Induction of Korean Standards Materials into KEPIC-MH and Method to Activate the Application of Alternative Materials

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1. Introduction to KEPIC

1.1 Definition and application scope

Korea Electric Power Industry Code (KEPIC) is a set of integrated standards applicable to the whole phases of design, manufacture, installation, operation, testing, inspection and maintenance of electric power facilities and components so as to ensure their safety and reliability. The application scopes of KEPIC are overall electric industry fields such as nuclear power plants, thermal power plant and transmission · transformation · distribution facilities.

KEPIC has been applied to the construction of Ulchin Nuclear units 5&6 since 1997 as per the endorsement of Ministry of Science and Technology, and is being completely applied to the construction of Shin-Kori and Shin-Wolsung Nuclear Power Plants (NPPs) in Korea and Barakah NPPs in UAE.

1.2 Structure

KEPIC is classified into the technical and administrative requirements. Technical requirements have been developed by the adaptation of foreign reference standards applied to electric power facilities in Korea. They are identical to the reference standards except for some editorial changes such as the use of KEPIC's own categorizing & numbering system. In case of absence of proper foreign reference standards, they have been developed on the basis of advanced domestic technologies.

Administrative requirements have been developed based on ASME BPVC Sec.III NCA "General Requirements" and modified to be suitable for the industrial circumstances and situation in Korea. KEA has established KEPIC's own certification system for nuclear safety-related items including quality program/system, authorized inspection, RPE, etc. KEA have also adopted the ISO 9000 quality system and the authorized inspection system for non-nuclear safety related and thermal power items.

KEPIC consists of Q (Quality Assurance), M (Mechanical), E (Electrical), S (Structural), N (Nuclear), F (Fire Protection), and G (Environmental). KEPIC-G have been developed on the basis of technical specifications and reports of domestic research & development organizations such as KEPCO Research Institute while other parts' standards are based on foreign codes and standards such as ASME, IEEE, etc.

1.3 KEPIC Committee

Each part of KEPIC are maintained and developed by KEPIC Committees. There are a policy committee, 8 technical committees and 34 subcommittees in KEPIC. Special committees and project committees can be organized if required. Each committee is composed of a secretary, a chairman, a vice-chairman, and members

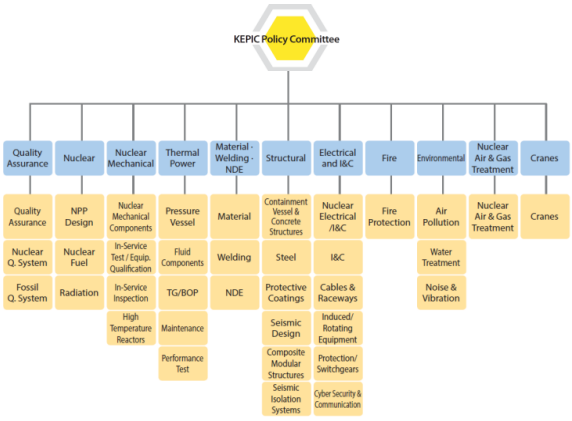

Figure 1. Structure of KEPIC Committees

To activate the application of KEPIC, Korea Electric Association (KEA) has been performing improvement studies such as 'integration of welding coordinator in welding quality system', 'introduction of the new certification program for repair and replacement organization'.

2. Status of KEPIC-MH

KEPIC-MH, the standards on nuclear air and gas treatment, provides requirements for the performance, design, construction, acceptance testing, and quality assurance of equipment of nuclear safety-related air and gas treatment systems in nuclear facilities.

2.1 Structure of KEPIC-MH

KEPIC-MH is classified into MHA (General Requirements), MHB (Air Cleaning and Conditioning), MHD (Testing Procedures), and MHN (In-Service Testing of Nuclear Air Treatment, Heating, Ventilation, and Air-Conditioning Systems). KEPIC-MH had been developed based on ASME AG-1. Adoption gap between KEPIC-MH and ASME AG-1 is shown is Table 1.

Table 1. Structures of KEPIC-MH and Publication Status

KEPIC	ASME	KEPIC Publication Status								
		00	03	05	06	10	11	12	14	15

MHA	AG-1 Div.I	97			04	07	09	10	*	10
MHB	AG-1 Div.II	97	00	03	04	07	09	10		10
MHD	AG-1 Div.IV	97					09	*		10
MHN	N 511							07		

* KEPIC-MHA 2014 add. and MHD 2012 add. is revised by KEPIC Committee's own activities, not in line of the reference standards.

2.2 Improvement activities in KEPIC-MH

There were four special committees named 'Project Committee on Nuclear Air Cleaning', 'Working Group on In-service Test of KEPIC-MH Systems', 'Project Committee on Alternative Materials', and 'Project Committee on General Requirements'.

Project Committee on Nuclear Air Cleaning had done the feasibility study on adaptation of ASME N 509, 510, and 511. As a result of the feasibility study, the draft of KEPIC-MH 2012 addenda referencing ASME AG-1a 2009.

Working Group on In-service Test of KEPIC-MH Systems had developed the new daft of KEPIC-MHN to be published in 2012 referencing ASME N511.

And Project Committee on Alterative Materials of KEPIC-MH had studies an acceptable Korean Standard (KS) materials table equivalent to ASME/ASTM material specification listed in KEPIC-MH. Based on the study,

3. Induction of KS material into KEPIC-MH

3.1 Background

KEPIC-MH specifies ASME/ASTM materials as allowable materials and requires that substitute materials shall be equivalent or more materials than AMSE/ASTM materials. Manufacturers are occasionally faced with problems that they have to substitute ASME/ASTM materials with KS materials. It can spend significant manufacturing process time and load manufacturers with additional work to get approval of substituting materials from the owner and/or the designer.

3.2 Method and purpose

KEPIC subcommittee on nuclear air and gas treatment organized the project committee on alternative materials to make a study on developing an acceptable Korean Standard (KS) materials table equivalent to or more ASME/ASTM material specification listed in KEPIC-MH.

3.3 Results of activities

Major activities of the project committee are listed as follows:

1) Determine the definition and limiting condition of 'equivalent materials'
2) Collect and review the related data (Supplier Deviation Disposition Request, etc.)
3) Select the object of alternative materials
4) Write the Table of KS materials corresponding to ASME/ASTM materials.

3.3.1 Definition of equivalent materials

Before the project committee reviewed the technical aspects, they made a draft of definition. The committee on nuclear air and gas treatment reviewed the draft and determined the definition of equivalent materials.

> Equivalent materials: it means the materials having the same level of nominal composition and manufacturing method, with similar physical properties, chemical composition, and applicability.

And the limiting condition of equivalent materials were also defined as follow:

1) All kinds of specified physical properties and chemical compositions for comparative materials may not be identical.
2) Physical and chemical data of each material specification utilized for design, analysis, test, welding procedure qualification, welder/welding operator qualification, and etc., shall not be replaced with those of the equivalent material. The data of each material specification used shall be applied only for itself.
3) The definition of equivalent materials is applied only to the materials listed in KEPIC-MH.

The definition of equivalency material which can be substituted to materials stated in KEPIC-MH were added into KEPIC-MHA as follows:

> **AA 3200 MATERIAL SUBSTITUTION**
> Substitute materials may be used provided they are equivalent to or exceed the stated requirements. In addition, other materials permitted by KEPIC-MN are acceptable materials. The materials selected shall be evaluated for suitability with service conditions and compatibility with other materials used in the system or component.

3.3.2 Select and review the equivalency materials

The member who is manufacturer selected 63 KS materials for major candidates of equivalency materials based on the related data such as SDDR.

The project committee excluded 18 KS materials which are not included in ASME AG-1a-09 and Table AA-3100. The equivalency review on 45 KS materials with ASME/ASTM materials was done for the following items:

1) Physical property
   - Tensile strength, Yield strength, Elongation percentage, Hardness, and Impact value

2) Chemical property
   - Maximum percentage of Carbon (C), Manganese (Mn), Silicon (Si), Phosphorus (P), Sulfur (S), Chromium (Cr), Nickel (Ni), Molybdenum (Mo), Mercury (Hg), Copper (Cu), Columbium (Cb), and Titanium (Ti)

As a result of equivalency review, it was confirmed that 41 KS materials can be substituted to be stated materials such as ASME/ASTM materials.

Committee on nuclear air and gas treatment made a table and added it into KEPIC-MH nonmandatory appendix.

No	Nominal Composition	ASME/ASTM Materials	KS Materials
1	Carbon Steel	SA/A283 Gr.C/D	KS D3503 SS400
2	Carbon Steel	SA/A285 Gr.B/C	KS D3560 SB410
3	18Cr-8Ni Stainless Steel	SA/A240 type304	KS D3698 STS304/ D3705 STS304
4	16Cr-12Ni-2Mo Stainless Steel	SA240 type316	KS D3698 STS316, KS D3705 STS316
5	Carbon Steel	SA/A36	KS D3503 SS400
	⋮	⋮	⋮
37	Al Alloy	SB/B211 7075-O	KS D6763 A7075 BE/BD-O
38	Al Alloy	SB/B211 7075 - T6,T62	KS D6763 A7075 BE/BD-T6,T62
39	Al-Si-Mg Alloy	SB/B108 356.0-F	KS D6008 AC4C-F
40	Al-Si-Mg Alloy	SB/B108 356.0-T6	KS D6008 AC4C-T6
41	Al-Si-Mg Alloy	SB/B108 A356.0-T61	KS D6008 AC4CH-T61

4. Method to Activate the Application

Since KEPIC-MH was revised to approve the usage of substitute materials in 2014, there are still problem to use them.

To activate the application of substituting alternative materials of which equivalency is confirmed, KEA is preparing to publish the Code Case ‘Request method for equivalent materials assignment for KEPIC-MH’.

With this Code Case, the users can make a request equivalent materials assignment to the materials that are not defined as equivalent materials and Appendix AA-E in KEPIC-MHA.

REFERENCES

[1] KEPIC-MHA, General Requirements on Nuclear Air and Gas Treatment, Korea Electric Association, 2015.
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[3] Worldwide Guide to Equivalent Irons and Steels, Fran Cverna, ASM International, 2006
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[5] Steel Standard, POSCO Co.. Ltd.. 1999.