Comparison of Electric Power Technical Standards and Policy Making for Technical Cooperation

Guideline

March 2006

Japan International Cooperation Agency
Economic Development Department

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Definition of Terms

	Terms	Explanation
1	Technical Standards	This means how to do (methods and idea in general) to achieve the target from the aspect of safety of electrical equipment. Here in after, Ministerial ordinance should be described as "Technical Standards (Ministerial Ordinance)" to distinguish from general technical standards. Please refer in detail chapter 1.
2	Technical Standards (Minister ordinance)	Prescribed technical standards as ministerial ordinance (Ex. for electrical facility, for thermal power plant, for hydro power plant, etc.)
3	Electrical Facility Technical Standards (Minister ordinance)	Abbreviation of "Technical standards for electrical facility (Ministerial Ordinance)" in Technical Standards.
4	Thermal Power Plant Technical Standards (Minister ordinance)	Abbreviation of "Technical standards for thermal power plant (Ministerial Ordinance)" in Technical Standards.
5	Standards	This prescribes specification of equipment, test methods and procedure. Ex. IEC, ANSI, BS, DIN and so on. Please refer in detail chapter 2.
6	Code	A series of industry provision in general to achieve some target. This should be distinguished form technical standards or standards.
7	Safety System	This means regulation conducted by governmental regulatory body or measure conducted by firm to keep safety of electrical facility, work, operation. Ex. Entry Inspection, Submit Report and so on.

Abbreviation

	Abbreviation	Explanation
1	AFNOR	**Association Francaise de Normalisation** Body which prescribe industry standards in France
2	ANSI	**American National Standards Institution** Body which prescribe industry standards in US.
3	AS	**Australia Standards** Industry Standards which is prescribed by SAI in Australia
4	BSI	**British Standards Institution** Body which prescribe industry standards in U.K.
5	CENELEC	**European Committee for Electrotechnical Standardization** Electrical industry standards in European Standards
6	DIN	**Deutsches Institut fur Noumung** Body which prescribe industry standards in Germany
7	DTI	**Department of Trading and Industry** Regulatory body of government for trade and industry and also electrical utility.
8	EDF	**Electricite de Francaise** Precursor is French Electric Corporation owned by government established in 1946. EDF was privatized (holding company) in 2004, this lead to present condition.
9	ENA	**Energy Network Association** Industrial body of transmission company in U.K.. ENA was established as body of transmission section after deregulation. Precursor is EA which is industry body of electrical utility.
10	GOST	**Gosudarstvennyj Komitet Standartov Ministrov** Industry Standards which is prescribed by S.S.R.R.(Old Soviet National Standards) .
11	IEC	**International Electrotechnical Commission** This was established to promote unification and international harmony for electrical standards.
12	IEEE	**Institute of Electrical and Electronics Engineers** This was established in 1884 and now is the biggest association of electrical engineer in the world. About 150 counties.
13	ISO	**International Standardizing Organization** This was established to promote unification and international harmony for except electrical standards.
14	JEAC	**Japan Electric Association Code** This is voluntary and industry standards and was established to complement" Technical Standards (ministerial ordinance)" .JESC：Japan Electrotechnical Standards and Code Committee.
15	JIS	**Japanese Industrial Standards** This was established by government based on Industry Standardization Law
16	NEC	**National Electrical Code** This is the code which should be complied in electrical work by electrician. This was established by NFPE and approved by ANSI. The object is customer's facilities in general.

17	NESC	**National Electrical Safety Code** This was established by IEEE to protect public safety from the hazard caused by electrical equipment and facility installed and approved by ANSI. The object is facilities for business.
18	NF	**Normalisation de Francaise** Industry Standards which is prescribed by AFNOR in France.
19	NFPA	**National Fire Protection Association** This is Non-profit international organization to provide information concerning the safety of electricity and fire.
20	NZS	**New Zealand Standards** Industry Standards which is prescribed by SANZ in New Zealand.
21	OSHA	**Occupational Safety health Administration** This is the one of the authorities of DOL(Department of Labor) in US. and the body which prescribes relative law from the view point of occupational safety and healthy. The representative law is OSH Act (Occupational Safety and Health Act).
22	SAI	**Standard Australia International** Body which prescribes industry standards in Australia.
23	SANZ	**Standard Association of New Zealand** Body which prescribe industry standards in New Zealand.
24	UTE	**Union Technique de Electricite** Body which prescribes the code concerning electrical engineering(generator, transmission, distribution, equipment), and also is charge in prescribe NF standards.
25	VDE	**Verbamd Deutscher Elektrotechniker** Body which prescribes electrical industry standards in Germany to maintain safety . The lower organization of DIN.
26	VDN	**Verbamd Deutscher Netzbetreiber** Industrial body of transmission company in Germany. The lower organization of DEW(Verband der Elektrizitätswirtschaft).

1 The definition of "Technical Standards"

In Japan, "Electric Power Technical Standards" corresponds to "Technical Standard for Electrical Equipment", the ministerial (Ministry of Economy, Trade and Industry) ordinance, which is used as a proper noun. The reason is that the ordinances cover the standards concerning electric power equipment broadly and the role of the ordinances is as primary standards of electric power equipment. However, strictly speaking, standards for voltage/frequency or for the environment regulated according to Electric Power Industry Law are also technical standards of electric power. The ordinances are not sole technical standards. "Technical Standards" correspond to a very wide range of regulations according to their purpose and object. Therefore, the meaning of "Technical Standards" should be defined clearly before proceeding to project suggestions.

"Technical Standards" usually means "KIJYUN" and "KIKAKU". "KIJYUN" and "KIKAKU" may be confused with each other, so they should be clearly defined to accurately distinguish "Technical Standards". ("KIKAKU" and "KIJYUN" are Japanese words. Both are translated into English as "standards". Therefore we use these Japanese words to make highlight differences here and later in this chapter.)

1.1 Categorizing "KIJYUN" and "KIKAKU"

Each meaning of "KIJYUN" and "KIKAKU" is as follows.

"KIKAKU": This is established based on agreement and approved by an official organization with the aim of achieving adequate order (Ref. " IEC/ISO Guidebook"). This idea is universal. "KIKAKU" is categorized General, Products and Methods.

- General: Here it is defining Term, Symbol, Unit and so on, which are common.
- Products: Here it is defining the shape, size, material, quality and performance.
- Methods: Here it is defining the methods of test, analysis, inspection and work.

We should understand that "KIKAKU" usually prescribes Products and Methods. However, "KIKAKU" has a unique system in each country, so this situation differs in some cases. Especially in Japan, JIS (Japanese Industry Standards), that is Japanese "KIKAKU", is specifies Products, and does not have any parts in common part with "KIJUN". "KIKAKU" of each country (Ex. BS, DIN) is mentioned in detail in section 1.5.

"KIJYUN": This prescribes design and installation methods of facilities or structures. That is to say, prescribes the methods, how or what to do, to achieve the targets. (Especially, safety of not only each type of equipment but also all through the transmission and distribution facility system, including the methods of installation and connection, which are very important. This is because transmission and distribution facilities are composed of several products, such as tower, conductor, transformer etc.)

That is to say, "KIKAKU" and "KIJYUN" don't mean different parts, they have a common part, that is Methods.

Figure 1.1.1 and Figure 1.1.2 show portions of "KIKAKU" and "KIJYUN".

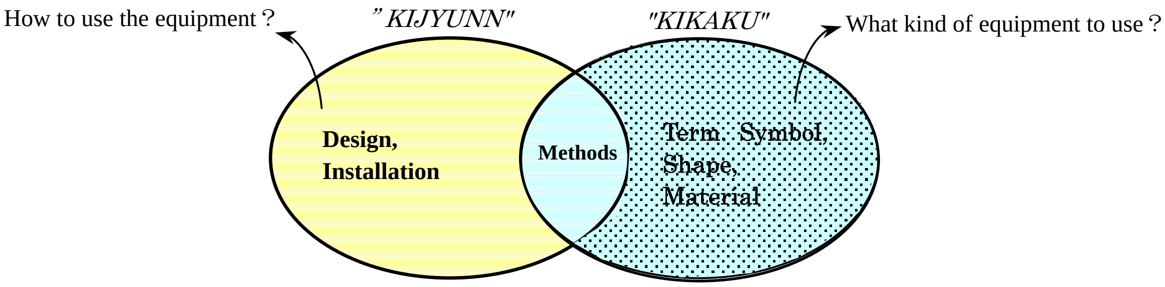


Figure 1.1.1 Concept of "KIKAKU" and "KIJYUN".

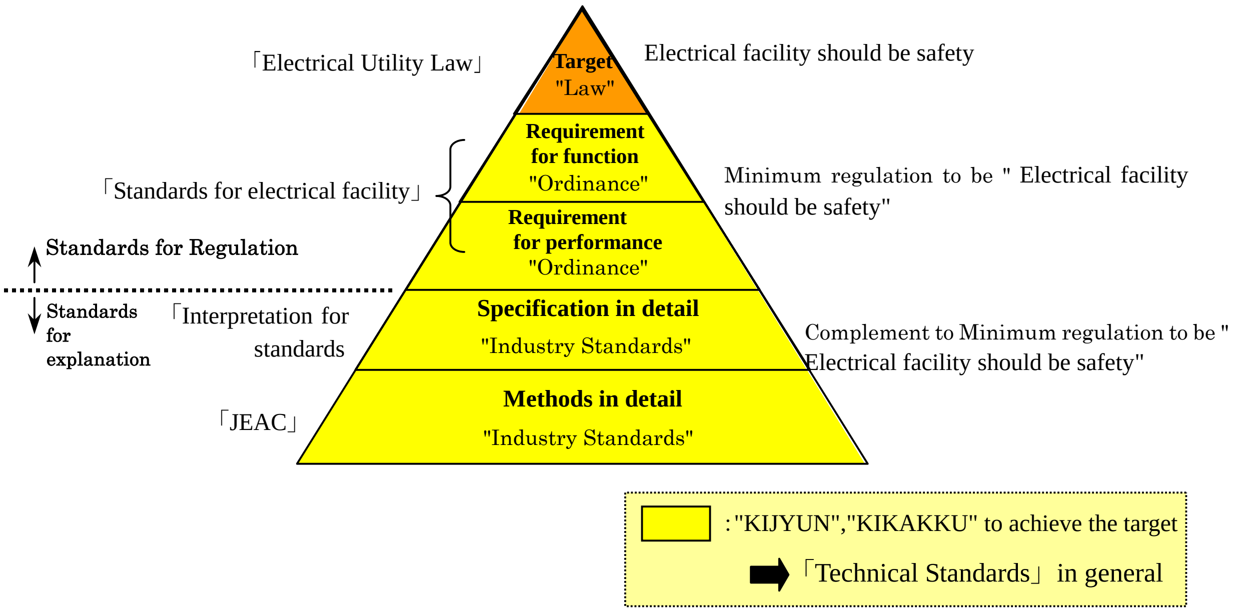
Organization of establishiment	Legal obligation	"KIJYUN","KIKAKU"（Standards)	
		"KIJYUN" for installation of facility	Standards for electrical equipment
State	Yes	Standards for electrical facility	
	Non	Interpretation of standards	
			Japan Industry Standards（JIS）

Figure 1.1.2 Portions of "KIKAKU" and "KIJYUN" (Example in Japan)

As shown in Figure.1.1.1, "KIJYUN" doesn't contain specifications of equipment. These ideas are assumed knowledge in this research report.

1.2 Meaning of "Technical Standards"

Figure 1.2.1 shows the Japanese system of electric power technical standards as an example, and explain the meaning of "KIJYUN" in detail. In this case, standards aiming to achieve a target prescribed in the Electric Power Industry Law, take priority. These standards mean "Technical Standards" in general.



【Reference】Law relative to standards of electrical facility （In the case of Japan）

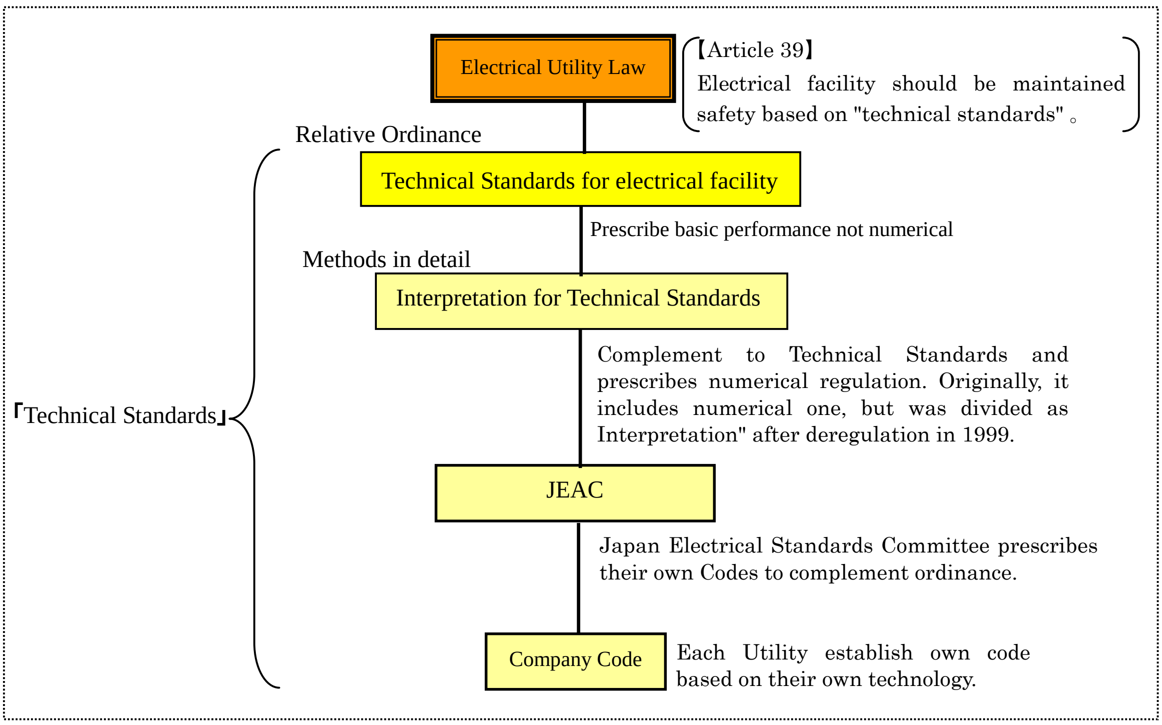


Figure 1.2.1 System of Technical Standards for Electrical Facility (In the case of Japan)

The system shown in Figure 1.2.1 is example of standards aiming to secure safety of electric facilities (that is public safety). In the case where the aim is secure safety of workers, the technical standards correspond to Occupation Safety & Healthy Law. The Technical Standards differ according to the purpose, but the idea that the standards aim to achieve the target, the meaning of "Technical Standards" in general is common.

1.3 What is "Technical Standards" in Technical Assistant?

The dotted part in Figure 1.1.1 shows equipment specification and is unified with international "KIKAKU", that is IEC (International Electrotechnical Commission). Considering this situation, establishment of new national "KIKAKU" is not logical. Therefore in this report, we define this part, excepting that "KIJYUN" corresponds to "Technical Standards" in Technical Aid Program. However we should point out that "Technical Standards" correspond to several kinds of standards according to their purpose and object. "Technical Standards" refer to international or national standards if necessary.

1.4 "KIKAKU" system

Figure 1.4.1 shows the rank of "KIKAKU". Here "KIKAKU" are standards for equipment.

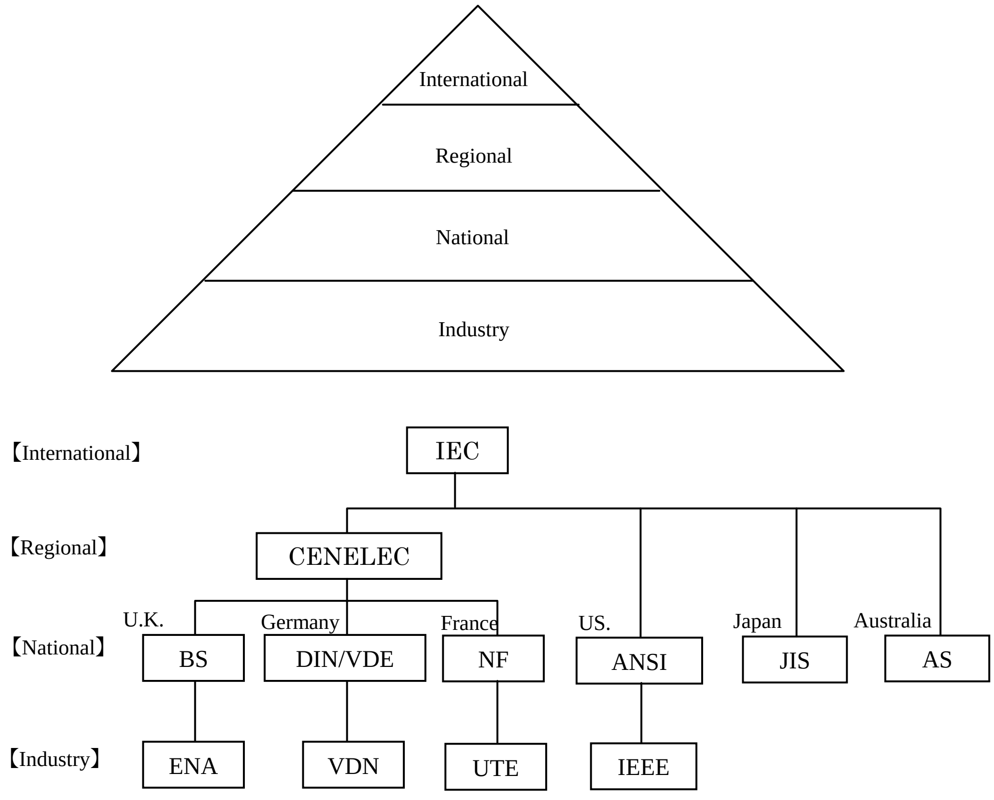


Figure 1.4.1 System of "KIKAKU"

The world's highest ranking standards are the international standards, IEC (International Electrotechnical Commission) standards, concerning electrical engineering. International standards gained their importance, though the need for unified standards in Europe, and therefore establishment of unified standards (European standards) became a matter of great urgency in CENELEC (European Committee for Electrotechnical Standardization) to institute the unitary market in Europe.

At this time, ISO (International Standards Organization) and CEN (European Committee for Standardization) concluded the Vienna agreement concerning technical assistant in the establishment of the standards. Together, IEC and CENELEC concluded the Dresden agreement of in electrical standards. Under these agreements, IEC established its position as the basic standardization. Unified standards are matched with IEC automatically by Dresden Agreement, so Europe is the leading area as unification of standards has proceeded aggressively. Standards for equipment are unified with international standards gradually and worldwide. It follows that is more rational for a developing country that has the ability to adopt international standards, do so, rather than establish new national standards for equipment.

1.5 Foreign Standards

(1) IEC

IEC (International Electro-technical Commission) is the authoritative international organization on standards related to electrical engineering. It was established to reach mutual agreement on standardization of electrical equipment standards. There are fifty industrialized countries that are members of IEC. Recently, some developing countries, such as Indonesia, Philippines, Pakistan, Malaysia, and Thailand in Asia have become members of IEC. Industry Associations, consumer groups, government, and several engineering association have joined the IEC committee as interested parties.

(2) CENELEC

CENELEC (European Committee for Electro-Technical Standardization) was established to establish voluntary electrical standards. CENELEC also aims to remove trade barriers, to create new markets and to support in formulating Europe's economic areas.

Under the Dresden agreement, European standards are established based on IEC. CENELEC members are 28 countries in Europe, including 8 countries in East Europe.

(3) BS

BS (British Standards) is the leading set of standards of the world. BSI (British Standards Institution) has a long history, in which 2001 was the centenary of foundation. BS is established with the aim of being applied worldwide, and covers several areas including terms, methods, specifications, installation and so on. Industry Association, consumer group, government, several engineering associations joined BS committee as interested parties. BSI members exceed 19,000. The attached document #2 shows the catalogue of BS.

(4) VDE

VDE (Verbamd Deutscher Elektrotechniker) was established by DKE (Deutsche Kommission Elektrotechnik) according to the contract based on Energy Economic Law. Manufacturers, Electric Power Companies, Government, joined the DKE committee. Therefore, consensus on several aspects can be reached easily. VDE contains not only equipment specifications but also standards on facility installation and inspection. Energy Economic Law confers legal binding force on VDE standards. Attached document #3 shows the catalogue of VDE.

(5) NF

NF (Normalisation de Francaise) is approved by AFNOR, a government organization. Staff members in charge of standards are assigned to AFNOR from the relevant ministry.

AFNOR doesn't establish any standards, it only approves standards prepared by the body that is in charge of establishing standards. The organization for electric engineering standards is UTE (Electric Engineering Association), which is France's largest organization in this field, and the second one is UNM (Mechanical Engineering Association). NF is referred to as legally binding standards by the ministerial ordinance.

(6) ANSI

The role of ANSI (American National Standards Institution) is not to establish standards but to formulate consensus on standards among qualified standards establishment bodies. Industry Associations, consumer groups, government and several engineering associations have joined the ANSI committee as interested parties. The membership consists of 850 companies, 35 governmental organization and more than 300 related parties.

(7) AS

AS (Australia Standards), is the national standards body of Australia, and covers all industry fields. SAI (Standard Australia Institution) establish AS. SAI is a non-profit corporate body formed to manage AS. Standards established by SAI are not legally binding standards. SAI make efforts to gather wide consensus widely in several industries.

2 Safety System of Electrical Equipment in Japan

2.1 Electrical Utility System

In the context of the public utility businesses changing dramatically worldwide, the electrical utilities have been moving toward deregulation since around 1990. In Japan, the deregulation of electrical utilities has been promoted "to realize electricity prices as low as the world standard by allowing new entrants from outside of the existing general electrical utility companies and exercising market principles." After the amendments of Electrical Utility Law in 1995 and 2000, which allowed Independent Power Producers (IPP) and Power Producers and Suppliers (PPS) to enter the electricity generation business, and liberalized the electricity retail business for large demand customers, Japanese electrical utilities have drastically changed in the last decade. The following diagram shows the current (as of Mar. 2006) electrical utilities in Japan.

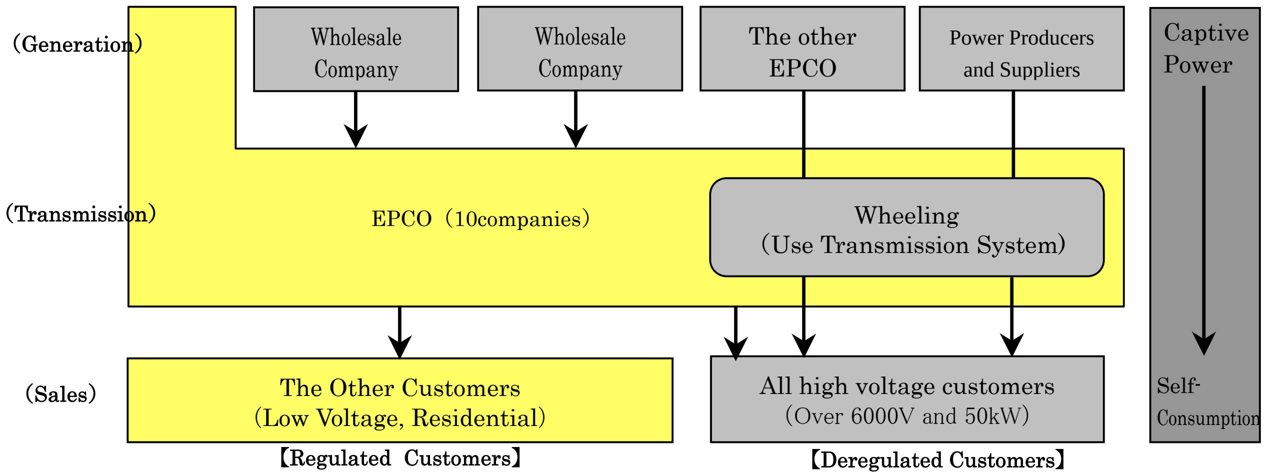


Figure 2.1.1 Electrical Utility System (Mar. 2006)

Electrical utility companies (10 companies) have remained vertically integrated although there are new entrants into the generation and retail businesses. However, new operation rules for transmission sections have been introduced to secure neutrality and transparency of wheeling.

As of Mar. 2006, the electric retail business has been liberalized up to the high voltage (greater than 6000V and 50kW) customer level. Liberalization for other customers is to be discussed after 2007.

2.2 Laws and Regulations on Safety of Electrical Equipment

2.2.1 Progression of the Safety Regulation Law

There is a long history associated with the electric power industry safety regulation in Japan. Originally, this regulation was an order of local government and then became a safety regulation law promulgated by national government. The contents changed from being focused on new project approval to detailed regulations concerning safety when the "Regulatory law of electric power industry" came into force in 1911. After that, it was divided into two categories, "Electric Utility Industry Law" and "Electrical Work Regulations" in 1931. So independent safety regulations were established to ensure safety of persons in charge of electrical equipment and have existed ever since. At present, the organization responsible for safety is established according to the Ministry of Economy, Trade and Industry ordinance that defines technical standards on electrical equipment.

(1) Safety Organization in the Early Stages

The specific regulations for electric power industry regarding safety were orders consisting of 15 clauses promulgated by the metropolitan police department on Aug. 8th, 1908 and originally imposed on TEPCO's predecessor. Construction licensing, inspection and the distance between wires and communication wires or roofs of houses were stipulated in these regulations. Applications for installation of lights on sidewalks were basically submitted to the Tokyo Metropolitan Government, however activities involving roads was a matter for metropolitan police department. Therefore, the metropolitan police department had an intimate involvement in this issue at that time.

(2) Safety Regulations Enforced by Local Government

A fire of unknown cause, which burned down the Imperial Diet House in 1991, prompted discussion for establishing the Electrical Utility Law. As an electricity leakage was suspected to be the cause, this increased awareness regarding the danger of electricity and drove the electrical utilities into a corner. Regulations covering electricity business and electrical engineering in general were required, so "Regulatory law of electric power industry" was established as a law to regulate the electric power industry in the same year. It was the first time that central government was able to regulate the electric power industry with this regulation. This regulation not only enabled securing of electric safety but also made a significant contribution to reconfirming the regulatory procedures conducted by local governments. .

(3) Safety Regulation through Centralization of Administrative Power

The 3rd ministry ordinance (enforced in 1891) passed by the communication department prescribed that any regulation set by a local government governor would also require agreement from the Minister of the communication department. This ordinance contributed to enhance regulation because applications from of the electric power industry significantly increased due to an electric power demand increase. Furthermore, the "Regulation for extra high voltage lines management" which includes regulations restricting construction under power lines, was promulgated on Dec. 21st, 1907. This was the first safety regulation for transmission lines which were not conventional overhead distribution lines

(4) The Birth of the Electric Work Regulation

In 1911, the existing regulation, "Regulatory law of electric power industry", was divided into two parts, "Electric Utility Industry Law" (enforced on Mar.29th) and "Electrical Work Regulations" (enforced on Sep.5th), and hence establishing laws specifically focused on electric power industry regulation and safety regulation respectively. With respect to the "Electric Utility Industry Law", articles governing rights of land possession, land entrance and tree trimming under power lines were newly specified. However, the "Electrical Work Regulations" were established by combining the regulation covering extra high voltage equipment with the "Regulatory law of electric power industry" and the original regulation was modified significantly.

(5) The Movement to the Voluntary Safety Organization

The current electric power industry law came into force in 1965. This law was revised considerably, twice, in 2000 and 1995. The aim of these revisions was deregulation in the electric power industry. Strictly speaking, the revisions were made to allow IPPs to enter the generation division and to advance liberalization of retail for large-scale customers. Other than these business deregulations, the revision in 2000 deregulated safety and voluntary safety by electric power utilities was defined as a principle of the safety organization.

As mentioned earlier, the security regulation law has been amended considerably. In particular, revision and division of and between public and private roles and rationalization of regulations within these categories have been made to ensure safety, while adapting to the prevailing conditions in terms of social needs, innovations in technology and the practical performance of voluntary safety by electric power utilities.

2.2.2 Role of the Electrical Utility Law

The Electrical Utility Law regulates the management of electrical utility companies to ensure public safety and environmental protection as well as customers' welfare. It regulates two main areas, "business regulation" and "safety regulation", which the Technical Standards are based on.

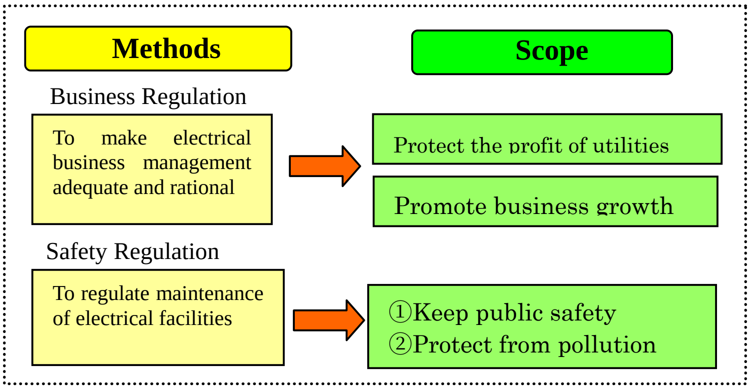


Figure 2.2.1 Scope of Electrical Utility Law

2.2.3 Role of the Technical Standards

Article 39 of the Electrical Utility Law stipulates that the Technical Standards, which are legally binding ministerial (Ministry of Economy, Trade and Industry) ordinances, shall regulate the design, construction and maintenance of electrical equipment to ensure public safety and stable supply of electricity. Article 39, Section 2 outlines the scope and contents of the Technical Standards as follows.
Contents of the Technical Standards (as specified by Article 39 of the Electrical Utility Law)

1) Electrical equipment for business use shall not endanger any person or cause damage to property.

- Prevention of electrocution, fire due to electricity leakage, flashover or short circuits, dam break, boiler explosion, leakage of radioactive material, smoke, soot and other pollutants.

2) Electrical equipment for business use shall not cause electrical or magnetic damage to other electrical equipment or property.

- Prevention of inductive interference, radio disturbance, electrical corrosion and interference of magnetic observation.

3) A failure of electrical equipment for business use shall not severely obstruct electricity supply by general electrical utility companies.

- Prevention of damage spreading from electrical equipment for private use to electrical utility companies.

2.2.4 Role of the Interpretations of the Technical Standards

The current Technical Standards were promulgated in Mar. 1997 and enforced in Jun. of the same year. They were greatly simplified from the previous versions by concentrating on equipment performances, which excluded most of the numerical standards, such as for example, standard for separation between overhead wires and buildings, instead, "The Interpretations of the Technical Standards" were introduced to specify numerical standards. In this manner, the Technical Standards specify, not quantitatively but qualitatively, the required function and performance of electrical equipment. Table 2.2.1 shows examples of the simplification of the Technical Standards.

Table 2.2.1 Examples of Simplification of the Technical Standards

(Article 25 of the Technical Standards) Heights of Overhead Wires
"Overhead wires shall be stretched at such heights to ensure safety from any contact, inductive interference or traffic disturbance."

↓

(Article 107 of the Interpretations of the Technical Standards) Heights of Overhead Wires of Extra High Voltage
"Overhead wires of extra high voltage shall be stretched above ground at heights above the values in the right column of the following table, in accordance with the service voltage classified in the left column."

Service voltage	Height above ground
Not greater than 35,000V	5m (5.5m for railway crossings, 6m across roads and 4m for insulated wires or cables stretched over bridges)
Greater than 35,000V and not greater than 160,000V	6m (5m for rarely visited areas such as mountains, and 5m for insulated wires or cables stretched across bridges)
Greater than 160,000V	6m (5m for rarely visited areas such as mountains) plus 12cm for each 10,000V exceeding 160,000V or part thereof

The Technical Standards were simplified according to the following viewpoints.

【The reason why the technical standards were simplified】

- The Technical Standards shall flexibly reflect technological advances by concentrating on safety performance levels.
- The Technical Standards shall quickly adopt technological advances by referring to foreign and private standards.

The Interpretations of the Technical Standards are the basis for equipment owners to ensure the practical compliance of their equipment with the Technical Standards, which are ministerial ordinances, for planning, construction and operation of the equipment.

On the other hand, the Interpretations of the Technical Standards are not ministerial ordinances. A violation of the Technical Standards, which are legally binding, would be subject to administrative punishment. While compliance with the Interpretations of the Technical Standards ensures compliance with the Technical Standards themselves, electrical equipment can be installed in accordance with Technical Standards along technical grounds, rather than the Interpretations of the Technical Standards, which will ensure safety.

2.2.5 Types of Technical Standard

The Technical Standards, in terms of maintenance and inspection, include the five types in Figure 2.2.2. Among them, the Technical Standards for Electrical Equipment, Hydropower Generation Equipment and Thermal Power Generation Equipment are related to the corresponding Interpretation.

Technical Standards	(1) The Technological Standard for Electrical Equipment (2) The Technological Standard for Hydropower Generation Equipment (3) The Technological Standard for Thermal Power Generation Equipment (4) The Technological Standard for Nuclear Power Generation Equipment (5) The Technological Standard for Wind Power Generation Equipment
Interpretation	(1) The Interpretation of The Technological Standard for Electrical Equipment (2) The Interpretation of The Technological Standard for Hydropower Generation Equipment (3) The Interpretation of The Technological Standard for Thermal Power Generation Equipment

Figure 2.2.2 Catalogue of Technical Standards and Interpretation

2.3 Legal System for Safety of Electrical Equipment

As described above, the Technical Standards are the foundation of the legal system centered on the Electrical Utility Law. Figure 2.3.1 is an example of a technical standard for electrical equipment, which describes the relationship between the Electrical Utility Law, the Technical Standards and other standards.

The role of the Interpretations of the Technical Standards is mentioned above. They can refer to any standards established by fair, neutral and transparent organizations, for example those set by the Japan Electrical Standards and Codes Committee (JESC). It is publicly approved as a supplement for the Technical Standards.

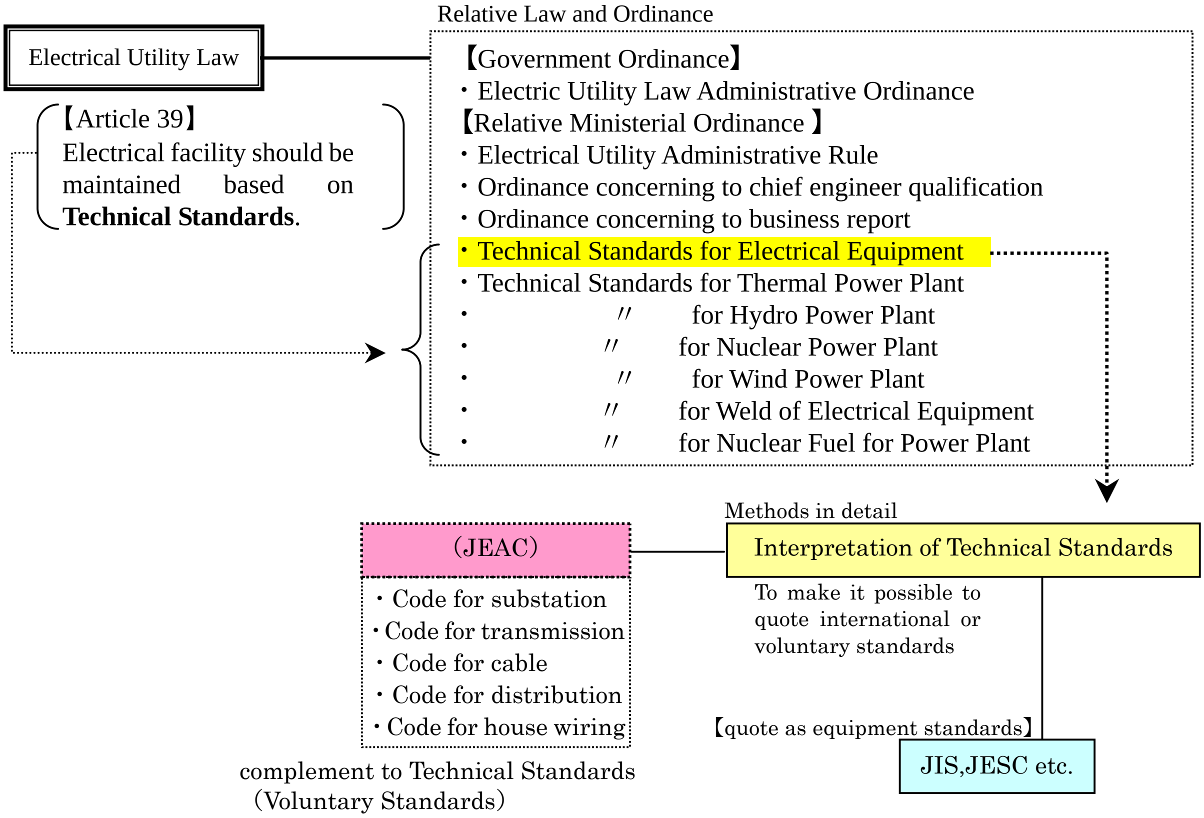


Figure 2.3.1 Relation between Electric Utility Law and Technical Standards

2.3.1 Role of JIS

Japanese Industrial Standards (JIS) are national standards, designed by the Japanese Industrial Standards Committee and established under the name of the minister in charge. As for electrical equipment, other than JIS, there are several independent industrial standards, including those in the table below.

Table 2.3.1 Relative Industrial Standards

Industrial standards	Acronym
Japanese Electro-technical Committee	JEC
Japanese Cable Standards	JCS
Japan Electrical Manufacturer	JEM
Electrical Insulating Materials Standard	EIMS
Japan Luminaries Association	JIL

JIS and other industrial standards are private agreements, which manufacturers, sellers, users and academic experts establish and have no binding authority, while the Technical Standards, based on the Electrical Utility Law and the Electrical Appliance Safety Law, can impose punishment on their violators. Therefore, any products, which are subject to the laws, must comply with the Technical Standards, regardless of whether they are manufactured in accordance with other industrial standards or not. The Interpretations of the Technical Standards refer to the JIS and other industrial standards.

Figure 2.3.2 shows relation between technical standards and standards for equipment.

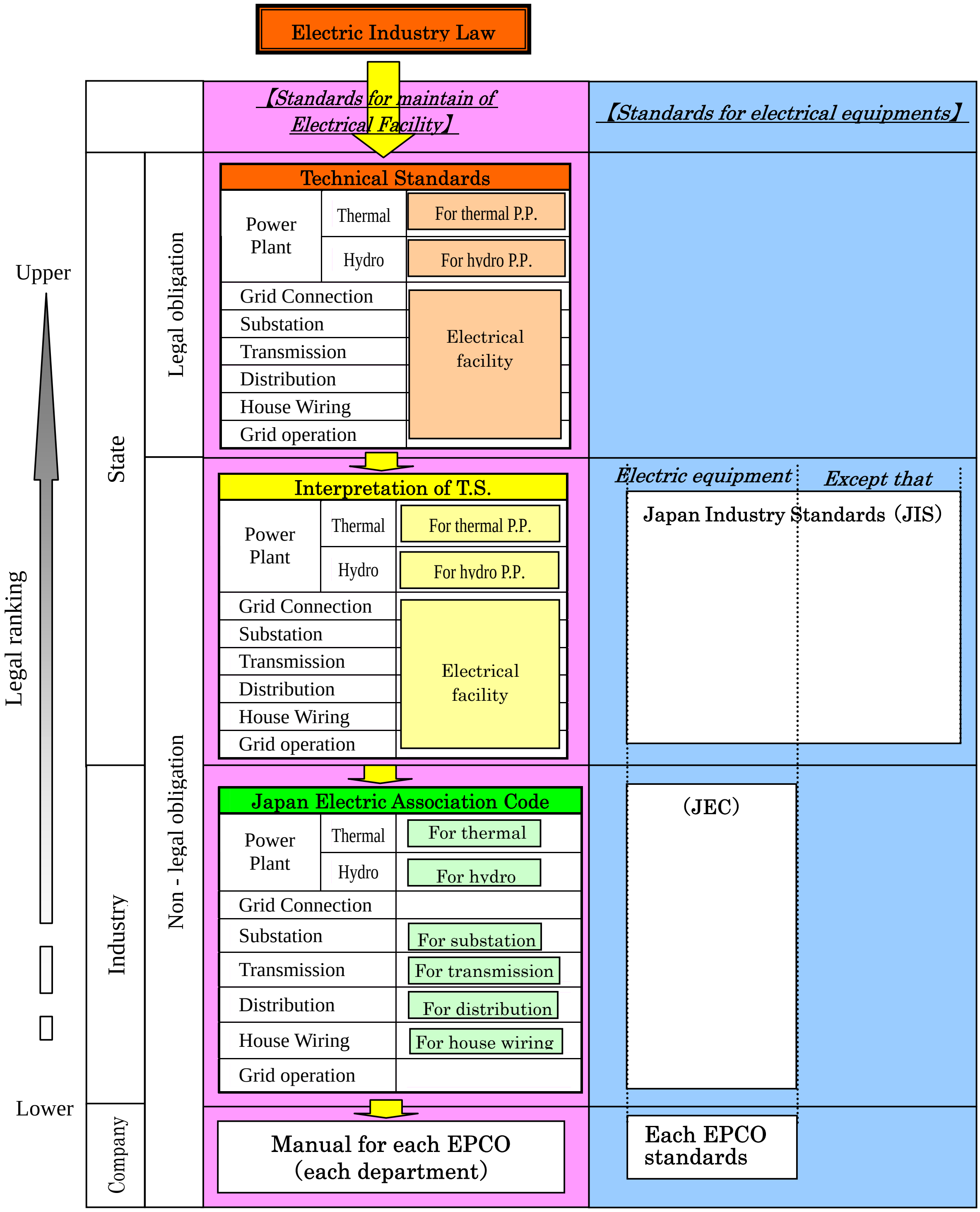


Figure 2.3.2 Relation between Technical Standards and Standards for Electric Equipment

2.4 Supplementary Legal System for Safety of Electrical Equipment

The Electrical Utility Law contains business, safety and environmental aspects. For each aspect, the following diagram classifies related laws and regulations according to the governing ministry, which demonstrates the extensive number of ministries and other entities involved in the regulation of electrical utilities in Japan. In addition to those described in the diagram, there are also laws and regulations governing electrical power development (the Electrical Power Development Promotion Law, etc.) and nuclear energy (Nuclear Energy Fundamental Law, etc.).

Laws governing safety of electrical equipment include the Electrical Utility Law, the Electrical Appliance Safety Law, the Electrical Engineering Technician Law and the Electrical Engineering Company Law, which constitute the so-called Quartet of Electrical Security Laws. They complement the Technical Standards to secure the safety of electrical equipment. As for workers' safety, there is the Industrial Safety and Health Law. The Quartet of Electrical Security Laws and the Industrial Safety and Health Law are summarized in the following.

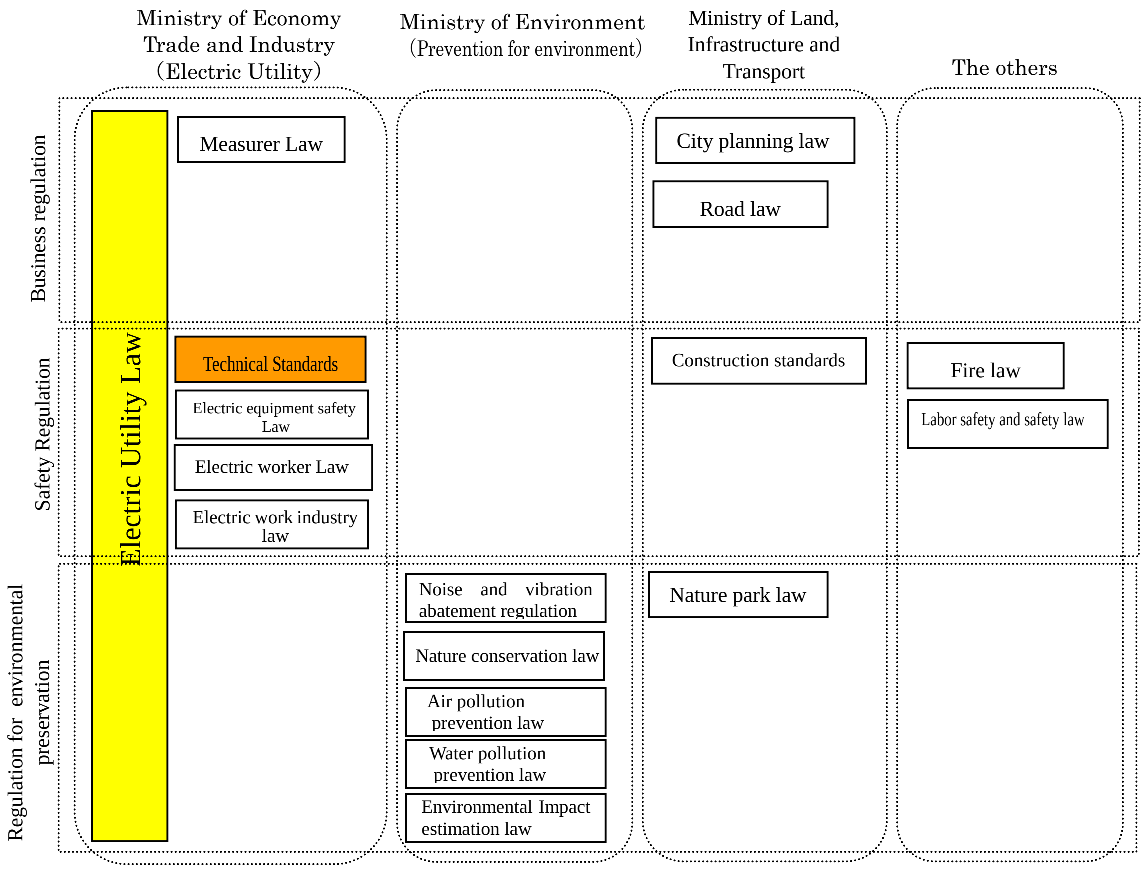


Figure 2.4.1 Relative Law to Electric Utility

2.4.1 The Quartet of Electrical Security Laws

Table 2.4.1 shows the scope and outline of " The Electrical Appliance Safety Law", "The Electrical Engineering Technician Law" and "The Electrical Engineering Company Law".

Table 2.4.1 Scope and Outline of the Electrical Security Laws

	Scope	Outline
The Electrical Appliance Safety Law	To eliminate the danger and failure of electrical appliances by regulating the manufacturing and sale of electrical equipment as well as promoting the voluntary activities among private entities on electrical appliance safety.	1) Registration as manufacturers and sellers of electrical appliances; 2) Compliance with the standards and management of records; 3) Permission of compliance labeling; 4) Regulations for sale and use of electrical appliances; etc.
The Electrical Engineering Technician Law	To prevent accidents due to defective electrical engineering works by specifying the qualifications of workers engaged in engineering works on general and private electrical equipment.	Qualifications for First and Second Class Electrical Engineering Technicians are specified, including First or Second Class Technicians only to engage in engineering works on general electrical equipment and solely First Class Technicians on private electrical equipment greater than 500kW.
The Electrical Engineering Company Law	To ensure adequate operation of electrical engineering companies and safety of general and private electrical equipment by specifying the procedures for registration of electrical engineering companies, appointment of electrical engineering technicians and other business administrations.	1) Registration of electrical engineering companies; 2) Notification by electrical engineering companies; 3) Appointment of Electrical Chief Engineers; 4) Business administration of electrical engineering companies, etc.

2.4.2 The Occupational Safety and Health Law

The regulation from the aspect of occupational safety is also important except facility safety (Public safety) as electricity safety. "Occupational Safety and Health Law" was prescribed as this kind regulation. This law regulated not only electrical industry also another industry. The purpose of this law is promotion of comfort occupational environment.

There are a couple of thousands article in this law, the article relative to electrical industry is Chapter 5 " Protection from Electrical Hazard". The bulletin based on this rule is for example "Standards of Insulation Tool and protection tool", "Regulation of Hot line work", and so on.

2.5 Safety System of Electrical Equipment in Japan

This section will summarize the role of each law relating to electrical safety. All objects posing potential danger to any person, including various types of equipment ranging from large equipment such as power plants and transmission lines to small equipment such as household appliances and wiring, are subject to these laws. Therefore, electrical equipment in power plants of electrical utilities and large factories, which are under the supervision of electrical experts, and the equipment in households and other locations, used by persons with little electrical knowledge, need to be categorized in terms of electrical safety. The Electrical Utility Law mainly regulates the former while the Electrical Appliance Safety Law and the Electrical Engineering Technician Law as well as the Electrical Utility Law regulates the latter.

The Electrical Utility Law divides electrical equipment into the categories of business use and general use, to which a suitable safety system is applied to each respectively. The equipment for business use includes equipment used by electrical utilities and large private companies (with a maximum output of 500kW or greater), and others are considered to be for general use. In principle, the owners are responsible for the security of their equipment on a voluntary basis. However, the administrative offices give instructions on several aspects of the safety requirements. The following diagram outlines the safety system applied to electrical equipment for business use.

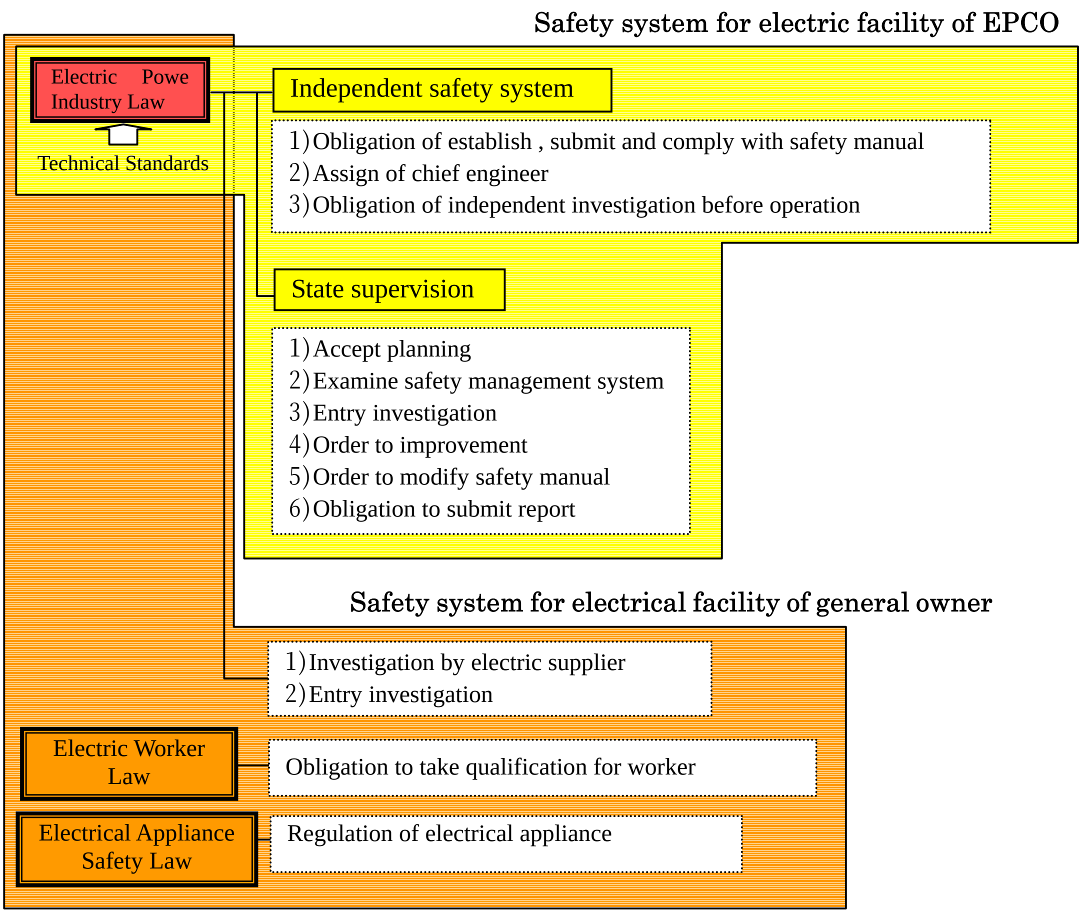


Figure 2.5.1 Safety System for Electric Facility

The state authorities oversee a wide range of activities such as notification of engineering work plans, report of accidents, suspension of engineering work or operation of electrical equipment in case of violations of technical standards. Although the owners are responsible for their equipment on a voluntary basis, they are specified to appoint and dedicate Electrical Chief Engineers, who are qualified by the state, for maintenance of the equipment. They are also required to establish Safety Standards of their own and inspect their equipment, which is crucial for ensuring safety.

The owners of electrical equipment for general use are responsible for their equipment as well. However, since most of the electrical equipment owned by households and stores is for general use, they are not imposed with the same requirements that apply to locations containing equipment for business use. On their behalf, the suppliers (most likely electrical utility companies) of electricity are responsible for ensuring compliance with the Technical Standards. The following diagram outlines the provisions specified in the Electrical Utility Law for the safety system described above.

System of independent Safety

【Obligation to confirm Standards】

(Maintenance of power facilities for business use) Article39
A firm which installs power facilities for business use shall maintain the power facilities for business use in such a way as to conform to such technological standards as specified in the Ministerial Ordinance of the METI

(Order to conform to technological standards)Article**40**
METI may, if Minister recognize that power facility do not conform to standards, order the firms to repair or to remodel so as to make them confirm to standards.

【Establishment and comply to safety rule】

（Safety Rule） Article42
A firm, for the purpose of ensuring safety, establish a safety rule for each facility, the safety which requires to be ensured uniformly, and shall be give notification of said safety rule prior to commencement of construction work.

【Appointment of Chief Engineer】

（Chief Engineer） Article43
A firm which install power facility appoint chief engineers from among engineers, to whom have been delivered the chief engineer's licenses, so as to place them in charge of supervision of safety mattes of construction work, maintenance and operation。

【Legal Independent Inspection】

（Preoperational safety inspection)Article**50-2**
A firm shall, before using power facility, conduct a voluntary inspection of such facility and record the results of the inspection.

（Periodical safety inspection) Article 55
A firm which install special facility (which refer to boilers, turbines) shall conduct operator inspection of such special power facility periodically and keep and maintain a record of the results.

Governed by state

【Approve and submit work plan】

（Plan for construction work) Article47
A firm which intends to carry out a project to install power facility for business use shall obtain the approval on the plan for the said works from METI.

（submission of plan for work) Article48
A firm which intend to install or charge power facility shall submit to METI the plan of work, also submit to METI revised work plan。

【Examination of safety system 】

(Preoperational examination) Article 50-2
A firm which install power facility which are subject to preoperational voluntary inspection shall submit a system for implementation of inspection to an examination conducted by METI。

（Periodical examination) Article55
A firm which install power facility which are subject to periodical inspection shall submit a system for implementation of inspection to an examination conducted by METI.

【Submit the commencement of use】

（Commencement of captive power)Article53
A firm which intended to install power facility for captive power shall submit to METI the commencement of use captive power。

【Obligation to submit report】

（Collection of reports) Article106
METI cause a person to submit report or informative material on the condition of activities related to safety of power facility.

【Entry inspection】

（Entry inspection) Article107
METI enter and inspect power facility to enforce the law

Figure 2.5.2 Law relative to Electrical Utility Law

Furthermore, the Electrical Engineering Technician Law specifies that only First or Second Class Electrical Engineering Technicians shall engage in engineering works on general electrical equipment, and the Electrical Appliance Safety Law regulates the appliances and materials as well. In this manner, state regulations have been relaxed and are now based on a voluntary safety system. However, in reality, the voluntary system is heavily imposed with state regulations, which is unique to Japan.

3 Safety System in Developed Countries

3.1 Outline of Safety system in Developed Countries

We visited on our research mission 5 countries, US, U.K., Germany, France, Australia. Here, we visited two states in US. and Australia because the safety system is different in each state. We took the influence of electric utility system (the situation of deregulation) to safety system into account, selected the state to research 1) keeping the vertical integrated system (Georgia State), 2)established deregulated system (New Jersey State). In Australia, we selected main state, Victoria and New South Wales state.

3.1.1 Legal system for Electrical Equipment Technical Standards

Table 3.1.1 outlines details regarding the legal system associated with electrical equipment technical standards for five developed countries, based on this investigation.

Table 3.1.1 Legal system for Electrical Equipment Technical Standards in Developed Countries

Existence Technical Standard Law		Type	State	Note
None		Detailed private standards	U.S. (Georgia)	
Existing	Recommendation for adopting technical standard	Detailed private standards	Australia (New South Wales)	
	Obligation of complying with technical standards	Ministry standards (essential points only)	U.K.	Present system in Japan
		Detailed private standards	U.S. (New Jersey) Germany France	
		Detailed ministry standards	Australia (Victoria)	Previous system in Japan

Therefore, each developed country investigated in this study has a technical standard equivalent to the "Technical standard on electrical equipment" (Ministry ordinance), and its explanation, in Japan, even though these countries possess differences in history, culture, thought and so on. Nonetheless, the detailed standards, like the explanation of the technical standards, in Japan are rarely established as law. In almost all countries, these detailed standards are established as private standards.

With respect to regulation of environment protection and labor safety, every country has different legal organizations with respect to the technical standards because aims and supervisory agencies are different.

The table 3.1.2 shows the technical standards and the related laws of developed countries.

Table 3.1.2 Comparison of Technical Standards and Relative Laws in developed countries

			Japan	US		U.K.	Germany	France	Australia	
				Georgia	New Jersey				Victoria	N.S.W.
Law to regulate electric utility		Law	Electrical Utility Law	Public Utility Law		Electricity Act 1989	Energy Economic Law	Distribution Law	State Electricity Safety Law	Electricity Supply Law
		Authority	METI	Public Utility Committee		DTI	Ministry of Economic and Technology	DEDIM	Energy Authority	Public Utility Committee
Law to give the obligation to technical standards（includes recommendation）			Electrical Utility Law	No	Public Utility Law	Electricity Act 1989	Energy Economic Law	Distribution Law	State Electricity Safety Law	Electricity Supply Law
technical Standards for electric facility	Facility for utility	Standards	Technical Standards for Electrical Facility	NESC (National Electric Safety Code)		Electricity safety, quality Rule2002	DIN-VDE	Governmental Ordinance 1927.7.29 Ministerial Ordinance 2001.3.17	State Electricity Safety Code	NENS
		Organization of establishment	METI	IEEE		DTI	DKE	Ministry of Economic, Finance and Industry	Electricity Safety Authority	ESAA
		Regulation Body	〃	State Government		〃	State Government	Ministry of Economic, Finance and Industry	〃	Public Utility Committee
		Legal Obligation	YES	No	Yes	Yes	Yes	Yes	Yes	No
	Facility of Customer	Standards	・Technical Standards for Electrical Facility ・Electrical Worker Law	NEC (National Electric Code)		Construction Standards	Customer Facility Rule （Ministerial Ordinance）	NF Standards	State Electricity Safety Code	AS/NZS3000
		Organization of establishment	METI	NFPA		the Ministry of Construction	Ministry of Economic and Technology	UTE	Electricity Safety Authority	AS
		Regulation Body	〃	City or County		〃	State Government	Ministry of Economic, Finance and Industry	〃	Public Utility Committee
		Legal Obligation	YES	No		Yes	Yes	Yes	Yes	
Standards to complement Technical Standards for electrical facility		Standards	Interpretation of T.S.	—		ENA Code	—	NF Standards	AS	
		Organization of establishment	Agency of Natural Resources and Energy	—		ENA	—	UTE	SAI	
		Legal Obligation	No （Basically comply. If not, it should be proved to be accommodated to technical standards）	—		No （comply it from view point of protection from suit）	—	Yes	Yes (In case of that it is quoted in State Law)	
Standards for specification of equipment		Standards	Japan Industry Standards（JIS）	ANSI Standards		BS	DIN-VDE	NF Standards	AS	
		Organization of establishment	Japan Standard Institution	ANSI		BSI	DKE	AFNOR	SAI	
		Legal Obligation	No	No		No	No	No	No	
Relative Law except technical standards		Occupation Safety	Occupation Safety and Health Law	NESC、NEC、Labor Law		Electric Work Rule 1989	Labor Law	Labor Law、UTE Code	Occupation Healthy and Safety Law	
		Environment	Environmental Law	Environment Impact Estimation Law		Environment Law	NF Standards	NF Standards	Environment Protection Law	Environment Operational Protection Law
		Others	Measurement Law	Measurement Law		Energy Regulation Code	—	DEDIM Code	National Electricity Code	
Entry investigation by Authority			YES	YES		Yes （Once a year）	Yes (Monitoring based on Energy Law)	Yes (Based on Ordinance)	Yes	
Qualification for electrical engineer			"Chief Engineer" as administrator, "Electrician" as worker.	License for electrician （issued by city and county）		No	Maister System (for supervisor of electric work)	Qualification of electrician （Based on NFS standards）	Qualification of electrician	
Safety certification system for electrical appliance			JIS Standards（PSE Mark）	UL Standards（UL Mark）		EN Standards（CE Mark）			AS Standards（RCM Mark）	

(1) US

There are no federal level regulations. Instead, states are responsible, and their attitudes are different from one state to another. For example, New Jersey legally requires compliance with certain private standards, while Georgia does not intervene at all. However, like Georgia, most states at least require compliance with "The National Electric Safety Code (NESC)", a private standard set by IEEE, which is similar to "The Technical Standards for Electrical Equipment" of Japan.

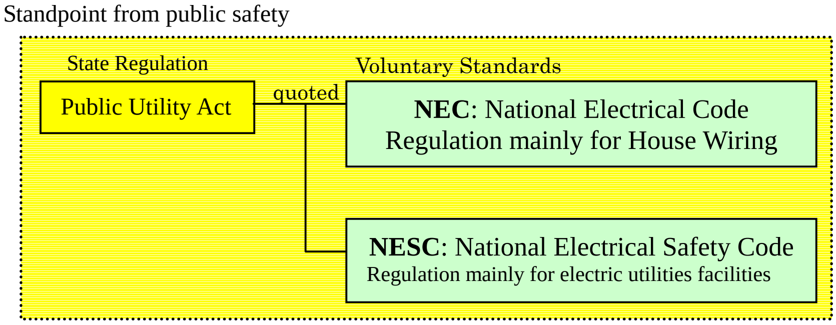


Figure 3.1.1 Legal System of Technical Standards in US.

(2) U.K.

"The Electricity Act of 1989", as the prime law, regulates electrical utilities. It requires establishment of legally binding technical standards for electrical equipment, and designates "The Electricity Safety, Quality and Continuity Regulations of 2002" set by the Department of Trade and Industry (DTI) as those standards. The regulations, which provide basic specifications for electrical equipment regarding safety and stability of electricity supply, are similar to "The Technical Standards" of Japan. "The Recommendation" and "The Best Practice", technical standards set by the Electrical Power Network Association, are not legally binding and UK's equivalents to "The Interpretations of The Technical Standards" of Japan. However, electrical utilities construct their electrical equipment according to those standards in order to protect themselves from possible lawsuits. The expression, "Reasonably Practicable", represents UK's philosophy, which is "While adequate investment, regardless of its cost, is essential for important and potentially hazardous equipment, less important and relatively safe equipment shall be reasonably and practicably dealt with."

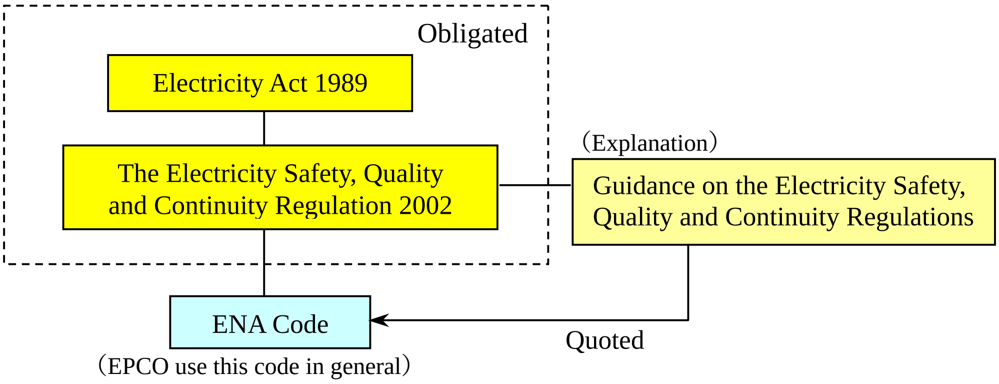


Figure 3.1.2 Legal System of Technical Standards in U.K.

(3) Germany

Traditionally, there had been no regulations regarding technical standards for electrical equipment. However, deregulation of electrical utilities necessitated a certain level of standards, and "The New Energy Economy Law", enacted in 2005, stipulates, "Electrical equipment shall be maintained as technically safe, and generally applicable technical standards shall be observed", and it also stipulates, "Technical standards set by Verband Deutscher Elecktrotechniker (VDE) shall be applied to electrical equipment." While other national standards including British Standards (BS) and French Standards (NF) primarily provide basic specifications for equipment, materials, and inspection methods, VDE standards also provide specifications for equipment installation, which are covered by "The Technical Standards for Electrical Equipment" of Japan.

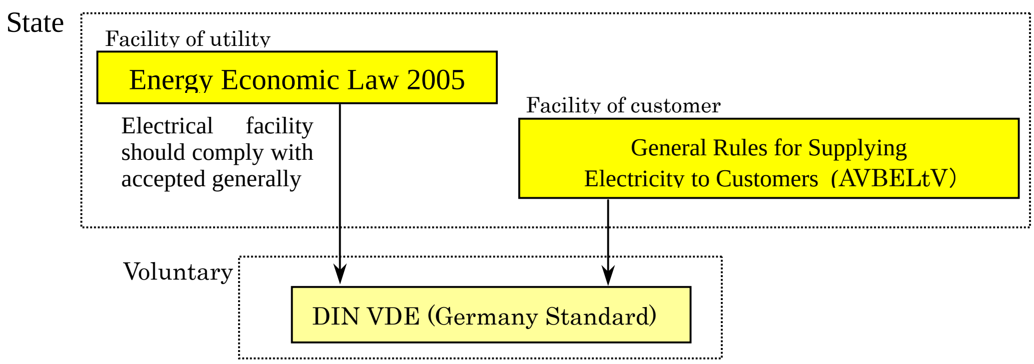


Figure 3.1.3 Legal System of Technical Standards in Germany

(4) France

"The Electricity Distribution Law", enacted in 1906, was the first law to regulate safety of electricity. According to the law, "The Government Ordinance, Jul. 29, 1927" and " The Ministerial Ordinance, May 17, 2001" were decreed. Those ordinances, which provide technical standards, are France's equivalents to "The Interpretations of The Technical Standards" of Japan. Furthermore, French Standards (NF), which are practical implementation guides for the ministerial ordinance, provide detailed specifications for electrical equipment. Government and ministerial ordinances refer to, thus, confer a legal binding force to French Standards. As a result, even detailed technical standards are legally binding in France.

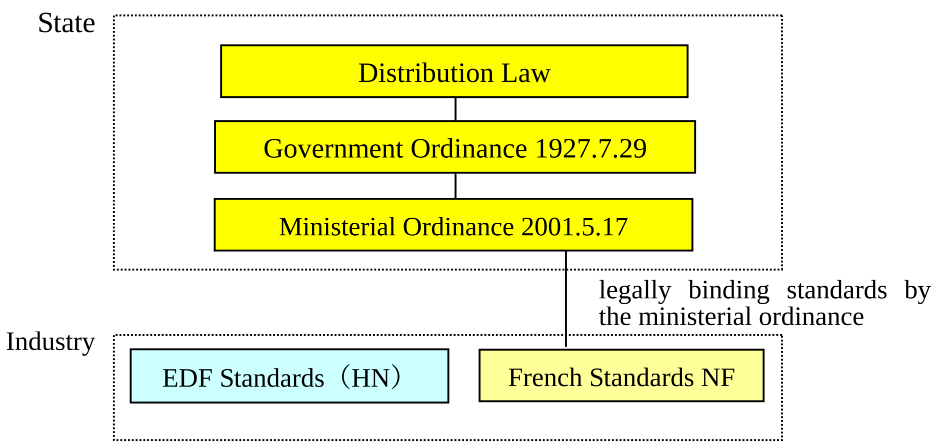


Figure 3.1.4 Legal System of Technical Standards in France

(5) Australia

As in US, states regulate electrical utilities. Both in Victoria and New South Wales, which our research mission visited, there are legally binding technical standards. In Victoria, "The Electricity Safety Act of Victoria" confers a legal binding force to "The Electricity Safety Regulations" set by Energy Safe Victoria (ESV). In New South Wales, "The Electricity Supply (Safety and Network Management) Regulations" require electrical utilities to establish and submit their own technical standards to the state. The standard contents are left under each utility's jurisdiction. For example, Energy Australia adopts "The National Electricity Network Safety Code" set by the Electricity Supply Association of Australia (ESAA).

3.1.2 Safety System for Electrical Equipment

In all countries that our research mission visited, regulatory authorities conduct on-site inspections. Particularly in UK, inspectors stipulated by The Electricity Act annually inspect each electrical utility. In all countries, in-house inspections of electrical utilities are left on the voluntary basis, and no country requires submission of safety rules. In all countries except US, electrical utilities are required to report serious accidents to regulatory authorities. Even in US, regulatory authorities reserve power to require electrical utilities to report accidents if necessary. Practical regulations in each country are described below.

(1) US

The contents and strictness of regulations are significantly different from one state to another. In most states, The Public Utility Commissions regulate electrical utilities. While electrical utilities in Georgia are regulated only with regard to the appropriateness of their electricity charges, The Public Utility Law of New Jersey provides regulations for electrical equipment of electrical utilities.

In Georgia, the state imposes very little regulations regarding safety, and relies on safety awareness of electrical utilities. A self-reliant safety system that has been established in the long history of monopolistic regime of electrical utilities contributes significantly to safety. On the other hand, New Jersey's safety system relies on cooperation between regulatory authorities and electrical utilities. New Jersey's regulatory authorities are greatly aware of safety and electrical utilities there respond with a self-reliant safety system. They compliment each other very well.

(2) U.K.

Article 30 of The Electricity Act stipulates, "Appointment of Electricity Inspectors for inspections and examinations of electrical equipment". According to this clause, the electricity inspectors conduct annual and random inspections for electrical utilities. In addition, Article 5 of The Electricity Safety, Quality and Continuity Regulations of 2002 stipulate, "Electrical utilities shall inspect their equipment at adequate intervals and maintain complete inspection records." However, there is no specification for inspection intervals and it is left under the jurisdiction of electrical utilities. Furthermore, "The Electrical Work Regulations of 1989" stipulate establishment of inspection system of generation and substation equipment for workers' and operators' safety. The Electricity Safety, Quality and Continuity Regulations of 2002 also require electrical utilities to report serious accidents to DTI. However, there is no UK's equivalent status to Japan's Electrical Chief Engineers.

(3) Germany

As Germany is a federation, federal and state governments share authority to regulate electrical utilities. However, regulations do not vary greatly from one state to another like other federations including US and Australia. The federal government leads state governments, while state governments are vested with a certain level of authority.

The federal government directly regulates business aspects of electrical utilities, while state governments regulate electrical equipment.

The Energy Economy Law provides almost all regulations regarding electrical utilities' business. For Example, Article 51 of the law requires states to report current status and forecasts of Electricity demand and supply, supply capacity and reliability, failures and accidents, etc. to the federal government and provides them with authority to inspect electrical utilities' equipment on-site and inquire for maintenance records. This clause was added in the 2005 renewal.

(4) France

Ministry of Economy, Finance and Industry, Department of Energy Demand Market regulates electrical utilities, and "The Ministerial Ordinance, May 17, 2001" specifies practical regulations. For example, the ordinance specifies the heights of wires above ground and separations between wires and trees, and requires electrical utilities that own transmission and distribution systems to inspect separations between wires and trees. In addition, it requires them to maintain and submit inspection records to regulatory authorities, and to report public accidents involving equipment failures and electrifications to Industry Research Institutes, which are provincial agencies of Ministry of Economy, Finance and Industry.

(5) Australia

The Electricity Safety Act of Victoria stipulates, "Energy Safe Victoria (ESV) may appoint enforcement officers to confirm compliance with it and its related regulations." Serious accidents and failures are required to be reported to ESV and those involving distribution companies are publicly available. On the other hand, in New South Wales, according to The Electricity Supply Act of the State, state inspectors reserve authority to inspect electrical equipment prior to its commencement of operation and authority to inspect the equipment on-site in case of serious accidents. As in Victoria, serious accidents and failures are required to be reported to DEUS and those involving distribution companies are publicly available.

There is no equivalent to Japan's Electrical Chief Engineers either in Victoria or New South Wales.

3.1.3 Safety System for Customers' Equipment

All countries have technical standards for customers' equipment, which are referred by ministerial ordinances and others to be legally binding. However, it is customers rather than electrical utilities that are required to comply with the standards. In US, France and Australia, new houses and buildings are required to be inspected by private inspection agencies employed by the owners, and they are supplied electricity only after safety has been confirmed. In Australia and New Jersey of US, there are equivalent statuses to Japan's Electrical Engineering Technicians. Germany's Meister System is also similar to those statuses. Although other countries do not have such statuses, some countries require workers to acquire adequate skills for safety. Practical systems in each country are described below.

As it is essential to prevent fires and electrifications due to defective electrical equipment, each country has established qualification systems for electrical equipment. In practical terms, Europe, US and Australia have adopted qualification systems of Conformite Europeenne (CE) as EU uniform standards, Underwriters Laboratories (UL) and Regulatory Compliance Marking (RCM), respectively.

(1) US

Cities and counties, as well as State Public Utility Commissions, regulates customers' equipment. They establish their own technical standards based on The National Electric Code (NEC) set by the National Fire Protection Association. Inspectors employed by cities and counties conduct on-site inspections for electrical equipment prior to its commencement of operations. Generally, those inspectors are from private inspection agencies qualified by cities and counties. Cities and counties also conduct examinations and issue certificates for electrical engineering technicians, who are US's equivalents to Japan's Electrical Engineering Technicians, and they require supervisors of electrical engineering tasks to acquire the certificates.

(2) U.K.

Although there was no legislation for domestic wirings, The Regulation of Electrical Installation (BS7671) had been voluntarily applied. However, "The Building Regulation, Part P", which was established in 2005 and is under the jurisdiction of Deputy Prime Minister, now requires compliance with the regulation. Article 29 of The Guidance on Electricity Regulations stipulates that electrical utilities shall reserve the right to refuse supplying electricity to inadequate electrical equipment of customers. However, there is neither obligations to inspect domestic wirings nor any equivalent requirements outlined for Japan's Electrical Engineering Technicians. Although The Electrical Work Regulations of 1989 prohibit workers without adequate knowledge and experiences in electrical engineering from entering work sites that require certain qualifications, it is not for the benefit of improving the performance of customers' equipment, but rather to ensure workers' safety. However, the performance of customers' equipment is likely to improve if only workers with adequate knowledge and experiences are allowed to engage in engineering tasks.

(3) Germany

States are vested with authority to regulate customers' equipment according to an ordinance: "The General Rules for Supplying Electricity to Customers", which obligates customers to comply with the rules for safety. Electrical utilities are not required, but vested with authority to confirm customers' equipment compliance with technical standards for connection to transmission system, and they reserve a right to refuse connection to customers' equipment that is not of the required quality.

(4) France

"The Government Ordinance, Dec. 14, 1972", which was decreed under The Building and Housing Law, provides for safety inspections of customers' equipment. It requires owners of new houses to have inspection agencies to examine them and submit inspection certificates issued by the agencies to distribution companies. Furthermore, it stipulates that distribution companies reserve authority to inspect customers' equipment in cases where equipment failures pose a risk to their distribution system.

(5) Australia

In Victoria, "The Electrical Safety (Installation) Regulations" is equivalent to The Ordinance for The Technical Standards for Domestic Wirings of Japan, while, in New South Wales, Article 32 of "The Electricity (Consumer Safety) Act" stipulates, "Any electrical equipment that do not comply with 'AS/NZS3000:2000 Wiring Rule' shall not be supplied electricity." Both states require that new equipment of customers shall be inspected and certified by qualified electrical engineering companies prior to an electricity supply from electrical utilities. Furthermore, there are equivalent statuses to Japan's Electrical Engineering Technicians in both states.

3.2 Safety System of Thermal Power Generation Equipment

Among thermal power generation equipment, boilers and pressure vessels are critical for safety maintenance, as vapor or gas leaks from such equipment, due to equipment damage, may lead to serious accidents such as explosions.

Current technical standards for boilers and pressure vessels in the US and Europe are largely at the same level of detail as Japan's standards, several specifications including inspection procedures are different. While Japan's electrical utilities voluntarily conduct their own periodical inspections under the jurisdiction of the Ministry of Economy, Trade and Industry according to The Electrical Utility Law, insurance companies and other private inspection agencies conduct the inspections on behalf of electrical utilities in the US and Europe.

The safety system of boilers and pressure vessels in US is regulated by each state's regulatory agency based on the state law. Even though the "Boiler and Pressure Vessel Code of ASME" (design standard) and the "Inspection Code of NBI" do not have legal force, each state law prescribes that they shall be used as authoritative private standards. It is the characteristics that private insurance companies contribute significantly to the safety of boilers and pressure vessels because of historical background. Additionally, special inspectors from insurance companies inspect the boilers that are covered by their insurance policies.

The Pressure Equipment Directive 97/23/EC (PED) has been enforced since 2002 in Europe (EU member countries) as a design standard for boilers and pressure vessels. Each EU member country has adopted a certain part of EN standards, which is compatible with the PED, so that its own national standards and EN standards coexist in each country. On the other hand, there is no EU standard for boiler and pressure vessel inspection as historical backgrounds differ from one country to another. So they are inspected under each country's law and standard.

Table 3.2.1 Regulations and Standards for Boilers

	Regulation	Design Code	Regulatory Agency
US	・Regulations by each state	Boiler and Pressure Vessel Code of ASME (Private Standard)	Regulatory agencies of each state
U.K.	・PED ・The Pressure Systems Safety Regulations	BS1113, BS2790 (national standards)	The Department of Trade and Industry
Germany	・PED ・The Equipment Safety Law (GCG)	TRD (national standards)	Bundesministerium fur Wirtschaft und Arbeit
France	・PED	NF E32-100 (national standard), COVAP (private standard)	Ministere de I'economie, des finance et I'industrie
Australia	・Regulations by each state	National Standard for Plant NOHSE1010 (national standard), AS1200 (private standard) and others (varying in different states)	Regulatory agencies of each state

3.3 Technical Points on Power System Interconnection between Nations

One of the most prominent grids in Europe is the UCTE grid. Almost all European grids belong to this UCTE. UCTE represents the "Union for the Coordination of Transmission of Electricity", a grid operator in Europe which is responsible for coordination with the other 34 grid operators in 23 countries in Europe to secure overall reliability of the interconnected power system. UCTE was founded in 1951. It was originally UCPTE（Union for the Coordination of Transport and Production of Electricity） and included generation companies, however generation companies were separated and now, finally, UCTE, consisting of grid a operation division only, was established in 1999.

UTCE established the "Operation Handbook" as the reliability standards (grid operation rules) for the interconnected power system in Europe. This handbook does not have the same legal background as that of the "EU Electric Power Instruction" because UCTE is a private organization of many grid operators. However, the handbook aims to secure the reliability of power system interconnection among nations. The handbook does have legal force conferred upon. In terms of penalties, the handbook stipulates that if one grid operator causes damage to the equipment of neighboring grid operators, they shall pay the penalty.

The UCTE Operation Handbook stipulates the following main points regarding the UCTE power system interconnection for each grid operator.

(a) Normal State

- Maintain voltage (within the range of 380 to 420kV in case of 380/400kV system)
- Spinning reserve saving in preparation for failure
- Complying with N-1* criterion taking periodical repair into consideration (Both in planning and operation)
  *N-1 refers to the criterion where there is no serious supply interruption even if equipment of one section is out of service, such as failure of one transmission line.
- System stability check by simulation
- Data exchange between grid operators through the SCADA system

(b) Emergency Stage

- Recovery procedure agreement between neighboring grid operators in case of failure
- Confirming system condition method agreement between neighboring grid operators in case of failure

4 The Safety Management System in Asian Countries

4.1 The Safety Management System in China

The technical standards and relevant statutes in China have the following characteristics:

1) Since power companies are basically state-run, the technical standards, including industry standards, are formulated by government agencies.
2) Under the Standardization Act, the safety-related standards and those specified by law or administrative ordinance as mandatory are all legally-binding standards. Accordingly, compliance with the electrical safety-related standards is a legal obligation.
3) There are different technical standards for urban and rural areas. The Low Voltage Work Safety Code for Rural Areas and the Safety Code for Electricity Use in Rural Area have been established especially for rural areas.
4) The specifications in the Standardization Act and the SERC Ordinance on Standardization Management in Electric Power Industry demonstrate a clear intention by the Chinese government to adopt international standards in its national or industry standards.
5) Similar to the system in Japan, consumers have an obligation to ensure electrical safety for their own installations. In addition, a working competency, equivalent to the Electrical Technician requirements in Japan, is mandatory for those engaging in electrical engineering works in China.

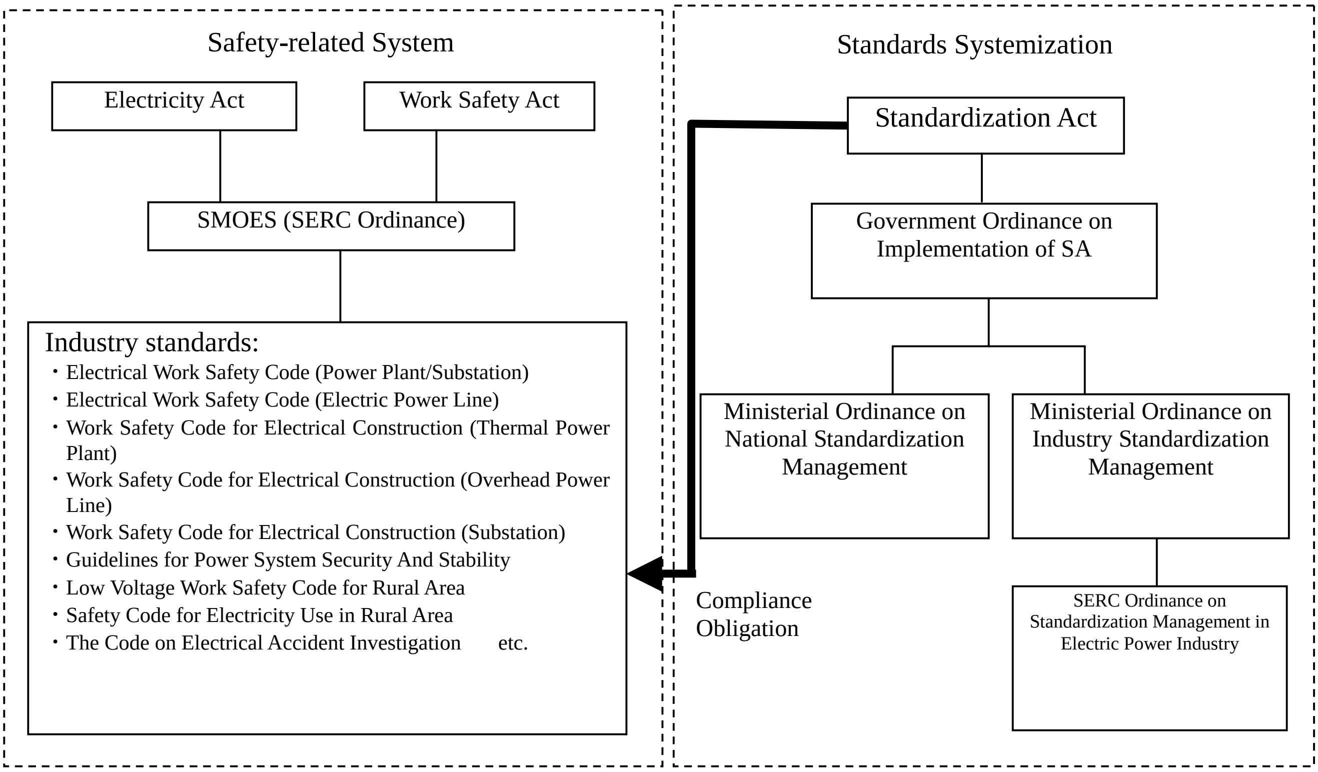


Figure 4.1.1 The Legal System for Electrical Safety

4.2 Safety system in Southeast and Southwest Asia

11 countries in Southeast and Southwest Asia in 15 countries we researched have some kind of technical standards, though the regulation for electric utility in each country is different. All technical standards has legal obligation based on relative law. Especially in Singapore, technical standards has obligation based on Electricity Act, so this case is good example for technical assistance in developing country. The summery of research in shown in table 4.2.1 and 4.2.2.

Table 4.2.1 Safety System in Southeast Asia and Southwest Asia（Where there is Technical Standards）

	Country where there is Technical Standards										
Country	Indonesia	Cambodia	Singapore	Thailand	Philippine	Vietnam	Malaysia	Laos	India	Nepal	Pakistan
Whether Electricity Law is there or not	No (Under taking)	Yes Electricity Law	Yes Electricity Act	No (Under taking)	Yes Republic Act No.9136	Yes Electricity Act	Yes Electricity Supply Act	Yes Electricity Law	Yes Electricity Act	Yes Electricity Act	Yes Electric Power Act, 1997
Technical Standards	Yes SNI (Standard National Indonesia)	Yes Electric Technical Standards	Yes Transmission Code	Yes EGAT Code	Yes Philippine Electrical Code	Yes General Term, T&D Installation	Yes (Unknown in detail)	Yes Lao Electric Power Technical Standard	Yes Indian Electricity Rules	Yes (Unknown in detail)	Yes Distribution Code, Grid Code
Legal position of technical standards	Obligated based on Government ordinance	Obligated based on Electricity Law	Obligated based on Electricity Law	Company Code	Obligated based on Electricity Law	Obligated based on Electricity Law	Obligated based on Electricity Supply Law	Obligated based on Electricity Law	Obligated based on Electricity Law	Obligated based on Electricity Law	Obligated based on Electricity Utility Regulation Law
Organization of standards establishment	NA	Ministry of Mining industry	Energy Market Authority	EGAT	Energy Regulatory Commission	Ministry of Industry	NA	Ministry of handcraft industry	Central Electricity Regulatory Commission	NA	Each T&D EPCO
Whether National Standards is there or not (Reference)	SNI (Standard National Indonesia) (IEC)	No (IEC etc.)	Singapore Standards (IEC,BS)	TIS Standards (ANSI)	Philippine National Standards (ANSI)	Vietnam Standard (IEC)	No (IEC)	No (IEC etc.)	Indian Standard (IEC,IEEE)	NA	NA
Certification for electric safety	SNI Standards	No	CAB Standards	TIS Standards	PS Standards	VS Standards	SIRIM Standards	No	IS Standards	NA	NA

Table 4.2.2　Safety System in Southeast Asia and Southwest Asia（Where there is not Technical Standards）

	Country where there is not Technical Standards			
Country	Myanmar	Sri Lanka	Bangladesh	Bhutan
Whether Electricity Law is there or not	Yes Electricity Act of 1910 Electricity Supply Act of 1948	Yes Electricity Reform Act No.28 of 2002	Yes Electricity Act, 1910	Yes Electricity Act
Whether National Standards is there or not（Reference）	No （IEC, BS）	No （IEC, BS, IEE）	Bangladesh Standards （IEC, BS）	No （IEC, Indian Standards）
Note	————	————	Bangladesh Standards is not useful recently.	Construction Standards concerning distribution system is being prescribing under ADB assistance.

(1) The Republic of Indonesia

In Indonesia, there are technical standards such as the distance required between lines and objects by SNI. Ministerial ordinance No.47, enacted in 1992, confers legal status on this technical standard. Whereas, equipment specifications and inspection procedures for generation, transmission and distribution are described in SNI, a number of which are based on IEC.

There are six inspection agencies: PT SUCPFINDO, PT PLN UNIT BISNIS JASA SERTIFIKASI, PT DEPRIWANGGA, PT INDOSPEC ASIA, PT KONBEBA, PT FINDO DAYA INSPEKSI, to confirm whether electric power utilities secure equipment and public safety. One of the clearly stipulated activities is the inspection which must be conducted before new power plants commence operation. The number of these agencies is expected to be increased to 12 to further facilitate the carrying out of these enforcement functions.

(2) The Kingdom of Cambodia

In Cambodia, the Electricity Act was established as the regulatory law for the electric power industry. According to the stipulation in section 5, the EAC is responsible for supervising power company compliance with all the operational, safety, and environmental technical standards promulgated by the MIME. Please refer to chapter 5 for further details.

(3) The Republic of Singapore

In Singapore, the Electricity Act stipulates that all electricity licensees shall comply with the codes of practice and other standards of performance issued or approved by the Energy Market Authority (EMA) and directions given by EMA.

The Transmission Code sets out the technical requirements to be met by those who are connected to the transmission system, from the point of view of maintaining the stability, security and reliability of the power system. It not only sets forth the technical standards and requirements for transmission installations, but also lists those for generating facilities and distribution installations. Also, the Transmission Code sets out the inspection and maintenance requirements for the electricity licensees. All electricity licensees, including the transmission licensees, generation licensees and retail licensees, are required to inspect, test, monitor and maintain their own electrical facilities and installations in order to determine whether such facilities and installations comply with all applicable technical standards and requirements. In addition, the Electricity Act stipulates that only licensed electrical workers can carry out electrical installation, maintenance and repair work.

In Singapore, technical standards are normally reviewed by a technical committee initiated by the Institution of Engineers Singapore (IES) or Professional Engineers Board of Singapore (PEB). As can be seen in the Transmission Code, IEC and BS standards are adopted extensively for electrical facilities and installations.

(4) The Kingdom of Thailand

Thailand is in the process of enacting an Electricity Industry Act, which aims, among a number of objectives, to promote secure and safe provision of electric power. At present, the draft act has been prepared and is under final review. In Thailand, a set of national standards for electricity industry does not exist, however, the standards of EGAT can be viewed as such. The reason is that the EGAT owns the power system all over Thailand, and all generators are connected to the EGAT system, therefore the lack of a set of national standards is no great cause for concern. To be more specific, EGAT standards are based on such international standards/codes as IEC, ANSI, and JIS, of which ANSI is adopted for transmission voltage levels. The equivalent to IEC or JIS in Thailand is Thailand Industry Standard (TIS).

In case of emergency or other necessity, a licensee is authorized to enter the land or the premises of any person at any time for inspection or repair of the power network system. If the owner or occupying person is present at the site, they are notified prior to such entrance.

(5) The Republic of the Philippines

In the Philippines, the Republic Act No.9136, also known as the "Electric Power Industry Reform Act of 2001", was enacted in 2001 to facilitate reforms in the electric power industry. In this act, TRANSCO is required to ensure and maintain the reliability, adequacy, security, stability and integrity of the national grid in accordance with the performance standards set forth in the Grid Code. Also, a distribution utility is required to provide distribution services and connections for any end-users within its supply area consistent with the Distribution Code. The Grid Code prescribes that the grid owner and the system operator shall develop, operate, and maintain the grid in a safe manner and always ensure a safe work environment for their employees.

In this regard, parts 1 and 2 of the Philippine Electrical Code (PEC), which govern the safety requirements for electrical installations, operation, and maintenance, are stipulated as mandatory for the grid owner and the system operator. In addition, the Occupational Safety and Health Standards (OSHS) set by the Department of Labor and Employment constitute mandatory standards in order to protect every working person against workplace injury, sickness and death. In a very similar way, the Distribution Code prescribes that parts 1 and 2 of the PEC and the OSHS are mandatory for compliance by the distributor for the safety of electrical facilities and working persons respectively.

The Grid Code requires the grid owner and grid users to adopt and use a set of Safety Rules and Local Safety Instructions (SR&LSI) for implementing safety precautions on high voltage (HV) and extra-high voltage (EHV) equipment. Additionally, the grid owner and grid users are obliged to provide each other with a copy of their SR & LSI.

(6) The Socialist Republic of Viet Nam

In Viet Nam, the entire industry from electricity generation to electricity consumption (house wiring and electrical equipment) is regulated by the Electricity Act, which was enacted in December of 2004. Technical standards are established by the Minister of Industry in accordance with the fourth term of the 11th article in the Electricity Act. However, the current technical standards were drawn up according to Soviet Union techniques in 1984. Therefore, they are outdated and require immediate review.

To comply with the 11th article of Electricity Act, the 32nd article stipulates that the government shall define the electric power industry license publication, revision, addition and expiring date as well as orders and procedures. Additionally, the 21st article of government ordinance No.105 stipulates that the techniques and electrical equipment used by generation companies, transmission companies and distribution companies shall meet present technical standards and that they shall construct their equipment accordingly. Furthermore, the electric power regulation agency, newly established under the Electricity Act, shall assess their compliance through the electric power industry license assessment. While the Technique and Safety Department in the Ministry of Technology is responsible for confirming compliance with safety standards. In terms of electrical safety, the 29th and 30th articles of government ordinance No.105, under the legally binding force of the 11th article of the Electricity Act, orders related agencies to comply with the sector standards on the design and construction of electric power facilities. Therefore, the 11th article of the Electricity Act is a comprehensive law, especially with regards to safety.

The Vietnam standards, which are recommended standards for electrical apparatus with no legal force, contain standards for electric power equipment and electrical appliances which conform to IEC standards.

(7) Malaysia

In Malaysia, the Electricity Supply Act 1990, the Electricity Supply Regulations, the IEE Wiring Regulations Edition 16 have been enacted to establish a set of technical standards for the electric power industry. These regulations contain service standards, such as power quality, which are stipulated in the Licensing Agreement.

The Factory and Machinery Regulations under the Occupational Safety and Health Act 1994 obligates electric licensees to implement periodic inspections, as well as pre-use inspections, of their electric facilities including boilers and turbine-generators. In addition, electric licensees are required to formulate and observe their own internal safety rules. For instance, the TNB has formulated its own Electrical Safety Manual, with reference to the Central Electricity Generating Board (CEGB, UK) rules, for in-house use. A licensed electrical engineer is required to take responsibility for the safety and supervision of the construction, maintenance, and operation of electric facilities. When an electricity accident occurs, the electric licensee concerned must report to both the Energy Commission and the Department of Occupational Safety and Health. All opinions and requests of concerned parties are submitted to the Energy Commission for any changes regarding technical standards revision. There is an ongoing process in Malaysia to adjust technical standards to incorporate the IEC standards and other international standards.

(8) The Union of Myanmar

The two main laws governing the power sector in Myanmar are the Electricity Act of 1910 and the Electricity Supply Act of 1948. The latter legislation serves to nationalize the electricity supply sector, which was brought under the MEPE in 1972.

Due to the lack of a set of uniform standards, grid code or distribution code to regulate electric planning, design, construction, power generation, transmission and distribution in Myanmar, a variety of foreign standards and codes are concurrently employed. Currently, the IEC standards and BS standards are most extensively used, while other local standards and codes are employed in some projects on a case-by-case basis.

(9) The People's Democratic Republic of Lao

In April 1997, the Electricity Law was established as the regulatory law for the electric power industry. In February 2004, the Lao Electric Power Technical Standards were formulated and a legally binding authority was conferred upon them by the Electricity Law. Please refer to chapter 5 for further details.

(10) India

In India, the Electricity Act was enacted in 1910. The Act requires every transmission licensee to comply with the technical standards for transmission system operation and maintenance as stipulated in the grid standards, specified by the Central Electricity Authority. Still, the Act requires each SERC to specify their State Grid Code consistent with the Grid Code specified by the CERC, as well as the Electricity Supply Code. All states regulate the electric power industry within their jurisdictions in line with the aforementioned codes. In terms of the installation and maintenance of electric facilities, the Indian Electricity Rules 1956 (IER 1956), which was established under the Electricity Act (1910), stipulates specific measures for construction, installation, maintenance and safety. Under Rule 46 of the IER 1956, periodical inspection at intervals not exceeding 5 years for high voltage/extra high voltage generating plants, substations, distribution transformers and other electrical equipment is required to be carried out by the Electrical Inspector. In addition, high voltage/ extra high voltage consumer installations are subject to periodical inspection as well. Additionally, Rule 63 requires that the inspection of high voltage/extra high voltage installations be carried out before commissioning of the installation to confirm compliance with the safety provisions prescribed in the rules. If the inspection confirms that the installation is found to comply with the provisions, an approval in writing is issued to the owner/occupier of the installation.

Under the Indian Electricity Act 2003 and Rule 44A of the IER 1956, if any accident occurs in connection with the installations of generation, transmission, distribution or use of electricity by any person, such a person or any authorized person should submit a report within 24 hours of experiencing or learning of the its occurrence to the Electrical Inspectorate.

(11) The Democratic Socialist Republic of Sri Lanka

In Sri Lanka, the Electricity Reform Act, No.28 of 2002 (ERA 2002) was enacted in 2002 to repeal the Electricity Act, No.19 of 1950, while the administration of the ERA 2002 was placed under the Public Utilities Commission of Sri Lanka (PUCSR).

According to the provisions within the ERA 2002, the PUCSR is authorized to set technical and other standards, including safety standards. In this respect, the Sri Lanka Standard (SLS) was set forth only for commercial products. At this stage, standards for electrical engineering, still, do not exist in Sri Lanka. Instead, IEC and BS standards are primarily applied in practice, IEE standard is used for wiring, while IEEE and ANSI standards are not widely adopted. Additionally, there are no license required for the construction, maintenance and operation of electrical facilities.

(12) The Kingdom of Nepal

In Nepal, section 2049 of the Electricity Act, stipulates that the licensees of electricity generation, transmission or distribution facilities shall operate in accordance with the electricity quality standards and other technical requirements prescribed. Formulated one year after the Act, the Electricity Regulation 2050, pursuant to the Act, specifies the standards for voltage levels, frequency and power factors of electric power, while safety measures regarding electric devices, such as minimum heights of overhead wires, are also specified. As to the inspection of power plants and electric facilities and installations, the Electricity Regulation 2050 requires licensees to conduct all prescribed technical tests when bringing a new plant, facility or installation into operation, or after repairing an old one. Additionally, it also obligates each licensee to arrange an inspection of their operating plant, facility or installation every year and to obtain a certificate to confirm compliance. Furthermore, distribution licensees, in particular are required to inspect and maintain the service line in their supply area to ensure the safety of electric power supply.

Licensees must submit a detailed report to the Electricity Inspector in case of any accidents or damage involving their plants or involving their facilities and installations. Upon receiving an accident report, the Electricity Inspector may, as required, inspect to investigate the cause of an accident and may order the licensee to amend its safety measures to prevent re-occurrence of such accidents.

(13) The Islamic Republic of Pakistan

In Pakistan, the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (Act 1997) prescribes that the National Electric Power Regulatory Authority (NEPRA) shall be exclusively responsible for prescribing and enforcing performance standards for generation, transmission and distribution companies.

In the National Electric Power Regulatory Authority (Distribution) Rules, 1999, the NEPRA requires the distribution licensee to prepare and submit its distribution code. Apart from this, the NEPRA issued the Performance Standards (Distribution) Rules in 2005, in which a distribution licensee is required to observe the Guaranteed Standards of Performance and Overall Standards of Performance as well. In particular, Overall Standards 7 in the same Rules lays down the safety provisions for the distribution licensee:

In addition, the generation licensee is required to comply with the grid code, industry standards and uniform codes of conduct that have a bearing on the safety, reliability, stability of the power system as well.

(14) The People's Republic of Bangladesh

The Electricity Act of 1910 is the law which regulates electric power business, however, it does not address technical matters or contain clauses related to electric facilities.

Actually, MPEPR stipulates adherence to BS standards or ANSI standards for all projects.

However, IEB (Institution of Engineers, Bangladesh), an industry and technical related association body, has recently commenced the establishment of technical standards. The electric utility BPDB is a governmental body, which explains why no process exists with regard to government inspection or approval. However, Power Cell, a subordinate organization of BPDB, examines each IPP project's technical proposals.

(15) The Kingdome of Bhutan

At present, there are no any technical standards with respect to electric power generation, transmission and distribution in Bhutan, except regarding the permissible voltage fluctuation for transmission and distribution (±5%) and the permissible frequency fluctuation (±3%) published in the DOE's Power Data.

Although the DOP formulated the "Basic Standards, Guidelines and Cost Estimation for Infrastructure Construction pertaining to Power Sub-transmission and Distribution" in 1998, in practice, BPC determines the design standards in conjunction with consulting agencies on a case-by-case basis, thus making the standards used in construction projects slightly different from one project to another. In order to facilitate the formulation of electrical standards in Bhutan, an investigation mission was dispatched in 2004 under the auspices of the Asian Development Bank. It is now in the process of establishing the electrical safety provisions and a standard for construction of distribution facilities will be prepared before long.

BPC implements patrols and inspections of electrical installations based on the in-house "Maintenance Schedule for Distribution System", which prescribes the detailed inspection items and report formats for each distribution installation. Inspection periods are also prescribed. However, in practice, patrols or inspections are implemented according to the appropriate instructions given by the relevant managers.

5 Lessons from the Projects in Laos and Cambodia

5.1 Projects in Laos

5.1.1 Outline of Projects

(1) Background of Projects

Most of the power facilities constructed in Lao P.D.R. were funded by foreign investment and were based on different technical standards. As a result, the disparity of technical standards causes confusion and complications with operation, maintenance and control of the power facilities, and there is a concern that it adversely impacts reliability of power facilities or endangers the public due to risk of electric shock, fire or collapse of a supporting structure. In order to improve this situation, JICA project-type technical cooperation, "The Project on Electric Power Technical Standard Establishment in Lao P.D.R." (hereinafter referred to as "STEP 1"), aimed at the preparation and arrangement of a set of unified electric power technical standards, was carried out over three years from 2000. The technical cooperation project entitled, "The Project on Electric Power Technical Standards Promotion in Lao P.D.R." (hereinafter referred to as "STEP 2"), focusing on human resources training to utilize Lao Electric Power Technical Standard (hereinafter referred to as "LEPTS") prepared and arranged in STEP 1 (enacted in February 2004), has been conducted since 2005 and it will be completed in 2008.

(2) Outline of Projects in Laos

The Outline of each project is shown in Table 5.1.1.

Table 5.1.1 Outline of Projects in Laos

	The Project on Electric Power Technical Standards Establishment in Lao P.D.R (STEP 1)	The Project on Electric Power Technical Standards Promotion in Lao P.D.R (STEP 2)
Framework	Long-term experts: 6 persons (Chief-adviser, Coordinator, Hydro-civil engineering, Generation/Substation, Transmission line and Distribution line) Short-term experts : total 23 persons Acceptance of trainees : 8 persons Disposition of Counterparts : 17 persons	Long-term experts: 3 persons - Department of Electricity (DOE), Ministry of Industry and Handicrafts (MIH): 1 person - Electricite du Laos (EDL): 1 person - Coordinator : 1 person Short-term experts : from 6 fields (Hydro-civil engineering, Hydroelectric generation, Substation, Transmission line, Distribution line and Indoor-wiring), total 34 persons Disposition of Counterparts : total from all fields 34 persons
Method	Technical Cooperation Project	Technical Cooperation Project
Period	From May 2000 to Apr. 2003	From Jan. 2005 to Jan. 2008
Expense	Approximately 350 million JPY	Approximately 350 million JPY
Contents	- Survey on conditions of power - Facilities in both urban and in local areas. - Preparation of Electric Power Technical Standards Draft - Preparation of Draft Guideline on Operating and Managing Electric Power Technical Standards - Preparation of Draft Explanation of LEPTS etc. - Electricite du Laos (EDL): 1 person - Coordinator: 1 person	- Preparation of Examination and Inspection Manual - Preparation of databases for accident reports - Preparation of Safety Rules - Improvement of training center - Technology transfer to counter parts (Training of Trainers, etc.)

(3) Scope and Contents of LEPTS

The contents of LEPTS correspond to portions of Japan's "Electricity Utility Industry Law", "Technical Standards for Hydropower Electric Power Generation Facilities and Electric Equipment" and "Interpretation of Technical Standards". And importantly, LEPTS regulates both the electric utilities industry and power safety (required specification for power facilities etc.).

A compendium of LEPTS is shown in Figure 5.1.1, and the main stipulated contents are shown in Table 5.1.2.

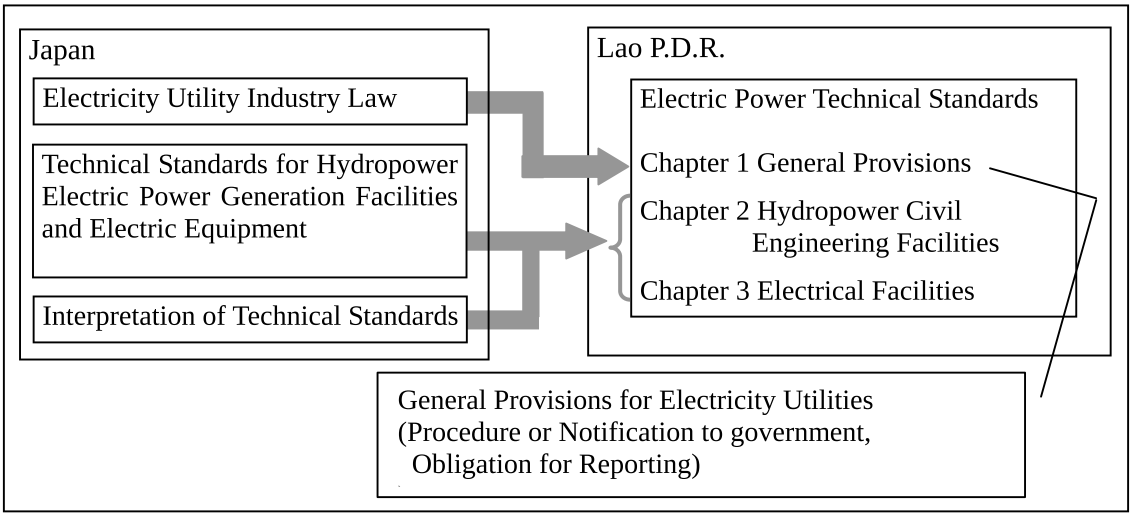


Figure 5.1.1 Compendium of LEPTS

Table 5.1.2 Main Stipulated Contents of LEPTS

Chapter	Stipulated Contents
Chapter 1 General Provisions	- Purpose, Scope and Observance of Technical Standards - Nomination of Chief Engineers - Examination for commencement of construction and inspection for commencement of operation - Order of Remedy for Conformance to Technical Standards and Restriction of operation - Obligation for Reporting (Commencement of construction, Commencement of Operation, Regular Inspection, Accident etc.)
Chapter 2 Hydropower Civil Engineering Facilities	- Fundamental Requirements (Dam Stability, Prevention of Seepage Failure of Dams, Prevention of Damage to Upstream and Downstream Areas, etc.) - Dams - Waterways - Reservoirs - Regulation of Discharge to Downstream Areas, Powerhouses and other facilities, etc.
Chapter 3 Electrical Facilities	- Fundamental Requirements (Protection or Prevention against danger, or disaster) - Hydropower Electrical Plants, Substations and Switching Stations - Transmission Lines - Distribution lines - User's Sites Electrical Installations

(4) Counterparts

The number of counterparts involved in each part of STEP 1 and STEP 2 is shown in Table 5.1.3 and Table 5.1.4 respectively.

Table 5.1.3 The Number of Counterparts in each part of STEP 1

[Breakdown：(DOE side／EDL side),Total]

	Hydro-civil engineering	Hydroelectric generation and Substation	Transmission line	Distribution line	Total
Full-time Counterpart	(1/0)1	(1/0)1	(1/0)1	(1/1)2	(4/1)5
Part-time Counterpart	(1/1)2	(1/2)3	(1/2)3	(1/3)4	(4/8)12
Total	(2/1)3	(2/2)4	(2/2)4	(2/4)6	(8/9)17

Table 5.1.4 The Number of Counterparts in each part of STEP 2

[Breakdown：(DOE side／EDL side),Total]

	Hydro-civil engineering	Hydro-electric generation	Substation	Trans-mission line	Distribution line	House Wiring	Total
Full-time Counterparts	(1/1)2	(1/1)2	(1/1)2	(1/1)2	(1/1)2	(1/1)2	(6/6)12
Part-time Counterparts	(1/2)3	(1/2)3	(1/2)3	(1/3)4	(1/3)4	(1/3)4	(6/15)21
Total	(2/3)5	(2/3)5	(2/3)5	(2/4)6	(2/4)6	(2/4)6	(12/21)33

Especially in the case of DOE, counterparts were selected from a small number of DOE staff, and there are counterparts who have other tasks outside STEP 1 or STEP 2. Therefore, counterparts are to be classified into full-time counterparts and part-time counterparts in order to make their roles clearer.

(5) Technology Transfers

(a) STEP 1

The contents of LEPTS were explained to each individual counterpart to enhance their understanding. And when a workshop or a seminar was held, counterparts prepared materials regarding the contents or outcomes of STEP 1 and made a presentation for themselves. Thus, all counterparts had an opportunity to make a presentation and improve their understanding.

(b) STEP 2

Technology transfer has been implemented through the explanation of prepared manuals or rules. Case examples of technology transfer are shown below.

1) Preparation of manuals and rules concerning LEPTS and explanation
   - Examination Manual (Examination for commencement of construction)
   - Inspection Manual (Inspection for commencement of operation)
   - Safety Rules etc.
2) Improvement of LEPTS explanation materials and lecture to counterparts regarding contents of explanation manuals
3) Training of inspection for before commencement of operation etc.

5.1.2 Lessons from Projects in Laos and Cambodia

(1) Implementation Framework

(a) Improvement and Strengthening of the Governing Authorities

In the present system, ministries in charge of electricity utilities in Lao P.D.R. have no authority to permit or approve construction or operation of facilities or to check compliance with technical standards. Thus it is important to strengthen the function of the governing authorities for regulation of the safety system.

In addition, the administration must be reorganized, including an increase in the number of staff, because the number of staff currently engaged in permission or approval, and regulating electricity utilities is insufficient. At present, it is practically impossible to select all officers to be engaged in examination, etc. exclusively from Department of Electricity staff. Therefore, it is necessary to secure some officers by means of temporary transfer from related organizations such as public electric companies.

(2) Scope and Content of Technical Standards

(a) Level of Technical Standards

LEPTS contains many articles that were made by referring to technical standards of Japan. If the quality of the content in the technical standards is of the same high level commonly seen in advanced countries, extremely high reliability can be secured, but the construction cost of power facilities is higher and slows the promotion of rural electrification and so on. Therefore, it is important to consider that the contents of technical standards should be based on the economic power of the country or regional situation to avoid hindering the promotion of rural electrification and so on.

(b) Safety of Customers' facilities

In case of Lao P.D.R., there have been a number of accidents involving casualties or fires at factories or residences caused by defects of customers' facilities, which has highlighted that improving the safety of customers' facilities may be more necessary than that of power facilities. Therefore, in response to a strong request from the Laos side, technical standards concerning indoor-wiring were also prepared during STEP 1. However, the indoor-wiring workers have such insufficient knowledge regarding these standards that they are not being applied at all now.

(3) Counterparts

If counterparts have other tasks outside the scope of the project, they are sometimes inexplicably absent from various project activities. Institutional support and human resource training should go hand in hand in projects, but training activities depend on the participation of counterparts. Therefore, securing the attendance of members is an essential consideration, not only at the planning stage of the project but also during the implementation stage. During STEP 1 or STEP 2, some counterparts accepted job offers in unrelated sections inside their organization, and there was a counterpart who resigned from the project after being recruited by a private company proposing much higher pay. The employment conditions and personnel management of counterparts is a matter for the Lao side, but it is necessary that certain measures are taken, such as assignment of a sufficient number of counterparts, to allow for any unforeseen events or personnel changes.

(4) Technology Transfer

(a) Technology Transfer Regarding Technical Standards

LEPTS covers detailed contents that correspond to Japan's "Interpretation of Technical Standards" including extremely complicated information. Therefore, preparation of explanation material regarding each item is important to make it easier to understand. It is also important to prioritize key items for the transfer of technology to counterparts, because it is difficult for counterparts to master all items in the short period of time available.

(b) Arrangement of Manuals for Technology Transfer

The rules, stipulating procedures or notification to government and so on, were prepared during STEP 1 or STEP 2. But implementing these rules in practice, it is necessary to prepare a guideline, manuals and so on which reflect the methods and the formats of application forms, and it is also necessary to train counterparts in the use of these documents.

(c) Training of Trainers (TOT)

To disseminate technical standards through all parts of the country, it is necessary to train prospective leaders who will train general electric utilities or relevant people in local areas.

(5) Others

(a) Treatment of Existing Facilities

The existing facilities that do not conform to LEPTS will not be repaired, because "Lao Electric Power Technical Standards" has no article that obligates such action. However, considering that the main purpose of technical standards is to prevent dangers to persons or objects, it is unacceptable to allow defective facilities that do not conform to technical standards to operate with the risks of electric shock or collapse remaining in operation for a long period. In such cases, appropriate measure should be considered.

(b) Introduction of SWER Method

If supplying only single-phase electric power, a single-phase two-wire system, that has two wires as medium-voltage line, is usually used. But the SWER method (Single Wire Earth Return method) can also supply single-phase electric power.

SWER requires lower installation costs due to the substitution of earth for one wire as the return pass. It is widely adopted for rural electrification in African countries. Additionally, it has been applied with success in some advanced countries such as Australia and New Zealand. Some donors such as World Bank and Asian Development Bank recommend the SWER method for rural electrification projects because of the lower costs associated with using only one conductor.

However, there are some problems associated with the SWER method such as the compulsory installation of an isolating transformer and restriction of power-carrying capacity. Implementing SWER does not necessarily achieve cost reduction in all cases. If three-phase electric power becomes necessary in SWER hereafter, the transformer would have to be replaced, because a special transformer is required to transform medium-voltage to low-voltage. Therefore, before adopting SWER, a sufficient feasibility study must be carried out.

In Lao P.D.R, SWER had been introduced before the enactment of LEPTS. There is a report of considerable damage from a lightning attack in SWER and almost all of the destroyed SWER facilities were replaced with the normal three-phase three-wire system or single-phase two-wire system. However, it has not been clarified whether the SWER facilities were destroyed by characteristics of SWER or by a material defect.

LEPTS does not regulate detailed SWER requirements. However, it is necessary to discuss whether SWER is adopted as a general method or whether SWER is treated as an irregular case. In terms of data gathered during the site investigation in Australia, SWER standards from Australia are shown in Table 5.1.5. However, otherwise internationally there seems to be very few available standards.

Table 5.1.5 SWER Standards in Australia

Standards	Organization	Abstract of regulations
AS2558 Transformers for use on single wire earth return distribution systems	Standards Australia International	Rated voltage, rated capacity, insulation level and shape of SWER transformers
A4 60322 (Earthing System for SWER Substations)	Shortland County Council in New South Wales State	Earthing method, values of earth resistance Capacity of Transformers / Value of earth resistance 5kVA / 30 ohms 10kVA / 25 ohms 15kVA / 15ohms 25kVA / 5 ohms 50kVA / 5 ohms
Code of Practice Works for Protective Earthing	Department of Industrial Relations, Queensland Government	Earth, value of current, safety measures, clearance to communication lines in SWER system and so on • The ground resistance of SWER transformers and isolators is determined by a requirement in these guidelines that the maximum voltage on the earth lead with respect to remote earth under operating conditions resulting in maximum continuous earth current should not exceed 20 V.
NZECP41 New Zealand Electrical Code of Practice (Reference)	Office of the Chief Electrical Inspector, Energy and Resources Division, Ministry of Commerce, New Zealand	General requirements for SWER facilities (earth, value of current, safety measures, clearance to communication lines) • The earth resistance for SWER transformer shall be 5 ohms or less. • The load current in SWER circuits shall be 8 amperes or less.

5.2 Projects in Cambodia

5.2.1 Outline of Projects

(1) Background of Projects

According to the ARTICLE 5 of Electricity Law of the Kingdom of Cambodia, Electricity Authority of Cambodia (EAC) shall perform their work in accordance with the Technical Standards for the Electrical Equipment which would be issued by the Ministry of Industry, Mines and Energy (MIME). However, the Technical Standards have actually not been issued yet, therefore, EAC cannot fulfill their obligations in terms of regulation, administration and supervision for the Electric Power Services, stipulated by the Electricity Law. In this country, most electric power equipment has been imported with a variety of technical levels. In such circumstances, the power service companies are not restricted from purchasing and installing electric power equipment with poor quality unless minimum acceptable technical standards are established. Therefore, in the Electric power sector, earliest possible establishment of Technical Standards for the Electric Power Equipment is an important priority. In order to improve this situation, 「The Study for Establishment of Electric Power Technical Standards and Guidelines in Cambodia」(hereinafter referred to as " Study of Establishment")commenced in October 2002. The purpose of this Study was to prepare the draft of "Electric Power Technical Standards". The Resulting document from that study, The Electric Power Technical Standards(hereinafter referred to as " GREPTS ")was enacted as law. However, the knowledge and the management ability of EAC and Electricity de Cambodia(EDC)are not sufficient at this stage. Therefore, in order to improve the management ability regarding technical standards for both organizations, [Project for Capacity and Institutional Building of the Electric Sector in Cambodia](hereinafter referred to as "Technical Cooperation Project ")was commenced by JICA in September 2004. At present, the draft of Specific Requirements of Electric Power Technical Standards is being prepared (hereinafter referred to as "SREPTS")and technology transfer with the Cambodian counterpart is proceeding through the Technical Cooperation Project.

(2) The Outline of Study and Project in Cambodia

The Outline of Study and Project in Cambodia is shown in Table 5.2.1

Table 5.2.1 Outline of Study and Project in Cambodia

	The Study for Establishment of Electric Power Technical Standards and Guidelines in Cambodia	Project for Capacity and Institutional Building of the Electric Sector in Cambodia (Only description of the project for EAC)
Framework	Consultants: 8 persons (Manager, Thermal power, Hydro power, Transmission, Distribution, House wiring, Renewable Energy, Coordinator) Counterparts; Total 8 persons	Long term expert: 1 person (EAC) Short term expert: Thermal power, Transmission, Distribution Counterparts; Total 11 persons (Project Manager; 1 person)
Method	Consultants	Technical Cooperation Project
Period	From Nov. 2002 to Nov. 2004	From Sep. 2004 to Sep. 2007
Expense	Approximately 240 million JPY	Approximately 140 million JPY (The budget for EDC is included)
Contents	・Preparation of the draft of The Electric Power Technical Standards ・Preparation of Guide book for Power Engineer ・The general survey for Cambodian electric power industry etc	・Preparation of the draft of Specific Requirements of Electric Power Technical Standards and Explanation Sheet, and technology transfer to counterparts ・Support to seminar for explanation of SREPTS for local small-scale electric power companies

(3) Scope and Contents of GREPTS

The contents of GRETPTS contains portions from "The Electricity Industry Law", "Technical Standard for the Electric Power Facility" and" Interpretation of Technical Standard" of Japan. GREPTS regulates both electric business and electric safety (specification of electric equipment etc) as well as a Laotian electric power technical standard.

The basic policy for preparation of GREPTS was as follows:

Avoid outlining details of performance standards for power equipment in terms of the numerical value and the method etc. as much as possible because making frequent changes or revisions of GREPTS after issuing it as a law is not suitable and contents of GREPTS will not be changed for 10 years or more. Therefore, numerical values were described only in items where quantification is needed for the safety of equipment in addition to the functional requirements that correspond to the ministerial ordinance of a technical standard from Japan. Table 5.2.2 shows main stipulated contents of GREPTS.

Table 5.2.2 Main Stipulated Contents of GREPTS

Provisions	Contents
Chapter 1 General Provisions	- Purpose, Applied Area, Enforcement （Employment of qualified electrical engineers, Authorization of qualified electricians are also included） - Quality of Electric Power, Prevention of Electric Power Disasters - Prevention of Electric Power Outage, Preservation of Environment
Chapter 2 Electric Power Facilities	- General （Life of Electrical Power Facility, Grounding, Connection of Conductors, Accuracy of Power etc） - Generating Facilities (Thermal Power) - Generating Facilities (Hydroelectric Power) - Generating Facilities (Others) - Transmission and Distribution Facilities (Common) - Transmission and Distribution Facilities (High Voltage) - Transmission and Distribution Facilities (Medium and Low Voltage) - House Wiring

SREPTS, being prepared through the Technical Cooperation Project, has aimed to clarify the rules to follow GREPTS by providing clear numerical values and methods for installation of facilities etc, which are not already outlined in GREPTS. In the Technical Cooperation Project, it was decided that SREPTS would be made for thermal power, transmission and substation, distribution because these areas are of a high priority.

The draft of SREPTS will be enacted as a law by MIME as well as GREPTS in the future. Table 5.2.3 shows contents of the SREPTS draft.

Table 5.2.3 Contents of the SREPTS Draft

Parts	Contents
All Electric Power Facilities	- Prevention of Electric Power Disasters, Prevention of Accidents Caused by Electric Power Facilities - Safety of Third Person, Prevention of Failures of Electric Power Facilities from Natural Disasters - Prevention of Electric Power Outage, Environmental Protection, Applicable Standards, Life of Electrical Power Facilities - Grounding, Grounding for Stations and High-voltage and Medium-voltage user's sites, Grounding for Distribution Lines and Electrical User's Sites, - Connection of Conductors, Communication System and Telecommunication System, Accuracy of Power Meters
Thermal Generating Facilities	- Boiler and its Accessories, Steam Turbine and its Accessories - Gas Turbine and its Accessories, Internal Combustion Engine and its Accessories - Gas Turbine Combined Cycle and its Accessories
Transmission and Distribution Facilities	- Property of Conductors, Prevention of Climbing on Supporting Structures, Safety Factor of Bare Conductors and Ground Wires of Overhead Electrical Lines - Side by Side Use and Joint Use of Electrical Lines or Communication Lines, Underground Lines - Protection against Over-current, Protection against Ground Faults - Design of Supporting Structures of Overhead High-voltage Lines, Design of Fittings for Conductors and/or Ground Wires of Overhead High-voltage Lines - Clearance between Bare Conductors and Supporting Structures of Overhead High-voltage Lines, Height of Overhead High-voltage Lines - Clearance among Overhead High-voltage Lines and Other Facilities or Trees - Prevention of Danger and Interference due to Electrostatic Induction and Electromagnetic Induction, Surge Arresters etc

(4) Counterparts

The number of counterparts for each part is as follows:

In the Technical Cooperation Project, one or more counterparts were selected from each organization, and the SREPTS draft was prepared on the basis of the consensus of the organization related to the counterparts. Though the arrangement for selection of counterparts in Study of Establishment was biased because counterparts were selected from one organization only.

The number of counterparts for each part in Study of Establishment and the Technical Cooperation Project is shown in table 5.2.4 and 5.2.5.

Table 5.2.4 The Number of Counterparts in Study of Establishment

Organizations	Thermal Power	Hydro Power	Transmission	Distribution	House Wiring	Renewable Energy	Total
MIME		2*			2	2*	6
EDC	2		1*	1*			4
Total	2	2	1	1	2	2	10

* Counterparts overlap

Table 5.2.5 The number of Counterparts in the Technical Cooperation Project

Organizations	Thermal Power	Hydro Power	Transmission	Distribution	House Wiring	Renewable Energy	Total
MIME	1	-	1	1	-	-	3
EAC	2	-	1	1	-	-	4
EDC	1	-	2	1	-	-	4
Total	4	-	4	3	-	-	11

(5) Technology Transfer

In Study of Establishment, technology transfer by way of meetings held during the decision stage of the GREPTS draft were carried out. Moreover, the understanding level of counterparts improved by instructing them to explain GREPTS in the workshop.

At the Study of Establishment stage the preparation of the GREPTS draft was a high priority.

The problems in technology transfer remained. For example, counterparts were not able to concentrate on the project because they had additional works, study team visiting days were short, and some counterparts didn’t have a basic understanding regarding their area of responsibility.

The main purpose of the Technical Cooperation Project is personnel training for the administration of GREPTS. So the GREPTS draft and explanation sheet draft, which explains SRETPTS and related technology transfer, are being prepared. To improve the level of understanding of the content, the counterparts will translate the SREPTS draft etc.

5.2.2 Lessons from the Projects

(1) Implementation Framework

(a) The Appointment of Counterpart Coordinator

There are a many members who only attend the conference however there are 3-4 counterparts arranged for each of thermal power, distribution, and transmission because counterparts have work to carry out in addition to the project. This situation interferes with the progress of project. Therefore, nominating a coordinator (Cambodian side leader of each part) provides leadership in terms of timely consideration of the project's progress and also in terms of encouraging counterparts to participate positively. In addition, coordinators are expected to become important for personnel training in this country in the future.

(2) Scope and Content of Technical Standards

(a) Regulation Policy for House Wiring Parts

The house wiring part is not within the jurisdiction of EAC, which manages electric power companies but within the jurisdiction of MIME. The draft of GREPTS concerning the house wiring was made in response to the Cambodia request made in Study of Establishment. However, it is not being used because the relating law is not yet established. It is necessary to discuss the system of related laws in terms of making decisions regarding the establishment of technical standards.

(3) Counterparts

(a) Motivation of Counterparts

It would be preferable for counterparts to be actively engaged in the preparation of the SREPTS draft. The JICA experts lead the preparation of the SREPTS draft and explain it to the counterparts. In such circumstances, counterparts tend to leave the responsibility for preparing the draft of SREPTS to JICA experts only. It seems that the prevailing attitude by engineers in Cambodia is that consultants or JICA experts should prepare any material at their request because various organizations have been helping or supporting Cambodia for such a long period of time. It is necessary to improve project progression by increasing counterpart’s willingness to contribute and participate in a way that reflects the ability of the engineers throughout the country

(4) Technology Transfer

(a) Learning Basic Knowledge

There are no large-scale thermal power stations in Cambodia. It is a very difficult for counterparts to understand each item of SREPTS because they cannot understand the importance or role of each part. In the Technical Cooperation Project, the JICA expert prepares the material concerning basic knowledge of thermal power and explains it to the counterparts in order to improve the level of their understanding. Therefore, a project should progress efficiently through the provision of basic education to counterparts regarding the technology, which is not widespread throughout the country prior to the project commencement.

(5) Others

(a) Transitional Provision for an Existing Facility

Clause 5 Transitional Provision in GREPTS regulates the treatment for an existing facility as follows;

1. The existing electric power facilities not harmful to human beings, animals and trees could be operated till the time of its renewal or replacement.
2. The existing electrical power facilities harmful to human beings, animals and trees shall be modified within two years to be satisfactory with the requirement of the Technical Standards.

It is quite different to the technical standard of Laos (LEPTS) which does not stipulate the adaptation of an existing facility as one of its regulations. However, it is important to note that some electrical companies which do not have the required funds may not be able to complete all the repairs before the designated deadline.

(b) Clarification regarding the Basis of Enactment

The technical standards in Japan have been revised many times since their enactment in 1965. It is necessary to clarify the basis of enactment at the time when technical standards come into effect because it is necessary to refer to them for each item at the time of their revision. The explanation sheet, which explains SREPTS, clarifies the basis for each item in the Technical Cooperation Project.

(c) Preparing the Material Data Base for the Project Related to Technical Standards

New projects may be more viable and executed more efficiently by JICA if the material prepared and information collected during past projects are combined and used effectively.

6 Recommend practice of technical cooperation on electric power technical standards

6.1 Recommend practice of preparation of technical cooperation on electric power technical standards

Information collection and analysis of legal framework of electricity law and current situation of electric power industries in host country are critically important for successful technical cooperation on electric power technical standards under electricity law (herein after referred to as the technical standards)

The technical standards are the main component of technical regulations under electricity law, which aim to secure consistency of frequency, voltage and reliability of electricity supply from power generation to electricity demands and to secure safety on electricity supply and consumption. Technical regulations consist of various regulatory measures such as technical reviews on designs of electric power works and on-site inspections prior to commissioning of electric power works by regulatory agency and requirements of reporting on faults of electricity supply and accidents caused by electricity supply and consumption to regulatory agency as well as the technical standards. It should be noted that understandings of these regulatory framework on technical regulations are basic requirements for JICA staff to design technical cooperation on the technical standards, because the objective of technical cooperation on the technical standards is not limited to establishment of the standards but also improving compliance of technical standards to secure reliable, efficient and safe electricity supply.

Contents of the technical standards are different by countries, because objectives and scopes of electricity law and legal frameworks of relevant laws are different by countries. For example, if the objective of electricity law is focused on regulation of electric power industry, the technical standards which are applicable only to electric power industries such as power generation, transmission and distribution are needed. If the electricity law includes regulations on electricity consumption as well as electric power industries, the technical standards need to include the technical standards on house wiring and appliances. In general, electric power industries are regulated not only by electricity law but also numbers of laws such as labor law, environmental protection law etc. There is no common model on allocation of responsibility between electricity law and other relevant laws to regulate electricity supply and consumption, because of different histories of establishment of legal frameworks and different philosophies on national regulatory frameworks.

There are 2 alternatives of measures of technical cooperation on the technical standards, which are development studies[1] and technical cooperation projects[2]. In fact, the establishment of the Electric Power Technical Standards in Lao PDR was implemented as a technical cooperation project and the establishment of the Electrical Power Technical Standards in Cambodia was implemented as a development study. In Cambodia, development of detailed guidance on the Technical Standards is being implemented as a technical cooperation project, following to the development study. In Vietnam, a development study on updating the existing technical standards, consistent with restructuring of regulatory framework and power industries, will be started this year as a development study.

The contents of technical cooperation on the technical standards need to be identified, taking into account of above mentioned variations of scopes and contents of the technical standards in each country and measures of technical cooperation. The post project evaluations also need to include evaluations on appropriateness of selection of technical cooperation measures, identification of contents of technical standards etc. taking into account of the variety of legal structures and situation of electric power industries. in each country.

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1 Development studies are part of JICA's technical cooperation which support the formulation of plans for public projects that are beneficial to social and economic development in developing countries.

2 Technical cooperation projects are one of JICA's main types of overseas activities. They are results-oriented, with Japan and a developing country pooling their knowledge, experience, and skills to resolve specific issues within a certain timeframe. The projects may involve the dispatching of experts from Japan to provide technical support, invitation of personnel from developing countries for training, or the provision of necessary equipment.

The following table 6.1.1 shows the checklist of current situation on the technical standards in each country. The Figure 6.1.1 shows general procedures to identify contents of the technical standards.

6.1.1 Information collection and preliminary analysis prior to preparatory study

Information collection and preliminary analysis on electricity law, relevant regulations, and current situation of electric power industry etc. are necessary to conduct a preparatory study on technical cooperation to establish the technical standards effectively. It is necessary to conduct a project formulation study or preliminary study prior to preparatory study if above mentioned information is not available in Japan.

(1) Electricity law and relevant regulations

It is the basic requirement, to understand legal structure of electricity law including the technical standards, to design technical cooperation projects on the technical standards effectively. Therefore collection of electricity law and relevant regulations under the law are the first priority.

Background information collection and analysis on enactment of electricity law such as electric power policy etc. may be helpful to understand the needs and missions of the technical standards, if the law is newly established.

Collection and analysis of the existing technical standards, including the purpose of updating of the technical standards, are necessary in the case of technical cooperation on updating the existing technical standards. Collection of the existing technical standards in advance to preparatory study is extremely important in the case of countries which official language is not English, because translation of the technical standards in local languish into English takes time.

(2) Institutional framework of government organizations which is responsible to electric power policy and regulations

Counterpart organization of technical cooperation on the technical standards is generally either or both the ministry which is responsible to electric power policy and/or regulatory agency which is established as an independent authority to regulate electric power industries under the power sector's restructuring law. There may be few experienced experts on electric power technologies and industries in Ministry or regulatory agency, if government owned electric power company has been privatized recently, because most experts generally choose to remain the privatized electric power company instead of moving to government. In this case, experts of electric power company need to be added to the counterparts of the project. Therefore it is important to analyze institutional framework and capacity of government organizations which is responsible to electric power policy and regulations, to identify appropriate counterpart organizations and persons. This information is also necessary to identify appropriate organizations to visit during preparatory study.

Table 6.1.1 The Checklist of Current Situation on the Standards

Situation of technical standards developments	Countries without technical standards	Countries with technical standards
Previous projects	Lao PDR., Cambodia	Vietnam
Regal framework on electric power	- Enactment of Electricity law - Issuances of regulations under the Electricity law （Regulations which are necessary the Electricity law to enter into force） - Procedures to establish a technical standards - Legal status of technical standards under the law	- Objective to update the existing standards or establish a new technical standards - Procedures to establish a technical standards - Legal status of technical standards under the law
Scope of technical standards	- Electric power user's equipments are included or not? - Rural electrification is included or not?	same as the left column
Analysis of technical standards	———	- Analysis of the existing technical standards
Institutional framework on technical standards	- Organization to establish technical standards - Organization to enforce technical standards (the capacity of organization often may not enough to enforce technical standards)	same as the left column
Compliance of technical standards	- Relationship with electricity supply licensing - Review of design of electricity power works, on-site inspection, reporting of faults on electricity supply or accidents	same as the left column
Establishments of relevant laws	- Relationship of rolls between labor law, environmental protection law etc. and electricity law (In less developed countries, relevant legal framework may not be completed. In that case, it is necessary to survey the work plan to complete the legal framework.)	- Relationship of rolls between labor law, environmental protection law etc. and electricity law (There may be inconsistency or overlapping of regulations between those laws.)
Establishment of relevant technical standards	- National standards, technical standards or recommendations by academic organizations or industry organizations (There may be few non profit organization in less developed country)	- National standards, technical standards or recommendations by academic organizations or industry organizations - Evaluation of potentials to use the above mentioned organizations to establish the standards
Current situation of electric power industries	- Analysis of current situation and tackling issues of electric power industries - Current situation on establishment of statistics such as faults of electric power supply and accidents.	same as the left column

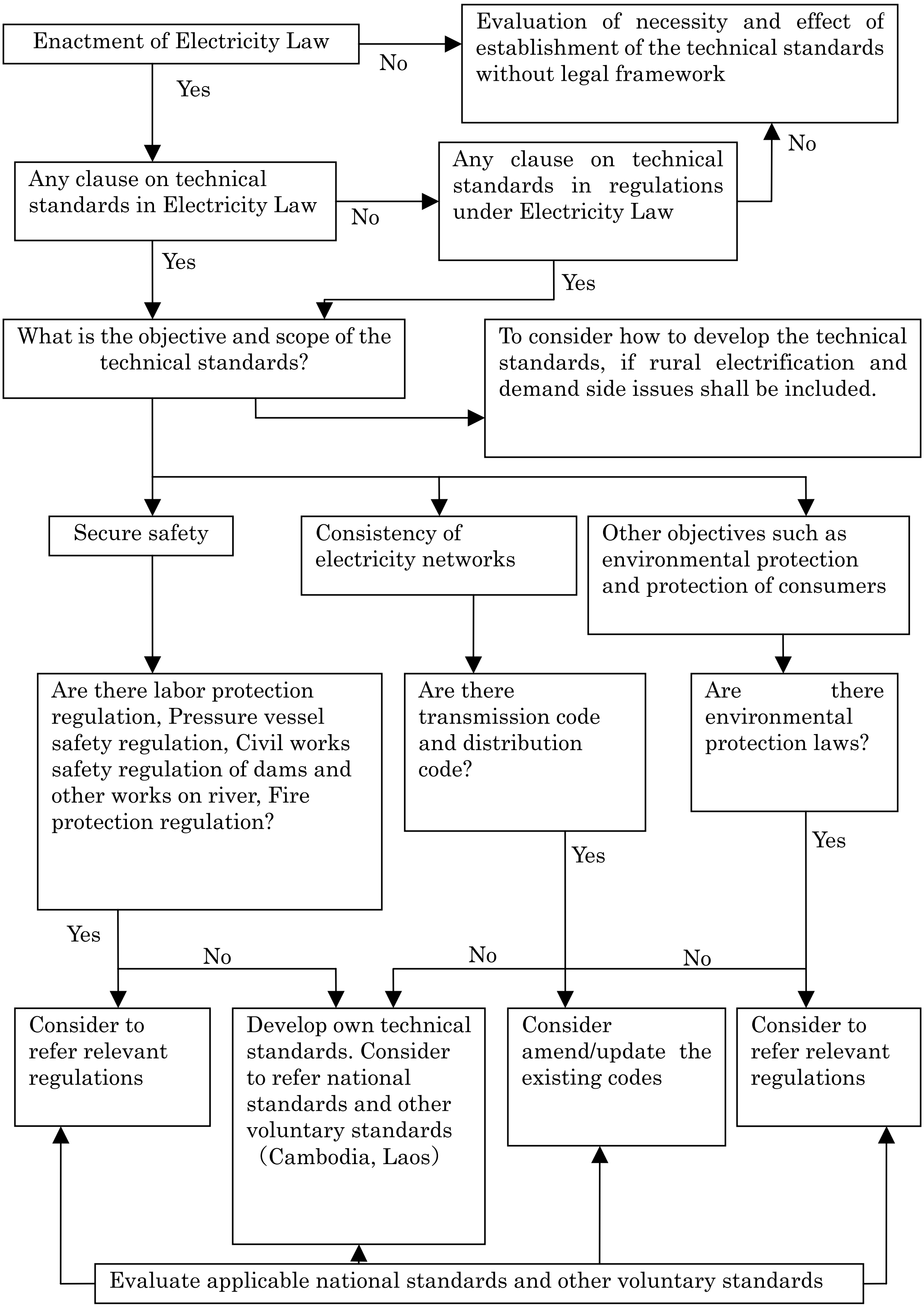

Figure 6.1.1 General Procedures to Identify Contents of the Technical Standards

(3) Institutional framework of electric power industry and current situation of electric power works

There are several variations on institutional framework of electric power industries in developing countries. These variations include electric power supply by government agency, electric power supply by vertically integrated government owned electric power company, electricity supply by combination of government owned power generation and transmission company and private distribution company, and power supply by private electric power company. During the transitional period to move to fully unbundled and privatized electric power companies, there may be many variations of institutional framework of electric power supplier.

If a new electricity law intends to privatize and unbundled electric power industries urgently, establishment of transmission code and distribution code might be the first priority to secure consistency and reliability of transmission and distribution services. If a new electricity law mainly intends to establish competitive power generation market, establishment of the technical standards on power generation might be the first priority. Therefore it is very important to identify priority of the technical standards to be established through information collection and analysis on the current and future institutional framework of electric power industry.

It is also necessary to analyze current situations of electric power industries and electric power works, to identify priority and scopes of the technical standards. For example, priority to establish the technical standards on specific electric power generation technologies is depend on the power generation mix in host country and scopes of the technical standards on transmission and distribution depends on the situation of transmission line developments and utilization of underground cables etc. Therefore it is recommended to collect and analyze information on electric power industries such as annual report of electric power companies.

(4) Organizations to establish technical standards and relevant government agencies

Most countries have the national standards on appliances and equipments such as electric power generation and distribution. IEC and ISO have been developing various technical standards in the world. It is important to understand the progress of these standardizations relevant to electric power supply and demand to establish the technical standards. Therefore information collection and analysis on standardization organization in host country (generally a government agency is responsible for standardization in developing countries) and progress of standardization are necessary. These information collection and analysis also enable to identify appropriate organizations to visit during preparatory study. Information collection and analysis on institutional framework and activities of academic and industrial organizations on electric power technologies and industries are recommended to evaluate possibilities to use these organizations to develop voluntary technical standards and guidelines. Visits of these organizations during preparatory study is expected to be informative.

There are numbers of laws relevant to electric power supply and demands. It is necessary to understand the demarcation of responsibility among there laws including electricity law to identify scopes of the technical standards. Therefore it is recommended to survey the relevant laws which have close relationships with electricity law and the responsible ministries to the laws. It is also recommended to visit some ministries during preparatory study, if necessary.

6.1.2 Preparatory study

(1) Scope of electricity law and legal structure of the technical standards

Regulations on electric power industry generally consist of business regulations (business licensing and tariff regulation etc.) and technical regulations (standards on frequency and voltage, standards on electrical equipments, connection standards etc.).However scope and details of regulations are different by countries. Technical regulations consist of regulations such as frequency and voltage to secure consistency of electricity supply between generation, transmission, distribution and customers and safety regulations (technical standards of equipments, etc.). The objectives of safety regulations are divided into public safety and labor's safety. The Figure 6.1.2 shows common regulatory structures of electricity law. Analysis on the structure and scopes of electricity law is the first step to identify appropriate contents and measures of technical cooperation on the technical standards. This analysis is not focused only to the electricity law but also to the relevant regulations under the law such as decrees, minister's order etc., because in some countries technical regulations are defined in decree or minister's order etc. under the electricity law.

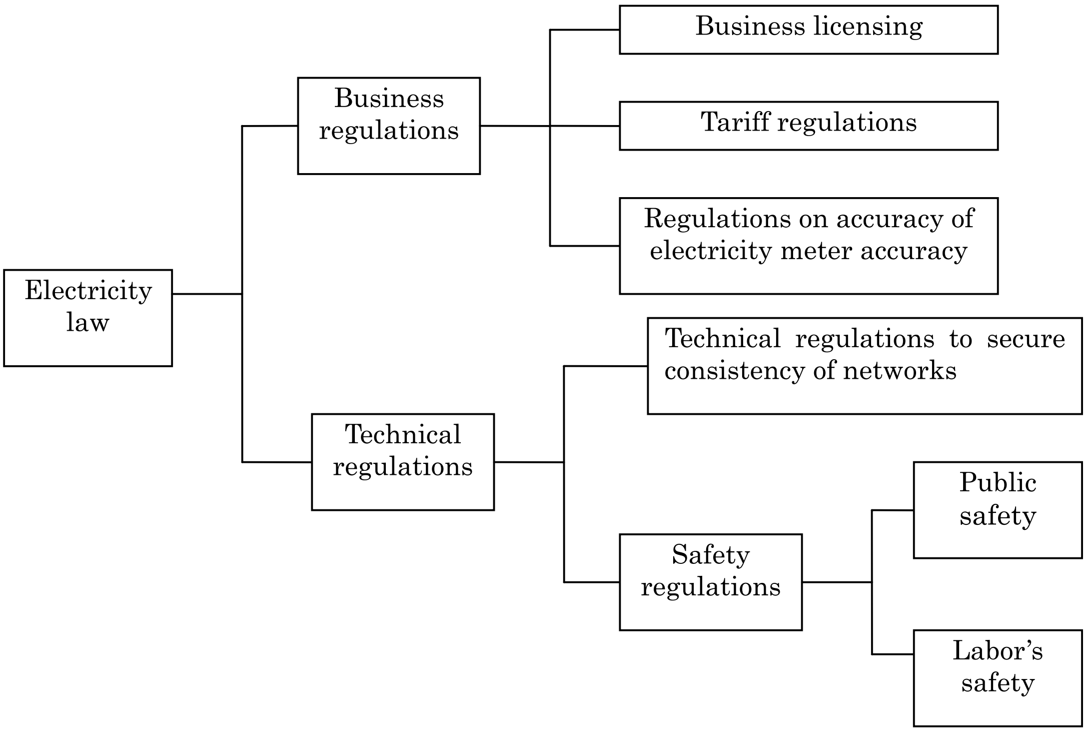

Figure 6.1.2 Regulatory Structure of Electricity Law

It is also important to analyze scope of electricity law in terms of flow of electricity. Primary energies are converted to electricity at electric power stations and then generated electricity is delivered to customers through transmission and distribution lines. Electric power industries are responsible to deliver electricity to customers (usually to the electricity meters). Therefore electricity law usually regulate from electric power generation to distribution of electricity. However improper house wiring often causes electricity leakages problems and sometime faults of house wiring causes problems of quality of electricity supply to other customers. Taking into account of these problems, electricity law may include regulations of house wiring in some developing countries. Although regulations of appliances are not commonly included in technical regulations under electricity law, some countries may include regulations of appliance in electricity law. The Figure 6.1.3 shows the electricity flow and relationship between electric power companies and customers. It is important to clarify if electricity law includes regulations of customer's facilities and equipments.

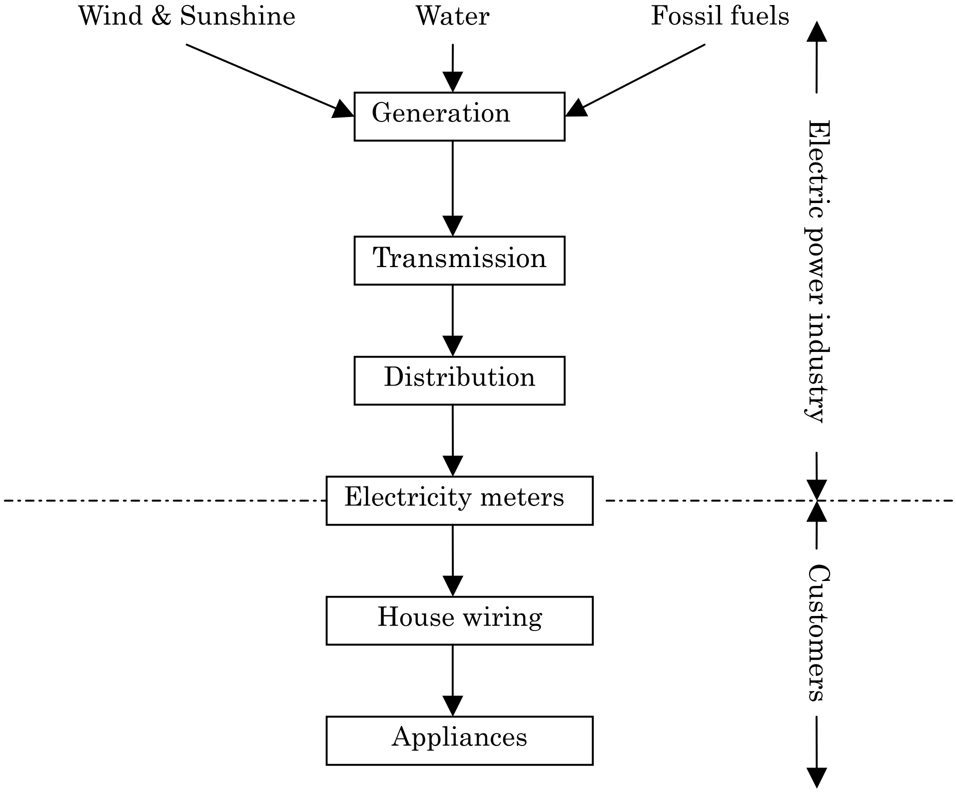

Figure 6.1.3 Electricity Flow and Relationship between Electric Power Companies and Customers

Power generations to convert primary energy to electricity include technologies which may be regulated by other reasons than electricity safety. There are several typical examples of these regulations. Hydro power plants may be regulated by safety regulations of dams and other civil works and steam generations may be regulated by safety regulations of pressured vessels. Nuclear power plants are regulated by safety regulation on handling of radioactive materials. Large scale power plants are regulated by environmental protection laws to regulate effluents and waste gas emissions. These regulations are applicable to other facilities to use similar technologies (for example: dams for flood control and irrigation use same technologies as hydro power dams and industrial boilers use similar technologies as boilers for steam generation). Therefore these electric power generation technologies may be regulated by either the regulations of specific technologies or technical regulations under the electricity law. The Figure 6.1.4 shows examples of regulations on specific generation technologies. It is necessary to clarify scope of the technical standards on electric power generations which are needed to be established under the electricity law, taking into account of scope of the other regulations on specific technologies.

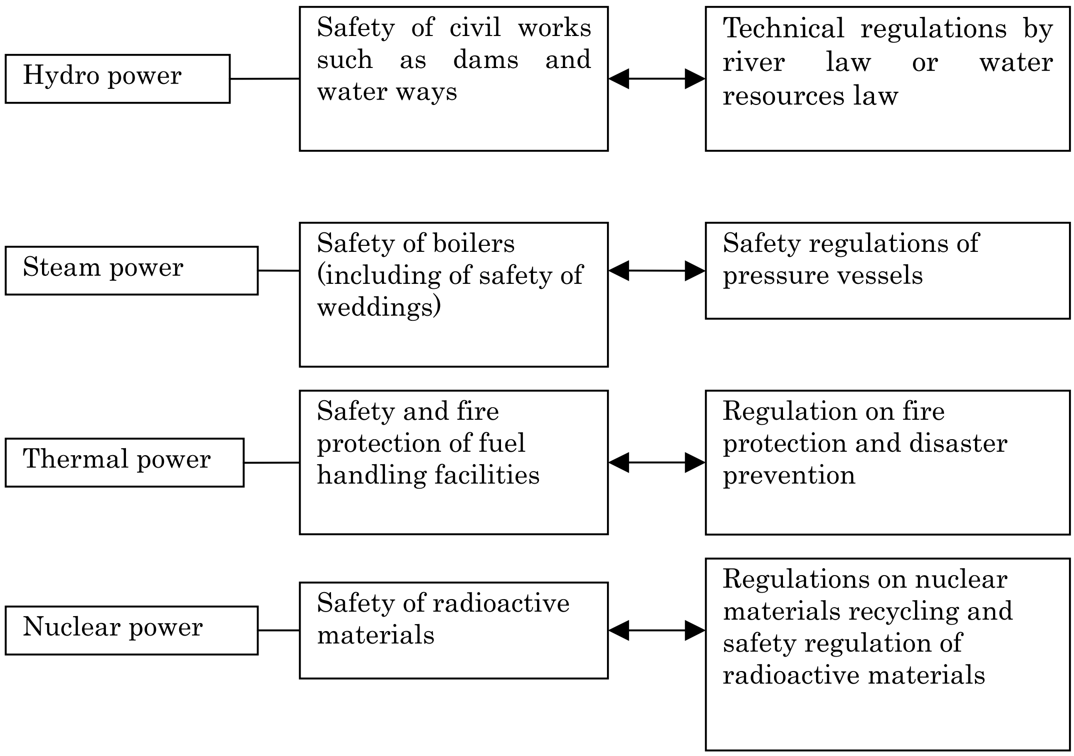

Figure 6.1.4 Examples of Regulations of Specific Generation Technologies

(2) Technical regulation of electric power industry by other laws

Electric power industries are regulated by other laws to regulate specific technical issues such as labor protection law, environmental protection laws and fire protection laws etc. as well as electricity law. Electric law itself may have a mission to regulate electric safety specifically, not only limited to electric power industry but also other industries and electricity consumptions. The relationship between electricity law and other laws to regulate cross industrial specific issues is different by countries, because of different histories of enactment of these laws (for example: if electricity law was enacted prior to other laws or not.) and different national legal framework in each country. Even most countries have labor protection law, environmental protection law and fire protection law, the application of these laws to electric industries are different by countries, in terms of relationship with technical regulations under electricity law. In some countries, electric industries are regulated for a specific technical issue by both electricity law and other law to regulate a specific issue. In some countries technical regulations under electricity law excludes technical issues which are regulated by other laws specified to the technical issues. Regarding to electric power generations, electricity law often excludes specific technical issues which are regulated by other laws. Electricity law needs to include technical regulations on cross industrial specific issues, if host countries do not have laws to regulate these issues. Also it is necessary to clarify coordination mechanisms to secure consistency of technical regulations on specific issues between electricity law and other laws, if both laws are applied to electric industries. The Figure 6.1.5 shows examples of relationship between electricity law and other laws.

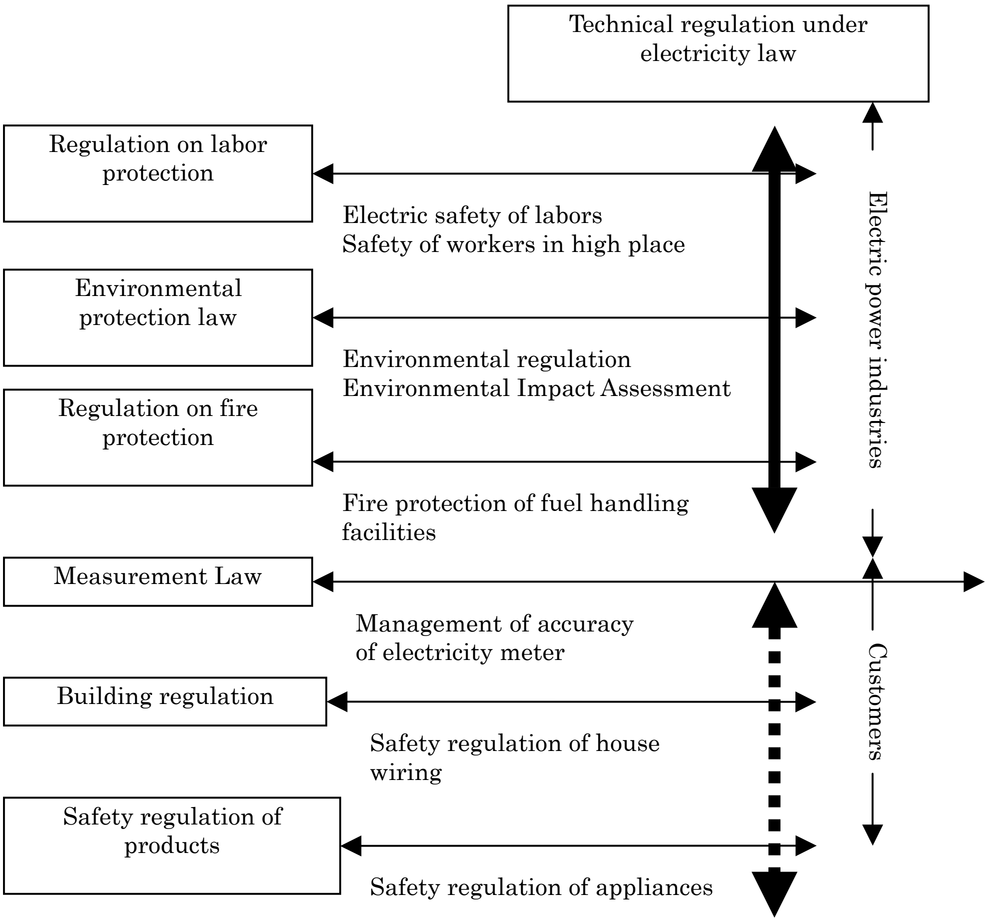

Figure 6.1.5 Examples of Relationship between Electricity Law and Other Laws

(3) Voluntary technical standards and guidelines

There are various voluntary technical standards on electric power supply and demand as well as the technical standards under electricity law. These standards include the international standards such as IEC and ISO, national standards such as JIS, and technical standards which are established by academic or industrial organizations in each country. These voluntary technical standards are well established in Japan and other developed countries and are recognized and used as de-fact standards in each country, although these standards are not mandatory technical standards under electricity law. The technical standards in these countries usually describe only basic requirements and voluntary standards are used as detail description of the technical standards. In these countries, the technical standards of electricity law often refer voluntary standards as parts of the mandatory requirements of the law. Once voluntary standards are referred as parts of the mandatory technical standards of electricity law, the voluntary technical standards become mandatory standards under the law. (Please see the Figure 6.1.6)

International standards such as IEC and ISO are becoming widely adapted as national standards in most countries to comply with TBT treaty under WTO recently. The TBT (Technical Barriers to Trades) treaty requests WTO member countries to apply international standards to national standards principally and to make procedures to establish or update technical standards transparent to avoid standardization and conformity test procedures in each country to be unnecessary barrier to trade. EU countries have a common policy to use international standards such as IEC and ISO and regional standards such as CENELEC standards principally instead of establishing own technical standards in each country.

It is necessary to evaluate if there are any voluntary technical standards applicable to the technical standards and to identify contents of technical standards or detailed descriptions of the technical standards which need to be establishment as parts of the technical cooperation on the technical standards. It is important that technical cooperation on the technical standards shall contribute to harmonization of technical standards with international standards in host country.

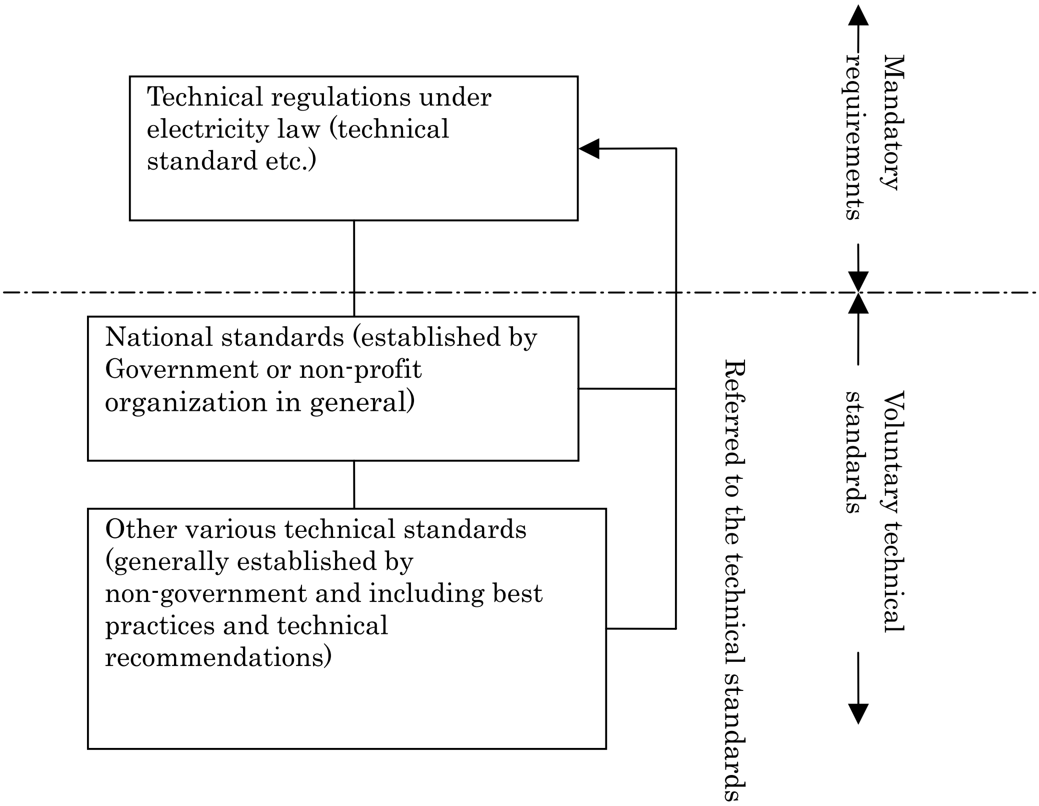

Figure 6.1.6 Relationship between Mandatory Technical Standards and Voluntary Technical Standards

(4) Enforcement of compliance of the technical standards

Technical regulations commonly include regulations on inspections and reporting of faults or accidents as well as establishment of technical standards. The technical standards are not effectively complied without these relevant regulations. It is common to evaluate capabilities of electric power companies to comply with the technical standards as well as financial and institutional capability during reviewing of application of electric power supply service licenses, although there are variety of measures and procedures to confirm compliance of the technical standards in each country. Also it is common to require inspections before commissioning of electric power works and periodical inspections during operation of electric power works.

As a part of power sector restructuring in the world, it becomes common to establish an independent regulatory organization to regulate electric power industries. In some countries, ministry which is responsible for electric power policy promulgates the technical standards and independent regulatory organization is responsible to enforce the technical standards. In the other case, independent regulatory organization promulgates and enforces the technical standards.

It is very important, to understand enforcement measures of the technical standards and institutional framework to establish and enforce the technical standards, in order to identify needs of capacity building and counterpart agencies. The Figure 6.1.7 shows examples on enforcement measures and institutional framework on the technical standards.

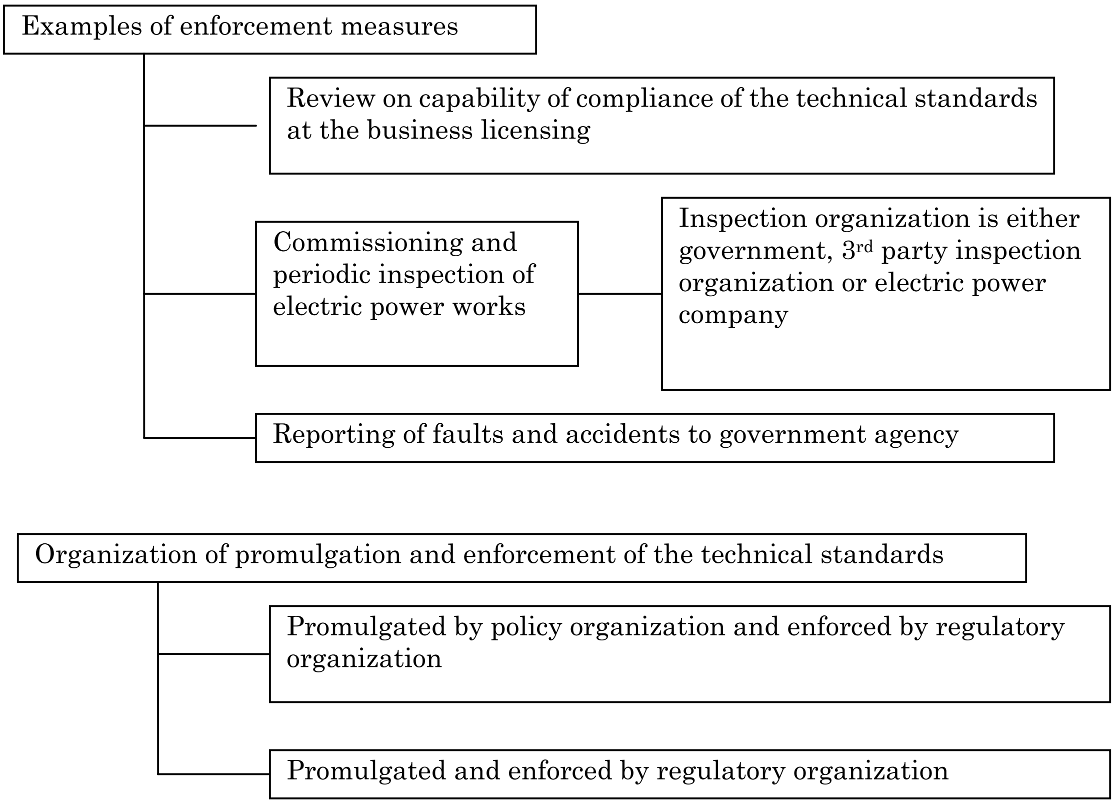

Figure 6.1.7 Examples on Enforcement Measures and Institutional Framework on the Technical Standards

(5) Technical standards on rural electrification

Electricity laws in some developing countries establish specific technical standards on rural electrification, which is different from the technical standards for traditional electric power industries. It is also necessary to evaluate if nation wide technical standards are applicable to rural electrification projects in terms of financial availability in countries with low electrification rate.

There are 3 major technologies to electrify rural area including extension of existing distribution networks, standalone mini-grid with small power plant electrification and standalone on-site electrification. The technologies and quality of service of standalone mini-grid electrification and standalone on-site electrification are quite different from the traditional electric industries, although the technology of grid extension is same as traditional electric power industries.

It is necessary to evaluate carefully if the establishment of overall technical standards including rural electrification technical standards are required and effective for host country, taking into account of the fact that the technical standards of rural electrification are very different from the technical standards in terms of technologies and financial resources. It may be better to develop the technical standards on rural electrification together with development of rural electrification master plan than to develop the technical standards on rural electrification independently, because the technical standards on rural electrification are needed to balance safety issues and economical issues. The Figure 6.1.8 shows a decision tree to evaluate necessity of the technical standards on rural electrification.

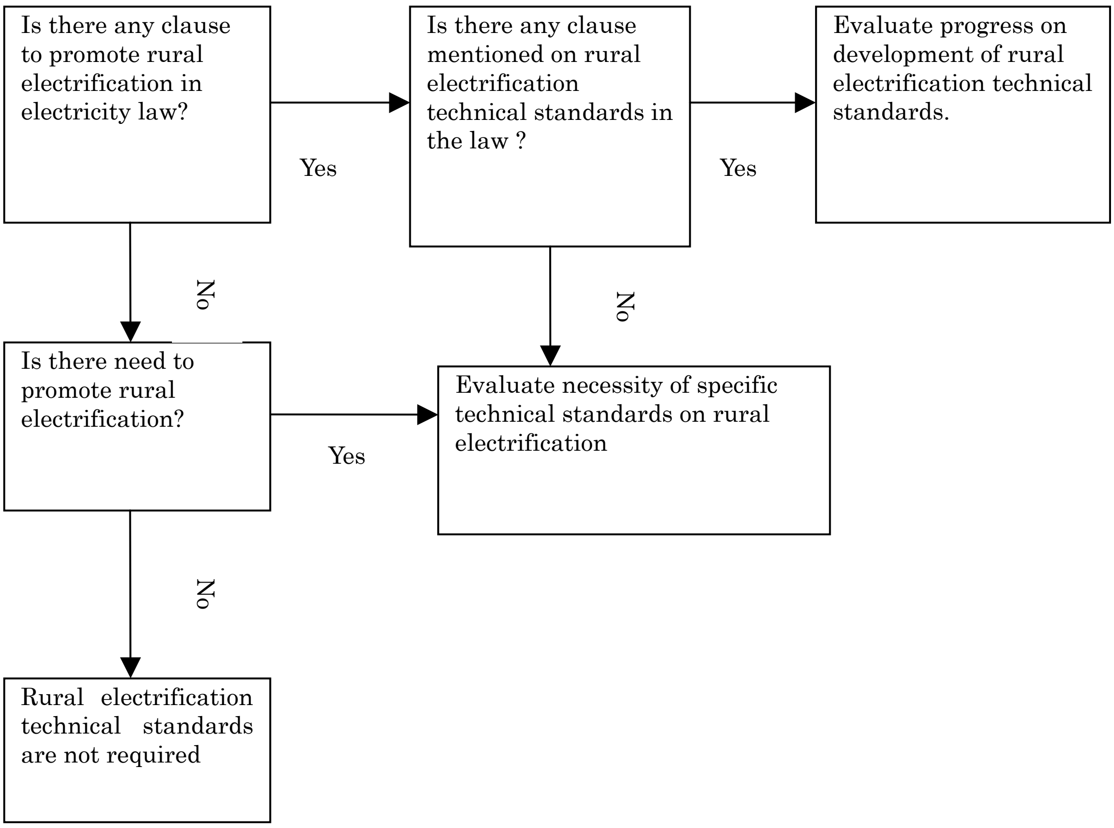

Figure 6.1.8 Decision Tree on Necessity of Rural Electrification Technical Standards

(6) Procedures to establish/update the technical standards

The ultimate objective of technical cooperation on the technical standards is that the technical standards are promulgated as a regulation of electricity law and to be complied by electric industries to provide reliable electricity safely. It is necessary to confirm procedures of promulgate and legal status (minister’s order is very common in the world) of the technical standards, because legal framework and procedures to promulgate regulations are different by countries. Public consultation procedure and timetable from drafting to promulgating the technical standards are most important issues among procedures of establishment of the technical standards, to design realistic timetable of technical cooperation on the technical standards.

6.2 Items Requiring Attention for Conducting Main Study or Follow-up Study

(1) Clarification of the Position on Electric Power Technical Standards

As mentioned earlier, various standards exist for each object, aim and equipment. This point should be clarified when identifying key study issues or in the preliminary study stage and between the Study Team and counterparts when the main study starts and should remain as a consistent focus. Especially in cases where a counterpart is an electrical engineer from the electric power industry, "standardization of equipment" as a design standard based on considerations of economical efficiency and other factors, is almost always expected as a technical standard for electric power. The concept of standards differs among countries, so the contents of standards require that a discussion between counterparts and the Study Team be held in advance.

(2) Clarification of the Contents for Electric Power Technical Standards

Some contents of the electric power technical standards require a broad discussion with counterparts because in some cases no international standard exists. Concrete items are shown below.

(a) Wind Load

To ascertain the wind load that is used to calculate tower strength, practical wind velocity data is essential. However in many cases, this data is not collected. On the other hand, an estimate of the wind load may be made as it is proportional to the square of the wind velocity. Unfortunately, overestimating the wind velocity may lead to an over-compensation of the tower strength and also considerable investment. In particular, the cost impact for rural electrification is quite large. Therefore, the standard for wind load should be formed on the basis of comprehensive discussion.

(b) Height of conductor

The standard for the height of conductor differs from country to country. Nonetheless, the height of conductor should be determined based on the conditions of each individual country. This is because it is an important factor requiring consideration of safety issues, such as electrical shock and investment issues, such as costs associated with the height of conductor. The standards for the height of conductor (road crossing) differ among the main developed countries and are shown in the table 6.2.1.

Table 6.2.1 Height of Conductor in Developed Countries

<table>
<tr><th>United States</th><th>United Kingdom</th><th>Japan</th></tr>
<tr><td>5.0 m
(Less than or equal to 750V)</td><td rowspan="2">5.8 m
(Less than and equal to 33kV)</td><td rowspan="2">6.0 m
(Less than and equal to 35kV)</td></tr>
<tr><td>5.6 m
(Greater than 750V, less than and equal to 22kV)</td></tr>
</table>

Source: NESC (United State), Safety and quality regulation of the electric power as of 2002 (United Kingdom), Technical standard on the electric power (Interpretation)(Japan)

(c) The use of naked Wires at Low Voltage

The use of naked wires is widely authorized around the world, whilst being prohibited in Japan. Recently, a lot of ABC (Aerial Bundle Cable) has been installed as wires at low voltage in developing countries. Nevertheless, most small utilities use naked wires and regulations governing tower height are not strict, so these conditions are likely to cause risks of electric shock. Therefore, study and discussion from the viewpoints of safety and cost are needed regarding installation of naked wires at low voltage.

(d) Differentiation by Area: Urban and Rural Areas

Double standards on safety are basically prohibited. However, this may be ignored in case of rural areas where restricting costs may be essential after an assessment of the relationship between risks and cost. The British approach of "reasonably practicable" should be applied. For example, tower heights may be able to set lower in areas where large vehicles never pass.

Even if double standards are established, the areas, i.e. urban areas and rural areas, should be clearly defined so that everybody is clear on what the target area is.

(e) Consideration of Area Characteristics

In countries characterized by varying weather conditions, setting a nationwide standard is a very difficult task. For example in Bhutan, the southern area adjacent to India has a subtropical climate whereas other areas including Himalaya Mountains have a highland climate. The existing wind load standard, which is calculated according to prevailing conditions regarding extent of ice attached to the conductors, is the same nationwide. However, for the southern area this is an overprotective design requiring alteration reflect the design needs of the area's specific characteristic. With respect to the "Technical standard on the electric power (Interpretation)" in Japan, there are three different sets of wind load specifications to compensate for the characteristics of different areas.

(f) SWER

SWER is a method used all over the world for rural electrification. In fact, it is actually recommend by the World Bank and ADB for implementation of rural electrification programs. Therefore, it is the optimum method for all programs. However, if demand forecast is inadequate, there is a possibility of dual investment. Therefore, sufficient study is necessary when the SWER method is adopted. Furthermore, if it is adopted as the normal method, there are some cases that require a particular standard to ensure safety and prevent communication failure.

(3) Translation Time from English to Mother Language and Confirmation of accuracy post-translation

In countries where the native language is not English, translation of the "Technical standard on the electric power" from English to the mother language is an important task. Not only to secure adequate time at the issue formation stage or preliminary study stage but it is also essential to assess the ability and number of translators at the main study stage.

It is extremely important to assess the accuracy of the contents after translation. To confirm accuracy, it is important that the people assessing the translated material are familiar with the contents. In Laos and Cambodia projects, we achieved high quality translation and technical transfer through the translation of counterparts.

(4) Technical Transfer to officials in Charge of Forming or Utilizing the Electric Power Technical Standards

The aim of the program to assist target countries with the "Technical Standard on the Electric Power" is not only to form them but also to make the standards work adequately. To achieve this, technical transfer to the counterparts who are utilizing the standards, is important. With respect to the technical transfer, it is essential to gain their understanding regarding the contents of each clause but also the process to prepare for future amendment. In terms of personnel transfer, technical transfer to more than one person is one method, but the JICA Study Team believe that 'training the trainers', a self-dependent system organized by counterparts, is an effective method, as has been shown in projects carried out in Laos and Cambodia.

Furthermore, this method is also effective from the viewpoint that in the future, counterparts will train electric power utilities and supervising agencies in rural areas.

(5) Consultation of Opinions from Related Industries and Customers

Apart from electric power utilities and its supervising agency, railroad utility, telecommunications utility, manufacturer companies and customers are affected by the "Technical Standard on the Electric Power". Therefore, when formulating the standards, related industries and customers should be consulted and their opinions should be reflected in the standards.

The NESC committee, private standard-making committee in the United States, consists of members described in the following box.

The members of committee in NESC

Department of Energy, Department of Agriculture, EEI, IEEE,
Federation of telecommunications, Cable TV Association, Railroad Association,
Public Transportation Association, Electrical Appliance Association,
United States Insurance Service Group, United States Safety Conference,
Professional Engineer (PE) Association, etc.

(6) Establishing the Safety System

Even when "the technical standard on the electric power" is formulated, ensuring safety will be difficult unless the standard compliance is maintained. In developed countries, leaving the matter to the electric power utilities is possible from the viewpoints of social responsibility, preventing risk of court case and so on. In developing countries however, expecting safety to be maintained on the basis of voluntary activities is hardly realistic. Therefore, when establishing the safety system on-the-spot inspections by supervising agency should be strongly considered.

(7) The View of Existing Facilities' Management

Existing facilities' management should be determined when the "Technical standard on the electric power" is formed. Obviously dangerous facilities must undergo immediate repair but others should be granted some time for repair. Also, in consideration of economic efficiency, the concept of whether it is "reasonably practicable" for relatively low risk facilities to continue without repair until next renewal time should be discussed. Moreover, the injection of public funds for some facilities needing immediate repair should also be also discussed.

7 Suggestions for the technical cooperation in technical standards

7.1 Suggestions for the development of technical standards

(1) Clarification of the technical standard purpose and objective

The examples from developed countries show that many kinds of technical standards exist for varying purposes and necessities, and the number of clauses increases in lines with the number of facilities covered. Therefore, it would be extremely difficult to prepare the technical standards for all conceivable purposes and facilities at the same time. When considering to undertake the project for development of technical standards, it is especially important to make clear the targeted purposes and facilities. The purposes of the technical standards are to ensure safety (public safety and worker safety), increasing reliability of power supply and protecting the environment. The targeted facilities are generating facilities such as thermal power, hydro power and renewable energy, transmission facilities, substations, distribution facilities and house wirings. In particular, it is important to clarify the purpose of the technical standards because the several authorities may refer to the standards depending on the purpose.

(2) Contents of technical standards

(a) Areas covered

The areas covered by the technical standards shall be decided on the basis of the needs in the country concerned. For example, there are approximately 300 clauses in the Japanese technical standard for electric facilities and more than 450 clauses in the NESC in US. Though all of these clauses are necessary for ensuring public safety, the clauses have differing levels in terms of their safety importance. Furthermore, it requires considerable time, both from the assistance side (specialists or consultants) as well as from the country concerned (counterparts) when they develop standards to cover all conceivable areas. It is important that the priority of each clause is considered on the basis of the project country and engineering skill level of the counterparts. Then the standards should be developed step by step based on their priority.

(b) Level of standard

Developing a set of high-level standards like that of developed countries is highly beneficial for ensuring excellent safety conditions but it also inevitably leads to increases in costs for facilities. It is important to evaluate the balance between the level of standards and the costs for facilities. When developing a standard, high-level standards cannot be a barrier against promotion of rural electrification especially considering the situation of the concerned country. The 'reasonably practicable' applied in the U.K. may be appropriate for developing countries and practical standards should be arranged. It is effective to prepare the different standards appropriate for the regional characteristics (urban and rural) and weather conditions in each country in order to reduce facility costs.

(3) Development of equipment standards

When a technical standard is developed, there should be a discussion regarding whether or not clauses regarding standards for equipment will be included in the standard. There are many standards for equipment, such as IEC of international standard, ANSI of US standard, BS of UK standard, NF of French standard, VDE of German standard and AS of Australian standard. Since most of these national standards are inclined to correspond with IEC, it is useful to discuss if the standards for equipment should be based on IEC, even though some existing facilities may comply with a specified national standard. Considering the inclination to correspond with IEC, domestic standards for equipment may not necessarily be developed. The adoption of IEC should be promoted and, if necessary conditions of IEC for some equipment should be quoted in the newly developed technical standards. The development of specification of size and capacity for equipment is frequently requested from developing countries. It is inappropriate for the specification to be developed as a compulsory standard because the purpose of the specification is more for economic, procurement and other reasons other than for safety. Even when several power utilities exist in a country, the difference between specifications among these companies is not a problem as long as these companies do not exchange their equipment with each other. Generally, the specifications should be developed on an individual company basis.

(4) Incentive for technical standard compliance

Compliance with technical standards will not occur without legal force. In the developed countries, since the incentive to comply with standards is a mandatory social responsibility due to the risk of lawsuits, even though the standards have no legal authority, power utilities will maintain the standards voluntarily. However, it would be difficult to expect the power utilities to keep the standards voluntarily and so another incentive must be introduced. When the incentive is based on legal action, it is important to establish a system to monitor power utilities through the regulatory authority.

(5) Clarification of the legal system for technical standards

In developed countries, technical standards are not developed generally as regulations but as voluntary standards by independent private organizations. These voluntary standards do not have any legal power by themselves, but can have it granted when quoted by a law or an ordinance. Therefore, the technical standards are not necessarily developed as laws or ordinances, so far as they are given a definite legal power. When a standard is developed as a voluntary standard, there is an advantage in that the standard can be modified easily, for example, if new technology is developed.

In developing countries, it is also important to develop appropriate clear standards in the first instance. For the prospective modification, a voluntary standard established by a committee formed of concerned companies and organizations can be modified easily rather than the standards regulated as a law or an ordinance like a developed country. However, since the possibility of this method depends on the capacity of engineers in the developing country concerned, it would, for example, be difficult to achieve in a country where there is a shortage of engineers with the required knowledge. Furthermore, when a technical standard is developed as a voluntary standard, it is important to give legal power to the standard and set a rule for the modification of the standard so that it may not to be modified without the regulatory authority's knowledge.

(6) The selection of counterparts and technology transfer

As the contents of technical standards should reflect the needs of the developing country concerned, the selection of appropriate counterparts and their positive participation in the project are important conditions for the success of the project. The best counterparts should be selected for each project. Recruitment of counterparts from several organizations and the type of the counterparts (full-time counterparts or part-time counterpart) should be considered for each project. In order to distribute the standard throughout the country and transfer the knowledge for the standard to other engineers, an adequate technology transfer to the core counterpart is especially important, and the Training of Trainers (TOT) may be an effective method.

(7) Consultation of opinion from related organizations and reflection in the standard

Though the development of technical standard will be promoted primarily by cooperation of a project study team (specialists and consultants) and counterparts, it is very important to collect wide opinion not only from power utilities and regulatory authority but also such other concerned organizations and persons as railway companies, communication companies, manufacturers, administrators of public roads, intellectuals and consumers before establishment of the standards. It is also important to prepare a process for prospective modification of the standard and to establish a committee made up of concerned organizations when the standard is developed as a voluntary standard.

7.2 Suggestions for maintaining the safety system

(1) Inspection by regulatory authority

After establishment of a standard, no benefit will be gained unless it is observed. Though, in developed countries, it is possible to expect voluntary observation by power utilities, it is difficult, in developing countries, to expect it. Therefore, for a standard to be observed, pressure from the regulatory authority on power utilities through such legal action as 'entrance and inspection' may be necessary. However, such action will be a load both on the regulatory organization and the power utilities. The method and frequency of the 'entrance and inspection' should be considered in terms of what is achievable given the conditions in the country concerned.

(2) Power utility voluntary safety measures

Facility safety should basically be achieved through the power utility's voluntary safety maintenance system and the 'entrance and inspection' system is the auxiliary measure for safety maintenance. In developed countries, the frequency and contents of patrols and inspections implemented by a power utility are generally left to the discretion of the power utility. However, in developing countries, it seems that power utilities do not necessarily implement the planned patrols and inspections unless the regulatory authority takes part in it. In Japan, although power utilities implement patrols and inspections voluntarily, by law they must prepare their own safety rules and submit them to the regulatory authority. Similar systems may be effective for developing countries too. Furthermore, it is necessary to refer to the safety maintenance systems in a law or an ordinance in order to force power utilities to implement and keep records of patrols and inspections.

In order to reduce accidents involving the public, analysis of the cause of accidents and countermeasures for prevention of similar accidents is essential. Of course, the most important point is that all power utilities have the will to reduce the number of accidents. In order to develop this will, submitting reports to the regulatory authority is significant and the action should be regulated by a law in developing countries.

(3) Inspection by special inspection organization

It is not easy for engineers in developing countries to inspect facilities where expert technical knowledge is required such as is the case with thermal power facilities. Though the technology transfers for their self-inspection are important, entrusting the inspection to an special external inspection organization is also effective, before capacity for self-inspections is developed. . In developed countries, there are inspection organizations such as TUV and many power utilities generally trust inspections to such organizations.

7.3 Other suggestions

(1) Technical conditions for international network connection

Even when power interchange is implemented among many countries, it is not necessary to integrate their technical standards except for frequency and voltage. However, in order to secure stable power supply, each country prepares measures for an emergent serious power failure in other countries. The measures will be consented by agreement among the countries concerned. The risk management for power security is also very important.

(2) Safety regulations for customer facilities

There are technical standards for house wiring in developed countries, and consumers themselves are responsible for their safety. In Germany, electric utilities should inspect the house wiring of newly-built houses, and in France, customers must hire third party inspectors and submit the inspection result to power utilities to receive their power supply. In Japan, power utilities conduct periodical inspections on house wiring. It can be said that the development of legal systems to protect customers in the event of disasters has decreased the amount of faulty work by electrical technicians.

There are urgent requirements for the development of technical standards on house wiring in developing countries and once the standards are developed, utilization of the standards has to be carefully monitored. It is crucial to develop the capacity of engineers and technicians and to motivate them to achieve high-quality works. Also, it is important to improve regulations to protect customers like the cases of Germany and France before capacity of engineers and technicians for house wiring is developed.

Along with house wiring, safety of home electrical appliances is very important. In Japan, each electric appliance requires the approval of the Electrical Appliance and Material Safety Law. Similarly, there is CE marking in Europe, UL standard authorization system in the US and RCM in Australia. The same kind of authorization system exists in Southeast Asian and Southwest Asian countries, such as Thailand, Indonesia, Malaysia, the Philippines, Singapore and India. The authorization system is essential for the safety for customer facilities.

(3) Safety regulations for workers

Laws regarding the safety of workers are highly developed in advanced countries. Awareness for the protection of workers and risks in carrying out live line work can lead to the development of laws for work safety. However, it is often the case that the regulatory authority is different from that of power utilities and both of them their own separate standards. Therefore, the development of standards for worker safety which requires a high level of technical assistance can be as important as that for public safety in developing countries.