

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Assessment

#### 1. General Information

Nominal Load	(MW)		618,4
Turbine Manufacturer		Compagnie Electro Mechanique (ALSTOM)	
Turbine Heat Rate	(KJ/Kwh)		7.773
Turbine efficiency	(%)		46,31
Boiler Manufacturer		RAFACO S.A.	
Boiler Type		Pulverized Lignite Fired, Once Through, SULZER Type, model BB-1880	
Lignite Mills		6 Mills, EVT, type N-400.42,	
Boiler Maximum Continuous Rate	(t/h)		1880
Boiler Nominal Continuous Rate	(t/h)		1824
Superheated steam pressure	(bar)		186,5
Superheated steam temperature	°C		540
Reheated steam pressure	(bar)		
Reheated steam temperature	°C		540
Boiler Efficiency	(%)		88,3
Unit Efficiency	(%)		36,81
Electrostatic Precipitators		2, 2_Chamber, LURGI, type BS 672	
Induced Draft Fans		2, TLT-Turbo GmbH (KKK), type KKK-AN42e6	
Air Pre Heaters		2, LURGI, Rotary (Ljungstrom) Horizontal type,	

#### Required Collection Area after ESPs Refurbishment and steam turbine upgrade (calculations according to measured data during periodic tests)

Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m <sup>2</sup> )		87.594
Required ESPs Collection Area increase	(%)		18,50

#### Required Collection Area after ESPs Refurbishment and steam turbine upgrade (calculations according to initial ESP's design data)

Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m <sup>2</sup> )		107.262
Required ESPs Collection Area increase	(%)		45,10

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Assessment

2. Fuel / Ash Characteristics			
2.1 Design Data			
Low Calorific Value	KJ/Kg		6.720
Moisture	(%)		47,79
Ash	(%)		19
Sulphur Content	(%)		0,5
Volatiles Content	(%)		20,09
2.2 As Fired Fuel Data (average values)			
Low Calorific Value	KJ/Kg		8.202
Moisture	(%)		49,29
Ash	(%)		13,09
Sulphur Content	(%)		0,51
Carbon fixed	(%)		15,49
Volatiles	(%)		22,16
Combustibles content	(%)		37,39
3. Ash Analysis (as measured, average values)			
SiO <sub>2</sub>	(%)		54,97
Al <sub>2</sub> O <sub>3</sub>	(%)		27,02
Fe <sub>2</sub> O <sub>3</sub>	(%)		4,39
CaO	(%)		7,44
MgO	(%)		2,99
Na <sub>2</sub> O	(%)		0,22
K <sub>2</sub> O	(%)		0,58
TiO <sub>2</sub>	(%)		0,31
P <sub>2</sub> O <sub>5</sub>	(%)		0,05
SO <sub>3</sub>	(%)		2,18

# THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

## ESPs Efficiency / Performance Assessment

### 4. ESPs Characteristics

#### 4.1 General Information

ESPs Manufacturer		LURGI, Germany
ESPs type		BS 672
ESPs type		2- Chamber
Year of commissioning		1.983

#### 4.2 Technical Characteristics

##### 4.2.1 Mechanical

Nr of ESPs	(pcs)		2
Nr of Chambers / ESP	(pcs)		2
Nr of Fields (Zones)	(pcs)		4
Nr of Sections / Chamber	(pcs)		4
Nr of Sections / ESP	(pcs)		8
Total Nr of Sections	(pcs)		16
Chamber Length	(mm)		19.370
Chamber Width	(mm)		15.200
Flue gas duct cross section downstream Chamber	(m <sup>2</sup> )		19,80
Flue gas duct cross section upstream Chamber	(m <sup>2</sup> )		27,36
Collection Electrodes, type		CSV (13.750mmx510mm)	
Collection Electrodes, effective height	(mm)		13.750
Collection Electrodes Plates (Sections) effective length	(mm)		3.360
Total Chamber effective length	(mm)		13.440
Collection Electrodes spacing	(mm)		300
Nr of flue gas passages / Chamber	(pcs)		50
Nr of Collection Electrodes / ESP	(pcs)		2.800
Total Nr of Collection Electrodes	(pcs)		5.600
Collection Area / Chamber	(m <sup>2</sup> )		18.480
Collection Area / ESP	(m <sup>2</sup> )		36.960
Total Collection Area	(m <sup>2</sup> )		73.920
Casing utilization factor	(%)		69,39
Active cross section / Chamber	(m <sup>2</sup> )		206,25
Active Volume / Chamber	(m <sup>3</sup> )		2.772
Nr of Ash hoppers/ESP	(pcs)	Pyrimidal type	16

Attached to Visual Inspection Report of the ESP of TPP-NT B1

4.2 Technical Characteristics			
4.2.1 Mechanical			
Ash Hopper Volume	(m <sup>3</sup> )		81,50
Discharge Electrodes, type		wires, "star" type	
Discharge Electrodes, length	(mm)		3.000/4.500
Discharge Electrodes total effective length / ESP	(m)		280.800
4.2.2 Electrical			
Transformer - Rectifiers, manufacturer		Merlin Guerin, Silicon Controlled	
Nr of Transformer - Rectifiers / ESP	(pcs)		8
Total Nr of Transformer - Rectifiers	(pcs)		16
Secondary Voltage, maximum	(KV)		61
Secondary Current, maximum	(mA)		2.000
Apparent Power / Transformer - Rectifier	(KW)		134
Total Apparent Power Installed	(KVA)		1.517
Voltage Controller, manufacturer / type		Marlin Guerin, electronic / analog type	
Mains Voltage	(V)		380

Attached to Visual Inspection Report of the ESP of TPP-NT B1

THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1			
ESP's Efficiency / Performance Assessment			
5 ESPs Operational Data			
5.1 Design Operational Data			
Fuel (lignite) consumption (calculated)	(t/h)		900
Flue Gas Volumetric Flow (actual conditions)	(m <sup>3</sup> /h)		5.126.400
Flue Gas Volumetric Flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)		3.122.244
Flue gas Temperature	(°C)		170-175
Flue Gas Static Pressure upstream ESP	(KPa)		-4,905
O <sub>2</sub>	(%)		5,46
CO <sub>2</sub>	(%)		
Dust concentration on flue gas upstream ESPs (0 oC, 1013 mbar, dry)	(g/Nm <sup>3</sup> )		54,80
Dust concentration on flue gas downstream ESPs (0 oC, 1013 mbar, dry)	(mg/Nm <sup>3</sup> )		100
ESP's efficiency (100% of Nominal Load)	(%)		99,82
Pressure drop across ESP	(Pa)		295
Temperature drop across ESP	(° K)		
Ash quantity collected per ESP	(Kg/h)		64.500
Specific Collection Area (SCA)	(m <sup>2</sup> /m <sup>3</sup> /s)		51,91
Flue gas velocity inside ESPs	(m/s)		1,95
Treatment Time	(s)		6,90
Migration Velocity (Dutsch-Anderson)	(cm/s)		12,20
Effective Migration Velocity Factor as calculated (Matts-Ohnfeldt)	(cm/s)		76,61
5.2 Current Operational Data as measured during periodic tests (average values)			
Lignite Lower Calorific Value	KJ/Kg		8.202
Moisture content in lignite	(%)		49,29
Ash content in lignite	(%)		13,09
Moisture content in flue gas	(%)		19,83
O <sub>2</sub> content	(%)		6,47
Flue gas temperature	(°C)		169
Flue gas pressure	(Pa)		-2.144
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)		3.179.866
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)		2.549.326
Flue gas velocity downstream ESP	(m/s)		19,40
ESP's Efficiency	(%)		99,84

## Attached to Visual Inspection Report of the ESP of TPP-NT B1

Dust concentration (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )		36.867
Dust concentration (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )		57
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)		5.264.940
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)		1.462
Flue gas velocity into ESP	(m/s)		1,77
Active Collection Area	(m <sup>2</sup> )		73.920
Specific Collection Area	(m <sup>2</sup> / m <sup>3</sup> /s)		51,08
Treatment Time	(s)		7,34
Migration Velocity (Dutsch-Anderson)	(cm/s)		13,56
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)		93,81
<b>5.3 Required Design Data for the ESPs Upgrade</b>			
Nominal Load	(MW)		670
Boiler Maximum Continuous Rating	(Kg/s)		572
Lignite (reference) consumption	(t/h)		970
Flue Gas Volumetric Flow (approx. calculated, reference data)	(m <sup>3</sup> /h)		6.100.000
Flue Gas Volumetric Flow (approx. calculated, reference data)	(m <sup>3</sup> /s)		1.694
Flue Gas Volumetric Flow (0 oC, 1013 mbar, reference data)	(m <sup>3</sup> /h)		3.700.000
Flue gas temperature	(° C)		175
Flue gas Pressure	(KPa)		
O <sub>2</sub>	(%)		6
Dust concentration on flue gas upstream ESPs (0 oC, 1013 mbar, dry, 6% O <sub>2</sub> )	(g/Nm <sup>3</sup> )		52,89
Dust emission level requirement (Directive 2001/80/EC, 0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )		50
Required ESPs collection efficiency	(%)		99,91
<b>5.4 Required ESPs Collection Area to meet Directive's 2001/80/EC limits</b>			
<b>5.4.1 Required ESPs Collection Area calculated according to measured data during periodic tests</b>			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m <sup>2</sup> )		87.594
Required ESPs Collection Area increase	(%)		18,50
<b>5.4.1 Required ESPs Collection Area calculated according to initial design data</b>			
Required ESPs Collection Area to meet Directive's 2001/80/EC limits	(m <sup>2</sup> )		107.262
Required ESPs Collection Area increase	(%)		45,10

# THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

## ESP's Efficiency / Performance Tests 1984

Date		1984_1		1984_2		1984_3		1984_4		1984_5	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	622	623	624	503	503	507	503	614		617
<b>Lignite Analysis</b>											
Lower Calorific Value (H <sub>i</sub> )	(KJ/Kg)	8.085	7.942	8.474	8.529	7.804	8.235	8.876	8.671		8.122
Moisture (W)	(%)	49,10	48,50	45,90	50,00	49,10	49,90	46,30	50,90		48,70
Ash (A)	(%)	13,95	15,04	15,57	11,47	14,52	13,14	13,36	9,64		13,83
Sulphur content	(%)	0,61	0,76	0,62	0,47	0,53	0,75	0,49	0,38		0,36
Carbon content	(%)	29,65	30,41	31,64	26,86	29,07	28,97	29,89	25,95		28,64
Carbon fixed	(%)	15,76	15,37	16,67	15,39	14,55	15,83	16,53	16,31		14,81
Volatiles content	(%)	21,25	21,09	22,46	23,14	21,83	21,13	23,81	23,15		22,66
Combustibles content	(%)	36,95	36,46	38,53	38,53	34,13	36,96	40,34	39,46		37,47
<b>Ash Chemistry</b>											
SiO <sub>2</sub>	(%)	56,00	57,32			54,16	52,38				
Fe <sub>2</sub> O <sub>3</sub>	(%)	2,80	6,06			4,06	4,63				
Al <sub>2</sub> O <sub>3</sub>	(%)	27,97	26,21			26,48	27,43				
CaO	(%)	6,30	6,30			6,97	10,19				
MgO	(%)	3,21	2,24			3,05	3,46				
SO <sub>3</sub>	(%)	3,04	0,72			4,19	0,78				
P <sub>2</sub> O <sub>5</sub>	(%)	0,04	0,06			0,06	0,05				
TiO <sub>2</sub>	(%)	0,32	0,28			0,32	0,32				
Na <sub>2</sub> O	(%)	0,20	0,22			0,23	0,24				
K <sub>2</sub> O	(%)	0,74	0,49			0,58	0,51				
<b>ESP's Operational Characteristics (as measured)</b>											
Moisture content in flue gas	(%)	20,80	21,80	20,10	20,60	20,80	20,50	20,50	20,90		20,70
O <sub>2</sub> content	(%)	5,70	4,80	5,70	7,60	6,60	7,40	7,00	6,20		6,00
Flue gas temperature	(°C)	154	167	149	158	146	157	143	168		170
Flue gas pressure	(Pa)	-1.840	-2.154	-1.644	-1.678	-1.378	-1.693	-1.339	-2.286		-2.291
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)	1.412.879	1.679.028	1.284.105	1.394.207	1.138.889	1.441.509	1.153.459	1.733.249		1.686.003
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)	1.119.000	1.313.000	1.026.000	1.107.000	902.000	1.146.000	917.000	1.371.000		1.337.000
Flue gas velocity downstream ESP	(m/s)	16,00	19,50	14,35	15,90	12,50	66,40	12,65	20,50		20,00
ESP's Efficiency	(%)	99,95	99,80	99,96	99,95	99,87	99,97	99,98	99,92		99,96
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	25.480	28.710	20.700	23.840	26.460	25.140	23.030	23.630		26.780
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	13	57	8	11	34	7	5	19		11
<b>ESP's Operational Characteristics (calculated)</b>											
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)	2.250.324	2.764.342	2.017.308	2.237.734	1.771.732	2.308.638	1.780.860	2.863.907		2.798.611
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)	625	768	560	622	492	641	495	796		777
Flue gas velocity into ESP	(m/s)	1,52	1,86	1,36	1,51	1,19	1,55	1,20	1,93		1,88
Effective Collection Area	(m <sup>2</sup> )	36.960	36.960	36.960	36.960	36.960	36.960	36.960	36.960		36.960
Specific Collection Area	(m <sup>2</sup> / m <sup>3</sup> /s)	59,13	48,13	65,96	59,46	75,10	57,63	74,71	46,46		47,54
Treatment Time	(s)	8,87	7,22	9,89	8,92	11,26	8,65	11,21	6,97		7,13
Migration Velocity (Dutsch-Anderson)	(cm/s)	12,82	12,93	11,91	12,92	8,86	14,20	11,29	15,34		16,40
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	97,19	80,43	93,63	99,23	59,01	116,28	95,23	109,29		127,89

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESP's Efficiency / Performance Tests 1986

Date		1986	
ESP		ESP-1	ESP-2
Load	(MW)	619	616
<b>Lignite Analysis</b>			
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	8.108	8.287
Moisture (W)	(%)		
Ash (A)	(%)	9	13
Sulphur content	(%)		
Carbon content	(%)		
Carbon fixed	(%)		
Volatiles content	(%)		
Combustibles content	(%)		
<b>Ash Chemistry</b>			
SiO <sub>2</sub>	(%)		
Fe <sub>2</sub> O <sub>3</sub>	(%)		
Al <sub>2</sub> O <sub>3</sub>	(%)		
CaO	(%)		
MgO	(%)		
SO <sub>3</sub>	(%)		
P <sub>2</sub> O <sub>5</sub>	(%)		
TiO <sub>2</sub>	(%)		
Na <sub>2</sub> O	(%)		
K <sub>2</sub> O	(%)		
<b>ESP's Operational Characteristics (as measured)</b>			
Moisture content in flue gas	(%)	20,10	20,40
O <sub>2</sub> content	(%)	6,50	5,6
Flue gas temperature	(°C)	151	158
Flue gas pressure	(Pa)	-2230	-2345
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)	1.461.827	1.611.809
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)	1.168.000	1.283.000
Flue gas velocity downstream ESP	(m/s)	18,95	21,25
ESP's Efficiency	(%)	99,94	99,26
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	31.000	22.680
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	19	167
<b>ESP's Operational Characteristics (calculated)</b>			
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)	2.321.035	2.604.429
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)	645	723
Flue gas velocity into ESP	(m/s)	1,56	1,75
Effective Collection Area	(m <sup>2</sup> )	36.960	36.960
Specific Collection Area	(m <sup>2</sup> / m <sup>3</sup> /s)	57,33	51,09
Treatment Time	(s)	8,60	7,66
Migration Velocity (Deutsch-Anderson)	(cm/s)	12,90	9,61
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	95,45	47,21

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 1987

Date		1987	
ESP		ESP-1	ESP-2
Load	(MW)	620	620
<b>Lignite Analysis</b>			
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	8.294	8.294
Moisture (W)	(%)		
Ash (A)	(%)	10	10
Sulphur content	(%)		
Carbon content	(%)		
Carbon fixed	(%)		
Volatiles content	(%)		
Combustibles content	(%)		
<b>Ash Chemistry</b>			
SiO <sub>2</sub>	(%)		
Fe <sub>2</sub> O <sub>3</sub>	(%)		
Al <sub>2</sub> O <sub>3</sub>	(%)		
CaO	(%)		
MgO	(%)		
SO <sub>3</sub>	(%)		
P <sub>2</sub> O <sub>5</sub>	(%)		
TiO <sub>2</sub>	(%)		
Na <sub>2</sub> O	(%)		
K <sub>2</sub> O	(%)		
<b>ESPs Operational Characteristics (as measured)</b>			
Moisture content in flue gas	(%)	20,6	20,1
O <sub>2</sub> content	(%)	5,80	6,30
Flue gas temperature	(°C)	163	171
Flue gas pressure	(Pa)	-2358	-2604
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)	1.808.564	1.739.675
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)	1.436.000	1.390.000
Flue gas velocity downstream ESP	(m/s)	21,00	20,15
ESPs Efficiency	(%)	99,91	99,92
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	25.600	25.600
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	22	20
<b>ESPs Operational Characteristics (calculated)</b>			
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)	2.956.633	2.903.397
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)	821	806
Flue gas velocity into ESP	(m/s)	1,99	1,96
Effective Collection Area	(m <sup>2</sup> )	36.960	36.960
Specific Collection Area	(m <sup>2</sup> / m <sup>3</sup> /s)	45,00	45,83
Treatment Time	(s)	6,75	6,87
Migration Velocity (Deutsch-Anderson)	(cm/s)	15,7	15,6
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	110,7	111,7

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 1988

Date		1988	
ESP		ESP-1	ESP-2
Load	(MW)	625	625
<b>Lignite Analysis</b>			
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	7.877	7.877
Moisture (W)	(%)	51,90	51,90
Ash (A)	(%)	11,89	11,89
Sulphur content	(%)	0,34	0,34
Carbon content	(%)	26,46	26,46
Carbon fixed	(%)	14,58	14,58
Volatiles content	(%)	21,63	21,63
Combustibles content	(%)	36,21	36,21
<b>Ash Chemistry</b>			
SiO <sub>2</sub>	(%)		
Fe <sub>2</sub> O <sub>3</sub>	(%)		
Al <sub>2</sub> O <sub>3</sub>	(%)		
CaO	(%)		
MgO	(%)		
SO <sub>3</sub>	(%)		
P <sub>2</sub> O <sub>5</sub>	(%)		
TiO <sub>2</sub>	(%)		
Na <sub>2</sub> O	(%)		
K <sub>2</sub> O	(%)		
<b>ESPs Operational Characteristics (as measured)</b>			
Moisture content in flue gas	(%)	20,70	21,10
O <sub>2</sub> content	(%)	6,20	5,80
Flue gas temperature	(°C)	157	173
Flue gas pressure	(Pa)	-2.084	-2.675
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)	1.455.233	1.730.038
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)	1.154.000	1.365.000
Flue gas velocity downstream ESP	(m/s)	16,40	20,30
ESPs Efficiency	(%)	99,47	99,76
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	30.610	30.530
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	162	73
<b>ESPs Operational Characteristics (calculated)</b>			
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)	2.339.802	2.902.403
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)	649,94	806,22
Flue gas velocity into ESP	(m/s)	1,58	1,95
Effective Collection Area	(m <sup>2</sup> )	36.960	36.960
Specific Collection Area	(m <sup>2</sup> / m <sup>3</sup> /s)	56,87	45,84
Treatment Time	(s)	4,26	3,44
Migration Velocity (Dutsch-Anderson)	(cm/s)	9,2	13,2
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	48,3	79,5

# THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

## ESP's Efficiency / Performance Tests 1989

Date		1989	
ESP		ESP-1	ESP-2
Load	(MW)	620	
Lignite Analysis			
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	7.717	7.717
Moisture (W)	(%)		
Ash (A)	(%)	15	15
Sulphur content	(%)		
Carbon content	(%)		
Carbon fixed	(%)		
Volatiles content	(%)		
Combustibles content	(%)		
Ash Chemistry			
SiO <sub>2</sub>	(%)		
Fe <sub>2</sub> O <sub>3</sub>	(%)		
Al <sub>2</sub> O <sub>3</sub>	(%)		
CaO	(%)		
MgO	(%)		
SO <sub>3</sub>	(%)		
P <sub>2</sub> O <sub>5</sub>	(%)		
TiO <sub>2</sub>	(%)		
Na <sub>2</sub> O	(%)		
K <sub>2</sub> O	(%)		
ESPs Operational Characteristics (as measured)			
Moisture content in flue gas	(%)	20,50	20,20
O <sub>2</sub> content	(%)	6,00	6,10
Flue gas temperature	(°C)	176	173
Flue gas pressure	(Pa)	-2.136	-2.507
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)	1.471.698	1.760.652
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)	1.170.000	1.405.000
Flue gas velocity downstream ESP	(m/s)	22,95	20,90
ESPs Efficiency	(%)	99,93	99,89
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	42.000	41.750
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/Nm <sup>3</sup> )	29	45
ESPs Operational Characteristics (calculated)			
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)	2.472.090	2.948.739
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)	687	819
Flue gas velocity into ESP	(m/s)	1,66	1,99
Effective Collection Area	(m <sup>2</sup> )	36.960	36.960
Specific Collection Area	(m <sup>2</sup> / m3 /s)	53,82	45,12
Treatment Time	(s)	8,07	6,77
Migration Velocity (Dutsch-Anderson)	(cm/s)	13,5	15,1
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	98,4	103,5

# THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

## ESPs Efficiency / Performance Tests 1990

Date		1990_1		1990_2		1990_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	620		614		614	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	7.771	7.771	8.160	8.160	8.409	8.409
Moisture (W)	(%)						
Ash (A)	(%)	14	14	13	13	10	10
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
CaO	(%)						
MgO	(%)						
SO3	(%)						
P2O5	(%)						
TiO2	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	22,00	19,10	20,70	20,60	20,50	20,60
O2 content	(%)	4,90	7,50	5,60	5,50	5,70	5,70
Flue gas temperature	(°C)	171	171	175	170	177	171
Flue gas pressure	(Pa)	-2.149	-2.499	-2.157	-2.495	-2.207	-2.502
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.529.487	1.791.100	1.489.281	1.743.073	1.699.371	1.789.673
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.193.000	1.449.000	1.181.000	1.384.000	1.351.000	1.421.000
Flue gas velocity downstream ESP	(m/s)	17,85	20,95	17,75	20,65	20,40	21,20
ESPs Efficiency	(%)	99,94	99,88	99,93	99,93	99,91	99,89
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	39.010	38.880	35.370	35.370	26.490	26.500
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	23	47	26	23	23	28
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.540.895	2.986.046	2.496.585	2.899.317	2.862.930	2.983.756
Flue gas volumetric flow (as measured)	(m³/s)	706	829	693	805	795	829
Flue gas velocity into ESP	(m/s)	1,71	2,01	1,68	1,95	1,93	2,01
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	52,37	44,56	53,30	45,89	46,48	44,59
Treatment Time	(s)	7,85	6,68	7,99	6,88	6,97	6,69
Migration Velocity (Dutsch-Anderson)	(cm/s)	14,2	15,1	13,5	16,0	15,2	15,4
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	105,6	101,3	97,7	117,3	106,9	105,3

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### 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)	620		620		620	
Lignite Analysis							
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	9.557	9.557	8.669	8.669	8.622	8.622
Moisture (W)	(%)						
Ash (A)	(%)	15	15	12	12	13	13
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO <sub>2</sub>	(%)						
Fe <sub>2</sub> O <sub>3</sub>	(%)						
Al <sub>2</sub> O <sub>3</sub>	(%)						
CaO	(%)						
MgO	(%)						
SO <sub>3</sub>	(%)						
P <sub>2</sub> O <sub>5</sub>	(%)						
TiO <sub>2</sub>	(%)						
Na <sub>2</sub> O	(%)						
K <sub>2</sub> O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	17,80	17,00	19,10	19,40	19,60	19,70
O <sub>2</sub> content	(%)	5,60	6,40	6,40	6,00	5,90	5,80
Flue gas temperature	(°C)	157	162	162	155	159	157
Flue gas pressure	(Pa)	-2.050	-2.240	-2.310	-2.155	-2.207	-2.046
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)	1.507.299	1.639.759	1.640.297	1.606.700	1.634.328	1.559.153
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)	1.239.000	1.361.000	1.327.000	1.295.000	1.314.000	1.252.000
Flue gas velocity downstream ESP	(m/s)	17,25	19,00	19,00	18,25	18,60	17,70
ESPs Efficiency	(%)	99,93	99,98	99,89	99,96	99,87	99,93
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm <sup>3</sup> )	36.200	36.040	29.700	29.810	31.690	31.850
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm <sup>3</sup> )	25	7	33	11	42	23
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)	2.422.686	2.671.339	2.674.104	2.573.168	2.643.255	2.505.930
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)	673	742	743	715	734	696
Flue gas velocity into ESP	(m/s)	1,63	1,80	1,80	1,73	1,78	1,69
Effective Collection Area	(m <sup>2</sup> )	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m <sup>2</sup> / m3 /s)	54,92	49,81	49,76	51,71	50,34	53,10
Treatment Time	(s)	8,24	7,47	7,46	7,76	7,55	7,96
Migration Velocity (Dutsch-Anderson)	(cm/s)	13,3	17,2	13,7	15,3	13,2	13,6
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	96,4	146,6	93,0	120,8	87,2	98,5

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 1992

Date		1992_1		1992_2		1992_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	620		620		620	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	7.578	7.578	7.401	7.401	7.913	7.913
Moisture (W)	(%)						
Ash (A)	(%)	15	15	17	17	14	14
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
CaO	(%)						
MgO	(%)						
SO3	(%)						
P2O5	(%)						
TiO2	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	21,00	21,20	20,60	20,70	19,90	19,40
O2 content	(%)	6,30	6,10	6,50	6,40	6,80	7,20
Flue gas temperature	(°C)	164	171	165	160	169	158
Flue gas pressure	(Pa)	-2.083	-2.397	-2.118	-2.397	-2.173	-2.364
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.646.835	1.709.391	1.727.960	1.778.058	1.722.846	1.764.268
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.301.000	1.347.000	1.372.000	1.410.000	1.380.000	1.422.000
Flue gas velocity downstream ESP	(m/s)	19,00	20,05	20,30	20,65	20,50	20,50
ESPs Efficiency	(%)	99,95	99,91	99,91	99,91	99,78	99,85
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	40.990	41.030	50.320	50.320	39.190	39.060
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	19	36	44	45	86	59
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.690.933	2.846.884	2.830.947	2.887.906	2.849.919	2.851.326
Flue gas volumetric flow (as measured)	(m³/s)	747	791	786	802	792	792
Flue gas velocity into ESP	(m/s)	1,81	1,92	1,91	1,94	1,92	1,92
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	49,45	46,74	47,00	46,07	46,69	46,66
Treatment Time	(s)	7,42	7,01	7,05	6,91	7,00	7,00
Migration Velocity (Deutsch-Anderson)	(cm/s)	15,5	15,1	15,0	15,2	13,1	13,9
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	119,2	106,0	105,5	106,9	80,3	90,4

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESP's Efficiency / Performance Tests 1993

Date		1993_1		1993_2		1993_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	601		601		601	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	8.116	8.116	9.463	9.463	8.183	8.183
Moisture (W)	(%)						
Ash (A)	(%)	16	16	11	11	13	13
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
CaO	(%)						
MgO	(%)						
SO3	(%)						
P2O5	(%)						
TiO2	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	17,60	19,30	16,80	17,70	18,40	19,80
O2 content	(%)	8,00	6,60	7,70	6,90	7,70	6,50
Flue gas temperature	(°C)	172	171	170	173	169	178
Flue gas pressure	(Pa)	-2.305	-2.432	-2.354	-2.551	-2.396	-2.498
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.563.107	1.801.735	1.397.837	1.809.235	1.549.020	1.729.426
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.288.000	1.454.000	1.163.000	1.489.000	1.264.000	1.387.000
Flue gas velocity downstream ESP	(m/s)	18,35	21,20	16,30	21,30	18,25	20,80
ESPs Efficiency	(%)	99,96	99,97	99,95	99,92	99,96	99,91
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	48.740	47.450	27.250	26.980	38.700	37.230
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	20	13	14	22	14	34
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.606.694	3.001.740	2.321.759	3.031.456	2.568.153	2.928.637
Flue gas volumetric flow (as measured)	(m³/s)	724	834	645	842	713	814
Flue gas velocity into ESP	(m/s)	1,76	2,02	1,56	2,04	1,73	1,97
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3/s)	51,04	44,33	57,31	43,89	51,81	45,43
Treatment Time	(s)	7,66	6,65	8,60	6,58	7,77	6,81
Migration Velocity (Dutsch-Anderson)	(cm/s)	15,3	18,5	13,2	16,2	15,3	15,4
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	119,1	151,8	100,1	115,2	121,2	107,8

# THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

## ESP's Efficiency / Performance Tests 1994

Date		1994_1		1994_2		1994_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	580		571		620	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	8.603	8.603	7.925	7.925	7.424	7.424
Moisture (W)	(%)						
Ash (A)	(%)						
Sulphur content	(%)						
Carbon content	(%)	14	14	15	15	19	19
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
CaO	(%)						
MgO	(%)						
SO3	(%)						
P2O5	(%)						
TiO2	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	17,10	17,80	18,50	18,30	19,50	19,50
O2 content	(%)	8,20	7,50	8,00	8,10	7,40	7,30
Flue gas temperature	(°C)	167	169	175	171	173	168
Flue gas pressure	(Pa)	-2.266	-2.396	-2.171	-2.345	-2.427	-2.518
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.618.818	1.659.367	1.542.331	1.705.018	1.642.236	1.586.335
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.342.000	1.364.000	1.257.000	1.393.000	1.322.000	1.277.000
Flue gas velocity downstream ESP	(m/s)	19,05	19,50	18,30	20,00	19,40	18,55
ESPs Efficiency	(%)	99,21	99,95	99,88	99,95	99,94	99,77
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	40.780	39.000	44.070	44.310	59.670	59.970
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	324	19	51	24	36	139
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.668.226	2.751.101	2.585.881	2.838.110	2.748.192	2.627.312
Flue gas volumetric flow (as measured)	(m³/s)	741	764	718	788	763	730
Flue gas velocity into ESP	(m/s)	1,80	1,85	1,74	1,91	1,85	1,77
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	49,87	48,36	51,45	46,88	48,42	50,64
Treatment Time	(s)	7,48	7,25	7,72	7,03	7,26	7,60
Migration Velocity (Deutsch-Anderson)	(cm/s)	9,7	15,8	13,1	16,0	15,3	12,0
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	46,9	120,3	88,9	120,7	113,5	72,7

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESP's 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)	576		608		612	
Lignite Analysis							
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	6.543	6.543	8.411	8.411	7.240	7.240
Moisture (W)	(%)						
Ash (A)	(%)						
Sulphur content	(%)						
Carbon content	(%)	21	21	13	13	17	17
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO <sub>2</sub>	(%)						
Fe <sub>2</sub> O <sub>3</sub>	(%)						
Al <sub>2</sub> O <sub>3</sub>	(%)						
CaO	(%)						
MgO	(%)						
SO <sub>3</sub>	(%)						
P <sub>2</sub> O <sub>5</sub>	(%)						
TiO <sub>2</sub>	(%)						
Na <sub>2</sub> O	(%)						
K <sub>2</sub> O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	20,80	20,50	18,20	18,30	21,00	21,10
O <sub>2</sub> content	(%)	7,50	7,70	7,60	7,60	6,70	6,60
Flue gas temperature	(°C)	182	188	176	180	177	175
Flue gas pressure	(Pa)	-2.247	-2.449	-2.283	-2.512	-2.280	-2.442
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.712.121	1.698.113	1.695.599	1.768.666	1.734.177	1.768.061
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.356.000	1.350.000	1.387.000	1.445.000	1.370.000	1.395.000
Flue gas velocity downstream ESP	(m/s)	20,45	20,55	20,05	21,15	20,00	20,90
ESPs Efficiency	(%)	99,96	99,72	99,85	99,35	99,95	99,43
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	74.350	75.190	36.950	34.420	52.840	52.540
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	29	211	55	223	29	300
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.917.626	2.937.893	2.852.417	3.008.790	2.923.722	2.972.467
Flue gas volumetric flow (as measured)	(m³/s)	810	816	792	836	812	826
Flue gas velocity into ESP	(m/s)	1,96	1,98	1,92	2,03	1,97	2,00
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	45,60	45,29	46,65	44,22	45,51	44,76
Treatment Time	(s)	6,84	6,79	7,00	6,63	6,83	6,71
Migration Velocity (Dutsch-Anderson)	(cm/s)	17,2	13,0	14,0	11,4	16,5	11,5
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	135,1	76,2	90,9	57,4	123,9	59,6

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs 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)	565		590		582	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	7.325	7.325	7.562	7.562	7.766	7.766
Moisture (W)	(%)						
Ash (A)	(%)	17	17	16	16	12	12
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
CaO	(%)						
MgO	(%)						
SO3	(%)						
P2O5	(%)						
TiO2	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	21,00	20,40	21,20	21,20	21,20	21,30
O2 content	(%)	6,50	6,90	6,00	6,00	6,30	6,10
Flue gas temperature	(°C)	170	173	172	179	173	174
Flue gas pressure	(Pa)	-2.206	-2.161	-2.083	-2.128	-1.987	-2.101
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.677.215	1.636.935	1.590.102	1.516.497	1.571.066	1.500.635
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.325.000	1.303.000	1.253.000	1.195.000	1.238.000	1.181.000
Flue gas velocity downstream ESP	(m/s)	19,50	19,20	18,50	18,00	18,55	17,70
ESPs Efficiency	(%)	99,94	99,96	99,92	99,94	99,88	99,93
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	52.510	53.590	47.210	47.210	35.610	35.180
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	31	19	36	29	42	24
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.781.637	2.731.970	2.645.778	2.564.150	2.617.444	2.508.588
Flue gas volumetric flow (as measured)	(m³/s)	773	759	735	712	727	697
Flue gas velocity into ESP	(m/s)	1,87	1,84	1,78	1,73	1,76	1,69
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	47,83	48,70	50,29	51,89	50,83	53,04
Treatment Time	(s)	7,18	7,31	7,54	7,78	7,63	7,96
Migration Velocity (Dutsch-Anderson)	(cm/s)	15,5	16,3	14,3	14,3	13,3	13,7
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	115,6	129,6	102,5	105,4	89,4	100,2

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 2001

Date		2001_1		2001_2		2001_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	600		619		595	
Lignite Analysis							
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	8.837	8.837	7.708	7.708	8.604	8.604
Moisture (W)	(%)						
Ash (A)	(%)	12	12	16	16	10	10
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO <sub>2</sub>	(%)						
Fe <sub>2</sub> O <sub>3</sub>	(%)						
Al <sub>2</sub> O <sub>3</sub>	(%)						
CaO	(%)						
MgO	(%)						
SO <sub>3</sub>	(%)						
P <sub>2</sub> O <sub>5</sub>	(%)						
TiO <sub>2</sub>	(%)						
Na <sub>2</sub> O	(%)						
K <sub>2</sub> O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	19,20	19,00	20,70	20,00	20,90	20,40
O <sub>2</sub> content	(%)	6,50	6,60	6,30	6,90	5,60	6,10
Flue gas temperature	(°C)	174	179	169	181	177	185
Flue gas pressure	(Pa)	-2.127	-2.219	-2.314	-2.386	-2.063	-2.159
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.581.683	1.741.975	1.711.223	1.660.000	1.515.803	1.605.528
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.278.000	1.411.000	1.357.000	1.328.000	1.199.000	1.278.000
Flue gas velocity downstream ESP	(m/s)	18,55	20,80	20,05	20,05	18,20	19,55
ESPs Efficiency	(%)	99,90	99,75	99,92	99,69	99,84	99,46
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	32.390	32.540	47.740	49.340	27.090	27.820
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	33	82	40	152	44	150
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.644.768	2.948.101	2.834.724	2.826.558	2.549.967	2.751.569
Flue gas volumetric flow (as measured)	(m³/s)	735	819	787	785	708	764
Flue gas velocity into ESP	(m/s)	1,78	1,99	1,91	1,90	1,72	1,85
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	50,31	45,13	46,94	47,07	52,18	48,36
Treatment Time	(s)	7,55	6,77	7,04	7,06	7,83	7,25
Migration Velocity (Dutsch-Anderson)	(cm/s)	13,7	13,3	15,1	12,3	12,3	10,8
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	94,3	79,3	106,9	71,0	79,1	56,4

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 2003

Date		2003_1		2003_2		2003_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	604		604	620	550	620
Lignite Analysis							
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	7.994		8.823		7.516	
Moisture (W)	(%)						
Ash (A)	(%)						
Sulphur content	(%)						
Carbon content	(%)	13		11		16	
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO <sub>2</sub>	(%)						
Fe <sub>2</sub> O <sub>3</sub>	(%)						
Al <sub>2</sub> O <sub>3</sub>	(%)						
CaO	(%)						
MgO	(%)						
SO <sub>3</sub>	(%)						
P <sub>2</sub> O <sub>5</sub>	(%)						
TiO <sub>2</sub>	(%)						
Na <sub>2</sub> O	(%)						
K <sub>2</sub> O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	20,20	20,10	18,90	18,60	17,50	17,40
O <sub>2</sub> content	(%)	6,60	6,70	7,00	7,20	8,90	9,00
Flue gas temperature	(°C)	164	178	164	175	164	173
Flue gas pressure	(Pa)	-2.021	-2.355	-2.031	-2.343	-2.040	-2.173
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.487.469	1.633.292	1.515.413	1.637.592	1.546.667	1.615.012
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.187.000	1.305.000	1.229.000	1.333.000	1.276.000	1.334.000
Flue gas velocity downstream ESP	(m/s)	17,15	19,55	17,50	19,50	18,00	19,20
ESPs Efficiency	(%)	99,92	99,85	99,88	99,81	99,94	99,90
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	37.200	37.420	28.800	29.110	47.630	47.970
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	31	56	34	54	29	46
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.429.009	2.761.844	2.474.891	2.750.368	2.526.162	2.695.709
Flue gas volumetric flow (as measured)	(m³/s)	675	767	687	764	702	749
Flue gas velocity into ESP	(m/s)	1,64	1,86	1,67	1,85	1,70	1,82
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	54,78	48,18	53,76	48,38	52,67	49,36
Treatment Time	(s)	4,11	3,61	4,03	3,63	3,95	3,70
Migration Velocity (Dutsch-Anderson)	(cm/s)	12,9	13,5	12,5	13,0	14,1	14,1
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	91,8	87,8	84,5	81,8	104,1	97,9

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### 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)	580		579		567	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	8.960	8.960	8.336	8.336	9.274	9.274
Moisture (W)	(%)						
Ash (A)	(%)	9	9	8	8	10	10
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
CaO	(%)						
MgO	(%)						
SO3	(%)						
P2O5	(%)						
TiO2	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	19,80	19,80	21,30	21,50	18,80	19,50
O2 content	(%)	5,90	5,80	5,90	5,80	6,20	5,60
Flue gas temperature	(°C)	183	189	184	189	177	184
Flue gas pressure	(Pa)	-1.827	-2.052	-1.806	-2.047	-1.690	-1.827
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.370.324	1.588.529	1.360.864	1.560.510	1.300.493	1.449.689
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.099.000	1.274.000	1.071.000	1.225.000	1.056.000	1.167.000
Flue gas velocity downstream ESP	(m/s)	16,40	19,30	16,35	18,95	15,40	17,50
ESPs Efficiency	(%)	99,86	99,86	99,79	99,74	99,81	99,72
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	24.280	24.180	22.590	22.360	24.400	23.810
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	34	34	48	59	47	66
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.330.419	2.743.244	2.318.915	2.694.722	2.179.568	2.470.795
Flue gas volumetric flow (as measured)	(m³/s)	647	762	644	749	605	686
Flue gas velocity into ESP	(m/s)	1,57	1,85	1,56	1,81	1,47	1,66
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3/s)	57,10	48,50	57,38	49,38	61,05	53,85
Treatment Time	(s)	8,56	7,28	8,61	7,41	9,16	8,08
Migration Velocity (Dutsch-Anderson)	(cm/s)	11,5	13,5	10,7	12,0	10,2	10,9
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	75,6	88,9	66,0	71,4	64,0	64,4

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 2007

Date		2007_1		2007_2		2007_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	624		625		624	
Lignite Analysis							
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	10.097	10.097	8.653	8.653	9.001	9.001
Moisture (W)	(%)						
Ash (A)	(%)	7	7	10	10	8	8
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO <sub>2</sub>	(%)						
Fe <sub>2</sub> O <sub>3</sub>	(%)						
Al <sub>2</sub> O <sub>3</sub>	(%)						
CaO	(%)						
MgO	(%)						
SO <sub>3</sub>	(%)						
P <sub>2</sub> O <sub>5</sub>	(%)						
TiO <sub>2</sub>	(%)						
Na <sub>2</sub> O	(%)						
K <sub>2</sub> O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	15,70	16,80	19,40	19,40	20,70	19,30
O <sub>2</sub> content	(%)	7,30	6,30	6,40	6,90	5,00	6,30
Flue gas temperature	(°C)	167	165	167	175	186	169
Flue gas pressure	(Pa)	-1.888	-2.193	-1.883	-2.297	-2.297	-1.996
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.386.714	1.658.654	1.337.469	1.662.531	1.585.120	1.468.401
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.169.000	1.380.000	1.078.000	1.340.000	1.257.000	1.185.000
Flue gas velocity downstream ESP	(m/s)	16	19	15	20	19	17
ESPs Efficiency	(%)	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)						
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	63	84	65	44	18	24
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.276.969	2.719.459	2.195.998	2.790.956	2.726.318	2.424.688
Flue gas volumetric flow (as measured)	(m³/s)	632	755	610	775	757	674
Flue gas velocity into ESP	(m/s)	1,53	1,83	1,48	1,88	1,84	1,63
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	58,44	48,93	60,59	47,67	48,80	54,88
Treatment Time	(s)	8,77	7,34	9,09	7,15	7,32	8,23
Migration Velocity (Dutsch-Anderson)	(cm/s)	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!	#ΔIAIP/O!

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 2008

Date		2008_1		2008_2		2008_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	635		653		655	
Lignite Analysis							
Lower Calorific Value (H <sub>d</sub> )	(KJ/Kg)	8.366	8.366	9.264	9.264	8.410	8.410
Moisture (W)	(%)						
Ash (A)	(%)	10	10	9	9	11	11
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO <sub>2</sub>	(%)						
Fe <sub>2</sub> O <sub>3</sub>	(%)						
Al <sub>2</sub> O <sub>3</sub>	(%)						
CaO	(%)						
MgO	(%)						
SO <sub>3</sub>	(%)						
P <sub>2</sub> O <sub>5</sub>	(%)						
TiO <sub>2</sub>	(%)						
Na <sub>2</sub> O	(%)						
K <sub>2</sub> O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	20,30	20,40	19,20	19,00	21,00	20,20
O <sub>2</sub> content	(%)	6,70	6,60	5,90	6,40	5,70	6,40
Flue gas temperature	(°C)	168	164	166	161	165	162
Flue gas pressure	(Pa)	-1.879	-1.967	-1.954	-1.693	-2.021	-1.921
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.534.504	1.591.709	1.555.693	1.456.790	1.577.215	1.590.226
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.223.000	1.267.000	1.257.000	1.180.000	1.246.000	1.269.000
Flue gas velocity downstream ESP	(m/s)	19,80	20,35	20,05	18,55	20,15	21,00
ESPs Efficiency	(%)	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)						
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	54	60	50	64	31	67
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.525.135	2.597.818	2.550.320	2.354.806	2.581.455	2.582.328
Flue gas volumetric flow (as measured)	(m³/s)	701	722	708	654	717	717
Flue gas velocity into ESP	(m/s)	1,70	1,75	1,72	1,59	1,74	1,74
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	52,69	51,22	52,17	56,50	51,54	51,53
Treatment Time	(s)	7,90	7,68	7,83	8,48	7,73	7,73
Migration Velocity (Dutsch-Anderson)	(cm/s)	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!	#ΔIAIP/0!

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests 2009

Date		2009_1		2009_2		2009_3	
ESP		ESP-1	ESP-2	ESP-1	ESP-2	ESP-1	ESP-2
Load	(MW)	623		623		619	
Lignite Analysis							
Lower Calorific Value (Hd)	(KJ/Kg)	7.270	7.270	7.088	7.088	7.155	7.155
Moisture (W)	(%)						
Ash (A)	(%)	15	15	16	16	16	16
Sulphur content	(%)						
Carbon content	(%)						
Carbon fixed	(%)						
Volatiles content	(%)						
Combustibles content	(%)						
Ash Chemistry							
SiO2	(%)						
Fe2O3	(%)						
Al2O3	(%)						
CaO	(%)						
MgO	(%)						
SO3	(%)						
P2O5	(%)						
TiO2	(%)						
Na2O	(%)						
K2O	(%)						
ESPs Operational Characteristics (as measured)							
Moisture content in flue gas	(%)	22,00	18,60	22,80	18,70	21,40	19,40
O2 content	(%)	5,50	5,20	5,50	5,50	5,90	5,40
Flue gas temperature	(°C)	166	160	167	163	167	162
Flue gas pressure	(Pa)	-1.753	-1.787	-1.789	-1.842	-1.786	-1.932
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m³/h)	1.546.154	1.544.226	1.536.269	1.536.285	1.534.351	1.643.921
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m³/h)	1.206.000	1.257.000	1.186.000	1.249.000	1.206.000	1.325.000
Flue gas velocity downstream ESP	(m/s)	17,95	18,60	17,95	18,70	17,75	19,40
ESPs Efficiency	(%)	99,83	99,53	99,83	99,62	99,77	99,64
Dust concentration upstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	37.000	37.000	39.800	39.800	38.300	38.300
Dust concentration downstream ESPs (0 °C, 1013 mbar, dry, 6% O2)	(mg/Nm³)	64	174	67	151	90	137
ESPs Operational Characteristics (calculated)							
Flue gas volumetric flow (as measured)	(m³/h)	2.529.564	2.492.744	2.520.027	2.498.482	2.516.805	2.669.817
Flue gas volumetric flow (as measured)	(m³/s)	703	692	700	694	699	742
Flue gas velocity into ESP	(m/s)	1,70	1,68	1,70	1,68	1,69	1,80
Effective Collection Area	(m²)	36.960	36.960	36.960	36.960	36.960	36.960
Specific Collection Area	(m² / m3 /s)	52,60	53,38	52,80	53,25	52,87	49,84
Treatment Time	(s)	7,89	8,01	7,92	7,99	7,93	7,48
Migration Velocity (Dutsch-Anderson)	(cm/s)	12,1	10,0	12,1	10,5	11,5	11,3
Effective Migration Velocity Factor (Matts-Ohnfeldt)	(cm/s)	76,9	53,8	77,3	58,3	69,3	63,7

# APPENDIX 1

Attached to the Visual Inspection Report of ESP of TPP - NT B1

## THERMAL POWER PLANT "NIKOLA TESLA" B, Block B1

### ESPs Efficiency / Performance Tests (1984 -2009) Overview

Date		1982 - 2007		
		Min	Average	Max
Load	(MW)	503	603	655
<b>Lignite Analysis</b>				
Lower Calorific Value (Hd)	(KJ/Kg)	6.543	8.202	10.097
Moisture (W)	(%)	45,90	49,29	51,90
Ash (A)	(%)	7,00	13,09	21,00
Sulphur content	(%)	0,34	0,51	0,76
Carbon content	(%)	25,95	28,55	31,64
Carbon fixed	(%)	14,55	15,49	16,67
Volatiles content	(%)	21,09	22,16	23,81
Combustibles content	(%)	34,13	37,39	40,34
<b>Ash Chemistry</b>				
SiO <sub>2</sub>	(%)	52,38	54,97	57,32
Fe <sub>2</sub> O <sub>3</sub>	(%)	2,80	4,39	6,06
Al <sub>2</sub> O <sub>3</sub>	(%)	26,21	27,02	27,97
CaO	(%)	6,30	7,44	10,19
MgO	(%)	2,24	2,99	3,46
SO <sub>3</sub>	(%)	0,72	2,18	4,19
P <sub>2</sub> O <sub>5</sub>	(%)	0,04	0,05	0,06
TiO <sub>2</sub>	(%)	0,28	0,31	0,32
Na <sub>2</sub> O	(%)	0,20	0,22	0,24
K <sub>2</sub> O	(%)	0,49	0,58	0,74
<b>ESPs Operational Characteristics (as measured)</b>				
Moisture content in flue gas	(%)	15,70	19,83	22,80
O <sub>2</sub> content	(%)	4,80	6,47	9,00
Flue gas temperature	(°C)	143	169	189
Flue gas pressure	(Pa)	-2.675	-2.144	-1.339
Flue gas volumetric flow (0 °C, 1013 mbar, wet)	(m <sup>3</sup> /h)	1.138.889	1.589.933	1.809.235
Flue gas volumetric flow (0 °C, 1013 mbar, dry)	(m <sup>3</sup> /h)	902.000	1.274.663	1.489.000
Flue gas velocity downstream ESP	(m/s)	12,50	19,40	66,40
ESPs Efficiency	(%)	99,21	99,84	99,98
Dust concentration (0 °C, 1013 mbar, wet)	(mg/m <sup>3</sup> )	20.700	36.867	75.190
Dust concentration (0 °C, 1013 mbar, dry, 6% O <sub>2</sub> )	(mg/m <sup>3</sup> )	5	57	324
<b>ESPs Operational Characteristics (calculated)</b>				
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /h)	1.771.732	2.632.470	3.031.456
Flue gas volumetric flow (as measured)	(m <sup>3</sup> /s)	492	731	842
Flue gas velocity into ESP	(m/s)	1,19	1,77	2,04
Effective Collection Area	(m <sup>2</sup> )	36.960	36.960	36.960
Specific Collection Area	(m <sup>2</sup> / m <sup>3</sup> /s)	43,89	51,08	75,10
<b>Treatment Time</b>	<b>(s)</b>	<b>3,44</b>	<b>7,34</b>	<b>11,26</b>
<b>Migration Velocity (Dutsch-Anderson)</b>	<b>(cm/s)</b>	<b>8,86</b>	<b>13,56</b>	<b>18,50</b>
<b>Effective Migration Velocity Factor (Matts-Ohnfeldt)</b>	<b>(cm/s)</b>	<b>46,88</b>	<b>93,81</b>	<b>151,79</b>