



### **One Day Seminar On Energy Saving With Advance Motor Control & Protection Technology**

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On 2<sup>nd</sup> August 2018, IEM Electrical Engineering Technical Division (EETD) had successfully organised a one day seminar on Energy Saving With Advance Motor Control And Protection Technology at Sheraton Hotel, Petaling Jaya together with Technology Association of Malaysia (TAM). The seminar was well attended by more than 110 participants.

The first speaker, Mr. Jonathan Barrie delivered his talk on soft starting using power electronics for fixed speed applications. He focussed his discussion on fixed speed motor application. According to him, ideal medium voltage soft starter should involve low starting current but high starting torque. For marine based application, it should be type tested. DC brake with adjustable braking time and auto stop option is also favoured for quicker braking. He cited an example whereby a customised heating system was embedded into the oil drilling piping to heat the oil to allow it to be extracted more efficiently as the thick, viscous and cold oil had to be pumped from 2km deep in the sea.



Mr. Jonathan Barrie with the participants

Mr Jonathan then revisited the fundamentals of motor soft starting by comparing several methods. The first method was direct on-line starting which brings about several problems including starting current of up to 8 times nominal current which may trip upstream protection, severe voltage drop, frequency fluctuation and mechanical failure of motor bearings due to the high torque generated by the high current. The second method was a reduced voltage starting with star delta connection.

However, the inherent problem with this method is that the drop in voltage would translate to severe drop in torque estimated to be by a factor of square.

Another alternative of soft starting is by using auto transformers and this method is widely used in medium voltage (MV) applications. The advantages of this starting method is the ability to have multiple torque output due to the multiple taps available. Starting current can also be kept low. However, there is bound to be a high inrush of magnetising current and autotransformer tends to be large and heavy. Generally, soft-stopping is not an option which is crucial for applications like water pumps. The starting characteristics is also not adjustable as auto transformer is usually built to match a specific motor. Looking from a systemic point of view, this may also be a costly method as many contactors and protection relays have to be in place.

The fourth starting method using the line reactor limits the voltage drop by using an inductor. However, current is not limited and the high inrush current may cause nuisance tripping of the protective circuit. Neither soft-stopping nor soft-starting is possible. Another method called flux compensated magnetic amplifier (FCMA) was also introduced to be a variable reactance starter which also lacks the flexibility of adjusting the starting characteristic due to it being built to match the motor specifically.

Then, Mr Jonathan gave an overview on application of silicon controlled rectifier (SCR) which is capable to control both current and torque. SCR is switched by controlling the firing angle. It is turned off at zero crossing of current. Once motor is brought to full speed, SCR is bypassed and the motor is now direct on-line. However, one major disadvantage of SCR is the introduction of harmonics. He then pointed out that surge arrester installed on motors causes problems to soft starters as it may potentially pick up faulty motor bearing's fault for instance.

Finally, the speaker introduced IGBT starter which permits a high starting torque at low starting current by using inverters i.e. by varying the frequency. He also explained that by reducing the frequency, the torque speed curve can be shifted to the left hence resulting in lower starting current but higher starting torque. With this achievement, heating in motor's rotor can be significantly reduced compared to other starting approaches. However, the main challenge with IGBT starter lies in synchronisation between incoming and outgoing terminals. He then also introduced the drivestart with multiple starters technology which enables reduction of number of switchboards and downsizing of generator due to the reduction of starting current.

The second speaker was Mr. Ferooz who introduced the latest trends and technologies in MV circuit breakers. Due to advancement of technology, the size of vacuum circuit breaker (VCB) has shrunk by 94%. Hazardous substances are generally no longer in use in manufacturing the parts of circuit breakers to conserve the environment.



Mr. Martin Elvhage delivering his talk on harmonics

The last speaker of the day was Mr. Martin Elvhage who spoke on harmonics and power quality issues due to non-linearity nature of modern loads. Most drives cause harmonics which are multiples of the fundamental frequency. He recommended for engineers to check for load balancing first before opting for installation of harmonic filters. Mr. Martin then compared the active filter with the passive filter. He also strongly recommended IEEE 519 to gain better understanding on harmonics and its mitigations.

The seminar ended by presentation of tokens of appreciations to the speakers. Pictures below summarise the entire seminar.



Token of appreciation by EETD to Mr. Jonathan



Token of appreciation to Mr. Ferooz



Token of appreciation to Mr. Martin