



**23<sup>RD</sup> ANNUAL PQSYNERGY™ INTERNATIONAL  
CONFERENCE & EXHIBITION 2025**

**A VOLTAGE IMPROVEMENT STRATEGY TO MITIGATE  
TECHNICAL LOSSES AT THE 22 KV SAI YOK SUBSTATION**

**PRESENT BY**

**CHURIT PANSAKUL**

**PROVINCIAL ELECTRICITY AUTHORITY**



**PEA**  
PROVINCIAL ELECTRICITY AUTHORITY

# Introduction

This framework uses data analysis to resolve power quality issues from small power producers (SPP/VSPP).

The collaborative approach provides technical support, aiming to enhance grid reliability and stability through effective assessment and mitigation.

**Electrical  
Engineering**

**Churit Pansakul**  
**Power Quality and Small Power  
Plant Division**



# AGENDA



**Overview of Power Supply at Sai Yok Substation**

**4**



**Analysis of Technical Losses Following the Voltage Improvement Plan and Simulation with Power factory Programing**

**7**



**Impact Analysis and Problem-Solving Approaches for the Voltage Improvement Project**

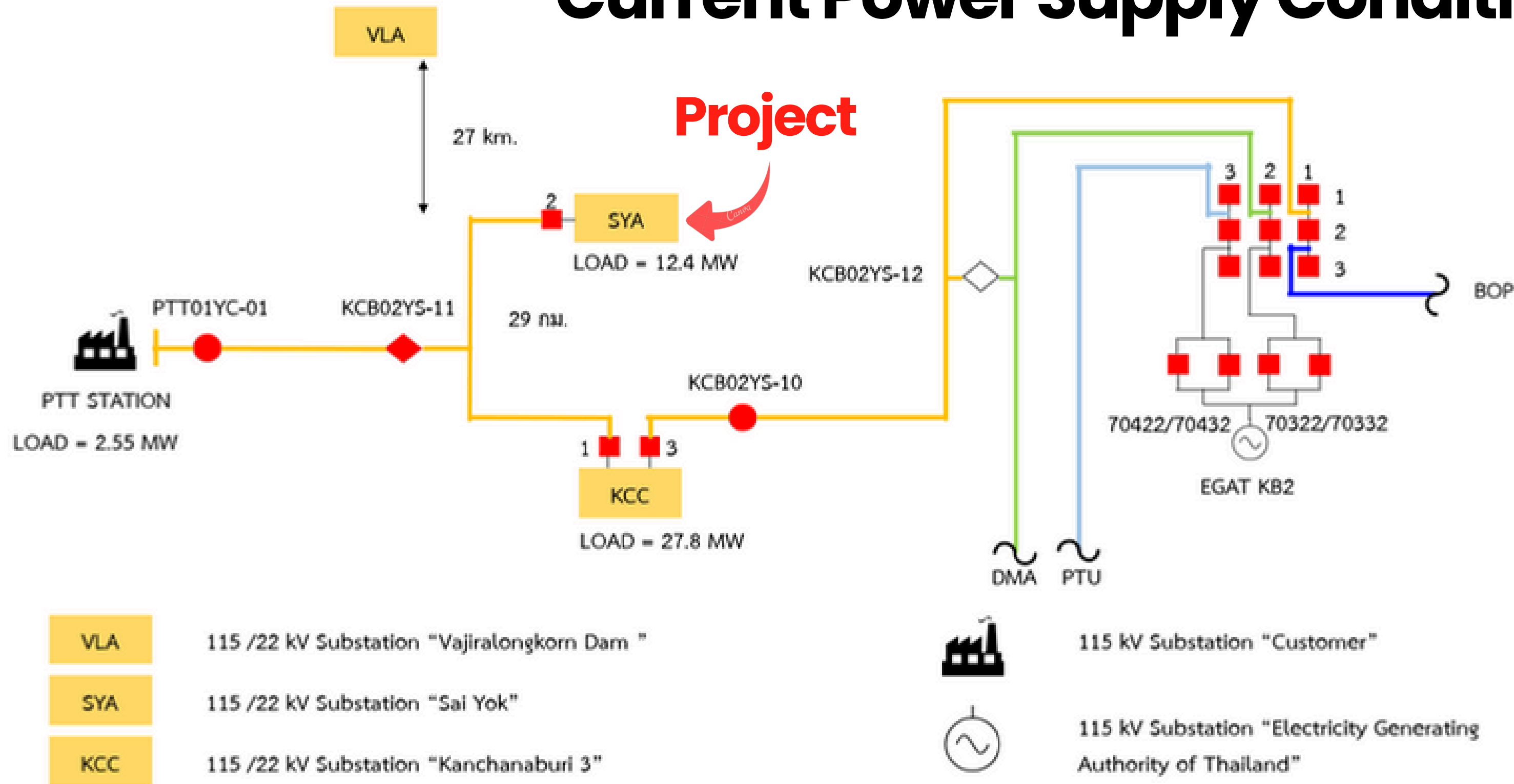
**24**



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# Overview of Power Supply at Sai Yok Substation

# Current Power Supply Condition at 115 kV



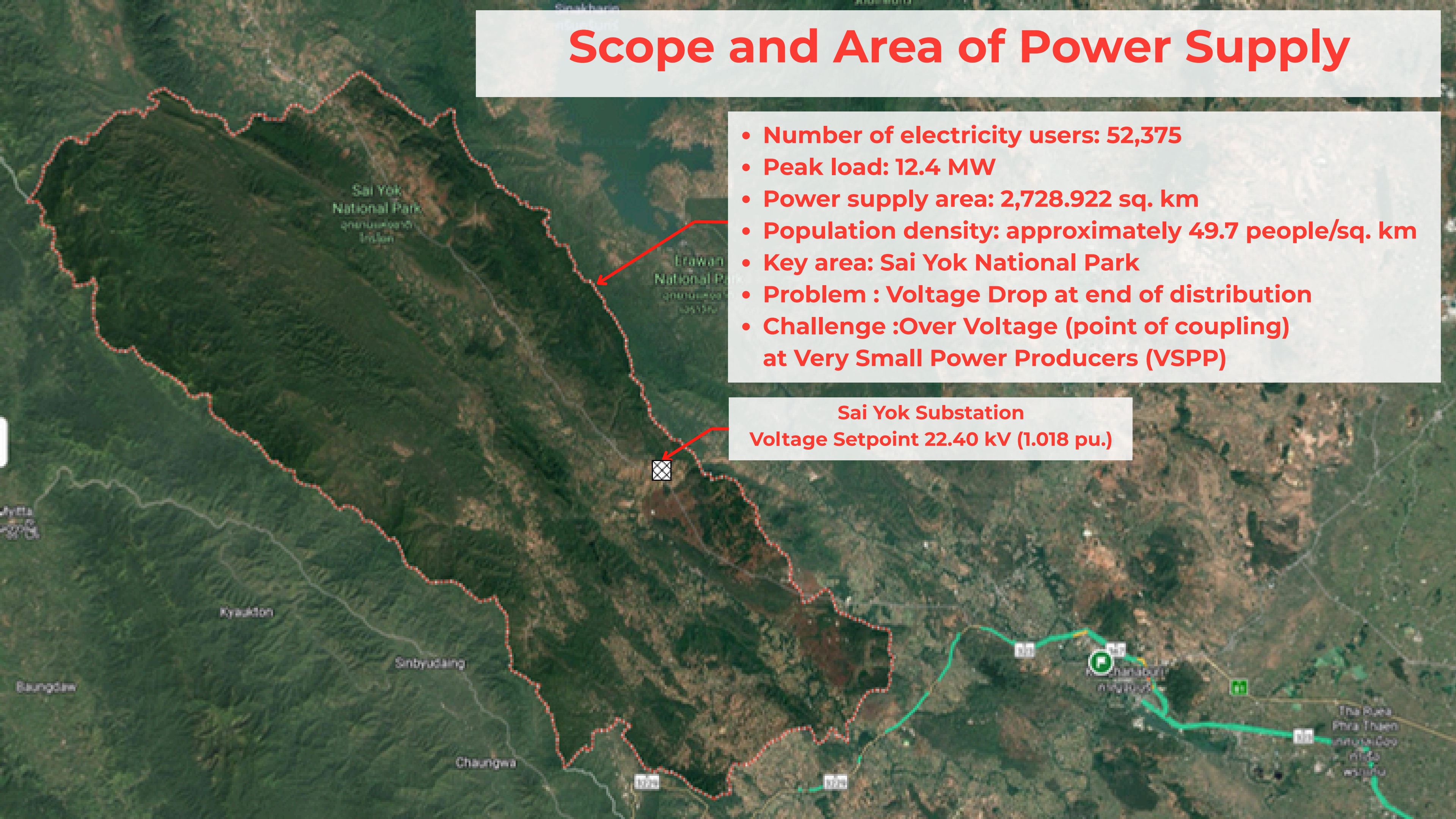
## Consideration Conditions

- The load group of Sai Yok Substation consists of residential households and small-scale industrial facilities, which are suitable for operation.
- Sai Yok Substation is located in a remote area and supplies electricity over long distances, making it suitable for implementing voltage improvement

# Scope and Area of Power Supply

- Number of electricity users: 52,375
- Peak load: 12.4 MW
- Power supply area: 2,728.922 sq. km
- Population density: approximately 49.7 people/sq. km
- Key area: Sai Yok National Park
- Problem : Voltage Drop at end of distribution
- Challenge :Over Voltage (point of coupling) at Very Small Power Producers (VSPP)

Sai Yok Substation  
Voltage Setpoint 22.40 kV (1.018 pu.)





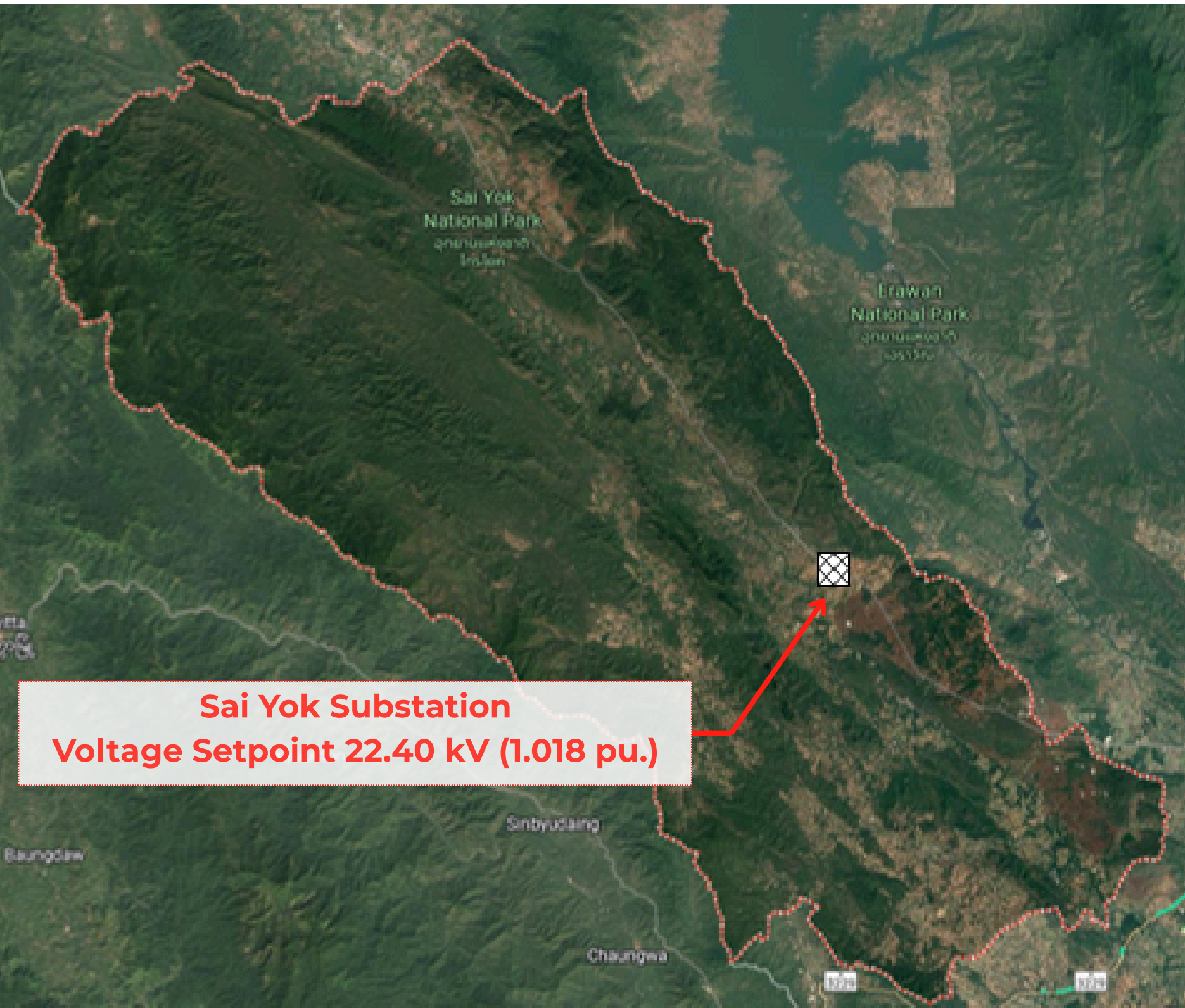
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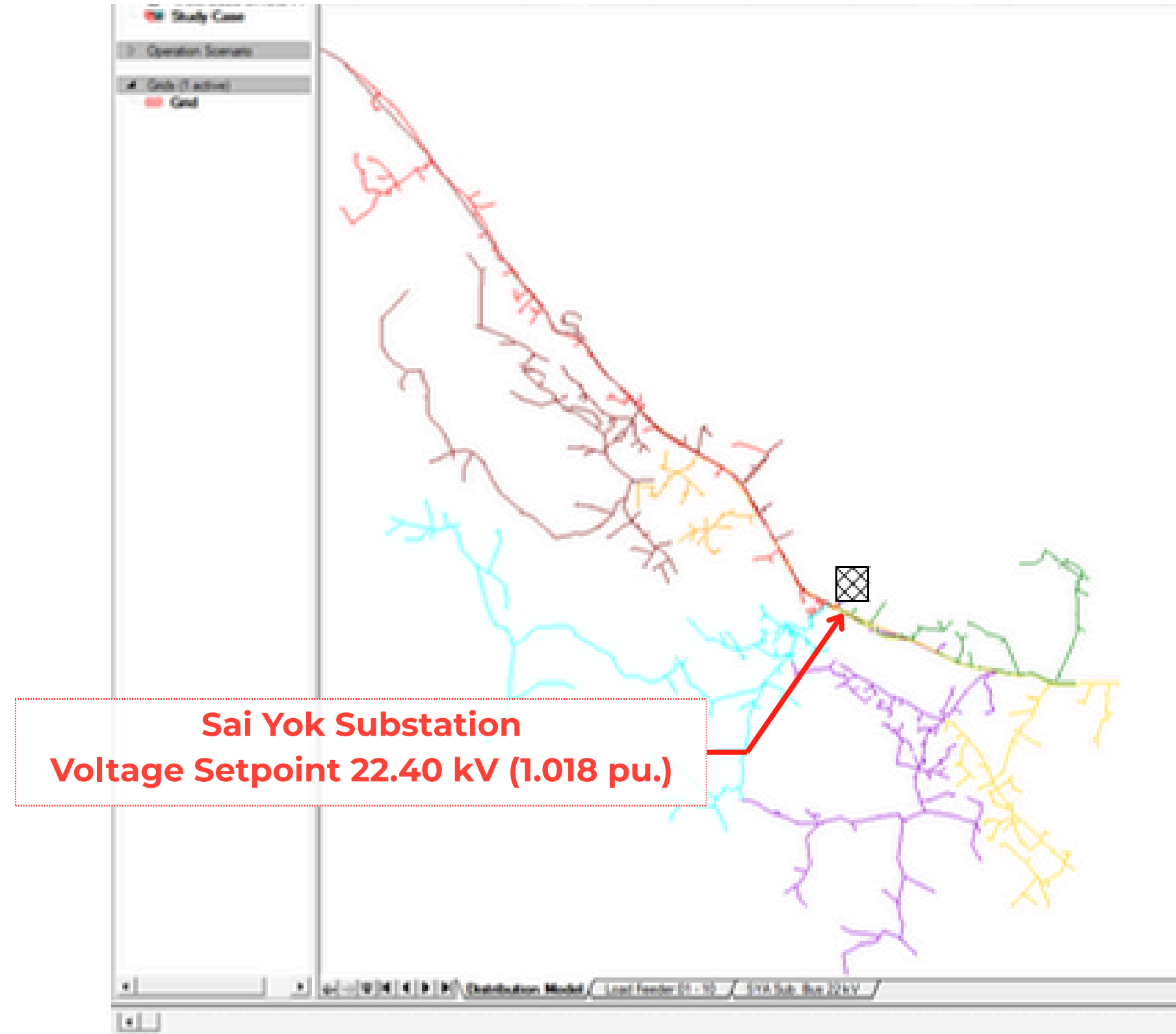
# Analysis of Technical Losses Following the Voltage Improvement Plan and Simulation with Power factory Programing

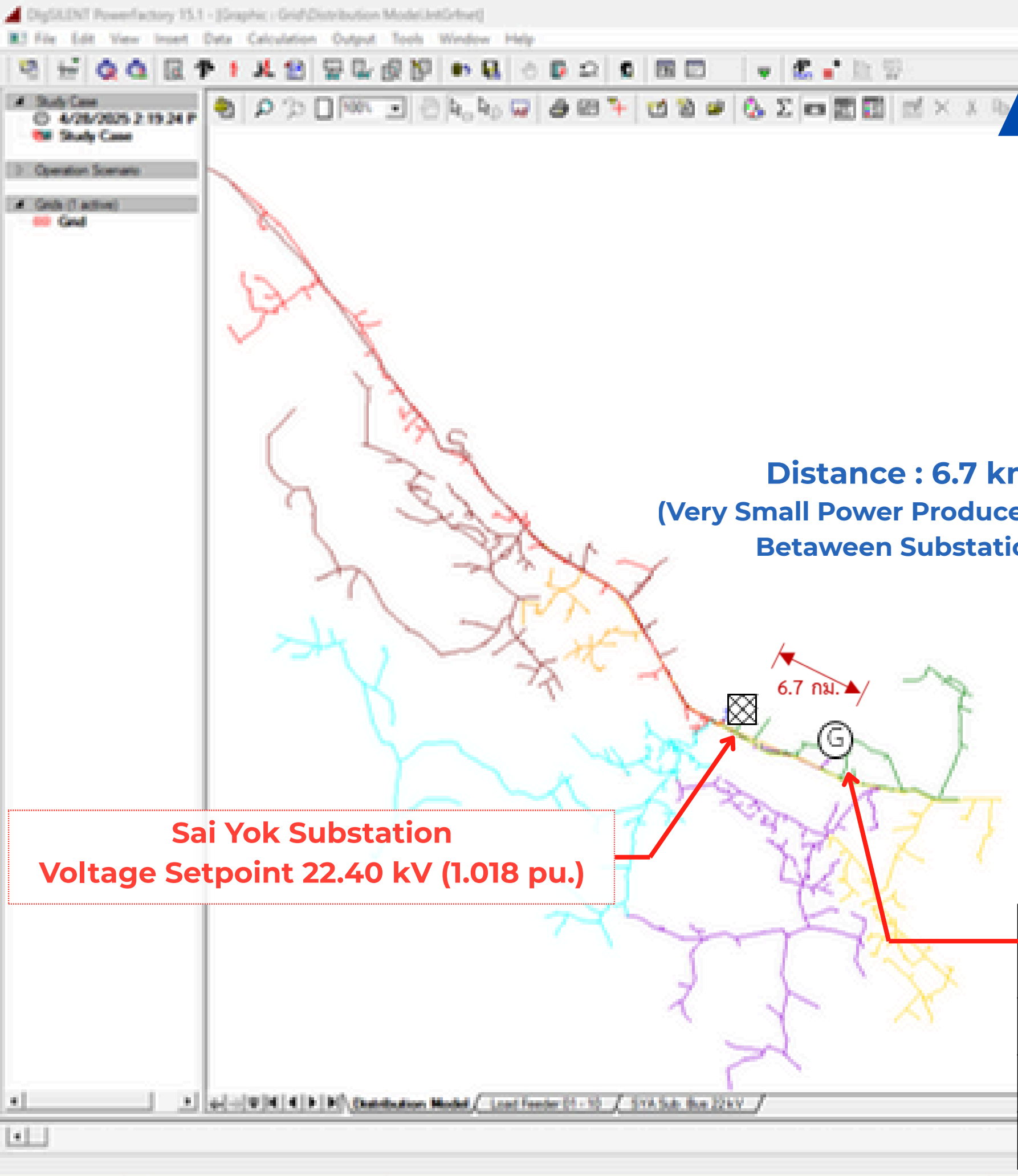
# Simulation with Power factory Programming

## ArcGIS



## Model in Programming





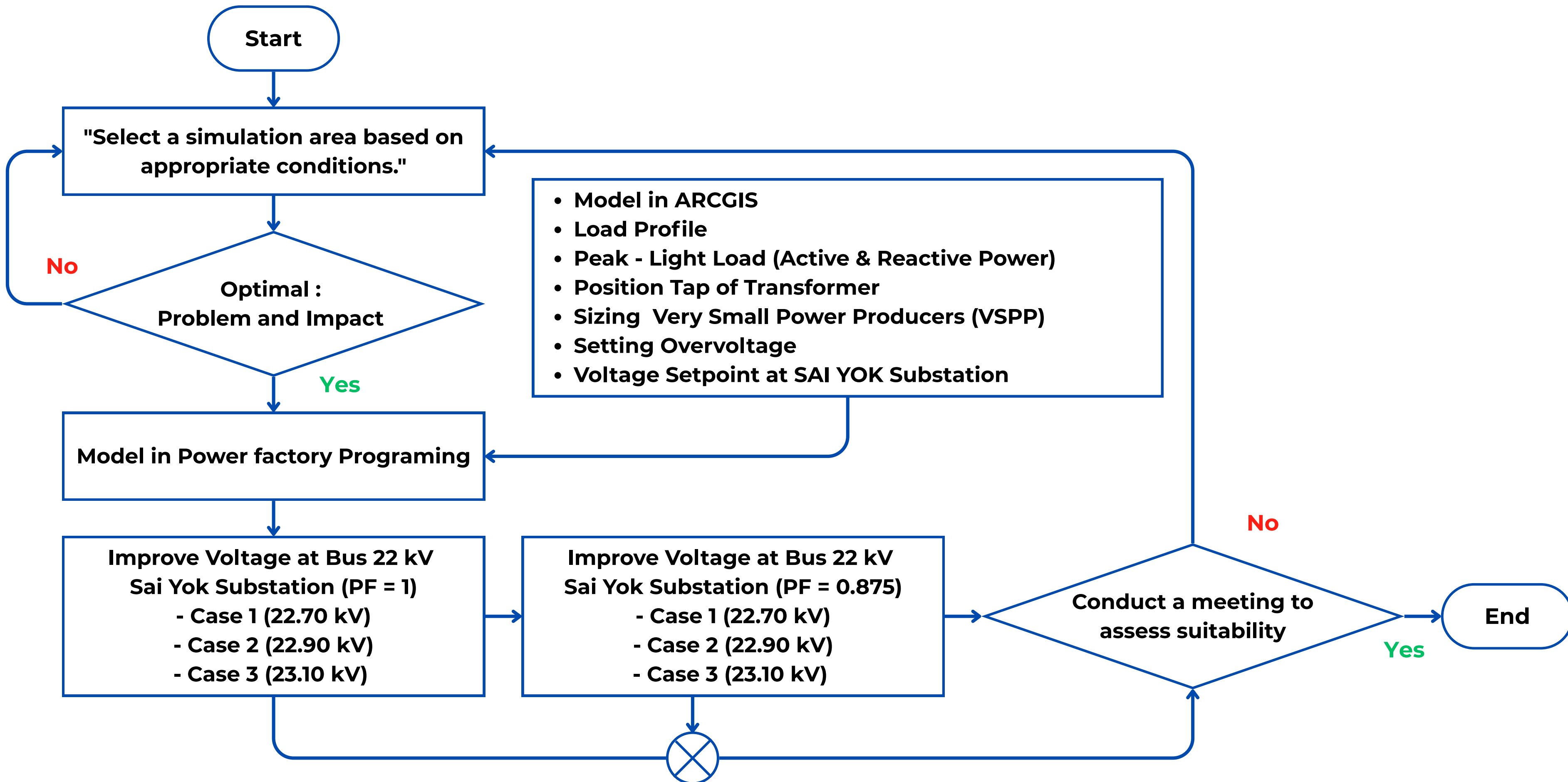
# Model in Power factory Programing

Feeder	Peak Load		Light Load	
	P (MW)	Q (MVAR)	P (MW)	Q (MVAR)
1	2.4	0.6	0.8	0.2
2	1.6	0.3	0.2	0.1
3	0.1	0.01	0.01	0
4	Out of Service			
5	3.0	0.6	1.5	0.4
6	1.4	0.2	0.01	0.00
7	0.3	0.03	0.1	0.01
8	Out of Service			
9	2.5	0.5	0.6	0.1
10	3.6	0.8	1.7	0.3

	Name	Type	Contract (MW)	Parallel Feeder
1	Conservation of Energy co.,ltd	Solar (PV)	6.00	Feeder02
2	Conservation of Energy co.,ltd	Solar (PV)	6.00	Feeder06
3	Conservation of Energy co.,ltd	Solar (PV)	6.00	Feeder09

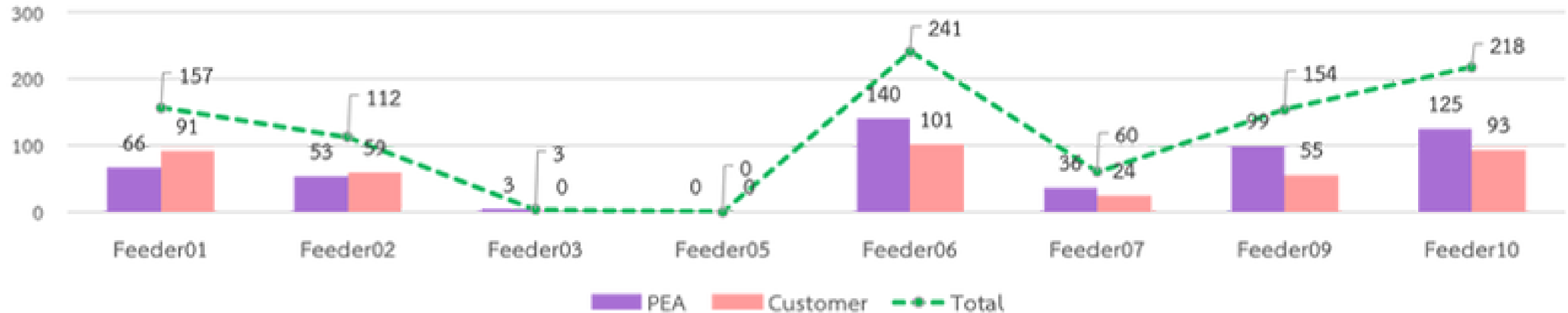
# Flow Chart Analysis

## Model in Power factory Programing



# Basic information (22 kV distribution transformer)

Number of Transformer

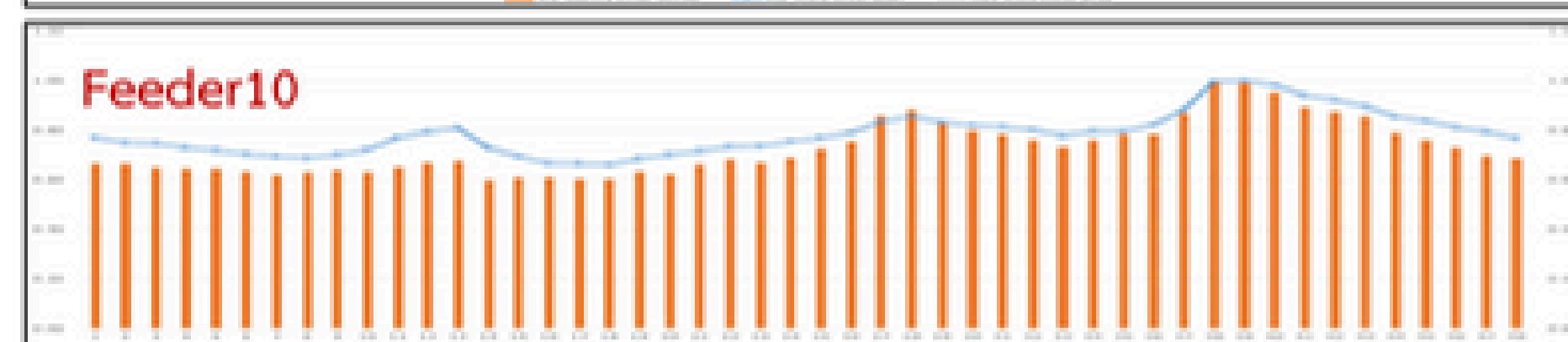
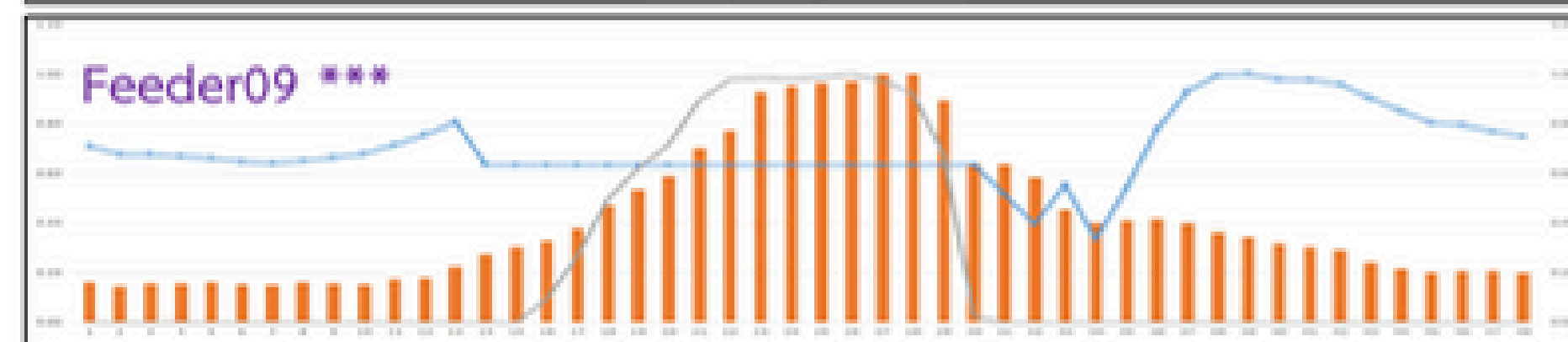
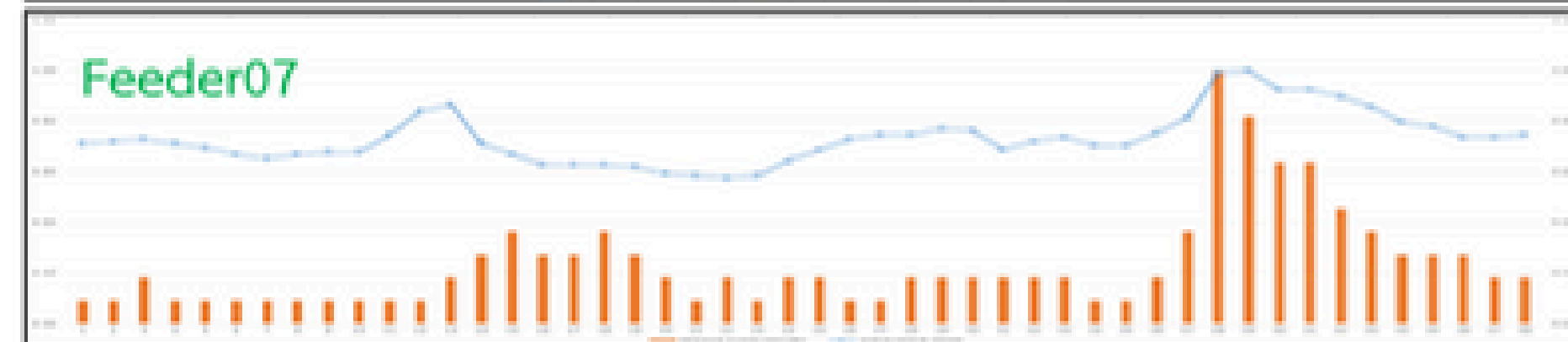
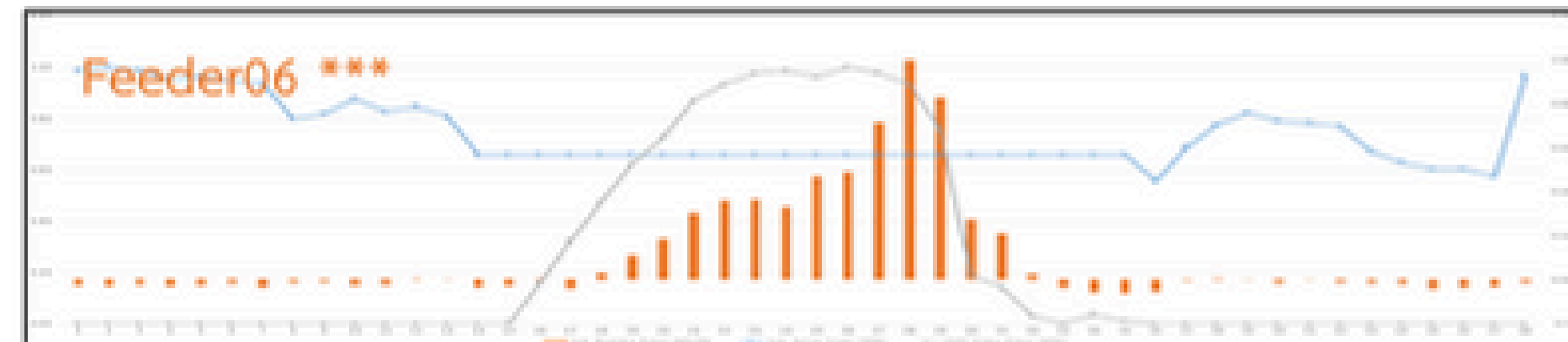
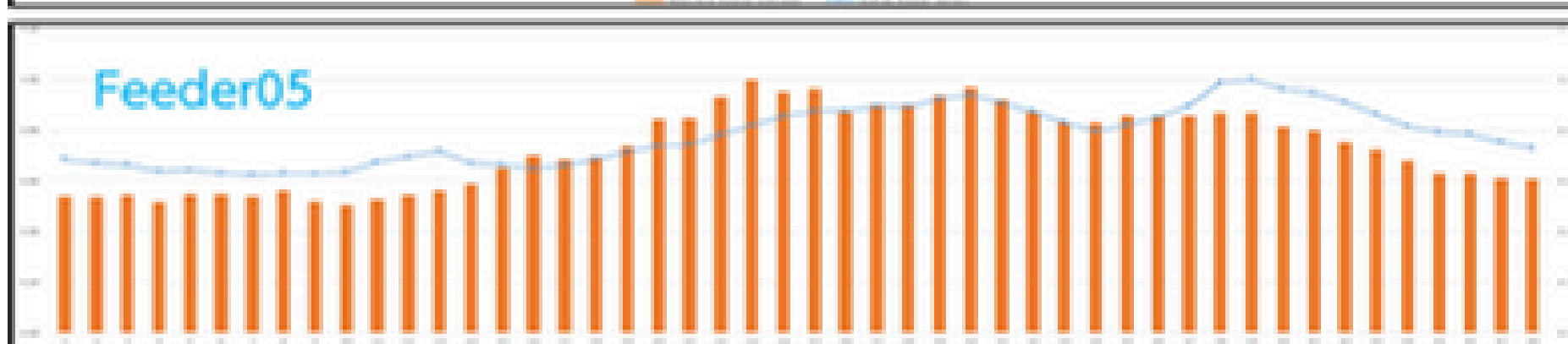
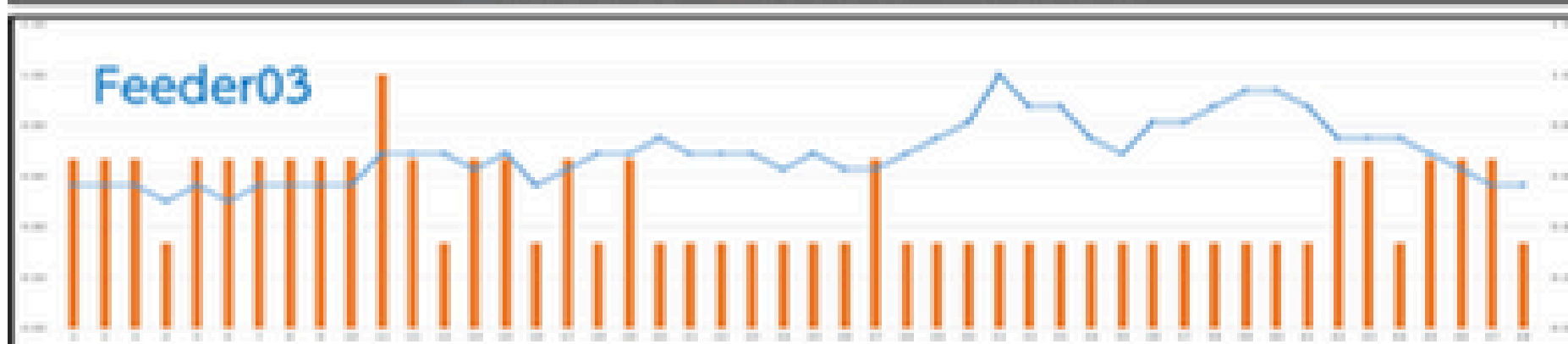
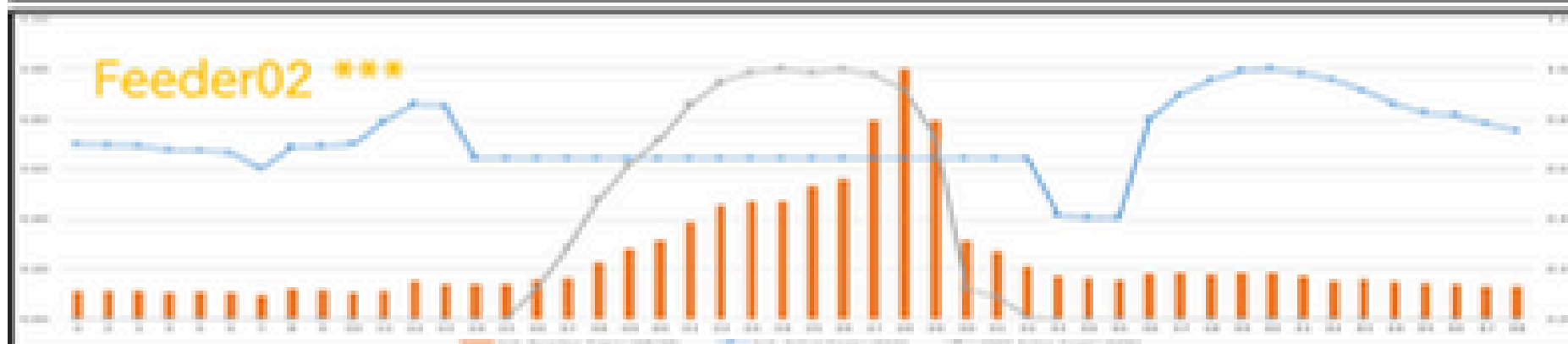
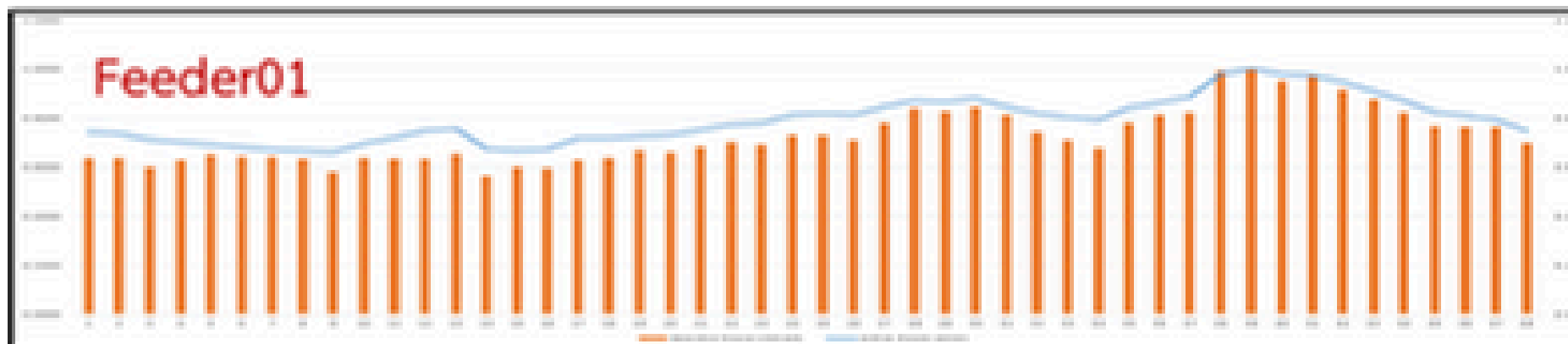


รหัส TAG	ระบบเฟส	PEANO	เฟสที่ติดตั้ง	ค่ากำลัง KVA หม้อแปลง	รูปแบบ Winding	เจ้าของหม้อแปลง	ค่าแรงยก TAP	ประเภทผู้ใช้ไฟ	สถานที่	รหัสสายบ่อนที่ 1
33XFIA000123435	หม้อแปลง 3 Phase	41-006243	ABC	100 kVA	Dyn11 (Default)	Customer	Tap 3	อื่นๆ	ค่ายกักโหรโยด	DMA06
33XFIA000171826	หม้อแปลง 1 Phase	67-108495	AB	30 kVA	Don't Apply	Customer	Tap 3	อื่นๆ	CUS.TR.แขวงทางหลวงกาญจนบุรี กรมทางหลวง จุดที่10 โด	DMA06
33XFIA000011537	หม้อแปลง 3 Phase	21-003737	ABC	250 kVA	Dyn11 (Default)	Customer	Tap 3	อุตสาหกรรม	โรงเคียวจักรน้ำไม่คัพพัฒน์ ด.ท่าเสา	SYA01
3371XF000006924	หม้อแปลง 1 Phase	22-002541	BC	10 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	DCC น.หุดะเคียน	SYA01
3371XF000007143	หม้อแปลง 3 Phase	22-003538	ABC	50 kVA	Dyn11 (Default)	Customer	Tap 3	อื่นๆ	ที่ทำการหมวดการทางโหรโยด	SYA01
33XFIA000011535	หม้อแปลง 3 Phase	22-004829	ABC	250 kVA	Dyn11 (Default)	Customer	Tap 3	อุตสาหกรรม	โรงแรมหมู่บ้านแม่ป่าแคว ด.ท่าเสา โหรโยด	SYA01
33XFIA000013523	หม้อแปลง 3 Phase	24-006110	ABC	100 kVA	Dyn11 (Default)	Customer	Tap 3	อื่นๆ	กคส.สหพ.บพ.(1) ด.ท่าเสา อ.โหรโยด	SYA01
3371XF000007146	หม้อแปลง 3 Phase	25-001079	ABC	50 kVA	Dyn11 (Default)	Customer	Tap 3	ธุรกิจ	นายประสิทธิ์ นกกาญจน์ บินโหรโยดปอย	SYA01
33XFIA000166873	หม้อแปลง 1 Phase	28-003990	CA	20 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	ปากทางวังใหญ่ ด.ท่าเสา	SYA01
3371XF000007042	หม้อแปลง 1 Phase	28-006169	CA	20 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	DCC บ้านหนองตาม่วง ม.10 ด.ท่าเสา	SYA01
3371XF000006898	หม้อแปลง 1 Phase	28-010804	CA	10 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	DCC หน้า รร.บ้านหาดจิว อ.โหรโยด	SYA01
3371XF000007029	หม้อแปลง 1 Phase	28-011849	CA	30 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	DCC หน้าวัดพุทธนิมิต ด.ท่าเสา	SYA01
33XFIA000056280	หม้อแปลง 1 Phase	29-004158	BC	30 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	DCC บ้านเขาโพน ม.3 ด.ท่าเสา อ.โหรโยด	SYA01
3371XF000007276	หม้อแปลง 3 Phase	29-015408	ABC	50 kVA	Dyn11 (Default)	Customer	Tap 3	ธุรกิจ	บ้านโหรโยด บ้านหุดะเคียน ด.ท่าเสา อ.โหรโยด	SYA01
33XFHA000054685	หม้อแปลง 1 Phase	33-001287	CA	20 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	หน้าวัดหาดจิว	SYA01
33XFIA000011534	หม้อแปลง 3 Phase	33-005521	ABC	500 kVA	Dyn11 (Default)	Customer	Tap 3	อุตสาหกรรม	โรงแรมหมู่บ้านแม่ป่าแคว ด.ท่าเสา โหรโยด	SYA01
3371XF000006917	หม้อแปลง 1 Phase	34-000966	AB	20 kVA	Don't Apply	Customer	Tap 3	อื่นๆ	สำนักกรมป่าไม้ ด.ท่าเสา อ.โหรโยด	SYA01
3371XF000006938	หม้อแปลง 3 Phase	34-004316	ABC	50 kVA	Dyn11 (Default)	Customer	Tap 3	ธุรกิจ	ธนาคารกรุงไทย ด.ท่าเสา อ.โหรโยด	SYA01
33XFHA000047808	หม้อแปลง 3 Phase	34-005749	ABC	100 kVA	Dyn11 (Default)	Customer	Tap 3	อื่นๆ	กองการเกษตรและสหกรณ์หน่วยทหารพัฒนา	SYA01
3371XF000006929	หม้อแปลง 1 Phase	34-009813	BC	30 kVA	Don't Apply	Customer	Tap 3	ธุรกิจ	ที่พักรถยนต์นายบุญเลิศ ด.ท่าเสา .โหรโยด	SYA01
3371XF000006942	หม้อแปลง 3 Phase	35-001199	ABC	50 kVA	Dyn11 (Default)	Customer	Tap 3	ธุรกิจ	บ้านพักพนักงานโรงแรมหมู่บ้านแม่ป่าแคว อ.โหรโยด	SYA01
33XFIA000144768	หม้อแปลง 1 Phase	35-005522	BC	30 kVA	Don't Apply	PEA	Tap 3	ที่อยู่อาศัย	บ้านเขาโพนบม ด.ท่าเสา	SYA01
3371XF000006914	หม้อแปลง 3 Phase	35-015719	ABC	50 kVA	Dyn11 (Default)	Customer	Tap 3	ธุรกิจ	สถานีโหรโยดขนาดเขารังเขมร ด.ท่าเสา โหรโยด	SYA01

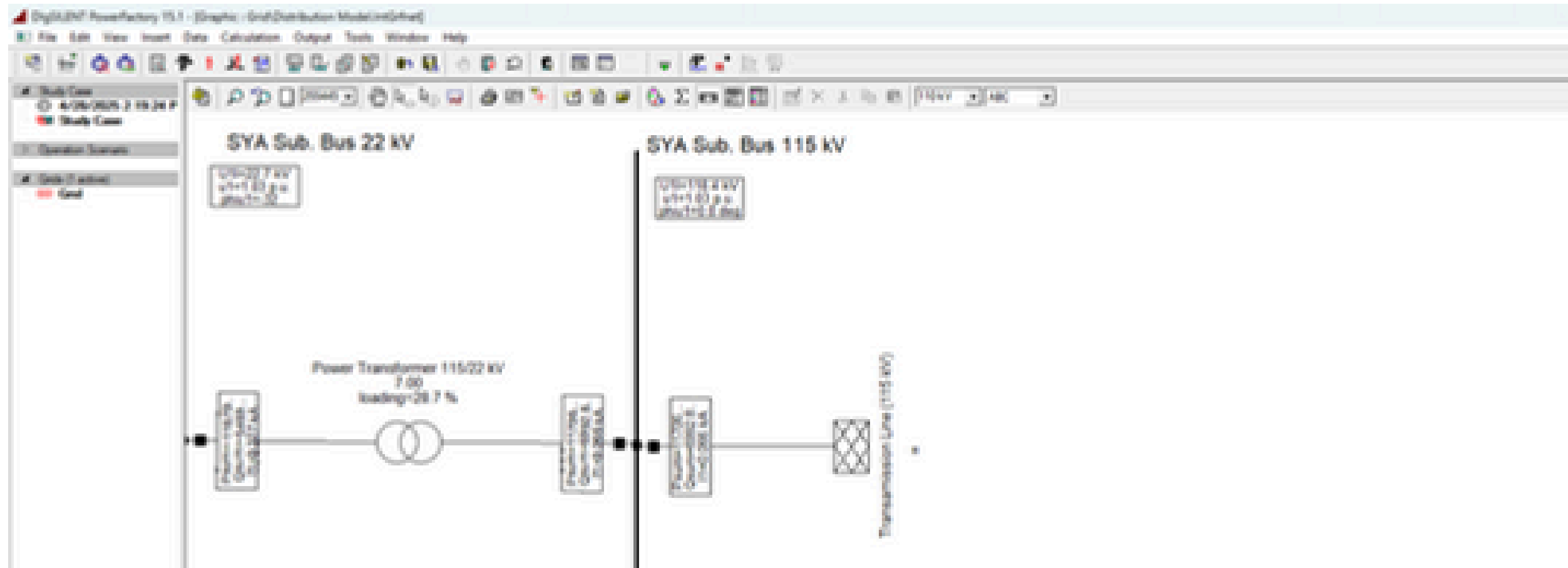
Total number of transformers  
in the area Sai Yok Power Station:

**945 units**

# Basic information (Peak – Light Load, Period : Year)

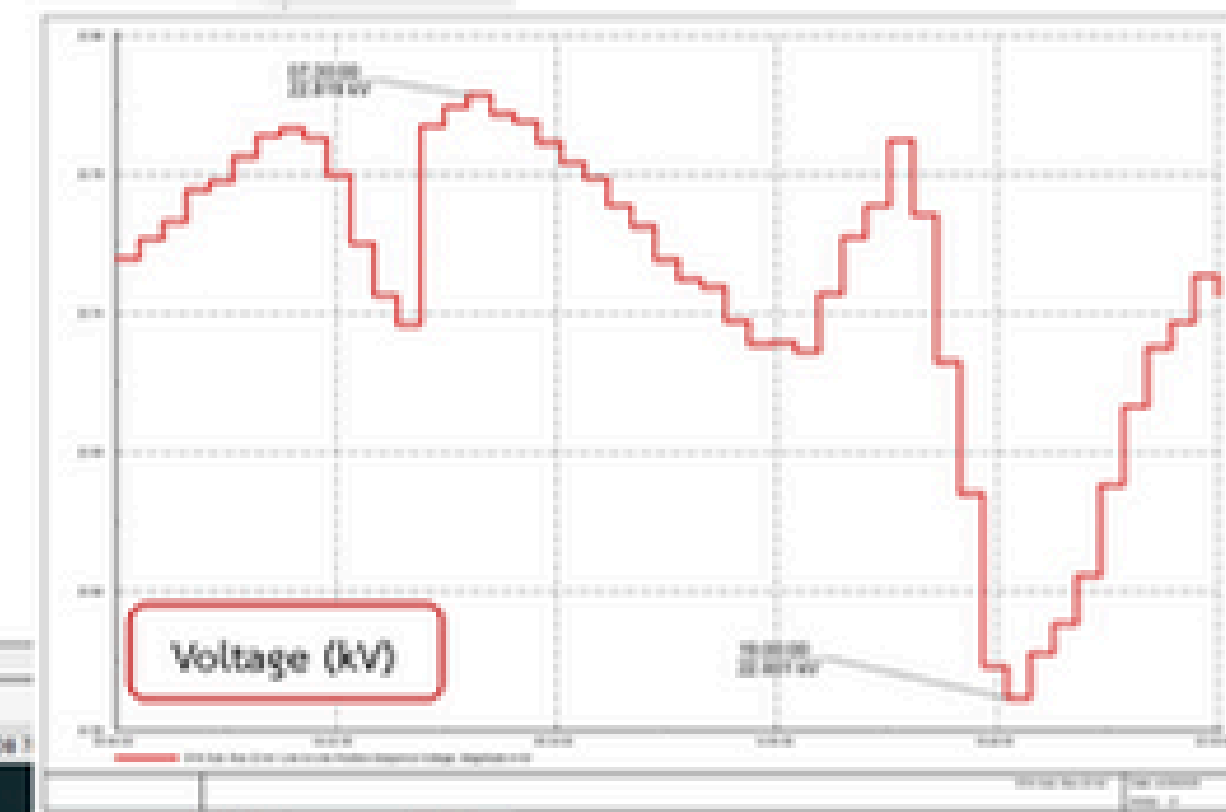


# Simulation with Power factory

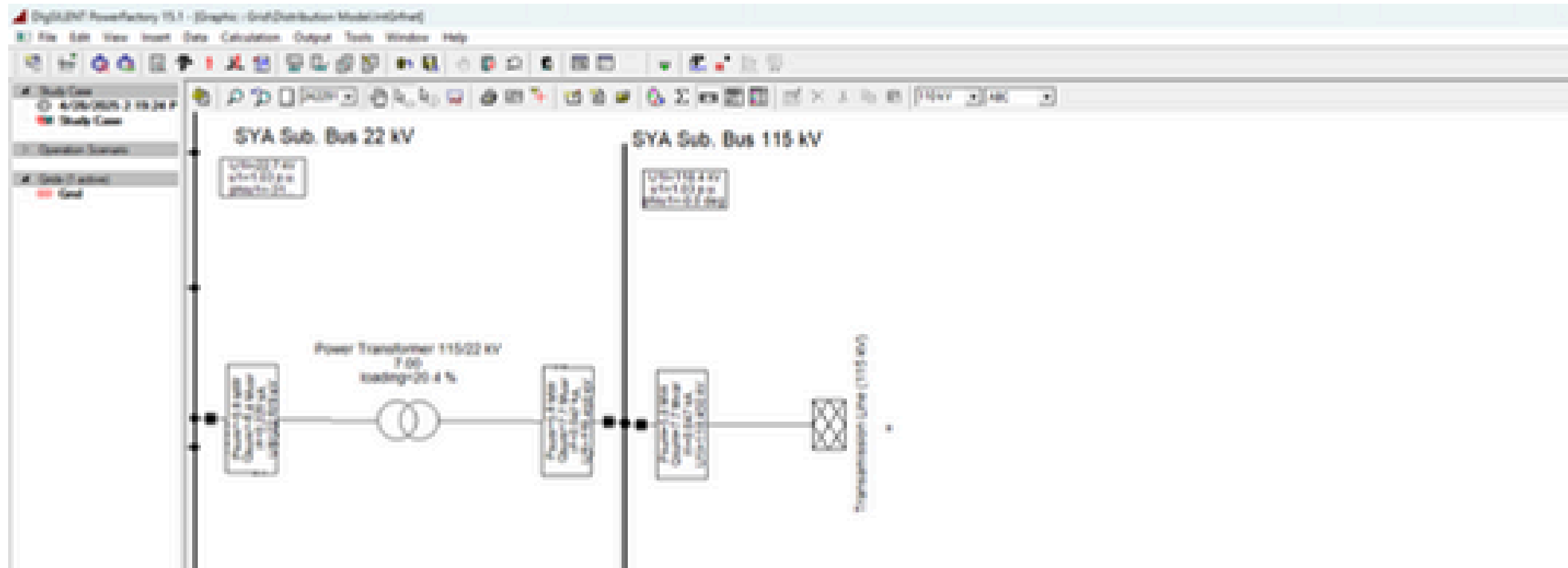


## Simulation Conditions

- Consideration of Peak Load and Light Load
- Voltage at Bus 22 kV is considered at each node in simulation
- High Voltage Side: 118.4 kV is constant
- Voltage Setpoint at Bus 22.40 kV (Secondary Side of Power Transformer)
- Very Small Power Producers (VSPP) **are not connected** in parallel to the grid.

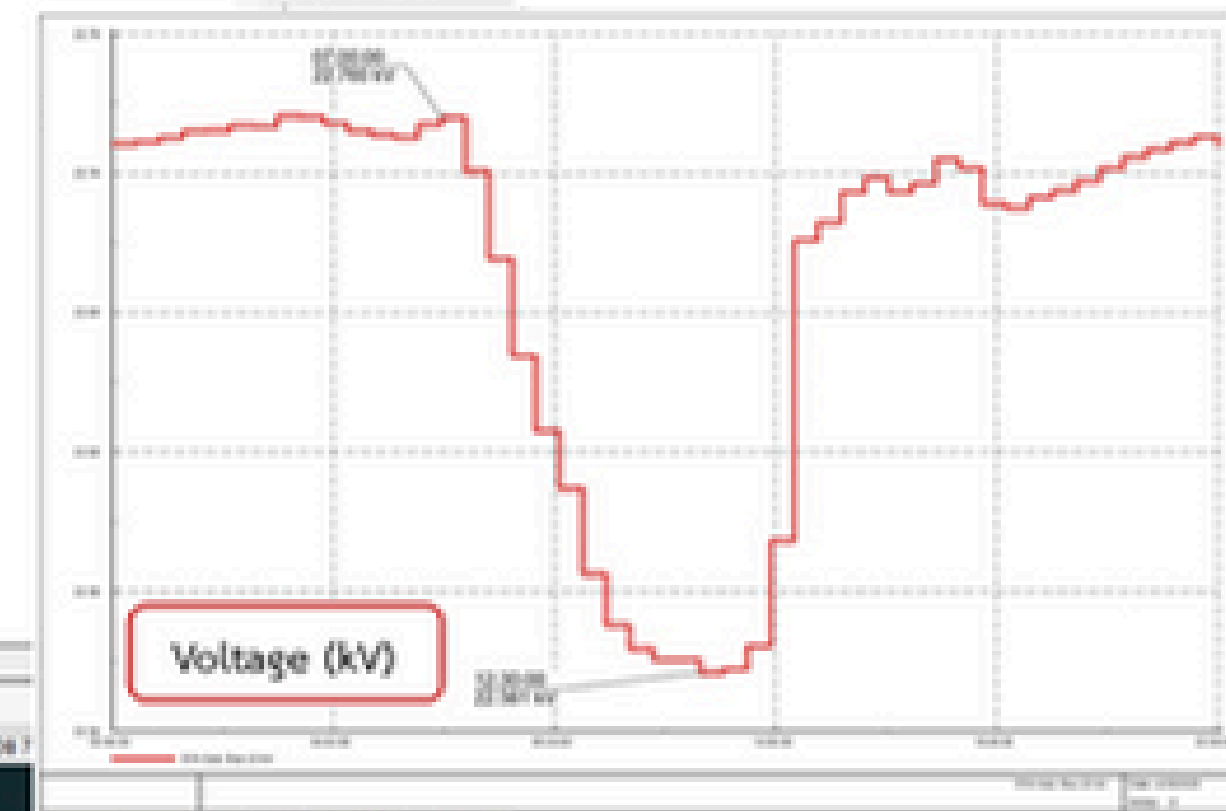
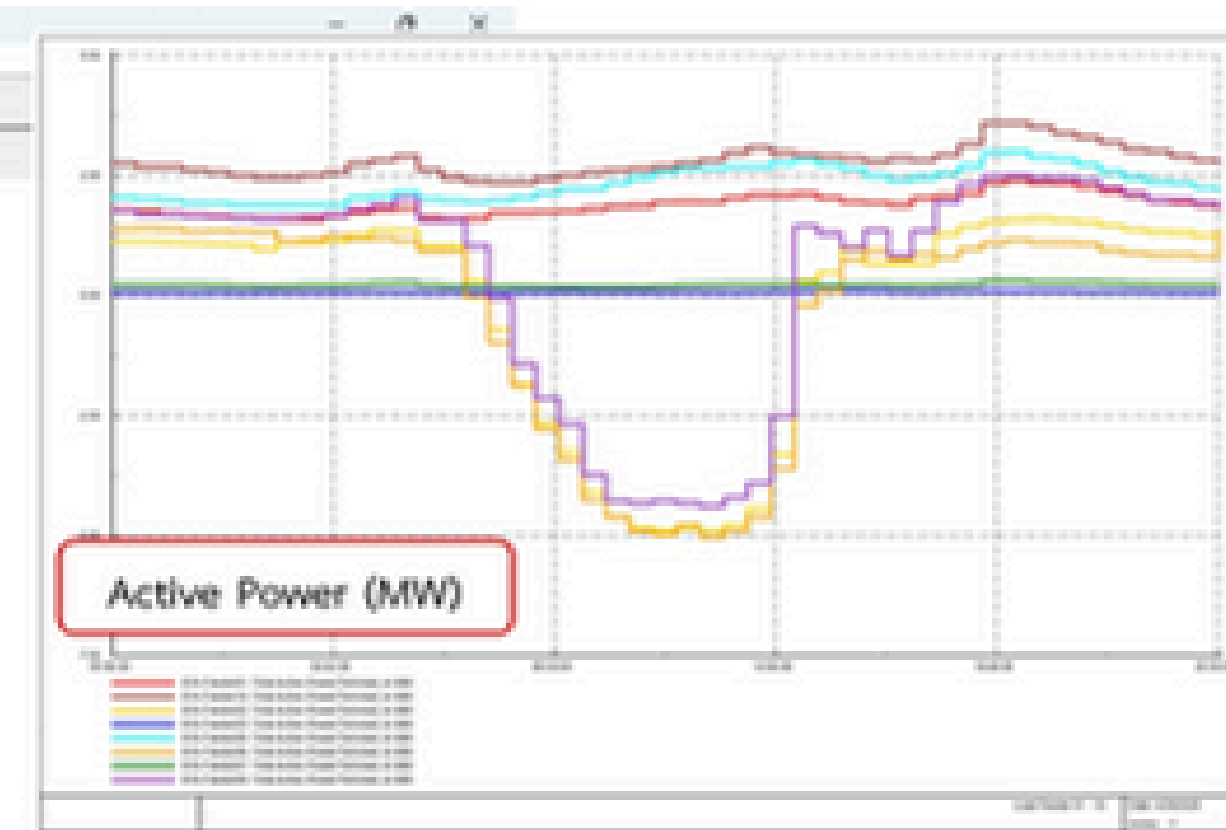


# Simulation with Power factory



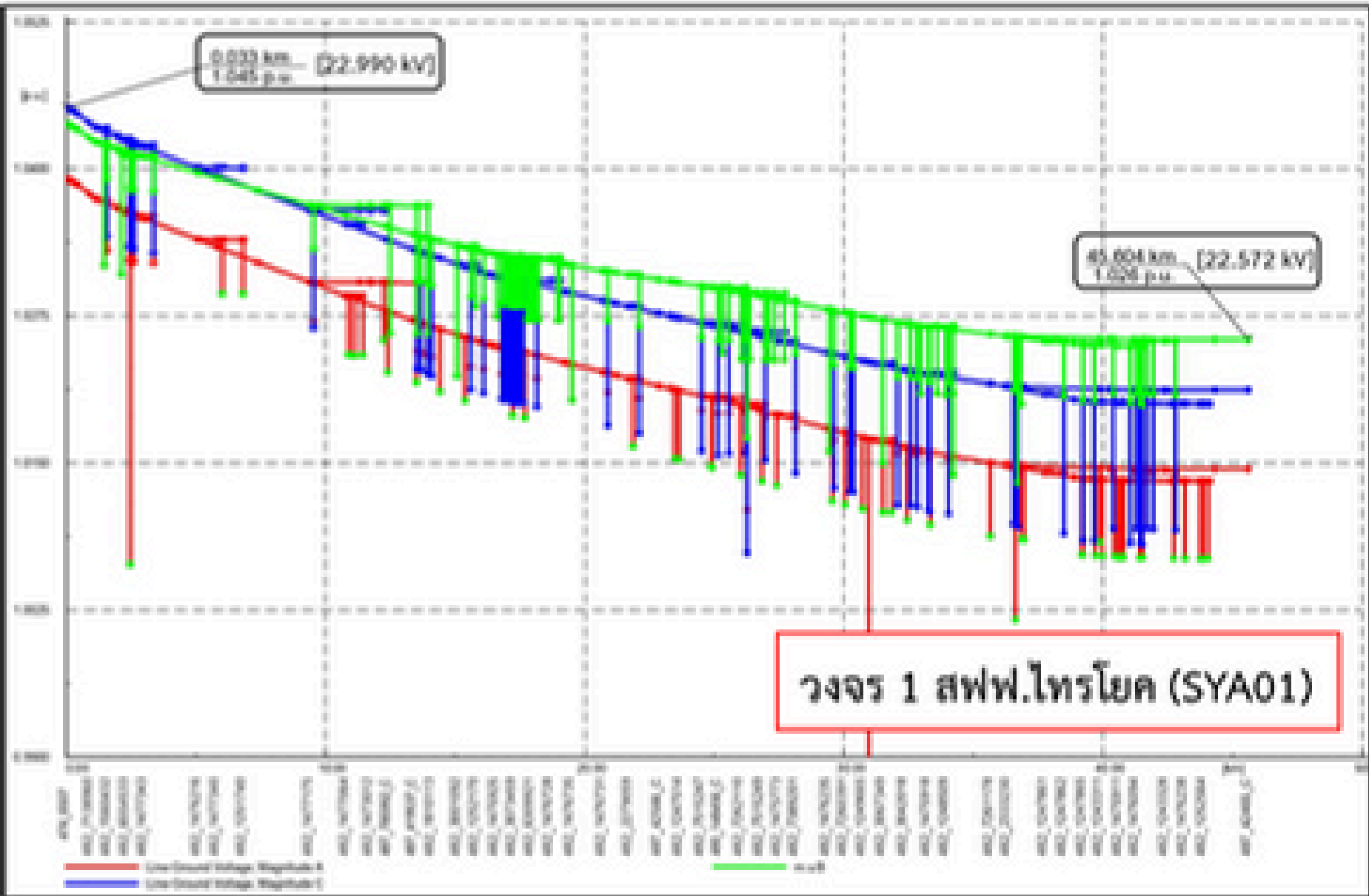
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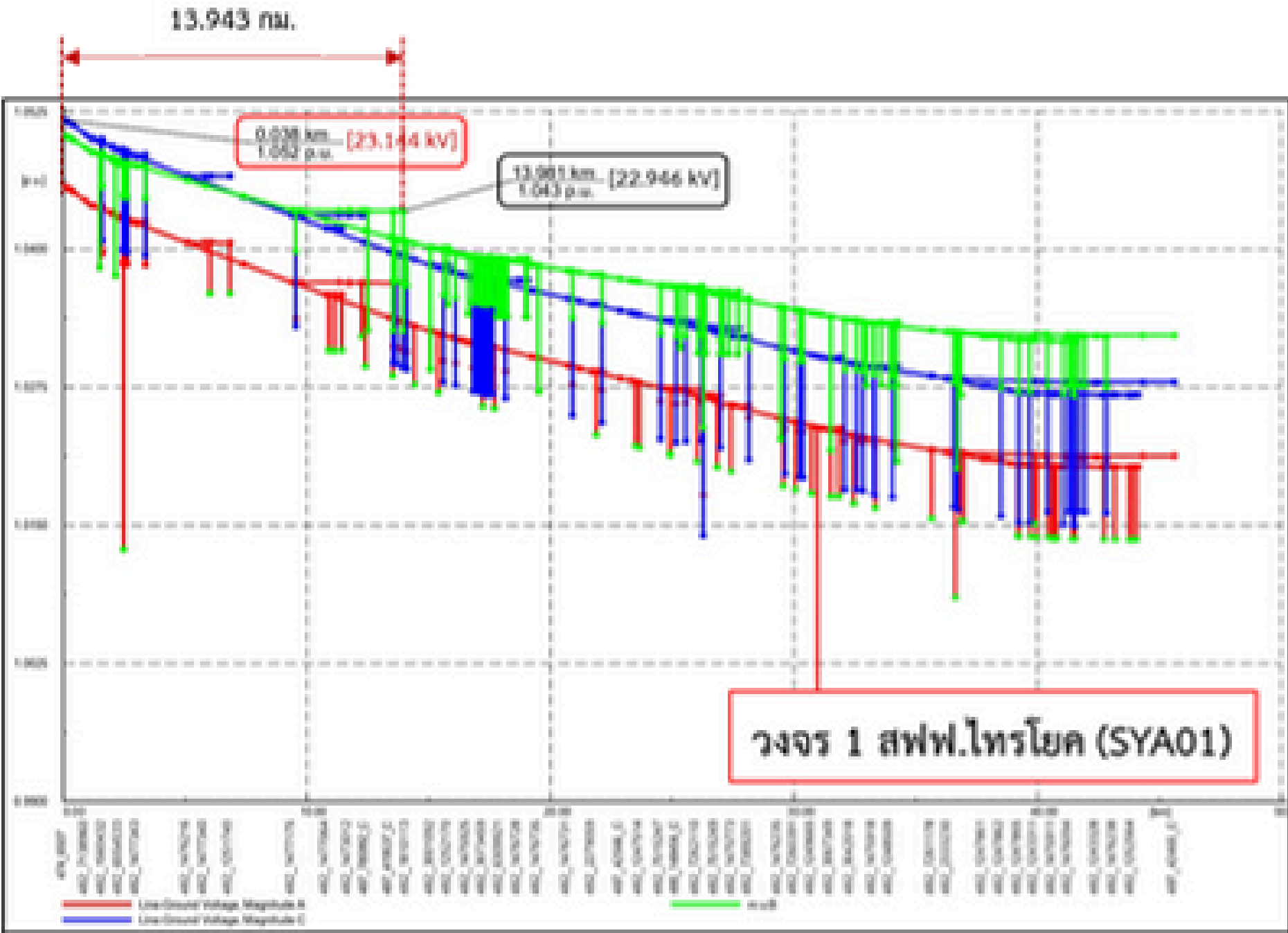


Feeder01 Sai Yok Substation

Result of Simulation with Power factory



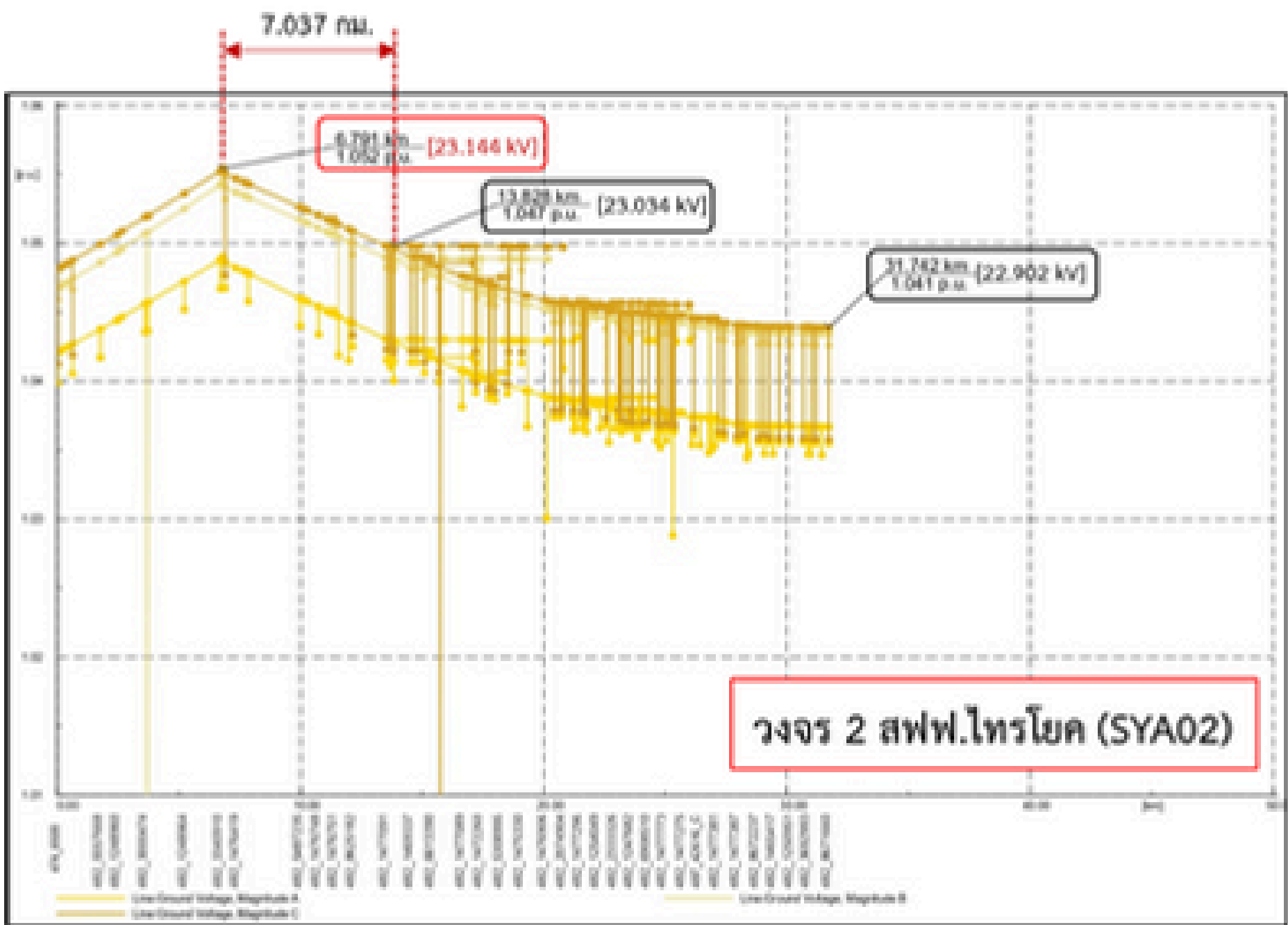
At 22.90 kV, the power transformer is not affected in terms of voltage.



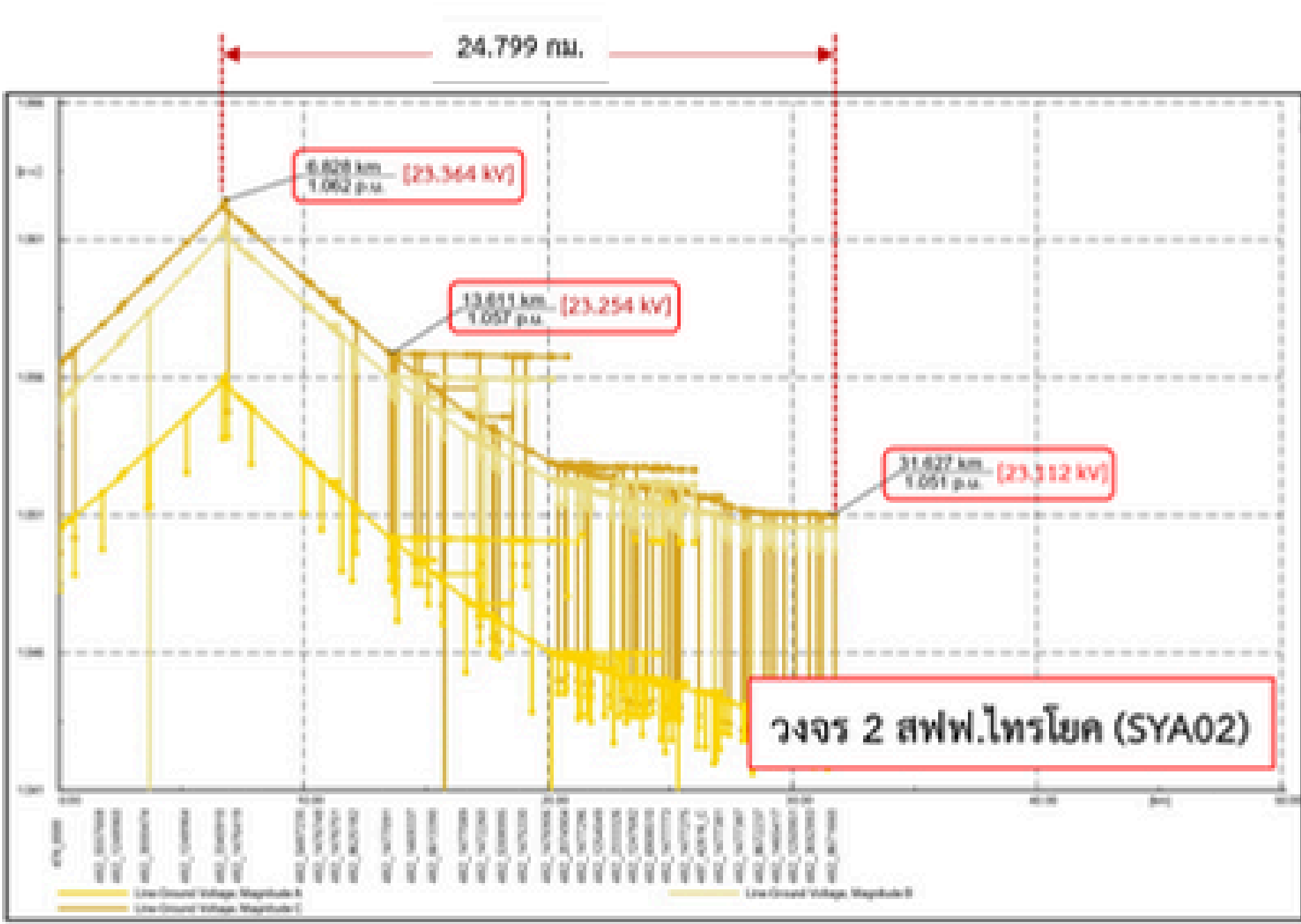
The 23.10 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 13.943 km from the Very Small Power Producer (VSPP)

Feeder02 Sai Yok Substation

Result of Simulation with Power factory



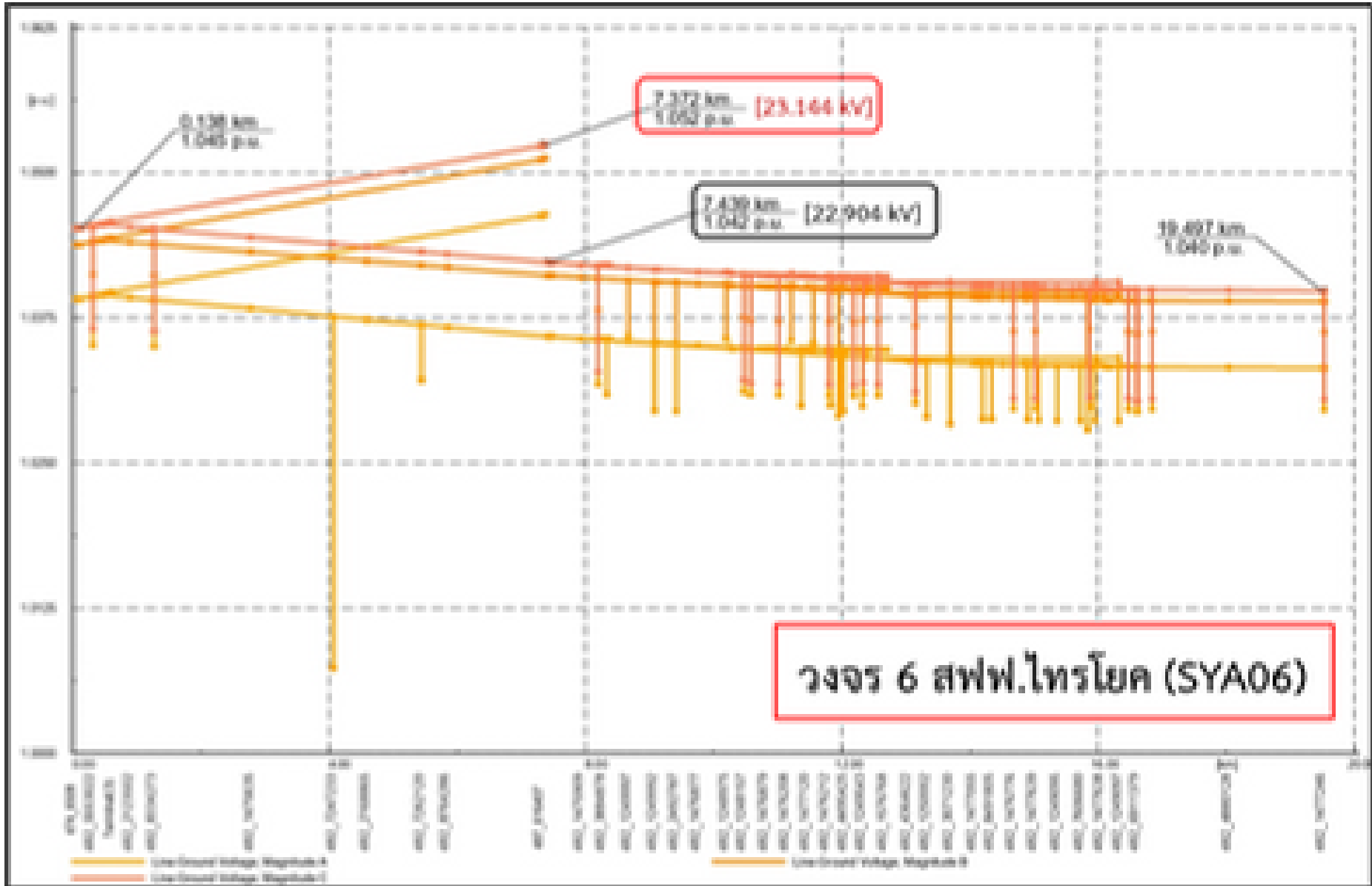
The 22.90 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 7.037 km from the Very Small Power Producer (VSPP)



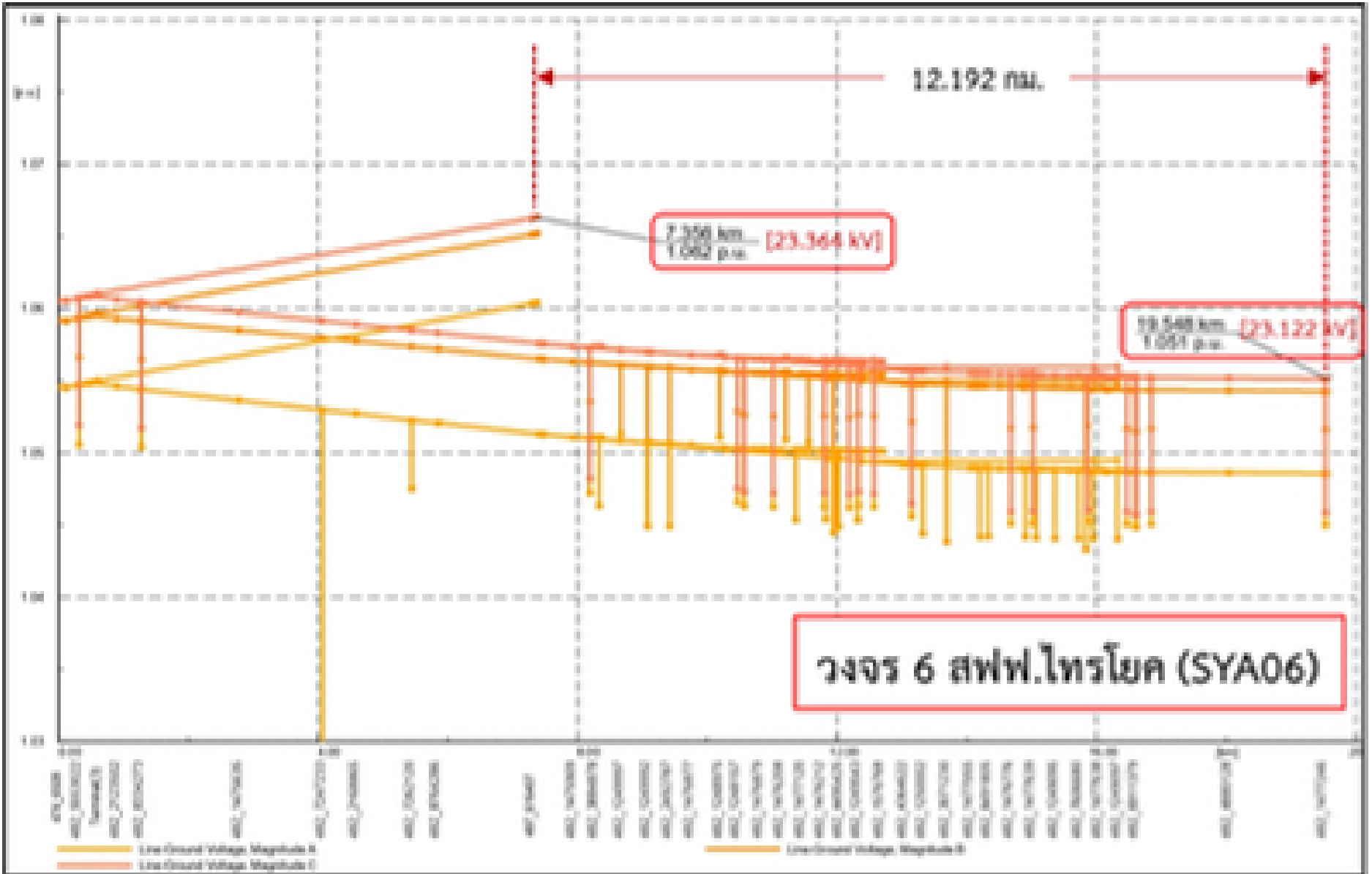
The 23.10 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 24.799 km from the Very Small Power Producer (VSPP)

Feeder06 Sai Yok Substation

Result of Simulation with Power factory



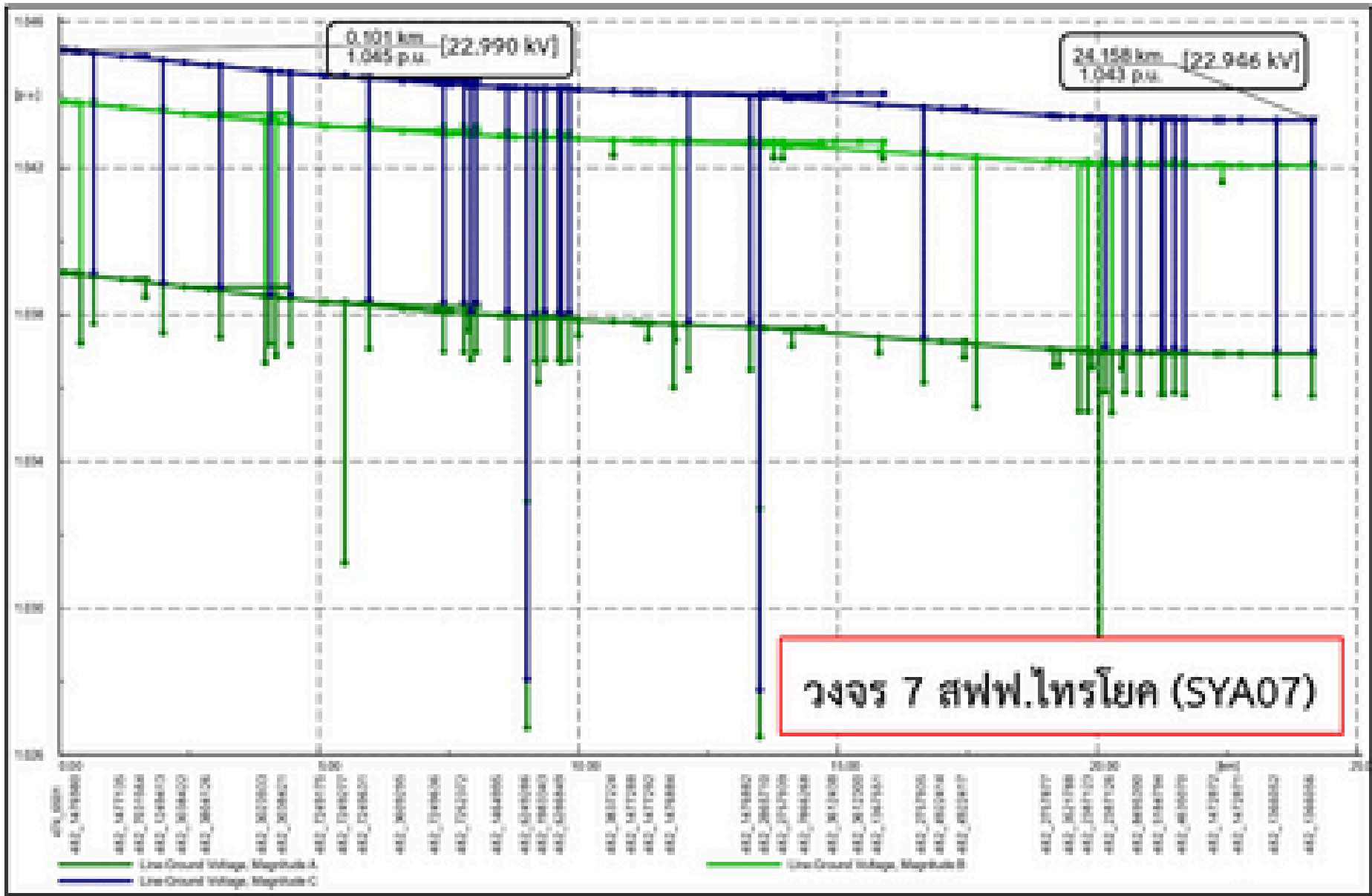
The 22.90 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 0.067 km from the Very Small Power Producer (VSPP)



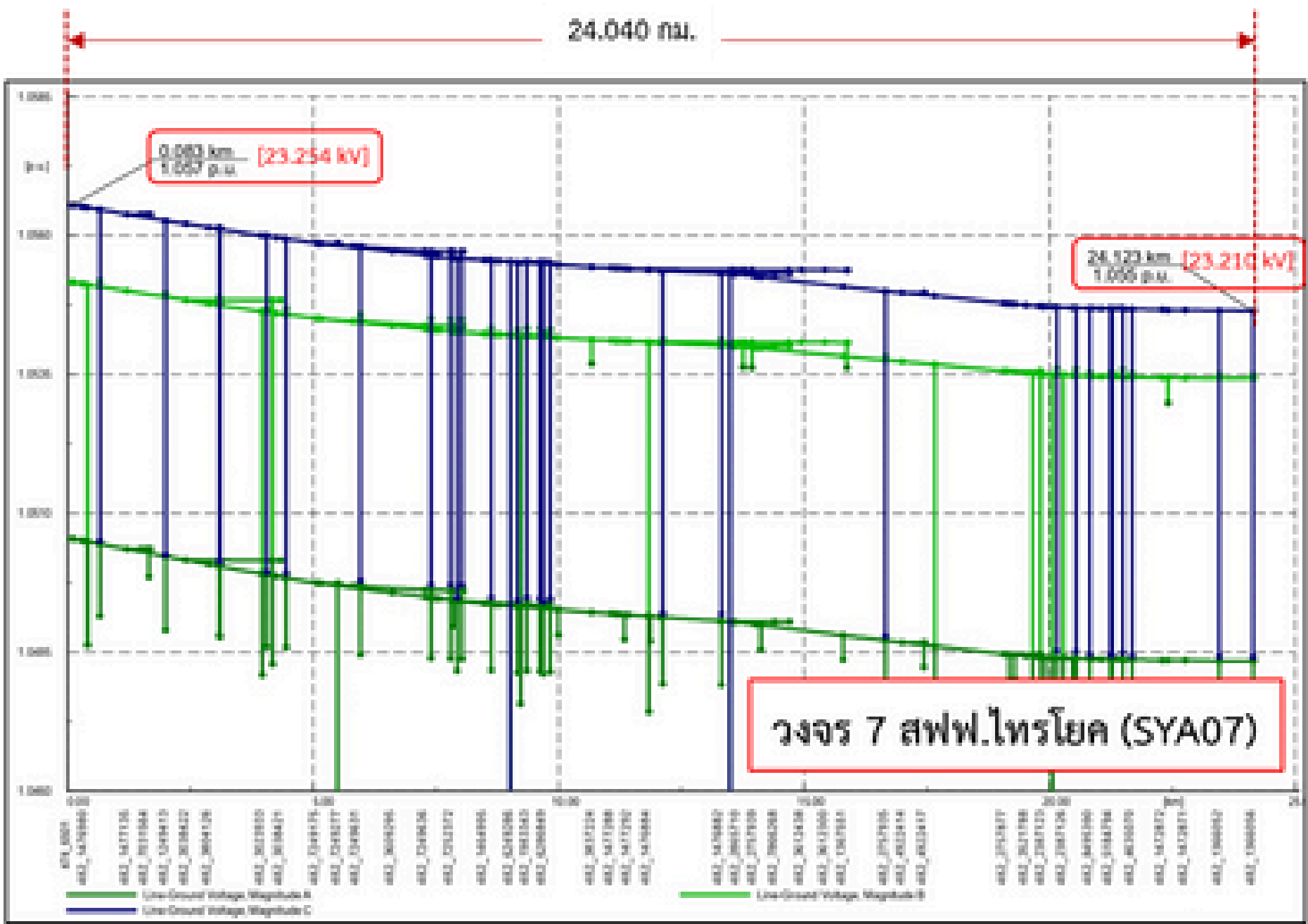
The 23.10 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 12.192 km from the Very Small Power Producer (VSPP)

Feeder07 Sai Yok Substation

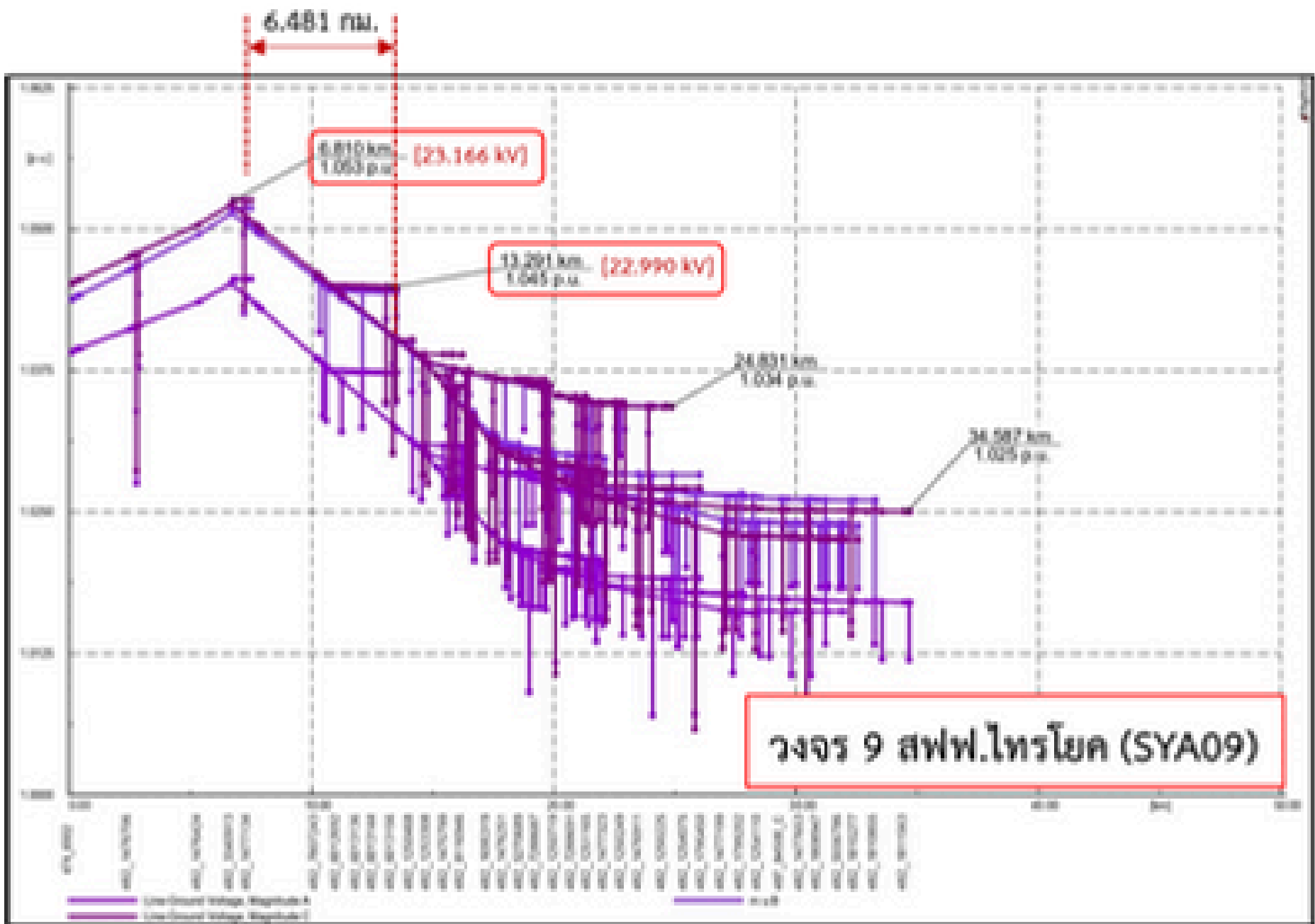
Result of Simulation with Power factory



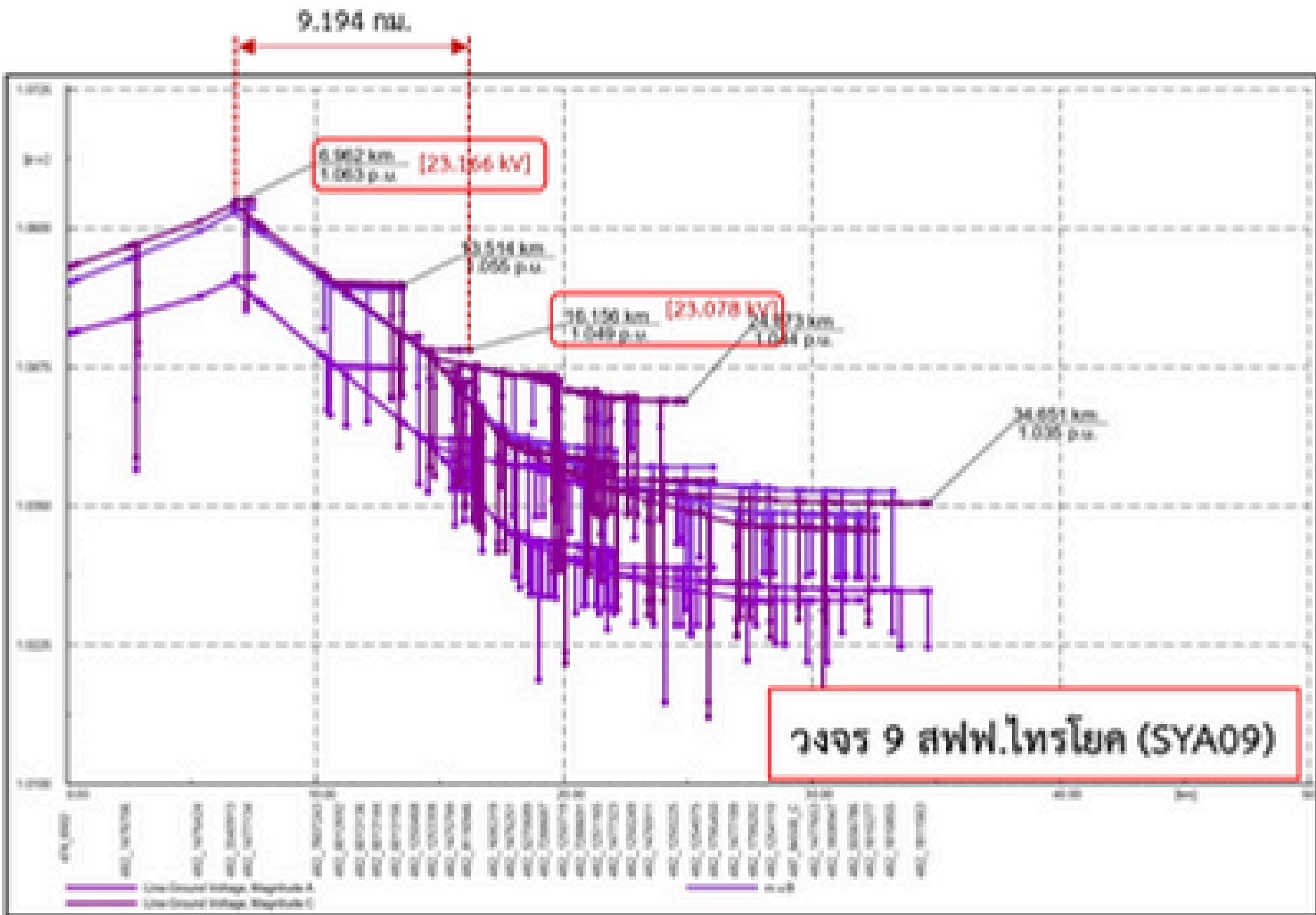
At 22.90 kV, the power transformer is not affected in terms of voltage.



The 23.10 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 24.040 km from the Very Small Power Producer (VSPP)



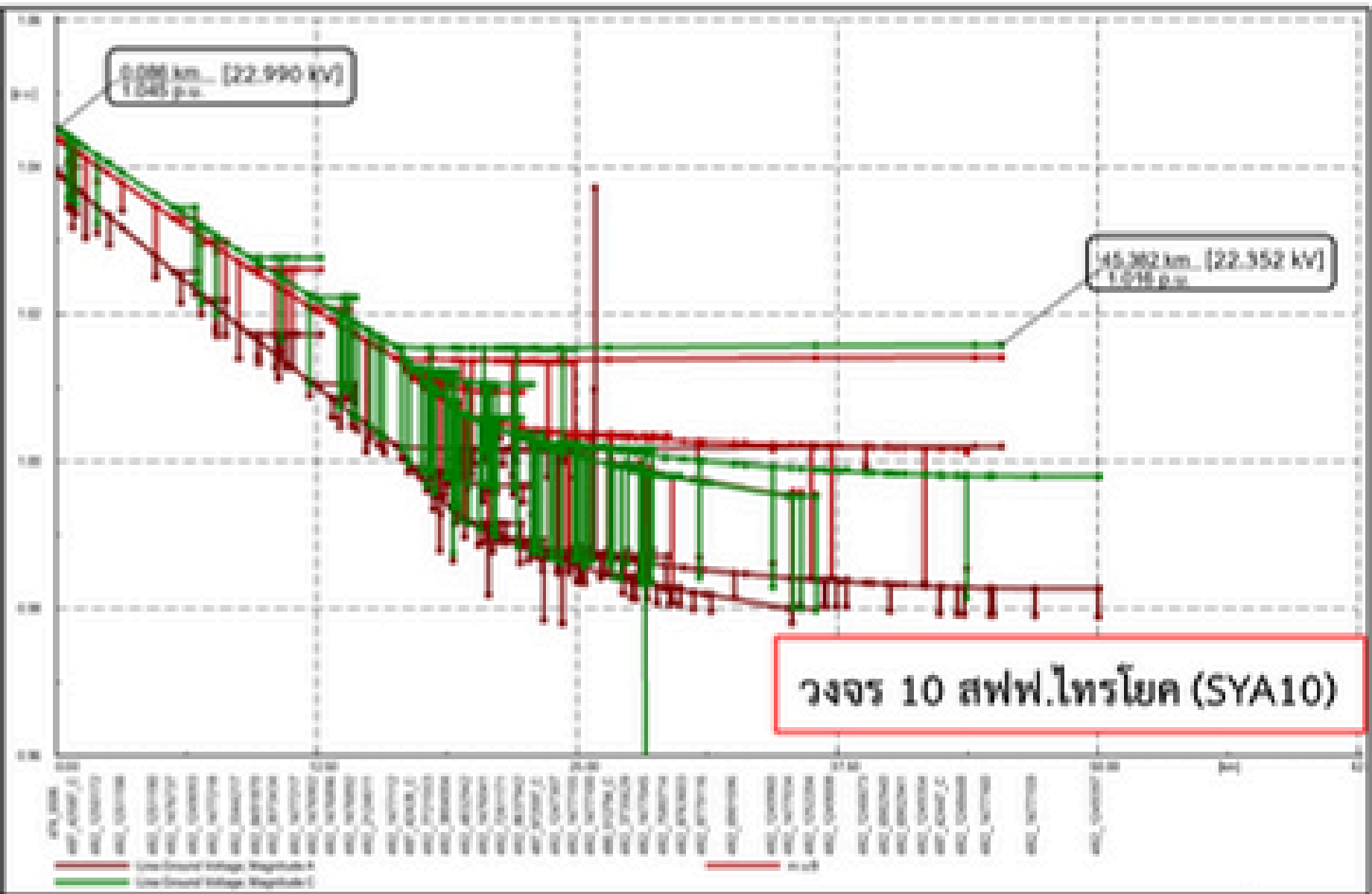
The 22.90 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 6.481 km from the Very Small Power Producer (VSPP)



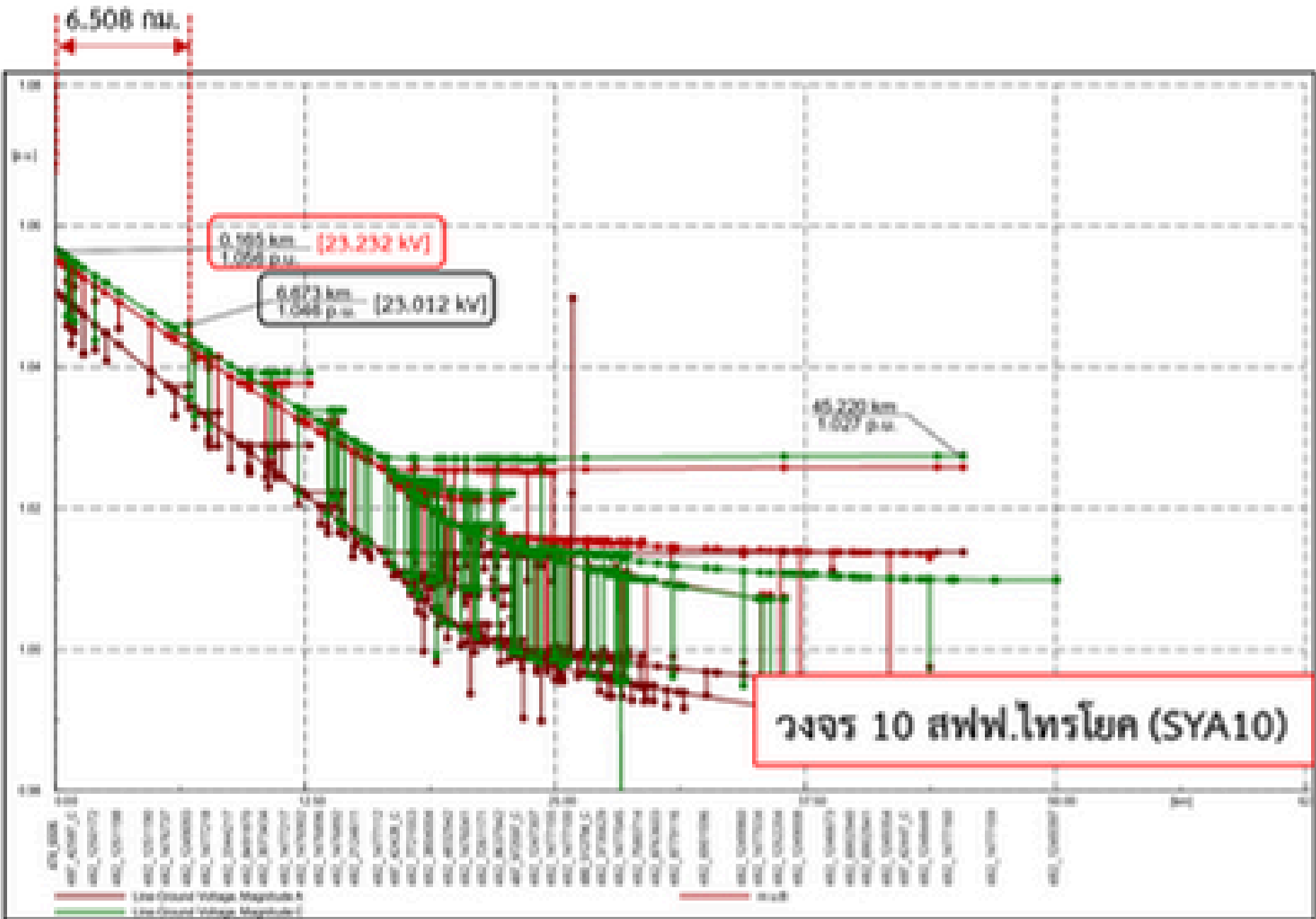
The 23.10 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 9.194 km from the Very Small Power Producer (VSPP)

Feeder10 Sai Yok Substation

Result of Simulation with Power factory



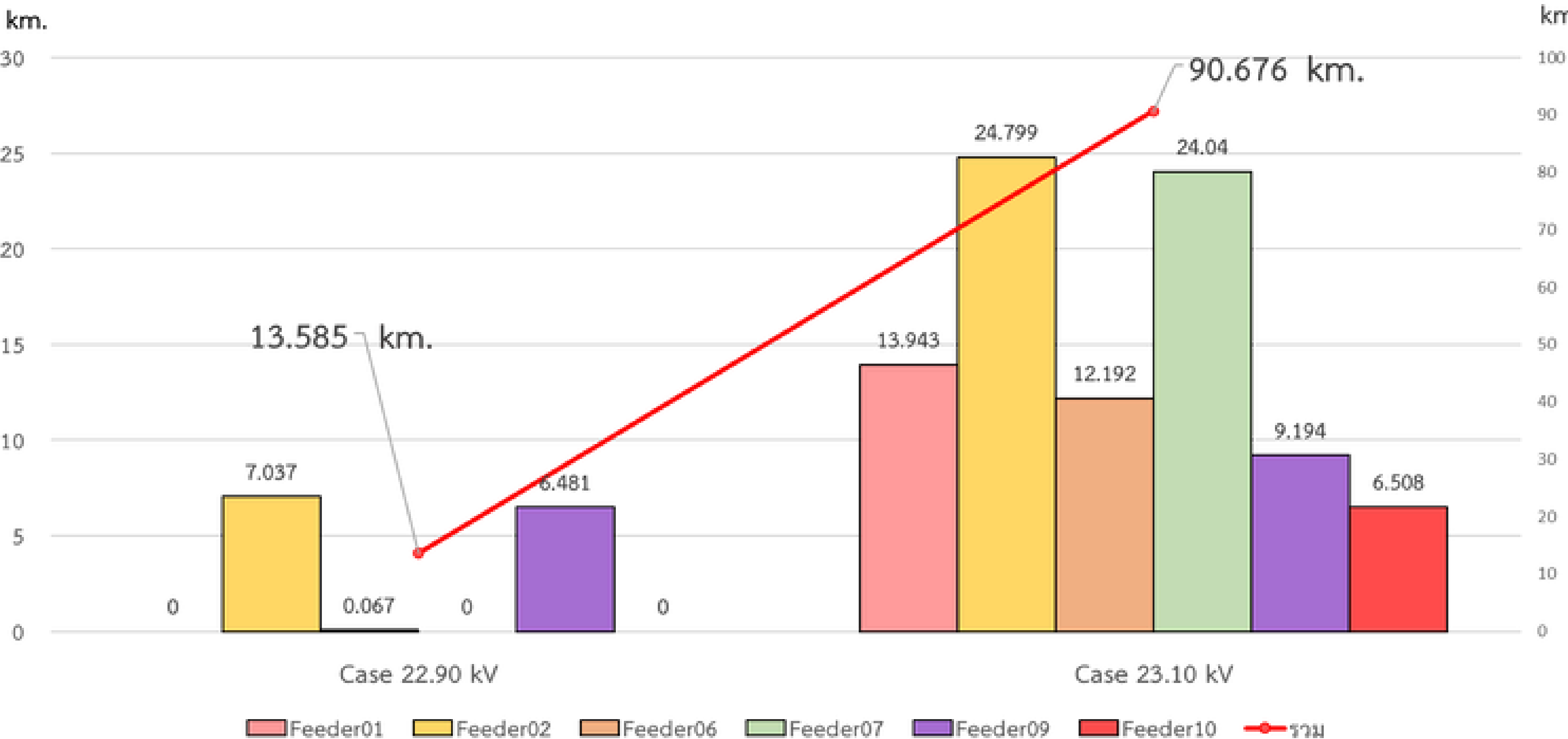
At 22.90 kV, the power transformer is not affected in terms of voltage.



The 23.10 kV voltage level of the transformer is affected by the voltage conditions, with a distance of approximately 6.508 km from the Very Small Power Producer (VSPP)

# Voltage Profile Feeder 1 - 10 and Total Distance

## Result of Simulation with Power factory



Technical Losses /Year  
(kW-hr)/Year

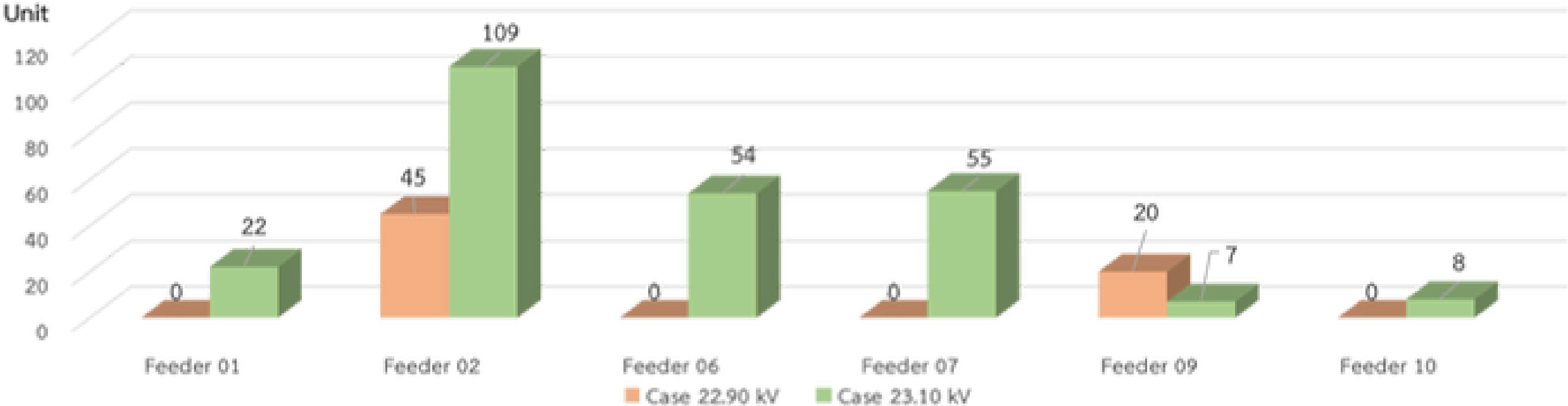
Result of Simulation with Power factor

Technical Losses /Year (kW-hr)/Year

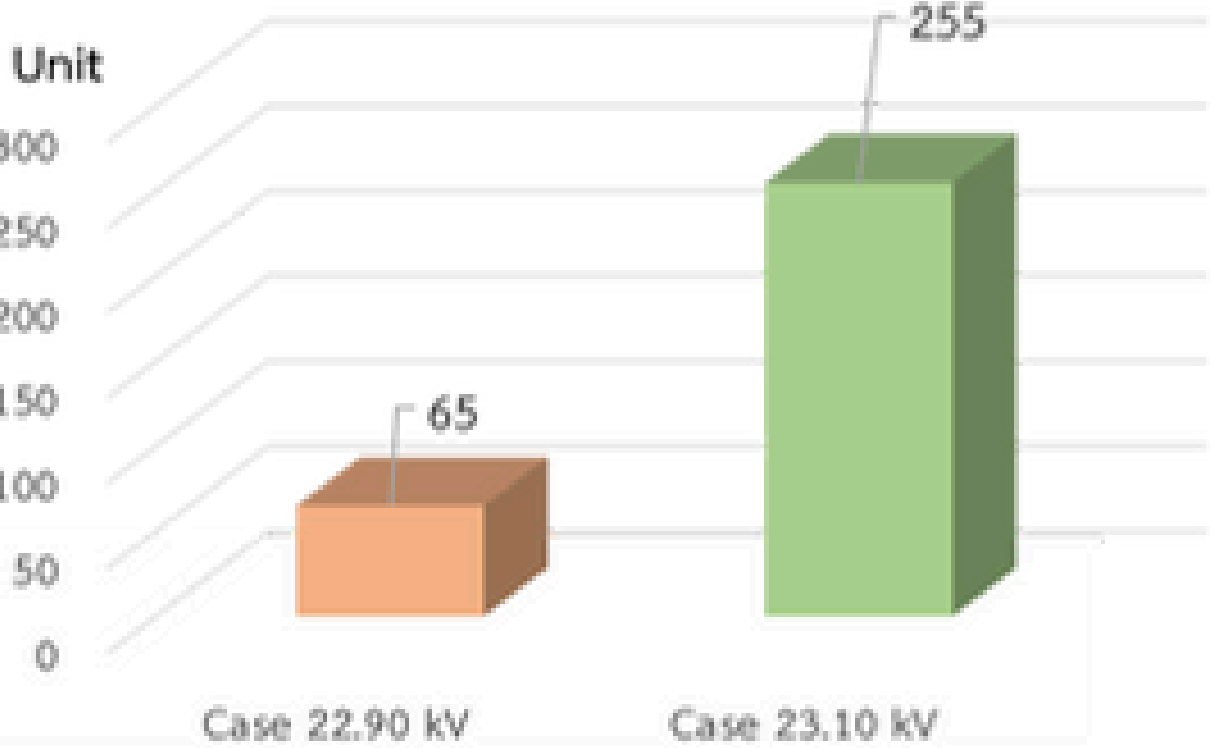
Power	Peak Load (kW)	APF Load (kW)	Load Factor	Loss Factor	Peak Loss (kW)	APF Loss (kW)	Loss Peak Rate (kW)	Loss Off Peak Rate (kW)	Wattage (kW)	Watt Peak Rate (kW)	Watt Off Peak Rate (kW)	Cost of Energy Loss (Bath)
22.40	1.780	0.760	0.427	0.427	66.667	27.434	76.511	40.719	40.719	343.586	166.868	479.776
22.70	1.875	0.772	0.412	0.412	68.562	28.477	78.544	41.729	41.729	354.400	172.200	493.790
22.90	1.940	0.800	0.412	0.412	70.526	29.574	80.540	42.739	42.739	365.214	177.514	507.804
23.10	2.000	0.830	0.415	0.415	72.500	30.688	83.612	43.750	43.750	376.028	182.828	521.818
23.30	2.050	0.860	0.419	0.419	74.574	31.800	86.688	44.761	44.761	386.842	188.142	535.832
23.50	2.100	0.890	0.424	0.424	76.648	32.912	89.760	45.771	45.771	397.656	193.456	549.846
23.70	2.150	0.920	0.428	0.428	78.722	34.024	92.832	46.782	46.782	408.470	198.770	563.860
23.90	2.200	0.950	0.432	0.432	80.796	35.136	95.904	47.793	47.793	419.284	204.084	577.874
24.10	2.250	0.980	0.436	0.436	82.870	36.248	98.976	48.804	48.804	430.098	209.398	591.888
24.30	2.300	1.010	0.440	0.440	84.944	37.360	102.048	49.815	49.815	440.912	214.712	605.902
24.50	2.350	1.040	0.444	0.444	87.018	38.472	105.120	50.826	50.826	451.726	220.026	619.916
24.70	2.400	1.070	0.448	0.448	89.092	39.584	108.192	51.837	51.837	462.540	225.340	633.930
24.90	2.450	1.100	0.452	0.452	91.166	40.696	111.264	52.848	52.848	473.354	230.654	647.944
25.10	2.500	1.130	0.456	0.456	93.240	41.808	114.336	53.859	53.859	484.168	235.968	661.958
25.30	2.550	1.160	0.460	0.460	95.314	42.920	117.408	54.870	54.870	494.982	241.282	675.972
25.50	2.600	1.190	0.464	0.464	97.388	44.032	120.480	55.881	55.881	505.796	246.596	689.986
25.70	2.650	1.220	0.468	0.468	99.462	45.144	123.552	56.892	56.892	516.610	251.910	703.999
25.90	2.700	1.250	0.472	0.472	101.536	46.256	126.624	57.903	57.903	527.424	257.224	718.013
26.10	2.750	1.280	0.476	0.476	103.610	47.368	129.696	58.914	58.914	538.238	262.538	732.027
26.30	2.800	1.310	0.480	0.480	105.684	48.480	132.768	59.925	59.925	549.052	267.852	746.041
26.50	2.850	1.340	0.484	0.484	107.758	49.592	135.840	60.936	60.936	559.866	273.166	760.055
26.70	2.900	1.370	0.488	0.488	109.832	50.704	138.912	61.947	61.947	570.680	278.480	774.069
26.90	2.950	1.400	0.492	0.492	111.906	51.816	141.984	62.958	62.958	581.494	283.794	788.083
27.10	3.000	1.430	0.496	0.496	113.980	52.928	145.056	63.969	63.969	592.308	289.108	802.097
27.30	3.050	1.460	0.500	0.500	116.054	54.040	148.128	64.980	64.980	603.122	294.422	816.111
27.50	3.100	1.490	0.504	0.504	118.128	55.152	151.200	65.991	65.991	613.936	299.736	830.125
27.70	3.150	1.520	0.508	0.508	120.202	56.264	154.272	67.002	67.002	624.750	305.050	844.139
27.90	3.200	1.550	0.512	0.512	122.276	57.376	157.344	68.013	68.013	635.564	310.364	858.153
28.10	3.250	1.580	0.516	0.516	124.350	58.488	160.416	69.024	69.024	646.378	315.678	872.167
28.30	3.300	1.610	0.520	0.520	126.424	59.600	163.488	70.035	70.035	657.192	320.992	886.181
28.50	3.350	1.640	0.524	0.524	128.498	60.712	166.560	71.046	71.046	668.006	326.306	900.195
28.70	3.400	1.670	0.528	0.528	130.572	61.824	169.632	72.057	72.057	678.820	331.620	914.209
28.90	3.450	1.700	0.532	0.532	132.646	62.936	172.704	73.068	73.068	689.634	336.934	928.223
29.10	3.500	1.730	0.536	0.536	134.720	64.048	175.776	74.079	74.079	700.448	342.248	942.237
29.30	3.550	1.760	0.540	0.540	136.794	65.160	178.848	75.090	75.090	711.262	347.562	956.251
29.50	3.600	1.790	0.544	0.544	138.868	66.272	181.920	76.101	76.101	722.076	352.876	970.265
29.70	3.650	1.820	0.548	0.548	140.942	67.384	184.992	77.112	77.112	732.890	358.190	984.279
29.90	3.700	1.850	0.552	0.552	143.016	68.496	188.064	78.123	78.123	743.704	363.504	998.293
30.10	3.750	1.880	0.556	0.556	145.090	69.608	191.136	79.134	79.134	754.518	368.818	1012.307
30.30	3.800	1.910	0.560	0.560	147.164	70.720	194.208	80.145	80.145	765.332	374.132	1026.321
30.50	3.850	1.940	0.564	0.564	149.238	71.832	197.280	81.156	81.156	776.146	379.446	1040.335
30.70	3.900	1.970	0.568	0.568	151.312	72.944	200.352	82.167	82.167	786.960	384.760	1054.349
30.90	3.950	2.000	0.572	0.572	153.386	74.056	203.424	83.178	83.178	797.774	390.074	1068.363
31.10	4.000	2.030	0.576	0.576	155.460	75.168	206.496	84.189	84.189	808.588	395.388	1082.377
31.30	4.050	2.060	0.580	0.580	157.534	76.280	209.568	85.200	85.200	819.402	400.702	1096.391
31.50	4.100	2.090	0.584	0.584	159.608	77.392	212.640	86.211	86.211	830.216	406.016	1110.405
31.70	4.150	2.120	0.588	0.588	161.682	78.504	215.712	87.222	87.222	841.030	411.330	1124.419
31.90	4.200	2.150	0.592	0.592	163.756	79.616	218.784	88.233	88.233	851.844	416.644	1138.433
32.10	4.250	2.180	0.596	0.596	165.830	80.728	221.856	89.244	89.244	862.658	421.958	1152.447
32.30	4.300	2.210	0.600	0.600	167.904	81.840	224.928	90.255	90.255	873.472	427.272	1166.461
32.50	4.350	2.240	0.604	0.604	169.978	82.952	228.000	91.266	91.266	884.286	432.586	1180.475
32.70	4.400	2.270	0.608	0.608	172.052	84.064	231.072	92.277	92.277	895.100	437.900	1194.489
32.90	4.450	2.300	0.612	0.612	174.126	85.176	234.144	93.288	93.288	905.914	443.214	1208.503
33.10	4.500	2.330	0.616	0.616	176.200	86.288	237.216	94.299	94.299	916.728	448.528	1222.517
33.30	4.550	2.360	0.620	0.620	178.274	87.400	240.288	95.310	95.310	927.542	453.842	1236.531
33.50	4.600	2.390	0.624	0.624	180.348	88.512	243.360	96.321	96.321	938.356	459.156	1250.545
33.70	4.650	2.420	0.628	0.628	182.422	89.624	246.432	97.332	97.332	949.170	464.470	1264.559
33.90	4.700	2.450	0.632	0.632	184.496	90.736	249.504	98.343	98.343	959.984	469.784	1278.573
34.10	4.750	2.480	0.636	0.636	186.570	91.848	252.576	99.354	99.354	970.798	475.098	1292.587
34.30	4.800	2.510	0.640	0.640	188.644	92.960	255.648	100.365	100.365	981.612	480.412	1306.601
34.50	4.850	2.540	0.644	0.644	190.718	94.072	258.720	101.376	101.376	992.426	485.726	1320.615
34.70	4.900	2.570	0.648	0.648	192.792	95.184	261.792	102.387	102.387	1003.240	491.040	1334.629
34.90	4.950	2.600	0.652	0.652	194.866	96.296	264.864	103.398	103.398	1014.054	496.354	1348.643
35.10	5.000	2.630	0.656	0.656	196.940	97.408	267.936	104.409	104.409	1024.868	501.668	1362.657
35.30	5.050	2.660	0.660	0.660	199.014	98.520	271.008	105.420	105.420	1035.682	506.982	1376.671
35.50	5.100	2.690	0.664	0.664	201.088	99.632	274.080	106.431	106.431	1046.496	512.296	1390.685
35.70	5.150	2.720	0.668	0.668	203.162	100.744	277.152	107.442	107.442	1057.310	517.610	1404.699
35.90	5.200	2.750	0.672	0.672	205.236	101.856	280.224	108.453	108.453	1068.124	522.924	1418.713
36.10	5.250	2.780	0.676	0.676	207.310	102.968	283.296	109.464	109.464	1078.938	528.238	1432.727
36.30	5.300	2.810	0.680	0.680	209.384	104.080	286.368	110.475	110.475	1089.752	533.552	1446.741
36.50	5.350	2.840	0.684	0.684	211.458	105.192	289.440	111.486	111.486	1100.566	538.866	1460.755
36.70	5.400	2.870	0.688	0.688	213.532	106.304	292.512	112.497	112.497	1111.380	544.180	1474.769
36.90	5.450	2.900	0.692	0.692	215.606	107.416	295.584	113.508	113.508	1122.194	549.494	1488.783
37.10	5.500	2.930	0.696	0.696	217.680	108.528	298.656	114.519	114.519	1133.008	554.808	1502.797
37.30	5.550	2.960	0.700	0.700	219.754	109.640	301.728	115.530	115.530	1143.822	560.122	1516.811
37.50	5.600	2.990	0.704	0.704	221.828	110.752	304.800	116.541	116.541	1154.636	565.436	1530.825
37.70	5.650	3.020	0.708	0.708	223.902	111.864	307.872	117.552	117.552	1165.450	570.750	1544.839
37.90	5.700	3.050	0.712	0.712	225.976	112.976	310.944	118.563	118.563	1176.264	576.064	1558.853
38.10	5.750	3.080	0.716	0.716	228.050	114.088	314.016	119.574	119.574	1187.078	581.378	1572.867
38.30	5.800	3.110	0.720	0.720	230.124	115.200	317.088	120.585	120.585	1197.892	586.692	1586.881
38.50	5.850	3.140	0.724	0.724	232.198	116.312	320.160	121.596	121.596	1208.706	592.006	1600.895
38.70	5.900	3.170	0.728	0.728	234.272	117.424	323.232	122.607	122.607	1219.520		

# Number of Transformers That Require Tap Adjustment

## Result of Simulation with Power factory

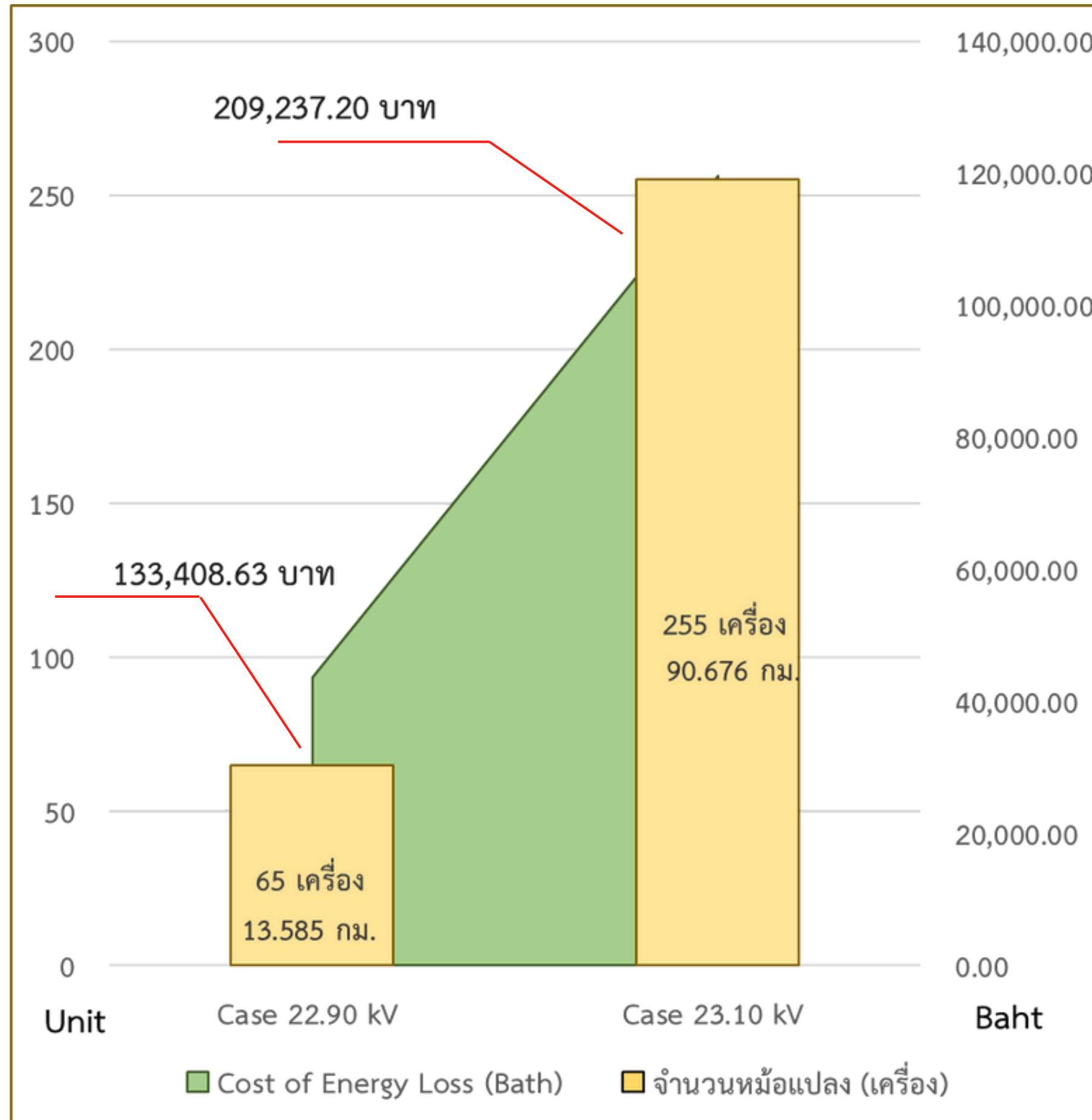


	Case 1 22.90 kV	Case 1 22.90 kV	Case 1 23.10 kV	Case 2 22.90 kV	Case 2 22.90 kV	Case 2 23.10 kV	Case 3 22.90 kV	Case 3 22.90 kV	Case 3 23.10 kV	Match Data For Foreign Key	
xtans_040719	0.993482	1.024491	1.040910	1.026445	1.041452	1.054153	1.047947	1.053454	1.071749	54-007714	xtans_040719
xtans_040719	0.9925014	1.023401	1.03775	1.027829	1.040415	1.053713	1.045458	1.057445	1.0494	42-004304	xtans_040719
xtans_040719	0.991734	1.020513	1.034445	1.024211	1.039039	1.05214	1.045054	1.054444	1.04903	52-011577	xtans_040719
xtans_040719	0.9910504	1.021144	1.034294	1.027432	1.04042	1.05352	1.044727	1.054545	1.04447	42-004307	xtans_040719
xtans_040719	0.9923407	1.021942	1.037447	1.024282	1.0391	1.05323	1.043454	1.055459	1.047953	54-004305	xtans_040719
xtans_040719	0.991457	1.020523	1.034454	1.027775	1.040172	1.053442	1.043443	1.055451	1.047427	55-002813	xtans_040719
xtans_040719	0.991544	1.020513	1.033545	1.027247	1.040109	1.053142	1.042937	1.05479	1.04935	42-004304	xtans_040719
xtans_040719	0.991444	1.020457	1.033012	1.027544	1.040142	1.053474	1.042408	1.054015	1.044499	55-004494	xtans_040719
xtans_040719	0.991401	1.020452	1.033004	1.027543	1.040142	1.053473	1.042405	1.054011	1.044494	44-011403	xtans_040719
xtans_040719	0.991407	1.020454	1.032942	1.027537	1.040154	1.053467	1.042404	1.054011	1.044497	55-004777	xtans_040719
xtans_040719	0.991404	1.020455	1.032921	1.027534	1.040153	1.053465	1.042401	1.054008	1.044495	54-014077	xtans_040719
xtans_040719	1.000407	1.054074	1.025211	1.024444	1.037487	1.050443	1.042173	1.054427	1.044497	55-001715	xtans_040719
xtans_040719	0.9914232	1.020579	1.032737	1.02734	1.040109	1.053451	1.042124	1.054005	1.044492	24-011240	xtans_040719
xtans_040719	0.991432	1.020571	1.03273	1.02734	1.04014	1.053452	1.042122	1.054001	1.044498	54-004434	xtans_040719
xtans_040719	1.012147	1.053234	1.032411	1.024474	1.041447	1.054173	1.042103	1.05404	1.044494	54-007215	xtans_040719
xtans_040719	0.991405	1.020524	1.032444	1.027544	1.040143	1.053454	1.042407	1.054054	1.044493	51-005405	xtans_040719
xtans_040719	0.9914112	1.020444	1.032424	1.02734	1.04014	1.053453	1.042401	1.054021	1.044499	45-002014	xtans_040719
xtans_040719	0.991404	1.020474	1.032434	1.027514	1.040113	1.053425	1.042403	1.054014	1.044491	54-011530	xtans_040719
xtans_040719	0.9914079	1.020452	1.032413	1.02734	1.04014	1.053452	1.042403	1.054013	1.044491	44-004449	xtans_040719
xtans_040719	1.0121	1.05324	1.032402	1.027114	1.039907	1.053012	1.042123	1.054032	1.044499	55-000117	xtans_040719
xtans_040719	1.000429	1.053403	1.030447	1.024177	1.037214	1.050344	1.041935	1.053734	1.043441	55-021444	xtans_040719
xtans_040719	1.000413	1.053445	1.02487	1.024127	1.037147	1.05032	1.041839	1.053499	1.043447	45-002144	xtans_040719
xtans_040719	0.9914244	1.021744	1.031541	1.027547	1.040148	1.053282	1.041759	1.053424	1.043779	45-000052	xtans_040719
xtans_040719	1.010403	1.054327	1.030525	1.024444	1.041413	1.054171	1.041309	1.05308	1.043441	57-007440	xtans_040719

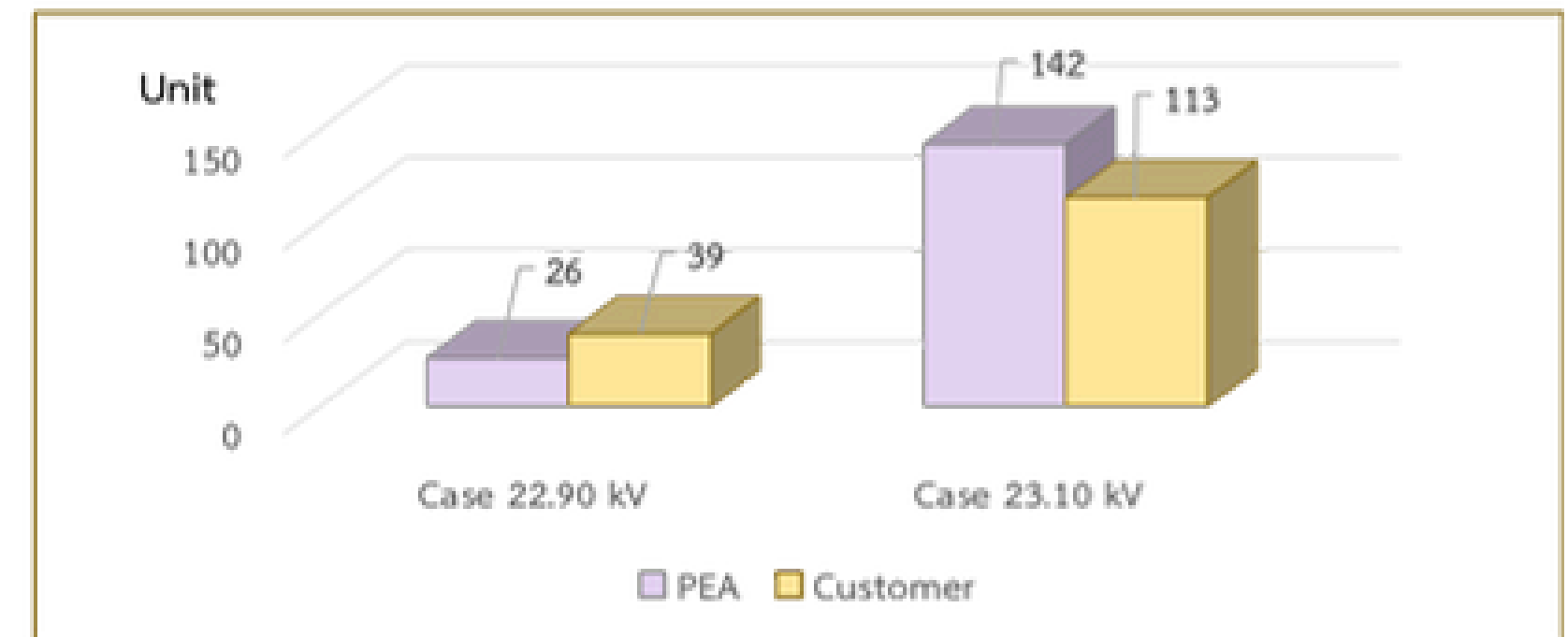


# Result of Simulation with Power factory

## Summary of Results



	Case	Total Energy Loss (kW.hr)	Cost of Energy Loss (Bath)	Decrease		
				Total Energy Loss (kW.hr)	Cost of Energy Loss (Bath)	%
1	22.40 kV	1,949,589.75	5,546,287.14	-	-	-
2	22.70 kV	1,918,081.48	5,456,650.90	31,508.27	89,636.24	1.62
3	22.90 kV	1,902,694.93	5,412,878.51	46,894.82	133,408.63	2.41
4	23.10 kV	1,876,040.24	5,337,049.94	73,549.51	209,237.20	3.78

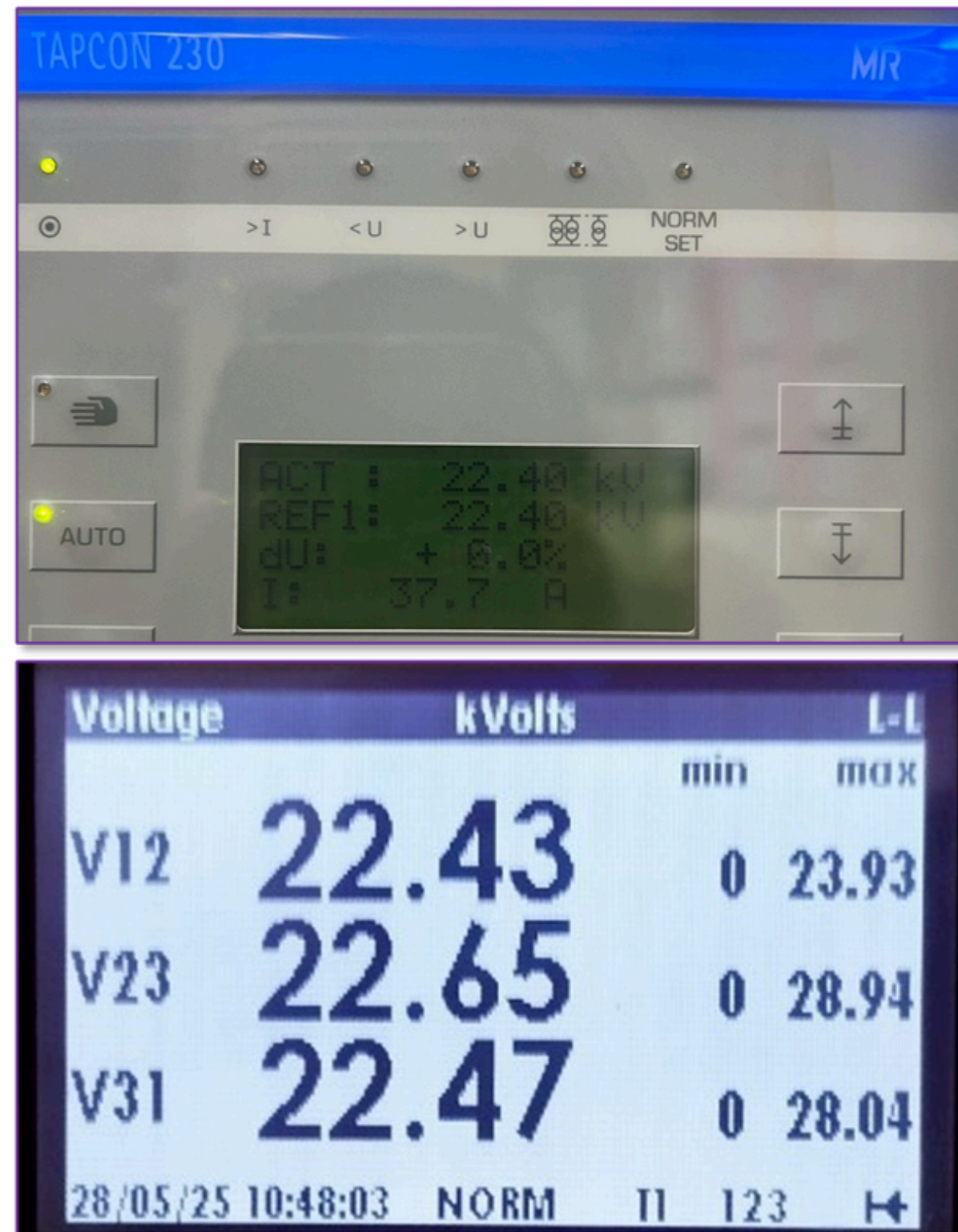




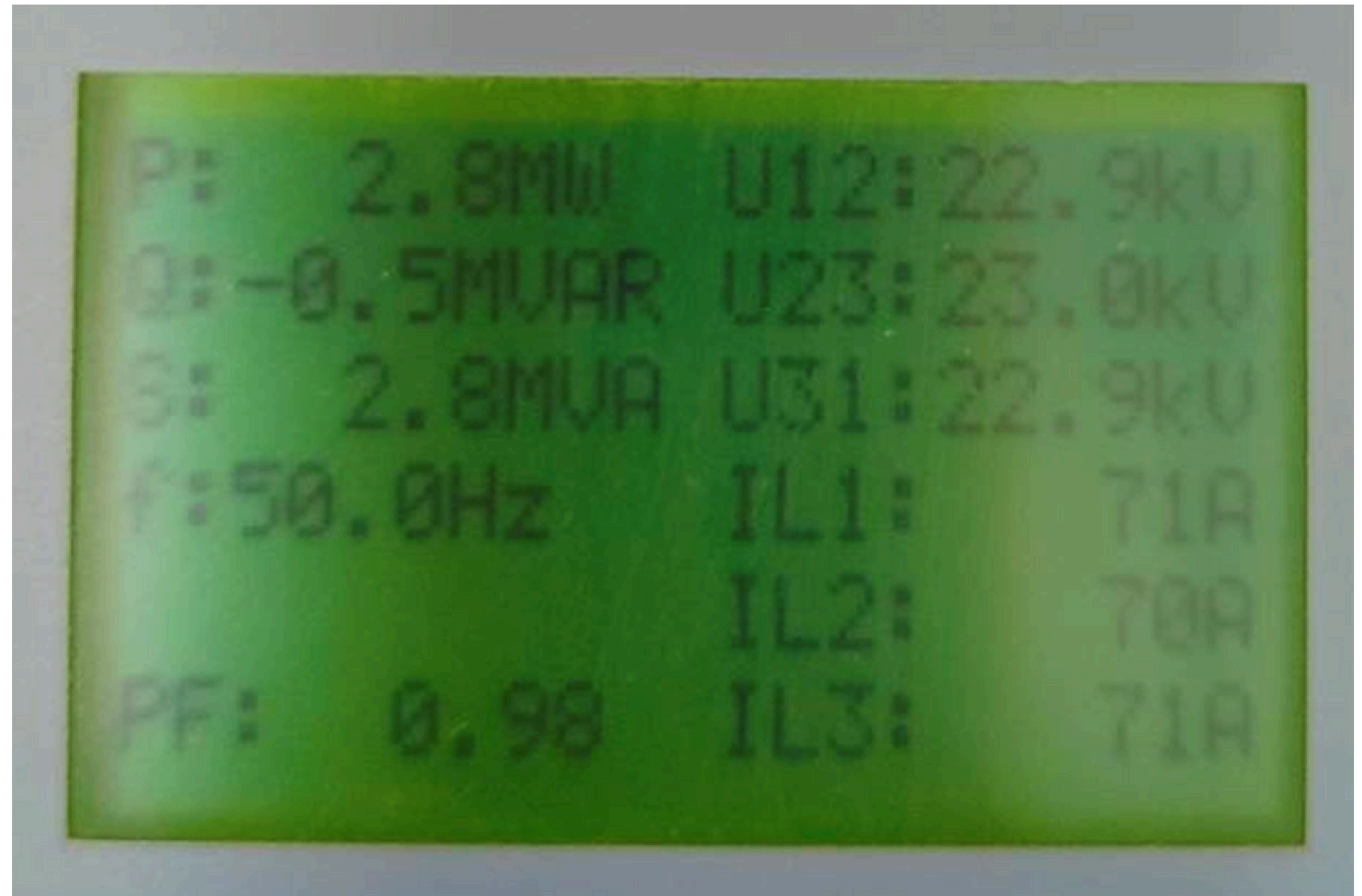
**PEA**  
PROVINCIAL ELECTRICITY AUTHORITY

# Impact Analysis and Problem- Solving Approaches for the Voltage Improvement Project

# Impact Analysis and Problem-Solving




**Voltage Bus**  
**SAI YOK Substation**



**Voltage Bus**  
**Very Small Power Producers (SPP/VSPP).**

# Impact Analysis and Problem-Solving

	CONSERVATION OF ENERGY CO.,LTD	Page 4 of 4
FIELD INSPECTION AND TEST REPORT OVER CURRENT RELAY		
CUSTOMER : Conservation Of Energy Co.,Ltd	LOCATION : San Nib_PYS	
PROJECT NAME : Preventive Maintenance Year 2024	PANEL NO. : Main substation Room 1	
CONTRACT NO. : -	FEEDER NAME : To 22KV to main grid <b>95.8</b>	

Under voltage protection S9			
U >	ON	U >>	ON
U > Pick up	68 VL-N	U >> Pick up	68 VL-N
Delay time	2.00 Sec.	Delay time	1.00 Sec.
Hysteresis	-		

FUNCTION	Should be (V)	Operating Under Voltage (V)	
		Pick up	Drop off
U >	68	67.4	66.4
U >>	68	67.4	66.4

FUNCTION	Current	Sec	Input (V)	Operating time (Sec)	
				Should be	As found
U >	0.0	2.0	0.2 x I <sub>N</sub>	2.0	2.000
			0.8 x I <sub>N</sub>	2.0	2.000
U >>	0.25	1.0	0.2 x I <sub>N</sub>	1.0	1.000
			0.8 x I <sub>N</sub>	1.0	1.000

Under voltage protection S9			
U >	ON	U >>	ON
U > Pick up	68 VL-N	U >> Pick up	68 VL-N
Delay time	2.00 Sec.	Delay time	1.00 Sec.
Hysteresis	-		

FUNCTION	Should be (V)	Phase N - Operating Under Voltage (V)	
		Pick up	Drop off
U >	68	67.4	66.4
U >>	68	67.4	66.4

RESPONSIBILITY	TESTED BY	CONFIRMED BY
CONTRACTOR	Beta Electric Service Co.,Ltd	Conservation Of Energy Co.,Ltd
Name	Wichuan L	
Signature		
Date Of Test	04-12-2024	04-12-2024

SETTING PARAMETER				
CT Pri.	: 300	A.	Voltage input	: 4W3M HV
CT Sec.	: 1	A.	Current input	: 4W3M HV
VT Pri.	: 22000	V.		
VT Sec.	: 110	V.		

OVER VOLTAGE PROTECTION S9			
U >	: ON	U >>	: ON
U > Pick up	: 68 VL-N.	U >> Pick up	: 68 VL-N.
Delay time	: 2.00 Sec.	Delay time	: 1.00 Sec.
Hysteresis	: -		

## Over voltage pick up test

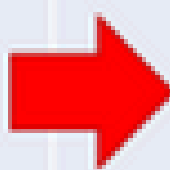
FUNCTION	Should be (V)	Operating Under Voltage (V)	
		Pick up	Drop off
U >	68	67.4	66.4
U >>	68	67.4	66.4

Setting Over Voltage (Line – Line Voltage, U >)

$$U > = \sqrt{3} \times 68 \times \frac{22000}{110} = 23.56 \text{ kV (1.071 pu.)}$$

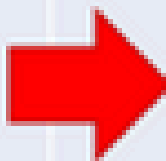
**VSPP, Power Factor = 1**

# Impact Analysis and Problem-Solving

Details	Base Case	Case 1	Case 2	Case 3
Magnitude Voltage (kV)	22.40	22.70	22.90	23.10
Technical Losses (kW-Hr/Year)	1,949,589.75 kW.Hr 5,546,287.14 Baht	1,918,081.48 kW.Hr 5,456,650.90 Baht	1,902,694.93 kW.Hr 5,412,878.51 Baht	1,876,040.24 kW.Hr 5,337,049.94 Baht
Technical Losses Decrease (kW-Hr/Year, Baht)	-	31,508.27 kW.Hr 89,636.24 Baht	46,894.82 kW.Hr 133,408.63 Baht	73,549.51 kW.Hr 209,237.20 Baht
Percent (%) of Decrease	-	1.62 %	2.41 %	3.78 %
Number of Transformers	-	-	65 unit	255 unit
Total Distance	-	-	13.585 km.	90.676 km.
PF Control (1.000) at (PCC)	Reactive Power (MVar)	Reactive Power (MVar)	Reactive Power (MVar)	Reactive Power (MVar)
Feeder 02	0.000	0.000	0.000	0.000
Feeder 06	0.000	0.000	0.000	0.000
Feeder 09	0.000	0.000	0.000	0.000
Voltage at (PCC)				
Feeder 02	22.561	22.851	23.148	<div><div>23.452 23.560 23.276</div></div>
Feeder 06	22.641	22.930	23.227	
Feeder 09	22.378	22.670	22.969	
Voltage Setting at Bus VSPP	23.56 kV (1.071 pu.)			

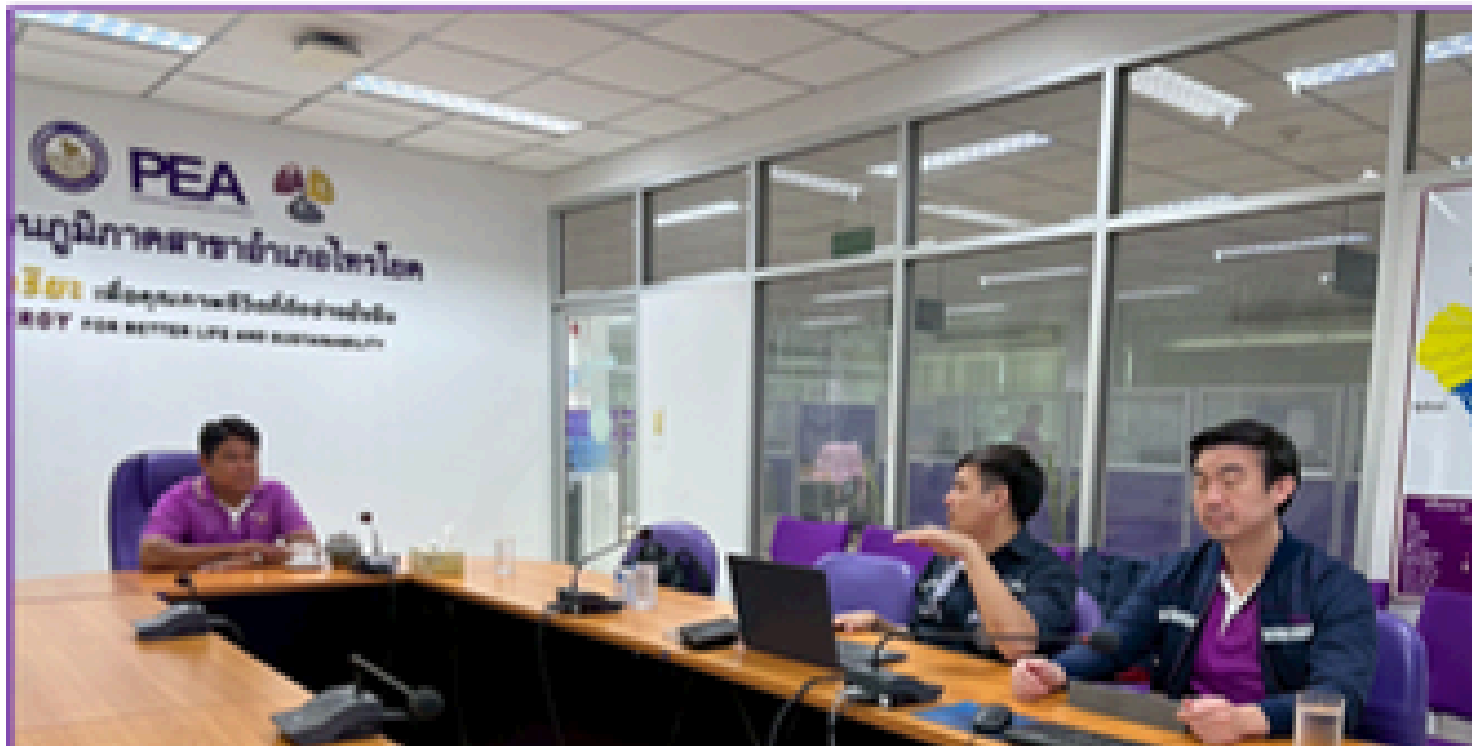
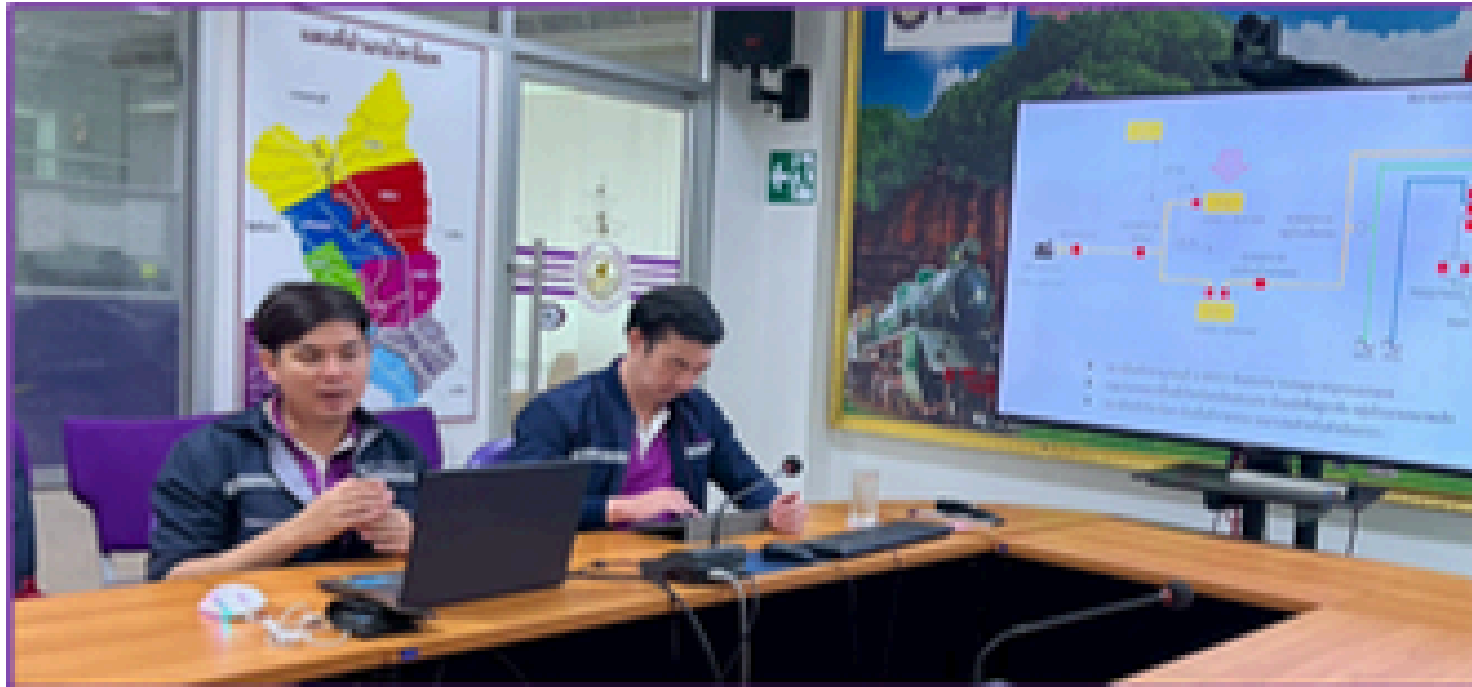
**VSPP, Power Factor = 0.875**

# Impact Analysis and Problem-Solving

Details	Base Case	Case 1	Case 2	Case 3
Magnitude Voltage (kV)	22.40	22.70	22.90	23.10
Technical Losses (kW-Hr/Year)	1,949,589.75 kW.Hr 5,546,287.14 Baht	1,918,081.48 kW.Hr 5,456,650.90 Baht	1,902,694.93 kW.Hr 5,412,878.51 Baht	1,876,040.24 kW.Hr 5,337,049.94 Baht
Technical Losses Decrease (kW-Hr/Year, Baht)	-	31,508.27 kW.Hr 89,636.24 Baht	46,894.82 kW.Hr 133,408.63 Baht	73,549.51 kW.Hr 209,237.20 Baht
Percent (%) of Decrease	-	1.62 %	2.41 %	3.78 %
Number of Transformers	-	-	65 unit	255 unit
Total Distance	-	-	13.585 km.	90.676 km.
PF Control (0.875) at (PCC)	Reactive Power (MVar)	Reactive Power (MVar)	Reactive Power (MVar)	Reactive Power (MVar)
Feeder 02	3.320	3.320	3.320	3.320
Feeder 06	3.320	3.320	3.320	3.320
Feeder 09	3.320	3.320	3.320	3.320
Voltage at (PCC)				
Feeder 02	22.856	23.113	23.376	<div><div>23.645 23.747 23.443</div></div>
Feeder 06	22.960	23.216	23.378	
Feeder 09	22.647	22.906	23.171	
Voltage Setting at Bus VSPP	23.56 kV (1.071 pu.)			

## First Meeting

# Impact Analysis and Problem-Solving



**Meeting on the Voltage Upgrade Project at Sai Yok Substation with the Provincial Electricity Authority (PEA) on-site team to provide clarification and gather feedback on issues related to the project**

## Second Meeting

# Impact Analysis and Problem-Solving



**"A meeting on the voltage upgrading plan was convened, inviting relevant stakeholders to provide their feedback."**



**PEA**  
PROVINCIAL ELECTRICITY AUTHORITY

# Thank You For Your Attention

**Mr. Churit Pansakul**