OVERVIEW GUIDE

2023 ASME boiler & pressure vessel code changes

As a globally recognised standard for the construction of pressure vessels, piping and components for nuclear facilities, the ASME Boiler and Pressure Vessel Code (BPVC) is updated and released every 2 years.

You must ensure that the changes are reviewed to verify your pressure equipment is safe and compliant. As an ASME accredited Authorised Inspection Agency, LRQA has compiled a summary of the changes in several BPVC code books to help you understand what has changed that is relevant to your business.

Key dates:

- **Release date 01 July 2023**
- **Becomes mandatory on 01 January 2024**

Key changes

Key changes to Section I – Rules for construction of power boilers

- Tables PG-67.5 & PG-67.5M have been expanded and revised for the Super-critical (Ksc) capacity correction factors in determining the rated relieving capacity of Pressure Relief Devices.
- PW-28.1.3 has been revised to permit simultaneous qualification of weld procedures by more than one organisation.
- The y factor table in PG-27.4.6 has been revised to make it consistent with Section II-D T-Notes.
- PW-39.2 has been revised to address the use of buttering welds without PWHT of both materials.
- Form P-4 has been revised to include a section for documenting BEP under qualifying conditions.
- Tables PG-67.5, PG-67.5M, PG-68.7, and PG-68.7M have been relocated to an appendix to improve the readability of overpressure protection requirements.

Key changes to Section II – Materials, part A, ferrous material specifications

- Over 60 specifications have been updated to the latest adopted edition.
- Two new specifications have been added:
  - SA-439/439M Specification for Austenitic Ductile Iron Castings
  - SA-1058/1058M Standard Test Methods for Mechanical Testing of Steel Products – Metric
- Two specifications have been removed:
  - SA-557/SA-557M Specification for Electric-Resistance-Welded Carbon Steel Feedwater Heater Tubes
  - SA-731/SA731M Specification for Seamless, Welded Ferritic, and Martensitic Stainless Steel Pipe
- A new statement of policy on the use of ASME material specifications has been added.
- Mandatory Appendix II has been completely rewritten and retitled to “The Framework of ASME Material Specifications”.

Key changes to Section II – Materials, part B, nonferrous material specifications

- Over 25 specifications have been updated to the latest adopted edition.
- The range of acceptable ASTM editions has been updated for a number of specifications.
- A new statement of policy on the use of ASME material specifications has been added.
- Mandatory Appendix II has been completely rewritten and retitled to “The Framework of ASME Material Specifications”.

Key changes to Section II – Materials, part C, specifications for welding rods, electrodes, and filler metals

- 14 AWS specifications for arc welding electrodes, gas welding rods and other filler metals were adopted or updated into the 2023 edition:

SFA-5.5/SFA-5.5M, SFA-5.9/SFA-5.9M, SFA-5.10/SFA-5.10M, SFA5.13/SFA-5.13M, SFA-5.16/SFA-5.16M, SFA-5.18/SFA-5.18M, SFA5.20/SFA-5.20M, SFA-5.23/SFA-5.23M, SFA-5.24/SFA-5.24M, SFA5.28/SFA-5.28M, SFA-5.29/SFA-5.29M, SFA-5.30/SFA-5.30M, SFA5.31/SFA-5.31M, SFA-5.32/SFA-5.32M.

Key changes to Section II – Materials, part D, properties (customary, metric)

- Code cases 2577, 2586-1, 2591, 2633, 2687-1, 2849, 2903, 2923 have been incorporated.
- Additions and revisions to stress tables and mechanical property tables have been made to support updated specifications.
- SA-283 Grade A and Grade B lines have been removed.
- Type/Grade column has been added to Tables 2B and 5B, and many values have been populated.

Key changes to Section III – Rules for construction of nuclear facility components, subsection NCA, general requirements for division 1 and division 2

- NCA-3000 and 5000 have been updated to permit the use of newly published Section XI, Division 2, Requirements for Reliability and Integrity Management (RIM) Programs for Nuclear Reactor Facilities, as a basis for designing for in service monitoring and nondestructive examination (NDE).
- Table NCA-7100-2 has been updated to align with revisions made to Table NCA-7100-1. Updates to the table include the identification of other acceptable editions and applicable subsections for listed referenced standards.

Key changes to Section III – Rules for construction of nuclear facility components, appendices

- Mandatory Appendices XI, XII, and L have been revised to extend the applicability to Section III, Division 5, Subsection HC, Subpart B.
- Mandatory Appendix XIII-1223 has been revised and updated to address the International Engineering Alliance and the European Federation of National Engineering Associations concerning the Certifying Engineer.
- Mandatory Appendix XXVIII was developed to allow for the usage of Powdered Metal/Hot Isostatic Pressing (PM/HIP) advance manufacturing for the production of items made from 316L SS as one Process Method.
- Nonmandatory Appendix G-2223 has been revised to clarify toughness requirements for nozzles and to provide methods that may be used for external loads, thermal loads, and internal pressure, as currently addressed.
- Mandatory Appendix XXVI has been revised and updated to include sidewall fusion, fittings, volumetric examination, and Code Case N-891.

Key changes to Section III – Rules for construction of nuclear facility components, subsection NB, class 1 components

- NB-2121(a) has been revised to permit the use of advanced manufacturing. This revision is to permit use of advanced manufacturing product forms not included in Section II, Part D, Subpart 1, Tables 2A, 2B, or Article NB-2000, provided that the product form meets the requirements of Mandatory Appendix XXVIII.
- NB-2321.2 has been revised to remove the requirement to use full-size test specimens, and test-specimen requirements were adjusted to be in accordance with SA-370.
- NB-5000 has been updated to permit the use of newly published Section XI, Division 2, Requirements for Reliability and Integrity Management (RIM) Programs for Nuclear Reactor Facilities, as a basis for designing for inservice monitoring and nondestructive examination (NDE).
- NB-5540 has been developed to permit the use of CP-189 as an acceptable NDE personnel qualification standard. Section III previously required qualification of examiners only to SNT-TC-1A, while Section XI requires personnel qualification per CP-189.

Key changes to Section III – Rules for construction of nuclear facility components, subsection NCD, class 2 and class 3 components

- NCD-2121(a) has been revised to permit the use of advanced manufacturing. This revision is to permit the use of advanced manufacturing product forms not included in Section II, Part D, Subpart 1, Tables 2A, 2B, or Article NCD-2000, provided the product form meets the requirements of Mandatory Appendix XXVIII.
- NCD-2321.2 has been revised to remove the requirement to use full-size test specimens, and test-specimen requirements were adjusted to be in accordance with SA-370.
- NCD-3124 has been updated to permit the use of Section XI, Division 2, Requirements for Reliability and Integrity Management (RIM) Programs for Nuclear Reactor Facilities, as a basis for designing for inservice monitoring and nondestructive examination (NDE).
- NCD-5540 has been developed to permit the use of CP-189 as an acceptable NDE personnel qualification standard. Section III, previously required qualification of examiners only to SNT-TC-1A, while Section XI, requires personnel qualification per CP-189.

Key changes to Section III – Rules for construction of nuclear facility components, subsection NE, class mc components

- NE-2321.2 has been revised to remove the requirement to use full-size test specimens, and test-specimen requirements were adjusted to be in accordance with SA-370.
- NE-3125 has been updated to permit the use of Section XI, Division 2, Requirements for Reliability and Integrity Management (RIM) Programs for Nuclear Reactor Facilities, as a basis for designing for inservice monitoring and nondestructive examination (NDE).
- NE-5540 has been developed to permit the use of CP-189 as an acceptable NDE personnel qualification standard. Section III, previously required qualification of examiners only to SNT-TC-1A, while Section XI, requires personnel qualification per CP-189.

Key changes to Section III – Rules for construction of nuclear facility components, subsection NF, supports

- NF-1000, NF -2000, NF -3000, Table NF-D, and Appendix NF-E have been revised for the addition of requirements for energy absorbers. Energy absorbing devices have not been fully defined prior to the noted revision.
- NF-2321.2 has been revised to remove the requirement to use full-size test specimens, and test-specimen requirements were adjusted to be in accordance with SA-370.
- NF-3300 has been revised to reflect applicable requirements, for austenitic stainless-steel design, found in AISC Design Guide 27.
- NF-5540 has been developed to permit the use of CP-189 as an acceptable nondestructive examination (NDE) personnel qualification standard. Section III, previously required qualification of examiners only to SNT-TC-1A, while Section XI, requires personnel qualification per CP-189.

Key changes to Section III – Rules for construction of nuclear facility components, subsection NG, core support structures

- G-2321.2 has been revised to remove the requirement to use full-size test specimens, and test-specimen requirements were adjusted to be in accordance with SA-370.
- NG-3200 and 3220 have been revised to facilitate merging primary stress limits, special stress limits, Level C and Level D limits, limit analysis, and experimental analysis into Section III, Appendix XIII-3000.
- NG-5540 has been developed to permit the use of CP-189 as an acceptable nondestructive examination (NDE) personnel qualification standard. Section III, previously required qualification of examiners only to SNT-TC-1A, while Section XI, requires personnel qualification per CP-189.

Key changes to Section III – Rules for construction of nuclear facility components, division 2, code for concrete containments

- CC-2331.2, CC-3532.1.7, Table CC-4333-1, and Table D2-VIII-1410-1's requirements, related to ASTM A615-20, have been updated to align with the current material requirements and grade options listed in the most current ASTM standard.
- CC-2466.2, now includes a "Note" to clarify what constitutes a change in heat treatment conditions when pre-stressing element materials.
- CC-2522.1.2 has been revised to remove the requirement to use full-size test specimens, and test-specimen requirements were adjusted to be in accordance with SA-370.

Key changes to Section III – Rules for construction of nuclear facility components, division 3, containment systems for transportation and storage of spent nuclear fuel and high-level radioactive material

WB-2321.2, WC-2321.2, and WD-2321.2 have been revised to remove the requirement to use full-size test specimens, and test-specimen requirements were adjusted to be in accordance with SA-370.

Key changes to Section III – Rules for construction of nuclear facility components, division 4, fusion energy devices

This is the first edition of BPVC Section III Division 4. It is expected that the global fusion community will continue to develop these requirements based on lessons learned from the evolution of fusion-power technologies and experiences.

Key changes to Section III – Rules for construction of nuclear facility components, division 5, high temperature reactors

- Table HBB-3225-4 was revised to extend the thermal aging factor for Class A, Grade 91 components from 300,000 to 500,000 hours.
- Mandatory Appendix HBB-I-14 Tables were revised to extend stress rupture factor values for Grade 91 from 300,000 to 500,000 hours.
- HBB-T-1800 was revised to extend isochronous stress-strain curves for Grade 91 components from 300,000 to 500,000.
- HHA-3142 and HHB-3142 have been revised to remove EDN (damage dose unit) and only use dpa (displacements per atom) damage dose unit.
- Nonmandatory Appendix HBB-Z added to provide guidance on constructing a suitable inelastic model from data and to offer designers an acceptable reference model for Grade 91.
- Nonmandatory Appendices HHB-D and HHB-E have been developed to cover Carbon-Carbon (C-C) Ceramic Matrix Composites.

Key changes to Section IV – Rules for construction of heating boilers

- HG-715, HG-803, HLW-810, HLW-902, HLW-903, HLW-904, & HLW-906 were revised to support the proposed drain valve language in HG803.2(c)(3) and HG-803.3(c)(2), in order to align with the requirements in Code Cases 2873 and 2983, so they can be incorporated into the Section IV code.
- Section IV, Table 2-100, now references the "latest edition" of the CA-1 Standard for Conformity Assessment Requirements, since Section 5.4, in the 2020 Edition of CA-1, incorporated requirements for reapplication of the ASME Single Certification Mark.
- A provision was added to HLW-602 and HG-531 for the removal of a nameplate or marking of a "Part" when incorporating the Part into a boiler that is to be certified.

Key changes to Section V – Nondestructive examination

- Article 1, T-120(e) has been modified to include exceptions made to SNT-TC-1A and CP-189. This eliminated the need for Mandatory Appendices III & IV, which were removed.
- A new Mandatory Appendix for Article 12 on the evaluation of the sensitivity of an acoustic emission instrumentation has been added.
- New requirements for the use of TOFD without the supplemental scan of near-surface has been added.
- Article 9, para. T-953, Remote Visual, to accommodate deployment mechanisms like unmanned aircraft vehicles and systems has been revised.
- Adopted updated ASTM Specifications documents: ASTM E273- 2020, E999-2020, E1030-2021, E1114-2020, E1165-2020, E2491- 2013(R2018), E213-2022, A745-2020, E2491-2018, E2700-2020, D7091-2021, E243-2018, E797-2021, E976-2021, E1067-2018, E1118- 2020, E1419-00, E2075-2020, and E2261-2021.

Key changes to Section VI – Recommended rules for the care and operation of heating boilers

- The definition of relief valve to Article 2 so it was consistent with BPVC XIII has been added.
- Added clauses to para. 6.4 "Pressure Relief Valve Discharge Piping" to align with similar changes made to BPVC IV, para. HG-716.6, along with the creation of BPVC XIII, Section 12.8.

Key changes to Section VII – Recommended guidelines for the care of power boilers

New section 103.1.4 added to include operational information for changeover valves.

Key changes to Section VIII – Rules for construction of pressure Vessels, division 1

- Added a new paragraph UG-84(d)(3) to clarify the impact test requirements for diffusion welding (DFW).
- Paragraph UG-101(a)(5) was added to address sharing of proof testing reports between manufacturers owned by the same entity.
- Part UHX has been realigned and revised for consistency between the heat exchanger types. The shell and channel coefficients have been revised to be based on the mean diameter instead of the inside diameter, which is consistent with PTB-7.
- Part UHX and Appendix 26 design rules, which are identical to Part 4.18 and 4.19 of Division 2, have been removed and point to Part 4.18 and 4.19 when appropriate. This will enable identical requirements for all heat exchangers, resulting in easier maintenance through one set of rules.
- Revised the “PRT” designator to “PRT VIII-1” throughout Section VIII, Division 1.

Key changes to Section VIII – Rules for construction of pressure vessels, division 2, alternative rules

- Part 2 has been revised to remove Certifying Engineers for Class 2 Design-byRule (DBR) applications. This action will eliminate conflicts with international engineering registration requirements for the majority of applications.
- Part 4.18 has been realigned and revised for consistency between the heat exchanger types. The shell and channel coefficients have been revised and are now based on the mean diameter instead of the inside diameter, which is consistent with PTB-7.
- Paragraph 4.2.5.7, Category F, Locations, has been added in order to assign a common joint category to tube-to-tube sheet welds.
- Paragraph 5.4, Protection against failure from buckling, has been completely re-written and a new table of load cases, Table 5.8, has been added.
- Paragraph 5.5.2.4 and Table 5.10 have been revised and now provide a quick and simple method to screen components in cyclic service, eliminating the need for a full-fatigue analysis.
- Revised the “PRT” designator to “PRT VIII-1” throughout Section VIII, Division 2.

Key changes to section VIII – rules for construction of pressure vessels, division 3, alternative rules for construction of high pressure vessels

- In KD-430, the minimum Delta Kth for the calculation of crack growth rates now includes Carbon and low-alloy steels with Sy less than or equal to 90ksi (620MPa).
- KD-322 provides additional clarity on the logarithmic interpolation between tabular values for individual design curves in Figures KD-320.1, KD320.1M, KD-320.2, and KD-320.2M. This new edition allows for linear interpolation for an intermediate ultimate tensile strength.
- KM-270 now includes the notch tensile-strength test along with the calculation of the notch strength ratio.
- KM-234.1 (b) has been revised to lower the minimum-design-metal temperature for all materials that are not fully austenitic stainless steels.
- KG-310, KG-311, and KG-323, along with KD-740 were revised to support manufactures seeking to use a single user's design specification for the production of vessel designs intended for use across multiple jurisdictions.

Key changes to section IX – welding, brazing, and fusing qualifications

- QG-108 has been revised to remove the 1962 provision and clarify the status of old PQRs when writing a WPS to a later edition.
- Definition of "initial heating interfacial pressure" was added to QG109.2 and previous omissions of "sidewall-fusing" was added to pertinent definitions within QG-109.2.
- Table QW-264 has a new requirement that includes carbon equivalent limits for applicable steel alloys, when laser welding is performed, in order to address the increased risk of any cracks occurring.
- A new paragraph in QW-403 also includes the new variable for a change in base metals.
- Table QW/QB-422 has been revised to include:
  - Weld metals based on SFA classification: SFA-5.9, SFA-5.18, & SFA-5.28
  - An explanatory note-QW-424.3
  - Base metal specification and grades for IRAM-IAS U 500-42, an Argentinian standard for structural use of hot rolled carbon steel sheets
- Nonmandatory Appendix L has been revised to further clarify the qualification requirements for welders and welding operators.

Key changes to section X – fiber-reinforced plastic pressure vessels

- Clarified service life requirements for Class III vessels, in 8-100.6, to indicate that the service life for glass fiber reinforced vessels is limited to 20 years, but the maximum service life is not limited for carbon fiber reinforced vessels.
- In 8-700.5.8, other leak test methods for Class III vessels that may be more reasonable and cost effective, but still yields satisfactory results, based on experience to date, are now permitted.

Key changes to section XI – rules for inservice inspection of nuclear reactor facility components, division 1, rules for inspection and testing of components of light-water-cooled plants

- IWB-2200(b) and IWC-2200(b) have been revised to indicate that Construction Code examinations may be credited for Section XI, Preservice Examination Credit, and that these examinations may be performed by personnel that are qualified in accordance with Section XI or the Construction Code, which may be different than Section III.
- IWL-2330 has been revised to address the use of the term Registered Professional Engineer (RPE). In addition, the Responsible Engineer requirements are now applicable to plants located outside of the United States and Canada.
- Mandatory Appendix Supplement 1 has been revised to allow use of calibration blocks fabricated from similar chemical analysis, tensile strength, and metallurgical structure.
- Mandatory Appendix VIII, Supplements 2, 4, 5, 8, 10, 11, 14, and 15 have been revised. The requirement for "specimen identification" and "identification" to be obscured or concealed to maintain a blind test has been removed.

Key changes to section XI – Rules for inservice inspection of nuclear reactor facility components, division 2, requirements for reliability and integrity management (rim) programs for nuclear reactor facilities

- The title and contents of Section XI, Division 2 have been revised to replace the term "Power Plant" with "Facility" to signify the use of the Code for nuclear facilities in addition to power plants.
- IV-1.3.2.2(d) has been revised to clarify how many nondestructive examination (NDE) Level IIIs are required for monitoring and non-destructive examination (MANDE), and what the NDE Level III requirements are in order to be certified for NDE methods and techniques.
- RIM-1.2 has been revised and now requires that the same edition of Section XI, Division 1 must be used when referenced in Section XI, Division 2.
- RIM-2.7.3 has been revised to include any MANDE methods approved by the monitoring and non-destructive examination panel (MANDEEP) for creating a pre-service baseline.
- RIM-4.2.4 has been revised to clarify when NDE volumetric and surface examinations may be used, when leakage testing is not applicable after a repair/replacement activity.

Key changes to section XII – Rules for construction and continued service of transport tanks

- TG-110.2(a) has been revised from 3,000 to 2,000 psig to align with the upper limit in Modal Appendix 4.
- Paragraph TD-320 has been added to address quick actuating devices. It will reference Section VIII, Division 1, UG-35.2 and Nonmandatory Appendix FF.
- TOP-170(a) has been revised to outline that the pressure relief device shall communicate with the vapor space of the vessel, and the requirement for 450 L (120 gal) has been removed since it is no longer applicable.
- Model Appendix 1, Article 2, Paragraph 1-2.1(c) has been revised to correct the minimum set pressure to 110% of MAWP or 3.3 psi, whichever is greater.
- TS-110(a), TS-200, Form T-2A, Forms T-2B, Form T-2C, and Nonmandatory Appendix D, item 1, item 3, and Note 1 have been revised to change PRT to XII PRT to match the designator shown in CA-1-2020, Table 1.1-1.
- Nonmandatory Appendix E-6(o) has been revised to change the required minimum melting point of brazing material from 525C (977F) to 538C (1000F). Nonmandatory Appendix E-6(p) was added. This new section requires pipe joints to be threaded, welded, or flanged.

Key changes to section XII – Rules for overpressure protection

- In Para 3.3.2, Seat and Disks, the meaning of the term steam cutting has been elaborated on.
- In Para 3.4.2.3, Test Results, guidance was provided on what to do when valves cannot be adjusted to meet blowdown performance, per Table 3.4.2.3-1.
- In Part 3, Section 3.5, Part 4, Section 4.2 and Section 1-2, definitions for assembler and manufacturer were revised for clarity and any requirements have been moved to the body of the standard.
- In Section 3.6 and Table 3.6, set pressure tolerance of –0% +10% has been added to Table 3.6.1.1-2 for UV valves when the sole source of overpressure is exposure to fire or heat.
- In 3.6.4, Seat Tightness Test, water and gas test media have been generalized to incompressible and compressible fluids.

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Visit **www.lrqa.com/uk** for more information, email **ukinspection@lrqa.com** or call **+44 (0)121 817 4300**

LRQA
1 Trinity Park
Bickenhill Lane
Birmingham
B37 7ES
United Kingdom