Power Quality Issues and Their Effects on Medical Equipment

Various electrical safety tests such as leakage current and insulation resistance have to be conducted on medical equipment to ensure the safe use which is governed by EN60601 standards (Medical Electrical Equipment and Systems). The quality of the power delivered to the hospital is also very critical. This is because the medical equipment used have sensitive microprocessors and require higher quality power. Power quality issues can result in the malfunction of the medical equipment such as display distortion, incorrect diagnostic results or control fault. It could also result in other severe situation as failure of ventilator which might lead to loss-of-life.

Power quality is the combination of voltage quality and current quality. Voltage disturbance is often from the power network which in turn affects the end users. While current disturbance is from the end users which will affect the network. Hospital's power quality issues occurred often due to non-linear loads, injection of harmonics, and interaction between medical equipment. As power quality issues are cumulative, small events detected should be taken seriously. Non-linear loads distort the current waveform and create harmonic currents to the system current. An example is from electric lighting lamps. In Indonesia, the lamps have to be tested by medical electricity laboratory before

being used by the hospitals. This measure is taken to reduce the harmonics resonating in the system and to ensure that the power factor to maintain at a minimal of 0.85.

3 samples of the electric lamps are being tested in the lab using Hioki Power Quality Analyser, PW3198. The objective of the test is to measure the direct line current and also the line neutral voltage (Figure 1). The parameters recorded are voltage, current, power factor, active power and reactive power. It is also important to observe the voltage and current waveform.

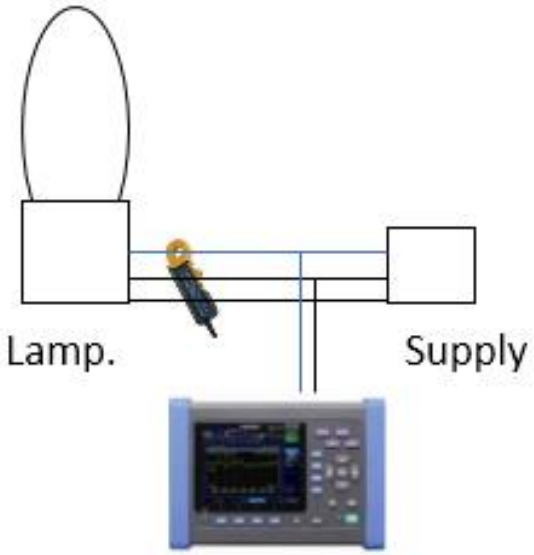

Figure 1: Diagram of Lab Test Setup.

Figure 2: Test Results from Sample A.

From Figure 2, it is observed that the current waveform is slightly distorted. The power factor of sample A is 0.892 which is of acceptable level. Sample B (Figure 3) shows an even more distorted current waveform with a power factor of 0.567 which is considered poor.

Figure 3: Test Results from Sample B.

Figure 4: Test Results from Sample C.

Sample C (Figure 4) has the worst test results. The current waveform has been distorted which does not resemble a sinewave anymore. The power factor of sample C is 0.048 which means that the tested lamp is an inductive load and is not acceptable.

Below shows the summary of test results from the 3 samples (Table 1):

Test	Data Test					
	Voltage	Current	Power Factor	Real Power	Reactive Power	Waveform
Sample A	233.31V	158.50 mA	0.892	32W	36VA	Pass
Sample B	230.35V	32.38 mA	0.567	4.35W	7.55VA	N/A
Sample C	233.32V	72.24 mA	0.048	0.81W	16.86VA	N/A

Table.1 : Summary of Results

The results are compared against standards provided by the regulating authority. It is concluded that only sample A is suitable to be used in the hospital facilities.