

Improved Management of Part Safety Classification System for Nuclear Power Plant

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1. Introduction

As, in recent years, many quality assurance (QA) related incidents, such as falsely-certified parts and forged documentation, etc., were reported in association with the supply of structures, systems, components and parts to nuclear power plants, a need for a better management of safety classification system was addressed so that it would be based more on the level of parts .

Presently, the Korean nuclear power plants do not develop and apply relevant procedures for safety classifications, but rather the safety classes of parts are determined solely based on the experience of equipment designers. That may have the potential to cause safety degradation to nuclear power plant.

So proposed in this paper is a better management plan for safety equipment classification system with an aim to strengthen the quality management for parts. The plan was developed through the analysis of newly introduced technical criteria to be applied to parts of nuclear power plant.

2. Current Status of Part-level Safety Classifications in Korea

Domestic technical criteria for safety classifications for equipment installed at nuclear power plants are limited to structures, systems and components with respect to design and maintenance. However, in the case of parts, which belong to the so called 'lower category' items after 'higher category' items such as structures, systems and components, the documentation on history and classifications are not well established and maintained. Reviewed in the study was the applicability of the safety classification for parts based on ANSI/ANS 51.1, which currently provides the backbone for CNSS Notices on NPP equipment classification in Korea. The review showed, however, that detailed procedures and applicable criteria are not provided sufficiently, and further, the current technical criteria may not be adequately applicable to operation and maintenance area where the part-level procurements are actually taking place. So its application is assessed as very much limited at the moment.

From the view point of safety classification system, ANSI/ANS 51.1 suggests a system in which nuclear equipment is classified as "Safety Class 1", "Safety Class 2", "Safety Class 3", and "Non-Nuclear Safety", in the meantime, ANSI/ANS 58.14, which represents the new safety classification system, classifies in terms of "Safety Related (Q)", "Non-Nuclear Safety with Augmented Grade (A)", and "Non-Safety Related (N)", and it is focused in such a way that they are classified according to whether or not a safety function is performed and also according to the impact of malfunction.

Applying ANSI/ANS 58.14, a detailed safety classification is possible for structures, systems, components and up to parts. It takes a systematic methodology for safety classification to determine the appropriate safety classes by starting with the identification of DBE, plant-level safety-related functions, then safety-related SSC and parts, and to non-safety-related augmented requirements items and up to non-safety-related items. So ANSI/ANS 58.14 has a strong point in determining the safety classifications more accurately through identifying and understanding the requirements for safety functions, installation locations and the impact on the safety functions of the installed SSCs.

3. Part-level Safety Classifications: Application Example

3.1 ANSI/ANS 58.14 Application Standard Analysis

ANSI/ANS 58.14 was used as a reference to refer to in this study to develop a plan to improve the part-level safety classification system with an aim to upgrade the performance of safety-related equipment. As shown in table 1, ANSI/ANS 58.14 divided the safety classification criteria into 2 groups such as 'Safety Classification' and 'Pressure Integrity Classification' so as to remove the confusion in between the classification criteria for safety class and also for pressure integrity, which existed in ANSI/ANS 51.1. Further in consideration of the importance of pressure integrity function, 5-class criteria are provided under the 'Pressure Integrity Classification.'

ANSI/ANS 51.1 Classification Criteria	ANSI/ANS 58.14 Classification Criteria	
Safety Classification (PWR)	Safety Classification (LWR)	Pressure integrity Classification
<ul style="list-style-type: none"> Safety Class 1 Safety Class 2 Safety Class 3 	<ul style="list-style-type: none"> Safety Related (Q) 	<ul style="list-style-type: none"> Class 1 Class 2 Class 3
<ul style="list-style-type: none"> Non-Nuclear Safety 	<ul style="list-style-type: none"> Non-Nuclear Safety with Augmented Grade (A) 	<ul style="list-style-type: none"> Class 4
	<ul style="list-style-type: none"> Non-Safety Related (N) 	<ul style="list-style-type: none"> Class 5

Table 1. Comparison of Safety Classification Criteria between ANSI/ANS 51.1 and ANSI/ANS 58.14

ANSI/ANS 58.14 provides classification criteria in such a way that a part in the safety-related components which normally does not perform safety function, but if it impacts on the safety functions of the mother components when it fails to perform its function, it should be classified as safety related.

And items subject to certain regulatory requirements or under plant specific requirements should be classified as non-safety-related with augmented requirements (A), even though they normally don't perform safety-related functions. These are the major differences between ANSI/ANS 51.1 and ANSI/ANS 58.14.

3.2 Safety Classifications of the Parts in the Safety-related Components: Application Example

Part-level safety classification method and criteria given in ANSI/ANS 51.1 and ANSI/ANS 58.14 were applied to determine the safety classes of the parts which compose the isolation valve installed in the component cooling water system heat exchanger as shown in Figure 1. The study shows the results as follow:

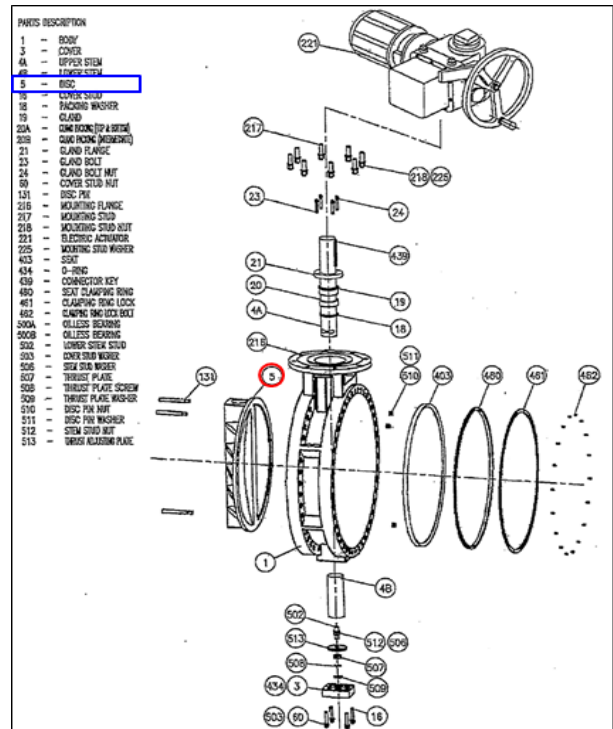


Figure 1. Isolation Valve Installed in CCWS Heat Exchanger

Both classification systems showed the same results on the pressure integrity parts. However, as shown in Table 2, they showed some important differences.

In the study, the upper stem and lower stem, which are non-pressure integrity items, were evaluated to find qualified replacements. When they were classified applying ANSI/ANS 51.1, they were determined as safety-related or non-safety-related depending on the plant operator, mainly because of its unclear safety classification criteria for parts.

With ANSI/ANS 58.14, however, they were classified consistently as safety-related parts as shown in Table 2. It is because ANSI/ANS 58.14 provides classification criteria for pressure integrity items separately from the ones for non-pressure integrity items. It also is clear that even the non-pressure integrity parts could be classified as safety-related depending on whether they perform safety related functions.

With the application of ANSI/ANS 58.14, we can provide a well-defined safety classification system, in such a way that even the parts, which are normally classified as non-safety related, could be classified as safety-related or classified as non-safety-related with augmented requirements (A) as discussed above. Thus the nuclear power plant operators are expected to establish and implement a better systematic management system that will contribute greatly to

assure and maintain the quality of the safety class SSC and parts. Also expected is the prevention of the safety cases in which some safety important parts may be classified into lower safety class than it should be.

are necessary to assure the safety function of the safety equipment in general, is identified and established as a system and the relevant technical criteria (including the supplier's internal standards/guides) are applied, then the quality of safety class structures, systems, components and parts would expect to be assured and maintained.

References

- [1] Nuclear Safety Commission Public Article NO. 2014-15, Safety Classification and Standard of Reactor Facility in respect of regulating., Nuclear Safety Commission(2014)
- [2]ANSI/ANS 58.14, Safety and Pressure Integrity Classification Criteria for Light Water Reactors, USA(2011)
- [3]ANSI/ANS 51.1, Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants, USA(1983)
- [4]EPRI NP-6895, Guidelines for the Safety Classification of Systems, Components, and Parts Used in Nuclear Power Plant Applications, EPRI(1991)
- [5] EPRI NP- 6406, Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants, EPRI(1989)

Part name	Part Function	Part Safety Classification	
		*ANSI/ANS 51.1	ANSI/ANS 58.14
BODY	PRESSURE INTEGRITY BOUNDARY PART	S	S
COVER	PRESSURE INTEGRITY BOUNDARY PART	S	S
UPPER STEM	TRANSFERRING VALVE DRIVING FORCE	S or NSR	S
LOWER STEM	TRANSFERRING VALVE DRIVING FORCE	S or NSR	S
DISK	PRESSURE INTEGRITY BOUNDARY PART	S	S
COVER STUD	PRESSURE INTEGRITY BOUNDARY PART	S	S
PACKING WASHER	LEAK TIGHTNESS	NSR	NSR
GLAND	GLAND PACKING COMPRESSION	NSR	NSR
GLAND PACKING	LEAK TIGHTNESS	NSR	NSR

* Safety Classification by ANSI/ANS 51.1:SC-1, SC-2, SC-3
Table 2. Comparison of Safety Classifications by ANSI/ANS 51.1 and ANSI/ANS 58.14

4. Conclusions

As demonstrated in the study conducted as above, a well-defined safety classification system for non-pressure integrity parts was developed according to ANSI/ANS 58.14 which is the most current technical classification criteria for nuclear power plant equipment, and it was applied to assess and supplement the improvement plan to strengthen the management of part-level safety classification system for domestic nuclear power plants. As a result, when the safety classification of the non-pressure integrity parts, which