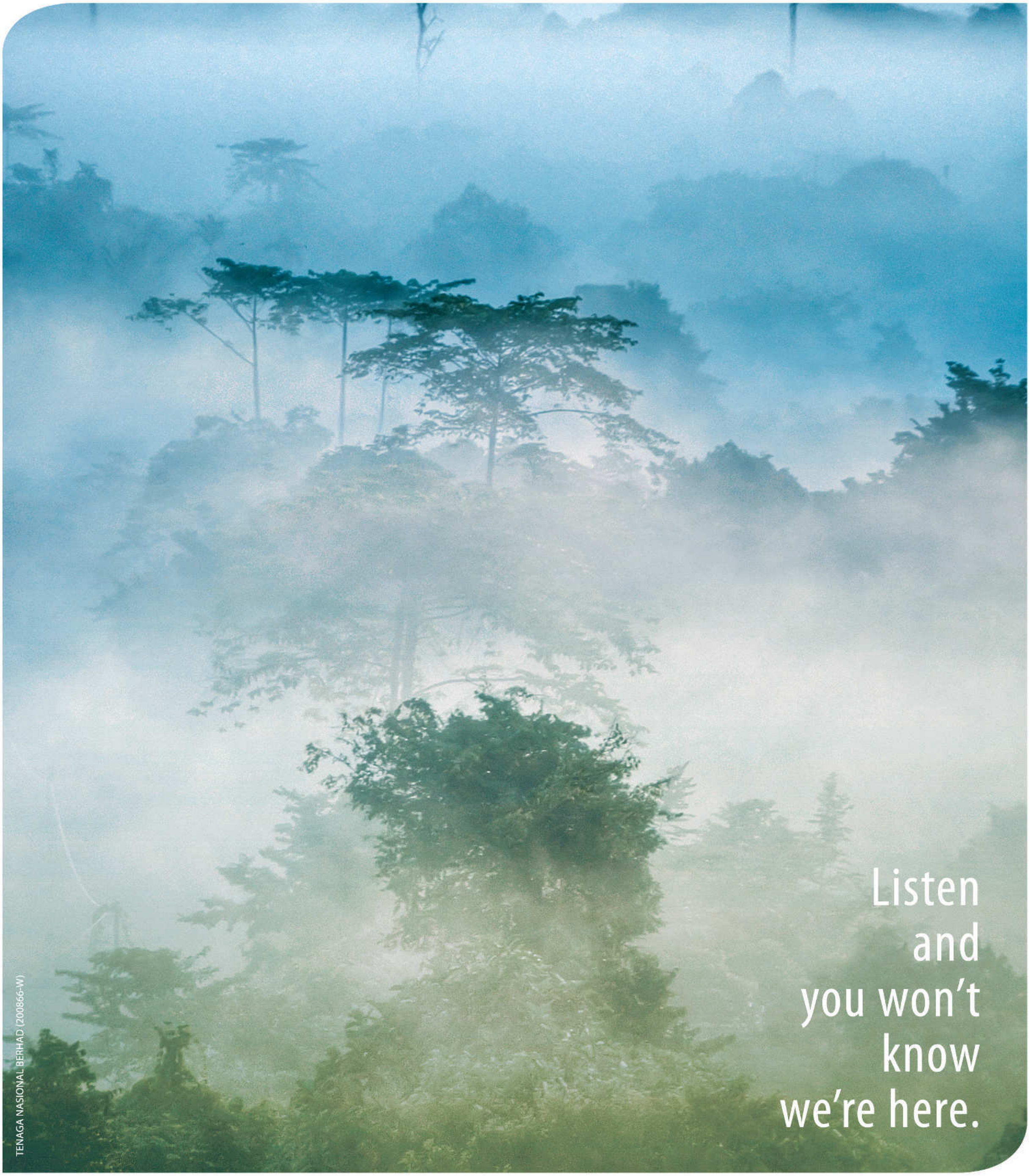
JURUTERA

"Safe, Smart and Innovative Development in Power Systems"



Down below, the natural sounds of the forest can be heard echoing across the land. All is as it has long been, as it should be, despite the fact that construction of the Puah and Tembat hydroelectric dams began in 2010. We have gone to great lengths to ensure the everyday lives of bats, birds, gaurs, tigers, tapirs, elephants and rhinoceroses were disturbed as little as possible. Selective clearing of the forest and the creation of special corridors that allow the 'natives' to roam and forage freely has helped us make significant progress; as a business, and a responsible, eco-friendly neighbour.

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Number 02, February 2016 IEM Registered on 1 May 1959

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By Ir. Yau Chau Fong
Chairman,
Electrical Engineering Technical Division

Ir. Yau Chau Fong, graduated from Universiti Malaya and has a total of 14 years of professional working experience in the consulting industry. He is currently serving as Excomm Member and Council Member of IEM. He is also the current Vice Chairman of the IEM Standing Committee of Activities.

Safe, Smart, Innovative Development in Power Systems

We talk about smart power systems and about integrating information technology with power system grid. But do we ever look into the safety aspects of the power systems that we have developed and installed to date?

In recent years, there have been numerous fatal incidents concerning power systems in residential, commercial and industrial areas. These include electrocution due to water heater installation works, faulty installation of electrical equipment, protection devices and earthing systems as well as lack of safety awareness in substation operations. Many more such incidents are not even reported.

In December last year, we organised an international conference on "Safe, Smart and Innovative Development In Power Systems" where 27 renowned speakers were invited to present and address the above subjects.

Our cover story is an exclusive interview with Datuk Seri Ir. Azman bin Mohd, President and Chief Executive Officer of Tenaga Nasional Berhad (TNB), the country's largest electric utility company. He shares with us how TNB provides safe, smart and innovative power systems.

In the coming months, EETD plans to hold a series of technical talks, courses and seminars on the importance of safe, smart and innovative power systems. We will also hold dialogues and collaborate with various stakeholders involved in the development of power systems, both locally and internationally.

We hope our members will benefit from these activities and continue to support our efforts towards the development of safe, smart and innovative power systems. ■

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Printed by
HOFFSET PRINTING SDN. BHD. (667106-V)
No. 1, Jalan TPK 1/6, Taman Perindustrian Kinrara,
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JURUTERA MONTHLY CIRCULATION: 36,000 COPIES

Submission or placement of articles in JURUTERA could be made to the:-

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THE INSTITUTION OF ENGINEERS, MALAYSIA (IEM)
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TNB UP TO CHALLENGES

With the introduction of Independent Power Producers (IPPs) since late 90s, Tenaga Nasional Berhad (TNB) will no longer the sole stakeholder when it comes to power generation although its core activities continue to be the generation, transmission and distribution of electricity. Now, electric power is produced by both TNB and several IPPs.

With the introduction of Independent Power Producers (IPPs) since late 1990s, TNB will no longer the sole stakeholder when it comes to power generation although its core activities continue to be the generation, transmission and distribution of electricity. Now, electric power is produced by both TNB and several IPPs.

At the helm of TNB is Datuk Seri Ir. Azman bin Mohd, 58, who was appointed President and Chief Executive Officer of TNB in July 2012. Prior to this, he was the Executive Director/Chief Operating Officer of TNB from April 2010 until June 2012, after having served as Vice President, Distribution, from November 2008 until April 2010.

He has also served TNB in various technical and engineering capacities within the Distribution Division, one (1) of the Company's core business division since 1979, including as Assistant District Engineer, District Manager, Area Manager, Assistant General Manager, General Manager and Senior General Manager.

Datuk Seri Ir. Azman received a Bachelor of Engineering (Electrical Engineering) degree from University of Liverpool, UK and later a Master of Business Administration (MBA) degree from Universiti Malaya.

In recognition of his services to the industry, he was presented the Asian CEO Of The Year Award at the Annual Power & Electricity Awards 2014, Transformational Corporate Leader Brand Icon Leadership Award 2014 and Top 50 Influencer in Asia's Power & Electricity World Asia.

In this issue of JURUTERA, Datuk Seri Ir. Azman talks about the challenges ahead for TNB since the introduction of IPPs, ways to ensure greater safety in the workplace, promoting energy efficiency, steps taken to reduce carbon emissions and how IEM can work with TNB to ensure there are more experienced and skilled engineers in the industry.

After the introduction of IPPs, TNB is no longer the sole stakeholder in power generation. How will TNB approach such a challenge in terms of smart grid/grid integration if the Energy Commission opens up the Transmission/Distribution systems to accommodate multiple sources of generation and distributors?

Datuk Seri Ir. Azman: Smart grid will enable the easier integration of distributed generation including RE (Renewable Energy). The TNB network system is ready to accommodate the dynamics of the Distributed Generation (DG) with the incorporation of smarter controls and ICT communication devices.

What is required is to balance the energy demand-supply mix with the right regulatory policies to encourage growth in DG with the appropriate mechanisms to ensure adequate return on investments by all parties. In addition, any change in the Transmission/Distribution system will need to be gradual to ensure the stability and security of the national grid and associated reticulation system is maintained and to not adversely disrupt the commercial equilibrium (including tariff).

With the assistance of *Akaun Amanah Industri Bekalan Elektrik* (AAIBE or Electricity Supply Industries Trust Account), TNB has taken the bold step to implement a "live" smart meter pilot project in Melaka and Putrajaya. From this modest yet ambitious project, TNB will gather experience and know-how on smart meter (advanced metering infrastructure) development, including related technologies and implementation which is one of the critical enablers of Smart Grid and DG.

TNB is also embarking on numerous RE/DG projects and plans such as biomass, solar facilities in the electricity supply industry. This is in line with our commitment towards the national low carbon target.

Distributed Generation has achieved significant progress recently due to the acceleration in technology evolution and emergence of Disruptive Technologies. TNB is of the opinion that new technologies require sustainable and prudent learning growth in order to achieve the most benefit without jeopardising the prevalent reliability, security and economics of the electric supply industry (ESI).

In developed countries, the electric supply industries are gradually shifting away from a linear supply value chain model that produces electricity from Generation, transmitted over long distance through Transmission infrastructure, and eventually distributed to respective loads on the consumer side at Distribution level. This model will soon change with the advent of new Disruptive Technologies that redefine the capability and economics of smart grids, distributed generation, energy efficiency and conservation, networking and connectivity.

This evolution spawns new products and services beyond "keeping the lights on". Customers will have a choice of products and services which will create new consumer experience and feedback and which will objectively lead to greater customer satisfaction, trust and needs.

According to the Energy Commission (EC) statistics on electrical accidents, presented at the recent IEM-IET Electrical Conference 2015 (IIEC 2015), the highest rates were recorded in the utility company. Tell us the measures that TNB has taken to reduce and mitigate this situation.

Datuk Seri Ir. Azman: Most of the accidents were due to either human factor or equipment failures. To address the human factor, we are focusing on safety awareness and to further enhance our technical competency. These include:

- More stringent SOPs have been established and safety gears given to the operational staff.
- Continuous education and awareness programmes to enhance safe work practice
- Certification and recertification programmes to ensure competency of technical employees.
- New safe work procedure, enhanced permit to work system, skill competition have been introduced
- Continuous audit, inspection and enforcement activities to monitor non-compliance and at-risk behaviour.
- Increase in promotional activities, safety campaign, safety posters and leaflets
- Disciplinary action against those who violate safety rules and cause accidents

To address the issue with regards to equipment quality, there is greater emphasis to ensure that only proven and tested products and technologies are utilised.

- TNB has established its own product certification programme to prevent defective equipment from getting into our system.
- Increased use of technology will reduce risks of accident e.g. Distribution Automation/SCADA, remote switching, Regional Control Centre, switching robots, modern switchgears, use cable spiker
- Employees will be equipped with adequate testing tools, earthing rods, arc flash suit and personal protective equipment.

What is TNB's role in promoting energy efficiency in the country?

Datuk Seri Ir. Azman: TNB has always been promoting energy efficiency. Energy efficiency initiatives will benefit TNB, our customers and the nation. We will benefit in term of optimisation of energy transfer, which will enhance the efficiency of the electricity supply industry.

Apart from cost, supply reliability and energy security are prime factors that need to be considered seriously. Striking an optimal balance between these correlated factors has always been the prime objective for TNB and the Government. In reality, fossil fuel as a resource, is limited and will become more expensive in the long term as it gets scarcer (although it is also affected by intermittent large fluctuation), the world's population becomes larger and standards of socio-economic level increases.

In line with the Government's policies, TNB believes that the Energy Efficiency/Conservation should constitute other fuel sources to help prolong the availability of existing energy resources. Additionally, it will negate the detrimental impact of the energy supply industry to the environment by cutting down emissions.

TNB is supporting the 11th Malaysia Plan (RMK11) which focuses on improving infrastructure and service deliveries in ESI, via the implementing of specific strategies that include better management of resources through Demand Side Management and Energy Efficiency (EE) as well as addressing public communication.

To promote EE, TNB uses various channels such as our own *Kedai Tenaga* and TNB website. Even our street furnitures have energy saving tips on them. We also meet and share tips on energy saving with customers through dialogues, official visits, campaigns, exhibitions and education in schools.

Additionally, our subsidiary, TNB Energy Services Sdn. Bhd., offers customers EE services which include energy audit, retrofitting of energy efficient equipment, power quality and power factor improvement as well as Energy Performance Contract where the customers do not have to invest in upfront costs as this will be recovered from the energy savings in their monthly bills.

Currently, TNB is partnering with a third party, a global leader in the utility industry customer engagement programme, to launch a pilot customer engagement programme, called Home Energy Report.

We are the first in the ASEAN region to implement the Home Energy Report and the 3rd in Asia after TEPCO (Japan) and CLP (Hong Kong). This pilot programme will help customers to manage their energy use and save money on their monthly electricity bills, using the concept of similar peers/neighbours benchmarking.

The programme is part of TNB's corporate strategy to empower and engage residential customers. Launched in August 2015, it will involve about 200,000 households in the Klang Valley, Negri Sembilan and Melaka. This customer engagement programme is part of our latest efforts to enhance customer experiences and TNB will continue to strive further in developing and introducing innovative and effective initiatives to enhance Malaysia's Electricity Supply Industry.

To date, TNB has carried out many energy efficiency initiatives aimed at educating and instilling awareness in the public culture and mindset. These initiatives are:

- Energy audits and consultancy at TNB and private buildings to improve energy efficiency and carbon footprint.
- Training and certification to produce competent Energy Managers in order to fulfill the requirement in Efficient Management of Electrical Energy Regulations 2008 guidelines as set out by the Energy Commission.
- Sponsoring Formula E 2015 as a platform to showcase how Electric Vehicles (EV) can change motorsport and the transportation landscape.
- Home Energy Report (HER), a new programme launched in August 2015, utilises innvovation analytics, behavioural science, and peer/neighbours comparison concept to motivate residential consumers to implement energy saving practices.

How committed is TNB to increasing the percentage of Green Energy in the country's electricity generation?

Datuk Seri Ir. Azman: TNB fully supports the Government initiatives to increase the percentage of Green Energy. The government's target is to

have 2080MW of RE generation by 2020 and TNB plans to contribute significantly towards this.

Through our Distribution Division, we have opened our network and allowed connections of small scale RE plants for RE developers participating in the Feed-in Tariff (FiT) scheme. To date, there are approximately 340MW of RE (FIT scheme) operating in the TNB network while another 540MW are in the pipeline under the FIT RE quota scheme.

With our experience in technical operations and our financial capabilities, we are pursuing joint-partnerships for the development of RE plants, e.g. Amcorp Power (20MW Mini Hydro in Sungai Liang), Felda (12MW Biomass in Jengka) and Sime Darby (3.2MW Biogas in Tanjung Malim and Kulai). We are constantly looking for new opportunities to invest in RE and are keen to work with both local and international partners.

TNB is committed to becoming a green utility company that embodies sustainability elements in its operation, products and services. We are allocating Green Funds for the development of sustainability projects (including Green and RE projects) that benefit the nation and society.

What are the initiatives that TNB has taken to reduce carbon emissions? What are the challenges in this area?

Datuk Seri Ir. Azman: The Malaysian Energy Industry is still largely dependent on fossil fuel (more than 90% predominantly gas, LNG and coal) for power generation. The options available are to invest in more efficient generating plants and to use the latest technologies to mitigate the carbon emissions.

TNB has conducted a study on carbon footprint for the generation, transmission and distribution sector. This will provide a baseline reference in our future attempts to further reduce carbon emission. Various initiatives are being undertaken now in this respect.

For example, the deployment of the latest technologies, such as an ultra-supercritical power plant, will mean higher efficiency and less emissions. Research is also being conducted on the Integrated Gasification Combine Cycle (IGCC) technology, Carbon Capture & Utilisation (CCU) technology etc. We have already established a pilot IGCC test facility at TNB Research (TNBR) as well as a pilot carbon capture plant using microalgae at the Manjung Power Station.

As for the challenges we are facing, most of these new technologies are relatively more expensive and we also need to build local expertise in these.

Malaysia is adopting an indicator of a voluntary (CO_2) reduction of up to 40% in terms of emissions intensity of Gross Domestic Product (GDP) by the year 2020 as compared to the 2005 level.

TNB is fully supporting the government's pledge by integrating low carbon technology in our conventional power plants, developing low carbon generation plants (RE) and promoting energy efficiency (EE) among customers. Our latest coal power plant in Manjung has adopted the ultra-supercritical boiler technology, which is up to 40% more efficient than conventional boilers currently operating in Malaysia. Greater efficiency means reduced use of coal and thus, lower carbon emissions.

We are also in the midst of reducing electricity consumption in all our offices as we have retrofitted these with EE equipment and installed solar panels on the roof tops. As part of our CSR programme, we also installed solar panels on the premises of the Social Welfare Department (*Jabatan Kebajikan Masyarakat*) to help reduce its operating costs. The money saved can then be channeled to more critical operations.

Aside from that, our research arms (TNBR and Universiti Tenaga Nasional (UNITEN)) are exploring new low carbon technologies such as Carbon Capture & Storage (CCS) and gasification. TNB has also added low/zero carbon generation plants such as 2 x 186MW Ulu Jelai Hydo, 265MW Hulu Terengganu Hydro, 12MW Chenderoh Hydro, 5.8Mw Tekai Hydro, 12MW Jengka Biomass, 20MW Sungai Liang Hydro and 3.2MW Tanjung Malim & Kulai Biogas.

We are also striving towards building capacity and resources in the RE sector. TNB has accomplished various achievements in conducting RE projects and infrastructures that are currently dominated by hydroelectric power generation and which commands 8.8% of total TNB's installed capacity equivalent to 1,911

MW. Apart from that, TNB also embarked on various local RE projects, such as:

- Biomass 12MW JV project with Felda (Jengka, Pahang)
- Biogas 2 x 2MW JV with Sime Darby Plantation Sdn. Bhd. (Perak & Johor)
- Demonstration project of Solar BIPV at Vibrant Café (120kW)
- Project implementer for numerous rural electrification projects (Solar Hybrid stations).

Some of the challenges TNB is facing in carbon emission reduction are:

- High entry cost. This is one of the major barriers for new technologies pertaining to Clean Coal Technology (CCT) and RE. However as technology matures and impact of economic of scales, the cost is declining towards commercialisation and grid parity.
- Striking an optimal balance between Cost Of Energy and Economic Growth. As a developing country, Malaysia requires significant amounts of energy to sustain and underpin the economic growth rate at a reasonable and competitive tariff. At the moment, fossil fuel is still the cheapest and most reliable source of energy for fulfilling the criteria in particular base load requirement although in the future, renewable energy will become more competitive.
- Most RE resources are not suitable for serving base load. Since RE resources fluctuate, depending on daytime, weather and climate, this poses uncertainty and reliability of power generation. Such a characteristic underpins the deployment of fossil fuel power plant to accommodate base load demand.
- Location of RE infrastructures. Malaysia is blessed with plenty of sunshine which compels the interest and investment in solar power. However, solar power generation still requires a big land bank size despite technology advancement enhancing the efficiency of solar panels. Solar power generation also has to compete with property development which may offer better value and returns comparatively. A solar power plant is often classified as Distributed Generation, hence location within the load vicinity is preferred to reduce losses and raise system efficiency.
- Restrictive financing scheme. Financing frameworks and facilities are less supportive of RE development as the industry is quite new.

How can IEM work with TNB to develop engineers who can contribute towards creating safe, smart and innovative power systems?

Datuk Seri Ir. Azman: TNB is always open to collaboration possibilities (e.g. joint training and conferences) with all parties, including IEM, to further develop engineers in the latest and innovative power system technologies and know-how.

Within the TNB workforce are many experienced and skilled engineers who are IEM members. In other words, TNB is already a part of the IEM community and TNB professionals have regularly contributed to provide insights, news and updated materials in IEM publications as well as at seminars and talks.

IEM can help to promote and disseminate TNB's efforts towards achieving safe, smart and innovative power systems, through the various media and communication channels.

Inviting TNB engineers to share industry experiences with IEM will enable its young engineers to gain a better understanding of the issues and challenges in order that focus can be given to these areas.

IEM can also work with the TNB Quality Assurance Team to share experiences and expertise that will ensure the quality and safety of equipment. IEM can also assist equipment manufacturers to implement a safety system and product quality certification. ■

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Professional Competency Exam: Why, What and How?

Ir. Lai Sze Ching

***Ir. Lai Sze Ching** is currently a Council member and an EXCOMM member in IEM. He is the Vice-Chairman of Standing Committee of Examination and Qualification, Secretary of the Standing Committee of Professional Practice, Chairman of the sub-committee on Amendment of IEM Constitution and the Chairman for the sub-committee of Legislations Affecting Engineering Profession. Ir. Lai is also a committee member of the Amendment of Registration of Engineers Act under the Board of Engineers Malaysia.*

Malaysia made its commitment to liberalise its services in 1995 in the Uruguay Round of the WTO and through the ASEAN Framework Agreement on Services (AFAS). In AFAS, ASEAN leaders gave their commitment to liberalise the services sector completely by 2015 in line with the formation of the ASEAN Economic Community (AEC). The AEC enables freer trade in goods and services as well as transfer of expertise within the ASEAN member states.

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Since the mid-1980s, a substantial amount of liberalisation has taken place in the area of international trade and services. Much of this is inspired by WTO and various regional agreements. However, Malaysia is regarded as being defensive in the GATS negotiations due to high level of protection of the services markets. Nonetheless, Malaysia's services offer involved a wide coverage of sectors and substantive bindings of current policies. Up to 2009, Malaysia had made commitments in 83 services activities, including both the financial and non-financial sectors under GATS. The services sectors that were offered for liberalisation comprised business services, professional services, telecommunication services, marine services, audiovisual and broadcasting services, construction services, financial services, health services, tourism services, computer services, travel services, rental and leasing services and entertainment services.

Malaysia has since acknowledged and viewed positively the benefits of the current global liberalisation of the service sector. Many Malaysian companies have benefited from the global liberalisation of the sector and have successfully ventured into the global market. For example, in the construction sector, Malaysia companies are actively involved in various projects in the Middle East, India, China and ASEAN countries. Other international markets that Malaysian companies have penetrated include the oil and gas service sector, education, aviation, health and professional services.

In April 2009 the government liberalised another 27 services sub-sectors to strengthen its economy and to face the increasing challenges of globalisation. This was also in line with the government's objective to implement structural reforms in our economy. In this new economy model, the services sector will be developed intensively as the main engine of growth of the country.

Subsequently, in 2011, the government announced that another 17 service sub-sectors would be opened up and that 100% foreign equity participation would be permitted in those service sectors. These service sub-sectors included accounting and taxation services, legal services, architectural services and engineering services.

Architectural and engineering services were scheduled to be liberalised by 2015, pending amendments to the relevant Acts. Once these two sectors were liberalised, foreign equity participation up to 100% would be permitted. Thereafter local engineering and architectural firms would have to compete with international companies.

AMENDMENT OF REGISTRATION OF ENGINEERS ACT 1967 AND ITS REGULATIONS

The amendment to the Registration of Engineers Act 1967 (Act 138) (REA) was finally completed and passed by Parliament on 12 February 2015 and came into operation on 31 July 2015. The Registration of Engineers Regulations 1990 was also amended and came into operation on 31 July 2015.

THE PURPOSE OF THE AMENDMENT WAS TO ACHIEVE, AMONG OTHERS, THE FOLLOWING OBJECTIVES:

1. To liberalise engineering services by permitting foreign engineers to practise in the country.
2. To improve the competency of local engineers so that they would be competitive when the engineering service was liberalised.
3. In view of frequent construction failures of late, it is necessary to improve the competency of the engineers so that the public safety and interests would be safeguarded.

SUBMITTING OR QUALIFIED PERSONS

Prior to the amendment, professional engineers registered with the Board of Engineers Malaysia (BEM) are allowed to be the Submitting or Qualified Person as defined under the Street, Drainage and Building Act 1974 (Act 133). They are authorised to submit plans and design to the authorities for Road, Drainage and Building Works. With the P.E. registration, the professional engineer is able to set-up an engineering consultancy practice that's registered with BEM within a short period of time. But this practice has led to questions that many have asked, such as:

1. Are professional engineers competent and do they possess sufficient general engineering experience?
2. Do they understand the duty of care and due diligence to the public as well as to the client?
3. Do they possess necessary integrity and honesty while discharging their duty?

TWO-TIER SYSTEM OF PES

Against this background, the amendment introduced a two-tier system of Professional Engineers.

The First Tier comprises those who have passed the Professional Assessment Examination (PAE) or who are Corporate Members of Institution of Engineers Malaysia. The objective of the PAE is to test the candidate on "what he knows".

The Second Tier, newly introduced under the amendment, comprises First Tier professional engineers who have passed the Professional Competency Examination (PCE). This is a new examination system to test the competency of professional engineers and the objective is to "test a candidate on what he does not know and which he ought to know".

Under the amended REA, professional engineers who have passed the PCE will be eligible to apply for a practicing certificate. He shall then be entitled to register with BEM as a Professional Engineer With Practicing Certificate.

So professional engineers who wish to set-up an Engineering Consultancy Practice (ECP) under Section 7A or 7B of the REA and to offer professional engineering services, must pass the PCE and be registered with BEM as a Professional Engineer With A Valid "Licence" (or "Practising Certificate"). In addition, for submission of plans to local authorities and relevant statutory authorities, professional engineers must possess valid practising certificates issued by BEM.

RATIONALE OF TWO-TIER SYSTEM

Of professional engineers registered with BEM, 85% are registered under Civil, Mechanical and Electrical discipline. As at mid-2014, only a small fraction (approx. 2,000 to 3,000) of these are "practising" or wish to be the "Submitting Person". The rest are employed in the fields of contracting, maintenance, sales, government service, and academia or as employees of engineering consultants.

Therefore BEM will issue a "licence" to PEs who wish to become "Submitting Person" under the building laws and who are technically competent and expected to practise professionalism in their work.

In short the rationale for setting up a new tier of professional engineers is to set and maintain high standards of engineering practice and to regulate and enforce acceptable standards of professional conduct.

AIMS OF PCE

The Professional Competency Examination will test candidates within the limits of "professional engineering services" as defined by the REA, which will be within the engineering disciplines of civil & structural, mechanical and electrical engineering. It will test a candidate's knowledge, experience and application of the following:

1. Regulations and rules of engineering practice in Malaysia
2. Statutory laws, design codes, regulations and
3. Standards of professionalism and ethical behaviour.

FORMAT OF PCE

The Professional Competency Examination shall be conducted in two parts:

Part A is a common paper to be taken by all candidates, irrespective of which discipline they are registered under with the BEM. This paper will be non-technical in nature but will test the candidate's knowledge of:

- Laws governing the engineering profession
- The responsibility of an engineer as professional towards the general public and
- Standard of professionalism and ethical behaviour.

Part B consists of technical paper that shall be taken by candidates registered in the respective engineering disciplines. This paper will test the candidate's competency in his respective field.

A candidate must pass both Part A and B. If a candidate passes only one part, he or she will be allowed to sit the failed paper at a later date. The passed result for Part A or B is valid for 3 years and there is no limit to the number of attempts to re-sit the failed paper as long as it is within the 3-year period. After this time, a candidate will have to re-sit both papers again.

PART A OF PCE

Part A tests the candidate's knowledge of laws governing the profession, the responsibility of the professional engineer towards the general public and standards of professionalism and ethical behaviour.

There are 2 papers in Part A and candidates must pass both papers in one sitting. Paper 1 will have 40 objective questions and the time limit is 1.5 hours. Paper 2 comprises 5 essay type questions, of which a candidate is required to answer 3, within 1.5 hours.

The syllabi for Part A are:

a) Laws and regulations governing the engineering profession in Malaysia
b) An engineer's responsibility to society and the public
c) Professionalism on a conceptual basis, ethical conduct and professional practice
d) Overview of laws having relevance
e) Basic knowledge of Contract Laws being practised locally, with respect to the construction industry
f) In-depth knowledge of the functions of a consulting engineer during the various stages of project implementation in accordance with BEM Model Form of Agreement
g) Management of engineering consultancy practices in Malaysia.

The passing mark for both papers is 50%. The weightage of the topics is as below:

i. Construction law – 25%
ii. Registration of Engineering Act 1967 (Act 138) and Registration of Engineers Regulation 1990 – 35%
iii. Local laws relevant to the engineering practice – 30%
iv. Management of engineering consultancy practice – 10%
v. The overall weightage of law issues is 90%.

PART B OF PCE

For Part B, candidates will sit for the paper in their discipline of practice. The objective is to test a candidate's competency in his field.

There are 2 papers in Part B and candidates must pass both papers in one sitting. Paper 1 comprises 40 objective questions and the time limit is 1.5 hours. Paper 2 comprises 5 essay type questions, of which a candidate is required to answer 3. The time limit is 2 hours for Civil & Structure Engineering and 1.5 hours for Mechanical and Electrical Engineering.

The passing mark for both papers is also 50%. The weightage of the topics is as below:

Civil & Structure

- Geotechnical – 20%
- Civil Infrastructure – 30%
- Structure – 40%
- Uniform Building Bylaw etc – 10%

Mechanical

- Air-conditioning and ventilation – 40%
- Fire protection – 30%
- Hydraulics – 20%
- Other mechanical systems – 10%

Electrical

- Regulatory practice – 20%
- The electricity distribution system – 30%
- System protection – 25%
- Building systems – 25

The topics covered under Part B are very wide ranging and a candidate is expected to understand and be familiar with all relevant technical knowledge pertaining to general engineering practices such as building services, infrastructure work etc. ■

Electric Motors & Energy Management: Back to Basics

Ir. Dr Gobbi Ramasamy

Ir. Dr Gobbi Ramasamy *is an associate professor at Faculty of Engineering, Multimedia University, Malaysia. He is a consultant providing solutions for problems associated to electric motors and drives system for various industries. He is also an Electric Energy Manager Registered to Energy Commission, Malaysia, and a Senior Member, IEEE.*

In industry, an induction motor usually runs only at 50-60% loading conditions, for two reasons. Firstly, it reduces the chances of overloading the motor and minimises the thermal effect on the motor system. Secondly, the motor is literally oversized to allow room for future expansion.

It is important to note that motors operating at 50-60% loading produces a relatively greater loss compared to those operating at 75% loading (where optimum efficiency is achieved). Besides, the power factor is also affected by the loading conditions. A bigger motor (e.g. 1kW) gives much better power factor at full load and this is lowered gradually when load is reduced as shown in Figure 1.

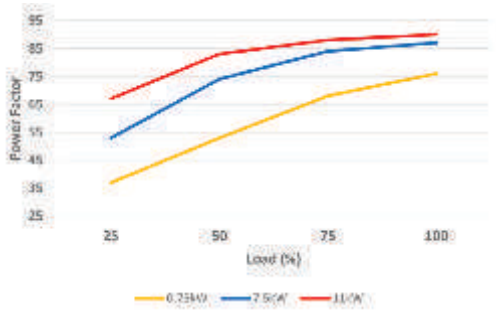

Figure 1: Power factor under various loading conditions

If a smaller motor (e.g. 0.75kW) is used, the power factor is much lower. When the motor runs at a lower power factor, the motor draws a higher current to produce the required mechanical power. Higher current means higher copper losses in the cable and motor windings. The relationship of these parameters is shown in equation 1, where I is the line current, P_m is the mechanical power which is constant for a given load and speed, P_L is the rotational and copper losses. V is the supply voltage which is constant, cosθ is the power factor.

$$I = \frac{P_m + P_L}{\sqrt{3} V cos\theta} \qquad (1)$$

In order to minimise energy usage by the motor system, the first option is to minimise losses. For this reason, the existing load should be increased and the motor should always run at 75%. Increasing loading from 50% to 75% makes the motor operate at higher efficiency, usually between 1% and 3.5% for a typical IE1 motor. Unfortunately, increasing the loading is very subjective as it depends on production line requirements. In practice this may prove difficult to implement.

In order to minimise energy usage by the motor system, the first option is to minimise losses. For this reason, the existing load should be increased and the motor should always run at 75%. Increasing loading from 50% to 75% makes the motor operate at higher efficiency, usually between 1% and 3.5% for a typical IE1 motor. Unfortunately, increasing the loading is very subjective as it depends on production line requirements. In practice this may prove difficult to implement.

The next option is to consider high efficient motors (HEMs), that is IE2 or IE3 motors. It is stated in MS1525:2014 "Energy efficiency and use of renewable energy for non-residential buildings - Code of Practice (second revision)", that only IE2 or IE3 motors shall be used based on economic justification basis. IE2 motors give higher efficiency, typically from 6% (for 0.75kW) to 1% (for 200kW and above) whereas IE3 motors give 10% (for 0.75kW) to 2% (for 200kW and above) as compared to IE1 motors. Accordingly, at lighter loading conditions, IE2 and IE3 motors have a higher efficiency than IE1. But the issue is the initial cost of changing to HEMs.

Figure 2 shows the comparison study between IE1 and IE2 motors over three years of operations for motor rating of 15kW to 75kW. The initial cost of IE2 is 80% higher than IE1 (price quoted by suppliers in Malaysia). However, based on savings in energy cost by using IE2 motors, it has been found that this cost can be recovered in under 3 years. The energy cost calculation is based on 50 sen per unit for 3,600 hours of motor operation annually.

Amid concerns over the initial cost of HEMs, most companies opt to rewind faulty IE1

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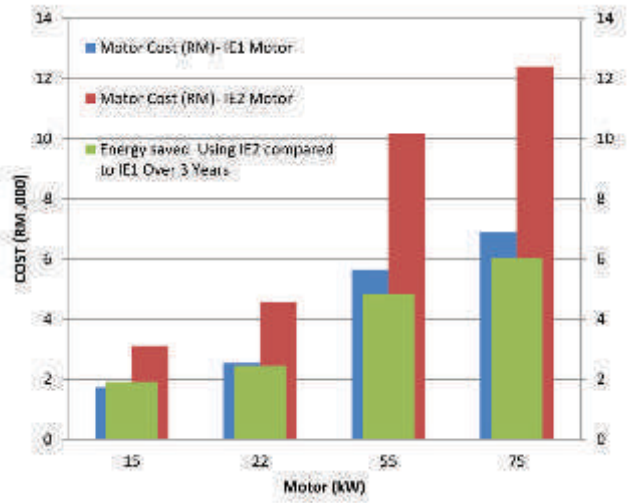

Figure 2: Cost Comparison between IE1 and IE2 motors

motors at least 4 times before considering new motors. The frequency of rewinding is, on average, once every 2 years. It is also understood that motor efficiency drops between 3% (for 0.75kW) and 10% (for 200kW and above) after each rewinding process. Figure 3 shows the cost comparison between rewinding existing IE1 and purchasing new IE2 motors. The results show that although the cost for rewinding is much lower, the lower efficiency of the rewound motors increases energy cost over the years. The graph also shows that the payback period for investing in new IE2 motors is about 2 years.

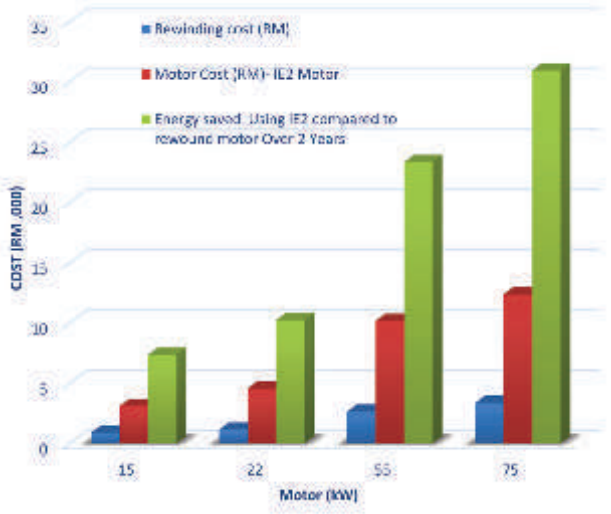

Figure 3: Cost comparison between Rewinding Existing IE1 and Purchasing New IE2 Motors

There are many industries that opt for electronic controllers to minimise the energy usage in electric motor systems. There are two controllers available in the market – soft starters and variable speed drives.

Soft starter is a simple electronic controller with thyristors which control the voltage sent to motor during Start and Stop operations. It is not able to directly control the speed, except during the starting and stopping of the motors. It is therefore suitable for applications where starting torque is relatively low (since soft starter gives much lower voltage at

starting) so that starting current peak is reduced. This can be a solution to avoid high maximum demand charges.

On the other hand, variable speed drive (VSD) controls both the speed and torque throughout the motor operations (starting, constant/variable loading, and stopping). Generally, a fixed voltage, fixed frequency AC source is converted to a DC source by using an arrangement of diodes and/or insulated gate bipolar transistors (IGBTs). This process is called rectification. The DC source is then smoothed by a group of capacitors. The smoothed DC source is converted to a variable voltage, variable frequency AC source using an inverter with an arrangement of IGBTs. VSD controls power to the motor based on load requirement, so this is a better solution for saving energy, especially for motor systems running at variable speed and under variable load conditions.

Unfortunately, most old VSDs use a diodes arrangement for rectification process. This produces current harmonics at the source which will affect the power factor of the power system and directly contribute to energy losses in electrical equipment. To minimise this, a passive filter should be installed to minimise the harmonics level to within the IEEE 519 requirements.

With significant changes in our local climate, afternoon temperature can reach as high as 36 C (3) compared to 34 C reported 17 years (4) ago. In addition, the high humidity, reported within 70% to 90%, also creates an uncomfortable atmosphere at work for people and equipment. So it can be expected that, without proper ventilation, electric motors and systems will overheat. The hot spot in a motor is actually a combination of motor design (temperature rise) and the ambient (surrounding) temperature. As 50% of motor loss comes from copper loss, cooling of the motor is essential to minimise insulation failures. Besides, when self-cooled motors run at lower speed with VSD, the cooling effect will be lower and this can result in overheated motors.

Adding force cooling fans may solve this issue. In fact when the motor is connected to VSD, the location of VSD is very crucial. The IGBT at the VSD operates typically at 4 kHz switching high current and this produces excessive heat and transfers heat to the heat sink. The ventilation at the heat sink ensures the transfer of heat to its surroundings. Improper ventilation will trigger the temperature sensor at the heat sink and trip the VSD. Moreover, the hot heat sink will reduce the life cycle of IGBTs.

CONCLUSION

There are four basic issues to tackle to minimise the electricity bill for motor systems:

1. To manage the motor load
2. To improve power factor at the motor
3. To minimise current harmonics at the supply point of variable speed drive
4. To provide proper ventilation for motors and variable speed drive systems.

In addition, for greater savings, opt for IE2/IE3 motors rather than rewinding or purchase of new IE1 motors, should there be a need to replace the motors. ■

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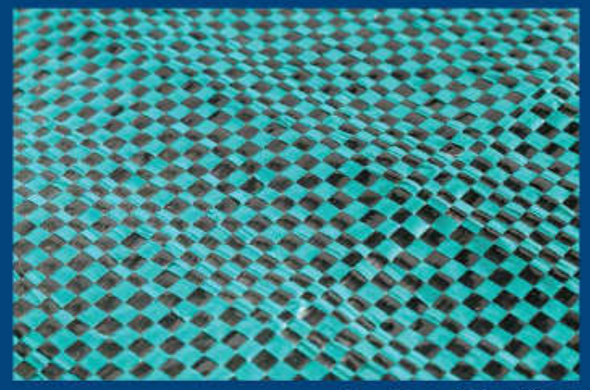

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SAFE TEA TIME

Looking Back 2

by Ir. Shum Keng Yan

***Ir. Shum Keng Yan** is a chemical engineer and a certified accident prevention and safety practitioner. He advises on EHS in the chemical, fast moving consumer goods, heavy metal manufacturing and building services industries across Asia Pacific and beyond. He regularly delivers talks at conferences, forums and universities.*

Here is the list of articles from 2013 – 2016.

Year	Issue	Title	Topic
2013	January	Home Safety 2	Safety at Home
	March	Loss Reduction	Loss Reduction Principles
	May	Business Crisis and Continuity Management	Crisis and Continuity Management
	July	Fruit for Thought	PEAR Principles
	September	More Fruit for Thought	PEAR Implementation
	November	Trigger	Identification of Crisis Triggers
2014	January	Hot Planning	10 Steps to respond to a Crisis
	March	Business Continuity	Getting back to Business
	May	Frequent or Severe	A relook at our Priorities
	August	Addressing High Impact	The New Focus on Managing High Impact
	September	Getting the Right Profile	Analysing Accident Profiles
	November	Annual Management Review	Meaningful Management Review
2015	January	Engagement Safety	Beyond Traditional Safety Models
	May	Easy Recall with Mental Hooks	Maintaining Share of Mind
	August	Driving Ownership	Techniques to Drive Ownership
	October	Gaining Ownership	How Ownership is Established
	December	Looking Back	Index of Articles from 2009 - 2012
2016	February	Looking Back 2	Index of Articles from 2013 - 2016
	April	Our Journey	Engagement Safety Training Principles 1
	June	The True Journey	Engagement Safety Training Principles 2
	August	A New Beginning	Engagement Safety Training Principles 3

I hope the list is helpful to you to search for the older articles. We will resume the regular column in the coming issues. Share your thoughts on what you would like to read or share: *pub@iem.org.my.*
Every journey should also have a destination so that we know where it ends!

IEM DIARY OF EVENTS

Title: 2-Day Course On 'Contract Management for Construction Projects'

22 - 23 February 2016

Organised by : Project Management Technical Division
Time : 8.30 a.m. – 5.30 p.m.
CPD/PDP : 14

Title: Talk on "Approval Processes and Technology Transfer Particularly On Rolling Stocks"

25 February 2016

Organised by : Mechanical Engineering Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

Title: Technical Visit to Boustead Shipyard and Royal Malaysian Navy Base, Lumut

26 - 27 February 2016

Organised by : Project Management Technical Division
Time : 7.00 a.m. – 5.00 p.m.
CPD/PDP : 5.5

Title: Talk on "Malaysian's First Hydrodynamic Marine Laboratory"

3 March 2016

Organised by : Marine Engineering & Naval Architecture Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

The IEM & IET Electrical Conference (IIEC 2015) on Safe, Smart and Innovative Development in Power Systems

ELECTRICAL ENGINEERING TECHNICAL DIVISION

reported by
Ir. Ng Win Siau

***Ir. Ng Win Siau** graduated from the National University of Singapore in Bachelor of Engineering and a Master of Engineering in Electrical Engineering. He is currently an electrical engineer with Perunding MM 20-20 and a committee member of EETD.*

The IEM & IET Electrical Conference 2015 at Sime Darby Convention Centre gathered more than 150 participants, including local and overseas experts. This is the third IIEC, jointly organised by the Electrical Engineering Technical Division (EETD) of The Institution of Engineers Malaysia (IEM) and the Institution of Engineering and Technology (IET), Malaysia Network. The IIEC has been held biannually since 2011.

Deputy President Ir. Tan Yean Chin visiting the technical exhibition accompanied by Ir. Yau Chau Fong

This year, the conference theme was "Safe, Smart and Innovative Development in Power Systems", in line with the nation's push for enhancing safety in electrical supply and usage, improving energy efficiency with technology and the effective adoption of renewable energy sources. The conference provided a platform for participants to stay updated on the latest trends and technologies in the industry, and for experts to gain valuable feedback on the industry requirements.

A one-day tutorial session was held on 30 November 2015 while the two-day conference was held on 1-2 December, 2015. Throughout the 3 days, there was an exhibition where companies showcased their safe, smart and innovative solutions.

30 NOVEMBER: TUTORIAL SESSION

The first speaker, Ir. Assoc. Prof. Dr Gobbi Ramasamy, an associate professor in the Faculty of Engineering, Multimedia University, Malaysia, presented a tutorial on "Motor And Drives". Dr Gobbi started with a brief introduction on the relationship between motor and pumps, and the generation of flow while determining the power output and types of losses. He explained that with motor efficiency of only about 30% at light load, Variable Speed Drives (VSD) offers a significant reduction in losses, bearing in mind that each unit loss in motor output is equivalent to about 3 unit loss in energy production cost.

He then introduced High Efficiency Motors (HEM), describing the efficiency classes under the international standards. In the examples he showed, the higher efficiency class entailed higher initial costs but showed a significant amount in energy costs saved during the lifespan of the motor, with potential payback within 2 years. He highlighted the low uptake of HEM in a Malaysian market study largely due to challenges in convincing the decision makers considering the low electricity tariff and unregulated price of HEM.

While encouraging the use of VSDs, Dr Gobbi cautioned on the need for the proper implementation of VSD while sharing its typical practical issues. The production of undesirable power harmonics by the DC Link in VSD, the effects of power harmonics including overheating, power factor reduction and bearing current, and a comparison of the harmonics mitigation methods were discussed. Also discussed were parameter settings without good understanding of motor physical limitations and equipment location choice, considering

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Second tutorial by Assoc. Prof. Dr Izham bin Datuk Zainal Abidin

the environment temperature and cooling capacity. He made particular focus on the effect of our climate to VSD systems in his examples. The issues prompted the recommendation for proper training on operation and maintenance of VSD.

The second speaker, Assoc. Prof. Dr Izham bin Datuk Zainal Abidin, Dean of the College of Engineering, Universiti Tenaga Nasional (UNITEN) spoke on "Research Trends in Power System Analysis Research with Focus Towards Smart Grid". He introduced the Smart Grid as a complete electrical system, from generation to consumption, beyond general perception relating the Smart Grid to just smart meters. He described the benefits of a Smart Grid such as its capability to incorporate renewable energy sources without jeopardising the grid, handling new consumption including charging of electrical vehicles, smart metering with communication of demand to the utility and a transmission system with more sensors to ensure stability and reliability. As he talked about the criticality of standards to govern the application of the Smart Grid, he also spoke of Standards Malaysia's effort in looking into international standards to ensure compliance and compatibility of Smart Grid devices in Malaysia.

He went on to present researches currently taking place on Smart Grid to tackle the various grid issues including fluctuations of renewable energy source, demand side management, personal data protection, smart home affordability, practicality and robustness of operation, cyber security, integration of different communication protocols and standards, application and network communication reliability. He cited research works from Universiti Putra Malaysia, Universiti Malaya, Universiti Teknologi Malaysia and Universiti Tenaga Nasional.

He ended his presentation with an overview on the status of Smart Grid implementation in Malaysia, showing the various implementations in the transmission, distribution and standards. He recommended good communication with clear objectives to address the implementation challenges.In conclusion, he stressed on the need for a strategic implementation, with the Malaysian Smart Grid in its infancy, with the potential to grow.

The third speaker, Ir. Thomas K.C. Chan from Hong Kong, is a Director of WSP/Parsons Brinckeroff and Vice-President of The Hong Kong Institution of Engineers (HKIE). He presented the tutorial "LV Electrical Installation Design – Hong Kong Perspective", which focused on the key issues of Low Voltage (LV) electrical design in Hong Kong.

Ir. Chan started with an introduction to the Electricity Ordinance (Chapter 406), its subsidiary regulations, Code of Practices, Standards and other related ordinances and regulations applied by Hong Kong. He talked about the general assessment of the purpose, supplies and structure of an electrical installation, such as the type of incoming supply, its maximum demand and diversity, supply characteristic, external influences, compatibility and maintainability.

He covered the best engineering practices in the selection of cables and wiring methods, circuit arrangement design, overcurrent protection and its discrimination, protection against electric shock for direct and indirect contact as well as protective conductors' types and requirements. In Hong Kong, aluminium was less used as a conductor, except by supply companies and Cross-linked Polyethylene (XLPE) cable insulation usage was picking up pace. Frequent references were made to The Code of Practice for the Electricity (Wiring) Regulations, 2009 edition.

Ir. Mohd Zamri Laton was the final tutorial speaker with the topic, "Renewable Energy: Current Status and Further Development of Feed-in Tariff". He is currently attached to the Feed-in Tariff Division of Sustainable Energy Development Authority (SEDA Malaysia), focusing on Solar Roof top Programme.

First, he introduced SEDA Malaysia, the Renewable Energy (RE) development in Malaysia since the 8th Malaysia Plan in 2001, and the Malaysia National RE Targets of 4000MW by 2030. He then shared the history, objectives and functions of the Renewable Energy Act 2011 and SEDA Malaysia, and how it led to the implementation of Feed-in Tariff (FiT).

He described FiT as a mechanism that allowed electricity produced from indigenous RE resources to be sold to power utilities at a fixed premium price and for a specific duration. It served to provide a conducive and secured investment environment. The key RE sources eligible for FiT were biomass, biogas, small hydro and solar PV. Under the "polluters pay" concept, an additional 1-1.6% has been imposed on tariffs collection in consumer electricity bills to fund the FiT since 2011.

Through statistics and examples of FiT implementations, Ir. Mohd Zamri showed that the 2015 target had not been achieved, with less interest in biogas and biomass, financial difficulties, and river concession approval challenges with small hydro projects. Finally the RE mix tilted towards solar PV, which had higher FiT rates, easier access to financing and lower risk with shorter construction time.

He talked about the revision of Malaysia's RE target for year 2020 to 9000MW, following the inclusion of large hydro and off-grid hybrid RE systems into the RE classification. To increase the share of RE through solar PV, which was seen to have greater potential beyond the existing quota, the Net Energy Metering (NEM) and Utility Scale Solar (USS) mechanisms were introduced, overcoming the limited FiT

fund. NEM allows electricity consumers to install PV systems for self-consumption, with the balance being exported to the grid, and net-off from their monthly bills at displaced cost. USS allows PV plants with capacity less than 50MW to be selected through open biding and connected to the distribution or transmission network.

1 DECEMBER 2015: FIRST DAY OF CONFERENCE

In the opening ceremony of the IIEC 2015, Ir. Dr Matthew Teow Yok Wooi, Chairman of The Institution of Engineering and Technology (IET), Malaysia Network gave the first welcome address. He reiterated the long solid partnership with IEM and thanked IEM, especially the organising committee, for the support in delivering the event, bringing in experts from various technical fields. He then shared the history of IIEC since 2011 and highlighted the strong relevance of the theme of IIEC 2015: Safe, Smart and Innovative Development in Power Systems.

The next welcome address was by Ir. Tan Yean Chin, Deputy President of The Institution of Engineers Malaysia (IEM). He congratulated EETD and IET for jointly organising IIEC 2015 and said IIEC is a forum for practicing engineers to discuss safety issues. He stressed that engineering was the key component in building the energy infrastructure. Finally, he thanked the sponsors and declared IIEC 2015 officially opened.

The first keynote speaker on the topic "Electrical Safety in Malaysia" was Ir. Mohd Elmi bin Anas, Director of Department of Electrical Safety Regulation, Suruhanjaya Tenaga Malaysia, representing Datuk Ir. Ahmad Fauzi bin Hasan, CEO of Suruhanjaya Tenaga Malaysia. Ir. Mohd Elmi explained the roles and function of the Energy Commission, stressing on the protection of the public from dangers arising from the supply and use of electricity as provided for under the electricity supply laws. He said the recent amendment to the Electricity Supply Act, 1990 was gazetted on 5 November 2015 and was awaiting enforcement.

Ir. Mohd Elmi, Director of Department of Electrical Safety Regulation, Suruhanjaya Tenaga Malaysia

He presented the statistics of electrical accidents in Malaysia, which he believed was important to gauge the situation. Although the number of reported accidents since 2002 showed a slight upwards trend, the rate of casualty per million consumers was a declining and stabilising trend. Nevertheless, he added, we need to constantly look into minimising electrical accidents.

He said major causes of accidents were improper installation and maintenance as well as non-compliance to safety work procedures, with a majority of the accidents occurring in utility installations. The Residual Current Devices (RCD) showed that the highest number of accidents involved electrical appliances, hence the stringent equipment testing requirement imposed. He also highlighted the disparity between the large number of certificate of competency issued and the low number of registered competent persons in the workforce.

As a way forward, strengthening of the regulatory framework, enhancement of enforcement activities, increasing awareness of safety and promotion of high voltage training centre were some of the key initiatives taken by the Energy Commission.

The first session with the sub-theme, "Electrical Safety", was chaired by Mr. Murugiah Suppiah. The first speaker was Dato' Ir. Jimmy Lim Lai Ho, CEO of Tokai Engineering (M) Sdn. Bhd., who presented on MS IEC 62305 Lightning Protection Standard Overview and Lightning Safety Management of Personnel and Equipment. He said Malaysia ranked second in the world for lightning activity, with an average of 2.59 million strikes per year. He pointed out a high profile incident, the 2009 collapse of Putrajaya Hospital wall due to lightning, as the catalyst for endorsement and approval of MS IEC 60325. He then spoke in detail about the 4 parts of the MS IEC 60325 before highlighting the major differences between BS 6651 and the MS IEC 62305, and the concept of Lightning Safety Management for Open Areas.

The second speaker, Ir. Mohd Elmi bin Anas, presented "Electrical Safety from a Regulatory Perspective". He talked about the latest amendment to the Electricity Supply Act, 1990, aimed at achieving a reliable and affordable electricity supply for our economic development towards being a developed nation by 2020. The amendments were categorised into four objectives: To enhance governance of the industry, to improve safety practices, to protect consumer interests and to enable more effective enforcement.

The third speaker, Ir. Lim Kim Ten of Hager Engineering (M) Sdn. Bhd. presented on the topic, "Household Electrical Protection", which encompassed the parties involved and responsible, the types of electrical faults and circuit breaking devices, and a detailed overview of the Residual Current Devices (RCD) and the wiring regulations.

Datuk Ir. Baharin bin Din, Vice President (Distribution), Tenaga Nasional Berhad presented the second keynote address on "Energy Efficiency and Management". He started by describing sustainability challenges, including

fossil fuel dependency, increasing cost, energy security, emissions reduction and higher customer demand. He then talked about the green and smart society related initiatives in Malaysia such as the pledge to reduce emissions, the Feed-in-Tariff (FiT) programme, efficient and green generation, TNB renewable energy and smart meters as well as energy management regulations. He spoke in detail on the Demand Side Management (DSM) and Energy Efficiency (EE) Initiatives in TNB, citing the 1000 smart meter project AMI business case driven by TNB and government objectives.

The session continued with the sub-theme "Energy Efficiency And Management", chaired by Ir. Lam Sing Yew.

The first speaker was Ir. Abdul Rahim bin Ibrahim, Director of Energy Management, Suruhanjaya Tenaga Malaysia, who presented the "Energy Performance Contract Roadmap". He said Energy Efficiency (EE) was embedded in Malaysia's national energy policy and talked about the history of EE promotion initiatives leading to the Minimum Energy Performance Standards (MEPS) 2013 regulations. He showed charts of increasing but stabilising electrical intensity and emphasised on the need to decrease electrical intensity as Malaysia ranked second highest among ASEAN countries for electrical intensity and electrical consumption, and our electrical intensity was much higher than that of developed nations.

He also talked about Energy Performance Contracting (EPC) as a mechanism to implement energy saving measures in government building by private investment, to overcome the capital cost. Energy Service Companies (ESCOs) are engaged to evaluate and execute the project, with payment based on guaranteed savings achieved. Development of the ESCOs, measurement and verification by registered electrical energy manager and effective financing of the EPC project will be important for further success in the EPC implementation.

Ir. Ahmad Izdihar of Malaysia Green Building Confederation was the second speaker and he presented on "Profiling Energy Use for Buildings". He described the steps in building energy profiling towards effective understanding and usage of the collected data.

The third speaker, Mr. Toni Niemi of ABB, presented on "Latest Electric Motor Technology to Reduce Total Cost of Ownership". He introduced the Super-Premium efficiency IE4 efficiency class launched last year and described the areas of losses in electrical motors. He talked about Synchronous Reluctance Motor Technology which eliminates resistive rotor losses to achieve the IE4 efficiency in a magnet-free design.

The fourth speaker was Mr. Siegfried Kreutzfeld, President of WEG China and Asia market, with the topic, "How Electric Motor Could Help Improve the GDP Efficiency of a Country". Saying that motors represent about 50% of a country's electric energy consumption, he introduced a term GDP efficiency (nation's GDP divided by its electrical consumption) and explained how improving the efficiency of the existing large install base

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of low efficiency motors would significantly improve the GDP efficiency.

The third session with sub-theme, "Electrical Installation Codes and Standards". It was chaired by Ir. Rocky H.T. Wong, who gave an insight into the standards writing organisation and its role in the development of the Malaysian Standards.

Ir. Thomas K.C. Chan, the first speaker, presented on "Electrical Installation Safety at Construction Site – Hong Kong Perspective". Speaking from his experience in Hong Kong, he shared the statistics of electrical accidents in Hong Kong, its primary causes and the protection and preventive measures taken including ensuring a safe electrical environment at site.

The second speaker, Ir. Lim Kim Ten, presented an "Overview of Latest Malaysian Standards, MS 1979 and MS 1936", describing the different scopes of each standard. He described the changes after the adoption of MS IEC 60364 and clarified the interpretation of the voltage drop requirements and Malaysian specific electrical safety protection requirements such as RCD.

The third speaker, Ir. Francis Xavier Jacob, Chairman of Working Group for IEM EETD Electrical Installation Inspection Guidelines, presented on "Guidelines for Low Voltage (LV) Electrical Installations of Buildings – Verification by Inspection and Testing". He gave a brief background on the Electrical Inspection Standard approved by AFEO in December 2011 and how IEC 60364 Part 6 was adopted as the base requirements. He then described in detail the components of planning, inspection and testing in IEC 60364 Part 6.

2 DECEMBER 2015: SECOND DAY OF CONFERENCE

Third keynote address by Ir. Prof. Academician Dato' Dr Chuah Hean Teik

The day started with the third keynote address by Ir. Prof. Academician Dato' Dr Chuah Hean Teik, President/CEO of Universiti Tunku Abdul Rahman (UTAR), who presented on "Educating Engineers as Trend Setters and Problem Solvers".Regardless of stone or computer age, it is science that drives civilisation, with each evolution period becoming shorter. The upcoming life science and

Q & A panel for session chaired by Mr. Murugiah Suppiah

ecosystem evolution will not allow complacency, requiring continuous skill update.Engineering would continue to create the value in a globalised world with faster pace, borderless, well informed and higher expectations.

He compared the past (where focus was on small group of experts, hardware based and requiring big investment) with the future (which is human centric, focusing on knowledge creation and an open market with smaller investment barriers). He talked about the booming and widening trends and described the challenges faced. Education remained the driver, creating the critical source of human capital. He shared his concern on the dropping percentage of science stream secondary school students in Malaysia even as we aimed for a 1:100 ratio of engineers to population by 2020. Malaysia will need to utilise the lessons learned from the developed nations, balancing between ready to market and ready to evolve in the global market.

He concluded with a story of the farmer and the cocoon, highlighting that, at times, struggle would be critical before we could learn to fly.

The conference continued with the fourth session with sub-theme "Electrical Engineering Education" chaired by Ir. Dr Matthew Teow.

The first speaker was Dato' Ir. Prof. Dr Hj. Wan Hamidon Hj. Wan Badaruzzaman, Director of Engineering Accreditation Department (EAD), Board of Engineers Malaysia and Professor from Department of Civil and Structural Engineering, The National University of Malaysia (UKM). He presented on "Enhancing the Engineering Education Quality in Malaysia". He highlighted the role of Engineering Accreditation Council (EAC) under Board Engineer Malaysia (BEM) in enhancing the quality of engineering education in Malaysia. BEM is empowered by Malaysia Qualification Agency Act (MQA) 2007 and Registration of Engineers Act 1967 to conduct accreditation, ensuring the practice of continual quality improvement by Institutions of Higher Learning.

He talked about the need to raise the standard of engineering graduates, addressing complaints that many graduates were unfit for the industry, to which many of the conference participants agreed. Greater awareness of the engineering profession and leaving the comfort zone on a paradigm shift towards Outcomes-Based Education (OBE) will be critical to achieving the goals. References were made to the International Engineering Alliance (IEA), an independent authority on best practices in standards, assessment and monitoring of engineering education and professional competence.

The second speaker, Encik Ridzwan Kassim, Senior Director (Standardisation) at Standards Malaysia, presented on the "Role of Standards Malaysia in Educating Electrical Engineers in Standardisation". He described the structure of Standards Malaysia, introducing Malaysia National Electrotechnical Committee (MyENC) as one of the main committees that oversaw the Industrial Standards Committees (ISCs), Technical Committees and Working Groups. He spoke about the process of standard development and the status of MS standards in Malaysia, 57% of which were aligned with international standards.

He highlighted the importance of participation in international standards committees and international accreditation to safeguard national interest. Standards Malaysia is educating in a big way to introduce new standards, with the National Standards Compliance Programme (NSCP) helping Small and Medium Enterprises (SMEs) comply with the standards. Memorandum of Understandings (MoUs) have been signed with IHLs to integrate standards education into university syllabus. Constantly improving standards awareness, young professionals were also sent to participate in technical committees and working groups in standards writing.

The third speaker, Associate Professor Ir. Dr Leong Wai Yie, presented the "ASEAN Perspective: Women in Engineering", sharing the report from IES Women in Science, Engineering and Research (WISER). She shared the statistics of women engineers by discipline and management rank. She said the participation of women in engineering was generally low compared to other professions. The 11th Malaysia Plan seeks to encourage women in engineering through more family-friendly employment strategies such as better access to quality childcare facilities, flexible working hours, work-from-home options and employment re-entry opportunities.

The fifth session with sub-theme, "New Frontiers in Power Engineering", was chaired by Ir. Chew Shue Fuee.

The first speaker, Mr. Mohamed Azrin Mohamed Ali, Vice President of Green Catalyst, Greentech Malaysia, presented "Electric Vehicle Roadmap in Malaysia". He spoke of the significantly higher efficiency in energy conversion of electric cars compared to cars with internal combustion engines (ICEs), which was the driver for electric mobility. He highlighted that many studies might have neglected the cost of refining and transportation of fuel in the calculation of efficiency for ICE. He mentioned multiple Electric Vehicle (EV) initiatives in Malaysia such as the Electric Mobility Blueprint promoting electric public transportation and private EV ownership and the strengthening of the eco-system and charging infrastructure to accelerate the technology localisation opportunities.

The second speaker, Encik Shyful Bahrin Ismail, Deputy Chief Engineer (Protection), Transmission, Tenaga Nasional Berhad (TNB) presented on "HVDC Technology - Malaysia (TNB) Experience, Future Development and Challenges". High Voltage Direct Current (HVDC) Technology provided economical energy transfer over long distance, connecting asynchronous AC power networks, with better control and efficiency. With higher initial equipment, training and

maintenance costs, break even occurred at distances above 800km or submarine links above 50km. He described the components in the HVDC system and TNB's HVDC experience at the 300MW 300kV DC Malaysia-Thailand interconnection, which allowed the sharing of spinning reserve between TNB and EGAT and alleviating multiple major power trip incidents. HVDC development continued on Ultra High Voltage Direct Current 800kV design with power capacity exceeding 5000MW on a single system, the shift towards use of Voltage Source Converters and Multi-terminal HVDC designs for HVDC grids.

The third speaker was Ir. Dr Amir Basha Ismail of Minconsult Sdn. Bhd., who spoke on "Malaysia's Electric Railways: A Systems View". He talked about the history of electric railway in Malaysia, beginning primarily with the Light Rail Transit (LRT) and KTMB train systems. The electric train system, comprising infrastructure, rolling stock and system of operating procedures, required more than just civil and structural engineering skills. Currently, a local electrical graduate has minimal knowledge of an electrical train system, traction power system, train control and signalling and operation software integration. Dr Amir Basha elaborated on the traction power system and the fundamentals of train propulsion, giving examples from KTMB 25kV AC Klang Valley traction power system and Prasarana/RapidRail DC traction power systems.

The final session with the sub-theme, "Renewable Energy", was chaired by Prof. Ir. Dr Vigna Kumaran.

The first speaker was Encik Thariq bin Husni of MTS Green Energy, who presented "The Present and the Future of Wind Turbine Technology in Malaysia". First, he asked participants if there was sufficient wind in Malaysia. Then, he gave a brief history of wind turbine and its design considerations, such as height of tower and propeller diameter, with a focus of existing installations in Malaysia. Wind technology remains a challenge due to the lack of data on potential wind area and insufficient incentives or confidence for its development.

The second speaker was Dr Thomas Riendl, Deputy CEO, Cluster Director, Solar Energy Systems, Solar Energy Research Institute of Singapore (SERIS), NUS, who presented on "Future Trends in Solar PV". He shared data on how the global Photo Voltaic (PV) market hadboomed very quickly, with 40GW added in 2014 alone. The statistics showed that each time the cumulative production doubled, the PV module price went down by 20%. He said that solar cell efficiency was 18-23%, with only a marginal increase of about 0.5% each year. On the other hand, the PV system design, if not designed properly, could cause a large variance in the overall power output. Variability and uncertainty remain the two main challenges of PV systems penetration in electricity grid, prompting the need for PV power forecasting, optimised PV location planning and PV potential analysis. Dr Riendl spoke about the Levelised Cost of Energy (LCOE), which was critical for economical feasibility study of a Solar PV implementation.

The third speaker, Ir. Khor Chai Huat, Managing Director of Angkasa Consulting Sdn. Bhd., presented on "Viability of Small Hydro Power Scheme Under The Renewable Energy Programme". There was a large jump in small hydro power of 10-30MW capacity in approved projects for 2016. Ir. Khor described the technical feasibility, economic viability and legal requirement studies prior to the licence application with the example of the Mini Hydropower Scheme in Way Malaya, Lampung Province, Sumatera, Indonesia. He highlighted common issues and risks involved, from feasibility studies to construction and final operation, one of which was the lack of stream flow records to predict power generation.

The fourth speaker, Prof. Dato' Ir. Dr A. Bakar Jaafar, Professor at UTM's Perdana School of Science, Technology, Innovation and Policy, spoke on "Ocean Thermal Energy - H_2 Fuel Cell Renewable Energy Mix in Electrical Power Generation in Malaysia". Ocean Thermal Energy (OTEC) converts part of the heat from the sun which is stored in the surface layers of a body of water, into electrical energy or energy product equivalent such as hydrogen, H_2. Prof. Abu Bakar spoke about the barriers of the technology and ways to overcome the challenge including the use of project life costing to overcome the high initial capital and the reference to Territorial Sea Act and Exclusive Economic Zone Act to govern the development of OTEC in the sea. He shared plans for the first public funded OTEC project off Pulau Layang-Layang under the 11th Malaysia Plan, to supply power to deep water oil and gas production, the surplus of which to generate H_2.

The fifth speaker, Dato' Ir. Muhamad Guntor Mansor Tobeng, Managing Director, Gading Kencana Sdn. Bhd., presented on "Powering the Economy with Solar Technology". First he spoke on government policies that helped the PV take-up in Malaysia with a target of 1.25GW capacity by 2020. He shared his experiences in the various projects implemented, elaborating on the restrictions of the actual available land area due to land use requirements, study of shadow casting and sun path considering the land terrain and the use of PV roof in aiding the cooling of the building.

The sixth speaker was Encik Sansubari Che Mud, Renewable Energy, Tenaga Nasional Berhad (TNB) who spoke on TNB Renewable Energy Guidelines. He described the implementation of the FiT scheme, defining the scope of TNB's role based on the capacity of the project and the status of projects in progress. With remote meters already implemented, in the bid to enhance customer experience, TNB is implementing projects to allow checking of RE account online, comparing self-consumption for the Net Metering scheme to be implement from 2016.

CONCLUDING REMARKS

The conference came to a close with Chairman of EETD, Ir. Yau Chau Fong expressing his gratitude and thanks to the organising committee, the conference secretariat staff and the participants for contributing to the success of the event. Ir. Yau and the organizing commitee looked forward to meeting all the delegates again in the next IIEC in 2017. ■

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How Smart is Smart Grid?

ELECTRICAL ENGINEERING TECHNICAL DIVISION

reported by
Ir. Lee Cheng Pay

Ir. Lee Cheng Pay *received his Bachelor Degree in Electrical Engineering from Universiti Malaya and Master in Engineering Management in Universiti Putra Malaysia. He is the Director of Duriane Consult Services.*

The term Smart Grid does not refer to a specific technology. It is an aggregate term that encompasses a set of technologies in modernised electrical network. Through Smart Grid, we can achieve greater efficiency in the system, save money and help reduce CO_2 emissions.

The Electrical Engineering Technical Division (EETD) organised a pre-AGM talk titled "Is The Grid Smart?". It was delivered by Prof. Dr Hew Wooi Ping and chaired by EETD Chairman, Ir. Yau Chau Fong.

DEVELOPMENTS

Prof. Hew reviewed several major power outages in Northeast US, Italy and India that affected millions of people and led to the development of Smart Grid.

The Smart Grid initiatives started with IEEE Smart Grid Standard development in 2007. IEC formed Strategic Group (SC) 3 to work on Smart Grid Standard in 2008. Beside the effort by IEEE and IEC, several countries also started their own initiatives.

China Smart Grid Initiatives has set a target to reduce carbon emission per unit of GDP to 40-45% of the 2008 level by 2020. United States Smart Grid Initiatives focuses on maintaining a secure and reliable electricity infrastructure by using "smart" technology. Japan Smart Grid Initiatives 2009 aims to develop a low carbon society to reduce carbon emission to 75% of the 1990 level or two-third of the 2005 level by 2020.

SMART GRID DRIVERS

"The smartness of the grid is measured in term of carbon emission, active consumer participation in energy management and intelligent post fault configuration to avoid cascaded faults", said Prof. Hew. He quoted from IEC on Smart Grid that Smart Grid drivers include ageing infrastructure, integrating intermittent energy sources, lower energy price and security of supply and increasing energy need, sustainability and challenges faced by utility.

In effect, Smart Grid is a concept of electric grid modernisation covering the whole spectrum of electric grid, from power generation at one end to the consumer at the other. Through the inclusion of Smart Grid technologies, the grid is able to provide real time feedback and hence becomes more flexible, interactive and reliable.

Prof. Hew discussed briefly the six IEC White papers:

1. Orchestrating infrastructure for sustainable smart cities
2. Internet of things: Wireless sensor networks
3. Micro grids for disaster preparedness and recovery, with electricity continuity plans and systems
4. Grid integration of large-capacity renewable energy sources and use of large-capacity electrical energy storage
5. Electrical energy storage
6. Coping with the energy challenge.

The future power system as suggested is shown in Fig 1.

Some questions were raised from the audience. A participant asked whether the carbon emission can be consistently reduced despite the increase in energy utilisation. Another participant asked about consumers' role in deciding on generation and transmission of energy.

In conclusion, Prof. How suggested that Malaysia should refer to EU as a benchmark on the carbon emission level per GDP, consumer participation scope, and post-fault reconfiguration capabilities. ■

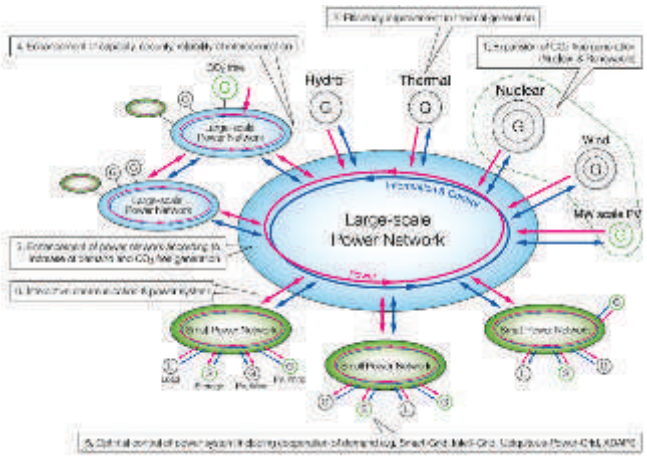

Figure 1: Suggested future power system (IEC White Paper: Coping with the energy challenge)

Technical Visit to SIRIM QAS International Electrical and Electronic Testing Facilities

ELECTRICAL ENGINEERING TECHNICAL DIVISION

reported by
Ir. Amir Hussein bin Jaafar

Ir. Amir Hussein bin Jaafar *graduated from Universiti Technologi Petronas (UTP) with Bachelor Engineering (Electrical and Electronics) and from Universiti Teknologi Malaysia (UTM) with Master Science (Real Time Software). He has over 14 years of experience in automotive electrical and electronics. He is currently Head of Design and Development Engineering with Eco Motive Sdn. Bhd.*

Consumers have rights and the body entrusted to safeguard the safety and efficiency of household electrical, electronic appliances and communication devices sold in Malaysia is SIRIM QAS International, a subsidiary of SIRIM Berhad.

The Electrical Engineering Technical Division (EETD) arranged a technical visit to the SIRIM QAS International facilities in Shah Alam, which was spread over two days (17 November and 15 December 2015). Only a section of the tests showed to the party is reported herein.

On the first day of the visit, SIRIM QAS International senior general manager, Puan Nur Fadhilah, gave the 16 IEM visitors an overview briefing. She clarified that while all household appliances sold must be certified by SIRIM QAS International, the regulatory institution under the law is Suruhanjaya Tenaga, Malaysia.

TESTING SERVICES

Three types of testing service are available:

1. Mandatory certification, which includes safety tests, performance tests and energy efficiency tests
2. Voluntary testing, which includes product conformity to manufacturer's requirement or national and international standards and
3. Market surveillance, which includes auditing the market for appliances already granted the SIRIM label.

VISIT TO DOMESTIC PRODUCT TESTING LAB

A test personnel explained that the lab was equipped to carry out tests on 34 types of household appliances such as boiler, washing machine, water heater, refrigerator, fan, oven, rice cooker, iron, and power tool. These appliances must pass the prescribed safety tests, according to IEC Standard 60335.

During the visit, the personnel demonstrated a temperature rise test on a refrigerator and an endurance test on a water heater. The personnel then performed the primary and secondary suspension tests on a ceiling fan while it was stationary and while in operation. The drop test on an iron was also conducted.

The group then proceeded to the air delivery room. This was where the air delivery performance of ceiling fans and standing electric fans were measured and compared against the electrical power consumed. This automated test was part of the performance and energy efficiency test.

The group was then visited the wiring accessories testing lab where the group saw how switches, wall plug and sockets were subjected to endurance testing through the continuous switching on and off of the appliances. The appliances were all rigged to test machines and test executions and result data gathering and analysis were all automated.

ENERGY EFFICIENCY LAB

During the second visit on 15 December, the group went to SIRIM QAS International Energy Efficiency Laboratory in Seksyen 16, Shah Alam.

Here, the tests conducted were to rate electrical appliances under the Energy Efficiency and Energy Labelling programme. In one of the test labs, the personnel demonstrated how household air conditioner performance was measured when the appliance was set to maintain specific temperature decreased within a specific air volume and then compared against the electrical power it consumed.

In the next test lab, refrigerator performance was measured where the appliance was set to maintain a specific internal temperature and then compared against the electrical power it consumed.

In another test lab, household lamps and ballast performances were measured. In a test equipment called integrating sphere, the total light radiation of lamps was measured and compared against the electrical power consumed. Test personnel also demonstrated how a photometer was used to measure the light intensity.

It was a good learning experience for the members who took part in the visit. SIRIM QAS International is the consumers' line of defence with regards to the safety of household electrical, electronic appliance and communication devices sold in Malaysia. ■

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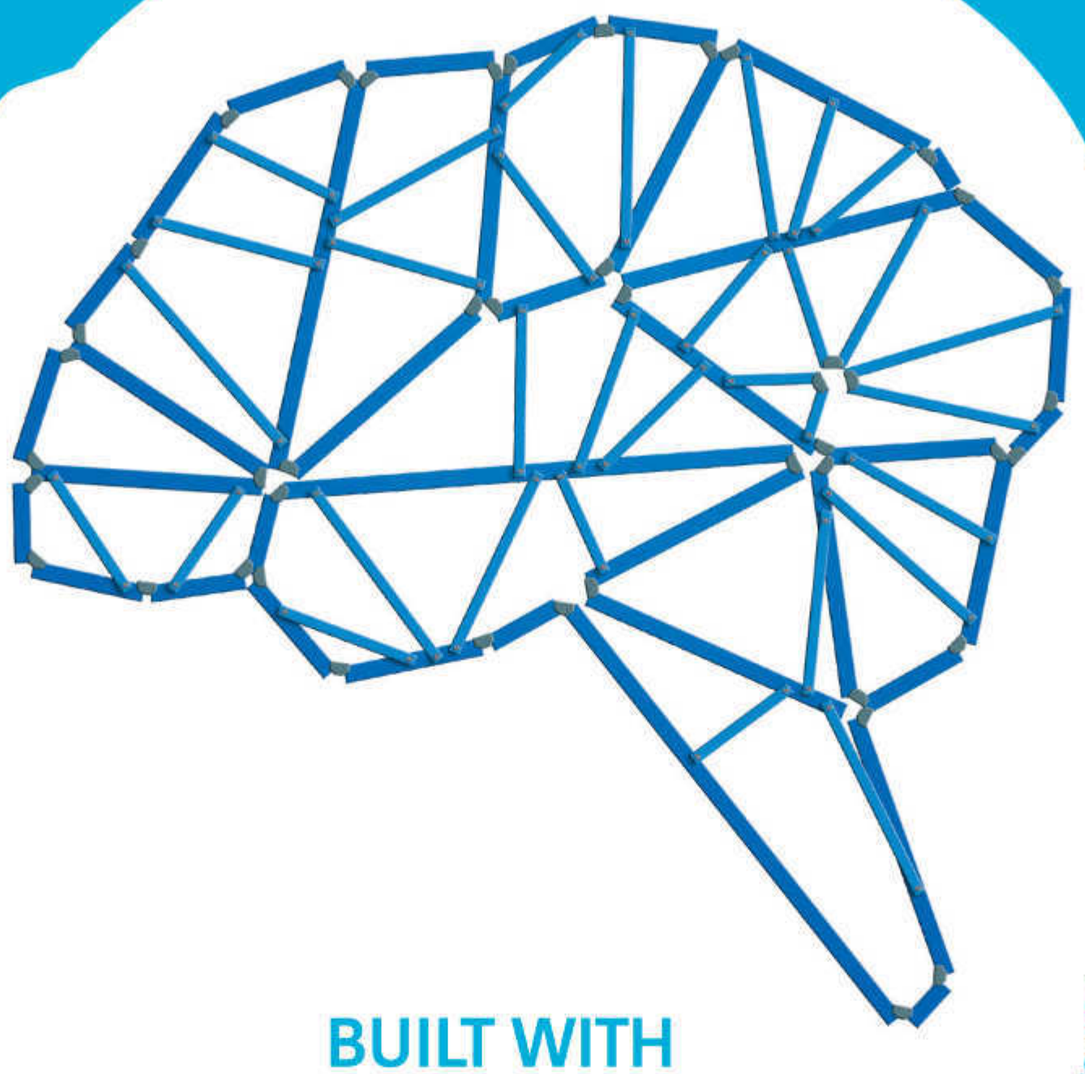

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The 7th Annual General Meeting (AGM) of Electronic Engineering Technical Division (eETD)

ELECTRONIC ENGINEERING TECHNICAL DIVISION

reported by
Ir. Dr Lee Choo Yong

***Ir. Dr Lee Choo Yong** is a committee member of Electronic Engineering Technical Division (eETD).*

The 7th AGM of eETD, attended by 17 members, was held at the IEM Penang branch office on 10 October, 2015.

Chairman Ir. Bernard Lim Kee Weng delivered the welcome speech and thanked all the members who were present, especially those who had come all the way from Miri and Kuala Lumpur. He expressed his gratitude to his committee members for their support and hard work in organising various activities which benefitted IEM members and cultivated engineering innovation in undergraduate students.

During the AGM, the election of committee members for 2015/16 was held. Engr. Dr Leow Cheah Wei was announced by Ir. Bernard Lim as the new eETD Chairman. The new committee members are as listed below:

Chairman	Engr. Dr Leow Cheah Wei Grad. IEM
Vice chairman	Engr. Lau Heng Kar Grad. IEM
Honorary secretary cum treasurer	Ir. Bhuvendhraa Rudrusamy
Committee members	Engr. Dr Chang Boon Peng Grad. IEM
	Engr. Dr Huzein Fahmi Hawari Grad. IEM
	Ir. Dr Khor Jeen Ghee
	Ir. Dr Lee Choo Yong
	Ir. Dr Mui Kai Yin
	Engr. Sivarama Rajah Grad. IEM
	Engr. Tiong Teck Chai Grad. IEM
	Engr. Dr Wong Yew Hoong Grad. IEM
Advisor	Ir. Bernard Lim Kee Weng

Second row (left to right): *Ir. Dr Khor J.G., Ir. Dr Mui K.Y., Ir. Sivarama R., Engr. Dr Huzein F.H Grad. IEM., Ir. Dr Lee C.Y., Engr. Tiong T.C Grad. IEM., Engr. Dr Chang B.P Grad. IEM., Engr. Dr Wong Y.H. Grad. IEM*
First row seated (left to right): *Ir. Bernard Lim K.W., Ir. Bhuvendhraa R., Engr. Dr Leow C.W Grad. IEM., Engr. Lau H.K. Grad. IEM.*

It was a great achievement that eETD recorded a substantial increase in the number of members from 126 the previous year to 607. Membership breakdown as of 30 September 2015 as shown:

Membership grade	Numbers of Members in eETD
Fellow	2
Senior member	1
Member	138
Companion	9
Graduate	365
Incorporated	2
Associate	2
Student	88

There were 14 committee meetings held from August 2014 to October 2015. The eETD organised 9 technical talks, delivered by distinguished scholars and/or engineers worldwide. Many of the talks were held in Universiti Sains Malaysia (USM) to facilitate convenient participation of engineers working in Bayan Lepas industrial zones. Technical talk details are shown in the table below:

Date	Title	Speaker
8 October 2014	Splitting our (computer) brains: Multi-processor, Multi-core and multi-threads	Dr Shawn Tan (Independent consultant)
3 December 2014	Catalyse business development	Meemusari (Independent consultant)
16 December 2014	Breaking the 3D power delivery wall using voltage stacking	Prof. Dr Mircea R. Stan, University of Virginia
16 January 2015	Design and verification techniques using system Verilog	Cliff Cummings of Sunburst Design Inc.
13 March 2015	The internet, the web and the future of everything	Prof. Wendy Hall of University of Southampton
13 April 2015	Business development in multi-disciplinary	Prof. Dr Andrew Richardson, enablingMNT (United Kingdom)
25 June 2015	Electromigration simulation at circuit levels	Prof. Dr Tan Cher Ming, Chang Gung University
26 June 2015	A review pertinent to next generation RRAM (Resistive Random Access Memory) reliablity	Prof. Dr Chao-Sung Lai, Chang Gung University
2 September 2015	Technology and standard for virtual-view 3D systems	Prof. Hsueh-Ming Hang, National Chiao Tung University

The eETD also endorsed NEPCON Malaysia held in Spice Arena, Penang, on 9-11 June 2015. On the other hand, eETD also contributed to CAFEO 33 by inviting speakers from electronics multinational companies to participate. The eETD co-organised an embedded system workshop with IEEE Nottingham University Malaysia Campus student branch. This workshop gave students good exposure to microprocessor platform so that they would be better prepared when entering the industry.

The eETD also continued to sponsor the IEM Best Paper Award worth RM1,500 of Innovate Malaysia Design Competition 2015, organised by renowned technology companies like Altera, CEDEC, Intel, Keysight, Mathworks, Microsoft, National Instrument and Silterra. The eETD has been participating in Innovate Malaysia Design Competition since 2010. This award is open to all final-year undergraduate engineering and computer science students in Malaysia to promote innovation culture and mindsets among university graduates, to enhance knowledge and skills set in practical engineering and to promote greater interest in engineering design, and to promote more industry and university collaboration. The award was won by Yiauw Diing Shenq and Wee Hin Sheik from USM with their paper titled "Development of Add-On Active Vibration Control (AVC) for Power Tools" (https://www.youtube.com/watch?v=8c4GN2zP14E).

Penang Maker Faire, organised by Collaborative Research in Engineering Science and Technology (CREST), was held together with Penang Science Fair in Spice Arena on 15-16 November, 2014. It was sponsored by Intel, National Instruments, Penang Science Cluster, Koridor Utara Malaysia and Silterra. The eETD supported this event to promote makers culture and 10 student members of eETD participated in the event.

A dialogue with USM on 25 November, 2014, was another initiative by IEM Penang branch and eETD to drive student membership recruitment and foster collaboration in training activities, engineering career talk and route to be professional engineers. Deputy vice chancellor (industry and community network) Professor Dato' Dr See Ching Mey led the USM team to support this important dialogue. The result was the significant increase in eETD student members.

The eETD committee, under the leadership of Ir. Bernard Lim, has brought it to the next level, resulting in IEM being recognised by engineering fraternities and academic institutions as the professional body for promoting science and technology advancement, particularly in electronic engineering in Penang, the Silicon Valley of the East. ■

IEM DIARY OF EVENTS

Title: Half Day Seminar on "Smelly Toilets – Why, Where, What, Who, When and How To Eliminate"

04 Mar 2016

Organised by : Building Services Technical Division
Technical Division
Time : 9.00 a.m. – 1.00 p.m.
CPD/PDP : 3.5

Title: 18th Annual General Meeting of Information and Communications Technology Special Interest Group

05 Mar 2016

Organised by : Information and Communications Technology Special Interest Group
Time : 11.00 a.m. – 1.00 p.m.
CPD/PDP : 2

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

Technical Visit to Lafarge's Construction Development Lab (CDL)

CIVIL AND STRUCTURAL ENGINEERING TECHNICAL DIVISION

reported by
Ir. Dr Ng Soon Ching

Ir. Dr Ng Soon Ching *graduated with BEng (Civil) and MSc (Construction Management) from Universiti Teknologi Malaysia (UTM) and PhD (Engineering) from UTAR. He is currently the Deputy Chairman in the committee of IEM CSTD.*

reported by
Engr. Wong Ai Ming
Grad.IEM

Engr. Wong Ai Ming *graduated from Monash University, Melbourne, with a Bachelor of Materials Engineering (Hons).*

Engr. Wong is the Construction Specialist of Lafarge Malaysia Bhd. and currently a committee member of CSTD division.

The Civil and Structural Engineering Technical Division (CSETD) recently organised a technical visit to Lafarge Construction Development Lab (CDL) Petaling Jaya. There were 40 participants, comprising student members, academicians and practitioners.

On arrival at CDL, the participants were welcomed by a Lafarge staff member who gave a safety briefing, followed by a presentation on the background of Lafarge and an introduction to CDL. According to her, CDL is the fifth in the world and the first in Southeast Asia which aims to promote construction efficiency by adapting innovative solutions to better meet our construction and building needs.

CDL houses three labs (cement, concrete and aggregates and soil labs) which are equipped with state-of-the-art testing equipment for quality control and assurance of its products. It also has an open testing area for prototypes and demonstrations of new building systems and structures.

After the briefing, the participants were divided into two groups for a tour of the labs and testing area. They were ushered to the two model houses, concrete pavement, cement lab, concrete lab and finally soil lab.

One of the model houses was constructed using the conventional method and the other was constructed using monolithic building system which engages the use of an aluminium formwork, with the spaces filled with Self Compacting Concrete (SCC). The whole process of construction takes four days, from the installation of vertical rebars and wall formwork, installation of horizontal rebars and deck formwork, M&E, formwork alignment and filling of Self Compacting Concrete to the final removal of the formwork.

The next stop was the car park which was constructed using both coloured concrete and pervious concrete. The latter allows the flow of water into the ground and reduces ponding. Adjacent to the car park were 2 concrete pavements, JPCP (Jointed Plain Concrete Pavement), and RCC (Roller Compacted Concrete). Both were constructed using 2 types of finishing, i.e. without surface treatment and with surface treatment of exposed aggregates method.

Demonstration on SCC at Concrete and Aggregates Lab

In the lab tour section, CDL houses three labs: Concrete and Aggregate Lab, Cement Testing Lab and Soil Lab.

The Concrete and Aggregate testing lab is equipped with 3-layer curing tank and refrigerated bath circulator, coring machine, Methylene Blue Test (MBT), in addition to the usual compression and flexural test equipment. MBT is used to assess the quantity of potentially harmful fines in fine aggregates. A demonstration on the SCC was conducted during the visit.

The Cement Testing Lab is equipped with lab oven, mini ball mill, Rapid Chloride Permeability Test Equipment (RCPT) and a full range of EN mortar testing equipment. The lab officer explained and showed us the RCPT. The Soil Lab is equipped to test California Bearing Ratio (CBR), plastic limit of soil, and Unconfined Compressive Strength (UCS).

After the tour, there was a Q&A session, during which the visitors could seek further clarification to their queries. Then, the Chairman of CSETD, Ir. Hooi WC, presented a memento of appreciation to Lafarge at the end of the Q&A session. It was certainly an informative visit to the group. ■

How is a Boiler Made?

AGRICULTURAL AND FOOD ENGINEERING TECHNICAL DIVISION

reported by
Ir. Hor Kok Luen

Ir. Hor Kok Luen *is a graduated from Universiti Sains Malaysia (USM) in 2001 with Bachelor of Degree (Hons.) in Mechanical Engineering. He is currently chief engineer of a established palm oil group involved in palm oil mill processing, long fibre plant, short fibre plant, solvent extraction plant, biogas capturing plant and of green energy generation for grid connection.*
He is currently a committee member of Agricultural and Food Engineering Technical Division (AFETD).

Factory visit: Production lines for integral piping roll and fit

What is a boiler? A boiler is a piece of machinery that heats water inside it to boiling point. The water can be used for water heating, central heating, boiler-based power generation, cooking and sanitation purposes.

To learn more about boilers, the Agricultural & Food Engineering Technical Division (AFETD) of IEM recently organised a visit to a boiler manufacturer, Boilermech Sdn. Bhd., for 13 participants who included IEM members and engineers.

Mr. Wong Poon Han, the design manager of Boilermech, gave a briefing on the company and its nature of business.

"There are two types of steam boilers: Water tube and fire tube," said Mr. Wong. "Boilers are classified based on the type of fuel used, such as gaseous fuel (bio-methane gas, natural gas, etc), liquid fuel (diesel, petrol, methanol, etc) and solid fuel (biomass fuel, rice husk, wood chips, etc)".

The presentation included the following aspects of boiler systems:

1. The location of pressure containing principal components (steam drum, water drum, superheater, front headers, side headers, tubes and integral piping)
2. The process flow of steam drum and water drum
3. The major materials for steam drum and water drum
4. The marking and cuttings dished end blanks
5. Rolling and fit shell plates
6. Weld & Radiography test (RT) for long seams and weld seams
7. The joint process for shell and dished heads
8. Fit up of nozzles & attachment to shell/ head

Factory visit: A steam drum with completed marking and radiography test on shell and dish heads. Ready for drilling on different nominal sizes of tubes.

9. The application of Post Weld Heat Treatment (PWHT) & Magnetic Particles Test (MPT) & Hydrostatic Test (HT) in boiler manufacturing
10. The process flow of tubes and headers
11. The process flow of integral piping
12. The process flow of super heaters.

On the issues of quality and safety, Mr. Wong said its boilers are designed to meet the requirements of enforcement agency *Jabatan Keselamatan & Kesihatan Pekerja* (JKKP).

He said two types of carbon steel tubes are used, i.e. the BS 3059 Part II Grade 360 and BS 3059 Part I Grade 320. The selection of the nominal size of the tube is based on design and application requirements. These are mainly size 50.4mm and 76.2mm in diameter. The length of the generating tubes is based on design heating surfaces and market availability (the longest on record is 14 metres).

Mr. Wong said: "A boiler should be designed with high efficiency, high steaming pressure and a capacity with fuel that is available." Environmentally, however, a boiler must be well designed and constructed to perform lower dust concentration, with no dark smoke for the stack emission. Last but not least, the boiler must be able to operate safely.

The participants were then taken on a tour of the factory, after which Ir. Hor Kok Luen presented a token of appreciation to Mr. Wong. ■

IEM DIARY OF EVENTS

Title: 2-Day Course on Project Management for Operation & Maintenance Engineers (Postponed from 8 & 9 December 2015)

9 - 10 March 2016

Organised by : Graduates & Student - The Young Engineers Section
Time : 9.00 a.m. – 5.30 p.m.
CPD/PDP : 14

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

Call for Papers

The 2016 ASEE International Forum Steering Committee is seeking papers for the 5th Annual ASEE International Forum in **New Orleans, LA, Saturday, June 25, 2016**, immediately preceding the ASEE Annual Conference and Exposition.

The International Forum brings together engineering professionals from academia and industry from around the globe who are engaged in novel engineering education initiatives to share information on successful models, experiences and best practices.

2016 Plenary Speakers

Accreditation Board for Engineering and Technology (ABET)
United Nations Education, Scientific and Cultural Organization (UNESCO)
Student Platform for Engineering Education Development (SPEED)

New for 2016! All accepted papers for a paper presentation will be indexed in the ASEE PEER ***new*** repository at **https://peer.asee.org/** and in SCOPUS at **http://www.scopus.com/home.url.**

Call for Papers

Members of the ASEE and global engineering education communities are invited to submit abstracts for papers to be presented at the 2016 ASEE International Forum highlighting initiatives, projects, research, trends, programs and partnerships. There is particular interest in engineering education activities involving multiple nations. The abstracts and subsequent papers will be evaluated by a review committee for quality and best-fit with the aim of planning well-balanced sessions. Papers not selected for a podium presentation may be eligible for a poster session. The program will include but not limited to two (2) sessions with three (3) parallel tracks each.

Papers will be accepted for the following topics:

- *Accreditation*
- *Modifying cross cultural attitudes through international programs*
- *Best practices in various approaches for globalization of education and research*
- *Student programs*
- *Engineering education in developing nations*
- *Successful partnerships; industry, academia, government, multiple nations*
- *Global learning in engineering*
- *Ethics in global engineering education*

Additional topics in international engineering education will be considered.

2016 ASEE International Forum Call for Papers

Important Dates and Deadlines

All deadlines are 4:59PM Eastern Time

October 14, 2015	Abstract Submission Open
January 4, 2016	Registration Opens
January 22, 2016	Abstract Submission Closed
February 17, 2016	Abstract Decision
March 12, 2016	Final Paper Submissions Due
April 1, 2016	Final Paper Review Due
April 8, 2016	Notification of Authors
April 29, 2016	Final Papers Due

Submission Guidelines

Abstracts should follow the ASEE International Forum Abstract Format guidelines found in the 2016 International Forum Author Kit www.asee.org/InternationalForum. The abstract should be sufficiently complete to enable the Program Committee to determine the paper's suitability for presentation at the International Forum.

Review and acceptance is a two-part process for abstracts and full papers. Abstract acceptance does not guarantee acceptance of the paper. Full papers must be accepted and presented by a registered author attending the ASEE International Forum in order to be published in the proceedings. All presentations should be timed for delivery in no more than 10 minutes to allow time for questions and discussion.

All abstracts should be submitted through the Paper Management System on the ASEE home page at **www.asee.org.** Detailed submission instructions can be found in the 2016 International Forum Author Kit at **www.asee.org/InternationalForum**

2015 ASEE International Forum Steering Committee

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Questions?

For additional information please contact Stephanie Harrington-Hurd at **s.harrington-Hurd@asee.org**, or the committee chair, Howard Appelman at **howard.r.appelman@boeing.com.**

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A Globetrotting Engineer's Footprint

Ir. Chin Mee Poon *needs little introduction. He has, after all, served as an editor of JURUTERA. After an active career in engineering, he devoted his retirement to travel and this literally took him to every corner of the world. His travel experiences have been published as a regular feature in JURUTERA for the last 10 years. Recently, IEM published a book, "A Globetrotting Engineer's Footprint", a compilation of articles that were featured in JURUTERA. The book is available at the IEM Secretariat and major bookstores. JURUTERA spoke to Ir. Chin recently and here are excerpts from the interview:*

Q Tell me something about yourself.

Ir. Chin: There is a brief introduction of me on the back cover of "A Globetrotting Engineer's Footprints" and more information in the "Footnote" on page 199. I joined IEM as a Student Member in the early 1970s and became a Corporate Member in 1979. I became a Fellow in 1997.

Q What motivates you to travel so extensively?

Ir. Chin: Since young, I have always enjoyed visiting new places. The more I travelled, however, the more I realised that my knowledge and my understanding of the world were shallow and limited. Travel magazines and TV documentaries opened my eyes to so many fascinating places in the far-flung corners of the globe and I told myself that if I wanted to see all those places, I would have to travel wide and often, especially after I retired.

Q What can readers expect from "A Globetrotting Engineer's Footprints"?

Ir. Chin: I hope readers will enjoy reading the travel stories and perhaps learn something in the process. I will be extremely gratified if someone tells me, after reading the stories in the book, that he or she feels as if he or she has actually visited those places.

Q Can you explain the structure of the book.

Ir. Chin: The book contains 83 articles published in *JURUTERA*, arranged in chronological order of publication. Each article is spread over two pages and is illustrated by three photographs, compared with only one photograph accompanying the article in *JURUTERA*. These are followed by 5 longer travel stories published in The Star, also arranged in chronological order of publication.

Q You have published 4 other travel books in Mandarin and 1 in English. Please tell me a bit more about these books.

Ir. Chin: I am more proficient in Mandarin than English. I started writing for Chinese magazines and newspapers when I was in Standard 6, and I have been writing in Mandarin ever since. My first Mandarin travel book, A Rash Exploration Of The Ancient Tea-Horse Trade Road, was published in 2008. It's a factual account of an unforgettable adventure that my wife and I participated in.

My second book, Europe And Asia By Train In 102 Days, was published in 2011. It's a testimony of the longest train journey in the world that my wife and I, together with another couple, took part in.

My third book, The Call Of High Mountains, was published in 2012. It tells of how my friends and I overcame all odds to complete the world-famous Annapurna Circuit in the Himalayas in Nepal over 18 days.

My fourth book, Just Pack And Go, was published in 2015. It's a collection of some of my travel stories that were published in newspapers and travel periodicals over the last 18 years.

Q Were you inspired by any great traveller of the past?

Ir. Chin: Yes. The great Ming Dynasty traveller, XuHongzu (better known as XuXiake), is a big inspiration. Despite the extremely difficult means of transportation in those days, Xu managed to travel through a very large part of China. Another great Chinese traveller of more recent times who inspired me with his determination and perseverance, is Yu Chunshun. Unfortunately he died in Lop Nor in the remotest Xinjiang Uygur Autonomous Region of China during a solo walking trip.

Q Apart from seeing new places, what lessons have you learned from your travels?

Ir. Chin: I have learned that, in our world of 7 billion people who speak over 1,000 languages and are divided politically into over 200 countries, we are all human beings who belong to just one species, Homo sapiens, and we behave similarly under similar circumstances. Most people anywhere will show kindness to a lone traveller from another corner of the world and will try to make him or her feel welcome. Diversity of culture in human societies and biodiversity in nature make this world colourful and fascinating. Someone once said: Those who do not travel, read only one page of the book of life.

Q What are your travel plan for the next 10 years?

Ir. Chin: I will continue to trot the globe with my wife. We are no longer young but there are still so many interesting places out there, waiting to be explored. There are many different ways to travel. Most people cover one geographical region at a time. Some people choose a theme and plan their trip accordingly. For example, one may decide to traverse the ancient Silk Route by train from Xian in China all the way to Rome in Italy. Doesn't that sound exciting? I just may plan a trip along that line soon!

A-Bombs and A Peace-Loving People

Ir. Chin Mee Poon
www.facebook.com/chinmeepoon

***Ir. Chin Mee Poon** is a retired civil engineer who derives a great deal of joy and satisfaction from travelling to different parts of the globe, capturing fascinating insights of the places and people he encounters and sharing his experiences with others through his photographs and writing.*

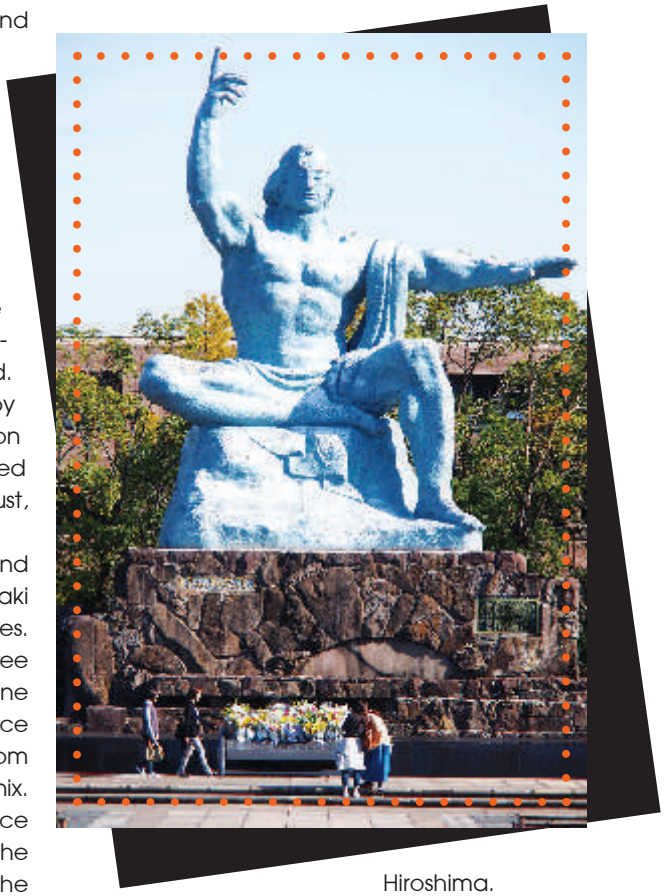
My wife and I visited Hiroshima and Nagasaki during a recent backpacking trip in West Japan. Both cities have the dubious distinction of being the targets of the only two nuclear bombs ever used in warfare in human history.

At 8.15 a.m. on 6 August, 1945, a uranium gun-type atomic bomb, nicknamed Little Boy, exploded at 580m over Hiroshima. The blast and resultant fire storm killed 70,000-80,000 people. Another 70,000 were injured. Three days later, Nagasaki was destroyed by another atomic bomb, a plutonium implosion bomb nicknamed Fat Man. This detonated 500m above the city at 11.02 a.m. on 9 August, 1945.

Now, 70 years after the end of the Second World War, visitors to Hiroshima and Nagasaki will be impressed by the charming cityscapes. At the same time, they will be amazed to see no signs of the horrors that the cities have gone through, except in their respective Peace Memorial Parks. Both cities have emerged from the ashes beautifully like the proverbial phoenix.

The main attractions of Hiroshima Peace Memorial Park are the A-Bomb Dome (the skeletal remains of a building close to the hypocentre of the explosion), the Memorial Cenotaph, the Peach Flame and the Peace Memorial Museum. Spend an hour or more in the museum and one cannot help but be deeply moved by the suffering and misery of the people in Hiroshima as a result of the A-bomb. The exhibits successfully illustrate the immediate destruction and subsequent damages caused by the bomb. There are even accounts of the Manhattan Project that developed the A-bombs, the construction of Little Boy and the principle of nuclear fission behind the bombs. However, any visitor with some knowledge about WWII will notice a glaring omission. There is no answer to a simple question: Why did the Allied Forces, the USA in particular, choose to drop the A-bombs in, of all countries, Japan?

In Nagasaki, the Peace Park is dominated by a 10m-tall statue of a man with his right hand pointing at the sky and his left hand showing a peace sign. But, to my disappointment, the Atomic Bomb Museum also paints a similar incomplete picture as its counterpart in Hiroshima.



I feel that both museums would present a more complete picture if they had also included the sufferings of the people in countries conquered and occupied by the Japanese forces during WWII. With so many lives lost and families broken, the sufferings of these people certainly deserve as much attention as that of the people of Hiroshima and Nagasaki caused by the A-bombs.

Recently, the Japanese government reached an agreement with the South Korean government on the longstanding issue of South Korean women forced to work as sex slaves (or comfort women) of Japanese soldiers during the war whereby the Prime Minister of Japan apologised to the President of South Korea and Japan would contribute a sizeable sum of money to a fund set up by the South Korean government to look after the welfare of scores of surviving comfort women. There are also some comfort women who are still alive elsewhere in other countries and a similar move to help these would certainly reinforce Japan's effort in projecting itself as a peace-loving nation. ■

Editor's Note: *We welcome contributions from all members on travel stories.*

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Updated Oct 2015

Tarikh: 11 Januari 2016

To All Members,

SENARAI CALON-CALON YANG LAYAK MENDUDUKI TEMUDUGA PROFESIONAL TAHUN 2016

Berikut adalah senarai calon yang layak untuk menduduki Temuduga Profesional bagi tahun 2016.

Mengikut Undang-Undang Kecil IEM, Seksyen 3.8, nama-nama seperti tersenarai berikut diterbitkan sebagai calon-calon yang layak untuk menjadi Ahli Institusi, dengan syarat bahawa mereka lulus Temuduga Profesional tahun 2016.

Sekiranya terdapat Ahli Korporat yang mempunyai bantahan terhadap mana-mana calon yang didapati tidak sesuai untuk menduduki Temuduga Profesional, surat bantahan boleh dikemukakan kepada Setiausaha Kehormat, IEM. Surat bantahan hendaklah dikemukakan sebulan dari tarikh penerbitan dikeluarkan.

Ir. Yam Teong Sian
Setiausaha Kehormat, IEM,

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28971	CHEN SHIN CHUAN	BE HONS (UTM) (CIVIL, 1997)
47585	FAZILAH BINTI HATTA @ ANTAH	BE HONS (UTM) (CIVIL, 2006)
27287	HASLAM RAMZAN BIN HASSAN	BE HONS (UTHM) (CIVIL, 2006)
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69503	LIM SOO FEEI, SOPHIA	BE HONS (UTM) (CIVIL, 2005)
75261	SHAHIRON BIN SHAHIDAN	BE HONS (UNISEL) (CIVIL,2007) ME (UPM) (STRUCTURAL & CONSTRUCTIONS, 2010) PhD (USM) (2014)
24873	TAUFIKUR RAHMAN BIN ADNAN	BE HONS (UiTM) (CIVIL, 2002)
7045	WAN MOHD AMZAR BIN WAN MANAN	BE HONS (KLiUC) (CIVIL, 2011)
47584	YONG SUI SU	BE HONS (QUT) (CIVIL, 2009)
KEJURUTERAAN ELEKTRIKAL		
52383	ADIRA BIN MUSTAFA	BE HONS (UTM) (ELECTRICAL, 2005)
36952	CHAN YIN YEWN, DANIEL	BE HONS (CANTERBURY, 2003) ME (CANTERBURY) (MANEGEMENT, 2004)
47536	HARBINDER SINGH A/L RAM SINGH	BE HONS (UNITEN) (ELECTRICAL POWER, 2009)
71102	IZZAIDAH KHAIRAN BTE IDRIS	BE HONS (UNITEN) (ELECTRICAL & ELECTRONICS, 2009)
43968	LOGANATHAN YAGAMBARAM	BE HONS (UTM) (ELECTRICAL, 2007)
31723	LUQMAN AL-HAKIM BIN AZIZAN	BE HONS (USM) (ELECTRICAL, 2007) MSc (UKM) (ELECTRICAL, ELECTRONIC & SYSTEM, 2014)
18288	MOHD HALIMI BIN ABDULLAH	BE HONS (WARWICK) (ELECTRICAL, 1994)
33968	MUHAMMAD IZWAN BIN ISMAIL	BE HONS (MALAYA) (ELECTRICAL, 2006)
36871	MUHAMMAD MUZA WAHIR BIN LIJONG	BE HONS (UiTM) (ELECTRICAL, 2004)
50132	REDZUAN BIN RASHID	BE HONS (UiTM) (ELECTRICAL, 2007)
22885	SYAHIRROHHIV BIN ABDUL SAMAT	BE HONS (UiTM) (ELECTRICAL, 2005)
50191	ZAIFULAMIR BIN MAHIDIN	BE HONS (UTM) (ELECTRICAL, 2006)
KEJURUTERAAN GEOTEKNIKAL		
18277	MUHAMMAD HAFIZ BIN JALALUDDIN	BE HONS (UPM) (CIVIL, 1996)
KEJURUTERAAN KIMIA		
36815	TAN YINN CHOW	BE HONS (UKM) (CHEMICAL, 2007)
KEJURUTERAAN MEKANIKAL		
70284	LOK ENG TATT	BE HONS (MALAYA) (MECHANICAL, 2006)
58658	LUM WAI LEONG	BSc (CALIFORNIA) (MECHANICAL, 2007)
72598	MOHD HISHAM BIN CHE AUN	BE HONS (UTM) (MECHANICAL, 2003)
15409	MOHD SAIFUL ANUAR BIN ZAINAL	BSc (BRADLEY) (MECHANICAL, 1991)
70391	MUKRIDZ BIN MD MOHTAR	DIPL.ING (ESSLINGEN) (AUTOMOTIVE, 2005) MSc (USM) (MECHANICAL, 2013)
29930	TAY LEE SIEN	BE HONS (USM) (MECHANICAL, 2010)
59076	TG MUHD AIMAN BIN TG ABDULLAH	BE HONS (IIUM) (MECHANICAL - AUTOMOTIVE, 2011)
41075	HARINDHARAN JEYABALAN	BE HONS (UNISEL) (MECHATRONICS, 2009)
29170	KUEH JOO KHENG, JUDY	BE HONS (UTM) (CIVIL, 2006)
33682	MUHAMAD KHAIRI BIN JALIL	BE HONS (UiTM) (CIVIL, 2008)

PERMOHONAN BARU MENJADI AHLI KORPORAT

KEJURUTERAAN ELEKTRIKAL		
-	MAZUAR BIN MOHD ANUAR	BSc (SYRACUSE) (ELECTRICAL, 1986)

MEMBERSHIP RENEWAL NOTICE AND ANNUAL SUBSCRIPTION FOR 2016

Greetings and Happy New Year 2016 from IEM.

In line with Bylaws Section 4.2 and 4.3, we are pleased to attach herewith your membership renewal notice for 2016. Kindly be informed that the annual subscription rates excluding the 6% GST for 2016, which will become due from 1st January 2016 are as follows:

FELLOW : RM 265.00
SENIOR MEMBER : RM 210.00
MEMBER : RM 155.00
COMPANION / GRADUATE / AFFILIATE / INCORPORATED MEMBER,
- who is on the 2016 have attained the age of 30 : RM 155.00
- have not attained the age of 30 : RM 100.00

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- have attained the age of 30 : RM 155.00
- have not attained the age of 30 : RM 100.00

STUDENT MEMBER, who is on the 2016
- have attained the age of 30 : RM 155.00
- have attained the age of 24 : RM 100.00
- have attained the age of 24 and are bona fide students of institutions of higher learning : RM 20.00
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Note: Kindly be informed that as per our announcement on 1 October 2015, GST is chargeable on IEM Subscriptions at the rate of 6%.

KEAHLIAN

79151	MOHAMAD SHAFIQ BIN IBRAHIM	B.E.HONS.(UITM) (ELECTRONIC, 2015)
79131	MOHAMAD SYAHMI BIN ZULLKIFFLE	B.E.HONS.(UITM) (ELECTRONIC, 2015)
79103	MOHAMAD SYAMIL BIN KAMARUDIN	B.E.HONS.(UITM) (ELECTRONIC, 2015)
78867	MOHD ARIFF BIN MAT YAZID	B.E.HONS.(UTM) (ELECTRICAL-ELECTRONICS, 2009)
79128	MOHD EEZLEE BIN MOHD SAPUDDIN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79137	MOHD FAIZULHAYAD BIN MASHURI	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79135	MOHD HARIZ BIN BADRUDDIN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
78887	MOHD HILMAN LUKMAN	B.E.HONS.(UITM) (ELECTRICAL, 2008)
79158	MOHD MOKHZANI BIN MOKHSIN @ MISRON	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79140	MOHD NASRUL AFFENDI B ABU HURAIRAH	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79118	MOHD NAZRIN SYAHMI BIN ZAINI	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79127	MOHD NOOR ASHRAF BIN MAAMOR	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79025	MOHD NORBI BIN BAHARIN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79153	MOHD RAFIUDDIN BIN MOHD ROBI	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79316	MOHD REDZUWAN BIN ABU KASIM	B.E.HONS.(UNITEN) (ELECTRICAL & ELECTRONIC, 2006)
79129	MOHD SAFUAN BIN ZULKIFLI	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
78486	MOHD SHARIF BIN ZAKARIA	B.E.HONS.(UTM) (ELECTRICAL-MICROELECTRONICS, 2001) M.E.(UTHM) (ELECTRICAL, 2013)
79161	MOHD SHUKRI BIN HUSIN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79108	MOHD ZAID BIN TAJUDIN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79141	MOHD. AZLAN BIN YUSUFF	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79110	MUHAMAD HAFIZ FARHAN BIN RAFII	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79134	MUHAMAD ZULHELMI BIN ABDULLAH	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79029	MUHAMMAD AFIQ ZIMAM BIN MOHAMED MUNAWAR	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79150	MUHAMMAD AIZAT BIN MD RASID	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79030	MUHAMMAD AIZAT BIN ZAKARIA	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79126	MUHAMMAD AIZUDDIN BIN AZMI	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79133	MUHAMMAD AMINUDDIN BIN ABIDIN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79117	MUHAMMAD AZHAR BIN BORHAN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79112	MUHAMMAD DANIAL BIN MOHD RADZI	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79163	MUHAMMAD HAFIZ BIN HARUN	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79114	MUHAMMAD SYUKRI MAULA ABDUL SAMAD	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79156	MUHAMMAD ZAHID BIN ZAMRI	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79036	MUSTAFA KAMAL BIN SURIF	B.E.HONS.(UITM) (ELECTRONIC-INSTRUMENTATION, 2015)
79145	MUSTAQIM BIN KAMARU' ZZAMAN	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79159	NABILAH HUMAIDI	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79157	NOOR AZIZAH BINTI ABU KHAMID	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79328	NOORFOZILA BINTI BAHARI	B.SC.(GEORGE WASHINGTON) (ELECTRICAL, 1988) M.SC.(UKM) (MICROELECTRONIC, 2007)
79122	NORHASNIZA BINTI WAHID	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79115	NORMASLINDA BINTI MOHD SAHAT	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79120	NUR FARAHAIN BTE MOHAMMED	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79116	NUR IZZATI BINTI NASIR	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79123	NUR SYAAHIDAH BINTI MUSTAFA	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79139	NURUL FARAHIN BINTI SAID	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79107	NURUL SYAHIDA BT MOHD TAJUDIN	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
78074	RASIDI BIN YAMIN	B.E.HONS.(BRADFORD) (ELECTRONIC, 1995)
79323	RUZITA BINTI ABU BAKAR	B.SC.(WIDENER) (ELECTRICAL, 1992) M.SC.(UPM)(COMPUTER & COMMUNICATION SYSTEMS, 2001)
79119	SALHA BINTI DALHAM	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79132	SHAHRIZAN BIN RASHID	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79146	SHARAFUDDIN BIN MOHD KHAIRUDDIN	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79147	SHAZLIEZAWATY BINTI SAHA HU HAMID	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79106	SHIMAN BIN SAIMAN	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79113	SITI SARAH BINTI KHALID	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79124	SYAKINAH BINTI ZAKARIA	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
78869	TING TZE MING, SIMON	B.E.HONS.(MMU) (ELECTRONICS-TELECOMMUNICATIONS, 2010)
79162	WAN ABDUL HAZIQULLAH BIN WAN JAMALUDDIN	B.E.HONS.(UITM) (ELECTRONIC-COMMUNICATION, 2015)
79130	WAN MOHAMMAD QODRY BIN WAN KAMIZI	B.E.HONS.(UITM) (ELECTRONIC-COMPUTER, 2015)
79155	WAN MOHD NAIM BIN WAN GHAZALI	B.E.HONS.(UITM) (ELECTRONIC-COMPUTER, 2015)
79138	WAN NUR ATHIRAH BINTI WAN AZAHAR	B.E.HONS.(UITM) (ELECTRONIC-COMPUTER, 2015)
79152	WAN ZUHELMI BIN WAN MUDA	B.E.HONS.(UITM) (ELECTRONIC-COMPUTER, 2015)
79125	ZURAINE AZANEN BINTI ZULKIPLI	B.E.HONS.(UITM) (ELECTRONIC-COMPUTER, 2015)

KEJURUTERAAN INDUSTRI

79507	SARAVIN KUMAR A/L T N BINU KUMAR	B.E.HONS.(UTAR) (INDUSTRIAL, 2015)

KEJURUTERAAN KIMIA

79494	ABDUL HALIM BIN NORDIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79493	AFIF BAZLAA BINTI JUWAHIR	B.E.HONS.(UITM) (CHEMICAL, 2015)
78467	AFIFAH BINTI HAPIDZ	B.E.HONS.(UMP) (CHEMICAL, 2010)
79492	AHMAD FAKHRI SYAHMI BIN MASRUDDIN	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
79491	AHMAD FIRDAUS BIN MUHAMMAD ASHA'RI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79490	ANITH ATHIRA BINTI CHE ABD RAHIM	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79489	ASMAA' BINTI ABDULLAH	B.E.HONS.(UITM) (CHEMICAL, 2015)
79488	AYU AZRAINE BINTI MOHAMMED SALLEH	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
78899	AZAD SHAHREN BIN MAT TAP	B.E.HONS.(UTM) (CHEMICAL, 2006)
79411	AZWADI BIN ALI	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
78469	CHANG HAI PENG	B.E.HONS.(MIINESOTA) (CHEMICAL, 2011)
79321	CHIN YONG BAO	B.E.HONS.(UTP) (CHEMICAL, 2013)
79545	CH'NG BOON SIN	B.E.HONS.(UTAR) (CHEMICAL, 2015)
79031	DR. LEO CHOE PENG	B.E.(UMP)(CHEMICAL, 2013)
78409	DR. SYED SHATIR ASGHRAR BIN SYED HASSAN	B.E.HONS.(NEWCASTLE UPON TYNE)(CHEMICAL, 2003) P.HD.(CURTIN) (2011)
79487	FARHAN FASEEHA BINTI ISMAIL	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79486	FARHANA BINTI HARUN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79485	HAIRIE BIN HELMAN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79484	HANISAH BINTI SARKAWI @ KAWI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79483	HAZWANI BINTI BASRI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79006	HENG SUI WOOI	B.E.HONS.(MALAYA) (CHEMICAL, 2004)
79482	HIDAYATUL HUSNA BINTI HUSSIN	B.E.HONS.(UITM) (CHEMICAL, 2015)
78455	HO MENG FAN	B.E.HONS.(UTAR) (CHEMICAL, 2013)
79481	IHSAN SABRI BIN ROSLI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79408	IRFAN SYUKRI BIN ISMAIL	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79480	KAIRUL SHA BIN DULDANG	B.E.HONS.(UITM) (CHEMICAL, 2015)
79318	KONG YEAN HUEY	B.E.HONS.(CURTIN) (CHEMICAL, 2006)
78860	LAM KA-MUN	B.E.HONS. (CANTERBURY) (CHEMICAL & PROCESS, 2009)
79532	LIM FUI CHIN	B.E.HONS.(UTAR) (CHEMICAL, 2015)
79409	LUQMAN HAKIM BIN ABDUL RAZAK	B.E.HONS.(UITM) (CHEMICAL, 2015)
79479	LYDIA CHRISTINE AK MARTIN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79526	MAH BEE LING	B.E.HONS.(UTAR) (CHEMICAL, 2015)
79478	MAHIRAH BINTI ABD MUBIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79421	MARCELLE MARTIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79416	MASLAN BIN HASSAN	B.E.HONS.(UITM) (CHEMICAL, 2015)

79418	MD.RAHMADI BIN RASALI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79477	MOHAMAD HAKIM BIN KAMARUDDIN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79476	MOHAMMAD AMIRUL AIMAN BIN AHAMAD	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79475	MOHAMMAD IZWAN BIN ABDUL WAHID	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79474	MOHAMMAD NAZREEN BIN ZAINURIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79473	MOHD ALFIE SABALI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79472	MOHD AMIRUL HAKIM BIN MOHD ZIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79471	MOHD FAIZZUL BIN MOHD ZAIDI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79470	MOHD FAROOQ BIN MOHAMAD KHALIL	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
78474	MOHD HAFIZ BIN ZAKARIA	B.E.HONS.(UTM) (CHEMICAL, 2009)
78882	MOHD KHAIRUL BIN YA'KUB	B.E.HONS.(UMP) (CHEMICAL, 2008)
79410	MOHD NUZUL AMIN BIN MOHD SALLEH	B.E.HONS.(UITM) (CHEMICAL, 2015)
79426	MOHD RIDZUAN BIN MOHATAR	B.E.HONS.(UITM) (CHEMICAL, 2015)
79419	MOHD ZULFADHLI BIN FAIZOL AZMI	B.E.HONS.(UITM) (CHEMICAL, 2015)
79469	MUFIDAH BINTI MAHFUZ	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
78404	MUHAMAD FAUZAN BIN AHMAD FADZIL	B.E.HONS.(UTM) (CHEMICAL, 2014)
79468	MUHAMAD SHAHIR BIN MOHD SAAT	B.E.HONS.(UITM) (CHEMICAL, 2015)
79467	MUHAMMAD AFIQ BIN IBRAHIM	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79422	MUHAMMAD FADHLI BIN SAMSUDIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79417	MUHAMMAD FAIZ BIN ISMAIL	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
78900	MUHAMMAD FAIZ BIN OMAR	B.E.HONS.(MELBOURNE) (CHEMICAL, 2013)
79466	MUHAMMAD FAKHRI BIN HASAN @ AHMAD	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79465	MUHAMMAD FAREEZUDDIN BIN MOHAMAD KHALIL	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79464	MUHAMMAD JASVIR BIN SULAIMAN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79463	MUHAMMAD KAMAL BIN ISMAIL	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
79462	MUHAMMAD NADZMI BIN RAMLAN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79461	MUHAMMAD NURFIRDAUS BIN RASIDI	B.E.HONS.(UITM) (CHEMICAL, 2015)
79460	MUHAMMAD RAIHAN BIN ABD TALIB	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79459	MUHAMMAD WAFIY BIN AHMAD	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
79458	MUHD SYAFIQ IZWAN BIN ZAINAL MURAD	B.E.HONS.(UITM) (CHEMICAL, 2015)
79457	MUZZAFFAR ZAIDI BIN MUSTAPHA	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79414	NABILA SHAFIQAH DABIMEL	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79525	NEOH KUANG HONG	B.E.HONS.(UTAR) (CHEMICAL, 2015)
78072	NG KAY WENG, DANIEL	B.E.HONS.(UTAR) (CHEMICAL, 2014)
79456	NOOR HIDAYAH BINTI HASBAH	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79455	NOR FARAHIDA BINTI ABU BAKAR	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
79413	NORAINI BINTI ALUWI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79454	NORASYIKIN BINTI MOKTAR	B.E.HONS.(UITM) (CHEMICAL, 2015)
79453	NORMASZIANA BINTI SIDEK	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79452	NORSOLEHAH BINTI HANAFIAH	B.E.HONS.(UITM) (CHEMICAL, 2015)
79346	NU'MAN BIN ABDUL HADI	B.E.HONS.(UTM) (CHEMICAL, 2009)
79428	NUR FATHIN AMIRAH BINTI SHAFIE	B.E.HONS.(UITM) (CHEMICAL, 2015)
79427	NUR RUZAINI BINTI ROSLI	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
79451	NUR SYAFIQA BINTI AMAN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79420	NURLIYANA BINTI SHAHADAN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79450	NURRUL SHAFIQAH BINTI MAHAMAD TAIB	B.E.HONS.(UITM) (CHEMICAL, 2015)
79425	NURUL AISHAH BINTI MAZLAN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79449	NURUL AZIANI BINTI SYAARI	B.E.HONS.(UITM) (CHEMICAL, 2015)
79448	NURUL FAZLINA BINTI NOOR FAZIL	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79447	NURUL HASIDAH BINTI MOHAMAD	B.E.HONS.(UITM) (CHEMICAL, 2015)
79446	NURUL NADIA BINTI MOHAMAD	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79445	NURUL WAHIDA BINTI ABD HALIM	B.E.HONS.(UITM) (CHEMICAL, 2015)
79520	PANG TUNG HEE	B.E.HONS.(UTAR) (CHEMICAL, 2015)
79444	PAZILAH BINTI MOHD YUSOF	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
79443	PEREGRINE DAVID	B.E.HONS.(UITM) (CHEMICAL, 2015)
79010	PHOON KOK HOONG	B.E.HONS.(UKM) (CHEMICAL, 2004) P.HD. (USM)(MEMBRANES/ MEMBRANE TECH FOR ENVIRONMENTAL POLLUTION CONTROL, 2008)
79442	RAJA MOHD ADLI BIN RAJA ARIS	B.E.HONS.(UITM) (CHEMICAL, 2015)
79441	ROHAZIERAH BINTI CHE OMAR	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79440	ROYDIA LENSY ANAK SIMAN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79439	SALIP ELNALYN SALIP MAWALLIL	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79519	SASHITHAARAN A/L GOVINDASAMY	B.E.HONS.(UTAR) (CHEMICAL, 2015)
79438	SITI AUNI NABILAH BINTI KAMARUDDIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79437	SITI FARAH NADIAH BINTI RUSLI	B.E.HONS.(UITM) (CHEMICAL & BIOPROCESS, 2015)
79412	SITI HAJARNAIMAH KAMARUDDIN	B.E.HONS.(UITM) (CHEMICAL, 2015)
78410	SITI KHATIJAH BINTI JAMALUDIN	B.E.HONS.(UTM) (CHEMICAL, 2005) M.SC.(UITM)(CHEMICAL, 2012)
78076	SITI MARIAH BINTI ABDUL MURAD	M.E.HONS. (MANCHESTER) (CHEMICAL, 2013)
79423	SITI NOR SAMRAH BINTI A.RAHIM	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79436	SITI NORFASHA BINTI ABU BAKAR	B.E.HONS.(UITM) (CHEMICAL, 2015)
79435	SITI NUR TAQINAH BINTI MURSIDI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79434	SITI NURAINSYAH BINTI SHARUDDIN	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79433	SITI SARAHNAIMAH BT KAMARUDDIN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79432	SITI ZAKIAH BT RAZALI	B.E.HONS.(UITM) (CHEMICAL, 2015)
79516	SOON ZHENG FOONG	B.E.HONS.(UTAR) (CHEMICAL, 2015)
79431	SUHAILA BINTI SHAWAL	B.E.HONS.(UITM) (CHEMICAL, 2015)
79305	SURENTHRAN A/L K SUNDAR	B.E.HONS.(UMP) (CHEMICAL, 2014)
79424	SYAHIRAH BT HARUN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79415	SYANTA JOSEPH	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79013	TEE PEI FANG	B.E.HONS.(UPM) (CHEMICAL, 2007)
79019	TEY SIU LEE	B.E.HONS.(UTP) (CHEMICAL, 2013)
79023	THIVAGAR A/L SUGUMARAN	B.E.HONS.(UTP) (CHEMICAL, 2014)
79430	WAN AFIFF BIN WAN AZNI	B.E.HONS.(UITM) (CHEMICAL & PROCESS, 2015)
79429	WAN FATHI HATIM DIYANA BT WAN NORMAN	B.E.HONS.(UITM) (CHEMICAL, 2015)
79510	WONG KIN KEN	B.E.HONS.(UTAR) (CHEMICAL, 2015)
78488	WONG SENG SIONG, RONNY	B.SC.(IOWA STATE) (CHEMICAL, 2004)
79018	WONG YEE YIEN	M.E.HONS. (NOTTINGHAM) (CHEMICAL, 2010)

KEJURUTERAAN KOMUNIKASI

79324	DR. NURUL SHAHRIZAN BINTI SHAHABUDDIN	B.E.HONS.(IIUM) (COMMUNICATION, 2006) M.SC.(MALAYA) (PHOTONIC, 2009) P.HD.(MALAYA) (PHOTONIC, 2013)

KEJURUTERAAN MEKANIKAL

78071	ADNAN BIN BAKRI	B.E.HONS.(ITM) (MECHANICAL, 1997)
78879	AMIRUL HAKIM BIN SUFIAN	B.E.HONS.(UPNM) (MECHANICAL, 2012)
79340	ANG PENG CHONG	B.E.HONS.(UTAR) (MECHANICAL, 2010)
79549	AU WING FAI	B.E.HONS.(UTAR) (MECHANICAL, 2015)
79322	AZUREEN BINTI MOHD KAMAL AZMEY	M.E.HONS.(SUSSEX) (MECHANICAL, 2014)
79306	CHAI KOON SENG	B.E.HONS.(UTP) (MECHANICAL, 2014)
79004	CHAN YING WAI	B.E.(SUNDERLAND) (MECHANICAL, 1988)
78463	CHEAH EE GUAN, AARON	B.E.HONS.(UNITEN) (MECHANICAL, 2014)
79352	CHEAH YUANFENG	B.E.HONS.(MALAYA) (MECHANICAL, 2014)
79016	CHENG SEOK THENG	B.E.HONS.(UNIMAS) (MECHANICAL & MAUFACTURING, 2014)
79546	CHIN GUANG MIN	B.E.HONS.(UTAR) (MECHANICAL, 2015)
78421	CHIONG JONG HUA	B.E.HONS.(PLYMOUTH) (MECHANICAL, 2003)
78418	CHOO LIANG FEE	B.E.HONS.(UKM) (MECHANICAL, 2008)
79506	CHOONG BOON HAO	B.E.HONS.(UTAR) (MECHANICAL, 2015)
79297	DINISHKARAN PILLAI A/L VELAYUTHAM PILLAI	B.E.HONS.(UNITEN) (MECHANICAL, 2010)
78460	DR. MUHAD ROZI BIN MAT NAWI	B.E.HONS.(USM) (MECHANIC, 2005) M.SC.(MECHANIC, 2008) P.HD.(TRINITY COLL. DUBMIN)(2015)
78458	DR. NURIN WAHIDAH MOHD ZULKIFLI	B.E.HONS.(MALAYA) (MECHANICAL, 2006) M.E.SC.(MONASH)(2009) P.HD.(MALAYA)(2014)
78865	DR.NG KEAN ENG	B.E.(MURORAN INST.) (MECHANICAL SYSTEMS, 1998) M.E.(MURORAN INST.)(MECHANICAL SYSTEMS, 2000) P.HD. (MURORAN INST.) (PRODUCTION & INFORMATION SYSTEMS, 2003)
79542	FANG WAI HONG	B.E.HONS.(UTAR) (MECHANICAL, 2015)
78406	IJHAR HIDAYAT BIN RUSLI	B.E.HONS.UITM() (MECHANICAL, 2007) M.SC. (UPM)(MECHANICAL, 2012)
78875	KANNAN A/L VIJAYAM	B.E.HONS.(UTP) (MECHANICAL, 2014)
79314	KUANG JIA FEI	B.E.HONS.(UTHM) (MECHANICAL, 2014)
79540	KUEH JIN FONG	B.E.HONS.(UTAR) (MECHANICAL, 2015)
79539	LEE CHUN WAI	B.E.HONS.(UTAR) (MECHANICAL, 2015)

78466	LEE LAI HOONG	B.E.HONS.(UNITEN) (MECHANICAL, 2014)
79535	LEE ZHENG HAU	B.E.HONS.(UTAR) (MECHANICAL, 2015)
79259	LIM CHAN CHENG	B.E.HONS.(MMU) (MECHANICAL, 2009) M.B.A.(UPM)(FINANCE, 2013)
78871	LIM HOOI PENG	B.E.HONS.(UTM) (MECHANICAL-MATERIALS, 2008) M.E.(UTM)(MECHANICAL, 2014)
78407	LIM SOON CHONG, JOHNSON	B.E.HONS.(KUITTHO) (MECHANICAL, 2002)
79531	LOCK WENG LEONG	B.E.HONS.(UTAR) (MECHANICAL, 2015)
79342	LOGESWARAN A/L ARUMUGAM	B.E.HONS.(UNISEL) (MECHANICAL, 2014)
79300	LOK YEE FAI	B.E.HONS.(UMS) (MECHANICAL, 2006)
79527	LU AIK WAY	B.E.HONS.(UTAR) (MECHANICAL, 2015)
79253	MOHAMAD FAIZ BIN MOHD SHAFIE	B.E.HONS.(UITM) (MECHANICAL, 2015)
78468	MOHAMAD SHIHAB BIN SENIK @ ABDUL MOKHTI	B.E.HONS.(UITM) (MECHANICAL, 2007)
78866	MOHAMAD ZULFADELI BIN RIPAN	B.E.HONS.(UNIMAS) (MECHANICAL & MANUFACTURING, 2013)
78411	MOHAMED SUKRI BIN MAT ALI	B.E.HONS.(UTM) (MECHANICAL, 2004) M.E.(UTM)(MECHANICAL, 2007)
79310	MOHD AZAM BIN MOHD AZNI	B.E.HONS.(UNISEL) (MECHANICAL, 2013)
78457	MOHD FAIRUZ BIN MUHAMMAD PILOS	B.SC.(ARIZONA STATE) (MECHANICAL, 1997)
78898	MOHD FAIZUL BIN ABD RAHMAN	DIPL-ING. (GELSENKIRCHEN) (MECHANICAL, 2010)
79349	MOHD FIRDAUS BIN ADAM	B.E.HONS.(UPM) (MECHANICAL, 2007)
79339	MOHD HAFIZUL HILMI BIN MOHD NOOR	B.E.HONS.(UTM) (MECHANICAL, 2011)
79254	MOHD ZAIMI BIN ABD RAHIM	B.E.HONS.(MALAYA) (MECHANICAL, 1994)
79033	MOKANARAJU A/L K.SELVARAJ	B.E.HONS.(UNITEN) (MECHANICAL, 2014)
78487	MUHAMMAD DZARFAN BIN MUHAIYUDDIN	B.E.HONS.(ADELAIDE) (MECHANICAL, 2012)
79252	MUHAMMAD JAAFAR BIN JAMAREI	B.E.HONS.(UITM) (MECHANICAL, 2015)
78481	MUHYIZZ BIN MOHAMMED	B.E.HONS.(LEICESTER) (MECHANICAL, 2012) M.SC.(LEICESTER)(ADV. MECHANICAL ENRG., 2014)
79353	NG CHEE CHUNG	B.E.HONS.(UTM) (MECHANICAL, 2014)
78485	NIK MOHD SYAFIQ HAZWAN B NIK AB GHANI	B.E.HONS.(UTM) (MECHANICAL-MATERIALS, 2010)
78484	NORHAMIDAH BINTI OTHMAN	B.E.HONS.(UITM) (MECHANICAL, 2009)
79522	NYIEW MIN WEI	B.E.HONS.(UTAR) (MECHANICAL, 2015)
79026	RAHMAT BIN KAMISAN	B.E.HONS.(UNITEN) (MECHANICAL, 2014)
79027	RAMESH SUGAN A/L RAJENDRAN	B.E.HONS.(UPM) (MECHANICAL, 2001) M.SC.(UPM) (MANUFACTURING SYSTEMS, 2008)
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Pengumuman yang ke-88

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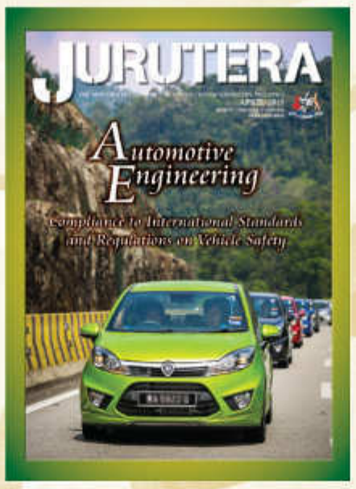

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Inside Back Cover (IBC)	6,750	6,250	5,950	5,650	5,350
Page 1	6,650	6,150	5,850	5,550	5,250
Facing Inside Back Cover (FIBC)	6,150	5,850	5,550	5,250	4,950
Facing Cover Note (FCN)	5,850	5,300	5,100	4,900	4,700
Facing Contents Page (FCP)	5,700	5,150	4,950	4,750	4,550
Centre Spread	11,200	9,500	9,000	8,500	8,000
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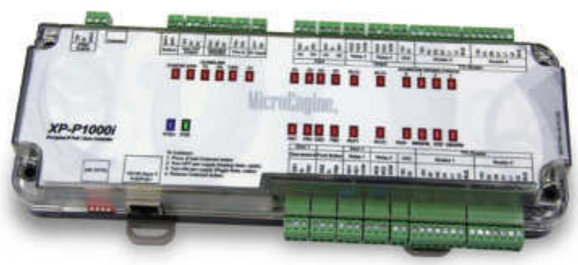

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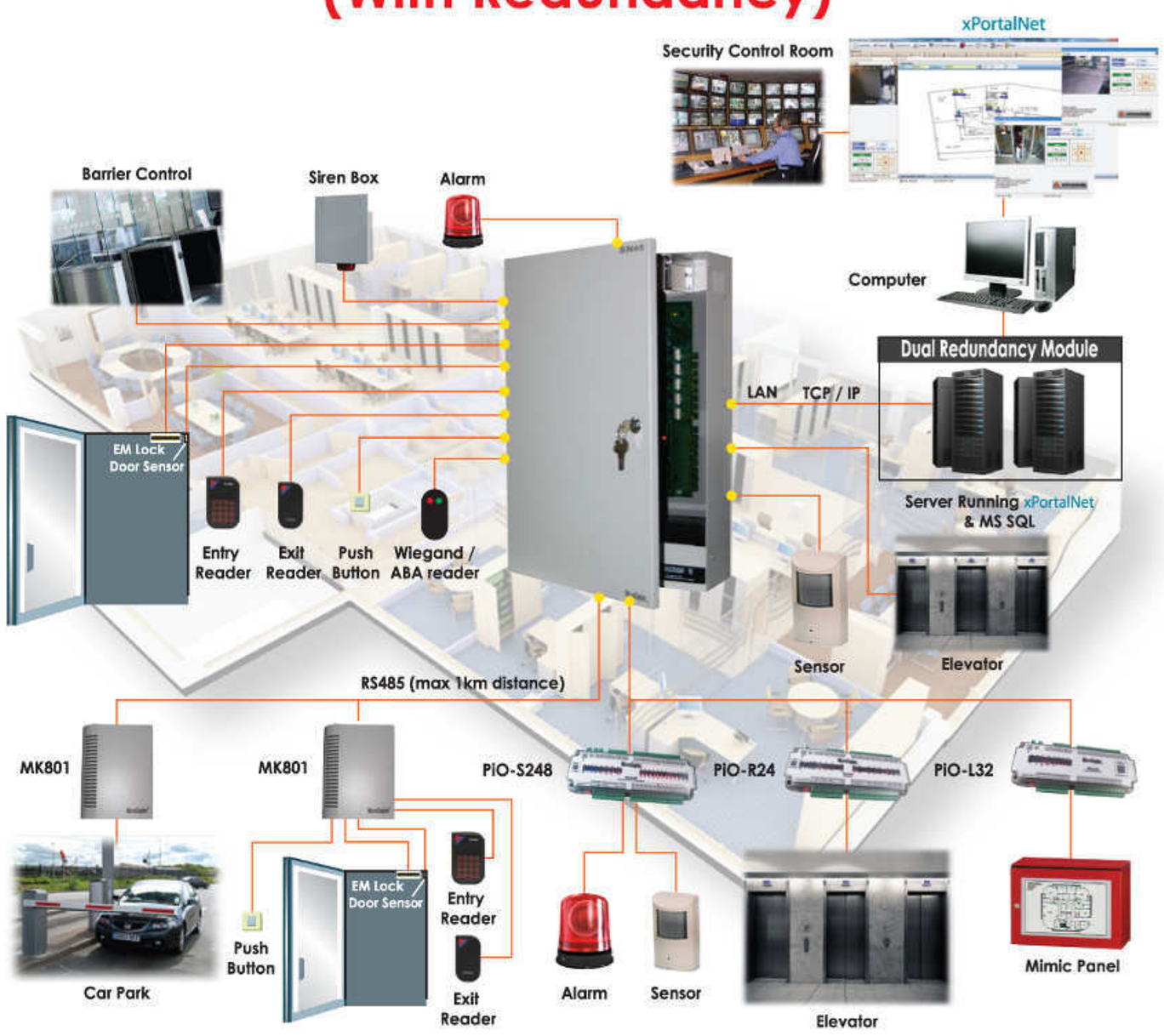

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