3159

March 12, 1962

Specification No. 3159-C-1
Job No. 3159
Rev. 1 December 31, 1959
Rev. 2 June 17, 1960
Rev. 3 July 22, 1960
Rev. 4 March 12, 1962

SPECIFICATIONS

for

DESIGN, FURNISHING, ERECTION AND TESTING

of

CONTAINMENT VESSEL

for

BECHTEL CORPORATION
CONTRACTOR

for the

BIG ROCK POINT PLANT

of the

CONSUMERS POWER COMPANY

near

CHARLEVOIX, MICHIGAN

Prepared by
BECHTEL CORPORATION
SAN FRANCISCO, CALIFORNIA

Date October 28, 19[illegible]
By
Approved

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2. SPECIAL CONDITIONS

2.1 Subcontract

By this reference, the Subcontract shall be deemed to include:

(a) The Subcontract, including the General Terms and Conditions.

(b) These Specifications.

(c) The drawings listed below:

3159-C-1 - Rev. 2 - Site Plan for Reactor Enclosure
3159-C-101 - Rev. 5 - Containment Vessel Requirements
3159-C-102 - Rev. 5 - Containment Vessel Penetration Locations
3159-C-103 - Rev. 0 - Containment Vessel Maintenance Scaffold

2.2 Definitions

2.21 Wherever, in any of the Subcontract documents, the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Owner	The Consumers Power Company A Corporation of the State of Maine
Contractor	The Bechtel Corporation A Corporation of the State of Delaware
Subcontractor	The party or parties to whom the Subcontract is awarded.
Bidder	The party or parties submitting a proposal for the work.
Work	All the work specified herein including the design, and furnishing of all materials, labor, plant, equipment and all incidentals necessary to complete and test the work.
Code	The ASME Boiler and Pressure Vessel Code, Section II, Material Specifications, Section VIII, Unfired Pressure Vessels, and Section IX, Welding Qualifications - latest edition, including supplements, as modified by code cases 1270N, 1271N, and 1272N.

2.22 Where "as directed", "as required", "as approved" or words of like import are used, it shall be understood that the direction, requirements, or approval of the Contractor is intended.

2.3 Responsibility

(2) It is the intent of this specification that the Subcontractor be entirely responsible for the design, procurement, fabrication, erection, inspection and testing of the Enclosure and its appurtenances so as to meet this specification and to produce a vessel of highest integrity suitable in every way for containing all gases and vapors under the conditions outlined in Par. 4.1 and 4.2. No approval, inspection or examination by Contractor or Owner of design, drawings, materials, or fabrication shall relieve Subcontractor of his responsibility.

2.4 Alternate Design and/or Erection Schedule

It is the intent of this specification to obtain a vessel of the highest overall integrity. If the Bidder believes that the quality or integrity of the vessel or of the overall structure can be improved by deviating from any provision of this specification, he may submit a proposal based upon a recommended change. In addition, he may submit a bid based entirely on the specification. All recommended provisions deviating from any provision of this specification shall be cited.

The Bidder may also submit an alternate proposal based on a design departing from the provisions of this specification, but which he believes to be of equal or better quality and safety, and more economical than a design meeting the specification. He may also submit an alternate proposal based on an erection and testing schedule other than that assumed in Par. 2.5 below if he believes it will shorten the overall construction period, or if he believes the completion date as specified in Par. 2.6 can not be met without excessive premium work time. (But see Par. 11.6.) He shall list the details in which his proposal deviates from the specification, and in addition shall submit a proposal based on a design and schedule meeting the specification. If the Bidder requires additional information to prepare an alternate design and/or schedule, he may contact the Contractor.

2.5 Construction Sequence

The special conditions set forth within this specification are based on the following assumed sequence (after completion of excavation and erection foundations) of construction and testing:

(1) Vessel completely erected including all locks, penetrations and appurtenances.

(2) Initial tests for pressure tightness performed in accordance with Par. 11.2 through 11.22, inclusive.

(3) Cut temporary construction opening.

(4) Foundation and interior concrete and major portion of plant equipment installed (by others).

(5) Close temporary construction opening.

(6) Perform final tests as outlined in Par. 11.3.

2.6 Erection Schedule

The Subcontractor will have access to the site on July 1, 1960 for erection of the vessel. The erection and testing shall be planned and coordinated with the Contractor so that the Contractor may assume occupancy of the vessel by January 1, 1961 to begin step (4).

It is anticipated that a period of approximately 16 months will be required for the work by others between steps (3) and (5).

3.0 LOCATION OF WORK

3.1 The Big Rock Point Plant is to be located on a 600 acre site which is on the east shore line of Lake Michigan approximately 4 miles northeast of the city of Charlevoix, Michigan. Drawing 3159-C-1, enclosed herewith, shows the proposed location of the plant on the site.

3.2 Site Conditions

3.21 Land Available for Subcontractor

A An area approximately as indicated on Drawing 3159-C-1, or a similar area mutually agreed upon by the Contractor and Subcontractor, will be made availabe to Subcontractor. Work on the other facilities adjacent to the vessel may be in progress simultaneously with Subcontractor's operations. The provisions of the General Terms and Conditions of the subcontract shall apply.

3.22 Transportation Facilities

The site is served by an access road connecting to U. S. Highway No. 31 and a railroad spur.

Access roads to and through the site will be constructed and maintained in useable condition by others throughout the duration of the subcontract and made available to Subcontractor.

3.23 Utilities

Electric power, 480 volts, 3 phase, 60 cycle, will be furnished without charge to Subcontractor's panel at a point adjacent to the vessel, to be designated by the Subcontractor. From this point, Subcontractor shall run such extensions as he may require and furnish all materials therefor. Subcontractor shall state his power requirements in his proposal.

Sanitary facilities will be constructed by Contractor and made available without charge to Subcontractor.

Drinking water will be available on the site without charge to Subcontractor.

3.24 Work by Contractor

Prior to the start of the erection by Subcontractor, Contractor will:

(a) Perform the necessary excavation so that there is a clear space not less than 2'-6" at any point between the shell and the soil or rock. If by reason of over-break of the rock this distance should exceed 5 feet at any point, Contractor will, upon request of Subcontractor, backfill such spaces.

(b) Furnish, maintain and operate such pumps that the excavation is kept reasonably dry at all times.

(c) Construct the foundations for columns supporting the enclosure and furnish and install such anchor bolts as may be specified by Subcontractor.

During the erection by Subcontractor, Contractor will furnish and erect any nets required to protect Contractor's personnel while working close to the vessel.

After completion and successful initial test of the vessel, Contractor will furnish and construct concrete vessel foundation and the interior structure.

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4. CONTAINMENT VESSEL

4.1 The enclosure herein specified is to house a nuclear reactor and miscellaneous appurtenances of a nuclear power plant. Normally it will not be under internal pressure. In the case of certain accidents or malfunction of the power plant, the structure may be subjected to an internal pressure and a coincident internal temperature rise. The design pressure and temperature rise are specified in Par. 4.2 below. Because of the great potential hazard to the environs from radioactive material, the highest degree of integrity is demanded of the containment vessel throughout the entire life of the plant.

4.2 The enclosure will be based on design conditions as follows:

	Design Internal Pressure	Design Temperature Rise
(Alternate I) Capsule Shaped Vessel	Deleted	
(Alternate II) Spherical Vessel	27 psig (coincident with max. temperature of 230°F)	190°F

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4.3 The vessel shall have the following dimension:

Capsule Shaped Vessel - Deleted

Spherical Shaped Vessel - The sphere shall have an inside diameter of 130'-0".

4.4 The vessel shall be provided with personnel and equipment access openings and other penetrations as described in Sections 9 and 10 of this specification.

4 4.5 An outside 24" stairway and walkway ladder shall extend from 4 feet below the 60th parallel to the top of the sphere as shown on Drawing C-103. The walkway and stair shall be placed a sufficient distance from the shell to permit the placing (by others) of the insulation and paint. Live load on stair and walkway shall be 100 psf.

4.6 Welded steel clips shall be provided on the inside surface of the top hemisphere for attaching scaffolds. Each clip shall carry a safe load of 1000 lbs and shall have one 1-1/16" diameter hole. Clips shall be spaced not more than 8 ft apart on parallels whose horizontal projections are not more than 8 ft apart. (See Drawing 3159-C-101). In considering the effect of loads on the shell, any two adjacent clips shall be taken as having a live load of 600 lbs each, and all clips as having a dead load of 200 lbs each.

4.7 Painters chair anchor as shown on Drawing 3159-C-101 shall be provided. The anchor shall be capable of withstanding a horizontal force of 2000 pounds.

4.8 Deleted.

4.9 Rain gutter as shown on Drawing 3159-C-101 and 3159-C-103 shall be provided. The gutter shall be capable of withstanding a uniform vertical live load of 2000 lbs on any 10 ft section.

△ 4.10 A manually operated traveling maintenance scaffold as shown on Drawing 3159-C-103 shall be provided and shall be equipped with fixed platforms giving access to the surface of the sphere. The ladder and platforms shall be capable of withstanding a uniform load of 100 lbs per sq ft. The scaffold as a whole shall be designed to support alternately loaded and unloaded platforms plus a single point load of 2500 lbs placed at any point on the scaffold

△ 4.11 A safety fence approximately 3 feet high shall be placed at the 60th parallel as shown on the drawings The railing shall be capable of resisting a uniform horizontal force of 40 lbs per linear foot applied at the top of the railing. The fence shall be of the open type which will not cause snow to pile up within the fenced area.

5. DESIGN, FABRICATION AND ERECTION

5.1 The submission of a proposal shall be considered a warranty by Bidder that, if awarded the Subcontract, he will execute the Subcontract with any exceptions specifically made a part of his proposal and will design, fabricate, erect and test the enclosure and its appurtenances herein specified in accordance with the Code except as specifically stated otherwise in this specification or in the Subcontract.

Within 30 days after the award of the Subcontract, Subcontractor shall submit preliminary detailed calculations for all parts of enclosure and appurtenances for the review of Contractor and agrees, without additional compensation therefor, to make such changes (except as specifically listed in his proposal) as may be necessary to meet the requirements of the Code and these specifications. The review or approval of these calculations shall not, in any way relieve Subcontractor of any of his responsibilities under the Subcontract.

As rapidly as possible after the award of the Subcontract, Subcontractor shall prepare detailed plans of the enclosure and appurtenances to be furnished by him and submit prints thereof for the review of Contractor.

(2) Drawing 3159-C-101, must be considered schematic, especially in regard to the concrete support and to the transition section of the foundation. Subcontractor shall analyze the problem and design details to give a satisfactory support and transition section. Contractor will, without cost to Subcontractor, construct such foundation details as may be required. Subcontractor shall make recommendations regarding precautions to be taken in design and placement of interior structure.

5.2 Exterior Columns and Bracing

It is expected that the enclosure will be supported on columns during erection and initial pressure and leakage testing. These columns shall be properly braced during erection and testing of the sphere.

All bracing shall be removed after the [illegible] concrete support has been constructed. Subcontractor has option of designing enclosure so that he may also remove columns after the concrete support has been constructed. If Subcontractor elects to make the columns permanent, he shall provide details such that the columns will not materially impede the expansion of the enclosure under design conditions, and means shall be provided for equalizing the load on the columns. If he elects to design the structure without permanent columns, he shall recommend a time of removal and shall remove the columns at that time or at such later time as the Contractor may direct.

5.3 Code

5.31 The design, fabrication, erection and testing of the enclosure shall as a minimum conform to the requirements of the Code, using the loads and pressures specified in Section 7 hereof, with the following exceptions:

Code Paragraphs	
UG 125 - 134	No internal pressure relief devices will be installed. (Code Case 1271N)
UW 2	Vessel as a whole will not be stress relieved as required for vessels containing lethal gases. (Code Case 1272N)
UCS 56(a)(4)	Vessel as a whole will not be stress relieved even though some shell plates may exceed 1-1/4 inches in thickness. (Code Case 1272N). However, see Par. 8.3, below.
UCS 25	No allowance will be made for corrosion. (Code Case 1272N)
UG 22	Stresses from earthquake loads or live load on accessories are not considered additive to those produced by internal or external pressure.
UG 99	Standard Hydrostatic Test not required

5.32 Vessel shall meet all requirements for being stamped, and shall be stamped upon completion of the initial test (Par. 11.2). Subcontractor shall prepare necessary data sheets required for stamp, and shall arrange and pay for required inspection. Refer to UG 116 - 120 and Code Case 1270N.

5.4 Access Openings and Penetrations

The design and construction of all access, all shell penetrations, any permanent covers therefor, and the reinforcement around such access and penetrations shall comply with the Code as a minimum requirement.

5.5 Accessories

Any structural accessories such as columns, stairways, etc., not within the scope of the Code shall conform to the "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction, latest edition.

5.6 Tolerance for Shell

The requirements in Par. UG 80(a) and UG 81(a) of the Code shall be followed. In addition a 15-foot long template curved to the required radius, when placed against the completed surface of the shell entirely within a single plate section and not closer than 12 inches at any point to a welded seam, shall show deviations not exceeding 1/2 inch. When the template is placed across one or more welded seams the deviations shall not exceed 1 inch. The effect of change in plate thickness or of weld reinforcements shall be excluded when determining deviations.

5.7 Building and Safety Regulations

In addition to the foregoing requirements, Subcontractor shall comply with all applicable provisions of state and local building and safety regulations. The Subcontractor shall have no responsibility for obtaining permits or licenses from the State of Michigan or the U.S. Atomic Energy Commission.

6. MATERIAL

6.1 The enclosure and all appurtenances subject to the Code shall be:

(a) Steel plate conforming to Specification SA-201, Grade B, Firebox Quality produced to SA-300 specification with fine grained practice and with guaranteed Charpy values at minus 50° F from transverse specimens.

(b) Forgings, Castings and Bolting Material -- As proposed by Subcontractor in accordance with the Code and as acceptable to Contractor.

6.2 Structural accessories not subject to the Code shall be of materials conforming to the requirements of Par. 5.5.

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7. DESIGN LOADS

The enclosure and all appurtenances included in the Subcontract shall be designed to meet the requirements of the Code for the following load conditions in Par. 7.1 and 7.2.

7.1 Vessel supported on columns during erection, and initial leakage and pressure testing.

7.11 Dead Load plus

7.12 Design Internal Pressure as specified in Par. 4.2, or

7.13 Wind Load - 15 psf on vertical projection of vessel above grade, or

7.14 Earthquake - Horizontal acceleration 5% of gravity.

7.2 Complete enclosure supported by concrete foundation

7.21 Dead Load - The weight of the steel shell and appurtenances plus an allowance of 15 psf for insulation and roofing.

⚠ 7.22 Snow Load - 40 psf in accordance with ASA standard A 58.1.

7.23 Live Load on Accessories - Pars. 4.5, 4.6, 4.9, 4.10, 4.11 9.11, and 9.12.

⚠ 7.24 Wind Load - 30 psf basic wind pressure in accordance with ASA standard A 58.1 without snow load or for 100 mph without snow load whichever governs; for 60 mph when coincident with snow load.

7.25 Earthquake Load - Horizontal acceleration 5% of gravity.

7.26 Design Internal Pressure and coincident temperature rise as specified in Par. 4.2.

7.27 The enclosure shall be so designed that primary membrane stresses resulting from any combination of the above loads (7.21 - 7.26) shall not exceed the stresses permitted by the Code. Earthquake load or live loads on accessories need not be considered to occur simultaneously with internal pressure.

7.28 The Subcontractor shall compute secondary membrane and bending stresses resulting from distortions due to specified internal pressure and/or temperature.

In the calculation of these stresses all resistances to uniform increase in radius shall be considered. Combined primary and secondary stresses shall not exceed by more than 50% the membrane stresses permitted by the Code.

7.89 External Pressure - Shell thickness shall be not less than that required for an external pressure of 0.5 psig. The effect of dead load only shall be considered together with this external pressure.

8. WELDING AND RADIOGRAPHING

8.1 General

All seam welds in the shell of the enclosure shall be of the double bevel butt type. All butt joints in any accessories subject to the Code shall be of the double bevel type or equivalent, and all tee joints shall be full penetration welds. Welding details at nozzles shall be of an approved type and, where applicable, shall be at least equal to that shown on Drawing 3159-C-101. All welds subject to the Code shall be fully radiographed. All mandatory provisions of the Code shall be followed, and all recommended provisions shall be followed where practical.

In addition to these requirements,

(a) The design, methods, and sequence of welding shall be subject to the review and approval of Contractor.

(b) In manual arc-welding the electrodes shall be of the low-hydrogen type, and shall be such that the physical and chemical properties of the resulting welds shall meet the full requirements of the physical and chemical properties of the base metal.

(c) All automatic welding shall be done by the submerged arc process, and the welds shall have physical and chemical properties that meet the full requirements of the physical and chemical properties of the base metal.

(d) Deleted.

(e) Preheat at 200° F minimum shall be applied to all seams whose thickness exceeds 1-1/4" regardless of ambient temperature. If the ambient temperature falls below 40° F, preheat at a minimum of 100° F shall be applied to all seams 1-1/4" or less in thickness and which are subject to the Code. The above requirements are minimum and if the Bidder proposes to employ more rigid practices he should describe the proposed procedure in his bid.

8.2 Testing

One test-plate shall be made and tested in accordance with Par. UG-84 of Section VIII of the ASME Code for a test temperature of -50° F using the same material and thickness range as in the shell for each welding position to be used in construction for:

(1) Each brand of low-hydrogen electrode to be used in construction.

(2) Each combination of wire and flux for automatic welding to be used in construction.

Only those low-hydrogen electrodes and combinations of wire and flux that produce welds meeting the requirements of Par. UG-84 shall be used in construction.

8.3 Stress Relief

(a) Any plate segment wholly containing a penetration, nozzle, or column connection shall be furnace stress relieved after insertion of the penetration.

(b) All large penetrations which must necessarily intersect more than one shell plate shall be stress relieved as follows. Any portion of a penetration containing seams joining metal over 1-1/4" thick shall be furnace stress relieved as a unit before welding into a penetration assembly or into the shell. Vessel seams and field welds attaching penetration assemblies to the shell need not be stress relieved, notwithstanding any requirements in this paragraph.

(c) Procedures for stress relief shall follow Pars. UW 40 (a)(3), (c), (d), (e), and UCS 56 of the Code. Bidder shall describe how he intends to accomplish the required furnace stress relief.

8.4 Radiography

Subcontractor shall radiographically examine all butt welds in those parts of the work subject to the Code by methods complying with Par. UW 51 of the Code. Any unsatisfactory negatives shall be rejected and Subcontractor shall again radiograph those portions of the work covered by the unsatisfactory negatives. Subcontractor shall examine all negatives and shall cut out, reweld and reradiograph all welds which fail to meet the standards of radiographic quality set forth in Par. UW 51(a) of the Code. Welds on which it is not practical to use radiographic examination shall be examined by the magnetic particle method.

All negatives and certified interpretations thereof shall be submitted to the Contractor. Contractor shall have the right to require that any negatives he deems unsatisfactory be repeated or any seams he deems unsatisfactory be revealed and reradiographed.

No acceptance by Contractor of the radiographs nor of the welds shall relieve, in any manner, the responsibilities of Subcontractor.

9. ACCESS OPENINGS

9.1 Personnel and equipment access openings as specified in this section, including suitable hardware and gaskets, shall be provided and suitably mounted and connected to the shell. Detailed location of openings will be furnished by Contractor at a later date.

9.11 Equipment Lock (E-1)

The lock shall provide a cross-sectional clear opening as shown on Drawing 3159-C-101, and a clear distance of 18'-0" between doors. The clear distance shall not be impaired by the door swing. The inner part of the lock and exterior removable portions such as bridges or floor sections shall have a level floor designed to support a fork-lift truck with 2 main wheel loads, each of 7000 lbs.

Rails for flanged wheels having a 4'-8-1/2" gauge shall be furnished and installed within the lock and over any exterior bridge or removable sections as described in Par. 9.16. The rails shall be capable of supporting two 40-ton axle loads on a 10'-0" wheel base. Contractor will furnish detailed requirements at a later date.

The lock shall have two gasketed doors in series, and the doors shall be mechanically interlocked such that one door cannot be opened unless the second door is sealed. The locking and swing of the doors shall normally be power operated. The type of power shall be subject to the approval of the Contractor. The powered operator shall be so designed and constructed that either door may be operated from

(a) inside the vessel,

(b) inside the lock, or

(c) outside the vessel.

Each door shall be equipped with a valve, manually operable from either side of the door, for equalising the pressure across the door. Each valve shall be operable from every point at which the associated door can be operated. The valves for the two doors of one lock shall be properly interlocked so that only one valve can be open at a time, and only when the opposite door is closed and locked. Doors which are not pressure seated shall be interlocked with the equalising valve or provided with suitable safety devices which will prevent

uncontrolled outward swing under internal pressure.

Each door shall be designed so that with the other door open it will withstand the design pressure inside the vessel or a vacuum inside the vessel of 0.5 psig. Doors, locking devices and seals shall also be adequate for a pressure or vacuum of 2 psig inside the lock with the vessel at atmospheric pressure.

Each door shall be so installed or shall have a manually operated locking device that will prevent its being closed while bulky items are being transported through the door.

Each door shall be provided with an emergency manual operator which can be operated from at least outside the lock. In other words, the inner door shall be manually operable from inside the vessel, and the outer door from outside the vessel. The powered operators shall be so designed and constructed that manual operation is not significantly impeded in the event of a power failure or jamming of the powered mechanism.

There shall be a positive indication outside the lock at each door showing whether the opposite door is open, closed or in the "locked open" position, and whether its valve is open or closed.

9.12 Personnel Lock (E-2)

The lock shall provide a cross-sectional clear opening of approximately 3'-6" wide by 6'-8" high and a minimum clear distance of 7'-0" between doors. The clear distance shall not be impaired by the door swing. The inner portion of the lock shall have a floor capable of supporting a uniform live load of 100 psf.

The lock shall have two gasketed doors in series, and the doors shall be mechanically interlocked such that one door cannot be opened unless the second door is sealed. The locking and swing of the doors shall be normally operated by a means which may be either manual or power at the option of the Subcontractor. If power operated doors are elected, the type of power shall be subject to the approval of the Contractor. The normal operator shall be so designed and constructed that either door may be operated from

(a) inside the vessel,

(b) inside the lock, or

(c) outside the vessel.

Each door shall be equipped with a valve, manually operable from either side of the door, for equalizing the pressure across the door. Each valve shall be operable from every point at which the associated door can be operated. The valves for the two doors of one lock shall be properly interlocked so that only one valve can be open at a time, and only when the opposite door is closed and locked.

Each door shall be designed so that with the other door open, it will withstand the design pressure inside the vessel or a vacuum inside the vessel of 0.5 psig. Doors, locking devices, and seals shall also be adequate for a pressure or vacuum of 2 psig inside the lock with the vessel at atmospheric pressure. Doors which are not pressure seated shall be interlocked with the equalizing valve or provided with suitable safety devices which will prevent uncontrolled outward swing under internal pressure.

If the doors are normally operated by power, each door shall be provided with an emergency manual operator which can be operated from at least outside the lock. The powered operators shall be so designed and constructed that manual operation is not significantly impeded in the event of a power failure or jambing of the powered mechanism.

There shall be a positive indication outside the lock at each door showing whether the opposite door is open, closed or in the "locked open" position, and whether its valve is open or closed.

9.13 Personnel Escape Lock (H-3)

The lock shall have 2'-6" diameter doors and a 5'-0" minimum inside diameter barrel and shall provide 8'-0" clear between bulk-heads. The lock shall have two gasketed doors in series, and the doors shall be mechanically interlocked such that one door cannot be opened unless the second door is sealed. Each door mechanism shall be operable from either side of the door and shall be mechanical only, without power assist. In addition, a mechanical means shall be provided to close and latch the outside door from inside the vessel and the inside door from outside the vessel.

Both doors shall open toward the inside of the vessel and the outer door shall be weathertight. Contractor will provide means for maintaining ice free conditions at the door. Doors, locking devices and seals shall be designed for the pressure and vacuum conditions outlined in Par. 9.11.

Interlocking equalizing valves shall be provided as outlined in Par. 9.11.

9.14 Equalizing valves of all locks shall be sized to equalize the pressure across its associated door within 30 seconds starting with a differential of design internal pressure.

9.15 If a lock cannot be supported entirely by the shell without excessive reinforcement, it may be supported at its outer end by an auxiliary support extending to the ground. Such support shall be so designed that it will not detrimentally restrain the movement of the lock or vessel during increase of temperature and/or pressure (See Par. 4.2). Contractor will furnish foundation support as in Par. 3.24(c).

9.16 Removable Portions and Exterior Structural Appurtenances Necessary for the Operation of the Locks

All removable floor or rail support sections adjacent to and an integral part of the lock shall be designed, constructed and installed by the Subcontractor. The system and details shall be subject to the approval of the Contractor.

The Contractor will furnish all supporting members not integral with the lock or vessel, in accordance with the Subcontractor's outline drawings.

9.17 Subcontractor shall design, furnish, install, connect, and test all equipment and mechanisms including all switchgear panelboards, limit switches, pushbutton stations, drive motors, wiring, conduit, penetrations, piping and valves that may be required to produce a complete operating system.

Electric power at 480 volts, 3 phase and/or compressed air for power and control of the lock will be provided by Contractor outside each lock in a weatherproof enclosure at a distance not exceeding 10 feet from the outer door. Beyond this point all wiring, piping or tubing to control and operate the lock shall be furnished by Subcontractor. Telephone and illumination systems will be furnished and installed by Contractor.

9.2 After completion and intial pressure and leakage testing of enclosure (Par. 11.2), one temporary access opening shall be provided in the shell. This opening shall have dimensions as shown on the drawings and shall be located with bottom of opening at approximately elevation 598'-0" and at a location around circumference as specified by Contractor. Cutting of shell plates for the opening shall be done by oxyacetylene burning. Care shall be taken during burning to prevent damage to shell plate. Sections of plate removed from the opening shall be carefully stored in a suitable place and properly protected to prevent damage or deformation until the sections are reinstalled in shell. Edges of plate on shell and sections removed shall be carefully cleaned of slag and suitably beveled for rewelding sections into shell. If necessary, the shell and column bracing shall be satisfactorily reinforced to permit making and using this opening.

9.3 After making the temporary access opening, Subcontractor shall promptly clear the site of all equipment and all debris resulting from his operations and leave the site in neat and orderly condition.

9.4 At such time in the total plant construction schedule as specfied by Contractor, the removed section shall be reinstalled and welded into place by the Subcontractor. Welding material and procedures used shall be as specified in Section 8, above, for pressure vessel welding. After welding, the newly welded joints shall be examined by radiographic methods as specified in Section 8. All defective sections of the welded joints disclosed by the radiographic examination shall be removed and replaced by satisfactory welding.

10. SHELL PENETRATIONS

10.1 Shell penetrations shall be provided as listed in the following Par. 10.11 to 10.13, and Drawing 3159-C-101.

10.11 Access openings:

M-1, Equipment Lock, see Par. 9.11
M-2, Personnel Lock, see Par. 9.12
M-3, Emergency escape lock, see Par. 9.13

10.12 M-4, 24-inch diameter manhole located at the bottom of the vessel. Cover shall be suitably bolted and gasketed for initial testing of the vessel. It shall be capable of being seal welded permanently shut at the desired stage during placement of the concrete under the vessel.

10.13 Nozzle Penetrations

⚠ The location and size of these penetrations and end preparations are shown on Dwg. C102. Subcontractor shall design, furnish, and install suitable temporary caps (except for those designated as spares) for use during the initial tests, and upon completion thereof, remove such caps. Minimum center to center distance between any two penetrations, including access openings, will be twice the average diameter of the finished opening in the shell.

Closures for "spare" penetrations shall be designed, furnished and installed in accordance with the provisions of this specification applying to permanent parts of the vessel. Ends of nozzles not to remain capped shall be prepared for welding in accordance with requirements to be furnished by the Contractor.

11. TESTS FOR PRESSURE TIGHTNESS

11.1 Pneumatic tests will be required to demonstrate the integrity of and to eliminate leakage from the enclosure. Subcontractor shall perform the tests listed below and shall be responsible for integrity of vessel during the tests. Sufficient compressor capacity shall be installed to raise the pressure in the vessel by at least 1 psi per hour.

11.2 Initial Tests

11.21 Initial Soap Bubble Test

Upon completion of the vessel, a soap bubble test at 5 psig shall be applied to all welds and seals. The test shall be applied to each door of a lock with the other door open.

11.22 Initial Pneumatic Test

After successful completion of the soap bubble test, a test shall be made at a pressure equal to 125% of design internal pressure in accordance with Par. UG-100 of the Code. Each door of the locks shall be tested separately at the overload pressure. The operation of the outer equalizing valve of each lock shall be tested at design internal pressure. The operation of the inner equalizing valve of each lock shall be tested at a differential of at least 9 psi.

11.3 Final Tests

11.31 Final Soap Bubble Test

After construction of the vessel foundation and internal structure, installation of equipment, sealing of all penetrations, and after reinstallation of the plates in the temporary openings, at a time selected by Contractor, a soap bubble test at 5 psig shall be applied to all seams added or worked on since the previous test and to all penetration closures which can be satisfactorily tested by this means.

11.32 Halide Leak Detection Test

Using a flame-type halide leak detector, or other approved device, discover any leaks at all access doors, shaft seals, electrical penetrations, and all other penetration closures in Subcontractor's work which cannot be satisfactorily tested with soapsuds.

June 12, 1961

11.33 Correction of Leaks

Subcontractor shall correct any leaks in work done by him. Contractor will correct other leaks.

△ 11.34 Final Leakage Rate Test

After successful completion of final soap bubble and halide testing, a leakage rate test will be made by the Contractor at an internal pressure of approximately 10 psig.

11.4 Leakage Rate Determination

△ (a) The Subcontractor shall perform a leakage rate test of the vessel as a part of the initial tests. This test shall be made at a pressure to be determined by the Contractor, but not to exceed the design internal pressure. Subcontractor shall furnish and install all equipment, take readings and record all data, and submit a report on the completed test. Subcontractor shall correct all leaks that become apparent in the work performed by him.

(b) The leakage rate shall be determined by measuring the pressure differential between the vessel and one or more air-tight reference chambers, suitably placed within the vessel to reflect average internal air temperature. Readings shall be taken and recorded hourly but only those readings taken during periods of relatively uniform temperature (usually the midnight-to-dawn period) will be used in calculating leakage.

(c) To assist in interpreting the primary data, Subcontractor shall obtain auxiliary data, including outside temperature and barometric pressure; and within the vessel, pressure, and at least one air temperature (at approximately the center) all at hourly intervals throughout the period of the test. A recording humidity instrument shall be placed within the vessel to operate during the test period.

(d) At the end of the first twenty-four to thirty-hour period beginning at midnight, if the test is mutually agreed to be satisfactory, the test will be discontinued. Otherwise, the test shall be continued for an additional twenty-four hours and/or until mutually agreed to be satisfactory by the Subcontractor and Contractor.

11.5 Test Procedure

Prior to performance of any test described in this section, Subcontractor shall prepare detailed description of procedure he intends to follow. This shall be submitted to the Contractor for approval at least 30 days prior to the beginning of the test.

11.6 Alternate Erection and Test Schedules

In order to meet or improve the construction schedule (Par. 2.6) the Subcontractor may propose an alternate to the erection and test schedule given in Par. 2.5. However, the Subcontractor shall fulfill the overall test requirements as outlined herein. As an example, if the Subcontractor elects to erect the vessel excluding the locks using temporary plates in their locations, the initial pneumatic test shall not be considered adequate. In this case a second pneumatic test as outlined in Par. 11.22 must be performed as part of the final tests. This same philosophy shall apply to other procedural alternates.

11.7 Control of Personnel and Clearance of Test Area

Prior to the performance of any test and area within a radius of 1200 feet from the center of the vessel shall be cleared of all movable equipment subject to damage and mutually agreed upon by the Contractor and Subcontractor. During the test no one shall be allowed within the exclusion area without written authorization from the Subcontractor. The enforcement of this provision will be the responsibility of the Contractor.

August 22, 1960

12. PAINTING

12.1 Subcontractor shall clean and prime all steel surfaces in accordance with the following:

12.11 Remove grease and oil. Remove all mill scale, rust and dirt by blast-cleaning according to SSPC* - SP6 for commercial Blast Cleaning or SSPC* - SP8 for Pickling followed by SSPC* - PT4 for Hot Phosphate Treatment, or Chicago Bridge & Iron Specification 57-P for Pickling of Steel by the Phosphoric Acid Process.

⚠ 12.12 After surface is cleaned and before rusting occurs, prime surface as follows:

a) Exterior Surface

Above El. 594'-0" and below El. 580'-8½" apply one coat of zinc chromate primer with properties similar to Pitt-Chem Insulmastic 5622. Follow manufacturer's recommendation for all phases of the coating application. Primer shall be omitted within 3 inches of field welds. Between El. 594'-0" and El. 580'-8½" apply one coat of Carboline Company Carbomastic No. 2. Follow manufacturer's recommendation for all phases of the coating application. Primer shall be omitted within 6 inches of field welds.

b) Interior Surface

Above El. 596'-3" and below El. 580'-8½" apply zinc chromate as in (a) above. Between El. 596'-3" and El. 580'-8½" primer shall be omitted.

12.13 After erection, field joints adjacent to zinc chromate primed areas, with the exception of the joint at El. 580'-8½", shall be cleaned in accordance with SSPC* SP3 for power tool cleaning and brush primed as required above for zinc chromate primer.

All field touch-up painting will be done by the Contractor on the exterior surface between El. [illegible] and El. 594'-8 1/2".

* Steel Structures Painting Council, 4400 Fifth Ave, Pittsburgh 13, Pennsylvania.

13. DRAWINGS

13.1 The Subcontractor shall prepare the necessary design, shop, and foundation requirement drawings. He shall submit drawings and data to the Contractor in accordance with Bechtel Form G-321-C. No fabrication shall commence until approved shop drawings are returned to Subcontractor.

13.2 Upon completion of the work, the originals of these drawings shall be corrected to show the "as built" conditions and shall be delivered to Contractor.

14. TESTS, RECORDS AND INSPECTION

14.1 Tests

All material entering the work shall be tested in accordance with the applicable specifications listed herein.

All materials subject to the Code shall be stamped at the mill. Fabricator shall transfer stamps as required to permit the complete identification of material at all stages of fabrication and erection.

The negatives of all radiographs shall be so marked as to permit positive identification of the seam and locations at which they were taken.

14.2 Records

Subcontractor shall promptly furnish Contractor with a record of all tests. Without limitation, these shall include:

(a) Mill tests, in triplicate, certified as to their accuracy by the Mill's chief inspector, of all materials entering the construction.

(b) The negatives of all accepted radiographs, and certified interpretations thereof.

14.3 Inspection

Inspectors, duly authorised by Contractor, shall have access at all times to any or all of Subcontractor's operations.

Subcontractor shall replace any material and cut out and replace any welding which inspector may find as not meeting the requirements of the specifications.

TEST PROCEDURE

CONTRACT 8-0580

PART A - PRELIMINARY

1. Shop test all air locks for tightness, strength, and operation of door mechanism, including equalizing valves.

2. Shop magnaflux all shop-welded manholes and nozzles inside and outside after shop stress-relief.

3. Field magnaflux all manhole and nozzle welds above 40" diameter inside and outside

4. If any cracks or leaks are found:

   (a) Use chipping tool or arc-air gouge to remove defect.

   (b) Magnaflux and inspect defective area thoroughly before rewelding.

   (c) Repair by welding.

   (d) Inspect repaired area by magnafluxing, or by radiographing where area is accessible.

5. After shop welding sections together to form an airtight Test Chamber (see Fig 1), insert Freon into chamber to 5 psig and check all welds and connections with Halide Leak Detector

6. If any leaks are found, release pressure, repair, and retest until Leak Detector does not find any leaks.

7. Field install Test Chamber on vertical centerline inside of Containment Sphere, approximately equidistant from top and bottom, and connect tubing to bottom end of chamber.

8. Connect tubing to valves and manometers as schematically illustrated in Fig 1

   NOTE: THE MANOMETERS ARE TO BE LOCATED IMMEDIATELY ADJACENT TO THE CONTAINMENT SPHERE.

11-4-60

9. Install sufficient mercury in Open End Manometer to measure about 35 psig pressure (71 inches of mercury).

10 Open Valve "B" and close Valves "C", "D", "E" and "F".

11. Insert approximately 1% Freon-air mixture in Test Chamber and tubing until 25 psig (50 0 inches of mercury) is reached.

12. Check tubing and valves between Test Chamber and Open End Manometer with Leak Detector, stopping all leaks until system is airtight

13. As a secondary check, hold pressure in Test Chamber and tubing for a minimum of 24 hours, comparing initial Open End Manometer reading with final reading

14. If Manometer indicates a measured drop in pressure which is not related to temperature conditions, recheck tubing, valves and Test Chamber with Leak Detector.

15. When Manometer indicates Test Chamber system is airtight, release pressure in Test Chamber by opening Valve "C", leaving Valves "B" and "C" open

16. Install piping and valves between:

    (a) Containment Sphere and Pressure Gages (Valves "A" and "H")

    (b) Containment Sphere and Air Supply Valves "A", "J" and "K"

    (c) Air Locks and Air Suppply Valves "M", "L" AND "I"

    NOTE: THE CONTROLLING AIR VALVES AND PRESSURE GAGES ARE TO BE LOCATED AT A DISTANCE NOT LESS THAN 600 FEET FROM THE SHELL

PART B - OVERLOAD TEST

17. Calibrate Recording and Dial Pressure Gages at 34 psig and install on Gage Line.

18. Open Shutoff Valves "A" and "M" and Blowoff Valve "I".

19. Close Blowoff Valves "H" and "J"

20. Close Air Lock Valve "L" and Drain Valve "G".

21. Close or blank all other connections in Containment Sphere.

22. Close Inner Doors of Locks, leaving Outer Doors open.

    NOTE: IMMEDIATELY AFTER CLOSING LAST CONNECTION ON DOOR, OPEN VALVE "K" AND START PUMPING AIR TO AVOID POSSIBILITY OF VACUUM OCCURRING INSIDE CONTAINMENT SPHERE.

23. Pump air into Containment Sphere to 5 psig.

24. Stop pumping and close Air Supply Valve "K".

25. Apply soapsuds to all seams of shell and nozzles, gaskets of manholes and doors, and test covers of nozzles except Outer Lock Doors and portion of Locks not pressurized.

26. If a leak in a welded seam is found during the soapsuds test at 5 psig or at any time before the overload pressure of 33-3/4 psig is reached, the procedure shall be as follows:

    (a) Release air pressure to atmospheric by opening Blowoff Valve "J".

    (b) Immediately after pressure has been released from the Containment Sphere, open a large enough connection in the shell to prevent the formation of a vacuum

(c) BEFORE REPAIRING ANY LEAKS OR DOING ANY WORK THAT MIGHT CAUSE A SPARK, TEST VAPOR SPACE TO MAKE SURE THAT IT IS GAS-FREE

(d) Use chipping tool or arc-air gouge to remove the defect.

(e) Magnaflux and inspect the defective area thoroughly before rewelding.

(f) Repair by welding

(g) Radiograph the repaired weld, or inspect by magnafluxing where not accessible for radiography.

(h) Retest, starting with Step 19, except that only the repaired weld and previously untested welds shall be inspected with soapsuds at 5 psig

27. Close Outer Doors of Locks and close Valve "I".

28. Open Lock Valve "L", allowing pressure to reach approximately 5 psig in Locks

29. Apply soapsuds to Outer Doors and seams of Locks not previously checked during Step 25

30. Close Lock Valve "L" and open Blowoff Valve "I" to release pressure in Locks

31 The following clearance rules are mandatory:

(a) ALL UNAUTHORIZED PERSONNEL (INCLUDING ALL MOVABLE EQUIPMENT SUBJECT TO DAMAGE) MUST MAINTAIN A CLEARANCE FROM CONTAINMENT SPHERE SATISFACTORY TO C B &I WHILE PRESSURE IS BEING INCREASED ABOVE 5 PSIG AND UNTIL OVERLOAD TEST AND FINAL SOAPSUDS TEST HAVE BEEN SUCCESSFULLY COMPLETED A MINIMUM DISTANCE OF 1200 FEET FROM THE CENTER OF THE SPHERE IS REQUIRED THE ENFORCEMENT OF THIS PROVISION IS THE RESPONSIBILITY OF THE BECHTEL CORPORATION

(b) AUTHORIZED PERSONNEL, SUCH AS C.B.&I EMPLOYEES AND NECESSARY OUTSIDE PERSONNEL WHO ARE AUTHORIZED IN WRITING BY C.B &I , MUST MAINTAIN A 600-FT CLEARANCE FROM THE OUTSIDE OF THE SPHERE EXCEPT DURING THE FINAL SOAPSUDS INSPECTION AT THE DESIGNATED PRESSURE

(c) DURING THE LEAKAGE RATE TEST (PART C), ONLY AUTHORIZED PERSONNEL SHALL BE ALLOWED ON OR ADJACENT TO SPHERE AND INSTRUMENTS. NO WORK SHALL BE PERMITTED WITHIN 25 FEET OF INSTRUMENTS, VALVES AND THE SHELL OF SPHERE

32. Open Valve "K" and start pumping air into Sphere to 17 psig.

33. Increase pressure from 17 psig to 33-3/4 psig in 3-1/2 psig increments.

34. Close Air Supply Valve "K" and hold 33-3/4 psig test pressure approximately 20 minutes

35 Close Valve "I" and open Air Lock Valve "L" to interconnect Air Locks with Containment Sphere

36. Hold 33-3/4 psig test pressure for another 40 minutes, adding or releasing air to compensate for temperature variations

37. Open Blowoff Valve "J" to reduce pressure in the Containment Sphere and Air Locks to 27 psig (design pressure).

NOTE: IF IT IS MUTUALLY AGREED TO START LEAKAGE RATE TEST AT THIS TIME (PRIOR TO FINAL SOAPSUDS TEST), PRESSURE SHOULD BE FURTHER REDUCED AS DESCRIBED IN STEP 50

38 Close Valve "J" and apply soapsuds to Outer Doors and Outer Seams of Locks, all seams of shell and nozzles, all gaskets of manholes, and all test covers of nozzles.

39 If any leak is found, the following procedure shall be followed:

(a) A leak which is considered to be of sufficient magnitude to affect the structural integrity of the

vessel shall be immediately repaired as described in Step 26, including a 33-3/4 psig retest, but only a soapsuds test of the repaired area.

(b) A leak which is considered not to affect the structural integrity of the vessel but which might prevent a successful leakage rate test shall be temporarily sealed, if possible, or the leakage measured, and the test procedure continued. Such a leak might be in a temporary closure, which could be repaired later without the necessity of a retest. If the air pressure must be released from the vessel in order to seal or to repair such a leak, the procedure shall continue, after the repair, into the Leakage Rate Test (Part C) without repeating the 33-3/4 psig overload test.

40. Close Shutoff Valve "M" at each lock.

41. Close Valve "L" and open Valve "I".

42. Close Shutoff Valve "A".

43. Open OUTER Equalizing Valves and check time of blowdown of pressure from each Lock.

44. Open Outer Door of each Lock.

45. Apply soapsuds to Inner Doors and seams of Locks not previously checked in Step 38.

46. Close Outer Door of each Lock and open INNER Equalizing Valves to pressurize Locks.

47. Check the time required to equalize the pressure in the Locks with the Containment Sphere which would permit the opening of the Inner Doors.

48. Open Inner Doors of each Lock and leave open.

49. Apply soapsuds to Outer Door of each Lock.

PART C - LEAKAGE RATE TEST

50. If the maximum expected temperature during the Leakage Rate Test exceeds the maximum temperature noted during the soapsuds test (Steps 38, etc.), reduce the Containment Sphere pressure to the following calculated gage pressure to avoid the possibility of exceeding the design pressure of 27.0 psig during the Leakage Rate Test:

$$= (27.0 + 14.7)\left[\frac{460^\circ \text{ F.} + \text{Maximum Temperature during 27.0 psig Soapsuds Test}}{460^\circ \text{ F.} + \text{Maximum Expected Temperature during Leakage Rate Test}}\right] - 14.7$$

51. Prior to the start of the Leakage Rate Test at midnight, blow out condensate, if any, from Test Chamber and tubing through Valve "D" and from Containment Sphere through Condensate Drain Valve "C".

52. Open Water Reservoir Valves "E" and "F" in sequence to allow water to flow into Differential Water Manometer to approximately Mid-Height of Scale, and then close Valves "E" and "F".

53. Open Valves "A" and "K" to pump additional air into Containment Sphere until Water Manometer indicates 8 inches higher pressure than Inner Reference System.

54. Close Valves "A" and "K", remove pipes to Valves "A" and "K", and check tightness of valves with soapsuds.

55. Record at hourly intervals the following data:

(a) Atmospheric Temperature, in Degrees Fahrenheit.

(b) Atmospheric Barometric Pressure, in Inches* of mercury.,

(c) Containment Sphere Gage Pressure as indicated on Open-End Mercury Manometer, in inches* of mercury.

(d) Containment Sphere Absolute Pressure as measured by the sum of (b) + (c), in inches* of mercury = P.

(e) Difference in pressure between Containment Sphere and Test Chamber as measured by Differential Water Manometer in inches* of water = ΔP.

*It is intended that the readings will be made to tenths of an inch and estimated to nearest hundredths of an inch.

56. After about 30 hours (during midnight-to-dawn period of relatively uniform temperature), calculate the per cent loss of total contained air by the following formula:

$$\text{Per Cent Loss} = \left(\frac{\text{Initial } \Delta P - \text{Final } \Delta P}{\text{Initial P} \times 13.6} \right) \times 100$$

NOTE: DURING THE NIGHT HOURS OF RELATIVELY UNIFORM TEMPERATURE (USUALLY THE MIDNIGHT-TO-DAWN PERIOD), THE TEMPERATURE IN THE TEST CHAMBER AND CONTAINMENT SPHERE WILL BECOME EQUAL. A COMPARISON OF THE MANOMETER DIFFERENCES BETWEEN THE INITIAL PERIOD OF UNIFORM TEMPERATURE AND THE FINAL PERIOD WILL ALLOW CALCULATION OF THE PER CENT LOSS OF AIR IN THE CONTAINMENT SPHERE BY THE ABOVE FORMULA.

57. If the calculated per cent loss as indicated by the reference system is mutally acceptable to the Subcontractor, the Contractor and the Owner, and the test is agreed to be satisfactory, open Valve "A" to release pressure.

58. If the calculated per cent leakage is slight but doubt exists that the results are a fair indication of actual leakage, continue test for an additional length of time as directed by the Contractor and at his expense.

59. If calculated per cent loss is substantial, recheck Containment Sphere, connections, valves and instruments for sources of leakage, and repeat Leakage Rate Test if necessary.

60. After successful completion of test, release air until Containment Sphere pressure is back to atmospheric pressure.

61. WHEN PRESSURE REACHES ATMOSPHERIC, IMMEDIATELY OPEN VESSEL TO AVOID POSSIBILITY OF VACUUM OCCURRING IN CONTAINMENT SPHERE.

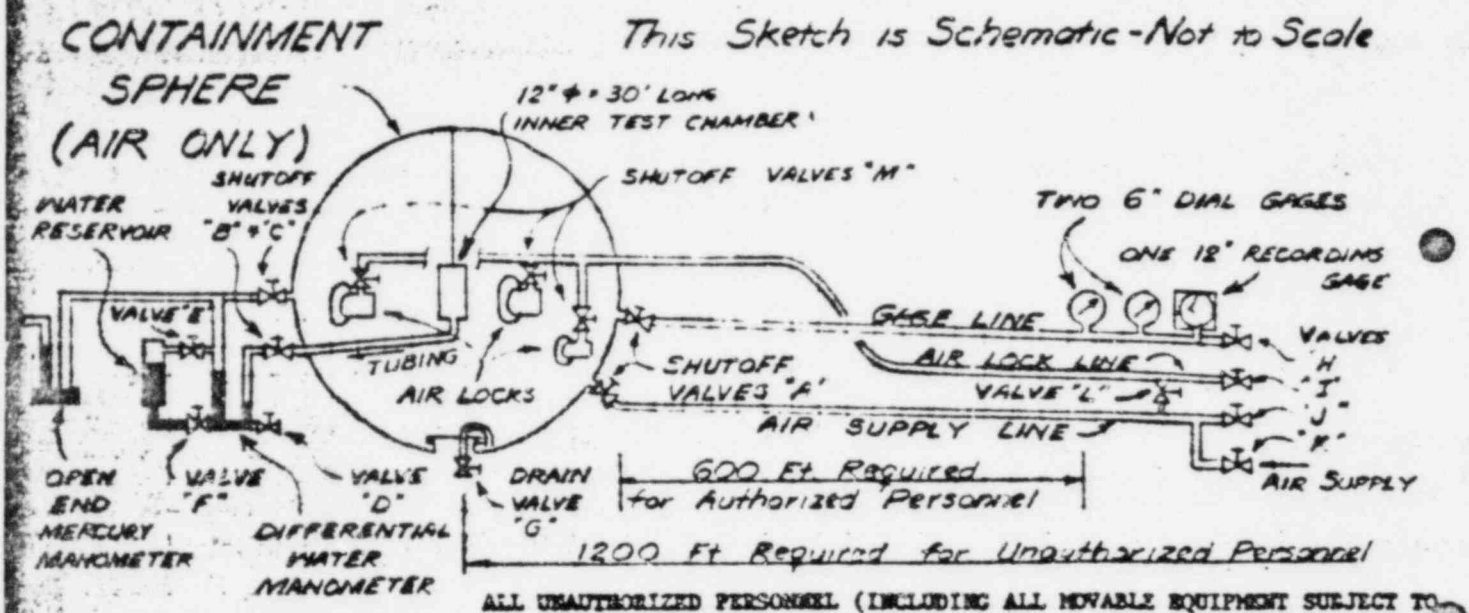
62. Remove Inner Test Chamber, tubing, instruments and temporary test covers.

CHICAGO BRIDGE & IRON COMPANY

EVH

11-4-60
Rev. 12-1-60

TEST LAYOUT - CONTR. 8-0580



OTHER INSTRUMENTS INCLUDE THERMOMETERS AND A MERCURY MANOMETER

ALL UNAUTHORIZED PERSONNEL (INCLUDING ALL MOVABLE EQUIPMENT SUBJECT TO DAMAGE) MUST MAINTAIN A CLEARANCE FROM CONTAINMENT SPHERE SATISFACTORY TO C.B.&I. WHILE PRESSURE IS BEING INCREASED ABOVE 5 PSIG AND UNTIL OVERLOAD TEST AND FINAL SOAPSUDS TEST HAVE BEEN SUCCESSFULLY COMPLETED. A MINIMUM DISTANCE OF 1200 FEET FROM THE CENTER OF THE SPHERE IS REQUIRED. THE ENFORCEMENT OF THIS PROVISION IS THE RESPONSIBILITY OF THE RECEIVING CORPORATION.

AUTHORIZED PERSONNEL, SUCH AS C.B.&I. EMPLOYEES AND NECESSARY OUTSIDE PERSONNEL WHO ARE AUTHORIZED IN WRITING BY C.B.&I., MUST MAINTAIN A 600-FT. CLEARANCE FROM THE OUTSIDE OF THE SPHERE EXCEPT DURING THE FINAL SOAPSUDS INSPECTION AT THE DESIGNATED PRESSURE.

DURING THE LEAKAGE RATE TEST (PART C), ONLY AUTHORIZED PERSONNEL SHALL BE ALLOWED ON OR ADJACENT TO SPHERE AND INSTRUMENTS. NO WORK SHALL BE PERMITTED WITHIN 25 FEET OF INSTRUMENTS, VALVES AND THE SHELL OF SPHERE.

FIG. 1

130'ϕ CONTAINMENT SPHERE
CONTR. 8-0580

GEOMETRIC VOLUME = 1,150,350 CU. FT.

INITIAL EXPANDED AIR CONTENT
(TOTAL VOLUME OF FREE AIR)

$$= 1,150,350 \times \left(\frac{27.0 \text{ psig} + 14.7 \text{ psig}}{14.7 \text{ psig}}\right) = 3,263,238 \text{ cu ft}$$

FOR 0.1 PER CENT ALLOWABLE LOSS, THE AIR VOLUME LEAKAGE AT 27 psig

$$= \frac{0.1}{100} \times 3,263,238 \text{ cu. ft} = 3,263 \text{ cu. ft.}$$

OR IN TERMS OF DIFFENTIAL PRESSURE

$$= \frac{0.1}{100} \times (27.0 + 14.7)(27.68)$$

= 1.15 INCHES OF WATER

RVM
DEC 1960

Proj. C-1

BHR

BIG ROCK POINT PLANT

CONSUMERS POWER COMPANY

CHARLEVOIX, MICHIGAN

Test Dates - January 11, 1961 thru January 18, 1961

GENERAL CONTRACTOR - BECHTEL CORPORATION

SPHERE SUPPLIER AND ERECTOR - CHICAGO BRIDGE AND IRON COMPANY

CONTENTS:

1. Test Procedure for Pressure Test of Reactor Containment Vessel.
2. Log Data of Actual Field Test.
3. Data Sheet of Inner Chamber Test.
4. Data Sheet of Leak Rate Test (Including Plotted Data).

CONSUMERS POWER COMPANY

LOG OF REACTOR CONTAINMENT VESSEL TEST

Step Nos. 1-6: Completed in the shops of Chicago Bridge & Iron Co.

Step Nos. 7-12: Completed in the field by Chicago Bridge & Iron Company on January 11, 1961 at 11:30 A.M.

Step No. 13: Started at noon on January 11, 1961 and continued until 9:30 A.M. January 12, 1961. The last reading was taken on this Step at 9:00 A.M., January 12, 1961, and there were no leaks. This reading was taken by Mr. Edward Garis of Chicago Bridge & Iron and Mr. J. D. Lessee of Consumers Power Company.

At 9:30 A.M., January 12, 1961, a worker was taking a live welding lead out of the Containment Vessel. This lead was pulled over the tubing connecting the inner test chamber and the manometer used to check the pressure of the inner test chamber. As the welding electrode holder passed over the tubing a hole was burned in the tubing. The tubing was repaired and Step 14 complied with. The readings were started again at 12:30 P.M. on January 12, 1961, and continued through 10:00 A.M., January 13, 1961.

After 10:00 A.M., January 13, 1961, readings on the inner test chamber showed no leakage and Mr. Edward Garis of C. B. & I. decided to go ahead with Step 23.

Step Nos. 18-22: Completed January 13, 1961, between 9:30 A.M. and 10:00 A.M.

Step No. 23: Started at 10:00 A.M., January 13, 1961. Mr. Robert Busby of C. B. & I. went into the Sphere after pressurizing of the Sphere had started to again take temperature readings for the inner test chamber. The temperature in the Sphere was steadily increasing because of the pressurizing, therefore, Step No. 13 was logged for a running total time of only twenty-two (22) hours.

Step No. 24: Complied with at 12:05 P.M., January 13, 1961.

Step No. 25: Complied with at 12:20 P.M., January 13, 1961.

Step No. 26: A leak did not develop so this step was omitted.

Step Nos. 27-30: Completed by 4:30 P.M., January 13, 1961.

Step No. 31: Enforced at 4:59 P.M., January 13, 1961.

Step No. 32: Started at 5:00 P.M., January 13, 1961, and seventeen (17) psig were reached at 10:30 P.M., January 13, 1961, as observed on recording chart.

Two 6" dial pressure gages were referred to as Gages No. 1 and 2 in the field. They and the recording chart were located in a trailer on the North side of the entrance road, approximately 600 feet from the Sphere. For gage numbers refer to Fig. 1 attached to test procedure steps. The recording gage read two (2) psig before being cut in, but it had been calibrated as called for in Step No. 17 in the shops of C. E. & I., and therefore, this reading was of no concern.

Step No. 33: Complied with by shutting down one compressor at a time. Five 600 cubic feet per minute compressors were used to pressurize the Sphere.

Step No. 34: Complied with at 7:56 A.M., January 14, 1961. A picture of the gages was taken by Dayton Reichert, Consumers Power Company photographer, at 8:00 A.M., January 14, 1961. At 8:10 A.M., January 14, 1961, cut in two compressors to take care of pressure reduction due to line loss and temperature. Pressure in vessel had dropped to 33 5/8 psig at this time.

Pressure increasing at 34 psig before starting Step 35 to compensate for pressure lost in Sphere when locks were pressurized.

Step No. 35: Complied with at 8:19 A.M., January 14, 1961.

Step No. 36: Complied with between 8:19 A.M., January 14, 1961, and 9:00 A.M., January 14, 1961.

Step No. 37: Started at 9:00 A.M., January 14, 1961.

Step No. 38: Started at 11:53 A.M., January 14, 1961. Sphere at 27 psig. Scoping of Sphere started at 12:25 P.M., January 14, 1961. No leaks were found during this step.

Step No. 39: Conditions did not develop to a point where Part A of this Step came into force. After Step No. 49 the following statement can be made: Part B of this Step was partially complied with where leakage could be temporarily sealed, but leakage around outside door of material lock and door shaft of inner bulkhead of personnel lock and escape lock could not be sealed or leakage measured. Mr. Garis of C. E. & I. felt leakage was small enough so that it would not cause leakage beyond acceptable limits during leak rate test.

Step No. 40: Complied with at 11:56 A.M., January 14, 1961.

Step No. 41: Complied with at 11:57 A.M., January 14, 1961.

Step No. 42: Complied with at 11:57 A.M., January 14, 1961. At 1:00 P.M., January 14, 1961, outside temperature 31° F., scoping of Sphere continuing. Pressure in vessel has risen to 47½ psig. Valves A and J (See Fig. 1) were opened to bleed off excess pressure. At 1:20 P.M., January 14, 1961, Valves A and J were closed. Sphere pressure back to 47 psig.

Step No. 43: Started at 2:11 P.M., January 14, 1961.

1. Equipment Lock-Time for blow-down, 11 minutes, 40 seconds
2. Escape Lock-Time for blow-down, 20 seconds.
3. Personnel Lock-Time for blow-down, 1 minute, 20 seconds.

Step No. 44: Started on equipment lock at 2:25 P.M., January 14, 1961, and Steps 45-49 follow in sequence on each seperate lock.

EQUIPMENT LOCK

Step No. 44: Started at 2:25 P.M., January 14. 1961.

Step No. 45: Complied with.

Step No. 46: Complied with.

Step No. 47: Could not measure time of blow-down. Few pounds of pressure released could not be heard from outside of lock. Inner door of lock would not open. It is possible pressure sensing device for this door on inside of Sphere is not operating correctly. *

Step No. 48: Could not be complied with. See above.

Step No. 49: This Step was complied with by leaving the equalizing valve open between the Sphere and the inside lock. Door showed leakage when soaped. Released pressure by closing inner equalizing valve and again blowing down lock. Time of blow-down could not be measured as ice had formed in equalizing valve, giving an erroneous reading. The gasket of the outer door was cleaned and greased and lock again pressurized. The leak appeared to be less but did not stop completely. Also the outer equalizing valve leaked. The outer equalizing valve was sealed with a pipe plug and Mr. Edward Garis of C. B. & I. decided to go ahead with the leak rate test, for he felt that the leak would not seriously affect it's results.

ESCAPE LOCK

Step No. 44: Complied with.

Step No. 45: Door shaft through inner bulkhead has small leak of apparently no concern. (To Leak Rate Test)

Step No. 46: Complied with.

Step No. 47: Time of blow-down, 30 seconds

Step No. 48: Complied with.

Step No. 49: Complied with and no leaks.

PERSONNEL LOCK

Step No. 44: Started at 3:30 P.M., January 14, 1961.

* See Page 5 *.

Step No. 45: Small leak of apparently no concern on inner lock door shaft through inner bulkhead. (Of no concern to Leak Rate Test only)

Step No. 46: Complied with.

Step No. 47: Time of blow-down, 1 minute, 45 seconds.

Step No. 48: Inner door of Lock would not open. Suspect pressure sensing device for this door on inside of Sphere is not operating correctly. *

Step No. 49: Complied with by leaving the equalizing valve open between Sphere and inside Lock. Soap test showed no leakage.

Step No. 50: Maximum temperature during soapsuds was 92° F. A 7° allowance was made for possible temperature rise during leak rate test.

Step No. 51: Complied with-approximately 10 gal. of water removed from bottom of Sphere.

Step No. 52: Complied with.

Step No. 53: Started two compressors pressurizing Sphere until water manometer indicated 8.5" higher pressure than inner reference chamber.

Step No. 54: Complied with.

Step No. 55: Complied with. All readings observed by Bechtel Corporation, Chicago Bridge and Iron Company, and Consumers Power Company.

* January 18, 1961 - Jack Feltes of C. B & I. reported bolt from push-pull cable was pulled on Equipment Lock and Personnel Lock inner door opening mechanism to check seal on shaft of door opening mechanism with soap. This bolt was not replaced, thereby, violating interlock.

CONCLUSION

At 9:00 A.M., January 16, 1961, all readings on Leak Rate Test were telephoned to Mr. Tom Bennett of Consumers Power Company. At approximately the same time all readings were telephoned to Mr. Raymond McGrath of Chicago Bridge and Iron Company. Both of these parties and field engineers agreed that Leak Rate Test was well within limits.

Chicago Bridge and Iron Company, Bechtel Corporation, and Consumers Power Company agreed that test was satisfactory and Sphere was blown down starting at 10:00 A.M., January 16, 1961.

J. D. Leece
Superintendent of Construction

PALISADES POWER PLANT

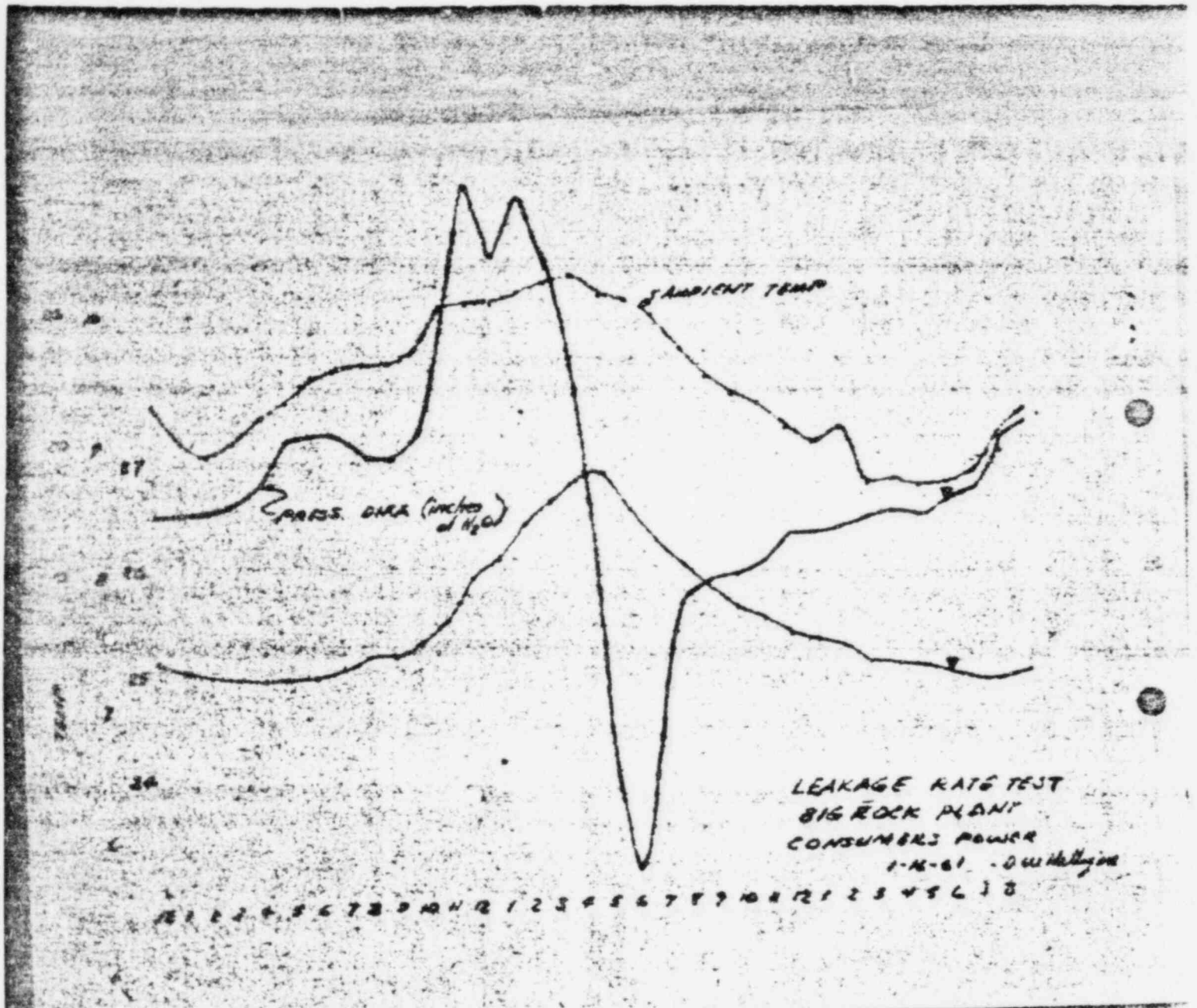
Consumers Power Co.

CHECK OF INNER CHAMBER

Date 12:30 PM Jan 12, 19

Time	1. Chan. Temp. In. Fahr.	2. Abs. Temp. In. Fahr.	3. Atm. Pres. In. Merc.	4. Chan. Pres. In. Merc.	5. Abs. Chan. Press. In. Merc.	6. Corr. Abs. Pres. In. Merc.	Remarks
Jan 12 - PM 12:30	40.6	500.6	29.56	51.89	81.45	81.45	
2:30	44.8	504.8	29.53	52.00	81.53	81.9	
3:30	46.1	506.1	29.54	53.50	83.04	82.0	
4:30	42.0	502.0	29.54	52.67	82.21	82.0	
6:00	45.2	505.2	29.54	53.10	82.64	81.9	
9:30	38.5	498.5	29.48	51.72	81.21	81.5	
Jan 13 - AM 7:00	38.3	498.3	29.38	51.80	81.18	81.8	
9:00	39.0	499.0	29.34	51.73	81.07	81.4	
10:00	40.5	500.5	29.33	51.80	81.13	81.1	(10:00) STARTED PUMPING TO FILL VESSEL TO 5 PSI
10:15	40.5	500.5	29.34	52.10	81.44	81.9	
10:20	41.9	~					WARM AIR PUMPED INTO SPHERE CAUSED ERRATIC READINGS

1. Temperature should be taken as close to Inner Chamber as practical.
2. Absolute Temperature is Chamber Temperature + 460.
3. Atmospheric Pressure is measured by Closed End Mercury Barometer.
4. Chamber Pressure is measured by Open End Mercury Manometer.
5. Absolute Pressure is Sum of Barometer and Manometer Readings.
6. Corrected Absolute Pressure is the measured Absolute Pressure corrected to the Temperature at the Start of the Holding Period = Meas. Abs. Pres. x Initial Abs. Temp. / Meas. Abs. Temp.


AMBIENT TEMP
PRESS. DIFF (inches of H2O)
LEAKAGE RATE TEST
BIG ROCK PLANT
CONSUMERS POWER
1-16-61 . D. Williams

CONTAINMENT VESSEL - BIG ROCK PLANT
CONSUMERS POWER CO.
LEAK RATE TEST - DAY

June 15-16, 1961

Time	Atmos. Conditions: Temp. In Fhar.			Closed End Baron. Inches Merc.	Cont. Vessel Pressure: Open End Manom. Inches. Merc.	Abs. Press. In. Mere.	Differential Manometer: Inner Chan. In. Water	Cont. Vessel Inches Water	Diff. In Press. Inches Water
12:00 N				29.43	51.70	81.13	3.41	4.72	8.10
1:00 PM				29.43	51.52	80.94	3.40	4.70	8.10
2:00				29.40	51.39	80.79	3.43	4.81	8.24
3:00				29.37	51.22	80.60	3.45	4.76	8.21
4:00				29.37	51.08	80.46	3.47	4.74	8.22
5:00				29.36	50.99	80.36	3.43	4.87	8.30
6:00				29.36	50.89	80.26	3.52	4.92	8.44
7:00				29.37	50.82	80.19	3.48	4.91	8.39
8:00				29.36	50.65	80.01	3.75	5.15	8.90
9:00				29.28	50.95	80.23	3.93	5.20	9.03
10:00									
11:00									
12:00 M									
1:00 AM									
2:00									
3:00									
4:00									
5:00									
6:00									
7:00									
8:00									
9:00									
10:00									
11:00									

A "A" or "B" refers to Water Level ABOVE OR BELOW Zero Mark.
A "-" Difference means Cont. Vessel Press. HIGHER than Inner Chamber.

CONTAINMENT VESSEL - BIG ROCK POINT
CONSUMERS POWER CO.
LEAK RATE TEST - DAY

12:01 A.M. JAN. 19, 1961

Time	Atmos. Conditions			Cont. Vessel Pressure		Differential Manometer		
	Temp. in Fahr.		Closed End Barom. Inches Merc.	Open End Manom. Inches Merc.	Abs. Press. In. Merc.	Inner Chan. In. Water	Cont. Vessel Inches Water	Diff. in Pres. Inches Water
	①	②	③					
12:00 M	27.0	27.3	29.9	29.51	51.91	30.92	3.78	4.66	8.44
1:00 AM	27.1	27.5	29.9	29.50	51.25	30.75	3.74	4.71	8.45
2:00	27.6	28.5	29.9	29.50	51.12	30.62	3.70	4.75	8.45
3:00	27.0	28.9	29.8	29.50	51.02	30.52	3.72	4.82	8.54
4:00	28.0	28.5	29.8	29.50	50.99	30.46	3.78	4.91	8.70
5:00	28.1	28.1	29.9	29.50	50.99	30.49	3.91	5.10	9.01
6:00	28.1	28.7	29.9	29.50	51.19	30.69	3.98	5.19	9.17
7:00	28.0	28.1	29.9	29.50	51.39	30.89	3.91	5.15	9.06
8:00	28.8	29.0	29.9	29.50	51.43	30.93	3.77	5.07	8.84
9:00	28.5	29.6	29.9	29.50	51.45	30.95	3.76	5.06	8.82
10:00	29.0	29.0	29.8	29.50	51.70	31.20	3.88	5.16	9.04
11:00	29.4	29.1	29.8	29.50	52.18	31.68	4.29	5.59	9.88
12:00 N	30.0	30.0	29.8	29.50	52.96	32.33	4.89	6.10	10.99
1:00 PM	30.9	31.2	29.8	29.50	53.35	32.85	4.59	5.98	10.57
2:00	30.9	31.4	29.7	29.45	53.91	33.35	4.85	5.96	10.81
3:00	30.0	31.0	29.8	29.48	54.46	33.94	4.97	5.94	10.91
4:00	29.3	30.4	29.8	29.49	54.53	34.00	4.10	5.20	9.30
5:00	29.0	29.1	29.7	29.46	54.24	34.20	2.91	4.15	7.06
6:00	28.5	28.5	29.8	29.46	54.15	33.41	2.16	3.52	5.68
7:00	28.7	28.8	29.8	29.45	53.52	32.97	2.68	4.00	6.68
8:00	28.0	28.7	29.8	29.45	53.00	32.45	3.20	4.55	7.75
9:00	27.9	28.2	29.8	29.44	52.60	32.04	3.25	4.60	7.85
10:00	28.1	28.0	29.8	29.44	52.26	31.70	3.26	4.62	7.88
11:00	27.2	27.8	29.8	29.43	52.00	31.49	3.31	4.69	8.00

① "A" or "B" refers to Water Level ABOVE OR BELOW Zero Mark.
②③ "A" & "B" Difference means Cont. Vessel Press. HIGHER than Inner Chamber.