Case study
Harmonic Distortion In a Steel Plant with Induction Furnaces

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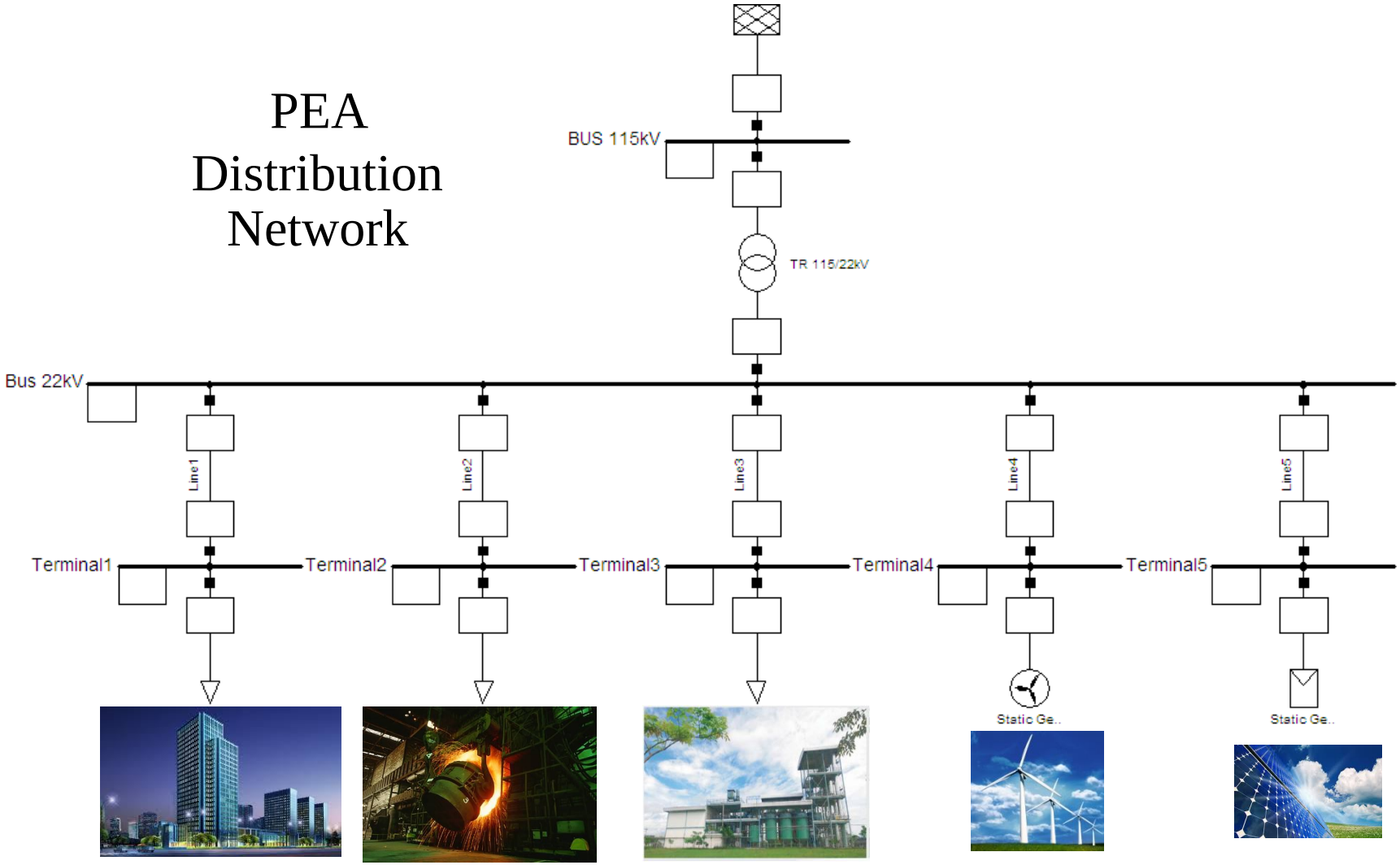
Outline

- Introduction
- Induction Furnace
- Instrument and Evaluate
- Conclusion

Introduction

PEA Distribution Network



Introduction

Power Quality Evaluation in Distribution Network Kao Yoi (KHY)
115/22kV Substation

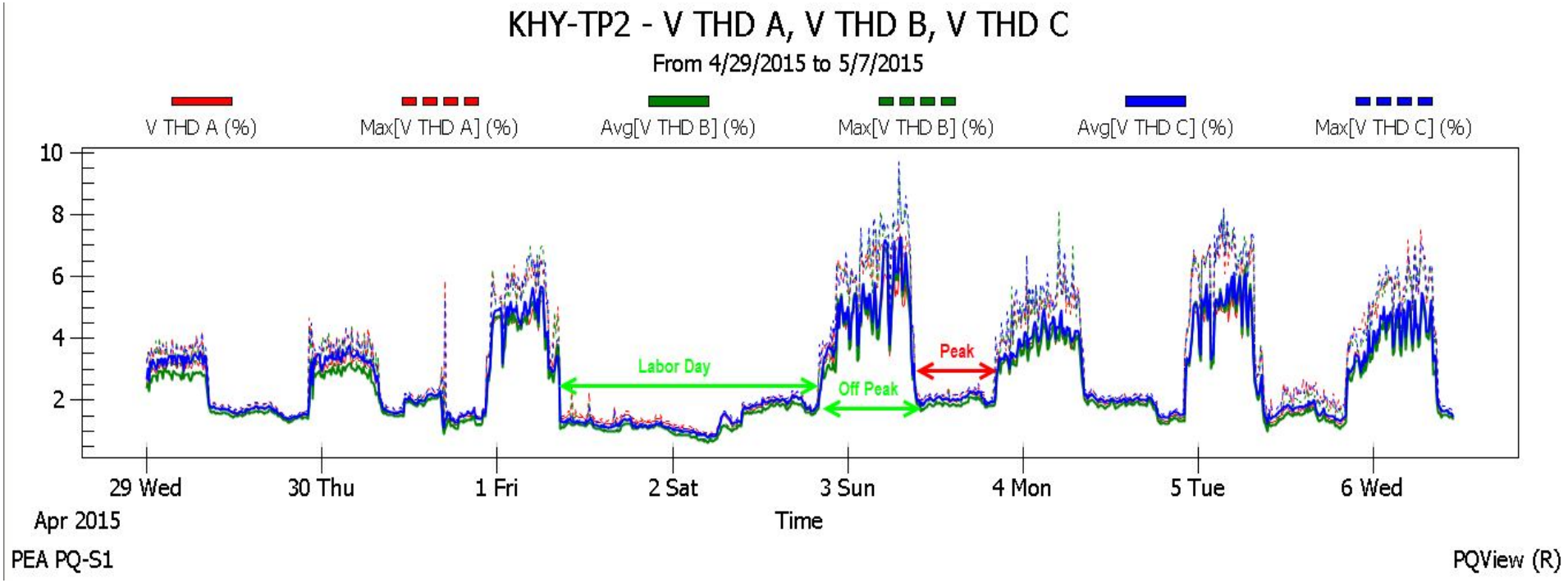
Parameter	EN50160	Phase	CP 95%
RMS Voltage	22 kV ± 5% (20.9-23.1 kV)	AB	22.90 kV
		BC	23.01 kV
		CA	22.93 kV
Power Frequency	± 1% 49.5-50.5 Hz*		50.08 Hz
Voltage Unbalance	2%		0.51%
Voltage Distortion	8%	A	4.28%
		B	4.41%
		C	4.91%
Voltage Flicker	Plt≤1	A	0.45
		B	0.46
		C	0.42

*for 99.5% of week

THDv exceed 4% (The Harmonic Regulations for The Commercial and Industrial (PRC-PQG-01/1998) in Thailand)

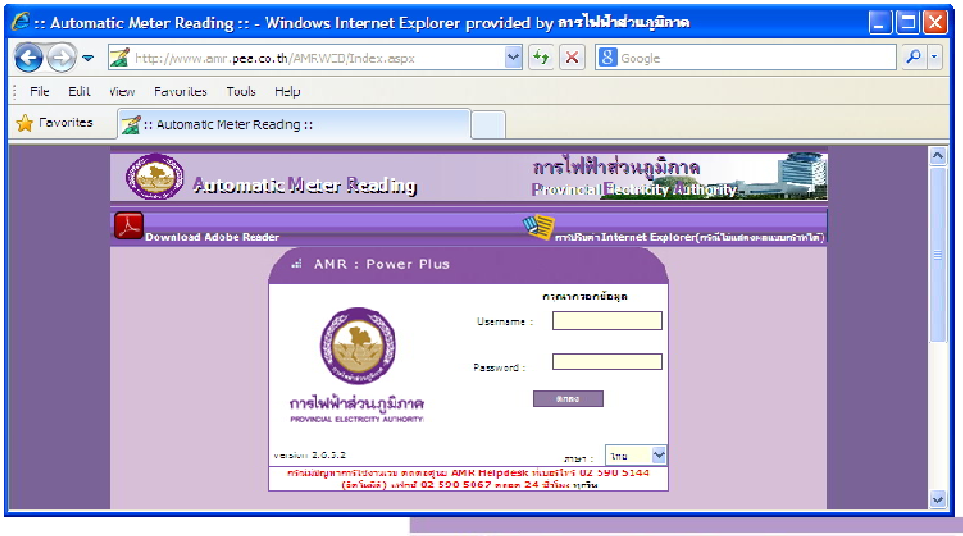
Introduction

Kao Yoi (KHY) 115/22kV Substation

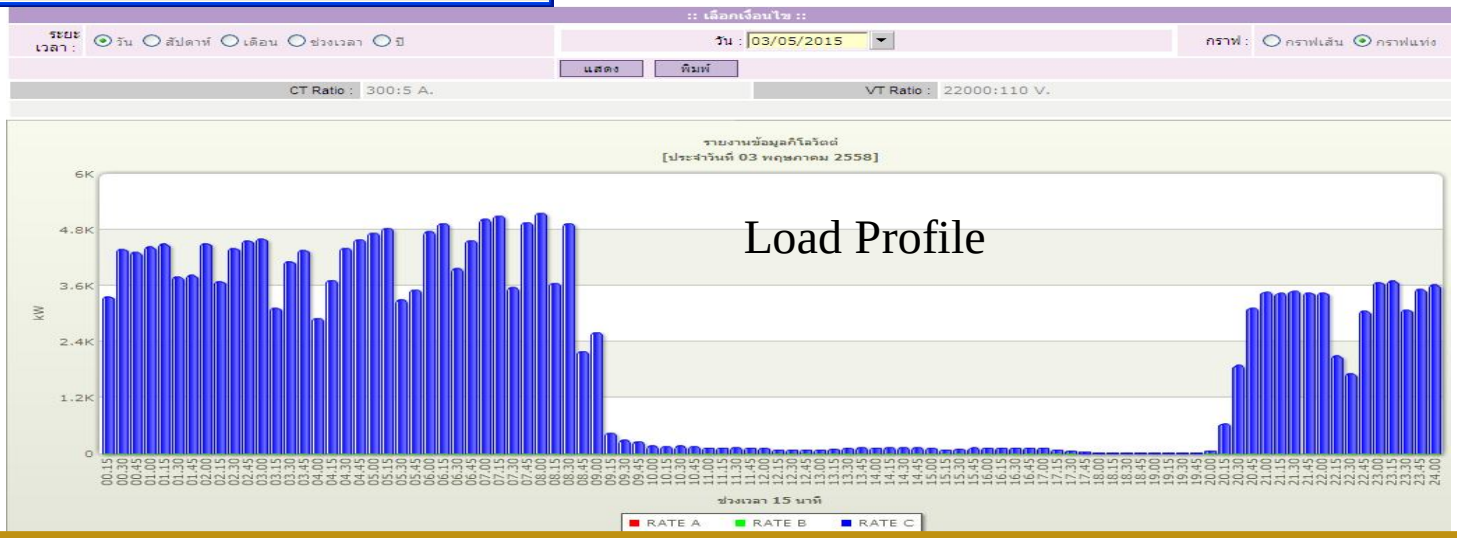


Harmonic increase on Off Peak (10 PM-9 AM)

Introduction

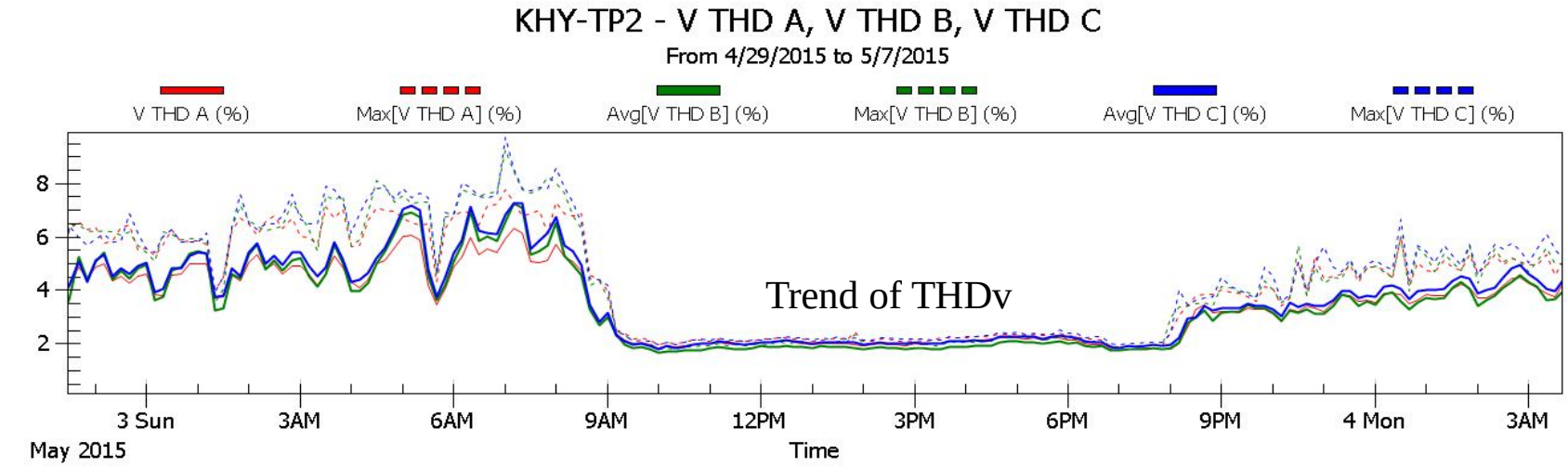


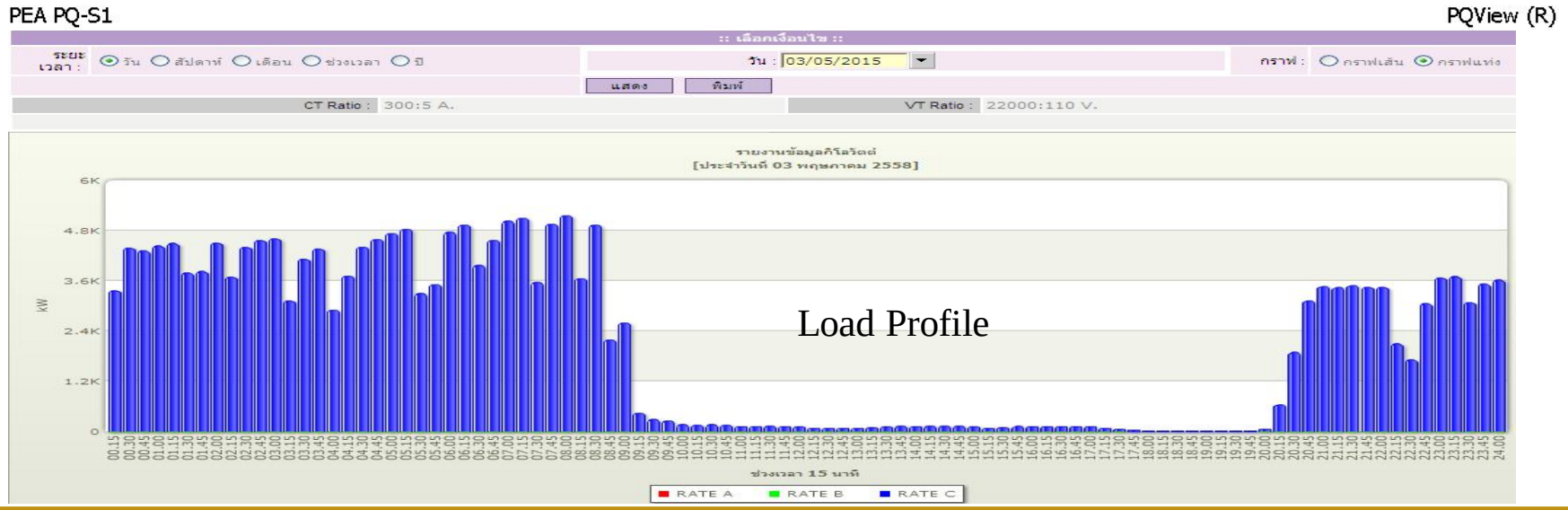
AMR (Automatic Meter Reading)
Via PEA Web Application



Load Profile

Introduction



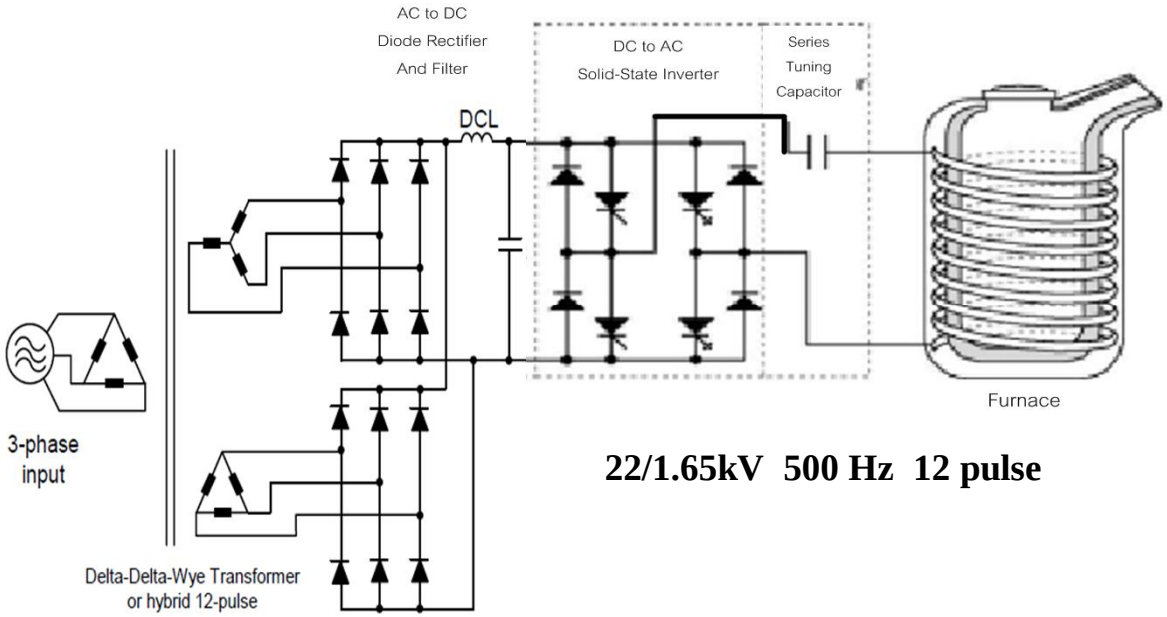


Induction Furnace

TR

22/ 0.95kV

6300kVA



22/1.65kV 500 Hz 12 pulse

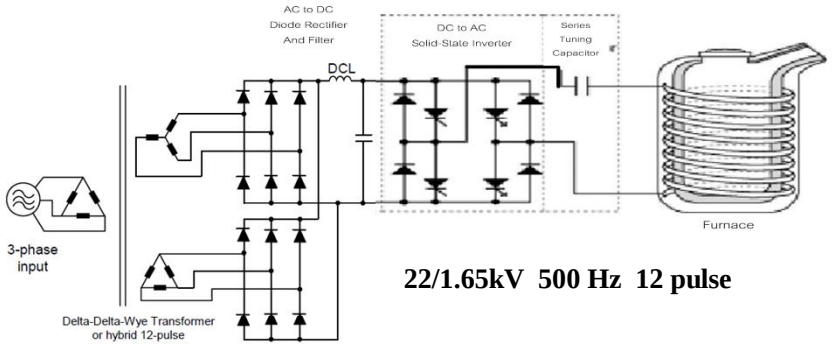
For the 12 Pulse system the input current will have theoretical harmonic components at the following multiples of fundamental frequency: 11, 13, 23, 25, etc.

Induction Furnace

Induction Furnaces in a Steel Plant:

Induction Furnace No.1

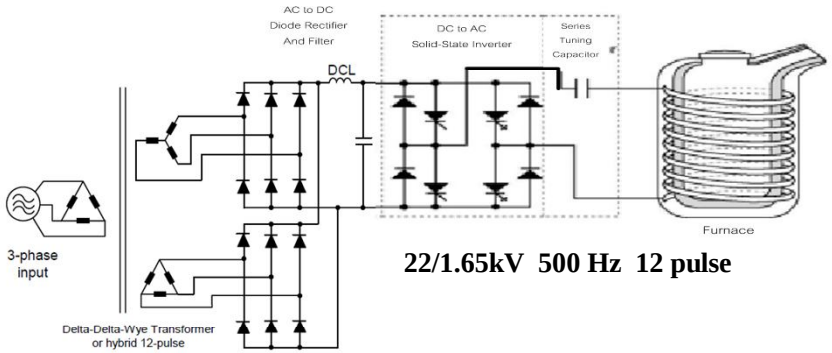
TR1 22/ 0.95kV 6300kVA



22/1.65kV 500 Hz 12 pulse

Induction Furnace No.2

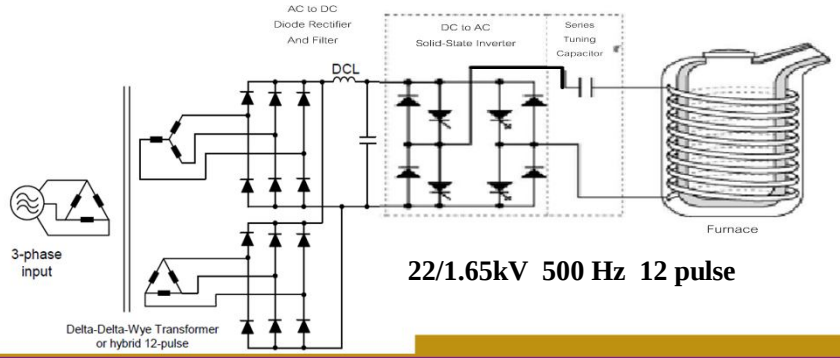
TR2 22/ 0.95kV 6300kVA



22/1.65kV 500 Hz 12 pulse

Induction Furnace No.3

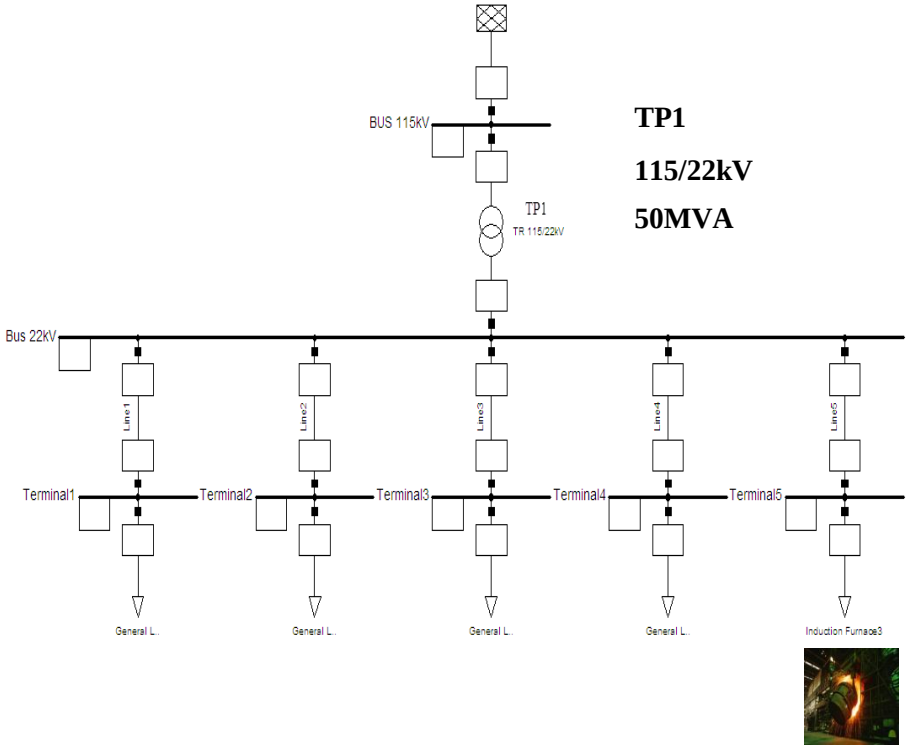
TR3 22/ 0.95kV 6300kVA



22/1.65kV 500 Hz 12 pulse

Instrument and Evaluate

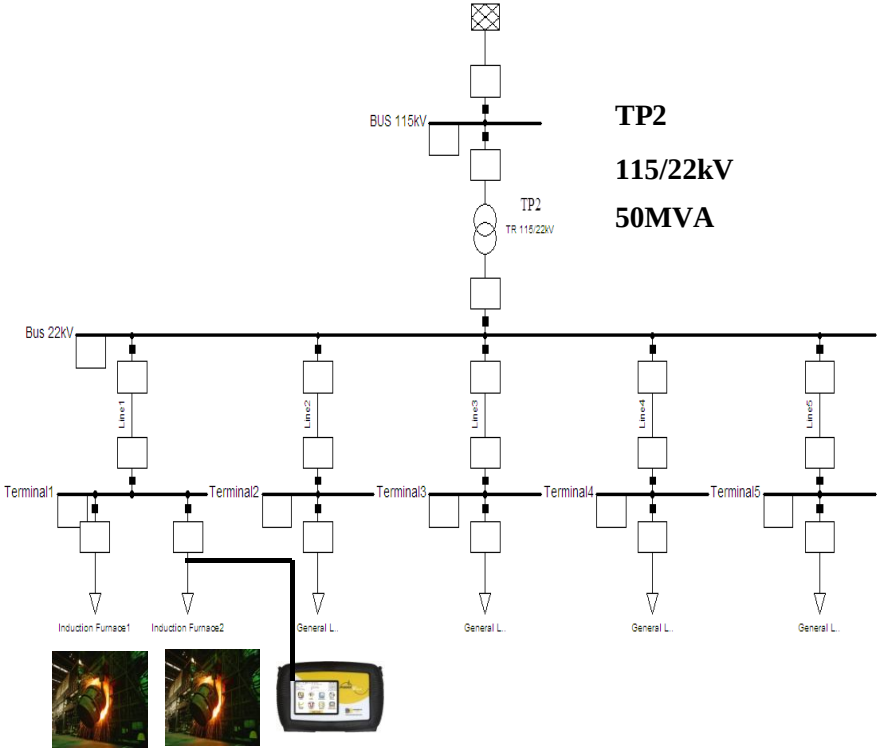
Kao Yoi (KHY) Substation



TP1

115/22kV

50MVA



TP2

115/22kV

50MVA

Dranetz BMI PowerVisa@PCC

Instrument and Evaluate

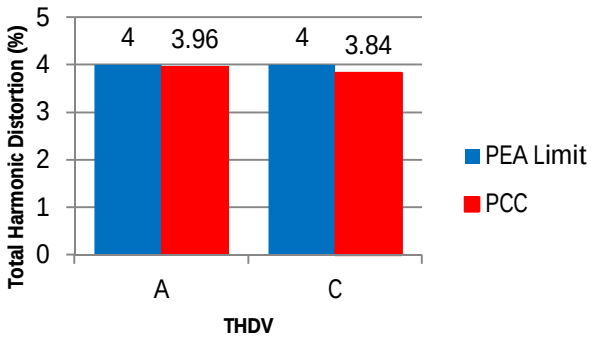
Harmonic Standard In Thailand : PRC - PQG - 01 / 1998 The Harmonic Regulations for The Commercial and Industrial

Voltage at PCC. (kV)	Total harmonic distortion (%)	Total harmonic distortion in each Order (THDV%)	
		Odd order	Even order
0.4	5	4	2
22 and 24	4	3	1.75
33	3	2	1
69	2.45	1.63	0.82
115 and above	1.5	1	0.5

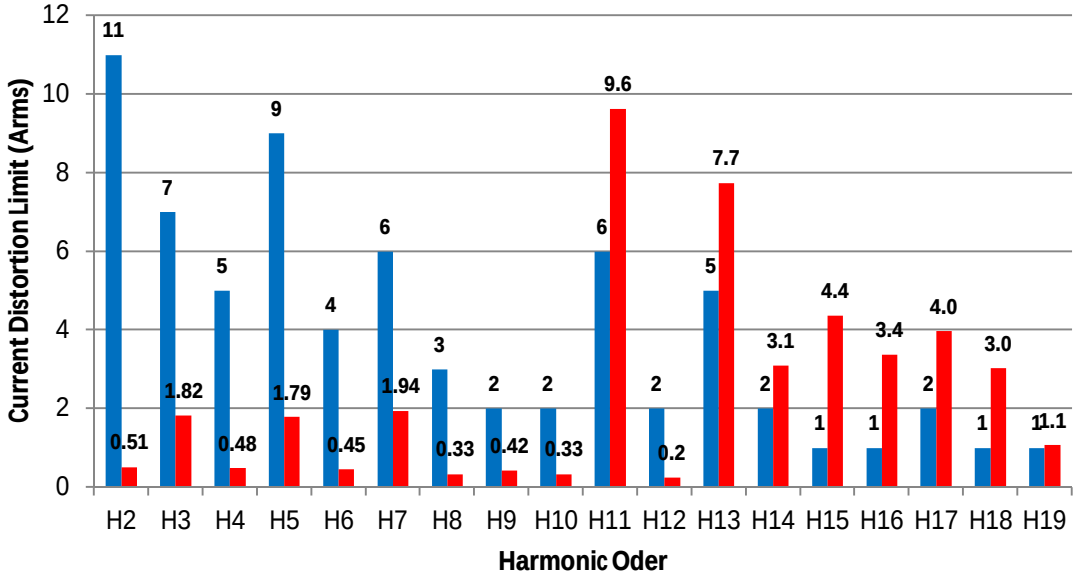
Voltage at PCC. (kV)	Current distortion limits in each order (Arms)																	
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0.4	48	34	22	56	11	40	9	8	7	19	6	16	5	5	5	6	4	6
11 and 12	13	8	6	10	4	8	3	3	3	7	2	6	2	2	2	2	1	1
22, 24 and 33	11	7	5	9	4	6	3	2	2	6	2	5	2	1	1	2	1	1
69	8.8	5.9	4.3	7.3	3.3	4.9	2.3	1.6	1.6	4.9	1.6	4.3	1.6	1	1	1.6	1	1
115 and above	5	4	3	4	2	3	1	1	1	3	1	3	1	1	1	1	1	1

Instrument and Evaluate

Results:



%THDv less than 4%



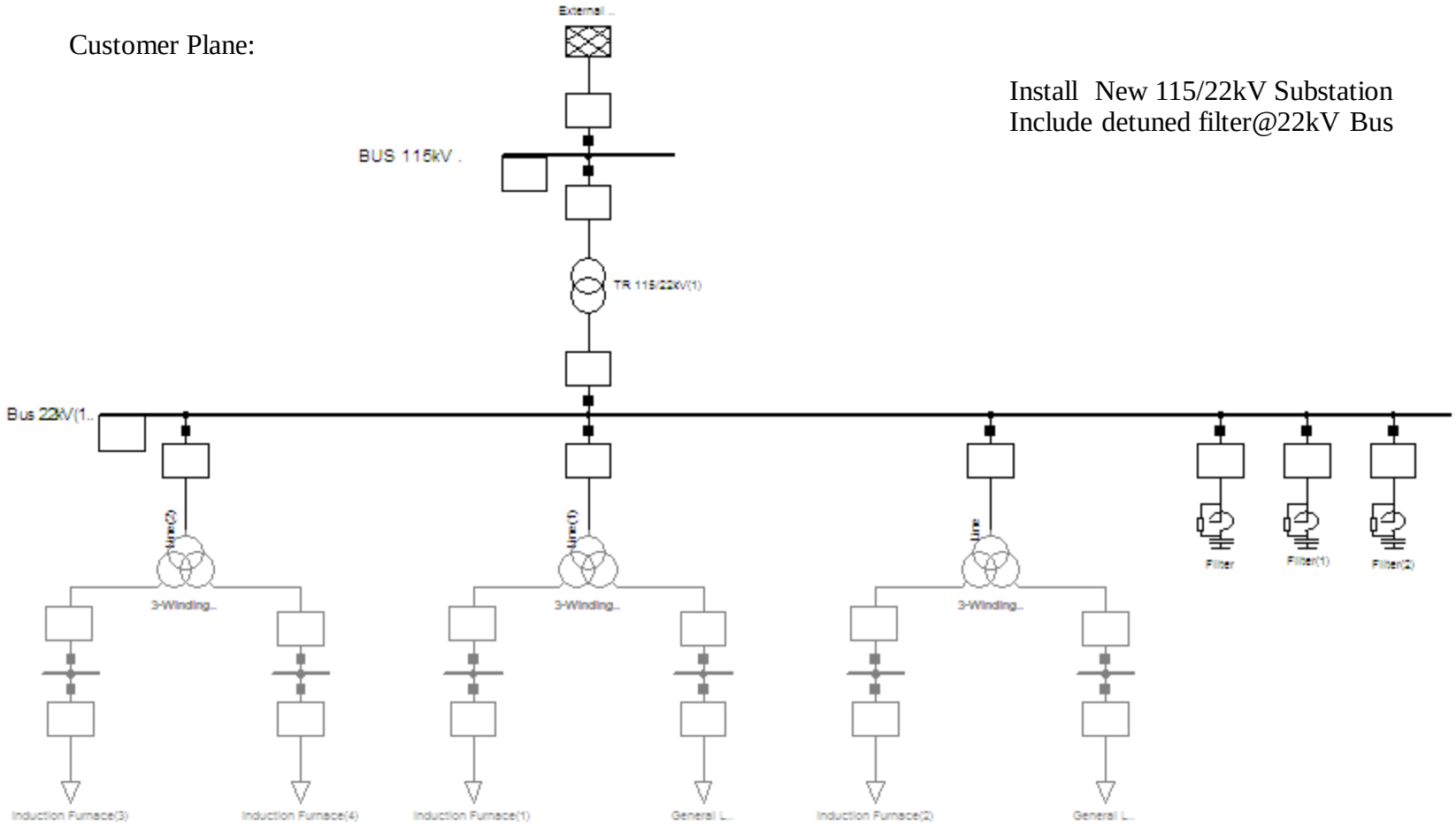
THDi order 11th , 13th , 14th , 15th , 16th , 17th, 18th are exceed PEA limit

Solution

- Install Tuned Filter or
- Detune Filter or
- Active Filter

Solution

Customer Plane:



Install New 115/22kV Substation
Include detuned filter@22kV Bus

Conclusion

- For decrease of harmonic distortion in a steel plant with induction furnace the customer should install harmonic filter for decrease of harmonic order 11^{th} , 13^{th} , 14^{th} , 15^{th} , 16^{th} , 17^{th}, 18^{th} that are exceed PEA limit

Thank You