APPENDIX 5D

QUALITY CONTROL

1 GENERAL ORGANIZATION

Final responsibility for establishing quality control procedures and enforcing such procedures belongs to the Metropolitan Edison Company. Met-Ed has assigned a Project Manager whose duties will include coordination and direction of all quality control measures. To carry out this responsibility in the field, Met-Ed will assign a permanent field representative to monitor inspection procedures and other quality control measures carried out by the constructor. In addition, Met-Ed is developing an organization which will monitor quality control measures in the fabricators' shops and the field, and will also audit all records. Met-Ed will also assign responsibilities for quality control functions to the following organizations. 2

1.1 BABCOCK & WILCOX

As contractor to the Met-Ed Co., B&W is responsible for developing quality control procedures and ensuring such procedures are observed for the shop fabrication of the nuclear components in their scope of supply. B&W will also develop or review field installation procedures for all such components. B&W will maintain technical representative (s) at the site as required by the Met-Ed Co.

1.2 GILBERT ASSOCIATES, INC.

As consultant to the Met-Ed Co., Gilbert Associates is responsible for developing quality control procedures for all elements of construction, excluding the nuclear components in the B&W scope of supply. This includes the development of detailed specifications, testing procedures, and surveillance of tests as required to ensure that construction is completed so as to meet the intent of the design. All test reports, including mill chemical and physical reports on steel, cement chemical analyses, welding procedures, and qualifications will be reviewed by Gilbert Associates to ensure specification compliance. In addition Gilbert Associates will maintain at the job site an engineer as required by the Met-Ed Co. The engineer will be familiar with the design of the Class I structures and qualified to interpret drawings and specifications for this work. The engineer will, through the Met-Ed representative, terminate work unless it meets the intent of the design. The prime function of the engineer will be to monitor the detailed inspection and other quality control procedures of the constructor.

1.3 UNITED ENGINEERS AND CONSTRUCTORS

As contractor to the Met-Ed Co., UE&C is responsible for all field quality control measures and all shop quality control measures for equipment and materials other than that supplied by B&W. This includes acceptance of materials and workmanship by subcontractors and the supply of all detailed inspection except that supplied by the testing agencies. UE&C will maintain

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a quality control file for the entire project for all work except that covered by B&W scope of supply and will present this file to the Met-Ed Co. at the completion of work.

1.4 INDEPENDENT TESTING AGENCY

For all soils and concrete work and welding, an independent testing agency/agencies will be retained by the construction manager, UE&C, to perform all field inspections and tests. These personnel will check earth backfilling and will maintain field operation surveillance of the concrete batch plant and job site concrete activities. They will have direct communication with the construction manager, by passing the job superintendent if such is required to correct construction deficiencies. In addition, a separate organization or agency will be maintained by Met-Ed to monitor and audit all inspection activities and records. This effort will be in addition to that provided by the field representatives of Met-Ed and the designer. 2

2 MATERIALS STANDARDS

2.1 CONCRETE

The Technical Specifications for structural concrete will require the following quality control measures:

2.1.1 QUALITY CONTROL

a. PRELIMINARY TESTS

The Owner will obtain the services of a Testing Laboratory which will, prior to the Contractor commencing concrete work, make preliminary determinations of controlled mixes, using the materials proposed and consistencies suitable for the work, in order to determine the mix proportions necessary to produce concrete conforming to the type and strength requirements called for herein or on the drawings. Aggregates shall be tested in accordance with the latest editions of the following ASTM Specifications: C29, C40, C12, C128, and C136. Compression tests shall conform to ASTM Specifications C39-64 and C192-65. The Contractor shall submit to the Testing Laboratory a sufficient time before concrete work will commence all concrete ingredients required by the Testing Laboratory for these preliminary tests.

The proportions for the concrete mixes will be determined by Method 2 of Section 309 of ACI 301 and as herein specified.

The Engineer shall have the right to make adjustments in concrete proportions if necessary to meet the requirements of these specifications.

In the event the Contractor furnished reliable test records of concrete made with materials from the same sources and of the same quality in connection with current work, then all or a part of the strength tests specified herein may be waived by the Engineer, subject, however, to any provisions to the contrary of building codes or ordinances of the governing authority.

b. FIELD TESTS

During concrete operations, the Testing Laboratory will have an inspector at the batch plant who will certify the mixed proportions of each batch delivered to the site and sample and test periodicall all concrete ingredients. Another inspector (s) at the constructic site will inspect reinforcing and form placements, take slump tests make test cylinders, check air content, and record weather conditic

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Except as noted hereinafter, test cylinders will be molded, cured, capped, and tested in accordance with ACI 301 except that one of the three cylinders will be tested at three days and the remaining two at 28 days. For the Reactor Building a set of four cylinders will be made for each 50 cubic yards or fraction thereof placed in any day.

One cylinder shall be tested at three days, another cylinder at seven days, and the remaining two cylinders at 28 days. Slump tests will be made at random with a minimum of one test for each 10 cubic yards of concrete placed, also slump tests will be made on the concrete batch used for test cylinders.

In the event that concrete is poured during freezing weather or that a freeze is expected during the curing period, an additional cylinder will be made for each set and be cured under the same conditions as the part of the structure which it represents.

c. TEST EVALUATION

The evaluation of test results will be in accordance with Chapter 17 of ACI 301. Sufficient tests will be conducted to provide an evaluation of concrete strength in accordance with this Specification.

d. DEFICIENT CONCRETE

Whenever it appears that tests of the laboratory cured cylinders fail to meet the requirements set forth in this Specification, the Engineer and/or Testing Laboratory shall have the right to:

1. Order changes to the proportions of the mix to increase the strength.

2. Require additional tests of specimens cured entirely under field conditions.

3. Order changes to improve procedures for protecting and curing the concrete.

4. Require additional tests in accordance with "Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete," ASTM C42-64.

2.2 REINFORCING STEEL

Testing and inspection of all reinforcing steel will be performed at the mill to ASTM requirements. Certified mill reports will be submitted to the Engineer, Gilbert Associates, Inc., for review and approval. Each bar is branded in the deforming process to carry identification as to the manufacturer, size, type, and yield strength.

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Example:

B - Bethlehem
18 - Size 18S
N - New billet steel
Blank - A-15 and A-408 steel
6 - A-432 60,000 psi yield
7 - A-431 75,000 psi yield

Because of the identification system and the large quantity, the material will be kept separated in the fabricator's yard. In addition, when loaded for mill shipment, all bars will be properly separated and tagged with the manufacturer's identification number.

Visual inspection of the bars will be made in the field for inclusions. The bars will be randomly sampled in the field and tested to destruction to check specification compliance.

2.3 CADWELD SPLICES

Tension splices for bar sizes larger than #11 will be made with a Cadweld splice which will develop the ultimate strength of the bar. To ensure the integrity of the Cadweld splice the quality control procedure will provide for a random sampling of splices in the field. The selected splices will be removed and tested to destruction.

A sampling of at least sixteen (16) splices will be initially tested to destruction to develop an average ($\bar{X}$) and standard deviation ($\bar{\sigma}$). Sufficient samples will, therefore, be tested to provide 99 per cent confidence level that 95 per cent of the splices meet the specification requirements. As additional data becomes available, the average ($\bar{X}$) and standard deviation ($\bar{\sigma}$) will be updated and the quantity of samples revised accordingly.

The distribution established on this basis will permit the development of the lower limit below which no test data should fall. If the result of any test falls below this limit, the subsequent or previous splice will be sampled. If this result is above the lower limit, the process is considered to be in control. If this result is again below the lower limit, the process average must have changed and an engineering investigation will be required to determine the cause of the excess variation and re-establish control. The work of each splicing crew will be individually sampled.

2.4 REACTOR BUILDING

The Technical Specifications for the Reactor Building liner require that steel plate for the main shell including the dome, cylindrical walls, and base shall conform to "Tentative Specification for Structural Steel," ASTM A36-63T or to ASTM 283.

Quality control measures required by this standard specification include the following:

"Two tension and two bend tests shall be made from each heat, unless the finished material from a heat is less than 30 tons, then one tension test and one bend test will be sufficient. If, however, material from one heat differs 3/8 in. or more in thickness, one tension test and one bend test shall be made from both the thickest and the thinnest material rolled, regardless of the weight represented."

The Technical Specifications for the Reactor Building liner further require that, "The materials for penetrations including the personnel and equipment access hatches as well as the mechanical and electrical penetrations shall conform with the requirements of the ASME Nuclear Vessels Code for Class "B" vessels... All materials for penetrations shall exhibit impact properties as required for Class "B" vessels..."

The material for the penetrations will, as a minimum requirement, conform to "Temtative Specification for Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels" ASTM A201-61T, Grade B Firebox, modified to "Standard Specification for Steel Plates for Pressure Vessels for Service at Low Temperature" ASTM A300-58.

Quality control measures required for ASTM A201 include the following:

"Two tension tests, one bend test, and one homogeneity test shall be made from each firebox steel plate as rolled. One tension test and one bend test shall be made from each flange steel plate as rolled."

The Technical Specifications for the Reactor Building liner further require the following quality control measures for welding:

The qualification of welding procedures and welders shall be in accordance with Section IX "Welding Qualifications" of the ASME Boiler and Pressure Vessel Code... Contractor shall submit welding procedures to the Engineer for review...

Longitudinal and circumferential welded joints within the main shell, the welded joint connecting the dome to the cylindrical side walls, and any welded joints within the dome shall be inspected by the liquid penetrant method and spot radiography... All penetrations... shall be examined in accordance with the requirements of the ASME Nuclear Vessels Code for Class "B" Vessels. All other shop fabricated components including the reinforcement about openings shall be fully radiographed. All non-radiographable joint details shall be examined by the liquid penetrant method.

Full radiography shall be in accordance with the procedures and governed by the acceptability standards of Paragraph N-624 of the ASME Nuclear Vessels Code. Spot radiography shall be in accordance with the procedures and governed by the acceptability standards of Paragraph UW-52 of the ASME Unfired Pressure Vessels Code except that 2 percent of the welds shall be spot radiographed.

Methods for liquid penetrant examination shall be in accordance with Appendix VIII of the ASME Unfired Pressure Vessels Code except that 20 percent of the welds shall be tested by liquid penetrant.

In order to ensure that the penetrations as well as all weld connections between penetration sleeves and plate are leak-tight, the Technical Specifications for the Reactor Building liner require that all welds "shall be examined by detecting leaks at 63.3 psig test pressure using a soap bubble test or a mixture of air and freon... and 100 per cent of detectable leaks arrested." These tests are all preliminary to the performance of the integrated leak rate test which will ensure that the containment leak rate is no greater than 0.2 per cent of the contained volume in 24 hours at 55 psig.

2.5 LINER WELDING RADIOGRAPHY

All accessible weld seams on the liner will be spot radiographed except for penetrations which will be fully radiographed. Spot radiography will be performed in accordance with Section UW-52 of the ASME Unfired Pressure Vessels Code except that 2 percent of the welds will be spot radiographed.

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2.6 PRESTRESSING TENDONS

The prestressing and tendons for the containment will be inspected by both the supplier and representatives of the Owner.

If the BBRV system is selected for use, the Supplier will do the following:

a. Obtain certified mill test reports of chemical and physical properties of each reel of wire and submit them to the Owner. Material must meet requirements of ASTM A421-65, Type BA.

b. Cut coupons from each end of each reel of wire, form buttonheads on the specimens and test them in tension to destruction. These tests will ensure that the wire ruptures before failure of the buttonhead and that the wire develops a minimum ultimate tensile strength of 240,000 psi. Coupons, and the coils they represent, not meeting the requirements will be rejected. Records will be maintained for each coupon test and for the tendons in which each coil of wire is used. These records will be submitted to the Owner.

c. Cut wires within ± 3/32 inch of the specified length of less than 50 feet and within ± 1/8 inch if greater than 50 feet.

d. Check each buttonhead by visual examination for general appearance and splits. Splits parallel to the tendon axis or inclined no more than 20 degrees are acceptable if their total width does not exceed .060 inch.

   A maximum of two splits inclined between 20 degrees and 45 degrees can be accepted providing they do not lie in the same plane. The total width of cracks cannot exceed 0.06 in.

Splits inclined more than 45 degrees are not acceptable.

e. Ten per cent of the buttonheads, selected by random, will be checked dimensionally. Diameter must not be less than .372 inch nor more than .388 inch. Head length must not be less than .252 inch nor more than .272 inch. The buttonhead must have a bearing surface on all sides.

The Owner's quality control representative/representatives will do the following:

a. Submit certified mill test reports to the Engineer, Gilbert Associates, Inc. for their review and comment.

b. Monitor the shop procedures and inspection by the Supplier.

c. Inspect each tendon at the Supplier's shop before shipment to insure conformance to specifications and proper preparation for shipment.

If a system utilizing wire strands is selected, an equivalent procedure of quality control measures will be developed.

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