Application test of heat dissipation paint for solar power station

A.Reason for testing:

1. In July 2022, the " Thermal Conductive Coating Testing for Solar Panels" was carried out. The laboratory uses small solar panels to compare the difference between whether the solar backplane uses a thermally conductive coating or not with a simple test method. In the process of heat dissipation, it helps to increase the power generation.
2. In this test, in cooperation with the solar power plant in operation, long-term data recording will start in October 2022 to obtain actual power generation data.

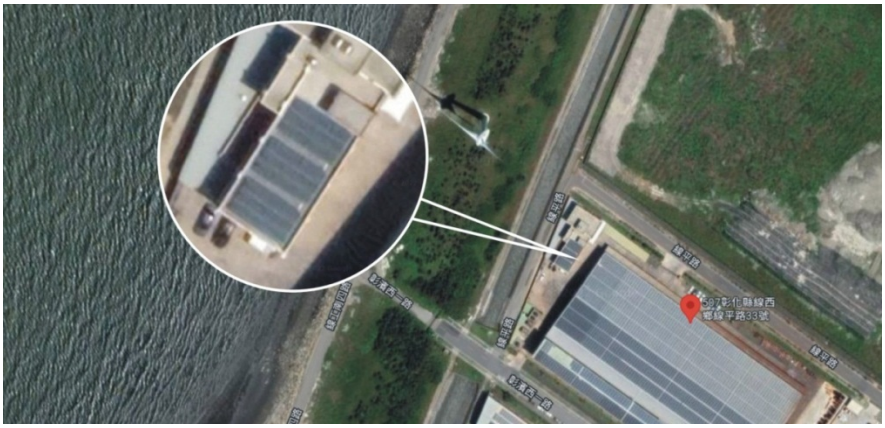
B.Testing purposes:

1. Gain experience in paint application and construction through hands-on experience.
2. The experiment did not test individual solar panels in a laboratory, but was scaled up with a working solar power station.
3. Through the long-term recording of the computer system, detailed power generation data can be obtained for analysis.

C.Testing process:

1. Solar plant location:

The test site is located in the Xianxi area of Changhua County's Zhangbin Industrial Zone, close to the coast. Due to the abundant sunshine and year-round sea breeze, it should belong to an area with good heat dissipation.



2. Test Methods:

2-1 Solar panel specifications: The solar station uses PM060MW2_295 solar panels manufactured by AUO in 2017 with a rated power of 295W, a module area of 1640X992mm = 1.627 square meters, and a conversion efficiency of 18.13%.

2-2 Test steps: Take 2 sets of Inverters to record data in the same field, and each set of Inverters is connected in parallel with 3 sets of 18 solar panels in series, a total of 54 = 15930W

Inverter A as the control group and Inverter B as the experimental group

Step 1: Record two sets of Inverter data from October 18th, grab a piece of data including voltage, current, power, etc. every minute, and record it for a month until November 17th, as the basic data of the two sets before use.

Inverter A in parallel		Inverter B in parallel	
LineA:295W×18 pieces in series	Unpainted	LineD:295W×18 pieces in series	Unpainted
LineB:295W×18 pieces in series	Unpainted	LineE:295W×18 pieces in series	Unpainted
LineC:295W×18 pieces in series	unpainted	LineF:295W×18 pieces in series	Unpainted

Continuous recording for one month, the construction time of heat dissipation paint is from November 18th to November 21st, and the construction period is not included in the calculation.

Construction methods include electric spray gun and hand brush.

Step 2: It was originally planned to use heat-dissipating paint on the D, E, and F lines of inverter B. Later, it was found that the line planning was wrong, and the actual coating was on C, E, and F lines. In order to get different usage patterns at the same time. Therefore, the study recorded this mode of operation from November 22 to December 2 to understand the power variation resulting from the different cooling capabilities of solar panels connected in series versus parallel.

Inverter A in parallel		Inverter B in parallel	
LineA:295W×18 pieces in series	Unpainted	LineD:295W×18 pieces in series	Unpainted
LineB:295W×18 pieces in series	Unpainted	LineE:295W×18 pieces in series	Painted
LineC:295W×18 pieces in series	Painted	LineF:295W×18 pieces in series	Painted

Step 3: Change the line at 9 am on December 3rd, change the line C and line D, and change to the default experimental group mode.

Persistent long-term recording after correction.

Inverter A in parallel		Inverter B in parallel	
LineA:295W×18 pieces in series	Unpainted	LineC:295W×18 pieces in series	Painted
LineB:295W×18 pieces in series	Unpainted	LineE:295W×18 pieces in series	Painted
LineD:295W×18 pieces in series	Unpainted	LineF:295W×18 pieces in series	Painted

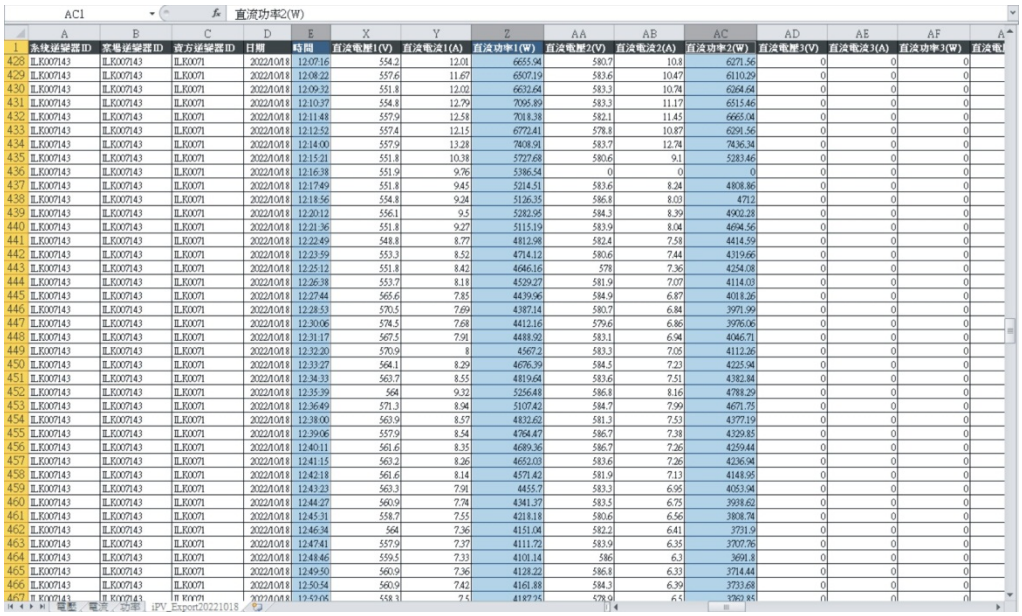
2-3 data selection:

2-3-1 Meteorological data such as daily average temperature, maximum temperature, and wind force are based on the data of the Xianxi station(C0G900) located in the Xianxi service building of Zhangbin Industrial Zone. Sunshine data are from the Taichung station(467490) at the same latitude.

2-3-2 In order to eliminate the conversion loss of the inverter, the power generation uses DC power that has not yet been converted.

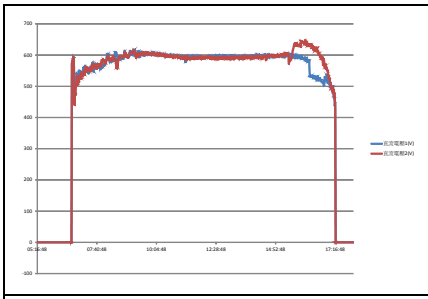
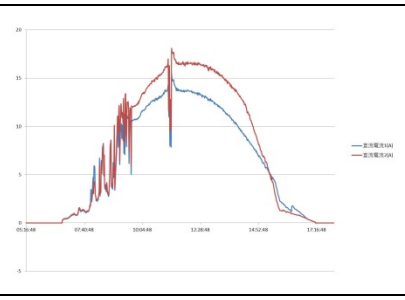
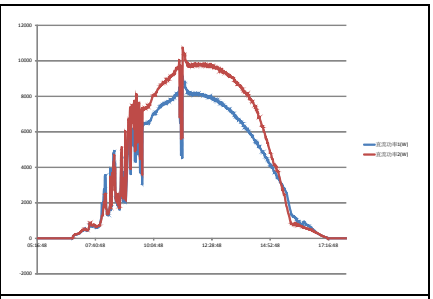
2-3-3 Before the line change on December 3, the statistical analysis of step2 and step1 was carried out with the original recorded data.

2-3-4 After changing the line on December 3rd, use the 3 strings of fully coated solar panels as a benchmark, and transfer the power data before December 2nd, transfer one-third of the DC power of Inverter A and Inverter B to the other One set to offset the error of line changing.


AC1 直流功率2(W)

	A	B	C	D	E	X	Y	Z	AA	AB	AC	AD	AE	AF
1	系統通訊器ID	案場通訊器ID	資方通訊器ID	日期	時間	直流電壓1(V)	直流電流1(A)	直流功率1(W)	直流電壓2(V)	直流電流2(A)	直流功率2(W)	直流電壓3(V)	直流電流3(A)	直流功率3(W)
428	IL1007143	IL1007143	IL10071	2022/10/18	12:07:16	554.2	12.01	6655.94	580.7	10.8	6271.56	0	0	0
429	IL1007143	IL1007143	IL10071	2022/10/18	12:08:22	557.6	11.67	6507.19	583.6	10.47	6110.29	0	0	0
430	IL1007143	IL1007143	IL10071	2022/10/18	12:09:32	551.8	12.02	6632.64	583.3	10.74	6264.64	0	0	0
431	IL1007143	IL1007143	IL10071	2022/10/18	12:10:37	554.8	12.79	7095.89	583.3	11.17	6515.46	0	0	0
432	IL1007143	IL1007143	IL10071	2022/10/18	12:11:48	557.9	12.58	7018.38	582.1	11.45	6665.04	0	0	0
433	IL1007143	IL1007143	IL10071	2022/10/18	12:12:52	557.4	12.15	6772.41	578.8	10.87	6291.56	0	0	0
434	IL1007143	IL1007143	IL10071	2022/10/18	12:14:00	557.9	13.28	7408.91	583.7	12.74	7436.34	0	0	0
435	IL1007143	IL1007143	IL10071	2022/10/18	12:15:21	551.8	10.38	5727.68	580.6	9.1	5283.46	0	0	0
436	IL1007143	IL1007143	IL10071	2022/10/18	12:16:38	551.9	9.76	5386.54	0	0	0	0	0	0
437	IL1007143	IL1007143	IL10071	2022/10/18	12:17:49	551.8	9.45	5214.51	583.6	8.24	4808.86	0	0	0
438	IL1007143	IL1007143	IL10071	2022/10/18	12:18:56	554.8	9.24	5126.35	586.8	8.03	4712	0	0	0
439	IL1007143	IL1007143	IL10071	2022/10/18	12:20:12	556.1	9.5	5282.95	584.3	8.39	4902.28	0	0	0
440	IL1007143	IL1007143	IL10071	2022/10/18	12:21:36	551.8	9.27	5115.19	583.9	8.04	4694.56	0	0	0
441	IL1007143	IL1007143	IL10071	2022/10/18	12:22:49	548.8	8.77	4812.98	582.4	7.58	4414.59	0	0	0
442	IL1007143	IL1007143	IL10071	2022/10/18	12:23:59	553.3	8.52	4714.12	580.6	7.44	4319.66	0	0	0
443	IL1007143	IL1007143	IL10071	2022/10/18	12:25:12	551.8	8.42	4646.16	578	7.36	4254.08	0	0	0
444	IL1007143	IL1007143	IL10071	2022/10/18	12:26:38	553.7	8.18	4529.27	581.9	7.07	4114.03	0	0	0
445	IL1007143	IL1007143	IL10071	2022/10/18	12:27:44	565.6	7.85	4439.96	584.9	6.87	4018.26	0	0	0
446	IL1007143	IL1007143	IL10071	2022/10/18	12:28:53	570.5	7.69	4387.14	580.7	6.84	3971.99	0	0	0
447	IL1007143	IL1007143	IL10071	2022/10/18	12:30:06	574.5	7.68	4412.16	579.6	6.86	3976.06	0	0	0
448	IL1007143	IL1007143	IL10071	2022/10/18	12:31:17	567.5	7.91	4488.92	583.1	6.94	4046.71	0	0	0
449	IL1007143	IL1007143	IL10071	2022/10/18	12:32:20	570.9	8	4567.2	583.3	7.05	4112.26	0	0	0
450	IL1007143	IL1007143	IL10071	2022/10/18	12:33:27	564.1	8.29	4676.39	584.5	7.23	4225.94	0	0	0
451	IL1007143	IL1007143	IL10071	2022/10/18	12:34:33	563.7	8.55	4819.64	583.6	7.51	4382.84	0	0	0
452	IL1007143	IL1007143	IL10071	2022/10/18	12:35:39	564	9.32	5256.48	586.8	8.16	4788.29	0	0	0
453	IL1007143	IL1007143	IL10071	2022/10/18	12:36:49	571.3	8.94	5107.42	584.7	7.99	4671.75	0	0	0
454	IL1007143	IL1007143	IL10071	2022/10/18	12:38:00	563.9	8.57	4832.62	581.3	7.53	4377.19	0	0	0
455	IL1007143	IL1007143	IL10071	2022/10/18	12:39:06	557.9	8.54	4764.47	586.7	7.38	4329.85	0	0	0
456	IL1007143	IL1007143	IL10071	2022/10/18	12:40:11	561.6	8.35	4689.36	586.7	7.26	4259.44	0	0	0
457	IL1007143	IL1007143	IL10071	2022/10/18	12:41:15	563.2	8.26	4652.03	583.6	7.26	4236.94	0	0	0
458	IL1007143	IL1007143	IL10071	2022/10/18	12:42:18	561.6	8.14	4571.42	581.9	7.13	4148.95	0	0	0
459	IL1007143	IL1007143	IL10071	2022/10/18	12:43:23	563.3	7.91	4455.7	583.3	6.95	4053.94	0	0	0
460	IL1007143	IL1007143	IL10071	2022/10/18	12:44:27	560.9	7.74	4341.37	583.5	6.75	3938.62	0	0	0
461	IL1007143	IL1007143	IL10071	2022/10/18	12:45:31	558.7	7.55	4218.18	580.6	6.56	3808.74	0	0	0
462	IL1007143	IL1007143	IL10071	2022/10/18	12:46:34	564	7.36	4151.04	582.2	6.41	3731.9	0	0	0
463	IL1007143	IL1007143	IL10071	2022/10/18	12:47:41	557.9	7.37	4111.72	583.9	6.35	3707.76	0	0	0
464	IL1007143	IL1007143	IL10071	2022/10/18	12:48:46	559.5	7.33	4101.14	586	6.3	3691.8	0	0	0
465	IL1007143	IL1007143	IL10071	2022/10/18	12:49:50	560.9	7.36	4128.22	586.8	6.33	3714.44	0	0	0
466	IL1007143	IL1007143	IL10071	2022/10/18	12:50:54	560.9	7.42	4161.88	584.3	6.39	3733.68	0	0	0
467	IL1007143	IL1007143	IL10071	2022/10/18	12:52:06	558.3	7.5	4187.25	578.9	6.5	3762.85	0	0	0

Data record, about one capture per minute

		
Daily voltage change	Daily current change	Daily power change

2-4 Paint dosage:

36 bottles of 250ml paint (9 liters) were used for 54 solar panels, each with an area of 1.627 square meters.

The average dosage is 102.4ml per square meter, close to the recommended dosage of 100ml per square meter for flat coating.

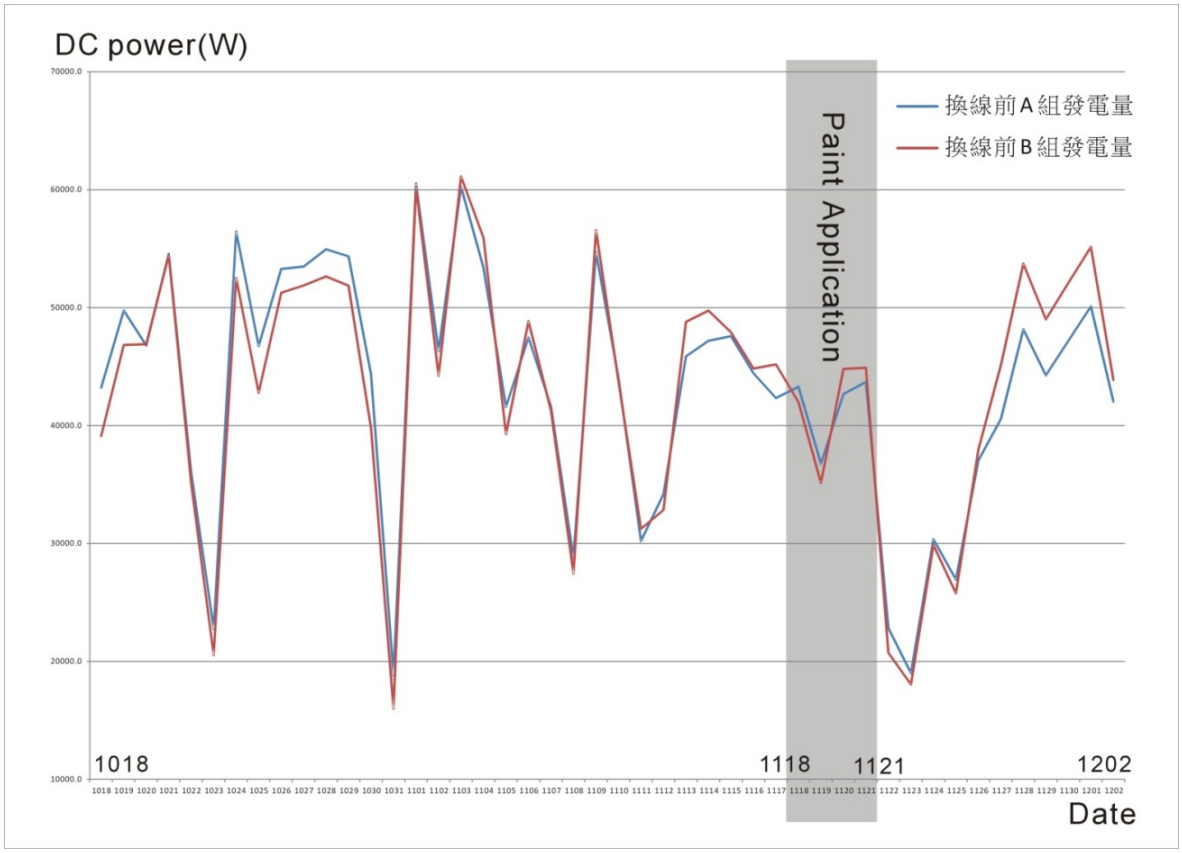
Equivalent to 565ml per 1kW solar panel.

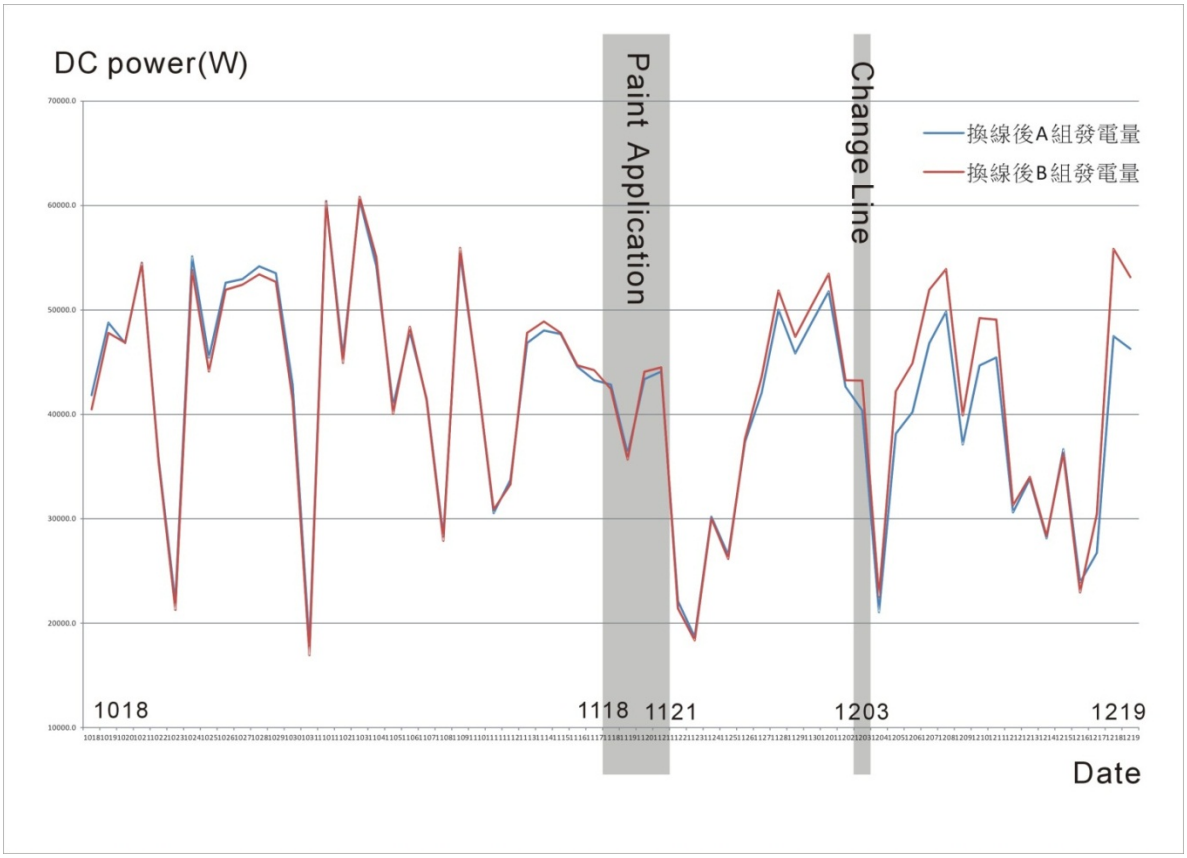
D.Test Record:

1. Check the validity of DC power data by correlation coefficient:

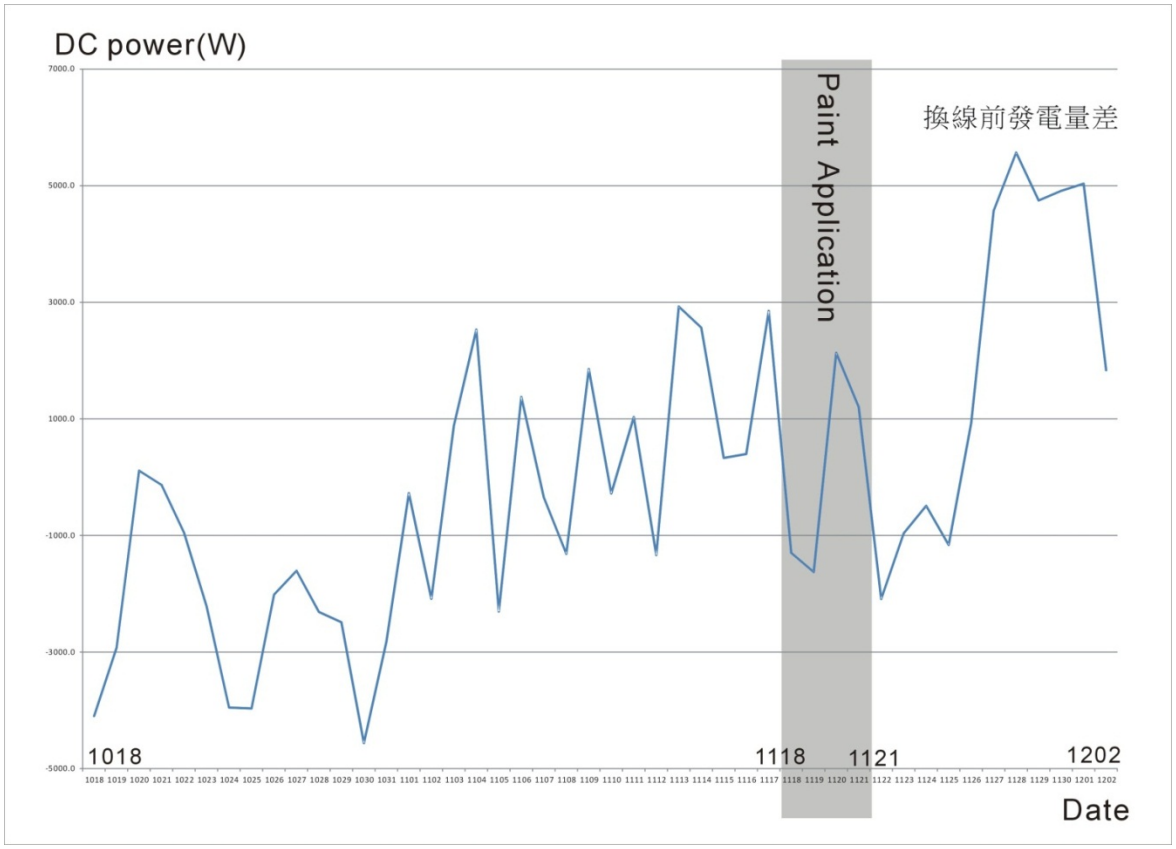
1203 Before changing lines	1018-1117 power correlation coefficients	0.98
	1122-1202 power correlation coefficients	0.997
1203 After changing lines	1018-1117 power correlation coefficients	0.998
	1122-1202 power correlation coefficients	0.9997
	1203-1219 power correlation coefficients	0.987

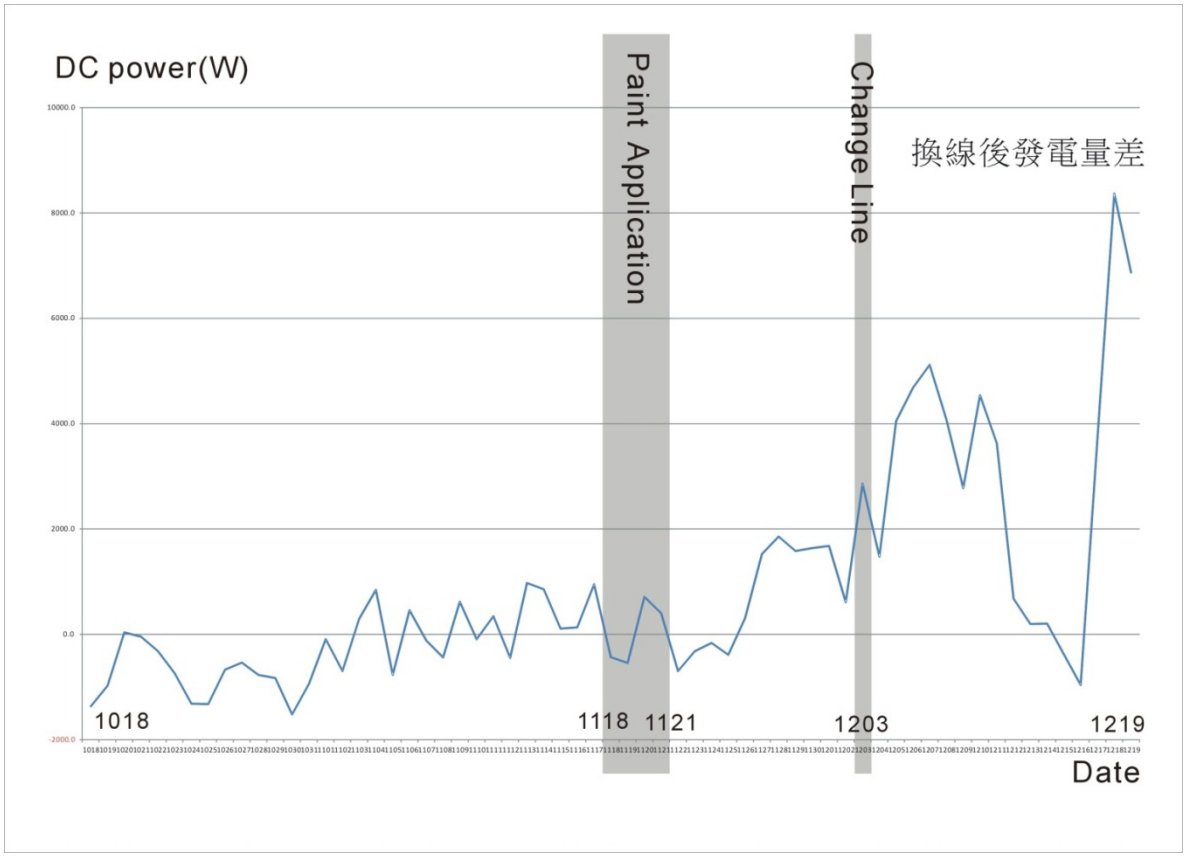
2. DC power change:



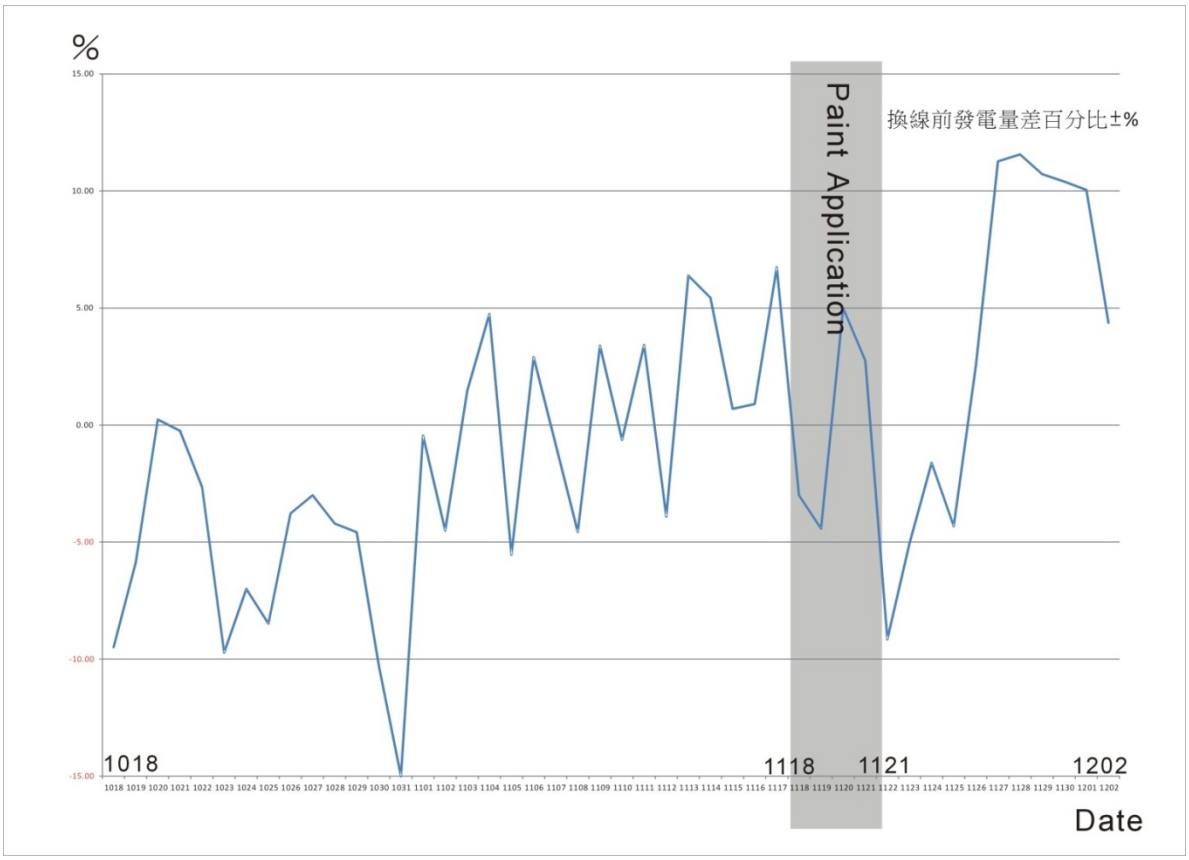


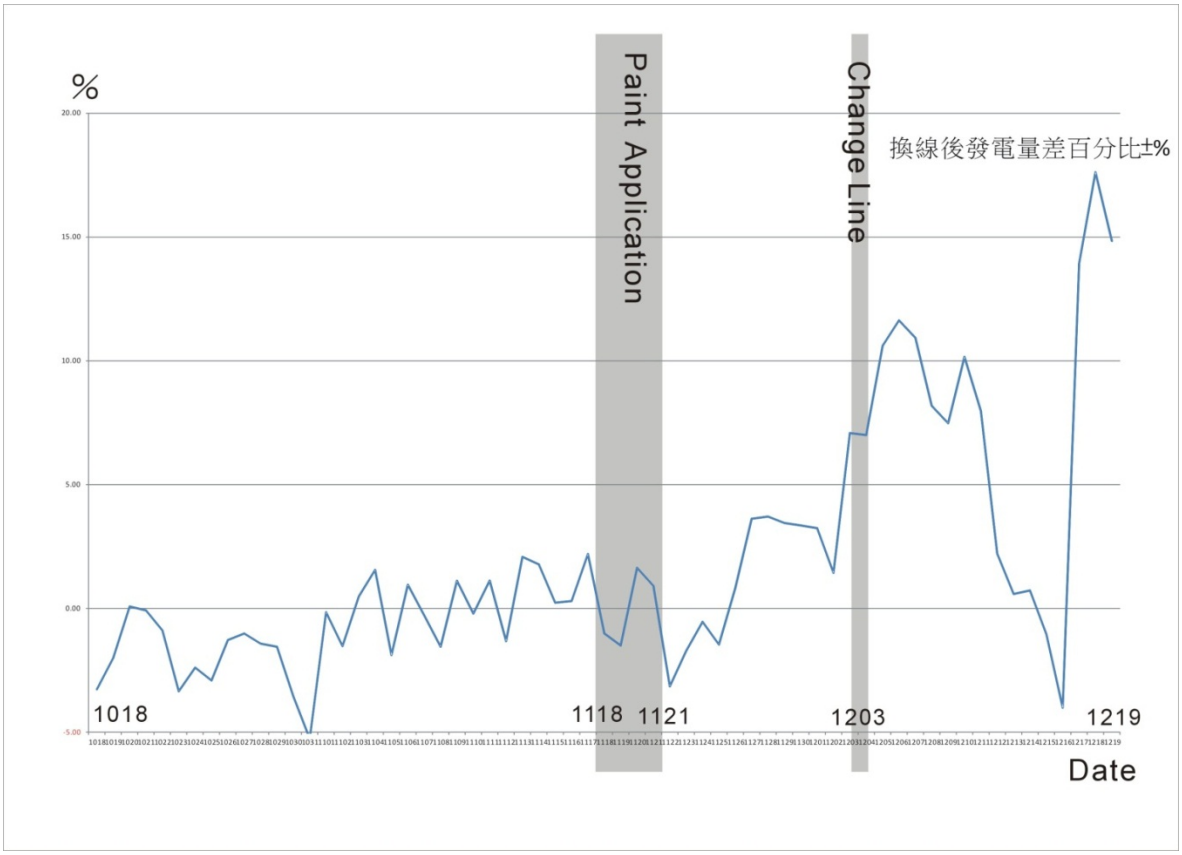
3. Power generation difference (power generation of group B minus power generation of group A):





4. Power generation difference percentage (power generation difference ÷ group A power generation X100%):





5. data comparison:

1203 Before changing lines	1018-1117 Power difference range（W）	-4561.7～2927.8	
	1122-1202 Power difference range（W）	-2088.4～5571.9	
	1018-1117 average power difference(W)	-810.57	**Increase 2892.44W**
	1122-1202 average power difference(W)	2081.87	
	1018-1117 Power difference percentage range (%)	-15%～6.74%	
	1122-1202 Power difference percentage range (%)	-9.15%～11.57%	
	1018-1117 average power difference percentage range(%)	-2.21%	**Increase 5.91%**
	1122-1202 average power difference percentage range(%)	3.7%	
1203 After changing lines	1018-1117 Power difference range（W）	-1520.5～975.9	
	1122-1202 Power difference range（W）	-696.2～1856.7	
	1203-1219 Power difference range（W）	-958.8～8370	
	1018-1117 average power difference(W)	-270.19	**Increase 964.1W**
	1121-1202 average power difference(W)	693.91	
	1203-1219 average power difference(W)	3053.18	**Increase 3323.37W**

	1018-1117 Power difference percentage range (%)	-5.26%～2.2%	
	1122-1202 Power difference percentage range (%)	-3.15%～3.71%	
	1203-1219 Power difference percentage range (%)	-4.01%～17.62%	
	1018-1117 average power difference percentage range(%)	-0.77%	**Increase 1.93%**
	1122-1202 average power difference percentage range(%)	1.16%	
	1203-1219 average power difference percentage range(%)	7.41%	**Increase 8.18%**

E.Analysis and inference:

1. According to the theory, for a solar system operating normally at the same location, under the same series and parallel specifications and the same external environmental conditions, although the DC power of the two sets of inverters will be different, they should show a high degree of positive correlation. The daily power generation at each stage is checked with the correlation coefficient, which is close to a complete positive correlation, which can be regarded as highly reliable power data that can exclude unnecessary variables.
2. After multiple solar panels are connected in series and parallel, not all voltages and currents can be converted into effective power generation. The basic principle is that the series mode takes the full voltage and the lowest current, and the parallel mode takes the full current and the lowest voltage. When comparing individual solar panels in the laboratory, there will be no series-parallel problems. As we all know, after a single solar panel enhances the heat dissipation capacity, there is room for improvement in voltage and current, but in a solar power station where multiple solar panels are connected in series and parallel, all the increased voltage and current will not all enter the inverter. The DC power data detected by the inverter is the effective power generation after excluding series and parallel losses.
3. According to the data analysis before the line change in 1203, one-third of the solar panels in group A are coated with heat-dissipating coating, and two-thirds of the solar panels in group B are coated with heat-dissipating coating. Compared with 1018-1117 without heat dissipation coating, the power generation of 1122-1202 increased by 5.91% on average.
4. After the 1203 line is changed, the data is transferred and corrected, so that group A has no heat dissipation coating, and group B has heat dissipation coating. Compared with the base data of 1018-1117 are not coated. From 1203 to 1219, the average increase in power generation reached 8.18%.
5. 1203 After changing the line, the data is adjusted based on the model of group A without heat dissipation coating and group B with heat dissipation coating as the benchmark. Compared with the

basic data of 1018-1117 without heat dissipation coating, the increase rate of 1122-1202 is reduced to only 1.93%, which is in line with the theoretical basis. After multiple solar panels are connected in series and parallel, the voltage and current are uneven, and cannot be fully input the Inverter and converted to effective DC power. Therefore, it is necessary to fully implement all the solar panels connected to a set of inverters in order to maximize the benefits.

6. Based on the comparison of the above data, the heat dissipation paint used on the back of the solar panel can increase the power generation by improving the heat dissipation capacity.
   The conversion efficiency of solar panels is calculated as:
   maximum module output power(W)/module frame area (m^2)/1,000 W/m^2X 100%
   The rated conversion efficiency is measured under the conditions of element temperature 25°C, illuminance 1000W/m^2, and air quality AM1.5 (sunlight radiates obliquely through the atmosphere). AUO PM060MW2_295 solar panel has a rated power of 295W and a module area of 1.627 square meters. The conversion efficiency is 18.13%. If the frame area and illuminance remain unchanged, the output power increases by 8.18%, and the conversion efficiency can be increased to 19.613%. Without making any changes to the solar module components, the conversion efficiency can be increased by 1.483% only by applying heat-dissipating paint, which is very valuable.
7. It has been known in the past that the temperature coefficient of a general module is about -0.3~-0.5%/°C. That is, every time the temperature rises by 1 degree Celsius, the power generation will decrease by 0.3-0.5%. In a real environment, especially in summer, the heat will rise rapidly and even exceed 70°C, which will seriously reduce the output power of solar energy. The test site is near the west coast of Taiwan. There is sea breeze all year round and it is autumn and winter. Should be a good cooling environment. In this season, the solar panels will not be too hot, and the average power generation can increase by 8.18%. According to the experimental model and the characteristics of heat dissipation paint, such as in summer high temperature conditions, it may increase the higher power generation.
8. There are many variables that affect the efficiency of solar power generation. Weather, sunlight angle, air quality, etc. will all have an impact on power generation. This test will continue to collect and update data. After accumulating more weather and seasonal change data, weather conditions will be analyzed separately to obtain more complete statistical results and technical knowledge of heat dissipation paint applied to solar panels.

Appendix 1: Meteorological data (continuously updated)

date	Daily average temperature^{0}C	daily maximum temperature^{0}C	average wind speed m/s	sunshine hours hr	Insolation rate %	Total Sky Insolation MJ/m^{2}
1018	23	25.4	7.4	1.7	14.9	11.55
1019	24.4	29.3	4.9	6.8	59.7	18.28
1020	25.6	31.5	3.1	5.1	44.8	14.16
1021	26.2	30.7	3.8	9.5	83.7	19.09
1022	27.5	32.3	2.8	3.7	32.7	11.26
1023	25.6	28.6	4.6	0	0	6.38
1024	24.8	28	5.6	3.5	31	14.17
1025	24.7	...	3.7	1.1	9.8	10.51
1026	25.3	29.3	2.6	9.1	80.9	17.32
1027	26	29.1	3.2	6.7	59.7	16.89
1028	26.5	28.9	3.9	9.2	82.1	18.31
1029	26.3	28.8	5	10	89.4	19.39
1030	26.2	28.8	5.2	5.5	49.3	14.53
1031	24.7	27.7	6.5	0.1	0.9	6.77
1101	25.1	29	6.4	6	53.9	16.07
1102	25.4	30	4.5	6.6	59.4	14.86
1103	25.8	28.5	3.9	8.2	74	18.42
1104	24.9	28.8	4.9	8.7	78.6	17.55
1105	23.3	26.8	4.5	2.9	26.1	11.57
1106	24	27.3	4.4	3.7	33.5	12.33
1107	25.2	28.1	3.8	5.5	49.9	15.03
1108	25.3	27.6	3	1.8	16.3	8.75
1109	25.9	29	2	9.5	86.5	17.42
1110	25.9	29.3	2.5	9.6	87.2	17.49
1111	26.2	28.6	2.7	5.2	47.5	12.66
1112	26	28.5	2.2	6.9	63.1	15.63
1113	26.1	28.2	3.5	9.5	87.1	18.43
1114	26	29	3.4	7.9	72.5	15.63
1115	25.6	29.9	3.4	9.4	86.4	16.65
1116	25.9	28.3	3.2	5.4	49.7	14.54
1117	25.6	28.6	3.1	9.1	83.9	16.82
1118	25.8	28.9	3.8	9.7	89.5	17.46
1119	25.8	29.2	3.6	9.6	88.7	16.93
1120	26.2	30.5	4	7.5	69.4	15.63
1121	26.1	28.4	3.3	7.9	73.2	14.49

1122	25.8	29.6	2.5	1.3	12.1	9.43
1123	24.9	28.4	3.2	0.1	0.9	4.18
1124	24.4	27.8	2.9	0.4	3.7	8.36
1125	24.9	27.5	3	0.1	0.9	6.7
1126	24.9	28.2	3.2	3	27.8	11.78
1127	25.5	28.8	1.7	4.4	41	12.09
1128	27.4	34.8	1.7	8.3	77.5	15.47
1129	28.5	33.7	1.3	8.3	77.6	15.84
1130	23.3	28.1	5.7	8.4	78.6	16.12
1201	22.3	27	5.7	9.1	85.2	16.61
1202	22.9	26.6	4.7	5.3	49.7	13.89
1203	24.2	...	4.1	9	84.4	16.54
1204	24	27.8	3.8	6.6	61.9	14.57
1205	21.5	25.9	5.5	4.8	45.1	14.23
1206	21.6	25.3	4.8	3.7	34.6	10.62
1207	21.7	27.2	4.1	7.9	74.3	15.06
1208	20.6	23.2	4.3	9	84.7	14.71
1209	20.7	22.8	4.8	9.4	88.5	16.69
1210	20.8	23.2	4.3	9.5	89.5	16.2
1211	18.8	...	6.2	8.7	82	16.21
1212	18.1	20	5.4	3.5	33	12.18
1213	17.7	20	5.1	3.9	36.6	11.93
1214	16.9	18.8	5.4	3.2	30.2	9.31
1215	18.2	20.6	4.6	3.4	32.1	12.01
1216	19.6	21.1	4.8	4.3	40.6	12.45
1217	15.2	19.3	7	0.5	4.7	6.02
1218	11.2	13.1	5.7	6.8	64.2	13.42
1219	14.7	19.9	2.8	7.4	69.8	14.35

Appendix 2: Daily power generation data before line change

date	Power generation of group A before line change	Power generation of group B before line change	Power generation gap before line change	Percentage of power generation gap before line change ±%
1018	43221.8	39122.9	-4098.9	-9.48
1019	49758.5	46833.6	-2924.9	-5.88
1020	46792.2	46904.4	112.2	0.24
1021	54568.5	54435.1	-133.4	-0.24
1022	36040.2	35086.4	-953.8	-2.65
1023	22760.2	20547.8	-2212.4	-9.72
1024	56447.9	52495.1	-3952.7	-7.00
1025	46758.4	42791.3	-3967.1	-8.48
1026	53282.1	51266.9	-2015.2	-3.78
1027	53492.2	51885.7	-1606.5	-3.00
1028	54956.0	52643.7	-2312.3	-4.21
1029	54352.4	51864.6	-2487.8	-4.58
1030	44350.7	39789.0	-4561.7	-10.29
1031	18828.7	16003.8	-2824.9	-15.00
1101	60539.2	60264.7	-274.6	-0.45
1102	46323.3	44237.7	-2085.6	-4.50
1103	60257.0	61139.4	882.4	1.46
1104	53376.9	55908.8	2531.9	4.74
1105	41593.7	39289.4	-2304.3	-5.54
1106	47467.7	48843.3	1375.6	2.90
1107	41626.1	41279.0	-347.1	-0.83
1108	28771.4	27456.7	-1314.7	-4.57
1109	54708.8	56564.9	1856.1	3.39
1110	44030.3	43751.5	-278.8	-0.63
1111	30205.5	31237.6	1032.1	3.42
1112	34177.3	32841.5	-1335.9	-3.91
1113	45863.0	48790.8	2927.8	6.38
1114	47186.5	49752.7	2566.2	5.44
1115	47586.6	47916.7	330.0	0.69
1116	44435.6	44833.9	398.4	0.90
1117	42334.0	45186.1	2852.1	6.74
1118	43292.0	41994.4	-1297.5	-3.00
1119	36769.0	35142.3	-1626.7	-4.42
1120	42667.7	44801.0	2133.3	5.00
1121	43701.9	44906.3	1204.4	2.76

1122	22814.4	20726.0	-2088.4	-9.15
1123	19006.3	18043.6	-962.7	-5.07
1124	30359.4	29869.7	-489.7	-1.61
1125	26938.7	25774.8	-1163.9	-4.32
1126	37044.8	37972.4	927.6	2.50
1127	40556.7	45127.8	4571.1	11.27
1128	48156.1	53728.0	5571.9	11.57
1129	44260.9	49008.8	4747.8	10.73
1130	47197.7	52109.9	4912.2	10.41
1201	50110.3	55148.5	5038.2	10.05
1202	42039.7	43876.3	1836.5	4.37

Appendix 3: Allocation and correction of daily power generation data after line change (data is continuously updated after 1219)

date	Power generation of group A after line change	Power generation of group B after line change	Power generation gap after line change	Percentage of power generation gap after line change ±%
1018	41855.5	40489.2	-1366.3	-3.26
1019	48783.5	47808.6	-974.9	-2.00
1020	46829.6	46867.0	37.4	0.08
1021	54524.0	54479.6	-44.4	-0.08
1022	35722.2	35404.3	-317.9	-0.89
1023	22022.8	21285.3	-737.5	-3.35
1024	55130.3	53812.7	-1317.6	-2.39
1025	45436.1	44113.7	-1322.4	-2.91
1026	52610.4	51938.6	-671.8	-1.28
1027	52956.7	52421.2	-535.5	-1.01
1028	54185.2	53414.5	-770.7	-1.42
1029	53523.1	52693.8	-829.3	-1.55
1030	42830.1	41309.6	-1520.5	-3.55
1031	17887.1	16945.5	-941.6	-5.26
1101	60447.7	60356.2	-91.5	-0.15
1102	45628.1	44932.9	-695.2	-1.52
1103	60551.1	60845.3	294.2	0.49
1104	54220.8	55064.8	844.0	1.56
1105	40825.6	40057.5	-768.1	-1.88
1106	47926.2	48384.7	458.5	0.96
1107	41510.4	41394.7	-115.7	-0.28
1108	28333.2	27894.9	-438.3	-1.55

1109	55327.5	55946.2	618.7	1.12
1110	43937.4	43844.5	-92.9	-0.21
1111	30549.5	30893.5	344.0	1.13
1112	33732.0	33286.7	-445.3	-1.32
1113	46839.0	47814.9	975.9	2.08
1114	48041.9	48897.3	855.4	1.78
1115	47696.6	47806.6	110.0	0.23
1116	44568.4	44701.2	132.8	0.30
1117	43284.7	44235.4	950.7	2.20
1118	42859.5	42427.0	-432.5	-1.01
1119	36226.8	35684.6	-542.2	-1.50
1120	43378.8	44089.9	711.1	1.64
1121	44103.4	44504.8	401.4	0.91
1122	22118.3	21422.1	-696.2	-3.15
1123	18685.4	18364.5	-320.9	-1.72
1124	30196.1	30032.9	-163.2	-0.54
1125	26550.7	26162.8	-387.9	-1.46
1126	37354.0	37663.2	309.2	0.83
1127	42080.4	43604.1	1523.7	3.62
1128	50013.4	51870.1	1856.7	3.71
1129	45843.5	47426.1	1582.6	3.45
1130	48835.1	50472.5	1637.4	3.35
1201	51789.7	53469.1	1679.4	3.24
1202	42651.9	43264.1	612.2	1.44
1203	40380.2	43239.9	2859.7	7.08
1204	21070.6	22546.3	1475.7	7.00
1205	38154.1	42201.9	4047.8	10.61
1206	40225.6	44905.6	4680.0	11.63
1207	46819.3	51936.5	5117.2	10.93
1208	49834.7	53912.8	4078.1	8.18
1209	37126.8	39903.2	2776.4	7.48
1210	44680.9	49220.5	4539.6	10.16
1211	45452.9	49077.5	3624.6	7.97
1212	30615.8	31293.2	677.4	2.21
1213	33813.2	34009.9	196.7	0.58
1214	28138.8	28342.8	204.0	0.72
1215	36648.2	36266.6	-381.6	-1.04
1216	23913.1	22954.3	-958.8	-4.01
1217	26743.0	30469.9	3726.9	13.94

1218	47489.8	55859.8	8370.0	17.62
1219	46280.4	53150.8	6870.4	14.85