



BECHTEL POWER CORPORATION
ENGINEERS
GAITHERSBURG, MARYLAND

Specification No. 6750-M-338
Job No. 6750

(H)

SPECIFICATION
FOR
PLANT INSULATION-EXCEPT REACTOR CAVITY
INSULATION, REACTOR COOLANT SYSTEM AND
STEAM GENERATORS INSULATION

CALVERT CLIFFS NUCLEAR POWER PLANT
UNITS NOS. 1 AND 2
BALTIMORE GAS AND ELECTRIC COMPANY
CALVERT COUNTY, MARYLAND

Comprising:

Cover Sheet
Individual Page Revision Index Sheet
Specific Conditions
Drawings and Data Requirements (Form G-321-C)
Insulation Measurement Diagram (Form M-977-E)
Appendix
Equipment to be insulated
List of Vendor Prints
Pipe Insulation Class Summary

Issued for C.O. No. 3: Rev. 4 Oye 5-8-74 Date: 5/13/70
(Proj Engr) (Date)
Issued for C. O. No. 4: Rev. 5 Oye 6-22-74 By: B. W. W. W. W.
(Proj Engr) (Date)
Issued for C.O. No. 5: Rev. 6 SWF 10-17-74 Group Supervisor: J. E. Burnham
(Proj Engr) (Date)
Issued for Comments/Approval: Rev. A Revised 5-26-70
(Proj Engr) (Date)
Issued for C. O. No. 6: Rev. 7 Oye 1-8-75
(Proj Engr) (Date)
Issued for Bids: Rev. 0 John Van Vorst 8-19-7
(Proj Engr) (Date)
Issued for C.O. No. 7: Rev. 8 Oye 1-23-75
(Proj Engr) (Date)
Issued for Purchase: Rev. 1 Rew 2-23-71
(Proj Engr) (Date)
Issued for C.O. No. 1: Rev. 2 Rew 5-9-72
(Proj Engr) (Date)
Issued for C.O. No. 2: Rev. 3 Rew 3-7-73
(Proj Engr) (Date)

8103130479



Power and Industrial
Division

Specification No. 6750-M-338

SPECIFICATION REV. 8
INDIVIDUAL PAGE REVISION INDEX SHEET

<u>Page Number</u>	<u>Latest Individual Page Revision No.</u>	<u>Latest Page Revision Date</u>
1	7	1/6/75
2	7	1/6/75
3	7	1/6/75
4	7	1/6/75
5	7	1/6/75
6	7	1/6/75
7	7	1/6/75
8	7	1/6/75
9	7	1/6/75
10	7	1/6/75
11	7	1/6/75
12	7	1/6/75
13	7	1/6/75
14	7	1/6/75
15 -	7	1/6/75
Form G-321-C	2	5/1/72
Form M-977-E	2	5/1/72

Appendix:

Sheet 1 of 8	8	1/21/75
Sheet 2 of 8	8	1/21/75
Sheet 3 of 8	8	1/21/75
Sheet 4 of 8	8	1/21/75
Sheet 5 of 8	8	1/21/75
Sheet 6 of 8	8	1/21/75
Sheet 7 of 8	8	1/25/75
Sheet 8 of 8	8	1/25/75

Pipe Insulation Class Summary - Unit 1:

Sheet 1 of 6	7	1/6/75
Sheet 2 of 6	2	5/1/72
Sheet 3 of 6	2	5/1/72
Sheet 4 of 6	2	5/1/72
Sheet 5 of 6	2	5/1/72
Sheet 6 of 6	2	5/1/72



SPECIFICATION REV. 8
INDIVIDUAL PAGE REVISION INDEX SHEET (continued)

<u>Page Number</u>	<u>Latest Individual Page Revision No.</u>	<u>Latest Page Revision Date</u>
Pipe Insulation Class Summary - Unit 2:		
Sheet 1 of 7	7	1/6/75
Sheet 2 of 7	7	1/6/75
Sheet 3 of 7	7	1/6/75
Sheet 4 of 7	7	1/6/75
Sheet 5 of 7	7	1/6/75
Sheet 6 of 7	8	1/21/75
Sheet 7 of 7	7	1/6/75



Maximum gamma radiation dosage	=	1.2×10^4 R/hr.
Neutron flux less than		3×10^{10} nv
Post-accident-temperature		271F
Post-accident-pressure		60.89psia
Boric acid spray concentration		1720ppm

8.0 DESIGN REQUIREMENTS

8.1 All the insulation shall be guaranteed to withstand continuously and without deterioration a temperature of 750F, and shall at least meet the following Specification:

- | a. | Combustibility | Will not burn | | | | | | | | | | | | | | | | |
|--------|---|--|--------|---|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|-------|-----------|
| b. | Design life | Life of pipes | | | | | | | | | | | | | | | | |
| c. | Lineal shrinkage in percent at the maximum temperature specified. | 1.0% maximum after 24 hour soaking period at 750 F. | | | | | | | | | | | | | | | | |
| d. | Rate of heat loss (K) in Btu per hour per sq. ft. per inch thickness per degree Fahrenheit difference between the surfaces of the covering for the temperature specified. | <table><tr><th>Mean T</th><th>K</th></tr><tr><td>800 F</td><td>0.68 max.</td></tr><tr><td>700 F</td><td>0.63 max.</td></tr><tr><td>500 F</td><td>0.54 max.</td></tr><tr><td>400 F</td><td>0.49 max.</td></tr><tr><td>300 F</td><td>0.45 max.</td></tr><tr><td>200 F</td><td>0.41 max.</td></tr><tr><td>100 F</td><td>0.38 max.</td></tr></table> | Mean T | K | 800 F | 0.68 max. | 700 F | 0.63 max. | 500 F | 0.54 max. | 400 F | 0.49 max. | 300 F | 0.45 max. | 200 F | 0.41 max. | 100 F | 0.38 max. |
| Mean T | K | | | | | | | | | | | | | | | | | |
| 800 F | 0.68 max. | | | | | | | | | | | | | | | | | |
| 700 F | 0.63 max. | | | | | | | | | | | | | | | | | |
| 500 F | 0.54 max. | | | | | | | | | | | | | | | | | |
| 400 F | 0.49 max. | | | | | | | | | | | | | | | | | |
| 300 F | 0.45 max. | | | | | | | | | | | | | | | | | |
| 200 F | 0.41 max. | | | | | | | | | | | | | | | | | |
| 100 F | 0.38 max. | | | | | | | | | | | | | | | | | |
| e. | Noncorrosive | As fabricated insulation for stainless steel shall contain no more than 200 parts per million of leachable chlorides. | | | | | | | | | | | | | | | | |

8.2 All water used in the fabrication of insulation materials for stainless steel shall be demineralized water of less than 1 ppm chloride. No zinc or aluminum shall be used in construction within the containment.

8.3 Insulation Thicknesses

The following insulation thicknesses are the minimum required under each class for power piping in the ~~Containment~~



~~the Auxiliary Building, the Turbine Building including Heater Bay Area, the Service Building, the equipment in these areas, and all other areas of the plant;~~ the Auxiliary Building, the Turbine Building including Heater Bay Area, the Service Building, the equipment in these areas, and all other areas of the plant;



Unit 1 Table:

<u>Calcium Silicate Insulation</u>			
<u>Pipe Size</u>	<u>Class III</u> <u>551 to 700F</u>	<u>Class IV</u> <u>351 to 550F</u>	<u>Class V</u> <u>126 to 350F</u>
1-1/2" & less	2"	2"	1-1/2"
2"	2-1/2"	2"	1-1/2"
2-1/2"	2-1/2"	2"	1-1/2"
3"	2-1/2"	2"	1-1/2"
4"	3"	2"	1-1/2"
6"	3-1/2"	2"	2"
8"	3-1/2"	2-1/2"	2"
10"	3-1/2"	2-1/2"	2"
12" & larger	3-1/2"	3"	2"
Equipment	3-1/2"	2-1/2"	2"

<u>Mineral Wool Fiber Insulation</u>			
<u>Pipe Size</u>	<u>Class III</u> <u>551 to 700F</u>	<u>Class IV</u> <u>351 to 550F</u>	<u>Class V</u> <u>126 to 350F</u>
1-1/2" & less	1"	1"	1"
2"	1"	1"	1"
2-1/2"	1"	1"	1"
3"	1-1/2"	1"	1"
4"	1-1/2"	1"	1"
6"	1-1/2"	1"	1"
8"	2"	1-1/2"	1-1/2"
10"	2"	1-1/2"	1-1/2"
12" & larger	2"	1-1/2"	1-1/2"
Equipment	2"	1-1/2"	1-1/2"

Note: The above thicknesses do not include weatherproof covering or metal lagging.

Unit 2 Table:

<u>Pipe Size</u>	<u>Fiberglass Insulation</u>		<u>Calcium Silicate Insulation</u>		
	<u>Class V</u> <u>160 to 299F</u>	<u>Class IV</u> <u>300 to 399F</u>	<u>Class III</u> <u>400 to 499F</u>	<u>Class II</u> <u>500 to 599F</u>	<u>Class I</u> <u>600 to 699F</u>
2" & less	1"	1-1/2"	2"	2"	2-1/2"
2-1/2"	1"	1-1/2"	2"	2-1/2"	2-1/2"
3"	1"	1-1/2"	2"	2-1/2"	3"
4"	1-1/2"	2"	2-1/2"	3"	3-1/2"
6"	1-1/2"	2"	2-1/2"	3"	4"
8"	1-1/2"	2"	2-1/2"	4"	4-1/2"
10"	1-1/2"	2-1/2"	2-1/2"	4"	4-1/2"
12"	2"	2-1/2"	2-1/2"	4"	4-1/2"
16" & larger including equipment	2"	2-1/2"	2-1/2"	4"	4-1/2"

Note: The above thickness do not include weatherproof covering or metal lagging



- △ 8.4 Protective Insulation: (PP) - Personnel Protection. Insulation for personnel protection on hot lines not usually insulated shall be applied to a height of 7 feet above floor or platform areas. Personnel Protection insulation locations shall be determined in the field. PP insulation thicknesses for Unit 1 shall be as shown in paragraph 8.3 in the Unit 1 Table. PP insulation thicknesses for Unit 2 shall be in accordance with the following table:



Personnel Protection (PP) Insulation for Unit 2:

Pipe Size	Fiberglas Insulation		Calcium Silicate Insulation		
	Class V 160 to 299F	Class IV 300 to 399F	Class III 400 to 499F	Class II 500 to 599F	Class I 600 to 699F
2" & less	1"	1"	1-1/2"	2"	2-1/2"
2-1/2"	1"	1"	2"	2"	2-1/2"
3"	1"	1"	2"	2-1/2"	3"
4"	1"	1"	2"	2-1/2"	3"
6"	1"	1-1/2"	2"	3"	3-1/2"
8"	1"	1-1/2"	2-1/2"	3"	3-1/2"
10"	1"	1-1/2"	2-1/2"	3"	4"
12"	1"	1-1/2"	2-1/2"	3-1/2"	4"
16" & larger including equipment	1"	1-1/2"	2-1/2"	3-1/2"	4-1/2"

Note: The above thicknesses do not include weatherproof covering or metal logging.

- 8.5 Instrumentation Piping Insulation shall be determined in the field for personnel protection.

8.6 ~~Insulation for all instrumentation piping, including equipment, and valves shall be determined in the field.~~



- Amosite Asbestos with Sodium Silicate and Diatomaceous Silicate filler and in conformance with ASTM designation C391-64 (Unit 1 only).
- Reacted Hydrous Calcium Silicate with reinforcing Mineral Fiber and in conformance with ASTM designation C533-67.



- Forth-eight M. F. Mineral Fiber (1200F) or equal for pipe and equipment operating at temperatures above 350F (Unit 1 only).
- Owens-Corning one-piece Fiberglas (450F) or equal for pipe and equipment operating at temperatures up to 350F.



- e. Pittsburgh Corning Temp - Mat for pipe and equipment operating at temperatures up to 1200°F.
- f. Armstrong Armaflex for pipe and equipment operating at temperatures up to 180°F.

△ 8.7 ~~Insulation for all steam and hot water piping, bends, fittings, equipment, and valves for the Service Water System inside and outside the containment except the Unit 1 Service Water Pump Room and Unit 2 ECCS Pump room, and for the Salt Water system outside the containment shall be Armstrong Armaflex.~~

8.8 ~~Insulation for all steam and hot water piping, bends, fittings, valves and equipment,~~ shall be of Pittsburgh Corning Temp-Mat type of equal.

8.9 All sectional or block covering having a total thickness, exclusive of the specified finish, greater than 2 inches may be applied in two or more layers care being taken that both longitudinal and end joints of outer layers match joints with those of inner layers, and that the ends of adjacent sections in each layer are butted tightly against each other.

△ 8.10 The Service Water except in the Unit 2 Service Water Pump Room and Unit 2 ECCS Pump Room and the Salt Water System's insulation (Armstrong Armaflex) outside the containment shall have no covering. All other insulation shall be 0.16" aluminum jacketed, except in the containment area where jacketing shall be of stainless steel, and conforming to the latest issue of ASTM Specification.

8.11 Weatherproof exterior finish shall be an outer lagging of 0.016", with vapor barrier permanently bonded which shall be used on all equipment and piping. Large fittings in the main steam and reheat lines shall be covered with the insulation specified under Paragraph 8.6 and lagged with 0.016" aluminum outside the containment area and with 0.010" stainless steel within the containment area.

8.12 All jacketing shall be of the flat type and shall be fastened with "Breakaway" type rivets. The jacket shall have taped longitudinal and end joints. Taped joints for jackets for pipe sizes up to 6 inch shall have a minimum overlap of 2 inch, 3 inch overlap for pipe sized 8 inch and 10 inch, and 4 inch overlap for pipe sizes over 10 inch. Longitudinal joints on horizontal runs of pipe shall be arranged so that the upper sheet overlaps the lower sheet. End joints in vertical runs of pipes shall be arranged so that upper sections of the jacket overlap the lower sections. For personnel protection all exposed corners of flat covering shall be trimmed and fastened with rivets to the trimmed edge.

8.13 The lagging used on pipe bends, fittings, valves, flanges, etc., shall be properly arranged to follow the contour of the fitting being covered, and secured with "pop" rivets.



8.14 The jackets on heaters shall be applied to both shell and head. The head covers and the insulation shall conform as close as possible to the contour of the heater head. Head covers shall be separate from shell covers and readily removable for maintenance of heaters without destruction of the insulation.

8.15 The completed installation of weatherproof outer covering as specified above shall be guaranteed to provide adequate protection for the insulation and to keep it dry under all normal climatic conditions existing in the locality of this installation. This guarantee extends over a period of one year from the date of commercial plant operation and includes performance of all work which may be required for necessary insulation and finishing.

8.16 All joints of outer covering for horizontal lines shall be located on the side of the pipe with laps turned downward.

8.17 Piping

- a. All pipe up to and including 12 inch nominal diameter shall be covered with sectional insulating material made up in 36 inch sections having not more than two longitudinal joints. Insulating material for piping over 12 inch nominal size and on all bends, may be made of segmental blocks, molded to fit circumference of pipe.
- b. Where parallel pipes are on such close centers that separate covering of each pipe is impractical, the pipe may be covered as a group.
- c. Where sectional or block covering is applied in two layers, each layer shall be securely wired on with No. 16 BWG gauge annealed iron wire, using not less than three loops of wire per section on pipes up to 6 inches inclusive and not less than four loops on larger sizes.

8.18 Fittings and Valves

The bodies of fittings and valves shall be covered with the same thicknesses as the insulation of the adjacent piping.

Insulation around Unit 2 valves shall be arranged so as not to interfere with future maintenance and repacking. The insulation installation shall allow for easy access to the valves without resulting in damage to the lagging. Bolts on fittings and valves for Unit 2 are to be left exposed.



8.19 Flanges

- a. Where flange covering is required, flanges shall be covered with a sectional pipe insulation to a thickness equal to that of the insulation on the adjacent piping.
- b. The sectional or block insulation shall be secured with No. 16 B&S gauge Monel or stainless steel wire, and shall overlap the adjacent piping insulation to a minimum of 2 inches. Filler rings of the same material shall be provided, if necessary, to insure a good bearing on the piping insulation and on the periphery of the flanges. Covers shall be finished to a smooth cylindrical form, and for each size of pipe shall be uniform in width and diameter. Covers shall be of a design which will permit the flanges and bolts to heat up quickly and be maintained at a temperature as nearly as possible equal to that of the pipe, thus avoiding excessive strains. The Subcontractor shall furnish for the approval of the Contractor, a sketch showing the proposed construction of these covers.
- c. Flanges shall in no case be permanently covered until the piping in which they are located has been tested and made tight. Flanges covered with Class III, or IV insulation shall be furnished with temporary covers for testing in order to avoid excessive temperature difference in the flanges and flange bolts. The test for tightness will normally consist of subjecting the piping to approximate operating conditions for 24 hours.
- d. The temporary flange covers shall be applied and removed by the Subcontractor.
- e. At all flanged joints on piping and equipment the insulation shall be tapered-off at an angle of approximately 45 degrees on both sides of the joint for a length sufficient to permit removing flange bolts or studs without damage to the covering.



8. 20 Equipment

- a. On equipment as specified in the attached Appendix "Equipment to be Insulated", the insulation shall be held securely in place by No. 16 B&S gauge Monel or stainless steel wire attached to metal clips or equivalent device.
- b. Care shall be taken that binding wires are drawn up tightly and are securely fastened. On very large surfaces, either heavy wire or suitable metallic strips may be used for binding the insulation in place, and shall be drawn up by mechanical tightening devices. If necessary, the ends shall be secured by suitable mechanical fasteners of a form which will permit a flat joint to be made.
- c. Subcontractor may use Nelson studs where approved by the Contractor's engineers.
- △

d. Insulation on Unit 2 equipment shall be arranged so as not to interfere with maintenance, and the installation shall allow for easy access without resulting in damage to the lagging. A removable cover shall be provided on Unit 2 pumps at all bolted joints.

8. 21 Miscellaneous

- a. On large, flat, or cylindrical surfaces, 0.016" aluminum jacket covering with vapor barrier shall be used except where other covering is specified.
- b. The Subcontractor shall furnish and attach all required wire, rods, etc., as necessary for attachment to clips for proper application of the insulation.



8.22 Doors, Panels

All access doors, removable panels, manhole covers, and other parts which must be opened or removed shall be insulated. The work on and adjacent to all removable parts shall be done in a manner that will minimize damage to the insulation, both on the parts removed, and on adjacent parts. Edges and corners shall be protected by light structural angles or metal strips and wire mesh shall be employed where necessary to hold the insulation securely and permanently in place. Heads on heaters shall be fitted with removable type covering such that inspection can be made without disturbing the insulation on heaters.

8.23 Nameplates

Nameplates on all equipment which is insulated shall be removed and reinstalled by the Subcontractor on the outside of the covered surface in a secure manner satisfactory to the Contractor. Alternate methods of exposing or replacing nameplates may be used on approval of the Contractor's Superintendent or his designated representative.

8.24 Reducers

Reducers shall be covered with insulation of a thickness and quality equal to that of the larger pipe.

8.25 Suitable and adequate means, acceptable to the Contractor shall be provided as required in all insulation for the effects of changes in temperature of the insulated surface and of any metal used in supporting the insulation. Insulation on surfaces where appreciable thermal movement may be expected shall be applied in a manner which will avoid the occurrence of breaking or telescoping due to alternate periods of expansion and contraction. Field welds of clips for the support of insulation is not allowed on the main steam piping. If expansion joints in the insulation are used they should not be spaced less than 15 feet apart, the Subcontractor may vary the spacing of expansion joints, if necessary due to configuration, with approval of the Contractor.

8.26 All thermal insulation shall comply with applicable codes (latest revision) of American National Standards Institute, American Society for



Testing and Materials and American Society of Mechanical Engineers. Also, construction shall comply with the laws of Maryland and with local ordinances.

8.27 In general, all piping and equipment operating at temperatures above 160F shall be completely insulated except where the Contractor specifically indicates that insulation shall be omitted or is to be insulated in part for personnel protection.

9.0 SEISMIC REQUIREMENTS

9.1 Insulation shall be capable of withstanding a seismic acceleration of 0.08g horizontally and 0.054g vertically occurring simultaneously with normal operating loads, without exceeding material allowable stress.

10.0 QUALITY ASSURANCE PROVISIONS, INSPECTIONS AND TESTING

10.1 The insulation specified herein shall conform to a Quality Assurance Program whose purpose is to assure that all components and materials involved will perform in accordance with the design objective.

The Subcontractor is required to supply insulation and perform work fully in accordance with this Specification utilizing recognized industry standards and practices with approvals as required by the Purchaser. The Subcontractor will have the responsibility of providing all necessary documents to certify that all the work within his responsibility is done in accordance with the provisions of this Specification. ✓

11.0 GUARANTEE

11.1 The Subcontractor shall guarantee that:

- a. All workmanship and materials shall be first class in every respect.
- b. Insulation for all insulation classes shall not deteriorate when continuously subjected to 750F.
- c. All thermal insulation shall have a conductivity coefficient (K-Btu/hr/sq. ft./inch thickness/F difference) not in excess of the values given in paragraph 8.1, subparagraph d.
- d. The insulating materials and protective coverings shall not show deterioration as evidenced by cracking, crumbling, excessive shrinkage, splitting or excessive charring, separately or collectively or otherwise mechanically.