULVERIZADOR A
RESET ALARMAS
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
SILO DE CARBON
2T0072
22.07 °C
2L0011
81.71 %
U2X0202
U2X0201
U2X0204
U2X0203
U2X0205
PRESION DEL HOGAR
-18.0 mmH2
202M53A
2FK0006 RT
12.17 T/H
DESBLOQUEADOR
U2_02M54
DESDE AIRE SELLO
2TC0069
65.31 °C
2FC0026
33.05 T/H
U2X0012
40.14 %
2P0018
311.8 mm H
PULVERIZADOR
2TC0069 AI
65.31 °C
2P0013
152.1 mm H
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
2P0015
583.7 mmH2
AIRE CAL
2T0156
319.0 °C
59.95 %
-0.00
BIAS
AIRE FRIO
2T0151
25.78 °C
2TC0069
2TI0061
203.1 °C
2P0011
496.1 mm H
2P0012
1058 mm H
2I0001
38.12 A
2V0001
13.61 um
A B C D

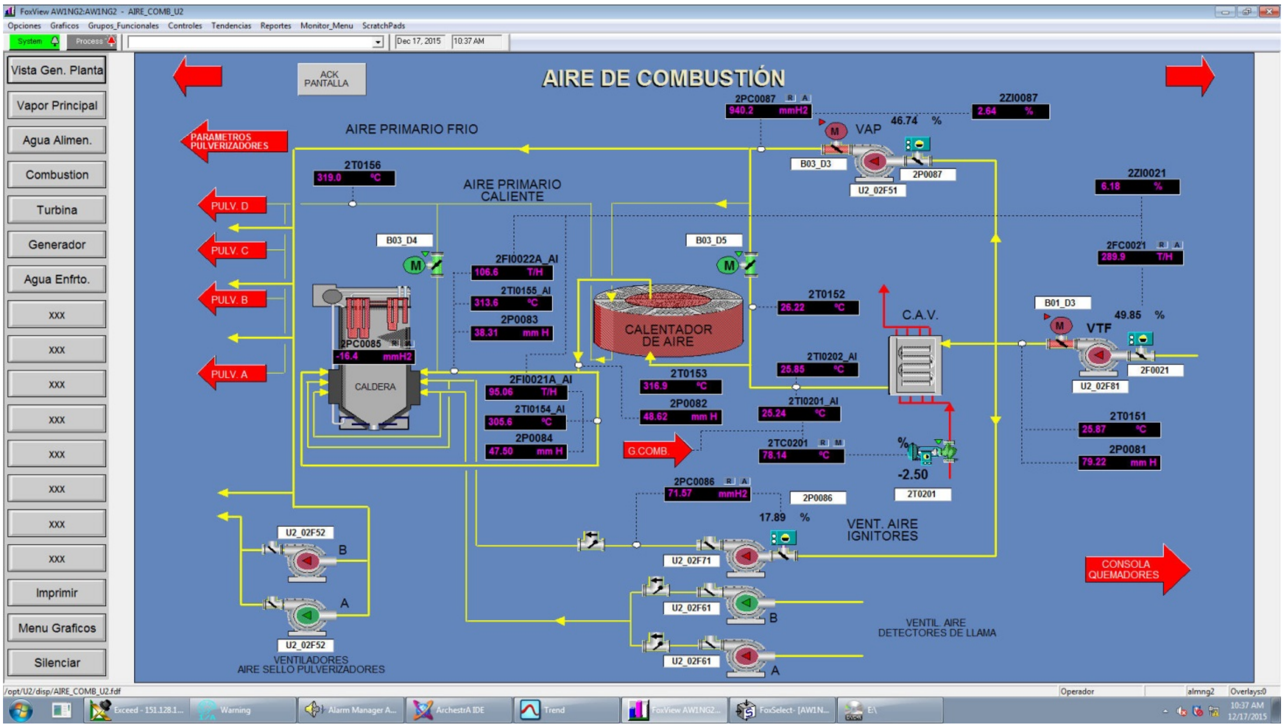

PULVERIZADOR B
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
PRESION DEL HOGAR
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESION DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS
B

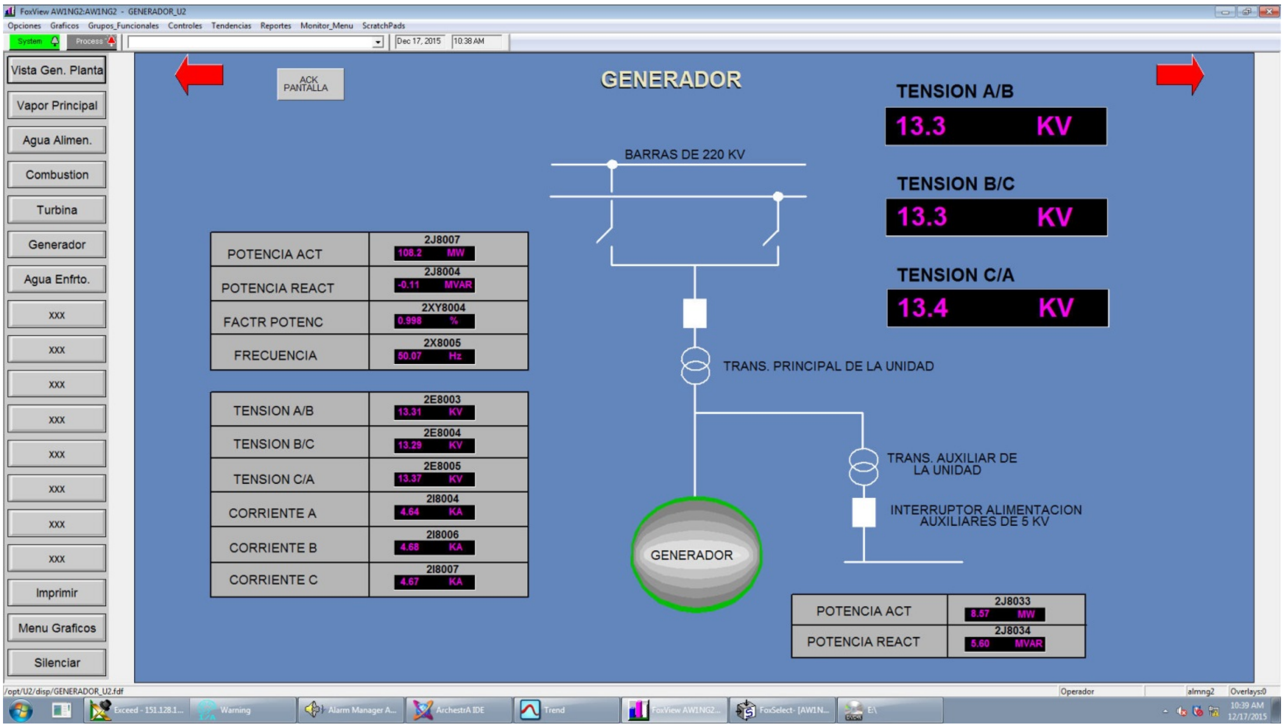

PULVERIZADOR C
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
PRESION DEL HOGAR
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESION DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS
C


PULVERIZADOR D
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
PRESIÓN DEL HOGAR
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS
D

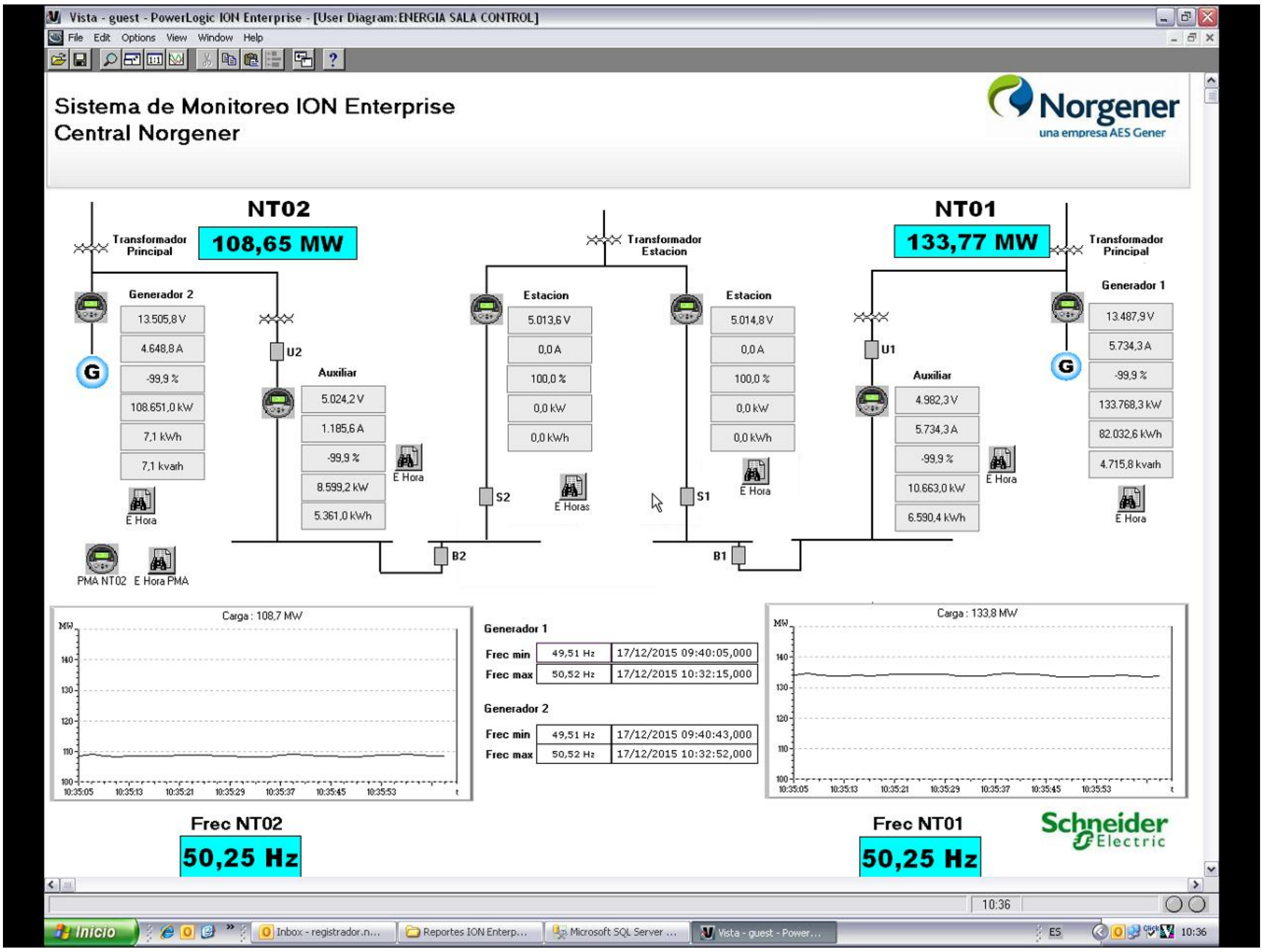

PARAMETROS PULVERIZADORES
ACK PANTALLA
A
B
C
D
VIBRACION
CORRIENTE
P. DIF PULVERIZADOR
P. AIRE SELLO
P. DIF ENTRE CAMARAS
P. DESCARGA PULVERIZADOR
P. ENTRADA AIRE PRIMARIO
FLUJO DE CARBON
FLUJO AIRE PRIMARIO
T. DESCARGA PULVERIZADOR
T. AIRE PRIMARIO
T. AIRE CALIENTE
T. AIRE FRIO
T. SILO
NIVEL SILO
SILO DE CARBON
PRESIÓN DEL HOGAR
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar


GASES DE COMBUSTIÓN
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
RECALENT.
AIRE FRÍO
CALDERA
VRG
CHIMENEA
CALENTADOR DE AIRE
FGD
VTI
AIRE CALIENTE
AIRE COMB.
SC 1RO
RC 2DO
RC 3ER
Pr SALIDA ECO
TEMP ENTRADA GASES ECO
O2
CO
BIAS
SO2
NOX
DEN.


AIRE DE COMBUSTIÓN
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
PARAMETROS PULVERIZADORES
AIRE PRIMARIO FRIO
AIRE PRIMARIO CALIENTE
PULV. D
PULV. C
PULV. B
PULV. A
VAP
CALDERA
CALENTADOR DE AIRE
C.A.V.
VTF
G.COMB.
VENT. AIRE IGNITORES
VENTIL. AIRE DETECTORES DE LLAMA
VENTILADORES AIRE SELLO PULVERIZADORES
CONSOLA QUEMADORES



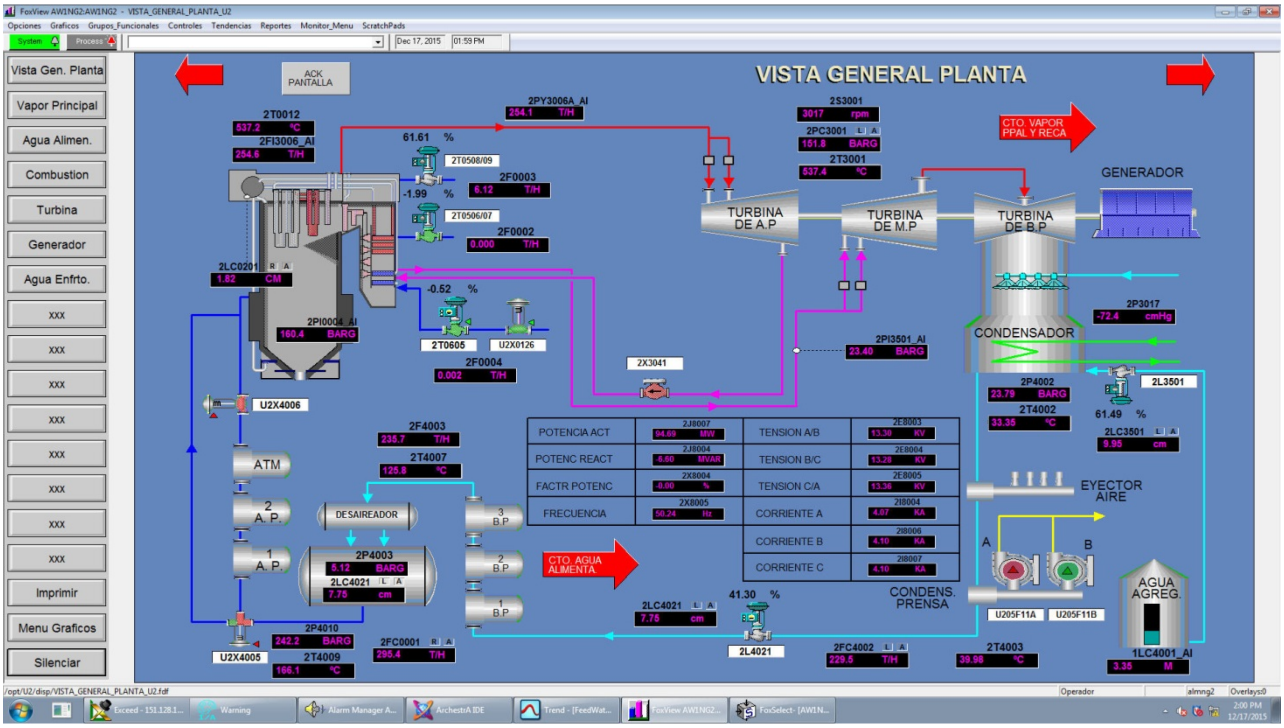
GENERADOR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
BARRAS DE 220 KV
POTENCIA ACT 2J8007 108.2 MW
POTENCIA REACT 2J8004 -0.11 MVAR
FACTR POTENC 2XY8004 0.998 %
FRECUENCIA 2X8005 50.07 Hz
TENSION A/B 2E8003 13.31 KV
TENSION B/C 2E8004 13.29 KV
TENSION C/A 2E8005 13.37 KV
CORRIENTE A 2I8004 4.64 KA
CORRIENTE B 2I8006 4.68 KA
CORRIENTE C 2I8007 4.67 KA
TRANS. PRINCIPAL DE LA UNIDAD
TRANS. AUXILIAR DE LA UNIDAD
INTERRUPTOR ALIMENTACION AUXILIARES DE 5 KV
POTENCIA ACT 2J8033 8.57 MW
POTENCIA REACT 2J8034 5.60 MVAR
TENSION A/B 13.3 KV
TENSION B/C 13.3 KV
TENSION C/A 13.4 KV

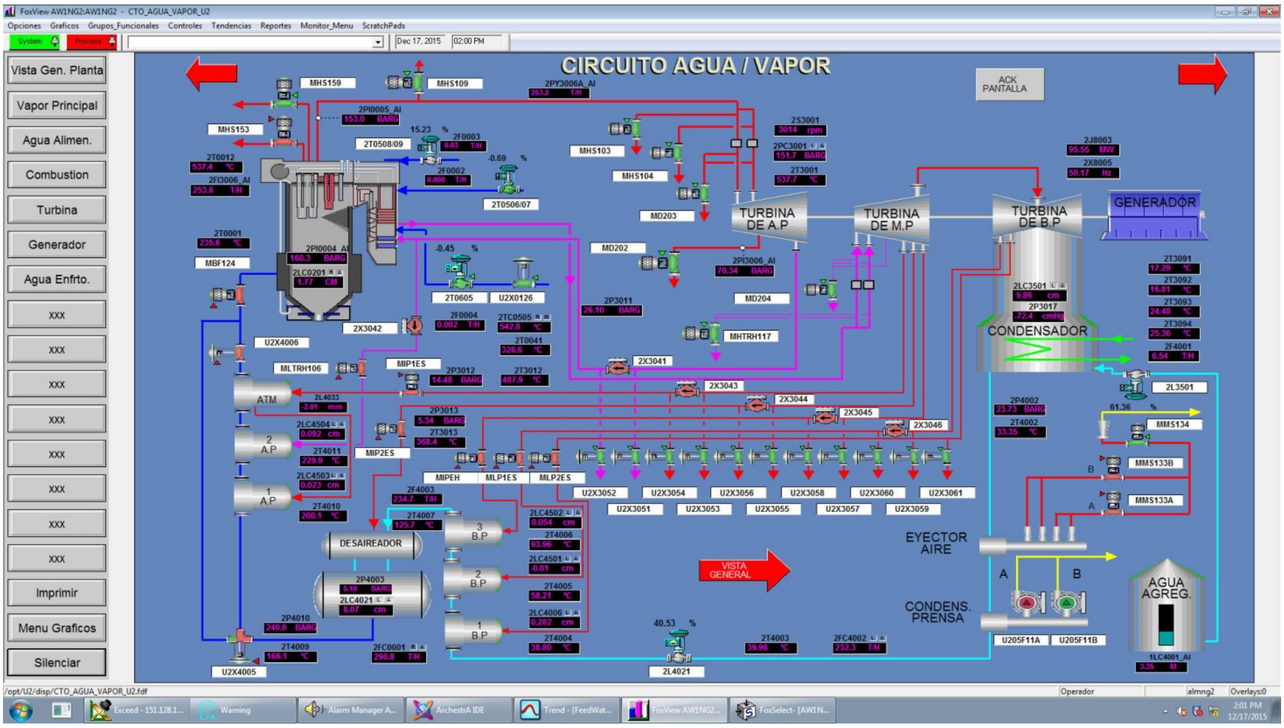


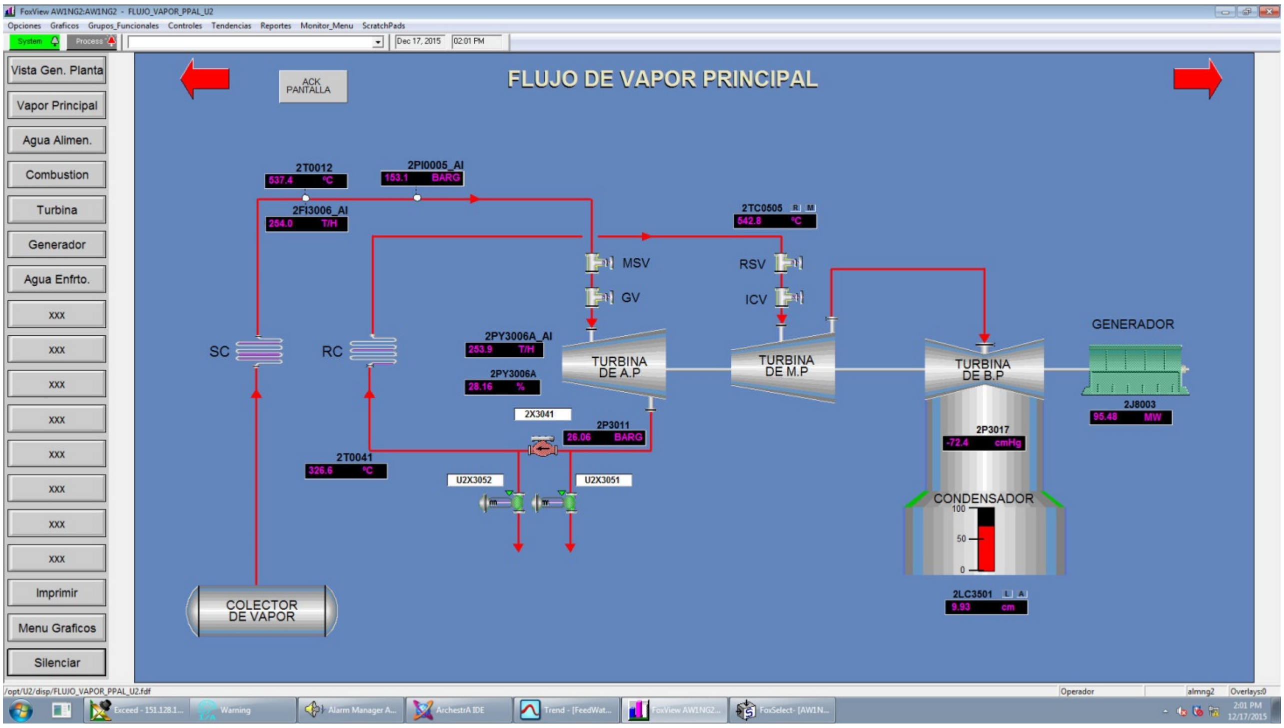
Vista - guest - PowerLogic ION Enterprise - [User Diagram:ENERGIA SALA CONTROL]
Sistema de Monitoreo ION Enterprise
Central Norgener
Norgener
una empresa AES Gener
NT02
108,65 MW
NT01
133,77 MW
Transformador Principal
Transformador Estacion
Generador 2
13.505,8 V
4.648,8 A
-99,9 %
108.651,0 kW
7,1 kWh
7,1 kvarh
Auxiliar
5.024,2 V
1.185,6 A
-99,9 %
8.599,2 kW
5.361,0 kWh
Estacion
5.013,6 V
0,0 A
100,0 %
0,0 kW
0,0 kWh
Estacion
5.014,8 V
0,0 A
100,0 %
0,0 kW
0,0 kWh
Auxiliar
4.982,3 V
5.734,3 A
-99,9 %
10.663,0 kW
6.590,4 kWh
Generador 1
13.487,9 V
5.734,3 A
-99,9 %
133.768,3 kW
82.032,6 kWh
4.715,8 kvarh
U2
U1
S2
S1
B2
B1
E Hora
PMA NT02
E Hora PMA
Carga : 108,7 MW
Carga : 133,8 MW
Generador 1
Frec min 49,51 Hz 17/12/2015 09:40:05,000
Frec max 50,52 Hz 17/12/2015 10:32:15,000
Generador 2
Frec min 49,51 Hz 17/12/2015 09:40:43,000
Frec max 50,52 Hz 17/12/2015 10:32:52,000
Frec NT02
50,25 Hz
Frec NT01
50,25 Hz
Schneider Electric

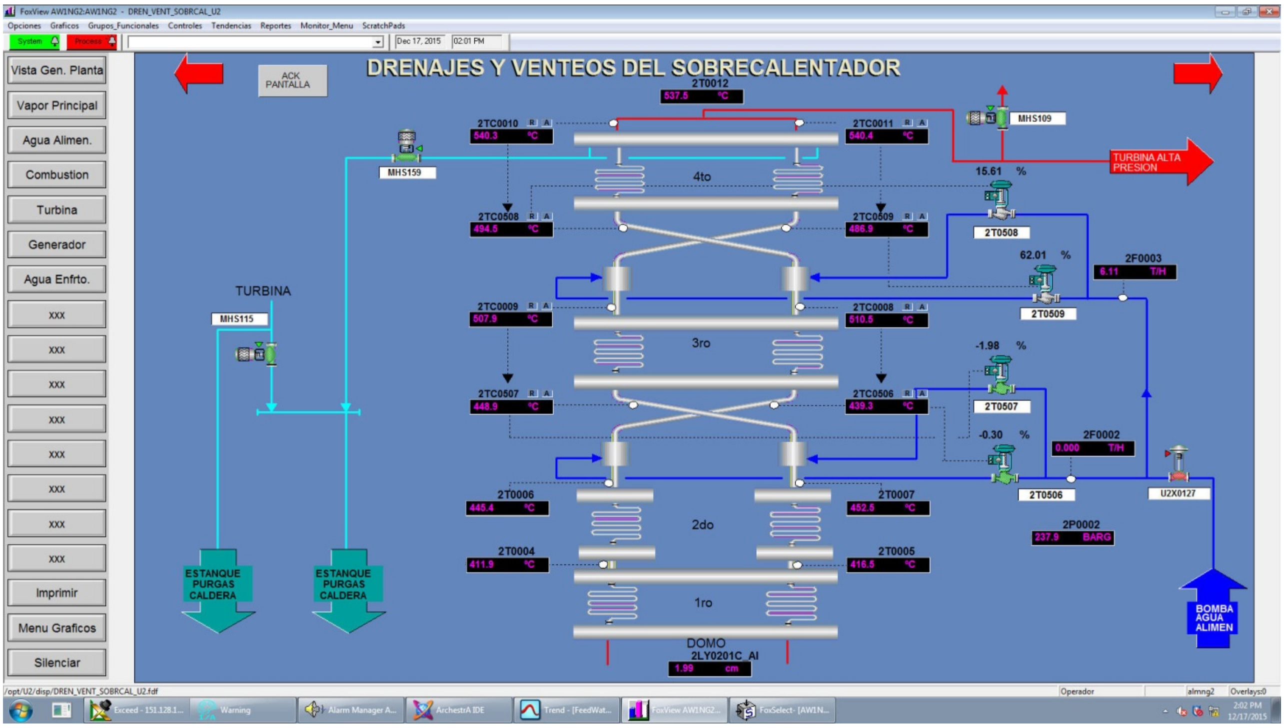
APPENDIX E5

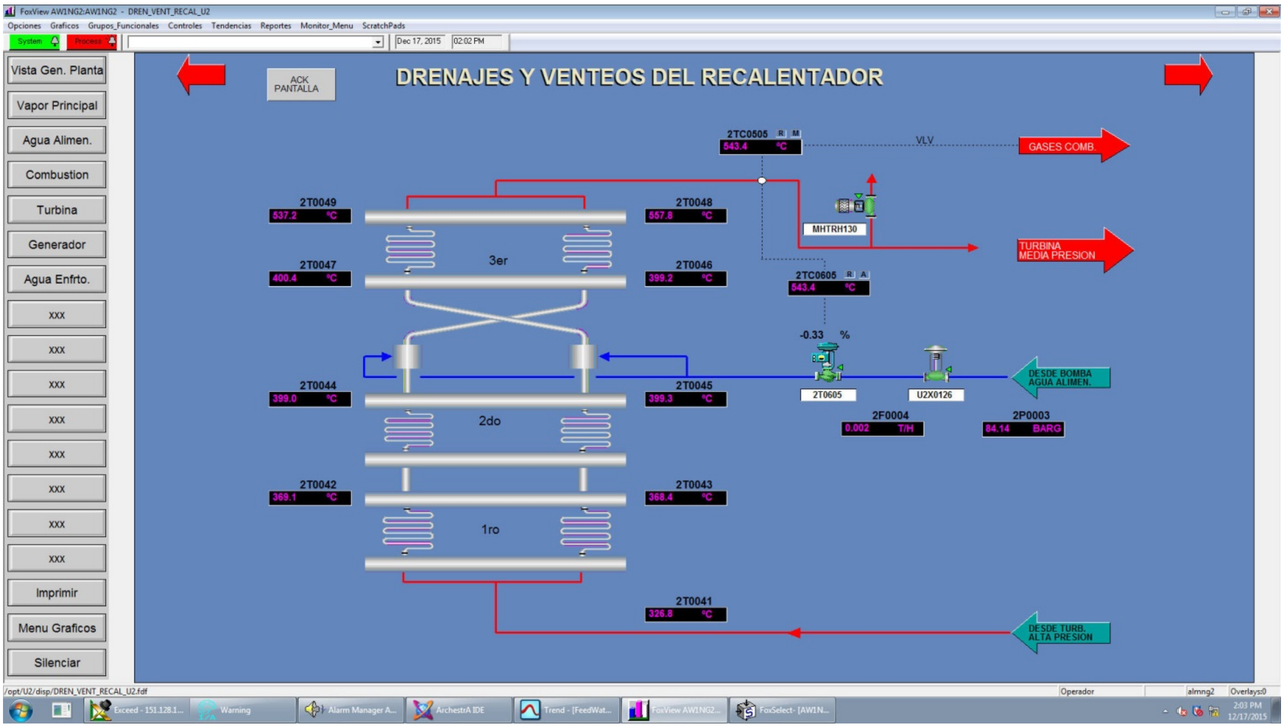
Control Panel Screen Dumps Test at 70% Load

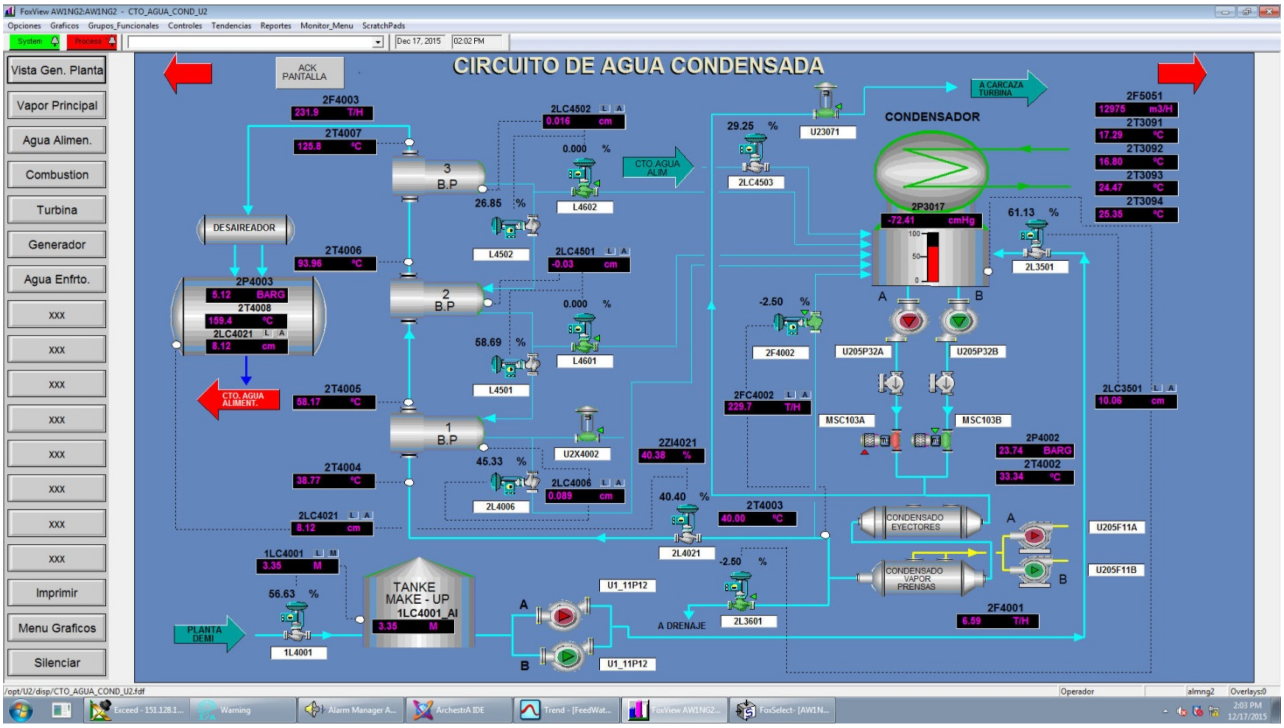

VISTA GENERAL PLANTA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
CTO. VAPOR PPAL Y RECA
EYECTOR AIRE
AGUA AGREG.
CONDENS. PRENSA
DESAIREADOR
CTO. AGUA ALIMENTA
POTENCIA ACT
POTENC REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C

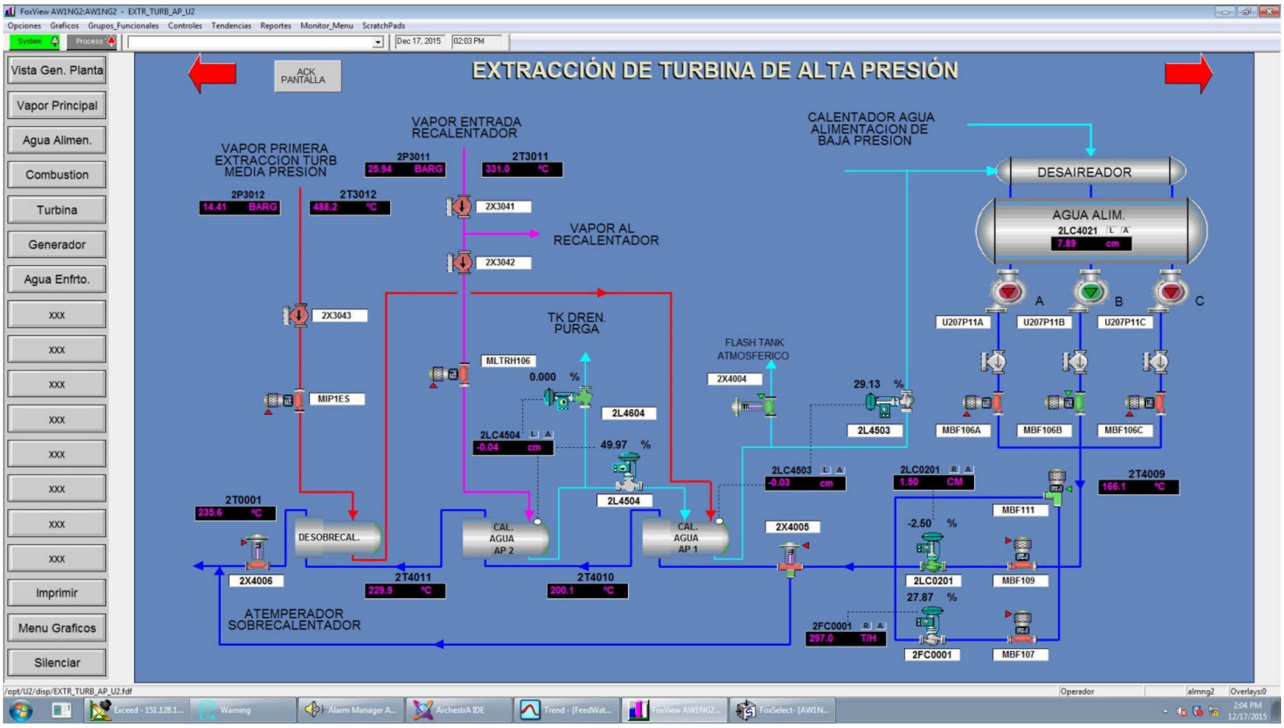

CIRCUITO AGUA / VAPOR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
EYECTOR AIRE
AGUA AGREG.
CONDENS. PRENSA
DESAIREADOR
VISTA GENERAL


FLUJO DE VAPOR PRINCIPAL
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
MSV
GV
RSV
ICV
SC
RC
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
CONDENSADOR
COLECTOR DE VAPOR

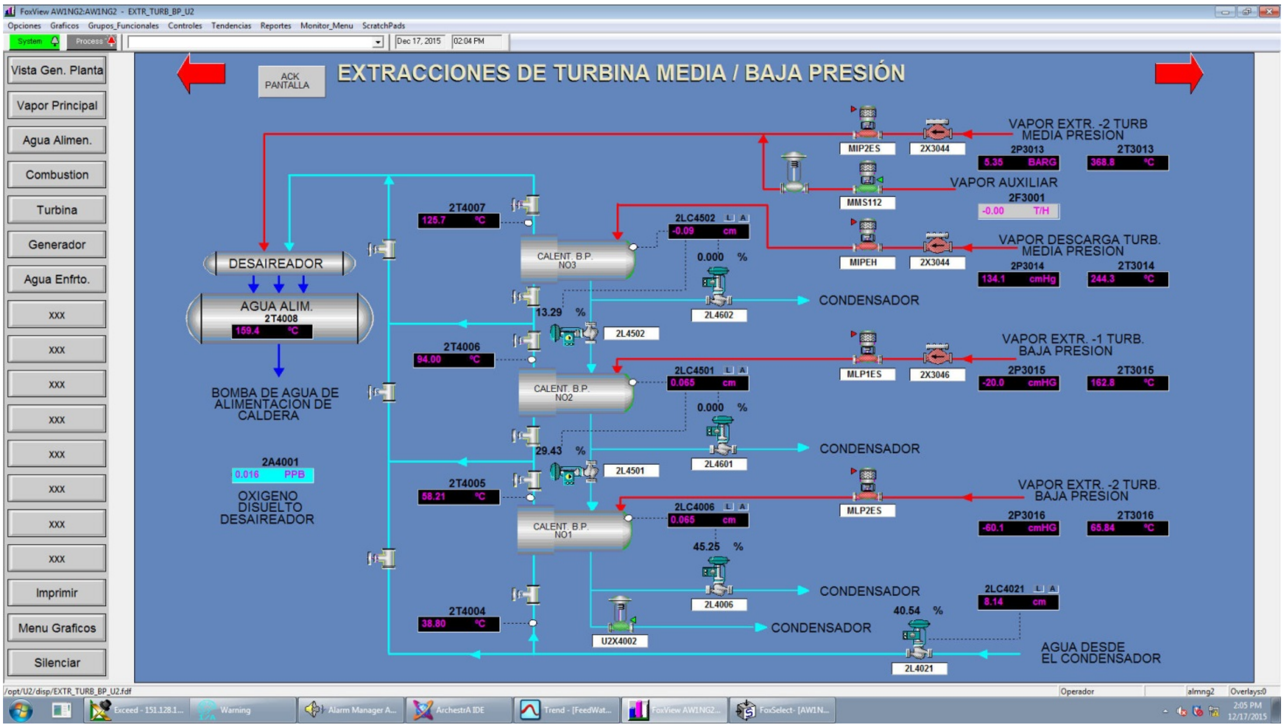

DRENAJES Y VENTEOS DEL SOBRECALENTADOR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
TURBINA
4to
3ro
2do
1ro
DOMO
TURBINA ALTA PRESION
ESTANQUE PURGAS CALDERA
ESTANQUE PURGAS CALDERA
BOMBA AGUA ALIMEN


DRENAJES Y VENTEOS DEL RECALENTADOR
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
GASES COMB.
TURBINA MEDIA PRESION
DESDE BOMBA AGUA ALIMEN.
DESDE TURB. ALTA PRESION
3er
2do
1ro

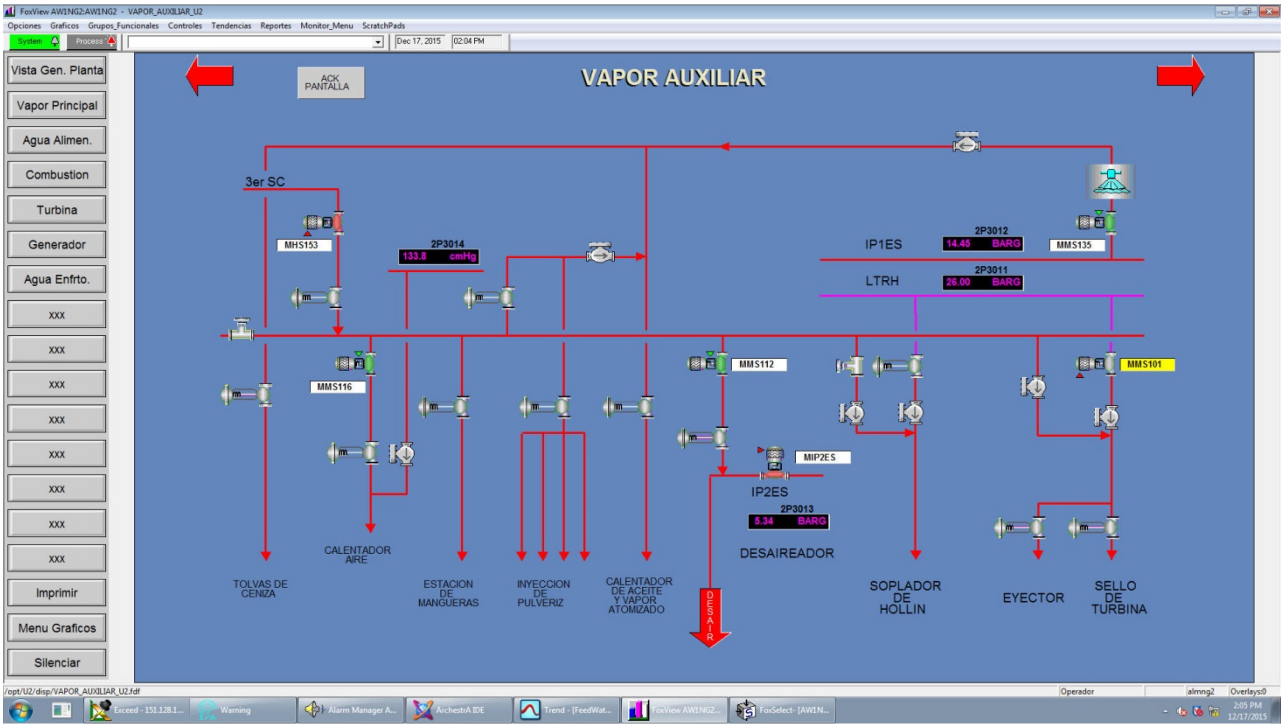

CIRCUITO DE AGUA CONDENSADA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
ACK PANTALLA
CONDENSADOR
DESAIREADOR
TANKE MAKE - UP
CTO. AGUA ALIMENT.
PLANTA DEMI
A DRENAJE
CONDENSADO EYECTORES
CONDENSADO VAPOR PRENSAS



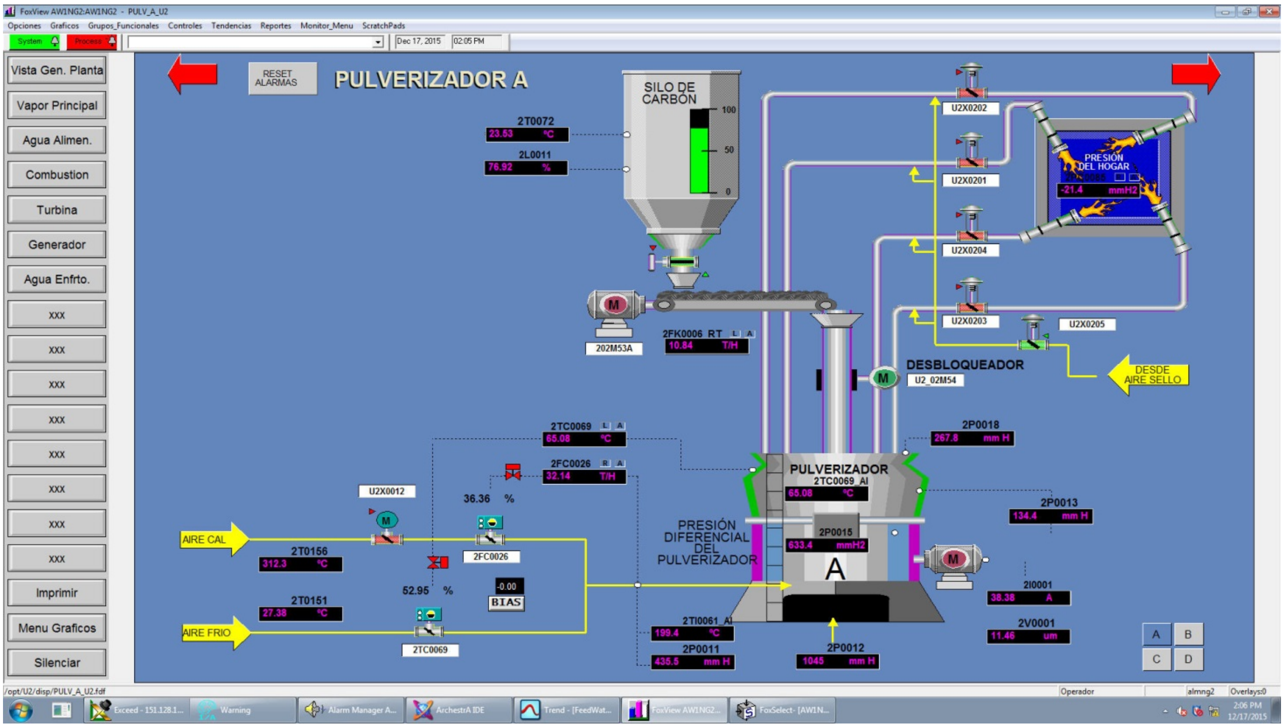
EXTRACCIÓN DE TURBINA DE ALTA PRESIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
VAPOR ENTRADA RECALENTADOR
VAPOR PRIMERA EXTRACCION TURB MEDIA PRESION
CALENTADOR AGUA ALIMENTACION DE BAJA PRESION
DESAIREADOR
AGUA ALIM.
VAPOR AL RECALENTADOR
TK DREN. PURGA
FLASH TANK ATMOSFERICO
DESOBRECAL.
CAL. AGUA AP 2
CAL. AGUA AP 1
ATEMPERADOR SOBRECALENTADOR



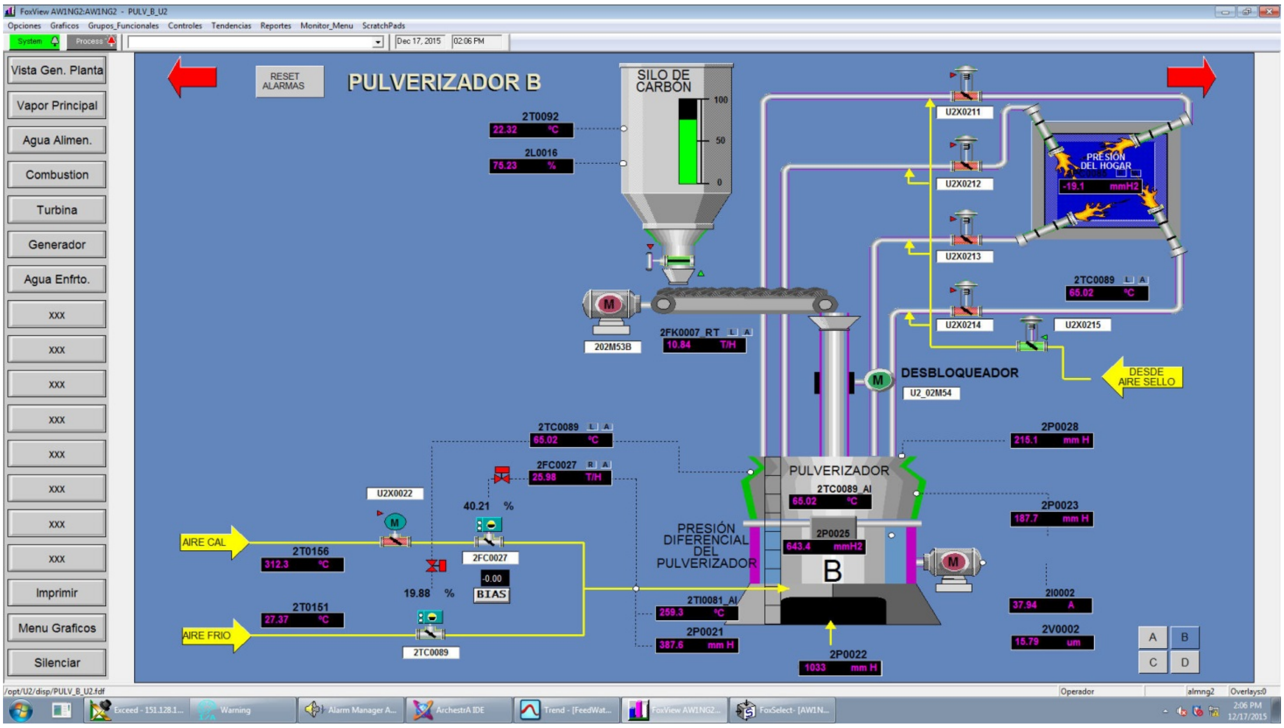
EXTRACCIONES DE TURBINA MEDIA / BAJA PRESIÓN
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
DESAIREADOR
AGUA ALIM.
BOMBA DE AGUA DE ALIMENTACION DE CALDERA
OXIGENO DISUELTO DESAIREADOR
CALENT. B.P. NO3
CALENT. B.P. NO2
CALENT. B.P. NO1
VAPOR EXTR. -2 TURB MEDIA PRESION
VAPOR AUXILIAR
VAPOR DESCARGA TURB. MEDIA PRESION
VAPOR EXTR. -1 TURB. BAJA PRESION
VAPOR EXTR. -2 TURB. BAJA PRESION
CONDENSADOR
AGUA DESDE EL CONDENSADOR

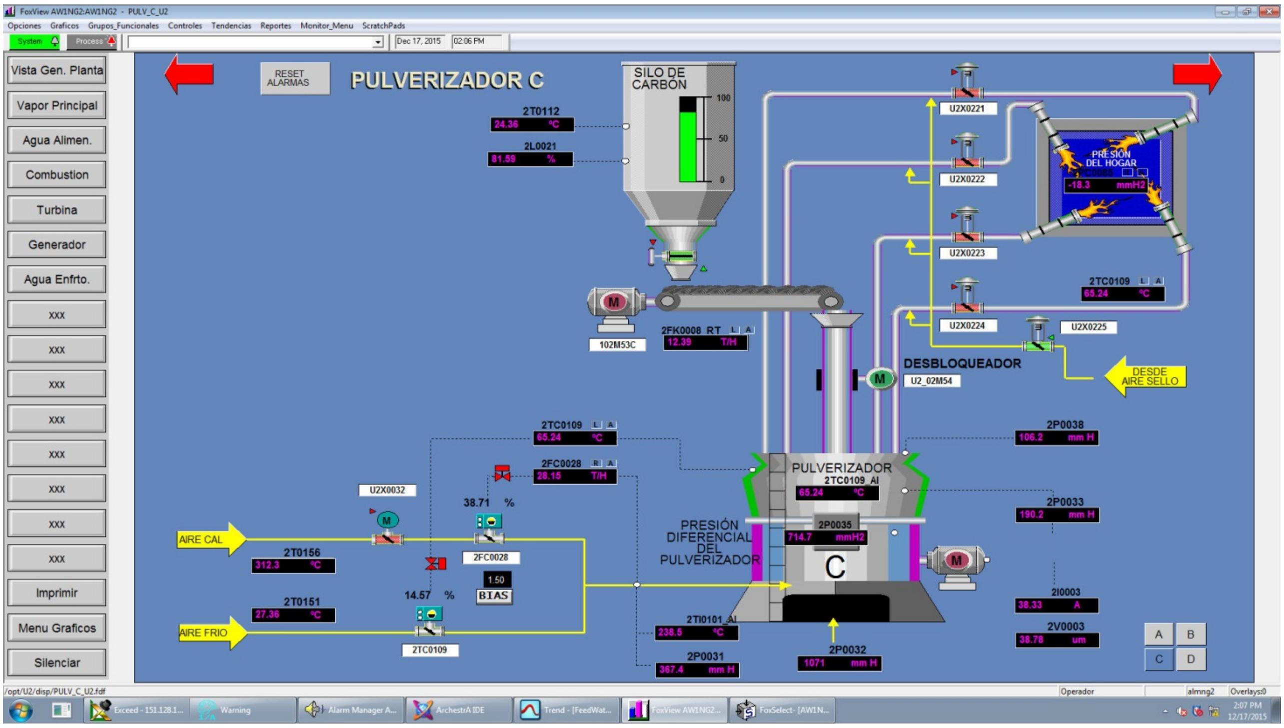


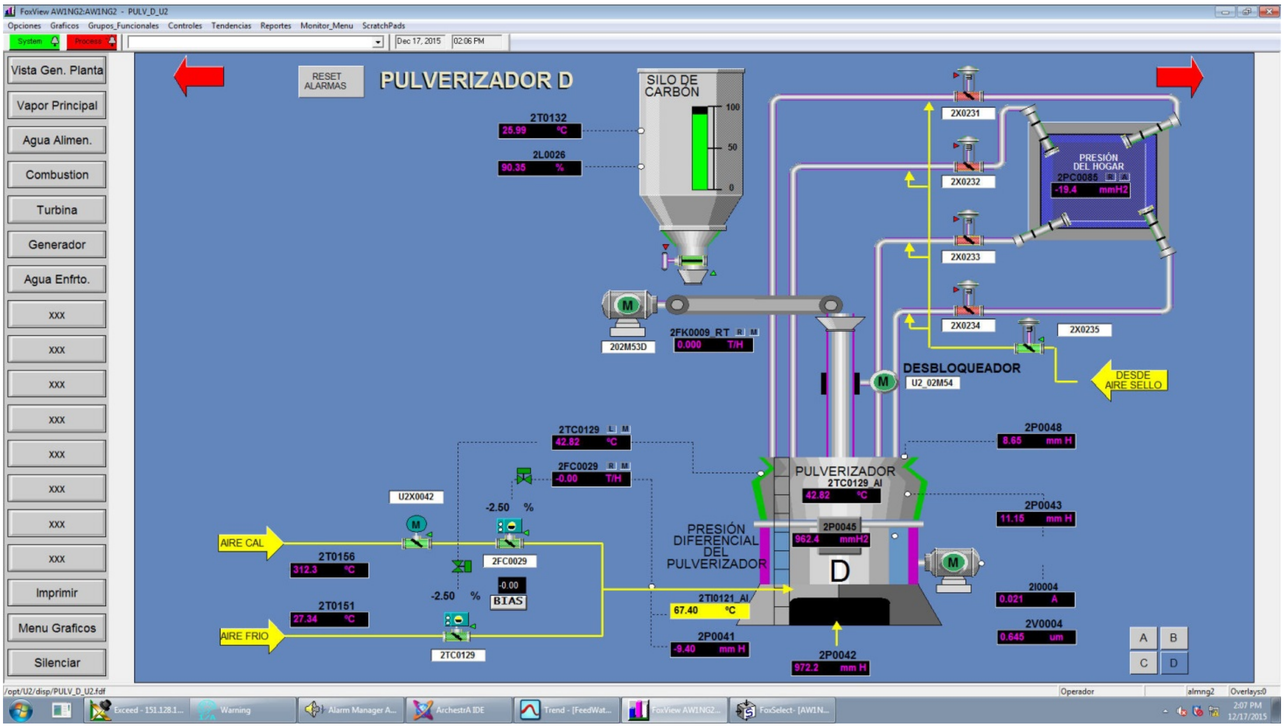
VAPOR AUXILIAR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
3er SC
IP1ES
LTRH
IP2ES
DESAIREADOR
TOLVAS DE CENIZA
CALENTADOR AIRE
ESTACION DE MANGUERAS
INYECCION DE PULVERIZ
CALENTADOR DE ACEITE Y VAPOR ATOMIZADO
SOPLADOR DE HOLLIN
EYECTOR
SELLO DE TURBINA

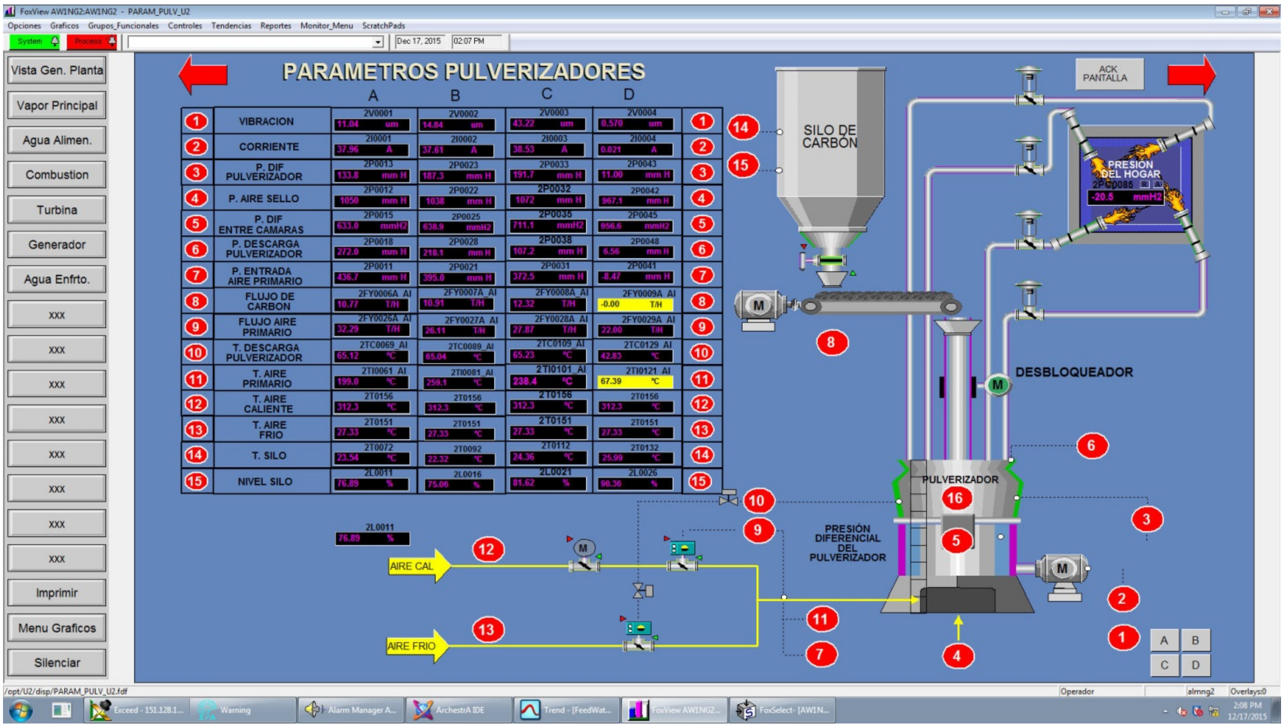


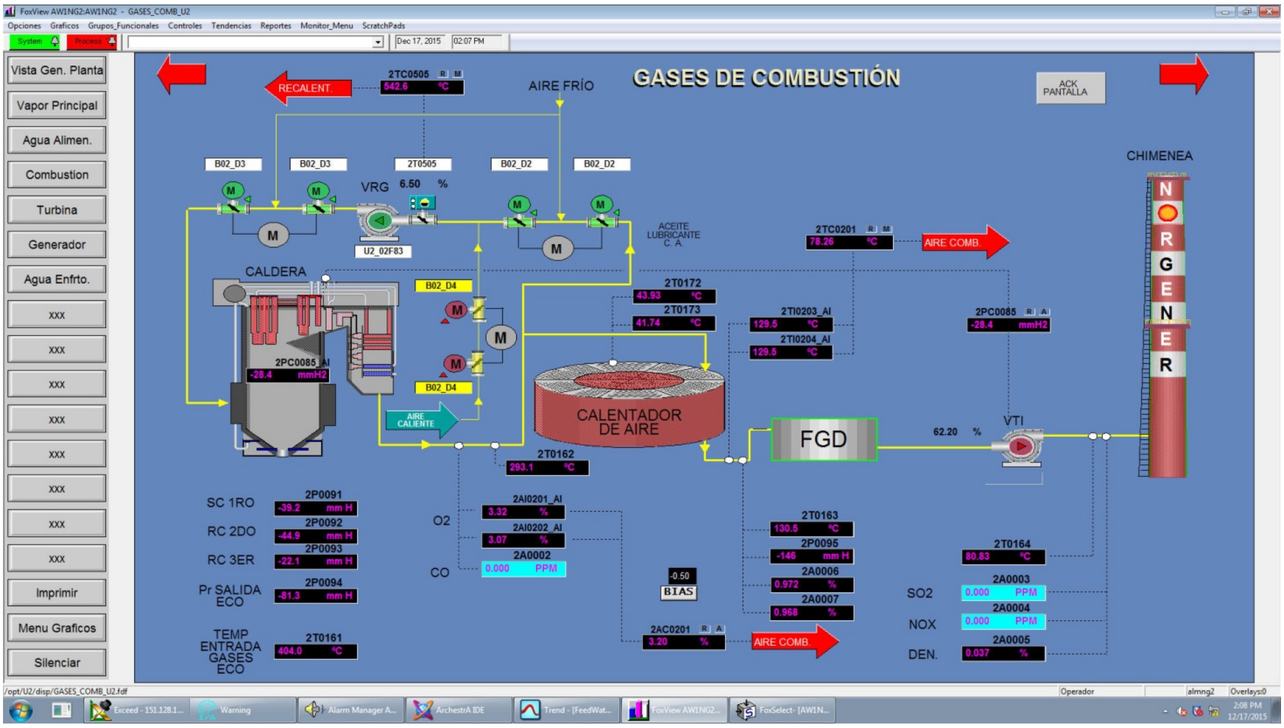
PULVERIZADOR A
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PRESIÓN DEL HOGAR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS

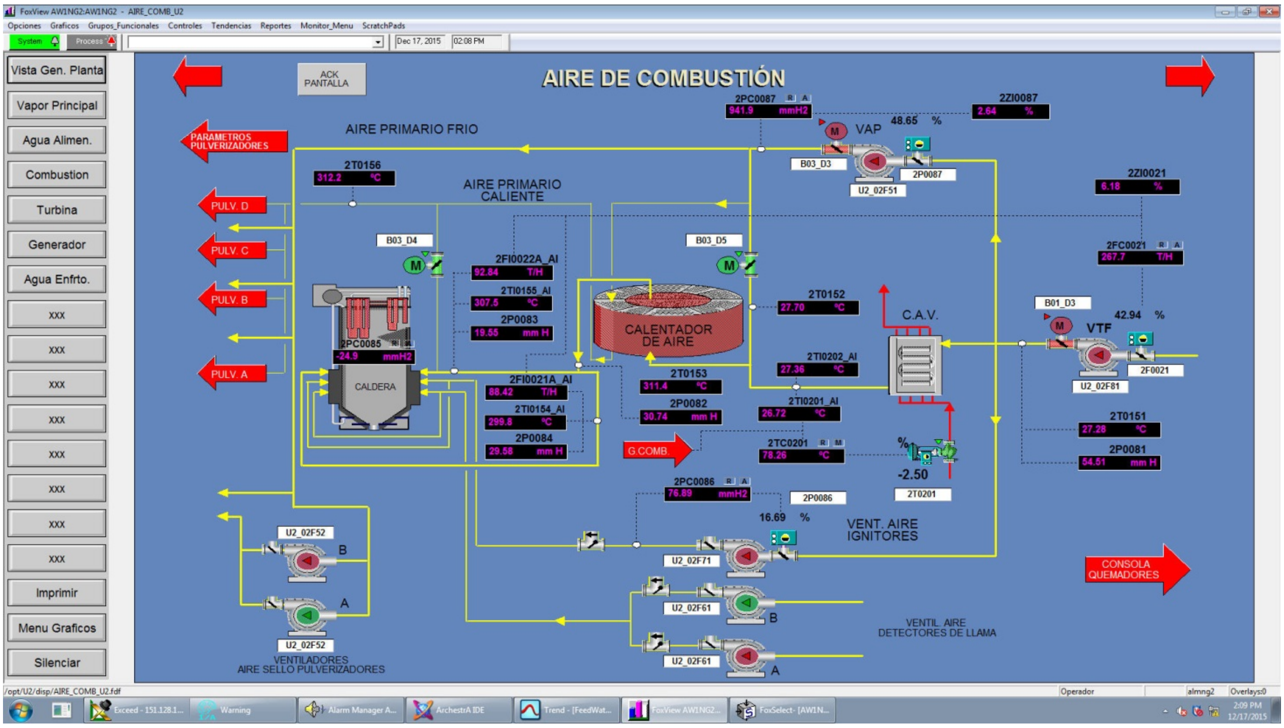

FoxView AW1NG2:AW1NG2 - PULV_B_U2
Opciones Graficos Grupos_Funcionales Controles Tendencias Reportes Monitor_Menu ScratchPads
Dec 17, 2015 02:06 PM
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
RESET ALARMAS
PULVERIZADOR B
SILO DE CARBON
2T0092
22.32 °C
2L0016
75.23 %
U2X0211
U2X0212
U2X0213
U2X0214
U2X0215
PRESION DEL HOGAR
-19.1 mmH2
2TC0089
65.02 °C
202M53B
2FK0007_RT
10.84 T/H
DESBLOQUEADOR
U2_02M54
DESDE AIRE SELLO
2P0028
215.1 mm H
PULVERIZADOR
2TC0089_AI
65.02 °C
2FC0027
25.98 T/H
U2X0022
40.21 %
AIRE CAL
2T0156
312.3 °C
19.88 %
-0.00
BIAS
PRESION DIFERENCIAL DEL PULVERIZADOR
2P0025
643.4 mmH2
B
2P0023
187.7 mm H
2I0002
37.94 A
2TI0081_AI
259.3 °C
2T0151
27.37 °C
AIRE FRIO
2TC0089
2P0021
387.6 mm H
2P0022
1033 mm H
2V0002
15.79 um
A B C D
/opt/U2/disp/PULV_B_U2.fdf
Operador

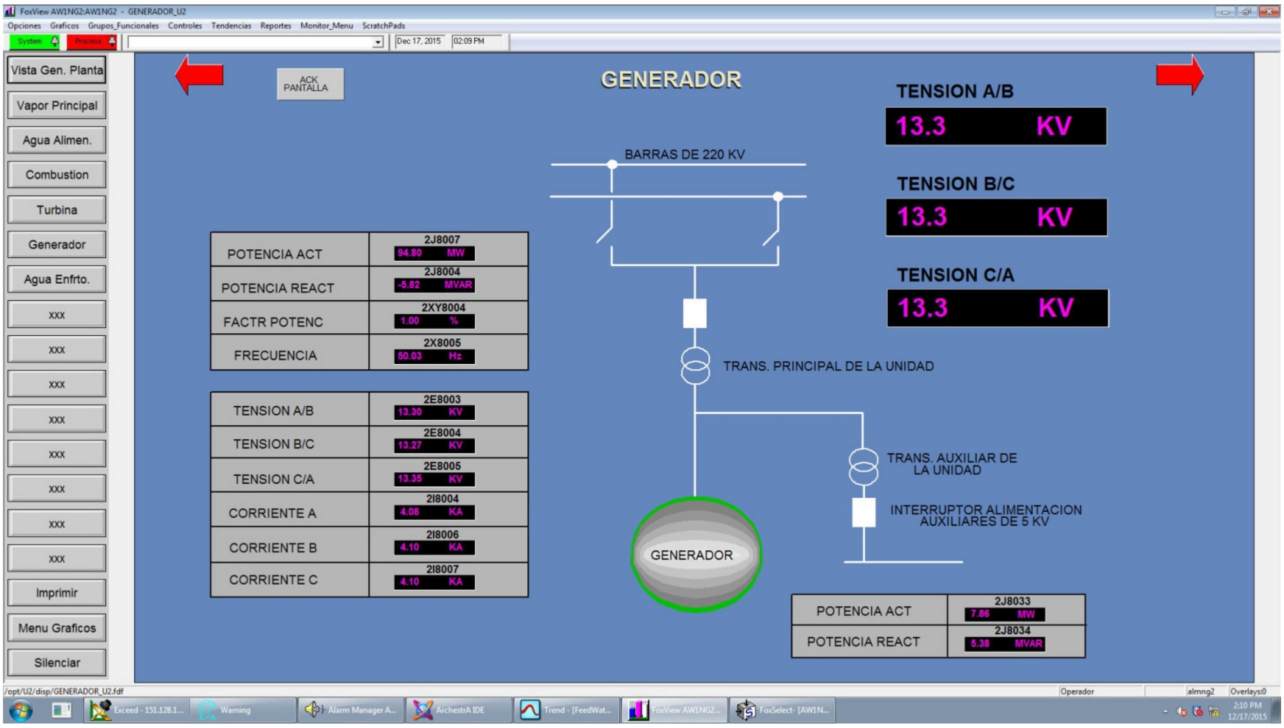

FoxView AW1NG2:AW1NG2 - PULV_C_U2
Opciones Graficos Grupos_Funcionales Controles Tendencias Reportes Monitor_Menu ScratchPads
Dec 17, 2015 02:06 PM
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
RESET ALARMAS
PULVERIZADOR C
SILO DE CARBON
2T0112
24.36 °C
2L0021
81.59 %
U2X0221
U2X0222
U2X0223
U2X0224
U2X0225
PRESION DEL HOGAR
-18.3 mmH2
2TC0109
65.24 °C
102M53C
2FK0008_RT
12.39 T/H
DESBLOQUEADOR
U2_02M54
DESDE AIRE SELLO
2P0038
106.2 mm H
PULVERIZADOR
2TC0109_AI
65.24 °C
2FC0028
28.15 T/H
U2X0032
38.71 %
AIRE CAL
2T0156
312.3 °C
14.57 %
1.50
BIAS
PRESION DIFERENCIAL DEL PULVERIZADOR
2P0035
714.7 mmH2
C
2P0033
190.2 mm H
2I0003
38.33 A
2TI0101_AI
238.5 °C
2T0151
27.36 °C
AIRE FRIO
2TC0109
2P0031
367.4 mm H
2P0032
1071 mm H
2V0003
38.78 um
A B C D
/opt/U2/disp/PULV_C_U2.fdf
Operador

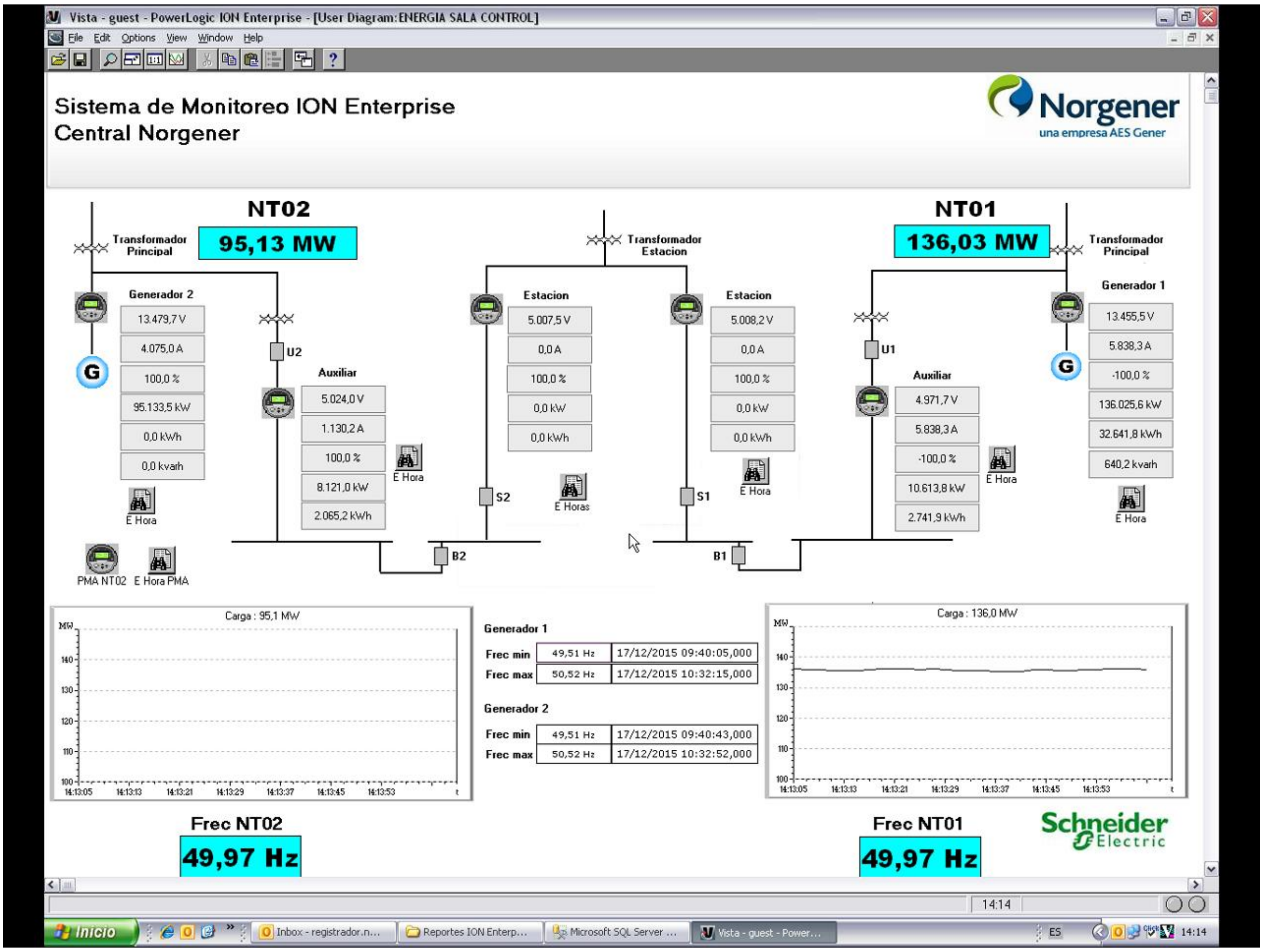

PULVERIZADOR D
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
PRESIÓN DEL HOGAR
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
BIAS


PARAMETROS PULVERIZADORES
ACK PANTALLA
VIBRACION
CORRIENTE
P. DIF PULVERIZADOR
P. AIRE SELLO
P. DIF ENTRE CAMARAS
P. DESCARGA PULVERIZADOR
P. ENTRADA AIRE PRIMARIO
FLUJO DE CARBON
FLUJO AIRE PRIMARIO
T. DESCARGA PULVERIZADOR
T. AIRE PRIMARIO
T. AIRE CALIENTE
T. AIRE FRIO
T. SILO
NIVEL SILO
SILO DE CARBON
PRESION DEL HOGAR
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO


GASES DE COMBUSTIÓN
CALDERA
CALENTADOR DE AIRE
FGD
CHIMENEA
AIRE FRÍO
AIRE COMB.
RECALENT.
VRG
VTI

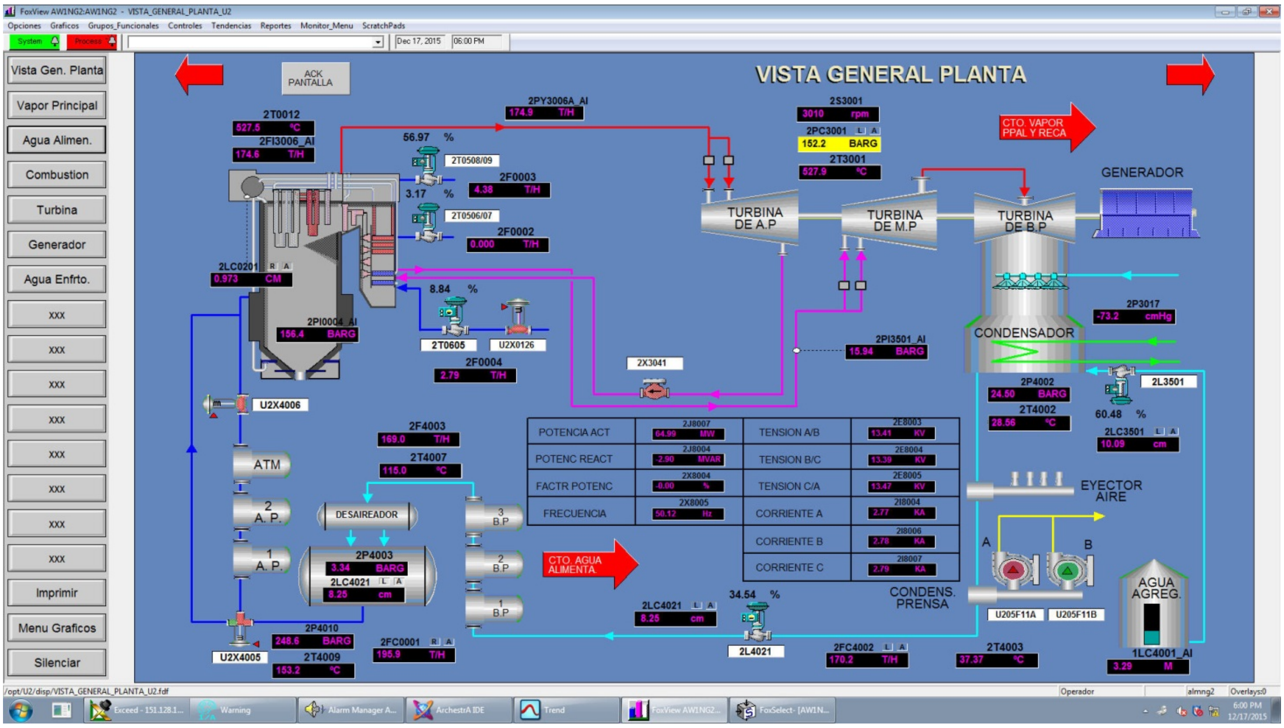

AIRE DE COMBUSTIÓN
AIRE PRIMARIO FRIO
AIRE PRIMARIO CALIENTE
CALENTADOR DE AIRE
CALDERA
VAP
VTF
C.A.V.
PARAMETROS PULVERIZADORES
CONSOLA QUEMADORES
VENT. AIRE IGNITORES
VENTIL. AIRE DETECTORES DE LLAMA
VENTILADORES AIRE SELLO PULVERIZADORES

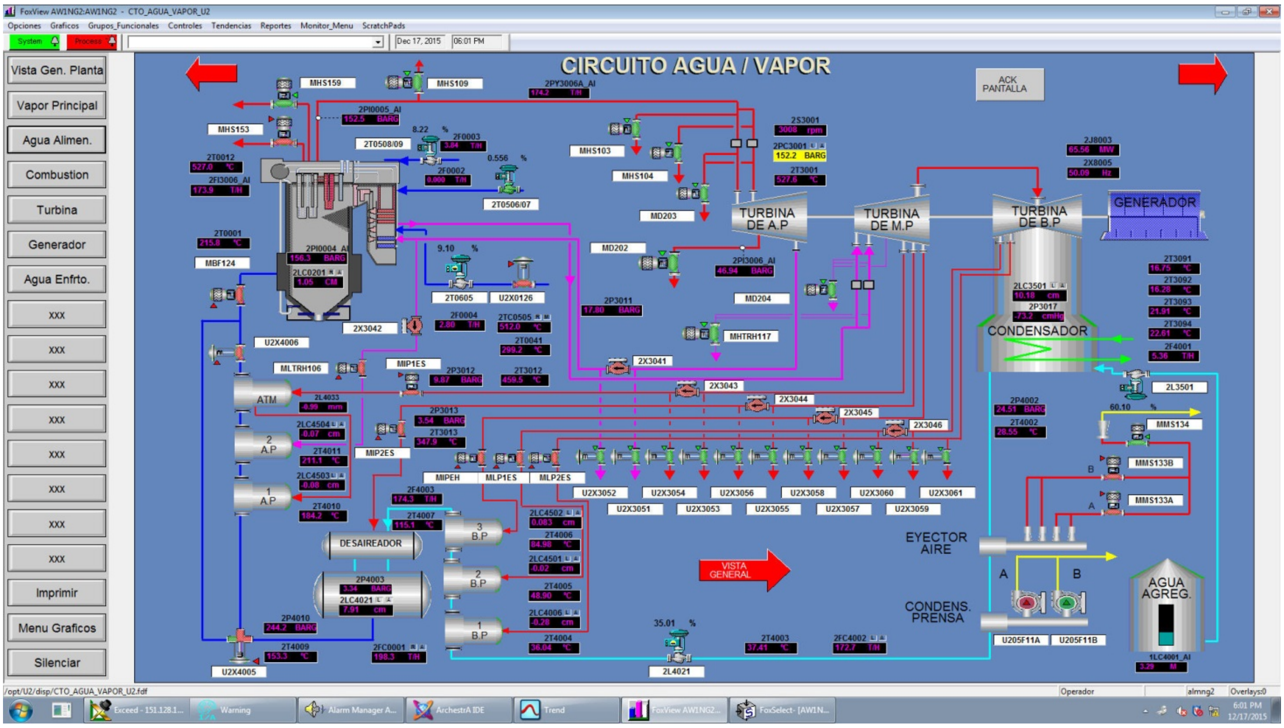

GENERADOR
TENSION A/B
13.3 KV
TENSION B/C
13.3 KV
TENSION C/A
13.3 KV
BARRAS DE 220 KV
TRANS. PRINCIPAL DE LA UNIDAD
TRANS. AUXILIAR DE LA UNIDAD
INTERRUPTOR ALIMENTACION AUXILIARES DE 5 KV
GENERADOR
POTENCIA ACT
POTENCIA REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar

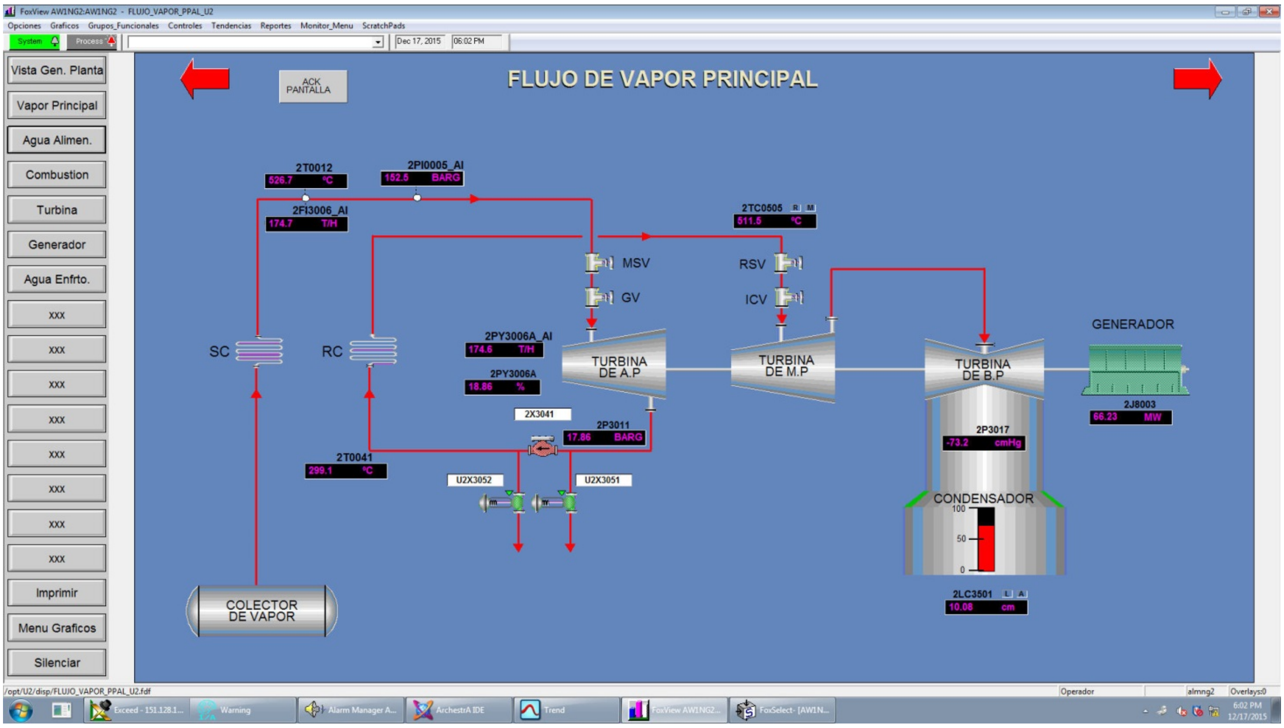

Sistema de Monitoreo ION Enterprise
Central Norgener
Norgener
una empresa AES Gener
NT02
95,13 MW
NT01
136,03 MW
Transformador Principal
Transformador Estacion
Generador 2
Generador 1
Auxiliar
Estacion
Generador 1
Frec min 49,51 Hz 17/12/2015 09:40:05,000
Frec max 50,52 Hz 17/12/2015 10:32:15,000
Generador 2
Frec min 49,51 Hz 17/12/2015 09:40:43,000
Frec max 50,52 Hz 17/12/2015 10:32:52,000
Carga : 95,1 MW
Carga : 136,0 MW
Frec NT02
49,97 Hz
Frec NT01
49,97 Hz
Schneider Electric

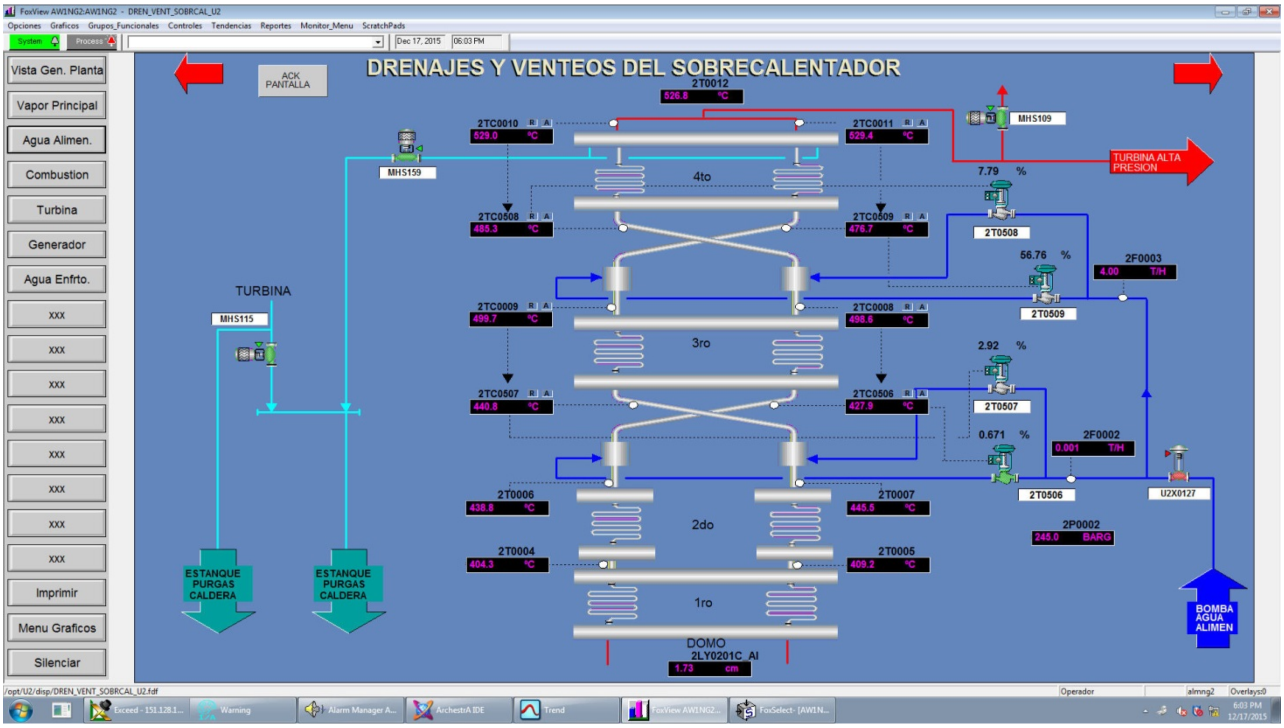
APPENDIX E6

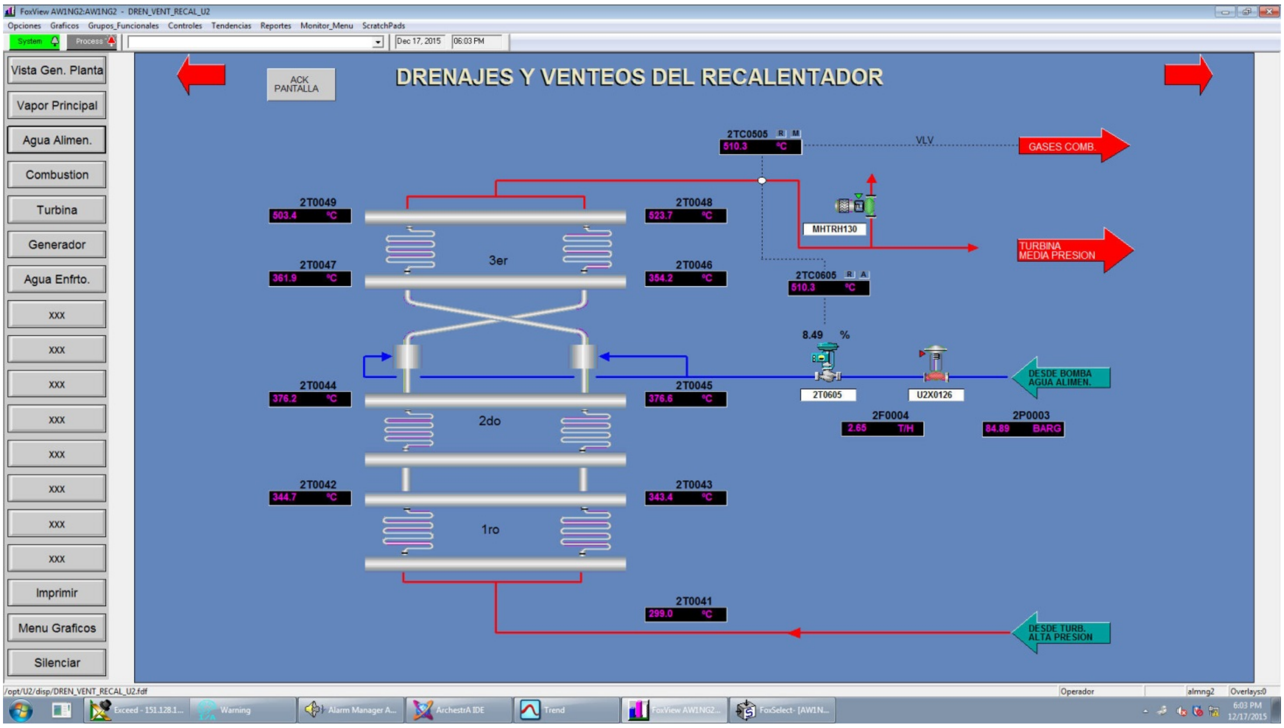
Control Panel Screen Dumps Test at 47% Load

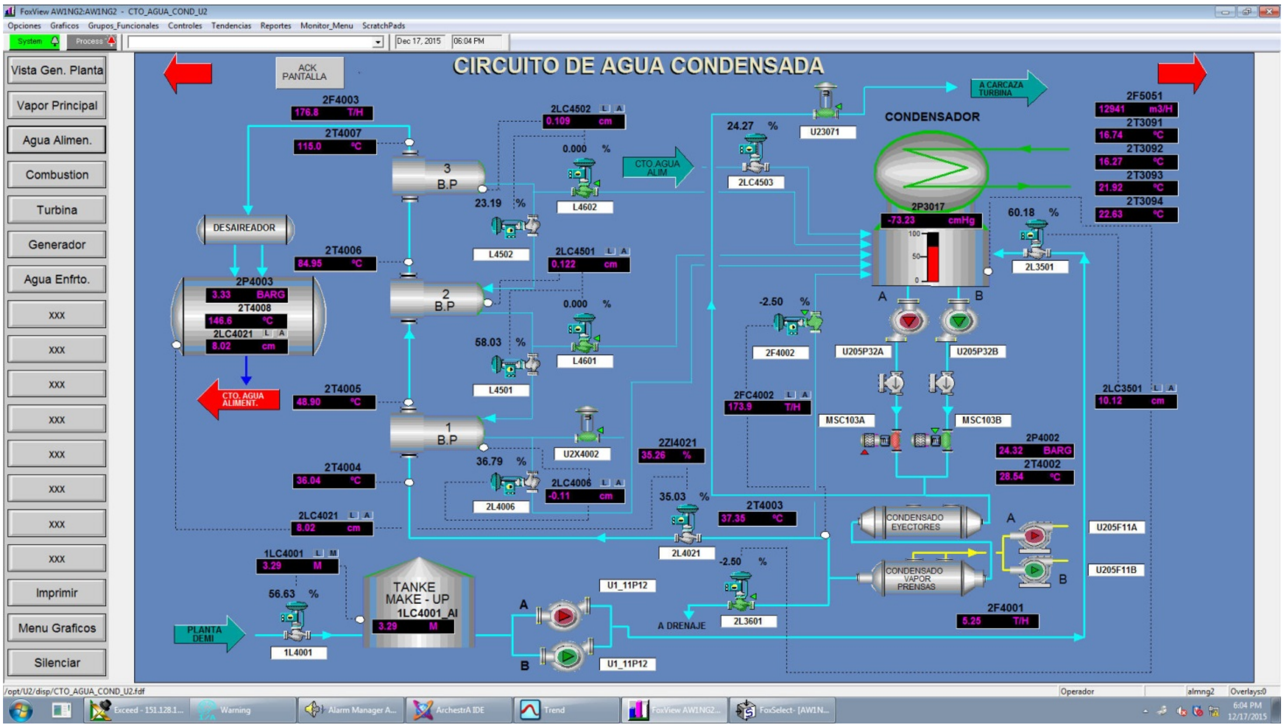


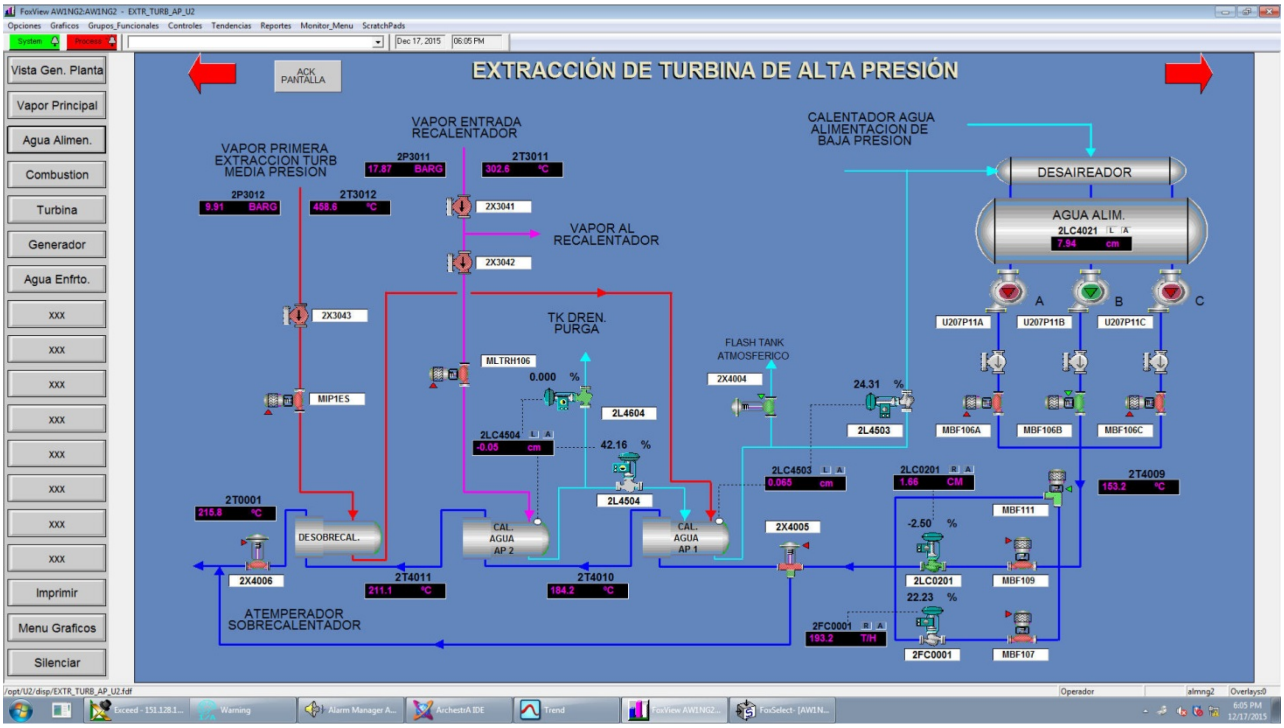


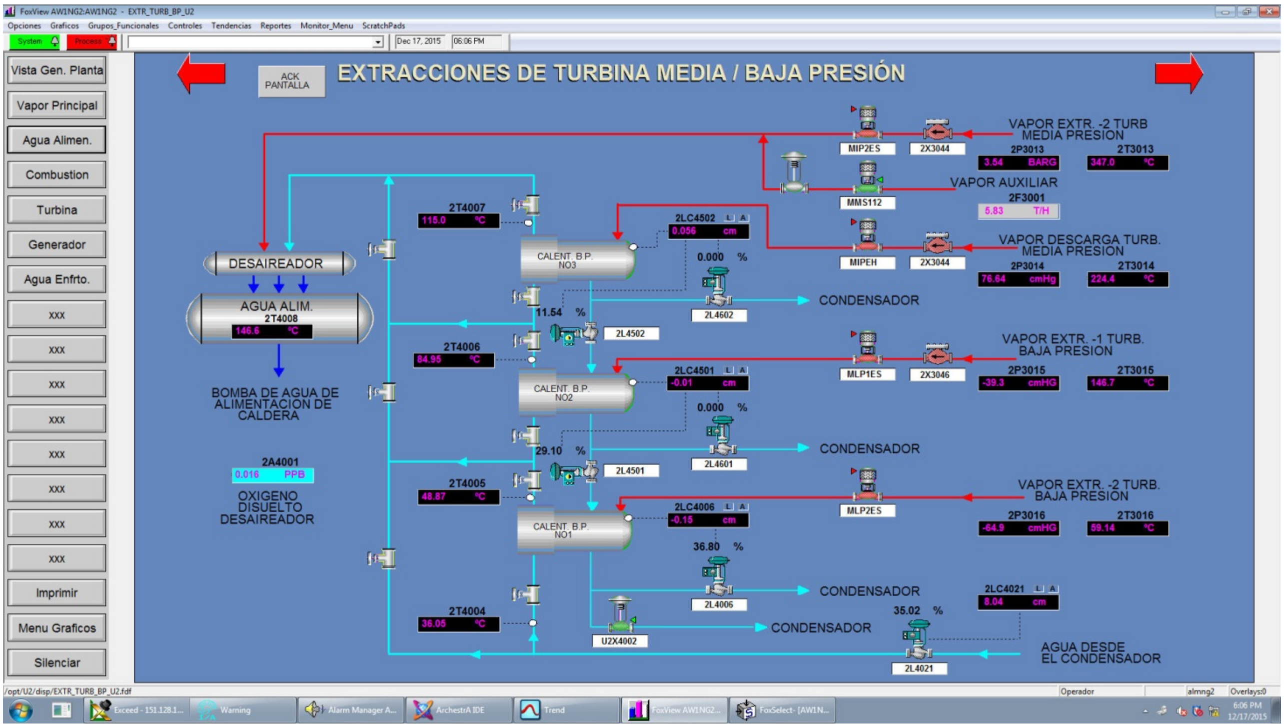

FLUJO DE VAPOR PRINCIPAL
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
2T0012
2PI0005_AI
2FI3006_AI
2TC0505
MSV
GV
RSV
ICV
SC
RC
2PY3006A_AI
2PY3006A
TURBINA DE A.P
TURBINA DE M.P
TURBINA DE B.P
GENERADOR
2J8003
2X3041
2P3011
2P3017
2T0041
U2X3052
U2X3051
CONDENSADOR
2LC3501
COLECTOR DE VAPOR

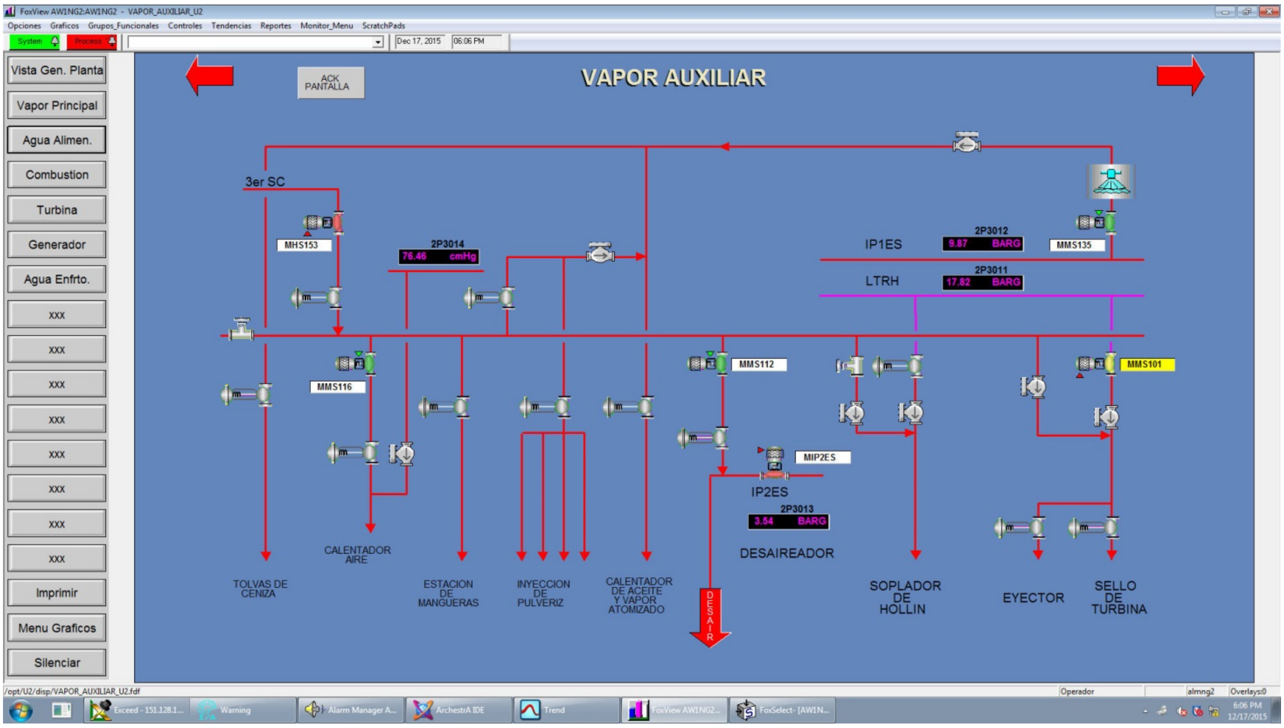

DRENAJES Y VENTEOS DEL SOBRECALENTADOR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
2T0012
MHS109
MHS159
TURBINA ALTA PRESION
2TC0010
2TC0011
4to
2TC0508
2TC0509
2T0508
2F0003
2T0509
TURBINA
MHS115
2TC0009
2TC0008
3ro
2TC0507
2TC0506
2T0507
2F0002
2T0506
U2X0127
2T0006
2T0007
2do
2P0002
2T0004
2T0005
1ro
ESTANQUE PURGAS CALDERA
ESTANQUE PURGAS CALDERA
DOMO
2LY0201C_AI
BOMBA AGUA ALIMEN

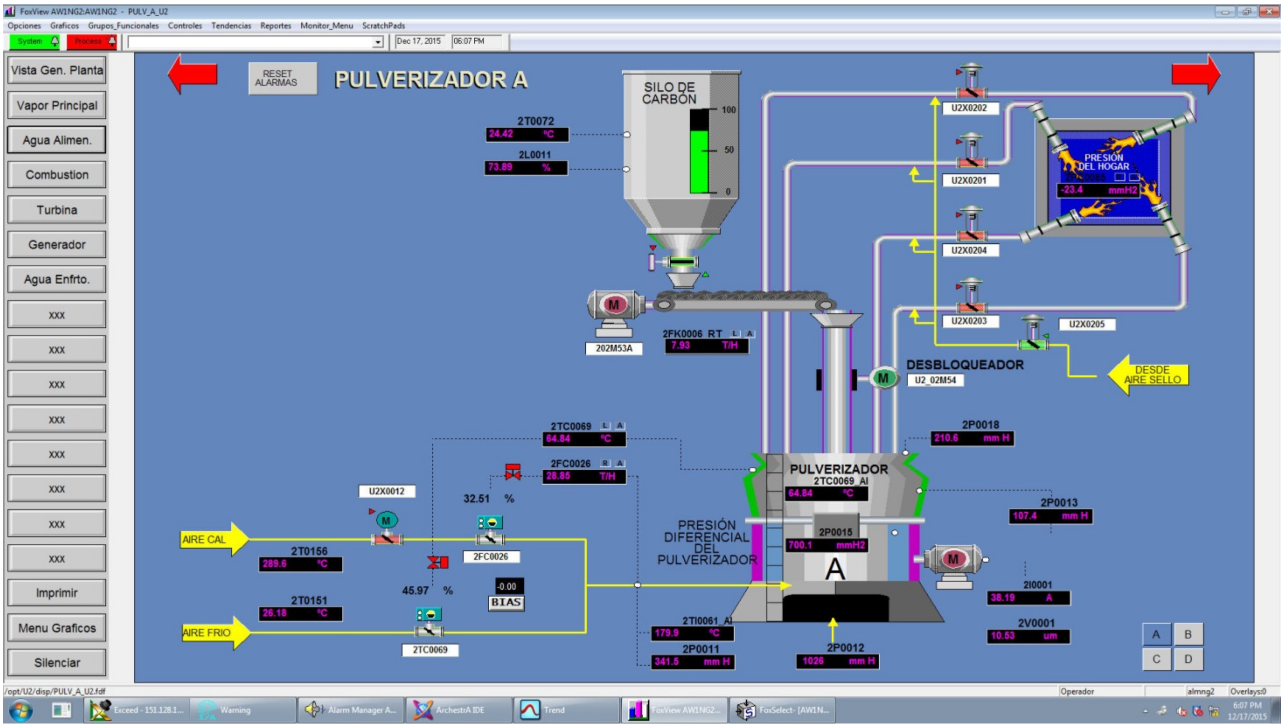

DRENAJES Y VENTEOS DEL RECALENTADOR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
GASES COMB.
TURBINA MEDIA PRESION
DESDE BOMBA AGUA ALIMEN.
DESDE TURB. ALTA PRESION
3er
2do
1ro
MHTRH130
2T0605
U2X0126
2F0004
2P0003

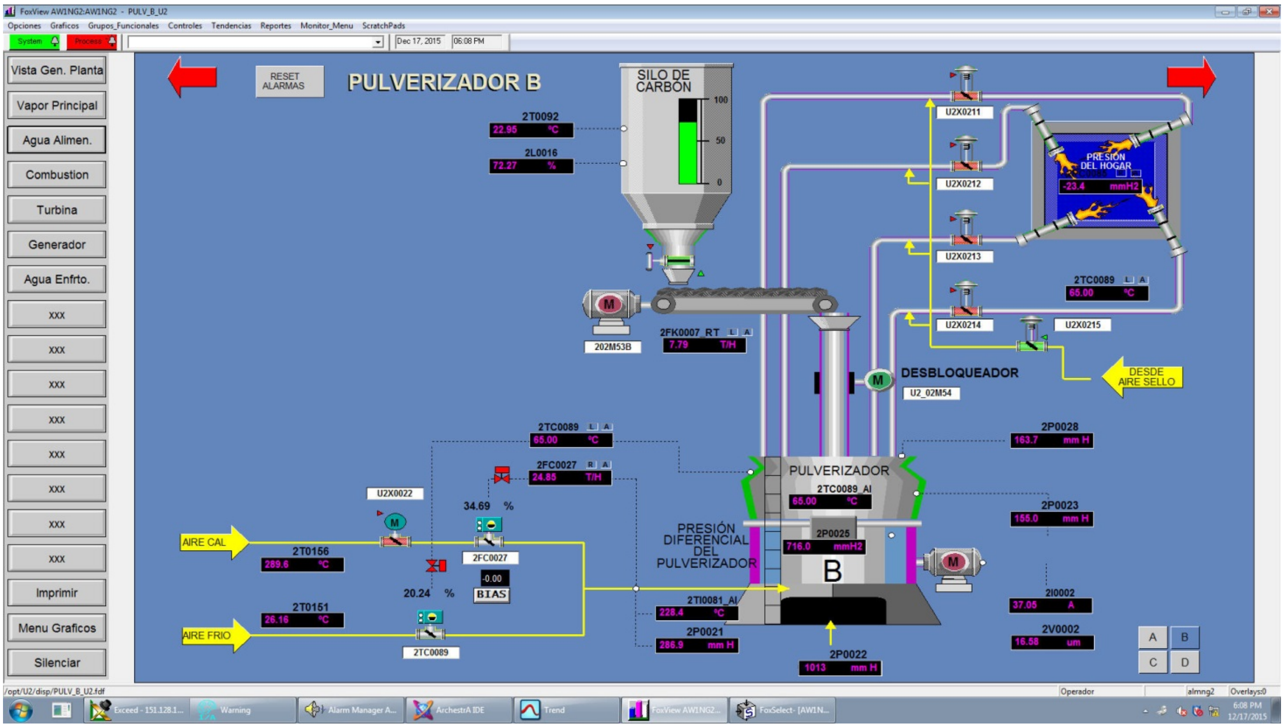

CIRCUITO DE AGUA CONDENSADA
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
DESAIREADOR
CONDENSADOR
A CARCAZA TURBINA
CTO AGUA ALIM
CTO. AGUA ALIMENT.
CONDENSADO EYECTORES
CONDENSADO VAPOR PRENSAS
TANKE MAKE - UP
PLANTA DEMI
A DRENAJE
3 B.P
2 B.P
1 B.P

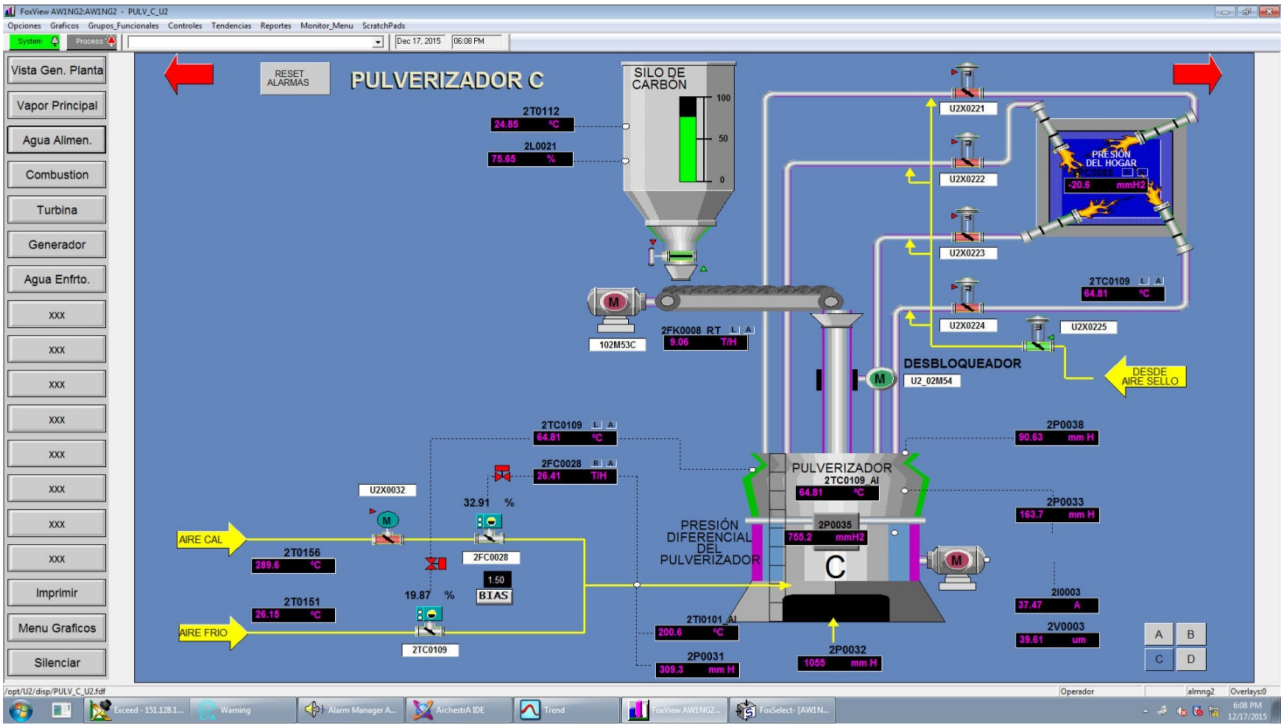

EXTRACCIÓN DE TURBINA DE ALTA PRESIÓN
VAPOR ENTRADA RECALENTADOR
VAPOR PRIMERA EXTRACCION TURB MEDIA PRESION
CALENTADOR AGUA ALIMENTACION DE BAJA PRESION
DESAIREADOR
AGUA ALIM.
VAPOR AL RECALENTADOR
TK DREN. PURGA
FLASH TANK ATMOSFERICO
DESOBRECAL.
CAL. AGUA AP 2
CAL. AGUA AP 1
ATEMPERADOR SOBRECALENTADOR

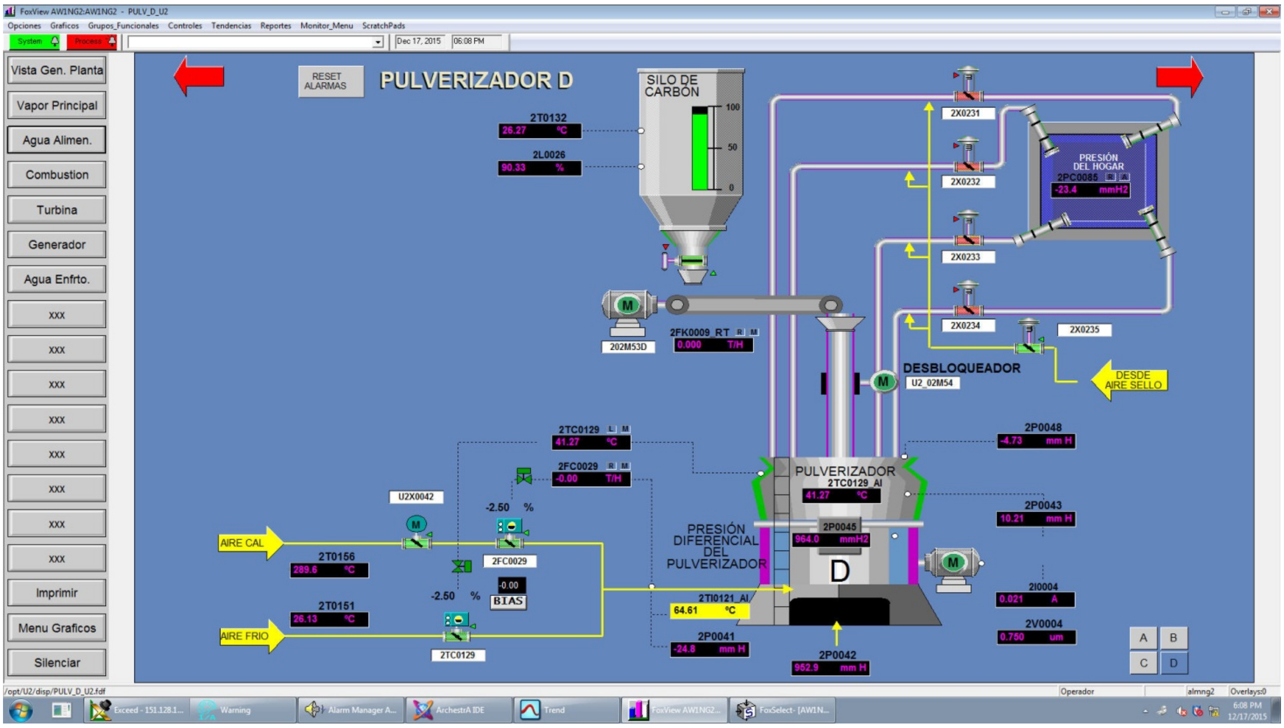

EXTRACCIONES DE TURBINA MEDIA / BAJA PRESIÓN
VAPOR EXTR. -2 TURB MEDIA PRESION
VAPOR AUXILIAR
VAPOR DESCARGA TURB. MEDIA PRESION
DESAIREADOR
AGUA ALIM.
CALENT. B.P. NO3
CALENT. B.P. NO2
CALENT. B.P. NO1
CONDENSADOR
VAPOR EXTR. -1 TURB. BAJA PRESION
VAPOR EXTR. -2 TURB. BAJA PRESION
BOMBA DE AGUA DE ALIMENTACION DE CALDERA
OXIGENO DISUELTO DESAIREADOR
AGUA DESDE EL CONDENSADOR

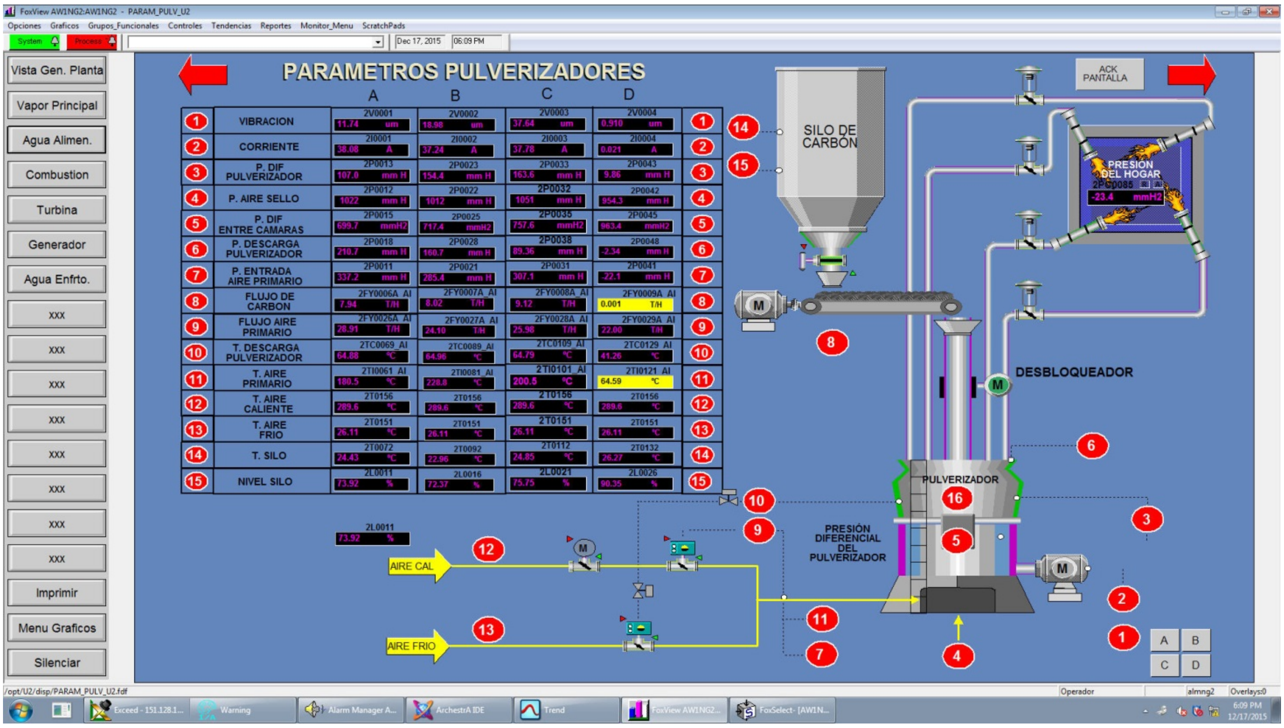

VAPOR AUXILIAR
ACK PANTALLA
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
3er SC
IP1ES
LTRH
IP2ES
DESAIREADOR
TOLVAS DE CENIZA
CALENTADOR AIRE
ESTACION DE MANGUERAS
INYECCION DE PULVERIZ
CALENTADOR DE ACEITE Y VAPOR ATOMIZADO
SOPLADOR DE HOLLIN
EYECTOR
SELLO DE TURBINA


PULVERIZADOR A
RESET ALARMAS
SILO DE CARBON
DESBLOQUEADOR
DESDE AIRE SELLO
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
AIRE CAL
AIRE FRIO
PRESIÓN DEL HOGAR
BIAS

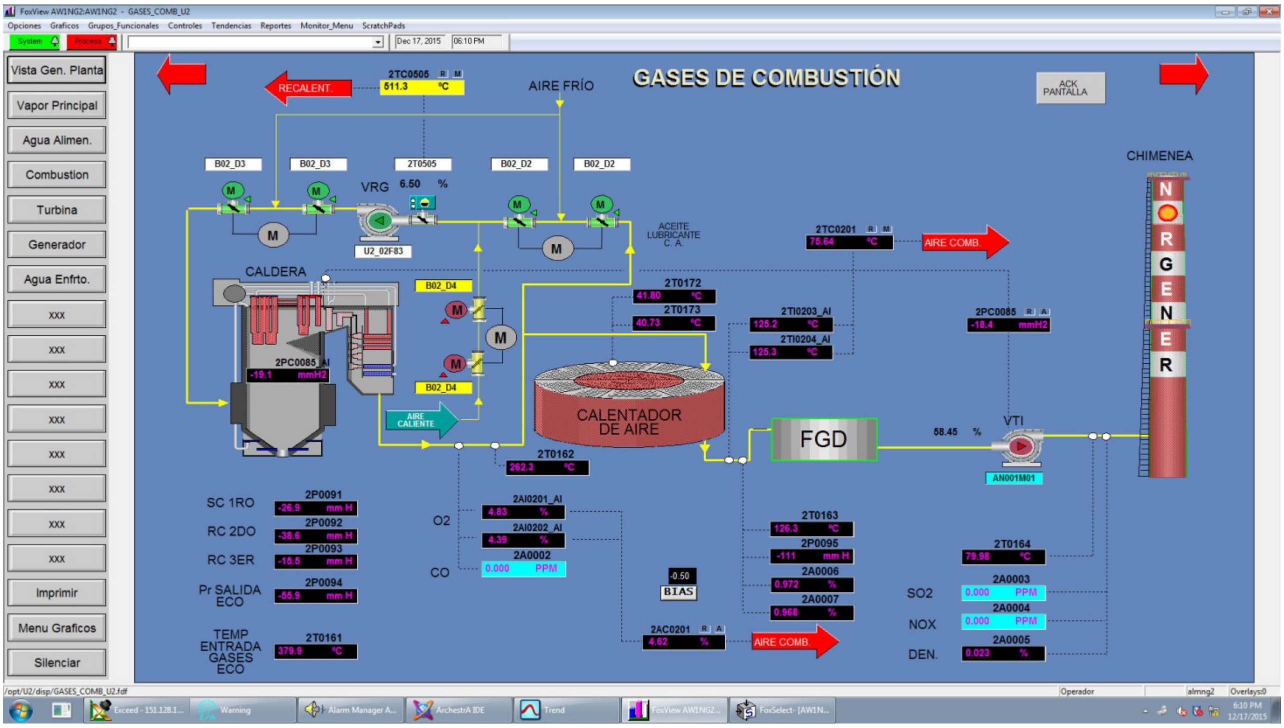

PULVERIZADOR B
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
2T0092
2L0016
2FK0007_RT
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
B
AIRE CAL
AIRE FRIO
DESDE AIRE SELLO
PRESION DEL HOGAR
2TC0089
2FC0027
2T0156
2T0151
2P0028
2P0023
2P0025
2TI0081_AI
2P0021
2P0022
2V0002
BIAS


PULVERIZADOR C
RESET ALARMAS
SILO DE CARBON
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar
2T0112
2L0021
2FK0008_RT
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
C
AIRE CAL
AIRE FRIO
DESDE AIRE SELLO
PRESION DEL HOGAR
2TC0109
2FC0028
2T0156
2T0151
2P0038
2P0033
2P0035
2TI0101_AI
2P0031
2P0032
2V0003
BIAS


PULVERIZADOR D
RESET ALARMAS
SILO DE CARBON
2T0132 26.27 °C
2L0026 90.33 %
PRESIÓN DEL HOGAR 2PC0085 -23.4 mmH2
2X0231
2X0232
2X0233
2X0234
2X0235
202M53D
2FK0009_RT 0.000 T/H
DESBLOQUEADOR
U2_02M54
DESDE AIRE SELLO
2P0048 -4.73 mm H
2TC0129 41.27 °C
2FC0029 -0.00 T/H
U2X0042
-2.50 %
AIRE CAL
2T0156 289.6 °C
2FC0029
-0.00
BIAS
-2.50 %
2T0151 26.13 °C
AIRE FRIO
2TC0129
PULVERIZADOR
2TC0129_AI 41.27 °C
2P0045 964.0 mmH2
PRESIÓN DIFERENCIAL DEL PULVERIZADOR
D
2TI0121_AI 64.61 °C
2P0041 -24.8 mm H
2P0042 952.9 mm H
2P0043 10.21 mm H
2I0004 0.021 A
2V0004 0.750 um
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar


PARAMETROS PULVERIZADORES
		A	B	C	D	
1	VIBRACION	2V0001 11.74 um	2V0002 18.98 um	2V0003 37.64 um	2V0004 0.910 um	1
2	CORRIENTE	2I0001 38.08 A	2I0002 37.24 A	2I0003 37.78 A	2I0004 0.021 A	2
3	P. DIF PULVERIZADOR	2P0013 107.0 mm H	2P0023 154.4 mm H	2P0033 163.6 mm H	2P0043 9.86 mm H	3
4	P. AIRE SELLO	2P0012 1022 mm H	2P0022 1012 mm H	2P0032 1051 mm H	2P0042 954.3 mm H	4
5	P. DIF ENTRE CAMARAS	2P0015 699.7 mmH2	2P0025 717.4 mmH2	2P0035 757.6 mmH2	2P0045 963.4 mmH2	5
6	P. DESCARGA PULVERIZADOR	2P0018 210.7 mm H	2P0028 160.7 mm H	2P0038 89.36 mm H	2P0048 -2.34 mm H	6
7	P. ENTRADA AIRE PRIMARIO	2P0011 337.2 mm H	2P0021 285.4 mm H	2P0031 307.1 mm H	2P0041 -22.1 mm H	7
8	FLUJO DE CARBON	2FY0006A_AI 7.94 T/H	2FY0007A_AI 8.02 T/H	2FY0008A_AI 9.12 T/H	2FY0009A_AI 0.001 T/H	8
9	FLUJO AIRE PRIMARIO	2FY0026A_AI 28.91 T/H	2FY0027A_AI 24.10 T/H	2FY0028A_AI 25.98 T/H	2FY0029A_AI 22.00 T/H	9
10	T. DESCARGA PULVERIZADOR	2TC0069_AI 64.88 °C	2TC0089_AI 64.96 °C	2TC0109_AI 64.79 °C	2TC0129_AI 41.26 °C	10
11	T. AIRE PRIMARIO	2TI0061_AI 180.5 °C	2TI0081_AI 228.8 °C	2TI0101_AI 200.5 °C	2TI0121_AI 64.59 °C	11
12	T. AIRE CALIENTE	2T0156 289.6 °C	2T0156 289.6 °C	2T0156 289.6 °C	2T0156 289.6 °C	12
13	T. AIRE FRIO	2T0151 26.11 °C	2T0151 26.11 °C	2T0151 26.11 °C	2T0151 26.11 °C	13
14	T. SILO	2T0072 24.43 °C	2T0092 22.96 °C	2T0112 24.85 °C	2T0132 26.27 °C	14
15	NIVEL SILO	2L0011 73.92 %	2L0016 72.37 %	2L0021 75.75 %	2L0026 90.35 %	15

2L0011 73.92 %
AIRE CAL
AIRE FRIO
ACK PANTALLA
SILO DE CARBON
PRESION DEL HOGAR 2PC0085 -23.4 mmH2
DESBLOQUEADOR
PULVERIZADOR
PRESIÓN DIFERENCIAL DEL PULVERIZADOR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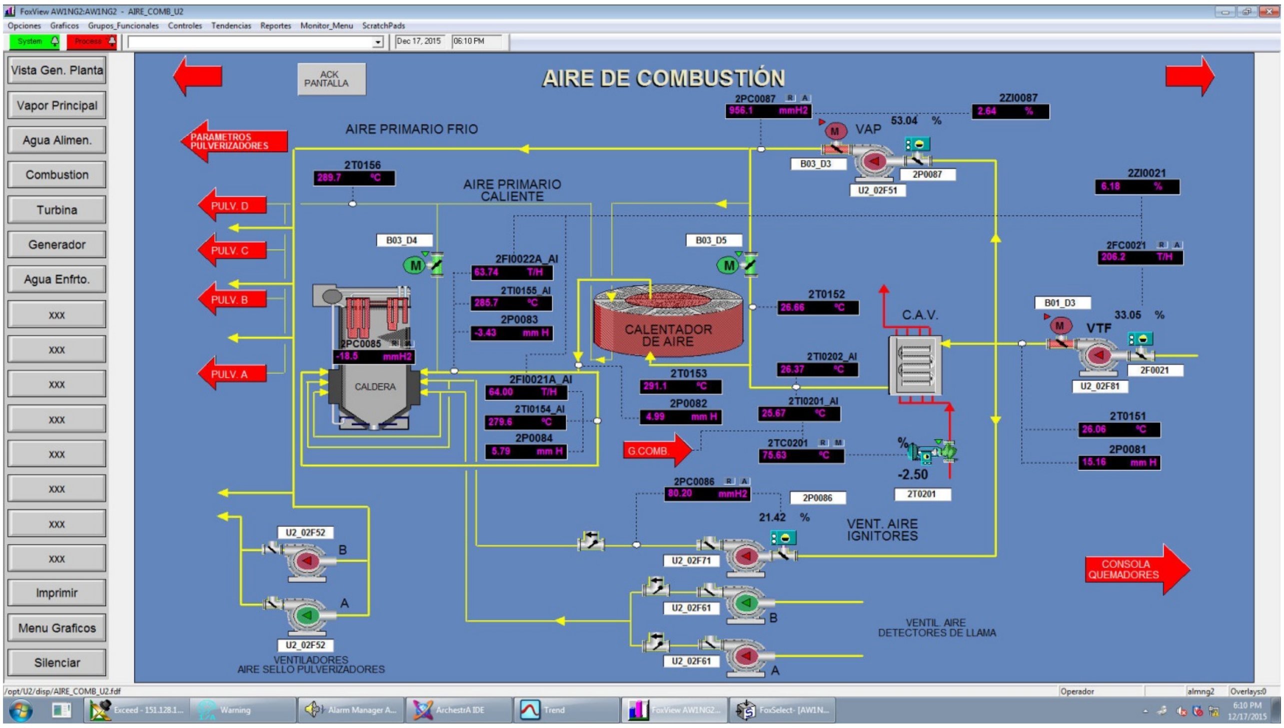
AIRE FRÍO
RECALENT.
CALDERA
CALENTADOR DE AIRE
FGD
VTI
CHIMENEA
NORGENER
AIRE COMB.
AIRE CALIENTE
SC 1RO
RC 2DO
RC 3ER
Pr SALIDA ECO
TEMP ENTRADA GASES ECO
O2
CO
SO2
NOX
DEN.
BIAS
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar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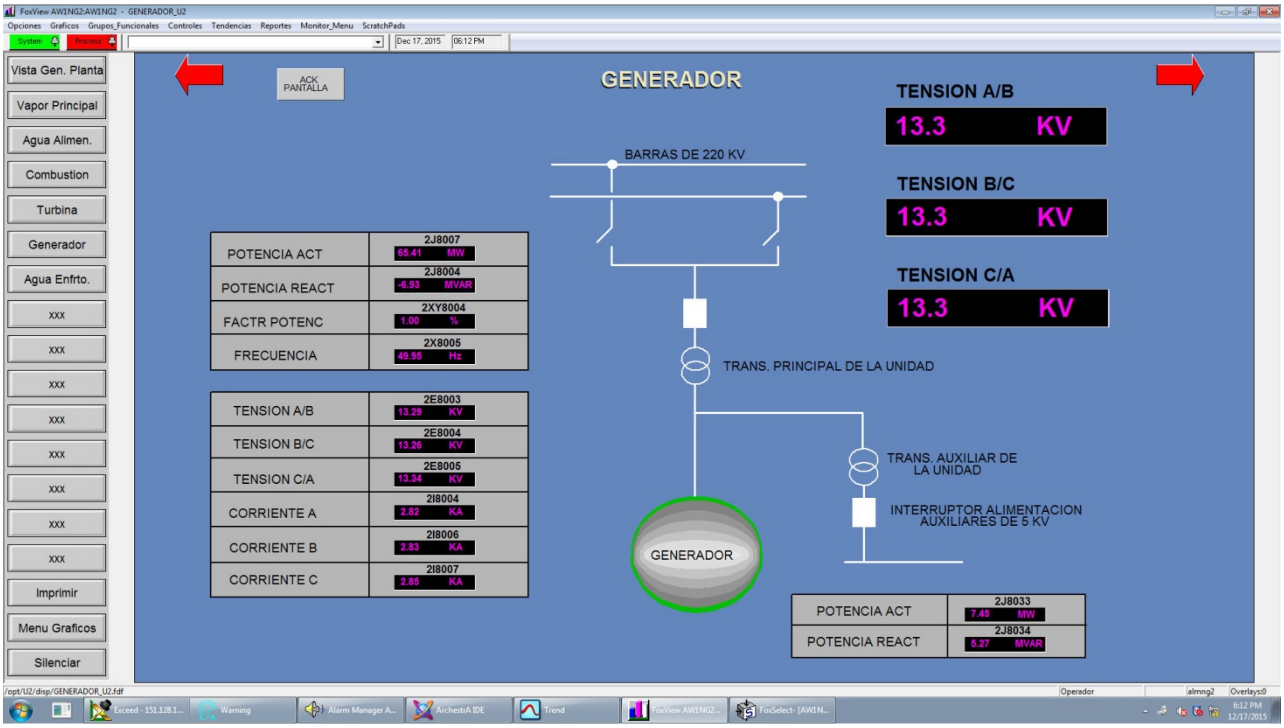
AIRE PRIMARIO FRIO
AIRE PRIMARIO CALIENTE
PARAMETROS PULVERIZADORES
PULV. D
PULV. C
PULV. B
PULV. A
CALDERA
CALENTADOR DE AIRE
VAP
VTF
C.A.V.
G.COMB.
VENT. AIRE IGNITORES
CONSOLA QUEMADORES
VENTIL. AIRE DETECTORES DE LLAMA
VENTILADORES AIRE SELLO PULVERIZADORES
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar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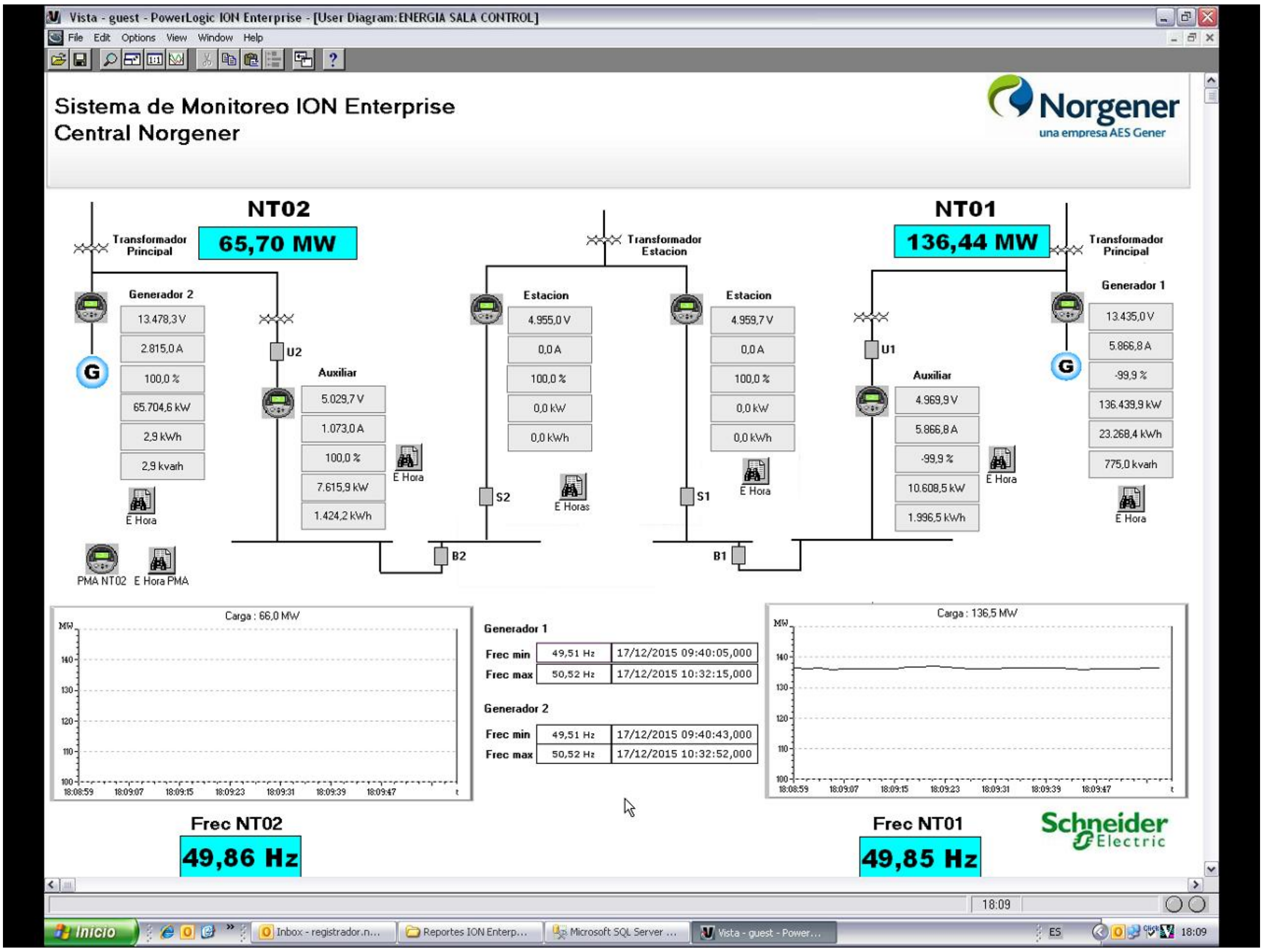
TENSION A/B
13.3 KV
TENSION B/C
13.3 KV
TENSION C/A
13.3 KV
BARRAS DE 220 KV
TRANS. PRINCIPAL DE LA UNIDAD
TRANS. AUXILIAR DE LA UNIDAD
INTERRUPTOR ALIMENTACION AUXILIARES DE 5 KV
GENERADOR
POTENCIA ACT
POTENCIA REACT
FACTR POTENC
FRECUENCIA
TENSION A/B
TENSION B/C
TENSION C/A
CORRIENTE A
CORRIENTE B
CORRIENTE C
Vista Gen. Planta
Vapor Principal
Agua Alimen.
Combustion
Turbina
Generador
Agua Enfrto.
Imprimir
Menu Graficos
Silenciar


Vista - guest - PowerLogic ION Enterprise - [User Diagram:ENERGIA SALA CONTROL]
Sistema de Monitoreo ION Enterprise
Central Norgener
Norgener
una empresa AES Gener
NT02
65,70 MW
NT01
136,44 MW
Transformador Principal
Transformador Estacion
Generador 2
Generador 1
Auxiliar
Estacion
Frec NT02
49,86 Hz
Frec NT01
49,85 Hz
Schneider Electric

APPENDIX F

Results DNV GL Calculation Program

APPENDIX F1

Measurement Input for DNV GL Calculation Program Balance Condensate

Norgener Deaerator Mass Balance Check Feed Water Flow
Performance Tests Unit #2

Standards and References used for Property Calculations as needed:
Steam Library : IFC 1997
Flue Gas Library : PTC 4.4 - 2008 (No dissociation included)
Dry Air Composition : PTC 4.4 - 2008

TestNumber		100%-HR	95%-HR	90%-HR	80%-HR	70%-HR	Min%-HR
Load		100%	95%	90%	80%	70%	47%
Date		12/15/2015	12/16/2015	12/16/2015	12/17/2015	12/17/2015	12/17/2015
Start Time		9:00:00 AM	9:00:00 AM	12:45:00 PM	9:30:00 AM	1:00:00 PM	5:00:00 PM
End Time		11:00:00 AM	11:00:00 AM	2:45:00 PM	11:30:00 AM	3:00:00 PM	7:00:00 PM
@012 M Cond.DCS Average	ton/hr	341.6	324.9	308.3	270.9	236.6	170.5
@013 dP Cond.Dearerator In	mbar	180.7	163.9	147.5	113.5	86.77	45.08
@020 P Cond. Deaerator In	bar(a)	10.21	9.776	9.339	8.342	7.445	5.625
@021 T Cond. Deaerator In	°C	136.6	135.2	133.6	129.6	125.5	114.8
@040 M FW Pump A	t/h	194.0	186.8	177.2	157.0	133.1	59.6
@041 M FW Pump B	t/h	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
@042 M FW Pump C	t/h	231.2	219.7	206.9	183.0	160.5	145.3
@050 P ST To Deaerator	bar(a)	8.710	8.301	7.888	6.928	6.075	4.306
@051 T ST To Deaerator	°C	356.6	356.6	357.0	353.1	352.6	334.5
@060 T FW Deaerator	°C	173.8	171.7	169.7	164.4	159.2	146.2
@077 P Steam to HP FWH 1	bar(a)	21.73	20.70	19.66	17.23	15.09	10.62
@078 T Steam to HP FWH 1	°C	273.5	270.1	266.8	257.9	248.9	224.7
@095 P ST HP Sub Heater	bar(a)	22.43	21.36	20.24	17.73	15.52	10.87
@096 T ST HP Sub Heater	°C	490.3	490.0	490.0	487.7	487.9	459.1
@100 dP FW after FW Pumps	mbar	440.9	401.0	357.9	277.8	206.1	98.96
@101 P FW after FW Pumps	bar(a)	213.5	218.8	222.8	232.6	243.0	246.8
@102 T FW after FW Pumps	°C	178.3	176.5	174.7	170.0	165.4	152.6
@105 dP HP Spray Water 1	mbar	0	0	0	0	0	0
@106 P HP Spray Water 1	bar(a)	168.7	215.8	219.9	229.7	240.1	243.9
@110 dP RH Spray Water	mbar	78.06	30.91	19.83	0	0	3.899
@111 P RH Spray Water	bar(a)	73.86	75.95	77.22	80.41	83.11	82.98
@112 T RH Spray Water A	°C	175.7	173.7	171.7	127.3	114.0	148.3
@113 T RH Spray Water B	°C	0	0	0	0	0	0
@114 T RH Spray Water C	°C	175.5	173.4	171.1	127.3	114.0	148.3
@115 dP HP Spray Water 2	mbar	0	18.85	63.47	8.202	39.95	18.16
@116 P HP Spray Water 2	bar(a)	168.7	215.7	219.7	229.6	240.0	243.8
@120 P ST To HP FWH 2	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@121 T ST To HP FWH 2	°C	351.0	345.3	342.9	334.1	324.7	296.4
@123 T FW HP FWH 2 In	°C	215.6	213.3	210.9	204.5	198.3	182.2
@124 P FW HP FWH 2 Out	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@125 T FW HP FWH 2 Out	°C	249.1	246.4	243.7	236.3	229.0	210.2
@126 T Drain HP FWH 2	°C	221.1	218.6	215.9	209.1	202.0	184.3
@127 T Drain HP FWH 1	°C	192.2	189.8	186.9	181.1	174.8	159.5
@140 P FW Inlet Boiler	bar(a)	182.3	177.7	174.6	169.2	164.0	159.3
@141 T FW Inlet Boiler	°C	256.6	253.9	251.1	243.7	236.3	216.6

APPENDIX F2

Results DNV GL Calculation Program Balance Condensate

Norgener Deaerator Mass Balance Check Feed Water Flow
Performance Tests Unit #2
Standards and References used for Property Calculations as needed:
Steam Library : IFC 1997
Flue Gas Library : PTC 4.4 - 2008 (No dissociation included)
Dry Air Composition : PTC 4.4 - 2008

TestNumber		100%-HR	95%-HR	90%-HR	80%-HR	70%-HR	Min%-HR
Load		100%	95%	90%	80%	70%	47%
Date		12/15/2015	12/16/2015	12/16/2015	12/17/2015	12/17/2015	12/17/2015
Start Time		9:00:00 AM	9:00:00 AM	12:45:00 PM	9:30:00 AM	1:00:00 PM	5:00:00 PM
End Time		11:00:00 AM	11:00:00 AM	2:45:00 PM	11:30:00 AM	3:00:00 PM	7:00:00 PM

REM Average

@1802=Average(@0112,@0114)

@0112 T RH Spray Water A	°C	175.7	173.7	171.7	127.3	114.0	148.3
@0114 T RH Spray Water C	°C	175.5	173.4	171.1	127.3	114.0	148.3
@1802 T RH Spray Boiler	°C	175.6	173.5	171.4	127.3	114.0	148.3

REM Flows

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water						
Element type	ISO 5167 Long Radius Nozzle						
Pipe diameter	mm	203.6					
Orifice diameter	mm	136.59					
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;					
Orifice Material	-	VDI 2040 - Steel V; 1.4401; X5CrNiMo 17 12 2;					
Corr factor pipe roughness	-	1					
Corr factor edge sharpness	-	1					
Flow Factor	-	0					
ASME Extrapolation	-	No					
@1601 P Condensate Flow	bar(a)	10.21	9.776	9.339	8.342	7.445	5.625
@1602 T Condensate Flow	°C	136.6	135.2	133.6	129.6	125.5	114.8
@0013 dP Cond.Dearerator In	mbar	180.7	163.9	147.5	113.5	86.77	45.08
Density	kg/m3	929.51	930.73	932.08	935.47	938.87	947.43
Dynamic Viscosity	uPas	202.0	204.3	206.9	213.8	221.3	243.4
Corrected Pipe Diameter	mm	203.91	203.91	203.90	203.89	203.88	203.85
Corrected Orifce Diameter	mm	136.87	136.86	136.86	136.85	136.84	136.81
Diameter Ratio	-	0.67121	0.67121	0.67120	0.67119	0.67118	0.67115
Reynolds Number D	-	2932975	2763654	2590265	2202298	1862799	1224449
Reynolds Number d	-	4369662	4117425	3859127	3281168	2775402	1824403
Discharge Coefficient	-	0.99338	0.99328	0.99318	0.99290	0.99258	0.99167
Velocity of Approach Factor	-	1.12012	1.12012	1.12011	1.12010	1.12009	1.12007
Flow Coefficient	-	1.11270	1.11259	1.11247	1.11214	1.11178	1.11073
Validity	-	VALID	VALID	VALID	VALID	VALID	VALID
@1600 M Condensate Flow	kg/s	94.88	90.41	85.82	75.38	66.00	47.72

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water						
Element type	ISO 5167 Long Radius Nozzle						
Pipe diameter	mm	211.8					
Orifice diameter	mm	125.61					
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;					
Orifice Material	-	VDI 2040 - Steel V; 1.4401; X5CrNiMo 17 12 2;					
Corr factor pipe roughness	-	1					
Corr factor edge sharpness	-	1					
Flow Factor	-	0					
ASME Extrapolation	-	No					
@1751 P FW after FW Pumps	bar(a)	213.5	218.8	222.8	232.6	243.0	246.8
@1752 T FW after FW Pumps	°C	178.3	176.5	174.7	170.0	165.4	152.6
@0100 dP FW after FW Pumps	mbar	440.9	401.0	357.9	277.8	206.1	98.96
Density	kg/m3	901.65	903.77	905.78	910.92	915.89	927.83
Dynamic Viscosity	uPas	156.6	158.4	160.2	165.0	170.1	185.1
Corrected Pipe Diameter	mm	212.25	212.24	212.23	212.22	212.21	212.17
Corrected Orifce Diameter	mm	125.96	125.96	125.95	125.94	125.93	125.90
Diameter Ratio	-	0.59346	0.59346	0.59346	0.59344	0.59343	0.59340
Reynolds Number D	-	4520840	4267381	3990417	3421067	2866202	1834571
Reynolds Number d	-	7617712	7190683	6724039	5764773	4829874	3091628
Discharge Coefficient	-	0.99413	0.99406	0.99398	0.99378	0.99353	0.99279
Velocity of Approach Factor	-	1.06846	1.06846	1.06846	1.06845	1.06845	1.06843
Flow Coefficient	-	1.06219	1.06212	1.06203	1.06181	1.06153	1.06072
Validity	-	VALID	VALID	VALID	VALID	VALID	VALID
@1750 M FW after FW Pumps	kg/s	118.02	112.67	106.55	94.10	81.24	56.59

@0900=(@1750-@2310)/@2310*100

@1750 M FW after FW Pumps	kg/s	118.02	112.67	106.55	94.10	81.24	56.59
@2310 M FW Boiler Total	kg/s	114.88	109.69	103.79	91.53	79.18	55.53
@0900 X Dev. FW Meas->Balance	%	2.73	2.72	2.66	2.81	2.60	1.90

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water						
Element type	ISO 5167 Long Radius Nozzle						
Pipe diameter	mm	61.4					
Orifice diameter	mm	37.4					
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;					
Orifice Material	-	PTC Carbon Steel (<3 Cr);					
Corr factor pipe roughness	-	1					
Corr factor edge sharpness	-	1					
Flow Factor	-	0					
ASME Extrapolation	-	No					
@1761 P HP Spray 1 Boiler	bar(a)	168.7	215.8	219.9	229.7	240.1	243.9
@1762 T HP Spray 1 Boiler	°C	178.3	176.5	174.7	170.0	165.4	152.6
@0105 dP HP Spray Water 1	mbar	0	0	0	0	0	0
Density	kg/m3	898.94	903.59	905.61	910.76	915.73	927.67
Dynamic Viscosity	uPas	155.5	158.3	160.1	165.0	170.0	185.0
Corrected Pipe Diameter	mm	61.53	61.53	61.53	61.52	61.52	61.51
Corrected Orifce Diameter	mm	37.47	37.47	37.47	37.47	37.47	37.46
Diameter Ratio	-	0.60901	0.60901	0.60901	0.60901	0.60901	0.60902
Reynolds Number D	-	0	0	0	0	0	0
Reynolds Number d	-	0	0	0	0	0	0
Discharge Coefficient	-	0	0	0	0	0	0
Velocity of Approach Factor	-	1.07680	1.07680	1.07680	1.07680	1.07680	1.07681
Flow Coefficient	-	0	0	0	0	0	0
Validity	-	VALID	VALID	VALID	VALID	VALID	VALID
@1760 M HP Spray 1 Boiler	kg/s	0	0	0	0	0	0

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water						
Element type	ISO 5167 Long Radius Nozzle						
Pipe diameter	mm	40.2					
Orifice diameter	mm	26.76					
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;					
Orifice Material	-	PTC Carbon Steel (<3 Cr);					
Corr factor pipe roughness	-	1					
Corr factor edge sharpness	-	1					
Flow Factor	-	0					
ASME Extrapolation	-	No					
@1771 P HP Spray 2 Boiler	bar(a)	168.7	215.7	219.7	229.6	240.0	243.8
@1772 T HP Spray 2 Boiler	°C	178.3	176.5	174.7	170.0	165.4	152.6
@0115 dP HP Spray Water 2	mbar	0	18.85	63.47	8.202	39.95	18.16
Density	kg/m3	898.94	903.58	905.60	910.75	915.72	927.67
Dynamic Viscosity	uPas	155.5	158.3	160.1	165.0	170.0	185.0
Corrected Pipe Diameter	mm	40.28	40.28	40.28	40.28	40.28	40.27
Corrected Orifce Diameter	mm	26.81	26.81	26.81	26.81	26.81	26.80
Diameter Ratio	-	0.66555	0.66555	0.66555	0.66555	0.66556	0.66556
Reynolds Number D	-	0	228630	416508	144887	312531	194307
Reynolds Number d	-	0	343519	625809	217694	469579	291945
Discharge Coefficient	-	0	0.98536	0.98825	0.98250	0.98697	0.98441
Velocity of Approach Factor	-	1.11540	1.11540	1.11540	1.11540	1.11540	1.11541
Flow Coefficient	-	0	1.09906	1.10229	1.09588	1.10087	1.09802
Validity	-	D<	D<	D<	D<	D<	D<
@1770 M HP Spray 2 Boiler	kg/s	0	1.145	2.110	0.756	1.681	1.137

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water						
Element type	ISO 5167 Long Radius Nozzle						
Pipe diameter	mm	44.5					
Orifice diameter	mm	27.24					
Pipe Material	-	PTC Carbon Steel (<3 Cr);					
Orifice Material	-	PTC Austenitic Stainless Steel;					
Corr factor pipe roughness	-	1					
Corr factor edge sharpness	-	1					
Flow Factor	-	0					
ASME Extrapolation	-	No					
@1801 P RH Spray Boiler	bar(a)	73.86	75.95	77.22	80.41	83.11	82.98
@1802 T RH Spray Boiler	°C	175.6	173.5	171.4	127.3	114.0	148.3
@0110 dP RH Spray Water	mbar	78.06	30.91	19.83	0	0	3.899
Density	kg/m3	895.82	898.09	900.34	941.06	951.83	922.94
Dynamic Viscosity	uPas	155.7	157.8	159.9	219.8	247.4	186.7
Corrected Pipe Diameter	mm	44.58	44.58	44.58	44.56	44.55	44.57
Corrected Orifce Diameter	mm	27.31	27.31	27.31	27.29	27.28	27.30
Diameter Ratio	-	0.61262	0.61261	0.61260	0.61248	0.61244	0.61254
Reynolds Number D	-	428566	265980	210220	0	0	80210
Reynolds Number d	-	699567	434175	343158	0	0	130948
Discharge Coefficient	-	0.98869	0.98659	0.98535	0	0	0.97845
Velocity of Approach Factor	-	1.07886	1.07886	1.07885	1.07878	1.07876	1.07882
Flow Coefficient	-	1.06666	1.06439	1.06305	0	0	1.05557
Validity	-	D<	D<	D<	D<	D<	D<
@1800 M RH Spray Boiler	kg/s	2.337	1.469	1.177	0	0	0.524

@2000=@1600

@1600 M Condensate Flow	kg/s	94.88	90.41	85.82	75.38	66.00	47.72
@2000 M Cond. Deaerator	kg/s	94.88	90.41	85.82	75.38	66.00	47.72

@2100=@2400-@1800-@1760-@1770

@2400 M FW Deae out	kg/s	117.2	111.2	105.0	91.53	79.18	56.06
@1800 M RH Spray Boiler	kg/s	2.337	1.469	1.177	0	0	0.524
@1760 M HP Spray 1 Boiler	kg/s	0	0	0	0	0	0
@1770 M HP Spray 2 Boiler	kg/s	0	1.145	2.110	0.756	1.681	1.137
@2100 M FW HP FWH I	kg/s	114.9	108.5	101.7	90.77	77.50	54.40

REM Deaerator In: Steam

@2400=@2000+@1300+@1400

@2000 M Cond. Deaerator	kg/s	94.88	90.41	85.82	75.38	66.00	47.72
@1300 M Drain HP FWH I	kg/s	16.58	15.38	14.10	11.90	9.587	5.911
@1400 M ST Deaerator	kg/s	5.756	5.372	5.046	4.245	3.590	2.423
@2400 M FW Deae out	kg/s	117.2	111.2	105.0	91.53	79.18	56.06

@1403=HPT(@1401,@1402,1)

@1401 P ST Deaerator	bar(a)	8.710	8.301	7.888	6.928	6.075	4.306
@1402 T ST Deaerator	°C	356.6	356.6	357.0	353.1	352.6	334.5
@1403 H ST Deaerator	kJ/kg	3175	3175	3177	3171	3171	3137

@2003=HPT(@2001,@2002,0)

@2001 P Cond. Deaerator	bar(a)	10.21	9.776	9.339	8.342	7.445	5.625
@2002 T Cond. Deaerator	°C	136.6	135.2	133.6	129.6	125.5	114.8
@2003 H Cond. Deaerator	kJ/kg	575.1	569.0	562.2	545.1	527.5	482.0

@2403=HPT(@2401,@2402,0)

@2401 P	FW Deae out	bar(a)	8.710	8.301	7.888	6.928	6.075	4.306
@2402 T	FW Deae out	°C	173.8	171.7	169.7	164.4	159.2	146.2
@2403 H	FW Deae out	kJ/kg	735.9	726.7	717.9	694.7	672.1	615.9

@1400=1.01*(@2000*(@2403-@2003)+@1300*(@2403-@1303))/(@1403-@2403)

@2000 M	Cond. Deaerator	kg/s	94.88	90.41	85.82	75.38	66.00	47.72
@2403 H	FW Deae out	kJ/kg	735.9	726.7	717.9	694.7	672.1	615.9
@2003 H	Cond. Deaerator	kJ/kg	575.1	569.0	562.2	545.1	527.5	482.0
@1300 M	Drain HP FWH I	kg/s	16.58	15.38	14.10	11.90	9.587	5.911
@1303 H	Drain HP FWH I	kJ/kg	817.8	807.1	794.1	768.4	740.6	673.5
@1403 H	ST Deaerator	kJ/kg	3175	3175	3177	3171	3171	3137
@1400 M	ST Deaerator	kg/s	5.756	5.372	5.046	4.245	3.590	2.423

REM HP FWH I

Preheater($12,$21,$22,$13,$11,@1310,@1311,@1312,@1313,@1314,Actual)

@2100 M	FW HP FWH I	kg/s	114.9	108.5	101.7	90.77	77.50	54.40
@2101 P	FW HP FWH I	bar(a)	213.5	218.8	222.8	232.6	243.0	246.8
@2102 T	FW HP FWH I	°C	178.3	176.5	174.7	170.0	165.4	152.6
@2103 H	FW HP FWH I	kJ/kg	766.5	759.1	751.5	731.9	712.8	658.6
@2200 M	FW HP FWH II	kg/s	114.9	108.5	101.7	90.77	77.50	54.40
@2201 P	FW HP FWH II	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@2202 T	FW HP FWH II	°C	215.6	213.3	210.9	204.5	198.3	182.2
@2203 H	FW HP FWH II	kJ/kg	928.9	918.6	907.6	879.0	851.3	780.6
@1200 M	ST HP FWH I	kg/s	8.306	7.688	7.016	5.875	4.699	2.884
@1201 P	ST HP FWH I	bar(a)	21.73	20.70	19.66	17.23	15.09	10.62
@1202 T	ST HP FWH I	°C	273.5	270.1	266.8	257.9	248.9	224.7
@1203 H	ST HP FWH I	kJ/kg	2955	2951	2947	2934	2921	2884
@1300 M	Drain HP FWH I	kg/s	16.58	15.38	14.10	11.90	9.587	5.911
@1301 P	Drain HP FWH I	bar(a)	21.73	20.70	19.66	17.23	15.09	10.62
@1302 T	Drain HP FWH I	°C	192.2	189.8	186.9	181.1	174.8	159.5
@1303 H	Drain HP FWH I	kJ/kg	817.8	807.1	794.1	768.4	740.6	673.5
@1100 M	Drain HP FWH II	kg/s	8.275	7.692	7.087	6.028	4.888	3.028
@1101 P	Drain HP FWH II	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@1102 T	Drain HP FWH II	°C	221.1	218.6	215.9	209.1	202.0	184.3
@1103 H	Drain HP FWH II	kJ/kg	949.1	937.6	925.2	894.0	861.8	782.6
@1313 Q	Heat Transfer HP FWH I	kW	18656	17312	15871	13348	10731	6637
@1314 Q	Heat Loss HP FWH I	kW	186.6	173.1	158.7	133.5	107.3	66.37
@1310	Ka Con. HP FWH I	kW/K	1135	1101	1059	974.8	867.3	633.6
@1311	Ka Sub. Cool. HP FWH I	kW/K	88.71	84.17	81.62	70.81	61.41	42.07
@1312	P. Loss Factor HP FWH I	-	1.968	2.991	4.049	6.821	11.85	27.17

REM HP FWH II

Preheater($10,$22,$35,$11,$00,@1110,@1111,@1112,@1113,@1114,Actual)

@2200 M	FW HP FWH II	kg/s	114.9	108.5	101.7	90.77	77.50	54.40
@2201 P	FW HP FWH II	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@2202 T	FW HP FWH II	°C	215.6	213.3	210.9	204.5	198.3	182.2
@2203 H	FW HP FWH II	kJ/kg	928.9	918.6	907.6	879.0	851.3	780.6
@3500 M	FW HP Sub Heater	kg/s	114.9	108.5	101.7	90.77	77.50	54.40
@3501 P	FW HP Sub Heater	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@3502 T	FW HP Sub Heater	°C	249.1	246.4	243.7	236.3	229.0	210.2
@3503 H	FW HP Sub Heater	kJ/kg	1082	1069	1057	1022	988.8	903.9
@1000 M	ST HP FWH II	kg/s	8.275	7.692	7.087	6.028	4.888	3.028
@1001 P	ST HP FWH II	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@1002 T	ST HP FWH II	°C	351.0	345.3	342.9	334.1	324.7	296.4
@1003 H	ST HP FWH II	kJ/kg	3098	3088	3087	3076	3064	3020
@1100 M	Drain HP FWH II	kg/s	8.275	7.692	7.087	6.028	4.888	3.028
@1101 P	Drain HP FWH II	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@1102 T	Drain HP FWH II	°C	221.1	218.6	215.9	209.1	202.0	184.3
@1103 H	Drain HP FWH II	kJ/kg	949.1	937.6	925.2	894.0	861.8	782.6

@1113 Q	Heat Transf.HP FWH II	kW	17604	16380	15169	13025	10658	6707
@1114 Q	Heat Loss HP FWH II	kW	176.0	163.8	151.7	130.2	106.6	67.07
@1110 kA	Con. HP FWH II	kW/K	1011	1000	987.7	925.2	859.7	681.1
@1111 kA	Sub. Cool. HP FWH II	kW/K	73.58	68.79	64.16	55.20	48.20	35.77
@1112 P	Loss Factor HP FWH II	-	0	0	0	0	0	0

REM Total Feed Water to Boiler (including HP Spray Waters)

@2310=@2400-@1800

@2400 M	FW Deae out	kg/s	117.2	111.2	105.0	91.53	79.18	56.06
@1800 M	RH Spray Boiler	kg/s	2.337	1.469	1.177	0	0	0.524
@2310 M	FW Boiler Total	kg/s	114.88	109.69	103.79	91.53	79.18	55.53

@2311=@2310*3.6

@2310 M	FW Boiler Total	kg/s	114.88	109.69	103.79	91.53	79.18	55.53
@2311 M	FW Boiler Total	t/h	413.6	394.9	373.6	329.5	285.0	199.9

REM

APPENDIX F3

Measurement Input for DNV GL Main Calculation Program

Performance Test Norgener Unit#1 and Unit#2 conducted in 2015
AES Gener Norgener, Chile

Standards and References used for Property Calculations as needed:
Steam Library : IFC 1997
Flue Gas Library : PTC 4.4 - 2008 (No dissociation included)
Dry Air Composition : PTC 4.4 - 2008

TestNumber		100%-HR	95%-HR	90%-HR	80%-HR	70%-HR	Min%-HR
Load		136 MW	129 MW	122 MW	109 MW	95 MW	65 MW
Date		12/15/2015	12/16/2015	12/16/2015	12/17/2015	12/17/2015	12/17/2015
Start Time		9:00:00 AM	9:00:00 AM	12:45:00 PM	9:30:00 AM	1:00:00 PM	5:00:00 PM
End Time		11:00:00 PM	11:00:00 AM	2:45:00 PM	11:30:00 AM	3:00:00 PM	7:00:00 PM
@010 F Unit#1 in Operation	1/0	0	0	0	0	0	0
@020 F Unit#2 in Operation	1/0	1	1	1	1	1	1
@030 F Appl.Fuel Corrections	1/0	0	0	0	0	0	0
@035 F Max.Power Test	1/0	0	0	0	0	0	0
@040 F FW Boiler Meas.Method	1/0	0	0	0	0	0	0
@050 F FW Boiler Cond.Method	1/0	1.000	1.000	1.000	1.000	1.000	1.000
@080 P Barometer	bar(a)	1.00959	1.00947	1.00821	1.00824	1.00705	1.00513
@081 T Ambient Temp.	°C	20.81	21.49	21.23	20.84	21.37	20.65
@082 X Rel.Humidity	%	64.82	68.98	63.98	61.61	64.47	74.84
@100 dP HP FW after FW Pumps	mbar	440.88	401.04	357.92	277.85	206.07	98.96
@101 P HP FW after FW Pumps	bar(a)	213.53	218.77	222.82	232.55	243.01	246.76
@102 T HP FW after FW Pumps	°C	178.29	176.47	174.69	169.97	165.42	152.56
@105 dP HP Spray 1 W.Boiler	mbar	0	0	0	0	0	0
@106 P HP Spray 1 W.Boiler	bar(a)	168.69	215.81	219.87	229.65	240.12	243.91
@110 dP RH Spray W.Boiler	mbar	78.06	30.91	19.83	0	0	3.90
@111 P RH Spray W.Boiler	bar(a)	73.86	75.95	77.22	80.41	83.11	82.98
@112 T RH Spray 1 at FW Pump	°C	175.75	173.74	171.70	127.30	97.28	130.48
@113 T RH Spray 2 at FW Pump	°C	0	0	0	0	0	0
@114 T RH Spray 3 at FW Pump	°C	175.46	173.35	171.14	97.81	113.97	148.30
@115 dP HP Spray 2 W.Boiler	mbar	0	18.85	63.47	8.20	39.95	18.16
@116 P HP Spray 2 W.Boiler	bar(a)	168.69	215.71	219.74	229.57	240.02	243.83
@120 P Extraction HPH#2	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@121 T Extraction HPH#2	°C	351.01	345.34	342.94	334.14	324.67	296.41
@123 T FW Inlet HPH#2	°C	215.59	213.32	210.91	204.46	198.33	182.23
@124 P FW Outlet HPH#2	bar(a)	184.71	179.83	176.58	170.85	165.32	160.14
@125 T FW Outlet HPH#2	°C	249.14	246.40	243.67	236.33	229.03	210.19
@126 T Drain HPH#2	°C	221.09	218.58	215.87	209.06	202.01	184.29
@127 T Drain HPH#1	°C	192.25	189.81	186.95	181.08	174.76	159.45
@130 P HP Steam Outl.Boiler	bar(a)	165.59	162.09	160.40	157.26	154.44	153.56
@131 T HP Steam Outl.Boiler	°C	540.37	535.12	535.20	536.49	535.79	525.89
@133 P Cold RH Inl.Boiler	bar(a)	39.08	37.14	35.17	30.75	26.73	18.59
@134 T Cold RH Inl.Boiler	°C	351.26	345.64	343.07	334.43	324.97	296.96
@135 P Hot RH Outl.Boiler	bar(a)	35.93	34.12	32.30	28.21	24.52	17.05
@136 T Hot RH Outl.Boiler	°C	545.61	544.95	545.02	543.05	542.88	511.91
@140 P FW Inlet Boiler	bar(a)	182.30	177.65	174.60	169.20	163.99	159.25
@141 T FW Inlet Boiler	°C	256.62	253.90	251.10	243.67	236.26	216.58
@150 T CW Inlet Cond.(a)	°C	16.45	16.64	17.64	16.65	16.84	16.52
@151 T CW Inlet Cond.(b)	°C	16.38	16.58	17.58	16.59	16.78	16.45
@201 T Exh.Inl.Air Heat.Aver.	°C	368.21	363.53	360.33	344.03	335.78	308.49
@203 T Exh.Outl.Air Heat.Aver	°C	143.52	139.71	143.06	132.39	131.26	127.16
@261 O2 Oxigen Inl.Air Heat.A	vol%,dry	3.11	3.73	3.03	3.58	4.40	5.68
@262 O2 Oxigen Inl.Air Heat.B	vol%,dry	2.96	3.09	4.04	4.02	4.37	5.87
@265 O2 Oxy.Outl.Air Heat.Aver	vol%,dry	6.55	6.69	6.73	7.09	7.50	8.90
@267 CO Outl.Air Heat.Aver.	ppm	0	0	1	0	1	11
@280 C Content Coal (Ultim.)	%	59.08	59.26	59.24	59.79	59.01	59.11
@281 H Content Coal (Ultim.)	%	3.70	3.71	3.71	3.74	3.70	3.67
@282 S Content Coal (Ultim.)	%	0.41	0.42	0.46	0.44	0.43	0.43
@283 N Content Coal (Ultim.)	%	0.94	0.95	0.94	1.12	1.18	1.18
@284 O Content Coal (Ultim.)	%	11.48	11.02	10.98	11.08	11.04	10.98
@285 W H2O in Coal (Proxim.)	%	18.62	18.98	18.97	18.24	19.08	18.99

@286 A Ash in Coal (Proxim.)	%	5.770	5.660	5.700	5.590	5.550	5.620
@287 V Volatile Coal(Proxim.)	%	32.96	33.00	32.82	33.22	33.41	33.50
@288 C Fixed Carbon (Proxim.)	%	42.64	42.36	42.51	42.94	41.95	41.88
@290 Ub Unburn.Bottom Ash	%	4.07	4.83	4.41	10.09	7.29	10.26
@291 Ub Unburn.Fly-Ash	%	2.58	3.49	2.30	2.15	0.55	0.46
@295 HHV Value of Coal	kJ/kg	23580	23614	23542	23777	23542	23505
@300 T Cold Prim.Air	°C	26.13	23.77	27.04	26.05	27.45	26.95
@305 T Cold Sec.Air A	°C	25.18	22.84	26.10	25.08	26.47	25.95
@306 T Cold Sec.Air B	°C	25.79	23.49	26.72	25.70	27.11	26.63
@310 T Hot Prim.Air	°C	342.35	337.33	335.83	319.04	312.18	289.59
@315 T Hot Sec.Air A	°C	327.02	322.25	321.76	305.51	299.69	279.62
@316 T Hot Sec.Air B	°C	334.78	330.25	329.40	313.58	307.39	285.61
@320 M Hot Sec.Airflow A	t/h	120.3	112.2	105.8	97.6	87.5	63.7
@321 M Hot Sec.Airflow B	t/h	131.5	124.8	117.5	108.7	94.7	61.8
@325 M Coal Feeder A	t/h	10.51	10.34	9.78	12.36	10.88	7.83
@326 M Coal Feeder B	t/h	10.62	10.45	9.86	12.46	10.97	7.88
@327 M Coal Feeder C	t/h	14.38	13.39	12.66	14.04	12.38	8.98
@328 M Coal Feeder D	t/h	14.42	13.41	12.67	0	0	0
@330 M Prim.Air Mill A	t/h	32.23	32.14	31.68	32.96	32.35	28.73
@331 M Prim.Air Mill B	t/h	25.93	25.82	25.38	27.23	26.18	24.03
@332 M Prim.Air Mill C	t/h	29.14	28.53	28.09	28.91	27.93	25.90
@333 M Prim.Air Mill D	t/h	29.65	29.05	28.60	0	0	0
@340 O2 Inl.Air Heat.A DCS	vol %	2.02	2.02	2.18	2.84	3.27	4.79
@341 O2 Inl.Air Heat.B DCS	vol %	2.62	2.58	2.65	2.63	2.97	4.29
@350 X Position HP Valves	%	82.3	65.4	63.7	61.1	52.7	36.3
@360 M Make-Up Water Flow	t/h	4.37	4.91	4.16	5.31	5.10	4.32
@480 D Pipe Diam.FW-Nozzle	mm	211.80	211.80	211.80	211.80	211.80	211.80
@481 d Nozzle Diam.FW-Nozzle	mm	125.61	125.61	125.61	125.61	125.61	125.61
@490 M Eject.Steam Design	kg/s	0.18	0.18	0.18	0.18	0.18	0.18
@500 Pe Power Mill A	kW	295	298	299	296	295	296
@501 Pe Power Mill B	kW	294	295	295	297	293	289
@502 Pe Power Mill C	kW	304	302	304	301	300	293
@503 Pe Power Mill D	kW	296	298	299	0	0	0
@505 Pe Power Recirc.Fan	kW	0	0	0	0	0	0
@510 M Unacc. System Leak	kg/s	0.670	0.670	0.670	0.670	0.670	0.670
@511 HHV Coal Standard	kCal/kg	6000.0	6000.0	6000.0	6000.0	6000.0	6000.0
@520 Ym Fuel Eff.Boiler Meas.	%	87.71	87.76	87.75	88.10	88.11	87.84
@525 M Coal Flow Calc.ASME	kg/h	54946	52331	49808	44012	38804	27973
@530 Pe Gross Pow.Gen (kWh)	kW	136252	129267	122472	108664	95407	65946
@531 Pe Aux. Power (kWh)	kW	9868	9553	9228	8552	8082	7604
@535 A Aux. Power FGD Ext.	Amp	307	277	253	208	177	153
@540 Pe Ligthing Unit 1	kW	152	152	152	152	152	152
@541 Pe Ligthing Unit 2	kW	152	152	152	152	152	152
@544 Pe Common Users Unit#1	kW	106	106	106	106	106	106
@545 Pe Common Users Unit#2	kW	57	57	57	57	57	57
@550 Pe Gross Power Gen.	kW	136342	129321	122549	108796	95580	66132
@551 U Voltage Generator	kV	13.260	13.330	13.333	13.340	13.329	13.329
@552 I Current Generator	kA	5.870	5.518	5.232	4.642	4.079	2.818
@553 Phi Power Factor	-	0.999	1.000	1.000	1.000	0.998	0.997
@554 Hz Freq.Generator	Hz	50.13	50.16	50.07	50.03	50.13	49.97
@555 S Rotor Speed	rot/min	3013.6	3015.5	3009.8	3005.4	3010.7	3001.8
@556 MVar Reactive Power Gen.	MVar	-4.038	-0.172	0.501	1.138	-5.090	-4.613
@560 Pe Net Power Unit (kWh)	kW	125479	118877	112468	99499	86803	57998
@600 M FW Boiler Cond.Method	kg/s	114.88	109.69	103.79	91.53	79.18	55.53

APPENDIX F4

Results DNV GL Main Calculation Program

Performance Test Norgener Unit#1 and Unit#2 conducted in 2015
AES Gener Norgener, Chile
Standards and References used for Property Calculations as needed:
Steam Library : IFC 1997
Flue Gas Library : PTC 4.4 - 2008 (No dissociation included)
Dry Air Composition : PTC 4.4 - 2008

TestNumber		100%-HR	95%-HR	90%-HR	80%-HR	70%-HR	Min%-HR
Load		136 MW	129 MW	122 MW	109 MW	95 MW	65 MW
Date		12/15/2015	12/16/2015	12/16/2015	12/17/2015	12/17/2015	12/17/2015
Start Time		9:00:00 AM	9:00:00 AM	12:45:00 PM	9:30:00 AM	1:00:00 PM	5:00:00 PM
End Time		11:00:00 AM	11:00:00 AM	2:45:00 PM	11:30:00 AM	3:00:00 PM	7:00:00 PM
REM Average Calculations							
@1152=Average(@0150,@0151)							
@0150 T CW Inlet Cond.(a)	°C	16.45	16.64	17.64	16.65	16.84	16.52
@0151 T CW Inlet Cond.(b)	°C	16.38	16.58	17.58	16.59	16.78	16.45
@1152 T CW Inlet Condenser	°C	16.42	16.61	17.61	16.62	16.81	16.49
@0905=(@0325+@0326+@0327+@0328)/3.6							
@0325 M Coal Feeder A	t/h	10.51	10.34	9.78	12.36	10.88	7.83
@0326 M Coal Feeder B	t/h	10.62	10.45	9.86	12.46	10.97	7.88
@0327 M Coal Feeder C	t/h	14.38	13.39	12.66	14.04	12.38	8.98
@0328 M Coal Feeder D	t/h	14.42	13.41	12.67	0	0	0
@0905 M Flow Coal Total (DCS)	kg/s	13.87	13.22	12.49	10.79	9.51	6.86
@0911=Average(@0305,@0306)							
@0305 T Cold Sec.Air A	°C	25.18	22.84	26.10	25.08	26.47	25.95
@0306 T Cold Sec.Air B	°C	25.79	23.49	26.72	25.70	27.11	26.63
@0911 T Cold Sec.Air Aver.	°C	25.48	23.16	26.41	25.39	26.79	26.29
@0913=Average(@0315,@0316)							
@0315 T Hot Sec.Air A	°C	327.02	322.25	321.76	305.51	299.69	279.62
@0316 T Hot Sec.Air B	°C	334.78	330.25	329.40	313.58	307.39	285.61
@0913 T Hot Sec.Air Aver.	°C	330.90	326.25	325.58	309.55	303.54	282.62
@0919=Average(@0261,@0262)							
@0261 O2 Oxigen Inl.Air Heat.A	vol%,dry	3.11	3.73	3.03	3.58	4.40	5.68
@0262 O2 Oxigen Inl.Air Heat.B	vol%,dry	2.96	3.09	4.04	4.02	4.37	5.87
@0919 O2 Oxig.Inl.Air Heat.Aver	vol%,dry	3.04	3.41	3.54	3.80	4.39	5.78
@1802=Average(@0112,@0114)							
@0112 T RH Spray 1 at FW Pump	°C	175.75	173.74	171.70	127.30	97.28	130.48
@0114 T RH Spray 3 at FW Pump	°C	175.46	173.35	171.14	97.81	113.97	148.30
@1802 T RH Spray Boiler	°C	175.61	173.55	171.42	112.56	105.63	139.39
REM Primairy Air and Secundairy Air							
@3020=Sum(@0320,@0321)							
@0320 M Hot Sec.Airflow A	t/h	120.3	112.2	105.8	97.6	87.5	63.7
@0321 M Hot Sec.Airflow B	t/h	131.5	124.8	117.5	108.7	94.7	61.8
@3020 M Secundairy Air	t/h	251.8	237.0	223.3	206.3	182.2	125.5
@3010=Sum(@0330,@0331,@0332,@0333)							
@0330 M Prim.Air Mill A	t/h	32.23	32.14	31.68	32.96	32.35	28.73
@0331 M Prim.Air Mill B	t/h	25.93	25.82	25.38	27.23	26.18	24.03
@0332 M Prim.Air Mill C	t/h	29.14	28.53	28.09	28.91	27.93	25.90
@0333 M Prim.Air Mill D	t/h	29.65	29.05	28.60	0	0	0
@3010 M Primairy Air	t/h	116.9	115.5	113.7	89.10	86.46	78.66

REM Estimated Shaft Power within System Boundary

@0930=(@0500+@0501+@0502+@0503)*0.95

@0500 Pe	Power Mill A	kW	295	298	299	296	295	296
@0501 Pe	Power Mill B	kW	294	295	295	297	293	289
@0502 Pe	Power Mill C	kW	304	302	304	301	300	293
@0503 Pe	Power Mill D	kW	296	298	299	0	0	0
@0930 Pe	Power System Boundary	kW	1130	1133	1138	849	844	835

REM Step Up Transformer Losses

@0651=((@0530-@0531)-@0560)/@0530*100

@0530 Pe	Gross Pow.Gen (kWh)	kW	136252	129267	122472	108664	95407	65946
@0531 Pe	Aux. Power (kWh)	kW	9868	9553	9228	8552	8082	7604
@0560 Pe	Net Power Unit (kWh)	kW	125479	118877	112468	99499	86803	57998
@0651 X	Step Up Losses	%	0.7	0.6	0.6	0.6	0.5	0.5

REM Composition Ambient Air

#20=AirComp(@3001,@3002,@0082)

@3001 P	Ambient Air	bar(a)	1.0096	1.0095	1.0082	1.0082	1.0071	1.0051
@3002 T	Ambient Air	°C	20.81	21.49	21.23	20.84	21.37	20.65
@0082 X	Rel.Humidity	%	64.82	68.98	63.98	61.61	64.47	74.84
@3050 Ar	Ambient Air	mol%	0.922	0.920	0.922	0.922	0.921	0.920
@3051 CO2	Ambient Air	mol%	0.0314	0.0313	0.0314	0.0314	0.0314	0.0313
@3052 N2	Ambient Air	mol%	76.85	76.72	76.83	76.91	76.81	76.67
@3053 O2	Ambient Air	mol%	20.62	20.58	20.61	20.63	20.61	20.57
@3054 H2O	Ambient Air	mol%	1.579	1.752	1.601	1.506	1.629	1.813

@3004=AbsoluteHumidity(@3001,@3002,@0082)

@3001 P	Ambient Air	bar(a)	1.0096	1.0095	1.0082	1.0082	1.0071	1.0051
@3002 T	Ambient Air	°C	20.81	21.49	21.23	20.84	21.37	20.65
@0082 X	Rel.Humidity	%	64.82	68.98	63.98	61.61	64.47	74.84
@3004 X	Abs.Humidity Air	kg/kg	0.00998	0.01109	0.01012	0.00951	0.01030	0.01149

@3005=WetBulb(@3002,@0082,@3001)

@3002 T	Ambient Air	°C	20.81	21.49	21.23	20.84	21.37	20.65
@0082 X	Rel.Humidity	%	64.82	68.98	63.98	61.61	64.47	74.84
@3001 P	Ambient Air	bar(a)	1.0096	1.0095	1.0082	1.0082	1.0071	1.0051
@3005 T	Wet Bulb Temp.	°C	16.50	17.65	16.75	16.09	16.94	17.64

REM Flow Calculations

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water						
Element type	ISO 5167 Long Radius Nozzle						
@0480 D Pipe Diam.FW-Nozzle	mm	211.80	211.80	211.80	211.80	211.80	211.80
@0481 d Nozzle Diam.FW-Nozzle	mm	125.61	125.61	125.61	125.61	125.61	125.61
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;					
Orifice Material	-	VDI 2040 - Steel V; 1.4401; X5CrNiMo 17 12 2;					
Corr factor pipe roughness	-	1					
Corr factor edge sharpness	-	1					
Flow Factor	-	0					
ASME Extrapolation	-	No					
@1751 P FW after FW Pumps	bar(a)	213.5	218.8	222.8	232.6	243.0	246.8
@1752 T FW after FW Pumps	°C	178.3	176.5	174.7	170.0	165.4	152.6
@0100 dP HP FW after FW Pumps	mbar	440.88	401.04	357.92	277.85	206.07	98.96
Density	kg/m3	901.67	903.79	905.79	910.95	915.87	927.86
Dynamic Viscosity	uPas	156.6	158.4	160.2	165.1	170.0	185.2
Corrected Pipe Diameter	mm	212.25	212.24	212.23	212.22	212.21	212.17
Corrected Orifce Diameter	mm	125.96	125.96	125.95	125.94	125.93	125.90
Diameter Ratio	-	0.59346	0.59346	0.59346	0.59344	0.59343	0.59340
Reynolds Number D	-	4520482	4266923	3990302	3420817	2866326	1834106
Reynolds Number d	-	7617109	7189912	6723847	5764353	4830084	3090845
Discharge Coefficient	-	0.99413	0.99406	0.99398	0.99378	0.99353	0.99279
Velocity of Approach Factor	-	1.06846	1.06846	1.06846	1.06845	1.06845	1.06843
Flow Coefficient	-	1.06219	1.06212	1.06203	1.06181	1.06153	1.06072
Validity	-	VALID	VALID	VALID	VALID	VALID	VALID
@1755 M FW Boiler Meas.Method	kg/s	118.02	112.68	106.55	94.11	81.23	56.59

@1750=(@0040*@1755+@0050*@1756)/(@0040+@0050)

@0040 F FW Boiler Meas.Method	1/0	0	0	0	0	0	0
@1755 M FW Boiler Meas.Method	kg/s	118.02	112.68	106.55	94.11	81.23	56.59
@0050 F FW Boiler Cond.Method	1/0	1.000	1.000	1.000	1.000	1.000	1.000
@1756 M FW Boiler Cond.Method	kg/s	114.88	109.69	103.79	91.53	79.18	55.53
@1750 M FW after FW Pumps	kg/s	114.88	109.69	103.79	91.53	79.18	55.53

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water							
Element type	ISO 5167 Long Radius Nozzle							
Pipe diameter	mm	61.4						
Orifice diameter	mm	37.4						
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;						
Orifice Material	-	PTC Carbon Steel (<3 Cr);						
Corr factor pipe roughness	-	1						
Corr factor edge sharpness	-	1						
Flow Factor	-	0						
ASME Extrapolation	-	No						
@1761 P HP Spray 1 Boiler	bar(a)		168.7	215.8	219.9	229.7	240.1	243.9
@1762 T HP Spray 1 Boiler	°C		178.3	176.5	174.7	170.0	165.4	152.6
@0105 dP HP Spray 1 W.Boiler	mbar		0	0	0	0	0	0
Density	kg/m3		898.95	903.62	905.62	910.78	915.71	927.71
Dynamic Viscosity	uPas		155.6	158.4	160.1	165.0	170.0	185.1
Corrected Pipe Diameter	mm		61.53	61.53	61.53	61.52	61.52	61.51
Corrected Orifce Diameter	mm		37.47	37.47	37.47	37.47	37.47	37.46
Diameter Ratio	-		0.60901	0.60901	0.60901	0.60901	0.60901	0.60902
Reynolds Number D	-		0	0	0	0	0	0
Reynolds Number d	-		0	0	0	0	0	0
Discharge Coefficient	-		0	0	0	0	0	0
Velocity of Approach Factor	-		1.07680	1.07680	1.07680	1.07680	1.07680	1.07681
Flow Coefficient	-		0	0	0	0	0	0
Validity	-		VALID	VALID	VALID	VALID	VALID	VALID
@1760 M HP Spray 1 Boiler	kg/s		0	0	0	0	0	0

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water							
Element type	ISO 5167 Long Radius Nozzle							
Pipe diameter	mm	40.2						
Orifice diameter	mm	26.76						
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;						
Orifice Material	-	PTC Carbon Steel (<3 Cr);						
Corr factor pipe roughness	-	1						
Corr factor edge sharpness	-	1						
Flow Factor	-	0						
ASME Extrapolation	-	No						
@1771 P HP Spray 2 Boiler	bar(a)		168.7	215.7	219.7	229.6	240.0	243.8
@1772 T HP Spray 2 Boiler	°C		178.3	176.5	174.7	170.0	165.4	152.6
@0115 dP HP Spray 2 W.Boiler	mbar		0	18.85	63.47	8.20	39.95	18.16
Density	kg/m3		898.95	903.61	905.61	910.78	915.70	927.71
Dynamic Viscosity	uPas		155.6	158.3	160.1	165.0	170.0	185.1
Corrected Pipe Diameter	mm		40.28	40.28	40.28	40.28	40.28	40.27
Corrected Orifce Diameter	mm		26.81	26.81	26.81	26.81	26.81	26.80
Diameter Ratio	-		0.66555	0.66555	0.66555	0.66555	0.66556	0.66556
Reynolds Number D	-		0	228592	416483	144845	312567	194257
Reynolds Number d	-		0	343464	625772	217631	469633	291868
Discharge Coefficient	-		0	0.98536	0.98825	0.98250	0.98697	0.98441
Velocity of Approach Factor	-		1.11540	1.11540	1.11540	1.11540	1.11540	1.11541
Flow Coefficient	-		0	1.09906	1.10229	1.09588	1.10087	1.09802
Validity	-		D<	D<	D<	D<	D<	D<
@1770 M HP Spray 2 Boiler	kg/s		0	1.15	2.11	0.76	1.68	1.14

FLOW CALCULATION ACCORDING ISO 5167-2003

Fluid type	Water						
Element type	ISO 5167 Long Radius Nozzle						
Pipe diameter	mm	44.5					
Orifice diameter	mm	27.24					
Pipe Material	-	VDI 2040 - Steel I; 1.0425; H II;					
Orifice Material	-	PTC Carbon Steel (<3 Cr);					
Corr factor pipe roughness	-	1					
Corr factor edge sharpness	-	1					
Flow Factor	-	0					
ASME Extrapolation	-	No					
@1801 P RH Spray Boiler	bar(a)	73.86	75.95	77.22	80.41	83.11	82.98
@1802 T RH Spray Boiler	°C	175.61	173.55	171.42	112.56	105.63	139.39
@0110 dP RH Spray W.Boiler	mbar	78.06	30.91	19.83	0	0	3.90
Density	kg/m3	895.81	898.07	900.32	952.78	958.10	930.91
Dynamic Viscosity	uPas	155.7	157.7	159.9	250.6	268.1	199.5
Corrected Pipe Diameter	mm	44.59	44.59	44.59	44.55	44.55	44.57
Corrected Orifce Diameter	mm	27.29	27.29	27.29	27.27	27.27	27.28
Diameter Ratio	-	0.61202	0.61202	0.61203	0.61206	0.61206	0.61204
Reynolds Number D	-	427689	265464	209818	0	0	75212
Reynolds Number d	-	698811	433748	342825	0	0	122886
Discharge Coefficient	-	0.98869	0.98658	0.98535	0	0	0.97787
Velocity of Approach Factor	-	1.07852	1.07852	1.07852	1.07854	1.07854	1.07853
Flow Coefficient	-	1.06632	1.06405	1.06272	0	0	1.05466
Validity	-	D<	D<	D<	D<	D<	D<
@1800 M RH Spray Boiler	kg/s	2.33	1.47	1.17	0	0	0.53

REM HP Heater 6

@1700=@1750-@1760-@1770

@1750 M FW after FW Pumps	kg/s	114.88	109.69	103.79	91.53	79.18	55.53
@1760 M HP Spray 1 Boiler	kg/s	0	0	0	0	0	0
@1770 M HP Spray 2 Boiler	kg/s	0	1.15	2.11	0.76	1.68	1.14
@1700 M FW Inlet HPH#6	kg/s	114.9	108.5	101.7	90.8	77.5	54.4

Preheater($102,$170,$171,$172,$00,@0800,@0801,@0802,@0803,@0804,Actual)

@1700 M FW Inlet HPH#6	kg/s	114.9	108.5	101.7	90.8	77.5	54.4
@1701 P FW Inlet HPH#6	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@1702 T FW Inlet HPH#6	°C	215.6	213.3	210.9	204.5	198.3	182.2
@1703 H FW Inlet HPH#6	kJ/kg	928.9	918.6	907.7	878.8	851.4	780.7
@1710 M FW Outlet HPH#6	kg/s	114.88	108.54	101.68	90.77	77.50	54.39
@1711 P FW Outlet HPH#6	bar(a)	184.7	179.8	176.6	170.9	165.3	160.1
@1712 T FW Outlet HPH#6	°C	249.1	246.4	243.7	236.3	229.0	210.2
@1713 H FW Outlet HPH#6	kJ/kg	1082.4	1069.5	1056.7	1022.6	989.0	903.8
@1020 M Extraction HPH#6	kg/s	8.246	7.654	7.043	6.011	4.865	3.008
@1021 P Extraction HPH#6	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@1022 T Extraction HPH#6	°C	351.0	345.3	342.9	334.1	324.7	296.4
@1023 H Extraction HPH#6	kJ/kg	3097.8	3088.3	3087.1	3076.4	3063.8	3019.8
@1720 M Drain HPH#6	kg/s	8.246	7.654	7.043	6.011	4.865	3.008
@1721 P Drain HPH#6	bar(a)	39.15	37.21	35.25	30.83	26.81	18.65
@1722 T Drain HPH#6	°C	221.1	218.6	215.9	209.1	202.0	184.3
@1723 H Drain HPH#6	kJ/kg	949.1	937.5	925.0	893.9	861.9	782.5

@0803 Q Heat Transfer HP6	kW	17630	16380	15151	13053	10658	6697
@0804 Q Loss HP6	kW	88.15	81.90	75.75	65.27	53.29	33.48
@0800 kA Preheater HP6	kW/K	1018	1003	987.1	931.5	866.8	682.1
@0801 kA Subcooler HP6	kW/K	73.33	68.57	64.01	55.07	48.07	35.79
@0802 CF Friction Coef HP6	-	0	0	0	0	0	0

REM HP Steam Flow Outlet Boiler and Hot Reheat Steam Flow Outlet Boiler

@1000=@1750-@0901-@0902

@1750 M	FW after FW Pumps	kg/s	114.88	109.69	103.79	91.53	79.18	55.53
@0901 M	Leakage Boiler	kg/s	0.268	0.268	0.268	0.268	0.268	0.268
@0902 M	Blow Down Boiler	kg/s	0	0	0	0	0	0
@1000 M	HP Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26

@1005=@1000*3.6

@1000 M	HP Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26
@1005 M	HP Outlet Boiler	t/h	412.6	393.9	372.7	328.5	284.1	198.9

@1035=@1000-@1020-@0900-@0490

@1000 M	HP Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26
@1020 M	Extraction HPH#6	kg/s	8.246	7.654	7.043	6.011	4.865	3.008
@0900 M	Leak HP Turb+Gland St.	kg/s	2.534	2.436	2.323	2.088	1.851	1.393
@0490 M	Eject.Steam Design	kg/s	0.18	0.18	0.18	0.18	0.18	0.18
@1035 M	CRH Inlet Boiler	kg/s	103.65	99.15	93.98	82.98	72.02	50.68

@1040=@1035+@1800

@1035 M	CRH Inlet Boiler	kg/s	103.65	99.15	93.98	82.98	72.02	50.68
@1800 M	RH Spray Boiler	kg/s	2.33	1.47	1.17	0	0	0.53
@1040 M	HRH Outlet Boiler	kg/s	105.99	100.62	95.15	82.98	72.02	51.21

REM Heat Production Boiler

@0830=@1000*@1003-@1650*@1653+@1040*@1043-@1035*@1033-@1760*@1763-@1770*@1773-@1800*@1803

@1000 M	HP Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26
@1003 H	HP Outlet Boiler	kJ/kg	3406.9	3396.1	3398.2	3405.4	3406.7	3380.0
@1650 M	FW Inlet Boiler	kg/s	114.88	108.54	101.68	90.77	77.50	54.39
@1653 H	FW Inlet Boiler	kJ/kg	1117.7	1104.7	1091.5	1056.6	1022.1	932.4
@1040 M	HRH Outlet Boiler	kg/s	105.99	100.62	95.15	82.98	72.02	51.21
@1043 H	HRH Outlet Boiler	kJ/kg	3554.1	3554.3	3556.2	3555.6	3558.8	3497.5
@1035 M	CRH Inlet Boiler	kg/s	103.65	99.15	93.98	82.98	72.02	50.68
@1033 H	Cold RH Inl.Boiler	kJ/kg	3098.6	3089.2	3087.6	3077.3	3064.7	3021.3
@1760 M	HP Spray 1 Boiler	kg/s	0	0	0	0	0	0
@1763 H	HP Spray 1 Boiler	kJ/kg	764.0	758.8	751.3	731.6	712.7	658.2
@1770 M	HP Spray 2 Boiler	kg/s	0	1.15	2.11	0.76	1.68	1.14
@1773 H	HP Spray 2 Boiler	kJ/kg	764.0	758.8	751.3	731.6	712.7	658.2
@1800 M	RH Spray Boiler	kg/s	2.33	1.47	1.17	0	0	0.53
@1803 H	RH Spray Boiler	kJ/kg	747.2	738.4	729.2	477.9	448.9	591.8
@0830 Q	Boiler Heat Prod.	kJ/s	315833	301067	286586	254021	223998	160985

REM Fuel Efficiency Boiler Corrected

@0950=@0520*(100+(@0952+@0953+@0954+@0955+@0956))/100

@0520 Ym	Fuel Eff.Boiler Meas.	%	87.90	87.82	87.86	88.27	88.33	88.04
@0952 Xc	Amb.Temp.Corr.Ym	%	-0.035	-0.048	-0.043	-0.036	-0.045	-0.032
@0953 Xc	Humidity Corr.Ym	%	-0.002	0.009	-0.001	-0.007	0.001	0.014
@0954 Xc	Hydrogen Corr.Ym	%	0.000	0.000	0.000	0.000	0.000	0.000
@0955 Xc	Moisture Corr.Ym	%	0.000	0.000	0.000	0.000	0.000	0.000
@0956 Xc	Theor.Dry Air	%	0.000	0.000	0.000	0.000	0.000	0.000
@0950 Yc	Fuel Eff.Boiler Corr.	%	87.87	87.79	87.82	88.24	88.29	88.03

REM Fuel Consumption Boiler Corrected

@0960=@0830/@0950*100

@0830 Q	Boiler Heat Prod.	kJ/s	315833	301067	286586	254021	223998	160985
@0950 Yc	Fuel Eff.Boiler Corr.	%	87.87	87.79	87.82	88.24	88.29	88.03
@0960 Qc	Fuel Cons.Corr.Plant	kJ/s	359445	342946	326338	287887	253696	182883

REM Correction as per CDEC-SING Definition

@0561=@0010*((@0544-(@0544+@0545)/2)+@0540)+@0020*((@0545-(@0545+@0544)/2)+@0541)

@0010 F	Unit#1 in Operation	1/0	0	0	0	0	0	0
@0544 Pe	Common Users Unit#1	kW	106	106	106	106	106	106
@0545 Pe	Common Users Unit#2	kW	57	57	57	57	57	57
@0540 Pe	Ligthing Unit 1	kW	152	152	152	152	152	152
@0020 F	Unit#2 in Operation	1/0	1	1	1	1	1	1
@0541 Pe	Ligthing Unit 2	kW	152	152	152	152	152	152
@0561 Pe	Aux.Power CEDC-SING	kW	128	128	128	128	128	128

REM Gross Power Plant Corrected and Heat Rate and Efficiency Steam Turbine

@0966=@0530+@0957+@0958

@0530 Pe	Gross Pow.Gen (kWh)	kW	136252	129267	122472	108664	95407	65946
@0957 Pe	Add.Corr.Pow.Factor	kW	-361	-327	-295	-238	-184	-90
@0958 Pe	Add.Corr.CW Temp.	kW	-191	-197	-65	-246	-235	-295
@0966 Pe	Gross Power Unit Corr.	kW	135700	128743	122112	108180	94988	65560

@0831=@0830/@0966*3600

@0830 Q	Boiler Heat Prod.	kJ/s	315833	301067	286586	254021	223998	160985
@0966 Pe	Gross Power Unit Corr.	kW	135700	128743	122112	108180	94988	65560
@0831 HR	Gross ST System	kJ/kWh	8378.8	8418.7	8448.9	8453.3	8489.4	8839.9

@0832=360000/@0831

@0831 HR	Gross ST System	kJ/kWh	8378.8	8418.7	8448.9	8453.3	8489.4	8839.9
@0832 Y	Eff. Gross ST System	%	42.97	42.76	42.61	42.59	42.41	40.72

@0965=@0560+@0561+@0957+@0958

@0560 Pe	Net Power Unit (kWh)	kW	125479	118877	112468	99499	86803	57998
@0561 Pe	Aux.Power CEDC-SING	kW	128	128	128	128	128	128
@0957 Pe	Add.Corr.Pow.Factor	kW	-361	-327	-295	-238	-184	-90
@0958 Pe	Add.Corr.CW Temp.	kW	-191	-197	-65	-246	-235	-295
@0965 Pe	Net Power Unit Corr.	kW	125055	118480	112236	99143	86512	57740

@0833=@0830/@0965*3600

@0830 Q	Boiler Heat Prod.	kJ/s	315833	301067	286586	254021	223998	160985
@0965 Pe	Net Power Unit Corr.	kW	125055	118480	112236	99143	86512	57740
@0833 HR	Net ST System	kJ/kWh	9092.0	9147.9	9192.3	9223.8	9321.2	10037.2

@0834=360000/@0833

@0833 HR	Net ST System	kJ/kWh	9092.0	9147.9	9192.3	9223.8	9321.2	10037.2
@0834 Y	Eff. Net ST System	%	39.60	39.35	39.16	39.03	38.62	35.87

REM Net Heat Rate of the Plant Corrected

@0970=@0960/@0965*3600

@0960 Qc	Fuel Cons.Corr.Plant	kJ/s	359445	342946	326338	287887	253696	182883
@0965 Pe	Net Power Unit Corr.	kW	125055	118480	112236	99143	86512	57740
@0970 HR	Net HR Plant Corr.	kJ/kWh	10347	10420	10467	10454	10557	11402

@0971=360000/@0970

@0970 HR	Net HR Plant Corr.	kJ/kWh	10347	10420	10467	10454	10557	11402
@0971 Y	Net Eff.Plant Corr.	%	34.79	34.55	34.39	34.44	34.10	31.57

REM Mass Flow of Coal based on HHV as Fired

@0975=@0960/@0295

@0960 Qc	Fuel Cons.Corr.Plant	kJ/s	359445	342946	326338	287887	253696	182883
@0295 HHV	Value of Coal	kJ/kg	23580	23614	23542	23777	23542	23505
@0975 M	Coal Corr.HHV (Fired)	kg/s	15.24	14.52	13.86	12.11	10.78	7.78

@0650=(@0975-@0905)/@0975*100

@0975 M Coal Corr.HHV (Fired)	kg/s	15.24	14.52	13.86	12.11	10.78	7.78
@0905 M Flow Coal Total (DCS)	kg/s	13.87	13.22	12.49	10.79	9.51	6.86
@0650 X Dev.Coal Calc->DCS	%	9.0	9.0	9.9	10.8	11.8	11.9

REM Mass Flow of Coal based on Standard HHV (6000 kCal/kg)

@0976=@0975*@0295/4.1868/@0511

@0975 M Coal Corr.HHV (Fired)	kg/s	15.24	14.52	13.86	12.11	10.78	7.78
@0295 HHV Value of Coal	kJ/kg	23580	23614	23542	23777	23542	23505
@0511 HHV Coal Standard	kCal/kg	6000.0	6000.0	6000.0	6000.0	6000.0	6000.0
@0976 M Coal Corr.HHV (6000)	kg/s	14.31	13.65	12.99	11.46	10.10	7.28

REM Net Heat Rate of Plant Corrected to Standard HHV (6000 kCal/kg)

@0980=@0976/@0965*3.6*10^6

@0976 M Coal Corr.HHV (6000)	kg/s	14.31	13.65	12.99	11.46	10.10	7.28
@0965 Pe Net Power Unit Corr.	kW	125055	118480	112236	99143	86512	57740
@0980 HR Net Plant Corr.(6000)	g/kWh	411.9	414.8	416.7	416.1	420.2	453.9

REM HP Steam Turbine Isentropic Efficiency

SteamTurbine($100,$00,$103,$00,$00,@0810,@0811,@0812,@0813,Actual,Pi)
Actual Calculation, Internal Power is unknown

@1000 M HP Outlet Boiler	kg/s	114.61	109.42	103.52	91.26	78.91	55.26
@1001 P HP Outlet Boiler	bar(a)	165.6	162.1	160.4	157.3	154.4	153.6
@1002 T HP Outlet Boiler	°C	540.4	535.1	535.2	536.5	535.8	525.9
@1003 H HP Outlet Boiler	kJ/kg	3406.9	3396.1	3398.2	3405.4	3406.7	3380.0
@1030 M Cold RH Inl.Boiler	kg/s	114.6	109.4	103.5	91.26	78.91	55.26
@1031 P Cold RH Inl.Boiler	bar(a)	39.08	37.14	35.17	30.75	26.73	18.59
@1032 T Cold RH Inl.Boiler	°C	351.3	345.6	343.1	334.4	325.0	297.0
@1033 H Cold RH Inl.Boiler	kJ/kg	3098.6	3089.2	3087.6	3077.3	3064.7	3021.3
@0813 Pi Power HP	kW	35336	33577	32161	29947	26985	19826
@0812 Q Loss HP	kW	0	0	0	0	0	0
@0811 CT Flow Factor HP	-	1.302	1.263	1.206	1.081	0.948	0.657
@0810 Ys Efficiency HP	%	74.61	73.52	72.50	71.70	70.34	64.78

REM End of Program

APPENDIX G

Results ASME PTC 4 Heat Balance Method

APPENDIX G1

Results ASME PTC 4 Heat Balance Method Test at 100% Load

Form CMBSTNa Combustion Calculations

	DATA REQUIRED				
1	HHV - Higher Heating value of Fuel, kJ/kg as fired, from Input Data Sheet [1]				23580
2	UBC - Unburned Carbon, kg/ 100 kg fuel from RES [11] or SRBb FORM				0.166
3	Fuel Flow, kg/hr [4b]				54856
4	a. Measured Fuel Flow		49932.0		
4	b. Calculated Fuel Flow 100,000 x [5] / [6] / [1]		54856.4		
5	Output, MJ/hr from Output Item [37]		1136999		
6	Fuel Efficiency, % (estimate initially), from Input Data Sheet [6]		87.90		
7	Moisture in air, kg/kg Dry Air		0.00998		
8	Barometric Pressure, mbar, from Input Data Sheet [8]		1009.6		
9	Dry Bulb Temerature, °C, from Input Data Sheet [9]		20.8		
10	Wet Bulb Temperature, °C, from Input Data Sheet [10]		16.5		
11	Relative Humidity, %, from Input Data Sheet [11]		64.8		
	Additional Moisture (Measured) kg/hr				
	Atomizing Steam from Output Item [14] kg/hr		0.0		
	Sootblowing Steam from Output Item [11] kg/hr		0.0		
	Other kg/hr		0.0		
12	Summation Addition Moisture		0.0		
13	Additional Moisture,kg/ 100 kg Fuel 100 x [12] / [3]				0.0
14	Additional Moisture, kg/100 kJ [13] / ([1] / 100)				0.0
	If Air Heater (Excl Stm/ Wtr Coil) Enter following				
15	Gas Temp Lvg AH, °C, from Input Data Sheet [15] Primairy / Secundairy or Main			**15A**	143.5
16	Air Temp Ent AH, °C, from Input Data Sheet [16] Primairy / Secundairy or Main	**16B**	25.5	**16A**	26.1
17	O2 in FG Ent Air Heater, %, from Input Data Sheet [17] Primairy / Secundairy or Main			**17A**	3.04
18	O2 in FG Lvg Air Heater, %, from Input Data Sheet [18] Primairy / Secundairy or Main			**18A**	6.55
18a	Mass Flow Fraction, %, from Input Data Sheet [18a] Primairy / Secundairy or Main	**18C**	68.29	**18D**	31.71
19	Mass Ash, kg/100 kJ 100 x [30J] / [1]				0.024
	If mass of ash (item [19]) exceeds 0.065 kg/100 kJ or Sorbent				
	utilized, Enter Mass Fraction of Refuse in Col [79] for each location				
	SORBENT DATA (Enter 0 if Sorbent not Used)				0
20	Sorbent Rate, kg/hr				0.000
21	CO2 from Sorbent, kg/ 100 kg Sorbent	from SRBa item [25I]			0.000
22	H2O from Sorbent, kg/ 100 kg Sorbent	from SRBa item [26I]			0.000
23	Sulfur Capture, kg/kg Sulfer	from SRBb item [45]			0.000
24	Spent Sorbent, kg/ 100 kg fuel	from SRBb item [48]			0.000
25	Sorb/Fuel Ratio, kg Sorb / kg Fuel	[20]/[3]			0.000
	HOT AIR QUALITY CONTROL EQUIPMENT DATA				
26	O2 in FG Ent HAQC Flue Gas Temperatures				N/A
	See Form EFFa for HAQC Flue Gas Temperatures				

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	1	DATE :	15-Dec-15	LOAD	100%
TIME START :	9:00	TIME END :	11:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 3	

Form CMBSTNb Combustion Calculations

COMBUSTION PRODUCTS

30	from Input Data Sheet Ultimate Analysis % Mass			31	Theo Air Flow kg/100kg Fuel [30] x K	32	Dry Prod Flow Mol/100 kg Fuel [30] / K	33	Wet Prod Flow Mol/100 kg Fuel [30] / K	34	H2O Fuel kg/100 kJ [30] x K / ([1]) / 100
A	C	59.08									
B	UBC		0.166								
C	Cb		58.91	11.51	678.10	12.0110	4.905				
D	S	0.41		4.31	1.77	32.0640	0.013				
E	H2	3.70		34.29	126.87			2.0159	1.835	8.937	0.140
F	H2O	18.62						18.0153	1.034	1.0	0.079
G	H2Ov	0.00						18.0153	0.000	1.0	0.000
H	N2	0.94				28.0134	0.034				
I	O2	11.48		-4.32	-49.59						
J	ASH	5.77									
K	VM	32.96									
L	FC	42.64									
M	TOTAL	100.00		31	757.14	32	4.951	33	2.869	34	0.219

35	Total Theo Air Fuel Check, kg/100 kJ	([31M] + [30B] x 11.51) / ([1] / 100)	3.219

CORRECTIONS FOR SORBENT REACTIONS AND SULFUR CAPTURE

40	CO2 from Sorb, kg/100 kg fuel	[21] x [25]	0.000
41	H2O from Sorb, kg/100 kg fuel	[22] x [25]	0.000
42	SO2 Reduction, Mol/100 kg fuel	[32D] x [23]	0.000
43	Dry Prod Comb, Mol/100 kg fuel	[32M] + [40] / 44.01 - [42]	4.951
44	Wet Prod Comb, Mol/100 kg fuel	[33M] + [41] / 18.0153 + [43]	7.820
46	Theo Air Corr, kg/100 kg fuel	[31M] +2.16 x [30D] x [23]	757.14
47	Theo Air Corr, Mol/100 kg fuel	[46] / 28.9625	26.142
48	Theo Air Corr, kg/100 kJ	[46] / ([1] / 100)	3.211
49	Wet Gas from Fuel, kg/100 kJ	(100 - [30J] - [30B] - [30D] x [23]) / ([1] / 100)	0.399

	LOCATION	AH In	AH Out
50	Flue Gas Temperature Entering Air heater °C	368.2	143.5
51	Air Temperature Leaving Air Heater, °C	25.69	334.5
52	Flue Gas Oxygen Content, %	3.040	6.550

	FLUE GAS ANALYSIS, Mol/100 kg Fuel	Dry	Wet	AH In	AH Out
53	Moisture in Air	0	[7] x 1.608	0.00	0.00
54	Dry/Wet Products Comb	[43]	[44]	4.951	4.951
55	Additional Moisture	0	[13] / 18.0153	0.00	0.00
56	[47] x (0.7905 + [53])			20.67	20.67
57	Summation [54] + [55] + [56]			25.62	25.62
58	20.95 - [52] x (1 + [53])			17.91	14.40
60	Excess Air, % 100 x [52] x [57] / [47] / [58]			16.63	44.57

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 1	DATE : 15-Dec-15	LOAD	100%
TIME START : 9:00	TIME END : 11:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 2 of 3	

Form CMBSTNc Combustion Calculations

	LOCATION							AH In	AH Out
60	Excess Air, %							16.63	44.57
	02, CO2, SO2, WHEN EXCESS AIR KNOWN								
61									
62	Dry	[47] x (0.7905 + ([60] / 100))						25.01	32.32
63	Wet	[47] x (0.7905 + [53] + (1 + [53]) x [60] / 100)						25.01	32.32
64	Dry Gas, Mol/100 kg Fuel	[43] + [62]						29.96	37.27
65	Wet Gas, Mol/100 kg Fuel	[44] + [63] + [13] / 18.015						32.83	40.14
			Dry	Wet					
66	O2, %	[60] x [47] x 0.2095 / [65]	[64]	[65]				2.77	6.08
67	CO2,%	([30c]/0.1201+[40]/0.4401)/[65]	[64]	[65]				14.94	12.22
68	SO2,ppm	(1-[23]) x [30D] / 0.32064 / [65]	[64]	[65]				389.4	318.6
	FLUE GAS PRODUCTS, kg/100 kJ								
69	Dry Air	(1 + [60] / 100) x [48]						3.745	4.642
70	Wet Gas from Fuel	[49]						0.399	0.399
71	CO2 from Sorbent	[40] / ([1] / 100)						0.000	0.000
72	Moisture in Air	[7] x [69]						0.037	0.046
73	Water from Sorbent	[41] / ([1] / 100)						0.000	0.000
74	Additional Moisture	[14]						0.000	0.000
75	Total Wet Gas	[69] + [70] + [71] + [72] + [73] + [74]						4.181	5.087
76	H2O in Wet Gas	[34M] + [72] + [73] + [74]						0.257	0.266
77	Dry Gas	[75] - [76]						3.925	4.822
78	H2O in Wet Gas, % Mass	100 x [76] / [75]						6.14	5.22
79	Residue, kg/kg Total Refuse at each location							0.00	0.00
80	Residue, kg/100 kJ	([30J] + [2] + [24]) / ([1] / 100)						0.0252	0.0252
81	Residue in Wet Gas, kg/kg	[79] x [80] / [75] Wet Gas						0.000	0.000
82	Leakage, % Gas Entering	100 x ([75L] - [75E]) / [75E]							21.67
	GAS TEMPERATURE CORRECTION FOR AH LEAKAGE								
83	Gas Temp Lvg (INCL LKG), °C	[15]						368.21	143.52
84	Average AH Air Leakage Temp, °C	([16B] x[18B]+[16A] x[18D])/100						25.69	334.53
85	H Air Lvg, kJ/kg	T=[83], H2O=[7]							120.61
86	H Air Ent, kJ/kg	T=[84], H2O=[7]						0.695	
87	Cpg, kJ/kg°C	T=[83], H2O=[78E], RES=[81E]							1.061
88	AH Gas Outlet Temperature Excluding Leakage, °C	[83] + ([82] / 100 x ([85] - [86]) / [87])							168.02
	AIR, GAS, FUEL & RESIDUE MASS FLOW RATES, kg/hr								
90	Input from Fuel, MJ/hr	[5] / [6] x 100							1293514
91	Fuel Rate, kg/hr	1000 x [90] / [1]							54856
92	Residue Rate, kg/hr	[80] x [90] / 10							3257
93	Wet Flue Gas, kg/hr	[75] x [90] / 10						540857	658058
95	Excess Air Lvg Blr, %	[60]							44.57
96	Total Air to Blr, kg/hr	(1 + [95] / 100) x (1 + [7]) x [48] x [90] / 10							606458

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 1	DATE : 15-Dec-15	LOAD	100%
TIME START : 9:00	TIME END : 11:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

Form RES Unburned Carbon and Residue Calculation

	DATA REQUIRED FOR RESIDUE SPLIT									
1	Ash in Fuel, %			from Form CMBSTNb [30J]	5.77	**2**	HHV Fuel, kJ/kg 'as fired'			23580
3	Fuel Mass Flow Rate, kg/hr			from Form CMBSTNa [4b]	54856	**4b**	from Form CMBSTNa [1]			
a)	Item [3] - Use measured or estimated value initially. (See CMBSTNa) Recalculate after boiler efficiency has been calculated until estimated value is within 1% of calculated value.									
b)	Residue splits estimated. Enter value in Col [8] and calculate Col [5]. Residue rate measured. Enter measured mass flow rates in Col [5]. Whem residue is not measured at all locations, estimate split and flow for measured locations. Reiterate until estimated total residue is within 2% of calculated.									
c)	Enter the % free carbon in Col [6] (total carbon correcter for CO2). Units with sorbent: Enter the % CO2 in Col [7].									
		5 Residue Mass Flow		**6**	**7**	**8** Residue Split %		**9**	**10**	
	Location	Input kg/hr	Calculated kg/hr	C in Residue %	CO2 in Residue %	Input	Calculated 100 x [5]/[5F]	C Wtd Ave % [6] x [8]/100	CO2 Wtd Ave % [7] x [8]/100	
A	Bottom Ash	0.00	0.00	4.07	5.00	15.00	0.00	0.611	0.750	
B	Fly Ash	0.00	0.00	2.58	2.00	85.00	0.00	2.193	1.700	
C	Economizer	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
D		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
E		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
F	TOTAL	**5** 0.00	0.00			**8** 100.0	0.00	**9** 2.804	**10** 2.450	

	UNITS WITHOUT SORBENT		
11	Unburned Carbon, kg/ 100 kg Fuel	[1] x [9F] / (100 - [9F])	0.166
20	Total Residue, kg/ 100kg Fuel	[1] + [11]	5.94
	UNITS WITH SORBENT		
d)	Enter average C and CO2 in residue, [9F] and [10F] above or SRBa (Items [4] and [5]) and complete Sorbent Calculation Forms.		
11	Unburned Carbon, kg/ 100 kg Fuel	from Form SRBb Item [49]	0.196
20	Total Residue, kg/ 100 Fuel	from Form SRBb Item [50]	6.99
	TOTAL RESIDUE		
21	Total Residue, kg/hr	[20] x[3] /100	3257
e)	When all residue collection locations are measured, the measured residue split is used for calculations. If a portion of the residue mass is estimated, repeat calculation above until Col [5F] and Item [21] agree within 2%.		
22	Total Residue, kg/100 kJ	100 x [20] / [2]	0.025

23	**SENSIBLE HEAT RESIDUE LOSS, %**									
	Location	**24** Temp Residue (°C)	[8] %	x	[22] Residue kg/ 100 kJ	x	H Residue kJ/kg	/ 10,000		Loss %
A	Furnace	1100	15.00	x	0.025	x	1205.2	/ 10,000		0.046
B	Fly Ash	120	85.00	x	0.025	x	76.7	/ 10,000		0.016
C	Economizer	0	0.00	x	0.025	x	-30.1	/ 10,000		0.000
D		0								0.000
E		0								0.000
								Total	**25**	0.062

H Residue = 0.16 x T + 1.09E-4 x T^2 - 2.843E-8 x T^3 - 12.95

PLANT NAME :	NORGENER ASME PTC 4 MASTER FORM			UNIT NO.	2
TEST NO :	1	DATE:	15-Dec-15	LOAD	100%
TIME START :	9:00	TIME END :	11:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 1	

Form EFFa Efficiency Calculations

Data

	TEMPERATURES,°C				
1	Reference Temperature, °C	25.0	1A	Enthalpy Water (0°C Ref), kJ/kg	104.57
2	Average Entering Air Temp, from	25.69	2A	Enthalpy Dry Air, kJ/kg	0.69
	CMBSTNa Item [84]: ([16B]x[18B]+[16A]x[18D])/100		2B	Enthalpy Water Vapor, kJ/kg	1.28
3	Average Exit Gas T (Excl Lkg)	168.0	3A	Enthalpy Dry Gas, kJ/kg	143.30
	from CMBSTNa [88]		3B	Enthalpy Steam @ 1 psia, kJ/kg	2814.9
			3C	Enthalpy Water Vapor, kJ/kg	270.37
4	Fuel Temperature	20.8	4A	Enthalpy Fuel, kJ/kg	-5.75
	HOT AIR QUALITY CONTROL EQUIPMENT				
5	Entering Gas Temperature	0.0	5A	Enthalpy Wet Gas	0.00
6	Leaving Gas Temperature	0.0	6A	Enthalpy of Wet Gas	0.00
			6B	Enthalpy of Wet Air	0.00
			6C	Enthalpy of Wet Air @ T = [3]	0.00
	RESULTS FROM COMBUSTION CALCULATION FORM CMBSTN				
10	Dry Gas Weight, kg/100 kJ [77]	3.925	18	Unburned Carbon, % [2]	0.166
11	Dry Air Weight [69]	3.745	19	HHV kJ/kg 'as-fired' [1]	23580.0
12	Water from H2 Fuel [34E]	0.140		**HOT AQC EQUIPMENT**	
13	Water from H2O Fuel [34F]	0.079	20	Wet Gas Entering [75E]	0.00
14	Water from H2Ov Fuel [34G]	0.000	21	H2O in Wet Gas, % [78E]	0.00
15	Moisture in Air kg/kg DA [7]	0.00998	22	Wet Gas Leaving [75L]	0.00
16	Moisture in Air kg/100 kJ [72]	0.037	23	Residue in Wet Gas, % [81E]	0.00
17	Fuel Rate Est. kg/hr [3]	54856			
			25	Excess Air, % [95]	44.57
	MISCELLANEOUS				
30	Unit Output, MJ/hr	1136999	31	Aux Equip Power, MJ/hr	4068
32	Loss Due to Surface Radiation and Convection, %				0.25

PLANT NAME :	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO :	DATE :	LOAD	100%
TIME START :	TIME END :	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form EFFb Efficiency Calculations

	LOSSES, % Enter Calculated Result in % Column [B]		A	MKB	B	%
60	Dry Gas	[10] x [3A] /100				
		x /100				5.624
61	Water from H2 Fuel	[12] x ([3B] - [1A]) / 100				
		x - 104.57) / 100				3.801
62	Water from H2O Fuel	[13] x ([3B] - [1A]) / 100				
		x - 104.57) / 100				2.140
63	Water from H2O Fuel	[14] x ([3C]) / 100				
		x / 100				0.000
64	Moisture in Air	[16] x [3C] / 100				
		x / 100				0.101
65	Unburned Carbon in Ref [18] x 33700 / [19] =	x 33700/				0.238
66	Sensible Heat of Refuse from Form RES					0.062
67	Hot AQC Equip	([20] x ([5A] - [6A]) - ([22] - [20]) x ([6C] - [6B])) / 100				
	(x (-) - (-) x (-)) / 100					0.000
68	Other Losses, % Basis from Form EFFc Item [110]					0.450
69	Summation of Losses, % Basis					12.416
	LOSSES, MJ/hr Enter in MKB Column [A]					
75	Surface Radiation and Convection from Form EFFa Item [32]			0.000		
76	Sorbent Calcination / Dehydration from Form SRBc Item [77]			0.000		
77	Water from Sorbent from Form SRBc Item [65]			0.000		
80	Other Losses, MJ/hr Basis from Form EFFc Item [111]			0.000		
81	Summation of Losses, MJ/hr Basis			0.000		
	CREDITS, % Enter Calculation Result in % Column [B]					
85	Entering Dry Air	[11] x [2A] /100				
		x /100				0.026
86	Moisture in Air	[16] x [2B] /100				
		x /100				0.000
87	Sensible Heat in Fuel	100 x [4A] / [19]				
		100 x /				-0.024
88	Sulfation from Form SRBc Item [80]					0.000
89	Other Credits, % Basis from Form EFFc Item [112]					0.000
90	Summation of Credits, % Basis					0.002
	CREDITS, MJ/hr Enter Calculated Result in MKB Column [A]					
95	Auxiliary Equipment Power [31]			4068.0		
96	Sensible Heat from Sorbent from Form SRBc Item [85]			0.000		
97	Other Credits, MJ/hr Basis from Form EFFc Item [113B]			0.000		
98	Summation of Credits, MJ/hr Basis			4068.0		
100	Fuel Eff, % (100 - [69] + [90]) x [30] / ([30] + [81] - [98])					
	(100 - +) x / (+ -)					87.90
101	Input from Fuel, MJ/hr 100 x [30] / [100] = 100 x /			1293508		
102	Fuel Rate, kg/hr 1,000 x [101] / [19] = 1,000 x /					54856

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 1	DATE : 15-Dec-15	LOAD	100%
TIME START : 9:00	TIME END : 11:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 2 of 3	

Form EFFc   Efficiency Calculations

Other Losses and Credits

The losses and credits listed on this sheet are not universally applicable to all fossil fired steam generators and are usuall minor. Losses/credits that have not been specifically identified by this Code but are applicable in accordance with th intent of the Code should also be recorded on this sheet

Parties to the test may agree to estimate the losses or credits in lieu of testing Enter a 'T' for tested or 'E' for esimate in the second column, and result in the appropriate column

Enter the sum of each group on Form EFFb.

Refer to the text of PTC 4 for the calculation method.

Itm	T or E	LOSSES, % Enter Calculated Result in % Column[B]	A MKB	B %
110A		CO in Flue Gas		0.000
110B		Formation of NOx		0.000
110C		Pulverizer Rejects		0.000
110D		Air Infiltration		0.000
110E		Unburned Hydrocarbons in Flue Gas		0.000
110F		Unburned Hydrogen in Refuse		0.000
110G	E	Unmeasured Loss, as per agreement		0.200
110H	E	Surface Radiation Loss, as per agreement		0.250
110		Summation of Other Losses, % Basis		0.450
		LOSSES, MJ/hr Enter in MKB Column [A]		
111A		Wet Ash Pit	0.000	
111B		Sensible Heat in Recycle Streams, Solid	0.000	
111C		Sensible Heat in Recycle Streams, Gas	0.000	
111D		Additional Moisture	0.000	
111E		Cooling Water	0.000	
111F		Air Preheater Coil (supplied by Unit)	0.000	
111G		Other	0.000	
111		Summation of other Losses, MJ/hr Basis	0.000	
		CREDITS, % Enter Calculation Result in % Column [B]		
112A		Other		0.000
112		Summation of Credits, % Basis		0.000
		CREDITS, MJ/hr Enter Result in MKB Column [A]		
113A		Heat in Additional Moisture (external to envelope)	0.000	
113B		Other	0.000	
113C		Heat by Auxiliary Equipment Power	4068.0	
113		Summation of Credits, MJ/hr Basis	4068.0	

PLANT NAME :	NORGENER	ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	1	DATE :	15-Dec-15	LOAD	100%
TIME START :	9:00	TIME END :	11:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 3 of 3	

APPENDIX G2

Results ASME PTC 4 Heat Balance Method Test at 95% Load

Form CMBSTNa Combustion Calculations

	DATA REQUIRED						
1	HHV - Higher Heating value of Fuel, kJ/kg as fired, from Input Data Sheet [1]						23614
2	UBC - Unburned Carbon, kg/ 100 kg fuel from RES [11] or SRBb FORM						0.217
3	Fuel Flow, kg/hr [4b]						52263
4	a. Measured Fuel Flow				47592.0		
4	b. Calculated Fuel Flow 100,000 x [5] / [6] / [1]				52262.8		
5	Output, MJ/hr	from Output Item [37]			1083841		
6	Fuel Efficiency, % (estimate initially), from Input Data Sheet [6]				87.82		
7	Moisture in air, kg/kg Dry Air				0.01109		
8	Barometric Pressure, mbar, from Input Data Sheet [8]				1009.5		
9	Dry Bulb Temerature, °C,	from Input Data Sheet [9]			21.5		
10	Wet Bulb Temperature, °C,	from Input Data Sheet [10]			17.7		
11	Relative Humidity, %,	from Input Data Sheet [11]			69.0		
	Additional Moisture (Measured)		kg/hr				
	Atomizing Steam	from Output Item [14]	kg/hr		0.0		
	Sootblowing Steam	from Output Item [11]	kg/hr		0.0		
	Other		kg/hr		0.0		
12	Summation Addition Moisture				0.0		
13	Additional Moisture,kg/ 100 kg Fuel 100 x [12] / [3]						0.0
14	Additional Moisture, kg/100 kJ	[13] / ([1] / 100)					0.0
	If Air Heater (Excl Stm/ Wtr Coil) Enter following						
15	Gas Temp Lvg AH, °C,	from Input Data Sheet [15]	Primairy / Secundairy or Main			**15A**	139.7
16	Air Temp Ent AH, °C,	from Input Data Sheet [16]	Primairy / Secundairy or Main	**16B**	23.2	**16A**	23.8
17	O2 in FG Ent Air Heater, %,	from Input Data Sheet [17]	Primairy / Secundairy or Main			**17A**	3.41
18	O2 in FG Lvg Air Heater, %,	from Input Data Sheet [18]	Primairy / Secundairy or Main			**18A**	6.69
18a	Mass Flow Fraction, %,	from Input Data Sheet [18a]	Primairy / Secundairy or Main	**18C**	67.23	**18D**	32.77
19	Mass Ash, kg/100 kJ 100 x [30J] / [1]						0.024
	If mass of ash (item [19]) exceeds 0.065 kg/100 kJ or Sorbent						
	utilized, Enter Mass Fraction of Refuse in Col [79] for each location						
	SORBENT DATA (Enter 0 if Sorbent not Used)						0
20	Sorbent Rate, kg/hr						0.000
21	CO2 from Sorbent, kg/ 100 kg Sorbent	from SRBa item [25I]					0.000
22	H2O from Sorbent, kg/ 100 kg Sorbent	from SRBa item [26I]					0.000
23	Sulfur Capture, kg/kg Sulfer	from SRBb item [45]					0.000
24	Spent Sorbent, kg/ 100 kg fuel	from SRBb item [48]					0.000
25	Sorb/Fuel Ratio, kg Sorb / kg Fuel	[20]/[3]					0.000
	HOT AIR QUALITY CONTROL EQUIPMENT DATA						
26	O2 in FG Ent HAQC Flue Gas Temperatures						N/A
	See Form EFFa for HAQC Flue Gas Temperatures						

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	2	DATE :	16-Dec-15	LOAD	95%
TIME START :	9:00	TIME END :	11:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 3	

Form CMBSTNb Combustion Calculations

COMBUSTION PRODUCTS											
30	from Input Data Sheet Ultimate Analysis % Mass			**31** Theo Air Flow kg/100kg Fuel [30] x K		**32** Dry Prod Flow Mol/100 kg Fuel [30] / K		**33** Wet Prod Flow Mol/100 kg Fuel [30] / K		**34** H2O Fuel kg/100 kJ [30] x K / ([1]) / 100	
A	C	59.26									
B	UBC		0.217								
C	Cb		59.04	11.51	679.59	12.0110	4.916				
D	S	0.42		4.31	1.81	32.0640	0.013				
E	H2	3.71		34.29	127.22			2.0159	1.840	8.937	0.140
F	H2O	18.98						18.0153	1.054	1.0	0.080
G	H2Ov	0.00						18.0153	0.000	1.0	0.000
H	N2	0.95				28.0134	0.034				
I	O2	11.02		-4.32	-47.61						
J	ASH	5.66									
K	VM	33.00									
L	FC	42.36									
M	TOTAL	100.00		31	761.01	32	4.963	33	2.894	34	0.221

35	Total Theo Air Fuel Check, kg/100 kJ	([31M] + [30B] x 11.51) / ([1] / 100)	3.233
	CORRECTIONS FOR SORBENT REACTIONS AND SULFUR CAPTURE		
40	CO2 from Sorb, kg/100 kg fuel	[21] x [25]	0.000
41	H2O from Sorb, kg/100 kg fuel	[22] x [25]	0.000
42	SO2 Reduction, Mol/100 kg fuel	[32D] x [23]	0.000
43	Dry Prod Comb, Mol/100 kg fuel	[32M] + [40] / 44.01 - [42]	4.963
44	Wet Prod Comb, Mol/100 kg fuel	[33M] + [41] / 18.0153 + [43]	7.857
46	Theo Air Corr, kg/100 kg fuel	[31M] +2.16 x [30D] x [23]	761.01
47	Theo Air Corr, Mol/100 kg fuel	[46] / 28.9625	26.276
48	Theo Air Corr, kg/100 kJ	[46] / ([1] / 100)	3.223
49	Wet Gas from Fuel, kg/100 kJ	(100 - [30J] - [30B] - [30D] x [23]) / ([1] / 100)	0.399

	LOCATION			AH In	AH Out
50	Flue Gas Temperature Entering Air heater °C			363.5	139.7
51	Air Temperature Leaving Air Heater, °C			23.36	329.9
52	Flue Gas Oxygen Content, %			3.410	6.690
	FLUE GAS ANALYSIS, Mol/100 kg Fuel	Dry	Wet		
53	Moisture in Air	0	[7] x 1.608	0.00	0.00
54	Dry/Wet Products Comb	[43]	[44]	4.963	4.963
55	Additional Moisture	0	[13] / 18.0153	0.00	0.00
56	[47] x (0.7905 + [53])			20.77	20.77
57	Summation [54] + [55] + [56]			25.73	25.73
58	20.95 - [52] x (1 + [53])			17.54	14.26
60	Excess Air, % 100 x [52] x [57] / [47] / [58]			19.04	45.95

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 2	DATE : 16-Dec-15	LOAD	95%
TIME START : 9:00	TIME END : 11:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 2 of 3	

Form CMBSTNc Combustion Calculations

					AH In	AH Out
	LOCATION				AH In	AH Out
60	Excess Air, %				19.04	45.95
	02, CO2, SO2, WHEN EXCESS AIR KNOWN					
61						
62	Dry	[47] x (0.7905 + ([60] / 100))			25.77	32.84
63	Wet	[47] x (0.7905 + [53] + (1 + [53]) x [60] / 100)			25.77	32.84
64	Dry Gas, Mol/100 kg Fuel	[43] + [62]			30.74	37.81
65	Wet Gas, Mol/100 kg Fuel	[44] + [63] + [13] / 18.015			33.63	40.70
			Dry	Wet		
66	O2, %	[60] x [47] x 0.2095 / [65]	[64]	[65]	3.12	6.21
67	CO2,%	([30c]/0.1201+[40]/0.4401)/[65]	[64]	[65]	14.62	12.08
68	SO2,ppm	(1-[23]) x [30D] / 0.32064 / [65]	[64]	[65]	389.5	321.8
	FLUE GAS PRODUCTS, kg/100 kJ					
69	Dry Air	(1 + [60] / 100) x [48]			3.836	4.703
70	Wet Gas from Fuel	[49]			0.399	0.399
71	CO2 from Sorbent	[40] / ([1] / 100)			0.000	0.000
72	Moisture in Air	[7] x [69]			0.043	0.052
73	Water from Sorbent	[41] / ([1] / 100)			0.000	0.000
74	Additional Moisture	[14]			0.000	0.000
75	Total Wet Gas	[69] + [70] + [71] + [72] + [73] + [74]			4.277	5.154
76	H2O in Wet Gas	[34M] + [72] + [73] + [74]			0.263	0.273
77	Dry Gas	[75] - [76]			4.014	4.881
78	H2O in Wet Gas, % Mass	100 x [76] / [75]			6.16	5.30
79	Residue, kg/kg Total Refuse at each location				0.00	0.00
80	Residue, kg/100 kJ	([30J] + [2] + [24]) / ([1] / 100)			0.0249	0.0249
81	Residue in Wet Gas, kg/kg	[79] x [80] / [75] Wet Gas			0.000	0.000
82	Leakage, % Gas Entering	100 x ([75L] - [75E]) / [75E]				20.50
	GAS TEMPERATURE CORRECTION FOR AH LEAKAGE					
83	Gas Temp Lvg (INCL LKG), °C	[15]			363.53	139.71
84	Average AH Air Leakage Temp, °C	([16B] x[18B]+[16A] x[18D])/100			23.36	329.88
85	H Air Lvg, kJ/kg	T=[83], H2O=[7]				116.82
86	H Air Ent, kJ/kg	T=[84], H2O=[7]			-1.663	
87	Cpg, kJ/kg°C	T=[83], H2O=[78E], RES=[81E]				1.060
88	AH Gas Outlet Temperature Excluding Leakage, °C [83] + ([82] / 100 x ([85] - [86]) / [87])					162.61
	AIR, GAS, FUEL & RESIDUE MASS FLOW RATES, kg/hr					
90	Input from Fuel, MJ/hr	[5] / [6] x 100				1234134
91	Fuel Rate, kg/hr	1000 x [90] / [1]				52263
92	Residue Rate, kg/hr	[80] x [90] / 10				3071
93	Wet Flue Gas, kg/hr	[75] x [90] / 10			527892	636092
95	Excess Air Lvg Blr, %	[60]				45.95
96	Total Air to Blr, kg/hr	(1 + [95] / 100) x (1 + [7]) x [48] x [90] / 10				586901

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 2	DATE : 16-Dec-15	LOAD	95%
TIME START : 9:00	TIME END : 11:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

Form RES Unburned Carbon and Residue Calculation

DATA REQUIRED FOR RESIDUE SPLIT

1	Ash in Fuel, %	from Form CMBSTNb [30J]	5.66	2	HHV Fuel, kJ/kg 'as fired'	23614
3	Fuel Mass Flow Rate, kg/hr	from Form CMBSTNa [4b]	52263	4b	from Form CMBSTNa [1]	

a) Item [3] - Use measured or estimated value initially. (See CMBSTNa)
Recalculate after boiler efficiency has been calculated until estimated value is within 1% of calculated value.

b) Residue splits estimated. Enter value in Col [8] and calculate Col [5].
Residue rate measured. Enter measured mass flow rates in Col [5]. Whem residue is not measured at all locations, estimate split and flow for measured locations. Reiterate until estimated total residue is within 2% of calculated.

c) Enter the % free carbon in Col [6] (total carbon correcter for CO2). Units with sorbent: Enter the % CO2 in Col [7].

	Location	5 Residue Mass Flow Input kg/hr	Calculated kg/hr	6 C in Residue %	7 CO2 in Residue %	8 Residue Split % Input	Calculated 100 x [5]/[5F]	9 C Wtd Ave % [6] x [8]/100	10 CO2 Wtd Ave % [7] x [8]/100
A	Bottom Ash	0.00	0.00	4.83	5.00	15.00	0.00	0.725	0.750
B	Fly Ash	0.00	0.00	3.49	2.00	85.00	0.00	2.967	1.700
C	Economizer	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
D		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
E		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
F	TOTAL	5 0.00	0.00			8 100.0	0.00	9 3.691	10 2.450

UNITS WITHOUT SORBENT

11	Unburned Carbon, kg/ 100 kg Fuel	[1] x [9F] / (100 - [9F])	0.217
20	Total Residue, kg/ 100kg Fuel	[1] + [11]	5.88

UNITS WITH SORBENT

d) Enter average C and CO2 in residue, [9F] and [10F] above or SRBa (Items [4] and [5]) and complete Sorbent Calculation Forms.

11	Unburned Carbon, kg/ 100 kg Fuel	from Form SRBb Item [49]	0.257
20	Total Residue, kg/ 100 Fuel	from Form SRBb Item [50]	6.97

TOTAL RESIDUE

21	Total Residue, kg/hr	[20] x[3] /100	3071

e) When all residue collection locations are measured, the measured residue split is used for calculations. If a portion of the residue mass is estimated, repeat calculation above until Col [5F] and Item [21] agree within 2%.

22	Total Residue, kg/100 kJ	100 x [20] / [2]	0.025

23 SENSIBLE HEAT RESIDUE LOSS, %

	Location	24 Temp Residue (°C)	[8] %	x	[22] Residue kg/ 100 kJ	x	H Residue kJ/kg	/ 10,000	Loss %
A	Furnace	1100	15.00	x	0.025	x	1205.2	/ 10,000	0.045
B	Fly Ash	120	85.00	x	0.025	x	76.7	/ 10,000	0.016
C	Economizer	0	0.00	x	0.025	x	-30.1	/ 10,000	0.000
D		0							0.000
E		0							0.000
								Total 25	0.061

H Residue = 0.16 x T + 1.09E-4 x T^2 - 2.843E-8 x T^3 - 12.95

PLANT NAME :	NORGENER ASME PTC 4 MASTER FORM			UNIT NO.	2
TEST NO :	2	DATE:	16-Dec-15	LOAD	95%
TIME START :	9:00	TIME END :	11:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 1	

Form EFFa Efficiency Calculations
Data

	TEMPERATURES,°C				
1	Reference Temperature, °C	25.0	1A	Enthalpy Water (0°C Ref), kJ/kg	104.57
2	Average Entering Air Temp, from	23.36	2A	Enthalpy Dry Air, kJ/kg	-1.65
	CMBSTNa Item [84]: ([16B]x[18B]+[16A]x[18D])/100		2B	Enthalpy Water Vapor, kJ/kg	-3.05
3	Average Exit Gas T (Excl Lkg)	162.6	3A	Enthalpy Dry Gas, kJ/kg	137.79
	from CMBSTNa [88]		3B	Enthalpy Steam @ 1 psia, kJ/kg	2804.6
			3C	Enthalpy Water Vapor, kJ/kg	259.98
4	Fuel Temperature	21.5	4A	Enthalpy Fuel, kJ/kg	-4.81
	HOT AIR QUALITY CONTROL EQUIPMENT				
5	Entering Gas Temperature	0.0	5A	Enthalpy Wet Gas	0.00
6	Leaving Gas Temperature	0.0	6A	Enthalpy of Wet Gas	0.00
			6B	Enthalpy of Wet Air	0.00
			6C	Enthalpy of Wet Air @ T = [3]	0.00
	RESULTS FROM COMBUSTION CALCULATION FORM CMBSTN				
10	Dry Gas Weight, kg/100 kJ [77]	4.014	18	Unburned Carbon, % [2]	0.217
11	Dry Air Weight [69]	3.836	19	HHV kJ/kg 'as-fired' [1]	23614.0
12	Water from H2 Fuel [34E]	0.140		**HOT AQC EQUIPMENT**	
13	Water from H2O Fuel [34F]	0.080	20	Wet Gas Entering [75E]	0.00
14	Water from H2Ov Fuel [34G]	0.000	21	H2O in Wet Gas, % [78E]	0.00
15	Moisture in Air kg/kg DA [7]	0.01109	22	Wet Gas Leaving [75L]	0.00
16	Moisture in Air kg/100 kJ [72]	0.043	23	Residue in Wet Gas, % [81E]	0.00
17	Fuel Rate Est. kg/hr [3]	52263			
			25	Excess Air, % [95]	45.95
	MISCELLANEOUS				
30	Unit Output, MJ/hr	1083841	31	Aux Equip Power, MJ/hr	4079
32	Loss Due to Surface Radiation and Convection, %				0.25

PLANT NAME :	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO :	DATE :	LOAD	95%
TIME START :	TIME END :	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form EFFb Efficiency Calculations

	LOSSES, % Enter Calculated Result in % Column [B]			A	MKB	B	%
60	Dry Gas	[10] x [3A]	/100				
		x	/100				5.531
61	Water from H2 Fuel	[12] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					3.791
62	Water from H2O Fuel	[13] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					2.170
63	Water from H2O Fuel	[14] x ([3C]) / 100					
		x / 100					0.000
64	Moisture in Air	[16] x [3C] / 100					
		x / 100					0.111
65	Unburned Carbon in Ref [18] x 33700 / [19] =	x 33700/					0.310
66	Sensible Heat of Refuse from Form RES						0.061
67	Hot AQC Equip ([20] x ([5A] - [6A]) - ([22] - [20]) x ([6C] - [6B])) / 100						
	(x (-) - (-) x (-)) / 100						0.000
68	Other Losses, % Basis from Form EFFc Item [110]						0.450
69	Summation of Losses, % Basis						12.424
	LOSSES, MJ/hr Enter in MKB Column [A]						
75	Surface Radiation and Convection from Form EFFa Item [32]				0.000		
76	Sorbent Calcination / Dehydration from Form SRBc Item [77]				0.000		
77	Water from Sorbent from Form SRBc Item [65]				0.000		
80	Other Losses, MJ/hr Basis from Form EFFc Item [111]				0.000		
81	Summation of Losses, MJ/hr Basis				0.000		
	CREDITS, % Enter Calculation Result in % Column [B]						
85	Entering Dry Air	[11] x [2A]	/100				
		x	/100				-0.063
86	Moisture in Air	[16] x [2B]	/100				
		x	/100				-0.001
87	Sensible Heat in Fuel	100 x [4A]	/ [19]				
		100 x	/				-0.020
88	Sulfation from Form SRBc Item [80]						0.000
89	Other Credits, % Basis from Form EFFc Item [112]						0.000
90	Summation of Credits, % Basis						-0.085
	CREDITS, MJ/hr Enter Calculated Result in MKB Column [A]						
95	Auxiliary Equipment Power [31]				4078.8		
96	Sensible Heat from Sorbent from Form SRBc Item [85]				0.000		
97	Other Credits, MJ/hr Basis from Form EFFc Item [113B]				0.000		
98	Summation of Credits, MJ/hr Basis				4078.8		
100	Fuel Eff, % (100 - [69] + [90]) x [30] / ([30] + [81] - [98])						
	(100 - +) x / (+ -)						87.82
101	Input from Fuel, MJ/hr 100 x [30] / [100] = 100 x /				1234133		
102	Fuel Rate, kg/hr 1,000 x [101] / [19] = 1,000 x /						52263

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	2	DATE :	16-Dec-15	LOAD	95%
TIME START :	9:00	TIME END :	11:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 2 of 3	

Form EFFc Efficiency Calculations

Other Losses and Credits

The losses and credits listed on this sheet are not universally applicable to all fossil fired steam generators and are usuall minor. Losses/credits that have not been specifically identified by this Code but are applicable in accordance with th intent of the Code should also be recorded on this sheet

Parties to the test may agree to estimate the losses or credits in lieu of testing Enter a 'T' for tested or 'E' for esimate in the second column, and result in the appropriate column

Enter the sum of each group on Form EFFb.

Refer to the text of PTC 4 for the calculation method.

Itm	T or E	LOSSES, % Enter Calculated Result in % Column[B]	A MKB	B %
110A		CO in Flue Gas		0.000
110B		Formation of NOx		0.000
110C		Pulverizer Rejects		0.000
110D		Air Infiltration		0.000
110E		Unburned Hydrocarbons in Flue Gas		0.000
110F		Unburned Hydrogen in Refuse		0.000
110G	E	Unmeasured Loss, as per agreement		0.200
110H	E	Surface Radiation Loss, as per agreement		0.250
110		Summation of Other Losses, % Basis		0.450
		LOSSES, MJ/hr Enter in MKB Column [A]		
111A		Wet Ash Pit	0.000	
111B		Sensible Heat in Recycle Streams, Solid	0.000	
111C		Sensible Heat in Recycle Streams, Gas	0.000	
111D		Additional Moisture	0.000	
111E		Cooling Water	0.000	
111F		Air Preheater Coil (supplied by Unit)	0.000	
111G		Other	0.000	
111		Summation of other Losses, MJ/hr Basis	0.000	
		CREDITS, % Enter Calculation Result in % Column [B]		
112A		Other		0.000
112		Summation of Credits, % Basis		0.000
		CREDITS, MJ/hr Enter Result in MKB Column [A]		
113A		Heat in Additional Moisture (external to envelope)	0.000	
113B		Other	0.000	
113C		Heat by Auxiliary Equipment Power	4078.8	
113		Summation of Credits, MJ/hr Basis	4078.8	

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 2	DATE : 16-Dec-15	LOAD	95%
TIME START : 9:00	TIME END : 11:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

APPENDIX G3

Results ASME PTC 4 Heat Balance Method Test at 90% Load

Form CMBSTNa Combustion Calculations

No.	Description	Reference	Note		Value		Value
	DATA REQUIRED						
1	HHV - Higher Heating value of Fuel, kJ/kg as fired, from Input Data Sheet [1]						23542
2	UBC - Unburned Carbon, kg/ 100 kg fuel from RES [11] or SRBb FORM						0.153
3	Fuel Flow, kg/hr [4b]						49881
4	a. Measured Fuel Flow				44964.0		
4	b. Calculated Fuel Flow 100,000 x [5] / [6] / [1]				49881.3		
5	Output, MJ/hr	from Output Item [37]			1031710		
6	Fuel Efficiency, % (estimate initially), from Input Data Sheet [6]				87.86		
7	Moisture in air, kg/kg Dry Air				0.01012		
8	Barometric Pressure, mbar, from Input Data Sheet [8]				1008.2		
9	Dry Bulb Temerature, °C,	from Input Data Sheet [9]			21.2		
10	Wet Bulb Temperature, °C,	from Input Data Sheet [10]			16.8		
11	Relative Humidity, %,	from Input Data Sheet [11]			64.0		
	Additional Moisture (Measured)		kg/hr				
	Atomizing Steam	from Output Item [14]	kg/hr		0.0		
	Sootblowing Steam	from Output Item [11]	kg/hr		0.0		
	Other		kg/hr		0.0		
12	Summation Addition Moisture				0.0		
13	Additional Moisture,kg/ 100 kg Fuel 100 x [12] / [3]						0.0
14	Additional Moisture, kg/100 kJ	[13] / ([1] / 100)					0.0
	If Air Heater (Excl Stm/ Wtr Coil) Enter following						
15	Gas Temp Lvg AH, °C,	from Input Data Sheet [15]	Primairy / Secundairy or Main			**15A**	143.1
16	Air Temp Ent AH, °C,	from Input Data Sheet [16]	Primairy / Secundairy or Main	**16B**	26.4	**16A**	27.0
17	O2 in FG Ent Air Heater, %,	from Input Data Sheet [17]	Primairy / Secundairy or Main			**17A**	3.54
18	O2 in FG Lvg Air Heater, %,	from Input Data Sheet [18]	Primairy / Secundairy or Main			**18A**	6.73
18a	Mass Flow Fraction, %,	from Input Data Sheet [18a]	Primairy / Secundairy or Main	**18C**	66.26	**18D**	33.74
19	Mass Ash, kg/100 kJ 100 x [30J] / [1]						0.024
	If mass of ash (item [19]) exceeds 0.065 kg/100 kJ or Sorbent						
	utilized, Enter Mass Fraction of Refuse in Col [79] for each location						
	SORBENT DATA (Enter 0 if Sorbent not Used)						0
20	Sorbent Rate, kg/hr						0.000
21	CO2 from Sorbent, kg/ 100 kg Sorbent	from SRBa item [25I]					0.000
22	H2O from Sorbent, kg/ 100 kg Sorbent	from SRBa item [26I]					0.000
23	Sulfur Capture, kg/kg Sulfer	from SRBb item [45]					0.000
24	Spent Sorbent, kg/ 100 kg fuel	from SRBb item [48]					0.000
25	Sorb/Fuel Ratio, kg Sorb / kg Fuel	[20]/[3]					0.000
	HOT AIR QUALITY CONTROL EQUIPMENT DATA						
26	O2 in FG Ent HAQC Flue Gas Temperatures						N/A
	See Form EFFa for HAQC Flue Gas Temperatures						

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 3	DATE : 16-Dec-15	LOAD	90%
TIME START : 12:45	TIME END : 14:45	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form CMBSTNb Combustion Calculations

	COMBUSTION PRODUCTS										
30	from Input Data Sheet Ultimate Analysis % Mass			31	Theo Air Flow kg/100kg Fuel [30] x K	32	Dry Prod Flow Mol/100 kg Fuel [30] / K	33	Wet Prod Flow Mol/100 kg Fuel [30] / K	34	H2O Fuel kg/100 kJ [30] x K / ([1]) / 100
A	C	59.24									
B	UBC		0.153								
C	Cb		59.09	11.51	680.09	12.0110	4.919				
D	S	0.46		4.31	1.98	32.0640	0.014				
E	H2	3.71		34.29	127.22			2.0159	1.840	8.937	0.141
F	H2O	18.97						18.0153	1.053	1.0	0.081
G	H2Ov	0.00						18.0153	0.000	1.0	0.000
H	N2	0.94				28.0134	0.034				
I	O2	10.98		-4.32	-47.43						
J	ASH	5.70									
K	VM	32.82									
L	FC	42.51									
M	TOTAL	100.00		31	761.85	32	4.967	33	2.893	34	0.221

35	Total Theo Air Fuel Check, kg/100 kJ	([31M] + [30B] x 11.51) / ([1] / 100)	3.244
	CORRECTIONS FOR SORBENT REACTIONS AND SULFUR CAPTURE		
40	CO2 from Sorb, kg/100 kg fuel	[21] x [25]	0.000
41	H2O from Sorb, kg/100 kg fuel	[22] x [25]	0.000
42	SO2 Reduction, Mol/100 kg fuel	[32D] x [23]	0.000
43	Dry Prod Comb, Mol/100 kg fuel	[32M] + [40] / 44.01 - [42]	4.967
44	Wet Prod Comb, Mol/100 kg fuel	[33M] + [41] / 18.0153 + [43]	7.861
46	Theo Air Corr, kg/100 kg fuel	[31M] +2.16 x [30D] x [23]	761.85
47	Theo Air Corr, Mol/100 kg fuel	[46] / 28.9625	26.305
48	Theo Air Corr, kg/100 kJ	[46] / ([1] / 100)	3.236
49	Wet Gas from Fuel, kg/100 kJ	(100 - [30J] - [30B] - [30D] x [23]) / ([1] / 100)	0.400

	LOCATION			AH In	AH Out
50	Flue Gas Temperature Entering Air heater °C			360.3	143.1
51	Air Temperature Leaving Air Heater, °C			26.62	329.0
52	Flue Gas Oxygen Content, %			3.540	6.730
	FLUE GAS ANALYSIS, Mol/100 kg Fuel	Dry	Wet		
53	Moisture in Air	0	[7] x 1.608	0.00	0.00
54	Dry/Wet Products Comb	[43]	[44]	4.967	4.967
55	Additional Moisture	0	[13] / 18.0153	0.00	0.00
56	[47] x (0.7905 + [53])			20.79	20.79
57	Summation [54] + [55] + [56]			25.76	25.76
58	20.95 - [52] x (1 + [53])			17.41	14.22
60	Excess Air, % 100 x [52] x [57] / [47] / [58]			19.91	46.35

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	3	DATE :	16-Dec-15	LOAD	90%
TIME START :	12:45	TIME END :	14:45	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 2 of 3	

Form CMBSTNc Combustion Calculations

	LOCATION				AH In	AH Out
60	Excess Air, %				19.91	46.35
	02, CO2, SO2, WHEN EXCESS AIR KNOWN					
61						
62	Dry	[47] x (0.7905 + ([60] / 100))			26.03	32.99
63	Wet	[47] x (0.7905 + [53] + (1 + [53]) x [60] / 100)			26.03	32.99
64	Dry Gas, Mol/100 kg Fuel	[43] + [62]			31.00	37.95
65	Wet Gas, Mol/100 kg Fuel	[44] + [63] + [13] / 18.015			33.89	40.85
			Dry	Wet		
66	O2, %	[60] x [47] x 0.2095 / [65]	[64]	[65]	3.24	6.25
67	CO2,%	([30c]/0.1201+[40]/0.4401)/[65]	[64]	[65]	14.52	12.04
68	SO2,ppm	(1-[23]) x [30D] / 0.32064 / [65]	[64]	[65]	423.3	351.2
	FLUE GAS PRODUCTS, kg/100 kJ					
69	Dry Air	(1 + [60] / 100) x [48]			3.881	4.736
70	Wet Gas from Fuel	[49]			0.400	0.400
71	CO2 from Sorbent	[40] / ([1] / 100)			0.000	0.000
72	Moisture in Air	[7] x [69]			0.039	0.048
73	Water from Sorbent	[41] / ([1] / 100)			0.000	0.000
74	Additional Moisture	[14]			0.000	0.000
75	Total Wet Gas	[69] + [70] + [71] + [72] + [73] + [74]			4.320	5.184
76	H2O in Wet Gas	[34M] + [72] + [73] + [74]			0.261	0.269
77	Dry Gas	[75] - [76]			4.059	4.915
78	H2O in Wet Gas, % Mass	100 x [76] / [75]			6.03	5.20
79	Residue, kg/kg Total Refuse at each location				0.00	0.00
80	Residue, kg/100 kJ	([30J] + [2] + [24]) / ([1] / 100)			0.0249	0.0249
81	Residue in Wet Gas, kg/kg	[79] x [80] / [75] Wet Gas			0.000	0.000
82	Leakage, % Gas Entering	100 x ([75L] - [75E]) / [75E]				20.01
	GAS TEMPERATURE CORRECTION FOR AH LEAKAGE					
83	Gas Temp Lvg (INCL LKG), °C	[15]			360.33	143.06
84	Average AH Air Leakage Temp, °C	([16B] x[18B]+[16A] x[18D])/100			26.62	329.04
85	H Air Lvg, kJ/kg	T=[83], H2O=[7]				120.15
86	H Air Ent, kJ/kg	T=[84], H2O=[7]			1.644	
87	Cpg, kJ/kg°C	T=[83], H2O=[78E], RES=[81E]				1.060
88	AH Gas Outlet Temperature Excluding Leakage, °C [83] + ([82] / 100 x ([85] - [86]) / [87])					165.42
	AIR, GAS, FUEL & RESIDUE MASS FLOW RATES, kg/hr					
90	Input from Fuel, MJ/hr	[5] / [6] x 100				1174306
91	Fuel Rate, kg/hr	1000 x [90] / [1]				49881
92	Residue Rate, kg/hr	[80] x [90] / 10				2920
93	Wet Flue Gas, kg/hr	[75] x [90] / 10			507270	608753
95	Excess Air Lvg Blr, %	[60]				46.35
96	Total Air to Blr, kg/hr	(1 + [95] / 100) x (1 + [7]) x [48] x [90] / 10				561791

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 3	DATE : 16-Dec-15	LOAD	90%
TIME START : 12:45	TIME END : 14:45	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

Form RES Unburned Carbon and Residue Calculation

	DATA REQUIRED FOR RESIDUE SPLIT									
1	Ash in Fuel, %		from Form CMBSTNb [30J]		5.70	**2**	HHV Fuel, kJ/kg 'as fired'			23542
3	Fuel Mass Flow Rate, kg/hr		from Form CMBSTNa [4b]		49881	**4b**	from Form CMBSTNa [1]			
a)	Item [3] - Use measured or estimated value initially. (See CMBSTNa) Recalculate after boiler efficiency has been calculated until estimated value is within 1% of calculated value.									
b)	Residue splits estimated. Enter value in Col [8] and calculate Col [5]. Residue rate measured. Enter measured mass flow rates in Col [5]. Whem residue is not measured at all locations, estimate split and flow for measured locations. Reiterate until estimated total residue is within 2% of calculated.									
c)	Enter the % free carbon in Col [6] (total carbon correcter for CO2). Units with sorbent: Enter the % CO2 in Col [7].									
		5 Residue Mass Flow		**6**	**7**	**8** Residue Split %		**9**	**10**	
	Location	Input kg/hr	Calculated kg/hr	C in Residue %	CO2 in Residue %	Input	Calculated 100 x [5]/[5F]	C Wtd Ave % [6] x [8]/100	CO2 Wtd Ave % [7] x [8]/100	
A	Bottom Ash	0.00	0.00	4.41	5.00	15.00	0.00	0.662	0.750	
B	Fly Ash	0.00	0.00	2.30	2.00	85.00	0.00	1.955	1.700	
C	Economizer	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
D		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
E		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
F	TOTAL	**5** 0.00	0.00			**8** 100.0	0.00	**9** 2.617	**10** 2.450	

	UNITS WITHOUT SORBENT		
11	Unburned Carbon, kg/ 100 kg Fuel	[1] x [9F] / (100 - [9F])	0.153
20	Total Residue, kg/ 100kg Fuel	[1] + [11]	5.85
	UNITS WITH SORBENT		
d)	Enter average C and CO2 in residue, [9F] and [10F] above or SRBa (Items [4] and [5]) and complete Sorbent Calculation Forms.		
11	Unburned Carbon, kg/ 100 kg Fuel	from Form SRBb Item [49]	0.184
20	Total Residue, kg/ 100 Fuel	from Form SRBb Item [50]	7.03
	TOTAL RESIDUE		
21	Total Residue, kg/hr	[20] x[3] /100	2920
e)	When all residue collection locations are measured, the measured residue split is used for calculations. If a portion of the residue mass is estimated, repeat calculation above until Col [5F] and Item [21] agree within 2%.		
22	Total Residue, kg/100 kJ	100 x [20] / [2]	0.025

23	**SENSIBLE HEAT RESIDUE LOSS, %**									
	Location	**24** Temp Residue (°C)	[8] %	x	[22] Residue kg/ 100 kJ	x	H Residue kJ/kg	/ 10,000		Loss %
A	Furnace	1100	15.00	x	0.025	x	1205.2	/ 10,000		0.045
B	Fly Ash	120	85.00	x	0.025	x	76.7	/ 10,000		0.016
C	Economizer	0	0.00	x	0.025	x	-30.1	/ 10,000		0.000
D		0								0.000
E		0								0.000
								Total	**25**	0.061

H Residue = 0.16 x T + 1.09E-4 x T^2 - 2.843E-8 x T^3 - 12.95

PLANT NAME :	NORGENER ASME PTC 4 MASTER FORM			UNIT NO.	2
TEST NO :	3	DATE:	16-Dec-15	LOAD	90%
TIME START :	12:45	TIME END :	14:45	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 1	

Form EFFa Efficiency Calculations
Data

	TEMPERATURES,°C				
1	Reference Temperature, °C	25.0	1A	Enthalpy Water (0°C Ref), kJ/kg	104.57
2	Average Entering Air Temp, from	26.62	2A	Enthalpy Dry Air, kJ/kg	1.63
	CMBSTNa Item [84]: ([16B]x[18B]+[16A]x[18D])/100		2B	Enthalpy Water Vapor, kJ/kg	3.02
3	Average Exit Gas T (Excl Lkg)	165.4	3A	Enthalpy Dry Gas, kJ/kg	140.65
	from CMBSTNa [88]		3B	Enthalpy Steam @ 1 psia, kJ/kg	2809.9
			3C	Enthalpy Water Vapor, kJ/kg	265.38
4	Fuel Temperature	21.2	4A	Enthalpy Fuel, kJ/kg	-5.16
	HOT AIR QUALITY CONTROL EQUIPMENT				
5	Entering Gas Temperature	0.0	5A	Enthalpy Wet Gas	0.00
6	Leaving Gas Temperature	0.0	6A	Enthalpy of Wet Gas	0.00
			6B	Enthalpy of Wet Air	0.00
			6C	Enthalpy of Wet Air @ T = [3]	0.00
	RESULTS FROM COMBUSTION CALCULATION FORM CMBSTN				
10	Dry Gas Weight, kg/100 kJ [77]	4.059	18	Unburned Carbon, % [2]	0.153
11	Dry Air Weight [69]	3.881	19	HHV kJ/kg 'as-fired' [1]	23542.0
12	Water from H2 Fuel [34E]	0.141		**HOT AQC EQUIPMENT**	
13	Water from H2O Fuel [34F]	0.081	20	Wet Gas Entering [75E]	0.00
14	Water from H2Ov Fuel [34G]	0.000	21	H2O in Wet Gas, % [78E]	0.00
15	Moisture in Air kg/kg DA [7]	0.01012	22	Wet Gas Leaving [75L]	0.00
16	Moisture in Air kg/100 kJ [72]	0.039	23	Residue in Wet Gas, % [81E]	0.00
17	Fuel Rate Est. kg/hr [3]	49881			
			25	Excess Air, % [95]	46.35
	MISCELLANEOUS				
30	Unit Output, MJ/hr	1031710	31	Aux Equip Power, MJ/hr	4097
32	Loss Due to Surface Radiation and Convection, %				0.25

PLANT NAME :	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO :	DATE :	LOAD	90%
TIME START :	TIME END :	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form EFFb Efficiency Calculations

	LOSSES, % Enter Calculated Result in % Column [B]			A	MKB	B	%
60	Dry Gas	[10] x [3A]	/100				
		x	/100				5.709
61	Water from H2 Fuel	[12] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					3.810
62	Water from H2O Fuel	[13] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					2.180
63	Water from H2O Fuel	[14] x ([3C]) / 100					
		x / 100					0.000
64	Moisture in Air	[16] x [3C] / 100					
		x / 100					0.104
65	Unburned Carbon in Ref [18] x 33700 / [19] =	x 33700/					0.219
66	Sensible Heat of Refuse from Form RES						0.061
67	Hot AQC Equip ([20] x ([5A] - [6A]) - ([22] - [20]) x ([6C] - [6B])) / 100						
	(x (-) - (-) x (-)) / 100						0.000
68	Other Losses, % Basis from Form EFFc Item [110]						0.450
69	Summation of Losses, % Basis						12.534
	LOSSES, MJ/hr Enter in MKB Column [A]						
75	Surface Radiation and Convection from Form EFFa Item [32]				0.000		
76	Sorbent Calcination / Dehydration from Form SRBc Item [77]				0.000		
77	Water from Sorbent from Form SRBc Item [65]				0.000		
80	Other Losses, MJ/hr Basis from Form EFFc Item [111]				0.000		
81	Summation of Losses, MJ/hr Basis				0.000		
	CREDITS, % Enter Calculation Result in % Column [B]						
85	Entering Dry Air	[11] x [2A]	/100				
		x	/100				0.063
86	Moisture in Air	[16] x [2B]	/100				
		x	/100				0.001
87	Sensible Heat in Fuel	100 x [4A]	/ [19]				
		100 x	/				-0.022
88	Sulfation from Form SRBc Item [80]						0.000
89	Other Credits, % Basis from Form EFFc Item [112]						0.000
90	Summation of Credits, % Basis						0.043
	CREDITS, MJ/hr Enter Calculated Result in MKB Column [A]						
95	Auxiliary Equipment Power [31]				4096.8		
96	Sensible Heat from Sorbent from Form SRBc Item [85]				0.000		
97	Other Credits, MJ/hr Basis from Form EFFc Item [113B]				0.000		
98	Summation of Credits, MJ/hr Basis				4096.8		
100	Fuel Eff, % (100 - [69] + [90]) x [30] / ([30] + [81] - [98])						
	(100 - +) x / (+ -)						87.86
101	Input from Fuel, MJ/hr 100 x [30] / [100] = 100 x /				1174303		
102	Fuel Rate, kg/hr 1,000 x [101] / [19] = 1,000 x /						49881

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	3	DATE :	16-Dec-15	LOAD	90%
TIME START :	12:45	TIME END :	14:45	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 2 of 3	

Form EFFc Efficiency Calculations
Other Losses and Credits

The losses and credits listed on this sheet are not universally applicable to all fossil fired steam generators and are usuall minor. Losses/credits that have not been specifically identified by this Code but are applicable in accordance with th intent of the Code should also be recorded on this sheet

Parties to the test may agree to estimate the losses or credits in lieu of testing Enter a 'T' for tested or 'E' for esimate in the second column, and result in the appropriate column

Enter the sum of each group on Form EFFb.

Refer to the text of PTC 4 for the calculation method.

Itm	T or E	LOSSES, % Enter Calculated Result in % Column[B]	A MKB	B %
110A		CO in Flue Gas		0.000
110B		Formation of NOx		0.000
110C		Pulverizer Rejects		0.000
110D		Air Infiltration		0.000
110E		Unburned Hydrocarbons in Flue Gas		0.000
110F		Unburned Hydrogen in Refuse		0.000
110G	E	Unmeasured Loss, as per agreement		0.200
110H	E	Surface Radiation Loss, as per agreement		0.250
110		Summation of Other Losses, % Basis		0.450
		LOSSES, MJ/hr Enter in MKB Column [A]		
111A		Wet Ash Pit	0.000	
111B		Sensible Heat in Recycle Streams, Solid	0.000	
111C		Sensible Heat in Recycle Streams, Gas	0.000	
111D		Additional Moisture	0.000	
111E		Cooling Water	0.000	
111F		Air Preheater Coil (supplied by Unit)	0.000	
111G		Other	0.000	
111		Summation of other Losses, MJ/hr Basis	0.000	
		CREDITS, % Enter Calculation Result in % Column [B]		
112A		Other		0.000
112		Summation of Credits, % Basis		0.000
		CREDITS, MJ/hr Enter Result in MKB Column [A]		
113A		Heat in Additional Moisture (external to envelope)	0.000	
113B		Other	0.000	
113C		Heat by Auxiliary Equipment Power	4096.8	
113		Summation of Credits, MJ/hr Basis	4096.8	

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 3	DATE : 16-Dec-15	LOAD	90%
TIME START : 12:45	TIME END : 14:45	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

APPENDIX G4

Results ASME PTC 4 Heat Balance Method Test at 80% Load

Form CMBSTNa Combustion Calculations

	DATA REQUIRED				
1	HHV - Higher Heating value of Fuel, kJ/kg as fired, from Input Data Sheet [1]				23777
2	UBC - Unburned Carbon, kg/ 100 kg fuel from RES [11] or SRBb FORM				0.193
3	Fuel Flow, kg/hr [4b]				43569
4	a. Measured Fuel Flow			38844.0	
4	b. Calculated Fuel Flow 100,000 x [5] / [6] / [1]			43569.5	
5	Output, MJ/hr from Output Item [37]			914476	
6	Fuel Efficiency, % (estimate initially), from Input Data Sheet [6]			88.27	
7	Moisture in air, kg/kg Dry Air			0.00951	
8	Barometric Pressure, mbar, from Input Data Sheet [8]			1008.2	
9	Dry Bulb Temerature, °C, from Input Data Sheet [9]			20.8	
10	Wet Bulb Temperature, °C, from Input Data Sheet [10]			16.1	
11	Relative Humidity, %, from Input Data Sheet [11]			61.6	
	Additional Moisture (Measured)	kg/hr			
	Atomizing Steam from Output Item [14]	kg/hr		0.0	
	Sootblowing Steam from Output Item [11]	kg/hr		0.0	
	Other	kg/hr		0.0	
12	Summation Addition Moisture			0.0	
13	Additional Moisture,kg/ 100 kg Fuel 100 x [12] / [3]				0.0
14	Additional Moisture, kg/100 kJ [13] / ([1] / 100)				0.0
	If Air Heater (Excl Stm/ Wtr Coil) Enter following				
15	Gas Temp Lvg AH, °C, from Input Data Sheet [15]	Primairy / Secundairy or Main		**15A**	132.4
16	Air Temp Ent AH, °C, from Input Data Sheet [16]	Primairy / Secundairy or Main	**16B** 25.4	**16A**	26.1
17	O2 in FG Ent Air Heater, %, from Input Data Sheet [17]	Primairy / Secundairy or Main		**17A**	3.80
18	O2 in FG Lvg Air Heater, %, from Input Data Sheet [18]	Primairy / Secundairy or Main		**18A**	7.09
18a	Mass Flow Fraction, %, from Input Data Sheet [18a]	Primairy / Secundairy or Main	**18C** 69.84	**18D**	30.16
19	Mass Ash, kg/100 kJ 100 x [30J] / [1]				0.024
	If mass of ash (item [19]) exceeds 0.065 kg/100 kJ or Sorbent				
	utilized, Enter Mass Fraction of Refuse in Col [79] for each location				
	SORBENT DATA (Enter 0 if Sorbent not Used)				0
20	Sorbent Rate, kg/hr				0.000
21	CO2 from Sorbent, kg/ 100 kg Sorbent	from SRBa item [25I]			0.000
22	H2O from Sorbent, kg/ 100 kg Sorbent	from SRBa item [26I]			0.000
23	Sulfur Capture, kg/kg Sulfer	from SRBb item [45]			0.000
24	Spent Sorbent, kg/ 100 kg fuel	from SRBb item [48]			0.000
25	Sorb/Fuel Ratio, kg Sorb / kg Fuel	[20]/[3]			0.000
	HOT AIR QUALITY CONTROL EQUIPMENT DATA				
26	O2 in FG Ent HAQC Flue Gas Temperatures				N/A
	See Form EFFa for HAQC Flue Gas Temperatures				

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 4	DATE : 17-Dec-15	LOAD	80%
TIME START : 9:30	TIME END : 11:30	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form CMBSTNb Combustion Calculations

COMBUSTION PRODUCTS											
30	from Input Data Sheet Ultimate Analysis % Mass			**31**	Theo Air Flow kg/100kg Fuel [30] x K	**32**	Dry Prod Flow Mol/100 kg Fuel [30] / K	**33**	Wet Prod Flow Mol/100 kg Fuel [30] / K	**34**	H2O Fuel kg/100 kJ [30] x K / ([1]) / 100
A	C	59.79									
B	UBC		0.193								
C	Cb		59.60	11.51	685.96	12.0110	4.962				
D	S	0.44		4.31	1.90	32.0640	0.014				
E	H2	3.74		34.29	128.24			2.0159	1.855	8.937	0.141
F	H2O	18.24						18.0153	1.012	1.0	0.077
G	H2Ov	0.00						18.0153	0.000	1.0	0.000
H	N2	1.12				28.0134	0.040				
I	O2	11.08		-4.32	-47.87						
J	ASH	5.59									
K	VM	33.22									
L	FC	42.94									
M	TOTAL	100.00		31	768.23	32	5.016	33	2.868	34	0.217

35	Total Theo Air Fuel Check, kg/100 kJ	([31M] + [30B] x 11.51) / ([1] / 100)	3.240

CORRECTIONS FOR SORBENT REACTIONS AND SULFUR CAPTURE			
40	CO2 from Sorb, kg/100 kg fuel	[21] x [25]	0.000
41	H2O from Sorb, kg/100 kg fuel	[22] x [25]	0.000
42	SO2 Reduction, Mol/100 kg fuel	[32D] x [23]	0.000
43	Dry Prod Comb, Mol/100 kg fuel	[32M] + [40] / 44.01 - [42]	5.016
44	Wet Prod Comb, Mol/100 kg fuel	[33M] + [41] / 18.0153 + [43]	7.883
46	Theo Air Corr, kg/100 kg fuel	[31M] +2.16 x [30D] x [23]	768.23
47	Theo Air Corr, Mol/100 kg fuel	[46] / 28.9625	26.525
48	Theo Air Corr, kg/100 kJ	[46] / ([1] / 100)	3.231
49	Wet Gas from Fuel, kg/100 kJ	(100 - [30J] - [30B] - [30D] x [23]) / ([1] / 100)	0.396

LOCATION		AH In	AH Out
50	Flue Gas Temperature Entering Air heater °C	344.0	132.4
51	Air Temperature Leaving Air Heater, °C	25.59	312.4
52	Flue Gas Oxygen Content, %	3.800	7.090

FLUE GAS ANALYSIS, Mol/100 kg Fuel		Dry	Wet		
53	Moisture in Air	0	[7] x 1.608	0.00	0.00
54	Dry/Wet Products Comb	[43]	[44]	5.016	5.016
55	Additional Moisture	0	[13] / 18.0153	0.00	0.00
56	[47] x (0.7905 + [53])			20.97	20.97
57	Summation [54] + [55] + [56]			25.98	25.98
58	20.95 - [52] x (1 + [53])			17.15	13.86
60	Excess Air, %	100 x [52] x [57] / [47] / [58]		21.71	50.11

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 4	DATE : 17-Dec-15	LOAD	80%
TIME START : 9:30	TIME END : 11:30	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 2 of 3	

Form CMBSTNc Combustion Calculations

								AH In	AH Out
	LOCATION							AH In	AH Out
60	Excess Air, %							21.71	50.11
	02, CO2, SO2, WHEN EXCESS AIR KNOWN								
61									
62	Dry	[47] x (0.7905 + ([60] / 100))						26.73	34.26
63	Wet	[47] x (0.7905 + [53] + (1 + [53]) x [60] / 100)						26.73	34.26
64	Dry Gas, Mol/100 kg Fuel	[43] + [62]						31.74	39.28
65	Wet Gas, Mol/100 kg Fuel	[44] + [63] + [13] / 18.015						34.61	42.14
			Dry	Wet					
66	O2, %	[60] x [47] x 0.2095 / [65]	[64]	[65]				3.49	6.61
67	CO2,%	([30c]/0.1201+[40]/0.4401)/[65]	[64]	[65]				14.34	11.77
68	SO2,ppm	(1-[23]) x [30D] / 0.32064 / [65]	[64]	[65]				396.5	325.6
	FLUE GAS PRODUCTS, kg/100 kJ								
69	Dry Air	(1 + [60] / 100) x [48]						3.932	4.850
70	Wet Gas from Fuel	[49]						0.396	0.396
71	CO2 from Sorbent	[40] / ([1] / 100)						0.000	0.000
72	Moisture in Air	[7] x [69]						0.037	0.046
73	Water from Sorbent	[41] / ([1] / 100)						0.000	0.000
74	Additional Moisture	[14]						0.000	0.000
75	Total Wet Gas	[69] + [70] + [71] + [72] + [73] + [74]						4.366	5.292
76	H2O in Wet Gas	[34M] + [72] + [73] + [74]						0.255	0.263
77	Dry Gas	[75] - [76]						4.111	5.029
78	H2O in Wet Gas, % Mass	100 x [76] / [75]						5.83	4.98
79	Residue, kg/kg Total Refuse at each location							0.00	0.00
80	Residue, kg/100 kJ	([30J] + [2] + [24]) / ([1] / 100)						0.0243	0.0243
81	Residue in Wet Gas, kg/kg	[79] x [80] / [75] Wet Gas						0.000	0.000
82	Leakage, % Gas Entering	100 x ([75L] - [75E]) / [75E]							21.22
	GAS TEMPERATURE CORRECTION FOR AH LEAKAGE								
83	Gas Temp Lvg (INCL LKG), °C	[15]						344.03	132.39
84	Average AH Air Leakage Temp, °C	([16B] x[18B]+[16A] x[18D])/100						25.59	312.41
85	H Air Lvg, kJ/kg	T=[83], H2O=[7]							109.17
86	H Air Ent, kJ/kg	T=[84], H2O=[7]						0.597	
87	Cpg, kJ/kg°C	T=[83], H2O=[78E], RES=[81E]							1.055
88	AH Gas Outlet Temperature Excluding Leakage, °C [83] + ([82] / 100 x ([85] - [86]) / [87])								154.22
	AIR, GAS, FUEL & RESIDUE MASS FLOW RATES, kg/hr								
90	Input from Fuel, MJ/hr	[5] / [6] x 100							1035951
91	Fuel Rate, kg/hr	1000 x [90] / [1]							43569
92	Residue Rate, kg/hr	[80] x [90] / 10							2520
93	Wet Flue Gas, kg/hr	[75] x [90] / 10						452290	548270
95	Excess Air Lvg Blr, %	[60]							50.11
96	Total Air to Blr, kg/hr	(1 + [95] / 100) x (1 + [7]) x [48] x [90] / 10							507220

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 4	DATE : 17-Dec-15	LOAD	80%
TIME START : 9:30	TIME END : 11:30	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

Form RES Unburned Carbon and Residue Calculation

	DATA REQUIRED FOR RESIDUE SPLIT					
1	Ash in Fuel, %	from Form CMBSTNb [30J]	5.59	2	HHV Fuel, kJ/kg 'as fired'	23777
3	Fuel Mass Flow Rate, kg/hr	from Form CMBSTNa [4b]	43569	4b	from Form CMBSTNa [1]	

a) Item [3] - Use measured or estimated value initially. (See CMBSTNa)
Recalculate after boiler efficiency has been calculated until estimated value is within 1% of calculated value.

b) Residue splits estimated. Enter value in Col [8] and calculate Col [5].
Residue rate measured. Enter measured mass flow rates in Col [5]. Whem residue is not measured at all locations, estimate split and flow for measured locations. Reiterate until estimated total residue is within 2% of calculated.

c) Enter the % free carbon in Col [6] (total carbon correcter for CO2). Units with sorbent: Enter the % CO2 in Col [7].

	Location	5 Residue Mass Flow Input kg/hr	Calculated kg/hr	6 C in Residue %	7 CO2 in Residue %	8 Residue Split % Input	Calculated 100 x [5]/[5F]	9 C Wtd Ave % [6] x [8]/100	10 CO2 Wtd Ave % [7] x [8]/100
A	Bottom Ash	0.00	0.00	10.09	5.00	15.00	0.00	1.514	0.750
B	Fly Ash	0.00	0.00	2.15	2.00	85.00	0.00	1.828	1.700
C	Economizer	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
D		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
E		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
F	TOTAL	5 0.00	0.00			8 100.0	0.00	9 3.341	10 2.450

	UNITS WITHOUT SORBENT		
11	Unburned Carbon, kg/ 100 kg Fuel	[1] x [9F] / (100 - [9F])	0.193
20	Total Residue, kg/ 100kg Fuel	[1] + [11]	5.78
	UNITS WITH SORBENT		
d)	Enter average C and CO2 in residue, [9F] and [10F] above or SRBa (Items [4] and [5]) and complete Sorbent Calculation Forms.		
11	Unburned Carbon, kg/ 100 kg Fuel	from Form SRBb Item [49]	0.231
20	Total Residue, kg/ 100 Fuel	from Form SRBb Item [50]	6.92
	TOTAL RESIDUE		
21	Total Residue, kg/hr	[20] x[3] /100	2520
e)	When all residue collection locations are measured, the measured residue split is used for calculations. If a portion of the residue mass is estimated, repeat calculation above until Col [5F] and Item [21] agree within 2%.		
22	Total Residue, kg/100 kJ	100 x [20] / [2]	0.024

23	SENSIBLE HEAT RESIDUE LOSS, %								
	Location	24 Temp Residue (°C)	[8] %	x	[22] Residue kg/ 100 kJ	x	H Residue kJ/kg	/ 10,000	Loss %
A	Furnace	1100	15.00	x	0.024	x	1205.2	/ 10,000	0.044
B	Fly Ash	120	85.00	x	0.024	x	76.7	/ 10,000	0.016
C	Economizer	0	0.00	x	0.024	x	-30.1	/ 10,000	0.000
D		0							0.000
E		0							0.000
								Total 25	0.060

H Residue = 0.16 x T + 1.09E-4 x T^2 - 2.843E-8 x T^3 - 12.95

PLANT NAME :	NORGENER ASME PTC 4 MASTER FORM			UNIT NO.	2
TEST NO :	4	DATE:	17-Dec-15	LOAD	80%
TIME START :	9:30	TIME END :	11:30	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 1	

Form EFFa Efficiency Calculations

Data

	TEMPERATURES,°C					
1	Reference Temperature, °C	25.0	1A	Enthalpy Water (0°C Ref), kJ/kg		104.57
2	Average Entering Air Temp, from	25.59	2A	Enthalpy Dry Air, kJ/kg		0.59
	CMBSTNa Item [84]: ([16B]x[18B]+[16A]x[18D])/100		2B	Enthalpy Water Vapor, kJ/kg		1.10
3	Average Exit Gas T (Excl Lkg)	154.2	3A	Enthalpy Dry Gas, kJ/kg		129.25
	from CMBSTNa [88]		3B	Enthalpy Steam @ 1 psia, kJ/kg		2788.5
			3C	Enthalpy Water Vapor, kJ/kg		243.88
4	Fuel Temperature	20.8	4A	Enthalpy Fuel, kJ/kg		-5.70
	HOT AIR QUALITY CONTROL EQUIPMENT					
5	Entering Gas Temperature	0.0	5A	Enthalpy Wet Gas		0.00
6	Leaving Gas Temperature	0.0	6A	Enthalpy of Wet Gas		0.00
			6B	Enthalpy of Wet Air		0.00
			6C	Enthalpy of Wet Air @ T = [3]		0.00
	RESULTS FROM COMBUSTION CALCULATION FORM CMBSTN					
10	Dry Gas Weight, kg/100 kJ [77]	4.111	18	Unburned Carbon, %	[2]	0.193
11	Dry Air Weight [69]	3.932	19	HHV kJ/kg 'as-fired'	[1]	23777.0
12	Water from H2 Fuel [34E]	0.141		**HOT AQC EQUIPMENT**		
13	Water from H2O Fuel [34F]	0.077	20	Wet Gas Entering	[75E]	0.00
14	Water from H2Ov Fuel [34G]	0.000	21	H2O in Wet Gas, %	[78E]	0.00
15	Moisture in Air kg/kg DA [7]	0.00951	22	Wet Gas Leaving	[75L]	0.00
16	Moisture in Air kg/100 kJ [72]	0.037	23	Residue in Wet Gas, %	[81E]	0.00
17	Fuel Rate Est. kg/hr [3]	43569				
			25	Excess Air, %	[95]	50.11
	MISCELLANEOUS					
30	Unit Output, MJ/hr	914476	31	Aux Equip Power, MJ/hr		3056
32	Loss Due to Surface Radiation and Convection, %					0.25

PLANT NAME :	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO :	DATE :	LOAD	80%
TIME START :	TIME END :	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form EFFb Efficiency Calculations

	LOSSES, % Enter Calculated Result in % Column [B]			A	MKB	B	%
60	Dry Gas	[10] x [3A]	/100				
		x	/100				5.314
61	Water from H2 Fuel	[12] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					3.773
62	Water from H2O Fuel	[13] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					2.059
63	Water from H2O Fuel	[14] x ([3C]) / 100					
		x / 100					0.000
64	Moisture in Air	[16] x [3C] / 100					
		x / 100					0.091
65	Unburned Carbon in Ref [18] x 33700 / [19] =	x 33700/					0.274
66	Sensible Heat of Refuse from Form RES						0.060
67	Hot AQC Equip ([20] x ([5A] - [6A]) - ([22] - [20]) x ([6C] - [6B])) / 100						
	(x (-) - (-) x (-)) / 100						0.000
68	Other Losses, % Basis from Form EFFc Item [110]						0.450
69	Summation of Losses, % Basis						12.020
	LOSSES, MJ/hr Enter in MKB Column [A]						
75	Surface Radiation and Convection from Form EFFa Item [32]				0.000		
76	Sorbent Calcination / Dehydration from Form SRBc Item [77]				0.000		
77	Water from Sorbent from Form SRBc Item [65]				0.000		
80	Other Losses, MJ/hr Basis from Form EFFc Item [111]				0.000		
81	Summation of Losses, MJ/hr Basis				0.000		
	CREDITS, % Enter Calculation Result in % Column [B]						
85	Entering Dry Air	[11] x [2A]	/100				
		x	/100				0.023
86	Moisture in Air	[16] x [2B]	/100				
		x	/100				0.000
87	Sensible Heat in Fuel	100 x [4A]	/ [19]				
		100 x	/				-0.024
88	Sulfation from Form SRBc Item [80]						0.000
89	Other Credits, % Basis from Form EFFc Item [112]						0.000
90	Summation of Credits, % Basis						0.000
	CREDITS, MJ/hr Enter Calculated Result in MKB Column [A]						
95	Auxiliary Equipment Power [31]				3056.4		
96	Sensible Heat from Sorbent from Form SRBc Item [85]				0.000		
97	Other Credits, MJ/hr Basis from Form EFFc Item [113B]				0.000		
98	Summation of Credits, MJ/hr Basis				3056.4		
100	Fuel Eff, % (100 - [69] + [90]) x [30] / ([30] + [81] - [98])						
	(100 - +) x / (+ -)						88.27
101	Input from Fuel, MJ/hr 100 x [30] / [100] = 100 x /				1035946		
102	Fuel Rate, kg/hr 1,000 x [101] / [19] = 1,000 x /						43569

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	4	DATE :	17-Dec-15	LOAD	80%
TIME START :	9:30	TIME END :	11:30	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 2 of 3	

Form EFFc Efficiency Calculations

Other Losses and Credits

The losses and credits listed on this sheet are not universally applicable to all fossil fired steam generators and are usuall minor. Losses/credits that have not been specifically identified by this Code but are applicable in accordance with th intent of the Code should also be recorded on this sheet

Parties to the test may agree to estimate the losses or credits in lieu of testing Enter a 'T' for tested or 'E' for esimate in the second column, and result in the appropriate column

Enter the sum of each group on Form EFFb.

Refer to the text of PTC 4 for the calculation method.

Itm	T or E	LOSSES, % Enter Calculated Result in % Column[B]	A MKB	B %
110A		CO in Flue Gas		0.000
110B		Formation of NOx		0.000
110C		Pulverizer Rejects		0.000
110D		Air Infiltration		0.000
110E		Unburned Hydrocarbons in Flue Gas		0.000
110F		Unburned Hydrogen in Refuse		0.000
110G	E	Unmeasured Loss, as per agreement		0.200
110H	E	Surface Radiation Loss, as per agreement		0.250
110		Summation of Other Losses, % Basis		0.450
		LOSSES, MJ/hr Enter in MKB Column [A]		
111A		Wet Ash Pit	0.000	
111B		Sensible Heat in Recycle Streams, Solid	0.000	
111C		Sensible Heat in Recycle Streams, Gas	0.000	
111D		Additional Moisture	0.000	
111E		Cooling Water	0.000	
111F		Air Preheater Coil (supplied by Unit)	0.000	
111G		Other	0.000	
111		Summation of other Losses, MJ/hr Basis	0.000	
		CREDITS, % Enter Calculation Result in % Column [B]		
112A		Other		0.000
112		Summation of Credits, % Basis		0.000
		CREDITS, MJ/hr Enter Result in MKB Column [A]		
113A		Heat in Additional Moisture (external to envelope)	0.000	
113B		Other	0.000	
113C		Heat by Auxiliary Equipment Power	3056.4	
113		Summation of Credits, MJ/hr Basis	3056.4	

PLANT NAME :	NORGENER	ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	4	DATE :	17-Dec-15	LOAD	80%
TIME START :	9:30	TIME END :	11:30	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 3 of 3	

APPENDIX G5

Results ASME PTC 4 Heat Balance Method Test at 70% Load

Form CMBSTNa Combustion Calculations

	DATA REQUIRED				
1	HHV - Higher Heating value of Fuel, kJ/kg as fired, from Input Data Sheet [1]				23542
2	UBC - Unburned Carbon, kg/ 100 kg fuel from RES [11] or SRBb FORM				0.088
3	Fuel Flow, kg/hr [4b]				38778
4	a. Measured Fuel Flow			34236.0	
4	b. Calculated Fuel Flow 100,000 x [5] / [6] / [1]			38777.5	
5	Output, MJ/hr from Output Item [37]			806393	
6	Fuel Efficiency, % (estimate initially), from Input Data Sheet [6]			88.33	
7	Moisture in air, kg/kg Dry Air			0.01030	
8	Barometric Pressure, mbar, from Input Data Sheet [8]			1007.1	
9	Dry Bulb Temerature, °C, from Input Data Sheet [9]			21.4	
10	Wet Bulb Temperature, °C, from Input Data Sheet [10]			16.9	
11	Relative Humidity, %, from Input Data Sheet [11]			64.5	
	Additional Moisture (Measured) kg/hr				
	Atomizing Steam from Output Item [14] kg/hr			0.0	
	Sootblowing Steam from Output Item [11] kg/hr			0.0	
	Other kg/hr			0.0	
12	Summation Addition Moisture			0.0	
13	Additional Moisture,kg/ 100 kg Fuel 100 x [12] / [3]				0.0
14	Additional Moisture, kg/100 kJ [13] / ([1] / 100)				0.0
	If Air Heater (Excl Stm/ Wtr Coil) Enter following				
15	Gas Temp Lvg AH, °C, from Input Data Sheet [15] Primairy / Secundairy or Main			**15A**	131.3
16	Air Temp Ent AH, °C, from Input Data Sheet [16] Primairy / Secundairy or Main	**16B**	26.8	**16A**	27.5
17	O2 in FG Ent Air Heater, %, from Input Data Sheet [17] Primairy / Secundairy or Main			**17A**	4.39
18	O2 in FG Lvg Air Heater, %, from Input Data Sheet [18] Primairy / Secundairy or Main			**18A**	7.50
18a	Mass Flow Fraction, %, from Input Data Sheet [18a] Primairy / Secundairy or Main	**18C**	67.82	**18D**	32.18
19	Mass Ash, kg/100 kJ 100 x [30J] / [1]				0.024
	If mass of ash (item [19]) exceeds 0.065 kg/100 kJ or Sorbent				
	utilized, Enter Mass Fraction of Refuse in Col [79] for each location				
	SORBENT DATA (Enter 0 if Sorbent not Used)				0
20	Sorbent Rate, kg/hr				0.000
21	CO2 from Sorbent, kg/ 100 kg Sorbent	from SRBa item [25I]			0.000
22	H2O from Sorbent, kg/ 100 kg Sorbent	from SRBa item [26I]			0.000
23	Sulfur Capture, kg/kg Sulfer	from SRBb item [45]			0.000
24	Spent Sorbent, kg/ 100 kg fuel	from SRBb item [48]			0.000
25	Sorb/Fuel Ratio, kg Sorb / kg Fuel	[20]/[3]			0.000
	HOT AIR QUALITY CONTROL EQUIPMENT DATA				
26	O2 in FG Ent HAQC Flue Gas Temperatures				N/A
	See Form EFFa for HAQC Flue Gas Temperatures				

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 5	DATE : 17-Dec-15	LOAD	70%
TIME START : 13:00	TIME END : 15:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form CMBSTNb Combustion Calculations

COMBUSTION PRODUCTS											
30	from Input Data Sheet Ultimate Analysis % Mass			**31**	Theo Air Flow kg/100kg Fuel [30] x K	**32**	Dry Prod Flow Mol/100 kg Fuel [30] / K	**33**	Wet Prod Flow Mol/100 kg Fuel [30] / K	**34**	H2O Fuel kg/100 kJ [30] x K / ([1]) / 100
A	C	59.01									
B	UBC		0.088								
C	Cb		58.92	11.51	678.19	12.0110	4.906				
D	S	0.43		4.31	1.85	32.0640	0.013				
E	H2	3.70		34.29	126.87			2.0159	1.835	8.937	0.140
F	H2O	19.08						18.0153	1.059	1.0	0.081
G	H2Ov	0.00						18.0153	0.000	1.0	0.000
H	N2	1.18				28.0134	0.042				
I	O2	11.04		-4.32	-47.69						
J	ASH	5.55									
K	VM	33.41									
L	FC	41.95									
M	TOTAL	99.99		31	759.23	32	4.961	33	2.895	34	0.222

35	Total Theo Air Fuel Check, kg/100 kJ	([31M] + [30B] x 11.51) / ([1] / 100)	3.229
CORRECTIONS FOR SORBENT REACTIONS AND SULFUR CAPTURE			
40	CO2 from Sorb, kg/100 kg fuel	[21] x [25]	0.000
41	H2O from Sorb, kg/100 kg fuel	[22] x [25]	0.000
42	SO2 Reduction, Mol/100 kg fuel	[32D] x [23]	0.000
43	Dry Prod Comb, Mol/100 kg fuel	[32M] + [40] / 44.01 - [42]	4.961
44	Wet Prod Comb, Mol/100 kg fuel	[33M] + [41] / 18.0153 + [43]	7.856
46	Theo Air Corr, kg/100 kg fuel	[31M] +2.16 x [30D] x [23]	759.23
47	Theo Air Corr, Mol/100 kg fuel	[46] / 28.9625	26.214
48	Theo Air Corr, kg/100 kJ	[46] / ([1] / 100)	3.225
49	Wet Gas from Fuel, kg/100 kJ	(100 - [30J] - [30B] - [30D] x [23]) / ([1] / 100)	0.401

LOCATION				AH In	AH Out
50	Flue Gas Temperature Entering Air heater °C			335.8	131.3
51	Air Temperature Leaving Air Heater, °C			27.00	306.3
52	Flue Gas Oxygen Content, %			4.390	7.500
FLUE GAS ANALYSIS, Mol/100 kg Fuel		Dry	Wet		
53	Moisture in Air	0	[7] x 1.608	0.00	0.00
54	Dry/Wet Products Comb	[43]	[44]	4.961	4.961
55	Additional Moisture	0	[13] / 18.0153	0.00	0.00
56	[47] x (0.7905 + [53])			20.72	20.72
57	Summation [54] + [55] + [56]			25.68	25.68
58	20.95 - [52] x (1 + [53])			16.56	13.45
60	Excess Air, % 100 x [52] x [57] / [47] / [58]			25.97	54.63

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 5	DATE : 17-Dec-15	LOAD	70%
TIME START : 13:00	TIME END : 15:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 2 of 3	

Form CMBSTNc Combustion Calculations

	LOCATION							AH In	AH Out
60	Excess Air, %							25.97	54.63
	02, CO2, SO2, WHEN EXCESS AIR KNOWN								
61									
62	Dry	[47] x (0.7905 + ([60] / 100))						27.53	35.04
63	Wet	[47] x (0.7905 + [53] + (1 + [53]) x [60] / 100)						27.53	35.04
64	Dry Gas, Mol/100 kg Fuel	[43] + [62]						32.49	40.01
65	Wet Gas, Mol/100 kg Fuel	[44] + [63] + [13] / 18.015						35.39	42.90
			Dry	Wet					
66	O2, %	[60] x [47] x 0.2095 / [65]	[64]	[65]				4.03	6.99
67	CO2,%	([30c]/0.1201+[40]/0.4401)/[65]	[64]	[65]				13.86	11.44
68	SO2,ppm	(1-[23]) x [30D] / 0.32064 / [65]	[64]	[65]				379.0	312.6
	FLUE GAS PRODUCTS, kg/100 kJ								
69	Dry Air	(1 + [60] / 100) x [48]						4.063	4.987
70	Wet Gas from Fuel	[49]						0.401	0.401
71	CO2 from Sorbent	[40] / ([1] / 100)						0.000	0.000
72	Moisture in Air	[7] x [69]						0.042	0.051
73	Water from Sorbent	[41] / ([1] / 100)						0.000	0.000
74	Additional Moisture	[14]						0.000	0.000
75	Total Wet Gas	[69] + [70] + [71] + [72] + [73] + [74]						4.505	5.439
76	H2O in Wet Gas	[34M] + [72] + [73] + [74]						0.263	0.273
77	Dry Gas	[75] - [76]						4.242	5.166
78	H2O in Wet Gas, % Mass	100 x [76] / [75]						5.85	5.02
79	Residue, kg/kg Total Refuse at each location							0.00	0.00
80	Residue, kg/100 kJ	([30J] + [2] + [24]) / ([1] / 100)						0.0239	0.0239
81	Residue in Wet Gas, kg/kg	[79] x [80] / [75]	Wet Gas					0.000	0.000
82	Leakage, % Gas Entering	100 x ([75L] - [75E]) / [75E]							20.73
	GAS TEMPERATURE CORRECTION FOR AH LEAKAGE								
83	Gas Temp Lvg (INCL LKG), °C	[15]						335.78	131.26
84	Average AH Air Leakage Temp, °C	([16B] x[18B]+[16A] x[18D])/100						27.00	306.32
85	H Air Lvg, kJ/kg	T=[83], H2O=[7]							108.09
86	H Air Ent, kJ/kg	T=[84], H2O=[7]						2.029	
87	Cpg, kJ/kg°C	T=[83], H2O=[78E], RES=[81E]							1.056
88	AH Gas Outlet Temperature Excluding Leakage, °C [83] + ([82] / 100 x ([85] - [86]) / [87])								152.09
	AIR, GAS, FUEL & RESIDUE MASS FLOW RATES, kg/hr								
90	Input from Fuel, MJ/hr	[5] / [6] x 100							912901
91	Fuel Rate, kg/hr	1000 x [90] / [1]							38778
92	Residue Rate, kg/hr	[80] x [90] / 10							2186
93	Wet Flue Gas, kg/hr	[75] x [90] / 10						411287	496535
95	Excess Air Lvg Blr, %	[60]							54.63
96	Total Air to Blr, kg/hr	(1 + [95] / 100) x (1 + [7]) x [48] x [90] / 10							459944

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 5	DATE : 17-Dec-15	LOAD	70%
TIME START : 13:00	TIME END : 15:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

Form RES Unburned Carbon and Residue Calculation

	DATA REQUIRED FOR RESIDUE SPLIT									
1	Ash in Fuel, %		from Form CMBSTNb [30J]		5.55	2	HHV Fuel, kJ/kg 'as fired'			23542
3	Fuel Mass Flow Rate, kg/hr		from Form CMBSTNa [4b]		38778	4b	from Form CMBSTNa [1]			
a)	Item [3] - Use measured or estimated value initially. (See CMBSTNa) Recalculate after boiler efficiency has been calculated until estimated value is within 1% of calculated value.									
b)	Residue splits estimated. Enter value in Col [8] and calculate Col [5]. Residue rate measured. Enter measured mass flow rates in Col [5]. Whem residue is not measured at all locations, estimate split and flow for measured locations. Reiterate until estimated total residue is within 2% of calculated.									
c)	Enter the % free carbon in Col [6] (total carbon correcter for CO2). Units with sorbent: Enter the % CO2 in Col [7].									
	Location	5 Residue Mass Flow Input kg/hr	Calculated kg/hr	6 C in Residue %	7 CO2 in Residue %	8 Residue Split % Input	Calculated 100 x [5]/[5F]	9 C Wtd Ave % [6] x [8]/100	10 CO2 Wtd Ave % [7] x [8]/100	
A	Bottom Ash	0.00	0.00	7.29	5.00	15.00	0.00	1.094	0.750	
B	Fly Ash	0.00	0.00	0.55	2.00	85.00	0.00	0.468	1.700	
C	Economizer	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
D		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
E		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	
F	TOTAL	5 0.00	0.00			8 100.0	0.00	9 1.561	10 2.450	
	UNITS WITHOUT SORBENT									
11	Unburned Carbon, kg/ 100 kg Fuel					[1] x [9F] / (100 - [9F])				0.088
20	Total Residue, kg/ 100kg Fuel					[1] + [11]				5.64
	UNITS WITH SORBENT									
d)	Enter average C and CO2 in residue, [9F] and [10F] above or SRBa (Items [4] and [5]) and complete Sorbent Calculation Forms.									
11	Unburned Carbon, kg/ 100 kg Fuel					from Form SRBb Item [49]				0.105
20	Total Residue, kg/ 100 Fuel					from Form SRBb Item [50]				6.73
	TOTAL RESIDUE									
21	Total Residue, kg/hr					[20] x[3] /100				2186
e)	When all residue collection locations are measured, the measured residue split is used for calculations. If a portion of the residue mass is estimated, repeat calculation above until Col [5F] and Item [21] agree within 2%.									
22	Total Residue, kg/100 kJ					100 x [20] / [2]				0.024

23	**SENSIBLE HEAT RESIDUE LOSS, %**								
	Location	24 Temp Residue (°C)	[8] %	x	[22] Residue kg/ 100 kJ	x	H Residue kJ/kg	/ 10,000	Loss %
A	Furnace	1100	15.00	x	0.024	x	1205.2	/ 10,000	0.043
B	Fly Ash	120	85.00	x	0.024	x	76.7	/ 10,000	0.016
C	Economizer	0	0.00	x	0.024	x	-30.1	/ 10,000	0.000
D		0							0.000
E		0							0.000
								Total 25	0.059

H Residue = 0.16 x T + 1.09E-4 x T^2 - 2.843E-8 x T^3 - 12.95

PLANT NAME :	NORGENER ASME PTC 4 MASTER FORM			UNIT NO.	2
TEST NO :	5	DATE:	17-Dec-15	LOAD	70%
TIME START :	13:00	TIME END :	15:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 1	

Form EFFa Efficiency Calculations

Data

	TEMPERATURES,°C				
1	Reference Temperature, °C	25.0	1A	Enthalpy Water (0°C Ref), kJ/kg	104.57
2	Average Entering Air Temp, from	27.00	2A	Enthalpy Dry Air, kJ/kg	2.01
	CMBSTNa Item [84]: ([16B]x[18B]+[16A]x[18D])/100		2B	Enthalpy Water Vapor, kJ/kg	3.72
3	Average Exit Gas T (Excl Lkg)	152.1	3A	Enthalpy Dry Gas, kJ/kg	127.08
	from CMBSTNa [88]		3B	Enthalpy Steam @ 1 psia, kJ/kg	2784.4
			3C	Enthalpy Water Vapor, kJ/kg	239.79
4	Fuel Temperature	21.4	4A	Enthalpy Fuel, kJ/kg	-4.97
	HOT AIR QUALITY CONTROL EQUIPMENT				
5	Entering Gas Temperature	0.0	5A	Enthalpy Wet Gas	0.00
6	Leaving Gas Temperature	0.0	6A	Enthalpy of Wet Gas	0.00
			6B	Enthalpy of Wet Air	0.00
			6C	Enthalpy of Wet Air @ T = [3]	0.00
	RESULTS FROM COMBUSTION CALCULATION FORM CMBSTN				
10	Dry Gas Weight, kg/100 kJ [77]	4.242	18	Unburned Carbon, % [2]	0.088
11	Dry Air Weight [69]	4.063	19	HHV kJ/kg 'as-fired' [1]	23542.0
12	Water from H2 Fuel [34E]	0.140		**HOT AQC EQUIPMENT**	
13	Water from H2O Fuel [34F]	0.081	20	Wet Gas Entering [75E]	0.00
14	Water from H2Ov Fuel [34G]	0.000	21	H2O in Wet Gas, % [78E]	0.00
15	Moisture in Air kg/kg DA [7]	0.01030	22	Wet Gas Leaving [75L]	0.00
16	Moisture in Air kg/100 kJ [72]	0.042	23	Residue in Wet Gas, % [81E]	0.00
17	Fuel Rate Est. kg/hr [3]	38778			
			25	Excess Air, % [95]	54.63
	MISCELLANEOUS				
30	Unit Output, MJ/hr	806393	31	Aux Equip Power, MJ/hr	3038
32	Loss Due to Surface Radiation and Convection, %				0.25

PLANT NAME :	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO :	DATE :	LOAD	70%
TIME START :	TIME END :	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form EFFb Efficiency Calculations

	LOSSES, % Enter Calculated Result in % Column [B]			A	MKB	B	%
60	Dry Gas	[10] x [3A]	/100				
		x	/100				5.391
61	Water from H2 Fuel	[12] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					3.764
62	Water from H2O Fuel	[13] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					2.172
63	Water from H2O Fuel	[14] x ([3C]) / 100					
		x / 100					0.000
64	Moisture in Air	[16] x [3C] / 100					
		x / 100					0.100
65	Unburned Carbon in Ref [18] x 33700 / [19] =	x 33700/					0.126
66	Sensible Heat of Refuse from Form RES						0.059
67	Hot AQC Equip ([20] x ([5A] - [6A]) - ([22] - [20]) x ([6C] - [6B])) / 100						
	(x (-) - (-) x (-)) / 100						0.000
68	Other Losses, % Basis from Form EFFc Item [110]						0.450
69	Summation of Losses, % Basis						12.062
	LOSSES, MJ/hr Enter in MKB Column [A]						
75	Surface Radiation and Convection from Form EFFa Item [32]				0.000		
76	Sorbent Calcination / Dehydration from Form SRBc Item [77]				0.000		
77	Water from Sorbent from Form SRBc Item [65]				0.000		
80	Other Losses, MJ/hr Basis from Form EFFc Item [111]				0.000		
81	Summation of Losses, MJ/hr Basis				0.000		
	CREDITS, % Enter Calculation Result in % Column [B]						
85	Entering Dry Air	[11] x [2A] /100					
		x /100					0.082
86	Moisture in Air	[16] x [2B] /100					
		x /100					0.002
87	Sensible Heat in Fuel	100 x [4A] / [19]					
		100 x /					-0.021
88	Sulfation from Form SRBc Item [80]						0.000
89	Other Credits, % Basis from Form EFFc Item [112]						0.000
90	Summation of Credits, % Basis						0.062
	CREDITS, MJ/hr Enter Calculated Result in MKB Column [A]						
95	Auxiliary Equipment Power [31]				3038.4		
96	Sensible Heat from Sorbent from Form SRBc Item [85]				0.000		
97	Other Credits, MJ/hr Basis from Form EFFc Item [113B]				0.000		
98	Summation of Credits, MJ/hr Basis				3038.4		
100	Fuel Eff, % (100 - [69] + [90]) x [30] / ([30] + [81] - [98])						
	(100 - +) x / (+ -)						88.33
101	Input from Fuel, MJ/hr 100 x [30] / [100] = 100 x /				912904		
102	Fuel Rate, kg/hr 1,000 x [101] / [19] = 1,000 x /						38778

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 5	DATE : 17-Dec-15	LOAD	70%
TIME START : 13:00	TIME END : 15:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 2 of 3	

Form EFFc Efficiency Calculations

Other Losses and Credits

The losses and credits listed on this sheet are not universally applicable to all fossil fired steam generators and are usuall minor. Losses/credits that have not been specifically identified by this Code but are applicable in accordance with th intent of the Code should also be recorded on this sheet

Parties to the test may agree to estimate the losses or credits in lieu of testing Enter a 'T' for tested or 'E' for esimate in the second column, and result in the appropriate column

Enter the sum of each group on Form EFFb.

Refer to the text of PTC 4 for the calculation method.

Itm	T or E	LOSSES, % Enter Calculated Result in % Column[B]	A MKB	B %
110A		CO in Flue Gas		0.000
110B		Formation of NOx		0.000
110C		Pulverizer Rejects		0.000
110D		Air Infiltration		0.000
110E		Unburned Hydrocarbons in Flue Gas		0.000
110F		Unburned Hydrogen in Refuse		0.000
110G	E	Unmeasured Loss, as per agreement		0.200
110H	E	Surface Radiation Loss, as per agreement		0.250
110		Summation of Other Losses, % Basis		0.450
		LOSSES, MJ/hr Enter in MKB Column [A]		
111A		Wet Ash Pit	0.000	
111B		Sensible Heat in Recycle Streams, Solid	0.000	
111C		Sensible Heat in Recycle Streams, Gas	0.000	
111D		Additional Moisture	0.000	
111E		Cooling Water	0.000	
111F		Air Preheater Coil (supplied by Unit)	0.000	
111G		Other	0.000	
111		Summation of other Losses, MJ/hr Basis	0.000	
		CREDITS, % Enter Calculation Result in % Column [B]		
112A		Other		0.000
112		Summation of Credits, % Basis		0.000
		CREDITS, MJ/hr Enter Result in MKB Column [A]		
113A		Heat in Additional Moisture (external to envelope)	0.000	
113B		Other	0.000	
113C		Heat by Auxiliary Equipment Power	3038.4	
113		Summation of Credits, MJ/hr Basis	3038.4	

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 5	DATE : 17-Dec-15	LOAD	70%
TIME START : 13:00	TIME END : 15:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

APPENDIX G6

Results ASME PTC 4 Heat Balance Method Test at 47% Load

Form CMBSTNa Combustion Calculations

	DATA REQUIRED				
1	HHV - Higher Heating value of Fuel, kJ/kg as fired, from Input Data Sheet [1]				23505
2	UBC - Unburned Carbon, kg/ 100 kg fuel from RES [11] or SRBb FORM				0.111
3	Fuel Flow, kg/hr [4b]				28005
4	a. Measured Fuel Flow		24696.0		
4	b. Calculated Fuel Flow 100,000 x [5] / [6] / [1]		28004.8		
5	Output, MJ/hr from Output Item [37]		579546		
6	Fuel Efficiency, % (estimate initially), from Input Data Sheet [6]		88.04		
7	Moisture in air, kg/kg Dry Air		0.01149		
8	Barometric Pressure, mbar, from Input Data Sheet [8]		1005.1		
9	Dry Bulb Temerature, °C, from Input Data Sheet [9]		20.7		
10	Wet Bulb Temperature, °C, from Input Data Sheet [10]		17.6		
11	Relative Humidity, %, from Input Data Sheet [11]		74.8		
	Additional Moisture (Measured) kg/hr				
	Atomizing Steam from Output Item [14] kg/hr		0.0		
	Sootblowing Steam from Output Item [11] kg/hr		0.0		
	Other kg/hr		0.0		
12	Summation Addition Moisture		0.0		
13	Additional Moisture,kg/ 100 kg Fuel 100 x [12] / [3]				0.0
14	Additional Moisture, kg/100 kJ [13] / ([1] / 100)				0.0
	If Air Heater (Excl Stm/ Wtr Coil) Enter following				
15	Gas Temp Lvg AH, °C, from Input Data Sheet [15] Primairy / Secundairy or Main			**15A**	127.2
16	Air Temp Ent AH, °C, from Input Data Sheet [16] Primairy / Secundairy or Main	**16B**	26.3	**16A**	27.0
17	O2 in FG Ent Air Heater, %, from Input Data Sheet [17] Primairy / Secundairy or Main			**17A**	5.78
18	O2 in FG Lvg Air Heater, %, from Input Data Sheet [18] Primairy / Secundairy or Main			**18A**	8.90
18a	Mass Flow Fraction, %, from Input Data Sheet [18a] Primairy / Secundairy or Main	**18C**	61.47	**18D**	38.53
19	Mass Ash, kg/100 kJ 100 x [30J] / [1]				0.024
	If mass of ash (item [19]) exceeds 0.065 kg/100 kJ or Sorbent				
	utilized, Enter Mass Fraction of Refuse in Col [79] for each location				
	SORBENT DATA (Enter 0 if Sorbent not Used)				0
20	Sorbent Rate, kg/hr				0.000
21	CO2 from Sorbent, kg/ 100 kg Sorbent — from SRBa item [25I]				0.000
22	H2O from Sorbent, kg/ 100 kg Sorbent — from SRBa item [26I]				0.000
23	Sulfur Capture, kg/kg Sulfer — from SRBb item [45]				0.000
24	Spent Sorbent, kg/ 100 kg fuel — from SRBb item [48]				0.000
25	Sorb/Fuel Ratio, kg Sorb / kg Fuel — [20]/[3]				0.000
	HOT AIR QUALITY CONTROL EQUIPMENT DATA				
26	O2 in FG Ent HAQC Flue Gas Temperatures				N/A
	See Form EFFa for HAQC Flue Gas Temperatures				

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	6	DATE :	17-Dec-15	LOAD	47%
TIME START :	17:00	TIME END :	19:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 3	

Form CMBSTNb Combustion Calculations

COMBUSTION PRODUCTS											
30	from Input Data Sheet Ultimate Analysis % Mass			**31** Theo Air Flow kg/100kg Fuel [30] x K		**32** Dry Prod Flow Mol/100 kg Fuel [30] / K		**33** Wet Prod Flow Mol/100 kg Fuel [30] / K		**34** H2O Fuel kg/100 kJ [30] x K / ([1]) / 100	
A	C	59.11									
B	UBC		0.111								
C	Cb		59.00	11.51	679.08	12.0110	4.912				
D	S	0.43		4.31	1.85	32.0640	0.013				
E	H2	3.67		34.29	125.84			2.0159	1.821	8.937	0.140
F	H2O	18.99						18.0153	1.054	1.0	0.081
G	H2Ov	0.00						18.0153	0.000	1.0	0.000
H	N2	1.18				28.0134	0.042				
I	O2	10.98		-4.32	-47.43						
J	ASH	5.62									
K	VM	33.50									
L	FC	41.88									
M	TOTAL	99.98		31	759.35	32	4.968	33	2.875	34	0.220

35	Total Theo Air Fuel Check, kg/100 kJ	([31M] + [30B] x 11.51) / ([1] / 100)	3.236
	CORRECTIONS FOR SORBENT REACTIONS AND SULFUR CAPTURE		
40	CO2 from Sorb, kg/100 kg fuel	[21] x [25]	0.000
41	H2O from Sorb, kg/100 kg fuel	[22] x [25]	0.000
42	SO2 Reduction, Mol/100 kg fuel	[32D] x [23]	0.000
43	Dry Prod Comb, Mol/100 kg fuel	[32M] + [40] / 44.01 - [42]	4.968
44	Wet Prod Comb, Mol/100 kg fuel	[33M] + [41] / 18.0153 + [43]	7.842
46	Theo Air Corr, kg/100 kg fuel	[31M] +2.16 x [30D] x [23]	759.35
47	Theo Air Corr, Mol/100 kg fuel	[46] / 28.9625	26.218
48	Theo Air Corr, kg/100 kJ	[46] / ([1] / 100)	3.231
49	Wet Gas from Fuel, kg/100 kJ	(100 - [30J] - [30B] - [30D] x [23]) / ([1] / 100)	0.401

	LOCATION			AH In	AH Out
50	Flue Gas Temperature Entering Air heater °C			308.5	127.2
51	Air Temperature Leaving Air Heater, °C			26.54	285.3
52	Flue Gas Oxygen Content, %			5.780	8.900
	FLUE GAS ANALYSIS, Mol/100 kg Fuel	Dry	Wet		
53	Moisture in Air	0	[7] x 1.608	0.00	0.00
54	Dry/Wet Products Comb	[43]	[44]	4.968	4.968
55	Additional Moisture	0	[13] / 18.0153	0.00	0.00
56		[47] x (0.7905 + [53])		20.73	20.73
57	Summation	[54] + [55] + [56]		25.69	25.69
58		20.95 - [52] x (1 + [53])		15.17	12.05
60	Excess Air, %	100 x [52] x [57] / [47] / [58]		37.34	72.38

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 6	DATE : 17-Dec-15	LOAD	47%
TIME START : 17:00	TIME END : 19:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 2 of 3	

Form CMBSTNc Combustion Calculations

					AH In	AH Out
	LOCATION				AH In	AH Out
60	Excess Air, %				37.34	72.38
	02, CO2, SO2, WHEN EXCESS AIR KNOWN					
61						
62	Dry	[47] x (0.7905 + ([60] / 100))			30.52	39.70
63	Wet	[47] x (0.7905 + [53] + (1 + [53]) x [60] / 100)			30.52	39.70
64	Dry Gas, Mol/100 kg Fuel	[43] + [62]			35.48	44.67
65	Wet Gas, Mol/100 kg Fuel	[44] + [63] + [13] / 18.015			38.36	47.54
			Dry	Wet		
66	O2, %	[60] x [47] x 0.2095 / [65]	[64]	[65]	5.35	8.36
67	CO2,%	([30c]/0.1201+[40]/0.4401)/[65]	[64]	[65]	12.81	10.33
68	SO2,ppm	(1-[23]) x [30D] / 0.32064 / [65]	[64]	[65]	349.6	282.1
	FLUE GAS PRODUCTS, kg/100 kJ					
69	Dry Air	(1 + [60] / 100) x [48]			4.437	5.569
70	Wet Gas from Fuel	[49]			0.401	0.401
71	CO2 from Sorbent	[40] / ([1] / 100)			0.000	0.000
72	Moisture in Air	[7] x [69]			0.051	0.064
73	Water from Sorbent	[41] / ([1] / 100)			0.000	0.000
74	Additional Moisture	[14]			0.000	0.000
75	Total Wet Gas	[69] + [70] + [71] + [72] + [73] + [74]			4.889	6.034
76	H2O in Wet Gas	[34M] + [72] + [73] + [74]			0.271	0.284
77	Dry Gas	[75] - [76]			4.618	5.750
78	H2O in Wet Gas, % Mass	100 x [76] / [75]			5.55	4.71
79	Residue, kg/kg Total Refuse at each location				0.00	0.00
80	Residue, kg/100 kJ	([30J] + [2] + [24]) / ([1] / 100)			0.0244	0.0244
81	Residue in Wet Gas, kg/kg	[79] x [80] / [75] Wet Gas			0.000	0.000
82	Leakage, % Gas Entering	100 x ([75L] - [75E]) / [75E]				23.42
	GAS TEMPERATURE CORRECTION FOR AH LEAKAGE					
83	Gas Temp Lvg (INCL LKG), °C	[15]			308.49	127.16
84	Average AH Air Leakage Temp, °C	([16B] x[18B]+[16A] x[18D])/100			26.54	285.31
85	H Air Lvg, kJ/kg	T=[83], H2O=[7]				104.01
86	H Air Ent, kJ/kg	T=[84], H2O=[7]			1.567	
87	Cpg, kJ/kg°C	T=[83], H2O=[78E], RES=[81E]				1.052
88	AH Gas Outlet Temperature Excluding Leakage, °C [83] + ([82] / 100 x ([85] - [86]) / [87])					149.97
	AIR, GAS, FUEL & RESIDUE MASS FLOW RATES, kg/hr					
90	Input from Fuel, MJ/hr	[5] / [6] x 100				658253
91	Fuel Rate, kg/hr	1000 x [90] / [1]				28005
92	Residue Rate, kg/hr	[80] x [90] / 10				1605
93	Wet Flue Gas, kg/hr	[75] x [90] / 10			321811	397184
95	Excess Air Lvg Blr, %	[60]				72.38
96	Total Air to Blr, kg/hr	(1 + [95] / 100) x (1 + [7]) x [48] x [90] / 10				370784

PLANT NAME : NORGENER	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO : 6	DATE : 17-Dec-15	LOAD	47%
TIME START : 17:00	TIME END : 19:00	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 3 of 3	

Form RES Unburned Carbon and Residue Calculation

	DATA REQUIRED FOR RESIDUE SPLIT					
1	Ash in Fuel, %	from Form CMBSTNb [30J]	5.62	2	HHV Fuel, kJ/kg 'as fired'	23505
3	Fuel Mass Flow Rate, kg/hr	from Form CMBSTNa [4b]	28005	4b	from Form CMBSTNa [1]	

a) Item [3] - Use measured or estimated value initially. (See CMBSTNa)
Recalculate after boiler efficiency has been calculated until estimated value is within 1% of calculated value.

b) Residue splits estimated. Enter value in Col [8] and calculate Col [5].
Residue rate measured. Enter measured mass flow rates in Col [5]. Whem residue is not measured at all locations, estimate split and flow for measured locations. Reiterate until estimated total residue is within 2% of calculated.

c) Enter the % free carbon in Col [6] (total carbon correcter for CO2). Units with sorbent: Enter the % CO2 in Col [7].

	Location	5 Residue Mass Flow Input kg/hr	Residue Mass Flow Calculated kg/hr	6 C in Residue %	7 CO2 in Residue %	8 Residue Split % Input	Residue Split % Calculated 100 x [5]/[5F]	9 C Wtd Ave % [6] x [8]/100	10 CO2 Wtd Ave % [7] x [8]/100
A	Bottom Ash	0.00	0.00	10.26	5.00	15.00	0.00	1.539	0.750
B	Fly Ash	0.00	0.00	0.46	2.00	85.00	0.00	0.391	1.700
C	Economizer	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
D		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
E		0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000
F	TOTAL	5 0.00	0.00			8 100.0	0.00	9 1.930	10 2.450

	UNITS WITHOUT SORBENT		
11	Unburned Carbon, kg/ 100 kg Fuel	[1] x [9F] / (100 - [9F])	0.111
20	Total Residue, kg/ 100kg Fuel	[1] + [11]	5.73
	UNITS WITH SORBENT		
d)	Enter average C and CO2 in residue, [9F] and [10F] above or SRBa (Items [4] and [5]) and complete Sorbent Calculation Forms.		
11	Unburned Carbon, kg/ 100 kg Fuel	from Form SRBb Item [49]	0.132
20	Total Residue, kg/ 100 Fuel	from Form SRBb Item [50]	6.83
	TOTAL RESIDUE		
21	Total Residue, kg/hr	[20] x[3] /100	1605
e)	When all residue collection locations are measured, the measured residue split is used for calculations. If a portion of the residue mass is estimated, repeat calculation above until Col [5F] and Item [21] agree within 2%.		
22	Total Residue, kg/100 kJ	100 x [20] / [2]	0.024

23	**SENSIBLE HEAT RESIDUE LOSS, %**								
	Location	24 Temp Residue (°C)	[8] %	x	[22] Residue kg/ 100 kJ	x	H Residue kJ/kg	/ 10,000	Loss %
A	Furnace	1100	15.00	x	0.024	x	1205.2	/ 10,000	0.044
B	Fly Ash	120	85.00	x	0.024	x	76.7	/ 10,000	0.016
C	Economizer	0	0.00	x	0.024	x	-30.1	/ 10,000	0.000
D		0							0.000
E		0							0.000
								Total 25	0.060

H Residue = 0.16 x T + 1.09E-4 x T^2 - 2.843E-8 x T^3 - 12.95

PLANT NAME :	NORGENER ASME PTC 4 MASTER FORM			UNIT NO.	2
TEST NO :	6	DATE:	17-Dec-15	LOAD	47%
TIME START :	17:00	TIME END :	19:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 1 of 1	

Form EFFa Efficiency Calculations

Data

	TEMPERATURES,°C				
1	Reference Temperature, °C	25.0	1A	Enthalpy Water (0°C Ref), kJ/kg	104.57
2	Average Entering Air Temp, from CMBSTNa Item [84]: ([16B]x[18B]+[16A]x[18D])/100	26.54	2A	Enthalpy Dry Air, kJ/kg	1.55
			2B	Enthalpy Water Vapor, kJ/kg	2.87
3	Average Exit Gas T (Excl Lkg) from CMBSTNa [88]	150.0	3A	Enthalpy Dry Gas, kJ/kg	124.93
			3B	Enthalpy Steam @ 1 psia, kJ/kg	2780.4
			3C	Enthalpy Water Vapor, kJ/kg	235.74
4	Fuel Temperature	20.7	4A	Enthalpy Fuel, kJ/kg	-5.97
	HOT AIR QUALITY CONTROL EQUIPMENT				
5	Entering Gas Temperature	0.0	5A	Enthalpy Wet Gas	0.00
6	Leaving Gas Temperature	0.0	6A	Enthalpy of Wet Gas	0.00
			6B	Enthalpy of Wet Air	0.00
			6C	Enthalpy of Wet Air @ T = [3]	0.00
	RESULTS FROM COMBUSTION CALCULATION FORM CMBSTN				
10	Dry Gas Weight, kg/100 kJ [77]	4.618	18	Unburned Carbon, % [2]	0.111
11	Dry Air Weight [69]	4.437	19	HHV kJ/kg 'as-fired' [1]	23505.0
12	Water from H2 Fuel [34E]	0.140		**HOT AQC EQUIPMENT**	
13	Water from H2O Fuel [34F]	0.081	20	Wet Gas Entering [75E]	0.00
14	Water from H2Ov Fuel [34G]	0.000	21	H2O in Wet Gas, % [78E]	0.00
15	Moisture in Air kg/kg DA [7]	0.01149	22	Wet Gas Leaving [75L]	0.00
16	Moisture in Air kg/100 kJ [72]	0.051	23	Residue in Wet Gas, % [81E]	0.00
17	Fuel Rate Est. kg/hr [3]	28005			
			25	Excess Air, % [95]	72.38
	MISCELLANEOUS				
30	Unit Output, MJ/hr	579546	31	Aux Equip Power, MJ/hr	3006
32	Loss Due to Surface Radiation and Convection, %				0.25

PLANT NAME :	ASME PTC 4 MASTER FORM	UNIT NO.	2
TEST NO :	DATE :	LOAD	47%
TIME START :	TIME END :	CALC BY	R. Tim
REMARKS :		DATE	11-Feb-16
		SHEET 1 of 3	

Form EFFb Efficiency Calculations

	LOSSES, % Enter Calculated Result in % Column [B]			A	MKB	B	%
60	Dry Gas	[10] x [3A]	/100				
		x	/100				5.769
61	Water from H2 Fuel	[12] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					3.734
62	Water from H2O Fuel	[13] x ([3B] - [1A]) / 100					
		x - 104.57) / 100					2.162
63	Water from H2O Fuel	[14] x ([3C]) / 100					
		x / 100					0.000
64	Moisture in Air	[16] x [3C] / 100					
		x / 100					0.120
65	Unburned Carbon in Ref [18] x 33700 / [19] =		x 33700/				0.159
66	Sensible Heat of Refuse from Form RES						0.060
67	Hot AQC Equip ([20] x ([5A] - [6A]) - ([22] - [20]) x ([6C] - [6B])) / 100						
	(x (-) - (-) x (-)) / 100						0.000
68	Other Losses, % Basis from Form EFFc Item [110]						0.456
69	Summation of Losses, % Basis						12.459
	LOSSES, MJ/hr Enter in MKB Column [A]						
75	Surface Radiation and Convection from Form EFFa Item [32]				0.000		
76	Sorbent Calcination / Dehydration from Form SRBc Item [77]				0.000		
77	Water from Sorbent from Form SRBc Item [65]				0.000		
80	Other Losses, MJ/hr Basis from Form EFFc Item [111]				0.000		
81	Summation of Losses, MJ/hr Basis				0.000		
	CREDITS, % Enter Calculation Result in % Column [B]						
85	Entering Dry Air	[11] x [2A]	/100				
		x	/100				0.069
86	Moisture in Air	[16] x [2B]	/100				
		x	/100				0.001
87	Sensible Heat in Fuel	100 x [4A]	/ [19]				
		100 x	/				-0.025
88	Sulfation from Form SRBc Item [80]						0.000
89	Other Credits, % Basis from Form EFFc Item [112]						0.000
90	Summation of Credits, % Basis						0.045
	CREDITS, MJ/hr Enter Calculated Result in MKB Column [A]						
95	Auxiliary Equipment Power [31]				3006.0		
96	Sensible Heat from Sorbent from Form SRBc Item [85]				0.000		
97	Other Credits, MJ/hr Basis from Form EFFc Item [113B]				0.000		
98	Summation of Credits, MJ/hr Basis				3006.0		
100	Fuel Eff, % (100 - [69] + [90]) x [30] / ([30] + [81] - [98])						
	(100 - +) x / (+ -)						88.04
101	Input from Fuel, MJ/hr 100 x [30] / [100] = 100 x /				658257		
102	Fuel Rate, kg/hr 1,000 x [101] / [19] = 1,000 x /						28005

PLANT NAME : NORGENER		ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	6	DATE :	17-Dec-15	LOAD	47%
TIME START :	17:00	TIME END :	19:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 2 of 3	

Form EFFc Efficiency Calculations

Other Losses and Credits

The losses and credits listed on this sheet are not universally applicable to all fossil fired steam generators and are usuall minor. Losses/credits that have not been specifically identified by this Code but are applicable in accordance with th intent of the Code should also be recorded on this sheet

Parties to the test may agree to estimate the losses or credits in lieu of testing Enter a 'T' for tested or 'E' for esimate in the second column, and result in the appropriate column

Enter the sum of each group on Form EFFb.

Refer to the text of PTC 4 for the calculation method.

Itm	T or E	LOSSES, % Enter Calculated Result in % Column[B]	A MKB	B %
110A		CO in Flue Gas		0.006
110B		Formation of NOx		0.000
110C		Pulverizer Rejects		0.000
110D		Air Infiltration		0.000
110E		Unburned Hydrocarbons in Flue Gas		0.000
110F		Unburned Hydrogen in Refuse		0.000
110G	E	Unmeasured Loss, as per agreement		0.200
110H	E	Surface Radiation Loss, as per agreement		0.250
110		Summation of Other Losses, % Basis		0.456
		LOSSES, MJ/hr Enter in MKB Column [A]		
111A		Wet Ash Pit	0.000	
111B		Sensible Heat in Recycle Streams, Solid	0.000	
111C		Sensible Heat in Recycle Streams, Gas	0.000	
111D		Additional Moisture	0.000	
111E		Cooling Water	0.000	
111F		Air Preheater Coil (supplied by Unit)	0.000	
111G		Other	0.000	
111		Summation of other Losses, MJ/hr Basis	0.000	
		CREDITS, % Enter Calculation Result in % Column [B]		
112A		Other		0.000
112		Summation of Credits, % Basis		0.000
		CREDITS, MJ/hr Enter Result in MKB Column [A]		
113A		Heat in Additional Moisture (external to envelope)	0.000	
113B		Other	0.000	
113C		Heat by Auxiliary Equipment Power	3006.0	
113		Summation of Credits, MJ/hr Basis	3006.0	

PLANT NAME :	NORGENER	ASME PTC 4 MASTER FORM		UNIT NO.	2
TEST NO :	6	DATE :	17-Dec-15	LOAD	47%
TIME START :	17:00	TIME END :	19:00	CALC BY	R. Tim
REMARKS :				DATE	11-Feb-16
				SHEET 3 of 3	

APPENDIX H

Results Uncertainty Calculation

UNCERTAINTY CALCULATION NET HEAT RATE NORGENER Unit #2				(as per ASME PTC 19.1)			
TestNumber	100%-HR						
Load	136 MW						
Date	12/15/2015						
Start Time	9:00:00 AM						
End Time	11:00:00 PM						
	UNCERTAINTY LEVEL						
VARIABLE	**UNITS**	**B_i**	**$2S_i$**	**U_{Ti}**	**Q**	**U_i^2**	**Ur**
@0080 P Barometer	bar(a)	0.0010	0.0008	0.0013	10.99	0.0002	
@0081 T Ambient Temp.	°C	0.2000	0.4691	0.5100	1.194	0.3706	
@0082 X Rel.Humidity	%	2.5000	1.9770	3.1873	-0.171	0.2979	
@0102 T HP FW after FW Pumps	°C	0.5000	0.1996	0.5384	-0.023	0.0001	
@0105 dP HP Spray 1 W.Boiler	mbar	0.0000	0.8233	0.8233	9.899	66.416	
@0106 P HP Spray 1 W.Boiler	bar(a)	0.1687	0.5577	0.5826	0.000	0.0000	
@0110 dP RH Spray W.Boiler	mbar	0.1561	5.8164	5.8185	1.384	64.876	
@0111 P RH Spray W.Boiler	bar(a)	0.0739	1.0224	1.0251	0.003	0.0000	
@0112 T RH Spray 1 at FW Pump	°C	0.5000	0.1734	0.5292	-0.224	0.0141	
@0114 T RH Spray 3 at FW Pump	°C	0.5000	0.1821	0.5321	-0.224	0.0143	
@0115 dP HP Spray 2 W.Boiler	mbar	0.0000	0.7017	0.7017	0.000	0.0000	
@0116 P HP Spray 2 W.Boiler	bar(a)	0.1687	0.5568	0.5818	0.000	0.0000	
@0120 P Extraction HPH#2	bar(a)	0.0392	0.1563	0.1611	-0.134	0.0005	
@0121 T Extraction HPH#2	°C	0.5000	1.4295	1.5144	0.142	0.0465	
@0123 T FW Inlet HPH#2	°C	0.5000	0.2072	0.5412	3.596	3.7888	
@0124 P FW Outlet HPH#2	bar(a)	0.1847	0.6016	0.6293	0.020	0.0002	
@0125 T FW Outlet HPH#2	°C	0.5000	0.2388	0.5541	-3.769	4.361	
@0126 T Drain HPH#2	°C	0.5000	0.2080	0.5415	-0.264	0.0205	
@0130 P HP Steam Outl.Boiler	bar(a)	0.1656	0.5556	0.5797	-4.227	6.0050	
@0131 T HP Steam Outl.Boiler	°C	1.2000	2.0897	2.4098	10.61	653.96	
@0133 P Cold RH Inl.Boiler	bar(a)	0.0391	0.1580	0.1627	7.859	1.6357	
@0134 T Cold RH Inl.Boiler	°C	0.5000	1.4205	1.5059	-8.446	161.76	
@0135 P Hot RH Outl.Boiler	bar(a)	0.0359	0.1523	0.1565	-3.319	0.2697	
@0136 T Hot RH Outl.Boiler	°C	1.2000	1.4844	1.9088	7.927	228.92	
@0140 P FW Inlet Boiler	bar(a)	0.1823	0.5780	0.6061	-0.018	0.0001	
@0141 T FW Inlet Boiler	°C	0.5000	0.2770	0.5716	-17.94	105.20	
@0150 T CW Inlet Cond.(a)	°C	0.1000	0.5520	0.5610	-3.939	4.8840	
@0151 T CW Inlet Cond.(b)	°C	0.1000	0.5520	0.5610	-3.939	4.8840	
@0280 C Content Coal (Ultim.)	%	0.5908	0.1477	0.6090	7.952	23.452	
@0281 H Content Coal (Ultim.)	%	0.0041	0.0010	0.0042	4.084	0.0003	
@0282 S Content Coal (Ultim.)	%	0.0370	0.0093	0.0381	149.11	32.341	
@0283 N Content Coal (Ultim.)	%	0.1862	0.0466	0.1919	11.209	4.6287	
@0284 O Content Coal (Ultim.)	%	0.0094	0.0024	0.0097	0.177	0.0000	
@0285 W H2O in Coal (Proxim.)	%	0.1148	0.0287	0.1183	-2.138	0.0640	
@0286 A Ash in Coal (Proxim.)	%	0.0577	0.0144	0.0595	11.70	0.4841	
@0287 V Volatile Coal(Proxim.)	%	0.3296	0.0824	0.3397	0.021	0.0001	
@0288 C Fixed Carbon (Proxim.)	%	0.4264	0.1066	0.4395	0.009	0.0000	
@0290 Ub Unburn.Bottom Ash	%	0.1018	0.0254	0.1049	1.120	0.0138	
@0291 Ub Unburn.Fly-Ash	%	0.0625	0.0156	0.0644	23.10	2.2154	
@0295 HHV Value of Coal	kJ/kg	353.70	88.425	364.59	-0.056	410.98	
@0520 Ym Fuel Eff.Boiler Meas.	%	0.2549	0.0637	0.2628	-118.2	963.91	
@0550 Pe Gross Power Gen.	kW	477.20	750.50	889.4	0.0001	0.0042	
@0553 Phi Power Factor	-	0.0035	0.0009	0.004	-4170	225.86	
@0560 Pe Net Power Unit (kWh)	kW	439.18	0.0000	439.18	-0.083	1330.4	
@1756 M FW Boiler Cond.Method	kg/s	2.200	0.8350	2.353	88.88	43742	
@0910 T Cold Prim.Air Aver.	°C	1.5000	0.6612	1.6393	-1.365	5.0105	
@0911 T Cold Sec.Air Aver.	°C	1.5000	0.6455	1.6330	0.000	0.0000	
@0912 T Hot Prim.Air Aver.	°C	2.5000	1.8432	3.1060	0.000	0.0000	
@0913 T Hot Sec.Air Aver.	°C	2.5000	1.7628	3.0590	0.000	0.0000	
@0914 T Exh.Inl.Air Heat.Aver.	°C	2.5000	8.9264	9.2699	0.000	0.0000	
@0915 T Exh.Outl.Air Heat.Aver	°C	2.5000	15.883	16.0789	5.447	7671.2	
@0919 O2 Oxig.Inl.Air Heat.Aver	vol%,dry	0.1520	0.1796	0.2353	-0.486	0.0131	
@0920 O2 Oxig.Outl.Air H.Aver.	vol%,dry	0.3275	1.1401	1.1862	21.62	657.67	
@0921 CO Outl.Air Heat.Aver.	ppm	0.0000	0.4601	0.460	0.016	0.000	
@1760 M HP Spray 1 Boiler (methodology)	kg/s	0.0031	0.0000	0.0031	12.70	0.0015	
@1770 M HP Spray 2 Boiler (methodology)	kg/s	0.0031	0.0000	0.0031	12.70	0.0015	
@1800 M RH Spray Boiler (methodology)	kg/s	0.0467	0.0000	0.0467	92.28	18.536	
Summation						***56397***	
Abs. Unc. Net Heat Rate	kJ/kWh						237.5
Rel. Unc. Net Heat Rate	%						**2.3**

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.