The MS1525 is a document which requires a multidisciplinary team of professionals to ensure compliance. This presentation will focus on the Electrical Engineer’s input/role in ensuring compliance to MS1525.
The content of this presentation is listed above. An understanding of laws and technical standards relevant to the electrical engineer is necessary before a brief review of the MS1525 is presented. A step by step explanation of the sections relevant to the electrical engineer in ensuring compliance to MS1525 then proceed. A reference to other publication concludes this presentation.
1 Laws & Regulations:
- ‘Energy Commission Act’ (2001) empowers the EC to advise the Minister on energy supply activities (which is defined as electricity and piped gas). The remit of the Act includes regulation on transmission, generation, safety and energy efficiency. The promotion of renewable energy is also included as a function of the EC.
- ‘Electricity Supply Act’ (1990) regulate the electricity industry from generation, transmission, safety to electrical efficiency.
- ‘Electricity Regulations’ (1994) under the provisions of the Electricity Supply Act (ESA), registers electrical installation, competent persons in the electrical industry, contractors, and provide a list of electrical equipment which are safe and can be used in Malaysia. Under this regulation, energy labeling of electrical equipment are also included.

2 Mandatory Standards
Technical standards and Code of Practice are mandatory by virtue of the Electricity Supply Act and Regulations spe

3. Voluntary Standards
Voluntary standards refers to standards published by SIRIM as Malaysian Standards. Where they are referenced in particular Acts or Regulations, then they become mandatory. Voluntary standards also become contractually mandatory if prescribed in specifications of contract documents.
The practice of MS1525 for Electrical Engineers can be categorised into the following sub disciplines:

- **Lighting Design**
  - Clause 6, Sub Clause 4.4 on daylighting
- **Power System & Distribution**
  - Clause 7
- **Energy Management System**
  - Clause 9
- **Energy Modelling**
  - Clause 10

For the electrical engineer, the use of MS1525 in reality is a multidisciplinary task involving the specialist in the fields listed above.
A list of major revision to the MS1525, 2007 edition is listed above.
Section 7 – Electrical Power Distribution

Electrical Power Distribution
Electrical system comprising components (cables, transformers, switch boards, fuses etc.) put together in a prescribed manner into a functioning system.

Section 7 can be summarised to contain the following prescriptions:

- **Standard Reference** to MS/IEC 60364 (Malaysian Wiring Code) & voltages standard
- **High Efficiency Motors** (HEM) motors recommended. Suruhanjaya Tenaga classification of HEM using EU/CEMEP is adopted.
- **Cables** – to comply with MSIEC 60364 & optimal sizing.
- **Transformers** - recommendation on min. losses and prescription for design to promote E.E. is included.
- **Inverters** – Recommendations on use at least 12-pulse type VSD.
- **Power Factor Correction Capacitors** – Low loss capacitors are recommended.
- **Sub Metering** – sub metering to facilitate monitoring of energy consumption is recommended at every load centres (including
Every electrical engineer should be well-versed in the following technical standards:

- **MS/IEC 60364 (Electrical Installation of Building)** is the de facto wiring standard referenced **NOT IEE 16th Edition (UK)**.
- **MS1979 (Electrical Installation of Buildings – Code of Practice)** is made mandatory by the Suruhanjaya Tenaga.
- **MS1936 (Guide to MSIEC60364)** companion to MSIEC 60364 specifically in the Malaysian context.

Contact SIRIM for a copies of the above [http://www.sirim.my](http://www.sirim.my).

Unfortunately many practitioners (including electrical engineers) are still unaware of the above.

The standards listed above, are Malaysian wiring standards which by virtue of its publication by SIRIM as a national standard, confers on said standard more locus-standii than British Standard IEE 16th edition (also known as BS7671). Unfortunately, to-date many industry practitioners are still referencing the old British IEE 16th Edition.
Malaysian Standard Voltages

It is a misconception that Malaysia Standard Voltage is at 415V/240V!

As of 1st January 2008, Malaysia Standard Voltage is declared at 400V/230V.


Rationalisation of voltage is to bring Malaysia in line with other member countries of the IEC. Singapore and the UK has already converted to 400V/230V from the old 415V/240V.

Other IEC member countries which have yet to convert is Germany and China (380V/220V) and India (415V/240V).

Practitioners must therefore design power distribution system to 400V/230V.

IEC = International Electrotechnical Commission (an international organisation responsible for compiling and maintaining technical standards for the electrical power (‘electrotechnical’) industry. More than 90% of nations in the world’s are member of IEC.
ELECTRICAL POWER DISTRIBUTION

Electrical system comprising components (cables, transformers, switch boards, fuses etc.) put together in a prescribed manner into a functioning system.

Malaysian Standard Voltages at 400V/230V +10%, -6%

- MS1525; 7 para 3 requires that supply voltage should be maintained as close as possible to design/optimum voltage.
- Electrical power distribution system should be designed to 400V/230V !
  - Change all reference in specifications to 400V/230V.
  - Specify transformers at nominal 11kV/420V (not 11kV/433V).
  - Check cable sizing as 400V/230V incur about 4% higher current.

Major reasons for rationalising to 400V/230V

- Standardisation among IEC countries. Multiple certification due to different voltage levels is avoided or minimised.
- Most motors and fluorescent light fittings works most efficiently within the voltage band of 210V to 220V. Thus reducing to 220V will
  - Save energy
  - Prolong life-span of electrical equipment.
In a typical office cum, commercial with residential complex, the energy usage profile is shown above.
Induction Motors constitute up to 20% of total load.
Section 7.1 prescribes High Efficiency Motors (HEM)

- HEM should be specified for all induction motors.
- Motors with low load diversity e.g. fire pumps which are run only during emergency and testing (monthly/biannual etc.) may be exempted from this ruling.
- Suruhanjaya Tenaga adopts EU/CEMEP classification of HEM.
  - EFF 1 (high-efficiency motors)
  - EFF 2 (improved-efficiency motors)
  - EFF 3 (standard motors)

The payback due to additional cost of HEM for motors which are not frequently operational (e.g. fire pumps) may not justify the use of HEM in such case.

EU = European Commission
CEMEP = (EU) Comité Européen de Constructeurs de Machines Electriques (European Sector Committee of Manufacturers of Electric Machines).
Look for energy efficient labels on the motors.
Unfortunately, the initiative on energy labelling for electrical equipment is currently is at a standstill in Malaysia. Practitioners who wish to pursue energy efficient product may include in their specifications energy labelling by other countries.
Inverters in most commercial building application would be mainly in:
(a) Pumps where pumping loads fluctuates e.g. chilled water system for ACMV, water pumping scheme etc.
(b) Lifts where load fluctuates and speed control is important.
(c) Large ventilation fans which requires response to varying ventilation load.

Using inverters and Variable Speed Drives (VSD) in motor application is a major design initiative in electrical energy efficiency.

However MS1525 prescription on inverters is inadequately formulated with only a general recommendation of using 12-pulse inverter as a minimum requirement.

Note: Given the audience and short time span allotted, discussions of inverters and VSD as measures for E.E. can only be brief.

Inverters are power electronic device which converts the normal AC (alternating current) electricity from the public network to DC (direct current) electricity. Inverters which converts AC mains to DC and then reconverts the DC back to AC current (but with varying frequency) are common application for motors. Such inverters are known as Variable Speed Drive (VSD).
Inverters are power electronic devices that convert the normal AC (alternating current) electricity from the public network to DC (direct current) electricity. Inverters which convert AC mains to DC and then reconverts the DC back to AC current (but with varying frequency) are common applications for motors. Such inverters are known as Variable Speed Drive (VSD).
Transformers are equipment which transforms the high voltage (11 KV or 11,000 V) brought into the building by the utility company, to low voltage (400V 3 phase, 230V single phase) suitable for distribution within a building.

Transformers are typically mounted in a substation. The specification and sizing of transformer (or sizing of substation capacity) is therefore a fundamental task of the electrical engineer which can affect system performance and energy loss.

Prescriptions for transformers in design:

- Transformers efficiencies should be (at full load):
  - Tx < 1,000kVA; eff. not less than 98%
  - Tx > 1,000kVA; eff. not less than 99%

- Average p.f. should not be less than 0.85.

- Transformer capacity should not normally exceed 150% of full load.
BEYOND THE SIMPLE '2-LEVEL' PRESCRIPTION OFFERED BY MS1525, OTHER GUIDES SHOULD ALSO BE CONSULTED.

Table 1 - Table of transformer losses for 6600/433 V and 11000/433 V

<table>
<thead>
<tr>
<th>Capacity (kVA)</th>
<th>No-Load Loss (W)</th>
<th>On-Load Loss (W)</th>
<th>Total Losses (W)</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>300</td>
<td>1,500</td>
<td>1,800</td>
<td>98.23</td>
</tr>
<tr>
<td>300</td>
<td>600</td>
<td>2,800</td>
<td>3,400</td>
<td>98.99</td>
</tr>
<tr>
<td>500</td>
<td>1,000</td>
<td>4,100</td>
<td>5,100</td>
<td>98.99</td>
</tr>
<tr>
<td>750</td>
<td>1,200</td>
<td>6,000</td>
<td>7,200</td>
<td>99.05</td>
</tr>
<tr>
<td>1,000</td>
<td>1,400</td>
<td>7,000</td>
<td>8,400</td>
<td>99.18</td>
</tr>
</tbody>
</table>

Table 2 - Table of transformer losses for 22000/433 V

<table>
<thead>
<tr>
<th>Capacity (kVA)</th>
<th>No-Load Loss (W)</th>
<th>On-Load Loss (W)</th>
<th>Total Losses (W)</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>240</td>
<td>1,600</td>
<td>1,840</td>
<td>98.19</td>
</tr>
<tr>
<td>300</td>
<td>700</td>
<td>4,100</td>
<td>5,100</td>
<td>98.99</td>
</tr>
<tr>
<td>500</td>
<td>900</td>
<td>7,200</td>
<td>8,200</td>
<td>98.99</td>
</tr>
<tr>
<td>750</td>
<td>1,200</td>
<td>9,200</td>
<td>10,400</td>
<td>98.63</td>
</tr>
<tr>
<td>1,000</td>
<td>1,500</td>
<td>11,700</td>
<td>13,200</td>
<td>98.70</td>
</tr>
</tbody>
</table>

Table 3 - Table of transformer losses for 33000/433 V

<table>
<thead>
<tr>
<th>Capacity (kVA)</th>
<th>No-Load Loss (W)</th>
<th>On-Load Loss (W)</th>
<th>Total Losses (W)</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>300</td>
<td>1,500</td>
<td>1,800</td>
<td>98.23</td>
</tr>
<tr>
<td>300</td>
<td>730</td>
<td>4,500</td>
<td>5,530</td>
<td>98.29</td>
</tr>
<tr>
<td>500</td>
<td>1,020</td>
<td>7,180</td>
<td>8,200</td>
<td>98.39</td>
</tr>
<tr>
<td>750</td>
<td>1,365</td>
<td>9,200</td>
<td>10,065</td>
<td>98.91</td>
</tr>
<tr>
<td>1,000</td>
<td>1,665</td>
<td>11,850</td>
<td>12,515</td>
<td>98.67</td>
</tr>
<tr>
<td>1,500</td>
<td>2,203</td>
<td>15,000</td>
<td>17,200</td>
<td>98.87</td>
</tr>
</tbody>
</table>

Clause 7.6 - prescription on Sub Metering requires that metering of load centres be included in the design. Cross-referenced to 9.8, monitoring should be linked to ‘EMS’ (Energy Monitoring System).

Sub Metering to Energy Monitoring System (EMS)

Install Meters at Load Centres
Section 6 – Lighting

- MS ISO 8994 (supersede MS603) Standards for Interior Lighting.
- E.E. Strategy in MS1525 can be summarised as follows:
  - Design strategy → design optimisation
    - day lighting (5.4)
  - Equipment efficiency (ballast, lamp etc.)
  - Lighting control (zone control, switching control).
  - Operation & Maintenance (As-Built & manual, maintenance, monitoring)
Section 6 – Lighting

Design strategy
Æ Understanding of design parameters (colour rendering)
Æ Understand photometric diagram
Æ Understand beam spread

Light at different wavelength (or energy) when refracted in glass travels at (slightly) different speed. Due to this a beam of white light refracted in a glass prism is split up into its compound colours.

White light is composed of different colours.
Section 6 – Lighting

Colour Temperature refers to:
.. the variation in the amount of colours within a light mixture affects the appearance of the light in terms of its relative warmness and 'coolness' or the colour of light sources.

Correlated Colour Temperature (CCT) which is more commonly used, apply to sources with a continuous spectrum (such as incandescent lamps and natural light). However for light sources with non-continuous spectral distribution (such as fluorescent lamps and discharge lamps where the spectrum consist of peaks of energy), CCT is sued mainly on an empirical sense (i.e. in a very 'near approximate' sense) to describe the degree of 'whiteness' of the said light source.
Section 6 – Lighting

Colour Rendering

A more common method of characterising light sources by its colour is the Colour Rendering Index (CRI). The CRI compares the spectral energy content of a light source to that of a standard reference source with full spectrum. The CRI value is a numerical value and is 100 for full spectrum natural white light. Incandescent lights are considered nearly white and has CRI close to 100. Most lights have CRI typically in the range 20 to 80.

The CRI model is not a perfect model and should only be used to compare light source with the same colour temperature. For example (about) 6000K daylight fluorescent and clear mercury has CRI of 76 and 22 respectively. The daylight fluorescent will therefore render colours better than clear mercury. The difference between a 3400K tungsten halogen with CRI 99 and ordinary 2800K incandescent with CRI 92 can usually also be differentiated by most observers. Despite the small difference in CRI values, the tungsten halogen will render colours more vividly compared to the ordinary incandescent.
The Colour Temperature of light is correlated to the temperature of a laboratory ‘black body’ and its corresponding colour as it is heated through the various stages of incandescent from red to blue-white. The Correlated Colour Temperature (CCT) is in Kelvin. The colour rendering index (CRI) for each source is shown in brackets.

The concept of Colour Temperature and Colour Rendering Index is important in interior and landscape lighting design as visual acuity include colour rendering of objects.
The example above shows contrast in colour rendering between two different type of lights. The ‘White SON’ (on the left) with a ‘whiter’ light (CRI about 60-70 or colour temperature about 3000ºK) brings out the colour of its surrounding more vividly compared to the normal ‘orange SON’ (on the right). The normal ‘orange SON’ with a CRI about 20 and colour temperature of about 2000ºK essentially emits light in the yellow to red spectrum. In this case (on the right), the colour of the trees (which is green) cannot be seen.
Common mistakes by Malaysian designers, overzealous use of SON lamps, creating a ‘yellow haze’ without any colour rendering.
Correct Application of lights to achieve good colour rendering in a street scene.

Note the contrast from the previous slide. Using ‘white SON’ to bring out the colours in a street scene.

Colour rendering has important consequence on façade lighting and interior lighting. Colour rendering is important if the task requires visual

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This slide illustrates the difference in colour rendering on interior objects using light source of CRI 85 (on the left) and CRI 70 (on the right). Designers should pay attention to the CRI of light source selected. In retail application, a CRI of not less than 80 would be required.
The choice of lamp type is important in interior and landscape lightings. In road lighting, where visual discrimination of shapes is sufficient and colour rendering is not important, HPS can be acceptable. However in case where colour rendering is important, e.g. effect lighting, building façade lighting, interior work area which require fairly good colour rendering then higher CRI is required, e.g.

- In area where reading activity is encountered, CRI of at least 75 would be required (daylight or at least warm white fluorescent).
- In effect lighting e.g. feature highlight, wall washing etc., a CRI of at least 85 may be required, in this case metal halide or halogen may be required.
From the table we can see that the Low Pressure Sodium (LPS) is the most efficient lamp in terms of wattage of light (lumens) output. However LPS suffers from a relatively short lamp life. The next most efficient lamp is the high pressure sodium (HPS). HPS has a 50% more lamp life than LPS. Due to this HPS (or sometimes referred to as ‘SON’ lamps are the most popular lamp type for street lightings. However both HPS & LPS has very low colour rendering index. case white SON,
Section 6 – Lighting Design

<table>
<thead>
<tr>
<th>Working Area</th>
<th>E Level (Lux)</th>
<th>Power Rate (W/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restaurants</td>
<td>200 lux</td>
<td>15 W/m²</td>
</tr>
<tr>
<td>Offices</td>
<td>300 – 400 lux</td>
<td>15 W/m²</td>
</tr>
<tr>
<td>Classrooms/lecture theatres</td>
<td>300 – 500 lux</td>
<td>15 W/m²</td>
</tr>
<tr>
<td>Auditoriums/Concert Halls</td>
<td>Refer MS8993 (200lux)</td>
<td>15 W/m²</td>
</tr>
<tr>
<td>Hotel/Motel/Guest Rooms</td>
<td>Refer MS 8993</td>
<td>15 W/m²</td>
</tr>
<tr>
<td>Lobbies/Atrium/Concourse</td>
<td>100 lux</td>
<td>20 W/m²</td>
</tr>
<tr>
<td>Supermarkets/Dept Store/Shops</td>
<td>200 – 750 lux</td>
<td>25 W/m²</td>
</tr>
<tr>
<td>Store/Warehouse/Corridors/Toilets</td>
<td>100 lux</td>
<td>10 W/m²</td>
</tr>
<tr>
<td>Car Parks</td>
<td>100 lux</td>
<td>6 W/m²</td>
</tr>
</tbody>
</table>

Practitioner should note other requirement prescribed by other laws on lighting level, e.g. lighting level for car parks in shopping complex is now required at minimum of 150 lux (for reasons of safety and security).
Calculation of Lighting Level – illuminance (lux)

The Room Index Method is the traditional method used by design engineers for lighting calculations.

- It is a manual form of calculation.
- It has more than 50 years of history.
- Many design engineers are STILL using this method.
- Simple software program also utilises this method.
- In most cases, this method is adequate and may not be sufficient to accurately gauge lighting level on a micro design basis.
- This method IS NOT suitable in effect lighting.

Calculation of Lighting Level – illuminance (lux)

Calculation: Lux = I * D / R

Where:
- Lux: Illuminance (Lux)
- I: Illuminance (Footcandles)
- D: Distance (Feet)
- R: Refractive Index

Lighting Design Equation: Lux = Footcandles * Distance / Refractive Index

Calculation:

1. Determine the Illuminance (Footcandles)
2. Determine the Distance (Feet)
3. Use the Refractive Index for the material
4. Calculate Lux using the formula

Example:

Illuminance = 200 Footcandles
Distance = 10 Feet
Refractive Index = 1.5

Lux = 200 * 10 / 1.5 = 1333.33 Lux

<table>
<thead>
<tr>
<th>Footcandles</th>
<th>Distance</th>
<th>Refractive Index</th>
<th>Lux</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>10</td>
<td>1.5</td>
<td>1333.33</td>
</tr>
</tbody>
</table>

Use the LIGHT LEVEL CALCULATION SHEET for detailed calculations.
Lighting software (for interior lighting) make calculations by using the geometry of space and the mathematics of optical flux in 3-D space.

- More accurate/optimal design
- Micro effect on space planning possible
- Isolux diagram plot.

Free Software ➔ http://www.dialux.com

Free Software ➔ http://www.visuallightingsoftware.com
The following 2 slides illustrate a case study of an office space by using software design tool. This slide shows target lighting level for office at 200 – 300 lux.
This slide shows lighting design with an average of about 480 lux for office space.
A summary of the calculation shows that doubling the lux level will double the number of light fittings.

<table>
<thead>
<tr>
<th></th>
<th>Case 1</th>
<th>Case 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of office</td>
<td>672 m²</td>
<td>672 m²</td>
</tr>
<tr>
<td>Average illuminance</td>
<td>220 lux</td>
<td>480 lux</td>
</tr>
<tr>
<td>Eave/Emin</td>
<td>4.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Typical spacing</td>
<td>4.8m row</td>
<td>4.8m row</td>
</tr>
<tr>
<td>of 2’x4’; 2x32W T8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>troffer light box</td>
<td>4.8m</td>
<td>2.4m</td>
</tr>
<tr>
<td>No of light troffer</td>
<td>23</td>
<td>45</td>
</tr>
<tr>
<td>W/m² with 6W ballast</td>
<td>2.6 W/m²</td>
<td>5 W/m²</td>
</tr>
<tr>
<td>W/m² with 4W ballast</td>
<td>2.5 W/m²</td>
<td>4.9 W/m²</td>
</tr>
<tr>
<td>W/m² with electronic</td>
<td>2.2 W/m²</td>
<td>4.3 W/m²</td>
</tr>
<tr>
<td>ballast</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14 February 2009
Types of Ballast

Magnetic Ballast:
Standard Loss = 10 – 12 W
Low Loss = 8 – 6 W
Super low loss = 4 W

Electronic Ballast:
Standard Loss ~ 1 W
**Fluorescent tube diameter designation comparison**

<table>
<thead>
<tr>
<th>Tube diameter designations</th>
<th>Tube diameter</th>
<th>Extra</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Imperial</strong></td>
<td><strong>Metric</strong></td>
<td><strong>Inches Ø (&quot;)</strong></td>
</tr>
<tr>
<td>T4</td>
<td>N/A</td>
<td>4/8&quot; Ø</td>
</tr>
<tr>
<td>T5</td>
<td>T16</td>
<td>5/8&quot; Ø</td>
</tr>
<tr>
<td>T8</td>
<td>T26</td>
<td>9/8&quot; Ø 1&quot; Ø</td>
</tr>
<tr>
<td>T9</td>
<td>T29</td>
<td>7/8&quot; Ø 1 1/8&quot; Ø</td>
</tr>
<tr>
<td>T12</td>
<td>T38</td>
<td>12/8&quot; Ø 1 1/2&quot; Ø</td>
</tr>
</tbody>
</table>

Fluorescent tubes designation T12, T8, T5 etc. are listed in 1/8 of an inch diameter. Thus the old T12 lamps (20W, 40W) have 1 ½" diameter, whilst the current T8 lamps have 1" diameter. T5 lamps are the most current for energy efficiency (5/8" diameter) and are especially designed for electronic ballast.
Clause 6.5 prescribes lighting control:

- Automatic lighting controls for lighting loads exceeding 100kW.
- Lighting zone control to take into account:
  - Day light
  - 1 switch for max. 1kW of lighting load.
  - 1 switch for each task or group of task within an area less than 30m².
- Automatic switch/timer for external lights.
- O & M manual for lighting system.
- Zone switching concept may be integrated into Building Management System (BMS) with multi-level switching scenario:
  - Security lighting (after 10 pm) – 10% on
  - Late night/after office hours – 40% on
  - Normal operation – 90% on
- ‘Alternate’ connection of light fittings to circuits is a simple, cost-effective concept for implementing multi-scenario zone switching.
The above illustrates a shift in thinking for open office concept. Open offices are designed with minimal future retrofitting (irrespective of future tenant). The above concept can only proceed with acceptance by the client and space planning by the architect.
Innovative /creative measures (chiefly involving the architect with input from the lighting engineer) include channeling day light into the inner recesses of a 'deep' building. Where daylighting is use, glare control is an important consideration to include in the design. The use of light diffusers and/or channeling the direct sunlight to diffusing reflectors are some examples.
Energy Management Systems area normally a sub set of the building management system and comprise ‘PLC’ (programmable logic controllers) and/or computers automatically monitoring and actively controlling the functions of a building M&E systems. The maturity of the industry is currently such that the designer can choose from a multitude of technologies which suit his need. The above diagram illustrates the 3 major technologies:

1. Conventional data cable (twisted pair) connection.
2. Power line cable connection (connection using existing power circuits).
3. Wireless radio frequency or infrared connections.
The ‘Efficient Management of Electrical Energy Regulations’ (2008) comes into force on 15 December 2008. It makes energy efficiency a mandatory requirement for building managers. The regulations apply to all following installations/buildings which consume or generate electricity of 3,000,000 kWh within a 6 months period. Installation/building covered under this regulations will be required to conduct energy audits, employ/appoint energy managers/facilitators and
Some pitfalls in implementing BMS/EMS:

- **Information Overload** Designers tend to be overzealous in implementing BMS. Monitor points and/or control equipment should only be included where essential. The designer in this case must also have some idea of the operation and maintenance procedure of the installation to gauge the extent of monitoring and controls.

- **Adopt Open System** where possible. Proprietary system traps a system operator into a supply/maintenance relationship with a vendor.

- **Simplicity** in design is the best option. In many cases, technology over-hype drives a designer (or client) to over complicated or sophisticated solution, when the level of sophistication may not be required.

- **Scalability** System must be scalable i.e. easy for future upgrades, and amenable to future modifications, which can be easily implemented without expensive referrals to ‘experts’ from overseas.
The above EMS system shows a simple EMS system. The numbers beside each sub system indicates the priority level of the system to be implemented. Thus the simplest system may only implement logging of electric energy (kW and kWh). Many small buildings/installation may fall under this category. Depending on the size of the project, being implemented, chiller controllers (typically separate and supplied by the chiller vendor may be included. Notice that lighting controls using BMS falls at level 4 priority. Due to the complexity of switching of lights, it more be more practical to implement simple timer-controlled switching of lighting circuit.
ENERGY MODELLING; SECTION 10

Section 10 is a whole new section devoted to energy modelling as an alternative method to assess compliance with MS1525.

- Energy Modelling is a performance-based criteria.
- Time stepped energy consumption pattern is modelled taking into account:
  - ACMV performance with consideration for OTTV/RTTV, thermal zones, climatic data etc.
  - Lighting with day lighting
  - Other M&E sub systems
- Is performed for a base-building and for a designed building.
- Compliance is confirmed if the designed building do not exceed the base-building in energy consumption rate.
- Exception is granted in case renewable energy is also included (e.g. photovoltaic).

Performance-based standards refers to standards which specify performance criteria for compliance, e.g. ‘the system must achieve performance rate of 5W/m² etc. In contrast, prescriptive-based standards (which most current standard would be classified) relies on clear rule-based statements, e.g. chilled water system MUST be used where air cond space is more than 3000m². Performance-based criteria allows for more creativity on the part of the designer. However, the designer must be more proficient in understanding the theory and practice behind design. In contrast, prescriptive-base criteria is more restrictive on designers. However designers need not be highly knowledgeable on the theory and practice of the system specified.
Energy Modelling; Free Software

- http://www.trnsys.com/
- http://sel.me.wisc.edu/trnsys/
- http://sel.me.wisc.edu/trnsys/downloads/download.htm
- http://www.iesve.com/content/default.asp?page=s130
Notwithstanding the availability of software, the usage of such software must be executed by a practitioner who understands energy consumption pattern and usage. Understanding energy demand and profile is fundamental in planning for energy modelling and designing or planning for E.E. measures.
Simulating energy use within a building requires an understanding of load profiles and energy consumption pattern.

An example of energy use profile is shown in the next slide as an illustration. The energy profile is based on the case study of:

COMMERCIAL COMPLEX
COMPRISING:
3 Storey Podium
18 Storey Apartment
26 Storey Office
1.3million ft²
This chart shows electricity demand for the case study building. The figures are typical for commercial building in Malaysia.
This chart shows electricity usage (which is a more useful indicator).
As a comparison, this chart is typical of commercial building in Singapore. A major difference is the lower chiller plant load (29% compared to 40% for a typical building in Malaysia.)
This chart shows energy use in a typical building in temperature climate. Note the substantial portion for heating.
1. **Demand Diversity** ($C_d$): Max. Demand (kW) = Connected Load (kW) x $C_d$

2. **Load Diversity** ($C_L$): Total kWh = Max. Demand (kW) x Hour Run (hr) x $C_L$

**Connected Load**

**Transformer capacity**

**Max. Demand**

**Average Demand**

**Energy consumed = Area under curve = kWh**

**Hour run/day**

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- **CONNECTED LOAD** = Total load (kW) connected to the system.
- **Maximum Demand** = Actual maximum demand (kW) logged during a ‘billing’ month.
- **Transformer capacity** = rated capacity of the transformer (kW or kVA). Transformer capacity usually must be at 15%-25% above maximum demand.
- **The electrical energy consumed is a summed of the area under the demand curve.**
- **The average demand over a period where the [Actual kWh] = [average demand] x hour in the period**

Energy and load demand estimation is fundamental to sound and economical system design and is a basis for identifying strategy for E.E.
Typical weekday consumption profile of an office building

**Power Consumption, Monday**

- Total
- General Power & AHU Fans
- Chiller Plant
- General Lighting
- Miscellaneous

A/C lunch hour off period

Base Load

Time, h

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

0 100 200 300 400 500 600 700

Power in KW
weekly consumption profile of an office building
Complementing the MS1525 are 2 publications dealing with detail measures for fulfilling E.E. targets.
OTHER PUBLICATION ON E.E. (Malaysian Perspective)

- Published by JKR
- Strong sections on:
  - Building envelope
  - Shading & building fenestration
  - Lighting
- This publication signal strong commitment from the Government sector in implementing E.E. for federal government buildings.
OTHER PUBLICATION ON E.E.
(Malaysian Perspective)

- Published by PTM
- Practice Guides for
  - Transformers
  - Motors
  - Chillers
  - Cooling Towers
  - Fans and Blowers
  - Pumps
  - Air Compressors
  - Lighting