A Code Reconciliation on Ulchin Unit 1&2 Replacement Steam Generator

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1. Introduction

The Ulchin nuclear power plant unit 1&2 are planning to replace Steam Generators due to Leakage of Steam Generator Tubes by PWSCC.

The original SGs for the Ulchin 1&2 plants were designed and manufactured to the requirements of the French Code RCC-M, 1981 edition. However, the new SGs are to be designed and manufactured to the requirements of the ASME Code Section III, 1998 edition through 2000 addenda**.**

2. Code Reconciliation for Ulchin unit 1&2 Replacement Steam Generator

2.1 Scope

In accordance with ASME XI, IWA-4222, technical requirements that could affect design, materials, fabrication, or examination, and affect the pressure boundary, or core support or component support function, need to be reconciled.

In order to reconcile the differences between RCC-M and ASME, only the differences of the code requirements applicable to the replacement steam generator (RSG) need to be evaluated. It doesn't need the complete resolution of the differences between RCC-M and ASME requirements.

Specifically, every paragraph in Section 1 Subsection B Chapters B4000 and B5000 was compared to the corresponding requirements given in ASME Code, Section III Subsection NB.

2.2 Comparison Table

The difference of codes reviewed were categorized as NA, NS and AE, AEJ, RC, RCJ

- Not Applicable to RSG pressure boundary material (NA)
- introductory to section organizations, no specific requirements (NS)
- ASME contains equivalent or more conservative requirements. Clear correspondence to ASME is possible (AE)
- ASME is judged to contain equivalent or more conservative requirements (AEJ)
- RCC-M is clearly more conservative than ASME (RC)
- RCC-M is judged to be more conservative than ASME (RCJ)

Table: Code Comparison Table

RCC-M Chapters	RCC-M Chapter Titles	Related ASME Paragraph	ASME Section Paragraph Title	Tech. Req. Code	Reconciliation Comment
S7363	Magnetic Particle Examination and Liquid Penetrant Examination	NB-2540 NB-5130	Examination and Repair of Forgings and Bars Examination of Weld Edge Preparation Surfaces	RCJ	Acceptance criteria given in RCC-M Tables 7363.I and 7363.II are comparable to the acceptance shown in NB-5130. However, there are differences between the acceptance criteria of the two Codes The same comments on MT and PT associated with Chapter S7714 are applicable to S7363.
S7422	Welding Requirements	NB-4432 NB-4435	Welding of Structural Attachments Welding of Nonstructural and Temporary Attachments and Their Removal	AEJ	RCC-M requires full penetration welds. ASME Section III permits qualified fillet and partial penetration welds with supporting analysis.
⋮	⋮	⋮	⋮	⋮	⋮

3. Sample Cases of Code Reconciliation on Ulchin Unit 1&2 RSG

3.1 Classifications of Pressure Boundary Components

RCC-M Subsection A 4220 defines Secondary Side as Class 1 components but ASME Subsection NCA 2110 defines Secondary Side as Class 2 components.

In this case, we implemented that the secondary side components are designed as Class 1 components to the design specification.

3.2 Level C (Emergency) Condition

RCC-M Subsection B-3123 limits Level C Condition transients to maximum of 20 cycles in the service life of the plant but ASME Section III limits total of 24 Level C Condition transient cycles.

In this case, there is no need to reconcile, because ASME code is more conservative.

3.3 Hydro test Pressure

The RCC-M Code Subsection B 5120 requires the Hydrotest Pressure = k x Design pressure.

- k = k1 x k2
- k1 = 1.25 for Forged parts
- k1 = 1.50 for Cast Steel parts
- k2 = (Su at Test Temperature ÷ Su at Design Temperature), for the main material of which the wall of the component constructed
- Su = Tensile strength of the material

The primary side and secondary side pressure boundary components are fabricated from forgings, SA-508 Gr. 3 Cl. 2 for the RSGs.

- k1 = 1.25 for primary side and secondary side main parts forgings, SA-508 Gr. 3 Cl. 2
- SuT = 90.0 ksi, tensile strength of the material at Test Temperature 149 °F
- SuD = 90.0 ksi, tensile strength of the material at Primary Design Temperature 650 °F and Secondary Design Temperature of 601 °F
- k2 = (90.0 ÷ 90.0) = 1.0, for the main material of which the wall of the component constructed
- k = k1 x k2 = 1.25 x 1.0 = 1.25
- Primary Side Design Pressure = 2,485 psig
- Required Primary Hydrotest Pressure = 1.25 x 2485 = 3,107 psig
- Secondary Side Design Pressure = 1,085 psig
- Required Secondary Hydrotest Pressure = 1.25 x 1085 = 1,357 psig

The ASME Code Subsection NB-6220 requires the hydrotest pressure to be 1.25 times the Design Pressure for the primary side and secondary side components.

- Primary Side Design Pressure = 2,485 psig
- Required Primary Hydrotest Pressure = 1.25 x 2,485 = 3,107 psig
- Secondary Side Design Pressure = 1085 psig
- Required Secondary Hydrotest Pressure = 1.25 x 1,085 = 1,357 psig

In this case, there is no need to reconcile, because both codes are equal according to the study.

4. Conclusions

The result of the comparisons of RCC-M Code and the ASME Code Section III requirements show that most of the RCC-M and ASME Code Section III requirements are similar for the purpose; however, about 20 of the requirements of RCC-M are more conservative.

These 20 requirements were reflected in Design Specification, Purchase Specification, or fabrication procedure for Ulchin unit 1&2 RSG.

As a result, Ulchin unit 1&2 RSGs satisfy the design , materials, fabrication and examination requirement of two codes that are RCCM, ASME Sec. III ; however, the costs and schedule is increase.

RSG code reconciliation was prepared but perfect reconciliation for all differences is almost impossible.

REFERENCES

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