

AFEO Energy WG: AEI for Electrical Installation in Buildings

Feasibility Study – White Paper on Electrical Installation Standards in Buildings amongst ASEAN Countries

Report Outline

1.0 ASEAN Electrical Installation Standards Executive Summary

1.1 Objectives

This feasibility study is an initiative of the ASEAN Engineers Register (AER) Committee – ASEAN Engineering Inspectorate for Electrical installation in buildings. It is being carried out and championed by the ASEAN Federation of Engineering Organisations (AFEO) Energy Working Group, led by the Electrical Engineering Technical Division of the Institution of Engineers, Malaysia (IEM).

Two (2) **milestones** have been set to be achieved in line with the objectives of the formation of AFEO itself which is to:

- ❖ promote goodwill and mutual understanding
- ❖ establish and develop an ASEAN baseline standard for the engineering profession with the objective of facilitating the mobility of the engineers within the ASEAN countries.

In order to achieve the aforementioned milestones, few immediate and long term objectives have been identified.

The **immediate objectives** are to:

- ❖ review, study and identify the possible gap in the various ASEAN Countries Electrical Installation Standards & Regulations and Application
- ❖ update the ASEAN Engineering Inspectorate (AEI) Electrical Installation Guidelines based on inputs from the survey.
- ❖ facilitate mobility of engineers with knowledge sharing of each country's practices and current applicable Standards & Regulations.

The **long term objectives** are to:

- ❖ provide training and certification of electrical engineers and contractors as per AEI guidelines
- ❖ work in line with the ASEAN initiatives of ASEAN Connectivity 2025 and to initiate a MRA for Electrical Installation Works amongst ASEAN Countries
- ❖ work towards the harmonisation of ASEAN Electrical Installation Standards & Regulation

1.2 Study Methodology

The following methodology as shown in Figure 1 has been adopted in carrying out the study.

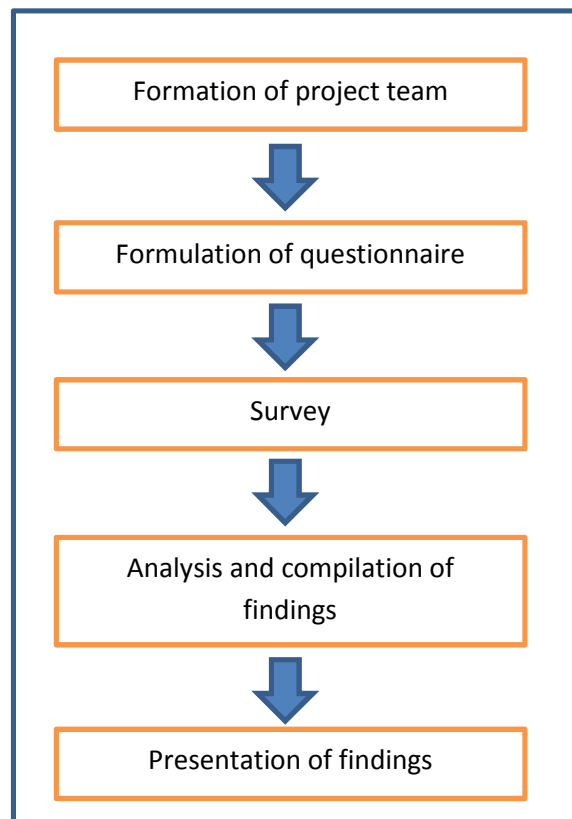


Figure 1: Methodology of this feasibility study

While adopting the methodology, the following are the key details:

- a) Briefing on the feasibility study and confirmation of Steering Committee Team and Stakeholders which comprises of AFEO members
- b) Finalisation of project plan and questionnaires with focus on –
 - I) Current Local Standards being applied
 - II) Local Roadmap on Electrical Safety & Installation Practices
 - III) Local Regulatory Body and Its Function
 - IV) Relevant person for Electrical Safety & Installation Issues
- c) Detailed ASEAN Country survey visits including visits to relevant authorities; interviews with stakeholders in each respective country and discussion/workshop with various country representatives. All countries are expected to be covered during the study.

The questionnaire used during the study is attached in Appendix A. Initially, the questionnaire was prepared based on the Malaysian stakeholders' point of view. As the survey progresses to each country, the questionnaire was further improvised and expanded with the addition of more questions in order to enhance the comprehensiveness of the study.

1.3 Reference Standards

Upon completion of the survey, it was observed that the electrical installation in ASEAN countries is largely based on three major standards:

- ❖ IEC 60364
- ❖ BS 7671
- ❖ NFPA 70

In addition, the following standards are referred to during the study. The list is not exhaustive but they are references made throughout the study:

a) **Malaysian Bylaw, Regulations & Standards**

- I. Electricity Regulations 1994
- II. Electricity Supply Act 1990 (Act 447)
- III. Electricity Supply Application Handbook, Tenaga Nasional Berhad
- IV. Fire Services Act 1988 (Act 341) and Regulations
- V. Uniform Building By - Laws 1984 (Act 133) and Regulations
- VI. Occupational Safety and Health Act 1994, (Act 514)
- VII. MS 1586: Part 3, Low voltage fuses - Part 3: supplementary requirements for fuses for use by unskilled persons (Fuses mainly for household and similar applications)
- VIII. MS 1979:2015, Electrical installations of buildings - Code of practice (First revision)
- IX. MS IEC 60038, IEC standard voltages
- X. MS IEC 60204-1, Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- XI. MS IEC 60332-1, Tests on electric cables under fire conditions Part 1: Test on a single vertical insulated wire or cable
- XII. MS IEC 60364-1, Electrical installations of buildings - Part 1: Fundamental principles, assessment of general characteristics, definitions
- XIII. MS IEC 60364-4-41:2007, Low-voltage electrical installations - Part 4-41: Protection for safety- Protection against electric shock
- XIV. MS IEC 60364-4-42, Electrical installations of buildings - Part 4-42: Protection for safety -Protection against thermal effects
- XV. MS IEC 60364-4-43:2003, Electrical installations of buildings - Part 4-43: Protection for safety- Protection against overcurrent
- XVI. MS IEC 60364-4-44:2007, Electrical installations of buildings - Part 4-44: Protection for safety- Protection against voltage disturbances and electromagnetic disturbances

- XVII. MS IEC 60364-5-51:2007, Electrical installations of buildings - Part 5-51: Selection and erection of electrical equipment - Common rules
- XVIII. MS IEC 60364-5-52:2003, Electrical installations of buildings - Part 5-52: Selection and erection of electrical equipment - Wiring systems
- XIX. MS IEC 60364-5-53:2003, Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control
- XX. MS IEC 60364-5-54:2004, Electrical installations of buildings - Part 5-54: Selection and erection of electrical equipment - Earthing arrangement and protective conductors
- XXI. MS IEC 60364-5-55, Electrical installations of buildings - Part 5-55: Selection and erection of electrical equipment - Other equipment
- XXII. MS IEC 60364-6-61:2003, Electrical installations of buildings - Part 6-61: Verification – Initial verification
- XXIII. MS IEC 60529, Degrees of protection provided by enclosures (IP Code)
- XXIV. MS IEC 61008-1, Residual current operated circuit-breakers without integral overcurrent protection for household uses (RCCBs) - Part 1: General rules
- XXV. MS IEC 61009, Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
- XXVI. MS IEC 61024-1:2001, Protection of structure against lightning - Part 1: General principles
- XXVII. MS IEC 61386-1, Conduit systems for cable management - Part 1: General requirements
- XXVIII. MS IEC 61643, Low voltage surge protective devices (all parts)
- XXIX. MS IEC 62305, Protection against lightning (all parts)

b) IEC Standards

- I. IEC 60445, Basic and safety principles for man - machine interface, marking and identification- Identification of equipment terminals, conductor terminations and conductors
- II. IEC 60617, Graphical symbols for diagrams
- III. IEC 60949, Calculation of thermally permissible short-circuit currents, taking into account nonadiabatic heating effects
- IV. IEC 62275, Cable management systems - Cable ties for electrical installations

c) Other Relevant Standards

- I. BS 7430, Code of practice for protective earthing of electrical installations

1.4 Key findings & Recommendations

1.4.1 Table of comparison

Description	Malaysia	Malaysia (Sarawak)	Brunei	Laos	Myanmar	Cambodia	Singapore	Thailand	Indonesia	Vietnam	Philippines
Electricity Regulations & Electrical Safety Regulations Authority	Energy Commission (EC)	Electrical Inspectorate Unit (EIU), Ministry of Public Utilities Sarawak	Department of Electricity Services (Till 2018)	The Ministry of Energy and Mines	Electrical Inspection Department, Directorate of Supervision and Inspection, Ministry of Industry	Ministry of Mines & Energy	Energy Marketing Authority (EMA)	Energy Regulatory Committee (ERC)	Direktorat Jenderal Ketenagalistrikan (DGE)	Ministry of Industry and Commerce, Ministry of Science and Technology, Ministry of Construction and other relevant ministries.	Board of Electrical Engineering (BEE)
Standards Writing Authority	Department of Standards Malaysia (DSM)	Refer to Department of Standards Malaysia (DSM)	Department of Electricity Services	The Ministry of Energy and Mines	Technical Committee of Electrical & Electronic, Ministry of Education	Ministry of Mines & Energy For Electrical Installation Works	Spring Singapore (Standards, Productivity and Innovation Board)	Engineering Institute of Thailand (EIT) – for engineering standards	Standards Nasional Indonesia (SNI)	Directorate for Standards, Metrology and Quality (STAMEQ)	Institute of Electrical Engineers (IIEE) Philippines
Registration of Electrical Products	Energy Commission (EC)	Electrical Inspectorate Unit (EIU), Ministry of Public Utilities Sarawak	Authority For Building Construction Industry (ABCI) – Consumer Product	The Ministry of Energy and Mines	Electrical Inspection Department, Directorate of Supervision and Inspection, Ministry of Industry	Not Available	Spring Singapore (Standards, Productivity and Innovation Board)	Thai Industrial Standards Institute (TISI)	Lembaga Sertifikasi Produk	Ministry of Science and Technology (MOST)	Bureau of Products Standards (BPS)

Description	Malaysia	Malaysia (Sarawak)	Brunei	Laos	Myanmar	Cambodia	Singapore	Thailand	Indonesia	Vietnam	Philippines
National standards on Electrical Installation and Electrical Safety	MS1979, MS1936 & MS IEC 60364	Refer to Malaysian Standards & International Standards	Electricity Installation Regulation 2011	Lao Electric Power Technical Standards	Electricity Law 2014, National Building Code 2016	The Electricity Law - promulgated by the Royal Decree no.NS/RKM/0201/03, dated February 02, 2001	CP 5 & CP 88	Thai Electricity Code 2013	Electrical Installation Regulation: Persyaratan Umum Instalasi Listrik (PUIL) 2011	National Technical Regulation on Electrical Installations of Dwelling and Public Building & National technical regulation on Electric safety	National Electrical Code (NEC)
General Reference Standards	IEC	IEC/BS	IEC	IEC	IEC	IEC	IEC/BS	IEC	IEC	IEC	Mixture

1.4.2 Recommendation

According to most of the countries under the survey, there has not been any involvement and activities of this collaborative nature thus far.

The following are some of the key findings from the survey:

- a) Existence of Electrical Installation Act & Regulations
 - ❖ All ASEAN Member States (AMS) have already put in place the electricity law and regulations implemented to the member state.
- b) Standards Reference for Electrical Installation
 - ❖ Majority of the ASEAN Member States (AMS) are currently using IEC standards as reference. A portion of the states are using British Standards (BS) or National Fire Prevention Association (NFPA) as reference.
- c) Agencies Related to Standard Development
 - ❖ All ASEAN Member States (AMS) have already put in place agencies to be responsible in standardization of the electrical installation standards.
- d) Registration
 - ❖ Majority of the ASEAN Member States (AMS) have registrations in place for the electrical design engineers, electrical engineers, electrical products and electrical installation works.

2.0 Development and Recent ASEAN Initiatives

2.1 Global Landscape of Electrical Installation Standards and Development

A standard is a document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. An International Standard is a standard adopted by an international standards organization and made available to the public.

The International Electrotechnical Commission (IEC) is a not-for-profit, quasi-governmental organization, founded in 1906. IEC prepares and publishes International Standards for all electrical, electronic and related technologies – collectively known as "electrotechnology". IEC standards cover a vast range of technologies from power generation, transmission and distribution to home appliances and office equipment, semiconductors, fibre optics, batteries, solar energy, nanotechnology and marine energy as well as many others. The IEC also manages three global conformity assessment systems that certify whether equipment, system or components conform to its International Standards.

The IEC's members are National Committees, and they appoint experts and delegates coming from industry, government bodies, associations and academia to participate in the technical and conformity assessment work of the IEC.

The IEC is one of the bodies recognized by the World Trade Organization (WTO) and entrusted by it for monitoring the national and regional organizations agreeing to use the IEC's international standards as the basis for national or regional standards as part of the WTO's Technical Barriers to Trade Agreement.

The definition given in all IEC standards reads: "A normative document, developed according to consensus procedures, which has been approved by the IEC National Committee members of the responsible committee in accordance with Part 1 of the ISO/IEC Directives."

The word "consensus" is important since it represents a common viewpoint of those parties concerned with its provisions, namely producers, users, consumers and general interest groups. IEC's International Standards are reached by international consensus among the IEC's members (National Committees). Any member of the IEC may participate in the preparatory work of an International Standard, and any international, governmental and non-governmental organization liaising with the IEC also participates in this preparation.

Another vital feature of a truly international standard is the fact that it can be submitted to public enquiry in any of the IEC NCs' countries. Thus, through the democratic tools of consensus and public enquiry, any interested party may speak up and have their say in the development and publication of an international standard.

An International Standard is approved if:

- a) a two-thirds majority of the votes cast by the P-members of the technical committee or sub-committee are in favour, and
- b) not more than one-quarter of the total number of votes cast are negative.

Adoption of IEC standards by any country, whether it is a member of the Commission or not, is entirely voluntary.

2.2 Development of ASEAN standards and roles of ASEAN

Standards centric domestic regulations drive ASEAN Coherence. According to ISO, a standard is a document that provides requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that materials, products, processes and services fit for their purpose.

Since Year 2000, ASEAN under the ambit of AFTA embarked upon the process of developing MRAs for the cross border trade (CBT) in goods such as E&E Equipment (EEE), Cosmetics, Pharmaceutical products, etc. Those MRAs were framed based on principles of WTO's TBT Agreement. The (first generation) MRA for IEC Standards centric E&E (albeit controlled consumer) Equipment was realised by 2002; operationalised by AMS' designated regulators over electrical safety of consumer products. Stakeholders' objective is: 1 standard, 1 test, and 1 approval. It lowers the cost of CBT in EEE; and promotes seamless trade in a common market. In response, the JSC implementing the ASEAN MRA on E&E Equipment (EEE) then developed AHEEERR, realised in 2005, but implemented by all AMS in 2015. AHEEERR is a "baby-step" towards ASEAN coherence.

With effect from 31st December 2015, the ASEAN Economic Community (AEC) has become a reality; and its planned evolution for the next ten years in the period; 2016 to 2025 is envisaged in the **AEC Blueprint 2025**, which laid down the deliverables to enable ASEAN (more so the AEC) to attaining five interrelated and mutually reinforcing characteristics, namely:

- ❖ A highly integrated and cohesive Economy;
- ❖ A competitive, innovative and dynamic ASEAN;
- ❖ Enhanced connectivity and sectoral cooperation;
- ❖ A resilient, inclusive, people-oriented and a people-centred ASEAN; and
- ❖ A Global ASEAN.

The AEC Blueprint 2025 is a 48 page, 91 para 10-year perspective plan. **In summary**, standards centric domestic regulations drive an integrated and cohesive AEC that will be competitive, innovative and dynamic; enabling Stakeholders to participate at the enhanced level of Global Value Chains. The springboard to that goal is for Stakeholders to be trained in Standards Compliance as a way of life in our occupation and profession; and have our views, hope & aspiration heard at the ASEAN "higher levels" of regional governance – e.g. at AEM and the ASEAN Summit.

It is recommended that ACPECC should initiate a study [by AMS stakeholder engineers and other engineering services professionals (ESPs)] on how to develop pan-ASEAN domestic regulations governing approval of engineering design/construction practices that will lead to realising a legal certification for fitness of occupation of buildings.

2.3 ASEAN Electrical Standards Development – Role of ASEAN

At ASEAN level, the ASEAN Consultative Committee on Standards and Quality (ACCSQ) has been endeavoured to harmonise standards as one of the means to support the establishment of an integrated market. The task of overseeing the harmonisation undertaken by its product working groups is assigned to Working Group 1 on Standards and Mutual Recognition Arrangements (WG 1).

As such in 2014, the ASEAN Guidelines for Harmonisation of Standards were prepared by WG 1 in order to ensure that a common and consistent approach to harmonisation of standards is adopted by the product working groups under the ACCSQ. This document defines the roles of the parties involved in the harmonisation process. The document was developed through deliberations between ASEAN Member States managed by WG 1. The Guidelines clarify existing practices and arrangements and are intended to serve as a reference to the product working groups and also for national standards bodies of ASEAN Members States. The ASEAN Guidelines for Harmonisation of Standards was endorsed by the ACCSQ at its 42nd ACCSQ Meeting held in Yangon, Myanmar from 22 to 17th September 2014.

The establishment of the ASEAN Economic Community (AEC) is reliant on harmonised standards. The harmonisation is undertaken to enable the removal of technical barriers to trade, especially when such barriers arise due to differences in standards referenced in technical regulations and used for mandatory conformity assessment procedures.

The ASEAN Economic Community (AEC) Blueprint calls upon ASEAN Member States (AMSs) to “Harmonise standards, technical regulations and conformity assessment procedures through their alignment with international practices”.

Chapter 7 of the ASEAN Trade in Goods Agreement (ATIGA) requires AMSs to harmonise their national standards with international standards as a means of removing unnecessary trade barriers. These Guidelines elaborate on the provisions that address harmonisation of standards as contained in the ASEAN Guideline on Standards, Technical Regulations and Conformity Assessment procedures (AG-STRACAP). It provides guidance to AMSs for facilitating the implementation of the provisions of the AG-STRACAP.

Taking into consideration the decision in the AEC Blueprint with regards to the importance of external trade to ASEAN and the need for the ASEAN Community as a whole to remain outward looking, the approach adopted in these Guidelines is consistent with the AGSTRACAP, in that harmonisation is reliant on international standards and practices. ASEAN has taken a decision not to establish an additional layer of standardisation between national standards and international

standards and not to publish unique ASEAN Regional Standards, but instead rely on existing international standardisation platforms.

As all AMS's are members of the World Trade Organisation (WTO), the provisions of Article 4.1 of the WTO Technical Barriers to Trade (TBT) Agreement apply and national standards bodies are obliged to adopt the Code of Good Practice for the Preparation, Adoption and Application of Standards (Annex 3 of WTO/TBT Agreement)

2.4 ASEAN Electrical Installations Situation

Currently, only two major milestones have been achieved in ASEAN pertaining to the electrical & electronics sector which is the ASEAN Sectoral Mutual Recognition Arrangement for Electrical & Electronic Equipment (ASEAN EE MRA) and The Agreement on ASEAN Harmonised Electrical and Electronic Equipment Regulatory Regime (AHEEERR).

2.4.1 ASEAN Sectoral Mutual Recognition Arrangement for Electrical & Electronic Equipment (ASEAN EE MRA)

Developed by EPWG (Electrical Product Working Group), EPWG was formed in 1999 and comprises ASEAN Electrical and Electronic Equipment (EEE) regulators main objective to develop the ASEAN EE MRA to support free trade initiatives.

MRA was then signed by ASEAN Economic Ministers (AEM) in 2002. The joint sectoral committee on Electrical and Electronic Equipment (JSC EE MRA) replaced EPWG upon signing of MRA by AEM. The JSC EE MRA is formed to implement the MRA and serves as platform by each member state to provide latest update on its EEE Regulatory Regime.

The MRA provides for recognition of test results and product certifications conducted by listed testing laboratories and certification bodies, respectively, in ASEAN thereby allowing the products tested and certified in the source country to verify compliance of the products to the importing country requirements prior to export. This saves costs and reduces time to market of an EEE product without compromising consumer safety and product quality.

The EEE sector has progressed beyond the MRA. While the ASEAN EE MRA is an effective tool for facilitating the entry of the product to the importing country, it does not fully address the existence of technical barriers with different national standards still in existence, and different conformity assessment procedures that apply for the same EEE product.

Hence this led to the birth of the Agreement on ASEAN Harmonised Electrical and Electronic Equipment Regulatory Regime (AHEEERR).

2.4.2 The Agreement on ASEAN Harmonised Electrical and Electronic Equipment Regulatory Regime (AHEEERR)

The Agreement on ASEAN Harmonised Electrical and Electronic Equipment Regulatory Regime (AHEEERR) was signed in December 2005 by the AEM to integrate the EEE sector in the area of standards and conformity assessment. Under the AHEEERR, the essential requirements for EEE have been defined, including health, safety and electromagnetic compatibility. Common standards are to be used for a particular EEE product, to accompany common conformity assessment procedures.

An ASEAN risk assessment guideline for EEE has also been developed as a basis for a common approach to determining the risk level of EEE, while an appropriate conformity assessment regime will be applied throughout the AMS.

2.4.3 Latest Development of ASEAN EE MRA and AHEEERR

To date (ASEAN Secretariat information at the end of 2015), there have been 121 international standards identified as meeting the essential requirements of the AHEEERR. In the absence of an international standard, relevant regional or national standards may be used. However, if necessary, the Joint Sectoral Committee (JSC) for EEE may supplement the listed standards with mutually agreed harmonised regulatory requirements. If different editions of international standards are being used by the AMS, or more than one standard can be applied, then the JSC EEE may consider listing more than one standard.

The AHEEERR places demands within several areas which are interrelated: the creation of harmonised standards ensuring the ER are met; the ability to harmonise conformity assessment in its broader context of measurement, methodology, certification and accreditation; the operation of effective post-market surveillance to protect consumers; and the essential compliance with any MRA. The failure to address issues in any one of these areas would compromise the operation of the AHEEERR. In this regard the JSC has the following guidelines in place, to date:

- ❖ Listed Mandatory Standards that meet the essential electrical safety requirements of the AHEEERR.
- ❖ Guidelines to determine the type of Conformity Assessment Regime based on the risk assessment for EEE.
- ❖ Guidance notes on the applicable Conformity Assessment Regime for the AHEEERR.
- ❖ Post-Market Surveillance Guidelines on EEE.

These guidelines were developed by the JSC on EEE for the implementation of AHEEERR. It is anticipated that more guidelines will be developed to provide clarity on implementation. Areas include such requirements as essential standards for electromagnetic compatibility and environmental protection.

Under the ASEAN EE MRA, any EEE product that has been tested or certified by a listed testing laboratory or certification body, respectively, would be accepted as having met the regulatory requirements of the importing AMS. As of June 2015, 16 testing laboratories and 5 certification bodies from five AMS were listed. As yet there have been no listed certification bodies from Brunei Darussalam, Cambodia, Lao PDR, Myanmar or the Philippines. Two testing laboratories from the Philippines are under process for listing.

A number of private sector business associations are specifically focused on the EEE sector. They currently operate in Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. As yet, there is no umbrella or apex ASEAN organisation representing the sector although the Asia Electronics Forum (AEF) has representation from some national associations. The AEF has met annually since 2004 as a venue for business associations representing the electronics sector to discuss and exchange views on important issues affecting electronics industries in the region. There is also the ASEAN Supporting Industries Database, a private enterprise-run data repository that includes information on electrical and electronics suppliers and is accessed through a membership-based system.

2.5 Catalyst and Hindrance towards Harmonisation of Electrical Installation in the ASEAN Region

2.5.1 Catalyst

There are already precedence and initiatives in the ASEAN region in the harmonisation of the Electrical Installation Standards. This could be reflected in the implementation of:

- a) ASEAN Sectoral Mutual Recognition Arrangement for Electrical & Electronic Equipment (ASEAN EE MRA)
- b) The Agreement on ASEAN Harmonised Electrical and Electronic Equipment Regulatory Regime (AHEEERR)

This will certainly provide a guide or reference in the implementation of the Electrical Installation Standards Harmonization. ASEAN has also set up numerous WGs in line with AEC Blueprint 2025.

2.5.2 Hindrance

However, the following hindrance or obstacles towards harmonisation of electrical installation have also been identified:

- a) lack of push in dissemination of knowledge of standards usage amongst AMS particularly in smaller provinces and states
- b) lack of push towards harmonisation of the electrical Installation amongst the regulatory bodies of AMS and government agencies
- c) lack of capacity building and discussion amongst AMS that requires fund to trigger the movement. Currently AFEO is an NGO and efforts are needed to seek for financial support for the harmonization to materialise.

2.6 The Electrical Installation Standards Cooperation

Throughout the survey across the 10 ASEAN member states, few of the developing countries are being assisted by international funds to develop their countries' electrical installation.

At the point of this study, no initiatives in standardization of the electrical installation have been found.

3.0 Detailed Studies and Outlook of Each ASEAN Country

3.1 BRUNEI DARUSSALAM

The output is based on the discussions with the following organizations:

- a) LKA Consult
- b) Department of Electrical Services
- c) The Institution of Engineering and Technology Brunei
- d) Pertubuhan Ukur Jurutera & Arkitek (PUJA)

3.1.1 Act & Regulation

3.1.1.1 Electricity Act 2008

Under the jurisdiction of Department of Electrical Services

3.1.1.2 Electricity Regulation

Under the jurisdiction of Department of Electrical Services

3.1.2 Mandatory Standards

Electrical Installation Requirement 2011 (EIR) is the mandatory standards which is based upon the IET Wiring Regulation.

3.1.3 Government Agencies

3.1.3.1 Department of Electrical Services

Department of Electrical Services (DES) reports to Energy Industry Department, which in return reports to Prime Minister Office.

3.1.3.2 Standard Council

Standard Council advises the Prime Minister Office regarding matters pertaining to standards. Under the Standard Council, there is an Electrical Standard Committee which develops the quality electrical safety standards.

3.1.4 Standards Development

Under the jurisdiction of Department of Electrical Services. Most of the standards are divided into two groups where Electrical Products are using IEC Standards while the Electrical Installation is using the IET.

3.1.5 Registration

3.1.5.1 Electrical Engineer

The engineers have to register with the Board of Architect, Professional Engineers and Quantity Surveyors (BAPEQS)

3.1.5.2 Electrical Contractor

There are three different classes' categories of contractors where the registration is under the Department of Electrical Services.

3.1.5.3 Electrical Products

The registration of products fall under the jurisdiction of Authority for Building Construction Industry (ABCI)

3.1.5.4 Electrical Competent Person

E01 – LV Wiring Installation

E02 – External LV

E03 – High Voltage

E04 – Neon, Signboard and Special Lighting

E05 – HV Cable Barrier

3.1.6 Statistics on Electrical Safety

3.1.7 The Electricity Distribution Company

Not Verified

3.1.8 Power Quality Requirements

Not Verified

3.1.9 Voltage Level

3.1.10 Inspection

3.1.11 Constraints

3.1.12 Other Findings Relevant to Our Studies and General Institutional Findings

3.2 CAMBODIA

The output is based on the discussions with the following organizations;

- a) Ministry of Energy and Mines
- b) Electricity Authority of Cambodia
- c) Board of Engineers, Cambodia

3.2.1 Act & Regulation

3.2.2 Mandatory Standards

3.2.3 Government Agencies

3.2.3.1 Ministry of Energy and Mines

3.2.3.2 Electricity Authority of Cambodia

3.2.4 Standards Development

3.2.5 Registration

Registration of electrical products fall under the jurisdiction of Ministry of Industry

3.2.6 Statistics on Electrical Safety

3.2.7 The Electricity Distribution Company

Not Verified

3.2.8 Power Quality Requirements

Not Verified

3.2.9 Voltage Level

115kV and 230kV

3.2.10 Inspection

3.2.11 Constraints

3.2.12 Other Findings Relevant to Our Studies and General Institutional Findings

3.3 INDONESIA

The output is based on the discussions with the following organizations;

- a) Electrical Contractor Association (AKLI)
- b) Inspection Electrical Installation Agency (KONSUIL)
- c) Himpunan Ahli Elektro Indonesia (HAEI)
- d) Electronic Appliances Manufacturer Association – (APPI)
- e) DGE Ministry of Energy and Mineral Resources
- f) Persatuan Insinyur Indonesia (PII)

3.3.1 Act & Regulation

3.3.2 Mandatory Standards

3.3.2.1 PUIL 2011

1. Electrical Installation Regulation: Persyaratan Umum Instalasi Listrik (PUIL) 2011
 - a. Versions: 1964, 1977, 1987, 2000, 2011
 - b. PUIL covers the entire Indonesian region
 - c. PUIL as a Standar Nasional Indonesia (SNI) together with Peraturan Menteri EDSM (Kementerian Energi dan Sumber Daya Mineral) – Direktorat Jenderal Ketenagalistrikan has been made as a regulation
 - d. General – Protection to human, livestock and asset
 - e. Covers design, installation and verification of electrical installation for:
 - i. Domestic
 - ii. Non-domestic (commercial, public, industrial, agricultural, biomedical, PV system, etc)
 - iii. 1000VAC or 1500VDC

3.3.3 Government Agencies

3.3.3.1 DGE-Regulatory-Director-General Electric-Ministry of Energy – Direktorat Jenderal Ketenagalistrikan

DGE-Regulatory-Director-General Electric-Ministry of Energy – Direktorat Jenderal Ketenagalistrikan is involved in the followings:

- Formulation of policies in the field of electricity
- Implementation of policies in the field of electricity
- Arrangement of norms, standards, procedures and criteria in the field of electricity

- Provision of technical guidance and evaluation in the field of electricity
- Implementation of the administration of the Directorate General of Electricity

3.3.3.2 Konsuil

Konsuil is a government appointed non-profit institution under the Act as an institution that checks the suitability of installed electrical installations with the applicable electrical installation standards.

3.3.3.3 Badan Standardisasi Nasional

3.3.4 Standards Development

3.3.5 Registration

Electrical equipment has to be endorsed and certified by Lembaga Sertifikasi Produk which is accredited by Komite Akreditasi Negara (KAN) including SNI labeling on the products

Electrical Installation has to be verified and approved by KONSUIL (Komite Nasional Keselamatan untuk Instalasi Listrik) atau PPILN (Perkumpulan Pemeriksa Instalasi Listrik Nasional), Sertifikat Laik Operasi (SLO) will be issued upon approval

Lampiran VII – Peraturan Menteri Energi dan Sumber Daya Mineral Republik Indonesia – Nomor 05 Tahun 2014 Tentang Tata Cara Akreditasi dan Sertifikasi Ketenagalistrikan – Mata Uji Sertifikasi Instalasi Pemanfaatan Tenaga Listrik Tegangan Rendah

Every electrical installation must fulfil SNI/IEC and/or other relevant standards

Frequency of Periodic Verification (Kekerapan Verifikasi Periodik)

- a. Periodic Verification Report – recommending make good and upgrading of existing electrical installation to fulfil the standards by a competent person responsible for the verification
- b. Report has to be signed and endorsed by a competent person

3.3.6 Statistics on Electrical Safety

3.3.7 The Electricity Distribution Company

3.3.8 Power Quality Requirements

3.3.9 Voltage Level

3.3.10 Inspection

3.3.11 Constraints

3.3.12 Other Findings Relevant To Our Studies And General Institutional Findings

3.4 LAOS

The output is based on the discussions with the following organizations;

- a) Lao Union of Science and Engineering Association (LUSEA)
- b) Department of Energy Policy and Planning, Ministry of Energy and Mines
- c) Electricity Du Lao
- d) EDL Generation Public Company

3.4.1 Act & Regulation

3.4.2 Mandatory Standards

3.4.3 Government Agencies

3.4.4 Standards Development

3.4.5 Registration

3.4.6 Statistics on Electrical Safety

3.4.7 The Electricity Distribution Company

Not Verified

3.4.8 Power Quality Requirements

Not Verified

3.4.9 Voltage Level

3.4.10 Inspection

3.4.11 Constraints

3.4.12 Other Findings Relevant to Our Studies and General Institutional Findings

3.5 MALAYSIA

The output is based on the discussions with the following organizations;

- a) Institution of Engineers, Malaysia
- b) Suruhanjaya Tenaga

3.5.1 Act & Regulation

3.5.1.1 Peninsular and Sabah

3.5.1.1.1 Electricity Act 1990

This act is available for download or view from this link <insert here>

3.5.1.1.2 Electricity Regulation 1994

This regulation is available for download or view from this link <insert here>

3.5.1.1.3 Energy Commission Act 2001

3.5.1.2 Sarawak

3.5.1.2.1 The Electricity Ordinance – Chapter 50 (Revised 2003)

3.5.1.2.2 The Electricity Rules, 1999

3.5.1.2.3 The Electricity (State Grid Code) Rules, 2003

3.5.2 Mandatory Standards

3.5.2.1 MS IEC 60364

3.5.2.2 MS 1936

- Electrical installations of buildings – Guide to MS IEC 60364

3.5.2.3 MS 1979

- Electrical installations of buildings – Code of Practice

3.5.2.4 MS IEC 62305

3.5.3 Government Agencies

3.5.3.1 Energy Commission

Suruhanjaya Tenaga (ST), a statutory body established under the Energy Commission Act 2001, is responsible for regulating the energy sector, specifically the electricity supply and piped gas supply

industries in Peninsular Malaysia and Sabah. Fully operational on January 1, 2002, the EC took over the role of the Department of Electricity and Gas Supply, which was dissolved on the same date. The Commission's responsibilities are enshrined by the Energy Commission Act 2001, and the following acts and regulations:

- ❖ Electricity Supply Act 1990 [Act 447] as amended in 2015
- ❖ Gas Supply Act 1993 [Act 501]
- ❖ Electricity Regulations 1994 as amended in 2014
- ❖ Licensee Supply Regulations 1990
- ❖ Electricity Supply (Compounding of Offences) Regulations 2001
- ❖ Efficient Management of Electrical Energy Regulations 2008
- ❖ Gas Supply Regulations 1997
- ❖ Gas Supply (Compoundable Offences) Order 2006

3.5.3.2 Electrical Inspectorate Unit Sarawak

The functions of Electrical Inspectorate Unit Sarawak are to:

- ❖ advise on the policy and direction with regard to the planning and development for an adequate, reliable, efficient, affordable and safe power system in the State
- ❖ monitor the technical performance of the electricity industry in general and licensees in particular to ensure technical compliances and public safety
- ❖ provide an environment that encourages continued investment in the sector, efficiency improvement and to protect consumer interests

The duties are:

- ❖ licensing of electricity generation and supply
- ❖ registration of electrical installations
- ❖ registration of electrical contractors
- ❖ issuance of Certificate of Competency for Competent Person
- ❖ establishment or adoption of technical and safety standards, monitor performance and enforce compliances
- ❖ regulate safety of electrical equipment and appliances
- ❖ conducting accidents notification and investigations
- ❖ technical and economic regulation in the planning, development and operation of the power grid system

3.5.3.3 DSM

3.5.4 Standards Development

In Malaysia, the Malaysian National Electrotechnical Committees (MyENC) was established to develop electrotechnical standards in Malaysia. In view that Malaysia adopts IEC standards. MyENC was formed to represent Malaysia as the member in the International Electrotechnical Commission (IEC). The main functions of the MyENC are to:

- ❖ represent Malaysia's interest in all matters pertaining to the working of the IEC and its various committees.
- ❖ promote and encourage the participation in the IEC activities by the local stakeholders in the electrotechnical industry.
- ❖ promote and facilitate domestic and international trade through services provided by the IEC.
- ❖ recommend to the Malaysian Standards and Accreditation Council (MSAC) strategies, programs and activities to promote industrial efficiency and development and for consumer protection through standardisation in the electrotechnical sector.
- ❖ recommend to the Council on priorities in respect to standardisation, both national and international, to ensure maximum effectiveness in the electrotechnical sector.
- ❖ establish the Industry Standards Committees (ISCs) in the electrotechnical sector which include the membership composition, appointment of chairmen, scopes and their terms of reference.
- ❖ perform any other functions as may be determined or delegated by the Council.

3.5.5 Registration

The Energy Commission regulates a list of 34 nos. of electrical household equipment and this equipment requires certificate of approval to manufacture, import, display, sell or advertise and their applicable safety and performance standards.

3.5.6 Statistics on Electrical Safety

3.5.7 The Electricity Distribution Company

3.5.8 Power Quality Requirements

3.5.9 Voltage Level

3.5.10 Inspection

3.5. 11 Constraints

3.5.12 Other Findings Relevant To Our Studies And General Institutional Findings

3.6 MYANMAR

The output is based on the discussions with the following organizations;

- a) Myanmar Engineering Society
- b) Association of Government Technical Institute
- c) Myanmar Electrical Manufacturer Association

3.6.1 Act & Regulation

Electricity Regulation 1985

3.6.2 Mandatory Standards

3.6.3 Government Agencies

3.6.3.1 Electrical Inspection Department

EID reports to Directorate of Industrial Supervision and Inspection and in return, reports to the Ministry of Industry

3.6.4 Standards Development

3.6.5 Registration

3.6.5.1 Electrical Competent Person

Registration with the Ministry of Labour with 4 levels of trade skills

3.6.5.2 Electrical Products

Ministry of Industry and Ministry of Commerce are regulatory authority for the registry. The Electrical Inspection Department will issue the electrical equipment safety certificates.

3.6.6 Statistics on Electrical Safety

Ministry of Industry have the records of electrical accidents across the country.

3.6.7 The Electricity Distribution Company

Yangon Electricity Supplier

3.6.8 Power Quality Requirements

Not Verified

3.6.9 Voltage Level

3.6.10 Inspection

3.6.11 Constraints

3.6.12 Other Findings Relevant to Our Studies and General Institutional Findings

3.7 PHILIPPINES

The output is based on the discussions with the following organizations;

- a) Association of City and Municipal Electrical Engineers and Electricians (ACMEE)
- b) Society of Philippine Electrotechnical Constructors and Suppliers
- c) Institute of Electrical Engineers (IIEE)
- d) Philippines Technological Council
- e) IEC TC1/TC77
- f) Philippines Electrical Codes

3.7.1 Act & Regulation

3.7.2 Mandatory Standards

3.7.2.1 *Philippines Electrical Code (PEC)*

3.7.3 Government Agencies

3.7.3.1 *Energy Regulatory Commission*

Energy Regulatory Commission supervises all electrical utilities at Philippines and is also in charge of ensuring affordable, reliable, sustainable and safe power to all. Philippines is the first ASEAN country in deregulating power generation with as many as 160 utilities. National grid operation covers thermal geothermal, wind, hydro and solar.

3.7.3.2 *Board of Electrical Engineering (BEE)*

The Board of Electrical Engineering (BEE) is involved in electricity regulations and electrical safety regulations. The Philippines Electrical Code (PEC) is based on NEC (NFPA 70). PEC falls under National Building Code. There is also Labour Code based on OSHA.

3.7.3.3 *Institute of Electrical Engineers (IIEE)*

3.7.4 Standards Development

Institute of Electrical Engineers (IIEE) Philippines is the main organisation involved in standards writing and local government implement them once the standards become code. It is interesting to note that Philippines Electrical Code (PEC) is being taught at electrical engineering programme. PEC 1 covers building structure and PEC 2 covers outside distribution. At the point of survey, IIEE is developing Guide for Designing & Installation for Services. The Philippines has adopted NEC since 1960's as WTO member. It also adopts IEEE, ANSI, UL and NEMA. The National Fire Code (The Philippines) is also referring to National Safety Code (US). NEC will automatically include standards

on solar and wind and IIEE can then adopt them. There are recreational vehicle and electrical vehicle standards in the pipeline. BEE (Republic Act 7920 or New Electrical Engineering Law 1995) PEC is revised every 4-5 years. Development of standards on solar is work in progress. National Electrical Code (NEC) is the main code for reference. Roadmap or future plans include electric car charging stations and smart grid

3.7.5 Registration

3.7.5.1 Electrical Engineers

Electrical Design Engineer needs to register with BEE. BEE reports to Professional Registration Commission (PRC).

Graduate engineer has to sit for a board exam in order to become registered electrical engineers. After 4 years of working experience, the registered electrical engineers can sit for an exam and upon passing can be registered as professional engineers

For electrical installation, there needs to be a registered Master Electrician

PCAB registers electrical contractor for both government and private. Sustaining Technical Employee is the technical qualification required for PCAB license. PCAB reports to DTI.

Electrical Inspectorate is in charge of registration of electrical installation or inspection works. After completion of construction, government inspectorate will certify based on safety (fire) code. Government means city or municipal.

Philippines Contractors Accreditation Board (PCAB) issues license to electrical contractor

Electrical installation plan signed by PE is the requirement for application of wiring permit for electrical installation works. Certificate of final electrical inspection will be done upon final inspection.

Since early 1990's, BPS has implemented Import Commodity Clearance (mark).

3.7.5.2 Product Registration

Bureau of Products Standards (BPS) is in charge of registration of electrical products. Electrical product is regulated by Department of Trade and Industry (DTI)

3.7.6 Statistics On Electrical Safety

For electrical accidents, the statistics lies with the Bureau of Fire Protection. Electrical fire could be attributed to appliance, machines or connection issues. 26.7% of fire incidents is due to electrical. Department of Health is responsible in determining the cause of fire that burns victim to death.

3.7.7 The Electricity Distribution Company

Utility complies with Electrical Distribution Code. Distribution licensee has to adhere to National Distribution Code

3.7.8 Power Quality Requirements

3.7.9 Voltage Level

3.7.10 Inspection

3.7.11 Constraints

3.7.12 Other Findings Relevant To Our Studies And General Institutional Findings

The mandatory colour code for cable is white for Neutral and green for Ground. Positioning of cables is used for others to differentiate the cables. For testing purpose, it is done by tagging A-B-C.

There are more than 140 distribution operators. Some of the distribution licensee adopted Asia Power Quality Initiative (APQI).

PEC is the minimum requirement. MERALCO is the biggest utility. Power factor should be at least 0.86 for industrial. Total Harmonic Distortion should not exceed 15% as per IEEE 59.

MERALCO has a checklist for inspection of solar PV rooftop installation

Electrical wiring permits are issued by local government electrical division. Certificate of electrical inspection is issued upon completion. Only then power is supplied.

BPS registers electrical products. For instance, ground fault circuit interrupters for wet areas.

Bureau of Fire Protection may have statistics for fire accidents but not for shock which is under Department of Health.

New colour code for cables has yet to be adopted.

Load flow study and short circuit analysis report for all electrical installation should be submitted for approval by local government.

3.8 SINGAPORE

The output is based on the discussions with the following organizations;

- a) Singapore Manufacturing Federation
- b) International Electrotechnical Committee (IEC)
- c) The Institution of Engineers, Singapore (IES)
- d) Singapore Electrical Contractor Association

3.8.1 Act & Regulation

3.8.1.1 Electricity Market Authority Act

Not Verified

3.8.1.2 Electricity Act 2002

Not Verified

3.8.1.3 Electricity Regulation

Not Verified

3.8.2 Mandatory Standards

3.8.2.1 CP5

CP5 is a gazette code under Electricity Act 2002 while other code of practices is only recommended best practices. Updated CP5 scheduled for public comment on mid-2017, and still based on BS7671 CP5 is still based on BS 7671/IET 17th Wiring Regulation rather than IEC60364 due to the difference in tripping time for ELCB/RCCB for 13A system. In current CP5 that based on BS7671, there are two suffixes namely L for localized and R for reserved for use. If IEC is to be adopted, there will be too many "R"s.

3.8.3 Government Agencies

3.8.3.1 Energy Marketing Authority (EMA)

EMA is the statutory body. Enforcement on electrical act, regulation and CP5 is by EMA.

3.8.3.2 Standard Development Organization

SPRING appoints SDO to assist for the standard development.

3.8.3.2.1 Singapore Manufacturing Federation

Food, Medical, General Engineering and Manufacturing SDO (4 different categories)

3.8.3.2.2 SPRING

Electrical SDO

3.8.3.2.3 The Institution Engineers, Singapore

Construction SDO

3.8.3.2.4 Chemical Association

Chemical SDO

3.8.3.3 SPRING

SPRING is in charge of CPS (Consumer Product Safety) and CP5 (electrical installation). Compliance to CP5 is mandated by electrical act while technical report is not as it is not permanent. SPRING is also pushing for accreditation of consultants. SPRING is developing product reliability law, similar to Europe, which is essential in conjunction with installation safety, to complete the system safety. SPRING has developed its own standards for instantaneous water heater. SPRING is in charge of 34 regulated items.

3.8.4 Standards Development

Under National Committee, there is Technical Committee. Under Technical Committee, there is Working Group. Stakeholders of Working Group are IES, LTA, HDB, SECA and Singapore Polytechnics. There are roadmaps for electrical safety on smart city, PV, charging of electric vehicle and cybersecurity

Most of the standards are comply with the IEC with the exception of CP5, which follows IET 17th Edition/BS 7671. For the product of electrical appliances/equipment, if there are no IEC standards, UL standard shall be adopted.

3.8.4.1 CP88

CP88 is mentioned in CP5 as a circular for temporary installation. Under CP88, there are building for temporary supply, fire alarm and shipyard (to be removed).

3.8.5 Registration

3.8.5.1 Contracting Firm

Singapore used to issue LEC (Licensed Electrical Contractor) for electrical contractors but has since been removed. However, any electrical contractor now would still needs to be under the supervision of LEE/LEW. IES has proposed QEC (Qualified Electrical Contractor) registry.

Licensed contractor registration was removed in line with liberalization of trade under the World Trade Organization

3.8.5.2 Engineers

Upon graduation, an electrical engineer has to work 5 years and sit for 2 exams prior to PE interview under Professional Engineer Board (PEB). First exam is on fundamentals and can be taken upon graduation while the second exam is on practicing experience where reports have to be submitted.

3.8.5.3 Building Inspectors

Not Verified

3.8.5.4 Licensed Electrical Worker

Application for LEE/LEW can only be done with EMA after obtaining PE. An LEW now has to sit for differentiated exams for different voltage levels under the new amendment, 1kV, 22kV, 66kV, 230kV.

LEW applicants are not required to attend any formal training prior to application. PUB used to provide such training. SECA offers some basic overview training or observation of an actual testing job to interested persons.

Level 1: Electrician – 45kVA

Level 2: Technician – 800A

Level 3: Engineers – As per below:-

- 1000V
- 32kV
- 66kV

3.8.6 Statistics on Electrical Safety

Statistics of electrical accidents can possibly be sourced from Ministry of Manpower or Ministry of Health

3.8.7 The Electricity Distribution Company

Not Verified

3.8.8 Power Quality Requirements

Not Verified

3.8.9 Voltage Level

230V

400V

22kV

66kV

3.8.10 Inspection

Before energization of an electrical installation, checking and inspection has to be done by Licensed Electrical Worker (LEW) under Singapore Power. Inspection of electrical installations at night market has to be done on a daily basis. Inspection of electrical installations at construction sites has to be done on a monthly basis. For commercial buildings, inspection has to be done yearly by SP and certified by EMA.

For electrical installation operating at higher than 45kVA, an LEW has to be present to be responsible.

Multitenant buildings need inspection by LEW every 6 months. SP Services conduct full inspection, certificate of compliance. (Residential/Domestic). LEW to conduct full inspection, certificate of compliance (Commercial).

3.8.11 Constraints

- a) Switches becoming hot/burnt, difficult to categorize into product or installation issue. Product reliability an issue not covered in CP5.
- b) IEC don't have installation standard for LED
- c) Universal socket outlet not allowed in CP5
- d) ESE are not allowed in Singapore, however an enhancement or additional are okay as long it has comply to the basic standard code

3.8.12 Other Findings Relevant to Our Studies and General Institutional Findings

Wiring color codes of brown, black and grey as per IEC has already been mandated.

Voltage regulation is within +6% and -6% compared to +10% and -6% in Malaysia.

Submission of Fire Protection Systems is separated into architect and mechanical engineers. For the passive design, architect shall be the one to endorse the drawing where else for the active design shall be endorsed by the Mechanical Engineers.

Singapore is proposing a Product Reliability Law to enhance product safety.

HDB now applies surge arrester built-in for domestic installations.

CP10 is for fire alarm, CP15 is for escalators, and CP39 is for MATV.

New codes would replace CP with SS. SS209 (Battery), SS530 (Energy Efficiency), SS531 (Illumination which comprise of Part I, II and III), SS535 (Standby Operation of Generators), SS538 (Maintenance of Equipment), SS550 (Lift), SS 551 (Grounding), SS 555 (Lightning) and SS 561 (Intrusion Alarm)

As supplementary references, EMA also publishes handbook for solar PV, charging of Electric Vehicle, fire codes and smart city.

Code 538 for calibration is implemented on Owner's initiative.

3.9 THAILAND

The output is based on the discussions with the following organizations;

- a) Engineering Institute of Thailand (EIT)
- b) International Copper Association – Thailand (ICA)

3.9.1 Act & Regulation

Not Verified

3.9.2 Mandatory Standards

Not Verified

3.9.3 Government Agencies

3.9.3.1 Energy Regulatory Committee (ERC)

Energy Regulatory Committee (ERC) falls under Ministry of Energy and its role is to issue regulations, rules, announcements or criteria, procedures and conditions in order to regulate various issues in the energy industry as prescribed by law.

3.9.3.2 Thailand Industrial Standards Institute (TISI)

TISI is the national standards organization for Thailand. TISI was established under the Ministry of Industry by virtue of the Industrial Product Standards Act B.E. 2511. According to the Act, TISI has, as its governing body, the Industrial Product Council which controls its policy, sets the priority of standards to be prepared, recommends qualified persons for the Minister to appoint to TISI technical committees, arbitrates and awards licenses under certification scheme.

3.9.3.3 Council of Engineers (COE)

The Council of Engineers (COE) is a statutory body under the Engineer Act, B.E. 2542 (1999). The professional engineering services in Thailand are regulated and controlled under the Act which is the central regulatory body for engineering services in Thailand.

3.9.4 Standard Development

Standards produced by EIT are being applied by the government as mandatory standards. They are largely based on IEC standards with partial adoption of IEEE Brown Book/NFPA.70/Germany Standards. Their criteria of adoption of standards are easy to install, operate, maintain and cost-efficient. Under the Electrical Engineering Technical Division of EIT, there are many working committees which include Electrical Installation, Data Center, Lightning Protection and few others. The standards are revised every 3-5 years.

3.9.5 Registration

3.9.5.1 Contracting Firm

At least 50% of the executive board of contracting firms should be licensed engineers of at least level 1 registered with Council of Engineers.

3.9.5.2 Engineers

Level 1 is for associate engineers, level 2 is for professional engineers while level 3 is for senior professional engineers. There is also another level for foreign engineers. They can be registered as adjunct engineers.

3.9.5.3 Building Inspectors

Visual inspection of buildings has to be done annually by certified building inspectors. Building Inspectors falls under Public Works Department.

3.9.6 Statistics on Electrical Safety

National Prevention Accidental Board which was established by the Prime Minister, focuses on disaster and may retain some information on regards of electrical related incidents.

3.9.7 The Electricity Distribution Company

EGAT, managed by Ministry of Energy, oversees power generation and transmission. It is the largest power producer. The power generated is sold to Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA). MEA supplies the Bangkok region while PEA supplies the rest of more than 70 districts (amphur). Under each district, there is another authority called subdistrict (tambon). Both MEA and PEA falls under the jurisdiction of Ministry of Interior and it can be summarized that both handles the distribution grid.

3.9.8 Power Quality Requirements

Not verified.

3.9.9 Voltage Level

The low voltage level for single and three phase were adjusted to suit IEC60364 namely 230/400V. For MEA, the voltage levels beyond low voltage in ascending order are 24kV, 69kV, 115kV, 230kV and 500kV. For PEA, the voltage levels beyond low voltage in ascending order are 22kV, 33kV, 69kV, 115kV, 230kV and 500kV

3.9.10 Inspection

Owners are required to submit to local administration/sub-district/tambon (usually hires contractor to perform the task) before MEA or PEA connects the electricity supplies to the user. Commercial buildings are required to be inspected annually.

For owners of factories, those documents are required for submission to Ministry of Industry instead of local administration. Inspection for factories is conducted bi-annually.

3.9.11 Constraints

None.

3.9.12 Other Findings Relevant To Our Studies and General Institutional Findings

Sensitivity of RCBO should not exceed 30mA.

Installation of SPD's is subject to engineering design. ESE is strictly prohibited. Lightning Protection Systems are largely based on NFPA 780, IEC 62305 and EIT blue books.

Lighting circuit are usually separated or do not share the same RCBO with other circuits

3.10 VIETNAM

The output is based on the discussions with the following organizations;

- a) Vietnam Electrical Engineering Association (VEEA)
- b) Vietnam Electrotechnical Industry Association (VELINA)
- c) Directorate For Standards, Metrology And Quality (STAMEQ)

3.10.1 Act & Regulation

3.10.2 Mandatory Standards

Vietnam electrical standard was drafted by the end of 2014 and it took effect as regulation since July 2015. Reference has been made to Malaysian Standards (MS1979) and 67 other standards from different countries.

3.10.3 Government Agencies

Standards are under the purview of Ministry of Science and Technology. Construction & Building Related Codes which is mandatory is under the purview of Ministry of Construction and Ministry of Industry and Trade.

Electricity Regulations and Electrical Safety Regulations are under the management of Ministry of Industry and Commerce, Ministry of Science and Technology, Ministry of Construction and other relevant ministries.

STAMEQ assists MOST for accreditation, standards & quality, national standards development, IEC, ISO, APEC (SESC), and ACCSQ (ASEAN).

3.10.4 Standard Development

Vietnam has national guidelines and standards on, among others, electrical installation, electrical generation, electrical distribution and electrical safety. Plans for future development of forthcoming national guidelines/standards are being under consideration by relevant ministries.

As Vietnam is a tropical country, certain standard is more stringent compared to IEC. Manufactured electrical products follows standards that the country adheres to.

Vietnam has officially adopted a number of international standards, including IEC, Siemens, ABB, Goss. Other international standards will be researched and applied when needed.

MOST regulates 13 products including cable.

Vietnam has issued development plans on electrical installation standards for the 2016-2020 and a vision to 2025.

3.10.5 Registration

No registration of engineers currently. Certificate to design is issued to company, not individual. MOIT regulates design drawings. Wireman needs to attend vocational courses and trainings. Consultants will endorse electrical installation and inspection works. Registration of electrical products was under QUATEST (Quality Assurance and Testing Center).

3.10.6 Statistics on Electrical Safety

Household electrical accidents statistics are not published by the Ministry of Labour. Electrical incidents for industrial usage are minimal.

Statistics on power failures can be obtained from authorities in charge of power supply and management such as EVN, Ministry of Industry and Trade.

3.10.7 The Electricity Distribution Company

Electricity distribution companies do not have their own regulations on their customer. They have to apply compulsory regulations of Ministry of Industry and Trade.

3.10.8 Power Quality Requirements

Power quality standards used for customers are also regulated by Ministry of Industry and Trade.

3.10.9 Voltage Level

3.10.10 Inspection

3.10.11 Constraints

There is currently a lack of enforcement and standards being developed at LV side. Most standards are for MV and HV.

3.10.12 Other Findings Relevant To Our Studies And General Institutional Findings

Currently, VUSTA is still working on roadmap for registration of professional engineers. Under VUSTA, there are 78 professional associations and 63 provisional associations. VUSTA has branches in 63 provinces and also consists of 400 research institutions

STAMEQ is divided into:

- (i) Standards ---policies, guidelines, review of standards, planning

(ii) VSQI---national standards at minister level, technical committees, subcommittees, national standard adopted from IEC 60364

Vietnam is associate member of IEC for TC2, TC20, TC23 and TC61

There are currently 600 QCVN. QCVN originated from TCVN. QCVN is Vietnam technical regulations and is mandatory while TCVN is standards and compliance is on a voluntary basis. QCVN is under the purview of ministry and setting up of QCVN is done as specified in the law.

The cable colours identification are still yellow, blue, black, red and green as referred to the BS standards. Regulations on colour for electrical cables can be obtained from Ministry of Science and Technology, Ministry of Industry and Trade and manufacturers of electrical and cable equipment.

4.0 Indicators & Way Forward

4.1 Electrical Installation Gaps

Upon completion of the survey, the main electrical installation gap lies in the variance in standards being used amongst ASEAN member states. In total, there are 3 major standards being used in the region in regards to electrical installation.

Another gap identified is the differing cable colour codes being used from one country to another. This may hinder or complicate the practice of electrical engineers across the border (e.g. Black in BS7671 is Neutral but Black in IEC60364 is Live).

Last but not least, the standards and regulations pertaining to electrical installation are only available in AMS's own national language. Though it was learned that translation to English is in progress, the expedition of such effort is the key towards harmonisation of electrical installation standards in the region.

4.2 Potential

Within the ASEAN process, standards-related measures imposed by ASEAN member states are subject to the ASEAN Trade in Goods Agreement (ATIGA), specifically Chapter 7 covering Standards, Technical Regulations, and Conformity Assessment Procedures. The Parties reaffirm their commitments under the TBT Agreement and agree to additional provisions under Article 73(2), as follows:

- ❖ harmonise national standards with relevant international standards and practices,
- ❖ promote mutual recognition of conformity assessment results among member states,
- ❖ develop and implement ASEAN Sectoral Mutual Recognition Arrangements and develop ASEAN Harmonized Regulatory Regimes in regulated areas where applicable, and
- ❖ encourage cooperation among national accreditation bodies and national metrology institutes, including relevant legal metrology authorities in the ASEAN to facilitate the implementation of mutual recognition arrangements (MRAs) in regulated and non-regulated sectors.

In addition, under the AEC Blueprint, the ASEAN acknowledges that harmonised standards, technical regulations, and conformity assessment procedures are vital to promote greater efficiency and lower the cost of intra-regional trade.³The ASEAN Policy Guideline on Standards and Conformance ('the Guideline') guides the implementation of the AEC Blueprint concerning standards-related measures. The Guideline aims to provide 'the guiding principles for the implementation of joint efforts of ASEAN Member [States] in the area of standards and conformance both in regulated and non-regulated sectors as one of the measures for accelerating economic integration towards the AEC.' Nonetheless, the AEC Blueprint cautions that the 'identification of standards, technical regulations and conformity assessment procedures to be harmonised or for sectoral MRAs to be developed, must take into consideration the impact on ASEAN trade, the complexity of the regulatory system, the technical infrastructure as well as the feedback from stakeholders.'

Based on this high-level guidance, ASEAN member states seek to prioritise the harmonization of standards and adoption of MRAs where possible, which may culminate in a single regulatory regime, such as those in the cosmetics and electrical and electronic equipment sectors. The basic principle of the harmonization process in the ASEAN is that national standards bodies would need to adopt regionally agreed international standards. If they do not adopt any of the identified international standards as their national standards, then the national standards bodies would accept the direct use of these international standards, meaning that the international standard would be directly applied and utilised in the national context.

4.3 Proposed Activities

Based on the survey results and feedback from the stakeholders, the AEI Steering Committee has chartered its way forward blueprint for the study.

This is in line with the points noted during the AFEO Mid-Term 2017 In Singapore whereby the AFEO Secretary General, Ir. Ong Chin Loon has indicated that the AEI Electrical Committee should look at long term plan and also efforts in providing a master plan in concurrent with the AEC Blueprint 2025. The AEI – Electrical Blueprint (2018-2035) charters the next action plans in 3 stages:

- a) Short Term (2018-2020)
- b) Mid Term (2021-2025)
- c) Long Term (2025-2035)

4.3.1 Short Term (2018-2020)

The short term approach is to create awareness amongst engineers/other stakeholders in ASEAN countries on the electrical installation standards & regulations scenario around the ASEAN region.

The following are the plans:

4.3.1.1 Plans in 2018

AEI Roadshows are being planned across the 10 ASEAN countries by the national working group of AEI to educate and publicised the survey outcome. The individual national working group activity plans are also to be discussed amongst the various AEI Committees to generate localised activities within each country as well. It is also timely after the survey to continue our updates of the AEI Electrical Inspection Guidelines V2.0. We envisaged that the V2.0 would be launched during CAFEO 2018 in Singapore.

4.3.1.2 Plans in 2019

Upon completion of the AEI Roadshows, additional workshops shall be carried out by AEI whereby AEI will be conducting localised Training On Electrical Inspection & Installation to cater for the needs and requirements of the country. AEI Steering Committee would then develop and train up more trainers to further educate the ASEAN electrical engineers on the standards especially in other parts of the provinces/states within the country. AEI also intends to publish a complete guide on AEI Electrical Installation Guidelines by CAFEO 2020. AEI Steering Committee via the National Working Group will also further identify potential stakeholders to be inducted into the AEI Steering Committee as advisors and National Working Group as part of the committee member.

4.3.2 Mid Term (2021-2025)

The mid-term plans would be focusing on bolder plans termed the “Implementation Stage”. In this term, the plan will be divided into four dimensions:

4.3.2.1 Education

Electrical standards will be introduced to university academician/students and to be included as elective/core subject for the universities students. AEI standards curriculum will be developed.

4.3.2.2 Stakeholders

Enhancement of stakeholders’ participation by inclusion of all relevant stakeholders in the national working group will also take place.

4.3.2.3 Standards Usage

Short course/seminar related to standards which provides certification to attendees will be organised to promote standards usage.

4.3.2.4 Registration of Electrical Engineers

Via the AER register, AEI should be able to register ASEAN electrical engineers accordingly to encourage movements of engineers within the region thus encouraging cross border trade.

4.3.3 Long Term (2026-2035)

At this stage, inter-governmental involvement will be intensified.

5 References & Bibliography

Brunei Electrical Installation Requirement 2011 (EIR)

Electrical Installation Regulation: Pensyaratan Umum Instalasi Listrik (PUIL) 2011

Malaysian Standards: MS 1979:2015, Electrical installations of buildings - Code of practice (First revision)

Malaysian Standards: MS 1936:2016, Guide To MS IEC 60364

Malaysian Standards: MS IEC 60364, Electrical Installations of buildings

Lao Electric Power Technical Standards

Myanmar Electricity Law 2014, National Building Code 2016

Cambodia: The Electricity Law - promulgated by the Royal Decree no.NS/RKM/0201/03, dated February 02, 2001

Thai Electricity Code 2013

Vietnam: National Technical Regulation on Electrical Installations of Dwelling and Public Building & National technical regulation on Electric safety

Philippines: National Electrical Code (NEC)

6.0 Acknowledgement

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