

## **Response to Action Item 3-52 Section 3.13**

### **MCB Issue List Regarding APR-1400, FSAR Section 3.13**

#### **Issue #1 (AI 3-52.20)**

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criterion 14 specifies that the reactor coolant pressure boundary will be designed, fabricated erected and tested in a manner that provides assurance of an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture. One element of nuclear power plant design that supports achieving this objective is the selection of threaded fasteners (bolts, studs, etc.) appropriate for their specific application and not susceptible to known, or expected, degradation mechanisms.

One such known, or expected, degradation mechanism is galvanic corrosion. The APR-1400 Final Safety Analysis Report (FSAR) Section 3.13 states,

In designing threaded fastener joints, consideration is given for the prevention of galvanic corrosion, except when the design or material of the fasteners has been demonstrated to be acceptable through satisfactory operation in the OPR 1000 plants...

Identify all reactor coolant pressure boundary threaded fastener joints in the APR-1400 design, if any, for which the design or material of the fasteners has been justified to be acceptable through satisfactory operation in the OPR 1000 plants and provide your assessment of OPR 1000 operational experience that supports this demonstration.

#### **Response**

The materials for reactor coolant pressure boundary threaded fastener joints are provided in the following Table. These materials have been used for many years in the OPR 1000 plants and will be used in APR 1400 plants. Those materials have been used successfully without any materials issues in Korea.

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Component	Item	Part	Material		Size	
			APR1400	OPR1000	APR1400	OPR1000
RV	Closure Bolting	Stud	SA-540 Gr.B24 Cl.3	SA-540 Gr.B24 Cl.3	7.375" Modified 8 Pitch Thread	6.75" Modified 8 Pitch Thread
		Nut	SA-540 Gr.B24 Cl.3	SA-540 Gr.B24 Cl.3	7.375" Modified 8 Pitch Thread	6.75" Modified 8 Pitch Thread
	Vent Pipe Flange Bolting	Stud	SA-193 Gr.B8M Cl.2	SA-193 Gr.B8M Cl.2	0.75-10UNC-2A	0.75-10UNC-2A
		Nut	SA-193 Gr.B8M Cl.2	SA-193 Gr.B8M Cl.2	0.75-10UNC-2B	0.75-10UNC-2B
SG	Primary Manway	Stud	SB-637 UNS N07718	SB-637 UNS N07718	1.75-8UN-2A	1.625-8UN-2A
		Nut	SB-637 UNS N07718	ASME SB-637 UNS N07718	1.75-8UN-2B	1.625-8UN-2B
	Secondary Manway	Stud	SA-540 Gr.B24 Cl.4	SA-540 Gr.B24 Cl.4	1.5-8UN-2A	1.5-8UN-2A
		Nut	SA-540 Gr.B24 Cl.4	SA-540 Gr.B24 Cl.4	1.5-8UN-2B	1.5-8UN-2B
	Handhole	Stud	SA-540 Gr.B24 Cl.4	SA-540 Gr.B24 Cl.4	1-8UNC-2A	1-8UNC-2A
		Nut	SA-540 Gr.B24 Cl.4	SA-540 Gr.B24 Cl.4	1-8UNC-2B	1-8UNC-2B
	Inspection Hole	Stud	SA-540 Gr.B24 Cl.4	N/A <sup>(1)</sup>	1-8UNC-2A	N/A
		Nut	SA-540 Gr.B24 Cl.4	N/A	1-8UNC-2B	N/A
PZR	Manway	Stud	SB-637 UNS N07718	SB-637 UNS N07718	1.5-8UN-2A	1.5-8UN-2A
		Nut	SB-637 UNS N07718	SB-637 UNS N07718	1.5-8UN-2B	1.5-8UN-2B
CEDM	Upper Pressure Housing Assembly	Vent Stem Housing Nut	SA-479 Type 316	SA-479 Type 316	1-12UNF-2A	1-12UNF-2A
		Upper End Fitting	SA-479 Type 316	SA-479 Type 316	1-12UNF-2B	1-12UNF-2B
		Lower End Fitting	SA-479 Type 316	SA-479 Type 316	5-11/32-6ACME-2G	5-11/32-6ACME-2G
	Motor Housing Assembly	Upper End Fitting	SA-182 F347	SA-182 F347	5-11/32-6ACME-2G	5-11/32-6ACME-2G
		Lower End Fitting	SB-166 UNS N06690	SB-166 UNS N06690	5.25-5ACME-2G	5.25-5ACME-2G
Component  Small Piping (2)(3)	Item	Part	Material		Size	
			APR1400	OPR1000	APR1400	OPR1000
		Bolts	ASME SA-193 Gr. B7	ASME SA-193 Gr. B7	various	various
		Nuts	ASME SA-194 Gr. 2H	ASME SA-194 Gr. 2H	various	various

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Notes)

- (1) As described in Section 5.4.2.16 in the DCD Tier 2, two 5 inches inspection holes are provided to remove the foreign objects trapped in the feedwater box for APR1400 SG design. There is no inspection hole for OPR1000 SG design except the recent RSG (Replacement Steam Generator).
- (2) Reactor Primary Coolant Piping does not have any fasteners.
- (3) Spiral wound metallic gasket is applied. In addition, stainless steel shim plate is placed between stainless steel flange and nuts to prevent direct contact.

### **Impact on DCD**

There is no impact on the DCD.

### **Impact on PRA**

There is no impact on the PRA.

### **Impact on Technical Specifications**

There is no impact on the Technical Specification.

### **Impact on Technical/Topical/Environmental Reports**

There is no impact on any Technical, Topical or Environmental Reports

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### **MCB Issue List Regarding APR-1400, FSAR Section 3.13**

#### **Issue #2 (AI 3-52.21)**

For the APR1400 FSAR, it is identified that the components and code classes APR-1400 FSAR Section 3.13 does not cite how the 10 CFR Part 50, Appendix G requirements for reactor vessel closure studs and nuts will be met, information which is detailed in FSAR Section 5.2.3.6. This leaves the information in FSAR Section 3.13 incomplete.

Revise FSAR Section 3.13 to reference FSAR Section 5.2.3.6 regarding specific requirements for reactor vessel closure studs and nuts to meet 10 CFR Part 50, Appendix G

#### **Response**

The following statement will be added at the end of FSAR Section 3.13.1.2. However, FSAR Section 5.3.1.7 will be referenced instead of FSAR Section 5.2.3.6 since 10 CFR Part 50, Appendix G is in FSAR Section 5.3.1.7 more clearly.

“The reactor vessel closure studs and nuts are fabricated to meet 10 CFR Part 50, Appendix G requirements as stated in FSAR Section 5.3.1.7.”

#### **Impact on DCD**

DCD 3.13.1.2 will be revised as indicated on the attached markup.

#### **Impact on PRA**

There is no impact on the PRA.

#### **Impact on Technical Specifications**

There is no impact on the Technical Specification.

#### **Impact on Technical/Topical/Environmental Reports**

There is no impact on any Technical, Topical or Environmental Reports

**APR1400 DCD TIER 2****3.13.1.2 Special Materials Fabrication Processes and Special Controls**

Special process and controls such as heat treatment, which affects the material properties, and tests for material property evaluation of threaded fasteners procured or fabricated, are in accordance with ASME Section II (Reference 3) and III. Table 3.13-1 identifies the appropriate Subparagraphs NB-2200, NC-2200, or ND-2200 of the ASME Code regarding material heat treatment and tensile test coupons preparation criteria for ferritic materials (e.g., carbon steel, high-strength low-alloy steel). The criteria of ASME Section III are applied rather than the criteria of the material specification of ASME Section II applicable to the mechanical testing if there is a conflict between the two sets of criteria.

In addition, threaded fasteners are fabricated using the materials, fabrication practices, and special processes that have been proven for the sensitivity of the stress corrosion cracking or other forms of material degradations through the previous experience and/or laboratory data.

Threaded fasteners are cleaned in accordance with NRC RG 1.28 (Reference 4) to provide reasonable assurance that contaminants to which they could be exposed will not damage or deteriorate the materials, alter their properties, accelerate effects associated with aging, or increase the susceptibility to failure mechanisms such as stress corrosion cracking.

Reactor vessel closure studs and nuts are surface-treated with a manganese-based phosphate coating for protection against corrosion effects.

**3.13.1.2.1 Fabrication Inspection**

ASME Section III Class 1, 2, and 3 component fasteners are inspected during fabrication in accordance with ASME Section III, NB-2580, NC-2580, and ND-2580 for the corresponding ASME Code Class (see Table 3.13-1) and material specification.

**3.13.1.2.2 Lubricants and Sealants**

Add here. "The reactor vessel closure studs and nuts are fabricated to meet 10 CFR Part 50, Appendix G requirements as stated in FSAR Section 5.3.1.7."

Lubricants used during installation of ASME Section III Class 1, 2, and 3 component fasteners are those that meet the requirements prescribed in the relevant design documents to provide reasonable assurance of the compatibility with the fasteners. Lubricants are

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### **MCB Issue List Regarding APR-1400, FSAR Section 3.13**

#### **Issue #3 (AI 3-52.22)**

APR-1400 FSAR Section 3.13.1.2 states:

In addition, threaded fasteners are fabricated using the materials, fabrication practices, and special processes that have been proven for the sensitivity of the stress corrosion cracking or other forms of material degradations through the previous experience and/or laboratory data.

The staff interprets that the intent of this statement is to convey that threaded fasteners will be fabricated using the materials, fabrication practices, and special processes that will minimize the potential for stress corrosion cracking or other forms of material degradation, but the statement as written is problematically ambiguous. As written, the staff could not make a clear safety finding regarding this issue of threaded fastener design.

Revise this section to clearly indicate materials for threaded fasteners will be selected to minimize stress corrosion cracking or other forms of material degradation.

#### **Response**

In order to clearly describe the resistance of threaded fasteners materials to stress corrosion cracking and other forms of material degradations, the second paragraph of FSAR Section 3.13.1.2 will be revised as follows:

“In addition, threaded fasteners are designed and fabricated using materials and processes that have been selected to minimize stress corrosion cracking or other forms of material degradation.”

#### **Impact on DCD**

DCD 3.13.1.2 will be revised as indicated on the attached markup.

#### **Impact on PRA**

There is no impact on the PRA.

#### **Impact on Technical Specifications**

There is no impact on the Technical Specification.

#### **Impact on Technical/Topical/Environmental Reports**

There is no impact on any Technical, Topical or Environmental Reports

**APR1400 DCD TIER 2****3.13.1.2 Special Materials Fabrication Processes and Special Controls**

Special process and controls such as heat treatment, which affects the material properties, and tests for material property evaluation of threaded fasteners procured or fabricated, are in accordance with ASME Section II (Reference 3) and III. Table 3.13-1 identifies the appropriate Subparagraphs NB-2200, NC-2200, or ND-2200 of the ASME Code regarding material heat treatment and tensile test coupons preparation criteria for ferritic materials (e.g., carbon steel, high-strength low-alloy steel). The criteria of ASME Section III are applied rather than the criteria of the material specification of ASME Section II applicable to the mechanical testing if there is a conflict between the two sets of criteria.

~~In addition, threaded fasteners are fabricated using the materials, fabrication practices, and special processes that have been proven for the sensitivity of the stress corrosion cracking or other forms of material degradations through the previous experience and/or laboratory data.~~

Threaded fasteners are cleaned in accordance with NRC RG 1.28 (Reference 4) to provide reasonable assurance that contaminants to which they could be exposed will not damage or deteriorate the materials, alter their properties, accelerate effects associated with aging, or increase the susceptibility to failure mechanisms such as stress corrosion cracking.

Reactor vessel closure studs and nuts are surface-treated with a manganese-based phosphate coating for protection against corrosion effects.

**3.13.1.2.1 Fabrication Inspection**

Revise. "In addition, threaded fasteners are designed and fabricated using materials and processes that have been selected to minimize stress corrosion cracking or other forms of material degradation."

ASME Section III Class 1, 2, and 3 component fasteners are inspected during fabrication in accordance with ASME Section III, NB-2580, NC-2580, and ND-2580 for the corresponding ASME Code Class (see Table 3.13-1) and material specification.

**3.13.1.2.2 Lubricants and Sealants**

Lubricants used during installation of ASME Section III Class 1, 2, and 3 component fasteners are those that meet the requirements prescribed in the relevant design documents to provide reasonable assurance of the compatibility with the fasteners. Lubricants are

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#### **Issue #4 (AI 3-52.23)**

APR-1400 FSAR Section 3.13.1.5 does not explicitly state that for ASME Code Class 1, 2 and 3 threaded fastener materials, documentation related to fracture toughness testing results, when required, are to be retained as part of quality assurance (QA) records, in compliance with the requirements of the American Society of Mechanical Engineers (ASME Code), Section III, which is invoked by reference in 10 CFR 50.55a.

Documentation relating to fracture toughness testing results for ASME Code Class 1, 2 and 3 threaded fastener materials, when required, should explicitly be required to be maintained as part of QA records. Revise FSAR 3.13.1.5 accordingly.

#### **Response**

The following statement will be added at the end of the first paragraph of FSAR Section 3.13.1.5:

“Documentation related to fracture toughness testing results for ASME Code Class 1, 2 and 3 component threaded fastener materials, when required, is to be maintained as part of QA records in compliance with the requirements of the American Society of Mechanical Engineers (ASME) Code, Section III.”

#### **Impact on DCD**

DCD 3.13.1.5 will be revised as indicated on the attached markup.

#### **Impact on PRA**

There is no impact on the PRA.

#### **Impact on Technical Specifications**

There is no impact on the Technical Specification.

#### **Impact on Technical/Topical/Environmental Reports**

There is no impact on any Technical, Topical or Environmental Reports



**APR1400 DCD TIER 2**3.13.1.4 [Reserved]3.13.1.5 Certified Material Test Reports

Quality records such as certified material test reports (CMTRs), which are associated with ASME Section III Class 1, 2, and 3 component fasteners, are controlled, maintained, and stored in accordance with the quality assurance program to meet the requirements of 10 CFR Part 50, Appendix B; ASME NQA-1; and ASME NCA. The CMTRs contain the contents required by ASME Section III, NCA 3860.

The combined license (COL) applicant is to maintain quality assurance records including CMTRs on ASME Section III Class 1, 2, and 3 component fasteners in accordance with the requirements of 10 CFR 50.71 (COL 3.13(1)).

Add here. "Documentation related to fracture toughness testing results for ASME Code Class 1, 2 and 3 component threaded fastener materials, when required, is to be maintained as part of QA records in compliance with the requirements of the American Society of Mechanical Engineers (ASME) Code, Section III."

3.13.2 Inservice Inspection Requirements

As required by 10 CFR 50.55a, except where written requirements of ASME Section XI Division 1 are more stringent, the COL applicant shall implement the plant preservice and inservice inspection of ASME Section III Class 1, 2, and 3 threaded fasteners (see Table 3.13-2).

The COL applicant is to submit the preservice and in-service inspection program for ASME Section III Class 1, 2, and 3 component threaded fasteners to the NRC prior to performing the inspection (COL 3.13(2)). The inservice inspection program identifies the applicable edition and addenda of ASME Section XI and provides reasonable assurance of conformance with the requirements of 10 CFR 50.55a (b) (2) (xxvi).

3.13.3 Combined License Information

COL 3.13(1) The COL applicant is to maintain quality assurance records including CMTRs on ASME Section III Class 1, 2, and 3 component threaded fasteners in accordance with the requirements of 10 CFR 50.71.