
**Supplement No. 2 to the
Specification for the Design, Fabrication, and Erection of
Steel Safety-Related Structures for Nuclear Facilities**
(ANSI/AISC N690-1994(R2004))

Supersedes Supplement No. 1 to the
*AISC Specification for the Design, Fabrication, and Erection
of Steel Safety-Related Structures for Nuclear Facilities*,
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October 6, 2004

Page 1

Q1.0.1 SCOPE

Revise Item 5 as follows:

5. A quality assurance program covering nuclear safety-related steel structures shall be developed prior to starting any work. The general requirements and guidelines for establishing and executing the quality assurance program during the design and construction phases of nuclear facilities are those established by Title 10 of the Code of Federal Regulations, Part 50 (10CFR50) Appendix B for Nuclear Power Stations and Independent Spent Fuel for Commercial Reactors Storage Facilities or Part 830.120 (10CFR830.120) for applicable U.S. Department of Energy Nuclear Facilities.

Add the following to the end of this section:

This Specification includes the list of symbols and the appendices.

Single angle members shall comply with the *Specification for Allowable Stress Design of Single-Angle Members* and with this Specification.

The design of structural joints shall comply with the *Specification for Structural Joints Using ASTM A325 or A490 Bolts* (Research Council on Structural Connections) and the *Structural Welding Code-Steel* (AWS D1.1), and with this specification.

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Q1.0.2 DEFINITIONS

Replace the definition for Secondary Stress with the following:

Secondary Stress

Secondary stress is a stress developed by the self-constraint of a structure rather than from external loads. It must satisfy an imposed strain pattern. The basic characteristic of a secondary stress is that it is self-limiting. Examples of secondary stresses are effects arising from contraction or expansion resulting from one or more of the following:

- Temperature changes
- Shrinkage, moisture changes, or creep in concrete for composite construction
- Movement due to differential settlement
- Variation from the assumed connection restraint

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Q1.0.3 REFERENCED CODES AND STANDARDS

Replace this section with the following:

The following documents are referenced in this Specification. Whenever referenced, the documents by date of issue indicated in this section apply.

ASTM A6/A6M-01	ASTM A20/A20M-01
ASTM A27/A27M-95(2000)	ASTM A36/A36M-00
ASTM A53/A53M-01	ASTM A106-99e1
ASTM A148/A148M-01	ASTM A167-99
ASTM A193/A193M-01	ASTM A194/A194M-01
ASTM A216/A216M-93(1998)	ASTM A217/A217M-99
ASTM A240/A240M-01	ASTM A242/A242M-00a
ASTM A276-00a	ASTM A307-00
ASTM A312/A312M-00c	ASTM A320/A320M-01
ASTM A325-00	ASTM A354-00a
ASTM A449-00	ASTM A479/A479M-00
ASTM A490-00	ASTM A500-01
ASTM A501-01	ASTM A514/A514M-00a
ASTM A515/A515M-92(1997)	ASTMA516/A516M-90(2001)
ASTM A529/A529M-01	ASTM A540/A540M-00
ASTM A563-00	ASTM A564/A564M-01
ASTM A568/A568M-00b	ASTM A572/A572M-00a
ASTM A588/A588M-00a	ASTM A606-01
ASTM A607-98	ASTM A618-01
ASTM A668/A668M-96e1	ASTM A709/A709M-01b
ASTM A852/A852M-01	ASTM A913/A913M-01
ASTM A992/A992M-01	ASTM A1011-01
ASTM C33-01	ASTM D3843-00
ASTM F436-93(2000)	ASTM F436M-93(2000)
ASTM F1554-99	ASTM F1852-00

American Concrete Institute, *Standard Code Requirements for Nuclear Safety-Related Concrete Structures*, ACI 349-01.

AISC *Specification for Allowable Stress Design of Single-Angle Members*, June 1, 1989.

AISC *Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design*, June 1, 1989.

AISC *Load and Resistance Factor Design Specification for Structural Steel Buildings*, December 27, 1999.

AISC *Code of Standard Practice for Steel Buildings and Bridges*, March 7, 2000.

ASME *Boiler and Pressure Vessel Code*, Section IX, QW-214, 2001.

American Welding Society, *Structural Welding Code – Steel*, D1.1:2000.

American Society of Civil Engineers, *Minimum Design Loads for Buildings and Other Structures*, ASCE 7-98.

ANSI/ASME NQA-1: *Quality Assurance Program Requirements for Nuclear Facilities*, 1992.

Research Council on Structural Connections, *Specification for Structural Joints Using ASTM A325 or A490 Bolts*, 2000.

Title 10 of the *Code of Federal Regulation*, Part 50, Appendix B, 2001.

Title 10 of the *Code of Federal Regulation*, Part 830.120 (to be used for Department of Energy Nuclear Facilities), 2001.

U.S. Nuclear Regulatory Commission Regulatory Guide 1.54, “Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants,” July 2000.

Visual Weld Acceptance Criteria for Structural Welding at Nuclear Power Plants (NCIG-01, Revision 2), Electric Power Research Institute, NP-5380, Volume 1, September 1987.

Page 7

Q1.3.6 LOAD COMBINATIONS

Add the following to this section:

When any load reduces the effects of other loads and if it can be demonstrated that the load is always present or occurs simultaneously with other loads, the corresponding coefficient for that load shall be taken as 0.90. Otherwise, the coefficient for that load shall be taken as zero.

Page 7

Insert the following new Section Q1.3.7:

Q1.3.7 COMBINED LOSS OF COOLANT AND SAFETY RELIEF DISCHARGE LOADS

In addition to the abnormal loads identified in Q1.3.5, hydrodynamic loads resulting from a postulated high-energy pipe break accident, and/or safety relief valve actuation shall be appropriately considered for steel structure components subjected to these loads. Any fluid structure interaction associated with these hydrodynamic loads and those from the postulated seismic loads shall be taken into account.

Page 8

Q1.4.1 STRUCTURAL STEEL

Add the following standard specifications:

ASTM A529/A529M	<i>High-Strength Carbon-Manganese Steel of Structural Quality</i>
ASTM A606	<i>Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance</i>
ASTM A709/A709M	<i>Structural Steel for Bridges</i>
ASTM A852/A852M	<i>Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi Minimum Yield Strength to 4-in. Thick</i>
ASTM A913/A913M	<i>High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)</i>
ASTM A992/A992M	<i>Steel for Structural Shapes for Use in Building Framing</i>

Add the following to the end of this section:

Exception: Types 301, 302 and 302B of ASTM A167, martensitic stainless steel grades of ASTM A276 and Class 1 stainless steel of ASTM A607 shall not be used in welded applications.

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Q1.4.3 BOLTS AND MATERIAL FOR THREADED RODS

Add the following standard specifications:

ASTM A36/A36M	<i>Carbon Structural Steel</i>
ASTM A588/A588M	<i>High-Strength Low-Alloy Structural Steel with 50 ksi [345MPa] Minimum Yield Point to 4-in. [100 mm] Thick</i>
ASTM A193/A193M	<i>Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service</i>
ASTM A194/A194M	<i>Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both</i>
ASTM F436	<i>Hardened Steel Washers</i>
ASTM F436M	<i>Hardened Steel Washers [Metric]</i>
ASTM F1554	<i>Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength</i>

ASTM F1852

*“Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies,
Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength*

Page 11**Q1.4.4 FILLER METAL AND FLUX FOR WELDING**

Add the following specifications of the American Welding Society:

AWS A5.23	<i>Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding</i>
AWS A5.28	<i>Specification for Low-Alloy Filler Metals for Gas Shielded Arc Welding</i>
AWS A5.29	<i>Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding</i>

Add the following to the end of this section:

For Charpy V-notch testing requirements, see Section Q1.17.1.

Page 18**Table Q1.5.2.1**

Insert the following at the bottom of the table:

A490 bolts, when threads are 54.0^d 21.0 18.0 15.0 13.0 40.0^f
excluded from shear planes

Page 20

Insert the following new Section Q1.5.3.1

Q1.5.3.1 DESIGN WALL THICKNESS OF HOLLOW STRUCTURAL SECTIONS

The design wall thickness t shall be used in calculations involving the wall thickness of hollow structural sections. The design wall thickness, t , shall be taken equal to 0.93 times the nominal wall thickness for electric-resistance-welded (ERW) HSS and equal to the nominal thickness for submerged-arc-welded (SAW) HSS.

Page 21**Q1.5.5 CONCRETE BEARING**

Revise the definition of A_1 and A_2 as follows:

A_1 = area of steel concentrically bearing on a concrete support, in.²
 A_2 = maximum area of the portion of the supporting surface that is geometrically similar to and concentric with the loaded area, in.²

Page 22**Table Q1.5.7.1**

Insert revised Table.

TABLE Q1.5.7.1
Load Combinations and Applicable Stress Limit Coefficients

Category	Load Combination ^f	Stress Limit Coefficient ^{b,h}
Normal	1. $D + L$ 2. $D + L + R_o + T_o$	1.0 ^c
Severe ⁱ	3. $D + L + W$ 4. $D + L + E_o$ 5. $D + L + W + R_o + T_o$ 6. $D + L + R_o + T_o + E_o$	1.0 ^c
Extreme	7. $D + L + R_o + T_o + W_t$ 8. $D + L + R_o + T_o + E_s$	1.6 ^{g,k}
Abnormal ^d	9. $D + L + R_a + T_a + P_a$	1.6 ^{g,k}
Abnormal ^{d,i}	9a. $D + L + T_a + P_a$	
Abnormal ^{d,e} Severe	10. $D + L + R_a + T_a + Y_r + Y_j + Y_m + E_o + P_a$	1.6 ^{g,k}
Abnormal ^{d,e} Extreme	11. $D + L + R_a + T_a + Y_r + Y_j + Y_m + E_s + P_a$	1.7 ^{g,k}

^a Coefficients are applicable to primary stress limits given in Sections Q1.5.1, Q1.5.2, Q1.5.3, Q1.5.4, Q1.5.5, Q1.6, Q1.10, and Q1.11.
^b In no instance shall the allowable stress exceed $0.7F_u$ in axial tension nor $0.7F_u$ times the ratio Z/S for tension plus bending.
^c For primary plus secondary stress, the allowable limits are increased by a factor of 1.5.
^d The maximum values of P_a , T_a , R_a , Y_j , Y_r , and Y_m , including an appropriate dynamic load factor, shall be used in load combinations 9 through 11, unless an appropriate time history analysis is performed to justify otherwise.
^e In combining loads from a postulated high-energy pipe break accident and a seismic event the SRSS (square root of the sum of the squares) may be used, provided that the responses are calculated on a linear basis.
^f All load combinations shall be checked for a no-live-load condition.
^g In load combinations 7 through 11, the stress limit coefficient in shear shall not exceed 1.4 in members and bolts.
^h Secondary stresses which are used to limit primary stresses shall be treated as primary stresses.
ⁱ Consideration shall also be given to snow and other loads as defined in ASCE 7.
^j This load combination is to be used when the global (non-transient) sustained effects of T_a are considered.
^k The stress limit coefficient where axial compression exceeds 20% of normal allowable, shall be 1.5 for load combinations 7, 8, 9, 9a, and 10 and 1.6 for load combination 11.

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Q1.5.8 DESIGN BASED ON DUCTILITY AND LOCAL EFFECTS

In subparagraph a, delete T_a from the list of load effects.

Page 23

Table Q1.5.8.1

In the title, replace “EXTREME AND ABNORMAL LOADS” with “IMPACTIVE AND IMPULSIVE LOADS”.

Add footnote “***” to Paragraph 3 heading.

Page 24

Q1.5.9.1 COMPRESSION

Revise Eqn. Q1.5-12 to the following:

$$F_a = F_y \left[0.40 - \frac{1}{600} \frac{Kl}{r} \right]$$

Page 26

Revise the last line to read:

T_b = specified pretension load in the bolt (see Table Q1.6.3.1), kips

Page 27

Add the following Table Q1.6.3.1 to this page.

TABLE Q1.6.3.1
Minimum Bolt Pretension, kips^a

Bolt Size, in.	A325 Bolts	A490 Bolts
1/2	12	15
5/8	19	24
3/4	28	35
7/8	39	49
1	51	64
1 1/8	56	80
1 1/4	71	102
1 3/8	85	121
1 1/2	103	148
^a Equal to 0.70 times the minimum tensile strength of bolts, rounded off to the nearest kip, as specified in ASTM specifications for A325 and A490 bolts with UNC threads.		

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Q1.6.3 SHEAR AND TENSION FOR BOLTS

Revise the definition for K_s as follows in sub-section 3a:

K_s = slip coefficient for the particular surface conditions taken from Table Q1.6.3.2.

Page 28

Table Q1.6.3 Slip Coefficient, K_s

Change this table heading to Table Q1.6.3.2.

Page 31

Q1.10.1 PROPORTIONS

Add the following sentence to the end of this section:

No limit is placed on the web stresses produced by the applied bending moment for which a hybrid girder is designed, except as provided in Sect. Q1.7 and Appendix QB.

Page 39

Q1.11.2.2 NON-ENCASED BEAMS USING SHEAR CONNECTORS

Delete the first paragraph on page 39.

Page 42

Q1.11.5.2 DECK RIBS ORIENTED PERPENDICULAR TO STEEL BEAM OR GIRDER

Make the existing item 4 as item 5 and add the following as item 4.

- Where there is only a single stud placed in a rib oriented perpendicular to the steel beam, the reduction factor of Equation Q1.11-7 shall be limited as follows:

$$\frac{0.85}{\sqrt{N_r}} \left(w_s / h_r \right) \left[\left(H_s / h_r \right) - 1.0 \right] \leq 0.75 \quad (\text{Q1.11-7a})$$

Page 43

Q1.13.2 PONDING

Revise the definitions in this section as follows:

S = spacing of secondary members, ft

I_p = moment of inertia of primary members, in.⁴

I_s = moment of inertia of secondary members, in.⁴

I_d = moment of inertia of the steel deck supported on secondary members, in.⁴ per ft

Add the following sentence to the 3rd paragraph of this section:

A steel deck shall be considered a secondary member when it is directly supported by the primary members.

Page 44

Q1.14.2.2 SHEAR LAG

In the 2nd paragraph, first line, delete “or rivets”.

In subparagraph a., 2nd and 3rd line, delete “or riveted”.

In subparagraph b., 3rd line, delete “or riveted”.

In subparagraph c., 1st line, delete “or riveted”.

Page 49

Q1.15.11 FIELD CONNECTIONS

Change the heading of this section to “Limitations on Bolted and Welded Connections”.

Replace entire section with the following:

Pretensioned high-strength bolts (see Table Q1.6.3.1) or welds shall be used for the following connections:

All column splices

Connections of all beams and girders to columns and of any other beams and girders on which the bracing of columns is dependent

Roof truss splices and connections of trusses to columns, column splices, column bracing, knee braces, and crane supports

Connections for supports of running machinery or of other live loads which produce impact or reversal of stress

Any other connections stipulated on the design plans.

In all other cases, connections shall be permitted to be made with high-strength bolts tightened to the snug-tight condition or with A307 bolts.

Page 50

Q1.16.1 HIGH-STRENGTH BOLTS

Replace the second and third line in the second paragraph with the following:

A449 bolts in tension and bearing-type shear connections shall have an ASTM F436 hardened washer installed under the bolt head, and the nuts shall meet the requirements of ASTM A563.

Page 50

Q1.16.2 EFFECTIVE BEARING AREA

Add the following sentence to this section:

For allowable bearing at bolt holes, see Sect. Q1.5.1.5.3.

Page 51

Q1.16.4.2 SPACING ALONG LINE OF FORCE

Replace the second line of the first paragraph with:

F_p is determined by Formulas Q1.5-7 and Q1.5-8. Otherwise, the distance between centers of holes shall not be less....

Page 51

Q1.16.5.2 SPACING ALONG LINE OF FORCE

Change heading of Section Q1.16.5.2 to EDGE DISTANCE ALONG THE LINE OF FORCE.

Replace the first paragraph with the following:

Along a line of transmitted force, in the direction of the force, the distance from the center of a standard hole to the edge of the connected part shall be not less than $1\frac{1}{2}d$ when F_p is determined from Formulas Q1.5-7 and Q1.5-8. Otherwise the edge distance shall not be less than:

Page 53

Q1.17.1 GENERAL

Replace the entire section with the following:

All provisions of AWS D1.1 apply under this specification, except that the provisions of the listed ANSI/AISC N690-1994 Specification Sections apply under this Specification in lieu of the cited AWS Code provisions as follows:

AISC Specification Section Q1.15.12 and Q1.15.13 in lieu of AWS D1.1 Section 5.17
 AISC Specification Section Q1.14.6 in lieu of AWS D1.1 Section 2.4.1.1
 AISC Specification Table Q1.5.3 in lieu of AWS D1.1 Table 2.3
 AISC Specification Table QB-2 of Appendix QB in lieu of AWS D1.1 Section 2.27.1
 AISC Specification Section Q1.7 and Appendix QB in lieu of AWS Section 2, Part C
 AISC Specification Section Q1.23.3.1 and Q1.23.3.2 in lieu of AWS Sections 5.15.1.2, 5.15.4.3 and 5.15.4.4

The length and disposition of welds, including end returns shall be indicated on the design and shop drawings.

The choice of filler metal for use with complete-joint-penetration groove welds subject to tension normal to the effective area shall comply with the requirements for matching weld metals given in AWS D1.1.

Filler metal to be used in the following joints shall be capable of depositing weld metal with a specified Charpy V-notch (CVN) toughness of 20 ft-lbs at 40°F.

- (a) Complete-joint-penetration groove welded T and corner joints with steel backing left in place, subject to tension normal to the effective area, unless the joints are designed with the allowable stress for partial penetration welds per Table Q1.5.3.
- (b) Complete-joint-penetration groove welded splices subject to tension normal to the effective area in Group 4 and Group 5 shapes and shapes built up by welding plates more than two in. thick.

Page 57

Q1.18.3.1 COMPONENTS IN CONTACT

Replace this section with the following:

The longitudinal spacing of connectors between elements in continuous contact consisting of a plate and a shape or two plates shall not exceed:

- 24 times the thickness of the thinner plate, nor 12 in. for painted members or unpainted members not subject to corrosion.
- 14 times the thickness of the thinner plate, nor 7 in. for unpainted members of weathering steel subject to atmospheric corrosion.

In a tension member the longitudinal spacing of fasteners and intermittent welds connecting two or more shapes in contact shall not exceed 24 inches. Tension members composed of two or more shapes or plates separated by intermittent fillers shall be connected to one another at these fillers at intervals such that the slenderness ratio of either component between the fasteners does not exceed 300.

Page 57

Q1.18.3.2 PERFORATED COVER PLATES

Replace the last sentence of this section with the following:

The spacing of tie plates shall be such that the slenderness ratio of any component in the length between tie plates does not exceed 300.

Page 60

Q1.23.3.1 THERMAL CUTTING

Delete the existing paragraph and replace with the following:

Thermally cut edges shall meet the requirements of AWS D1.1, Sections 5.15.1.2, 5.15.4.3 and 5.15.4.4 with the exception that thermally cut free edges subject to calculated static tensile stress shall be free of round bottom gouges greater than 3/16-in. deep and sharp V-shaped notches. Gouges greater than 3/16-in. up to 3/8-in. deep and notches shall be removed by grinding at a slope of 1 to 2 ½ or repaired by welding. Unrepaired notches and gouges shall not result in a weld gap that exceeds the maximum allowed by AWS D1.1. Notches or gouges 3/8-in. deep or greater shall be permitted to be repaired only with the approval of the engineer. Oxygen gouging shall be prohibited on quenched and tempered steels.

Page 61

Q1.23.7.2 LIMITATIONS ON PUNCHED HOLES

Add the following to the end of the first paragraph of this Section:

Finger shims up to ¼ in. shall be permitted to be introduced into slip-critical connections designed on the basis of standard holes without reducing the allowable shear stress of the fastener.

Page 62

Table Q1.23.7 Maximum Sizes of Fastener Holes, Inches

Change the heading to “Nominal Hole Dimensions” and replace the existing Table Q1.23.7 with the following table:

TABLE Q1.23.7
Nominal Hole Dimensions

Bolt Diameter	Hole Dimensions			
	Standard (Dia.)	Oversize (Dia.)	Short-slot (Width x length)	Long-slot (Width x length)
1/2	9/16	5/8	9/16 x 11/16	9/16 x 1 1/4
5/8	11/16	13/16	11/16 x 7/8	11/16 x 1 9/16
3/4	13/16	15/16	13/16 x 1	13/16 x 1 7/8
7/8	15/16	1 1/16	15/16 x 1 1/8	15/16 x 2 3/16
1	1 1/16	1 1/4	1 1/16 x 1 5/16	1 1/16 x 2 1/2
≥ 1 1/8	$d + 1/16$	$d + 5/16$	$(d + 1/16) \times (d + 3/8)$	$(d + 1/16) \times (2.5 \times d)$

Page 62**Q1.23.8 HIGH-STRENGTH BOLTED CONSTRUCTION – ASSEMBLING**

Add the following paragraph after the existing first paragraph of this section:

If the thickness of the material is not greater than the nominal diameter of the bolt plus $\frac{1}{8}$ in., the holes shall be permitted to be punched. If the thickness of the material is greater than the nominal diameter of the bolt plus $\frac{1}{8}$ in., the holes shall be either drilled or sub-punched and reamed. The die for all sub-punched holes and the drill for all sub-drilled holes shall be at least $\frac{1}{16}$ in. smaller than the nominal diameter of the bolt. Holes in A514 steel plates over $\frac{1}{2}$ -in. thick shall be drilled.

Page 64**Q1.24 SHOP PAINTING**

Delete the current wording and replace with the following:

Q1.24.1 GENERAL REQUIREMENTS

Shop painting and surface preparation shall be in accordance with the provisions of the *Code of Standard Practice* of the American Institute of Steel Construction, Inc.

Unless otherwise specified, steelwork that will be concealed by interior building finish or will be in contact with concrete need not be painted. Unless specifically excluded, all other steelwork shall be given one coat of shop paint.

The quality assurance requirements for painting (or coating) of structural steel shall be in accordance with ASTM D3843 as endorsed by Regulatory Guide 1.54.

Q1.24.2 INACCESSIBLE SURFACES

Except for contact surfaces, surfaces inaccessible after shop assembly shall be cleaned and painted prior to assembly, if required by the design documents.

Q1.24.3 CONTACT SURFACES

Paint is permitted unconditionally in bearing-type connections. For slip-critical connections, the faying surface requirements shall be in accordance with the RCSC *Specification for Structural Joints Using ASTM A325 or A490 Bolts*, paragraph 3.2.2.

Q1.24.4 FINISHED SURFACES

Machine-finished surfaces shall be protected against corrosion by a rust-inhibiting coating that can be removed prior to erection, or which has characteristics that make removal prior to erection unnecessary.

Q1.24.5 SURFACES ADJACENT TO FIELD WELDS

Unless otherwise specified in the design documents, surfaces within 2 in. of any field weld location shall be free of materials that would prevent proper welding or produce toxic fumes during welding.

Page 66**Q1.25.10 FIELD PAINTING**

Replace current text with the following:

Responsibility for touch-up painting, cleaning and field-painting shall be allocated in accordance with accepted local practices, and this allocation shall be set forth explicitly in the design documents.

Page 67

Q1.28 PACKAGING, SHIPPING, RECEIVING, STORAGE

Replace the sentence with:

Packaging, shipping, receiving, storage, and handling shall be in accordance with ASME NQA-1, Supplement 13S-1.

Page 67

Q1.29 QUALITY CONTROL

Add new Section Q1.29 as follows:

The fabricator shall provide control procedures to the extent deemed necessary to assure that all work is performed in accordance with this Specification. In addition to the fabricator's quality control procedures, material and workmanship at all times may be subject to inspection by qualified inspectors representing the purchaser. If such inspection by representatives of the purchaser will be required, it shall be so stated in design documents.

COMMENTARY

Page C-1

Add new Section CQ1.0.1.

CQ1.0.1 SCOPE

The following commentary pertains to Item 5:

DOE Standard 1020 (Department of Energy, 2002) has established Performance Categories and target probabilistic performance goals for each category of facility subjected to natural phenomena hazards (NPH). Performance goals in the context of the DOE standard are expressed as the mean annual probability of exceedance of acceptable behavior limits of structures and equipment due to the effects of natural phenomena. Such performance goals should not be confused with broader safety goals associated with the undefined release of radioactivity to the public (Performance Categories 2 and 3) that are typically one or two orders of magnitude less than the structural failure performance goals presented herein. Five Performance Categories (PC) have been established which range from PC-0 to PC-4 as shown in Table CQ1.0.1. Performance Categories and performance goals range from those for conventional buildings to those for facilities with storage or processing of high hazard materials.

The design and evaluation criteria for structures, systems and components (SSCs) in Performance Categories 0, 1, and 2 are similar to those given in model building codes. Performance Category 0 recognizes that for certain lightweight equipment items, etc., and for other special circumstances where there is little or no potential impact on life safety, mission, or cost, design or evaluation for natural phenomena hazards may not be needed. Assignment of an SSC to Performance Category 0 is intended to be consistent with model building code NPH provisions. Performance Category 1 applies to ordinary structures, systems and components and Category 2 applies to essential or hazardous structures, systems and components, as defined in national building codes.

Performance Categories 3 and 4 apply to facilities that pose a potential significant hazard to public safety and the environment because radioactive or toxic materials are present in significant quantities. Design objectives for these categories are to limit SSC damage so that these hazardous materials can be controlled, contained or confined, occupants are protected, and functioning of the SSC is not interrupted. The performance goal for Performance Category 3 and 4 SSCs is to limit damage such that DOE policy safety goals are achieved. For these categories, damage must typically be limited such that these hazardous materials are kept within containment or confinement barriers (e.g. buildings, storage canisters, vaults, etc.), and ventilation systems, filtering, and monitoring and control equipment perform their safety function in the event of Design Basis Hazards. In addition, SSCs can be placed in Performance Categories 3 or 4 if improved performance is needed due to cost of recovery or mission requirements.

TABLE CQ1.0.1
Structure, System, or Component (SSC) NPH
Performance Goals for Various Performance Categories

Performance Category	Performance Goal Description	NPH Performance Goal Annual Probability of Exceeding Acceptable Structural Behavior Limits, $P_F^{(1,2,3)}$
0	No Safety, Mission, or Cost Considerations	No Requirements
1	Maintain Occupant Safety	10^{-3} of the onset of SSC ⁽¹⁾ damage to the extent that occupants are endangered
2	Occupant Safety, Continued Operation with Minimum Interruption	5×10^{-4} of SSC damage to the extent that the component cannot perform its function
3	Occupant Safety, Continued Operation, Hazard Confinement	10^{-4} for SSC damage to the extent that the component cannot perform its function
4	Occupant Safety, Continued Operation, Confidence of hazard Confinement	10^{-5} of SSC damage to the extent that the component cannot perform its function
(1) (2) (3)	These performance goals are for each natural phenomenon hazard (earthquake, wind, and flood). SSC refers to structure, distribution system, or component (equipment). These Performance Goals should not be confused with undefined radiological risks to the public safety goals, which are typically set one to two orders of magnitude less than these risk levels.	

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CQ1.0.2 DEFINITIONS

Add the following new commentary.

It is appropriate to allow higher allowable stresses when the effects of conservatively estimated differential settlement are considered in the design, though it is recognized that the stresses induced are not self limiting. However, in the design of nuclear facilities, effects of differential settlement on the supported equipment and piping should also be explicitly considered.

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CQ1.0.3 REFERENCED CODES AND STANDARDS

Add the following new commentary.

This Supplement updates the applicable year of revision for the various Standards of the American Society for Testing and Materials (ASTM), and other referenced Codes and Standards, which were identified in ANSI/AISC N690-1994. Later editions of these Codes and Standards should be permitted to be used provided the Engineer performs a reconciliation.

ANSI 101.4 was withdrawn in 1988, and a number of ASTM Standards related to coatings were developed. The revised U.S. Nuclear Regulatory Commission Regulatory Guide 1.54 provides guidance in the use of these ASTM Standards for coatings to be used in the nuclear power plants.

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CQ1.3.6 LOAD COMBINATIONS

Delete the last sentence in the first paragraph and add the following new paragraph:

Dynamic loads are typically determined based on time history analysis or response spectrum modal analysis. Procedures for combining seismic dynamic load effects so determined can be found in ASCE 4 (ASCE, 1998b) for structures and ASME BPVC Section III, Appendix N for mechanical components and distribution systems. Procedures for determining wind and snow load effects can be found in ASCE 7 (ASCE, 1998a).

Insert the following at the end of this section:

For ASD, ASCE 7 (ASCE, 1998a) requires that the dead load shall be reduced to 60 percent of the calculated dead load when combined with lateral loads. For commercial buildings, ASCE may have found it appropriate to reduce the (dead) load factor to 0.6 in conjunction with lateral loads. For nuclear structures, it will be overly conservative. When the permanent equipment loads are considered as part of the dead load, NUREG/CR 3315, "A Consensus Estimation Study of Nuclear Power Plant Structural Loads," indicates that the mean values of dead loads for all types of reactors varies between 0.9 and 1.0 with a COV of 0.03. Thus, for nuclear plant design, the dead load factor remains unchanged.

This specification also takes exception to the load combination for dead load combined with lateral loads, given in the RCSC Specification.

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Add the following new commentary section.

CQ1.3.7 COMBINED LOSS OF COOLANT AND SAFETY DISCHARGE LOADS

The Nuclear Regulatory Commission's Standard Review Plan (SRP) Section 3.8.1, Appendix A, and SRP 3.8.3 provide guidance for incorporating the hydrodynamic loads.

Add the following new Commentary Section:

CQ1.4.1 STRUCTURAL STEEL

ASTM A167 - Types 301, 302, 302B:

These materials have carbon content of 0.15 and relatively low chromium and nickel content, which creates a problem with hot cracking. Further these materials are susceptible to severe sensitization, and therefore, will require a final annealing to redissolve the carbides.

ASTM A607, Class 1:

Class 1 is not readily weldable. Class 2 offers similar strength and offers improved weldability over Class 1.

ASTM A276:

Unmodified martensitic grade of this material is not readily weldable. Martensitic steels are susceptible to excessive hardening with consequent risk of cracking during welding.

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Add the following new Commentary Section:

CQ1.5.3.1 DESIGN WALL THICKNESS OF HOLLOW STRUCTURAL SECTIONS

The specification of a "design" wall thickness for hollow structural sections (HSS) originated in the *Specification for the Design of Hollow Structural Sections* (AISC, 1997). ASTM A500 tolerances allow for a wall thickness that is not greater than plus/minus 10 percent of the nominal value. Because the plate and strip from which electric-resistance-welded (ERW) HSS are made is produced consistently to a wall thickness that is near the lower-bound wall thickness limit, AISC and the Steel Tube Institute of

North America (STI) recommend that 0.93 times the nominal wall thickness should be used for calculations involving engineering design properties of ERW HSS. Submerged-arc-welded (SAW) HSS are produced with a wall thickness that is near the nominal thickness and require no such reduction. The design wall thickness and section properties based upon the reduced thickness have been tabulated in AISC and STI publications since 1997.

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CQ1.5.8 DESIGN BASED ON DUCTILITY AND LOCAL EFFECTS

Add the following to the beginning of this section.

Load T_a acting alone is deleted from this section as the temperature effects are sustained compared to R_a , Y_j , etc., and its effects are considered in load combination 9a. However, the global effects of T_a should be considered (as applicable) in conjunction with the impactive and impulsive loads as required by load combinations 9, 10, and 11.

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CQ1.11.5 COMPOSITE BEAMS OR GIRDERS WITH FORMED STEEL DECK

Replace the seventh paragraph (beginning “Based upon all tests,...”) with the following:

The strength of stud connectors installed in the ribs of concrete slabs on formed steel deck with the ribs oriented perpendicular to the steel beam is reasonably estimated by the strength of stud connectors in flat soffit composite slabs multiplied by values computed from Equation Q1.11-7.

This Supplement includes a new upper limit of 0.75 on the reduction factor of Equation Q1.11-7 for single studs located in deck ribs oriented perpendicular to the beam. This limit has been imposed as a temporary measure in response to a mounting set of test data (e.g., Easterling, Gibbings, and Murray, 1993; Kemp and Trincherro, 1997) that indicates that stud strengths calculated by the product of Equations Q1.11-7 and the tabulated values in Table Q1.11.4 may be unconservative when a single stud per rib is used. Research to further resolve this issue and to assess whether stud pairs are also affected is currently underway. Differences between recent test results and those originally used to develop Equation Q1.11-7 for ribbed decks (Grant et al., 1977) appear to be due to the fact that (1) most of the earlier tests reported by Grant et al. were for beams with studs placed in pairs centered within the ribs, (2) stud strengths used to originally calibrate Equation Q1.11-7 were back calculated from moment strengths of beam specimens which tend to mask variations in the stud strengths, and (3) differences in modern steel deck profiles that affect the placement of studs in the rib.

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CQ1.18 BUILT-UP MEMBERS

Add the following to the first paragraph:

The slenderness ratio L/r of tension members other than rods, HSS, or straps should preferably not exceed the limiting value of 300. This slenderness limit recommended for tension members is not essential to the structural integrity of such members; it merely assures a degree of stiffness such that undesirable lateral movement (“slapping” or vibration) will be unlikely.

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Add the following new commentary.

CQ1.29 QUALITY ASSURANCE

The Nuclear Regulatory Commission has accepted the use of ANSI/ASME NQA-1, “Quality Assurance Requirements for Nuclear Facilities”, 1986 Edition through 1992 Edition provided the owners of nuclear facilities utilize their 10 CFR 50, Appendix B quality assurance program in conjunction with the quality assurance and quality control requirements of this Standard.

Add the following references:

American Institute of Steel Construction, Inc. (1997), *Specification for the Design of Steel Hollow Structural Sections*, April 15, Chicago, IL.

American Society of Mechanical Engineers (ASME) (1992), *Quality Assurance Program Requirements for Nuclear Facilities*, ANSI/ASME NQA-1, New York, NY.

American Society of Civil Engineers (ASCE) (1998a), *Minimum Design Loads for Buildings and Other Structures*, ASCE 7, Reston, VA.

American Society of Civil Engineers (ASCE) (1998b), *Seismic Analysis of Safety-Related Nuclear Structures*, ASCE 4, Reston, VA.

Department of Energy (2002), "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," January, DOE-STD-1020-2002, Appendix B.



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