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April 9, 2009

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-09146

Subject: MHI's Response to US-APWR DCD RAI No. 273-2239

Reference: 1) "Request for Additional Information No. 273-2239 Revision 0, SRP Section: 03.13 – Threaded Fasteners – ASME Code Class 1, 2, and 3, Application Section: 3.13," dated 3/11/2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 273-2239, Revision 0."

Enclosed are the responses to 5 RAIs contained within Reference 1.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosure:

1. Responses to Request for Additional Information No. 273-2239, Revision 0

CC: J. A. Ciocco
C. K. Paulson

D081
NRO

Contact Information

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Enclosure 1

UAP-HF-09146
Docket No. 52-021

Responses to Request for Additional Information No. 273-2239,
Revision 0

April, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/9/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 273-2239 REVISION 0**
SRP SECTION:	**03.13 – Threaded Fasteners – ASME Code Class 1, 2, and 3**
APPLICATION SECTION:	**03.13**
DATE OF RAI ISSUE:	**3/11/09**

QUESTION NO. 3.13-1:

The ASME Code, Section III provides acceptance criteria for magnetic-particle and liquid-penetrant examinations in Subsections NB-2583.3 and NB-2584.3, respectively. In Tier 2, Section 3.13.1.3 of the US-APWR Design Control Document, under the section titled "Required Examinations," the applicant states the acceptance criteria for magnetic-particle and liquid-penetrant examinations as, "... the ASME Code specifies that all nonlinear, nonaxial indications are unacceptable, regardless of length." However, NB-2583.3 and NB-2584.3 both state that "linear", not "nonlinear" nonaxial indications are unacceptable. The applicant is requested to address this discrepancy.

ANSWER:

MHI agrees that the ASME Code specifies that all linear, nonaxial indications are unacceptable, regardless of length. The indication of "nonlinear, nonaxial indications" will be corrected to "linear, nonaxial indications."

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.13, Revision 2, changes to be incorporated.

- Change the next-to-last sentence in the first bullet (titled "Required Examinations:") in the 4th paragraph (beginning "For Fabrication Inspection/Examination Criteria for Bolts, Studs, and Nuts ...") of Subsection 3.13.1.3 to: "Under evaluation of indications, the ASME Code specifies that all linear, nonaxial indications are unacceptable, regardless of length."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/9/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 273-2239 REVISION 0**
SRP SECTION:	**03.13 – Threaded Fasteners – ASME Code Class 1, 2, and 3**
APPLICATION SECTION:	**03.13**
DATE OF RAI ISSUE:	**3/11/09**

QUESTION NO. 3.13-2:

Tier 2, Table 3.13-1 of the US-APWR Design Control Document entitled, "ASME Code, Section III Criteria for Selection and Testing of Bolting Materials," lists NB-2224.3 as the ASME Code, Class 1 criterion for test coupons requirements bolting/stud materials. However, Subsection NB-2444 of the ASME Code contains the ASME Code, Class 1 criteria for test coupons requirements bolting/stud materials. The applicant is requested to address this discrepancy.

ANSWER:

MHI reviewed the ASME Code, Section III Criteria for Selection and Testing of Bolting Materials, and determined Subsection NB-2224, opposed to NB-2224.3 or NB-2444, contains the ASME Code, Class 1 criteria for test coupons requirements of bolting/stud materials. Table 3.13-1 in the DCD was based on SRP Table 3.13-1, which incorrectly lists NB-2224.3 as the ASME Code, Class 1 criterion for test coupons requirements of bolting/stud materials. The reference to "NB-2224.3" will be corrected to "NB-2224".

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.13, Revision 2, changes to be incorporated.

- Change the table cell for ASME Class 1 Criteria (2nd primary column) for Material Test Coupons and Specimens for Ferritic Steel Material (Tensile Test Criteria), Test Coupons Requirements Bolting/Stud Materials (lower row of 3rd primary row) in Table 3.13-1 to:

NB-2221 NB-2224

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 273-2239 REVISION 0**
SRP SECTION:	**03.13 – Threaded Fasteners – ASME Code Class 1, 2, and 3**
APPLICATION SECTION:	**03.13**
DATE OF RAI ISSUE:	**03/11/09**

QUESTION NO. 3.13-3:

Tier 2, Section 3.13.1.3 of the US-APWR Design Control Document titled "Fracture Toughness Requirements for Threaded Fasteners Made of Ferritic Materials" contains fracture toughness requirements for Class 1, 2 and 3 fasteners. In the "acceptance standard" section, the applicant states "In NC-2333 and ND-2333 for bolting material, the Cv tests are performed at or below the lowest service temperature, and all three specimens shall meet the requirements of Table NC-2332.3-1 and Table ND-2333-1, respectively." However, Subsection NC-2332.3 of the ASME Code (not NC-2333) contains the Cv test criteria for ASME Class 2 fasteners. The applicant is requested to address this discrepancy.

ANSWER:

MHI agrees that the ASME Code Subsection NC-2332.3 contains the Cv test criteria for ASME Class 2 fasteners. The reference to "NC-2333" will be corrected to "NC-2332.3."

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.13, Revision 2, changes to be incorporated.

- Change the last sentence in the fourth bullet (titled "Acceptance Standards:") in 3rd paragraph of Subsection 3.13.1.3 to: "In NC-2332.3 and ND-2333 for bolting material, the C_v tests are performed at or below the lowest service temperature, and all three specimens are to meet the requirements of Table NC-2332.3-1 and Table ND-2333-1, respectively."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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4/9/2009

US-APWR Design Certification

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APPLICATION SECTION:	**03.13**
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QUESTION NO. 3.13-4:

Tier 2, Section 3.13.1.1.1 of the US-APWR Design Control Document entitled, "Class 1 Applications," references Tier 2, Subsection 5.3.1.7 for the specific criteria applicable to reactor vessel fasteners. In this section, the applicant specifies the Brinell hardness for reactor vessel fasteners to be 302 HB (minimum) to 311 HB (maximum). The applicant is requested to provide the basis for these hardness values.

ANSWER:

The range of Brinell hardness as 302 HB (minimum) to 311 HB (maximum) specified for the reactor vessel fasteners in DCD Subsection 5.3.1.7 is in error. The correct Brinell hardness range is 302 HB (minimum) to 388 HB (maximum), in accordance with ASME Code Section II SA-540. The maximum value will be corrected during the next revision of the DCD.

Impact on DCD

See Attachment 2 for the mark-up of DCD Tier 2, Section 5.3, Revision 2, changes to be incorporated.

- Change the last sentence in the fifth paragraph of Subsection 5.3.1.7 to the following: "The surface Brinell hardness shall be minimum 302 HB to maximum 388 HB."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/9/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 273-2239 REVISION 0**
SRP SECTION:	**03.13 – Threaded Fasteners – ASME Code Class 1, 2, and 3**
APPLICATION SECTION:	**03.13**
DATE OF RAI ISSUE:	**3/11/09**

QUESTION NO. 3.13-5:

Tier 2, Subsection 3.13.1.2.5 of the US-APWR Design Control Document references (3.13-10) ANSI N45.2.1, "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants," for cleaning and cleanliness controls of threaded fasteners. For cleaning and cleanliness controls of components (including threaded fasteners), the NRC currently references the use of Regulator Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," dated March 2007 (ref. 3.13-9) which endorses ASME NQA-1-1994, Part II, Subpart 2.1. NRC requests the applicant to use the guidance contained in RG 1.37 and ASME NQA-1-1994 for cleaning and cleanliness controls of threaded fasteners.

ANSWER:

MHI agrees to delete the requirements of ANSI N45.2.1 in Subsection 3.13.1.2.5, since RG 1.37 recognizes ASME NQA-1-1994, Part II, Subpart 2.1 contains updated QA criteria for ANSI N45.2.1-1973. The endorsement by RG 1.37 of ASME NQA-1-1994, Part II, Subpart 2.1 will be added as a reference for cleaning and cleanliness controls of threaded fasteners.

Impact on DCD

See Attachment 1 for the mark-up of DCD Tier 2, Section 3.13, Revision 2, changes to be incorporated.

- Delete the last half of second paragraph in Subsection 3.13.1.2.5, beginning with the seventh sentence: "RG 1.37 (Reference 3.13-9) describes the Quality Assurance requirements for cleaning fluid systems and associated components including threaded fasteners of water-cooled nuclear power plants."

- Insert the following as the third paragraph in Subsection 3.13.1.2.5:

  "Cleaning and Cleanliness: RG 1.37 (Reference 3.13-9), which endorses ASME NQA-1-1994, Part II, Subpart 2.1 (Reference 3.13-10), describes the Quality Assurance requirements for cleaning and cleanliness control of fluid systems and associated components, including threaded fasteners, of water-cooled nuclear power plants."

- Change Reference 3.13-10 in Subsection 3.13.4 to the following:

  "3.13-10 Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components for Nuclear Power Plants, ASME NQA-1-1994, Part II, Subpart 2.1, American Society of Mechanical Engineers, 1994."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

This completes MHI's responses to the NRC's questions.

graphite-based Neolube #1260, which is both a sealant and lubricant for bolting. ~~RG 1.37 (Reference 3.13-9) describes the Quality Assurance requirements for cleaning fluid systems and associated components including threaded fasteners of water-cooled nuclear power plants. The water quality for final flushes and associated components is generally at least equal to the quality of the operating system water in accordance with "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants", ANSI N45.2.1 (Reference 3.13-10). ANSI N45.2.1 allows that low (nil) levels of sulfur, fluorine, and/or chlorine compounds be used on austenitic SSs. In addition, low (nil) sulfur and low (nil) lead compounds also may be used on nickel-base alloys. Chemical compounds (e.g., thread lubricants, sealants) that could contribute to SCC are not be used with austenitic SSs and nickel-base alloys, such as compounds (products) containing leachable chlorides, fluorides, lead, zinc, copper, sulfur, or mercury. Since MoS_2 contains high sulfur levels and PTFE is fully fluorinated, these two lubricants are not acceptable for primary coolant system service along with other reasons discussed above (corrosion, poor radiation resistance). The COL Applicant is to provide information on procedures for the final selection of lubricants, sealants, and cleaning fluids.~~

Cleaning and Cleanliness: RG 1.37 (Reference 3.13-9), which endorses ASME NQA-1-1994, Part II, Subpart 2.1 (Reference 3.13-10), describes the Quality Assurance requirements for cleaning and cleanliness control of fluid systems and associated components, including threaded fasteners, of water-cooled nuclear power plants.

3.13.1.3 Fracture Toughness Requirements for Threaded Fasteners Made of Ferritic Materials

For threaded fasteners made from ferritic (carbon steel and HSLA) steels in ASME Code, Section III (Reference 3.13-1), Class 1 systems, the fracture toughness properties and associated impact testing are in compliance with the applicable acceptance criteria described in Reference 3.13-5. However, these fracture toughness requirements do not apply to ferritic bolts, studs, and nuts used in Class 2 or 3 applications. 10 CFR 50.55a (Reference 3.13-11) invokes fracture toughness requirements in ASME Section III (Reference 3.13-1), Subarticles NC and ND for ferritic bolting used in Class 2 and 3 applications where the appropriate Section III (Reference 3.13-1) criteria in Table 3.13-1 applies.

For Class 1 Applications, ferritic steel bolts, studs, and nuts used in the RCPB have fracture toughness properties meeting the requirements for ferritic (carbon steel and HSLA) steels specified in Subarticle NB, ASME Code, Section III (Reference 3.13-1) and meet the fracture toughness criteria of 10 CFR 50, Appendix G (Reference 3.13-5). These requirements apply to ferritic materials for bolting and other types of fasteners with specified minimum yield strengths below 130 ksi.

The following fracture toughness criteria apply to ASME Code, Section III (Reference 3.13-1), Class 1, 2, and 3 bolting materials (see Table 3.13-1):

- Material to be impact tested: NB-2311, NC-2311, and ND-2311 state that bolting, including bolts, studs, and nuts, with a nominal size of 1 inch or less do not require impact testing. Likewise, austenitic SSs and nonferrous materials need not be impact tested. Thus, only ferritic steel bolting with a nominal size more than 1 inch requires impact testing.

- Types of impact tests: Two types of impact tests are specified under NB-2321.1 and NC-2321.1:
  - Drop Weight Tests: When required, this impact test is performed in accordance with ASTM E208. Specimen types P-Nos. 1, 2, or 3 may be used. The results, orientation, and location of all tests conducted to meet the requirements of NB-2330 are reported in the certified material test report.
  - C_v Tests: When required, this impact test is performed in accordance with SA-370 with specimens in accordance with SA-370, Figure 11, Type A. A test comprises a set of three full size 10 mm by 10 mm specimens. The lateral expansion and absorbed energy, as applicable, and the test temperature along with the orientation and location of all tests conducted to meet the requirements of NB-2330 and NC-2330 are reported in the certified material test report. In ND-2321, the C_v test, when required, is performed in accordance with SA-370 with specimens in accordance with SA-370, Figure 11, Type A. The same C_v tests and specimens cited above for NB-2321.1 and NC-2321.1 are used, and the C_v test results meeting the requirements of ND-2330 are reported in the certified material test report.

- Test Coupons: NB-2322.I, NC-2322.1, and ND-2322.1 describe the location of test specimens. Impact test specimens are removed from the locations specified for tensile test specimens in the material specification. For bolting, the C_v impact test specimens are taken with the longitudinal axis of the specimens located at least one-half radius or 1 inch below the surface plus the machining allowance per side, whichever is less. The fracture plane of the specimens is at least one diameter or thickness from the heat-treated end. When the bolts, studs, or nuts are not sufficiently long, the mid-length of the specimen is at the mid-length of the fastener components. The bolts, studs, or nuts chosen to provide test coupon material are identical regarding the quenched contour and size except for length, which is equal to or exceeds the length of the selected fastener components. NB-2322.2 (orientation of impact test specimens) specifies that specimens obtained from bolting material for C_v impact testing shall be oriented in the axial direction. The notch of the C_v material is normal to the material surface for ASME Code Class 1, 2, and 3. NC-2322.2 (orientation of impact test specimens) specifies that specimens for C_v impact tests is oriented as required in NC-2200 for the tensile test specimen, or the orientation may be in the direction of maximum stress. ND-2321 covers only C_v impact test procedures, not drop weight impact tests, and has similar requirements for the C_v testing, ND-2322.1 for test coupon location, and ND-2322.2 for specimen orientation as the above two sections.

- Acceptance Standards: NB-2333 (bolting material) specifies that for bolts, studs, and nuts, three C_v specimens are tested at a temperature no higher than the preload temperature or the lowest service temperature, whichever is less. All three specimens meet the requirements of Table NB-2333-1, which lists the required lateral expansion and absorbed energy as a function of the nominal diameter of the bolting material. In NC-233~~2~~2.3 and ND-2333 for bolting material, the C_v tests are performed at or below the lowest service temperature, and all three specimens are to meet the requirements of Table NC-2332.3-1 and Table ND-2333-1, respectively.

- Number of Impact Tests Required: NB-2345, NC-2345, and ND-2345 state that one test is made for each lot of material, where a lot is defined as one heat of material that is heat treated in one charge or as one continuous operation, not to exceed certain weights (mass), as a function of the bolting diameter.
- Retesting (NB-2350, NC-2352, ND-2352): For C_v tests required by NB-2333, NC-2332.3, and ND-2333, one retest at the same temperature may be conducted provided the requirements of the following are met:
  - The average value of the test results meets the minimum requirements.
  - No more than one specimen per test is below the minimum requirements.
  - The specimen not meeting the minimum requirements is not less than 10 ft-lb or 5 mils below the specified requirements. A retest comprises two additional specimens taken as near as feasible to the failed specimens. To accept the retest, both specimens shall meet the minimum requirements.
- Calibration of the Test Equipment: NB-2360, NC-2360, and ND-2360 state that calibration of temperature instruments and C_v impact test machines used in impact testing are performed at the following frequency:
  - Temperature instruments used to control test temperatures of specimens are calibrated and the results recorded in accordance with NCA-3858.2 at least once every three months.
  - C_v impact test machines are calibrated and the results recorded in accordance with NCA-3858.2 requirements. Such calibrations are conducted using the methods and frequency described in ASTM E23 and using standard specimens obtained from the National Institute of Standards and Technology (NIST).

For Fabrication Inspection/Examination Criteria for Bolts, Studs, and Nuts (Table 3.13-1), ASME Code, Section III (Reference 3.13-1) Class 1 bolting material (bolts, studs, and nuts) specifies the following inspection methods for Class 1 fastener components in accordance with NB-2580:

- Required Examinations: NB-2581 requires that all bolting material be visually examined in accordance with NB-2582. Nominal sizes over 1 inch are generally examined by the magnetic particle examination method (MT) for carbon steel and HSLA steels, and the liquid penetrant examination method (PT) for SS. Also, nominal sizes above 2 inches but not over 4 inches are examined by the ultrasonic examination method (UT) in accordance with NB-2585, and nominal sizes greater than 4 inches are examined by UT in accordance with NB-2586. NB-2582 (visual examination) requires that the areas of threads, shanks, and heads of final machined parts be visually examined. Harmful defects or discontinuities such as laps, seams, or cracks that would be detrimental to the intended service are unacceptable. NB-2583: MT of ferritic steel bolting material are performed in accordance with ASTM A275. Alternately, PT of ferritic steel bolting may be performed in accordance with NB-2584, if desired. Either nondestructive examination (NDE) method should be performed on the finished bolting, or on the materials stock at approximately the finished diameter before threading and after heading (if done), and performed on all accessible surfaces.

Under evaluation of indications, the ASME Code specifies that all ~~non~~linear, nonaxial indications are unacceptable, regardless of length. These same acceptance standards apply to examination of bolting above 1 inch nominal bolt size by the PT in accordance with ASME Code, Section V, Article 6 (Reference 3.13-12), under NB-2584.

- UT Examination of Bolting: As described in Section 5.3.1.7, material for stud bolts, nuts and washers are UT examined in accordance with ASME Code Section III (Reference 3.13-1), NB-2580, after final heat treatment but prior to machining of threads. The stud bolt surfaces are to be examined by straight beam UT examinations in two directions in accordance with ASME Code, Section III (Reference 3.13-1), NB-2585, and ASME Code Section V, Article 23, SA 388. Surface examinations are to be performed in accordance with ASME Code Section III (Reference 3.13-1), NB-2583. NB-2585 covers UT of bolting over 2 inches nominal bolt size in which the entire cylindrical surface prior to threading is examined in accordance with SA-388 of Section V, Article 23. Any discontinuity that causes an indication over 20% of the height of the first back reflection or that prevents the production of a first back reflection of 50% of the calibration amplitude is unacceptable. NB-2586 covers UT of bolting above 4 inches nominal bolt size where such bolting is examined over the entire surface of each end before or after threading by the straight beam, longitudinal scan method. Any discontinuity that causes an indication in excess of that produced by the calibration hole in the reference specimen as corrected by the distance-amplitude curve is unacceptable. Acceptance examination of bolting are performed after the final heat treatment required by the basic material specification. Unacceptable surface defects on finished bolting (bolts, studs, and nuts) are not allowed and are cause for rejection. Weld repairs of bolting are not permitted.
- Examination Criteria for ASME Class 2 and 3 Bolting: For Class 2 and Class 3 bolting materials, only visual examination of bolts, studs, and nuts is required in accordance with NC-2581 and ND-2582. According to NC-2582 and ND-2582, such visual examinations are made on the areas of threads, shanks, and heads of final machined parts. Harmful defects and discontinuities such as laps, seams, or cracks that would be detrimental to the intended service are unacceptable.

3.13.1.4 [Reserved]

3.13.1.5 Certified Material Test Reports

The COL Applicant is to retain quality records including certified material test reports for all property test and analytical work performed on nuclear threaded fasteners in accordance with the requirements of 10 CFR 50.71 (Reference 3.13-13) (Maintenance of Records, Making of Reports). The results of bolting material chemical analyses,

3.13.3 References

3.13-1 ASME Boiler and Pressure Vessel Code, Section III. 2001 Edition through the 2003 Addenda, American Society of Mechanical Engineers.

3.13-2 Threaded Fasteners - ASME Code Class 1, 2, and 3. NUREG-0800 Standard Review Plan (SRP), Section 3.13, U.S. Nuclear Regulatory Commission, Washington, D.C., March, 2007.

3.13-3 ASME Boiler and Pressure Vessel Code, Section II. 2001 Edition through the 2003 Addenda, American Society of Mechanical Engineers.

3.13-4 Materials and Inspections for Reactor Vessel Closure Studs. Regulatory Guide 1.65, U.S. Nuclear Regulatory Commission, Washington, D.C., October 1973.

3.13-5 Fracture Toughness Requirements, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix G, U.S. Nuclear Regulatory Commission, Washington, D.C.

3.13-6 Good Bolting Practices – A Reference Manual for Nuclear Power Plant Maintenance Personnel, Large Bolt Manual. Electric Power Research Institute, NP-5067, Volume I, 1987.

3.13-7 Good Bolting Practices – A Reference Manual for Nuclear Power Plant Maintenance Personnel, Small Bolt Manual. Electric Power Research Institute, NP-5067, Volume II, 1990.

3.13-8 Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants. NUREG-1339, U.S. Nuclear Regulatory Commission, Washington, DC, June, 1990.

3.13-9 Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants. Regulatory Guide 1.37, Rev.1, March, 2007.

3.13-10 ~~Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants, ANSI N45.2.1, American National Standards Institute, 1973.~~ Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components for Nuclear Power Plants, ASME NQA-1-1994, Part II, Subpart 2.1, American Society of Mechanical Engineers, 1994.

3.13-11 Codes and Standards, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50.55a, U.S. Nuclear Regulatory Commission, Washington, D.C.

3.13-12 Nondestructive Examination, ASME Code, Section V, 2001 Edition through the 2003 Addenda, American Society of Mechanical Engineers.

3.13-13 Maintenance of Records, Making of Reports, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50.71, U.S. Nuclear Regulatory Commission, Washington, D.C.

3.13-14 Rules for Inservice Inspection of Nuclear Power Plant Components, ASME Code, Section XI, 2001 Edition through the 2003 Addenda, American Society of Mechanical Engineers.

Table 3.13-1 ASME Code, Section III Criteria for Selection and Testing of Bolting Materials[1]

Code Category		ASME Class 1 Criteria	ASME Class 2 Criteria	ASME Class 3 Criteria
Material Selection		NCA-1220 and NB-2128	NCA-1220 and NC-2128	NCA-1220 and ND-2128
Material Test Coupons and Specimens for Ferritic Steel Material (Tensile Test Criteria)	Heat Treatment Criteria	NB-2210	NC-2210	ND-2210
	Test Coupons Requirements Bolting/Stud Materials	NB-2221 NB-2224 ~~.3~~	NC-2221 NC-2224.3	ND-2221 ND-2224.3
Fracture Toughness Requirements	Material to be Impact Tested	NB-2311	NC-2311	ND-2311
	Types of Impact Test	NB-2321	NC-2321	ND-2321
	Test Coupons	NB-2322	NC-2322	ND-2322
	Acceptance Standards	NB-2333	NC-2332.3	ND-2333
	Number of Impact Tests Necessary	NB-2345	NC-2345	ND-2345
	Retesting	NB-2350	NC-2352	ND-2352
	Calibration of Test Equipment	NB-2360	NC-2360	ND-2360
Examination Criteria for Bolts, Studs, and Nuts		NB-2580	NC-2580	ND-2580
Certified Material Test Report Criteria		NCA-3860	NCA-3860	NCA-3860

Note :

1. Section III paragraphs listed in this table represent those specified in the 2001 Edition of Section III.

show that proper heat treatment has been performed. The surface Brinell hardness shall be ~~min.~~ minimum 302 HB to ~~max.~~ maximum 388 ~~311~~ HB.

NDE are carried out in accordance with ASME Code Section III requirements. Material for stud bolts, nuts and washers are ultrasonically examined in accordance with ASME Code Section III NB-2580, after final heat treatment but prior to machining of the threads. NDE procedures prepared for use are considered to be fully adequate to ensure proper material quality, based on compliance with the applicable requirements of ASME Code Section III NB-2580.

The stud bolt surfaces are examined by straight beam ultrasonic examinations in two directions, in accordance with ASME Code Section III and SA-388. Surface examinations are carried out in accordance with ASME Code Section III NB-2583 after final heat treatment and threading.

For removal of the reactor vessel closure head during refueling, the reactor vessel stud bolts, nuts, and washers are removed from the closure head and placed in storage racks. The storage racks are then removed from the refueling cavity and stored in a specified location on the containment operating deck. As an alternative, the studs bolts, nuts, and washers may be lifted out of the stud bolt holes of the reactor vessel closure head and a support collar inserted into place, after which the head assembly is removed. In this case, the stud bolts, nuts, and washers are lifted and stored with the reactor vessel closure head. In either of the methods, the stud bolts are not exposed to the refueling cavity water.

Closure plugs are used to seal the stud holes in the vessel flange before removing the reactor vessel closure head, preventing refueling water from entering the stud holes.

Manganese base phosphate surfacing treatment is also applied to the surfaces of the stud bolts for added protection against the possibility of corrosion.

Typical lubricants applied for the reactor vessel stud bolts include Fel-Pro N-5000. Detailed discussions concerning lubricants for ASME Code Class 1 threaded fasteners are provided in Section 3.13.

5.3.2 Pressure-Temperature Limits, Pressurized Thermal Shock, and Charpy Upper Shelf Energy Data and Analyses

The following regulatory requirements concerning P-T limits on the reactor vessel pressure boundary are considered.

- 10 CFR 50.55a (Ref. 5.3-1): structure, system, and component (SSC) are to be designed, fabricated, erected, constructed, tested and inspected to quality standards appropriate to the importance of the safety function to be performed.
- 10 CFR 50.60 (Ref. 5.3-2): compliance with the requirements of 10 CFR 50 Appendices G and H.
- 10 CFR 50.61 (Ref. 5.3-3): satisfy fracture toughness criteria relevant to pressurized thermal shock (PTS) events.