

Appendix 01.

TENT A6_ESPs Overview and Upgrade Data

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESP's Efficiency / Performance Assessment

1. General Information

Nominal Load	(MW)		308,5
Turbine Manufacturer		Compagnie Electro Mechanique (ALSTOM)	
Turbine Heat Rate	(KJ/Kwh)		7821
Turbine efficiency	(%)		46,03
Boiler Manufacturer		RAFACO S.A.	
Boiler Type		Pulverized Lignite Fired, Once Through, SULZER Type, model BB-920	
Lignite Mills		6 Mills, EVT, type N-270.45, capacity 93 t/h	
Boiler Maximum Continuous Rating	(Kg/s)		256
Boiler Efficiency	(%)		87,1
Unit Efficiency	(%)		40,09
Electrostatic Precipitators		2, 2_Chamber, gas tight, ELWO, type HE 2x33-2x750/3x4x9,6/800	
Induced Draft Fans		2, TLT-Turbo GmbH (KKK), type AN31W13	
Air Pre Heaters		2, LURGI, Rotary (Ljungstrom) Horizontal type,	

Required Collection Area after ESPs Refurbishment and steam turbine upgrade (calculations according to current ESP's design data)			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m ²)		72.535
Required ESPs Collection Area increase	(%)		139
Required Collection Area after ESPs Refurbishment and steam turbine upgrade (calculation based on operation data)			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m ²)		61.017
Required ESPs Collection Area increase	(%)		101
Calculation based on operation data without including the steam turbine upgrade			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m ²)		54.091
Required ESPs Collection Area increase	(%)		78

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESPs Efficiency / Performance Assessment

2. Fuel / Ash Characteristics			
2.1 Design Data			
Low Calorific Value	KJ/Kg		6700
Moisture	(%)		47
Ash	(%)		20
Sulphur Content	(%)		
	(%)		
2.2 As Fired Fuel Data (avarage values)			
Low Calorific Value	KJ/Kg		8270
Moisture	(%)		49,62
Ash	(%)		13,03
Sulphur Content	(%)		0,52
Carbon fixed	(%)		15,76
Volatiles	(%)		21,59
N+O ₂	(%)		10,36
3. Ash Analysis (as measured, average values)			
SiO ₂	(%)		58.03
Al ₂ O ₃	(%)		21.12
Fe ₂ O ₃	(%)		5.56
CaO	(%)		5.31
MgO	(%)		2.35
Na ₂ O	(%)		0.51
K ₂ O	(%)		1.17
TiO ₂	(%)		0.74
P ₂ O ₅	(%)		0.05
SO ₃	(%)		2.21

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESPs Efficiency / Performance Assessment

4. ESPs Characteristics

4.1 General Information

ESPs Manufacturer		ELWO, Poland
ESPs type		HE 2x33-2x750/3x4x9,6/800
ESPs type		2- Chamber, gas tight
Year of commissioning		1978

4.2 Technical Characteristics

4.2.1 Mechanical

Nr of ESPs	(pcs)		2
Nr of Chambers / ESP	(pcs)		2
Nr of Fields (Zones)	(pcs)		3
Nr of Sections / Chamber	(pcs)		3
Nr of Sections / ESP	(pcs)		6
Total Nr of Sections	(pcs)		12
Chamber Length	(mm)		17.100
Chamber Width	(mm)		20.700
Flue gas duct cross section downstream Chamber	(m ²)		12,80
Flue gas duct cross section upstream Chamber	(m ²)		26,00
Collection Electrodes, type		SIGMA IV (1.200x320)	
Collection Electrodes, effective height	(mm)		9.600
Collection Electrodes Plates (Sections) effective length	(mm)		4.000
Total Chamber effective length	(mm)		12.000
Collection Electrodes spacing	(mm)		300
Nr of flue gas passages / Chamber	(pcs)		33
Nr of Collection Electrodes / ESP	(pcs)		2.448
Total Nr of Collection Electrodes	(pcs)		4.896
Collection Area / Chamber	(m ²)		7.603,20
Collection Area / ESP	(m ²)		15.206,40
Total Collection Area / ESP	(m ²)		30.412,80
Casing utilization factor	(%)		70,18
Active cross section / Chamber	(m ²)		95,04
Effective Volume / Chamber	(m ³)		1.140

Attached to Visual Inspection Report of the ESP of TPP-NT A6

4.2 Technical Characteristics			
4.2.1 Mechanical			
Discharge Electrodes, type		"A", flat strip with spikes	
Discharge Electrodes, length	(mm)		2.450
Discharge Electrodes total effective length / ESP	(m)		45.971
4.2.2 Electrical			
Transformer - Rectifiers, manufacturer		Merlin Guerin	
Nr of Transformer - Rectifiers / ESP	(pcs)		6
Total Nr of Transformer - Rectifiers	(pcs)		12
Secondary Voltage, maximum	(KV)		90
Secondary Current, maximum	(mA)		800
Apparent Power / Transformer - Rectifier	(KVA)		720
Power factor, $\cos\phi$			0,85
Voltage Controller, manufacturer / type		Marlin Guerin, electronic / analog type	
Mains Voltage	(V)		380

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6			
ESP's Efficiency / Performance Assessment			
5 ESPs Operational Data			
5.1 Current Design Operational Data			
Fuel (lignite) consumption (calculated)	(t/h)		413
Flue Gas Volumetric Flow (as measured)	(m ³ /h)		3.457.211
Flue Gas Volumetric Flow (0 °C, 1013 mbar)	(m ³ /h)		1.520.000
Flue gas Temperature	(°C)		150
Flue Gas Pressure	(KPa)		-31,89
O ₂	(%)		4,7 ÷ 6,2
CO ₂	(%)		13 ÷ 14,5
Dust concentration on flue gas upstream ESPs (0 oC, 1013 mbar)	(g/m ³)		51,20
Dust concentration on flue gas upstream ESPs (0 oC, 1013 mbar)	(mg/m ³)		512
ESP's efficiency	(%)		99,00
Pressure drop across ESP	(Pa)		98,10
Temperature drop across ESP	(° K)		10
Ash quantity collected in Zone I	(Kg/h)		60.830
Ash quantity collected in Zone II	(Kg/h)		13.100
Ash quantity collected in Zone III	(Kg/h)		3.070
Specific Collection Area (SCA)	(m ²)		31,67
Flue gas velocity inside ESPs	(m/s)		2,53
Treatment Time	(s)		4,75
Migration Velocity Factor Duetsch-Anderson)	(cm/s)		14,54
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)		66,97
5.2 Current Operational Data as measured (average values)			
Lignite Lower Calorific Value	KJ/Kg		8.270
Moisture content in lignite	(%)		49,62
Ash content in lignite	(%)		13,03
Lignite consumption (calculated)	(t/h)		335
Moisture content in flue gas	(%)		18,66
O ₂ content	(%)		7,31
Flue gas temperature	(°C)		180
Flue gas pressure	(Pa)		-2.166
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)		1.716.892
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)		1.396.311
Flue gas velocity downstream ESP	(m/s)		15,85
ESP's Efficiency	(%)		99,29
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)		120
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)		213
Flue gas volumetric flow (as measured)	(m ³ /h)		2.908.243
Flue gas volumetric flow (as measured)	(m ³ /s)		808
Flue gas velocity into ESP	(m/s)		2,13
Effective Collection Area	(m ²)		30.413
Specific Collection Area	(m ² / m ³ /s)		38
Treatment Time	(s)		5,68
Migration Velocity (Dutsch-Anderson)	(cm/s)		13,84
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)		71,75

Attached to Visual Inspection Report of the ESP of TPP-NT A6

5.3 Estimated Operational Data After Steam Turbine Upgrade			
Upgraded Nominal Load	(MW)		348
Boiler Maximum Continuous Rating	(Kg/s)		292
Lignite (reference) consumption (calculated)	(t/h)		466
Flue Gas Volumetric Flow (approx. calculated, reference data)	(m ³ /h)		3.899.868
Flue Gas Volumetric Flow (approx. calculated, reference data)	(m ³ /s)		1.083
Flue Gas Volumetric Flow (0 °C, 1013 mbar, reference data)	(m ³ /h)		1.714.619
Lignite (as measured) consumption (calculated)	(t/h)		378
Flue Gas Volumetric Flow (approx. calculated, as measured data)	(m ³ /h)		3.280.611
Flue Gas Volumetric Flow (approx. calculated, as measured data)	(m ³ /s)		911
Flue Gas Volumetric Flow (0 °C, 1013 mbar, as measured data)	(m ³ /h)		1.575.093
Flue gas temperature	(° C)		165
Flue gas Pressure	(KPa)		
O ₂	(%)		6
5.4 Required ESPs Efficiency After Refurbishment			
Dust emission level requirement (Directive 2001/80/EC, 0 °C, 1013 mbar, dry, 6% O ₂)	(mg/Nm ³)		50
Required ESPs collection efficiency	(%)		99,90
5.4 Required Collection Area After ESPs Refurbishment			
5.4.1 Calculation based on design data and steam turbine upgrade			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m ²)		72.535
Required ESPs Collection Area increase	(%)		139
5.4.2 Calculation based on operation data and steam turbine upgrade			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m ²)		61.017
Required ESPs Collection Area increase	(%)		101
5.4.3 Calculation based on operation data without including the steam turbine upgrade			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m ²)		54.091
Required ESPs Collection Area increase	(%)		78

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESP's Efficiency / Performance Tests Sep. 1982

Date		08.09.1982				13.09.1982			
ESP		ESP-1.1	ESP-1.2	ESP-2.1	ESP-2.2	ESP-1.1	ESP-1.2	ESP-2.1	ESP-2.2
Load	(MW)	309				306			
Lignite Analysis									
Lower Calorific Value (H _d)	(KJ/Kg)	8185	8185	8185	8185	7796	7796	7796	7796
Moisture (W)	(%)	46,74	46,74	46,74	46,74	48,45	48,45	48,45	48,45
Ash (A)	(%)	15,96	15,96	15,96	15,96	15,65	15,65	15,65	15,65
Volatiles content	(%)	22,03	22,03	22,03	22,03	21,36	21,36	21,36	21,36
Carbon content	(%)	15,27	15,27	15,27	15,27	14,54	14,54	14,54	14,54
Sulphur content	(%)	0,72	0,72	0,72	0,72	0,5	0,5	0,5	0,5
Ash Chemistry									
SiO ₂	(%)								
Fe ₂ O ₃	(%)								
Al ₂ O ₃	(%)								
Na ₂ O	(%)								
K ₂ O	(%)								
ESPs Operational Characteristics (as measured)									
Moisture content in flue gas	(%)	19,77	20,80	18,58	19,51	17,50	18,00	18	18,20
O ₂ content	(%)	7,40	6,60	8,5	7,80	7,90	7,10	7,3	7,00
Flue gas temperature	(°C)	165,0	174,0	166	173,0	163,0	173,0	172	184,0
Flue gas pressure	(Pa)	-2187	-2207	-2168	-2148	-2060	-2060	-2109	-2148
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	440.008	413.298	395031	422.394	411.832	388.154	386.501	435.102
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	353.018	327.332	321.634	339.985	339.761	318.286	316.931	355.913
Flue gas velocity downstream ESP	(m/s)	15,90	15,20	14,3	15,50	14,80	14,20	14,1	16,40
ESPs Efficiency	(%)	99,42	99,66	93,34	99,28	99,61	99,50	94,74	98,28
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m³)	156	96	1984	201	121	167	1526	444
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m³)	214	126	2924	284	168	220	2038	582
ESPs Operational Characteristics (calculated)									
Flue gas volumetric flow (as measured)	(m³/h)	721.375	691.643	648.991	704.864	671.239	647.152	643.270	743.972
Flue gas volumetric flow (as measured)	(m³/s)	200,38	192,12	180,28	195,80	186,46	179,76	178,69	206,66
Flue gas velocity into ESP	(m/s)	2,11	2,02	1,90	2,06	1,96	1,89	1,88	2,17
Effective Collection Area	(m²)	7.603	7.603	7.603	7.603	7.603	7.603	7.603	7.603
Specific Collection Area	(m² / m³/s)	37,94	39,57	42,18	38,83	40,78	42,30	42,55	36,79
Treatment Time	(s)	5,69	5,94	6,33	5,82	6,12	6,34	6,38	5,52
Migration Velocity (Dutsch-Anderson)	(cm/s)	13,6	14,4	6,4	12,7	13,6	12,5	6,9	11,0
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	69,9	81,6	17,4	62,7	75,5	66,4	20,4	44,9

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6**ESPs Efficiency / Performance Tests 1984**

Date		1984	
ESP		ESP-1	ESP-2
Load	(MW)	306	
Lignite Analysis			
Lower Calorific Value (H _d)	(KJ/Kg)	8185	8185
Moisture (W)	(%)		
Ash (A)	(%)	12	12
Volatiles content	(%)		
Carbon content	(%)		
Sulphur content	(%)		
Ash Chemistry			
SiO ₂	(%)		
Fe ₂ O ₃	(%)		
Al ₂ O ₃	(%)		
Na ₂ O	(%)		
K ₂ O	(%)		
ESPs Operational Characteristics (as measured)			
Moisture content in flue gas	(%)	18,8	18,85
O ₂ content	(%)	7,20	7,20
Flue gas temperature	(°C)	173	175
Flue gas pressure	(Pa)	-2393	-2420
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	906.404	906.962
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(Kg/m ³)	736.000	736.000
Flue gas velocity downstream ESP	(m/s)	16,60	16,60
ESPs Efficiency	(%)	98,56	98,56
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)		
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	365	274
ESPs Operational Characteristics (calculated)			
Flue gas volumetric flow (as measured)	(m ³ /h)	1.516.296	1.524.448
Flue gas volumetric flow (as measured)	(m ³ /s)	421,19	423,46
Flue gas velocity into ESP	(m/s)	2,22	2,23
Effective Collection Area	(m ²)	15.206	15.206
Specific Collection Area	(m ² / m3 /s)	36,10	35,91
Treatment Time	(s)	5,42	5,39
Migration Velocity (Dutsch-Anderson)	(cm/s)	11,7	11,8
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	49,8	50,1

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6**ESPs Efficiency / Performance Tests 1985**

Date		1985	
ESP		ESP-1	ESP-2
Load	(MW)	307	
<u>Lignite Analysis</u>			
Lower Calorific Value (H _d)	(KJ/Kg)	8444	8444
Moisture (W)	(%)		
Ash (A)	(%)	12	12
Volatiles content	(%)		
Carbon content	(%)		
Sulphur content	(%)		
<u>Ash Chemistry</u>			
SiO ₂	(%)		
Fe ₂ O ₃	(%)		
Al ₂ O ₃	(%)		
Na ₂ O	(%)		
K ₂ O	(%)		
<u>ESPs Operational Characteristics (as measured)</u>			
Moisture content in flue gas	(%)	19,3	19,05
O ₂ content	(%)	6,60	6,10
Flue gas temperature	(°C)	152,0	173,0
Flue gas pressure	(Pa)	-1985	-1953
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	881.041	954.910
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)	711.000	773.000
Flue gas velocity downstream ESP	(m/s)	15,35	16,10
ESPs Efficiency	(%)	99,72	99,73
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)		
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	83	63
<u>ESPs Operational Characteristics (calculated)</u>			
Flue gas volumetric flow (as measured)	(m ³ /h)	1.398.723	1.590.366
Flue gas volumetric flow (as measured)	(m ³ /s)	388,53	441,77
Flue gas velocity into ESP	(m/s)	2,04	2,32
Effective Collection Area	(m ²)	15.206	15.206
Specific Collection Area	(m ² / m ³ /s)	39,14	34,42
Treatment Time	(s)	5,87	5,16
Migration Velocity (Dutsch-Anderson)	(cm/s)	15,0	17,2
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	88,3	101,6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESPs Efficiency / Performance Tests 1991

Date		1991_1		1991_2		1991_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	305		299		299	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	8172	8172	8957	8957	8739	8739
Moisture (W)	(%)						
Ash (A)	(%)	11	11	10	10	11	11
Volatiles content	(%)						
Carbon content	(%)						
Sulphur content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	18,6	18,1	17,8	17,5	19	18,7
O2 content	(%)	7,80	8,20	7,60	7,90	6,60	6,80
Flue gas temperature	(°C)	180,0	168,0	186,0	172,0	184,0	171,0
Flue gas pressure	(Pa)	-2830	-2526	-2580	-2475	-2155	-2195
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.176.904	908.425	1.075.426	940.606	962.963	853.629
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	958.000	744.000	884.000	776.000	780.000	694.000
Flue gas velocity downstream ESP	(m/s)	21,70	16,60	20,45	17,35	18,10	15,60
ESPs Efficiency	(%)	98,22	98,68	98,42	98,23	99,46	98,76
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m³)						
Dust concentration (0 °C, 1013 mbar, dry, 6% O2)	(mg/m³)	505	373	362	405	149	339
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.008.572	1.504.669	1.854.975	1.571.287	1.646.667	1.418.768
Flue gas volumetric flow (as measured)	(m³/s)	557,94	417,96	515,27	436,47	457,41	394,10
Flue gas velocity into ESP	(m/s)	2,94	2,20	2,71	2,30	2,41	2,07
Effective Collection Area	(m²)	15.206	15.206	15.206	15.206	15.206	15.206
Specific Collection Area	(m² / m3/s)	27,25	36,38	29,51	34,84	33,24	38,58
Treatment Time	(s)	4,09	5,46	4,43	5,23	4,99	5,79
Migration Velocity (Dutsch-Anderson)	(cm/s)	14,8	11,9	14,1	11,6	15,7	11,4
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	59,5	51,5	58,3	46,7	82,0	49,9

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESPs Efficiency / Performance Tests 1994

Date		1994_1		1994_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	303		295	
Lignite Analysis					
Lower Calorific Value (H _d)	(KJ/Kg)	8838	8838	8046	8046
Moisture (W)	(%)				
Ash (A)	(%)	10	10	15	15
Volatiles content	(%)				
Carbon content	(%)				
Sulphur content	(%)				
Ash Chemistry					
SiO ₂	(%)				
Fe ₂ O ₃	(%)				
Al ₂ O ₃	(%)				
Na ₂ O	(%)				
K ₂ O	(%)				
ESPs Operational Characteristics (as measured)					
Moisture content in flue gas	(%)	17,6	17	20,1	18,8
O ₂ content	(%)	7,90	8,50	6,30	7,40
Flue gas temperature	(°C)	208,0	156,0	214,0	151,0
Flue gas pressure	(Pa)	-2221	-2190	-2143	-2000
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	858.010	918.072	812.265	818.966
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)	707.000	762.000	649.000	665.000
Flue gas velocity downstream ESP	(m/s)	16,95	16,15	16,20	14,15
ESPs Efficiency	(%)	98,80	99,85	99,67	99,87
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)				
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	321	38	171	69
ESPs Operational Characteristics (calculated)					
Flue gas volumetric flow (as measured)	(m ³ /h)	1.545.252	1.474.269	1.479.945	1.297.311
Flue gas volumetric flow (as measured)	(m ³ /s)	429,24	409,52	411,10	360,36
Flue gas velocity into ESP	(m/s)	2,26	2,15	2,16	1,90
Effective Collection Area	(m ²)	15.206	15.206	15.206	15.206
Specific Collection Area	(m ² / m3 /s)	35,43	37,13	36,99	42,20
Treatment Time	(s)	5,31	5,57	5,55	6,33
Migration Velocity (Dutsch-Anderson)	(cm/s)	12,5	17,5	15,4	15,7
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	55,2	113,9	88,3	104,7

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6**ESPs Efficiency / Performance Tests 1995**

Date		1995_1		1995_2		1995_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	301		304		290	
Lignite Analysis							
Lower Calorific Value (H _d)	(KJ/Kg)	8216	8216	9273	9273	7464	7464
Moisture (W)	(%)						
Ash (A)	(%)	13	13	9	9	18	18
Volatiles content	(%)						
Carbon content	(%)						
Sulphur content	(%)						
Ash Chemistry							
SiO ₂	(%)						
Fe ₂ O ₃	(%)						
Al ₂ O ₃	(%)						
Na ₂ O	(%)						
K ₂ O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	19,2	19,8	18,1	18,6	19,5	20
O ₂ content	(%)	7,10	6,50	7,10	6,70	7,40	7,00
Flue gas temperature	(°C)	174,0	199,0	171,0	198,0	173,0	198,0
Flue gas pressure	(Pa)	-2060	-2207	-2108	-2262	-2207	-2318
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	820.545	854.115	822.955	834.152	844.720	868.750
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)	663.000	685.000	674.000	679.000	680.000	695.000
Flue gas velocity downstream ESP	(m/s)	16,35	14,85	16,00	14,85	16,70	15,35
ESPs Efficiency	(%)	99,61	99,86	99,32	99,40	99,68	99,86
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)						
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	151	52	154	129	178	76
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m ³ /h)	1.371.124	1.509.251	1.366.587	1.471.672	1.410.455	1.533.579
Flue gas volumetric flow (as measured)	(m ³ /s)	380,87	419,24	379,61	408,80	391,79	425,99
Flue gas velocity into ESP	(m/s)	2,00	2,21	2,00	2,15	2,06	2,24
Effective Collection Area	(m ²)	15.206	15.206	15.206	15.206	15.206	15.206
Specific Collection Area	(m ² / m ³ / s)	39,93	36,27	40,06	37,20	38,81	35,70
Treatment Time	(s)	5,99	5,44	6,01	5,58	5,82	5,35
Migration Velocity (Dutsch-Anderson)	(cm/s)	13,9	18,1	12,5	13,8	14,8	18,4
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	77,1	119,1	62,2	70,4	85,0	121,0

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESP's Efficiency / Performance Tests 1998

Date		1998_1		1998_2		1998_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	290		290		304	
Lignite Analysis							
Lower Calorific Value (H _d)	(KJ/Kg)	8070	8070	8666	8666	7860	7860
Moisture (W)	(%)						
Ash (A)	(%)	14	14	7	7	17	17
Volatiles content	(%)						
Carbon content	(%)						
Sulphur content	(%)						
Ash Chemistry							
SiO ₂	(%)						
Fe ₂ O ₃	(%)						
Al ₂ O ₃	(%)						
Na ₂ O	(%)						
K ₂ O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	19,7	19,7	19,7	19,7	19,7	20
O ₂ content	(%)	7,10	7,00	7,00	7,00	6,60	6,40
Flue gas temperature	(°C)	168,0	183,0	168,0	184,0	164,0	184,0
Flue gas pressure	(Pa)	-1864	-1885	-2011	-1943	-1913	-1913
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	955.168	834.371	924.035	834.371	972.603	841.250
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)	767.000	670.000	742.000	670.000	781.000	673.000
Flue gas velocity downstream ESP	(m/s)	17,05	14,45	16,65	15,65	17,50	15,75
ESPs Efficiency	(%)	99,65	99,71	98,24	99,19	99,79	99,86
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)						
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	126	119	343	167	100	72
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m ³ /h)	1.571.559	1.419.787	1.522.586	1.423.730	1.586.517	1.435.035
Flue gas volumetric flow (as measured)	(m ³ /s)	436,54	394,39	422,94	395,48	440,70	398,62
Flue gas velocity into ESP	(m/s)	2,30	2,07	2,23	2,08	2,32	2,10
Effective Collection Area	(m ²)	15.206	15.206	15.206	15.206	15.206	15.206
Specific Collection Area	(m ² / m ³ /s)	34,83	38,56	35,95	38,45	34,51	38,15
Treatment Time	(s)	5,23	5,78	5,39	5,77	5,18	5,72
Migration Velocity (Dutsch-Anderson)	(cm/s)	16,2	15,2	11,2	12,5	17,9	17,2
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	91,8	88,5	45,4	60,3	110,2	113,2

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESPs Efficiency / Performance Tests _ 2006

Date		2006_1		2006_2		2006_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	285		282		308	
<u>Lignite Analysis</u>							
Lower Calorific Value (H _d)	(KJ/Kg)	7859	7859	8177	8177	8034	8034
Moisture (W)	(%)						
Ash (A)	(%)	18	18	11	11	14	14
Volatiles content	(%)						
Carbon content	(%)						
Sulphur content	(%)						
<u>Ash Chemistry</u>							
SiO ₂	(%)						
Fe ₂ O ₃	(%)						
Al ₂ O ₃	(%)						
Na ₂ O	(%)						
K ₂ O	(%)						
<u>ESPs Operational Characteristics (as measured)</u>							
Moisture content in flue gas	(%)	18,1	18,1	18,9	18,7	18,7	18,3
O ₂ content	(%)	7,80	7,80	7,70	7,90	7,60	8,00
Flue gas temperature	(°C)	185,0	198,0	186,0	195,0	180,0	194,0
Flue gas pressure	(Pa)	-2043	-2135	-2191	-2041	-2147	-2138
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	807.082	769.231	776.819	687.577	753.998	760.098
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)	661.000	630.000	630.000	559.000	613.000	621.000
Flue gas velocity downstream ESP	(m/s)	15,15	14,85	14,50	13,15	14,00	14,50
ESPs Efficiency	(%)	99,28	99,08	99,37	99,37	99,02	99,43
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)						
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	380	483	364	201	386	231
<u>ESPs Operational Characteristics (calculated)</u>							
Flue gas volumetric flow (as measured)	(m ³ /h)	1.381.568	1.355.394	1.334.656	1.202.665	1.277.951	1.327.972
Flue gas volumetric flow (as measured)	(m ³ /s)	383,77	376,50	370,74	334,07	354,99	368,88
Flue gas velocity into ESP	(m/s)	2,02	1,98	1,95	1,76	1,87	1,94
Effective Collection Area	(m ²)	15.206	15.206	15.206	15.206	15.206	15.206
Specific Collection Area	(m ² / m3 /s)	39,62	40,39	41,02	45,52	42,84	41,22
Treatment Time	(s)	5,94	6,06	6,15	6,83	6,43	6,18
Migration Velocity (Dutsch-Anderson)	(cm/s)	12,5	11,6	12,4	11,1	10,8	12,5
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	61,4	54,4	62,6	56,4	49,9	64,8

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESPs Efficiency / Performance Tests _ Nov. 2007

Date		05.11.2007		06.11.2007		09.11.2007	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	309	309	309	309	312	312
Lignite Analysis							
Lower Calorific Value (H _d)	(KJ/Kg)	8823	8823	8833	8833	9084	9084
Moisture (W)	(%)	51,8	51,8	49	49	51,2	51,2
Ash (A)	(%)	10,45	10,45	11,58	11,58	8,53	8,53
Volatiles content	(%)	20,54	20,54	21,79	21,79	22,73	22,73
Carbon content	(%)	17,21	17,21	17,65	17,65	17,54	17,54
Sulphur content	(%)	0,68	0,68	0,62	0,62	0,34	0,34
Ash Chemistry							
SiO ₂	(%)	77,25	80,02	76,21	79,62	56,28	59,32
Fe ₂ O ₃	(%)	3,47	3,59	4,2	4,39	7,38	7,78
Al ₂ O ₃	(%)	10,68	11,06	8,03	8,39	22,02	23,21
Na ₂ O	(%)	0,32	0,33	0,27	0,28	0,33	0,35
K ₂ O	(%)	0,7	0,72	0,6	0,63	0,71	0,75
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	16,90	17,80	16,90	17,80	18,20	17,40
O ₂ content	(%)	8,10	7,50	7,80	7,40	6,90	7,70
Flue gas temperature	(°C)	178,0	191,0	176,0	193,0	177,0	194,0
Flue gas pressure	(Pa)	-2232	-2237	-2166	-2156	-2104	-2075
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	821.000	812.000	819.000	809.000	790.000	775.000
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)	682.251	667.464	680.589	664.998	646.220	640.150
Flue gas velocity downstream ESP	(m/s)	15,10	15,30	15,00	15,30	14,60	14,90
ESPs Efficiency	(%)	99,53	99,57	99,56	99,05	99,30	99,33
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)	90	180	94	149	72	108
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	126	244	130	202	93	148
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m ³ /h)	1.386.561	1.410.948	1.376.135	1.410.639	1.329.531	1.353.148
Flue gas volumetric flow (as measured)	(m ³ /s)	385,16	391,93	382,26	391,84	369,31	375,87
Flue gas velocity into ESP	(m/s)	2,03	2,06	2,01	2,06	1,94	1,98
Effective Collection Area	(m ²)	15.206	15.206	15.206	15.206	15.206	15.206
Specific Collection Area	(m ² / m ³ / s)	39,48	38,80	39,78	38,81	41,17	40,46
Treatment Time	(s)	5,92	5,82	5,97	5,82	6,18	6,07
Migration Velocity (Deutsch-Anderson)	(cm/s)	13,6	14,0	13,6	12,0	12,1	12,4
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	72,8	76,5	74,0	55,9	59,8	61,9

Attached to Visual Inspection Report of the ESP of TPP-NT A6

THERMAL POWER PLANT "NIKOLA TESLA" A, Block A6

ESPs Efficiency / Performance Tests (1982_2007) Overview

Date		1982 - 2007		
		Min	Average	Max
Load	(MW)	282	302	312
Lignite Analysis				
Lower Calorific Value (H _d)	(KJ/Kg)	7464	8335	9273
Moisture (W)	(%)	46,74	48,91	51,8
Ash (A)	(%)	7	12,86	18
Volatiles content	(%)	20,54	21,69	22,73
Carbon content	(%)	14,54	16,00	17,65
Sulphur content	(%)	0,34	0,58	0,72
Ash Chemistry				
SiO ₂	(%)	56,28	71,45	80,02
Fe ₂ O ₃	(%)	3,47	5,14	7,78
Al ₂ O ₃	(%)	8,03	13,90	23,21
Na ₂ O	(%)	0,27	0,31	0,35
K ₂ O	(%)	0,6	0,69	0,75
ESPs Operational Characteristics (as measured)				
Moisture content in flue gas	(%)	16,90	18,66	20,29
O ₂ content	(%)	6,10	7,31	8,50
Flue gas temperature	(°C)	151	180	214
Flue gas pressure	(Pa)	-2.830	-2.166	-1.864
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m ³ /h)	687.577	858.446	1.176.904
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m ³ /h)	559.000	698.156	958.000
Flue gas velocity downstream ESP	(m/s)	13,15	15,85	21,70
ESPs Efficiency	(%)	96,31	99,29	99,87
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m ³)	72	120	1.093
Dust concentration (0 °C, 1013 mbar, dry, 6% O ₂)	(mg/m ³)	38	213	1.604
ESPs Operational Characteristics (calculated)				
Flue gas volumetric flow (as measured)	(m ³ /h)	1.202.665	1.454.121	2.008.572
Flue gas volumetric flow (as measured)	(m ³ /s)	334	404	558
Flue gas velocity into ESP	(m/s)	1,76	2,13	2,94
Effective Collection Area	(m ²)	15.206	15.206	15.206
Specific Collection Area	(m ² / m ³ /s)	27	38	46
Treatment Time	(s)	4,09	5,68	6,83
Migration Velocity (Deutsch-Anderson)	(cm/s)	8,98	13,84	18,41
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	32,6	71,75	121,0