MEASUREMENT REPORT
Reactive Power Compensation

Reference:	*project reference*
Date measurement :	*XX/XX/XXXX*
Measurement executed:	*site address*
Responsible:	*client contact details*
Address:	*client address*

Measurement responsible :

ATS nv
Mr ----------
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G.S.M.: ----------








1) Goal of the measurements

This report describes the results of the measurements of harmonic distortion of voltage and current on the three low-voltage panels where heavy DC motors are connected to individual transformers at *"Clients name"*. These measurements were carried out in order to evaluate the overall power quality.

Remark :
This document contains confidential information. Nothing within this document shall be copied or multiplied without the specific agreement of both the client and A.T.S.

2) Location:

Mains distribution board #: xxx

Table 1: transformer "XXX" nameplate

Rating [KVA]	1250
Type	DY_0
HV/LV	12kV/400V
Cast resin	
P_0 [W]	1800
P_k [W]	9607
U_{cc} [%]	6%

3)Measurement equipment

FLUKE
Model number: 435 II
Serial number: xxxxxxxxx
Calibration date: date

Current probes:
Phase 1
i430TF (range 3000A)
Phase 2
i430TF (range 3000 A)
Phase 3
i430TF (range 3000 A)
Neutral
i430TF (range 3000 A)

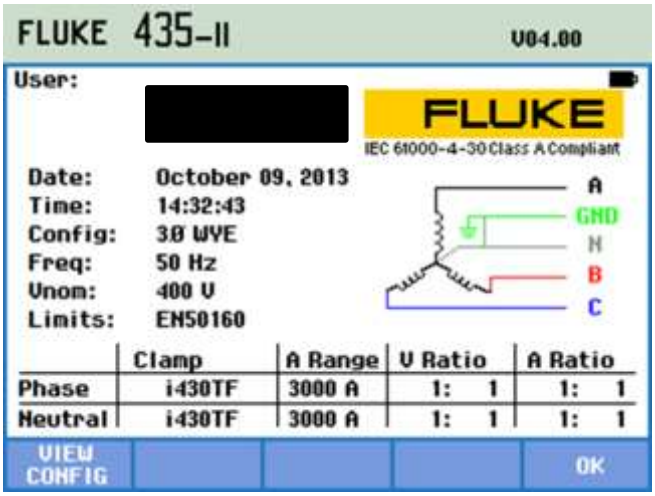

Figure 1: device setup

5) Measurement

5/1) Current, voltage, active power and reactive power

Figure 2: Phase voltage and current

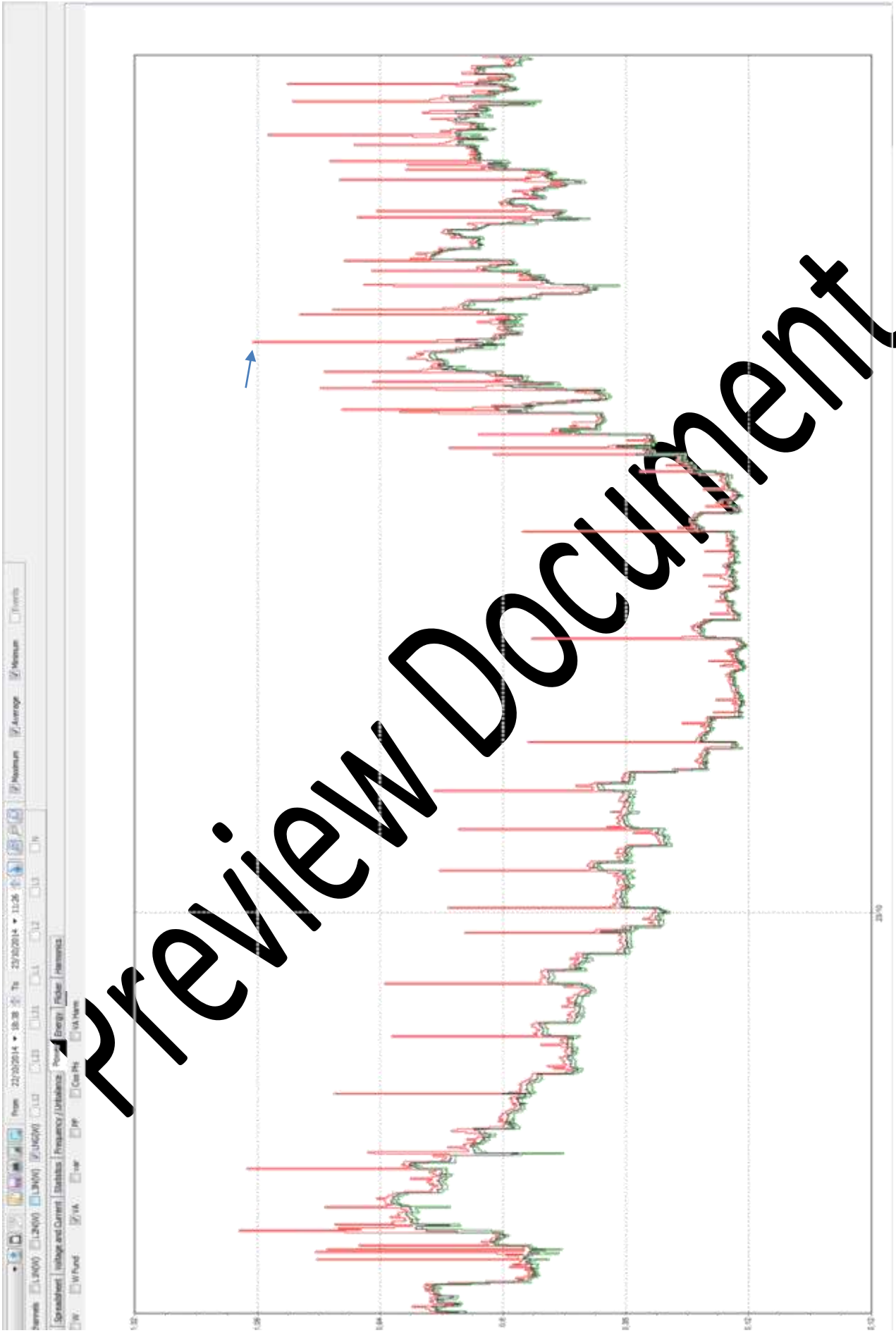

Figure 3: Total power consumption [KVA]

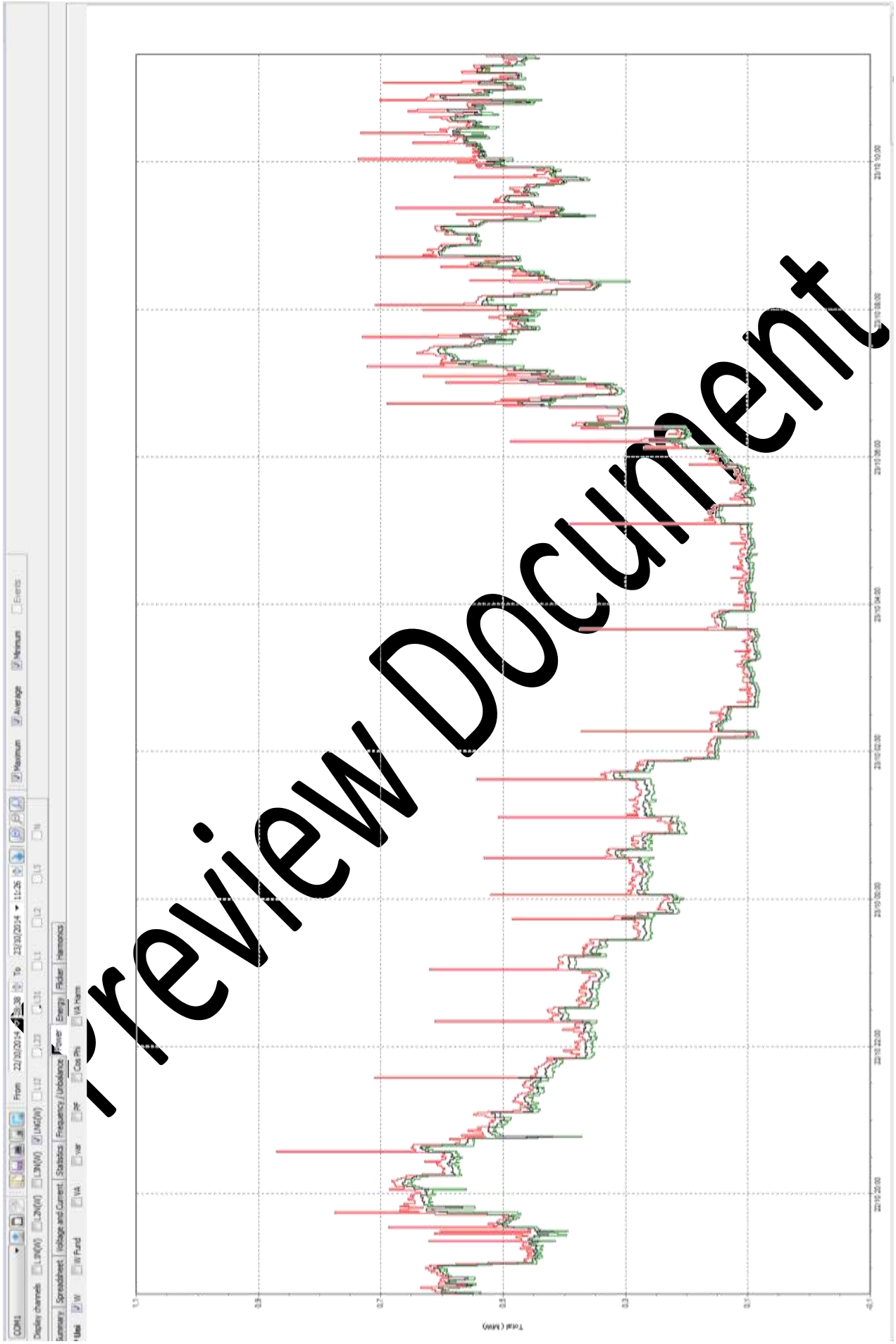

Figure 4:Total Active Power Consumption [kW]

5/2) Reactive Power and Power Factor

Figure 5: Variation of the Power Factor

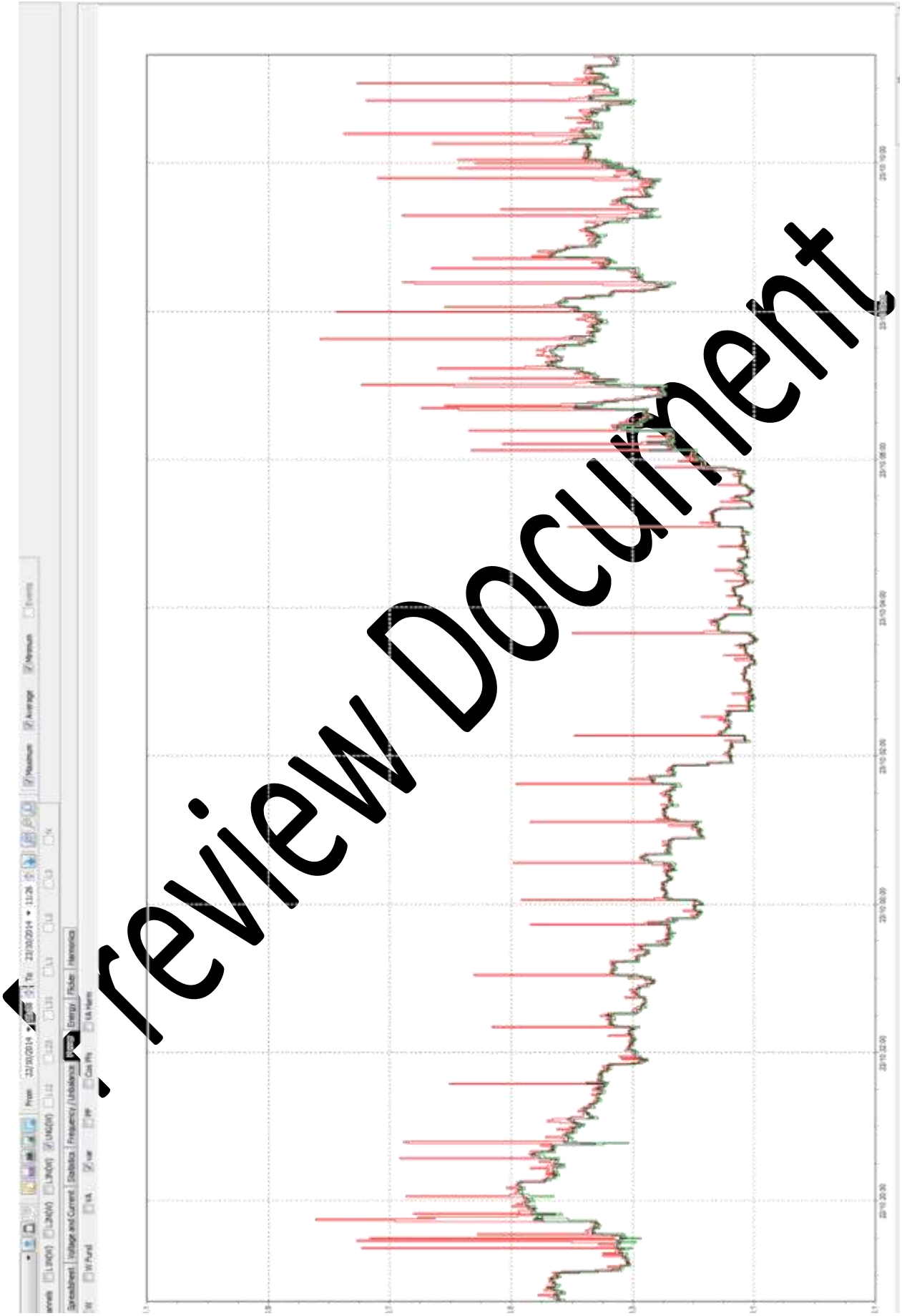

Figure 6: Consumed kVAr

5/3) Harmonic analysis, evolution of THDI and THDU over the measured timeframe.

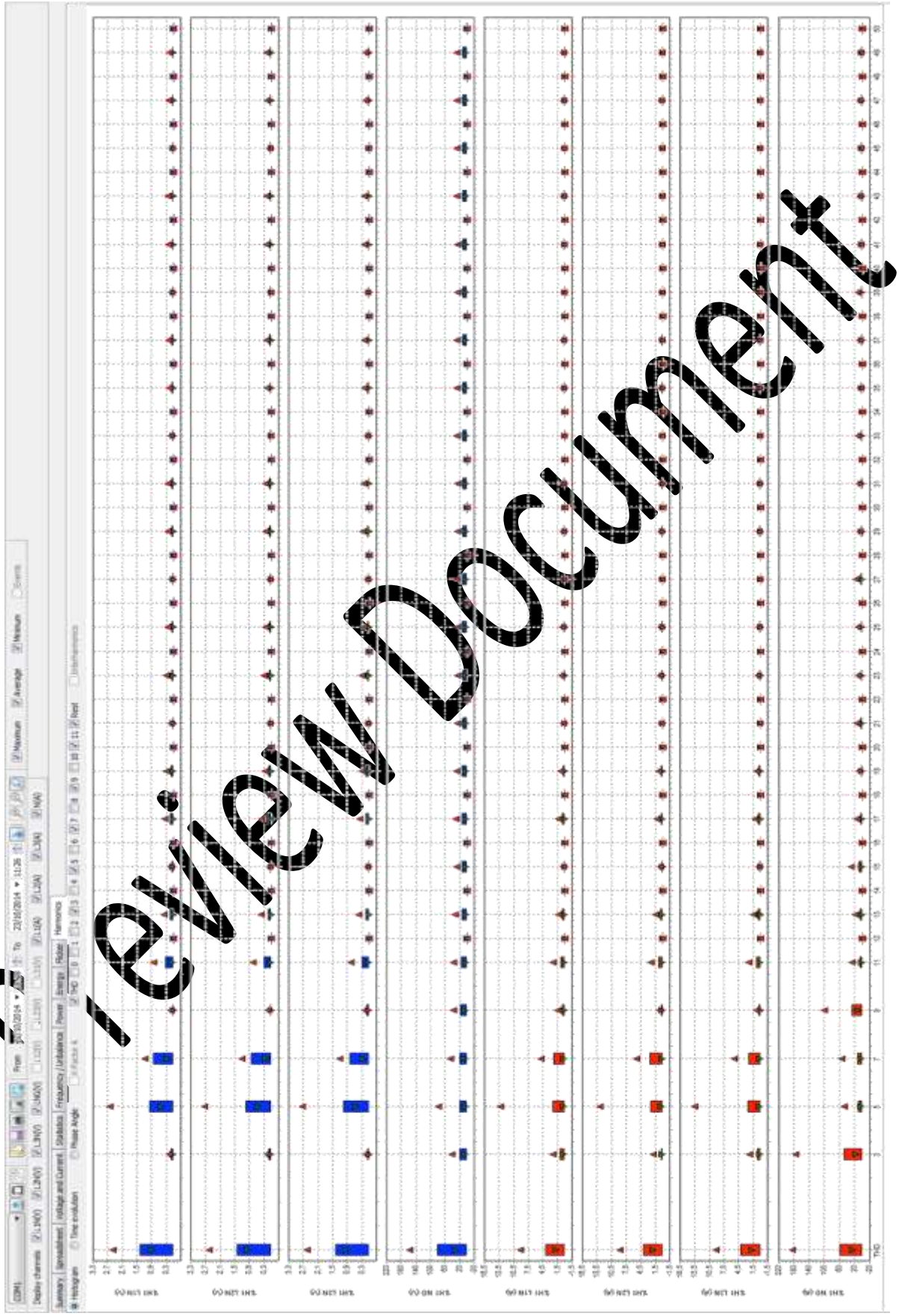

Figure 7: Harmonic analysis of phase voltage and current.

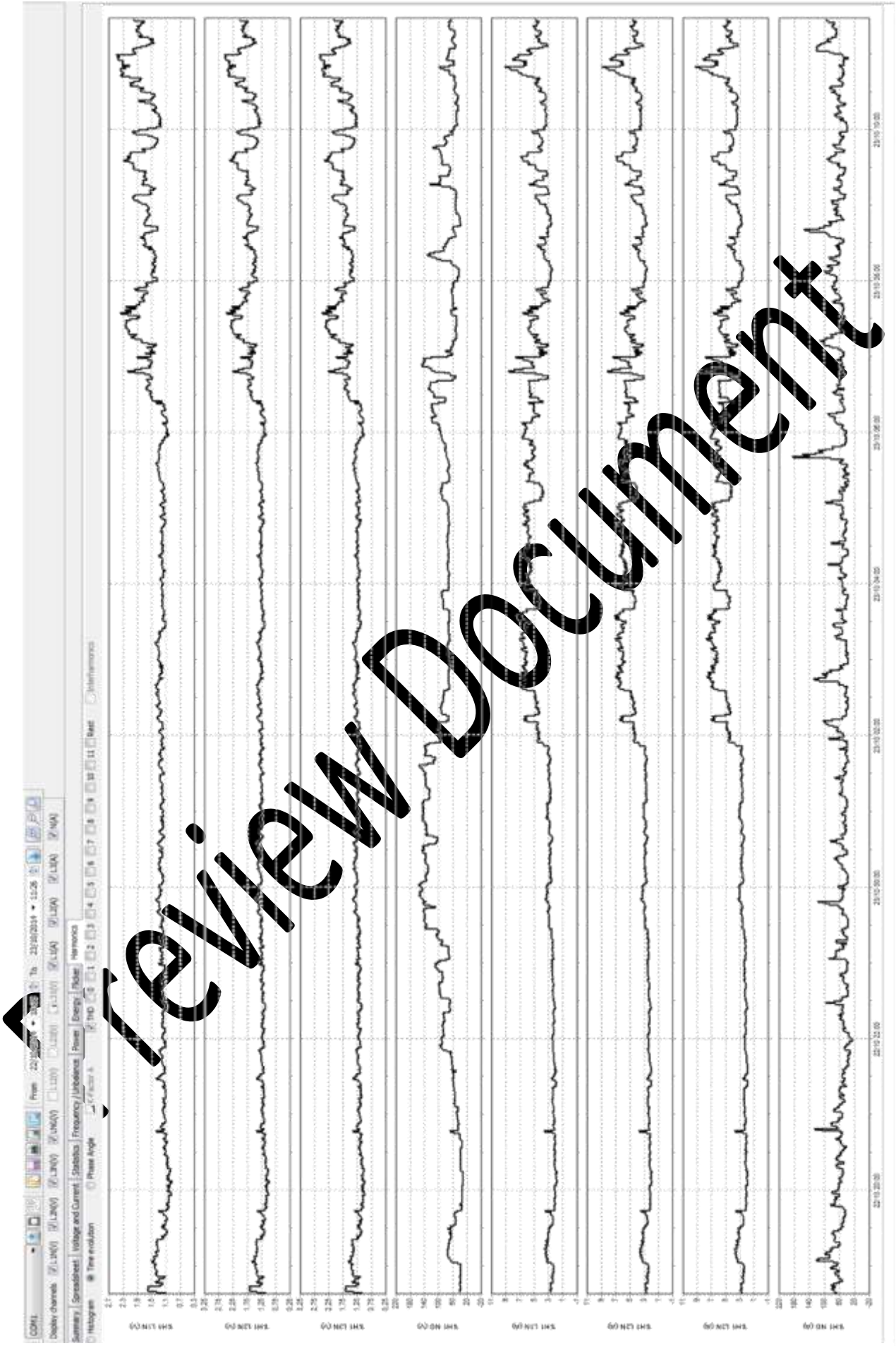

Figure 8: Evolution of the Total Harmonic Distortion

6) Conclusion

As noticeable in Figure 2, analysis the voltage indicates that the voltage is equally divided over the individual phases. The unbalance over the entire measurement period did never exceed the threshold of 2% as set in the EN50160. However, slight voltage sags hare noticed every time a peak current is registered, but as the voltage remains within the 10% limit of the nominal voltage no significant problems are expected.

Similar to the voltage, the current is equally divided over the measurement period. During the period of high current demand the unbalance is <10%. Evaluating the current under very low load does not give essential information, as this will not affect the correct operation of the installation. Current peaks are observed within a very short timeframe, which correspond with a high increase of active and reactive power. From Figure 6 a is a highly fluctuating power consumption has been measured, ranging from 37kW up to 927kW. Subsequently this corresponds to a fluctuation of the averaged dPF varying from 0.63 to 0.85 (Figure 5). When evaluating the maximum reactive power demand based on Figure 6, based on the one minute interval the maximum reactive power can increase above values of 800kVAr.

As it is requested by the client to compensate even these highly fast peak currents, a standard capacitor bank is not able to follow the highly dynamic profile of the reactive power, as it is to slow in dynamic performance. Standard capacitor banks have a dead time of on average 1 minute, in order to allow an instantaneous compensation a Thyristor Switched Capacitor bank of 800kVAr is suggested.

It is commonly known that capacitors create a low impedance path for higher harmonics, and they can also create a possible resonance in combination with the transformer. Therefore a harmonic analysis is executed to determine the detuning reactors. Taking into account the ripple control frequency 12,5% detuning is suggested.