Half-Day Course On "Power Quality In Modern Facility"

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The increased usage of Variable Speed Drives (VSDs), computers, and energy saving lightings in modern building has brought about reduced energy usage and increased productivity. However, this also placed higher stress on the electrical network due to harmonics pollution, irregular power factor swing, and voltage stability issues.

IEM Electrical Engineering Technical Division organised a half-day course on "Power Quality In Modern Facility" on 18th May 2016 at Wisma IEM, Petaling Jaya, Selangor. There were more than 40 participants comprising industry experts, engineering firms, plant owners, and academic institutions who attended the event. The speaker was Mr. Chee Khar Chit, an engineering specialist since 2002. He is currently the Product Development Manager at Mun Hean Singapore and is responsible for product and business development in the Asia region.

The course covered the following topics on:

i. Underlying technical fundamental of the sources of harmonics pollution and how to identify it objectively.
ii. Review on International Standards that help to assess the severity of a Power Quality condition.
iii. Current state of the art solution to mitigate Power Quality condition.

A linear load is where the voltage and current waveforms are sinusoidal, and the current at any time is proportional to the voltage. A load is considered non-linear if its impedance changes with the applied voltage, and that caused the current waveforms to be non-sinusoidal even when it is connected to a sinusoidal voltage. The distortion of the current waveform leads to the distortion of the voltage waveform. Hence, under these conditions, the voltage waveform is no longer proportional to the current waveform.

Harmonics are represented by multiple of orders where the fundamental is 1 at 50 Hz frequency system in Malaysia. The amplitude reduces with higher order harmonics, and the significant orders are 3, 5, 7, 13, 15, 19, 21.

The operation of any non-linear load such as inverter circuit in speed drives, computer power supply, and electronic ballast in lighting system introduce a current and voltage condition known as harmonics distortion on the electrical network. In some cases, the stability of the electrical network during critical periods may falter due to unexpected condition of how the network interacts with the Uninterruptible Power Supply (UPS) and the standby generators system. Consequences of power quality issues may result in catastrophic failure of the capacitor bank, causing EMI to sensitive signals, hot spots at busbars and panel cable

terminals, nuisance tripping of circuit breakers, skin effects on cables for higher harmonic orders, motor winding burnt (dv/dt), transformer overheating, neutral overloading, and problems to generators. In terms of business perspective, these failures translate to increased Operational Expenditures (OPEX), interruptions and downtimes costs, reduced system capacity, and the requirement of increased Capital Expenditure (CAPEX) due to unnecessary expansion.

The International Standards on Power Quality condition assessment reviewed were IEEE 519-1992, ER G5/4, and Hong Kong CLP Utility (based on BS 7671). The first two standards recommended Total Harmonic Distortion – Voltage (THD-V) limit is 5% for 69kV and below system, and 400V system, respectively. Meanwhile, the third standard only considers assessment of Total Harmonic Distortion – Current (THD-I).

The solutions for harmonics and Power Quality involve 3 processes: measure, analyse, and improve. The first and most important process is to measure and monitor the affected electrical network system using Power Monitoring Systems and Power Quality Meters to capture the power quality and individual harmonic orders in the system. The second process involve quantifying the readings captured and analysing the harmonics and power quality report in compliance with the International Standards on Power Quality condition assessment. The third process is to provide compensation solutions to mitigate the harmonics pollution by implementation of active harmonic filters, detuned power factor correction capacitor banks, etc.

Alex Looi Tink Huey (right) presenting a token of appreciation to Mr. Chee Khar Chit (left).