

Development Methodology of a P-Number Equivalent Table of Unassigned Materials for Nuclear Power Plants

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1. Introduction

Domestic inservice NPPs (Nuclear Power Plants) have been constructed with various reactor types by applying different Codes & Standards. Table 1 indicates construction characteristics of domestic inservice NPPs. Among the above NPPs, a number of unassigned materials (DIN, NF, BS, JIS, KS, etc.) were used at Kori Unit 1 and Hanul Unit 1&2. However, the Codes for repair & replacement of items for all domestic NPPs do not permit to secure weldability by using the unassigned materials besides the KEPIC or ASME materials assigned to P-Numbers in them. Since the material is one of the essential variables on welding, the unassigned materials shall be qualified in the WPS/PQR (Welding Procedure Specification/Procedure Qualification Report) by the unassigned material itself. When the repair & replacement activities are performed in these NPPs, there are some difficulties to obtain the unassigned materials and to increase the number of welding procedure qualification (PQ) tests because PQ test shall be carried out for each one of the unassigned materials[1]. Therefore, in this study, material equivalent table will be made through making a comparative analysis between the assigned material specification in KEPIC and the unassigned material specification to solve the welding issues and to support the economic operation of NPPs.

Table I: Construction characteristics of Domestic inservice NPPs

NPP types	Units	Code & Standards
Westinghouse	Kori 1~4, Hanbit 1&2	ASME
Combustion Engineering	Hanbit 3~6 Hanul 3&4	
CANDU	Wolsung 1~4	CSA (Canadian)
Framatome	Hanul 1&2	RCC-M (France)
Korean standards	Hanul 5&6	KEPIC

2. Application of unassigned materials and welding qualification

2.1 Application of unassigned materials

All unassigned materials applied at primary system of Hanul Unit 1&2 were supplied by Framatome Ltd. of France with RCC-M specification. Interior materials of heat exchanger and high-capacity pumps were supplied by Alstom Ltd. of France with NF specification, and the materials for general system were supplied by mostly ASTM specification in domestic including some of JIS (Japanese Industrial Standards) and API (American Petroleum Institute).

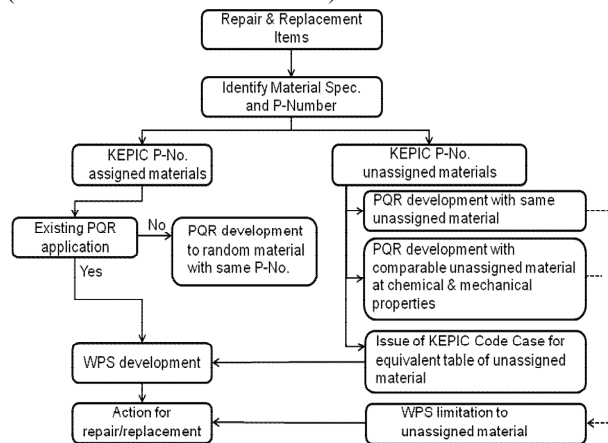


Fig.1. Repair/replacement procedure for KEPIC assigned material and unassigned material.

Even though Kori Unit 1 was constructed based on ASME Sec. III 1968 edition, a number of BS specification materials were applied such as BS 1501-223 Gr. in containment vessel & reinforcing plate and BS 2654 part 1 clause 6 in condensate storage tank plate. However, Kori Unit 1 is not the subject of consideration because it was decided permanent shutdown in 2017 by government.

2.2 Application of welding qualification for unassigned materials

Figure 1 represents repair & replacement procedures for KEPIC assigned materials and its unassigned

materials. In case of fillet welding for design improvement of Personal Hatch in Hanul Unit 1&2, KEPIC Code was not applied because of the usage of 7 kinds of unassigned materials including P235TR1. After purchasing the materials with NF specification of France, WPS/PQR were developed in accordance with RCC-M standards, and then it had accepted an approval for testing and qualification of WPS/PQR developed from Beuro Veritas, authorized agency of France. And finally, it had become applicable in field after an approval of an authorized nuclear inspector according to KEPIC Code. The materials of most RCC-M specifications are NF specifications that the purchase in domestic is difficult. Ultimately, the complicated process and time-consuming for purchasing unassigned materials can cause deterioration in the operation efficiency of NPPs.

3. Development of P-No. equivalent table for unassigned materials

3.1 Related Code & Standards

ASME Code Sec. IX, Appendix J (2011 addenda) is specifying P-No. requirements for the materials that are not registered in QW/QB-422 [2]. And in case of ASME Code Interpretation IX-89-05, if two materials with different specifications have same chemical compositions and mechanical properties, it has been regulating to consider as same unassigned material. In case of ISO and EN standards, P-No. for material specifications is not designated individually as ASME, and it has been suggesting only the criteria for classification with similar weldability. So, in case of ISO and EN specifications, when a welding engineer can judge directly that the specification of some materials indicates same weldability, it is possible an approval for production material and PQ material of different specifications.

3.2 Development methodology of an equivalent table

Figure 2 indicates the methodology of making a P-No. equivalent table for the unassigned materials. The method that KEPIC unassigned materials can approve to be equivalent with KEPIC materials, it is to confirm to meet the requirement of chemical compositions similar to the designated material classifying in ISO-15608. If it meets the requirements of chemical compositions, it evaluates satisfaction through cold cracking test according to ISO 17642-3 in carbon steel and Vareststraint test in stainless steel. Finally, it evaluates satisfaction through PQ test in accordance with ASME Sec. IX, III, and then it registers in the KEPIC MQ as a Code Case after making an equivalent table.

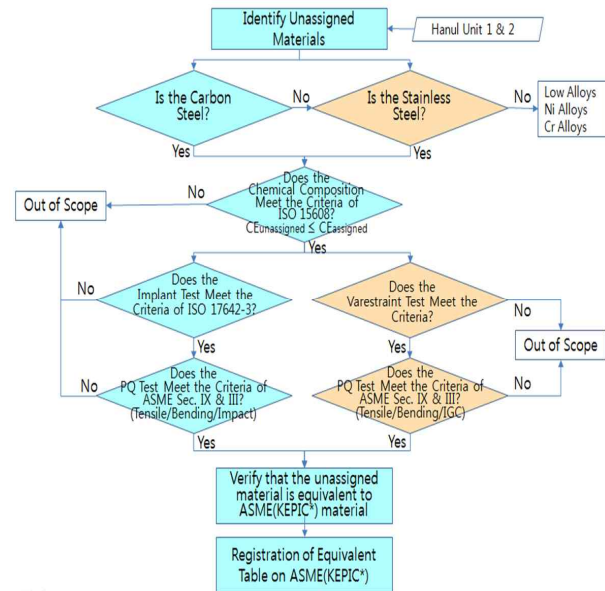


Fig.2. Methodology of making an equivalent table for unassigned materials

4. Conclusions

In order to solve the issues of long-term operation NPPs, the current status of unassigned materials was investigated and the methodology for making a P-No. equivalent table was developed. Next, it is scheduled to develop equivalent table by applying the above methodology through the purchase of unassigned materials.

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- [2] ASME Section IX, QW/QB-422