Power Quality Audit Report

FOR

A Industrial Textile Manufacturer

Gujarat

By

AB Energia Pvt Ltd.

Audit Period: September 2018

INDEX

Objective and the details of the equipment

Audit objectives:

1. Analysis of recorded power quality parameters.
2. Detailed Pie Charting of loading by major feeders.
3. Identifying sources of harmonics and their individual contribution in Total Harmonic Distortion.
4. Analysis of reactive power compensation.

Details of Equipment Used:

No	Name of the equipment	SR. No., Model	Make	Use
1	Power Analyzer	1645 (CA 8335)	Chauvin Arnoux	Electrical Parameter Measurement
2	Power Analyzer	211885 (CA 8335)	Chauvin Arnoux	Electrical Parameter Measurement
3	Power Analyzer	4377 (CA 8336)	Chauvin Arnoux	Electrical Parameter Measurement

Audit team

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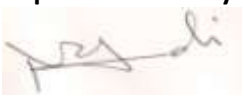
Certification:
Report Certified by:



Narendra R. Duvedi.
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Chartered engineer

Executive Summary:

1) XXXXAAA Industrial textiles is a large textile setup manufacturing industrial textile products. The running electrical plant load is around 8 to 9MW.

2) The last mile loads mainly include lot of machines involving motors with large to medium capacity AC/DC drives. The load is largely divided into process machinery and utility. Such loads demand large harmonic currents.

3) It appears that Reactive power compensation and Harmonic mitigation has not received it's due attention in plant design. Apart from increasing distribution loss within the plant, these two can contribute in reducing life of electrical installation due to overheating and extra stress on insulation. Although VFDs offer lot of flexibility over process in terms of product quality and optimizing energy consumption, they demand lot of harmonic currents, and if not mitigated properly, can generate it's ill effects.

4) We have identified following feeders where an immediate attention and correction is recommended.

Sr. No.	Feeder Name	VTHD% Max	ITHD% Max	KW Max
	Main Incomers			
1	11 KV Feeder 1	5.8	20	4390
2	11 KV Feeder 2	6.4	18.2	6070
				10460
	11KV Feeder 1 / TRAFO 1			
3	Spinning 2	11.1	24.4	1226
5	Utility Compressor	10.5	25	1235
6	Weaving 1	14.7	36.5	861.9
7	Weaving 3	9.9	19.2	1291
	11KV Feeder 2 / TRAFO 2			
8	Utility Chiller	12.1	30	1096
9	Weaving 2	14.1	35	1496
10	Spinning 1	11.1	29.4	1169
				8375

Above load is 80% of total load and the same is nonlinear demanding harmonic currents. The voltage distortion is also too high as above. All loads on these transformers are LT loads and the correction may be offered on LT side. Nature of correction would be detuned filters plus active harmonic filters.

Audit Methodology: -

1. Record for 24hrs, electrical load on both Transformers using high end recording type power analysers to know important parameters like voltage, current, power, harmonic distortion etc.

2. Analyse power quality parameters using recorded data.

3. Prepare detailed load Pie chart using recorded power parameters.

4. Analyse reactive power compensation based on recorded parameters.

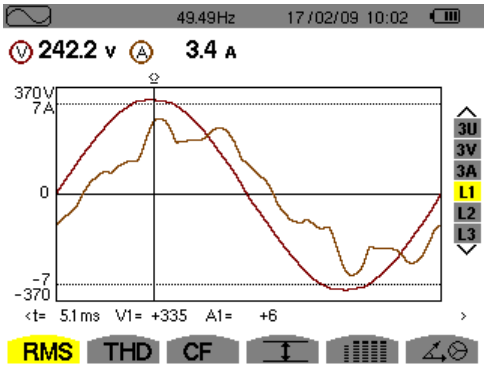
5. Identifying sources of harmonics and their individual contribution in Total Harmonic Distortion.

6. Present report based on above analysis.

A note on Power factor, current and voltage harmonic distortion

1. Power factor is characteristics of load and varies from -1 - 0 +1. Resistive loads like bulbs, heaters etc take current at unity power factor (i.e.1).Other loads like electric motors, computers, UPS systems, tube lights etc take current at power factors which are less than 1.
2. Electrical Power = $V \times I \times Cos\phi(PowerFactor)$
3. One can take 100 watts of electrical power at 100 volts by taking 1 Amp current, if power factor is 1, while if power factor is 0.5, then the current required will be 2 Amps for delivering same power of 100 watts.
4. One unit of electricity = 1Kilowatt x 1 Hr. If we use 1 KW for 1 hour then the utility meter advances by 1 unit.
5. It is clear from above that if power factor is low, utility company (Like MSEDCL) has to supply us more current while delivering same power but gets same revenue from us.
6. Infrastructure investment done by utility company is more for delivering more current, so for these commercial reasons, they insist on better power factor and offer incentives.

Non linear loads like computer power supplies, VFDs, UPS systems, electrical arc furnaces, Plating rectifiers, and Battery chargers take non sinusoidal current while sinusoidal voltage is applied to them. This is shown in waveforms bellow.



Mathematically it can be proved that these non sinusoidal currents are made up of sinusoidal currents having frequencies which are integral multiples of fundamental frequency i.e. 50 Hz. These (3^{rd} =150Hz, 5^{th} = 250Hz, 7^{th} = 350Hz etc) currents cause overheating of transformers, cables, switchgears etc due to increased losses requiring their derating for normal operation. Excessive current harmonics cause voltage harmonics distorting the voltage waveform. This can further cause harmonic currents in linear loads. This causes increased losses, vibrations in electrical motors, malfunctioning of electronic controls due to generated electromagnetic noise, Unwanted erratic tripping of circuit breakers due to overheating etc.

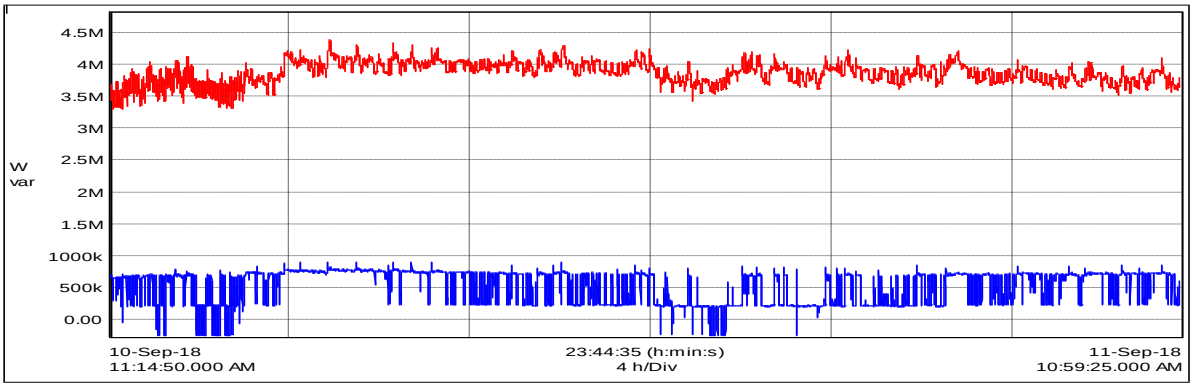
In electrical distribution networks, having presence of harmonic currents, if only capacitors are added to improve system power factor, there is a possibility of amplification of these harmonics due to resonance created by transformer inductance and these capacitors. This should be avoided by using detuned L – C filters or harmonic filters in place of capacitors. Utility companies also make it mandatory for consumer to control harmonics generated by his load as it improves their revenue potential by avoiding derating. Active filters also could be another solution to suppress harmonics. These are specially designed power electronic circuits, which take anti phase current from source which is equal and opposite of non linear component of load current. These filters are very costly and as such are not very popular as yet.

Audit Observations:

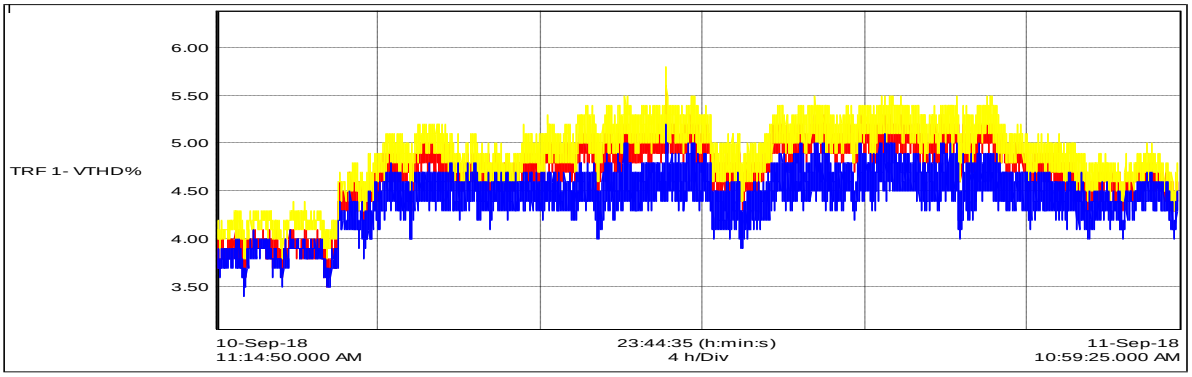
1. TRAFO 1 is loaded up to 4MW while TRAFO 2 loading is 6MW. In case of both the transformers, voltage distortion at 11KV is more than 5%.

   TRAFO 1 – 66 / 11KV – **1**

11KV Feeder 1- KW, Kvar –

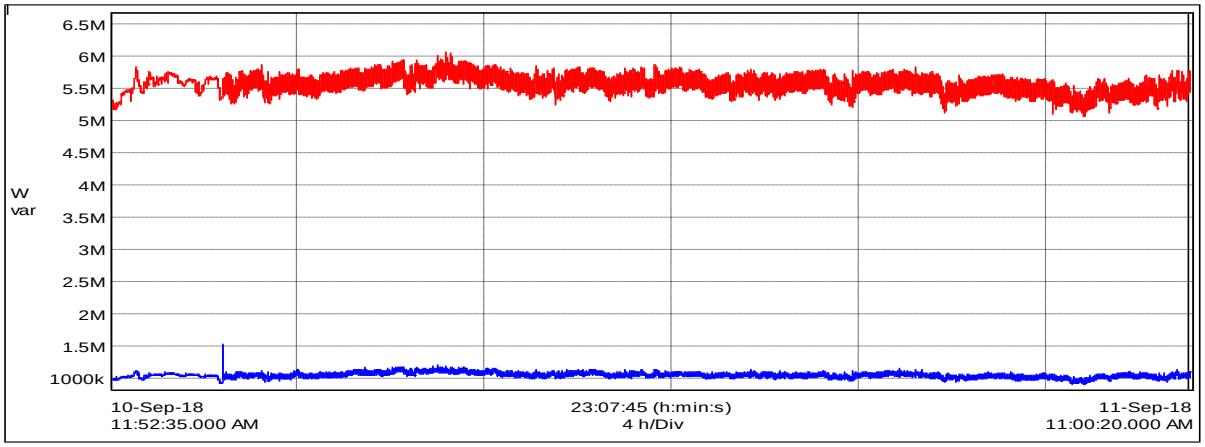


% Voltage distortion.

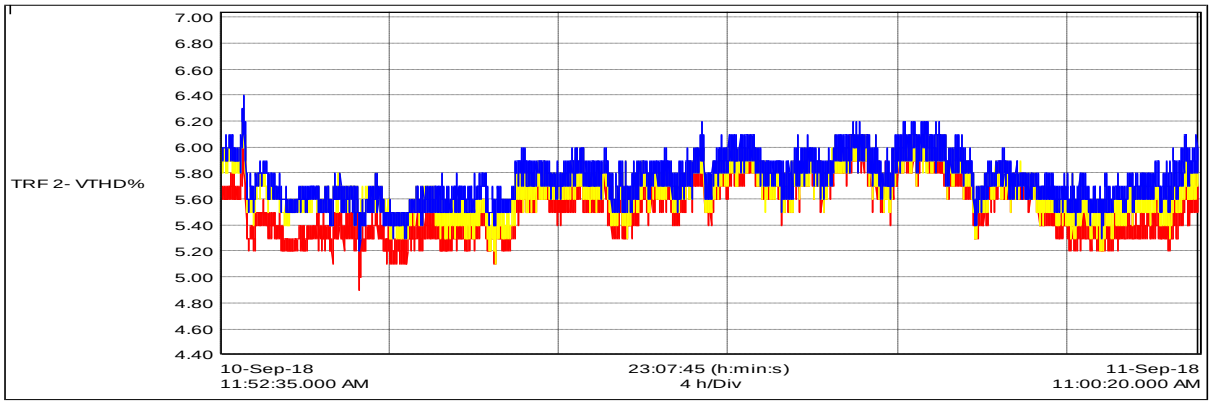


TRAFO 2 – 11KV

11KV Feeder 2 - KW, Kvar –

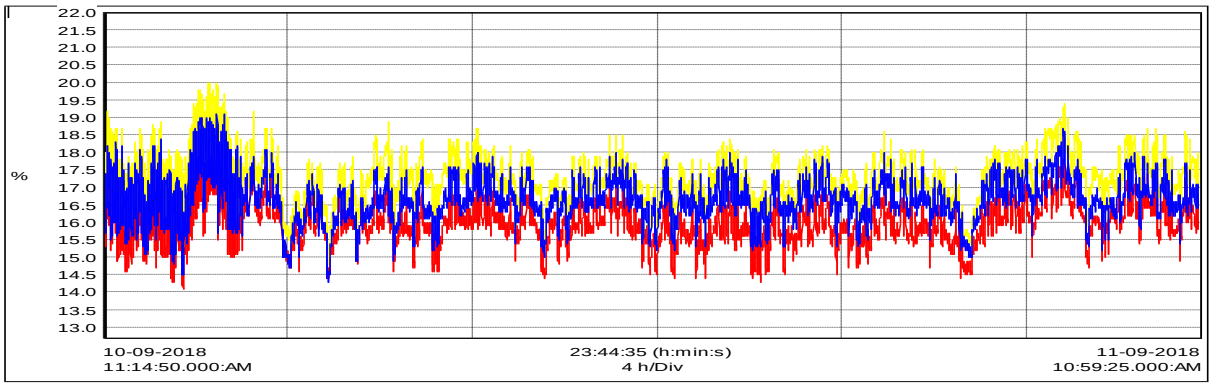


% Voltage distortion

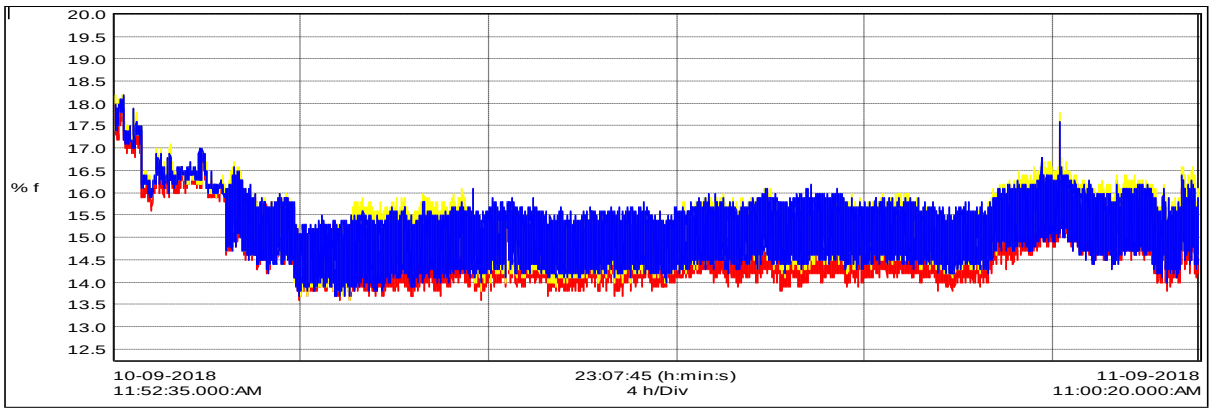


TRAFO1 trend shows reactive power requirement to be 500KVAR whereas the same for TRAFO 2 is 1100KVAR. The voltage distortion is beyond acceptable limits and will definitely increase on secondary side of all stepdown transformer. Such increased distortion can affect working of VFDs, Other automation systems, alignment between load and motors, Such distortion can also cause premature failure of motors.

TRAFO1 – current distortion



TRAFO2 – current distortion



Both transformers are supporting more than 15% Current harmonic distortion. At 11KV level this is on higher side and suggest requirement of correction downstream.

3 **Distribution Loss – Transformer Loss**

Table showing losses in transformers if all existing PF correction is removed as per ETAP Load flow analysis.

Sr	ID	Type	Rating 1	Rating 2	kW Flow	kvar Flow	Amp Flow	% PF	% Loading	kW Losses
1	T1	Transf. 2W	66 / 11 kV	10000 kVA	5737.1	2307.5	54.09	92.78	61.8	31.97
2	T2	Transf. 2W	66 / 11 kV	10000 kVA	4845.9	2254.9	46.76	90.67	53.4	22.33
3	T3	Transf. 2W	11 / 0.433 kV	1600 kVA	683.7	182.5	38.21	96.62	44.2	3.16
4	T4	Transf. 2W	11 / 0.433 kV	2250 kVA	285	31.12	15.48	99.41	12.7	0.411
5	T5	Transf. 2W	11 / 0.433 kV	2500 kVA	1212.4	420.3	69.29	94.48	51.3	7.47
6	T6	Transf. 2W	11 / 0.433 kV	1500 kVA	174.1	44.57	9.703	96.87	12	0.183
7	T7	Transf. 2W	11 / 0.433 kV	2000 kVA	1221.3	422.6	69.79	94.5	64.6	9.08
8	T8	Transf. 2W	11 / 0.433 kV	1600 kVA	852.1	333.5	49.41	93.12	57.2	5.15
9	T9	Transf. 2W	11 / 0.433 kV	2500 kVA	1276.5	457.3	73.22	94.14	54.2	8.1
10	T10	Transf. 2W	11 / 0.433 kV	1600 kVA	522.9	343	33.69	83.62	39.1	2.4
11	T11	Transf. 2W	11 / 0.433 kV	2000 kVA	578.9	224.9	33.45	93.22	31.1	1.97
12	T12	Transf. 2W	11 / 0.433 kV	2000 kVA	1084.8	378.1	61.88	94.43	57.4	7.14
13	T13	Transf. 2W	11 / 0.433 kV	2500 kVA	1480	598.9	85.99	92.7	63.9	10.59
14	T14	Transf. 2W	11 / 0.433 kV	2000 kVA	1156.9	419.7	66.29	94.01	61.5	8.21
									Total	**118.16**

Table showing losses in transformers with PF corrected as per ETAP Load flow analysis.

Sr	ID	Type	Rating 1	Rating 2	kW Flow	kvar Flow	Amp Flow	% PF	% Loading	kW Losses
1	T1	Transf. 2W	66 / 11 kV	.0000 kVA	5801	247.5	50.79	99.91	58.1	28.18
2	T2	Transf. 2W	66 / 11 kV	.0000 kVA	4900.9	110.3	42.88	99.97	49	18.78
3	T3	Transf. 2W	1 / 0.433 kV	1600 kVA	691.2	11.07	36.49	99.99	43.2	2.88
4	T4	Transf. 2W	1 / 0.433 kV	2250 kVA	287.6	1.7	15.18	100	12.8	0.395
5	T5	Transf. 2W	1 / 0.433 kV	2500 kVA	1227.1	28.32	64.78	99.97	49.1	6.53
6	T6	Transf. 2W	1 / 0.433 kV	1500 kVA	175.7	-4.47	9.278	-100	11.7	0.167
7	T7	Transf. 2W	1 / 0.433 kV	2000 kVA	1236.6	55.47	65.33	99.9	61.9	7.96
8	T8	Transf. 2W	1 / 0.433 kV	1600 kVA	862.4	39.77	45.57	99.89	54	4.38
9	T9	Transf. 2W	1 / 0.433 kV	2500 kVA	1292.1	45.98	68.24	99.94	51.7	7.04
10	T10	Transf. 2W	1 / 0.433 kV	1600 kVA	529.2	12.63	27.88	99.97	33.1	1.64
11	T11	Transf. 2W	1 / 0.433 kV	2000 kVA	585.1	8.4	30.83	99.99	29.3	1.68
12	T12	Transf. 2W	1 / 0.433 kV	2000 kVA	1097.9	33.99	57.87	99.95	54.9	6.25
13	T13	Transf. 2W	1 / 0.433 kV	2500 kVA	1498.8	57.77	79.02	99.93	60	8.94
14	T14	Transf. 2W	1 / 0.433 kV	2000 kVA	1171.2	51.11	61.76	99.9	58.6	7.12
									Total	**101.942**

If Power factor is controlled at secondary of each transformer to a value close to unity, the transformer losses can be reduced by almost 16KW. If this correction is done using Detuned filters, the voltage distortion will also reduce. Reduction in overall distribution loss will follow as a end result.

This will also contribute in improving quality of available power and electronic / electrical failures experienced if any, would reduce to a large extent.

Distribution Losses with cable loss.

ID	From Bus	To Bus	Type	Rating 1	Rating 2	kW Flow	Amp Flow	% Loading	kW Losses
Cable1	Bus2	11KV Feeder 1	Cable	30 m	2 - 3/C 300	5775.4	304.8	46.4	0.518
Cable2	11KV Feeder 1	Bus13	Cable	350 m	1 - 3/C 240	691.2	36.49	12.5	0.214
Cable3	11KV Feeder 1	Bus24	Cable	300 m	1 - 3/C 240	287.6	15.18	5.2	0.0318
Cable4	11KV Feeder 1	Bus18	Cable	350 m	1 - 3/C 240	1227	64.8	22.2	0.676
Cable5	11KV Feeder 1	Bus25	Cable	250 m	1 - 3/C 240	175.7	9.284	3.2	0.0099
Cable6	11KV Feeder 1	Bus16	Cable	350 m	1 - 3/C 240	1236.5	65.35	22.3	0.688
Cable7	11KV Feeder 1	Bus15	Cable	350 m	1 - 3/C 240	862.4	45.57	15.6	0.334
Cable8	11KV Feeder 1	Bus14	Cable	250 m	1 - 3/C 240	1292	68.25	23.3	0.536
Cable9	Bus26	Bus28	Cable	40 m	1 - 3/C 240	529.2	27.88	9.5	0.0143
Cable10	Bus26	Bus29	Cable	300 m	1 - 3/C 240	585.1	30.83	10.5	0.131
Cable11	Bus26	Bus30	Cable	300 m	1 - 3/C 240	1097.8	57.88	19.8	0.463
Cable12	Bus26	Bus31	Cable	250 m	1 - 3/C 240	1498.5	79.04	27	0.719
Cable13	Bus26	Bus32	Cable	300 m	1 - 3/C 240	1171	61.77	21.1	0.527
Cable14	11KV Feeder 2	Bus26	Cable	30 m	2 - 3/C 300	4883.4	257.4	39.2	0.369
T1	Bus1	Bus2	Transf. 2W	66 / 11 kV	10000 kVA	5803.6	50.8	58.1	28.2
T2	Bus1	11KV Feeder 2	Transf. 2W	66 / 11 kV	10000 kVA	4902.6	42.89	49	18.79
T3	Bus13	Bus3	Transf. 2W	11 / 0.433 kV	1600 kVA	691.2	36.49	43.2	2.88
T4	Bus24	Bus4	Transf. 2W	11 / 0.433 kV	2250 kVA	287.6	15.18	12.8	0.395
T5	Bus18	Bus5	Transf. 2W	11 / 0.433 kV	2500 kVA	1227	64.8	49.1	6.53
T6	Bus25	Bus11	Transf. 2W	11 / 0.433 kV	1500 kVA	175.7	9.276	11.7	0.167
T7	Bus16	Bus7	Transf. 2W	11 / 0.433 kV	2000 kVA	1236.5	65.35	61.9	7.96
T8	Bus15	Bus8	Transf. 2W	11 / 0.433 kV	1600 kVA	862.4	45.57	54	4.38
T9	Bus14	Bus9	Transf. 2W	11 / 0.433 kV	2500 kVA	1292	68.25	51.7	7.04
T10	Bus28	Bus20	Transf. 2W	11 / 0.433 kV	1600 kVA	529.2	27.88	33.1	1.64
T11	Bus29	Bus21	Transf. 2W	11 / 0.433 kV	2000 kVA	585.1	30.83	29.3	1.68
T12	Bus30	Bus22	Transf. 2W	11 / 0.433 kV	2000 kVA	1097.8	57.88	54.9	6.25
T13	Bus31	Bus27	Transf. 2W	11 / 0.433 kV	2500 kVA	1498.5	79.04	60	8.95
T14	Bus32	Bus23	Transf. 2W	11 / 0.433 kV	2000 kVA	1171	61.77	58.6	7.13
									107.223

4 Recorded Harmonic Currents on LT transformer feeders at maximum load are as under –

Sr. No.	Feeder Name	Harmonics at Max Current in Amp			
		Ah5	Ah7	Ah11	Ah13
	11 KV Feeder 1/TRAFO 1				
1	Dipping	75	30	30	15
2	Poly UPS	30	10	35	25
3	Spinning 2	300	60	40	35
4	Utility 2	18	-	11	18
5	Utility Compressor	80	55	130	150
6	Weaving 1	300	130	30	45
7	Weaving 3	280	120	60	35

Sr. No.	Feeder Name	Harmonics at Max Current in Amp			
		Ah5	Ah7	Ah11	Ah13
	11 KV Feeder 2/TRAFO 2				
1	Coal Fire Boiler	90	50	35	10
2	Poly TR	150	50	25	18
3	Utility Chiller	160	110	150	150
4	Weaving 2	500	200	160	170
5	Spinning 1	380	100	70	60

- It can be seen that predominant current harmonics are of 5^{th} and 7^{th} order. Other harmonics will reduce substantially if voltage harmonic distortion can be reduced substantially.
- It is observed that there is resonance at 5^{th} harmonic frequency – indicated by highest 5^{th} harmonic current.
- Detuned filters with selective detuning may be used to avoid this resonance, while correcting the power factor.

Following table shows current harmonics in present situation

Sr	Feeder	% Current distortion	
		Cap OFF	Normal condition
TRAFO 1			
1	Dipping	5%	10%
2	Poly UPS		11%
3	Spinning 2		22%
4	Utility 2		16%
5	Utility Compressor	8%	24%
6	Weaving 1.	24%	29%
7	Weaving 3	14.5%	19.5%
TRAFO 2			
1	Coal Fired Boiler		18%
2	Poly TR	21%	23%
3	Utility Chiller	20%	30%
4	Weaving 2		31%
5	Spinning 1		27%

Details of plant electrical system:

XXXXAAA Industrial Textile is Industrial Textile mill, largely involved in Polymer Thread and Polymer Cloth manufacturing for Tyre and Conveyor production use.

EHV Incoming	66KV From DGVCL
EHV Transformer	8MVA/10MVA, ONAN/ONAF, V.ratio=66/11KV, 02nos.
Contract Demand	10750KVA
Maximum Demand	10060KVA
KWH Consumption	Average 64Lac per month.
DG Sets Rating	750KVA =04nos.

- Billed PF for the month of **October 2018** was **0.983**.
- Transformer details and APFC/Capacitors arrangement is as given below.

	Transformer Details				
Sr.	**Transformer**	**Rating**	**TYPE**	**Voltage Ratio**	**Z %**
1	TR 1	8MVA/10 MVA	ONAN/ ONAF	66/11KV	8.73, 10.90%
2	TR 2	8MVA/10 MVA	ONAN/ ONAF	66/11KV	8.15, 10.19%
3	Spinning 1	2000KVA	ONAN	11/0.433KV	6.26%
4	Poly TR	2000KVA	ONAN	11/0.433KV	5.91%
5	Poly UPS	2250KVA	ONAN	11/0.415KV	6.46%
6	Weaving 1	1600KVA	ONAN	11/0.433KV	6.25%
7	Utility Compressor	2000KVA	ONAN	11/0.433KV	6.25%
8	Utility Chiller	2000KVA	ONAN	11/0.433KV	6.25%
9	Weaving 3	2500KVA	ONAN	11/0.433KV	6.33%
10	Weaving 2	2500KVA	ONAN	11/0.433KV	6.00%
11	Utility 2	1500KVA	ONAN	11/0.433KV	4.89%
12	Spinning 2	2500KVA	ONAN	11/0.433KV	6.52%
13	Coal Fire Boiler	1600KVA	ONAN	11/0.433KV	5.66%
14	Dipping	1600KVA	ONAN	11/0.433KV	5.81%
15	Weaving 1	1600KVA	ONAN	11/0.433KV	5.66%

Sr.	**Transformer**	**Reactive Power Compensation**	**Type**
1	TRAFO 2	750Kvar 11KV	Fixed HT
2	Spinning 1	50Kvar 440V	Fixed
3	Utility Chiller	75Kvar 440V	Fixed
4	Utility Compressor	75Kvar 440V	Fixed
		250Kvar 525V	Cont. Detuned APFC
5	Weaving 1	75Kvar 440V	Fixed
		200Kvar 525V	Cont. APFC
6	Weaving 2	150Kvar 440V	Fixed
7	Weaving 3	75Kvar 440V	Fixed
8	Utility 2	50Kvar 440V	Fixed
9	Dipping	480Kvar 525V	Thy. Detuned APFC

Recorded Power Quality Parameters: -

Sr. No.	Feeder Name	Voltage L-N		Voltage L-L		Voltage THD%		Current		Current THD%		KW		KVAR		PF		FREQ	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
	Main Incomers																		
1	66KV Main Incomer			66870	69360	1.4	2.2	86.2	95.2	16.1	18.1	9530	10320	2390	2830	0.97	0.97	50	50.1
2	11 KV Feeder 1			11380	11680	4.9	5.8	203.1	235.2	17.2	20	3310	4390	521	912	0.98	0.99		
3	11 KV Feeder 2			11480	11800	5.8	6.4	296	330	15.3	18.2	5560	6070	1050	1222	0.969	0.97		
	11KV Feeder 1 / TRAFO 1																		
4	**11 KV Feeder 1/TRAFO 1**			**11380**	**11680**	**4.9**	**5.8**	**203.1**	**235.2**	**17.2**	**20**	**3310**	**4390**	**521**	**912**	**0.98**	**0.99**		
5	Dipping	248	251	429	434	4.8	5.8	901	978	9.1	11.5	666	691	99	166	0.99	0.993		
6	Poly UPS	251	255	434	441	5.7	6	561.2	590	11	12.3	245.7	288.8	24	29	0.834	0.84		
7	Spinning 2	249	252	430.5	435.5	10.6	11.1	1510	1744	21.6	24.4	1050	1226	342	382.5	0.951	0.957		
8	Utility 2	249	253	428.4	438	6.7	7.1	244.4	270	16.4	17.5	168.4	175.9	36	44	0.96	0.97		
9	Utility Compressor	246	251	425	434	8.9	10.5	1369	1833	16.8	25	960	1235	270	375	0.96	0.97		
10	Weaving 1	245	251	422.4	432.8	13.9	14.7	1226	1310	29.1	36.5	810.6	861.9	284	308	0.94	0.95		
11	Weaving 3	246	248	426	428	9.4	9.9	1812	1917	18.3	19.2	1231	1291	373	416	0.96	0.96		
	11KV Feeder 2 / TRAFO 2																		
12	**11 KV Feeder 2/TRAFO 2**			**11480**	**11800**	**5.8**	**6.4**	**296**	**330**	**15.3**	**18.2**	**5560**	**6070**	**1050**	**1222**	**0.969**	**0.97**		
13	Coal Fire Boiler	247	251	428	434	5.3	5.6	625	1183	14	19.2	369	529	184	334	0.86	0.91		
14	Poly TR	248	251	429	435	6.3	6.7	788	847	21.2	23.7	544	585	194	216	0.94	0.95		
15	Utility Chiller	258	262.5	445.7	453.6	11.07	12.1	1306	1526	23.7	30	934	1096	296	341	0.95	0.96		
16	Weaving 2	247	253	428	437	12.6	14.1	1994	2200	29.8	35	1364	1496	490	545	0.94	0.95		
17	Spinning 1	245	248	424	429	10.4	11.1	1568	1728	25.9	29.4	1048	1169	348.3	377.5	0.95	0.95		

Voltage distortion is higher than permissible limit.

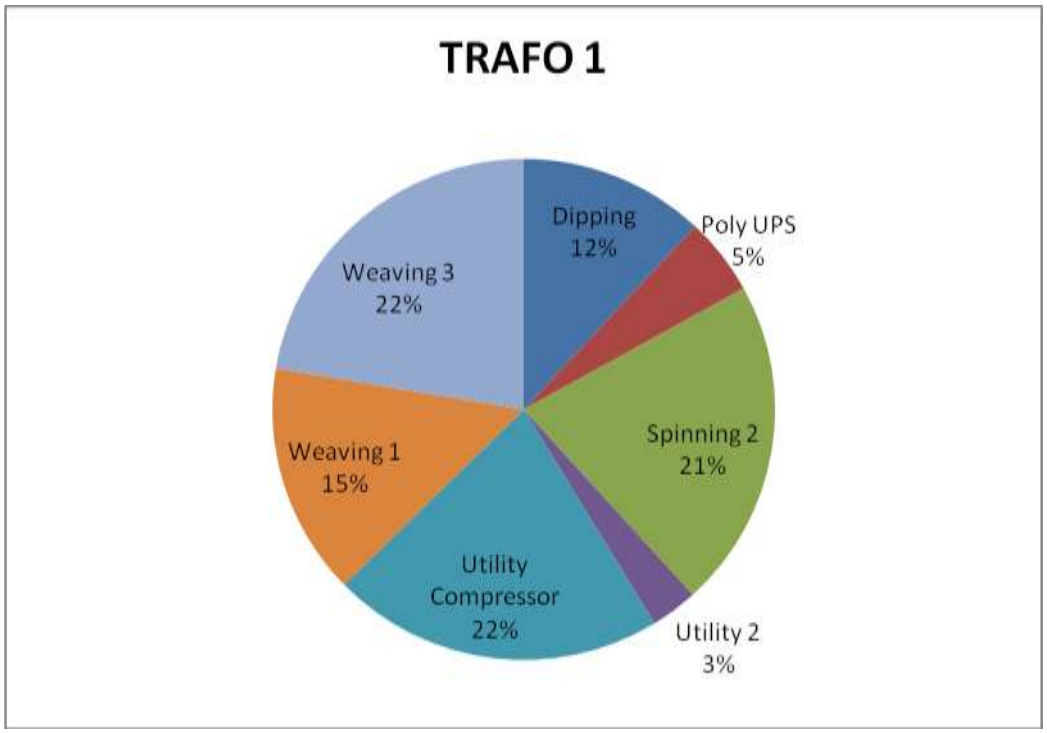
Reactive power requirement is not compensated properly.

PF is not maintained at unity.

- Feeders 7, 9, 11 contribute **85%** of total load on **Trafo 1** and also draw distorted current. Maximum V_{THD} % is **11.1%** and Current harmonic distortion is **25%**.

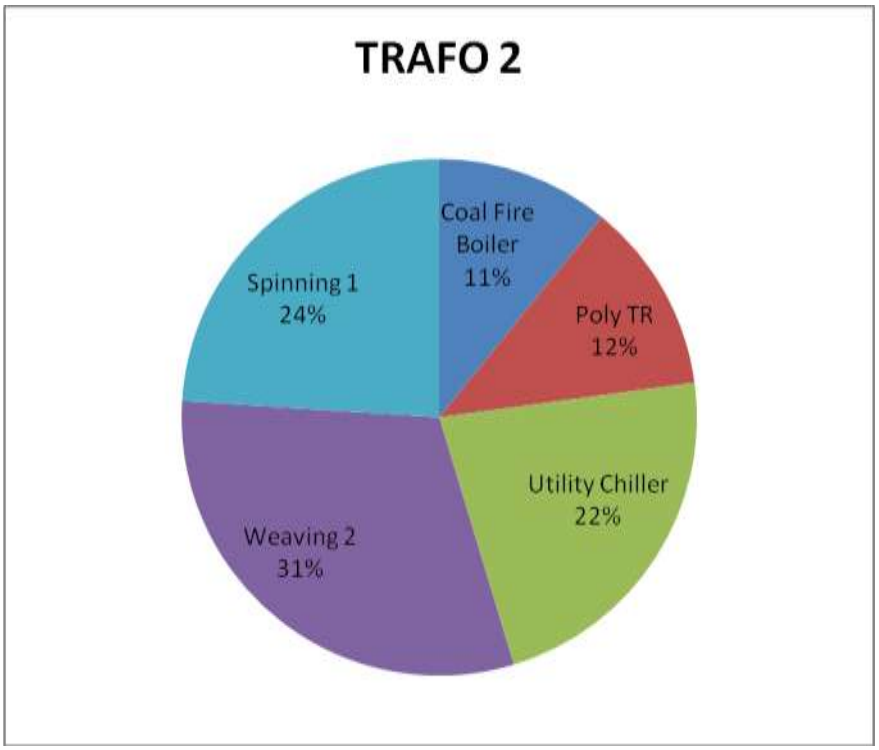
- Feeders 15, 16, 17 contribute **62%** of total load on **Trafo 2** and also draw distorted current. Maximum V_{THD} % is **14.1%** and Current harmonic distortion is **35%**.

Loading Pie Chart for Trafo 1- 8MVA/10MVA Transformer:



The percentage mentioned in above PIE Chart is considering total recorded load as 100%.

Loading Pie Chart for Trafo 2- 8MVA/10MVA Transformer:



The percentage mentioned in above PIE Chart is considering total recorded load as 100%.

Loads demanding large harmonic currents on TRAFO 1 –

Sr. No.	Feeder Name	Current THD%		KW		% Loading
		Avg	Max	Avg	Max	
1	**11 KV Feeder 1/TRAFO 1**	**17.2**	**20**	**3310**	**4390**	**100%**
2	Dipping	9.1	11.5	666	691	15.7
3	Poly UPS	11	12.3	245.7	288.8	6.6
4	Spinning 2	21.6	24.4	1050	1226	27.9
5	Utility 2	16.4	17.5	168.4	175.9	4.0
6	Utility Compressor	16.8	25	960	1235	28.1
7	Weaving 1	29.1	36.5	810.6	861.9	19.6
8	Weaving 3	18.3	19.2	1231	1291	29.4

Loads demanding large harmonic currents on TRAFO 2 –

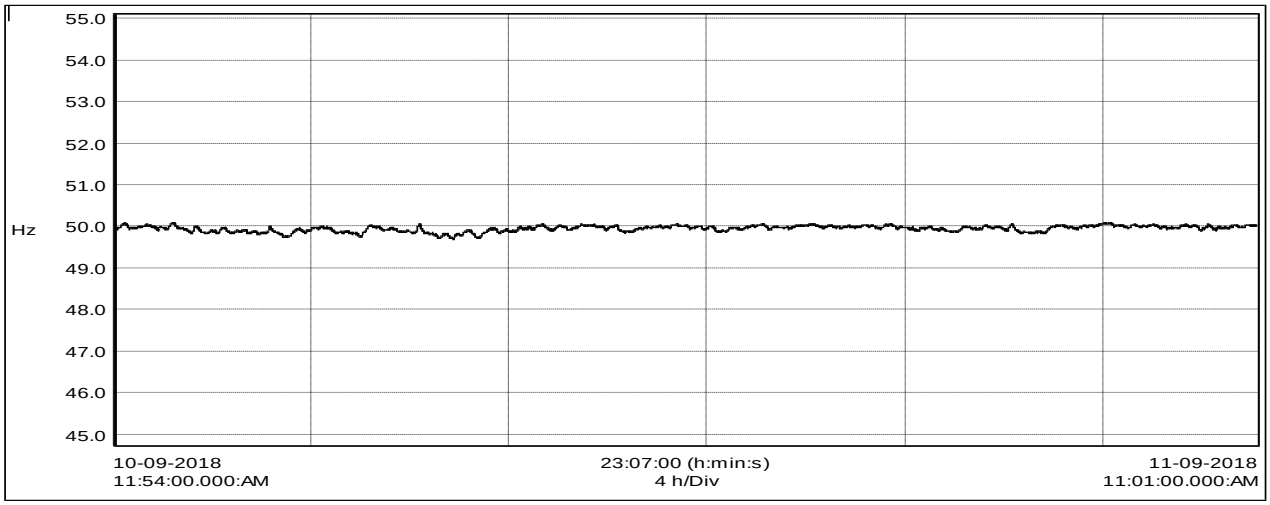
Sr. No.	Feeder Name	Current THD%		KW		% Loading
		Avg	Max	Avg	Max	
1	**11 KV Feeder 2/TRAFO 2**	**15.3**	**18.2**	**5560**	**6070**	**100%**
2	Coal Fire Boiler	14	19.2	369	529	8.7
3	Poly TR	21.2	23.7	544	585	9.6
4	Utility Chiller	23.7	30	934	1096	18.1
5	Weaving 2	29.8	35	1364	1496	24.6
6	Spinning 1	25.9	29.4	1048	1169	19.3

Recorded Data :-

INDEX

66KV Main Incomer :

Frequency



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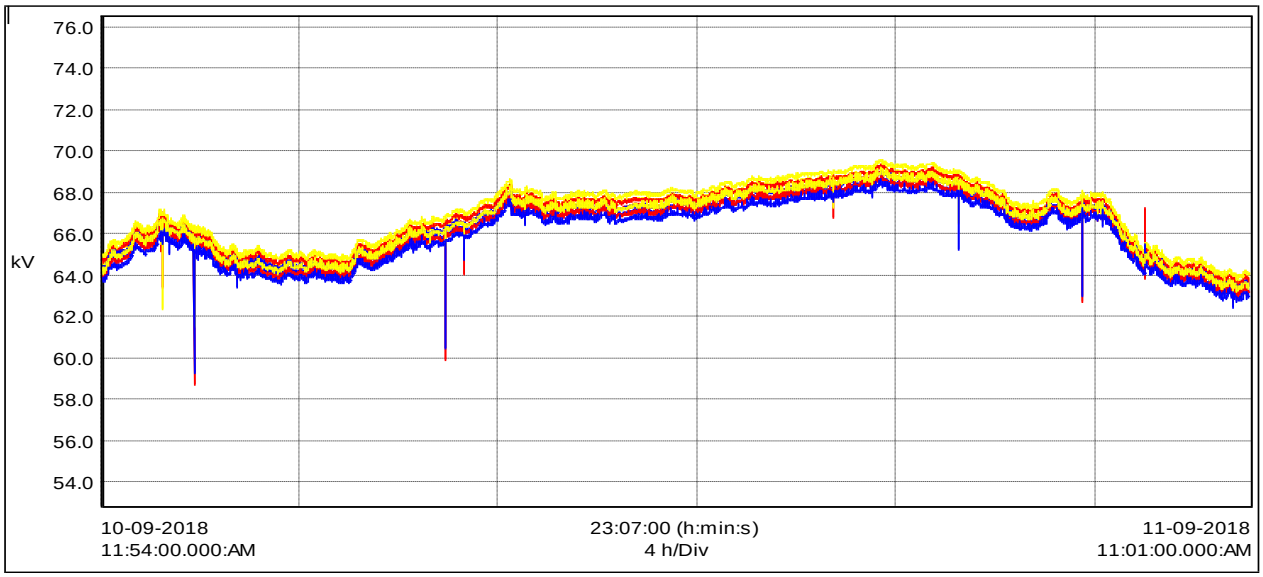

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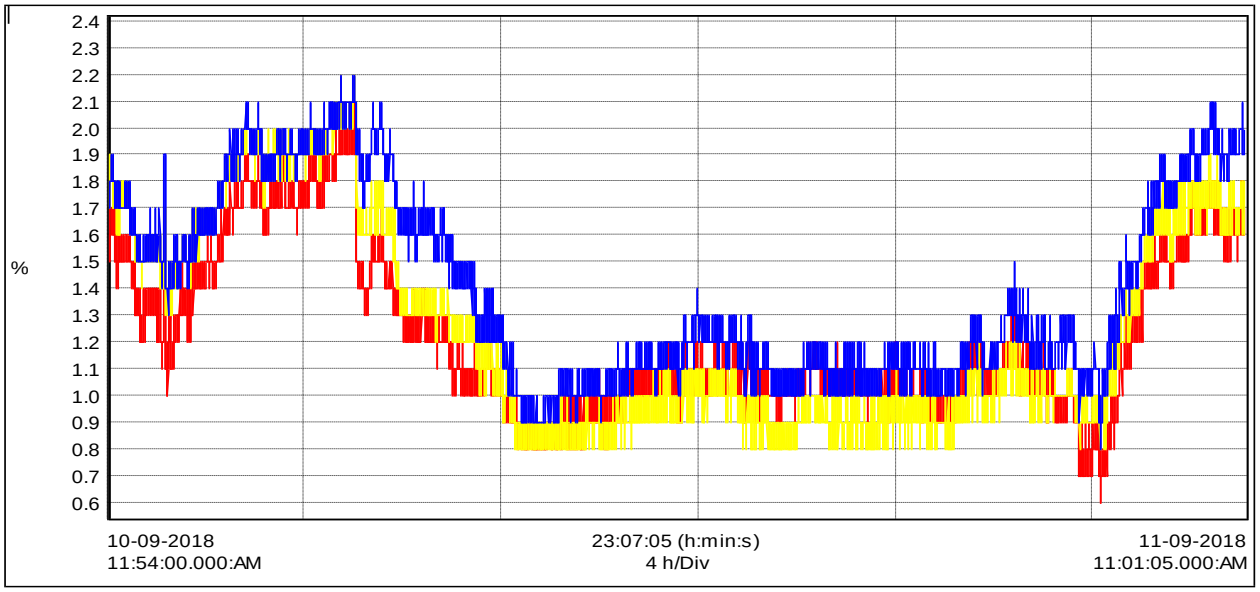

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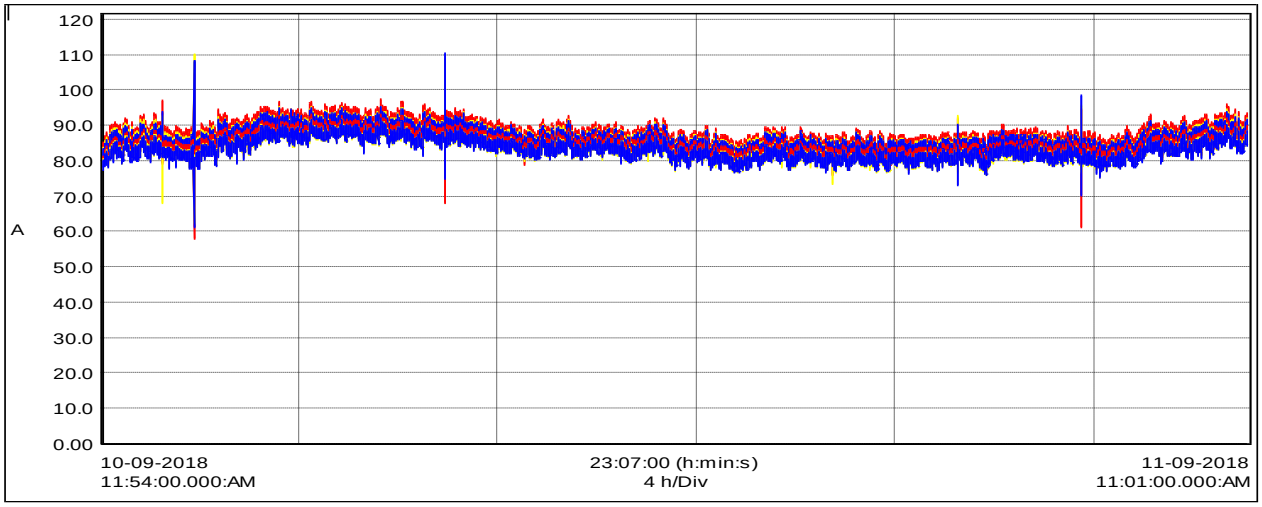

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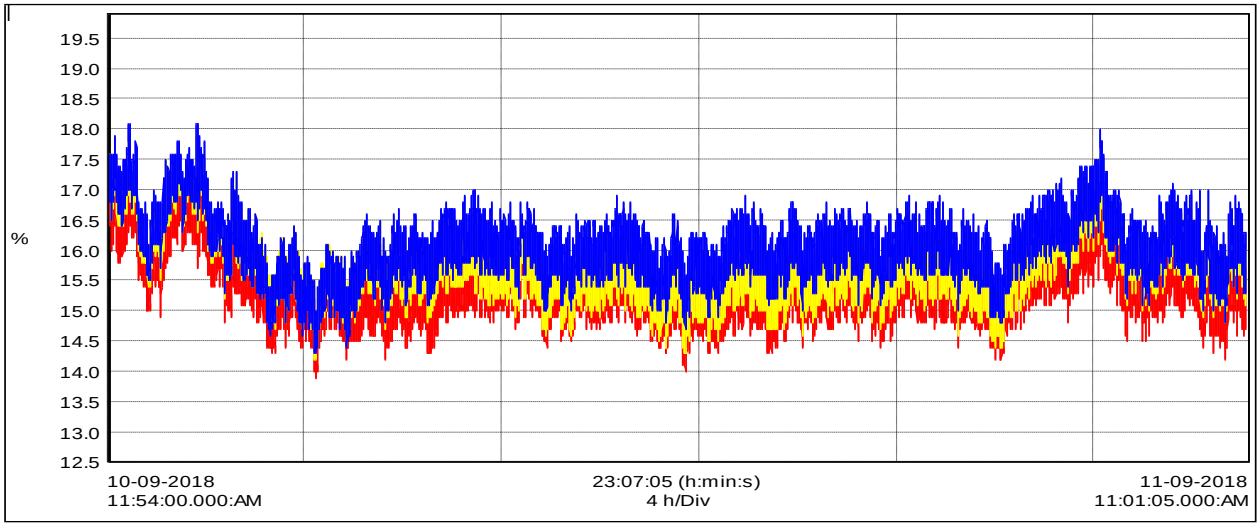

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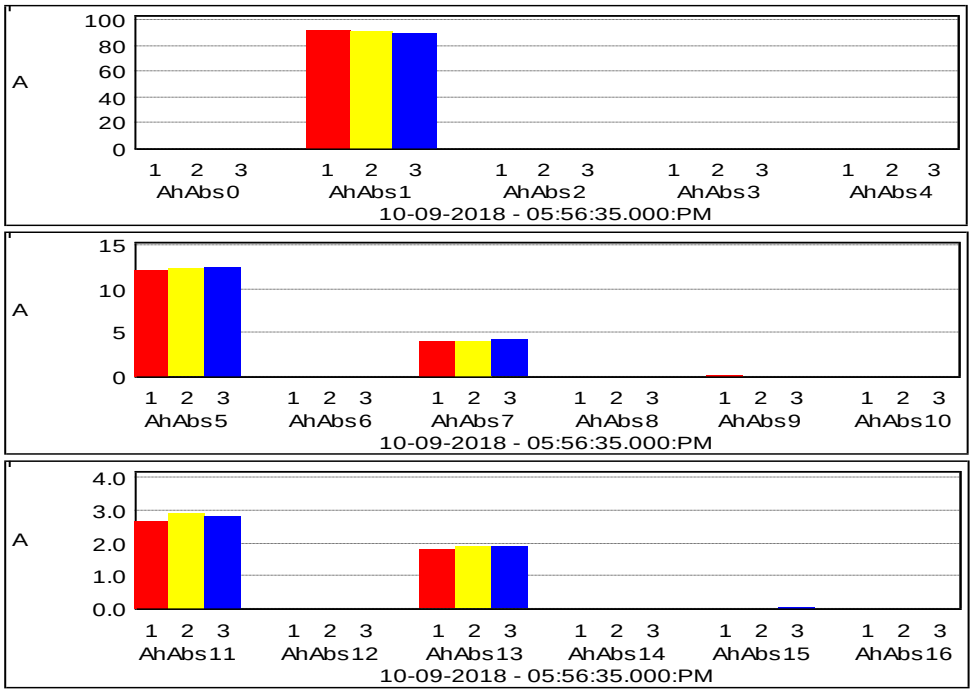
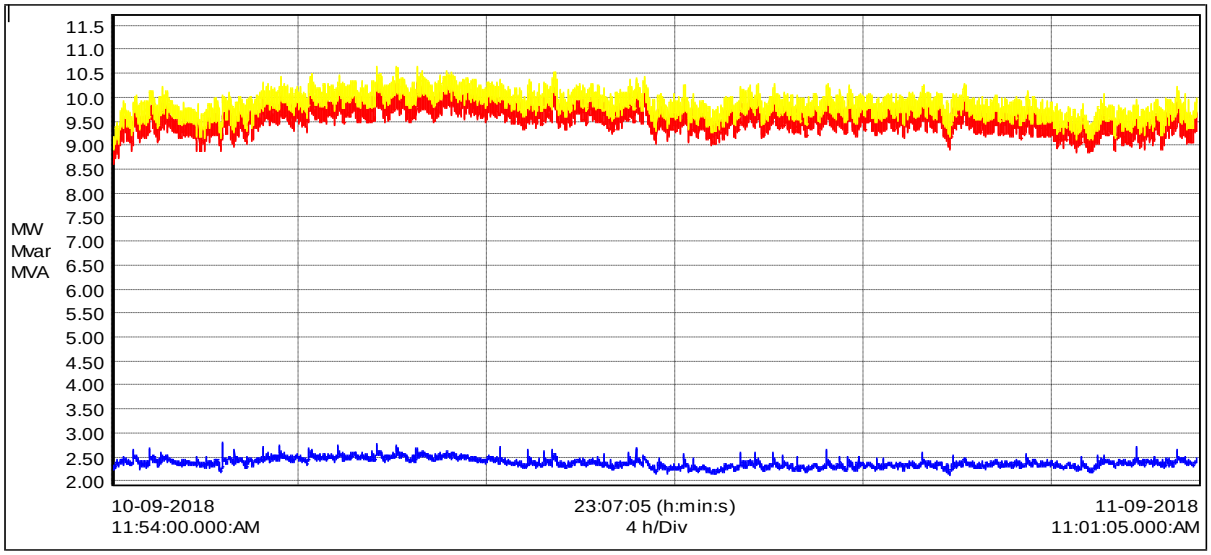


KW, KVAR, KVA



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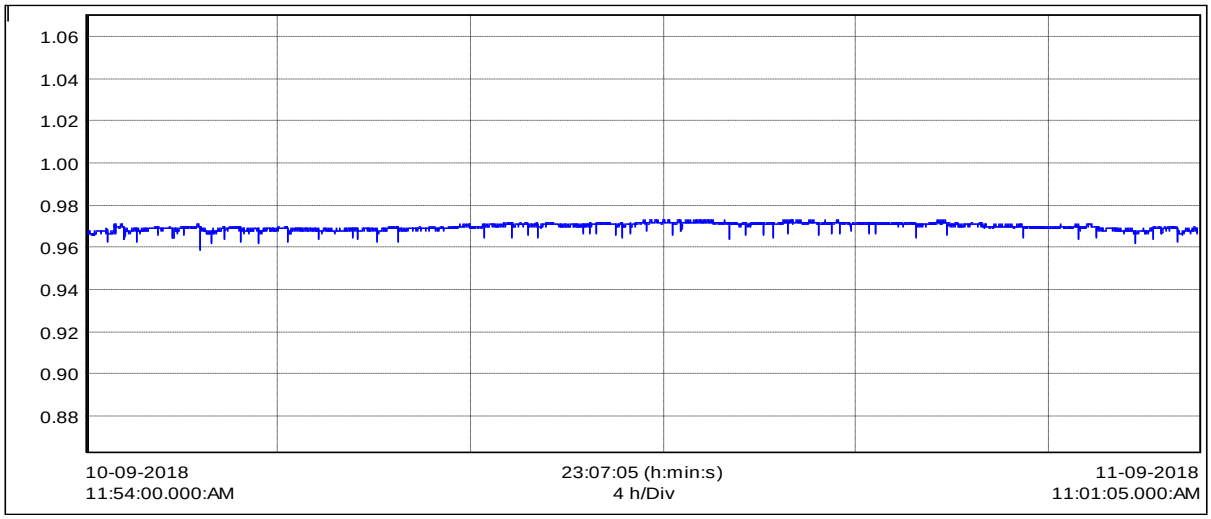

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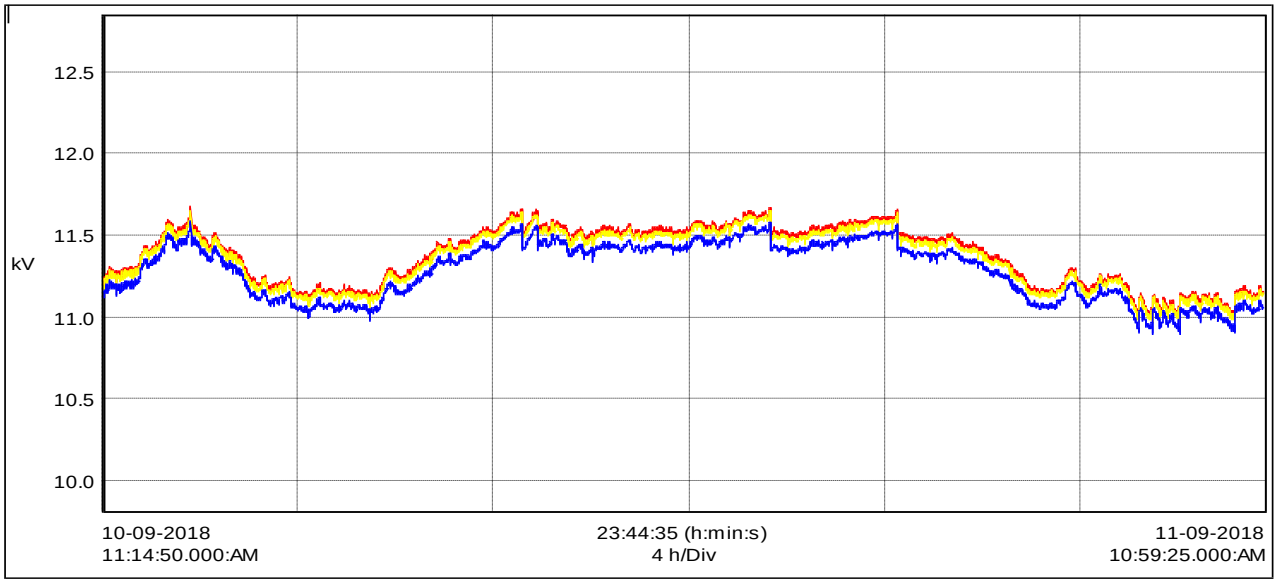

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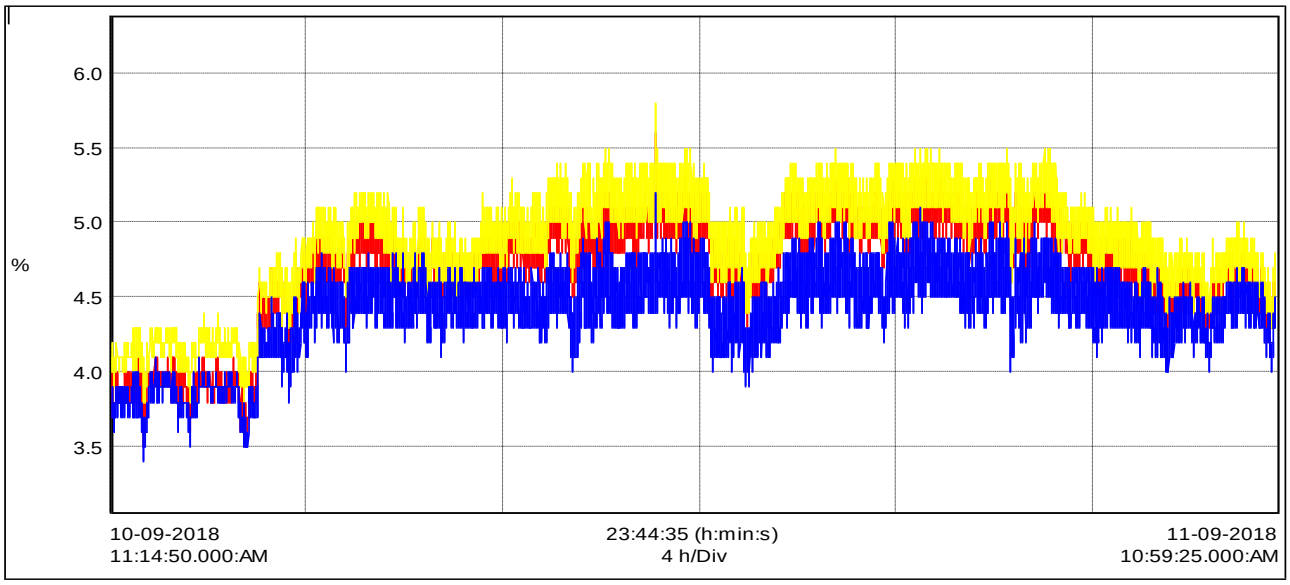

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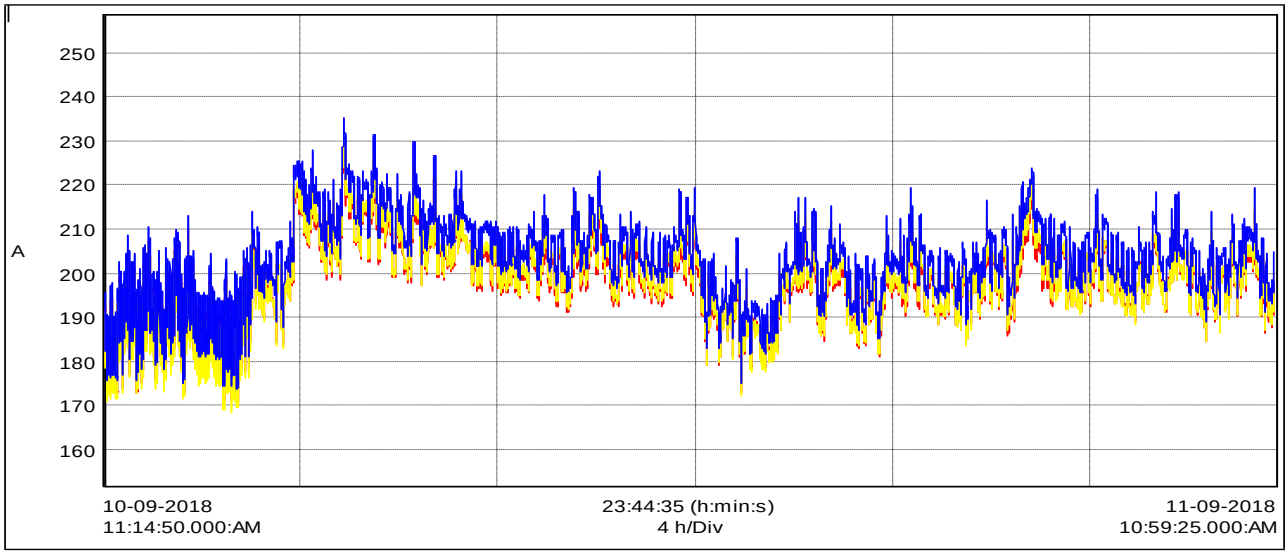

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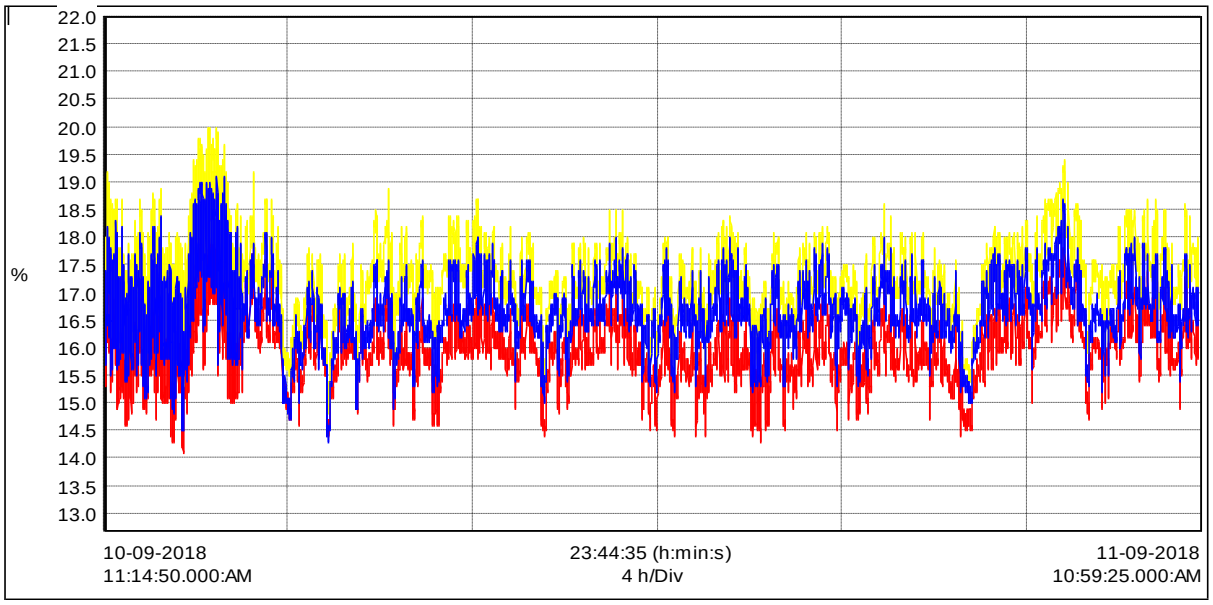

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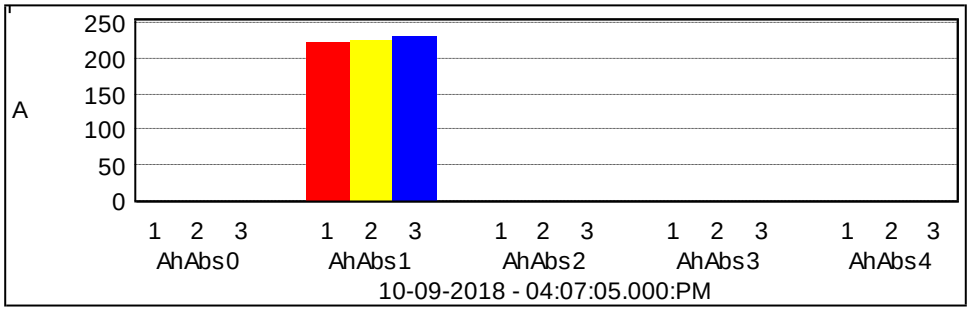

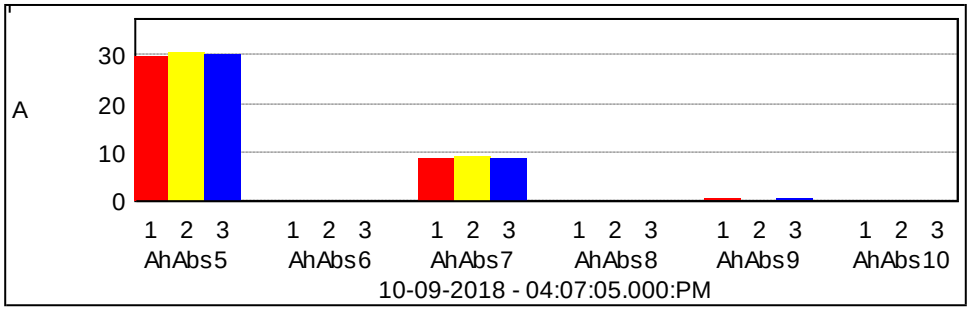

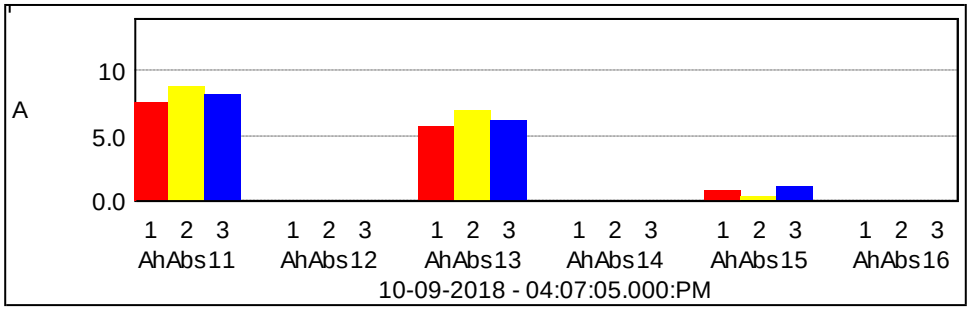
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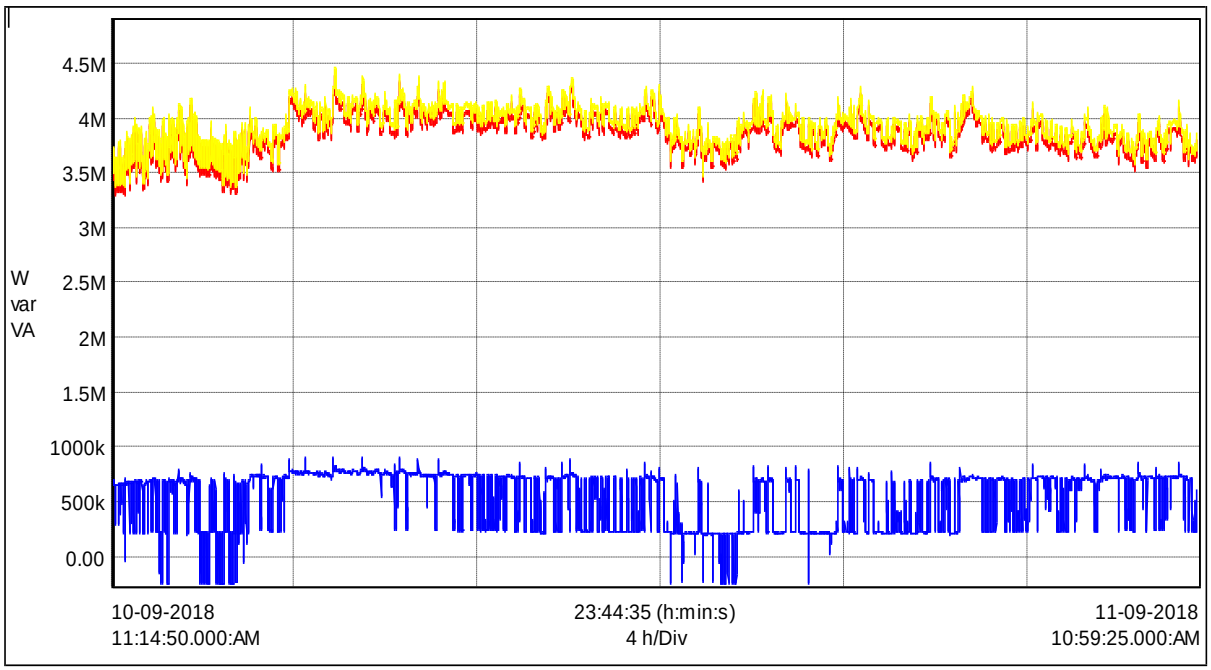
KW, KVAR, KVA



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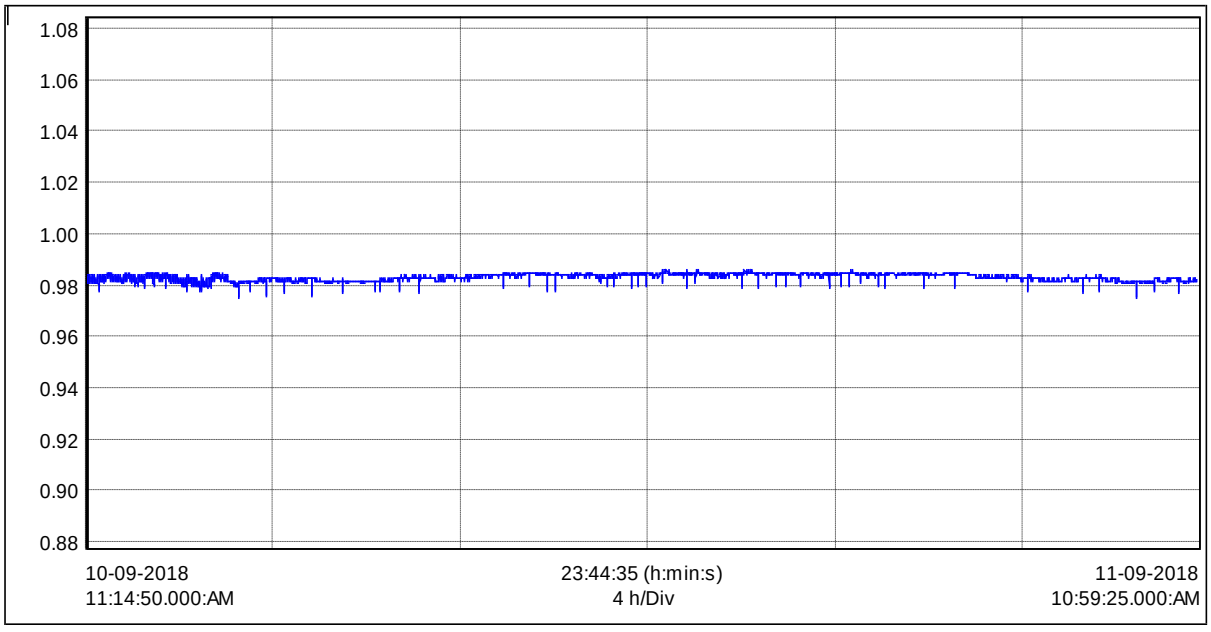

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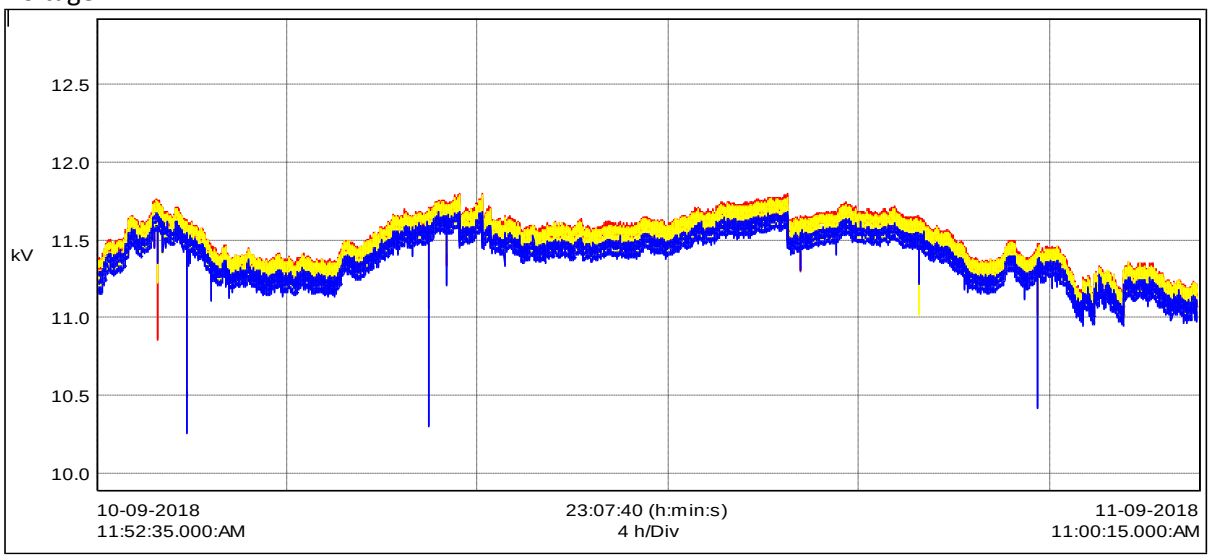

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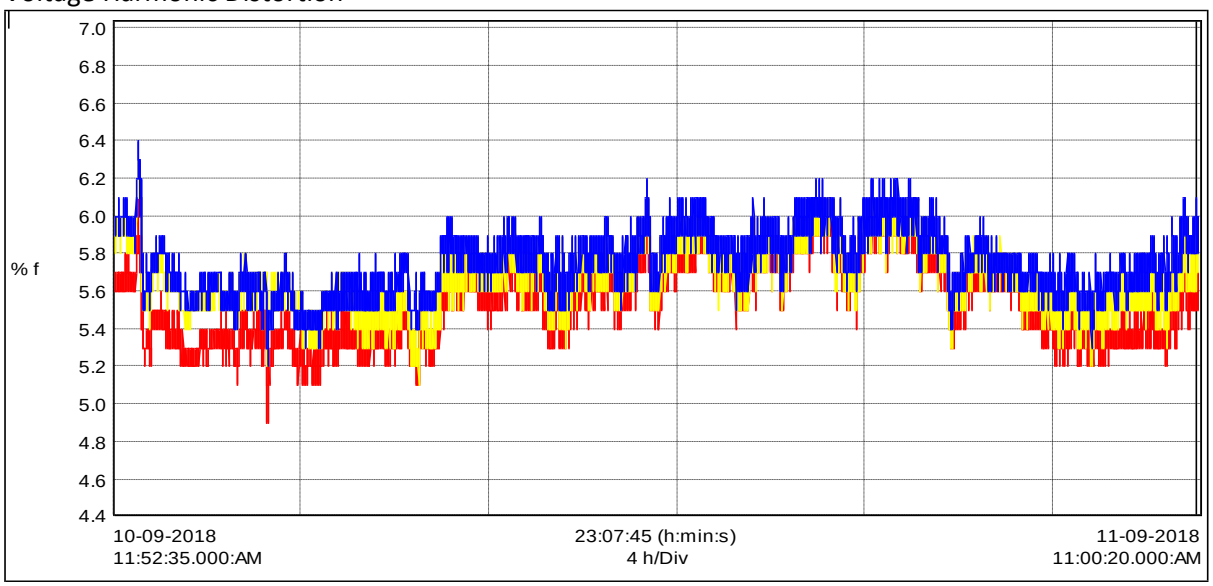

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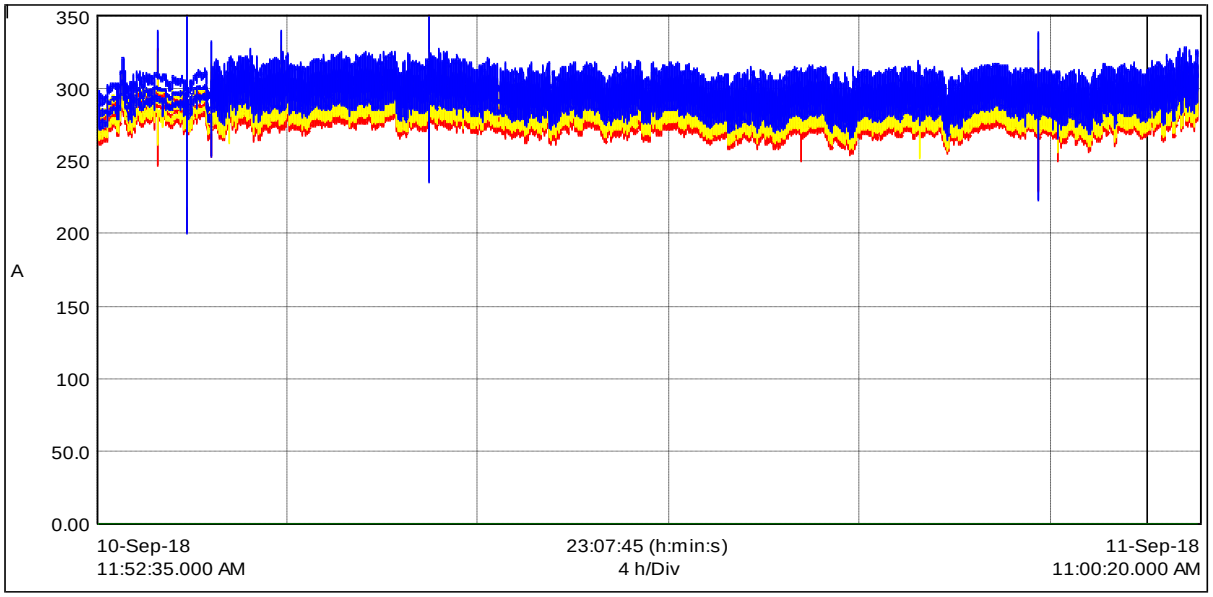

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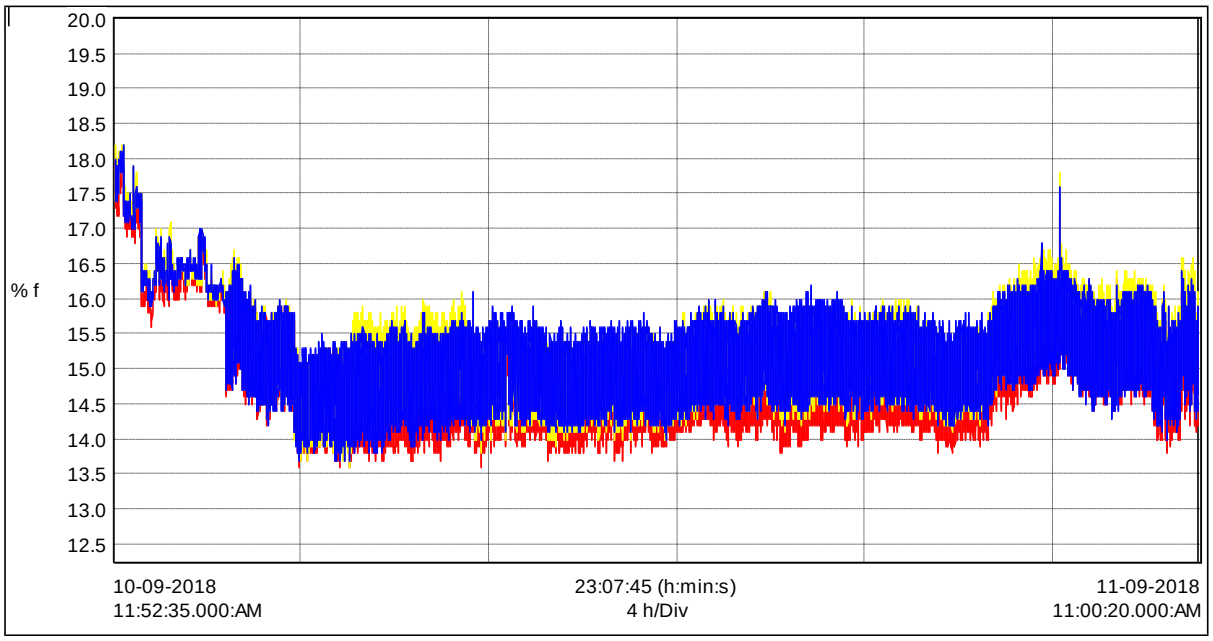

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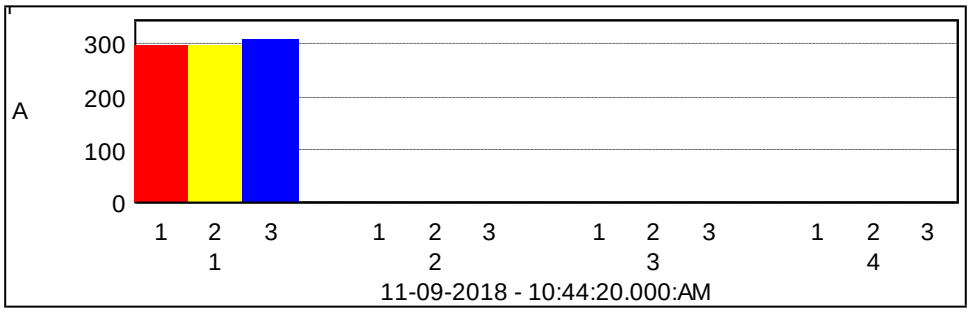

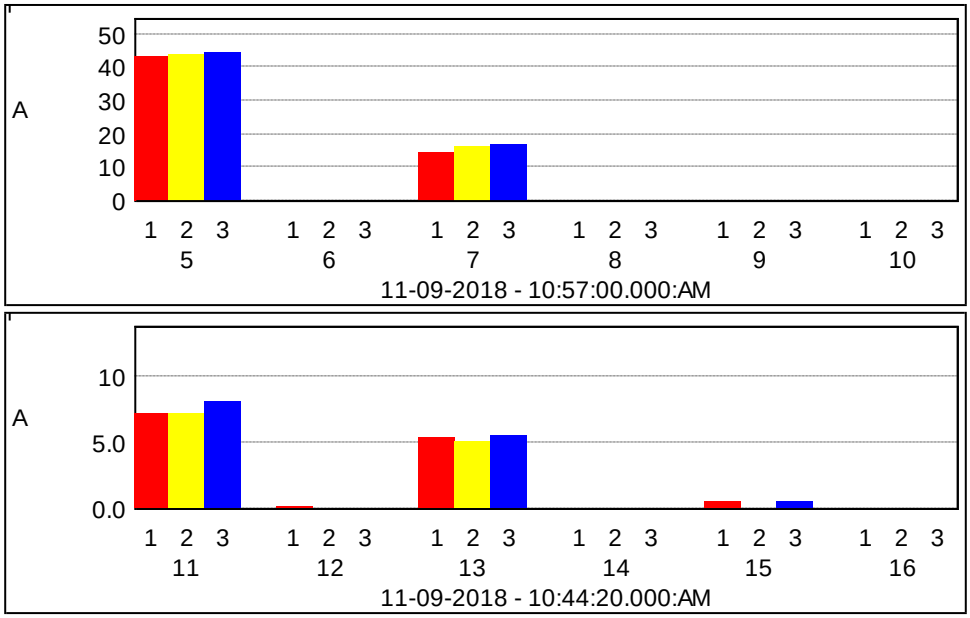
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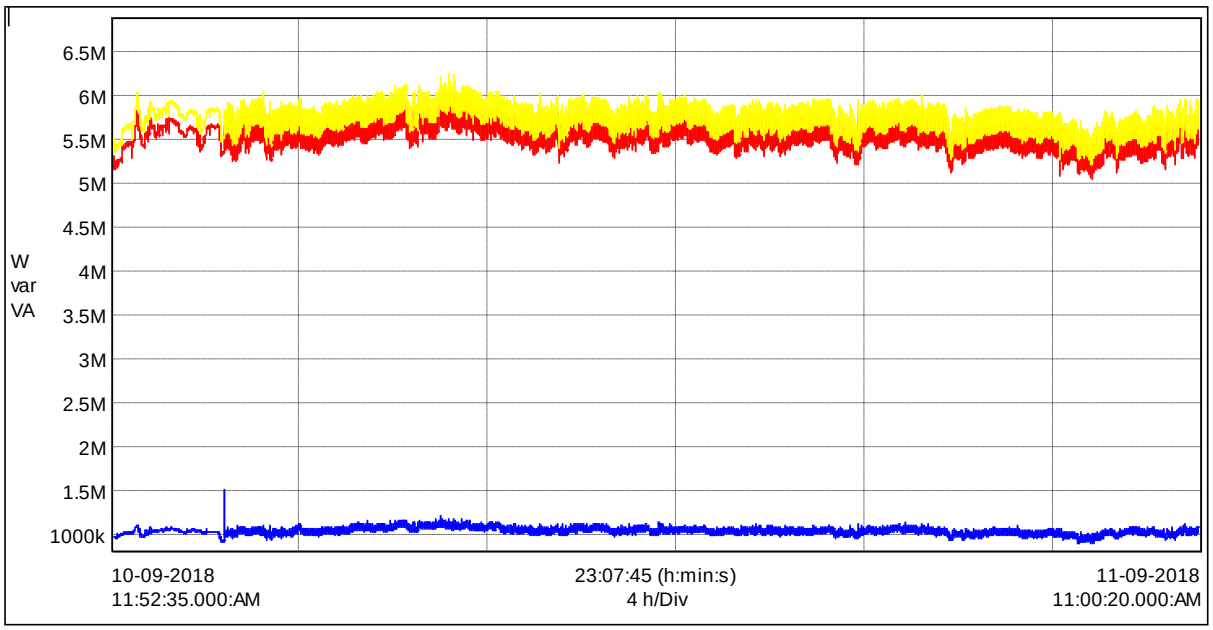
KW, KVAR,

KVA



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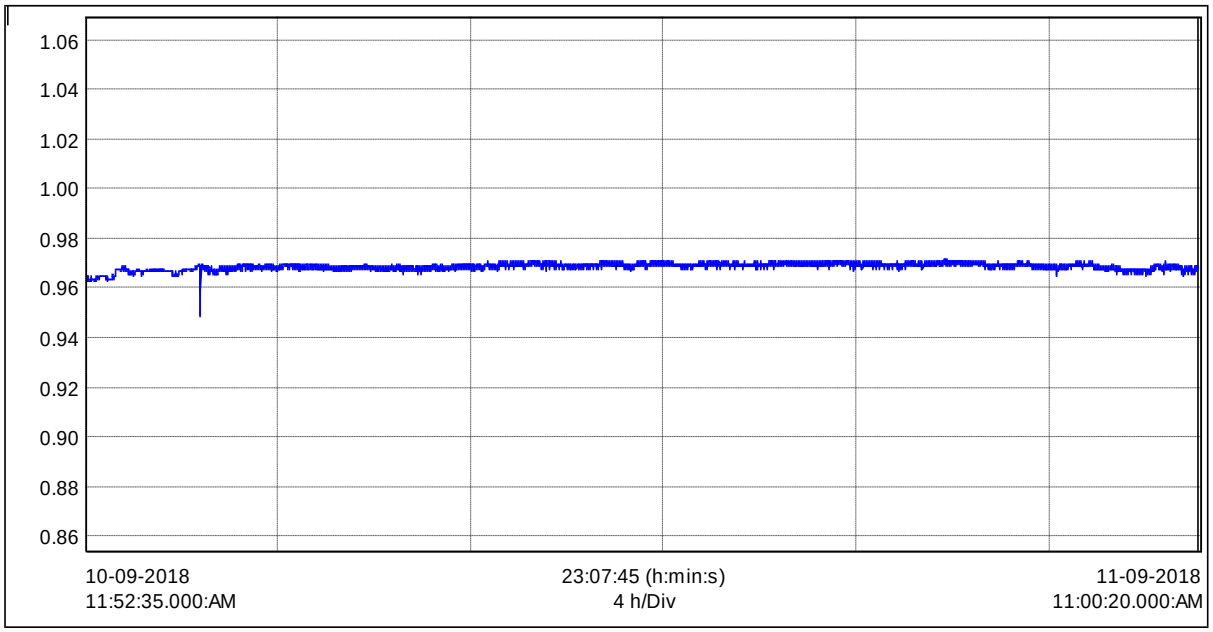

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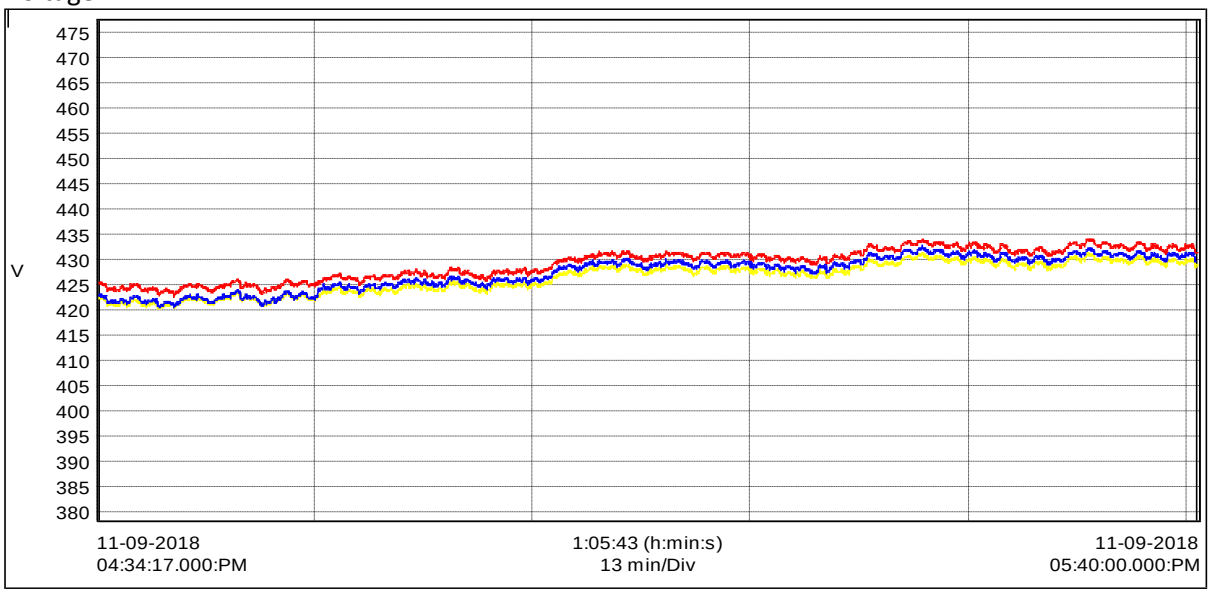
Voltage L-L



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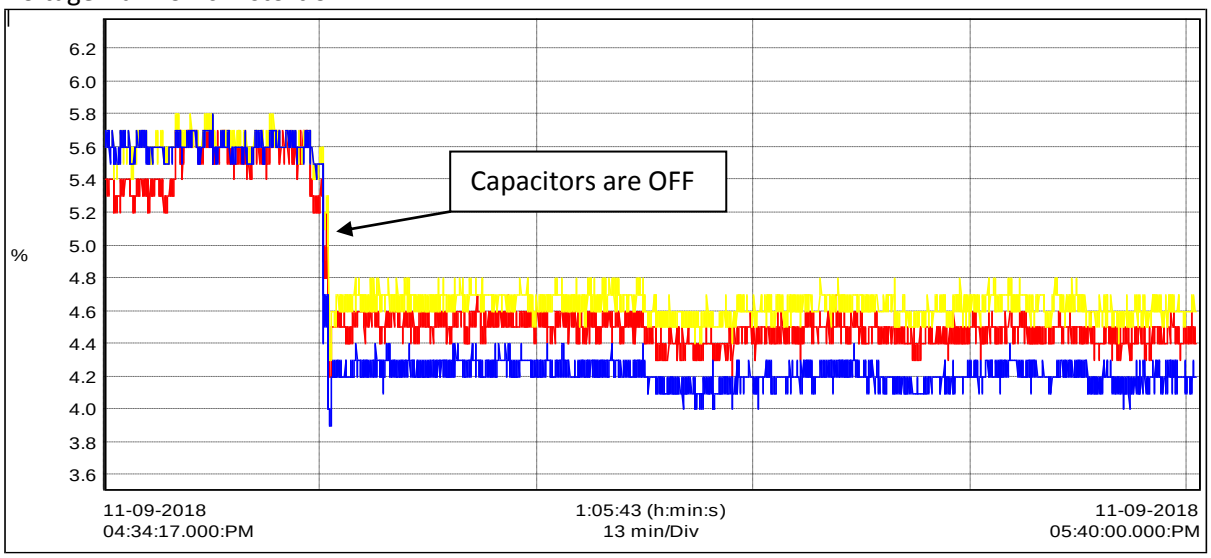

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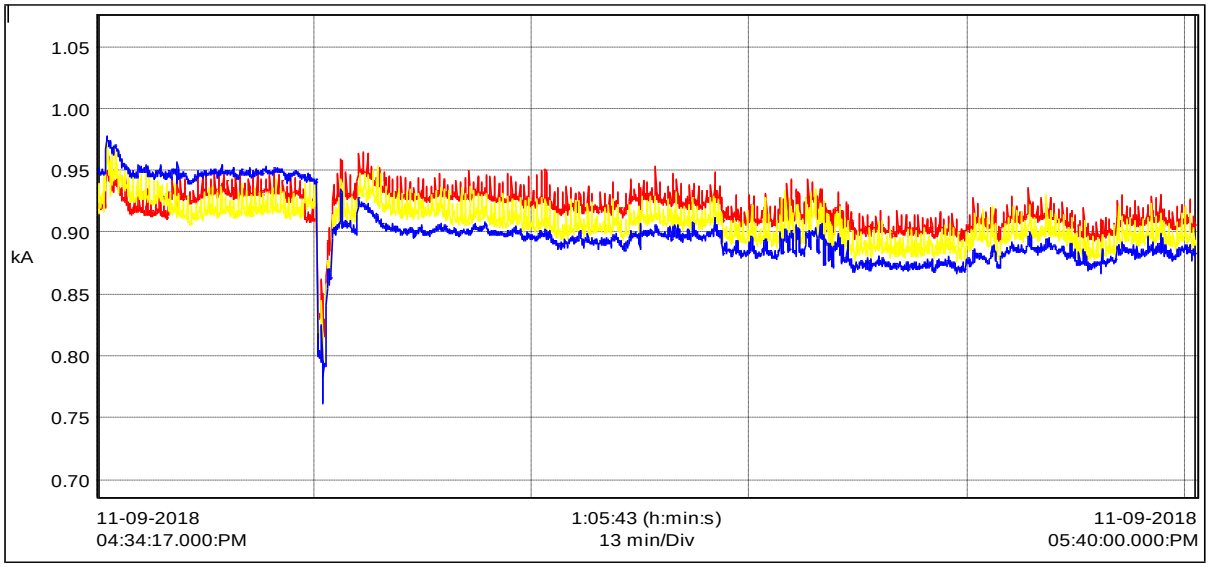

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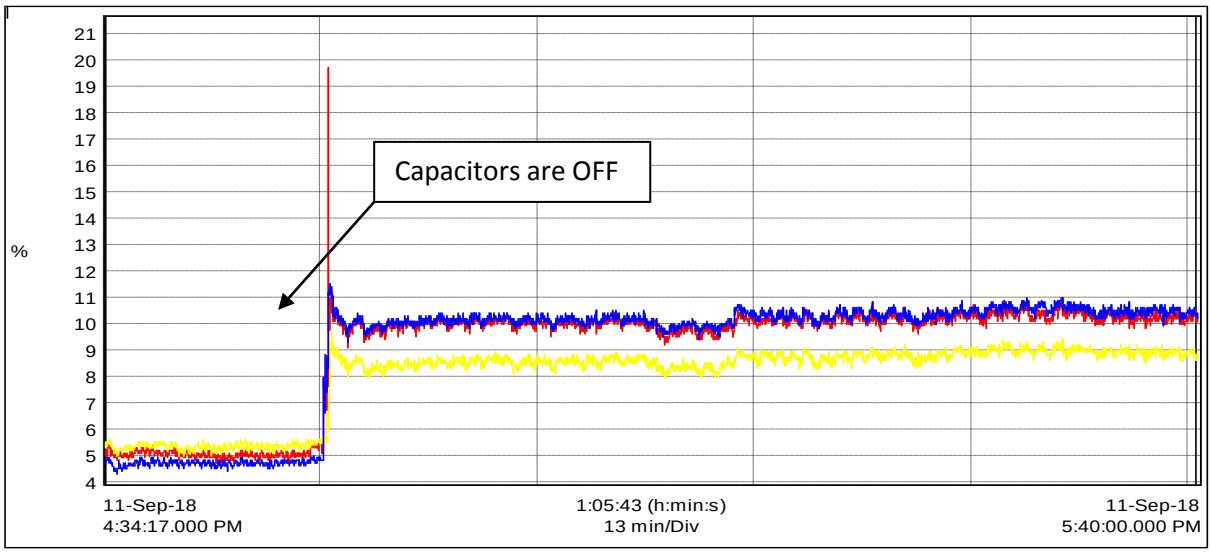

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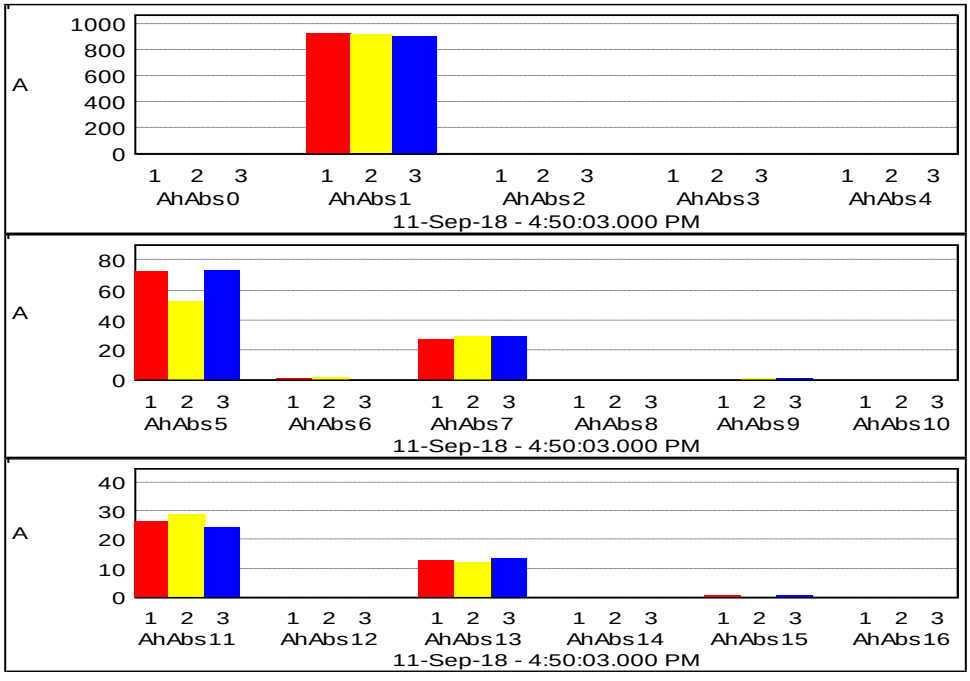
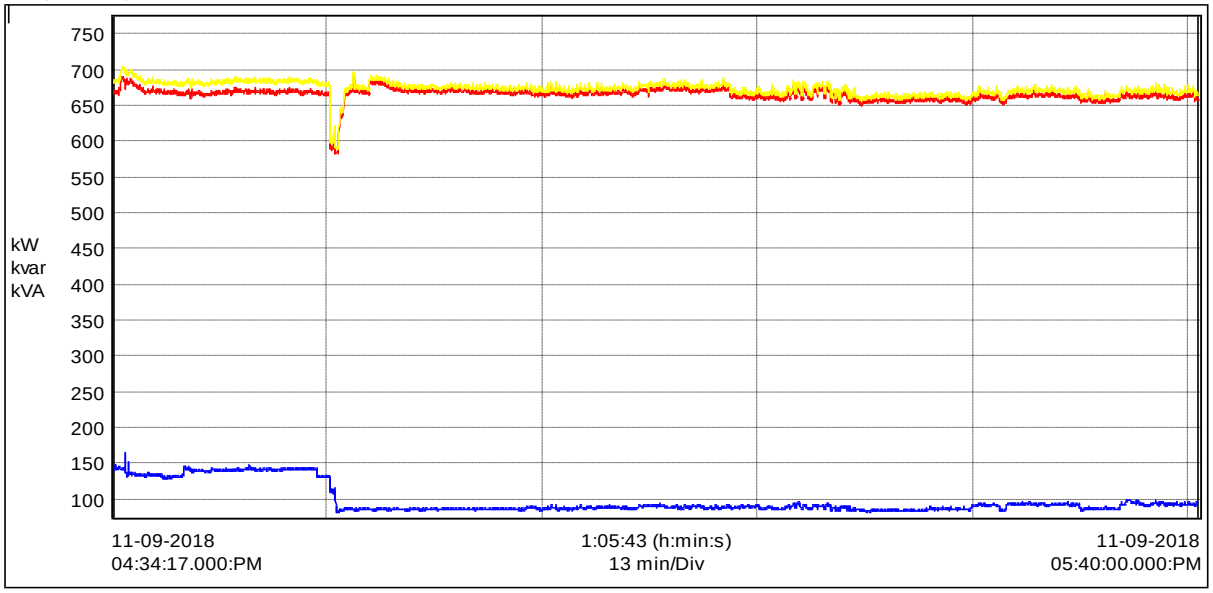


KW, KVAR, KVA



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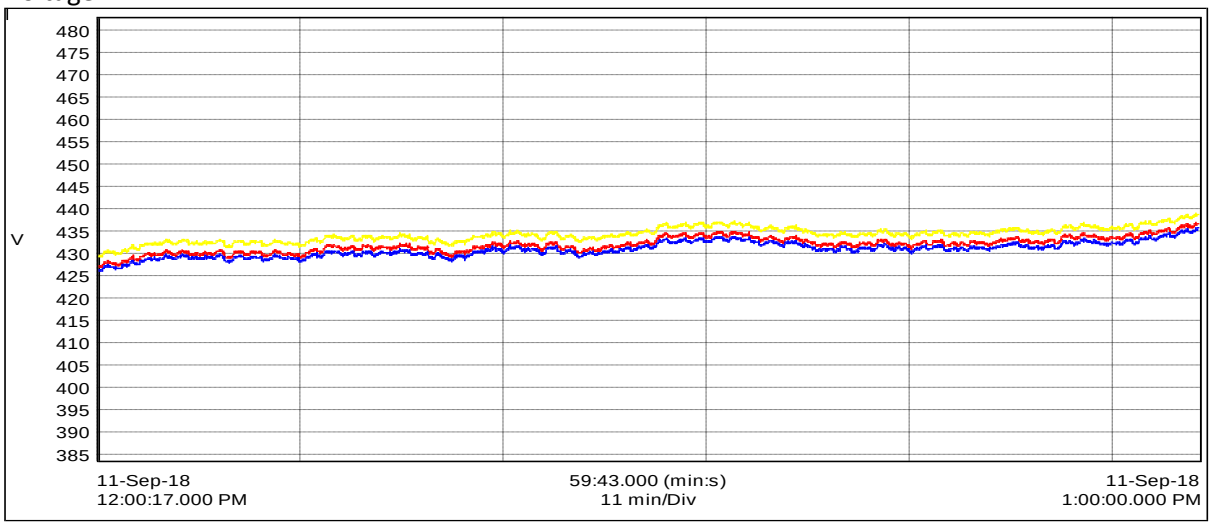
Voltage L-L



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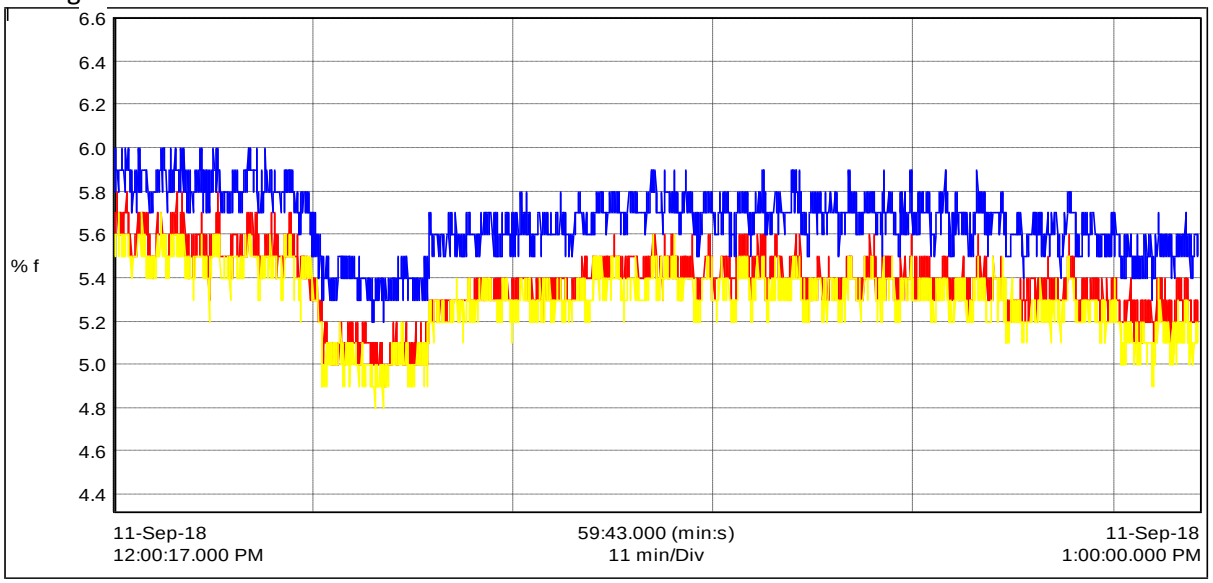

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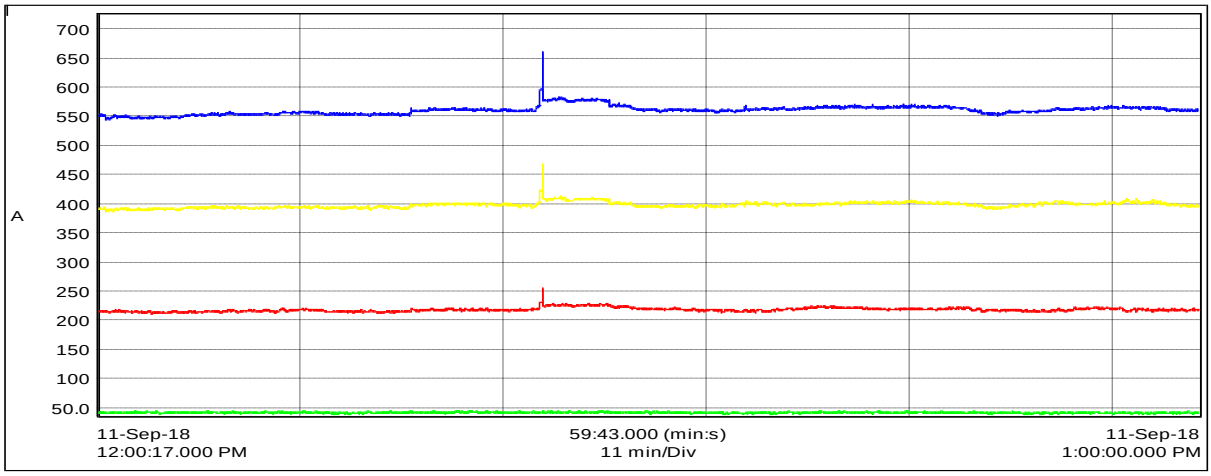

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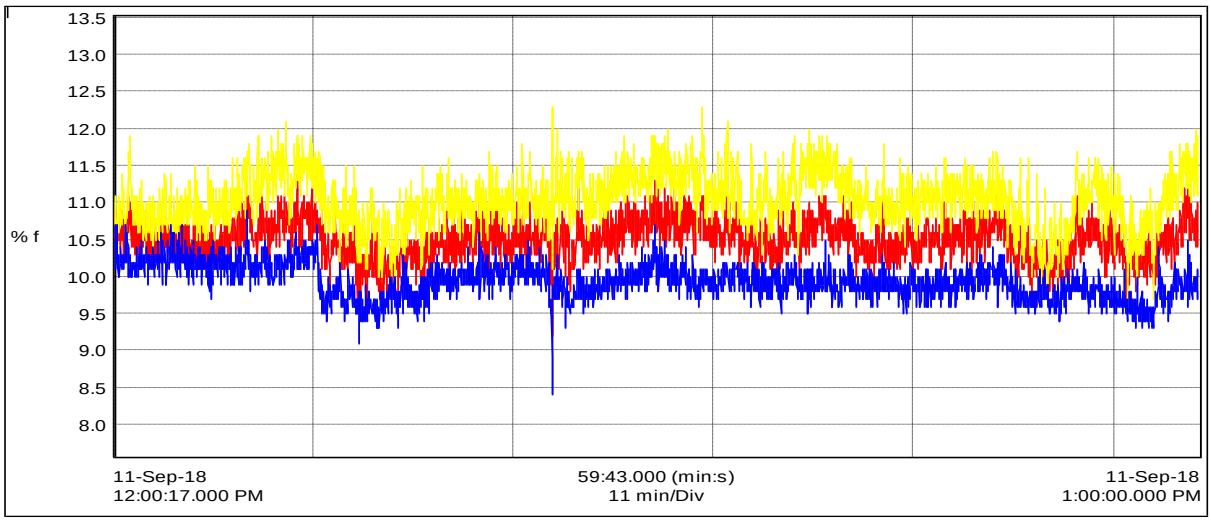

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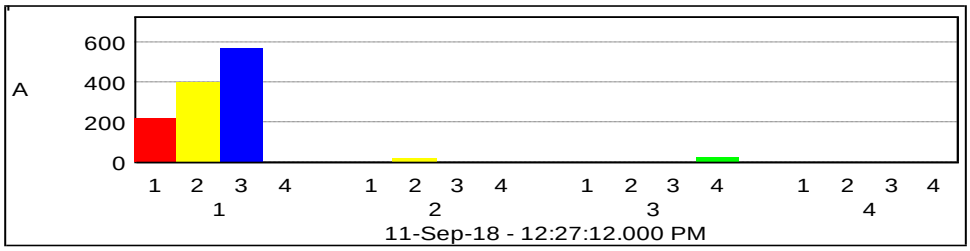

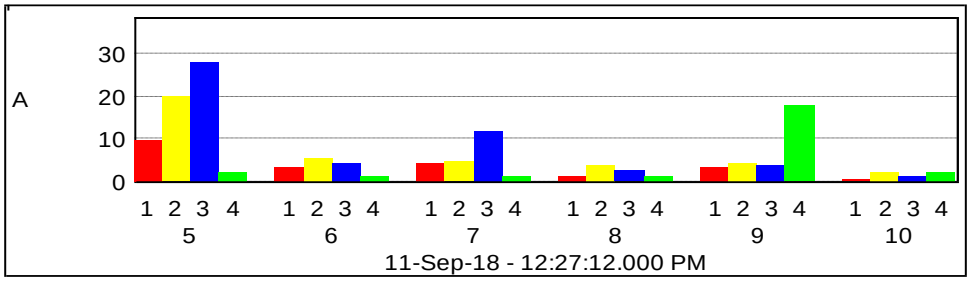

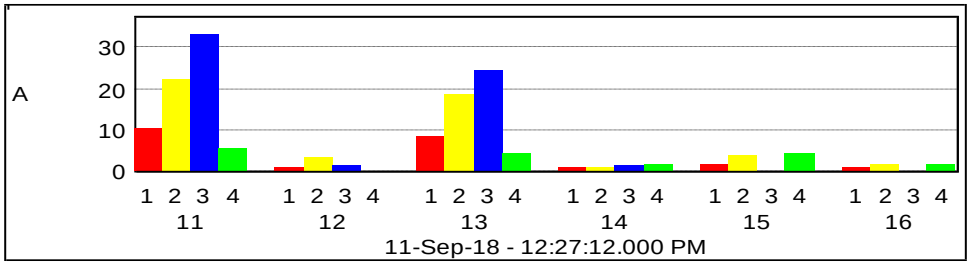

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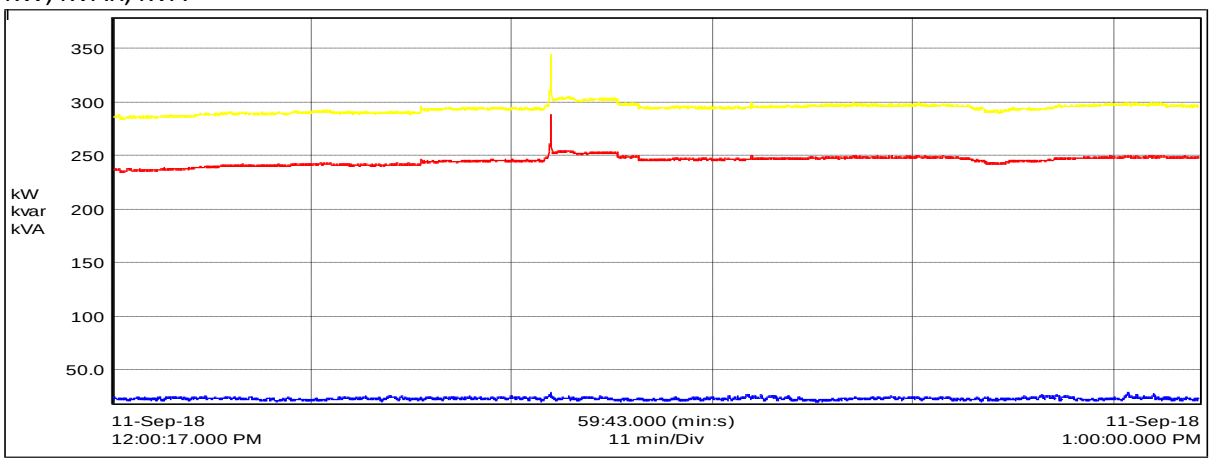
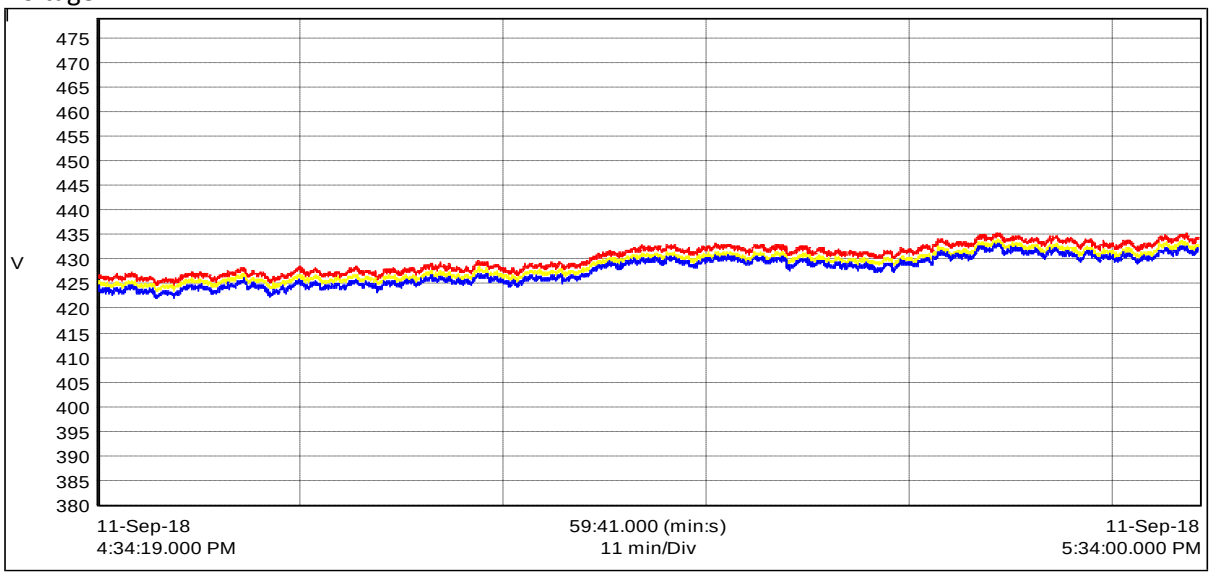


PF

Spinning 2:

Voltage L- L



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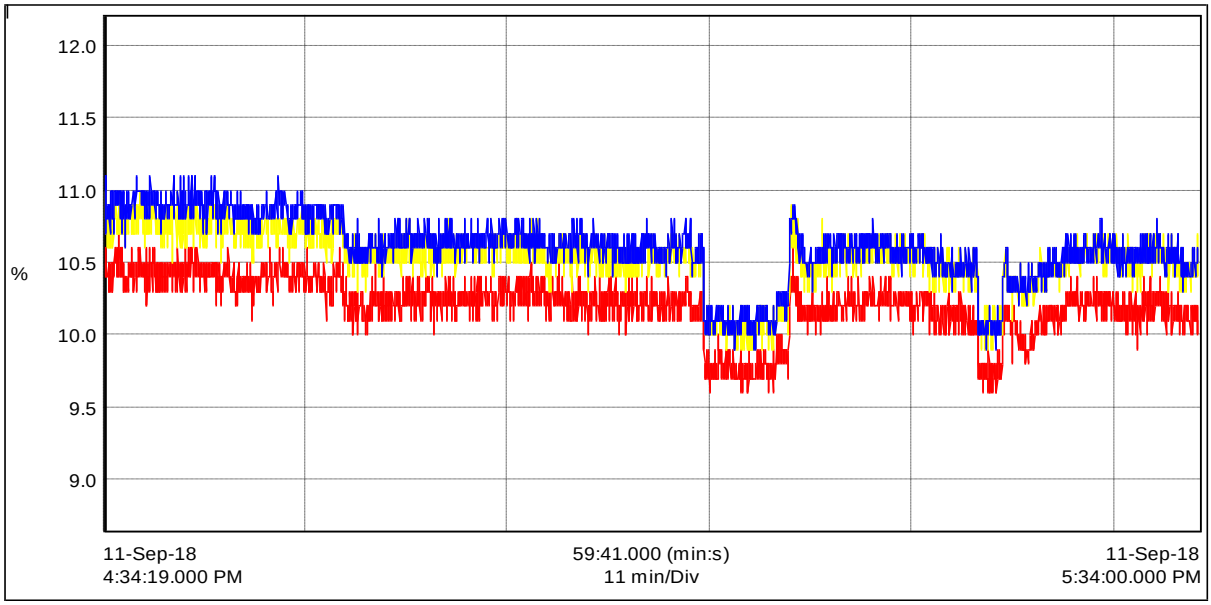

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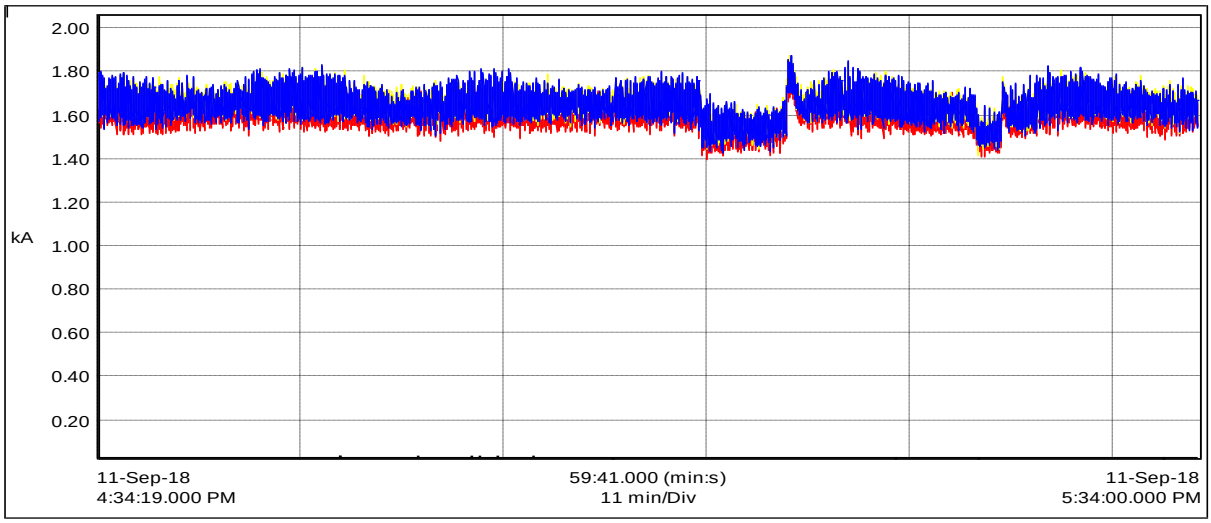

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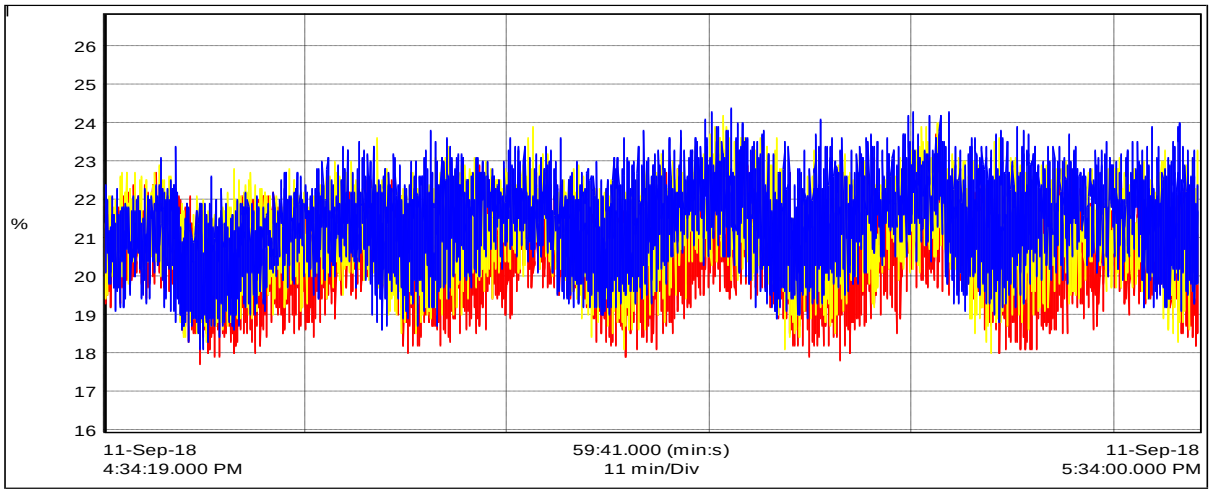

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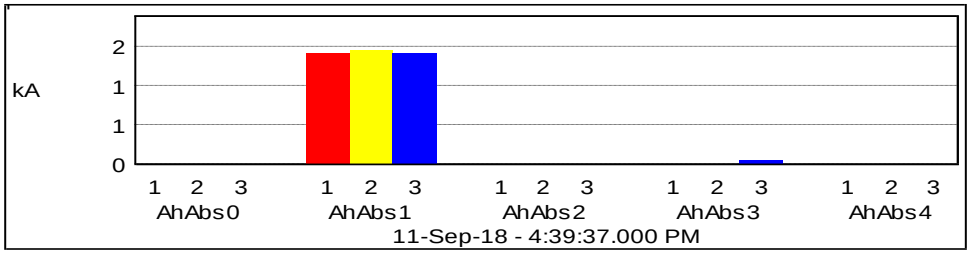

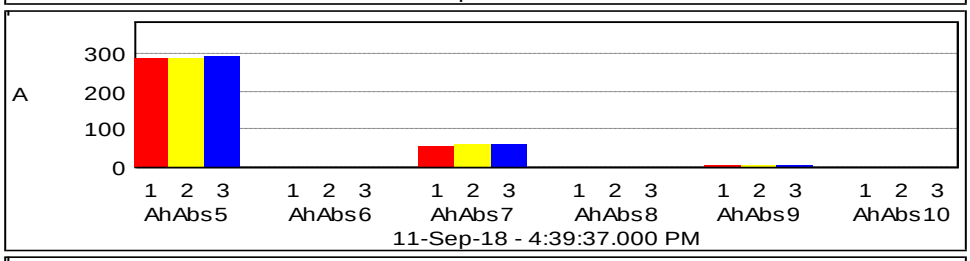

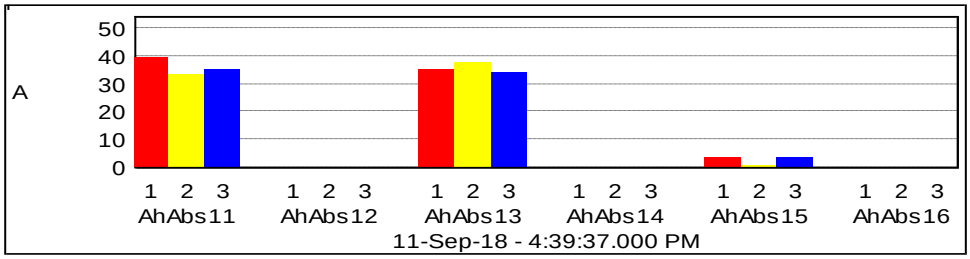

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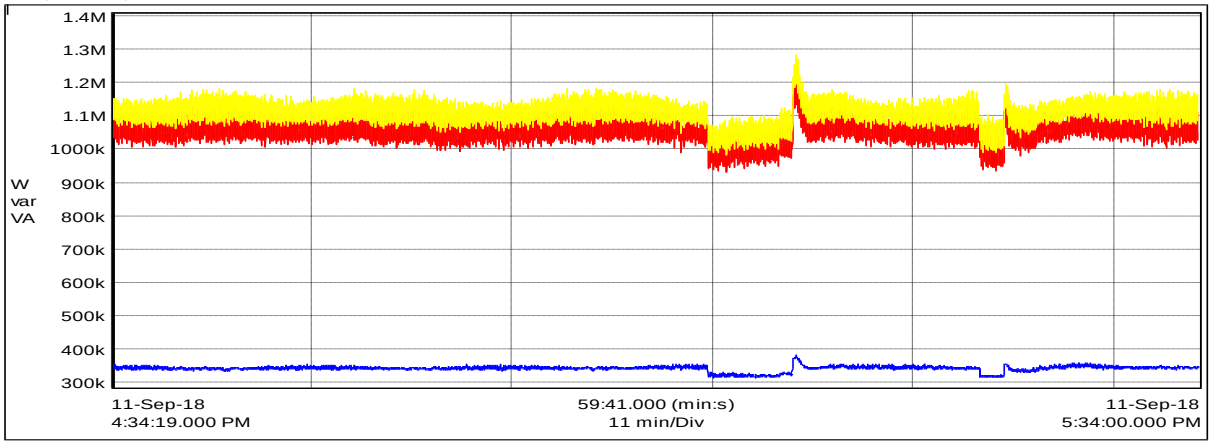

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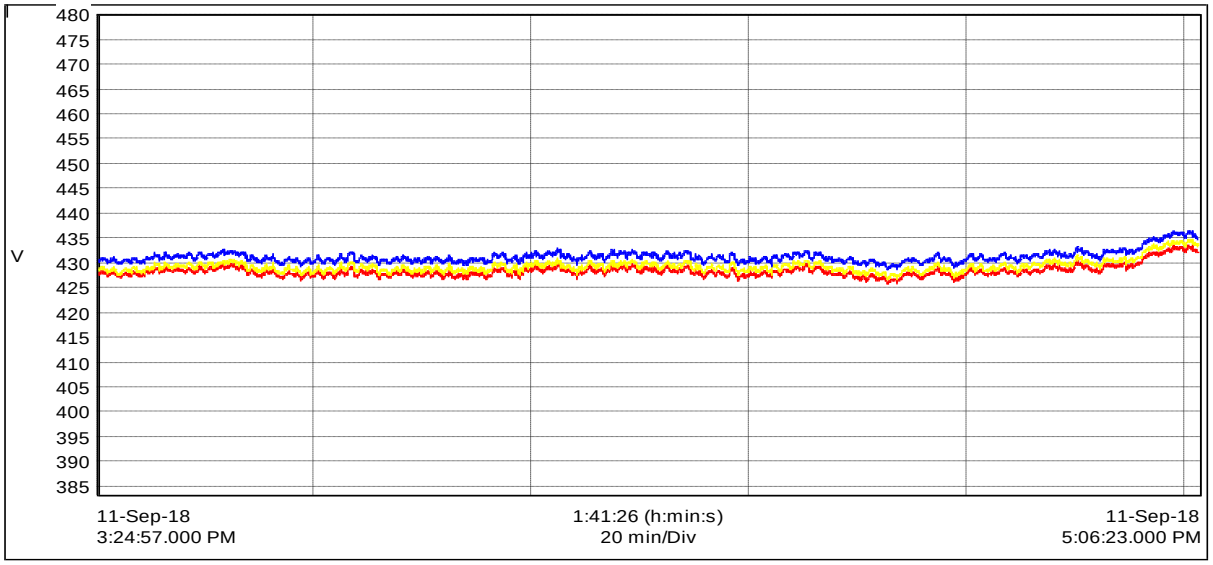

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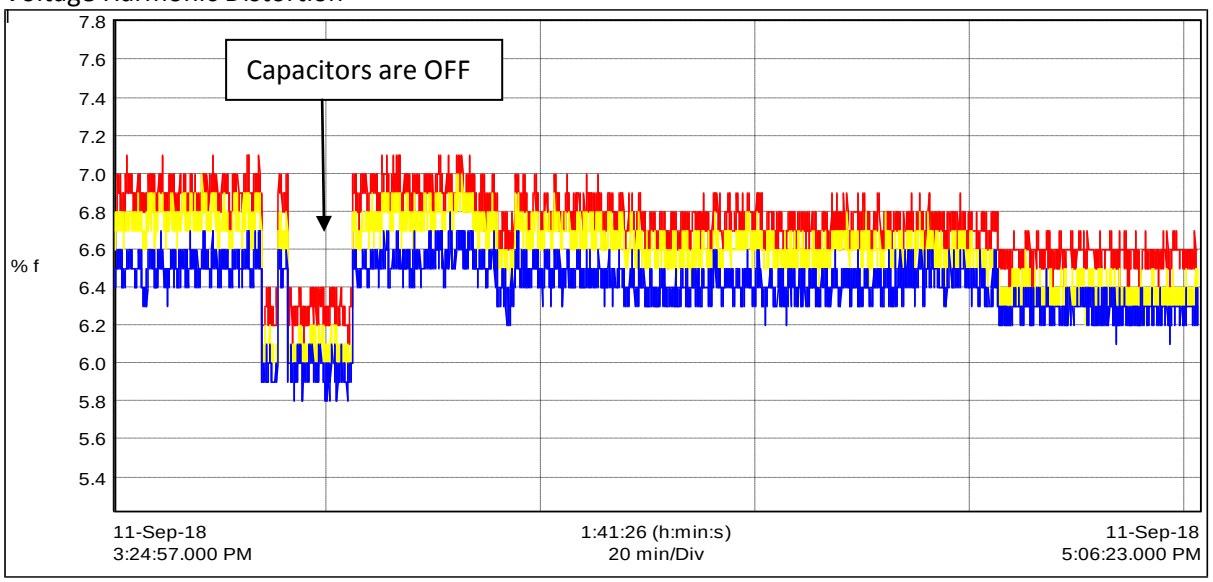
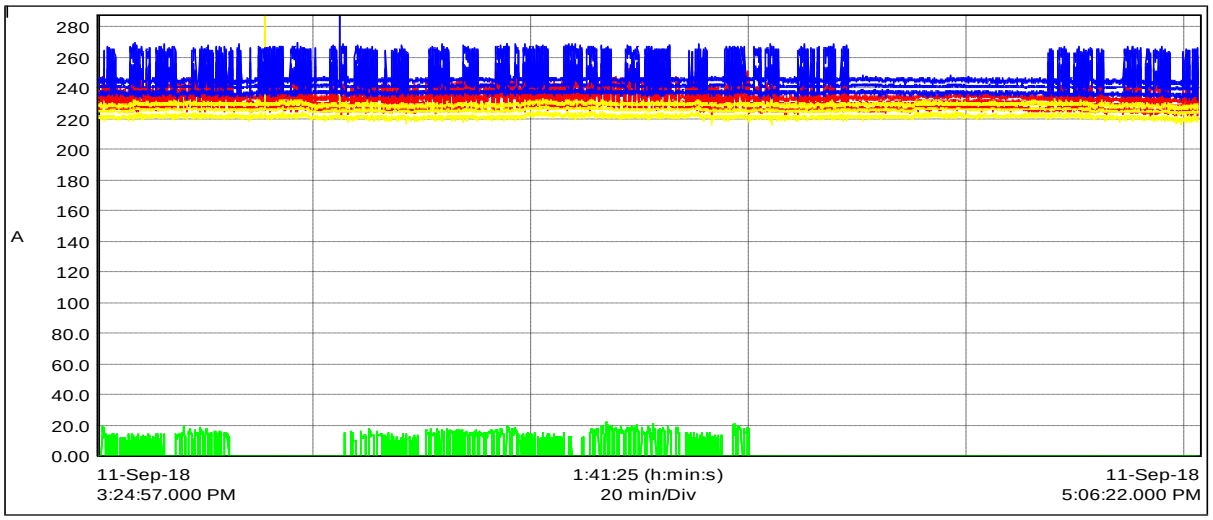
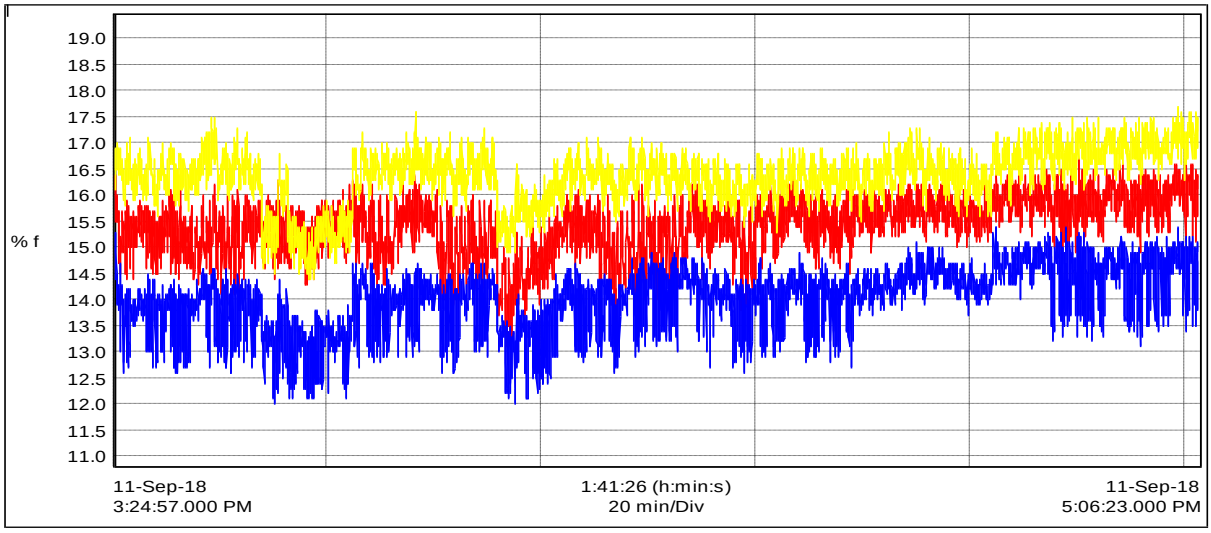


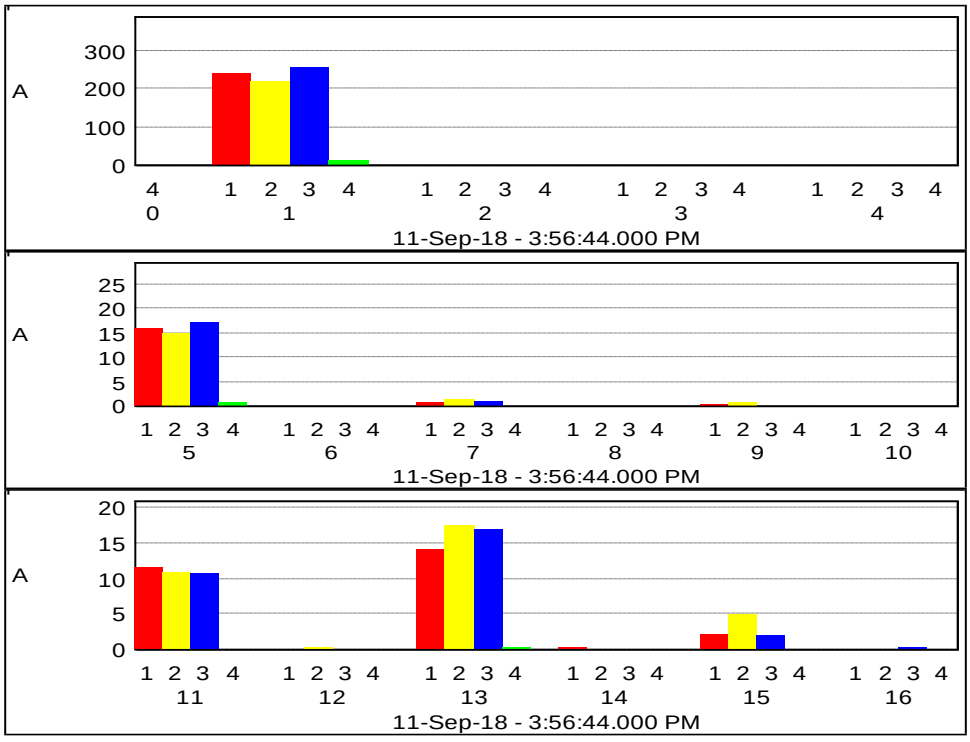
Current



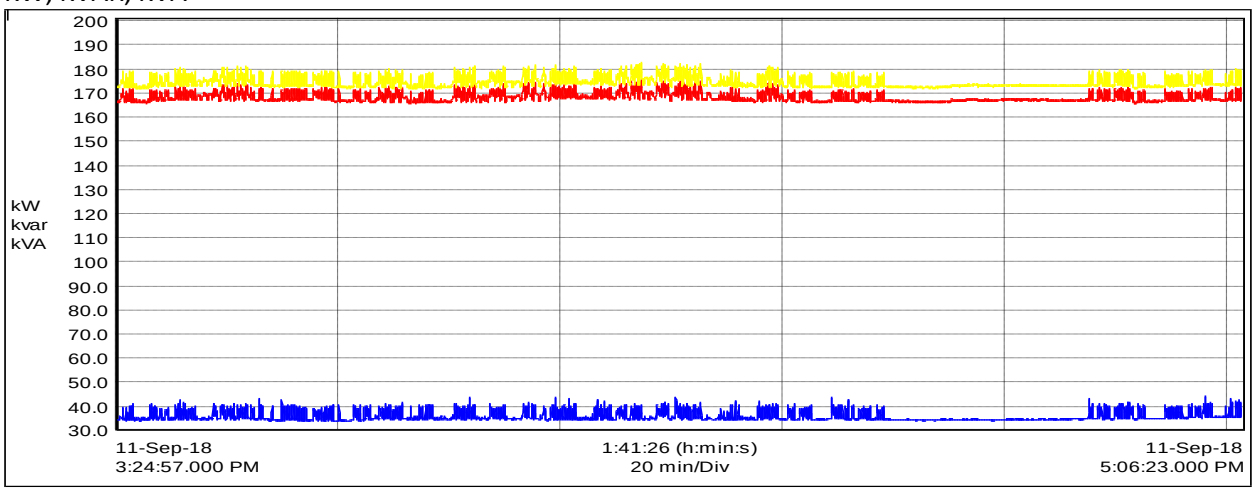
Current Harmonic Distortion



Individual Current Harmonics



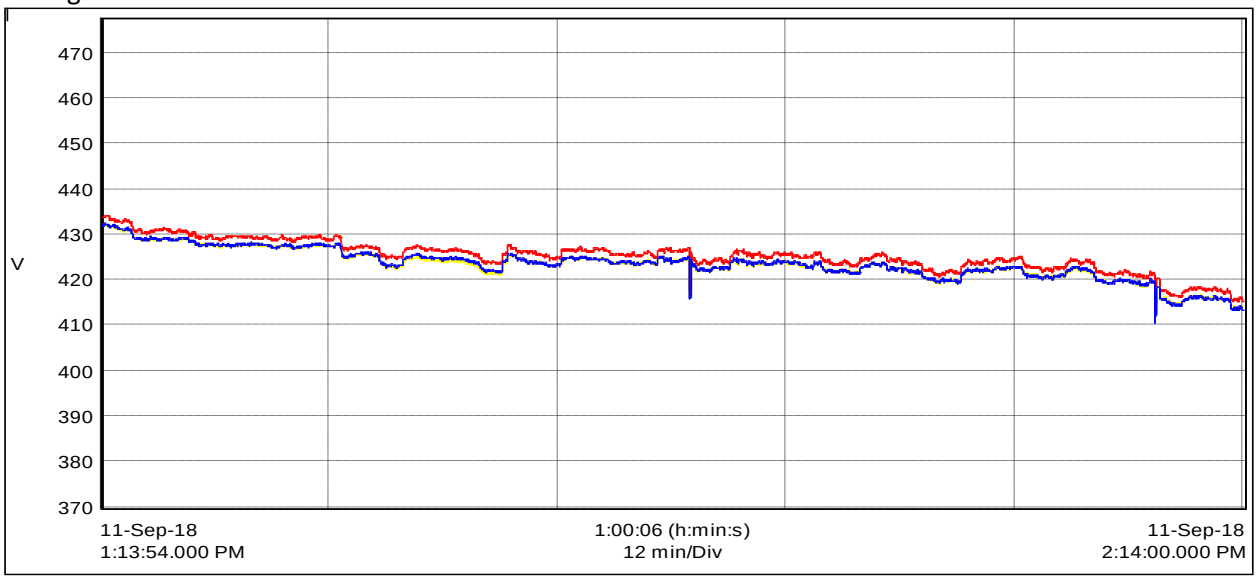
KW, KVAR, KVA



Utility Compressor:

Voltage L- N

Voltage L-L



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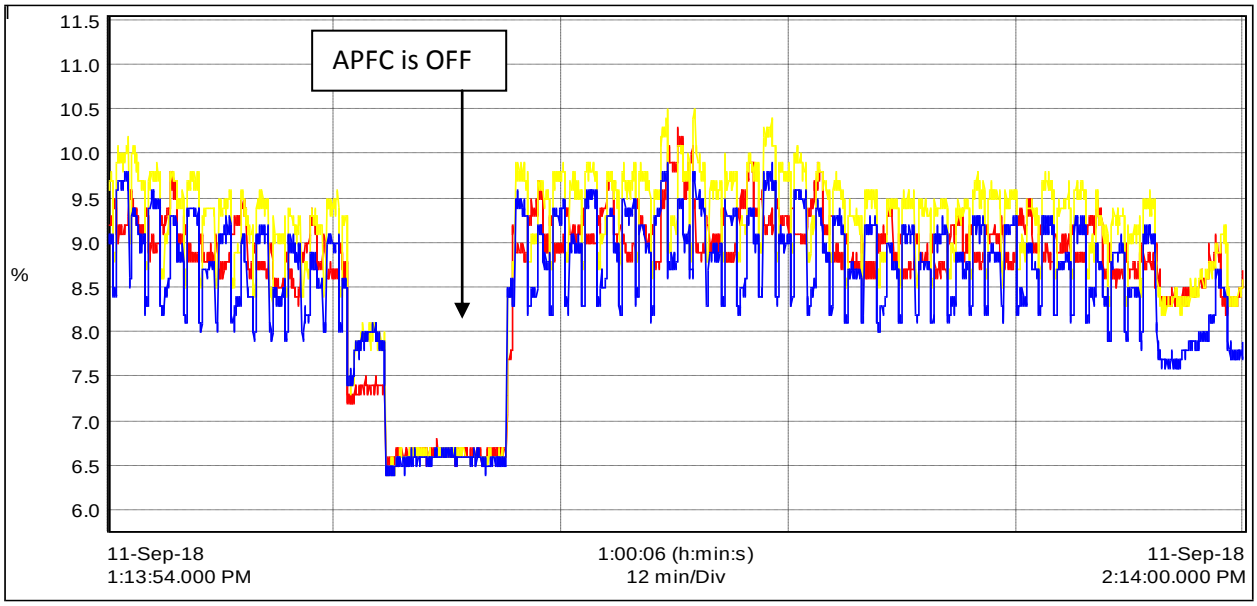

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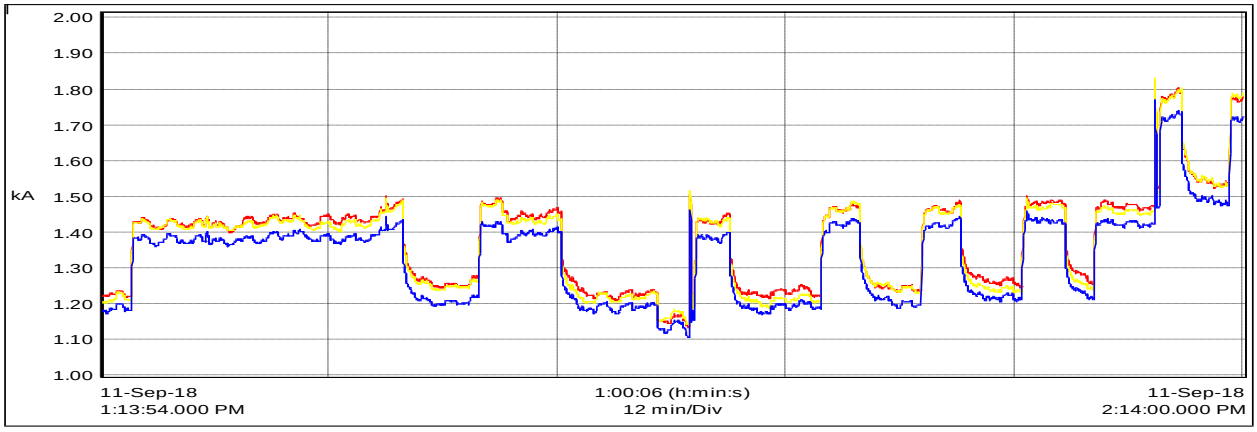

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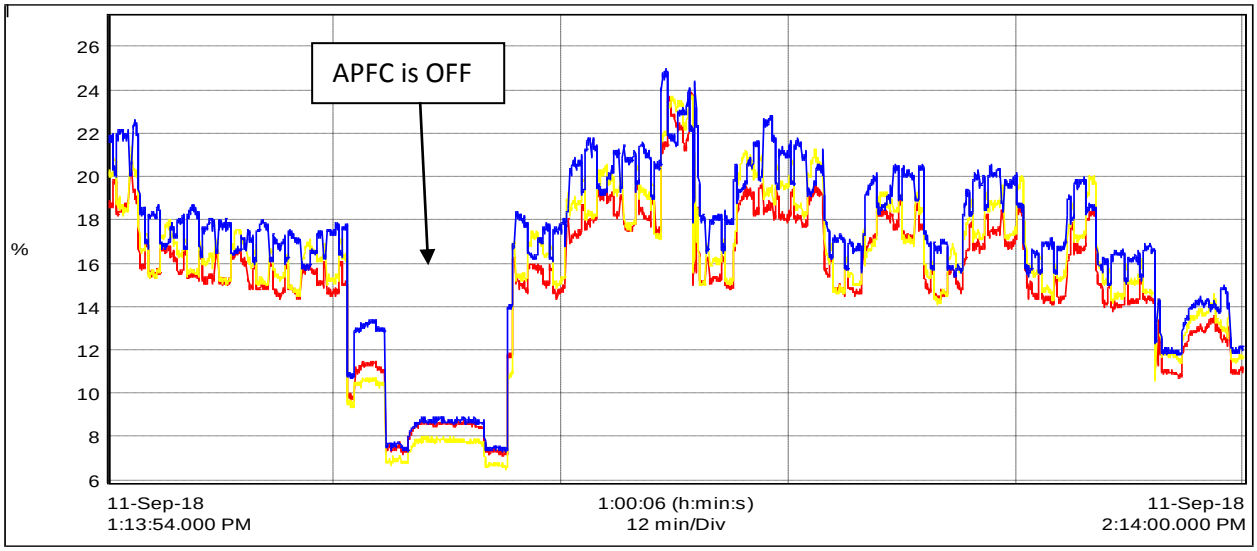
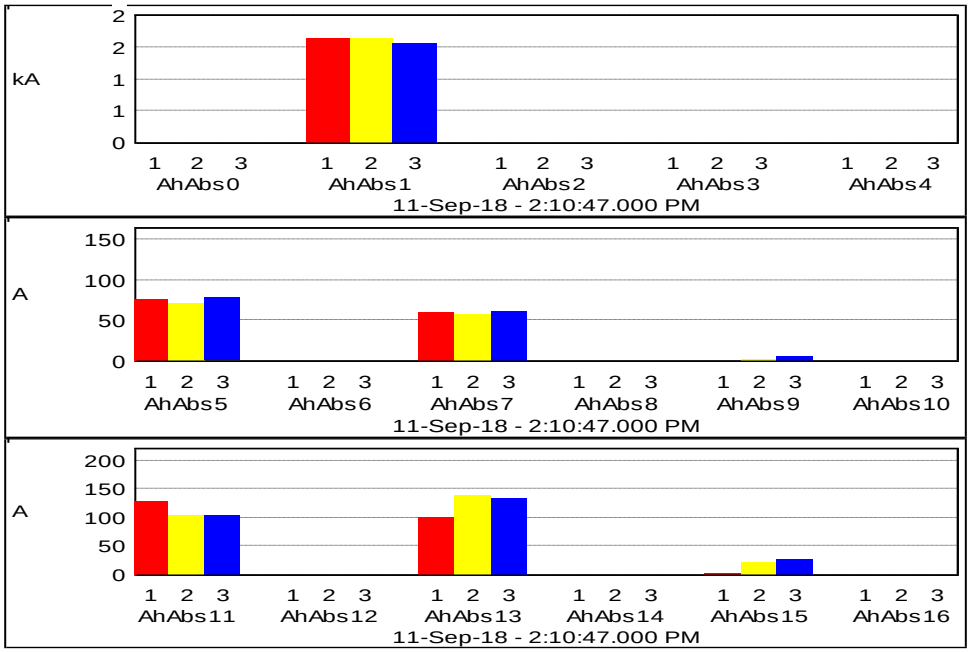
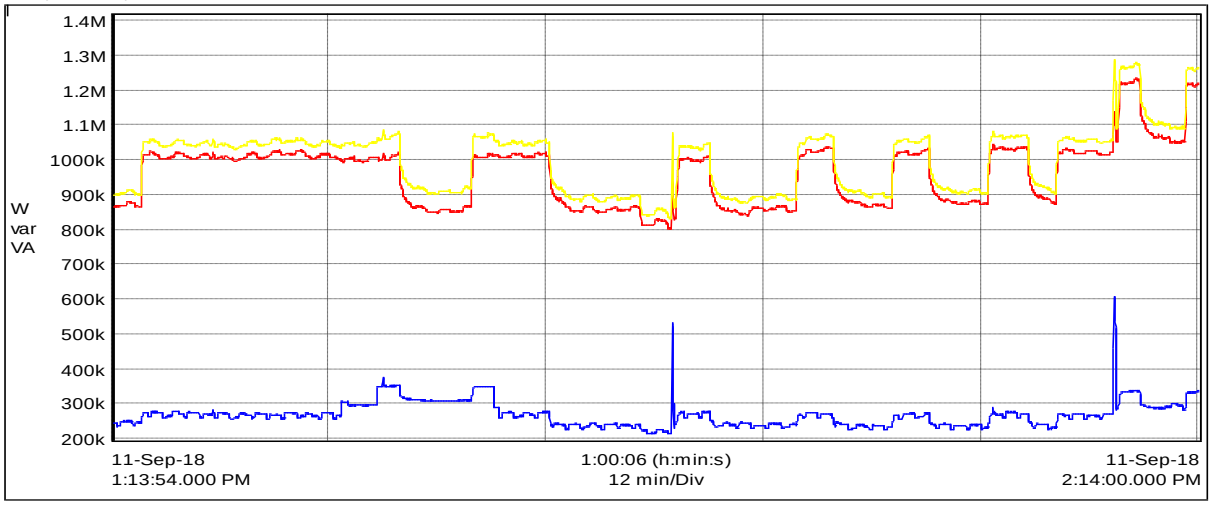


Individual Current Harmonics

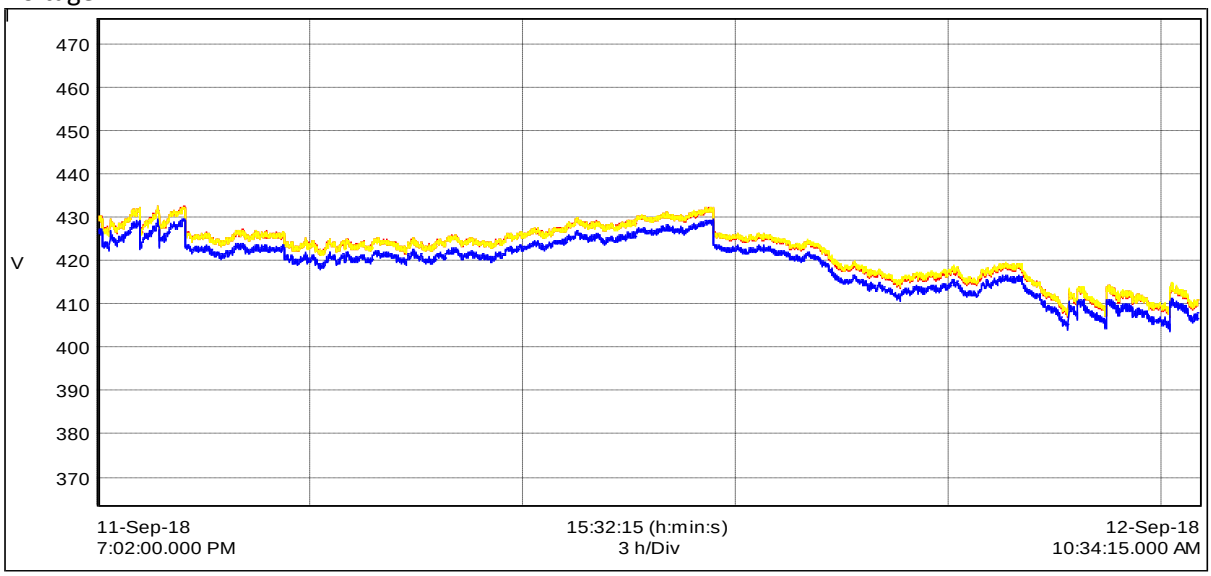


KW, KVAR, KVA

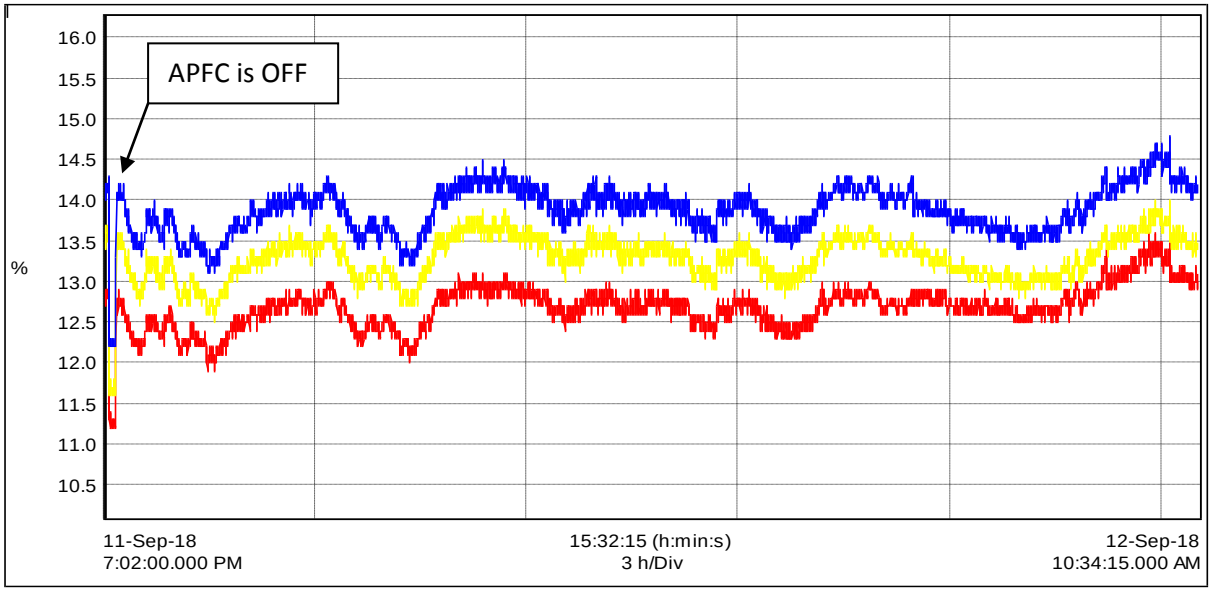


Weaving 1:

Voltage L- L



Voltage Harmonic Distortion



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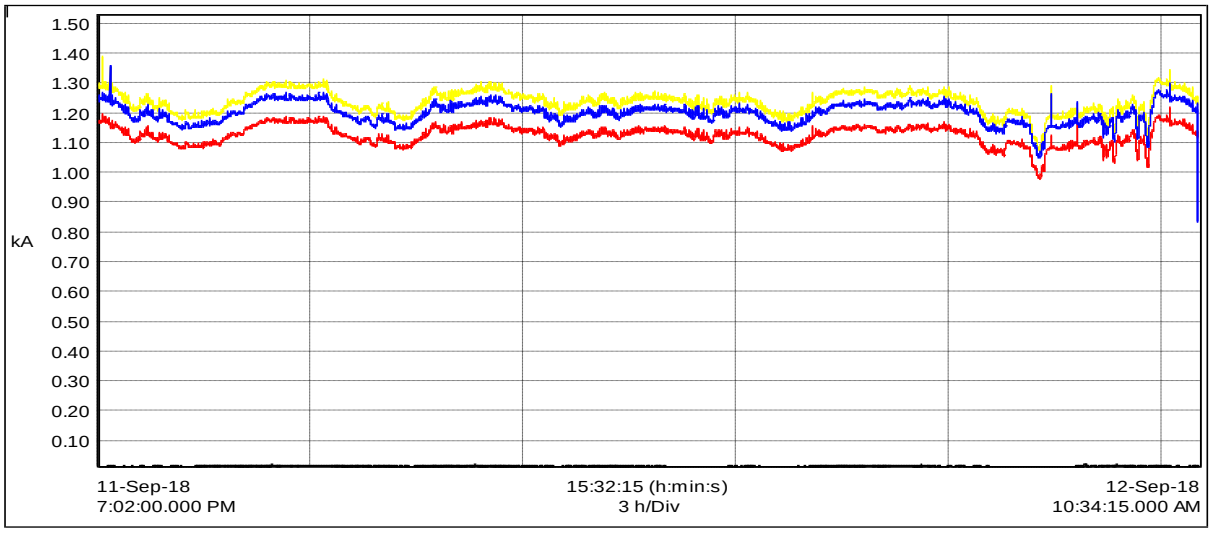

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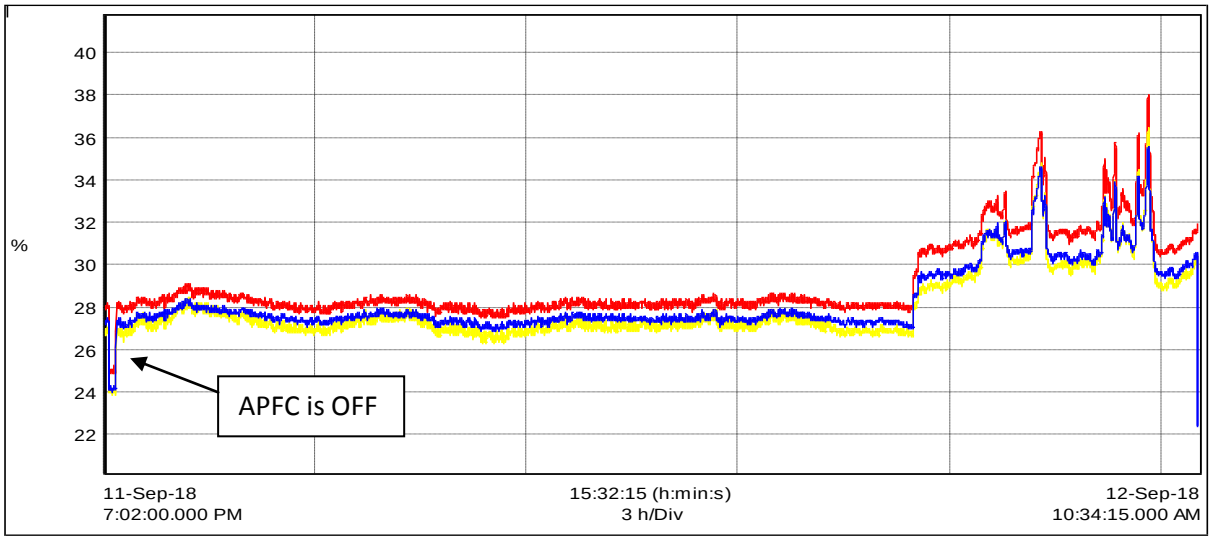
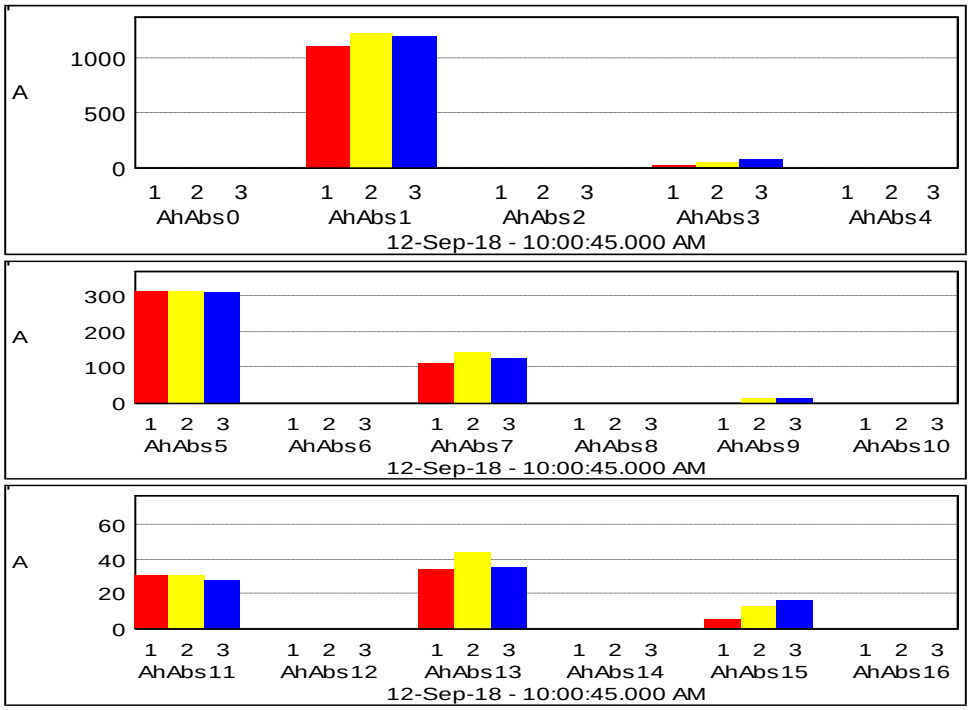
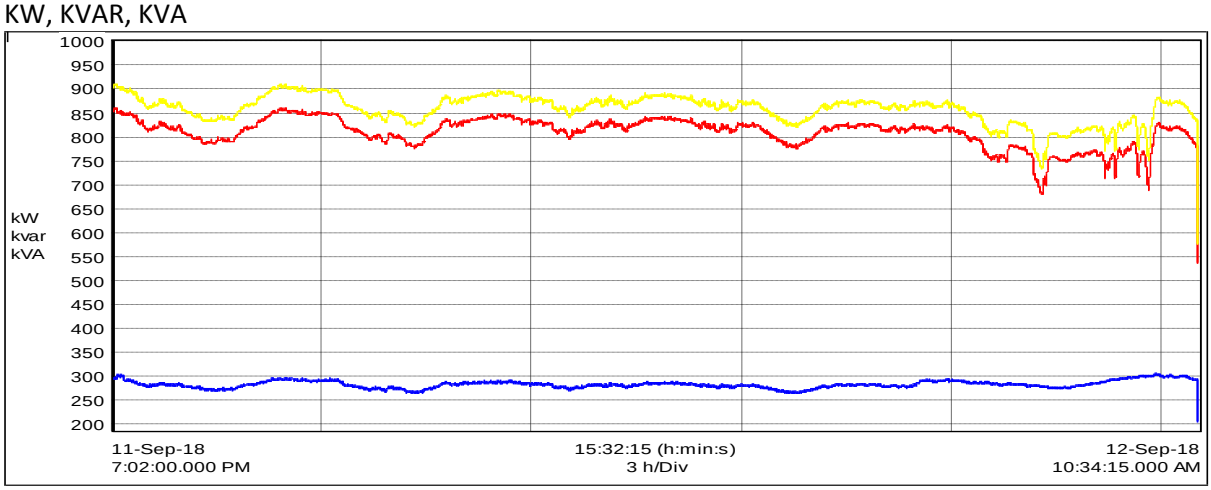


Individual Current Harmonics

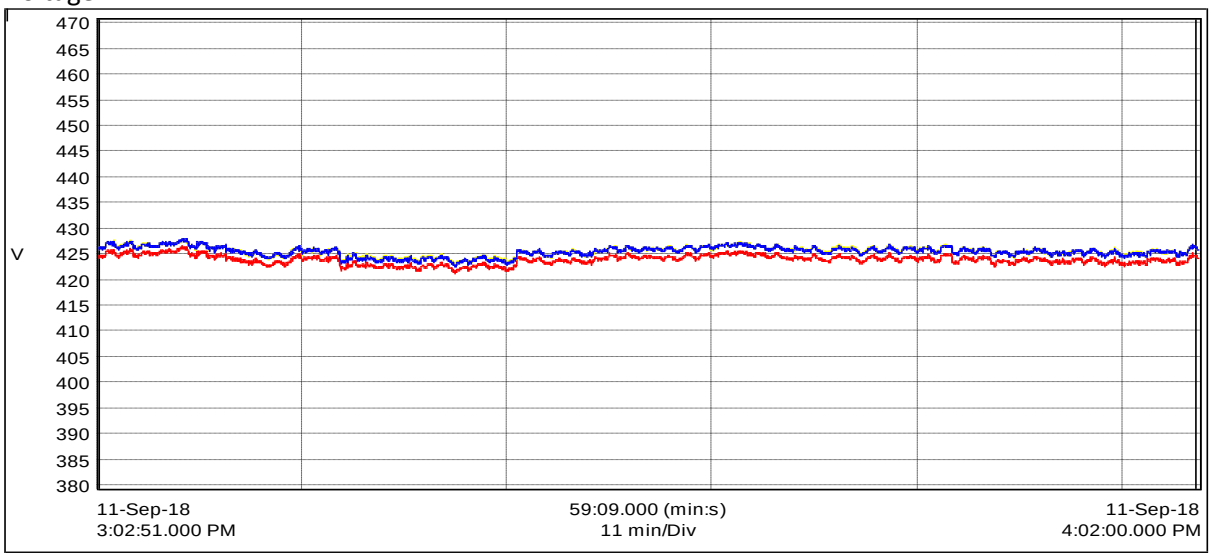


KW, KVAR, KVA



Weaving 3:

Voltage L- L



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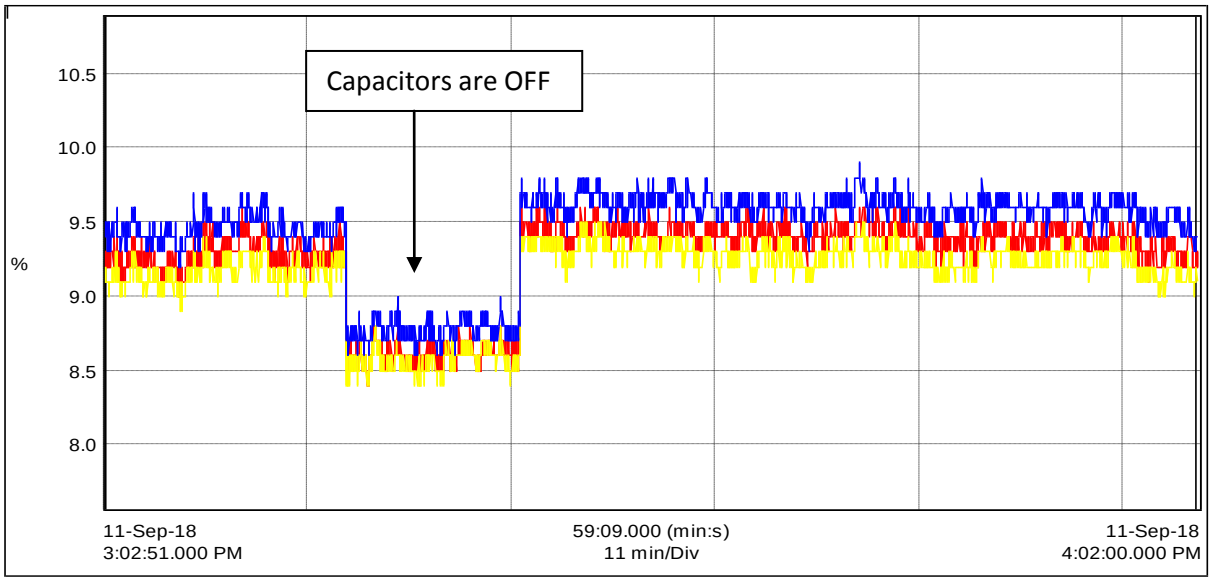
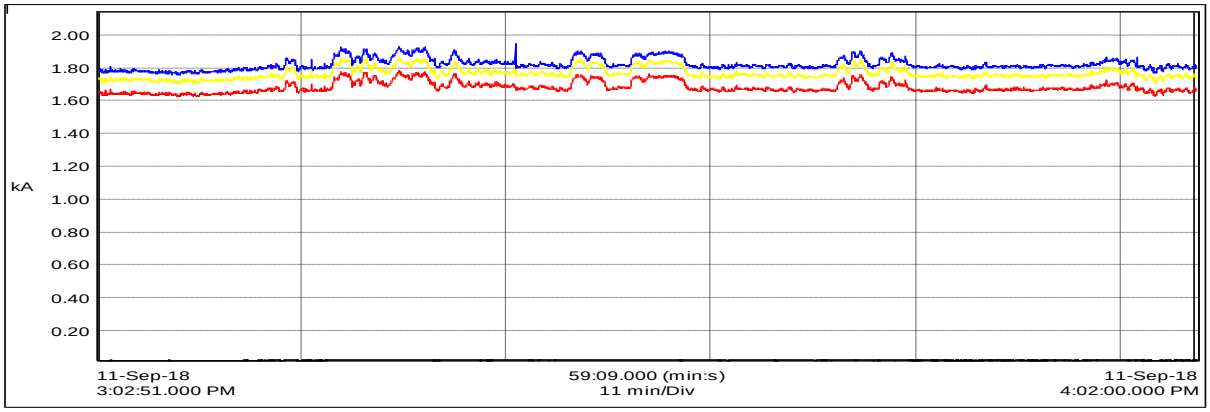
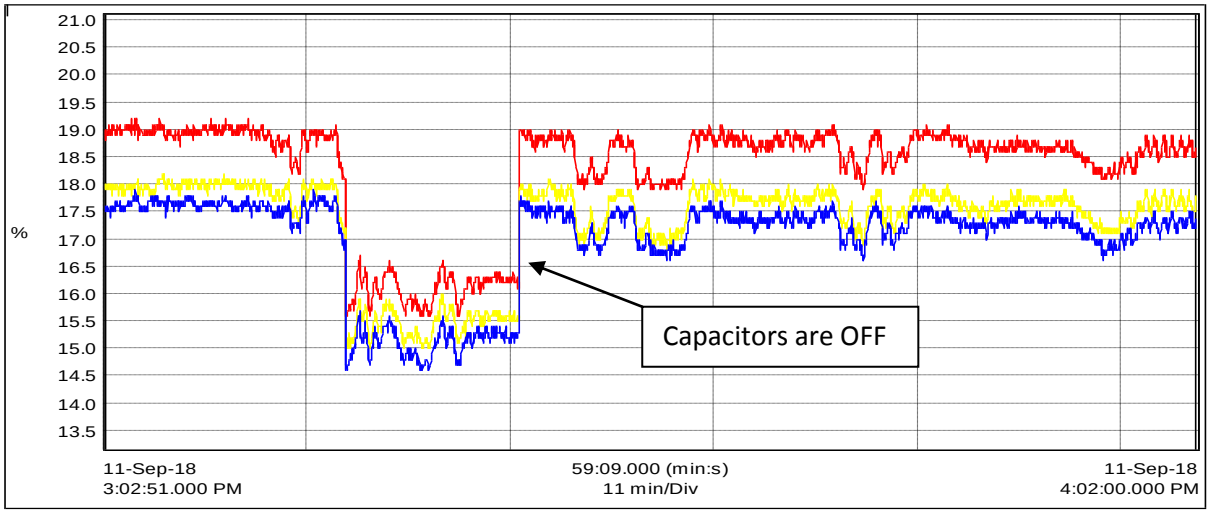


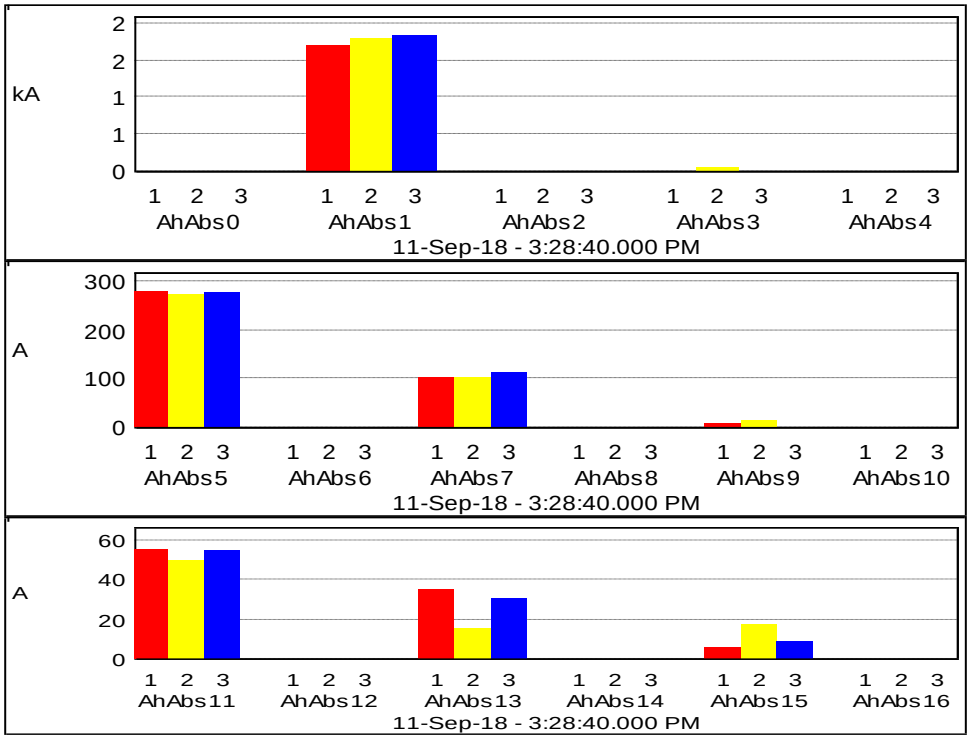
Current



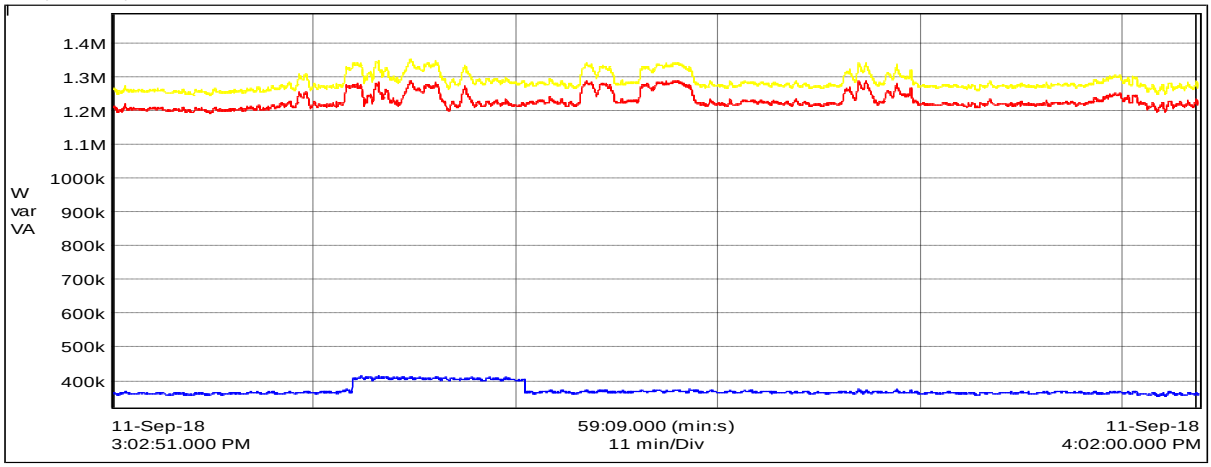
Current Harmonic Distortion



Individual Current Harmonics

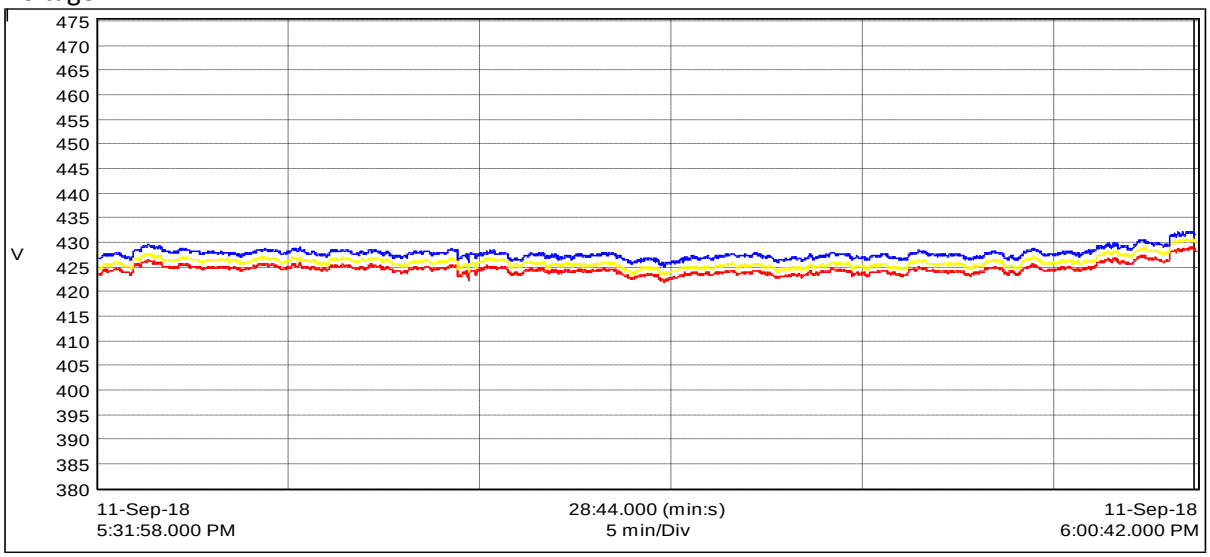


KW, KVAR, KVA

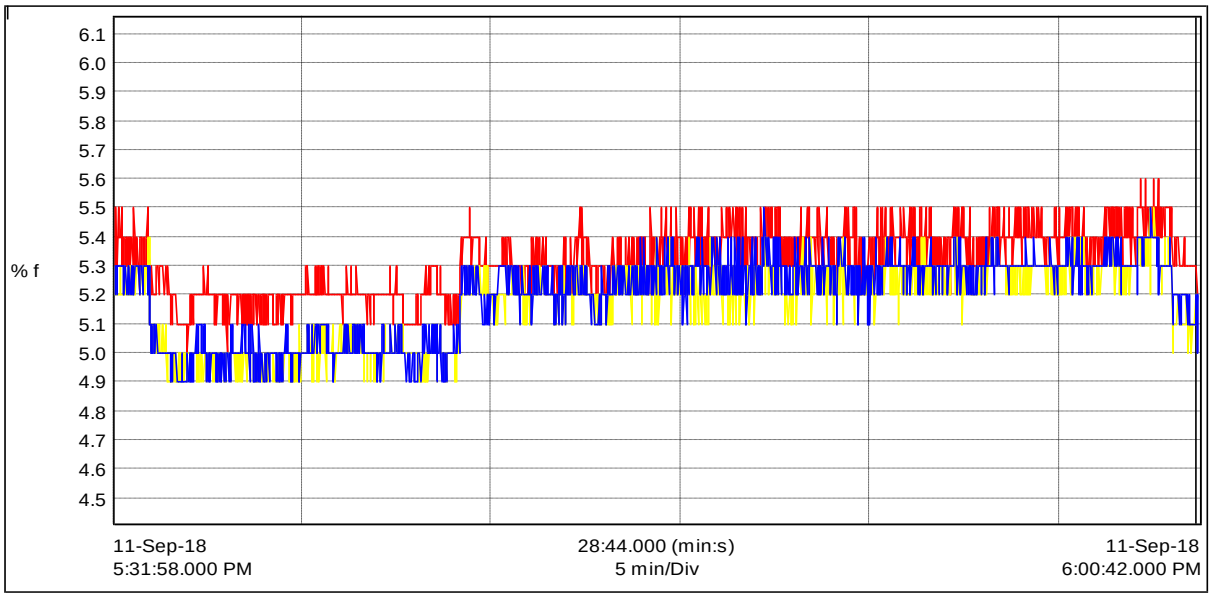


Coal Fire Boiler:

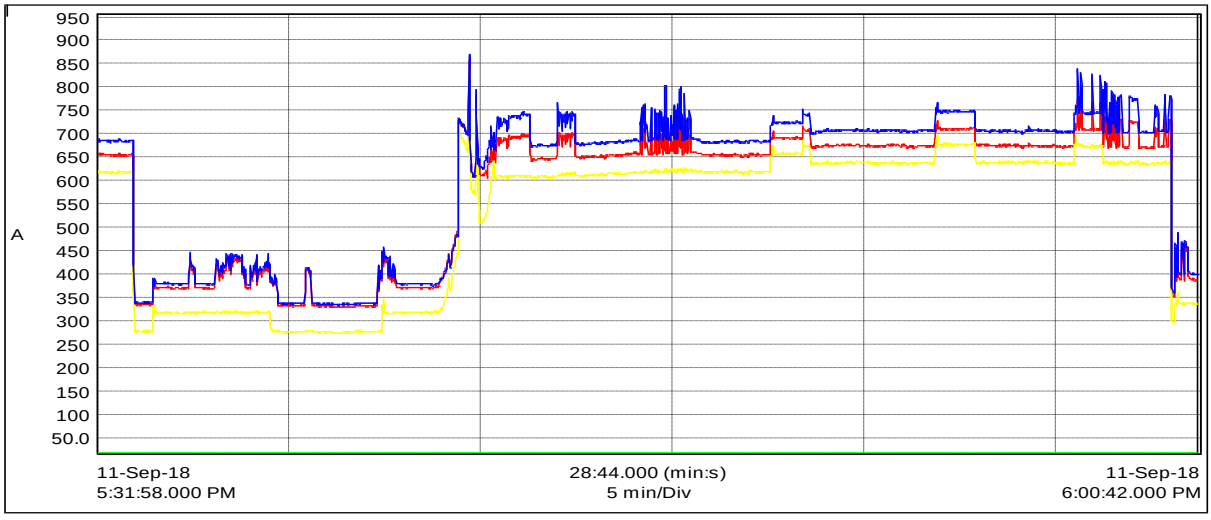
Voltage L- L



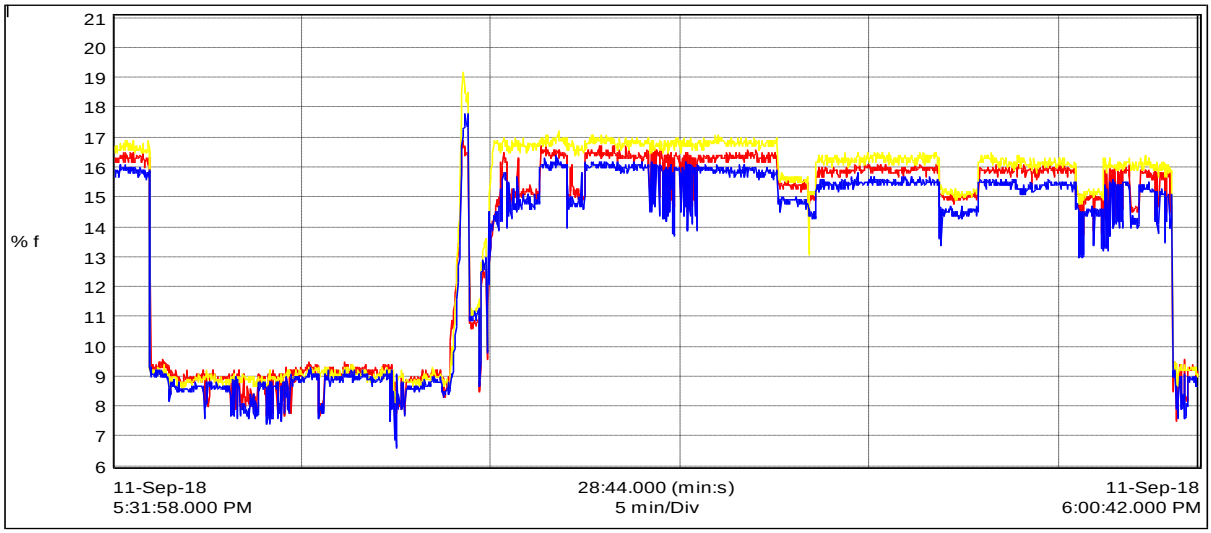
Voltage Harmonic Distortion



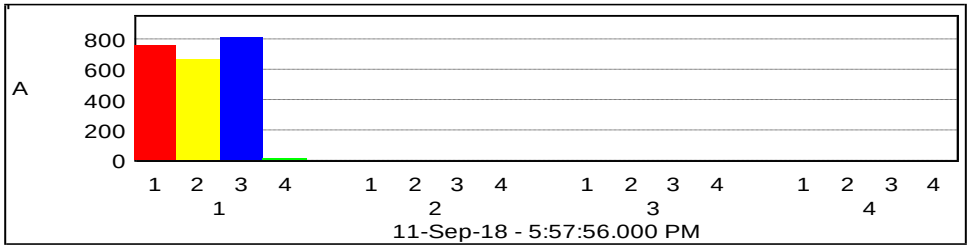
Current

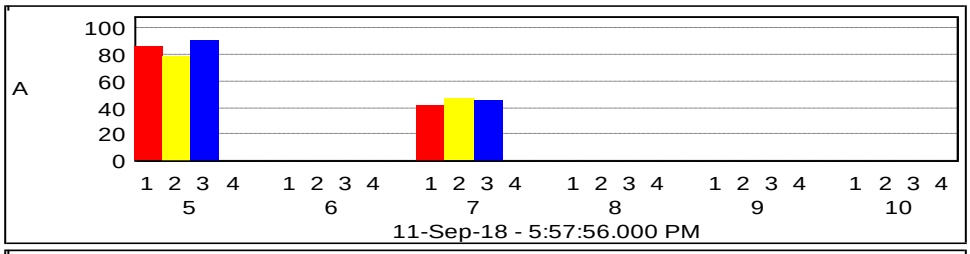


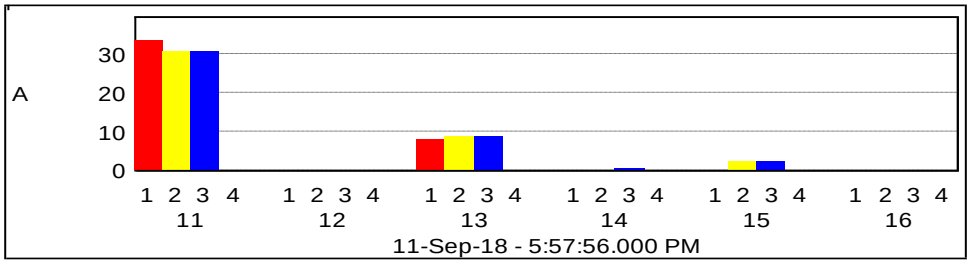
Current Harmonic Distortion



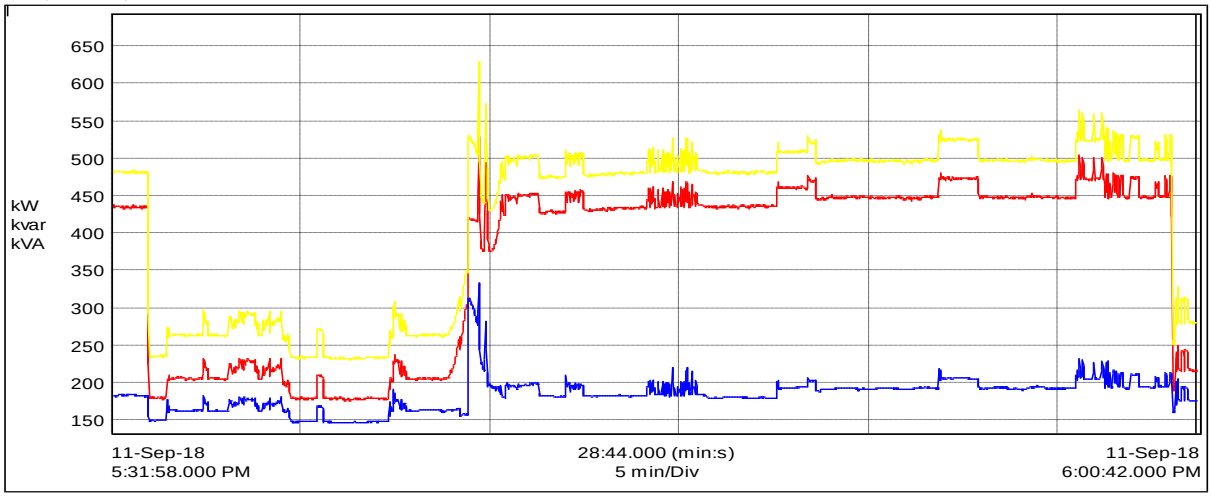
Individual Current Harmonics





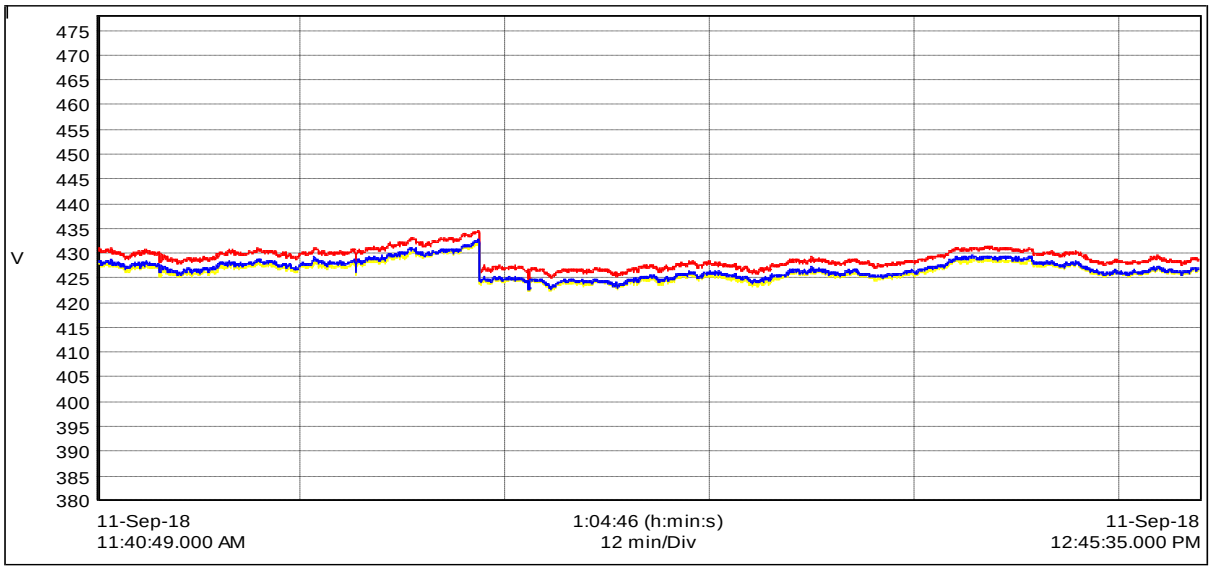


KW, KVAR, KVA

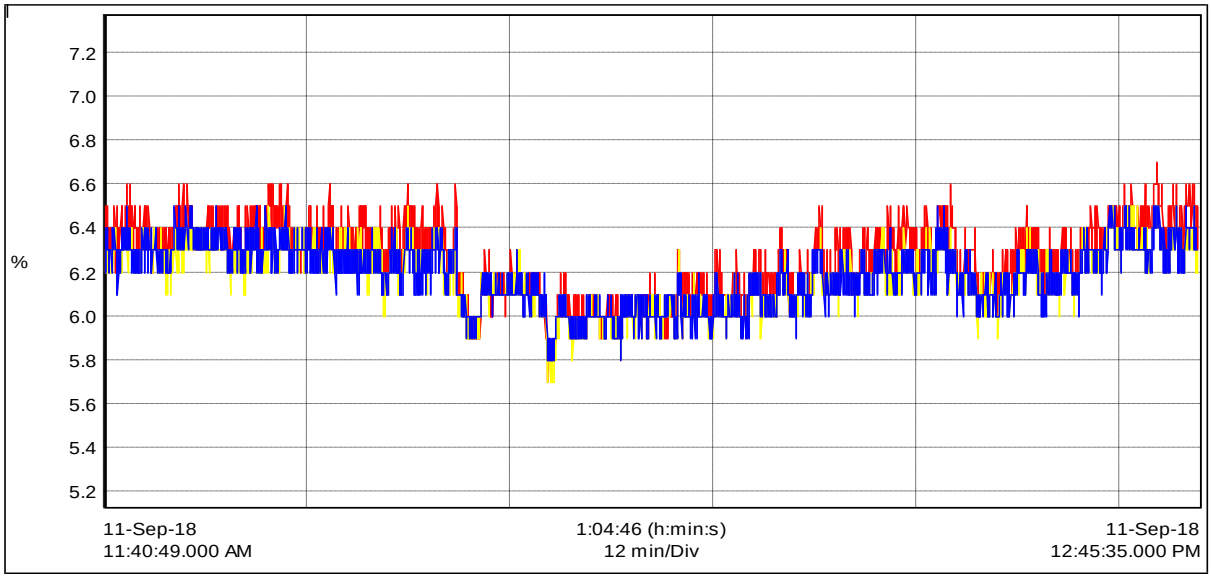


Poly TR:

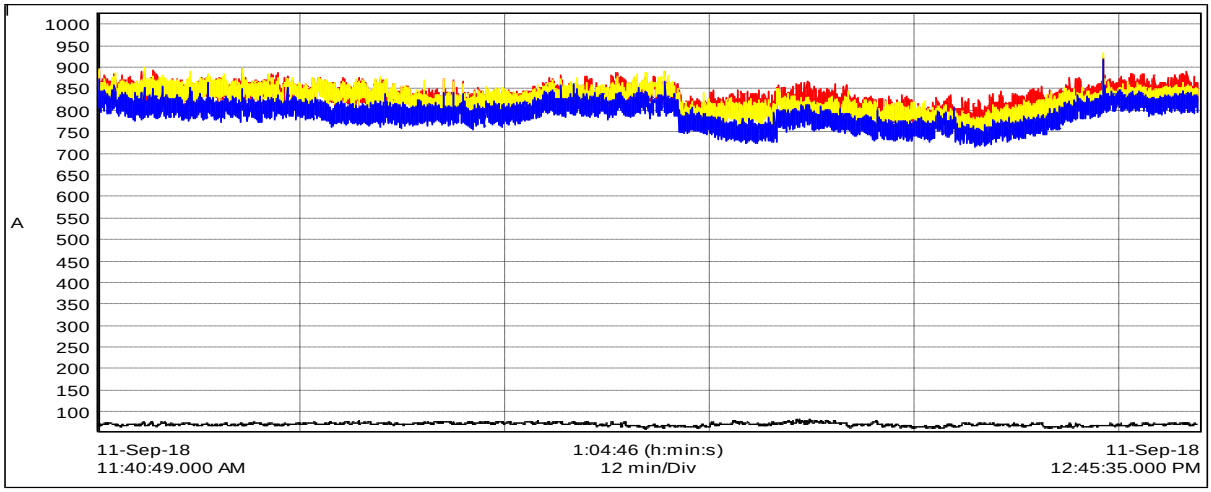
Voltage L-L



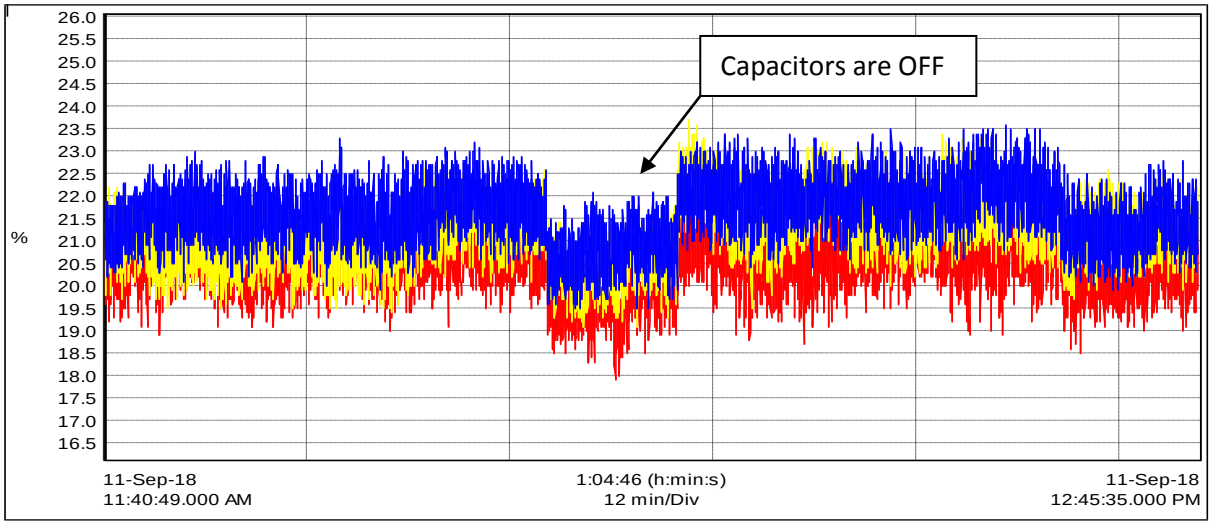
Voltage Harmonic Distortion



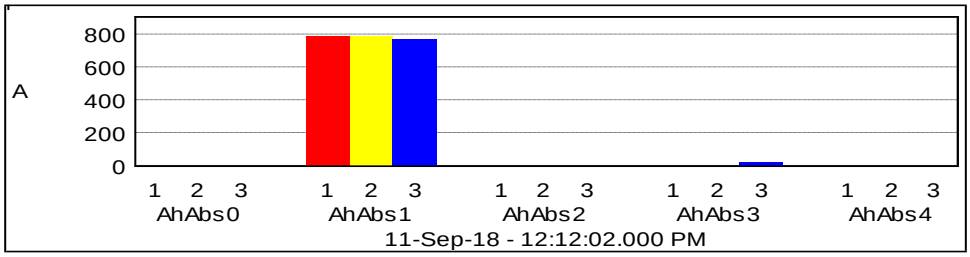
Current

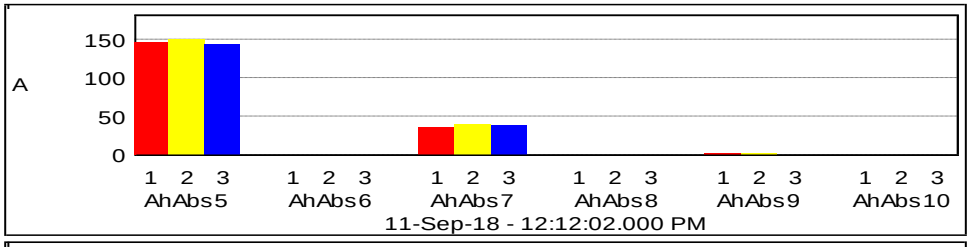


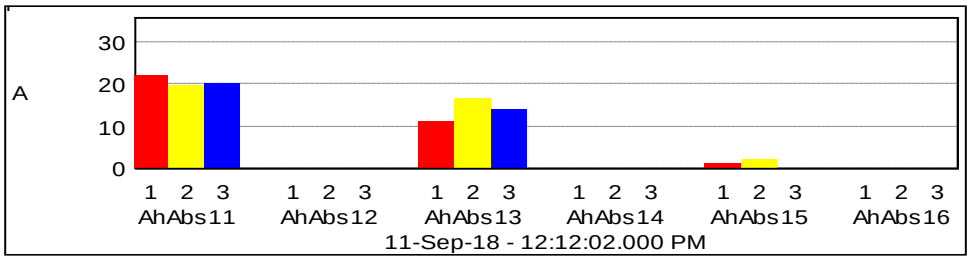
Current Harmonic Distortion



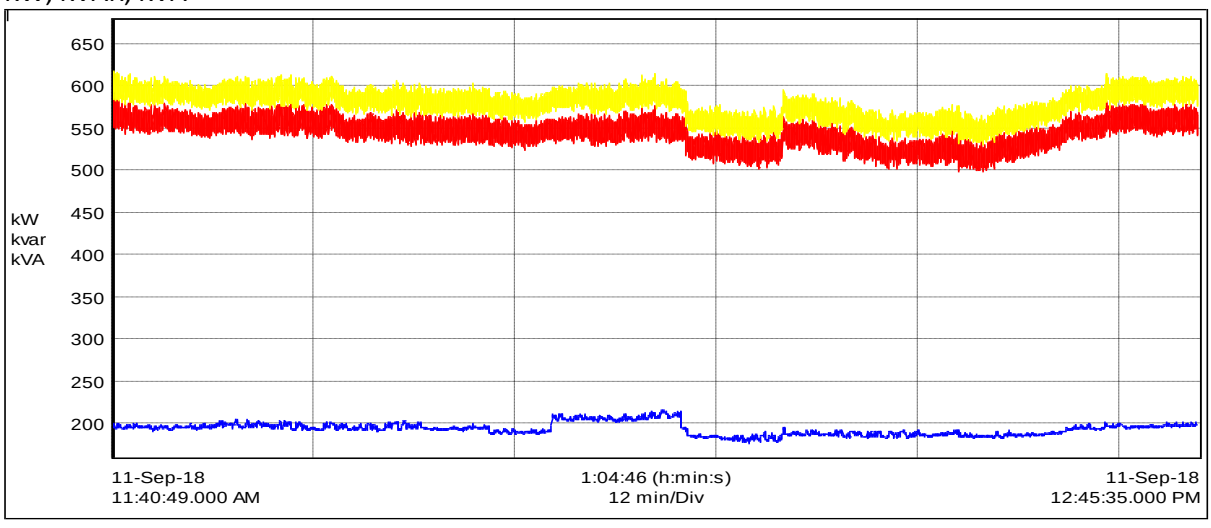
Individual Current Harmonics





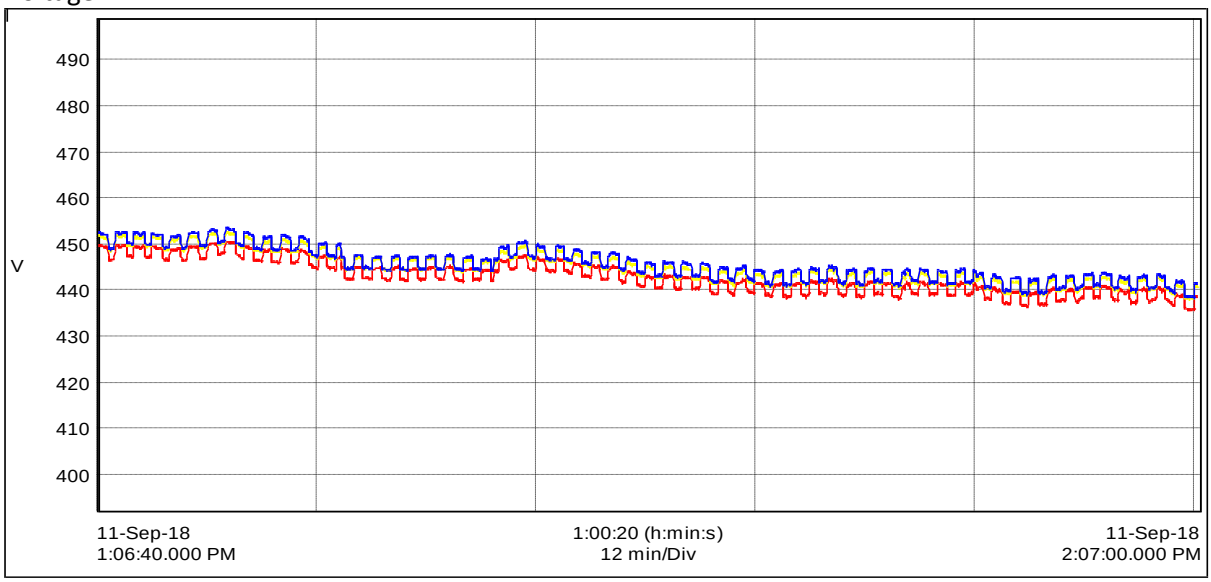


KW, KVAR, KVA

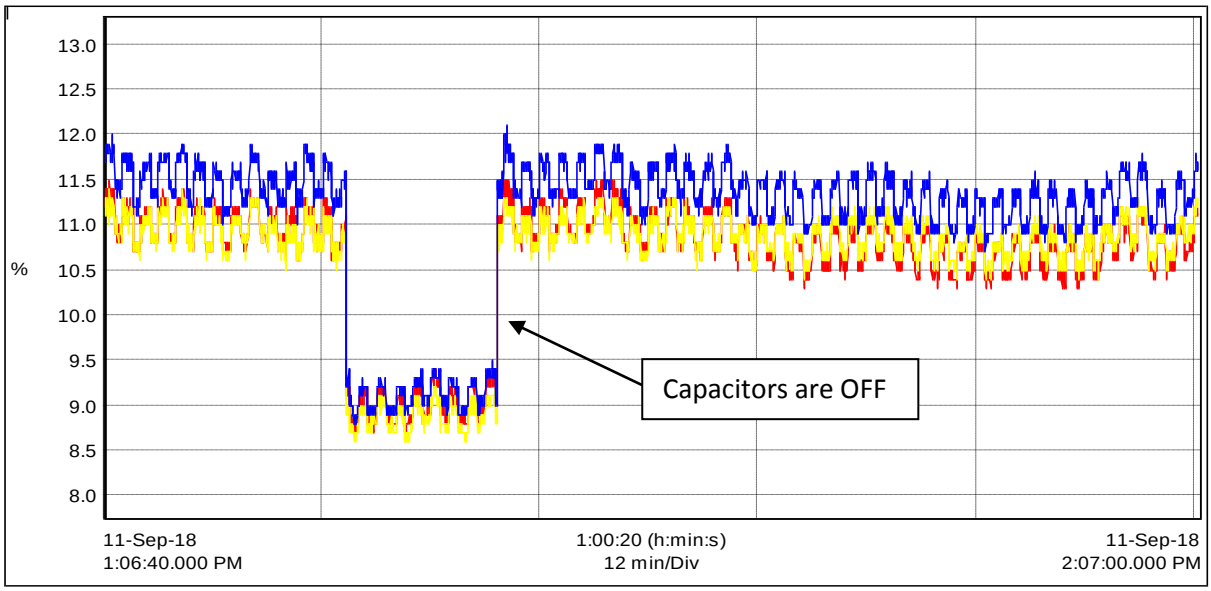


Utility Chiller:

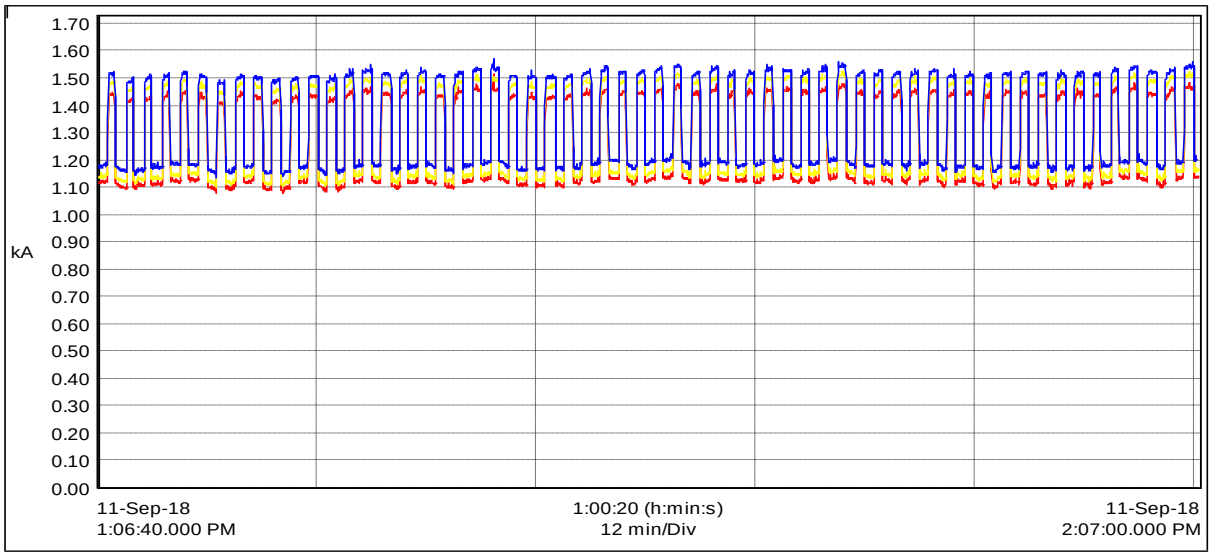
Voltage L- L



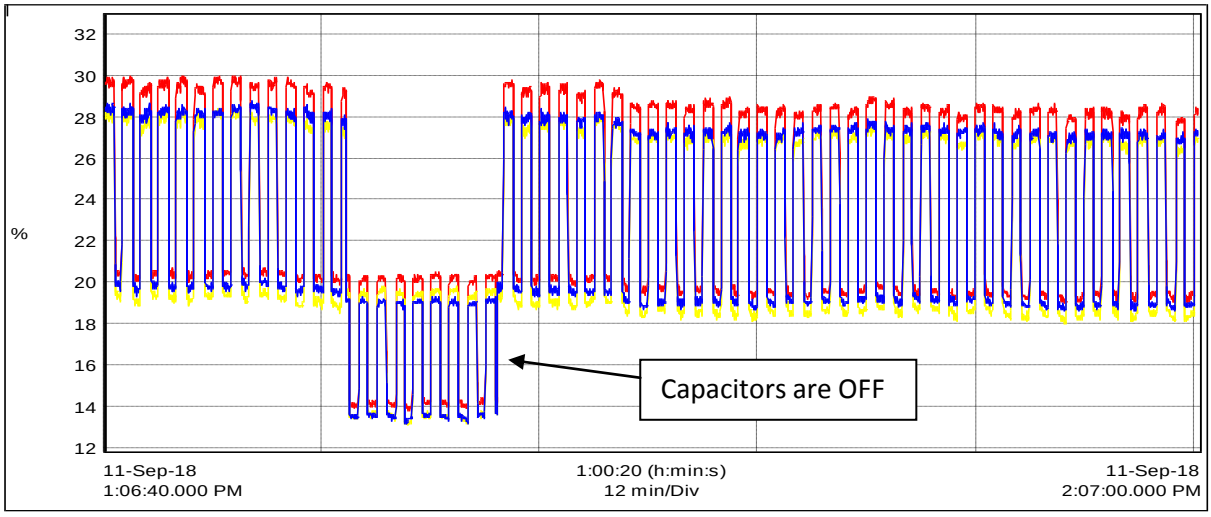
Voltage Harmonic Distortion



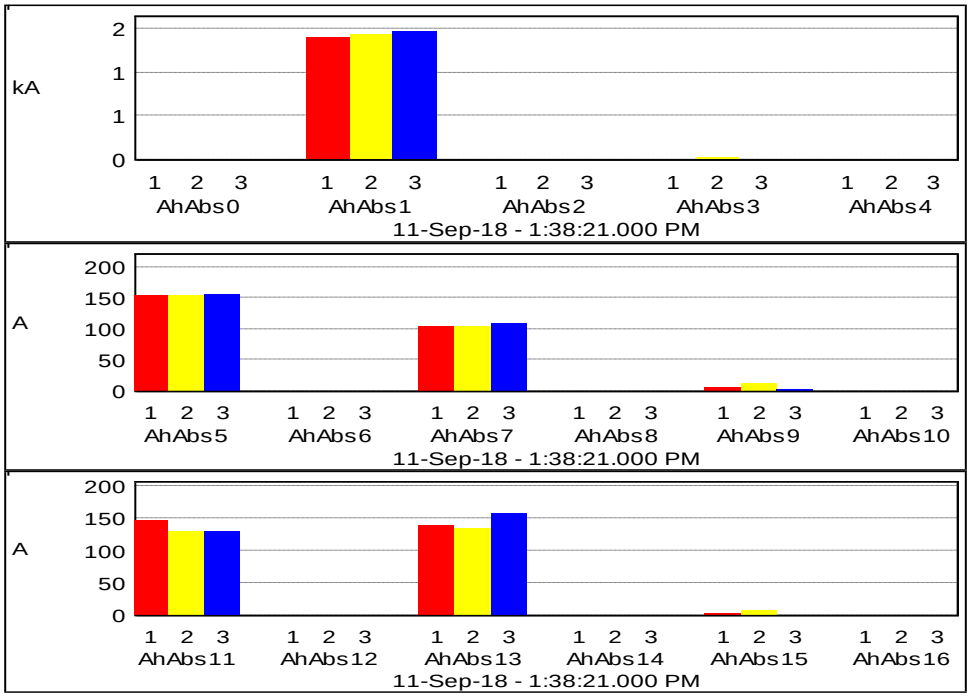
Current



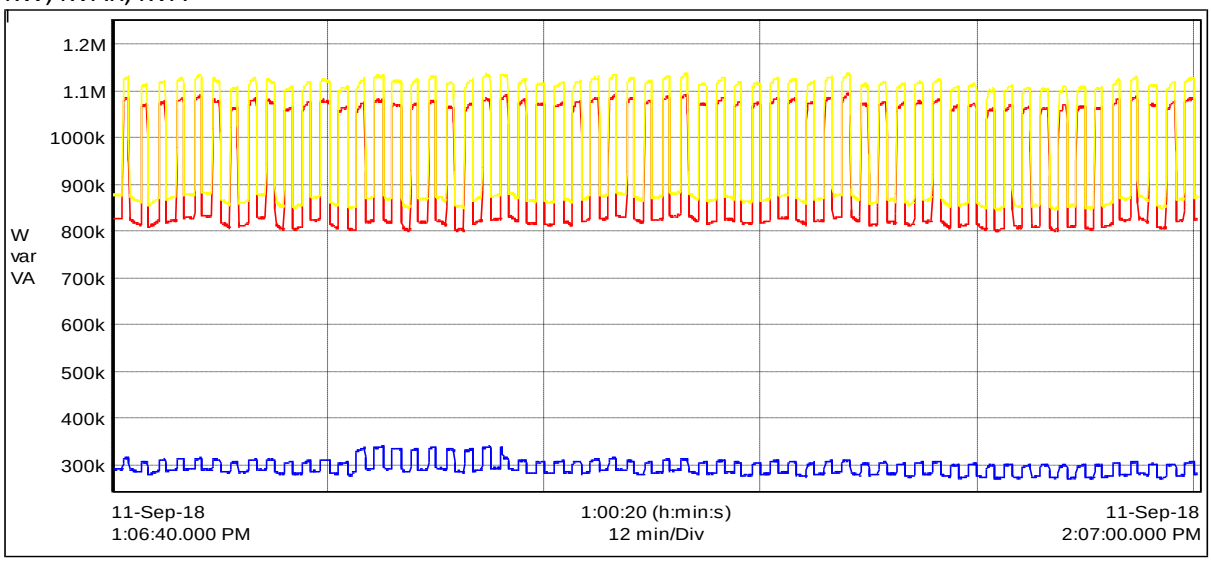
Current Harmonic Distortion



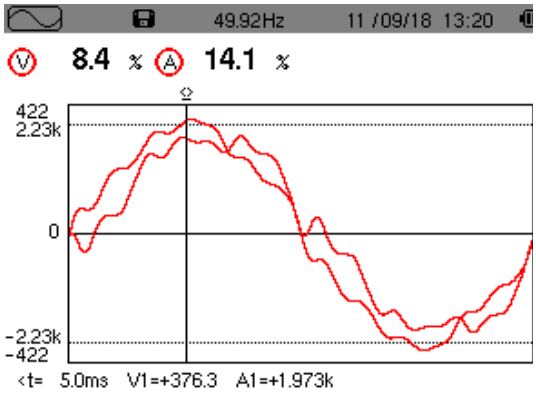
Individual Current Harmonics



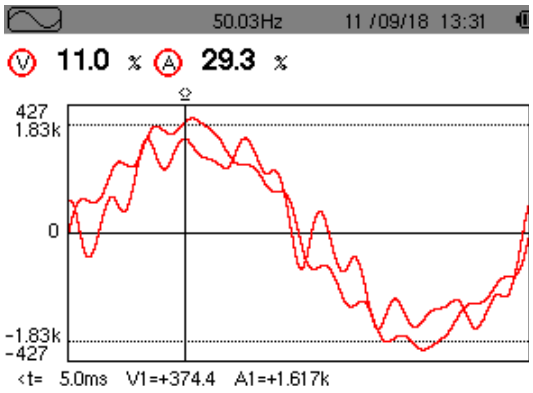
KW, KVAR, KVA



Capacitor OFF

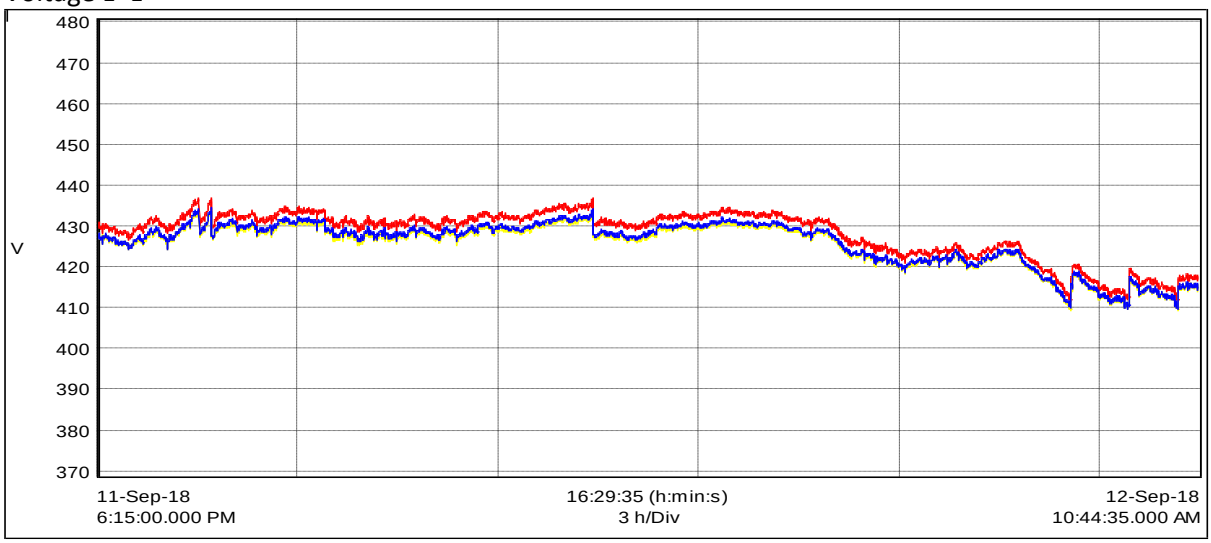


Capacitor ON

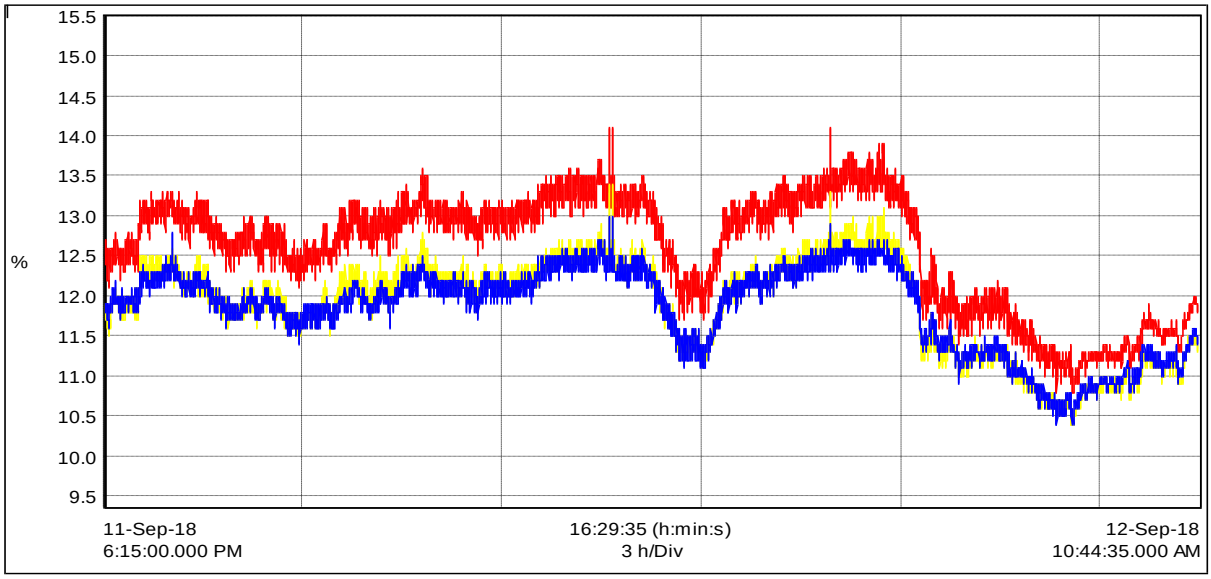


Weaving 2:

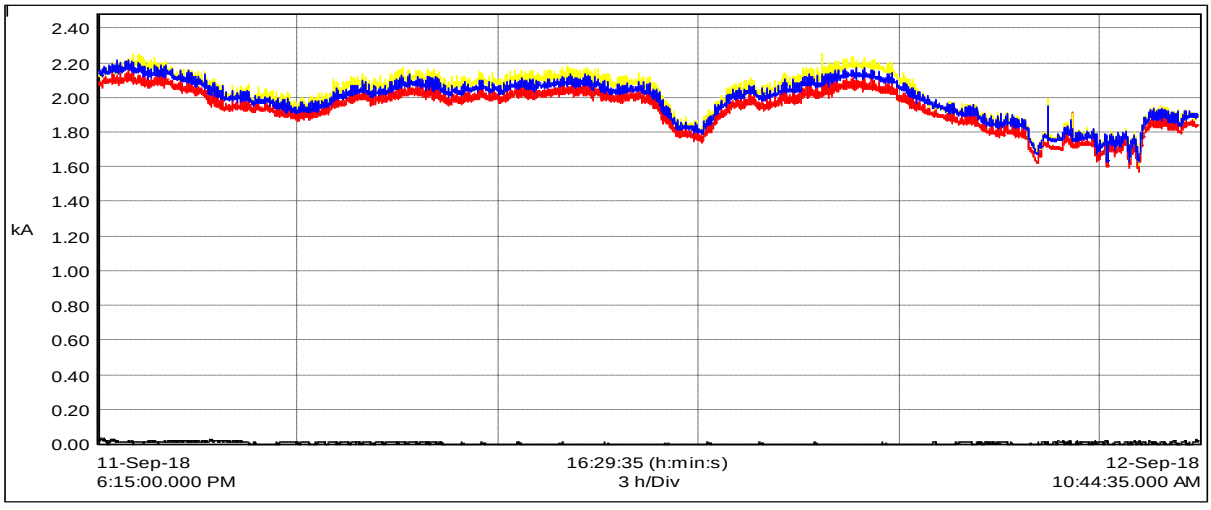
Voltage L- L



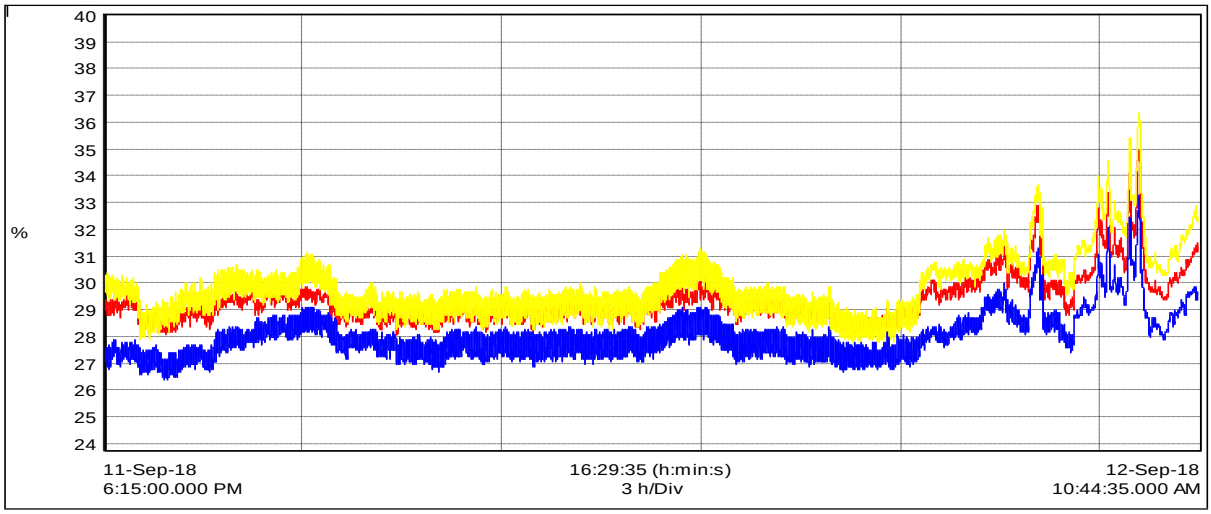
Voltage Harmonic Distortion



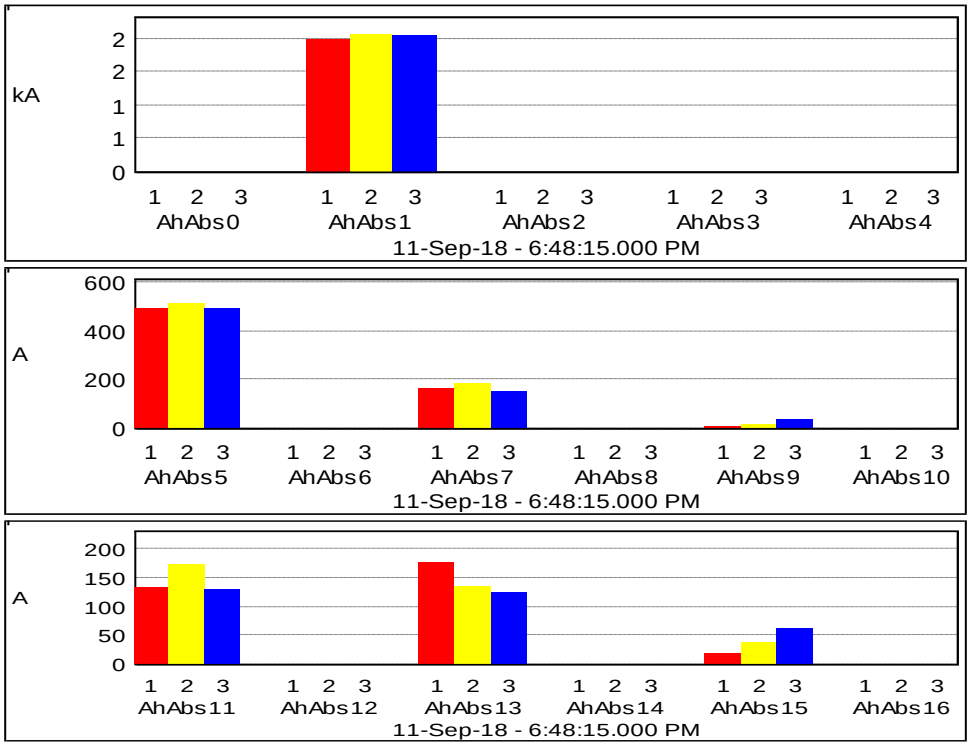
Current



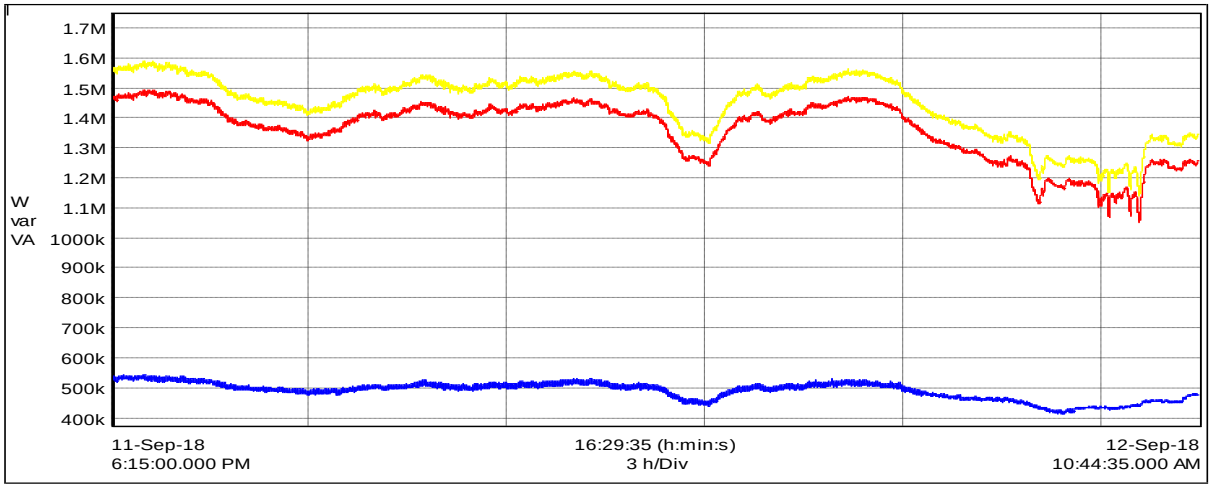
Current Harmonic Distortion



Individual Current Harmonics



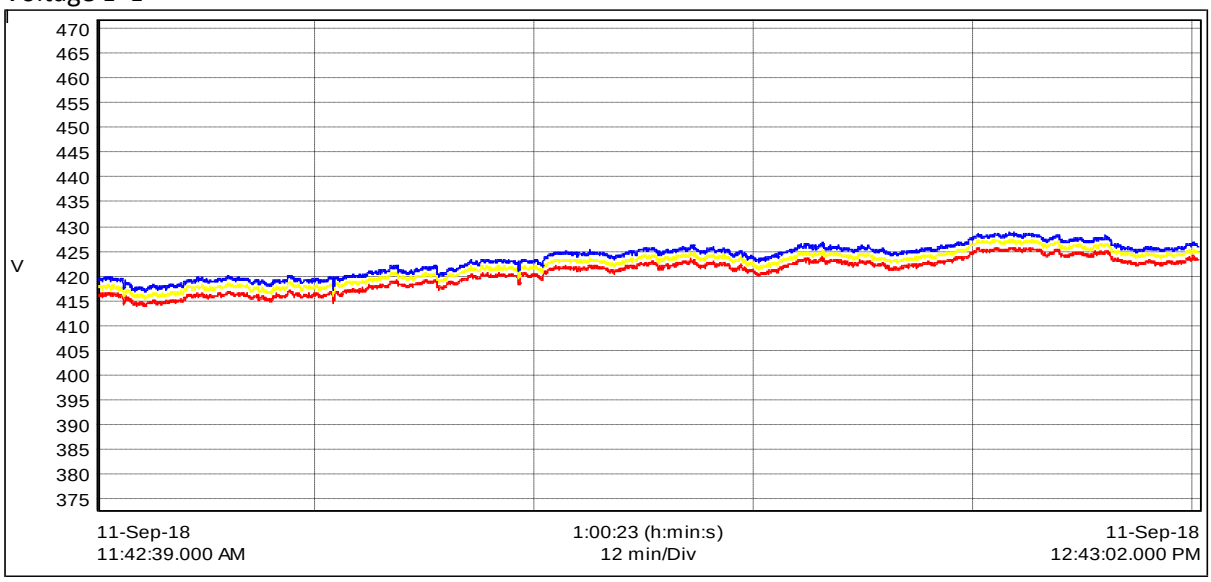
KW, KVAR, KVA



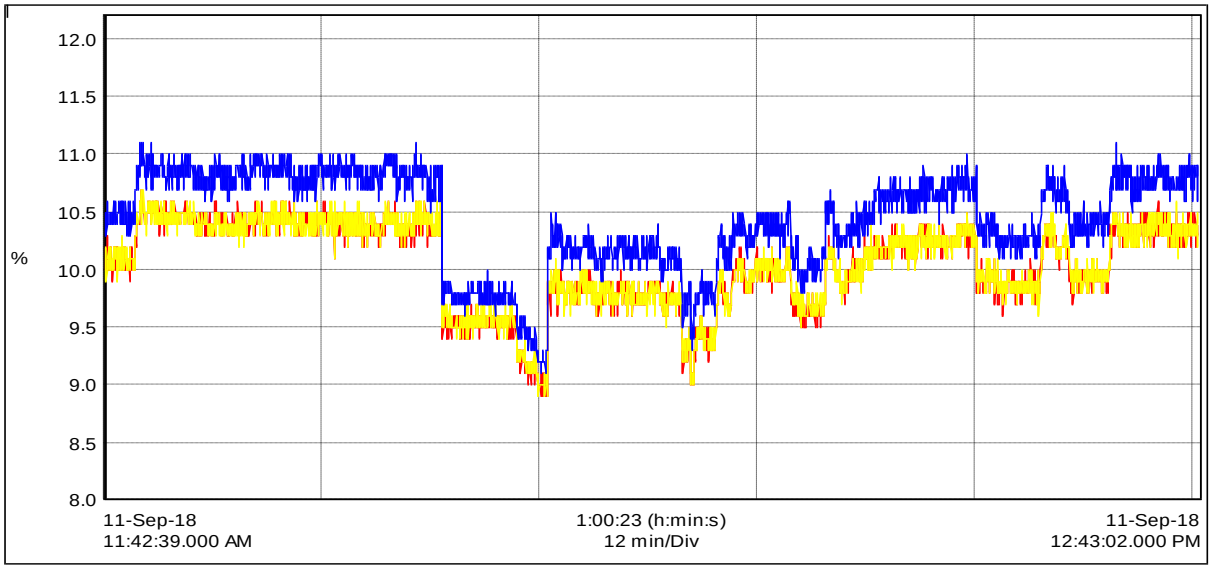
PF

Spinning 1:

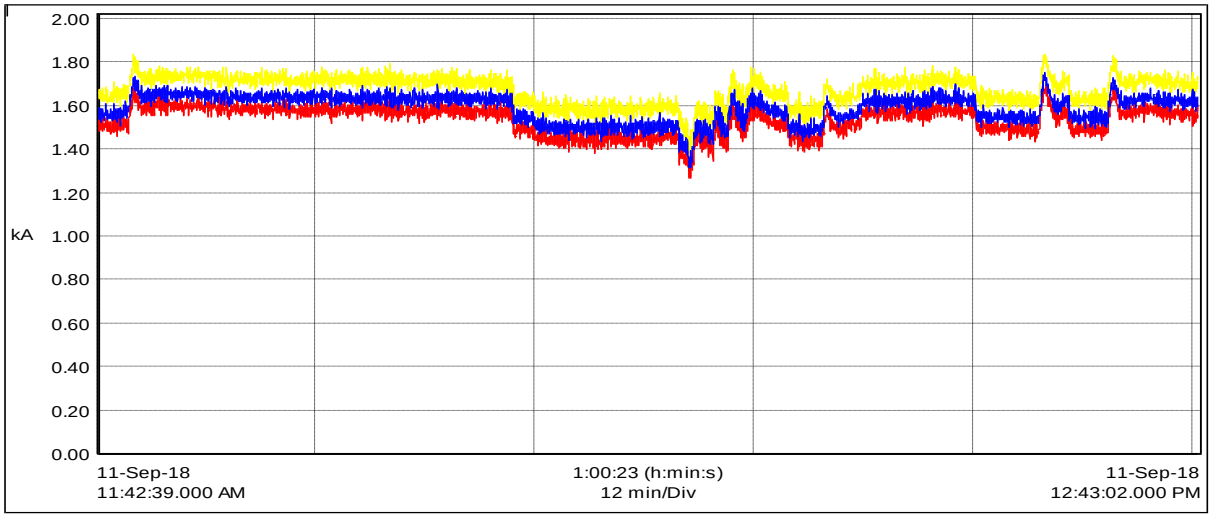
Voltage L- L



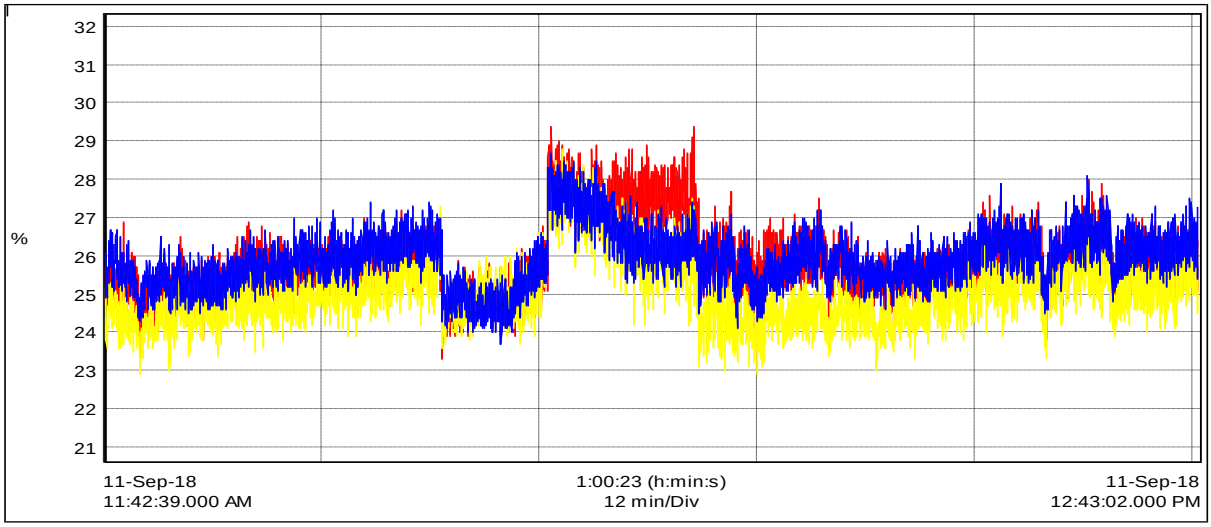
Voltage Harmonic Distortion



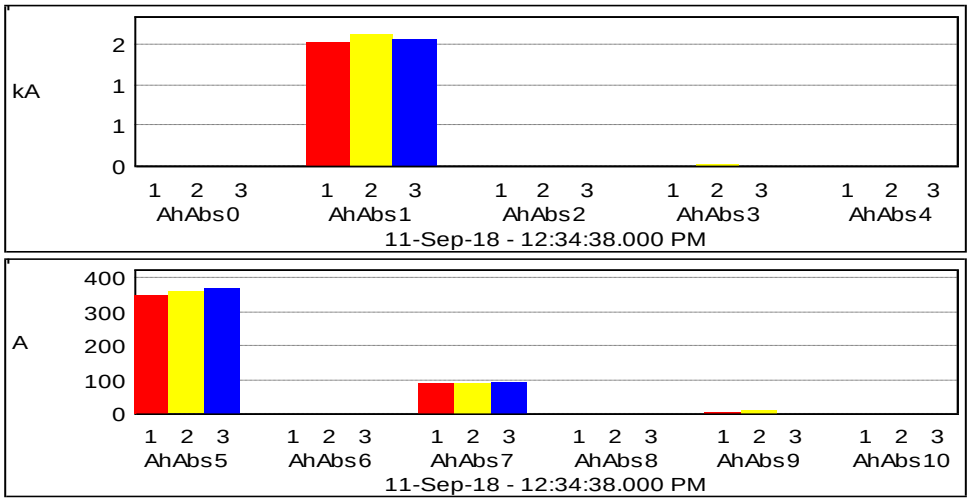
Current

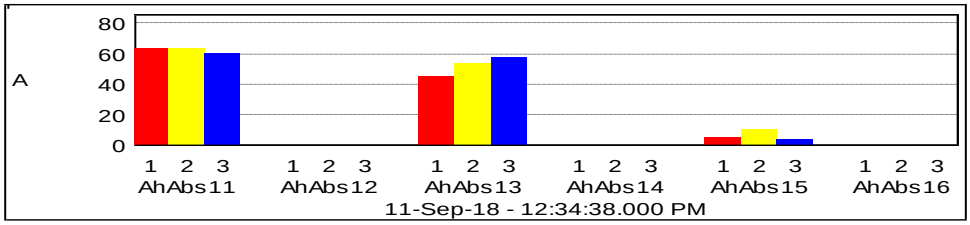


Current Harmonic Distortion



Individual Current Harmonics

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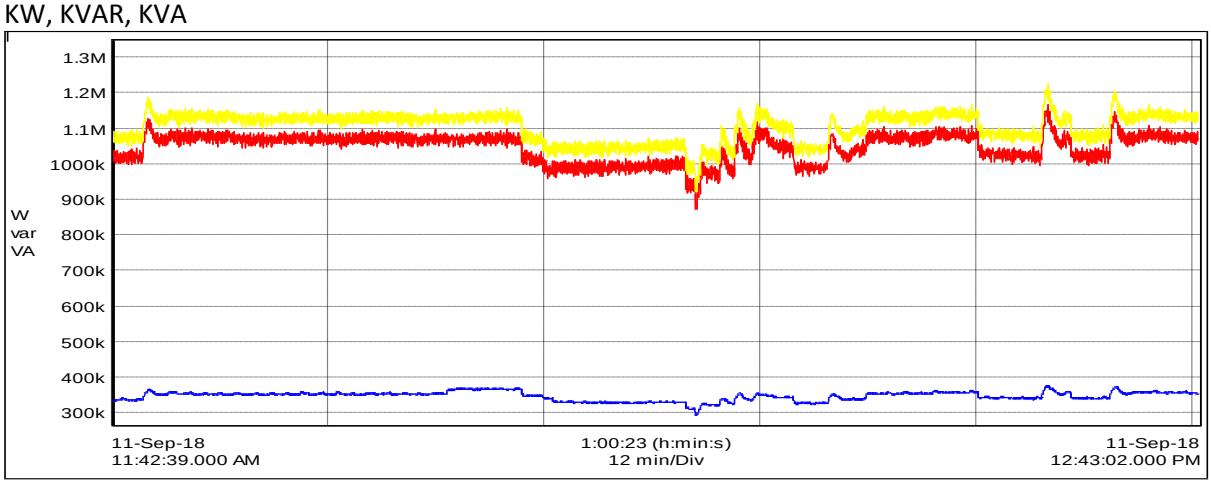
11-Sep-18 - 12:34:38.000 PM

KW, KVAR, KVA


W
var
VA
1.3M
1.2M
1.1M
1000k
900k
800k
700k
600k
500k
400k
300k
11-Sep-18
11:42:39.000 AM
1:00:23 (h:min:s)
12 min/Div
11-Sep-18
12:43:02.000 PM