



### One day course on “ATS MS IEC 60947-6-1 and Power Capacitors IEC 60831”

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A one day course on “ATS MS IEC 60947-6-1 and Power Capacitors IEC 60831” was organized by IEM Electrical Engineering Technical Division on 9<sup>th</sup> August 2016 at Wisma IEM. Automatic Transfer Switch (ATS) is an automatic electrical switch which switches a load between two sources namely the utility grid and the backup generator. An ATS should be appropriately installed in such a way that preserves the resiliency, redundancy and reliability of the power supply. It is essential especially in systems with critical loads such as those installed in hospitals and data centers. Under IEC 60947-6-1, ATS are classified in terms of their short-circuit capability and method of controlling the transfer. An ATS should ideally be able to be manually, remotely and automatically controlled. It should also be able to monitor supply deviation be it voltage supply or frequency of the power supply. ATS and its controller should be tested together to ensure that its operation is optimized. It should also be protected with a short-circuit protection device both on the utility and backup generator. When selecting an ATS, careful consideration has to be made as per the requirement of the protection level of a system. 2 common switching mechanisms are either break-before-make or make-before-break. The latter mechanism shall take place after the completion of the synchronization between the utility and the backup generator.

Figure below show the active engagement of the participants in the course



In the second half of the course, power capacitor was covered in the presentation. According to one of the speakers, the main cause of failure of power capacitor in a tropical country like Malaysia is the issue of heat. It is not uncommon to have capacitors passing laboratory tests yet fail at site primarily due to failure in mitigation of the issue of heat. IEC 60831-2 stipulates three types of tests for shunt power capacitors of the self-healing type for AC systems having a rated voltage of up to and including 1kV namely ageing test, self-healing test and destruction test. It is to be noted that self-healing protection is suitable for low fault current and would have limitations during high fault condition as continuous breakdown which occur will produce high amount of hydrocarbon gasses which when released are flammable and may be explosive due to the pressure built-up. To prevent case rupture and maintain case integrity, a strong and rigid container capable to withstand high pressure built-up and high fault current is required. Connecting terminals capable of carrying fault current should also be provided to channel away the fault current in the event of a breakdown. Operating temperature of the capacitor should be given due consideration as its life span is highly dependent on this parameter. Prolonged operation of power capacitor in excess of the upper limit of the operating temperature may accelerate the degradation of the dielectric. Hence, the key measure would be to minimize the temperature rise in the capacitor which can be accomplished by using oil-type capacitor even for Low Voltage condition or by having more capacitor elements per phase for current density flow with the aim to reduce stress to each element. Based on IEC 831-1 Section 4-24, the heat conducting property of impregnating materials or filler in descending order are vegetable oil, wax, gas and thermal set resin. Impregnating capacitor with vegetable oil or dielectric fluid provides excellent heat dissipation, maintain constant capacitance and higher safety margin by design. Dielectric fluid is especially recommended for high harmonic induced areas with reactor acting as detune filter. After all, the higher the amount of harmonics, the higher the amount of heat generated and the shorter the life span of the capacitor if heat management is poorly done. Hence, placement of capacitors in such a way that provisions adequate dissipation of heat is vital to prevent overstressing and overheating of power capacitor. As much as possible, natural cooling of heat should be allowed with installation of dedicated air-conditioners as the last resort. Series reactor is a measure to address the issue of harmonics. Appropriate sizing of the reactor targeted to address specific harmonic content could also significantly slows down the deterioration of capacitor's life span. Other than proper placement of capacitors, proper spacing between capacitors should also be in place with good air ventilation system. Proper spacing also conveniences the maintenance works to be done.

The course ended with presentation of souvenirs from IEM to the speakers as shown in the figures below.

