APPENDIX B - CONSTRUCTION MATERIAL STANDARDS AND QUALITY CONTROL PROCEDURES

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APPENDIX B

CONSTRUCTION MATERIAL STANDARDS AND QUALLTY CONTROL PROCEDURES

B.1 CONCRETE STANDARDS

B.1.1 General

Concrete work conformed to the requirements as cited from the Codes, Standards and Recommended Practices as listed in Table 3.8-4 with the exceptions and additional requirements indicated in this Section B.1.

B.1.2 Material Requirements and Quality Control

B.1.2.1 Cement

Type I and Type II Portland Cement, which conformed to the applicable requirements of "Specification for Portland Cement" (ASTM C150) was used in the concrete work. Type II cement was used in the containment structure where reduced heat of hydration was desirable.

Qualification Tests preliminary to mix design were performed on every source of cement for conformance with ASTM C150.

The cement supplier furnished certification with each shipment of cement to the project site for the following ASTM tests:

a. ASTM C114, "Chemical Analysis of Hydraulic Cement," including actual Na_20 content and requirements for tricalcium silicate and tricalcium aluminate as specified in Table 1A of ASTM C150.

b. ASTM C109, "Test for Compressive Strength of Hydraulic Cement Mortars" (results were forwarded within 30 days after delivery),

c. ASTM C204, "Test for Fineness of Portland Cement by Air Permeability Apparatus," and

d. ASTM C266, "Tests for Time of Setting of Hydraulic Cement by Gilmore Needles," or C191, "Tests for Time of Setting of Hydraulic Cement by Vicat Needle."

Control Testing was performed for the following ASTM tests, based on a frequency of every 1200 tons:

a. ASTM C114, "Chemical Analysis of Hydraulic Cement," including for Type II cement sum of tricalcium silicate and tricalcium aluminate as specified in Table 1A of ASTM C150.

b. ASTM C266 or C191,

c. ASTM C151, "Test for Autoclave Expansion of Portland Cement,"

d. ASTM C204,

e. ASTM C185, and

f. ASTM C109.

All cement was stored in accordance with the applicable requirements of Section 2.5.1 of ACI 301-72, "Specification for Structural Concrete for Buildings."

B.1.2.2 Aggregates

Fine and coarse aggregates conformed to "Standard Specification for Concrete Aggregates" (ASTM C33-74) and to the following:

a. Aggregate sizes used were numbers 67 or 8 (ASTM C33-74) or CA-7 (Illinois Division of Highways Standard Specification for Road and Bridge Construction - 1971).

b. Coarse aggregate contained less than 15% (by weight) flat and elongated particles as determined by CRD-C119-53, "Method of Test for Flat and Elongated Particles in Coarse Aggregate."

c. In the case of crushed coarse aggregate, if the material finer than the No. 200 sieve consisted of the dust fracture, essentially free from clay or shale, material up to 2.5% was allowed.

d. ASTM C33 paragraph 3.5 was deleted from specified requirements.

Samples of aggregate were obtained in accordance with ASTM D75, "Sampling Aggregates," and the following Qualification Tests preliminary to mix design were performed on each source and type of aggregate proposed for use:

a. ASTM C136, "Sieve or Screen Analysis of Fine and Coarse Aggregates,"

b. ASTM C117, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing,"

c. ASTM C40, "Organic Impurities in Sands for Concrete,"

d. ASTM C87, "Effect of Organic Impurities in Fine Aggregate on Strength of Mortar,"

e. ASTM C88, "Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate,"

f. ASTM C142, "Clay Lumps and Friable Particles in Aggregates,"

g. ASTM C123, "Lightweight Pieces in Aggregate,"

h. ASTM C131, "Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine,"

i. ASTM C235, "Scratch Hardness of Coarse Aggregate Particles,"

j. ASTM C127, "Specific Gravity and Absorption of Coarse Aggregate,"

k. ASTM C128, "Specific Gravity and Absorption of Fine Aggregate,"

l. ASTM C29, "Unit Weight of Aggregate,"

m. ASTM D1411, "Water-Soluble Chlorides Present as Admixes in Graded Aggregate Road Mixes,"

n. ASTM C295, "Petrographic Examination of Aggregates for Concrete," and

o. CRD-C119.

The following control tests were performed during periods of casting of concrete to ascertain conformance with ASTM C33, "Specifications for Concrete Aggregates," at the frequencies indicated:

a. ASTM C136, C566, and C117 - daily during concrete production;

b. ASTM C29 and C40 - weekly during concrete production;

c. ASTM C566, "Total Moisture Content of Aggregate by Drying" - daily;

d. ASTM C142, C123, and C235 - monthly during production; and

e. ASTM C131 or C535, CRD-C119, ASTM C289 and C88 every 6 months during concrete production.

If an aggregate sample failed any of these tests, two additional samples were taken immediately and the test for which the original sample did not meet specification requirements was repeated on each. If one or both of the retests failed, production was halted and appropriate engineering evaluation was performed to determine the necessary action required.

Samples for tests were in accordance with ASTM D75-71, Paragraph 3.3.3, with the following modification: the gradation tests for each source and type of aggregate proposed for use that day were performed on samples collected and blended into one combined sample from four locations in that portion of the stockpile intended for use that day.

Control, handling and storage of aggregates, were in accordance with Section 2.5.2 of ACI 301-72.

B.1.2.3 Admixtures

Air-entraining admixtures conformed to "Specification for Air-Entraining Admixture for Concrete" (ASTM C260), including "Optional Uniformity Requirements" in Section 5. Air-entraining admixtures containing more than 1% chloride ions were not used.

The air entrained admixture supplier furnished Certified Material Test Reports which state that the admixture was tested in accordance with ASTM C260 and satisfied both of these above additional requirements. This certification included the manufacturer's statements as described in Sections 4.1, 4.2, and 4.3 of ASTM C260, and also included the results of the following tests performed on a composite sample from each shipment:

a. Infrared spectrophotometry

b. pH value

c. Solid content

d. Chloride ion content

e. Specific Gravity.

Chemical admixtures conformed to "Specification for Chemical Admixtures for Concrete" (ASTM C494). Type A, water-reducing admixtures were permitted, subject to the following requirements:

a. The material was either a hydroxylated carboxylic acid base or a modified salt thereof, or a hydroxylated polymer base.

b. The material was not prepared by the addition of any chloride ions. The supplier certified that the admixture did not contain from all sources more than 1%, by weight, of chloride ions.

c. The supplier furnished certified test results of specific gravity, infrared spectrophotometry, pH value and solids content of the material used for the project, establishing the equivalence of materials from the different lots or different portions of the same lot in accordance with Article 4.4 of ASTM C494.

Storage of admixtures was as specified in Section 2.5.5 of ACI 301-72. Each shipment was also sampled and tested for pH, solids content, and infrared spectrophotometrics analysis in accordance with ASTM C494.

B.1.2.4 Water and Ice

Mixing water and ice conformed to the requirements of Section 2.3 of ACI 301-72.

Comparisons of mixing water and ice were made with distilled water by performing the following tests:

a. Soundness (ASTM C151) - The results obtained for mixing water or ice were not greater, by more than +0.10%, than those obtained with distilled water.

b. Time of Set (ASTM C191) - The results obtained for mixing water or ice were within ± 10 minutes for initial setting time and ± 1 hour for final setting time of those obtained with distilled water.

c. Compressive Strength (ASTM C109) - The results obtained with the mixing water or ice were not lower than 10% of those obtained from distilled water.

These test were performed initially and every 6 months during concrete production.

B.1.3 Concrete Properties and Mix Design

Concrete mix design conformed to ACI 211.1-74.

Mix Properties for Trial Mixes:

a. Slump - Concrete was proportioned to have a slump of 3 inches ± 1 inch at 70°F as determined by ASTM C143, "Slump of Portland Cement Concrete."

b. Air content - Air content was 3% plus or minus 1% as determined by ASTM C231, “Air Content of Freshly Mixed Concrete by the Pressure Mixture.”

c. Specified compressive strength: Two structural concrete strengths and one fill concrete strength were furnished as follows:

   1. 4000 psi at 91 days

   2. 3500 psi at 91 days

   3. 2000 psi at 28 days (fill concrete).

B.1.3.1 Trial Mixtures

Trial mixtures having proportions and consistencies suitable for the work were made using at least three different water-cement ratios which produced a range of strengths encompassing those required for the work. All materials including the water were those used at the project site.

For each water-cement ratio, at least three compression test cylinders for each test age were made and cured in accordance with "Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory" (ASTM C192). They were tested for strength at 7, 28, and 91 days, in accordance with "Method of Test for Compressive Strength of Cylindrical Concrete Specimens" (ASTM C39). From the results of these tests, curves were plotted showing the relationship between water-cement ratios and compressive strength.

B.1.3.2 Design Mixtures

Until the standard deviation was calculated for each of the mixtures used, the required average strength was determined by adding 1200 psi to the required compressive strengths of 4000 psi and 3500 psi at 91 days.

This required average strength was entered into water-cement ratio strength curves to determine the maximum water-cement ratio.

This water-cement ratio was used with the water requirement reported from trial mixes corrected for the allowed tolerances in slump, air content, and temperature for the aggregate size to calculate the minimum cement content.

Adjustments in absolute volume to maintain yield were made by adjusting aggregate amounts while maintaining the sand percentage of the original trial mixture.

B.1.3.3 <u>Adjustment of Design Mixtures</u>

After the accumulation of no less than 30 tests at 91 days of a mix design, these tests were evaluated by statistical methods in ACI 214 and the standard deviation was calculated. A new required average strength, fave required, was computed, using the higher of the values computed below:

f_{ave} req. = $f'_c + 1.343\ \sigma$

f_{ave} req. = $f'_c - 500 + 2.326\ \sigma$

where:

f'_c = specified compressive strength, and

σ = standard deviation.

With this new required average strength, the design mixtures procedure was repeated to obtain revised mix proportions using the curve for the water-cement ratio and compressive strength.

If, during the course of construction, statistical surveillance revealed that the required average was not achieved, or if the standard deviation had changed more than ± 75 psi, an investigation was performed by Sargent & Lundy to investigate the cause and determine what corrective action was necessary.

B.1.4 <u>Formwork</u>

All formwork conformed to Chapter 4 of ACI 301-72 and as hereinafter specified.

Forms for all exposed surfaces conformed to Section 10.2.2, "Smooth Form Finish," of ACI 301-72.

"Exposed surfaces" as used means all formed concrete surfaces exposed to view on completion of work.

All exposed projecting corners of concrete work such as piers, columns, equipment foundations, switchyard foundations, and turbine foundations were beveled.

For exposed surfaces and exposed vertical corners of structures in contact with the ground, the smooth form finish and the vertical bevels were extended 1 foot 0 inch below finish grade.

B.1.5 <u>Joints and Embedded Items</u>

Joints and embedded items conformed to the following:

a. For bonding, methods in Sections 6.1.4.1 and 6.1.4.2 of ACI 301-72 were implemented as approved for specific applications.

b. Horizontal construction joints in Category I structures were grouted immediately before placement of concrete in accordance with provisions of Section 8.5.3, ACI 301-72, with the following allowed exceptions:

1. Horizontal construction joints for columns, where slabs or slab-beam systems were being poured, had the top of the preceding pour sandblasted to remove laitance and curing compound after the initial curing time. Immediately prior to placing fresh concrete, the joint was moistened with water and covered with a maximum of 12 inches of fresh concrete which was thoroughly vibrated.

2. Where 3/8 inch aggregate concrete was used, horizontal construction joints were not required to be grouted.

c. Unformed construction joints were protected against loss of water required for curing, immediately after completion of construction, by one of the following methods:

1. Application of damp sand or moistened fabrics kept continuously moist for 7 days. Prior to resumption of placement, the curing materials were completely removed from the concrete surface.

2. Application of curing compound containing nonfugitive pigments. Prior to resumption of placement, this surface was completely cleaned by sand blasting, chipping, or jack hammering.

3. Curing according to ACI 301-72 Subsection 12.2.1.1.

B.1.6 Bar Placement

Bar placement conformed to the design drawings and to the applicable requirements of Section 7.2 and 7.3 of ACI 318-71; to Sections 5.4 and 5.5 of ACI 301-72; to Chapter 8, "Placing Reinforcement Bars" of CRSI "Manual of Standard Practice," 21st Edition; and to the following:

a. In lieu of tolerances in Section 7.3.2.1 of ACI 318-71 and Sections 5.4.2.1 and 5.4.2.4 of ACI 301-72, the following tolerances applied unless other specific requirements were identified on the design drawings:

1. Clear distance to formed surfaces:

For #3 through #11 bars:	±1/4 in. for straight bars, ±1/2 in. for bent bars.
For #14 and #18 bars:	±1/2 in. for straight bars, ±1 in. for bent bars;

but the cover was not be reduced by more than one-third of the specified cover, and cover was not less than 1-1/2 in. for #14 and ±18 bars at interior surfaces.

2. Spacing tolerance between parallel bars:

   For #3 through #18 bars: ±2 in.

   but minimum spacing and clear distance to surfaces was not violated. The clear distance between parallel bars in a layer was not less than the nominal diameter of the bars, nor 1-1/3 the maximum size of the cover aggregate, nor one inch. Where parallel reinforcement was placed in two or more closely spaced layers, the bars in the upper layers were placed directly above those in the bottom layer with the clear distance between layers not less than one inch.

3. Clear distance to formed surface of electrical duct runs had a tolerance of ±1-1/2 inches to -1/2 inch.

   The clear distance limitations between bars also applied to the clear distance between a contact (lap) splice and adjacent splices or bars.

   Placing tolerance for reinforcing lap lengths and development lengths indicated on design drawings was -2 inches or -2 bar diameters, whichever was larger; and lap lengths and development lengths were allowed to exceed lengths indicated on the design drawings as long as concrete cover requirements were not violated. If different sized bars were lapped, the diameter of the larger bar applied for determining the lap tolerance.

b. Reinforcement was accurately placed and adequately supported before concrete was placed and was secured against displacement beyond permitted tolerances. Welding of crossing bars was not permitted.

c. Reinforcing bars at time concrete was placed were free from mud, oil, ice, snow, or other nonmetallic coatings that adversely affect bonding. Reinforcing bars with rust, mill-scale, or a combination of both, were considered satisfactory provided the minimum dimensions, including height of deformations and weight of a hand wire brushed test specimen were not less than specified in ASTM A615.

B.1.7 <u>Bending or Straightening of Bars Partially Embedded in Set Concrete</u>

Bending or straightening of bars partially embedded in set concrete was not permitted except in isolated cases where corrective action or a field change was required and specifically approved by Sargent & Lundy.

The bend diameter conformed to the requirements listed below.

Bar No. 3 through No. 5 were cold bent once. Preheating was required for subsequent straightening or bending. Bars No. 6 and larger were preheated for any bending.

MINIMUM DIAMETER OF BEND

Bar Size	Minimum Diameter of Bend
No. 3 through No. 8	6 bar diameters
No. 9, No. 10, No. 11	8 bar diameters
No. 14, No. 18	10 bar diameters

When required, preheating prior to bending or straightening was performed in accordance with the following:

a. Preheating was applied by methods which do not harm the bar material or cause damage to the concrete.

b. The preheat was applied to a length of bar at least equal to five bar diameters in each direction from the center of the portion to be bent or straightened, except that preheat was not extended below the surface of concrete. To avoid splitting the concrete, the temperature of the bar at the concrete interface did not exceed 500° F.

c. The preheat temperature was 1100° F to 1200° F.

d. The preheat temperature was maintained until bending or straightening was completed.

e. The preheat temperature was measured by temperature measurement crayons or contact pyrometer.

f. Precautions were taken to avoid rapid cooling of preheated bars. Water was never allowed to be used for cooling.

B.1.8 Batching, Mixing, Delivery, and Placement

Concrete was produced with a central mixing plant and accessory equipment which conformed to the following:

a. Concrete Plant Standards, Concrete Plant Manufacturers Bureau, Fifth Revision - Effective March 1, 1973.

b. Certification of Ready Mixed Concrete Production Facilities, National Ready Mixed Concrete Association, Third Revision - effective January 1, 1976. Exception was taken to test weight requirements when an approved state agency performed the required scale calibration at 90-day intervals.

c. Standard Specification for Ready Mixed Concrete, ASTM C94-74, American Society for Testing and Materials, Sections 8, 9, 10, and Appendix XI. Mixer uniformity was tested initially, and every six months thereafter when concrete placement was proceeding, in accordance with provisions of Appendix XI, ASTM C94-74.

d. Concrete Plant Mixer Standards, Plant Mixer Manufacturers Division, Concrete Plant Manufacturers Bureau, Fourth Revision, July 1, 1973.

e. Recommended Guide Specifications for Batching Equipment and Control Systems in Concrete Batch Plants, CPMB Publication No. 102, Concrete Plant Manufacturers Bureau, 1971.

B.1.9 Concrete Placement

The limits on fresh concrete air content were as follows:

a. Concrete with 3/8-inch aggregate: 4% to 7%.

b. All other concrete: 3% ± 1%.

The limits on fresh concrete slump were as follows:

a. 3-1/2 inches, ± 1 1/2 inches.

b. In special cases mixes were adjusted in control conditions to facilitate placing.

Placing temperatures for concrete were 75° F maximum and as follows:

a. Less than 2-1/2 feet minimum dimension, 75° F maximum.

b. From 2-1/2 to 6 feet minimum dimension, 70° F maximum.

c. Over 6 feet minimum dimension, 65° F maximum.

B.1.10 Witness and Inspections

Concrete placement conformed to the applicable requirements of Sections 8.1, 8.2, and 8.3 of ACI 301-72 and the following:

a. All concrete was placed in a continuous and uninterrupted operation in such manner as to form a monolithic structure, the component parts of which were integrally bonded together. No concrete was deposited which had been segregated, contaminated by foreign materials, or considered nonplastic.

b. Concrete was considered plastic if either of the following requirements were met:

1. If immediately before recommencing concrete placement a vibrator spud suspended vertically was applied to the concrete surface and it penetrated at least 6 inches into the concrete during

15 seconds of application, the concrete was considered plastic, if not, the concrete was considered non-plastic.

2. If the temperature of the concrete in place and the time interval between placement of successive batches was within the following temperature and time limits:

Concrete Temperature	Time Limit
80° F	35 minutes
70° F	40 minutes
60° F	55 minutes
50° F	65 minutes

c. If concrete was found to be nonplastic, concrete was placed in accordance with requirements of Section 8.5.3 of ACI 301-72, except that no dampening was required before the application of grout.

d. Concrete was placed in the forms after introduction of mixing water to cement and aggregates, within the following time limits:

Concrete Temperature	Time
Below 60°F	2-1/2 hours
60o F to 70°F	2 hours
Above 70°F	1-1/2 hours

Concrete that was beyond the allowable limits for slump and air content but within the extreme limits allowed under tightened sampling was placed within a 1-1/2 hour time limit. Otherwise the concrete was rejected.

e. During hot weather concreting, when the ambient temperature rose above 85° F, adequate provisions against plastic shrinkage cracking, as specified in ACI 305-72, Chapter 2, were implemented.

f. During cold weather concreting, concrete was not placed at a temperature lower than that indicated in Line 7, Table 1.4.1 of ACI 306-66 and was maintained to at least that temperature for 3 days.

B.1.11 Concrete Control Tests

Concrete cylinders were molded and cured in accordance with "Method of Making and Curing Concrete Compression and Flexural Specimens in the Field" (ASTM C31). Two cylinders for 91 day tests were molded from each 100 yd^3 or from each day's pour if less than 100 yd^3. In addition, cylinders were molded as follows:

Total Cubic Yards of Concrete Placed in Each Continuous Placement of Concrete	Number of Sets of Cylinders and Total Cylinders Required
500 yd^3 or Less	Two sets of two each, total four, from each 100 yd^3 or from each day's placement if less than 100 yd^3 one set for 7-day test; one

	for 28-day test.
500 to 2000 yd^3	Two sets of two each, total four, from each 200 yd^3; one set for 7-day test; one for 28-day test.
Over 2000 yd^3	Two sets of two each, total four, from each 300 yd^3; one set for 7-day test; one for 28-day test.

Cylinders were tested in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C39). Concrete acceptance was based upon 91-day strength results, while the 7-day and 28-day results were used for information.

Normal samples of fresh concrete for measurement of slump (ASTM C143), air content (ASTM C173, C231), and temperature were taken for the first batch placed every day and every 50 yd^3.

When tests on normal samples indicated measurement of a concrete property; temperature, slump, or air content out of specification ranges, an additional sample was taken from the chute of the next available truck. If measurement of this additional sample indicated this property to be out of allowable limits but within extreme values, this truck load was placed. If not within these extreme limits, this truck load was rejected for remixing or wasting. A second additional sample was then taken from the next available truck and tested. This procedure continued until tests on two successive additional samples indicated that the concrete properties were within specification range. Normal sampling was then resumed.

In the event that seven consecutive sampled trucks remained on tightened inspection, placement of concrete was interrupted until adjustments at the batch plant could be made to provide acceptable concrete properties.

B.1.11.1 Evaluation and Acceptance of Fresh Concrete

Concrete which had set was not retempered but was discarded.

Concrete was rejected for remixing or wasting if any of the following conditions existed:

a. Time limitations after introduction of water to cement were exceeded.

b. Seven consecutive trucks or batches remained on tightened inspection in Subsection B.1.11.

c. Allowable limits or extreme limits were exceeded when tightened inspection was implemented, for tests discussed in Section B.1.11.

B.1.12 Evaluation and Acceptance of Concrete Compression Results

The strength level of concrete was considered satisfactory if the following two criteria were satisfied when using the standard deviation from at least 30 consecutive strength tests representing similar concrete, and conditions of concrete being evaluated:

a. A probability of not more than 1 in 100 that an average of three consecutive strength tests was below specified strength.

b. A probability of not more than 1 in 100 that an individual strength test was more than 500 psi below the specified strength.

Methods in ACI 214 were used in concrete evaluation along with the above criteria.

The above criteria were considered satisfied if either:

a. The average of all sets of three consecutive strength test results at 91 days equaled or exceeded the specified compressive strength by more than 500 psi, or

b. The average compressive strength, f required, conformed to the following two expressions:

$$f\ \text{required} = fc' + 1.343\sigma$$

$$f\ \text{required} = fc' - 500 + 2.326\sigma$$

where:

fc' = specified compressive strength

σ = standard deviation.

B.1.13 Consolidation of Concrete

Consolidation of concrete conformed to requirements in Section 8.3.4 of ACI 301-72, and the following:

a. All concrete was consolidated by sufficient vibration so that concrete was worked around reinforcement, around embedded items, and into corners of forms, eliminating air or stone pockets.

b. When a layer of concrete was being consolidated, the vibrator spud penetrated at least 6 inches into the previously consolidated layer.

c. Spacing of vibrator insertions and withdrawals caused overlapping "spheres of influence", generally at about 18-inch spacing.

d. Vibrators were not used to effect horizontal movement of concrete except in special cases where concrete was vibrated beneath obstructions following definite procedures.

e. If in the opinion of the inspector, segregation was occurring prior to adequate consolidation, adjustment of mixture or pattern of vibration was considered.

B.1.14 Curing and Protection

Curing and protection conformed to the requirements of Chapter 12 in ACI 301-72 and the following:

a. Subsections 12.2.1.1 through 12.2.1.6 and 12.2.2 of ACI 301-72 do not apply.

b. Where forms are stripped before completion of specified curing period, curing compound is applied immediately after completion of specified surface treatment.

c. Curing is continued for not less than the minimum periods specified in Section 12.2.3 of ACI 301-72 before applying any other surfacing or before opening to traffic.

B.2 REINFORCING STEEL

B.2.1 Requirements for Category I Materials

Reinforcing bars for all Category I structures were Grade 60 deformed bars tested in accordance with criteria in NRC Regulatory Guide 1.15 for "Testing of Reinforced Bars for Category I Concrete Structures." They met the requirements of ASTM A615, "Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement," with the following modifications: Paragraphs 4.2, 7.3, 8.4 and all of Sections 9 and 10, and Paragraphs 11.1, 11.2, 11.3 and 11.4 were modified as shown below and used in lieu of the same parts specified in ASTM 615, and Paragraphs 14.3.5 and 15.2 as indicated below were added to Sections 14 and 15 of ASTM 615.

a. The following sections or paragraphs of A615 were modified as indicated, except that for Paragraph 8.1 the new sentence indicated was added:

4.2 The chemical composition thus determined shall be transmitted to the Purchaser or his representative.

7.3 The percentage of elongation for bars numbers 3 through 11 shall be as prescribed in Table 2. For bars numbers 14 and 18, the minimum elongation in 8 inches shall be 12%.

8.1 The pin diameter for 90° bend-test shall be equal to 8d for bars numbers 14 and 18.

8.4 Bars of size numbers 14 and 18 shall be bend-tested as required in Paragraph 9.3.

9.0 Test Specimens

9.1 All the tension test specimens shall be full-section of the bar, as rolled, sampled by a recognized procedure of random sampling, as approved by the client.

9.1.1 Test procedures shall be in accordance with ASTM A370.

9.1.2 Shall not apply.

9.2 The unit stress determinations on full size specimens shall be based on the nominal bar cross-sectional area as indicated in Table 1.

9.3 The bend-test specimens shall be full-section of the bar as rolled, and sampled by a recognized procedure of random sampling.

10. Number of Tests

10.1 At least one full-section specimen from each bar size shall be tested for each 50 tons or fraction thereof of the reinforcing bars that are produced from each heat.

10.2 Testing shall include both tension tests and bend-tests.

11.1 If any test specimen develops flaws, or if it fails because of mechanical reasons such as failure of testing equipment or improper specimen preparation, it may be discarded and another full-section specimen of the same size bar from the same 50 tons, or fraction thereof, substituted.

11.2 If any of the tensile properties of one out of the total number of test specimens corresponding to a heat is less than that specified in Section 7 as modified herein, but is greater than the following limits, a retest may be allowed.

	Grade 60
Tensile strength, psi	83,00
yield, psi	55,000
Elongation in 8 inches,	percent
Bar No.	
3, 4, 5, 6	6
7, 8, 9, 10. 11	5
14, 18	9

11.2.1 Retest shall consist of at least two additional full-section tensile tests on samples of the same bar size and from the same 50 tons, or fraction thereof.

11.2.2 Each of the additional test specimens and the average of all of the test specimens secured from the 50 tons, or fraction thereof (including the original test), shall meet the requirements of Section 7 as modified herein.

11.3 If original test fails to meet limits shown in 11.2 or if any tensile or bending property of specimens as retested as in accordance with 11.2.1 and 11.2.2 does not meet the requirements in Section 7 as modified herein, the heat shall be rejected.

11.4 If any tensile property of the tension test specimen is less than that specified in Section 7 as modified in 11.2 and any part of the fracture is outside the middle third of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

b. The following paragraphs shall be added to Sections 14 and 15 of A615.

14.3.5 Reinforcing shall be tagged or marked to ensure traceability to the Certified Test Report during production, and while in transit and storage.

15.2 The Purchaser reserves the right to witness all required sampling and testing.

All reinforcing was tagged or marked in a manner to ensure traceability to the Certified Material Test Report (CMTR) during production, fabrication, transportation and storage. Traceability for all reinforcing bars was by the original heat number.

Traceability of all reinforcing was completed up to the placing of the reinforcing, which was considered as the last hold point for the bars.

B.2.2 Reinforcing Bar Fabrication

Fabrication for all reinforcing bars conformed to the requirements in Chapter 7 of CRSI "Manual of Standard Practice" and to the following:

a. Bar ends for bars which were spliced using Cadweld procedures were checked for clearance after shearing, using a test sleeve representing a standard Cadweld sleeve.

B.2.3 Cadweld Splicing

Bar sizes No. 14 and No. 18 were Cadweld spliced. The splice was designed to develop the specified minimum ultimate strength of the reinforcing bar.

B.2.3.1 Qualification of Operators

Prior to production splicing, each Cadweld operator prepared two qualification splices for each position used in his work. These were tested and met the joint acceptance standards for workmanship, visual quality, and minimum tensile strength.

B.2.3.2 Procedure Specifications

All joints were made in accordance with the manufacturer's instructions, "Cadweld Rebar Splicing," plus the following additional requirements:

a. A manufacturer's representative, experienced in Cadweld splicing of reinforcing bars, was required to be present at the jobsite at the outset of the work to demonstrate the equipment and techniques used for making quality splices. He was present for the first 25 production splices to observe and verify that the equipment was being used correctly and that quality splices were being obtained. The Cadweld manufacturer furnished the Certified Material Test Report for each lot of splice sleeve material delivered. This report included the physical and chemical properties of the sleeve material. The splice sleeves, exothermic powder, and graphite molds were stored in a clean dry area with adequate protection from the elements to prevent absorptions of moisture.

b. Each splice sleeve was visually examined immediately prior to use to ensure the absence of rust and other foreign material on the inside diameter surface, and to ensure the presence of grooves in the ends of the splice sleeve.

c. The graphite molds were preheated with an oxyacetylene or propane torch to drive-off moisture at the beginning of each shift when the molds were cold or when a new mold was used.

d. Bar ends to be spliced were power-brushed to remove all loose mill scale, loose rust, concrete, and other foreign material. Prior to power-brushing, all water, grease, and paint were removed by heating the bar ends with an oxyacetylene or propane torch.

e. A permanent line was marked 12 inches back from the end of each bar for a reference point to confirm that the bar ends were properly centered in the splice sleeve. In those cases where the 12 inch gauge length was not practical, different gauge lengths were used, provided they were properly documented.

f. Immediately before the splice sleeve was placed into final position, the previously cleaned bar ends were preheated with an oxyacetylene or propane torch to ensure complete absence of moisture.

g. Special attention was given to maintaining the alignment of sleeve and pouring basin to ensure a proper fill.

h. The splice sleeve was externally preheated with an oxyacetylene or propane torch after all materials and equipment were in position. Prolonged and unnecessary overheating was avoided.

i. Each splice was examined by the operator prior to forming to ensure compliance with all requirements. All completed splices and sister test specimens were stamped with the operator identification mark.

B.2.3.3 Visual Examination

All completed splices (including the sister test specimens) were inspected to ensure compliance with the visual examination acceptance standards. Splices that failed any requirement were rejected and replaced and not used as tensile test samples.

All visual examinations on completed splices were performed only after the splices had cooled to ambient temperature. The visual examination acceptances standards were:

a. Filler metal was visible at the end(s) of the splice sleeve and at the tap hole in the center of the sleeve. Except for voids, the filler metal recession was not more than 1/2 inch from the end of the sleeve.

b. Splices did not contain slag or porous metal in the tap hole or at the end(s) of the sleeves. When in doubt as to whether filler metal or slag was in the tap hole, the riser was broken with a punch or file, filler metal shines while slag remains dull. If slag was found, the inspector removed slag at the tap hole and searched for filler metal. This requirement was not cause for rejection unless the slag penetrated beyond the wall thickness of the sleeve.

c. A single shrinkage bubble present in the tap hole was distinguished from general porosity and it was not cause for rejection.

d. The total void area at each end of the sleeves did not exceed the following limits (for splicing bars up to Grade 60):

1. for No. 18 bars - 2.65 in^2
2. for No. 14 bars - 2.00 in^2
3. for No. 11 bars - 1.5 in^2
4. for No. 10 bars and splice Catalog Number RBT-10101 (H) - 1.58 in^2
5. for No. 1 bars in general and Nos. 9, 8, 7, and 6 - 1.031 in^2.

e. The distance between the gauge lines for a type "T" splice was 24-1/4 inches ± 1/2 inch. The center of the gauge line connecting the gauge marks fell within the diameter of the tap hole.

f. The distance between the gauge line and the structural steel for Type "B" splice was 12-1/4 inches ± 1/4 inch.

B.2.3.4 Sampling and Tensile Testing

Splice samples were production splices and sister splices. Production splice samples were not cut from the structure when Type "B" splices were used, or when Type "T" splices were used for curved reinforcing bars. Representative straight sister splice samples were used in such cases, using the same frequency as Type "T" splices on straight bars, except that all splice samples are sister splices. Separate sampling and testing cycles were established for Cadweld splices in horizontal, vertical, and diagonal bars, for each bar grade and size, and for each splicing operator or crew as follows:

a. one production splice out of the first ten splices,

b. one production and three sister splices for the next 90 production splices, and

c. one splice, either production or sister splices for the next subsequent units of 33 splices. At least 1/4 of the total number of splices tested were production splices.

The tensile testing acceptance standards were:

a. The tensile strength of each sample tested was equal or exceeded 125% of the minimum yield strength specified in Table 2 of ASTM A615-75 for the grade of reinforcing bar using loading rates as stated in ASTM A370-75 for the grade of reinforcing bar.

b. The running average tensile strength of 15 consecutive samples was equal to or exceeded the ultimate tensile strength specified in ASTM A615-75 for the grade of reinforcing bar.

Procedure for substandard tensile test results:

a. If any production splice used for testing failed to meet the strength requirements in (a) above and failure did not occur in the bar, the adjacent production splices on each side of the failed splice were tested. If any sister splice used for testing failed to meet the strength requirements in (a) above and failure did not occur in the bar, two additional sister splices were tested. If either of these retests failed to meet the strength requirements, splicing was halted. Splicing was not resumed until the cause of failures were corrected and resolved to the satisfaction of Sargent & Lundy.

b. If the running average tensile strength indicated in (b) above failed to meet the tensile requirements stated therein, splicing was halted. Sargent & Lundy investigated the cause, determined what corrective action (if any) was necessary, and notified the Contractor to perform the corrective action (if any).

c. When mechanical splicing was resumed, the sampling procedure was started anew.

B.3 STRUCTURAL STEEL

B.3.1 Structural Steel Materials

Structural support steel was ASTM A36, ASTM A572 Grade 50, and ASTM A588 Grade 50 high strength, low alloy corrosion-resistant steel.

B.3.2 Structural Steel Connections and Connection Material

B.3.2.1 Bolted Connections

High strength structural steel connections used ASTM A325 and ASTM A490 high strength bolts. These connections conform to AISC Specifications. For other types of connections, ASTM A36 and ASTM A193 Grade B7 material was used for threaded rods, ASTM A307 was used for headed bolts, and ASTM A307, A563 or A194 Grade 2 material was used for nuts.

B.3.2.2 Welded Connections

Standard welded beam connections conformed to Table III or IV of AISC Manual, Seventh Edition. Shop and field welding procedures were in accordance with AWS Specifications listed in Table 3.8-4. Selection of electrodes and recommended minimum preheat and interpass temperature were in accordance with AWS requirements. All welders and welding operators were certified by an approved testing laboratory and were qualified under AWS procedure as stated in AWS Specifications.

B.3.3 Quality Control

B.3.3.1 General

Quality control requirements were applied to the fabrication and testing of structures and components. Certified material test reports were furnished stating the actual results of all chemical analyses and mechanical tests required by ASTM specifications. Identifying heat numbers were furnished on all structural steel to trace the steel to the specific heat in which the steel was made.

B.3.3.2 Testing and Inspection of Weldments

One hundred percent of all complete penetration groove welds for beams, girders, and columns had complete radiographic examination, except that welds impractical to radiograph were examined by ultrasonic and either magnetic particle or liquid penetrant methods.

The above nondestructive test methods were in compliance with applicable sections of the following ASTM specifications:

a. E94, "Recommended Practice for Radiographic Testing,"

b. E142, "Controlling Quality of Radiographic Testing,"

c. E164, "Recommended Practice for Ultrasonic Contract Examination of Weldments,"

d. E109, "Dry Powder Magnetic Particle Inspection,"

e. E138, "Wet Magnetic Particle Inspection,"

f. E165, "Recommended Practice for Liquid Penetrant Inspection Method," and

g. AWS D1.1 (as clarified VWAC, Revision 2).

All other weld joints including fillet welds, were 100% visually examined. The visual examination conformed to all applicable requirements of AWS D1.1 through September 1985. Visual welding inspection after that date was performed to the criteria contained in VWAC, Revision 2. Clarifications to and deviations from portions of AWS D1.1 are made based on engineering evaluations.

B.3.3.3 Fabrication

The fabrication of structural steel conformed to AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," 1969 or 1978.

B.4 REACTOR PEDESTAL-SHIELD WALL

B.4.1 Type of Construction

The reactor pedestal and the reactor shield wall are shell-type structures fabricated from steel plates.

The materials, fabrication, erection, and examination procedures for the reactor pedestal conformed to the requirements of Articles NF-2000, NF-4000, and NF-5000 of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1974 Edition, Winter 1975 Addenda and applicable code cases acceptable to consulting engineers for a plate and shell-type Class I component support. The pedestal was not inspected by the authorized nuclear inspector (ANI) nor stamped in accordance with Section III of the ASME Code.

B.4.2 Materials

Materials used in the reactor pedestal and reactor shield wall conform to the following specifications:

Reactor Pedestal Application	Specification
Shell plates and diaphragms	A588, Grade A or Grade B
Plates highly stressed in the through-gauge direction	A588, Grade A made by electroslag remelt process
Penetration sleeves	SA-333, Grade 1 or 6 SA-516, Grade 60 or 70

Shield Wall Application	Specification
Shield plates and diaphragms	A588, Grade A or Grade B

Reactor Holddown Bolting Materials	Specification
Studs-nuts	SA-540, B-23, Class 4

B.4.3 Welding

B.4.3.1 Reactor Pedestal

The reactor pedestal was fabricated in accordance with the requirements of NF-4000, ASME Code, Section III, 1974 Edition, Winter 1975 Addenda. Shop and field welding procedures were in accordance with the requirements of ASME Section III and Section IX. Recommended minimum preheat, interpass temperature and postweld heat treatment were in accordance with ASME Section III requirements. All welders and welding operators were qualified in accordance with ASME Section IX.

Most temporary and permanent attachments were welded using welders and welding procedures qualified in accordance with the requirements of the ASME Code, Section III and

Section IX. Fillet and partial penetration welds were visually examined in accordance with the method in Article 9 of ASME, Section V.

B.4.3.2 Shield Wall

The shield wall conformed to the requirements of AISC Manual and AWS D1.1-1976. Shop and field welding procedures were in accordance with AWS D1.1 or ASME, Section IX, 1974 Edition, Winter 1975 Addenda. Selection of electrodes and recommended minimum preheat and interpass temperature were in accordance with AWS and ASME requirements. Postweld heat treatment requirements of ASME Code, Section III applied. All welders and welding operators were qualified in accordance with AWS D1.1 or ASME, Section IX.

B.4.4 Quality Control

B.4.4.1 General

B.4.4.1.1 Reactor Pedestal

Measures were established in accordance with the ASME Code, Section III, Subsection NF, for controlling the identification of material throughout fabrication and installation. Certified material test reports were furnished stating the actual results of all chemical analyses and mechanical tests required by ASTM or ASME specifications. ASTM A588 material was normalized. Where specified material properties could not be met by normalizing, quenching and tempering was allowed. The reactor pedestal material was impact tested in accordance with ASME Code, NF2300 at a test temperature of 30° F. In addition, plate material where the design stress was in the short transverse direction was made by the electroslag remelt process and 100% ultrasonically examined in accordance with the requirements of ASTM E114.

B.4.4.1.2 Shield Wall

Quality assurance requirements applied to the fabrication and testing of the materials. Certified material test reports were furnished stating the actual results of all chemical analyses and mechanical tests required by ASTM specifications. Identifying heat numbers were furnished on all materials to trace the steel to the specific heat in which the steel was made. All testing conformed to all applicable and specified requirements of ASTM A6, A20 and A370. All materials, except A36 bars and shapes, were impact tested in accordance with A370 at a test temperature of at least 30° F below the lowest service metal temperature of 30° F. In addition, plate material where the design stress was in the short transverse direction was 100% ultrasonically examined in accordance with ASTM A435 or A578.

B.4.4.2 Welding Inspections

B.4.4.2.1 Reactor Pedestal

The reactor pedestal was examined in accordance with the requirements for Class 1 components, Subsection NF, Section III, Division 1, ASME Code.

B.4.4.2.2 Shield Wall

All complete penetration welds were radiographed in accordance with the ASME Code, Section III, NB5000. Welds impractical to radiograph were examined 100% by both the ultrasonic method and either the magnetic particle or liquid pentrant methods in accordance with NB5000 of ASME Code, Section III.

All partial penetration welds and fillet welds were examined by magnetic particle or liquid penetrant methods in accordance with the requirements of NB5000 ASME Code, Section III. The method was used to inspect the root pass and each 1/4-inch thickness of welds.

B.4.5 Erection Tolerances

B.4.5.1 Reactor Pedestal

The reactor pedestal embedment plates were set in concrete to within ± 1/4 inch of their theoretical elevation. The as-built elevations of the embedment plates were provided by the reactor pedestal-shield wall fabricator so he could adjust dimensions of shop fabrication so the reactor pressure vessel support flange mating surface could be field erected to within ±1/4 inch of the required theoretical elevation.

The reactor pedestal ring girder was field erected within the following tolerances:

a. Elevation: ±1/4 inch of theoretical elevation.

b. Horizontal Position: ± 0.12 inch.

c. Levelness: ± 0.03 inch.

Plate components which form the cylindrical portion of the reactor pedestal between the lower embedment plates and the ring girder were erected within the following tolerance:

a. Radius: ± 1/2 inch.

Penetrations in the reactor pedestal were erected within the following tolerances:

a. Penetration centerline azimuth at inside shell plate: ± 1/4 inch.

b. Penetration centerline elevation at inside shell plate: ± 1/4 inch.

B.4.5.2 Reactor Shield Wall

The reactor shield wall was erected within the following tolerances:

a. The difference between the maximum and minimum inside diameters at any cross section (section in a horizontal plane) did not exceed 5% of the nominal diameter at the cross section under consideration. The actual radius was within 1 inch of the vertical radius.

b. Plumbness of the shell plates met the following tolerances:

    1. Local: ± 1/2 inch in 10 feet.

    2. Overall: ± 1 inch for the full height.

c. The maximum plus or minus deviation from the true circular form of a cylinder was measured from a segmental circular template having the design radius and a 10-foot chord length. Deviation from the template did not exceed 1/2 inch.

B.5 CONTAINMENT LINER WITHIN THE CONTAINMENT BACKED BY CONCRETE

B.5.1 General

The materials, erection and fabrication procedures conform to the technical provisions of Subarticles CC-2500 and CC-4500 of the 1973 ASME B&PV Code, Section III, Division 2 (Proposed). The testing requirements conform to ASME B&PV Code, Section III, Division 1, Articles NE-5000 and NE-6000. The liner was not inspected by the authorized nuclear inspector (ANI) nor stamped in accordance with Section III of the ASME Code.

B.5.2 Materials

The containment liner materials performing only a leaktight function (excluding leak test channels), within the containment backed by concrete meet the requirements of the 1973 ASME B&PV Code, Section III, Division 2, Subarticle CC-2500, and comply with the following specifications:

APPLICATION	SPECIFICATION
Liner Plate	SA-516-72, GRADE 60 SA-240, Type 304
Containment Liner Anchors	A36-70a - Rolled sections and plates A108 - Studs
Crane Brackets	A588
Embedments -Reactor Support Structure Anchorage Plates	SA-516, GRADE 70

B.5.3 Quality Control

B.5.3.1 Testing of Welds

B.5.3.1.1 General

All nondestructive examination procedures used were in accordance with the requirements of NE-5000 of the 1971 ASME B&PV Code, Summer 1973 Addenda, and conformed to Regulatory Guide 1.19, Revision 1.

Most temporary and permanent attachments were welded using welders and welding procedures qualified in accordance with the requirements of the ASME Code, Section III and Section IX. Fillet and partial penetration welds were visually examined in accordance with the method in Article 9 of ASME, Section V.

B.5.3.1.2 Liner Plate Seam Welds

B.5.3.1.2.1 Radiographic Examinations

The first 10 feet of weld for each welder and welding position was 100% radiographed. Thereafter one spot radiography of not less than 12 inches in length was taken for each welder and welding position in each additional 50-foot increment of weld. In any case a minimum of 2% of liner seam weld was examined by radiography. All radiographic examinations were performed as soon as possible after the weld was placed. The spots selected for radiography were randomly selected. Any two spots chosen for radiographic examination were at least 10 feet apart. If a weld failed to meet the acceptance standards specified in NE 5320, Section III of the ASME B&PV Code, two additional spots were examined at locations not less than 1 foot from the spot of initial examination. If either of these two additional spots failed to meet the acceptance standards then the entire weld test unit was considered unacceptable. Either the entire unacceptable weld was removed and the joint rewelded, or the entire weld unit was completely radiographed and the defective welding repaired. The repaired areas were spot radiographed.

B.5.3.1.2.2 Ultrasonic Examinations

When the joint detail did not permit radiographic examination to be performed in accordance with the ASME Code, the weld joint was 100% ultrasonic examined in accordance with the requirements of NE 5200 in ASME Section III. If a weld failed to meet the specified standards, the weld was repaired and reexamined.

B.5.3.1.2.3 Magnetic Particle Examination

Magnetic particle examination was performed on 100% of liner seam welds for ferritic material. If a weld failed to meet the acceptance standards specified in NE5340 of Section III of the 1971 ASME B&PV Code (Summer 1973 Addenda), the weld was repaired and reexamined according to the above Code using magnetic particle examination.

B.5.3.1.2.4 Liquid Penetrant Examination

Liquid penetrant examination was performed on 100% of liner seam welds for austenitic materials. If a weld failed to meet the acceptance standards specified in NE5350 of Section III of the 1973 ASME B&PV Code (Summer 1973 Addenda), the weld was repaired and reexamined according to the ASME Code using the liquid penetrant method of examination.

B.5.3.1.2.5 Vacuum Box Soap Bubble Test

The vacuum box soap bubble test was performed on 100% of liner seam welds for leaktightness. If leakage was detected the test was repeated after the weld was repaired.

B.5.3.1.3 Leak Test Channels

Wherever leak-chase-system channels were installed over the liner welds, the channel-and-liner plate welds were tested for leaktightness by pressurizing the channels to 1.15 times containment design pressure and doing a pneumatic test of 100% of the welds. A 2-psi change in pressure over a 2-hour holding period was allowed because of a possible variation in temperature during the holding period.

B.5.3.2 Fabrication and Installation

B.5.3.2.1 General

The fabrication and installation of the containment steel boundaries backed by concrete were in accordance with the 1973 ASME B&PV Code, Section III, Division 2, Subarticle CC-4500.

B.5.3.2.2 Welding Qualification

The qualifications of welders and welding procedures were in accordance with Section III, Division 2, Subarticle CC-4500 of the 1973 ASME B&PV Code.

Installation Tolerances

All pressure retaining components conformed to the applicable requirements of NE-4220 of ASME Section III.

Cylinder Tolerances:

a. For each 10 foot elevation of the liner the difference between the maximum diameter and minimum diameter did not exceed 8 inches. This requirement was satisfied by measuring diameters spaced approximately 30° apart.

b. The radius of the liner was within ± 3 inches of the theoretical radius.

c. The deviation of the liner from true vertical did not exceed 1 inch in any 10 feet nor 3 inches in the full height of the liner.

d. The local contour of the shell was controlled by limiting to the following deviations:

    1. A 1-inch gap between the shell and a 15-foot-long template curved to the required radius when placed against the surface of a shell within a single plate section and not closer than 12 inches to a welded seam.

    2. A 1 1/2-inch gap when the template above was placed across one or more welded seams.

    3. A 3/8-inch gap when a 15-inch-long template curved to the required radius was placed against the surface of the shell within a single plate section and not closer than 12 inches to a welded seam.

    4. A 3/4 inch deviation from a 10-foot straight edge placed in the vertical direction between circumferential seams.

Dome Tolerances:

a. For each point the height of the dome above the spring line was no greater than 12 inches above theoretical height but in no case was it less than the theoretical height above the spring line.

b. Radius measurements were taken at the top of each roof course at 30° intervals, to determine the horizontal distance from the vertical centerline of the containment to the dome roof liner plate, and the local contour of the dome was controlled by limiting to the following deviations:

1. A 1-inch gap between the shell and a 15-foot-long template curved to the required radius when placed horizontally against the surface of the shell within a single plate section and not closer than 12 inches to a welded seam.

2. A 1 1/2-inch gap when the template above was placed horizontally across one or more welded seams.

3. A 3/8-inch gap when a 15-inch-long template curved to the required radius was placed horizontally against the surface of the shell within a single plate section and not closer than 12 inches to a welded seam.

4. A 1-inch gap between the shell and a 15-foot-long elliptically curved template when placed along the meridional surface of a shell within a single plate section and not closer than 12 inches to a welded seam.

5. A 1 1/2-inch gap when the elliptical template above is placed across one or more welded seams.

6. A 3/8 inch gap when a 15 inch-long template is placed along the meridional of the surface of the shell within a single plate section and not closer than 12 inches to a welded seam.

B.6 CONTAINMENT STEEL BOUNDARY NOT BACKED BY CONCRETE

All references to the 1971 ASME B&PV Code Section III, Division 1 in this section shall be understood to include all addenda through the summer of 1973.

B.6.1 Materials

The materials complied with the requirements of the 1971 ASME B&PV Code, Section III, Division 1, Article NE-2000, and also to the following specifications:

APPLICATION	SPECIFICATION
Emergency Personnel Airlock and Equipment Access Hatch with Integral Personnel Airlock	SA-516-72 Grade 70
Penetration Pipe Sleeves	
(i) up to 24 inch diameter	SA-333 Grade 1 or 6 Seamless
(ii) over 24 inch diameter	SA-516 Grade 60

B.6.2 Quality Control

B.6.2.1 Testing

B.6.2.1.1 General

The testing of the containment leaktight boundaries not backed by concrete was in accordance with the 1971 ASME B&PV Code, Section III, Division I, Article NE-6000.

B.6.2.1.2 Examination of Welds

One hundred percent of all welds between penetration and flued fitting, and flued fittings and pipelines were examined by radiographic examinations. One hundred percent of all welds in the equipment hatch, personnel airlock, and penetration sleeves were also inspected by radiographic examination where possible. Where radiography could not be employed, ultrasonic examination was used. Penetration to insert plate welds and penetration to liner welds were magnetic particle or liquid penetrant examined in lieu of 100% radiography. Penetration insert plate to liner weld was spot radiograph examined in lieu of 100% radiography. Penetration insert plate to frame welds for air locks and access openings were 100% radiograph examined. If a weld failed to meet the acceptance standards specified in NE-5300, Section III of the ASME B&PV Code, the entire unacceptable weld was removed and the joint rewelded. The repaired areas were examined as required for the original weld.

B.6.2.2 Fabrication and Installation

B.6.2.2.1 General

The fabrication and installation of the containment steel boundaries not backed by concrete were in accordance with the 1971 ASME B&PV Code, Section III, Division I, Article NE-4000.

B.6.2.2.2 Qualification of Welders

The qualifications of welders and welding procedures were in accordance with Section III, Division 1, Article NE-4300 of the 1971 ASME B&PV Code.

B.7 STAINLESS STEEL POOL LINERS

B.7.1 Materials

Stainless steel pool liners were fabricated from SA-240 Type 304L material, hot rolled, annealed and pickled. All plate thicknesses up to 3/8 inch inclusive were further processed by cold rolling.

The materials, fabrication, erection and examination procedures conformed to the requirements where applicable of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1977 Edition, and Division 2, 1977 Edition. The liner was not inspected by the authorized nuclear inspector (ANI) nor stamped in accordance with Section III of the ASME Code.

B.7.2 Welding

Welding procedures were in accordance with the 1977 ASME B&PV Code, Section III, Division 2, Subarticle CC-4540, and ASME Section IX, 1977 edition. All seam welds were complete penetration groove butt welds.

The liner plate seam welds were examined and tested as follows:

a. Spot radiographic examination was performed in accordance with specification requirements that are equivalent to the requirements of ASME Section III, Division 2, 1977 Edition, Subarticle CC-5530.

b. Ultrasonic examination was not performed in lieu of radiography on liner seam welds.

c. Liquid penetrant examination was performed on austenitic materials in accordance with specification requirements that are equivalent to the requirements of CC-5500, ASME Code, Section III, Division 2, with acceptance standards per NB 5000, ASME Code Section III, Division 1, 1977 Edition.

d. Vacuum leak test was performed for leaktightness on all liner plate seam welds.

B.7.3 Fabrication and Installation

All cutting, forming and bending of the stainless steel liners conforms to CC-4521 of Section III, Division 2 of ASME.

Fitting and aligning of the liner work conforms to CC-4523 of Section III, Division 2.

Flat wall liners do not deviate from a vertical plane more than ± 5/8 inch in 15 feet nor ± 1 1/4 inch for the total wall height.

Floor liners do not deviate from a horizontal plane more than ±5/8 inch in 15 feet nor ± 3/4 inch for the total width or length of the floor.

B.7.4 Temporary and Permanent Attachments

Temporary and permanent attachments to the exposed pool surface were minimized. These attachments were welded using welders and welding procedures qualified in accordance with the requirements of the ASME Code, Section IX or AWS D1.1. Fillet welds were visually examined in accordance with AWS D1.1 with acceptance standards per paragraph 8.15 of AWS D1.1.

All temporary attachments were removed. The attachment area after weld removal was examined by the liquid penetrant method in accordance with the requirements of ASME Code, Section III, Division 2, CC-5500.

B.8 OTHER STAINLESS STEEL ELEMENTS

Stainless steel embedded plates and stainless steel checkered floor plates were fabricated from A240 Type 304 material, hot rolled, annealed, and pickled.

Stainless steel bars and rounds were fabricated from A276 or A479 Type 304 material, annealed and cold drawn.

Stainless steel pipes were fabricated from A312 Type 304 or A376 Type 304 materials, hot rolled, annealed, and pickled.

Stainless steel gratings were fabricated from A240 Type 304 or A276 Type 304 materials.

Stainless steel sump liners were fabricated from A240 Type 304 material.

Stainless steel bolts were fabricated from A193 Grade B8 or A479 Type 304 materials.

Stainless steel nuts were fabricated from A194 Grade 6 or Grade 6F material.

Stainless shapes were fabricated from A276 or A479 Type 304 materials.

For futher discussion on austenitic stainless steel, refer to Subsection 5.2.3.4.