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Globalization of Korean Electrical Installations Standards and Codes Based on Comparison of IEC 60364 with NFPA (NEC)

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Abstract : Most of the laws and standards relevant to technology in Korea bear a resemblance to those in Japan.

Electricity was not introduced to Korea until Lighting ceremony in Kyong-Bok palace observed in 1887. Since Korea was annexed to Japan in 1910 and our public works were under Japan control, we have applied Japanese laws and regulations made by Chosun government-general. Independently from Japan, the power electricity accepted power plants of USA, codes of NESC, ASME / ANSI, NEMA. Our generation and distribution system takes American style while our consumer side takes Japanese style.

As global trade system was transferred GATT into WTO, the harmonization of technological standards, certification, construction, testing in the trend of world.

This papers is based on WTO / TBT agreement coming in effect after 12th, April, 1979.

For Korea, the distribution system has a strong resemblance to American system so that engineers are confused in adopting standards. IEC 60364 and NEC are in part similar but unconvertible because IEC 60364 originated from Europe while NEC originated from USA. This papers deals with the fundamental elements of electrical safety system with comparing IEC 60364 with NEC. This papers considers how engineers should apply NFPA 70(NEC) and IEC based on the comparison of NEC to IEC in relation to electrical installations.

Key words : GATT, WTO / TBT, IEC 60364, NFPA 70 (NEC), NESC, KS, JIS, BS, Agreement Country, TN-C system, TT system, SELV, PELV, GFCI

1. Foreword

As global trade system was transferred GATT into WTO, it is an overwhelming trend of the world that technological standards, certification, construction, testing got unified.

This trend resulted from WTO / TBT agreement enacted as of 12th April, 1979.

In this context, for electrical installations of buildings, there is a heated controversy over the similarities and differences between IEC 60364 and NFPA 70. In particular, if any country out side Europe and USA is, the country should redeem which of them be adopted as a national code or standards.

Basically the internal technological standards and codes follow Japanese system.

It was a first time when the electricity was introduced to Korea. On Korea annexed to

Japan in 1910, the whole public works are under control of Japan government-general. The Japanese system spread all over the country and used till 1945.

Since 1945, Korea electric power USA electric power system and codes from NESC, ASME / ANSI, NEMA. Now Korean electric systems use America-styled power generation system and distribution system together with Japan-styled consumer system.

Japan established the decree related to electricity utility after British Standards in 1896, and then Electricity utility law in 1991, and announced Electricity utility law. Korea established Chosun Electricity utility decree in 1932, Chuson Electric Products in 1933.

Thus this law system sustained till 1945 when Korea got independent of Japan.

Since Korea was liberated from Japan, Korea announced Electricity utility law in 1961, and established the regulations for Electric products in 1962 and announced Electric Construction law formally.

In accordance with the industry change and technology innovation, Korea established Electricity Utility in 1973, Electrical Installations Standards Decree, and Regulations for Electrical Installations Standards. Also Electricity Utility law was drastically revised and announced in January in 1990, and Electric power management law in 1997.

Considered the internal situation, this papers deems over which of NFPA 70 and IEC 60364 Korea should adopt as National Electrical Standard.

2. Main Contents

2.1 Mutual relationship among ISO, IEC, NEC and BS

As you can see the below figure, the model of ISO originated from IEC. Therefore ISO asserts that the countries should observe the terms of IEC. If you look into origination of IEC, it can be inferred from British Standard.

The connection among ISO, IEC, NEC and BS can be drawn as below.

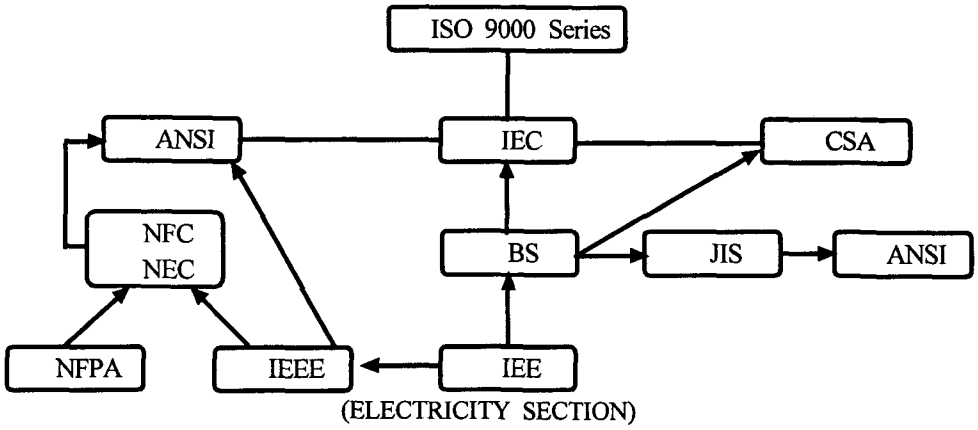


Fig. 1. Mutual relationship among ISO, IEC, NEC, BS

As set forth above, ANSI, NEC, ISO, CSA and JIS originated from BS.

Every international standards have basis on IEC while ANSI, NFC/NEC were created uniquely.

2.2 Two main standards are used to provide electrical safety in facilities : the Internationale Electrical Technical Commission (IEC) system in Europe and the National Electrical Code (NEC)

1) The first publication of the National Electrical Code

The National Electrical Code was first published in 1897, it revised every three years by the National Fire Protection Association. Its purpose, stated in Section 90-1, is "the practical safeguarding of persons and property from hazards arising from the use of electricity." [1] The NEMA report states it is "a specific set of rules intended to be used for design, installation and uniform enforcement of electrical system installations based on North American principles." [3]

2) The first publication of IEC 60364

IEC 60364 was started by Technical Committee 64 of IEC. Clause 12.1 of Part 1 states, "This standard contains the rules for the design and erection of electrical installations so as to provide safety and proper functioning for the use intended." [2] It is a single standard published in a number of interrelated parts and contains fundamental principles, practices and performance requirements based on European national standards but are generally applicable to all systems. Individual user countries and localities draw from this standard for specific wiring rules.

3) Relation of one to the other

IEC 60364 provides the fundamental principles for wiring rules used in the European Union (EU). Other countries either develop their own legally mandated and applied wiring rules based on IEC 60364 or use the application document of another country.

The NEC provides wiring rules for the USA, and suitable versions are adopted in Mexico, Columbia, Venezuela, Panama, Puerto Rico, the Philippines and other nations.

Until recently IEC 60364 and the NEC have had no formal relationship to each other. The US have been a member of the IEC since its inception, but participation has been nominal until very recently. While American National Standards Institute (ANSI) standards have been widely accepted and have been the preferred standards in many countries, the NEC and IEC served different area of the world.

We do find commonality. This confirms a harmony for basic electrical safety- there are more similarities than differences between IEC 60364 and the NEC. Some installation and wiring rule differences do exist because of the different electrical systems, building codes, practices, environments and infrastructure.

4) Similarities

① Both establish performance requirements that address fire and electric shock protection

② Both address installation of premises wiring systems and equipment.

③ Neither covers installations for generation, transmission or distribution of electric energy, nor those under exclusive control of electric or communications utilities.

④ The scope of both covers from the service point (point of supply) to outlets.

5) Differences

① Approach

The IEC 60364 approach is considered "open" as "a way" or "a guide for a way". The IEC system is based on an analytical approach of requirements, generalizing criteria, resolving additional situations and opened to non-specific I items. The IEC system highlights the role of the technical operator, designer or inspector, etc to accept the responsibility to choose, design and organize to the specific installation code. The installation then has the presumption of compliance

Inherent in this is the "information & training" requirement about safety as an essential imperative for all workers (Council Directive 89/391/EEC of 12 June 1989) and as a duty for the technical operator. IEC 60364 is published in a number of interrelated parts and contains normative references to other standards. Training in its use is difficult and is relatively expensive, as it does not have a formal revision schedule.

The NEC approach is considered "closed" or it is "the way", or "do this way". The NEC system is based on a synthetic (assumed set of conditions) approach (with feedback) ; it is a comprehensive for safety and "the" Installation Code. It is revised every three years and highlights the variations

② Approval

The approval of the IEC documents and the NEC is an effort respectively by manufactures, testing laboratories, inspectors, labor, utilities, facility owners.

③ Use

"IEC 60364 provides broad performance requirements and is not usable as an installation document by electrical system designers, installers, or enforcing authorities, but rather it can serve as a guide for development of national wiring rules. The NEC is a comprehensive set of electrical installation requirements that can be adopted and implemented without development of additional wiring rules." [3] It contains the detailed mandatory material needed to make it comprehensive and enforceable.

④ Scope

IEC 60364 covers a system for the point of supply for a building to the socket (receptacle) outlets. It does not include rules for appliances or other electrical equipment. Product requirements are in separate IEC standards, which are developed by other committees with

relation to TC 64 for installation issues. The NEC covers a system beginning at the service point of a premises up to including the outlet(s) and it also includes some rules for appliances and other utilization equipment, which the code making panels elect to include in the installation code.

IEC 60364 does not include rules for installations in area with explosive atmospheres. Those rules are provided in IEC 60079. The NEC includes rules for hazardous (classified) locations(explosive atmosphere). NEC rules include both traditional North American systems and rules that harmonize with those of IEC 60079.

The scope of IEC 60364 is limited to voltages up to 1000 V, with no similar voltage limitation in the NEC. TC 99 is developing a standards for installations for over 1000 volts with the European Standard. [5]

⑤ Examination of equipment for safety

The NEMA report concludes that for IEC 60364, "compliance with the safety requirements of the relevant equipment standards is to be made by visual inspection on permanently wired electrical equipment." NEC provisions in 90-1 "relieve the inspection authority from delving into internal wiring of appliances and equipment, and rely for safe operation on equipment that has been certified by a qualified electrical testing laboratory as meeting examination of the run of goods at factories, called follow-up inspection ad testing, is an integral require-

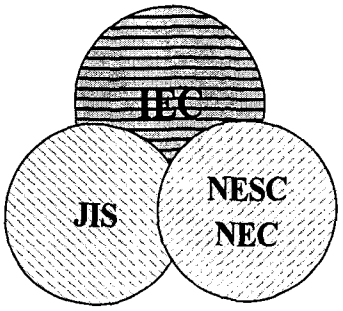
	NEC	IEC 60364
Process	NEC evolved along the 100 year development of electrical systems in the US	IEC 60364 began as a process of harmonization of existing rules in European countries to facilitate trade
Provision with relation to hazardous location	NEC covers hazardous locations (explosive atmospheres)	IEC 60364 does not cover explosive atmospheres (covered separately in IEC 60079).
Application	NEC is a comprehensive set of electrical installation requirements that can be adopted and implemented without the development of additional wiring rules	IEC 60364 provides broad performance requirements and is NOT usable as an installation document by electrical systems designers, installers or enforcing authorities. Rather, it can serves as a guide for the development of national wiring rules
Revision Cycles	Regular, 3-year cycle	Continual, as determined by the technical committee
Requirements	Prescriptive	Performance-based
Product Standards	Lacks a solid (direct) tie to product standards. This is handled through coordination by the SDO's.	Has a direct tie to IEC product standards through direct reference.
Applied voltage	No voltage limitation specified	Limited to 1,000 volts AC
	Designed to be legally adopted as the requirements for electrical installations	Provides a framework for development of an installation code. The fundamental principles are contained within Chapter 13.
Systems	Both cover TN, TNC, TNCS, IT. Prohibits TT systems	Both cover TN, TNC, TNCS, IT, Allows TT systems

ment of UL product certification to satisfy the NEC.

IEC 60364 allows examination of labels or documentation to verity that an item complies. Equipment made by a manufactured with QA certification is readily identified as meeting standards. However, European national laws guarantee that production is independently monitored and regulated.

2.3 Problems on the Korean Technical Standards and Codes

1) This papers took IEC 60364 and NEC into account. Comparing outside Korea with inside, Korean law system is similar to Japan system. Since liberated from Japan, Korea accepted Electric power system from the USA and adopted the standards for distribution



Therefore, for the electrical systems, Korea uses IEC from Europe, NESC (National Electrical Safety Code established by IEEE), NEC(National Electrical Code established by NFPA) together.

If Korea adopted IEC for Electrical system, at last Korea Electrical system consisted of four JIS, NESC & NEC as well as IEC.

The Korean standards imitated the way Japanese standards have changed. Korea may face a problem in competing with other developed countries.

NEC is established by a civil group NFPA and the revised contents are recognized by USA government automatically.

It can work well thanks to effective insurance and performance.

This system has strong point as follows.

① The codes are not mandatory but voluntary recommendation. This helps the promotion of trade.

② It doesn't belong to laws. There is no complicated revision procedures. The codes can be revised or added just if the relevant professional group agree.

③ The codes can support economical activities so that it keeps pace with the change of technology or meets social needs.

④ There can be voluntary interpretation or tolerance or error for the current problems are modified correctly.

For America, the diverse codes and standard are managed by the civil groups.

Whereas Korean law system has problems as follows.

① The technological standards belong to law, can't be modified easily.

② Most of Korean technological law attached Japanese law too much, so it can't recognize what makes difference.

③ Unnecessary regulations and restriction can result in shrinking of national economy.

④ Unrealistic regulation and restriction can waste valuable time and provoke absurdity.

⑤ If the relative technological standards may be part of law, it is a chief obstacle to having international codes. (We should have economic competition system based on voluntary standards.)

Except the above problems, the existing Korean standards are complicatedly connected to the interests of other industry, electrical engineers.

3. Conclusion

1) In Korea, the distribution system of the electrical installations adopts TN-C, American distribution system. Whereas in Japan it adopts TT, European distribution system. Korean electrical installations stands at the crossroads of adopting IEC 60364 or NEC.

For example, the Korean grounding system is valued inappropriate because TN-C and TT are mixed.

The standards for electric power system are composed of NESC. It is much beneficial for Korea to adopt more detail NEC rather than IEC.

IEC codes are adopted the extra details should added.

2) The Korean standards for electrical installations exclude the conditions on the specified products, so transfer into NEC step by step.

In the first place, it is the most desirable that the simple technology contents can be accepted.

3) For humid or damp locations, IEC 60364 has limitation of potential rise such SELV, FELV, PELV.

NEC requires that Ground Fault Circuit Interrupter should be installed in AC 115 [v] receptacle terminal.

However in Korea, the electricity is provided for AC 220 [V] where persons are exposed to danger.

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