

Globalization of Korean Electrical Installations Standards and Codes Based on Comparison of IEC 60364 with NFPA 70(NEC)

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Abstract : Most Technological laws of Korea are almost identical to those of 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, Korea have applied Japanese law and regulations made by Chosun government-general. And public works were under Japan control. Korea accepted adopted the power plants of America, codes of NESC, ASME / ANSI, NEMA while Japan accepted or adopted only IEC. Our generation distribution system takes American style while our consumer side takes Japanese style.

As global trade system was transferred GATT into WTO, the technological standards, certification, construction and testing are in harmony internationally. The WTO / TBT agreement came in effect after 12th, April, 1979. The sections in the agreement require the members to exchange their own standards and codes for the harmonized ones by degree.

The Korean distribution system has a strong resemblance to American system so that the internal engineers are confused in application of the relevant standards. IEC60364 and NEC are technologically similar but practically unconvertible because both have their different originality, that is to say Europe and USA. This paper deals with the fundamental elements of electrical safety system on review of IEC 60364 and NEC. This paper considers how engineers should apply IEC60364 and NFPA 70(NEC) based on all-the-way review of them.

Key word : GATT, WTO/TBT, IEC60364, NFPA70(NEC), NESC, KS, JIS, BS, Agreement Country, TN-C System, TT System

1. Introduction

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

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 is outside Europe and USA, the country should be in trouble to adopt one out of international codes and standards.

Basically the internal technological standards and codes follow Japanese system.

Since Korea was annexed to Japan in 1910, the whole public works have been under

control of Japan government-general. The Japanese system spread all over the country and used till 1945.

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

In 1896 Japan established the decree related to electricity, which was modeled on British Standards. And then Electricity utility law was established in 1911, and announced in 1931. On the other hand, Korea established Chosun Electricity utility decree in 1932, Chosun Electric Products in 1933.

Thus this legal system was 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 law in 1962 and announced Electric Construction law formally in 1963

In accordance with the industry change and technology innovation, Korea established Electricity Utility Decree 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 paper deems over whether Korea should adopt NFPA 70 or IEC 60364 as National Electrical Standard.

2. 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.

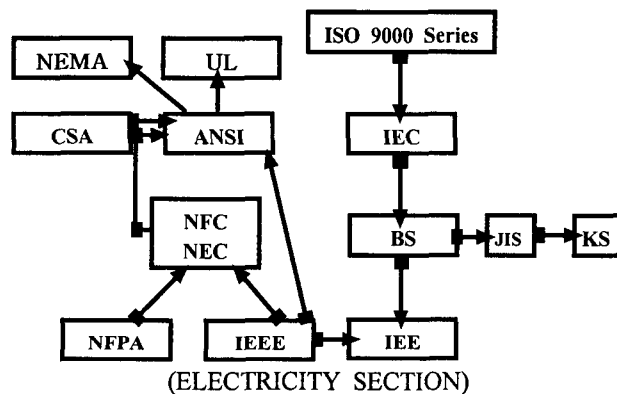


Figure 1. Mutual relationship among ISO, IEC, NEC, and BS

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

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

3. Two main standards are used to provide electrical safety in facilities : the International Electrotechnical Commission (IEC) systems in Europe and the National Electrical Code (NEC) systems in USA.

1) The first publication of the National Electrical Code

The National Electrical Code was first published in 1897, and it is 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." [2]

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." [3] 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 is generally applicable to all systems. Individual user countries and localities take this standard for specific wiring rules.

3) Relation of IEC 60364 to NEC

IEC 60364 provides the fundamental principles for wiring rules used in the European Union (EU). Other countries 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.

Up to 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 up to 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 as electrical codes.

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 describe fire and electric shock protection
- ② Both describe 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 systems are based on an analytical approach of requirements, generalizing criteria and resolving additional situations, and opened to non-specific items. The IEC system highlights the role of the technical operator, designer or inspector, etc to accept the responsibility to choose, design and organize the specific installation code. The installation then has the presumption of compliance.

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 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 manufacturers, testing laboratories, inspectors, labor, utilities, and 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." [2] It contains the detailed mandatory material needed to make it comprehensive and enforceable.

④ Scope

IEC 60364 covers a system from 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 technical committee panels decide 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

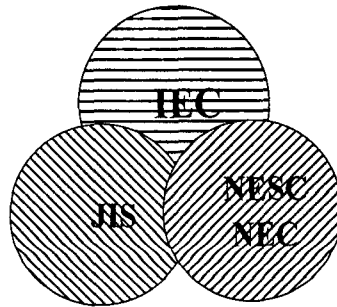
The NEMA report concludes that for IEC 60364, “compliance with the safety requirements of the relevant equipment standards is to be made by visual inspection on permanently wired electrical equipment.” NEC provisions in 90-1 “relieve the inspection authority from delving into internal wiring of appliances 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 and testing”, is an integral requirement of UL product certification to satisfy the NEC.

	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 serve 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
Adoption Conformity	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

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

4. Problems on the Korean Technical Standards and Codes

1) This paper 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), and NEC(National Electrical Code established by NFPA) together.

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

The Korean standards have changed in such a way as Japanese standards have. Korea may undergo hard time in competing with other developed countries.

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

NEC can be managed well due to the effective insurance and performance system.

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 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, therefore it can't be modified easily.
- ② Most of Korean technological laws are too deeply based on Japanese law, so it can't recognize what makes difference.
- ③ Unnecessary regulations and restriction can result in national economy recession.
- 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 and electrical engineers.

5. Summary

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 has a big problem in terms of engineering 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.

If Korea should adopt IEC codes, the extra details should be 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 as SELV, FELV, and PELV.

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

Nonetheless, Korea is still provided with AC 220 [V] where persons are exposed to danger. Therefore Korea should set the voltage to AC 120/208 [V] per IEC 60038 and NEC,.

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