SAS Powertech Pvt Ltd.

101, Gera's Regent Manor, Survey No. 33, Area No. 39/570,
Behind Opulent Car Care Center Baner, Pune 411045

Tel: 020 65203015
Email: solutions@saspowertech.com

INDEX

Intelligent Electrical Documentation for Industries using etap

- AC Electrical systems –
  Generating stations, Complex load and line impedances, CT/PTs, Circuit breakers and relays.

- Electrical calculations -
  Vector calculations and involve lot of mathematics.
  There is a trend to depend on thumb rules or compromise excel sheets.

- Updated electrical documentation helps in -
  Attending maintenance emergencies, brown field expansions, statutory requirements, internal EHS requirements.

- **AUTOCAD** drawings -
  Do not have electrical intelligence –
  Do not generate BOQs automatically.
  Are only **PICTURES** for electrical engineers.

Intelligent documentation offers:

a) Accurate Calculation of all electrical parameters
b) Displaying electrical parameters and component IDs / specifications on SLDs.
c) Auto Synchronized BOQ generation / updating.
d) Auto Synchronized Electrical parameter validation tables.
e) Load flow results, Short circuit analysis,
f) Auto Synchronized Relay parameter setting tables

SASPPL helps client to achieve compliance related to following standards.

Organizations follow different safety standards as adopted by their EHS policy. To name a few we are presenting a list below.

Standards related to Electrical Safety.

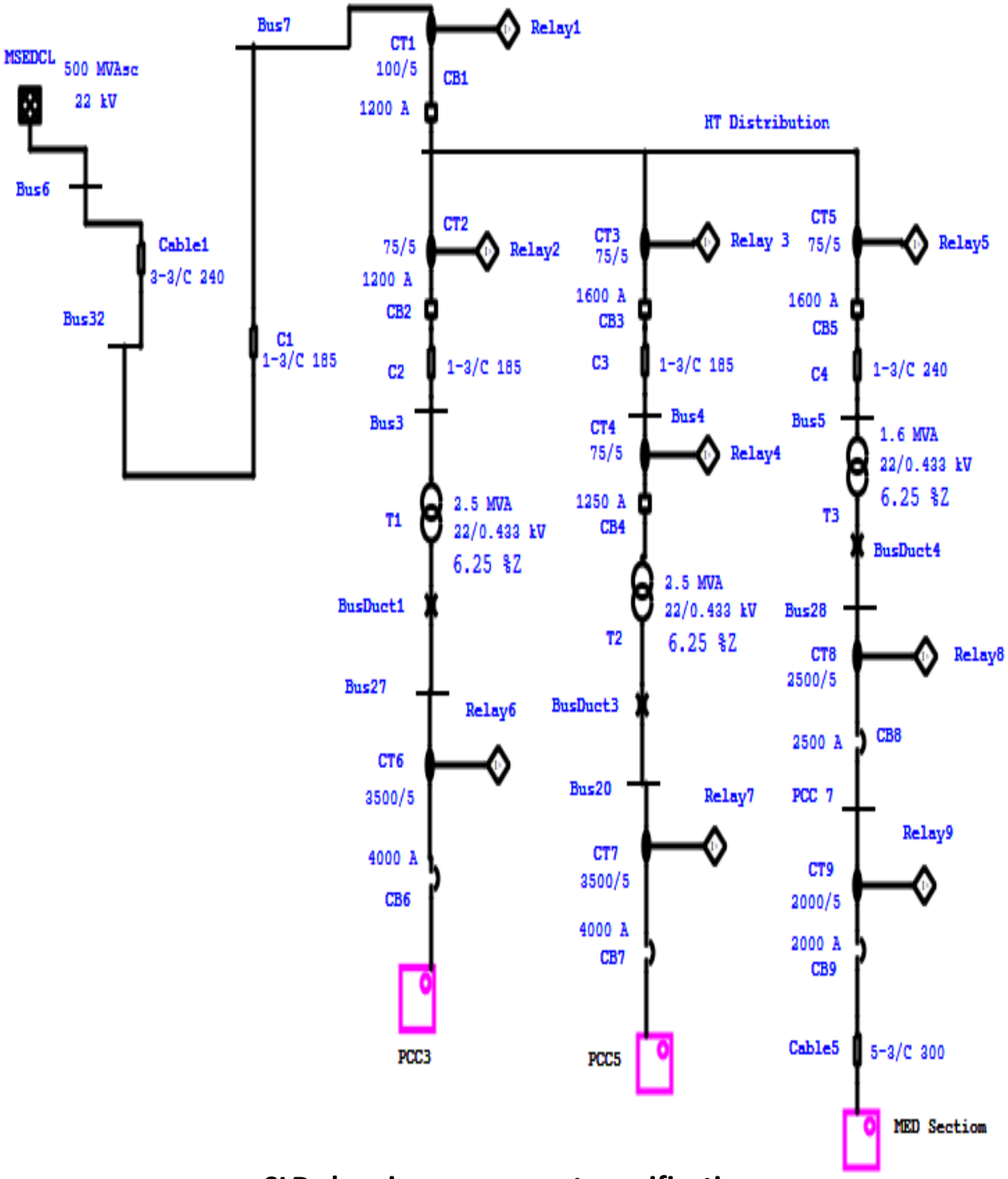
1. CEA 2010 regulations
2. IS 732 provision
3. IS 3024 – Earthing System
4. IS 62305 – Lightning Protection System
5. OSHA 29 Code of Federal Regulations (CFR) Part 1910 Subpart S.
6. NFPA 70E - Standard for Electrical Safety Requirements for Employee at Workplace.
7. IEEE Standard 1584-2002 - Guide for Performing Arc Flash Hazard Calculations.
8. National building code, National Electricity code (GOI, GOM)

Power Quality Study.

1. Applicable Utility supply code. (Supply code 2005 in case of MSEDCL)
2. IEEE 519 1992 – TDD (Harmonics) Compliance limit
3. Applicable reactive power billing method (KVAH billing / PF incentive ETC)

Sample Documentation For A Plant With

- 3MW Load At 22 KV
- Having HT Distribution
- 3 Transformers
- 3 PCCs



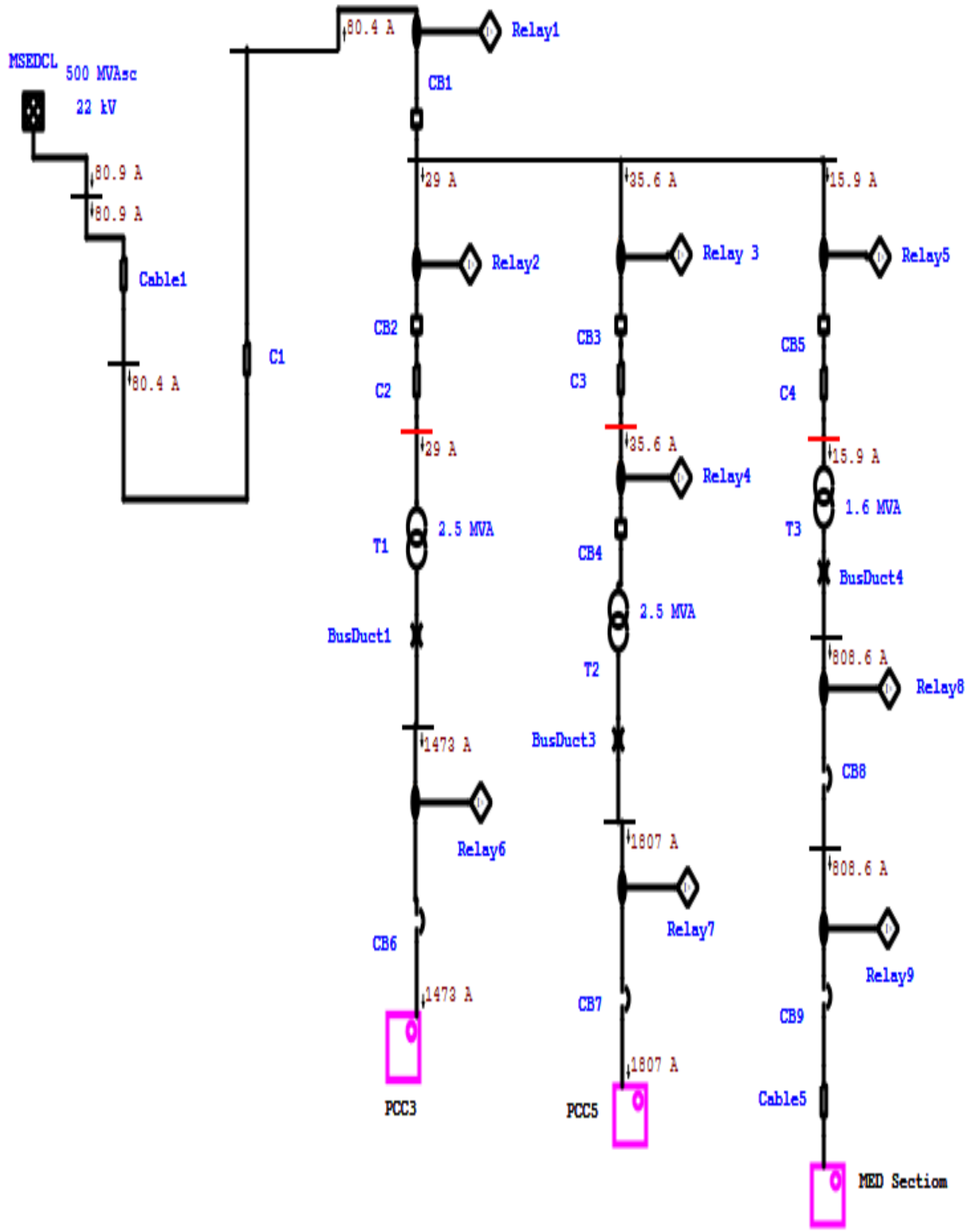
SLD showing component specifications

BOQ, Function and Specifications for all Relays and Trip devices in above SLD.

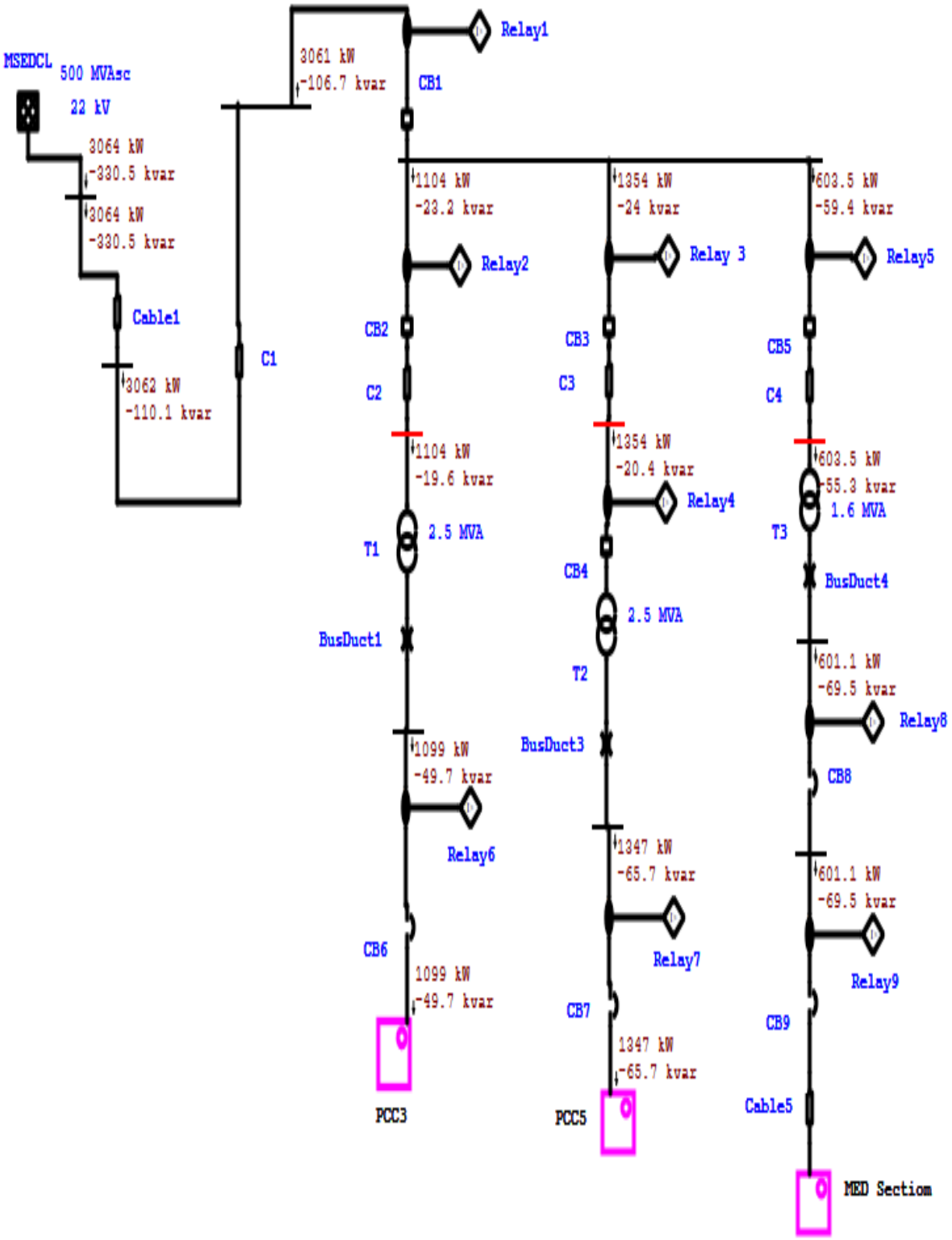
Relay ID	Adjacent Bus	Manufacturer	Model	CT Ratio	Device Function	Trip Element
Relay1	Bus7	CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Phase
Relay1	Bus7	CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Ground
Relay2	HT Distribution	CSPC	IRI-PRO-3I-EI	75:5	Overcurrent	Phase
Relay2		CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Ground
Relay 3	HT Distribution	Easun Reyrolle	MIT114	75:5	Overcurrent	Phase
Relay5	HT Distribution	CSPC	IRI-PRO-3I-EI	75:5	Overcurrent	Phase
Relay5		CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Ground
Relay4	Bus4	Easun Reyrolle	MIT114	75:5	Overcurrent	Phase
Relay6	Bus27	Easun Reyrolle	MIT114	3500:5	Overcurrent	Phase
Relay7	Bus20	L&T	MC61A	3500:5	Overcurrent	Phase
Relay9	PCC 7	L&T	MC61A	2000:5	Overcurrent	Phase
Relay8	Bus28	Easun Reyrolle	MIT114	2500:5	Overcurrent	Phase

LVCB ID	Adjacent Bus	Manufacturer	Model	Max Voltage	Size - Frame	Amps	SC Rating	Manufacturer	Model
CB7	Bus 20	Siemens	3WL12H 40	0.69 kV	3200	4000	85 kA @ 0.69 kV	Siemens	ETU15B
CB6	Bus 27	Siemens	3WL12H 40	0.69 kV	3200	4000	85 kA @ 0.69 kV	Siemens	ETU15B
CB8	Bus 28	Square-D	NW25H1	0.69 kV	2500	2500	65 kA @ 0.69 kV	Square-D	MICROLOGIC 2.0
CB9	PCC 7	Square-D	NW20H1	0.69 kV	2000	2000	65 kA @ 0.69 kV	Square-D	MICROLOGIC 2.0

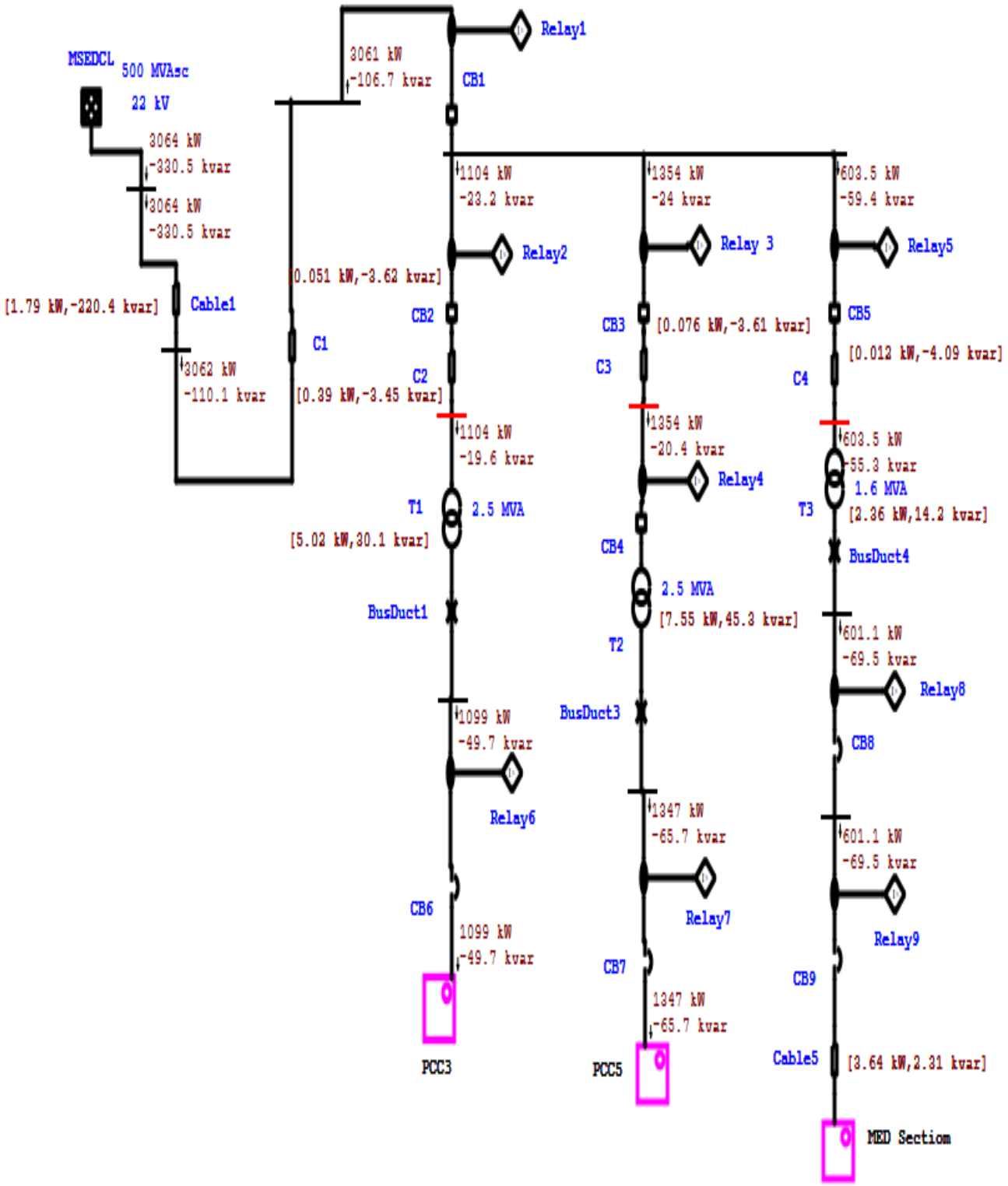
Auto generated version of SLD showing only currents in various branches.



SLD showing KW and KVAR at various bus Levels.



SLD showing KW / KVAR loads and transformer and Cable losses.

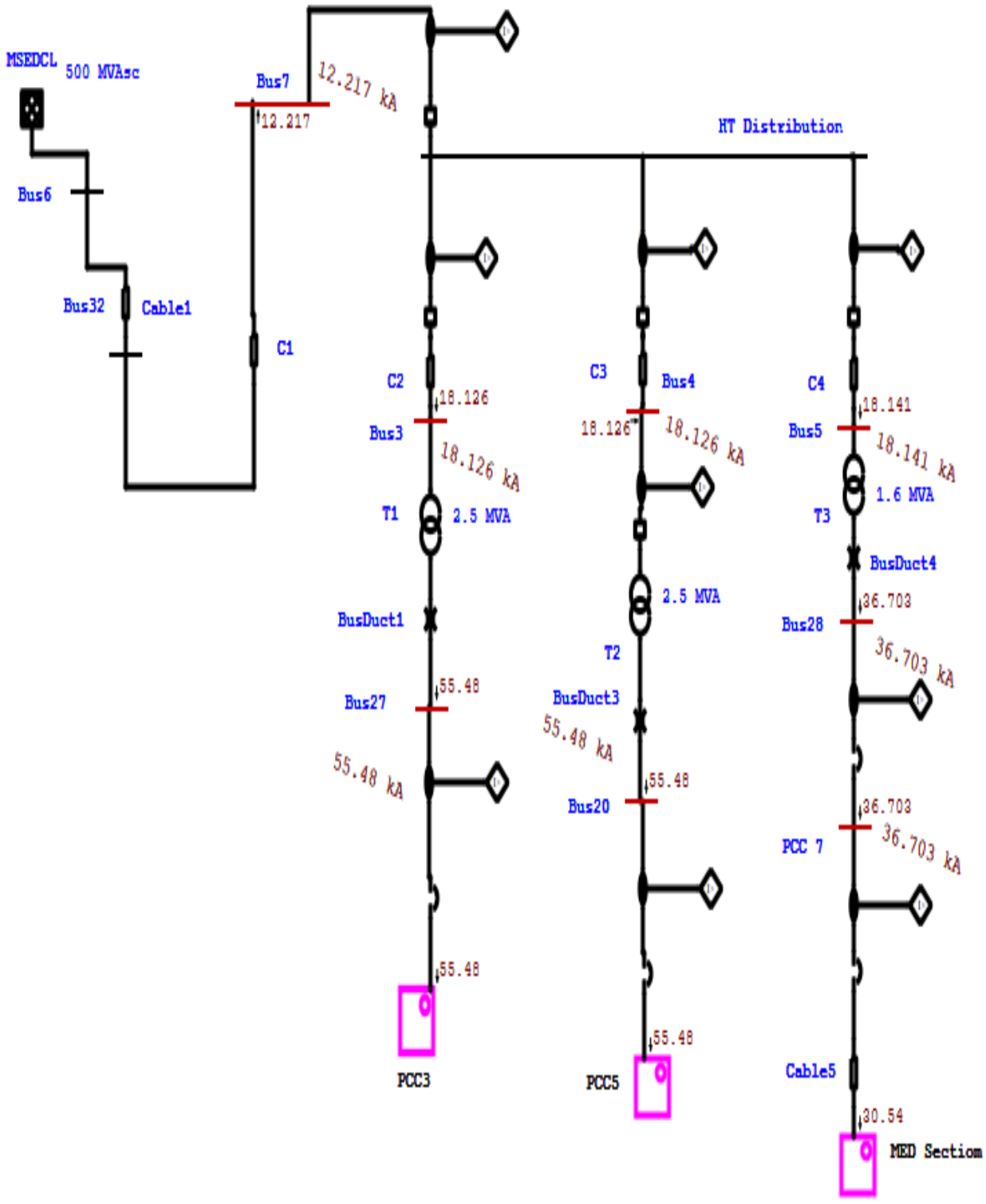


Branch Losses, Cable validation for all the branches as per previous SLD

ID	From Bus	To Bus	Type	Rating 1	Rating 2	Amp Flow	% Loading	kW Losses
Cable1	Bus6	Bus32	Cable	1800 m	3 - 3/C 240	80.87	9.1	1.79
C1	Bus7	Bus32	Cable	100 m	1 - 3/C 185	80.45	31.2	0.39
C2	HT Distribution	Bus3	Cable	100 m	1 - 3/C 185	28.99	11	0.0507
C3	HT Distribution	Bus4	Cable	100 m	1 - 3/C 185	35.57	13.4	0.0763
C4	HT Distribution	Bus5	Cable	100 m	1 - 3/C 240	15.93	5.4	0.0117
T1	Bus3	Bus27	Transf. 2W	22 / 0.433 kV	2500 kVA	28.99	44.2	5.02
T2	Bus4	Bus20	Transf. 2W	22 / 0.433 kV	2500 kVA	35.57	54.2	7.55
T3	Bus5	Bus28	Transf. 2W	22 / 0.433 kV	1600 kVA	15.91	37.9	2.36
Cable5	PCC 7	MED	Cable	75 m	5 - 3/C 300	808.6	49.3	3.64

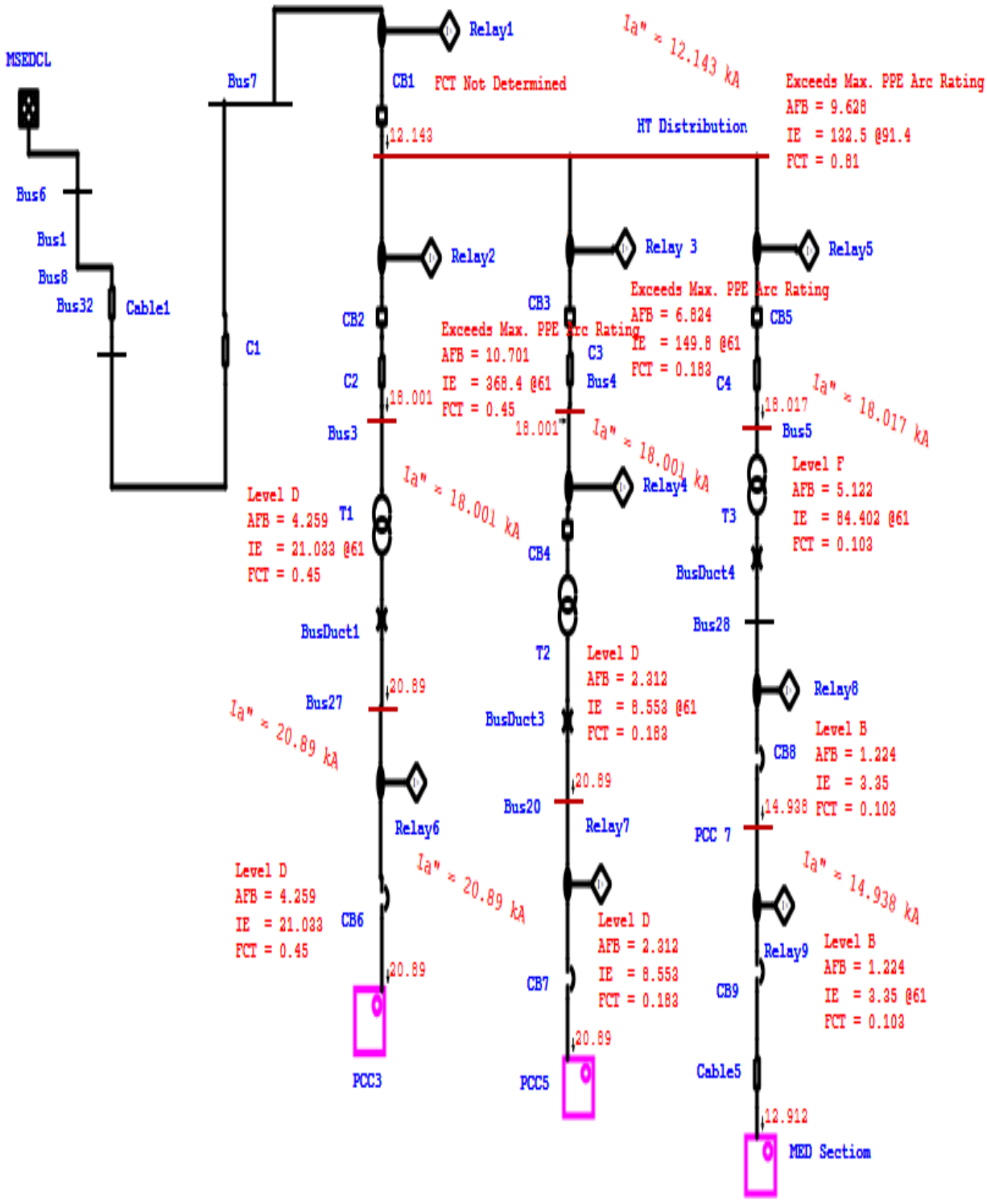
ID	kV	Cond / Phase	Cond/ Cable	Size mm²	Length m	Make	Cond Type	Insul. Type	Phase mm²	Base Amp	Installation	Operating Ta °C	Allowable Amp	Loading Amp	Vd %	SC Current kA
Cable1	22	3	3/C	240	1800	Polycab	AL	XLPE 90°C	9 - 240	846	U/GDuct	90	890.1	80.9	0.07	13.12
C1	22	1	3/C	185	100	Polycab	AL	XLPE 90°C	3 - 185	245	U/GDuct	90	257.8	80.4	0.01	12.18
C2	22	1	3/C	185	100	Polycab	AL	XLPE 90°C	3 - 185		A/GTrays	90	264.7	29	0.01	18.06
C3	22	1	3/C	185	100	Polycab	AL	XLPE 90°C	3 - 185		A/GTrays	90	264.7	35.6	0.01	18.06
C4	22	1	3/C	240	100	Polycab	AL	XLPE 90°C	3 - 240	282	U/GDuct	90	296.7	15.9	0	18.08
Cable5	3.3	5	3/C	300	75	Polycab	AL	XLPE 90°C	15 - 300	1560	U/GDuct	90	1641.3	808.6	0.71	35.74

SLD showing Short circuit currents



Protective Device Settings - Relay													
Relay ID	Manufacturer	Model	PT / CT Ratio	Device Function	Trip Element	Level /Stage	Curve	OCR (51, 51V), OLR (49, Acc.)			OCR (50), OLR (50, Jam)		
								Pickup	Prim. Amps	Time Delay	Pickup	Prim. Amps	Time Delay
Relay1	CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Phase	OC1	Definite Time	1.250	125.000	0.790			
Relay1	CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Ground	OC1	IEC - Extremely Inverse	0.050	5.000	0.010			
Relay2	CSPC	IRI-PRO-3I-EI	75:5	Overcurrent	Phase	OC1	Definite Time	0.950	71.250	0.450			
Relay2	CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Ground	OC1	IEC - Extremely Inverse	0.050	5.000	0.010			
Relay 3	Easun Reyrolle	MIT114	75:5	Overcurrent	Phase	OC1	Standard Inverse 3	94.000	70.500	0.110	550.000	412.50	0.1 s
Relay5	CSPC	IRI-PRO-3I-EI	75:5	Overcurrent	Phase	OC1	Definite Time	1.150	86.250	0.550	3.000	225.00	0.02 s
Relay5	CSPC	IRI-PRO-3I-EI	100:5	Overcurrent	Ground	OC1	IEC - Extremely Inverse	0.050	5.000	0.010			
Relay4	Easun Reyrolle	MIT114	75:5	Overcurrent	Phase	OC1	Standard Inverse 3	86.000	64.500	0.125	400.000	300.00	0.1 s
Relay6	Easun Reyrolle	MIT114	3500:5	Overcurrent	Phase	OC1	Standard Inverse 1	250.000	8749.999	0.025			
Relay7	L&T	MC61A	3500:5	Overcurrent	Phase	OC1	Normal Inverse 1.3 sec	0.650	2275.000	0.100			
Relay9	L&T	MC61A	2000:5	Overcurrent	Phase	OC1	Normal Inverse 3 sec	0.600	1200.000	0.200	7.400	14800.00	
Relay8	Easun Reyrolle	MIT114	2500:5	Overcurrent	Phase	OC1	Standard Inverse 3	60.000	1500.000	0.025	650.000	16250.00	0.025 s
Relay33	L&T	MC61A	1000:5	Overcurrent	Phase	OC1	Extremely Inverse	0.350	350.000	0.100	4.000	4000.00	
Relay33	L&T	MC61A	1000:5	Overcurrent	Ground	OC1	Extremely Inverse	0.050	50.000	0.100			
Relay55	L&T	MC61A	1000:5	Overcurrent	Phase	OC1	Normal Inverse 1.3 sec	0.600	600.000	0.100	8.000	8000.00	
Relay55	L&T	MC61A	1000:5	Overcurrent	Ground	OC1	Extremely Inverse	0.050	50.000	0.100			
Relay66	L&T	MC61A	1600:5	Overcurrent	Phase	OC1	Normal Inverse 1.3 sec	0.400	640.000	0.100	5.000	8000.00	
Relay66	L&T	MC61A	1000:5	Overcurrent	Ground	OC1	Extremely Inverse	0.050	50.000	0.100			
Relay77	L&T	MC61A	2000:5	Overcurrent	Phase	OC1	Normal Inverse 1.3 sec	0.300	600.000	0.100	4.000	8000.00	
Relay77	L&T	MC61A	2000:5	Overcurrent	Ground	OC1	Extremely Inverse	0.050	100.000	0.100			

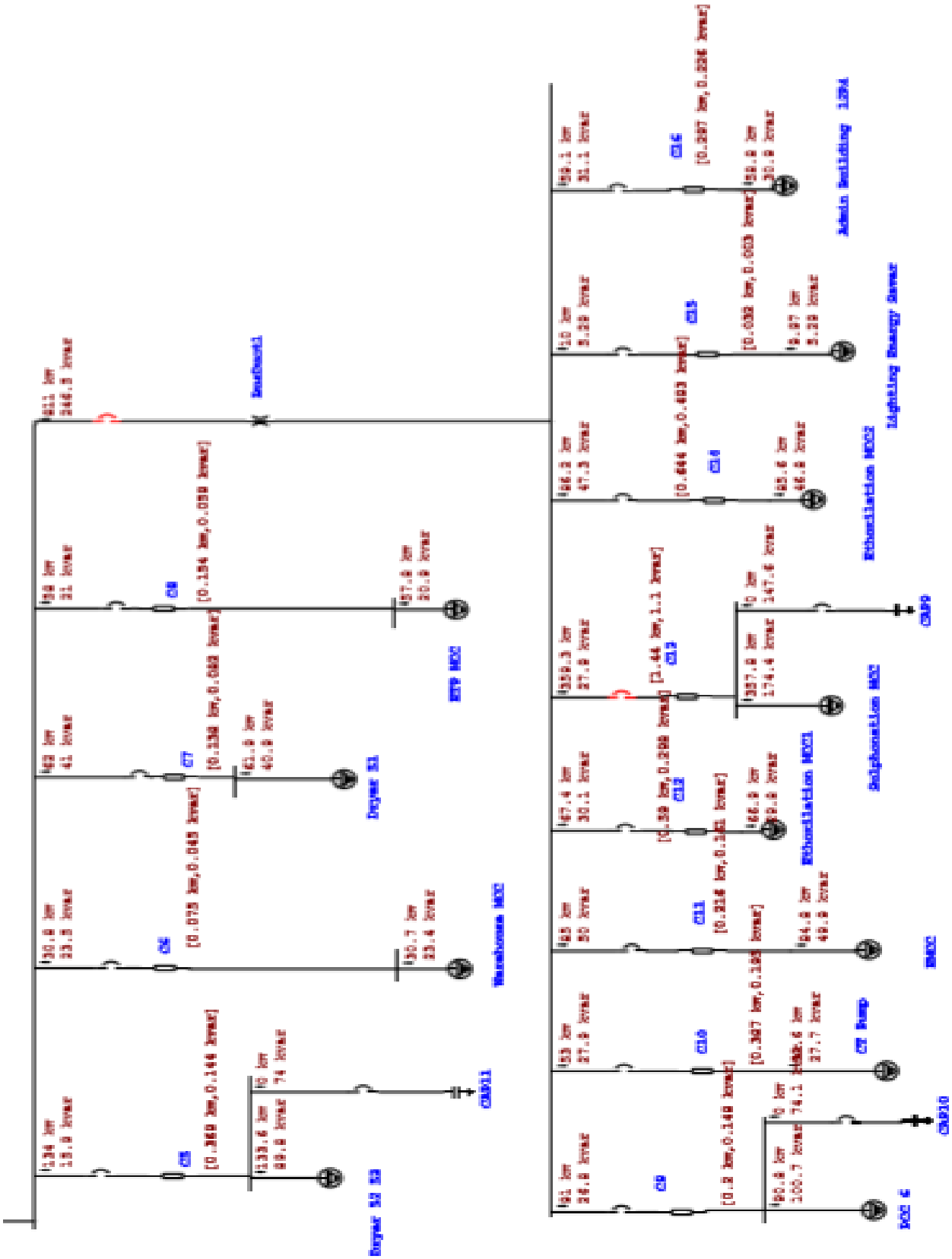
Arching current and arc flash parameters on SLD



SLD synchronized table – showing ARC flash analysis results, Recommended PPEs, Fault clearing time and Fault clearing protective device from SLD

BUS ID	kV (kV)	Bus Gap (mm)	Total Energy (cal/cm²)	PPE Description	AFB (m)	Energy Levels	Final FCT (ms)	Source PD ID
CB1	22			FCT Not determined	0			
HT Distribution	22		132.55	Exceeds Maximum PPE Rating	9.6	> Level G	810	CB1
Bus3	33		368.42	Exceeds Maximum PPE Rating	10.7	> Level G	450	CB2
Bus4	33		149.82	Exceeds Maximum PPE Rating	6.8	> Level G	183	CB3
Bus5	33		84.4	Exceeds Maximum PPE Rating	5.1	Level F	103	CB5
Bus20	0.433	32	8.55	Multilayer FR flash jacket and FR bib overalls (minimum arc rating of 4) or FR long-sleeve shirt and FR pants (minimum arc rating of 4) worn over untreated natural fiber long-sleeve shirt and pants, worn over an untreated cotton T-shirt	2.3	Level D	183	CB4
PCC 7	0.433	32	3.35	FR long-sleeve shirt (minimum arc rating of 4), worn over untreated cotton T-shirt with FR pants (minimum arc rating of 8)	1.2	Level B	103	CB5
P C C 3	0.433	32	21.03	Multilayer FR flash jacket and FR bib overalls (minimum arc rating of 4) or FR long-sleeve shirt and FR pants (minimum arc rating of 4) worn over untreated natural fiber long-sleeve shirt and pants, worn over an untreated cotton T-shirt	4.3	Level D	450	CB2
P C C 2	0.433	32	8.55	Multilayer FR flash jacket and FR bib overalls (minimum arc rating of 4) or FR long-sleeve shirt and FR pants (minimum arc rating of 4) worn over untreated natural fiber long-sleeve shirt and pants, worn over an untreated cotton T-shirt	2.3	Level D	183	CB4
CB8	0.433	32	3.35	FR long-sleeve shirt (minimum arc rating of 4), worn over untreated cotton T-shirt with FR pants (minimum arc rating of 8)	1.2	Level B	103	CB5

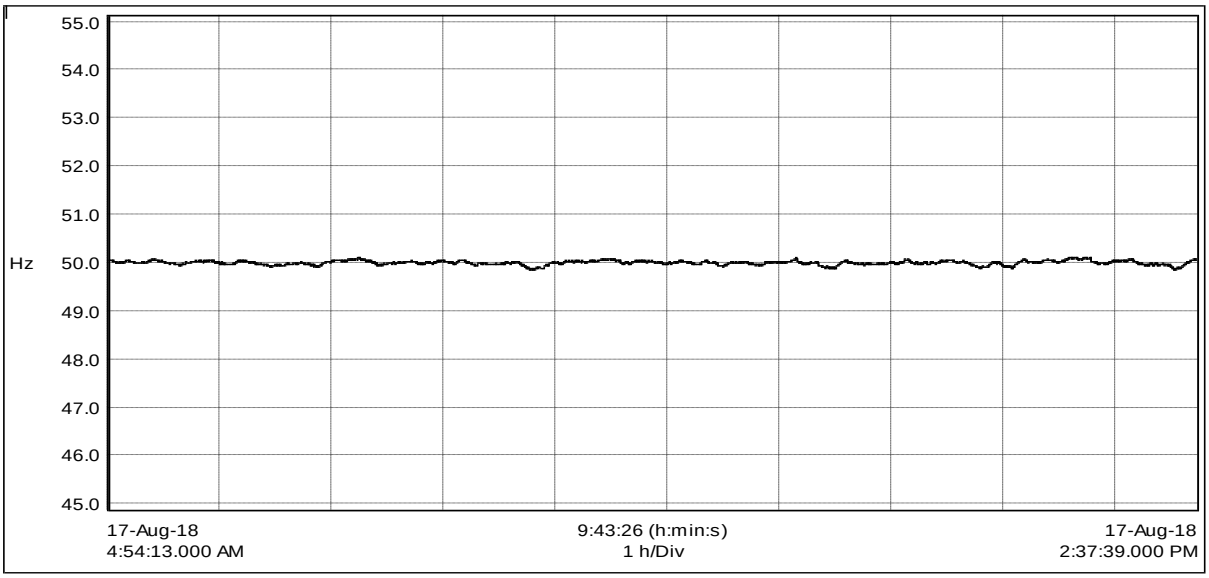
PCC 3 – Transformer 1 Distribution. (This SLDs can have elaborate BOQs and other parameters)



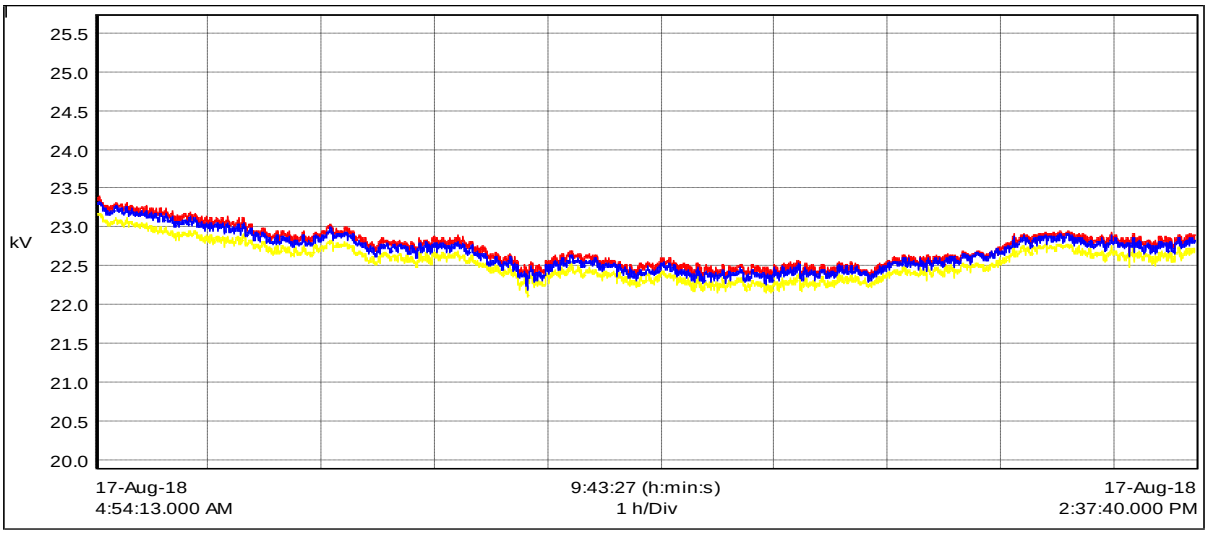
RECORDED DATA OF ALL LOAD PARAMETERS

HT Incomer:

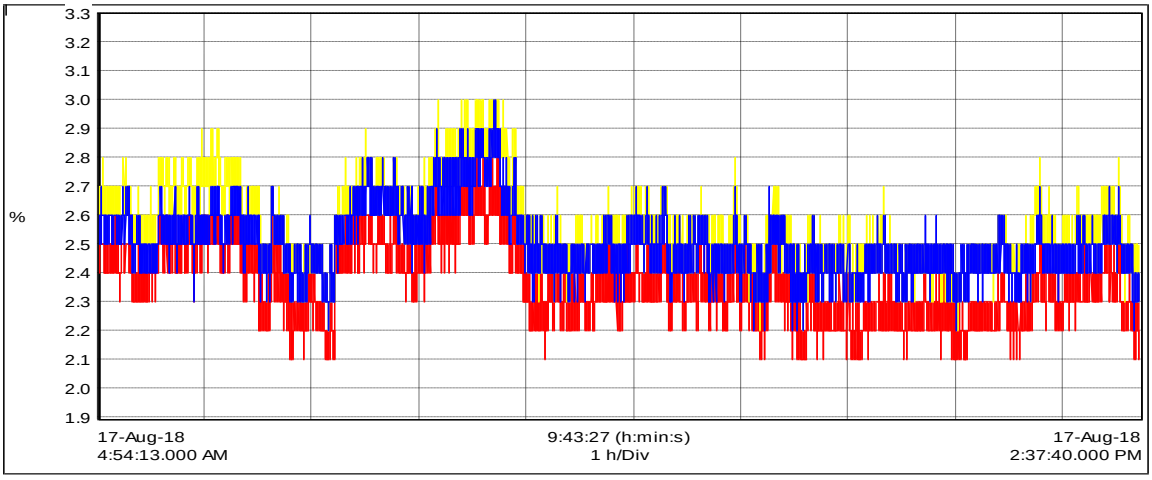
Frequency



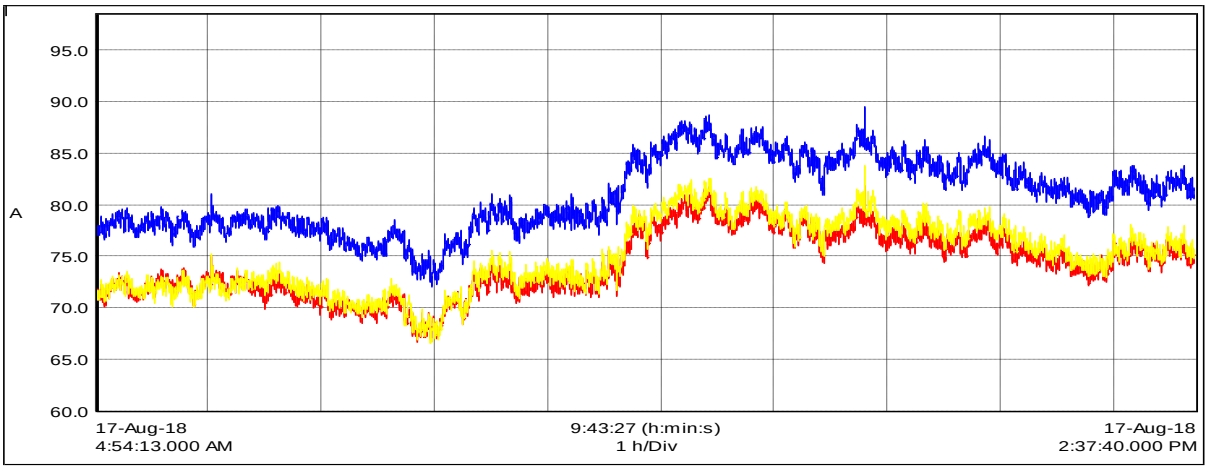
Voltage L-L



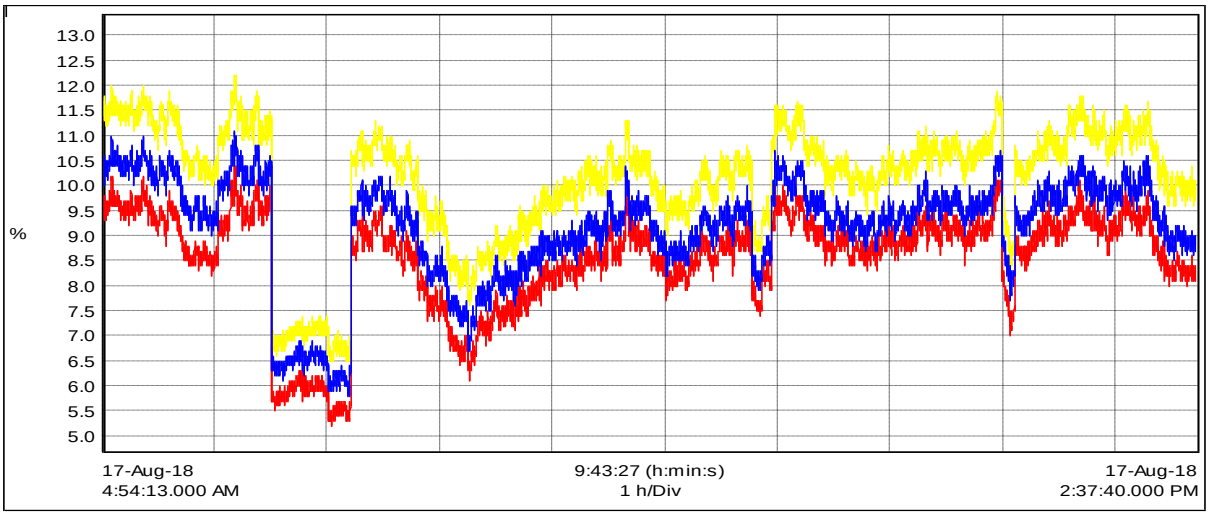
Voltage Harmonic Distortion



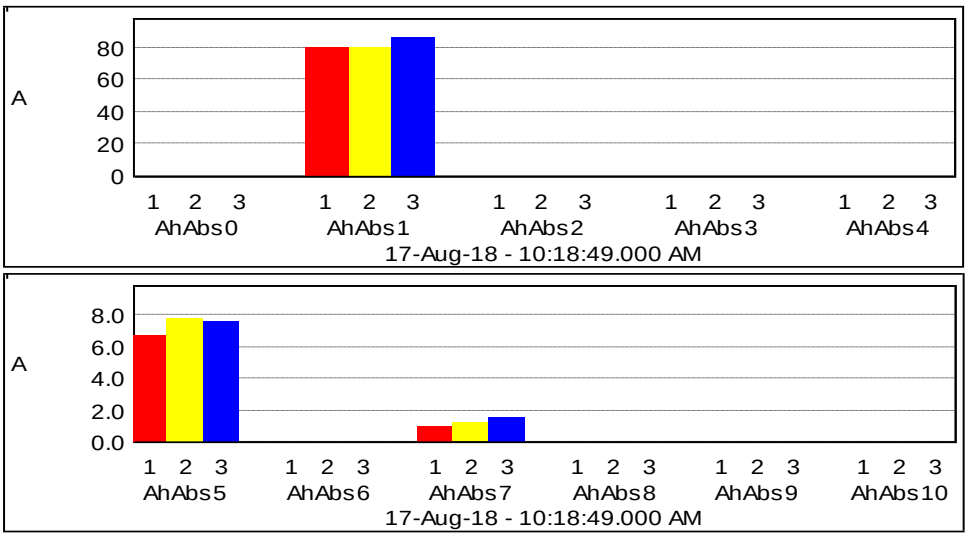
Current

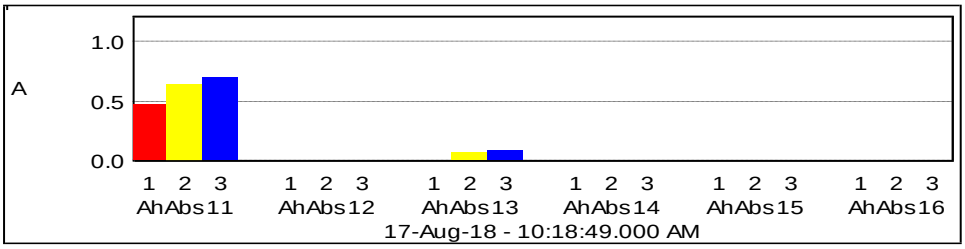


Current Harmonic Distortion



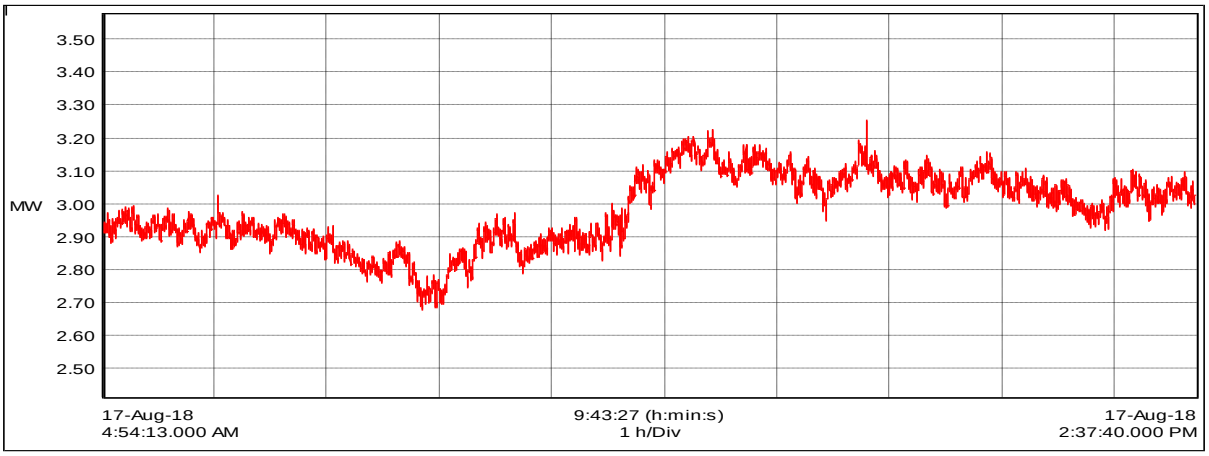
Individual Current Harmonics



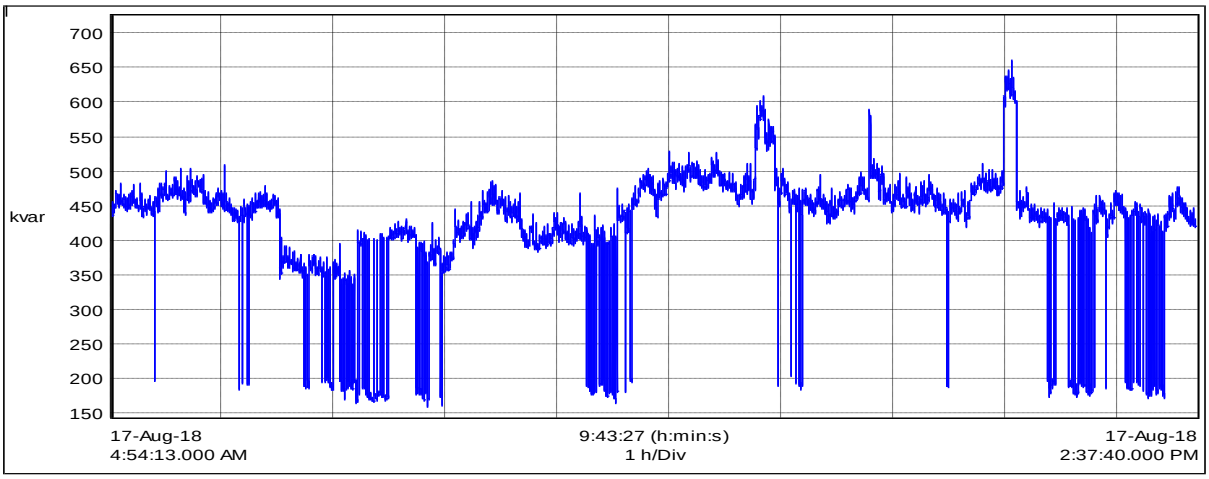


Predominant Current harmonics are 5th, 7th and 11th.

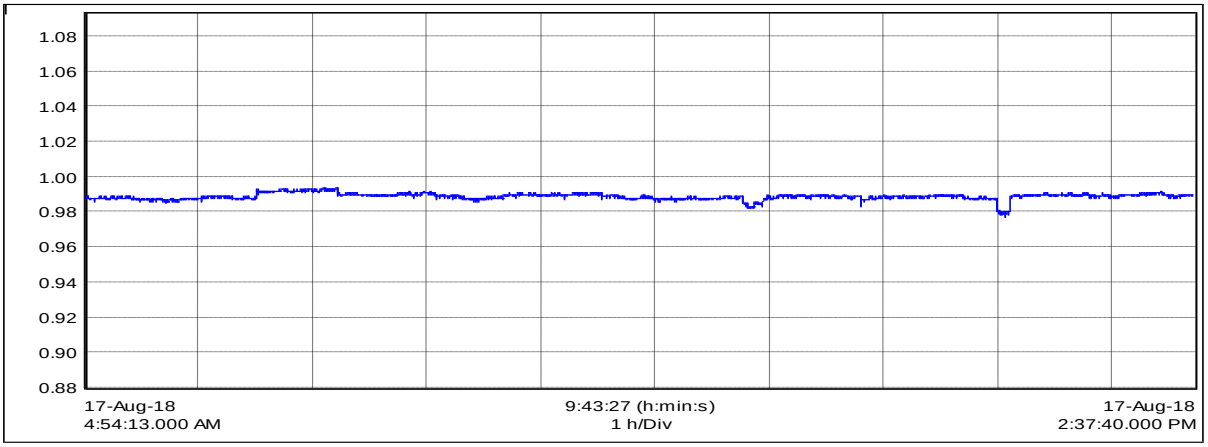
KW



KVAR

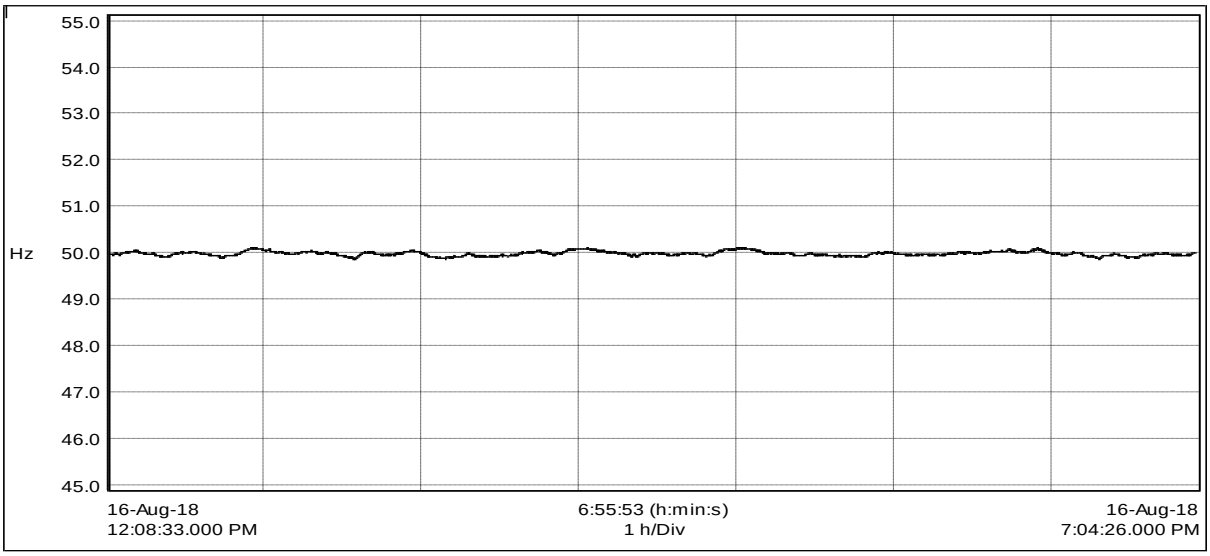


PF

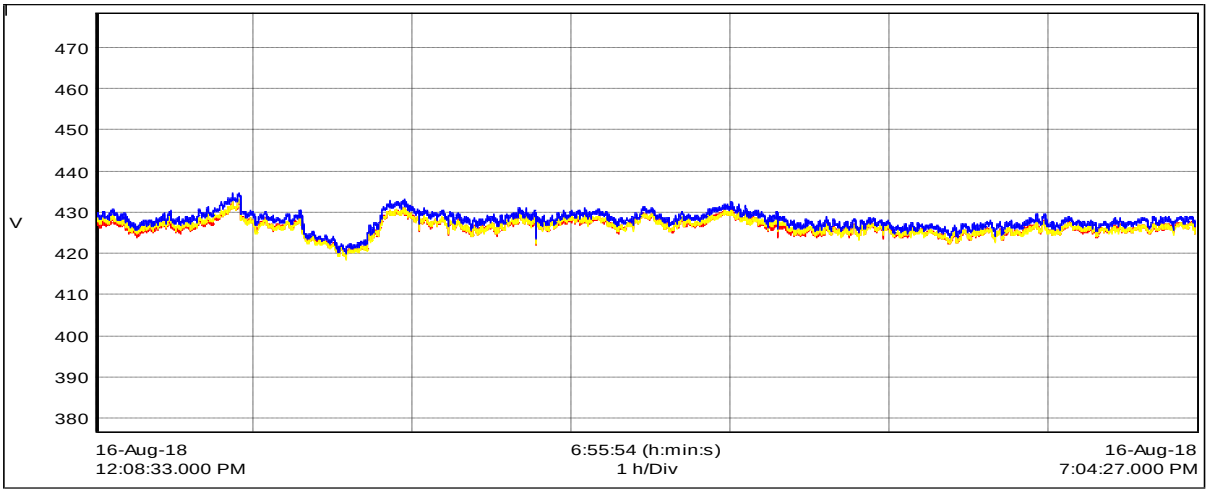


PCC 3 (I/C from TR 1) – Main Incomer :

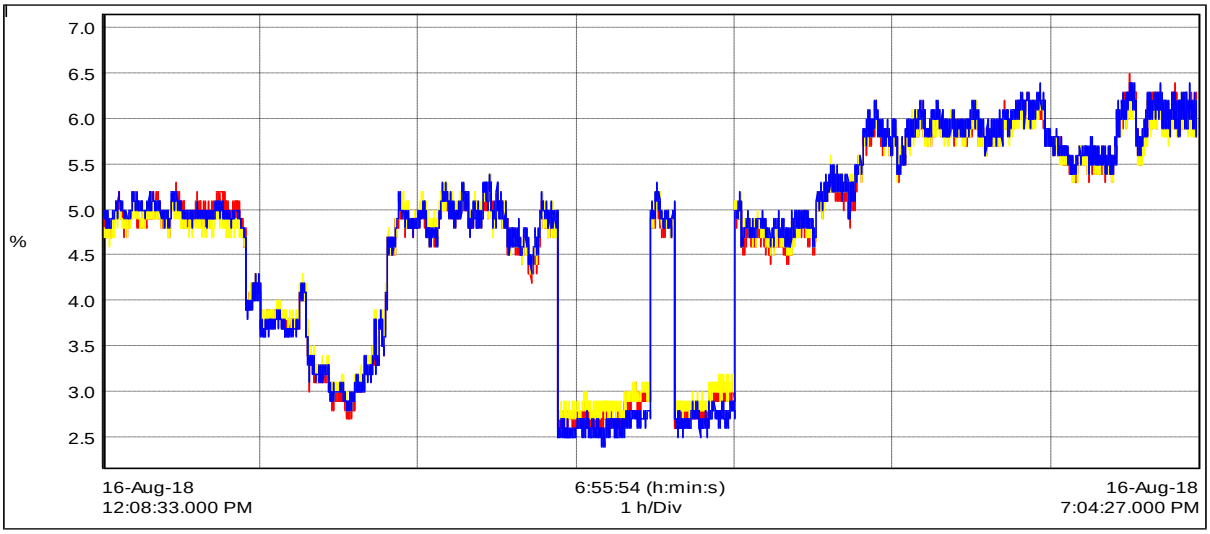
Frequency



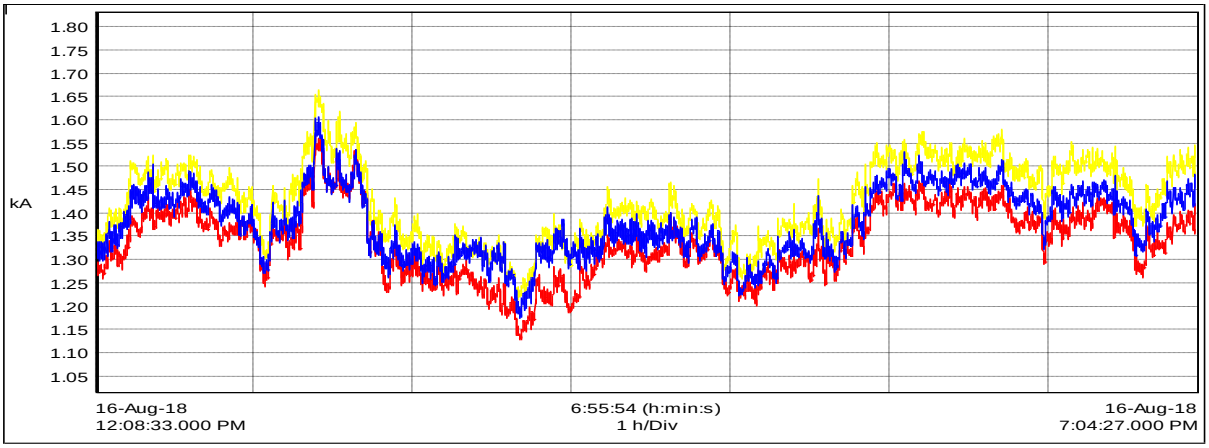
Voltage L-L



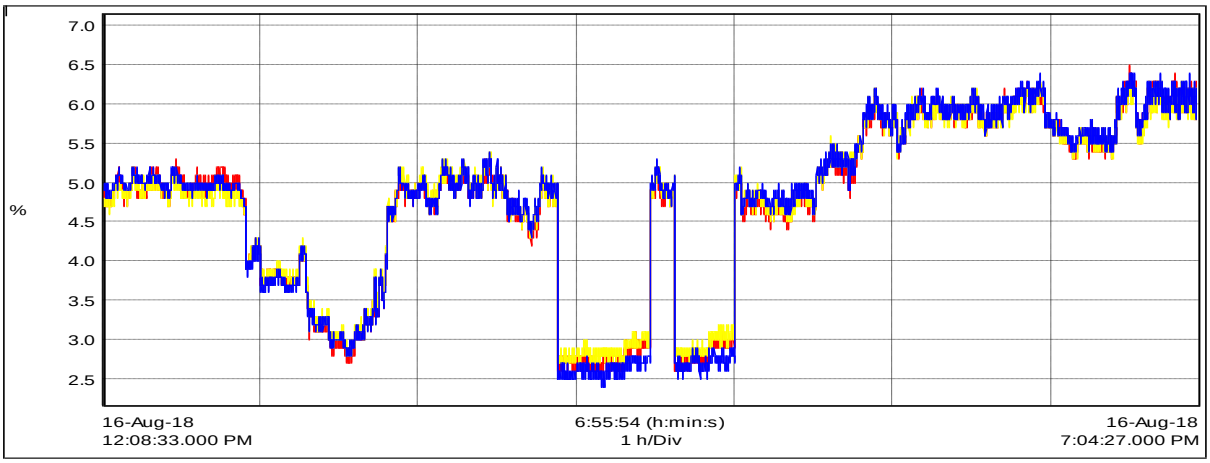
Voltage Harmonic Distortion



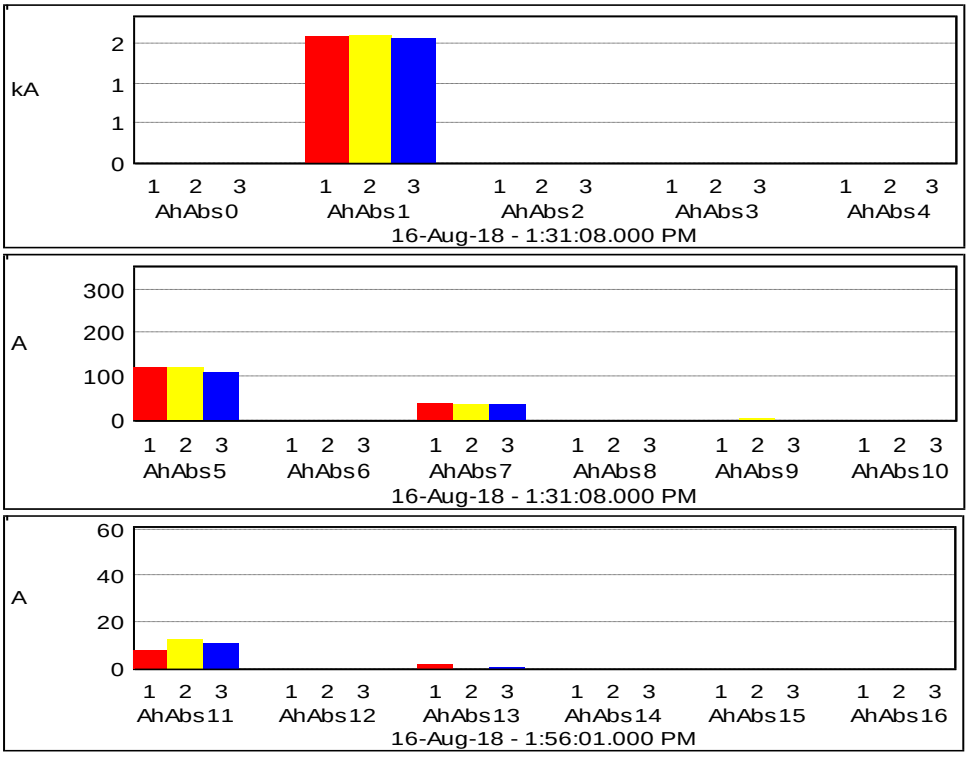
Current



Current Harmonic Distortion

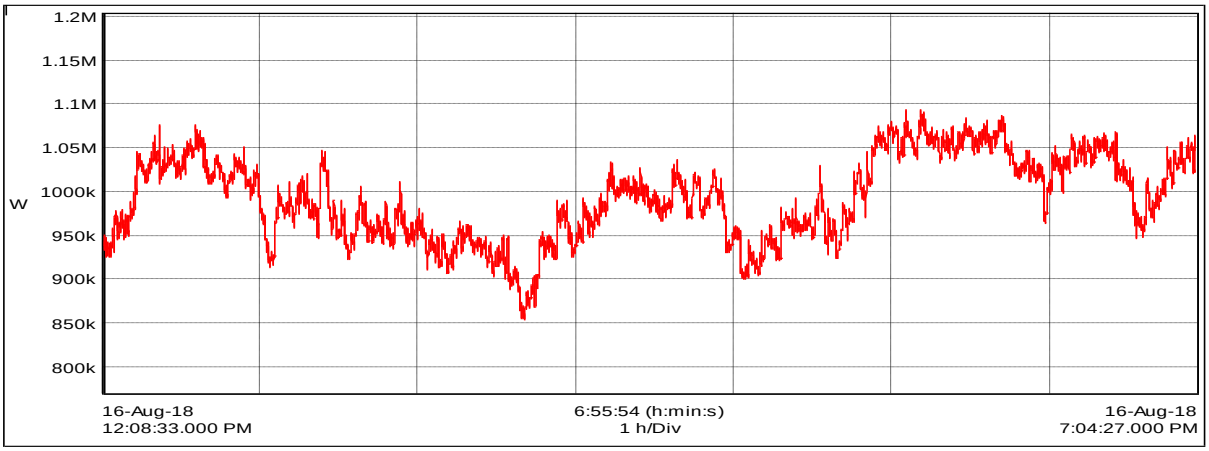


Individual Current Harmonics

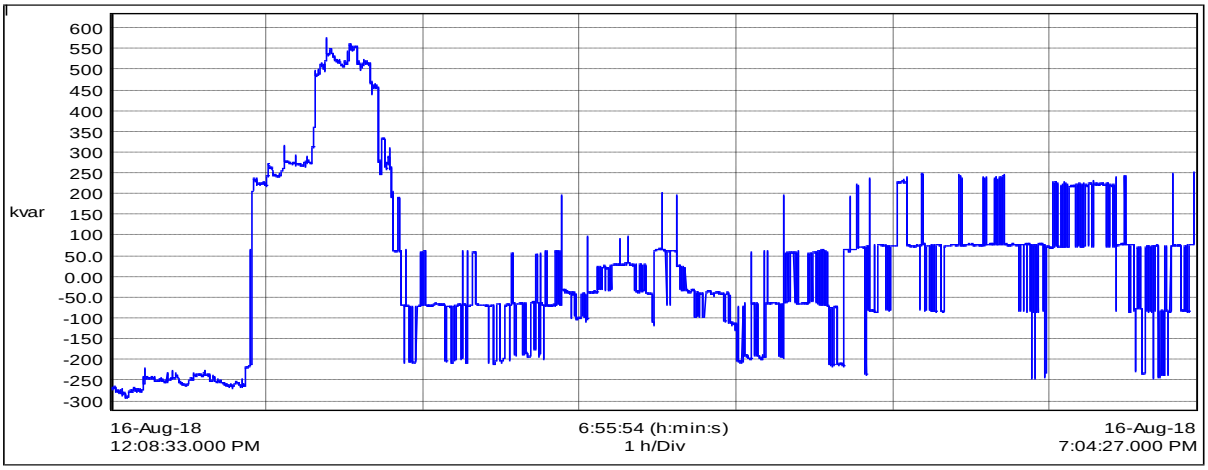


Predominant Current harmonics are 5th, 7th and 11th.

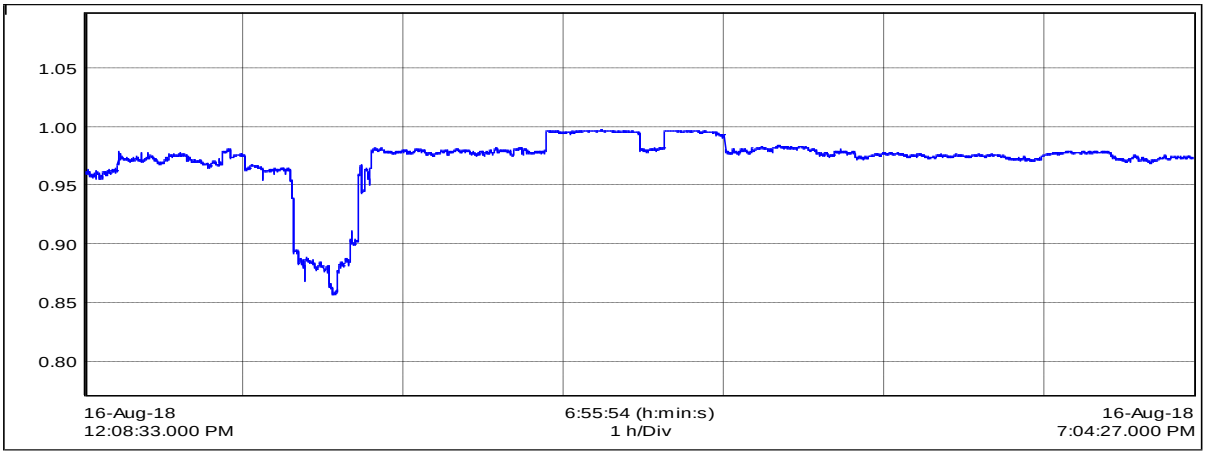
KW


1.2M
1.15M
1.1M
1.05M
1000k
950k
900k
850k
800k
W
16-Aug-18
12:08:33.000 PM
6:55:54 (h:min:s)
1 h/Div
16-Aug-18
7:04:27.000 PM

KVAR

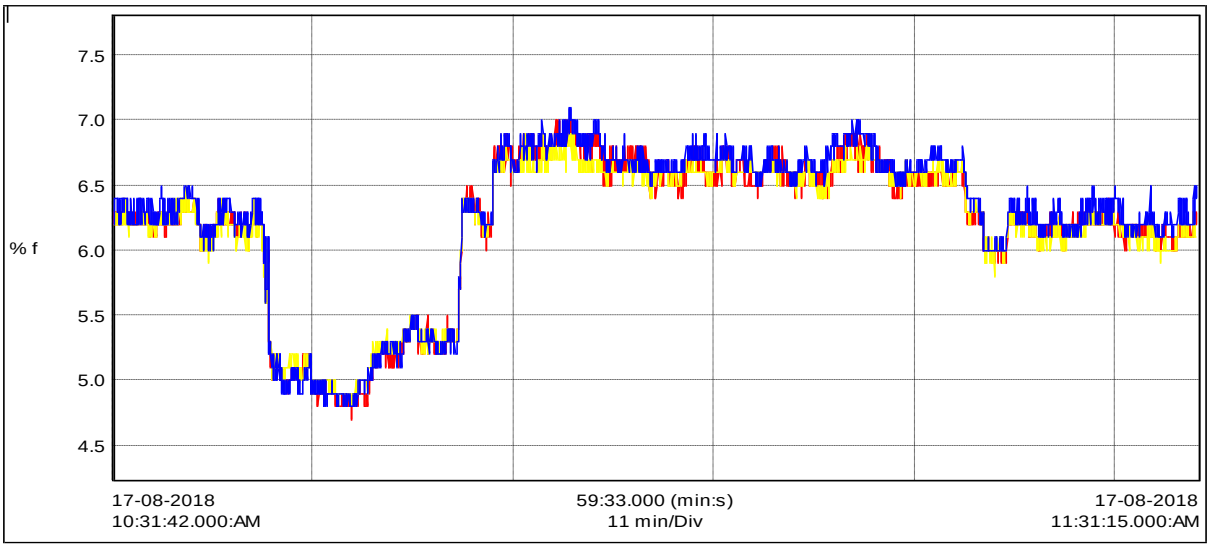

600
550
500
450
400
350
300
250
200
150
100
50.0
0.00
-50.0
-100
-150
-200
-250
-300
kvar
16-Aug-18
12:08:33.000 PM
6:55:54 (h:min:s)
1 h/Div
16-Aug-18
7:04:27.000 PM

PF

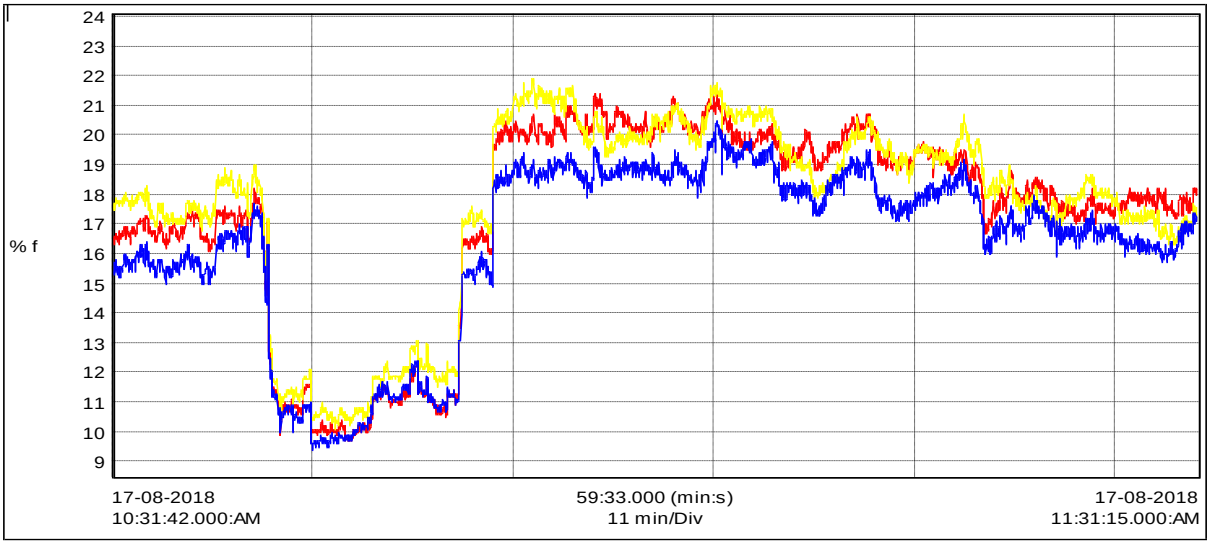

1.05
1.00
0.95
0.90
0.85
0.80
16-Aug-18
12:08:33.000 PM
6:55:54 (h:min:s)
1 h/Div
16-Aug-18
7:04:27.000 PM

PCC 1 (I/C from PCC 3) – Main Incomer :

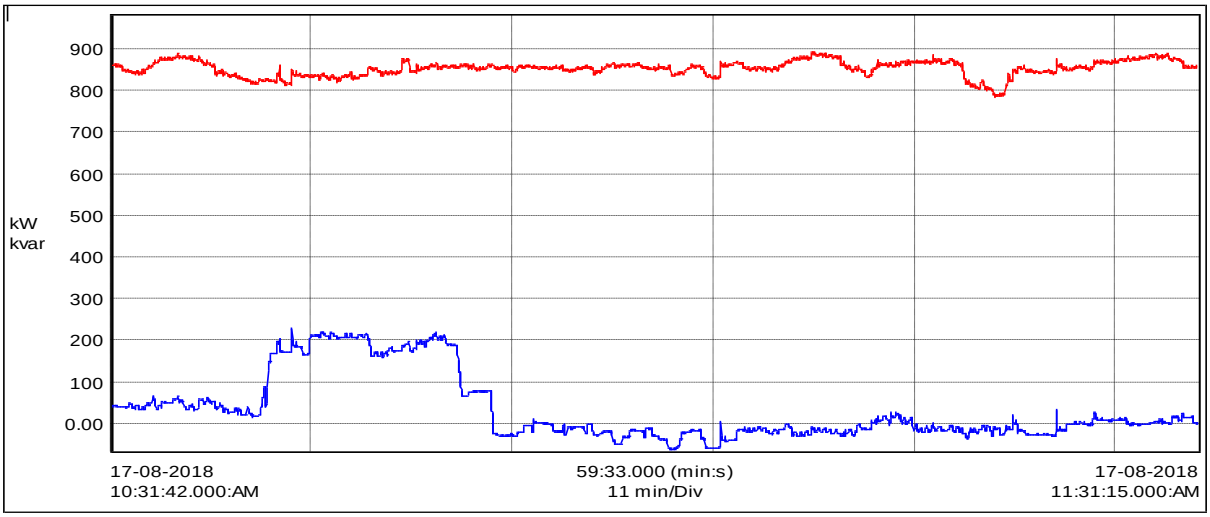
Voltage Harmonic Distortion



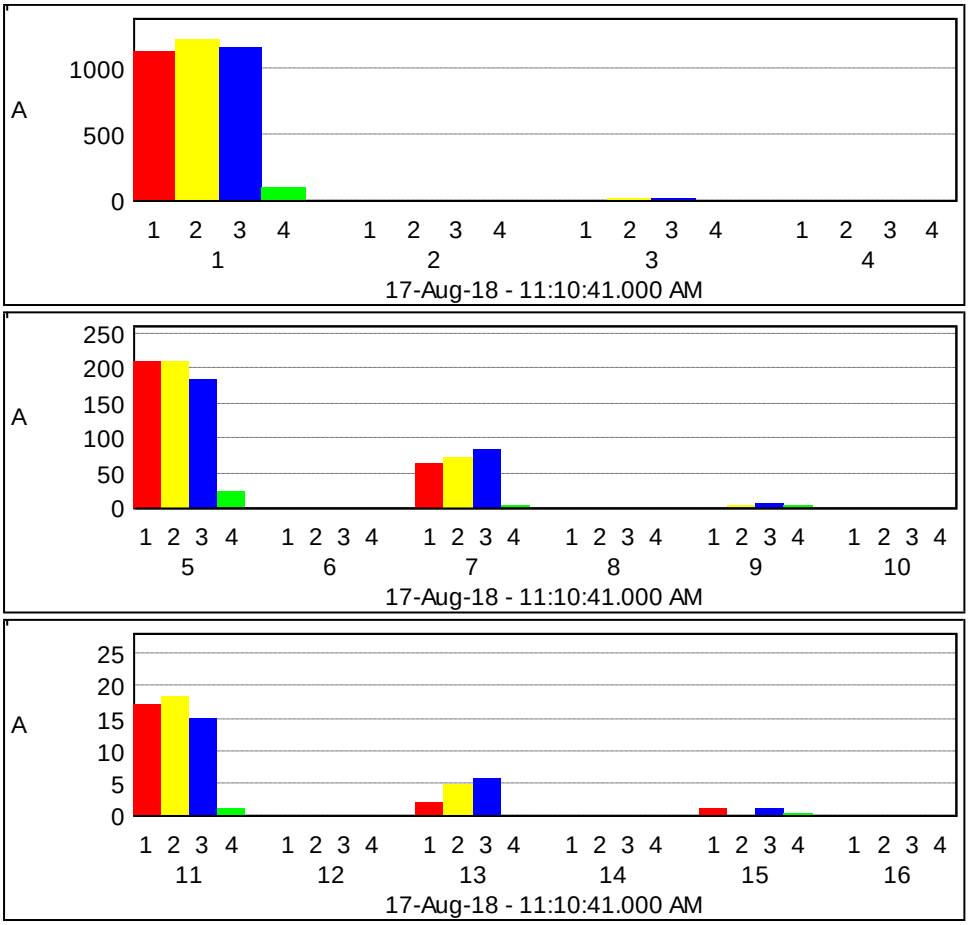
Current Harmonic Distortion



KW, KVAR



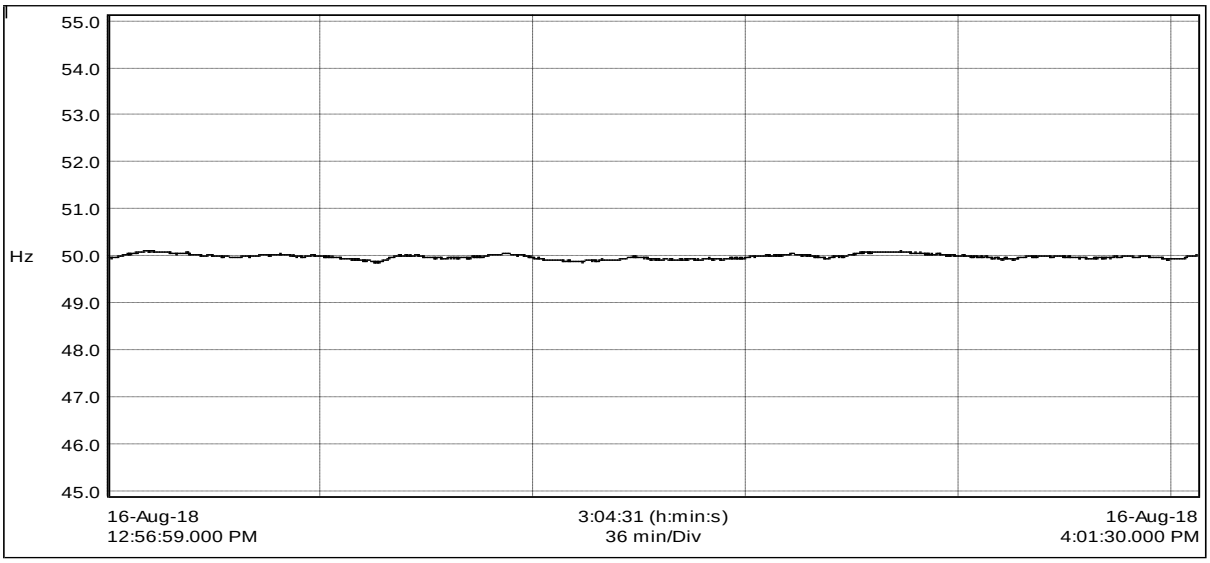
Individual Current Harmonics



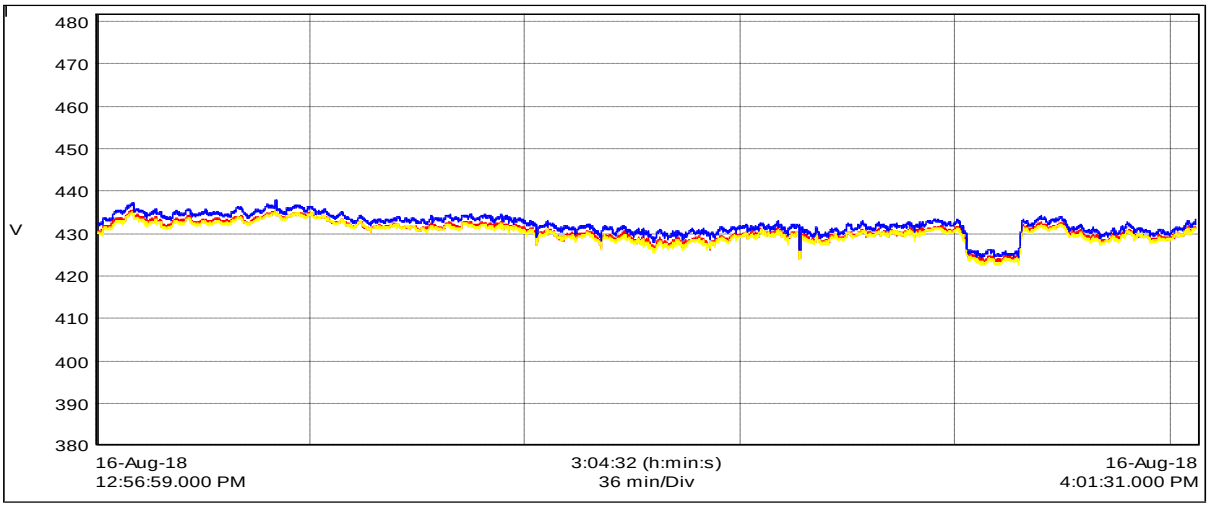
Predominant Current harmonics are 5^{th}, 7^{th} and 11^{th}.

PCC 7 MED (I/C from TR 3)– Main Incomer :

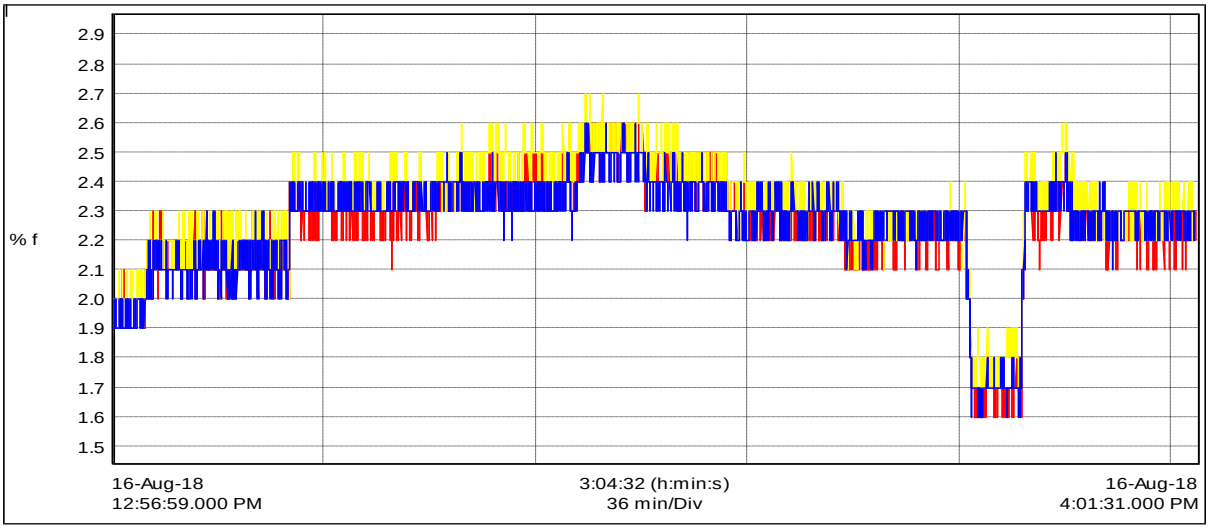
Frequency



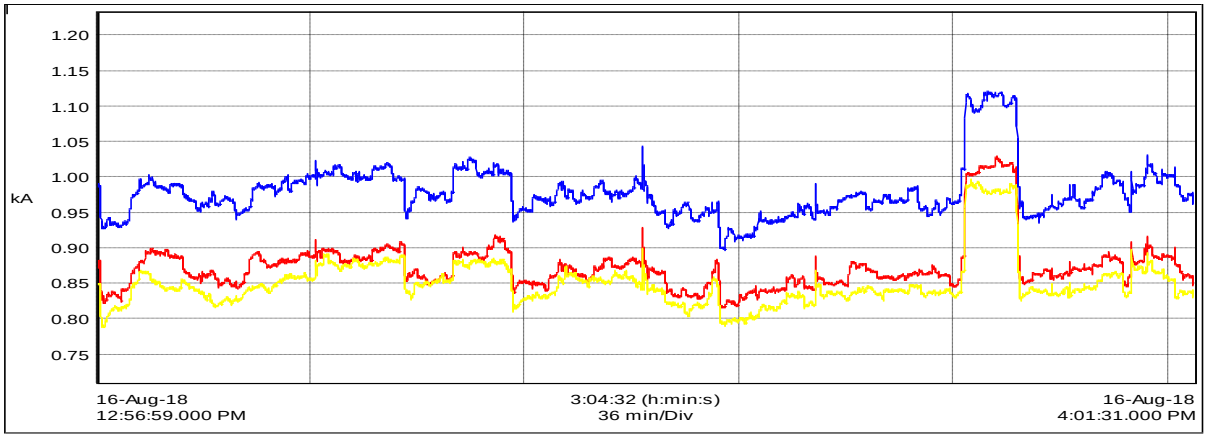
Voltage L-L



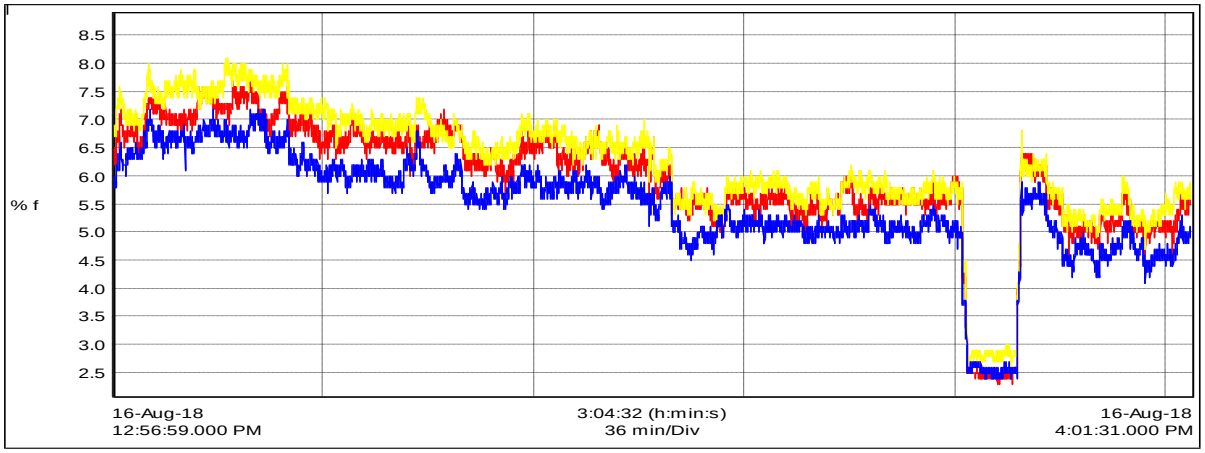
Voltage Harmonic Distortion



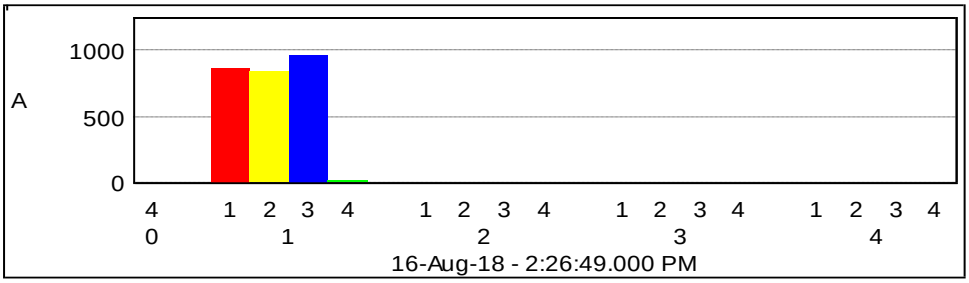
Current

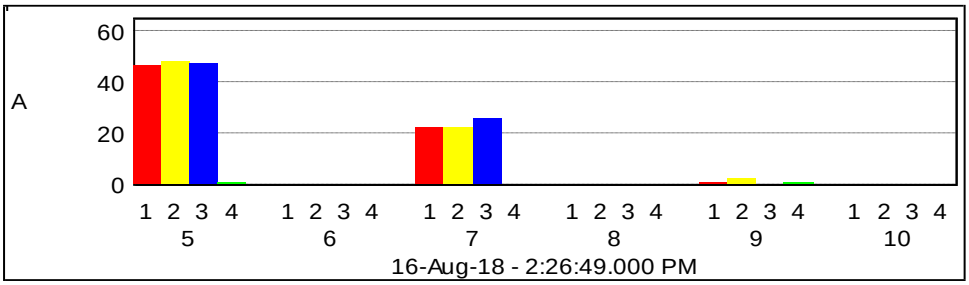


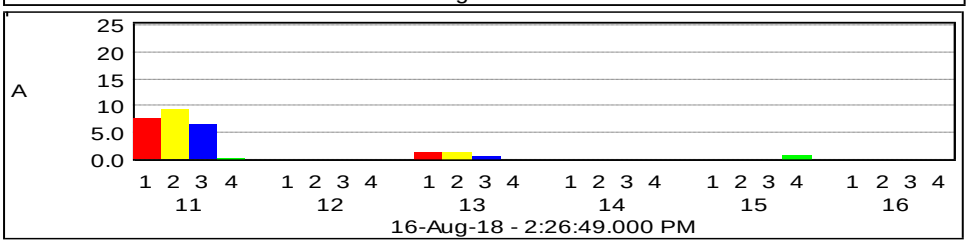
Current Harmonic Distortion



Individual Current Harmonics

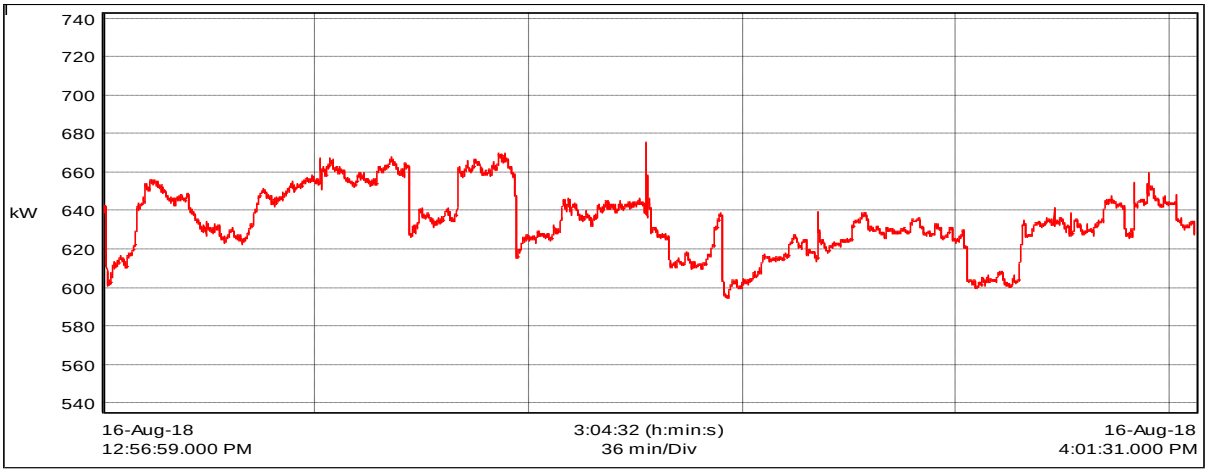




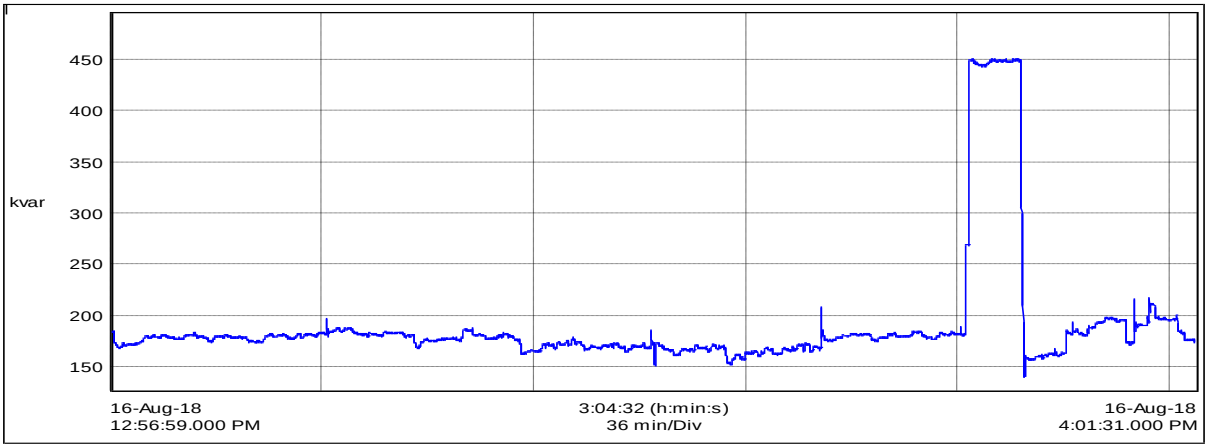


Predominant Current harmonics are 5th, 7th and 11th.

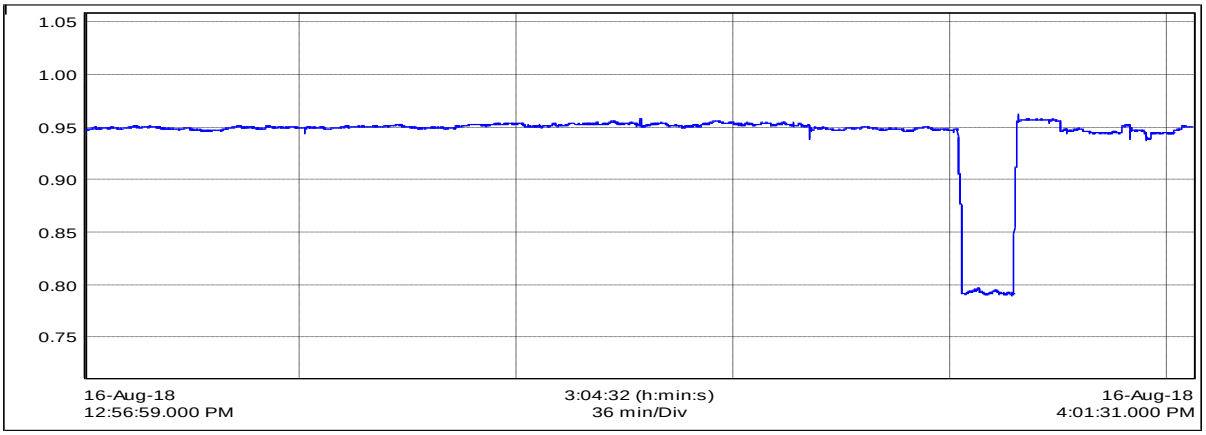
KW


740
720
700
680
660
640
620
600
580
560
540
kW
16-Aug-18
12:56:59.000 PM
3:04:32 (h:min:s)
36 min/Div
16-Aug-18
4:01:31.000 PM

KVAR

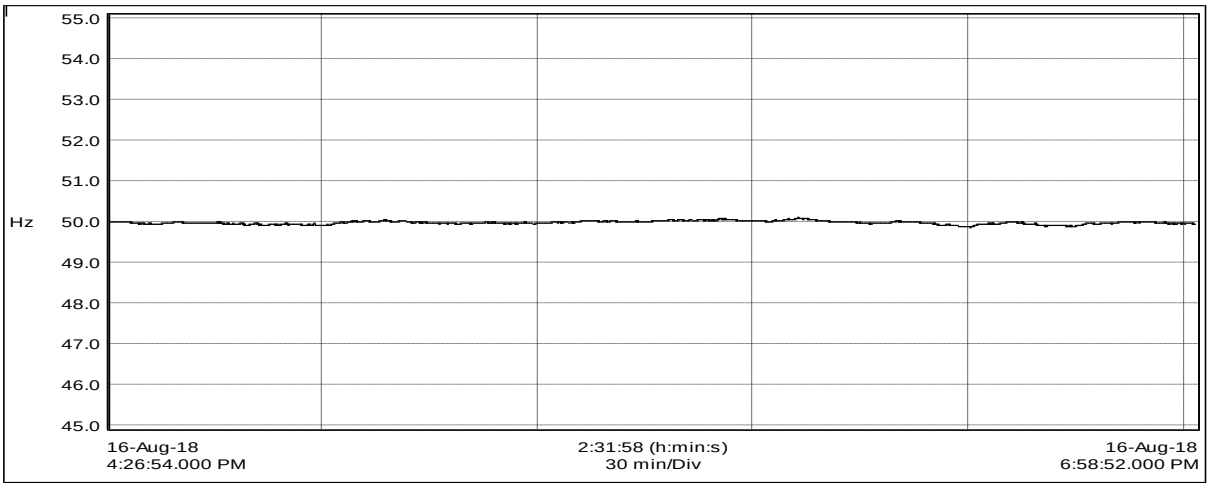

450
400
350
300
250
200
150
kvar
16-Aug-18
12:56:59.000 PM
3:04:32 (h:min:s)
36 min/Div
16-Aug-18
4:01:31.000 PM

PF

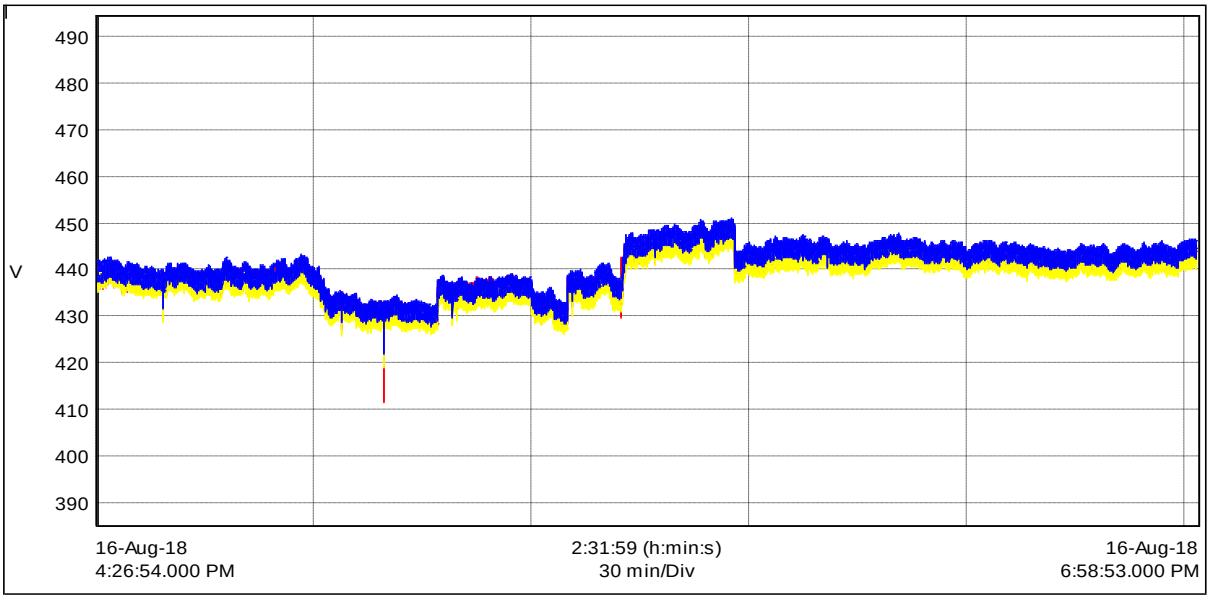

1.05
1.00
0.95
0.90
0.85
0.80
0.75
16-Aug-18
12:56:59.000 PM
3:04:32 (h:min:s)
36 min/Div
16-Aug-18
4:01:31.000 PM

PCC 5 (I/C from TR 2) – Main Incomer :

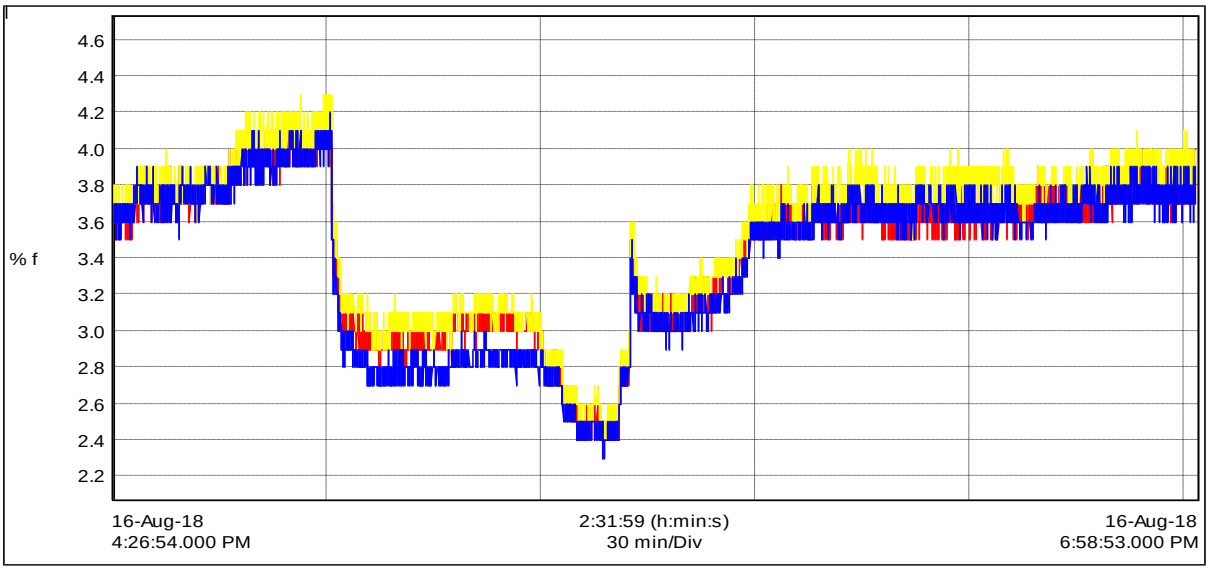
Frequency



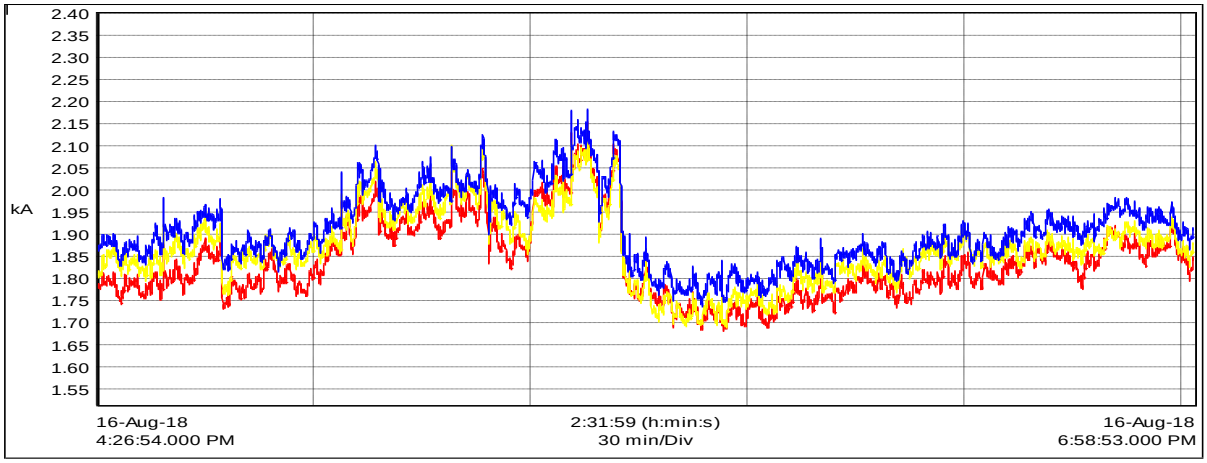
Voltage L-L



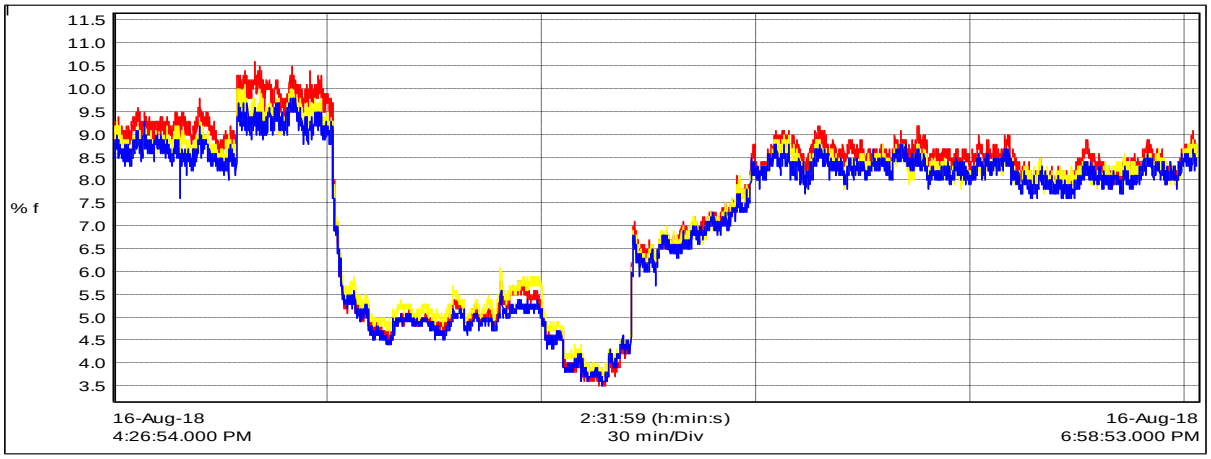
Voltage Harmonic Distortion



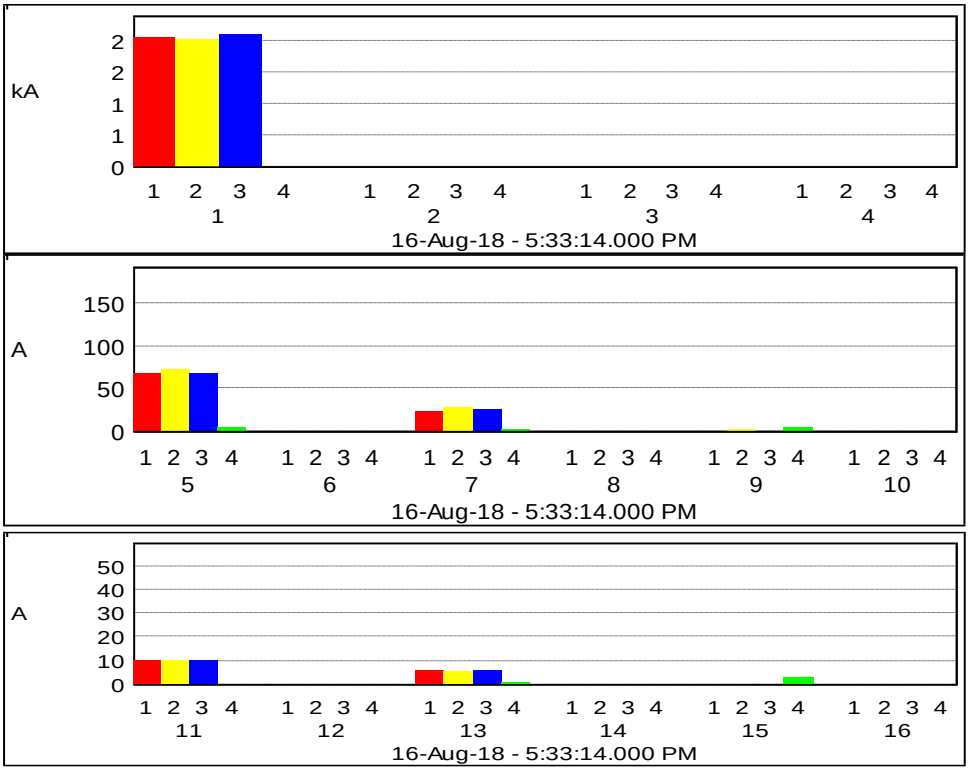
Current



Current Harmonic Distortion

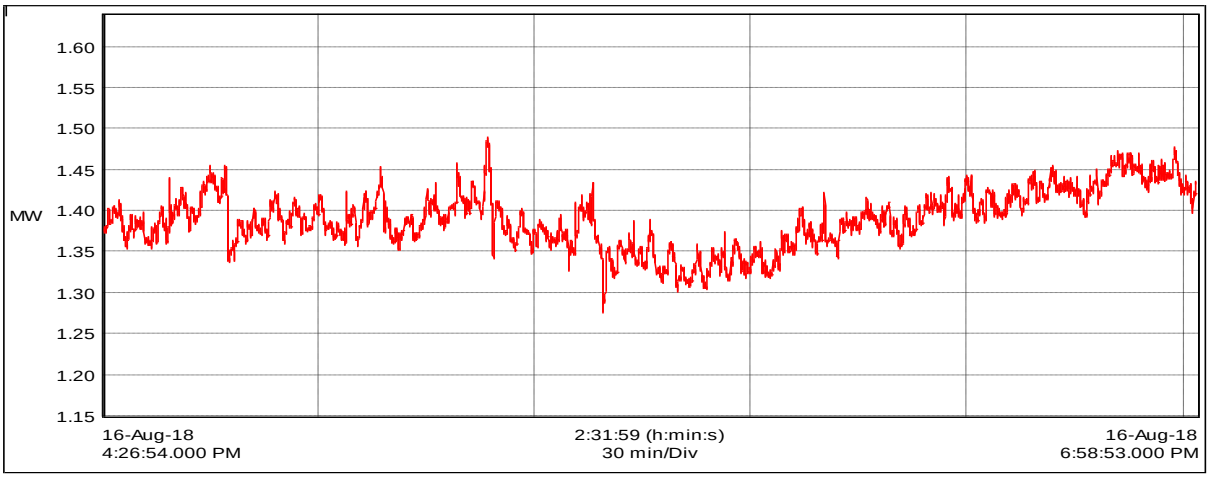


Individual Current Harmonics

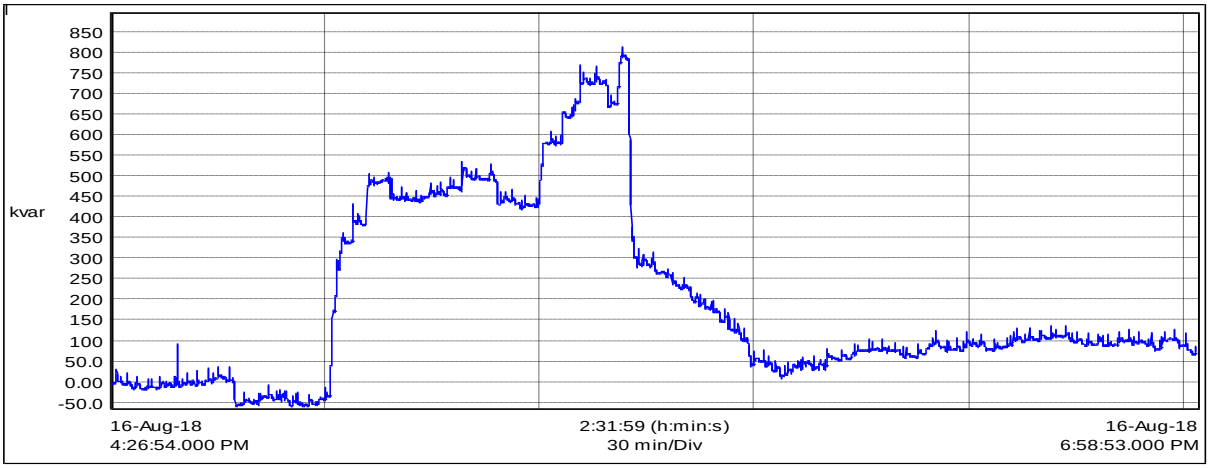


Predominant Current harmonics are 5th, 7th and 11th.

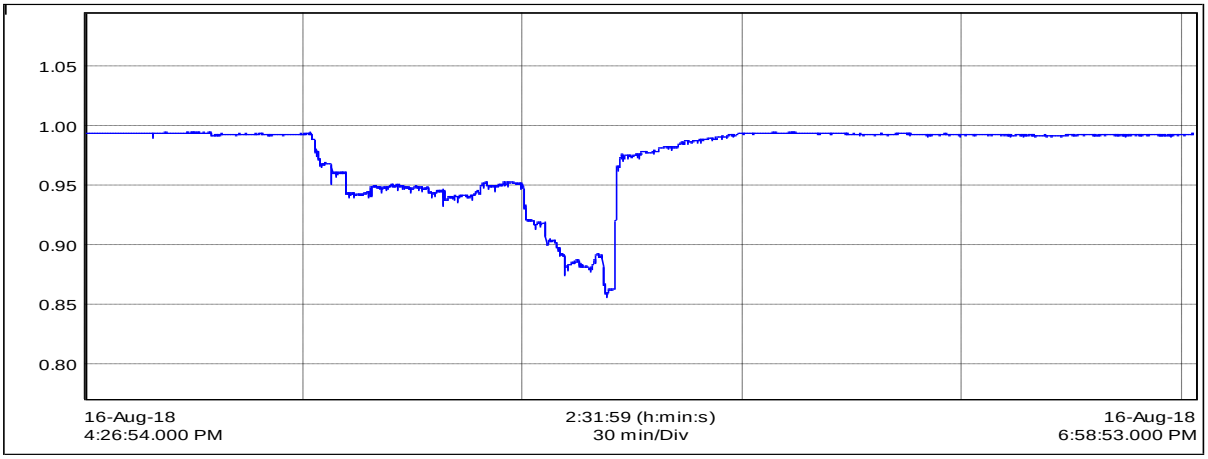
KW


MW
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
16-Aug-18
4:26:54.000 PM
2:31:59 (h:min:s)
30 min/Div
16-Aug-18
6:58:53.000 PM

KVAR

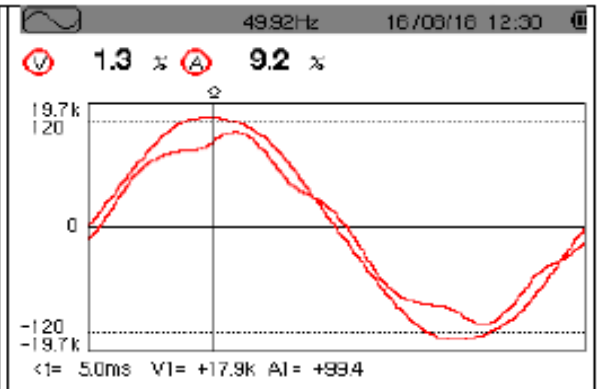

kvar
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50.0
0.00
-50.0
16-Aug-18
4:26:54.000 PM
2:31:59 (h:min:s)
30 min/Div
16-Aug-18
6:58:53.000 PM

PF


1.05
1.00
0.95
0.90
0.85
0.80
16-Aug-18
4:26:54.000 PM
2:31:59 (h:min:s)
30 min/Div
16-Aug-18
6:58:53.000 PM

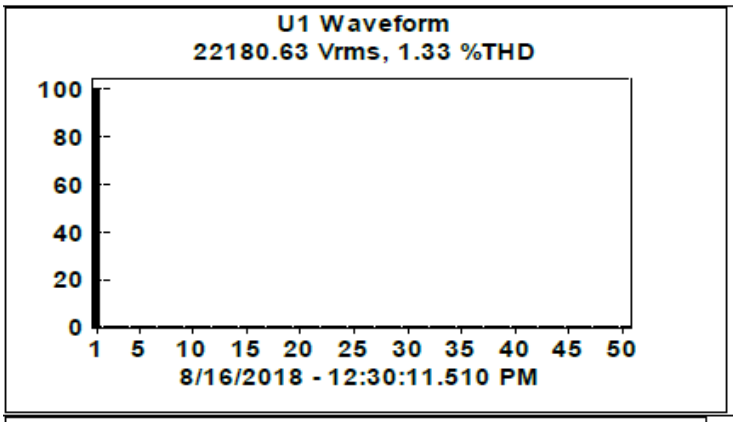
U1 Waveform

	(%)		(%)		(%)
H01	100.0	H18	0.0	H35	0.1
H02	0.0	H19	0.1	H36	0.1
H03	0.2	H20	0.0	H37	0.1
H04	0.0	H21	0.0	H38	0.0
H05	1.3	H22	0.0	H39	0.0
H06	0.0	H23	0.0	H40	0.0
H07	0.1	H24	0.0	H41	0.0
H08	0.0	H25	0.0	H42	0.0
H09	0.0	H26	0.0	H43	0.1
H10	0.0	H27	0.0	H44	0.0
H11	0.1	H28	0.0	H45	0.0
H12	0.0	H29	0.0	H46	0.0
H13	0.0	H30	0.0	H47	0.0
H14	0.0	H31	0.0	H48	0.0
H15	0.0	H32	0.0	H49	0.0
H16	0.0	H33	0.0	H50	0.0
H17	0.1	H34	0.0		

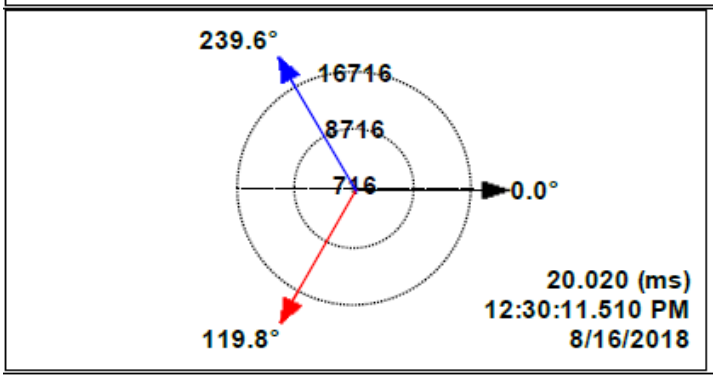


Recorded current and voltage waveforms

Recorded voltage harmonic spectrum ON LOAD.



Recorded RMS amplitude and harmonic spectrum of voltage

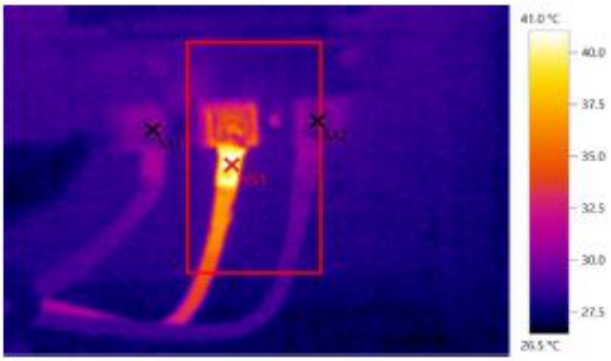


Recorded phase angle between HT Input line voltage.

Sample Base line thermography results -

IR Thermography Report

File:	IV_00215.BMT			**Date:**	30-11-2018
lens type:	Standard 32°	**lens serial no.:**	20244107	**Measuring Time:**	12:07:45:PM



Picture parameters:

Emissivity:	0.95
Refl. temp. [°C]:	20.0

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	30.1	0.95	20.0	-
Measure point 2	29.7	0.95	20.0	-
Hot spot 1	41.0	0.95	20.0	-

Remarks:
Location : 3rd Floor AHU-1 Panel MCCB.
Remark : Bottom side Y-Phase Lug loose.
Recommendation : Replace Lug with proper size.

CEA 2010 Compliance document (Form IV) -

STATUTORY SAFETY REQUIRMENT AS PER CEA 2010			
Sr. No	Regulation No.	Requirements	Report
8	Regulation 21	Whether flexible cables used for portable or transportable equipment covered under the regulation, are heavily insulated & adequately protected from mechanical injury	Yes
9	Regulation 24	Whether all circuits operated at different voltage level are distinguishable by means of some indication of permanent nature	Yes
11	Regulation 28	Whether instructions in English or Hindi and local language for the resuscitation of a person suffering from shock have been affixed	Yes
12	Regulation 35	Whether a suitable link switch or circuit breaker is placed near the point of commencement of supply so as to be readily accessible and operated to completely isolate the supply	**Most of the switchgears are over sized, the measured load current is small that it may not provide overload Protection.**
		Whether every circuit is protected against excess electricity by means of suitable circuit breaker.	
		Whether suitable linked switch or circuit breaker is provided near each motor or apparatus for controlling supply to the motor or apparatus	
		Whether adequate precautions are taken to ensure that no live parts are so exposed as to cause danger	Yes
13	Regulation 37	Whether clear space of 100 cm is provided in front of main switchboard	Yes
14	Regulation 41	Have the frame of every generator stationary motor and so far as practicable portable motor and the metallic parts of all transformer and any other apparatus used for regulating and controlling electricity at voltage exceeding 250 Volts but not exceeding 650 Volts been earthed by two separate and distinct connection with earth	Yes
		Is the earth wire free from any mechanical damage?	YES – No visible damage observed.

Current harmonic compliance document with TDD calculations –

MSEDCL MVA	50
% IMPEDANCE	14.23
MSEDCL SC MVA	351.3703
CONTRACT DEMAND IN KVA	4000
CONTRACT DEMAND IN MVA	4
Isc/IL	87.84259

TDD is TOTAL DEMAND DISTORTION IN CURRENT. This is same as harmonic distortion measured at maximum current at common HT incomer of the plant.

Maximum harmonic current distortion in percentage of IL for voltages less than 69KV						
Individual harmonic order (odd harmonics)						
Isc/IL	<11h	11≤h<17	17≤h<23	23≤h<35	35≤h<49	TDD % Allowed
<20	4	2	1.5	0.6	0.3	5
20<50	7	3.5	2.5	1	0.5	8
50<100	10	4.5	4	1.5	0.7	12
100<1000	12	5.5	5	2	1	15
>1000	15	7	6	3.5	1.4	20
Even harmonics are limited to 25% of odd harmonic limits above.						

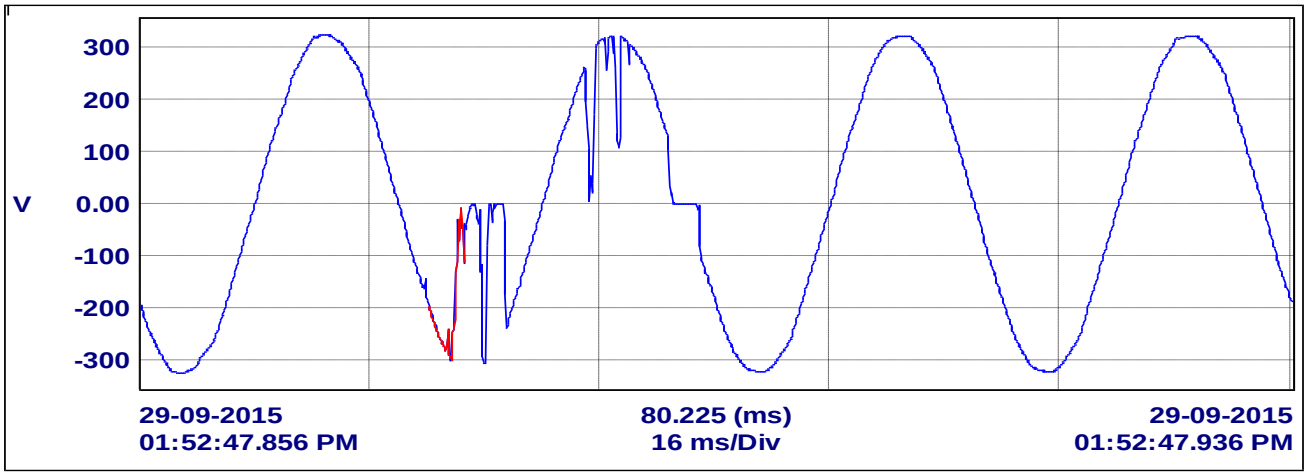
As shown in table above for values of ISC/IL ranging from <20 to >1000 and for voltages <69KV compliance limits for individual harmonics and those for TDD are specified. TDD should be less than 12% and Individual harmonics (<11th order) should be less than 10%. As shown in table and calculations on next page, plant is compliant to both these requirements.

Current harmonic compliance document with TDD calculations –

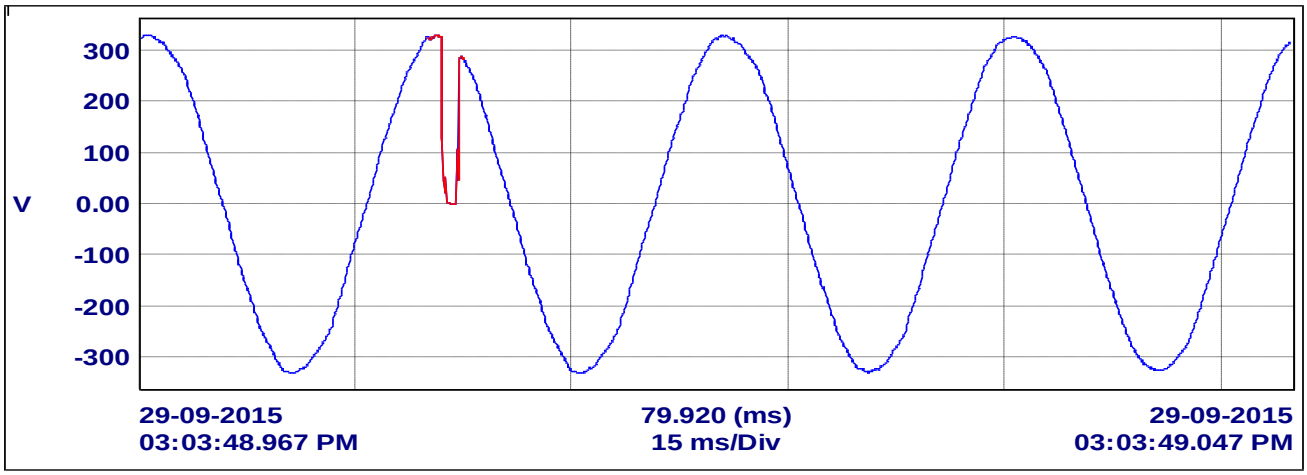
Analysis of Current harmonic distortion				Recorded % VTHD at IF Max	
TimeStamp of IF Max		Current Amps	% Distortion		Volts
17-08-2018	IFmax in B	88.02			
10:17:20:AM	Ih2	0.08802	0.1	Vh2	0
	Ih3	0.96822	1.1	Vh3	1
	Ih4	0	0	Vh4	0
	Ih5	7.83378	8.9	Vh5	2.6
	Ih6	0	0	Vh6	0
	Ih7	1.67238	1.9	Vh7	0.7
	Ih8	0	0	Vh8	0
	Ih9	0	0	Vh9	0.4
	Ih10	0	0	Vh10	0
	Ih11	0.61614	0.7	Vh11	0.1
	Ih12	0	0	Vh12	0
	Ih13	0.08802	0.1	Vh13	0.2
	Ih14	0	0	Vh14	0
	Ih15	0	0	Vh15	0.1
	Ih16	0	0	Vh16	0
	Ih17	0	0	Vh17	0.2
	Ih18	0	0	Vh18	0
	Ih19	0	0	Vh19	0
	Ih20	0	0	Vh20	0
	Ih21	0	0	Vh21	0.1
	Ih22	0	0	Vh22	0
	Ih23	0	0	Vh23	0
	Ih24	0	0	Vh24	0
	Ih25	0	0	Vh25	0
	Ih26	0	0	Vh26	0
	Ih27	0	0	Vh27	0
	Ih28	0	0	Vh28	0
	Ih29	0	0	Vh29	0
	Ih30	0	0	Vh30	0
	Ih31	0	0	Vh31	0
	Ih32	0	0	Vh32	0
	Ih33	0	0	Vh33	0
	Ih34	0	0	Vh34	0
	Ih35	0	0	Vh35	0.1
	Ih36	0	0	Vh36	0
	Ih37	0	0	Vh37	0
	Ih38	0	0	Vh38	0
	Ih39	0	0	Vh39	0
	Ih40	0	0	Vh40	0
	Ih41	0	0	Vh41	0
	Ih42	0	0	Vh42	0
	Ih43	0	0	Vh43	0
	Ih44	0	0	Vh44	0
	Ih45	0	0	Vh45	0
	Ih46	0	0	Vh46	0
	Ih47	0	0	Vh47	0
	Ih48	0	0	Vh48	0
	Ih49	0	0	Vh49	0
	Ih50	0	0	Vh50	0
	Sum of sq(A)	66.49753746			
	Sqrt(A)	8.093054891			
	TDD	9.194563611			

Voltage Transient Recordings -

A Machine - Matching transformer secondary



B Machine - Matching transformer secondary



Voltage Alarm Recordings –

Alarm - A Machine TX sec						
Date	**Time**	**Phase**	**Milliseconds**	**Voltage**	**Undervoltage/ Overvoltage**	**Set point**
29-09-2015	01.52.47.870 pm	Y	0.020	307	Undervoltage	
29-09-2015	01.52.47.860 pm	B	0.020	332	Undervoltage	
29-09-2015	03.03.48.970 pm	Y	0.010	370	Undervoltage	

Alarm - B Machine TX sec						
Date	**Time**	**Phase**	**Milliseconds**	**Voltage**	**Undervoltage/ Overvoltage**	**Set point**
29-09-2015	03.25.16.450 PM	R	0.050	206	Undervoltage	
29-09-2015	03.25.16.450 PM	B	0.050	189	Undervoltage	

Intelligent Electrical Document (IED) can also have –

1. Earthing layout and Compliance document as per IS 3024
2. Lightening Protection System Layout and Compliance document as per IS 62305.