Washington Public Power Supply System
P.O. Box 968 3000 George Washington Way Richland, Washington 99352 (509) 372-5000

Docket No. 50-460
June 6, 1983
G01-83-0214

Director of Nuclear Reactor Regulation
Attention: Elinor G. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: NUCLEAR PROJECT NO. 1
ASME SECTION III, DIVISION 2
ADDENDA ARTICLES AND CODE CASE APPROVAL

Reference: NRC letter, Thomas M. Novak to R.L. Ferguson, dated April 14, 1983

The WNP-1 Containment Design Specification and Containment construction is based on the ASME Boiler and Pressure Vessel Code, Section III, Division 2, 1975 Edition up to and including Winter 1976 Addenda (hereinafter termed the Reference Code). During the Containment design and construction, it was necessary to use Code Cases and later ASME Code Addenda articles. Attachment A is a discussion of the remaining ASME approved Code Cases and ASME Code Addenda articles which were utilized and for which we request NRC approval. Additional information is also provided for the Staff's reconsideration of our request for approval of the Winter 1977 Addenda, Subarticle CC-3422.1 and Summer 1979 Addenda of Subarticle CC-3432.1 (see Reference). The Supply System requests approval for the following Code Cases and Addenda as they relate to the WNP-1 containment structures. The complete text of each Code Case as approved by the ASME is included in Attachment B for your information.

To support the Supply System's efforts to N-stamp the Containment and reduce the Construction Management effort on the Containment Construction, we would appreciate a written reply to this letter by June 17, 1983.

G D Bouchey

G. D. Bouchey, Manager
Nuclear Safety & Regulatory Programs (340)

GDB:pp

Attachments

cc: MC Thadani, NRC MD-116
NS Reynolds, Debevoise & Liberman
V Mani, United Engineers 897
G Valentenyi, UE&C, PA 8U6
ORM 847
FDCC 899

B001
1/1

ATTACHMENT A

CODE CASES

Code Case N-285

Subarticles CC-3532.1.2(b) and (h) of the Reference Code pertains to development length of reinforcing bars. Code Case N-285 permits the reduction of the required development length for flexural reinforcement that are not stressed to yield by the ratio of area required/area provided.

The design of the WNP-1 containment structures reflects the use of this Code Case. The application of this Code Case was limited to radial reinforcing bars in the foundation mat.

Code Case N-344

The Reference Code does not address the subcontracting of services for the splicing of reinforcing bars, including preparation of procedures and qualification of splicers. Code Case N-344 permits the subcontracting of these services provided they are under the control of the Certificate Holder's Quality Assurance Program as described in the Reference Code.

For WNP-1, the services for splicing of reinforcing bars has been subcontracted. The Certificate Holder has approved all applicable procedures and qualifications of splicers to assure that the requirements of Code Case N-344 were satisfied.

Code Case N-354

The Reference Code does not address the subcontracting of services for the welding of reinforcing splice sleeves to plate embedments, including preparation of procedures and qualification of welders. Code Case N-354 permits the subcontracting of these services provided they are under the control of the Certificate Holder's Quality Assurance Program as described in the Reference Code.

For WNP-1, the services for welding of reinforcing splice sleeves has been subcontracted. The Certificate Holder has approved all applicable procedures and qualifications of welders to assure that the requirements of Code Case N-354 were satisfied.

Code Case N-364

Subarticle CC-2232.3.1 of the Reference Code requires that concrete, after curing, which is subject to freezing temperatures while wet, shall contain entrained air within the limits of Table CC-2232.3-1. Code Case N-364 permits alternate requirements for vertical walls that may be subjected to cycles of freezing temperatures while wet.

For WNP-1 there were some instances where the air content percentage did not comply with Table CC-2232.3-1. Subject instances were all limited to local vertical wall areas, below grade, which will not be subjected to repeated cycles of freezing temperatures while wet during the life of the plant. The subject areas meet the requirements of Code Case N-364.

Code Case N-365

Subarticle CC-2621.4 of the Reference Code requires that studs be produced by cold heading, cold rolling or machining. Code Case N-365 permits the use of studs manufactured by stud welding the head to the shank.

The WNP-1 equipment hatch and personnel airlock barrels have studs attached which were manufactured in compliance with Code Case N-365. The stud welding procedures and personnel qualifications were approved by the NPT Certificate Holder. The integrity of the studs is not compromised and satisfies the design requirements of the Reference Code.

Code Case N-366

Subarticle CC-4333.4.3 of the Reference Code specifies the testing frequency of production samples of reinforcing bar splicing. Code Case N-366 permits alternate rules and essentially changes the testing frequency to two production samples for each 200 production splices after the initial 100 production splices.

Approximately 20,000 reinforcing bar splices are used in for the WNP-1 Containment shell and dome. Although the actual number of tests taken at WNP-1 exceeds the 2% minimum number required, the frequencies did not necessarily meet Reference Code requirements in all cases. In addition, all production samples tested satisfied the Reference Code requirements. Code Case N-366 permits alternate frequencies which have been complied with during the construction of the WNP-1 Containment.

Code Case N-380

Table CC-5200-1 of the Reference Code requires the testing of concrete compressive strength for each 100 cubic yards of each concrete class. Code Case N-380 permits, under certain conditions, the use of the "After Field Experience" test frequency in Table CC-5200-1 for concrete compressive strength prior to accumulation of data from the first thirty consecutive strength test results.

The Containment foundation mat was placed using the 1973 Proposed, Section III, Division 2 Code which specified concrete compressive strength sampling for each 150 cubic yards. For the WNP-1 Containment, the first 30 consecutive compressive strength test results and all subsequent compressive strength test results, satisfy the strength requirements of the Reference Code. Therefore, the requirements of Code Case N-380 have been satisfied for the foundation mat.

ASME Section III, Division 2, Summer 1982 Addenda - Subarticle CC-5340

Subarticle CC-5340 of the Reference Code requires the visual examination of the bent or straightened surfaces of bars for indication of cracks but does not differentiate between shop fabrication, field bending or bending of already embedded bar. Article CC-5000 covers "Construction Testing and Examination" and Subarticle CC-5340 covers the "Examination of Bends". This is the only subarticle covering this item. This subarticle being placed under the "Construction Testing and Examination" article is meant to be applicable to construction related activities only and not to shop fabrication. The Summer 1982 Addenda clarifies this by revising CC-5340 to specify that only bars partially embedded in concrete require examination.

For WNP-1, there were instances where fabricated bars were not visually examined. These bars were bent to a minimum radius of 75'-0. All bars are ASTM A615, Grade 60 and all heats were subjected to bend tests, and complied with the Reference Code.

ASME Section III, Division 2, Summer 1980 Addenda - Subarticle CC-5200

Subarticle CC-5200 of the Reference Code requires the minimum testing frequencies of Table CC-5200-1 for concrete constituents and concrete. The Summer 1980 Addenda relaxes the testing frequency for water and ice as tabulated below:

		Winter 1976 Addenda	Summer 1980 Addenda
Compliance with CC-2223		Yes	(Deleted)
Effect on compressive strength	(ASTM C 109)	Monthly	Every 6 months
Setting time	(ASTM C 191)	Monthly	Every 6 months
Soundness	(ASTM C 151)	Monthly	(Deleted)
Total solids	(ASTM D 1888)	Monthly	Every 6 months
Chlorides	(ASTM D 512)	Monthly	Monthly

The Summer 1980 Addenda relaxed the testing frequencies for ASTM C 109, ASTM C 191 and ASTM D 1888 tests considering the constant source of water and the negligible influence of the water quality on compressive strength and soundness of concrete. The chloride test (ASTM D 512) is the most important test and requires monthly tests in both Addenda. The soundness test (ASTM C 151) which was eliminated from the Code mainly relates to tests for cement, determining the autoclave expansion of Portland cement caused by the hydration of CaO and MgO.

A quotation from "Manual of Cement Testing" (Annual Book of ASTM Standards, Part 13), Paragraph 19.1 states: "In general, water fit for drinking is satisfactory for cement testing. In case of doubt, distilled water may be used for comparison or reference." The ACI Standard Specification for Structural Concrete for Buildings (ACI 301-72, Revised 1975), a long standing Standard for concrete construction specification, does not list the ASTM C151 Standard as a requirement for testing mixing water for concrete.

During construction of WNP-1, the water for concrete production was obtained from the well on site and ice from controlled off-site locations. The water and ice testing results have been consistent for several years and have been within the limits specified by the Reference Code. For WNP-1 construction, testing of water and ice has been performed monthly as required by the Referenced Code except for two instances when a monthly test was not performed. All the tests show consistent results with minor variations well within acceptable limits. Therefore, the alternate testing frequencies have no effect on the quality or compressive strength of the concrete.

ARTICLES CC-3422.1 and CC-3432.1

The following is provided as further justification for the use of Subarticle CC-3422.1 of Winter 1977 Addenda and Subarticle CC3432.1 of Summer 1979 Addenda.

ASME Section III, Division 2, Winter 1977 Addenda - Subarticle CC-3422.1

Subarticle CC-3422.1 of the Reference Code permits reinforcing bar yielding under loading conditions which include accident temperature. However, no limits of yielding are established. Article CC-3422.1 of the 1977 Winter Addenda established a maximum net tensile strain of $2\epsilon_y$ in the reinforcing. This limit has been established to control cracking, and hence is more conservative than the Reference Code which has no limit of yielding specified.

In the WNP-1 design this controlled yielding is applied only to the main reinforcing bars in bending and/or tension. No yielding is permitted for radial or peripheral shear reinforcing bars, which are located in discontinuous regions such as at the shell/mat junction and in the vicinity of large opernings. This assures overall ductile behavior of the Containment.

ASME Section III, Division 2, Summer 1979 Addenda - Subarticle CC-3432.1

Subarticle CC-3432.1 of the Reference Code permits reinforcing bar stresses to be increased by one-third during the Structural Integrity Test. This amounts to 40 ksi (30 ksi + 1/3 X 30 ksi) for 60 ksi reinforcing steel used in WNP-1 construction. The Summer 1979 Addenda of the Code permits a one-half increase which amounts to 45 ksi (30 ksi + 1/2 x 30 ksi).

The 5 ksi increase would permit greater flexibility in the differential between the the containment outside and inside temperature during the Structural Integrity Test. The 5 ksi increase is justified since:

1. All reinforcing bars used conformed to ASTM A615 Grade 60 with a minimum yield of 60 ksi and a minimum tensile strength of 90 ksi.

2. Higher rebar stresses during the test, which are still well within the elastic limits of the rebar, better demonstrate the satisfactory response of the Containment to pressure loads. Additional concrete cracking is minimal due to the 5 ksi stress increase since the structural response is elastic.

CASE
N-285

CASES OF ASME BOILER AND PRESSURE VESSEL CODE

Meeting of May 9, 1980
Approved by Council, July 14, 1980
Approved by ACI, March 8, 1980

This Case shall expire on July 14, 1983
unless previously annulled or reaffirmed.

Case N-285
Alternative Rules for Calculating Development Lengths for Bars Not Stressed to Yield
Section III, Division 2

Inquiry: What alternative rules to those in Section III, Division 2, CC-3532.1.2(b) and CC-3532.1.2(h), may be used to reduce the required development length for bars not stressed to yield?

Reply: It is the opinion of the Committee that the basic development length for flexural reinforcement may be reduced by the ratio of:

$$\frac{\text{area required}}{\text{area provided}}$$

Meeting of May 7, 1982
Approved by Council, July 7, 1982
Approved by ACI, September 24, 1982

This Case shall expire on June 30, 1983
unless previously annulled or reaffirmed.

Case N-344
Subcontracted Construction Services —
Welding Splice Sleeves to Parts, Structural Shapes, and Plates
Section III, Division 2, Class CC

Inquiry: What alternative rules to those presently in NCA-3132(c) and (d) may be used for preparation of procedures and qualification of splicers for subcontracted construction services for Class CC construction?

Reply: It is the opinion of the Committee that, as an alternative to the rules in NCA-3132 for preparation of procedures and qualification of splicers for subcontracted construction services, the procedures may be prepared and the splicers may be qualified by the subcontractor under the control of the Certificate Holder as described in NCA-3132(a), (b), (e), (f), and (g). Authorized Inspection access to all areas and functions shall include those of procedure development and qualification performance by a subcontractor for the Certificate Holder. The procedures shall be approved by the Certificate Holder, and Code responsibility for such procedures shall be retained by the Certificate Holder.

CASES OF ASME BOILER AND PRESSURE VESSEL CODE

Meeting of June 25, 1982
Approved by Council, September 7, 1982
Approved by ACI, September 24, 1982

This Case shall expire on September 24, 1985
unless previously annulled or reaffirmed

Case N-354
Subcontracted Service
Section III, Division 2

Inquiry: For Section III, Division 2 construction, may an N-Certificate Holder subcontract to a non-Certificate Holder the welding of reinforcing splice sleeves to plate embedments placed in concrete, in accordance with the provisions of CC-4333.6 of the Summer 1977 Addenda or earlier Editions and Addenda?

Reply: It is the opinion of the Committee that, for Section III, Division 2 construction, an N-Certificate Holder may subcontract to a non-Certificate Holder the welding of reinforcing splice sleeves to plate embedments placed in concrete, in accordance with the provisions of 4333.6 of Summer 1977 Addenda or earlier Editions Addenda, provided that the following provisions are met:

(1) The welding shall not be to pressure retaining portions of the containment system, such as the linear or penetrations.

(2) The N-Certificate Holder shall define in his ASME accepted Quality Assurance Program the use of subcontractors not holding Certificates of Authorization. The subcontractor's personnel and work shall be an extens[illegible] of the N-Certificate Holder's organization, Code responsibility, and Quality Assurance Program controls. The N-Certificate Holder shall have direct technical and contractual control of the subcontractor's personnel and work.

(3) The welding procedures and welders shall be qualified by the subcontractor to procedures reviewed and approved by the N-Certificate Holder. The welders' qualifications shall be reviewed and approved by the N-Certificate Holder. Authorized Inspection access to all areas and functions required by NCA-3132(g) shall include those of procedure development qualification performance by a subcontractor for the Certificate Holder.

(4) The assemblies shall be subjected to the mechanical splice test frequency requirements of CC-4333.4 and shall meet the joint tensile strength requirements of Table CC-4333.1.

INTER-OFFICE MEMO

DATE May 18, 1983

Ulene Klinghoffer/Rosemarie Palumbo FROM Steve Weinman, Secretary JC SW/lv

SUBJECT Section III, Div. 2 Code Cases

The following Code Cases were approved by the ACI Standards Board on March 21, 1983 and can be published in the next available MC. These items are ready for publication in the Code Case Book. JC item #82-44 was approved by BNCS on February 14, and JC item 8-44 was approved on April 4, 1983.

JC#	Code Case #	MC#/Date
79-6	N-332	MC81-547/10.30.81
79-73	N-324	MC82-345/6.25.82
82-44	N-364	MC82-633/11.12.82
82-45	N-380	MC83-123/1.14.83

Thank you,

cc: B. B. Scott

MC 82-512

MCF 82-18
JC 82-44

Code Case N - 364

Concrete Air Content

Section III Division 2, Class CC

Inquiry: For Section III Division 2 Class CC construction, what ~~alternate~~ alternative requirements to CC-2232.4.1 may be used for the limits of entrained air of Table CC-2232.3-1 for concrete for vertical walls that will be subject to repeated cycles of freezing temperatures while wet during the life of the structure?

Reply: It is the opinion of the Committee that for Section III Division 2 construction the rules of CC-2232.4.1 are satisfied for vertical walls that may be subject to repeated cycles of freezing temperatures while wet during the life of the structure if the following conditions are satisfied:

1. The water/cement ratio ~~does~~ shall not exceed 0.48 when the concrete will not be exposed to sea water and 0.44 if exposed to sea water.

2. No more than one individual test result in a placement ~~shall~~ shall be outside the specified range of air content by more than 20%.

3. The average of all test results in each placement ~~is~~ shall be within the limits specified in Table CC-2232.3-1.

To: Jim Babcock
Page 1 of 4 N365
CASE
N-365

CASES OF ASME BOILER AND PRESSURE VESSEL CODE

Meeting of September 17, 1982
Approved by Council, December 13, 1982
Approved by ACI, September 24, 1982

This Case shall expire on December 13, 1985
unless previously annulled or reaffirmed.

Case N-365
Stud Welding Material
Section III, Division 2

Inquiry: For Section III, Division 2 construction to the 1975 Edition, is it permissible to produce studs by stud welding the shank to the head as an alternative to the rules in CC-2621.4?

Reply: It is the opinion of the Committee that, for Section III, Division 2 construction to the 1975 Edition, it is permissible to produce studs by stud welding the shank to the head as an alternative to the rules in CC-2621.4, provided the following provisions are met:

(1) Work is performed in accordance with all requirements related to studs and stud welding in CC-2000, CC-4000, and CC-5000. This shall include material, fabrication, inspection (visual), testing, and examination requirements, including welder qualification and weld procedure qualification.

(2) If work is performed by a metallic material Manufacturer, the requirements of CC-2700 are applicable.

CASE
N-366

Meeting of September 17, 1982
Approved by Council, December 13, 1982
Approved by ACI, September 24, 1982

This Case shall expire on December 13, 1985
unless previously annulled or reaffirmed.

Case N-366
Splicing of Reinforcing Bars – Production Testing Frequency
Section III, Division 2

Inquiry: For Section III, Division 2 construction to the 1975 Edition with the Winter 1976 Addenda, are alternate rules permitted for the reinforcing bar testing frequencies in CC-4333.5.3?

Reply: It is the opinion of the Committee that, for Section III, Division 2 construction to the 1975 Edition with the Winter 1976 Addenda, the following alternate rules are permitted for the reinforcing bar testing frequencies in CC-4333.5.3.

The frequency of two production samples for each 100 production splices, after the initial production splices, may be decreased to two production samples for each 200 production splices under the following conditions:

(1) The total number of samples in each cycle (bar position) equals or exceeds the total number of samples obtained if sampling was done in accordance with CC-4333.5.3 (1975 Edition with the Winter 1976 Addenda, two production samples for each 100 production splices).

(2) The testing frequency in CC-4333.5.3 must be followed for at least 30% of the groups of 100 production splices for each cycle.

N 380
N 82-17
MCE 82-10

JC82-45

Code Case N - _____

Concrete Compressive Strength Test Frequency Requirements

Section III, Division 2

INQUIRY: For Section III, Division 2 construction when conditions permit the use of the "After Field Experience" test frequency in Table CC-5200-1 for concrete compressive strength tests, prior to the accumulation of data from the first thirty consecutive strength test results.

REPLY: It is the opinion of the Committee that for Section III Division 2 construction the "After Field Experience" test frequency in Table CC-5200-1 for concrete compressive strength tests is permitted prior to the accumulation of data from the first thirty consecutive strength tests results under the following conditions.

1.0 Results from the first thirty and any successive strength tests satisfy the requirements of Table CC-5200-1 Note (3).

2.0 Concrete is produced in a central mixing plant and the standard deviation of the compressive strength test results is less than 600 psi.

3.0 All concrete quality control test results satisfy the requirements of Section III, Division 2.

4.0 All concrete testing frequencies, other than compressive strength test frequency, satisfy the frequency requirements of the Construction Specification and the "Initial" frequency requirements of the Code.

CC-5332.2 Acceptance Standards. Welds that are shown by radiography to have any of the following types of discontinuities are unacceptable:

(a) any type of crack or zone of incomplete fusion or penetration

(b) any other elongated indication which is greater than:

(1) 1/8 in. for bar sizes No 10 and smaller

(2) 3/16 in for bar sizes No. 11 and No. 14

(3) 1/4 in for bar size No. 18

(c) any group of indications in line that total more in the sum of their longest dimensions than:

(1) 1/16 in. for bar sizes No. 9 and smaller

(2) 1/4 in. for bar sizes No. 10 and No. 11

(3) 5/16 in. for bar size No. 14

(4) 7/16 in. for bar size No. 18

CC-5332.3 Reexamination

(a) If any of the radiographs indicate unacceptable joints, the joints shall be replaced and reexamined by radiography. Two additional joints, one on either side of the unacceptable joint, shall also be subject to radiographic examination. If both reexaminations meet the acceptance criteria, all of the remaining joints out of that group of 25 shall be considered acceptable subject to continuous requalification tests.

(b) If either of the reexaminations does not meet the radiographic acceptance criteria, 25% of the remainder of that group of 25 joints shall be radiographed. The two radiographically poorest joints shall be removed and tensile tested to demonstrate their ability to satisfy the strength requirements. If either of the two joints fails to equal or exceed 125% of the specified yield strength as shown in Table CC-4333-1, all 25 joints of that group shall be rejected. The operator shall then be requalified in accordance with CC-4334.5 and the joints remade and reexamined. The operator shall be permitted to weld the next 25 joints if both of the joints equal or exceed 125% of the specified yield strength as shown in Table CC-4333-1.

1975 EDITION

CC-5340 EXAMINATION OF BENDS

The bent or straightened surfaces of bars shall be visually examined for indications of cracks.

(a) Bars exhibiting transverse cracks shall be rejected or, if partially embedded, the bent or straightened section shall be removed and replaced using a splice in accordance with CC-4330.

(b) The presence of longitudinal surface seams shall not be cause for rejection or removal.

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CC-5400 EXAMINATION OF PRESTRESSING SYSTEMS

CC-5410 GENERAL

This Subarticle describes the examination requirements for prestressing systems. Aspects of the systems which affect quality, such as tendon fabrication, placement and tensioning of tendons, installation of ducts and bearing plates, and the injection of the corrosion prevention materials, shall be examined.

CC-5420 REQUIRED EXAMINATION

CC-5421 General

The design, fabrication, and installation of prestressing systems shall be in conformance with the Construction Specification. The Construction Specification shall include provisions to control and examine tendon length, twist, temporary protective coatings if required, anchorage hardware, conformance to Manufacturer's standards, coiling and packaging requirements, handling, shipping, and storage procedures.

CC-5422 Bearing Plates

CC-5422.1 Preplacement. Bearing plates shall be examined for dimensional accuracy, out-of-square, and surface smoothness in accordance with the criteria stated in the Construction Specification.

CC-5422.2 Post-Placement. Following installation, the position of all bearing plates shall be examined prior to concrete placement for proper location and orientation. Placement tolerances shall be in accordance with the Construction Specification. If the orientation of the plate tends to inhibit concrete placement, a program shall be specified in the Construction Specification for the examination of the soundness of the concrete in the bearing zone.

CC-5423 Tendon Ducts

CC-5423.1 Preplacement. Tendon ducts shall be examined to ensure compliance with requirements of the Construction Specification as to type, diameter, and wall thickness. The frequency of examination shall be specified in the Construction Specification.

CC-5423.2 Post-Placement. Tendon ducts shall be examined for position and alignment in accordance with CC-4452. After installation, but prior to concrete

(b) any other elongated indication which is greater than:

(1) 1/8 in. (3.2 mm) for bar sizes No. 10 and smaller;

(2) 3/16 in. (4.8 mm) for bar sizes Nos. 11 and 14;

(3) 1/4 in. (6 mm) for bar size No. 18.

(c) any group of indications in line that total more in the sum of their longest dimensions than:

(1) 1/16 in. (1.6 mm) for bar sizes No. 9 and smaller;

(2) 1/4 in. (6 mm) for bar sizes Nos. 10 and 11;

(3) 5/16 in. (8 mm) for bar size No. 14;

(4) 7/16 in. (11 mm) for bar size No. 18.

CC-5332.3 Reexamination

(a) If any of the radiographs indicate unacceptable joints, the joints shall be replaced and examined by radiography. Two additional joints from the same group, preferably one on either side of the unacceptable joint, shall also be subject to radiographic examination. If these joints meet the acceptance criteria, all of the remaining joints out of that group of 25 shall be considered acceptable subject to continuous requalification tests.

(b) If any of the additional joints do not meet the radiographic acceptance criteria, all 25 joints of that group shall be rejected. The operator shall then be requalified in accordance with CC-4334.5 and the joints remade and reexamined. The operator shall be permitted to weld the next 25 joints if both of the joints equal or exceed 125% of the specified yield strength as shown in Table CC-4333-1.

82 SUMMER ADDENDA

CC-5340 EXAMINATION OF BENDS S82

The bent or straightened surfaces of all reinforcing bars that are partially embedded in concrete and that are bent and/or straightened in the field shall be visually examined for indications of cracks.

(a) Bars exhibiting transverse cracks or fissures shall be rejected and the bent or straightened section shall be removed and replaced using a splice in accordance with CC-4330.

(b) The presence of longitudinal seams shall not be cause for removal.

CC-5400 EXAMINATION OF PRESTRESSING SYSTEMS

CC-5410 GENERAL

This Subarticle describes the examination requirements for prestressing systems. Aspects of the systems which affect quality such as tendon fabrication, placement and tensioning of tendons, installation of

TABLE CC-5200-1
TESTING FREQUENCIES FOR CONCRETE MATERIALS AND CONCRETE

Material	Requirements	Test Method	Frequency
Cement	Standard physical and chemical properties	ASTM C 150	Each 1200 tons
Fly Ash and Pozzolans	Chemical and physical properties in accordance with ASTM C 618	ASTM C 311	Each 200 tons
Aggregate	Gradation	ASTM C 136	Once daily during production[1]
	Moisture content	ASTM C 566	Twice daily during production
	Material finer than #200 sieve	ASTM C 117	Daily during production
	Organic impurities	ASTM C 40	Daily during production
	Flat and elongated particles	CRD-C 119	Monthly during production
	Friable particles	ASTM C 142	Monthly during production
	Lightweight particles	ASTM C 123	Monthly during production
	Soft fragments	ASTM 235	Monthly during production
	Specific gravity and absorption	ASTM C 127 or ASTM C 128	Monthly during production
	Los Angeles abrasion	ASTM C 131 or ASTM C 535	Every 6 months
1975 EDITION	Potential reactivity	ASTM C 289	Every 6 months
	Soundness	ASTM C 88	Every 6 months
Water and Ice	Compliance with CC-2223		
	Effect on compressive strength	ASTM C 107	Monthly
	Setting time	ASTM C 191	Monthly
	Soundness	ASTM C 151	Monthly
	Total solids	ASTM D 1888	Monthly
	Chlorides	ASTM D 512	Monthly
Admixtures	Chemical composition	Infrared spectrophotometry pH and solids content in accordance with ASTM C 494	Composite of each shipment
Concrete	Mixer uniformity	ASTM C 94	Initially and every 6 months
	Sampling method	ASTM C 172	
	Compression cylinders	ASTM C 31	
	Compressive strength	ASTM C 39	One set of 2 cylinders from each 100 cu yd or a minimum of 1 set per day for each class of concrete given in CB-5234.2
	Slump	ASTM C 143	First batch placed each day and every 50 cu yd placed
	Air content	ASTM C 173 or ASTM C 231	First batch placed each day and every 50 cu yd placed
	Temperature		First batch placed each day and every 50 cu yd placed
	weight/yield	ASTM C 138	Daily during production

NOTE:

(1) Twice daily during production if more than 200 cu yd are placed.

SUMMER 1980 ADDENDA

TABLE CC-5200-1 (CONT'D)
TESTING FREQUENCIES FOR CONCRETE CONSTITUENTS AND CONCRETE

	Material	Requirements	Test Method	Frequency
S80	Water and Ice	Effect on compressive strength	ASTM C 109	Every 6 months
		Effect on setting time	ASTM C 191	Every 6 months
		Total solids	ASTM D 1888	Every 6 months
		Chlorides	ASTM D 512	Monthly
	Admixtures	Uniformity	Infrared spectrophotometry, pH, and solids content in accordance with ASTM C 494	Composite of each shipment or production lot, whichever is smaller
	Concrete	Mixer uniformity	ASTM C 94	Initially and every 6 months
		Compressive strength	ASTM C 39 or CRD-C 84	One set of 2 cylinders from each 100 cu yd or a minimum of 1 set per day for each class of concrete
		Slump	ASTM C 143	First batch placed each day and every 50 cu yd placed
		Air content	ASTM C 173 or ASTM C 231	First batch placed each day and every 50 cu yd placed
		Temperature		First batch placed each day and every 50 cu yd placed
		Weight/yield	ASTM C 138	Daily during production
	Grout[2]	Compressive strength	ASTM C 109	Daily during production

NOTES:
(1) Twice daily during production if more than 200 cu yd are placed.
(2) Grout for general use (General Purpose Grout).

where

f_m = membrane stress in meridional direction, compression positive

f_h = membrane stress in hoop direction, compression positive

(b) The value of v_c shall be calculated as a weighted average of v_{ch} and v_{cm}; v_{ch} is the allowable shear stress on a failure surface perpendicular to a meridional line; and v_{cm} is the allowable shear stress on a meridional failure surface perpendicular to the plane of the shell. For a circular failure surface, v_c is the average of v_{ch} and v_{cm}.

CC-3421.6.1 Critical Section. The failure surface for peripheral shear shall be perpendicular to the [illegible] the containment [illegible] so that its periphery is at a distance $d/2$ from the periphery of the concentrated load or reaction area, except for impact loads where the critical section is defined in CC-3931.

CC-3421.7 Torsion. The shear stress taken by the concrete resulting from pure torsion shall not exceed v_{ct} as calculated from the following equation:

$$v_{ct} = 6\sqrt{f_c'}\sqrt{1+\frac{f_h+f_m}{6\sqrt{f_c'}}-\frac{f_m f_h}{6\sqrt{f_c'}}}$$

CC-3421.8 Brackets and Corbels. These provisions apply to brackets and corbels having a shear span to depth ratio, a/d, of unity or less. The distance, d, shall be measured at a section adjacent to the face of the support but shall not be taken greater than twice the depth of the corbel or bracket at the outside edge of the bearing area.

(a) The shear stress shall not exceed:

$$v_u = [6.5-5.1\sqrt{(N_u/V_u)}]\ [1-0.5(a/d)]\ \times \left\{1+[64+164\sqrt{(N_u/V_u)^3}]\ \rho\right\}\sqrt{f_c'} \qquad (8)$$

where ρ shall not exceed $0.13f_c'/f_y$ and N_u/V_u shall not be taken less than 0.20, and where N_u is the design tensile force on a bracket or corbel acting simultaneously.

(b) When provisions are made to prevent tension due to restrained shrinkage and creep so that the member is subject to shear and moment only, v_u shall not exceed

$$v_u = 6.5\ [1-0.5\ (a/d)]\ [1+64\ \rho_s]\ \sqrt{f_c'} \qquad (9)$$

where $\rho_s = (A_s + A_{sh})/bd$ but shall not be greater than $0.20f_c'/f_y$, and A_{sh} shall not exceed A_s.

(c) Closed stirrups or ties parallel to the main tension reinforcement having a total cross-sectional area A_{sh} not less than $0.50A_s$, shall be uniformly distributed within two-thirds of the effective depth and adjacent to the main tension reinforcement.

(d) The rates $\rho = A_s/bd$ shall not be less than $0.04f_c'/f_y$.

CC-3421.9 Bearing. Bearing stresses shall not exceed $0.6f_c'$ except as provided below:

(a) When the supporting surface is wider on all sides than the loaded area, the permissible bearing stress on the loaded area may be multiplied by $\sqrt{A_2/A_1}$ but not by more than 2.

(b) When the supporting surface is sloped or stepped, A_2 may be taken as the area of the lower base of the largest frustum of a right pyramid or cone contained wholly within the support and having for its upper base the loaded area, and having side slopes of 1 vertical to 2 horizontal.

(c) This Subsection does not apply to post-tensioning anchorages.

CC-3422 Reinforcing Steel

CC-3422.1 Tension

(a) The design yield strength of reinforcement shall not exceed 60,000 psi.

(b) The average tensile stress shall not exceed $0.9f_y$.

(c) The tensile strain may exceed yield when the effects of thermal gradients through the concrete section are included.

CC-3422.2 Compression

(a) For load-resisting purposes, the stress shall not exceed $0.9f_y$.

(b) The strains may exceed yield when acting in conjunction with the concrete if the concrete requires strains larger than the reinforcing yield to develop its capacity.

CC-3423 Tendon System Stresses

The axial tensile capacity of the tendon shall not exceed $0.9f_{py}$.

CC-3430 ALLOWABLE STRESSES FOR SERVICE LOADS

CC-3431 Concrete Stresses

CC-3431.1 Compression. The allowable stresses for service compression loads are summarized in Table CC-3431-1. Compression under the tendon end anchor bearing plates shall not exceed

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CC-3136.5 *Add to read:*

CC-3136.5 Classification of Forces. Forces shall be classified in accordance with Table CC-3136.5-1.

Table CC-3136.5-1 *Add as shown on p. 19 of this Addenda.*

CC-3410 *Revise to read:*

CC-3410 GENERAL

In order to keep the containment basically elastic under service load conditions and below the range of general yield under factored primary loads, the allowable stresses and strains specified in this Subarticle shall be used. The allowable stresses given in CC-3421, CC-3422, CC-3423, CC-3431, CC-3432, and CC-3433 shall not be exceeded when the containment is subjected to the loads given in Table CC-3230-1.

CC-3422.1 *Revise to read:*

CC-3422.1 Tension

(a) The design yield strength of reinforcement shall not exceed 60,000 psi (433,000 kPa).

(b) The allowable stress for load resisting purposes shall not exceed 0.9 ϵy.

(c) The tensile strain in rebars resisting membrane and flexural components of the local section forces (but not the strain in rebars resisting local section shear forces) may exceed yield, provided that:

(1) Under primary forces only, a sufficient number of rebars must remain below yield strain to preclude attainment of a general yield state with respect to any components of section membrane strain and section flexural curvature. Rebar may be permitted to exceed yield strain under the effects of primary forces only under the following conditions:

(a) Primary Bending Moment—If more than one layer of reinforcing steel is provided to resist primary bending moments, one or more layer of reinforcing steel may be permitted to exceed yield strain provided that the strain at the centroid of all bars more than $h/6$ from the center of the concrete section on the maximum tension side of the section shall not exceed 0.9 ϵy.

(b) Tension Diagonal Rebar—The strain in the tension diagonal rebar of a 4-way rebar system subjected to primary loads may exceed 0.9 ϵy provided that the resulting section, when subjected to primary plus secondary loads, shall not have strains in excess of those specified in CC-3422.1(d). To avoid the possible buckling of compression diagonal rebars either diagonal rebars shall be enclosed by at least one layer of hoop rebars or tension and compression diagonal rebars shall be tied at their intersections.

(c) Adjacent to Large Openings—The maximum strain in rebar adjacent to large openings may exceed yield strain provided that, when a section of width one-half nominal containment shell thickness h extending from the opening or 25% of the opening diameter, whichever is smaller, is analyzed for the total forces and moments assumed uniformly distributed over the section width, no rebar strain shall exceed 0.9 ϵy.

(d) Net calculated tensile strains in any reinforcing bar (i.e. the total tensile strain in the bar minus the thermal strain in the adjacent concrete) shall not exceed 2 ϵy. For analysis purposes, ϵy is defined as the yield stress divided by Young's modulus.

CC-3432.1 *Revise subparagraph* (b)(3) *to read:*

(3) when secondary effects are combined with other loads

CC-3432.2 *Revise subparagraph* (b)(3) *to read:*

(3) when secondary effects are combined with other loads

CC-3511.1 *Revise subparagraph* (c) *to read:*

(c) Stress in reinforcement below 0.9 of the specified yield strength for the grade of steel used shall be taken as E_s times the steel strain. For strains greater than that corresponding to 0.9 ϵy, the stress in the reinforcement shall be considered independent of strain and equal to 0.9 ϵy.

CC-3842.1 *Revise to read:*

CC-3842.1 Category A. All welded joints of Category A shall meet the fabrication requirements of CC-4542 and shall be capable of being examined in accordance with CC-5520.

by 2 and substituted for N_u/A_g, f_m, or f_b in invoking the provisions of CC-3431.4.1, CC-3431.6, and CC-3431.7. The allowable stresses for bearing shall be 35% of the stresses given in CC-3421.9.

CC-3432 Reinforcing Steel Stresses and Strains

CC-3432.1 Bar Tension

(a) The average tensile stress shall not exceed $0.5 f_y$.

(b) The calculated average stress for the reinforcing in zones which have predicted concrete tension due to prestressing loads shall not exceed $0.5 f_y$. The maximum load considered need not exceed the initial force at tendon anchoring. The values given in (a) above may be increased by 33⅓% when the following loads are combined with other loads in the load combination:

(1) the temporary loads from prestressing which will reduce at completion of prestressing

(2) the temporary pressure loads during the test condition

(3) when temperature effects are combined with other loads

CC-3432.2 Bar Compression

(a) For load-resisting purposes, the stress shall not exceed $0.5 f_y$.

(b) The stress may exceed that given in (a) above for compatibility with the concrete but this stress may not be used for load resistance.

(c) The valves given in (a) above may be increased by 33⅓% when the following loads are combined with other loads in the load combination:

(1) the temporary loads from prestressing which will be reduced at completion of prestressing

(2) the temporary pressure loads during the test condition

(3) when temperature effects are combined with other loads

CC-3433 Tendon System Stresses

The tendon stresses at the anchor point shall not exceed the following allowables during stressing and anchoring:

(a) tension stress during stressing of $0.80 f_{pu}$ or $0.95 f_{py}$, whichever is greater:

(b) tension stress in a tendon at $0.75 f_{pu}$ anchoring;

(c) average tension stress of the $0.70 f_{pu}$ tendons after anchoring;

(d) the effective prestress shall be based on the force at $0.70 f_{pu}$ minus all losses up to the time being considered. End anchorage adequacy shall be based on testing.

CC-3440 CONCRETE TEMPERATURES

(a) The following temperature limitations are for normal operation or any other long term period. The tem- peratures shall not exceed 150 F except for local areas, such as around a penetration, which are allowed to have increased temperatures not to exceed 200 F.

(b) The following temperature limitations are for accident or any other short term period. The temperatures shall not exceed 350 F for the interior surface. However, local areas are allowed to reach 650 F from steam or water jets in the event of a pipe failure.

(c) Higher temperatures than given in (a) and (b) above may be allowed in the concrete if tests are provided to evaluate the reduction in strength and this reduction is applied to the design allowables. Also, evidence shall be provided which verifies that the increased temperatures do not cause deterioration of the concrete either with or without load.

CC-3500 CONTAINMENT DESIGN DETAILS

CC-3510 DESIGN FOR FLEXURE, AXIAL, AND SHEAR LOADS

CC-3511 Assumptions

CC-3511.1 Factored Load Design

(a) The design of sections for flexure and membrane loads shall be based on the assumptions given in this paragraph and on satisfaction of the applicable conditions of equilibrium and compatibility of strains.

(b) Strain in the reinforcing steel and concrete shall be assumed directly proportional to the distance from the neutral axis.

(c) Stress in reinforcement below the specified yield strength, f_y, for the grade of steel used shall be taken as E_s times the steel strain. For strains greater than that corresponding to f_y, the stress in the reinforcement shall be considered independent of strain and equal to f_y.

(d) Tensile strength of the concrete shall be neglected in flexural calculations of reinforced concrete.

(e) The relationship between the concrete compressive stress distribution and the concrete strain used in the analysis of sections may be assumed to be a triangle, parabola, or any other shape which results in prediction of stress and strains in substantial

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ASME BOILER AND PRESSURE VESSEL CODE
An American National Standard
(ACI Standard 359-77)

SECTION III — DIVISION 2
Code for Concrete Reactor Vessels and Containments

1977 Edition

This is the fifth Addenda to be published to the 1977 Edition of Section III, Division 2. Previous Addenda were published in Summer 1977, Winter 1977, Summer 1978, and Winter 1978.

CB-2520 *Revise as follows:*

(1) Delete CB-2524 *in its entirety.*

(2) Delete CB-2525 *in its entirety.*

(3) Redesignate CB-2526, CB-2526.1, CB-2526.2, *and* CB-2526.3 *as* CB-2524, CB-2524.1, CB-2524.2, *and* CB-2524.3, *respectively.*

(4) Redesignate CB-2527 *as* CB-2525.

(5) Revise CB-2528 *as follows:*

(a) Redesignate as CB-2526.

(b) In the first line, revise reference to CB-2525 *to read* CB-2523.

(6) Redesignate CB-2529 *as* CB-2527.

CC-3432.1 *Revise as follows:*

(1) Delete subparagraph (b)(2) *in its entirety.*

(2) Redesignate subparagraph (b)(3) *as subparagraph* (b)(2).

(3) Add subparagraph (c) *to read:*

(c) The values given in (a) above may be increased by 50% when the temporary pressure loads during the test condition are combined with other loads in the load combination.

CC-3510 *Revise the title to read:*

CC-3510 DESIGN FOR FLEXURE AND AXIAL LOADS

Table I-2.2 *Under* Plate, *as shown on p. 2 of this Addenda:*

(1) Revise entries for SA-537.

(2) Add SA-299 *and* SA-738.