PQGuard Remote/Local Power Quality Monitoring Systems for Offshore Oil, Drilling & Marine Industries Worldwide

Salient description and features

June 2013

Sentinel Power Quality FZE, PO Box 16111, Ras Al Khaimah, United Arab Emirates.
Mob : +971 (0)50 917 8196 Res Office Tel/Fax : +971 (0)7 243 3257 Skype : icevans1
Tel : +971 (0)7 207 5515 Fax : +971 (0)7 204 1010
info@sentinelpowerquality.com www.sentinelpowerquality.com

PQGuard Remote/Local Power Quality Monitoring Systems for Offshore Oil, Drilling & Marine Industries Worldwide

Introduction

It should now be appreciated by the reader that an acceptable level of power quality (i.e. voltage quality) is absolutely crucial to the safety and operational integrity of any vessel or offshore installation, irrespective of type. In order to ensure this, continuous (including event monitoring) of all the salient power quality (PQ) parameters is strongly recommended. Indeed, continuous monitoring of PQ, especially harmonic voltage levels, may be well be a future mandatory requirement from offshore and marine safety authorities throughout the world who are responsible for fixed and mobile offshore installations in the respective waters (and land, where applicable).

The rationale for continuous power quality monitoring is clear. As well as satisfying any future regulatory requirements for offshore and marine safety authorities with respect to harmonic voltage distortion levels, continuous monitoring can ensure that any signs of any degradation in power quality are recognized timeously and remedial action taken to resolve matters before equipment is adversely affected. In addition, any 'events' (e.g. voltage dips and/or events leading up to, for example, a breaker trip or total blackout of power are captured to assist in any investigations as to the cause)**.**

PQGuard General Purpose Power Quality Monitors

Due to the reduction of costs of electronic equipment and the considerable advances in software over recent years it is now possible to provide small, but powerful remote (and local) power and power quality measuring/monitoring/reporting systems at relatively low cost to the marine, drilling and offshore sector such as the Sentinel Power Quality, PQGuard' monitor (Fig 1). This low cost PQ monitoring system uses a Microsoft Windows™ internet interface with embedded website (IP addressable which can be accessed remotely anywhere in the World, subject to suitable password and other security controls.

Using this remote access capability individual and/or fleets of vessels, rigs and offshore installations can monitored over the internet by maintenance departments, fleet managers or third party specialist companies contracted to manage power quality on behalf of the owners and/or operators.

Fig 1 : PQGuard UMG605 switchboard mounted monitoring system

This type of 'PQ monitor' can provide and display power and power quality data locally to single or multiple dedicated stations, can be interfaced with ship, platform or rig supervisory systems and, as are they web based with dedicated IP addresses, can also communicate with any PC (personal computer) connected to the intranet/internet to provide remote monitoring, analysis and reporting anywhere in the World. They can also be interfaced to DCS (distributed control systems) systems such as Modbus, Profibus and Ethernet. Instantaneous, trend and event recording is provided. Panel/switchboard displays and touch panel PCs can also be interfaced.

Single monitoring units (Fig 1) can provide an overall power system overview or alternatively, multiple devices, for example to monitor discrete generators, can also be configured and communicated locally and/or remotely within the installation and/or with the shore.

Fig 2 below illustrates the dashboard of a PQGuard, low cost, but powerful PQ monitoring system. The seven tabs represent various sections of the device measurement menu, each of which has several sub-sections (and sub-sub sections). Clicking on the appropriate tab accesses the desired section.

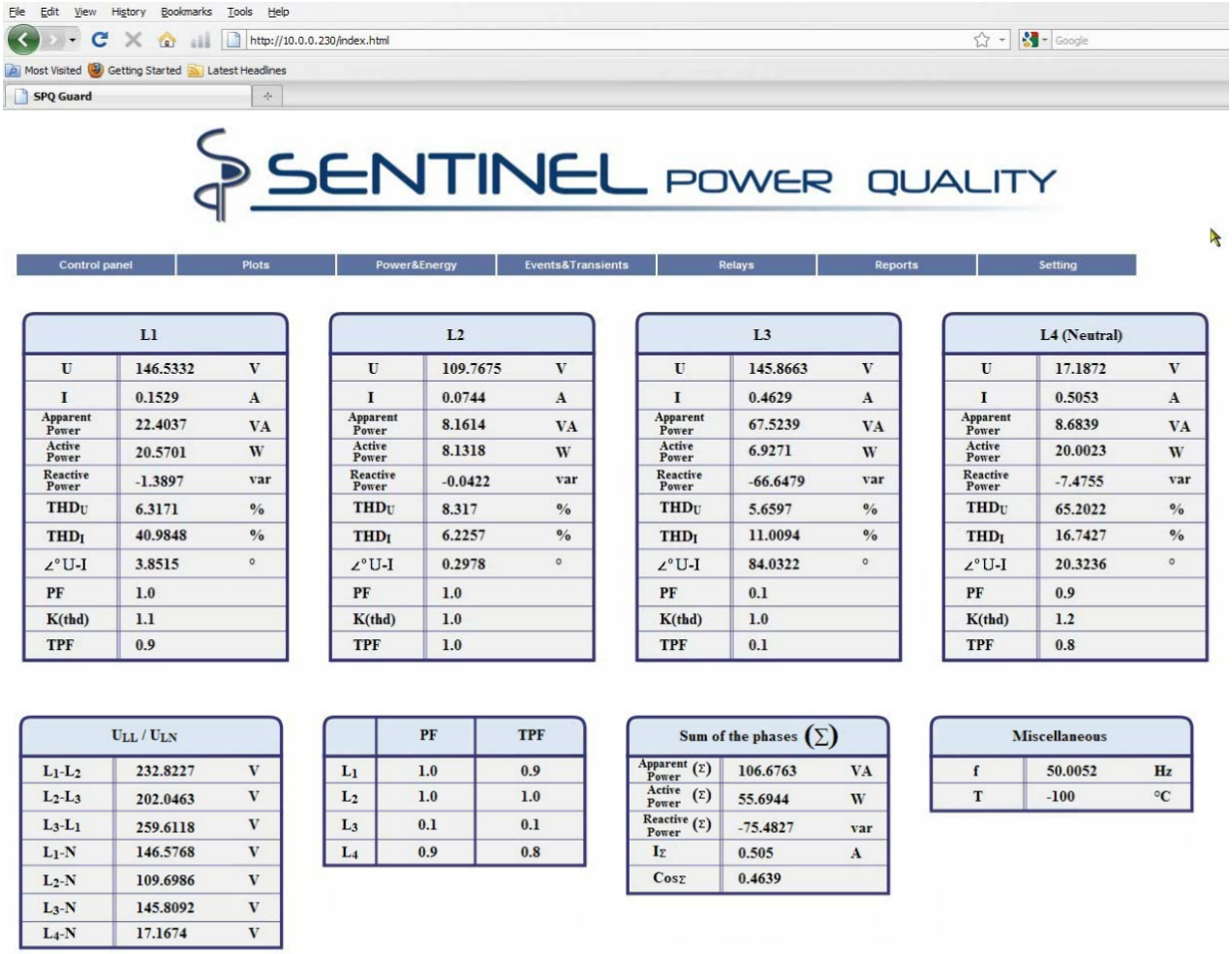

Fig 2 : PQGuard monitoring unit dashboard with salient power and PQ parameter reporting page and measurement tabs.

Note : The all parameter information displayed and all data captured is updated every second.

A high quality, high specification remote power quality (PQ) monitoring system should provide continuous monitoring of all power parameters including waveforms and harmonic spectrums :

- Voltages (Line and Phase Voltages)
- Total harmonic voltage distortion both including Uthd (Line voltages) and Vthd (Phase voltages)
- Currents (A)
- Current distortion (Ithd)
- Frequency (Hz)
- Energy - kW, kVA, kVAr
- Displacement power factor (DPF) and true power factor (TPF)
- Harmonic voltages and currents (tables and harmonic spectrums to at least 50th or 63rd)
- Flicker (Pst)
- Temperature (if PT 100s connected)

The general purpose remote power quality monitoring systems can be powerful tools, some of which, can also provide the following facilities including

- Full set of trend recordings for up to one year with date/time playback. More advanced models can also provide magnification of parameters to assist with analysis. The trend recording parameters are usually updated every second. The accuracy is based on the sampling rate.

- Adjustable event recording (e.g. "SCR 1 trip") with two cycles before and after the event with playback. The limit values of each PQ parameter can be set and alarms initiated if required. On some more advanced monitors, emails can be sent to programmed address(s) to advise that an event has occurred.

- Waveforms of voltage and current for trouble shooting or monitoring. PQGuard units can also provide magnification of waveforms and spectrums to assist real time analysis.

- Harmonic voltage and current spectrums at point of connection to 63rd harmonic.

- If additional I/O installed, MCCBs and other equipment can be monitored.

Remote/local power quality monitoring can provide important information on all the salient power and power quality parameters (see examples in Section 12, Figures 2 to 10) and may provide prior notice of some impending power or power quality problems.

The unit can be connected to either the low voltage or medium voltage systems via suitable PTs ('potential' or voltage transformers) (PTs) and CTs (current transformers). The monitor can communicate directly to a laptop or pc, a local monitoring panel or to the owners or operators office onshore thousands of miles away; or indeed, to a specialist company, contracted to monitor the company's ships, rigs or platform's power quality.

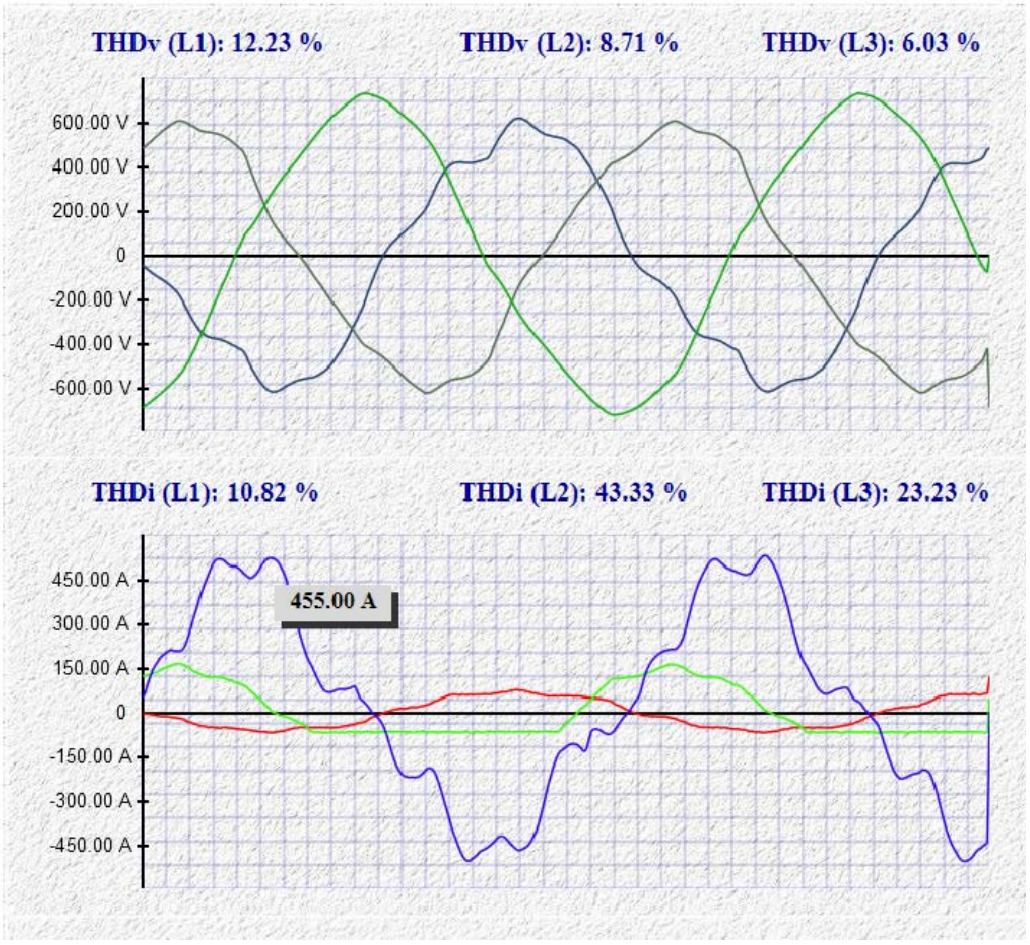

Fig 3 : Example of real time voltage and current from PQGuard monitor

Figure 3 above is an illustration of line real time line voltage and current waveforms from the PQGuard unit. The waveforms to be displayed are selected by ticking the appropriate boxes at the bottom of the screen (not shown in Fig 3).

By laying the computer mouse cursor on the appropriate waveform, the instantaneous value of voltage or current can be obtained (e.g. 455A as seen above). The total harmonic voltage and current distortion (THDv and THDi respectively) are updated continuously. The cursor can only be used to highlight a particular area of any waveform to expand the trace for analysis purposes as illustrated in Fig 4 below.

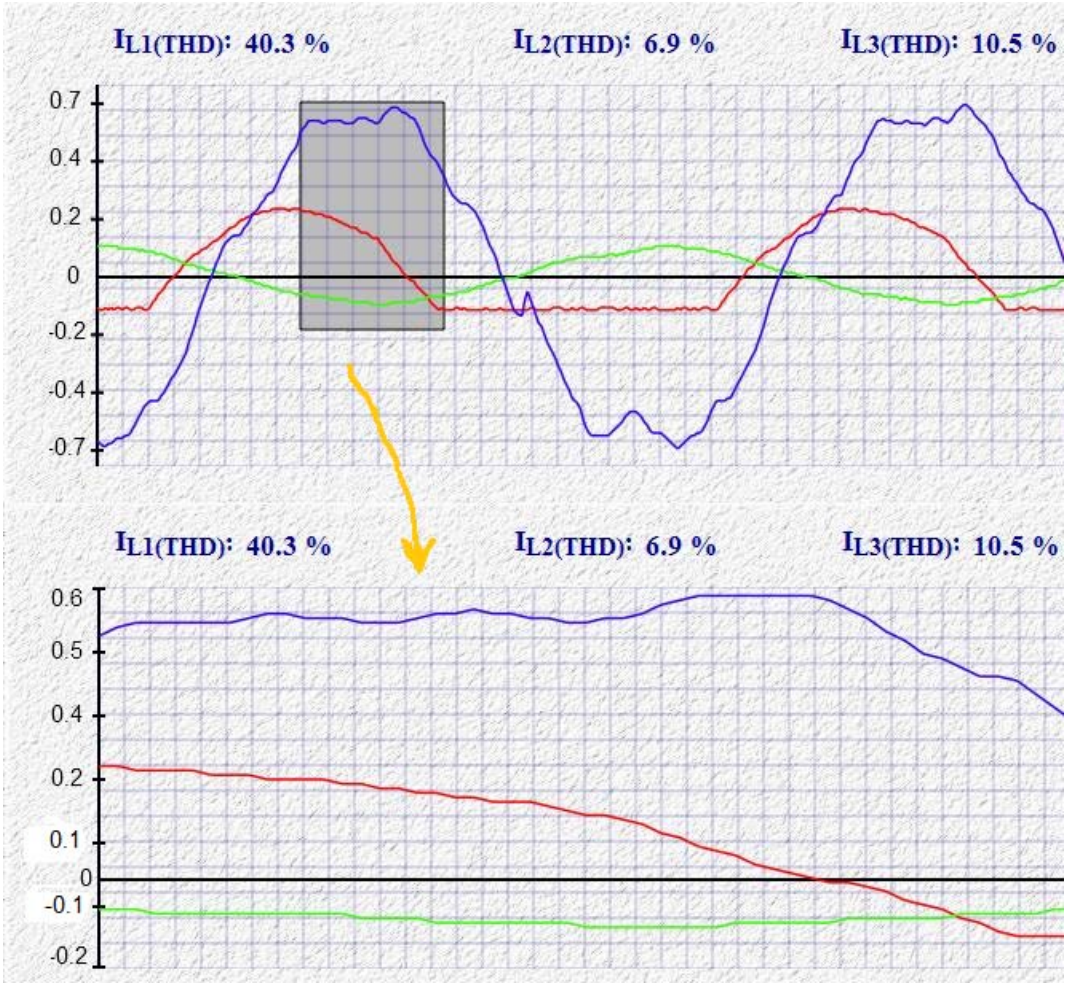

Fig 4 : Expansion of real time waveforms via PQGuard monitor

As can be seen in Fig 4 above it is possible to expand any real time waveform to obtain the detail for analysis purposed. As stated previously, similar expansion is also possible for real time harmonic spectra and trends. This feature may be of assistance for trouble shooting.

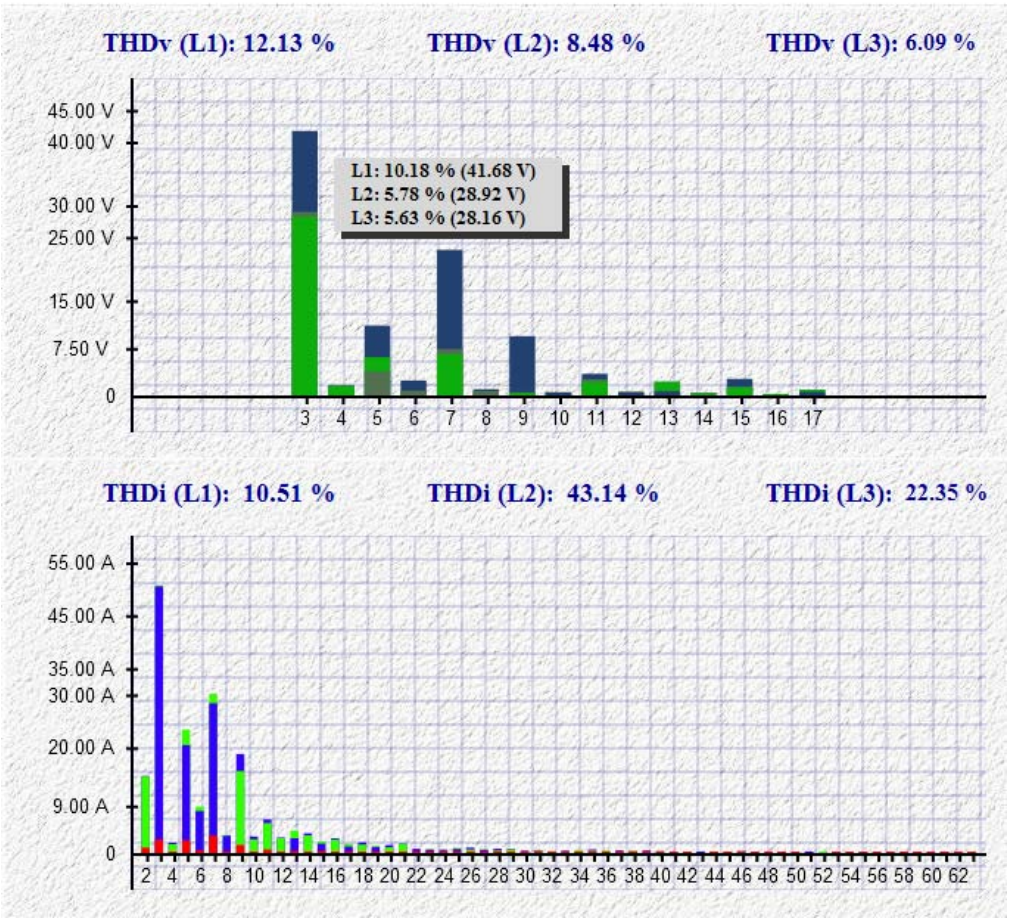

Fig 5 : Example of real time harmonic voltage and current spectra from PQGuard monitor

Fig 5 above illustrates an example of the real time harmonic voltage and harmonic current spectrums with the fundamental voltage and current removed to provide enhanced detail of the individual harmonics. The voltage and current phase information to be display can also be selected by ticking the appropriate box at the bottom of the screen (not shown in Fig 5). The cursor can only be used to highlight a particular area of any spectra (e.g. 5th to 19th harmonic voltage and/or current) to expand it for analysis purposes. The PQGuard device monitors harmonics up to the 63rd order.

Note : The type of spectral display (e.g. as above with all three phase value for each order superimposed in different colours) or the more conventional display of “harmonic bars for each phase” alongside each other are interchange via tick box.

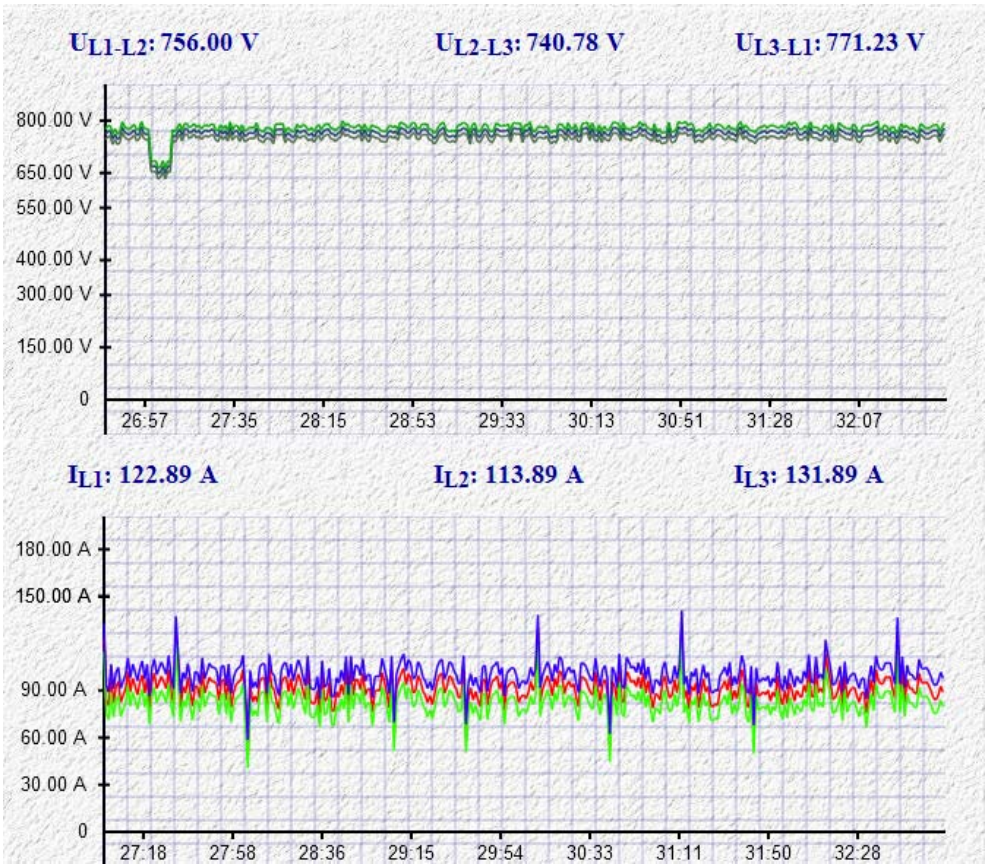

Fig 6 : Example of real time trend information from PQ monitor

Fig 6 is a simple example of real time trends, in this case line voltage and phase currents. As will be explained in Fig 7 below and the associated text, the trend lines can be expanded and interrogated to assist in analysis.

Trend information is fully flexible and readily available in real time and historically to provide full coverage for all power and power quality parameters.

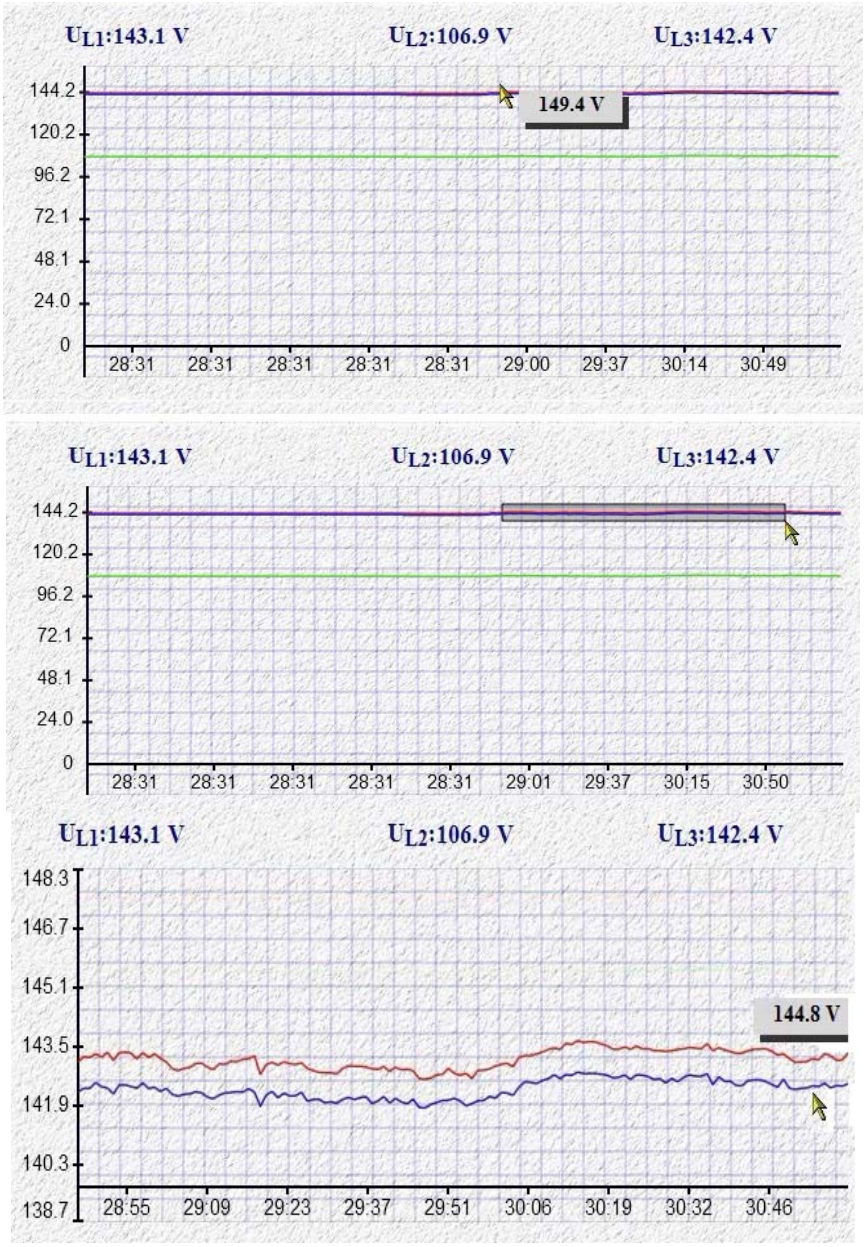

Fig 7 : Example of obtaining more detailed information on PQGuard

Fig 7 illustrates the sequence of obtaining more detailed data, in this case voltage trends, by using the computer mouse.

The top trend shows three voltage trends, two are of very similar value but the other is of a lesser value. The middle trend illustration shows the grey shaded area two the two voltages (this area was selected using the computer mouse). This is the area of interest.

Finally the bottom trend shows, in more detail, the two voltage trends. This technique can be used and any live or historic data including waveforms, trends and harmonic spectra.

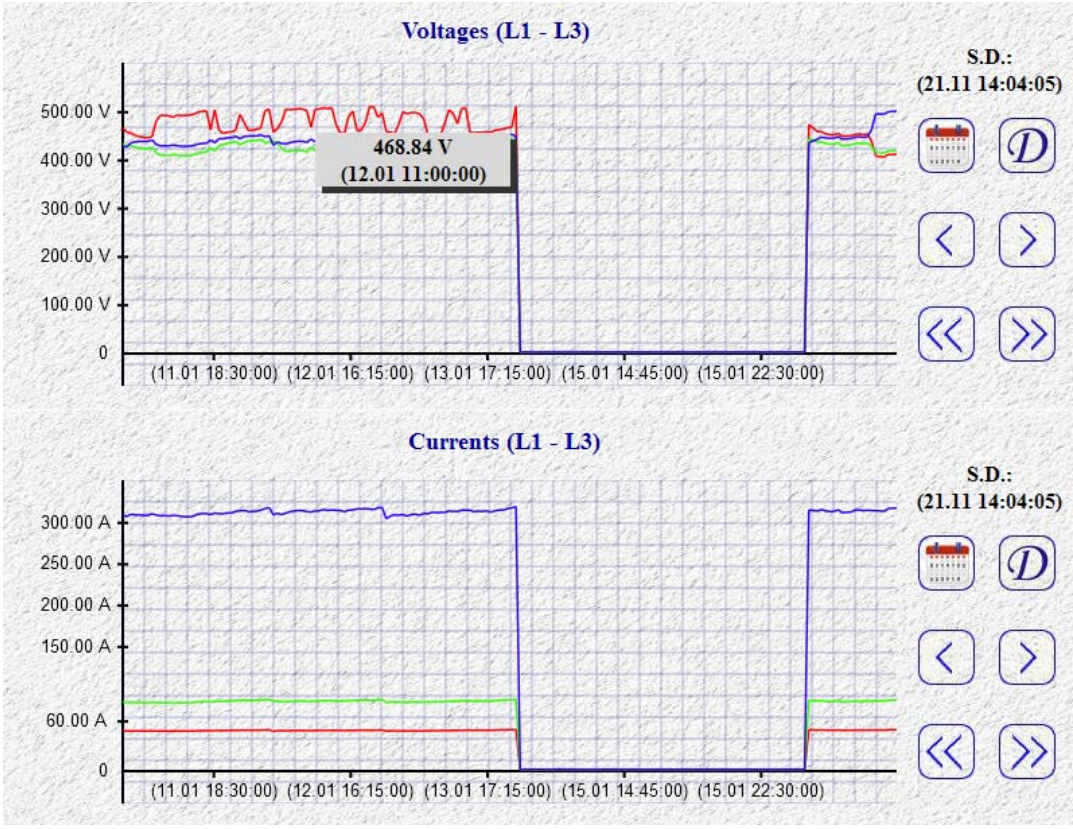

Fig 8 : Viewing historical data via PQGuard monitoring device

Fig 8 shows simplified historical trends for voltage and current. The device can store up to one year's (12 months) worth of full data recordings which can be accessed via the calendar icon on the left hand side of the traces. The by using the calendar we can select the day of interest. The exact times for the information requested can be selected using the <<, < and >, >> tabs.

All historical data can be accessed similarly. Any trend line, transient or event detail can be expanded for analysis using the computer mouse and selecting the area of interest.

#	Reason	Tstart	Tend	Duration	Value
1	L3 Umax	01.12.2011 16:35:20	01.12.2011 16:48:42	13.37 m	143.0 V
2	L3 Umax	01.12.2011 16:32:51	01.12.2011 16:34:22	91.85 s	143.0 V
3	L3 Umax	01.12.2011 09:40:19	01.12.2011 16:27:37	407.29 m	143.0 V
4	L1 Umax	30.11.2011 16:12:42	30.11.2011 18:37:56	145.23 m	143.0 V
5	L1 Umax	28.11.2011 16:52:15	28.11.2011 17:08:15	16.00 m	143.0 V
6	L1 Umax	28.11.2011 16:38:56	28.11.2011 16:48:38	9.69 m	143.0 V
7	L2 Umin	28.11.2011 16:36:08	28.11.2011 16:38:56	2.80 m	198.0 V
8	L1 Umin	28.11.2011 16:36:08	28.11.2011 16:38:56	2.80 m	198.0 V
9	L3 Umin	28.11.2011 16:36:08	28.11.2011 16:38:56	2.80 m	198.0 V
10	L1 Umax	28.11.2011 16:13:37	28.11.2011 16:36:08	22.52 m	143.0 V
11	L3 Umax	28.11.2011 15:32:23	28.11.2011 16:36:08	63.76 m	143.0 V
12	L3 Umax	28.11.2011 14:24:07	28.11.2011 15:30:21	66.23 m	143.0 V
13	L3 Umax	28.11.2011 14:21:12	28.11.2011 14:24:01	2.83 m	143.0 V

Fig 9 : Event capture from PQGuard

Voltage, current, toal harmonic voltage and total current harmonic distortion, active power and all power and power quality limit values can be set from the dashboard. Fig 9 displays a typical event log. Using date of the event and the T_{start} and T_{end} times the trend data can be accessed as per accessing historic data.

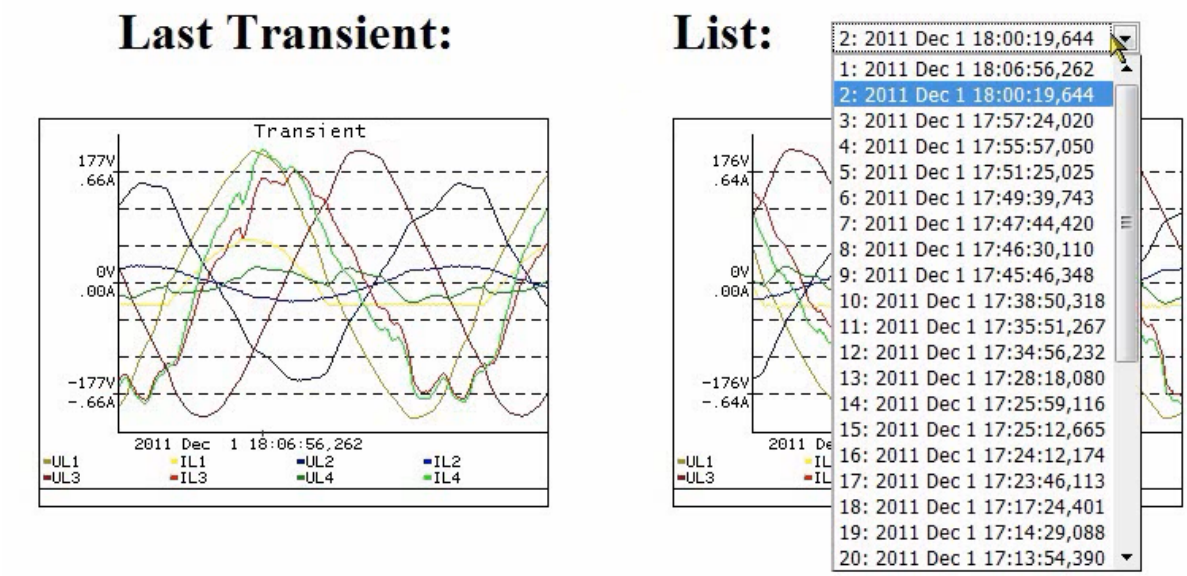

Fig 10 : Transient capture and display from Marine PQGuard

Voltage and current transient can be captured an stored similar to how the PQ monitoring device stores events. As can be seen from Fig 10 above, simply selecting the transient date and time using the results in the transient being displayed (right hand side of Fig 10); the last transient stored is displayed as the 'last transient' on the left hand side.

	S, kVA	P, kW	Q, kVAr	K(thd)	DPF	TPF
L1	20.26	20.11	-0.82	1.00	1.00	0.99
L2	36.21	32.91	0.88	1.09	1.00	0.92
L3	161.34	2.82	-157.85	1.02	0.02	0.02
L4	0.12	0.07	0.11	1.02	0.51	0.49

Total energy (from last reset):

	Apparent - S (kVAh)	Active - P (kWh)	Reactive - Q (kVArh)
L1	832.25	823.41	-84.65
L2	1292.56	1147.97	243.09
L3	5073.33	-505.10	-4902.68
L4	10.96	-6.98	16.20
$L_{\Sigma 3}$	7198.14	1466.28	-4744.24
$L_{\Sigma 4}$	7209.10	1459.30	-4728.04

Reset Energy

Energy (Selected Period):

From: 21.11.2011 To: 16.01.2012

	Apparent- S (kVAh)	Active - P (kWh)	Reactive - Q (kVArh)
L1	798.58	797.17	-82.17
L2	1240.99	1104.85	244.05
L3	4906.14	-512.23	-4755.83
L4	10.02	-8.52	16.45
$L_{\Sigma 3}$	6945.70	1389.78	-4601.07
$L_{\Sigma 4}$	6955.72	1381.26	-4584.62

Fig 11 : Energy usage and monitoring

For operators and/or ship-owners who require full electrical energy information, complete monitoring and analysis is avail as standard as can be seen in Fig 11 above.

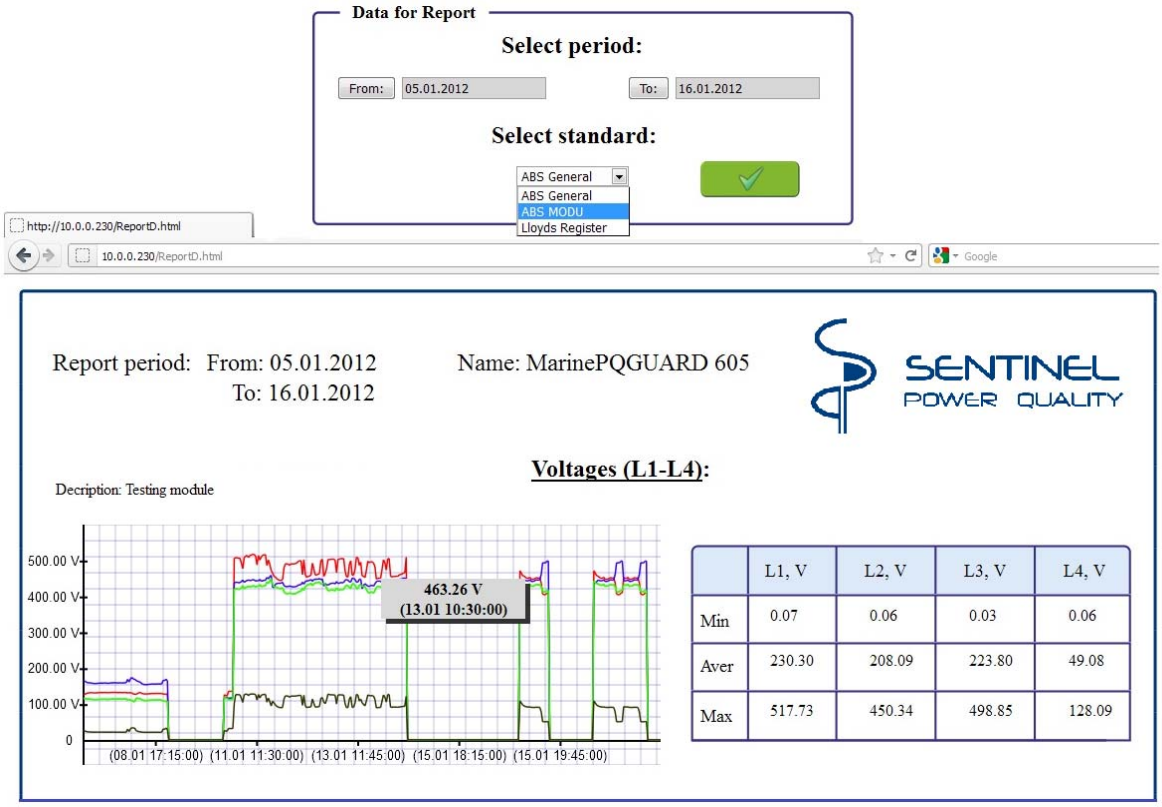

Fig 12 : Report generator; general and compliance against standard/rules

A feature available within MarinePQGuard and other advanced power monitoring devices is report generator (Fig 12) which can be set to cover specific time periods and/or on demand.

In addition, the device can check compliance with ABS general, ABS MODU rules or against other marine classification society's total harmonic voltage rules.

Through the use and operation of this type of device any deviations from the acceptable power quality limits can detected quickly. Any potential problems can be investigated by onboard electrical engineers or, if the more serious, by third party shore based harmonics and PQ experts.

This type of system can be used to monitor power quality to ensure power is used most efficiently and that the harmonic currents and subsequent harmonic voltages are maintained at an acceptable level.