APAE No. 34
Vol. II of III Volumes

BI-METALLIC TUBE STEAM GENERATOR FOR APPR-1 INSTALLATION PROCEDURES

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VOL. II OF III VOLUMES

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BI-METALLIC TUBE STEAM GENERATOR

FOR

APPR-1

VOLUME II

INSTALLATION PROCEDURES

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BI-METALLIC TUBE STEAM GENERATOR

FOR

APPR-1

INSTALLATION PROCEDURES

SCOPE: These procedures are prepared for the purpose of presenting a basic method of removing the existing steam generator at APPR-1 and installing a new unit. It must be realized that there will be areas during the performance of these procedures which are not specifically covered and will require field expediencies. The basis of these procedures requires that the reactor fuel elements have been removed from the core by the operating crew following normal operating procedures. In addition it is presumed that - all health physics personnel and special clothing will be supplied by the plant operating personnel - primary system flush, fill, fuel loading and performance testing will be performed by the normal operating crews.

I Outline of Work

Items

1. Drain water from primary shield tank.
2. Radiation survey and work permit.
3. Remove seal weld from top cover V.C.
4. Strip insulation from steam generator and 12" and 4" primary pipe at work areas.
5. Dismantle and remove from V.C. stairway and miscellaneous steel.
6. Cut out section of primary shield tank to make work space.
7. Install adequate supports for piping, pumps and Wye valve.
8. Cleanup V.C. before cutting primary piping.
9. Cut at specified points 12" and 4" primary piping, as shown on Drg. AES-214. Cut miscellaneous piping on steam generator.
10. Remove and store existing steam generator.
11. Check and clean up weld ends of 12" and 4" piping.

12. Check dimensions on Bi-metallic steam generator nozzles with 12" primary piping.

13. Install Bi-metallic steam generator using EB rings when welding.

14. Prepare for welding (inert Gas Shielded Arc Welding Process and the Metallic Arc Welding Process).

15. Clean up and grind welds in accordance with weld specification.

16. Check welds by the Dye check method.

17. Helium leak test.

18. Hydrostatic test.

19. Replace and weld section of Primary Shield Tank.

20. Insulate Steam Generator and piping.

21. Remove temporary pipe and pump supports.

22. Paint and thorough cleanup in V.C.

II Method and Procedure for Bi-Metallic Tube Steam Generator Installation

The following procedure will cover the Health Physics aspects, the removal of existing steam generator and the installation of the Bi-Metallic steam generator. Included in this procedure will be the method of cutting the 12" and 4" primary piping, preparation of weld ends, supporting of piping, pumps, handling of equipment, welding, testing, and insulation removal and replacement on new steam generator.

A. Health Physics Aspects of Cutting Into and Rewelding of the Primary Piping Of APPR-1.

The cutting into and rewelding of the primary system of the APPR-1 requires a review of the potential radiation hazards that may be encountered and the methods, techniques and procedures required to maintain personnel exposure below maximum permissible levels.

1. External Expose Levels

The radiation level from the pipe which is cut is expected to be negligible.

However, high radiation levels from other components, such as the levels from other components, such as the elbow of the pressurizer leg, contribute to the radiation level in the particular work location and may limit the working time to less than 8 hrs. per day. In draining the system, every effort should be made to flush the corrosion products from the dead legs or local shielding of the spots may be required.

The draining and cutting of the shield tank, after removal, is not expected to increase the radiation level at the work area.

Radiography of the weld will produce high radiation levels in the vicinity of the source. Strict control of source and personnel access must be maintained.

2. Airborne Contamination

No radioactive airborne concentrations will exist until the cut through into the pipe is made. From that point on, the dry corrosion products may become airborne. Rewelding the system will produce airborne concentrations until the closure pass is completed. Later break thru of the initial pass is possible. Adequate ventilation with exhaust to the filter bank and stack should be provided on a continuous basis near the pipe openings.

3. Contamination

No surface contamination will exist until the cut through of the pipe is made. However, slag, cuttings, or any lengths of pipe cut from the system will be considered contaminated and disposed of to radioactive waste. When the end of a pipe is freed, it should be covered with masking tape or capped to prevent spread of contamination. Buckets should be available to collect any water which may drain from the system.

B. Health Physics Procedures

Prior to the start of the job, a Radiation Work Permit will be initiated. As a result of the radiation surveys, time limits, protective clothing, respiratory protection, and the special instructions concerning waste disposal,

and the procedures pertinent to work in the area. Instructions A,C,D,E, F APAE 78 Revision II will be reviewed with the contractor personnel who will do the work.

C. Preparation and Removal of Existing Steam Generator

It is assumed that the reactor core will be removed before any cutting will be done on the primary piping.

The water will be drained from the primary shield tank so that a section of shield tank can be cut out in the area of the inlet to Steam Generator to allow sufficient working space at that point as shown on Dwg. AES 214.

Health Physics people will make radiation survey after draining of primary shield tank and they shall determine the radiation levels and permissible time allowed in working area which will be stated on work permit.

1. Cut Out Section of Primary Shield Tank - A section of Primary Shield Tank shall be cut out as shown on Dwg. AES 214. Care shall be taken that the cut is made with a minimum loss of metal, the edges ground and made ready for reinstallation. These cutouts shall be stored inside the shield tank until ready to replace.

2. Replacement of Sections Cut Out of Primary Shield Tank - When testing of the Primary System has been satisfactorily completed the cutout sections of Primary Shield Tank will be replaced. In order to make the welds on these sections which were cut out with a cutting torch it will be necessary to use 1" x 1/8" backing strip after grinding edges for welding.

Seal weld on top cover of V. C. shall be ground off, removing as little of the seal lips as possible, to assure sufficient metal remaining to make the seal weld again upon completion of installation.

Cover shall be lowered when existing Steam Generator is ready to be removed.

3. Insulation

Insulation shall be stripped from existing Steam Generator and from the areas to be cut on primary piping and from miscellaneous piping on Steam Generator. When removing insulation care shall be taken to preserve as much of the Foamglas sections as possible for re-use on Bi-metallic Steam Generator.

4. Dismantling Miscellaneous Steel in V. C.

Stairway, handrails, etc., to the top of Primary Shield Tank shall be dismantled and removed from V.C. by way of top manhole. Primary Shield Tank extension shall be removed from V.C.

Any other miscellaneous steel structure shall be removed which affects the removal of Steam Generator or which is in any way hazardous to the working personnel in V.C.

5. Temporary Supports

Adequate pipe or steel supports shall be installed to support piping, pumps, and Wye valve before cutting primary piping from Steam Generator in order to keep piping in proper alignment and to facilitate fitup to new Steam Generator when installed. A ring clamp shall be bolted to 12 inch pipe at each cutting point as close as possible to the proposed cutting line and steel struts shall be welded to ring 90° apart and to the nearest and most rigid support point. See drawing AES-214.

6. Removal of Existing Steam Generator

The method to be used in removing existing Steam Generator shall be as follows:

Four machined cuts will be made as shown on Drawing AES-214, which include inlet and two outlet nozzles and one at discharge of #2 pump

(long leg outlet). The #2 pump shall be removed and stored in a safe place until ready for reinstallation. The four nuts shall be removed from anchor bolts and the cable slings rigged for the Steam Generator removal from the Vapor Container.

The Steam Generator, which weighs 22,500 pounds, will require a truck crane with a minimum capacity of 35 tons. The boom length requirement shall be a minimum of 80 feet - 0 inches to satisfy the 43 foot - 0 inches radius to Vapor Container centerline. Four lifting lugs shall be welded to the upper reinforcing ring as shown on Drawing AES 214. Before starting to raise the Steam Generator, place a sling around the girth and hook a chain hoist to it so that the Steam Generator can be held away from the severed joint and will not damage same.

It is also necessary to hold the Steam Generator with a chain hoist until it is clear of the Primary Shield Tank at which time it can be allowed to swing free and be raised out of the Vapor Container and stored in a location specified by the Health Physics technician.

Severed ends of 12 inch piping shall be thoroughly cleaned as specified and sheet metal caps placed on ends and taped until ready to install the new Steam Generator.

D. Cutting Method

A ratchet action pipe cutter (tentative) will be used for severing and making weld preparation on the 12 inch pipe. A forming tool will be used to serve as a cutting medium and also as a means to make the edge preparation for welding as shown on Drawing AES 214 attached herewith. A parting tool will be used on the final 1/16 inch to sever pipe with a minimum loss of pipe.

The same procedure shall be used in cutting the 4 inch piping to the pressurizer.

Standard pipe cutters will be used to cut miscellaneous pipe connections on the Steam Generator including main steam, centrifix drain, boiler feed, blowdown and liquid level connections.

E. Method of Installation

The Bi-metallic Tube Steam Generator will be lowered into the Vapor Container. Before attempting to place it on anchor bolts, a thorough check of the steam generator nozzle dimensions must be made to insure fitup to existing primary piping. A check on the graphited slide plates should also be made to insure freedom of movement prior to setting the Steam Generator. Then it shall be lowered into place securing the EB rings in each joint. The joints will be clamped together using angle clips and bolts. When the inlet and one outlet joint are secured by bolting angle clips together, the #2 pump will be lowered into place and checked for alignment at pump inlet and outlet. If any misfit is apparent at the pump outlet, the long leg to Wye valve can be reworked to suit.

Using this method with the pump out of the system, the handling, lowering and fitting up of the Steam Generator is made considerably easier. After fitup of piping to the Steam Generator and pump, the welding shall be accomplished as dictated in the attached "Procedure Specification for Inert Gas Shielded and Metallic Arc Welding for ASTM-A-312 Type 304 Stainless Steel Piping Materials".

Inspection of welds will be in accordance with the attached specifications.

The four 12 inch and the two 4 inch welds shall be completely radiographed in accordance with the attached specifications.

There will be problems which cannot be anticipated that will necessarily have to be solved in the field as they arise.

III Vapor Container

For grades and elevations, etc., on the Vapor Container and other details, reference drawings are designated below and attached herewith.

9315-FA-1C	D-9-47-1003
9315-FA-2A	AEL-16
9315-FV-1B	AES-214
D-9-47-1001	D-AES-236
D-9-47-1002	AES-234

IV Welding Procedure

When piping fitup is checked and satisfactory, preparations for welding will be made. Equipment will be set up for Manual Inert Gas Shielded welding. The Primary System will be purged of air with argon gas and welding will proceed in accordance with the attached welding specification.

V Helium Leak Test Procedure

After pipe joints have been welded, inspected, and radiographed, there shall be a helium leak test placed on the Primary System and the new welds checked for leaks in accordance with the following procedure:

1. Connect the vacuum pump to the pressurizer vent pipe with as large a diameter hose or pipe as possible.
2. Connect helium bottle to system.
3. Evacuate system with vacuum pump until it is under a pressure of 15 inches hg. absolute.

4. Close valve isolating system from vacuum pump.

5. Introduce helium to system until system pressure is approximately 15 to 20 pounds per square inch gage.

6. Using a Consolidated Engineering Model 101-A Helium Leak Detector (or equal) set a sensitivity recommended by the manufacturer (calibrated to detect a leak of at least 10^{-5} cc/sec) hand probe points indicated on Drawing AES-214. The hose length from detector to probe shall not be greater than 10 feet. Probe speed shall not be greater than 10 feet per minute.

7. If any leaks are detected, these shall be indicated and repaired after system pressure has been relieved.

8. Where repairs have been made, the complete test procedure must be repeated until all leaks are eliminated.

VI Hydrostatic Testing

A hydrostatic test shall be placed on the primary loop to test the new welds at 1-1/2 the design pressure (2400 pounds). (See Appendix 5). 5)

A helium-air mixture leak test will be placed on the Primary Loop to check for leaks on the new welds, using a Consolidated Electro-Dynamics Leak Detector or equal. See "Helium Leak Test Procedure" attached herewith.

VII Miscellaneous Secondary Piping

The secondary piping shall be installed and tested in accordance with ASME Boiler Code. Tube bundle in the Steam Generator shall be tested from the secondary side at the time the piping is tested.

VIII Instrumentation

Instrumentation will be installed on the Steam Generator and Primary Piping after it is tested and checked.

IX Insulation

Insulation shall be applied in accordance with "Specification for Hot Service Thermal Insulation" which is included in the Appendix.

X Miscellaneous Steel Installed

Reinstall stairway, shield tank extension, handrails and replace steel plate cut out of primary shield tank.

XI Clean-up and Painting

Thoroughly clean equipment in the Vapor Container and paint new installation where necessary. The specification for paint will be found in the Appendix.

APPENDIX 1

WELDING PROCEDURES

1.13 PROCEDURE SPECIFICATION FOR MANUAL INERT GAS AND METALLIC ARC WELDING FOR ASTM-A-312 TYPE 304 STAINLESS STEEL PIPING MATERIALS INCLUDING FORGINGS AND CASTINGS.

PURPOSE

This specification has been prepared in accordance with section IX of the ASME Boiler Code for the purpose of shop fabrication and field erection of Type 304 austentitic stainless steel pressure piping systems. Part I applies to shop fabrication and Part II applies to field erection work. Only those items covered in Part II apply to field erection work, otherwise all other items of Part I apply to both shop and field work.

PART I

PROCESS

The welding shall be performed by a combination of the "Inert Gas Shielded Arc Welding Process" and the "Metallic Arc Welding Process".

BASE METAL

The base metal covered by this specification shall conform to ASTM-A-312-54T, Type 304, and the chemistry shall be within the limits specified in Table I.

Table I

Chemical Composition Limits

Carbon, max percent	0.08
Manganese, max percent	2.00
Phosphorus, max percent	0.030
Sulfur, max percent	0.030
Silicon, max percent	0.75
Nickel, percent	8.0-11.0
Chromium, percent	18.0-20.0

FILLER METAL

a. An EB weld insert of 308L composition shall be used with the Inert Gas Shielded Arc Welding Process.

b. The filler metal for the Metallic Arc Welding Process shall be in accordance with ASTM Specification A-298-55T for Shielded Metal-Arc Electrodes, Type E-308, with a line type coating.

c. Lime type coated, shielded arc electrodes shall be stored in heated rod storage ovens at a temperature of not less than that recommended by the electrode manufacturer.

SHIELDING AND PURGING GAS

The shielding and purging gas for the Inert Gas Shielded Arc Welding Process shall be argon. It shall be necessary that the argon gas be of the "Welding Quality Grade".

POSITION*

The shop welding shall be performed with the pipe in the horizontal rolled position and the weld deposited upward at the (ten after two) or (ten to ten) position.

NATURE OF ELECTRIC CURRENT

The Inert Gas Shielded Arc Welding Process shall be performed using direct current with straight polarity. The Metallic Arc Welding Process shall be performed using direct current with reverse polarity.

CLEANING

Stringent service requirements of piping and all equipment assembled in the primary circuit make it imperative that an unusual degree of cleanliness be maintained on all surfaces which will be in contact with the primary fluid. Debris, dirt, slag, etc., may not be of particular harm to the piping itself, but transportation of such contaminants by the primary fluid can result in serious interference with the proper functioning of other components, such as fuel elements, or control rod drive mechanisms. Since many of these surfaces can not be recleaned properly in the field, the importance of the cleanliness of all primary fluid surfaces as shipped cannot be over emphasized.

Cleaning operations shall be performed in a room which, as well as the atmosphere therein, is as clean as is practically feasible. The air in this room shall be filtered and recirculated so that it shall be completely changed at least once per hour. The floor shall be vacuum cleaned at least once per day, prefereably before starting cleaning operations. There should be no dirt producing operations in the vicinity, and every effort should be made to prevent contamination during the cleaning operations themselves. On components or vessels in which the inner surface only must be clean, all openings should be covered with plastic sheet or clean bright metal covers taped around the edge when not being worked on. On components in which both the inner and outer surfaces must be clean, the component should be completely covered with plastic sheeting when not being worked on.

* See Part II for field erection work.

Insofar as possible, final cleaning operations should be performed with the plane of openings in the vertical.

If contamination is introduced during any particular stage of fabrication or testing, recleaning operations shall be performed as necessary.

a. All surfaces exposed to the primary fluid, except the surface of root passes of piping welds which are inaccessible, shall be machined, ground or polished to a surface finish of 125 RMS.

b. All dirt, chips, abrasive dust, scale, etc., is to be removed by vacuum cleaner, air blast or lint-free cloth.

c. All surfaces are to be thoroughly washed with acetone or alcohol.

d. All surfaces are to be thoroughly rinsed with commercial distilled water and dried with steam, oven, hot air or lint-free cloth.

e. The cleanliness of any component or unit of the primary circuit shall be subject to inspection by the fabricator prior to sealing for shipment.

f. The component or unit is to be thoroughly flushed with an inert gas, openings are to be sealed with expanding rubber plugs capable of maintaining an internal gas pressure of 2-4 psi gage and the unit is to be filled with an inert gas to a pressure of 4 psi gage. Pipe ends which have been beveled for field welding shall be covered with end caps securely fastened.

EDGE PREPARATION

a. The ends or edges of the piping or parts to be joined by welding shall be prepared by machining and shall be in accordance with the sketches shown on attached sheets.

b. If the pipe or parts have not been cleaned as before specified, prior to welding, the welding groove and adjacent surfaces shall be thoroughly cleaned of all rust, scale, grease, oil or other foreign matter by thoroughly swabbing, using lint-free cloths, with fresh or redistilled acetone, rinsing thoroughly with distilled water and thoroughly drying.

PREHEATING AND INTERPASS TEMPERATURE

a. In general, preheating shall not be required; however, no welding shall be performed when the edges of the parts to be joined are below a temperature of 32 F. When such conditions exist it shall be necessary to preheat to a temperature of 70 F $\pm$ 10 F.

b. Preheating may be performed by the resistance heating method or by an oxyacetylene flame. Resistance heating is preferred; however, if an oxyacetylene flame is employed, a neutral flame should be used and care should be taken to prevent the cone of the blue flame from impinging on the metal surface.

c. Interpass temperatures during the welding shall not exceed 300 F. Preheat and interpass temperatures may be checked with a surface contact pyrometer or with a recording instrument through thermocouples. If thermocouples are used, they shall not be attached to the metal by brazing or by an electrode or filler rod containing copper. "Tempilstiks" or "Tempil Pellets" may be used for checking metal temperatures.

WELDING PROCEDURE

A. Inert Gas Shielded Arc Welding Process

1. The Inert Gas Shielded Arc Welding Process shall consist of fusing the EB insert and the root edges of the joint together using the tungsten arc method and employing an internal argon atmosphere. The internal argon atmosphere shall be contained inside the pipe by any suitable means if the internal surface can be cleaned to specification after welding. If the internal surfaces have been thoroughly cleaned previous to welding and are not to be cleaned after welding, the expanded rubber plugs in the other ends of the pipes or other suitable means external to the pipes shall be used to contain the inert gas, with an entrance for gas flow in one end and an exit in the other. Argon gas flow through the joint itself shall be suitably controlled with masking tape or similar device on the external surface of the pipe.

2. Fit EB insert and pipe ends; spring the insert into the smaller pipe end and tack to pipe with about 4 in. spacings, starting at one end of the ring and continuing for one-half the circumference. Use starting tab for starting the arc and break the arc on the bevel or on the tab, using tungsten arc torch. Use Mullenback Arc-Trol or equal foot control to taper current down on breaking arc for both tacking and welding. Maintain inert gas coverage of puddle during solidification. Tungsten electrodes are to have a long taper to a point and welding is to be performed only with electrodes that are pointed. Trim the ring overlap so that the gap between ring ends is not over 1/32 in. Continue tack welding on the remainder of the circumference.

3. Fit other pipe end over the tacked ring. Maximum misalignment should not exceed 1/64 in. Tack in between the previous tacks, all around the circumference, joining both pipe ends and the insert. Refuse the first tacks, joining both pipe ends and the insert. One of the tacks should be at the split ends of the EB insert.

4. The root pass shall be made by fusing the root of the pipes and the insert together, including re-fusing of the tacks. Use starting tab for striking the arc, and break the arc on the weld bevel. Use combination of travel speed and amperage to make the inside contour with minimum of reinforcement and with small even ripples.

5. At the conclusion of the root pass, inspect visually. Any portion of the outside of the bead that shows a depression should be remelted and re-fused. The outside surface shall then be inspected by the fluorescent or dye-penetrant method. Any objectionable defects shall be repaired with the Inert Arc Method using the internal gas atmosphere.

The subsequent welding may now be performed by the Metallic Arc Welding Method as outlined in "B".

B. Electric Metallic Arc Welding Process

1. The welding beads shall be deposited in a manner that will assure proper penetration and fusion of the base metal. Each bead deposited shall be thoroughly cleaned; all slag or flux remaining on any bead of welding shall be removed using a pneumatic scaling tool and stainless steel wire brush before depositing the next successive bead. Each crater, and any cracks or blowholes, on the surface of each bead of welding shall be removed by grinding prior to starting the next successive bead of welding. Care should be taken in the adjustment of the welding amperate and voltage in order to assure proper deposition of the weld metal. The weld shall be started with a 3/32 in. diam. electrode and the electrode size shall be increased as the welding groove is filled up, as indicated in the tables on the attached sheets. The flow of inert gas for internal gas atmosphere shall be maintained during the deposition of at least the next two layers of weld metal.

The weaving technique of the lime type coated electrodes specified shall be limited to not more than 2 1/2 times the diameter of the electrode.

2. At the completion of the weld, all slag, flux and spatter shall be thoroughly cleaned from the weld and surface adjacent thereto. Such cleaning shall be performed using a pneumatic scaling tool and a stainless steel wire brush.

3. The finished surface of all butt welded joints shall be ground smooth with the outside diameter of the base metal. The finished surface of all fillet welds shall be ground smooth and blended into the adjacent base metal.

STRESS RELIEVING

Welded joints in the material covered by this specification shall not be stress relieved or heat treated.

INSPECTION (Completed Welds)

A. Fluorescent or Dye-Penetrant Method

1. All welds shall be inspected by the fluorescent or dye-penetrant method in accordance with the following:

   a. The finished surfaces of all welds shall be examined and this examination shall include base metal 1 in. on each side of the weld.

   b. All evidence of cracking, harmful porosity and slag-filled voids detected shall be removed, the areas re-welded and the repair weld reexamined.

   c. The examination must be conducted on a clean surface and prior to any surface treatment which will close up surface openings or otherwise interfere with the examination. Rough surfaces, such as weld heads and sand castings, shall be ground to 250 RMS prior to inspection.

   d. Following mechanical removal of all injurious matter, surfaces shall receive a final cleaning prior to inspection by swabbing with a clean cloth saturated with a volatile solvent, allowing the surface to dry thoroughly before proceeding.

   e. When the inspection is concluded, the inspection materials shall be removed as soon as possible by swabbing with a clean cloth saturated with a volatile solvent.

B. Radiographic Inspection

1. Radiographic inspection of butt welded joints shall be performed using the X-ray method.

*2. All butt welded joints in piping of 4 in. nominal diameter and larger shall be completely radiographed. All butt welds in piping less than 4 in. nominal diameter shall be partially radiographed; radiographs shall be made which represent at least 60 deg of the circumference of the joint.

a. All radiographs shall be compared with "X-ray Standards for High-Pressure - High Temperature Steam Piping", American Welding Society publication.

b. Defects in excess of this radiographic standard in any 6 in. length of weld penetration shall be considered unacceptable and only such defects be removed and the weld repaired as to render the weld equivalent or better than the radiographic standard.

c. Any cracks or zone of incomplete fusion or penetration shall be considered unacceptable.

WELDING QUALIFICATION

Qualification test of procedure and operators shall be performed in accordance with Section IX of the ASME Boiler Code, 1953 Edition.

* See Radiographic Inspection, Part II, for field erection work.

PART II

CLEANLINESS

It is an intent of this part of the specification to produce an as-welded primary circuit which will be as nearly surgically clean as is possible to attain. Provision has been made in this and other specifications for cleaning and packaging so that all piping and component units will be received in the field with the required degree of cleanliness. The required as-welded cleanliness of the primary circuit can be attained if no contaminants of any kind are introduced into the circuit in the process of erection in the field. The importance of the cleanliness of the primary system as assembled and welded cannot be over-emphasized.

One possible exception to the as-received cleanliness of piping and nozzles is the area from lip of beveled edge to the expanded rubber plug. Any contamination in this area shall be removed by swabbing with acetone and a line-free cloth, swabbing with commercial distilled water and a lint-free cloth and drying with a lint-free cloth.

WELDING

Welding of the primary circuit shall be performed by a combination of the "Inert Arc Welding Process" and the "Metallic Arc Welding Process", as in Part I. If the piping or parts being joined plus any other affected portion of the primary circuit can be cleaned to specification, any convenient method of providing an argon gas backing can be used. If the piping or parts plus any other affected portion of the primary circuit cannot be cleaned to specification after welding, the expanded rubber plugs in the unwelded or other ends of the piping or parts or other suitable means external to the piping or parts shall be used to contain the argon backing, with an entrance for gas flow in one end and an exit in the other. Resultant chambers shall be thoroughly flushed with argon before welding is started. Argon gas flow through the joint itself shall be suitably controlled with masking tape or similar device on the external surfaces of the joints.

Extreme care shall be used in all stages of handling, fitting, tacking and welding in order to prevent the entrance of any contaminants into the primary circuit. Cleaning of the piping or part ends, fitting, tacking and first-pass welding shall be performed in a "clean area", which shall be obtained by completely surrounding the working area with a tent-like structure of canvas. The floor of this "clean area" shall be vacuum cleaned, at least once per day, preferably before starting work. No dust or particle forming operations, such as grinding, shall be performed in or near this area until any open part of the joint is completely protected from such dust or particles. Work on the joint, including removal of the dust protective, shall not be resumed until the outer surface of the pipe inside the "clean area", the floor and all other horizontal surfaces in the "clean area" have been vacuum cleaned.

If desired to prevent possible "burn through", the first pass over the root pass (second pass) may be deposited using the "Inert Gas Shielded Arc Welding Process" and filler wire of 308L composition.

POSITION

The welding may be performed with the pipe in the horizontal fixed position and the vertical fixed position, thus involving the application of the weld in the vertical, overhead and horizontal positions.

Butt welds in piping 10 in. nominal diameter or greater shall be welded by two welders working simultaneously, one on each side of the pipe.

INTERRUPTION OF WELDING

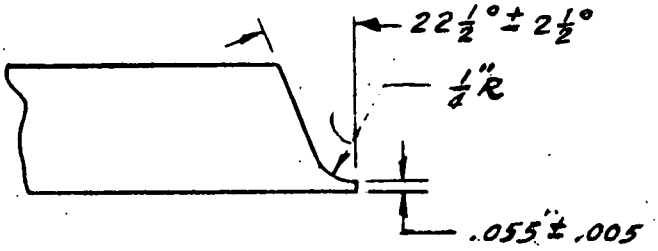
The welding may be interrupted provided at least one-half of the wall thickness of the pipe at the welding groove has been welded. To proceed with the welding, the metal temperature shall be checked and the welding resumed until the weld is completed.

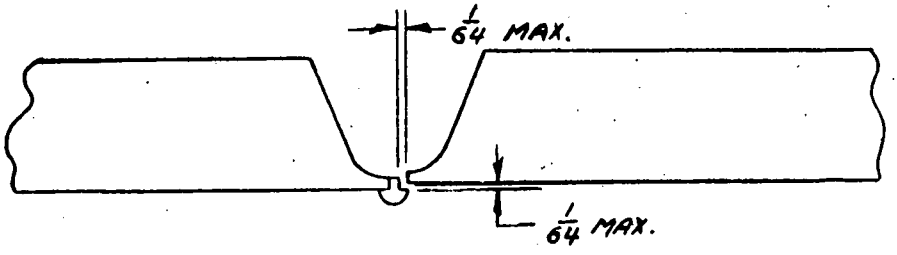
RADIOGRAPHIC INSPECTION

All field welded primary circuit joints shall be radiographed using the double wall, double film technique with Iridium 192 as the source. 2 percent sensitivity shall be obtained with the pentrameter placed between film and wall. A density of 1.6 to 2.0 shall be obtained using Kodak Type A industrial film.

All butt welded joints in piping of 4 in. nominal diameter and larger shall be completely radiographed. All butt welds in piping less than 4 in. nominal diameter shall be partially radiographed; radiographs shall be made which represent at least 60 deg of the circumference of the joint. Radiographs of welds made in the horizontal fixed position shall represent the portion of the welds made in the overhead and vertical position.

WELDED JOINT DETAIL

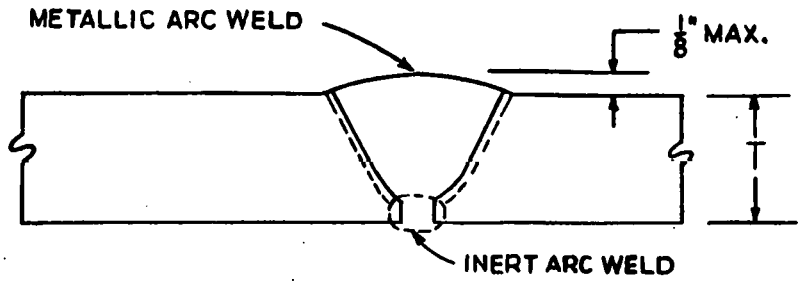




MAXIMUM MISALIGNMENT 1/64"

EB Insert - 5/32" 308L

TYPE OF JOINT: Single U-Butt Joint (Gas Backing)



WELDING TECHNIQUE

INERT GAS SHIELDED ARC WELD - ROOT PASS

Beads	*Tungsten Electrode	Welding Gas Argon, CFH	Purging Gas Argon, CFH	D.C. - Str. Pol.	
				Amp	V
1	1/16"	10-15	5-8	60-75	10-12

*Thoriated tungsten electrode

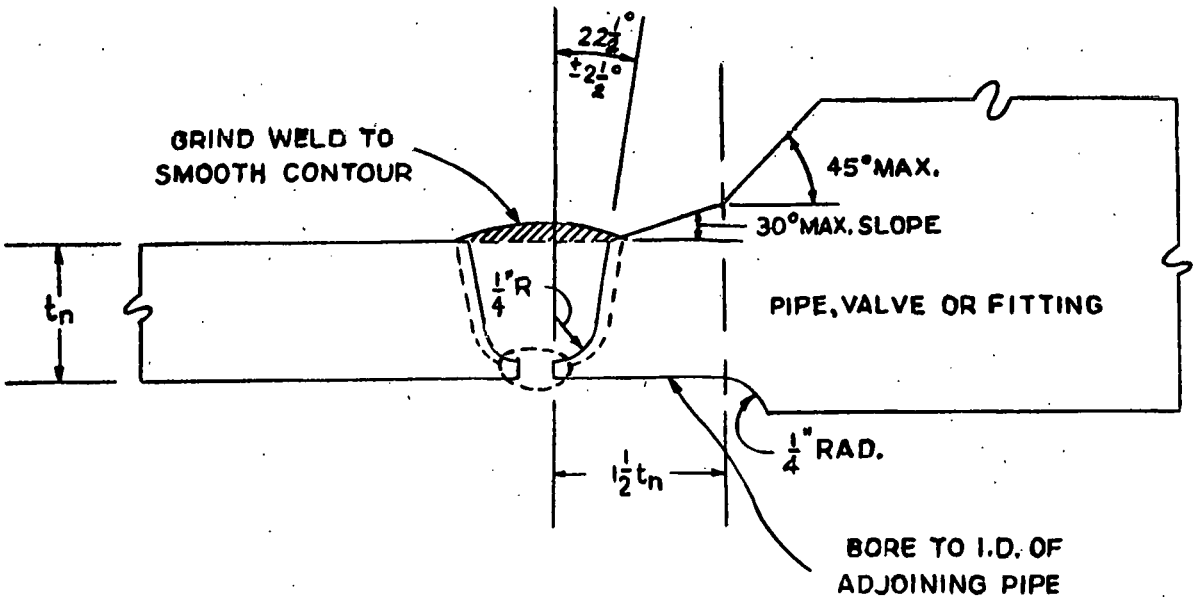
METALLIC ARC WELD

T	Electrode Size	Beads			D.C. - Rev. Pol.	
		1	2	3	Amp	V
5/16	3/32 - 1/8 - 5/32	3	3	4	70-100-130	18-20-22
3/8	3/32 - 1/8 - 5/32	4	5	6	70-100-130	18-20-22
1/2	3/32 - 1/8 - 5/32	5	7	9	80-110-135	18-21-24
5/8	3/32 - 1/8 - 5/32	6	8	11	80-110-135	18-21-24
3/4	3/32 - 1/8 - 5/32	7	9	13	80-110-135	18-21-24
7/8	3/32 - 1/8 - 5/32	8	10	16	80-110-135	18-21-24
1	3/32 - 1/8 - 5/32	9	12	19	80-110-135	18-21-24
1 1/4	3/32 - 1/8 - 5/32	14	18	30	80-110-135	18-21-24
1 1/2	3/32 - 1/8 - 5/32	20	28	45	80-110-135	18-21-24
1 5/8	3/32 - 1/8 - 5/32	23	32	50	80-110-135	18-21-24

1. Horizontal Rolled - Average number of beads
2. Horizontal Fixed - Average number of beads
3. Vertical Fixed - Average number of beads

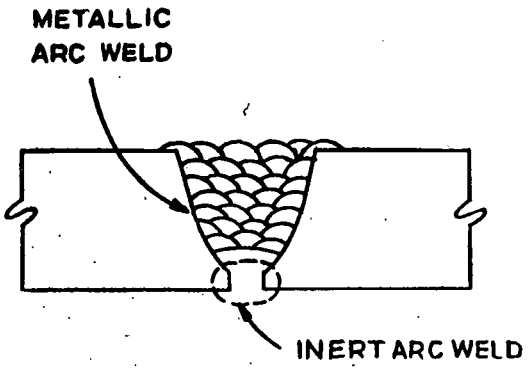
TYPE OF JOINT: Single U-Butt Joint (Gas Backing)

UNEQUAL WALL THICKNESS

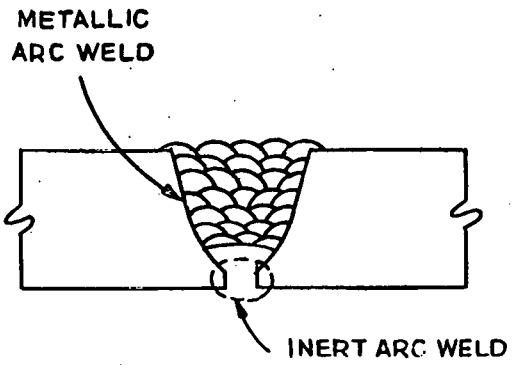


Note: Welding technique for this type of joint shall be as shown on Sheets Nos. 10 and 12.

METHOD OF DEPOSITING WELDING BEADS

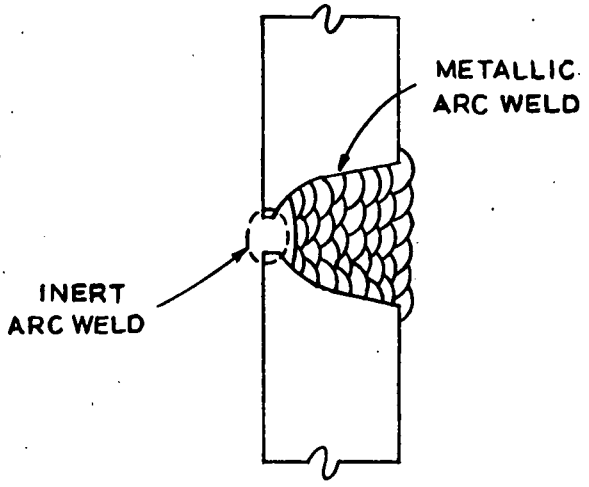


1. Horizontal Rolled Position



2. Horizontal Fixed Position

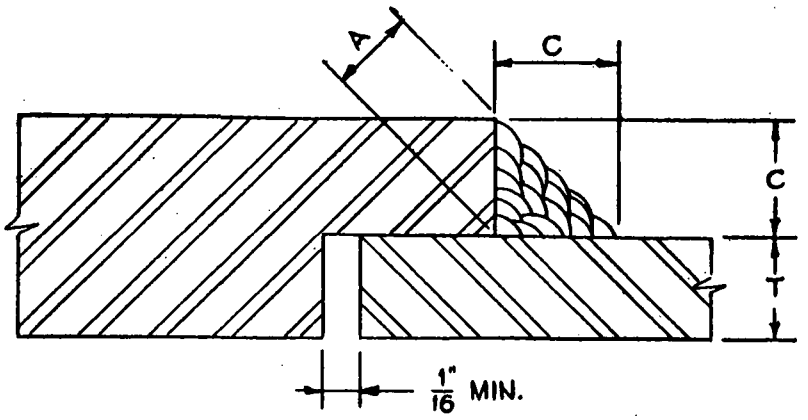
Note: The weld shall be deposited using the stringer bead technique as shown in these sketches. The weaving motion shall not exceed 2 1/2 times the electrode diameter.



3. Vertical Fixed Position

TYPE OF JOINT: Socket Weld Joint

METALLIC ARC WELDING PROCESS



T = nominal pipe wall thickness .

C = minimum = 1 1/4 T, but not less than 5/32"

A = .8T

WELDING TECHNIQUE

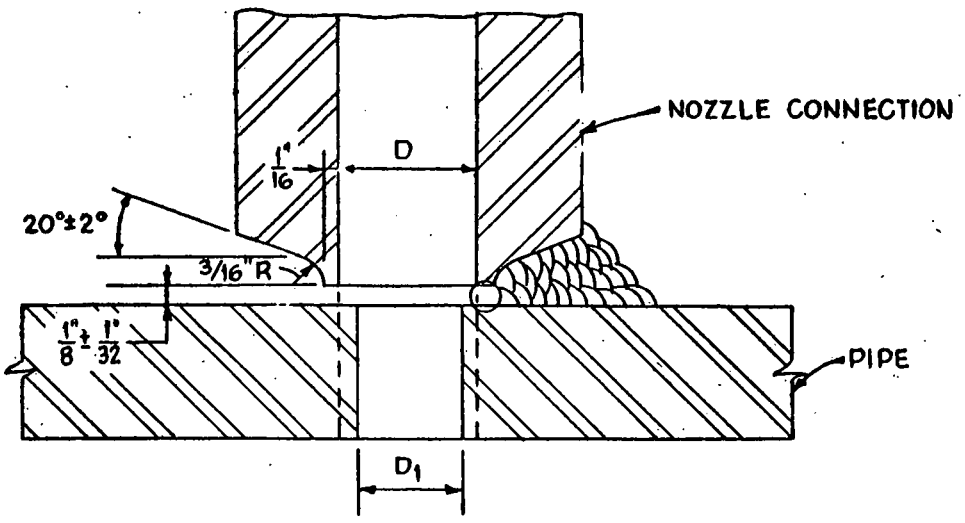
T	Electrode Size	Beads			D.C. - Rev. Pol.	
		1	2	3	Amp	V
3/16	1/8 - 5/32	2	2	3	100-130	20-22
1/4	1/8 - 5/32	2	3	4	100-130	20-22
3/8	1/8 - 5/32	3	4	5	110-135	20-22
1/2	1/8 - 5/32	4	5	7	110-135	21-24
5/8	1/8 - 5/32	6	8	10	110-135	21-24
3/4	1/8 - 5/32	8	10	14	110-135	21-24

1. Horizontal Rolled - Average number of beads
2. Horizontal Fixed - Average number of beads
*3. Vertical Fixed - Average number of beads

*Overhead welding condition

TYPE OF JOINT: Branch or Nozzle Connections
(3 in. diam or less)

METALLIC ARC WELDING PROCESS

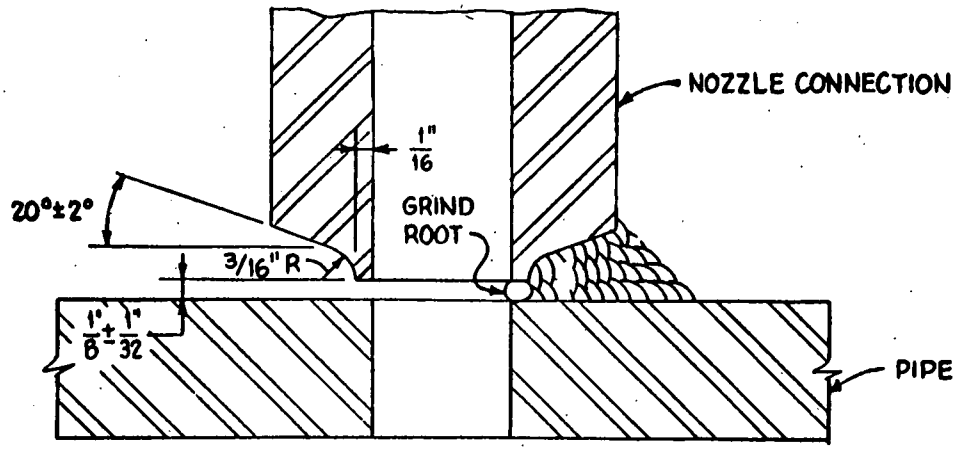


Notes: 1. D_1 shall be 3/16 in. smaller than D and after the weld has been made D_1 shall be bored or reamed to the same as D thus cleaning up the inside root of the weld.

2. The welding technique shall be similar to that used for socket weld joints shown on sheet No.

TYPE OF JOINT: Branch or Nozzle Connections
(Greater than 3 in. diam)

METALLIC ARC WELDING PROCESS



Notes: 1. After the weld has been made the inside area of the root bead shall be ground smooth.

2. The welding technique shall be similar to that used for socket weld joints as shown on sheet No.

APPENDIX 2

SPECIFICATION

FOR

PRIMARY PIPE

SPECIFICATION

FOR

PRIMARY PIPE

CLASS 901SS
12 3/4 IN. TYPE 304 STAINLESS STEEL TUBING

MAXIMUM OPERATING CONDITIONS

Design: Max. Temp. 500 F
Max. Pressure 1500 psi. gage

Operating: Temp. 450 F
Pressure 1185 psi. gage

FLUID

Primary coolant high pressure water.

GENERAL

All material shall be stainless steel, AISI, Type 304. This class shall be used for all primary coolant piping. All piping shall conform to the requirements of the ASME Power Boiler Construction Code.

PIPE

Material

12-3/4 In. OD, 3/4 In. wall, AISI, Type 304 stainless steel tubing produced by the extrusion process under ASTM Spec. A-312, Type 304, including supplementary requirements, except tolerances shall be held to:

Outside diameter, in.	+3/32 - 1/32
Inside diameter, in.	1/16 - 1/16
Minimum wall, in.	+5/64 - 3/64 (based on nominal wall)

4 in. schedule 80 seamless pipe, ASTM A-312 Type 304
The tubing shall be subjected to and meet the intergranular corrosion test, ASTM Spec. A-240, Section 12.

Physical Properties Desired

The chemical composition of the material shall conform to and be certified to ASTM A-312, Type 304, with a maximum carbon content of .08%. It shall be suitable for bending and other usual types of fabrication. It shall be suitable for welding to piping of same material, to steel forgings such as valves and fittings made to ASTM Spec. 182, Gr. F-304 and to castings.
It shall be furnished with minimum eccentricity to facilitate welding.

Finish Requirements

The inside wall shall have an internal finish surface roughness height rating not exceeding 125 rms micro-inches. The outside wall shall have a surface finish of 250 rms.

Test Requirements

The following supplementary requirements for special consideration are required as specified in ASTM A-312:

PIPE (CONT.)

1. Check Analysis
2. Transverse Tension Tests
3. Flattening Tests
4. Etching Tests

1 photomicrograph from one length of pipe in the finished condition to be furnished Purchaser. The photomicrograph shall be of a longitudinal section.

Preparation for Shipment
Prior to shipment the inside of the pipe shall be thoroughly cleaned of all scale, rust, grease, oil or other foreign material. The ends of the pipe shall be sealed tight by an acceptable method to preclude entrance of foreign material. Only fully annealed material shall be pickled.

JOINTS

Welds shall be made by the inert gas, shielded arc process for the initial pass, insuring a clean internal surface in accordance with the attached Alco Products, Inc. Welding Procedure Specification No. W-44B.

FITTINGS

Material
900 lb. forged, ASTM A-182, Gr. F 304 stainless steel, butt welded, ends bored to match adjacent pipe.
Tee branches: Intersectional welds reinforced per 1951 Code for Pressure Piping, Par. 634; or seamless butt welding with thickness not less than adjacent pipe, or forged and bored as specified on drawings.
Ells: Bends preferred, or butt welding with thickness not less than adjacent pipe.

Instrument Connections on Piping
Except for flowmeters: Welded on nipple per fig. 13K of Code for Pressure Piping. Nipple to be in accordance with piping specification, Class 902SS.
For Flowmeters:
Mark No. #W90304

#Prefix letters for Mark Nos:

E	90° Elbow
L	45° Elbow
T	Straight Tee
S	90° Elbow SR
K	Cap
RC	Reducer, Conc.
R	Reducer, Ecc.
X	Cross

APPENDIX 3

SPECIFICATION

FOR

HOT SERVICE THERMAL INSULATION

SPECIFICATION

FOR

HOT SERVICE THERMAL INSULATION

STEAM GENERATOR AND PRIMARY PIPING

Acceptable insulation for this equipment shall be cellular glass material (Foamglas or equal) 4" thick applied in two layers.

Insulation shall be attached with No. 52 Acme strapping bands and seals or equal, approved by the purchaser.

Bands shall be 3/4" wide, .020 in. thick monel. Bands shall be rubbed into the insulation surface to provide a flush setting of the band. The insulation surface beneath the seal shall be slightly undercut to permit flush setting of the seal. Proper tools shall be used to cinch and tighten the bands and to crimp and lock the seals.

If wire is required on vessel or piping in addition to the strapping bands, it shall be No. 16 gage monel.

CLADDING

After the Foamglas insulation has been applied and properly secured to vessel and piping, it shall be clad on the outside surface using the cladding material and adhesive specified below or equal approved by the purchaser.

The surface cladding shall be Dow Corning Corp. Silastic R-10 sheet (10 mils thick). The Silastic sheet shall be applied to the outside surface of the Foamglas insulation with Dow Corning Corp. catalyzed adhesive A-4000. Joints in the cladding shall overlap a minimum of 1-1/2 inches.

In applying the adhesive to the Foamglas insulation and cladding the manufacturer's specifications shall be followed and account shall be

taken of the following requirements:

1. The manufacturer's instructions shall be followed in regard to the life of the mixed adhesive during application.

2. The adhesive shall be applied to both the Foamglas surface and to the inside or slightly grained surface of the cladding. The smooth surface of the cladding shall be placed on the outside. The adhesive shall be applied to both contact surfaces of the cladding at overlapping joints.

After application, the adhesive shall be allowed to dry approximately one hour before the surfaces are joined. After joining, the surfaces shall be held in contact for a few seconds until adhesion is complete. Since full adhesion does not develop for 24 hours, the cladding, particularly where sharp changes of direction are involved, may have to be temporarily bound in place over the insulated surface with tape or soft cord. After full adhesion has been attained, the temporary binding material shall be removed.

Any gross excess of adhesive on the outside of the cladding shall be removed with a suitable solvent.

APPENDIX 4

SPECIFICATION

FOR

PAINTING

SPECIFICATION

FOR

PAINTING

SCOPE: This specification covers the paint to be applied to all new surfaces and damaged surfaces in the area of work performed under the attached procedures.

Preparation of New Surfaces

Before applying the paint, the various surfaces shall be prepared as described below. This work shall be done by the painting contractor except where it is particularly specified to be done by others, but it shall always be the responsibility of the painting contractor to see that the surface is properly prepared before the paint is applied.

Steel and iron work shall be thoroughly scraped, wire-brushed or cleaned to the satisfaction of the Engineers, to remove all dirt, grease, gypsum, cement, concrete, or any other foreign matter before the paint is applied.

Concrete surfaces shall be thoroughly cleaned of dirt, grease, dust, loose particles of mortar, cement or other foreign materials before applying paint. Concrete walls which are spotted with dirt or grease shall first be cleansed, using a suitable solvent, after which all traces of acids or chemicals shall be removed by washing with soap and rinsing with clean water. Small holes in concrete ceilings and walls will be neatly filled with cement by the concrete contractor.

The painting contractor shall report to the Engineers all surfaces which are not in a condition to receive the priming coat, and shall not apply any material until such surfaces have been properly prepared.

Material

General - The painting schedule has been prepared on the basis of products of the Pittsburgh Plate Glass Company, the Debevoise Company and the Amercoat Corp. With the exception of the Amercoat, paints manufactured by other companies which are

the equal of those specified may be substituted, provided the bidder submits a complete schedule of the paints he proposes to use and provided such substitutions are approved in writing by the Engineers before the painting contract is placed.

All paints shall be delivered to the site of the work in the original unbroken packages, marked with the manufacturer's name and brand and the quality of the contents.

Oil Paint - All oil paint shall be prepared oil paint of the best quality for the purpose indicated in the painting schedule manufactured by the Pittsburgh Plate Glass Company and the Debervoise Company.

Enamel - All enamel shall be a prepared oil varnish base enamel of the best quality for the purpose indicated in the painting schedule manufactured by the Pittsburgh Plate Glass Company. All enamel shall be tough and elastic and shall be suitable for either dull, polished, or flat finish. It shall be proof against discoloration when exposed to boiling or freezing water and shall not chip or crack under dry heat.

Amercoat - The Amercoat paint and any thinners, dryers and cleaners used in conjunction therewith shall be as manufactured by the Amercoat Corporation of South Gate, California, and shall be applied in strict accordance with the manufacturer's standard instruction sheets.

Plastic Coating - The plastic coating to be applied to the structural steel in the Electrical Equipment Room to prevent condensation drip shall be "No Drip", as manufactured by the J. W. Mortell Company of Kankakee, Illinois, and shall be applied in strict accordance with the manufacturer's standard instruction sheets.

Workmanship

Paint shall be used as it comes from the manufacturer's package without adulteration and shall be handled and applied in strict accordance with the printed instructions of the manufacturer and in the most workmenlike manner.

On outside surfaces painting shall preferably be done when the temperature is above 50 F and no painting shall be done when the temperature is below freezing, or in damp or foggy weather except under such conditions as will insure dry surfaces and as may be approved by the Engineers.

No painting shall be done on surfaces that are not thoroughly dry. In painting successive coats sufficient time shall be allowed to elapse between coats for the last coat to become thoroughly dry before the next coat is applied.

PAINTING SCHEDULE

Surface	Priming Coat By	Priming Coat Material	First Coat By	First Coat Material	Second Coat By	Second Coat Material	Final Color	Remarks
Reactor Container								
Ladder on exterior of dome.	Fab.	Shop Coat	Contr.	Pitt. Dilute Florhide 3-17	Contr.	Pitt. Flor-hide 3-17	Dixie Gray	
External steel of dome manhole.	Contr.	Inhibitive red Ironhide 8-2	Contr.	Pitt. Flor-hide 3-17	Contr.	Pitt. Flor-hide 3-2	Cruiser Gray	
Insulation on exterior of dome.	Contr.	Asphalt sealer	Contr.	Pitt. Florhide 3-17	Contr.	Pitt. Flor-hide 3-2	Cruiser Gray	
Manhole surface in pump room.	Contr.	Inhibitive red Ironhide 8-2	Contr.	Pitt. Aluminum 22-2	Contr.	Pitt. Alum-inum 22-2	Aluminum	
Interior surfaces of manholes.	Fab.	Devevoise Dereka metallic gray No. 555	Contr.	Debevoise Dereka Metallic gray No. 555	Contr.	Dereka Alum-inum No. 174	Aluminum	
Interior liner surface.	Fab.	Debevoise Dereka metallic gray No. 555	Contr.	Debevoise Dereka	Contr.	Dereka alum-inum gray No. 521	Aluminum gray	Incl. floor
Crane and supports	Fab.	Shop Coat	Contr.	Debevoise Dereka red No. 505	Contr.	Dereka red No. 500	Red	Paint Crane hook bright yellow.
Handrail inside container.	Fab.	Shopcoat	Contr.	Debevoise Dereka Red No. 505	Contr.	Debevoise transformer Gray No. 590	Gray	
Stair treads, stringers, supports	Fab.	Shopcoat	Contr.	Debevoise Dereka red No. 505	Contr.	Debevoise transformer gray No. 590	Gray	Inside container

Surface	Priming Coat By	Priming Coat Material	First Coat By	First Coat Material	Second Coat By	Second Coat Material	Final Color	Remarks
Equipment supports and anchors.	Fab.	Shopcoat	Contr.	Debevoise Dereka red No. 505	Contr.	Debevoise transformer gray No. 590	Gray	
Seal leakage pumps 13A & 13B		Stainless st.						
Seal leak-off tank TK11 S.S.		Stainless steel					Stainless St.	
Pressure vessel E-5		Stainless st.					Stainless St.	
P.C. blowdown cooler E-8		Insulated					Red	
Pressurizer F-9		Insulated					Red	
Ladder inside container	Fab.	Shopcoat	Contr.	Debevoise Dereka red No. 505	Contr.	Debevoise transformer gray No. 590	Gray	
Primary coolant pumps P-11A & P-11B	S.S.	Insulated					Red	Red & S.S.
Steam generator E-7		Insulated					Red	
Primary Shield Tank TK-7	Contr.	P.H. Inhibitive red Ironhide 8-2	Contr.	P.H. Ironhide	Contr.	P.H. Ironhide 8-5	Light gray	
Checkered plate on platforms	Fab.	Shopcoat	Contr.	Debevoise Dereka red No. 505	Contr.	Debevoise transformer gray No. 590	Gray	
Sump in vapor container & plug	Contr.	Amercoat No. 86	Contr.	Amercoat No. 33	Contr.	Amercoat No. 33	Light gray	
Cooling coil and fan	Fabr.	Shopcoat		-	Contr.	Debevoise transformer gray No.590	Gray	
Cooling water cooler.	Fab.	stainless steel					Stain. St.	

APPENDIX 5

FILLING, CLEANING, AND HYDROSTATIC TEST PROCEDURES

PRIMARY SYSTEM FILLING AND CLEANING PROCEDURES

A. PREPARATION

1. Compressed air system is to be in operation.
2. Vacuum test is to be completed.
3. All tanks are to be filled with distilled water from the portable distilling unit if necessary.
4. Hot well is to be filled, with level controls in operation.
5. Condensate recirculating pumps and system are to be ready for operation. Refer to operating manual for check-out procedures.

B. FILLING

1. Fill primary system with distilled water from TK-5, using primary fill pump until solid water appears at pressurizer vent.
2. Stop fill pump.
3. Close pressurizer vent.

C. IN-PLACE FLUSHING AND FINAL FILL

1. Connect steam generator cover drain connection to the inlet of a cartridge type filter. The cartridges should be rated to remove ten micron particles or smaller.
2. Connect outlet of above filter to suction of primary blowdown return pump, P-19.
3. Install connection from pressurizer vent to discharge of P-19.
4. Open pressurizer vent and valve at suction connection of P-19.
5. Start P-19, circulate for two hours, and stop pump.
6. Close valves on pressurizer vent P-19 suction.
7. Check cartridge filters; if filter surfaces are mostly covered with visible foreign material, replace with clean cartridges.

8. Open valves at P-19 suction and pressurizer vent.

9. Start P-19, circulate for two hours, and stop pump.

10. Close valves as in step #6.

11. Remove cartridge filters.

12. Remove P-19 and temporary connections.

13. Perform hydrostatic test on system in conformance with ASME Code - Section VII. Test pressure 1-1/2 times design pressure or 2400 psig.

14. System ready for normal core loading procedures as described in APPR-1 Operating Manual.

Valve and pump identification refers to nomenclature in the present APPR-1 Operating Manual.

APPENDIX 6

EQUIPMENT LIST

EQUIPMENT REQUIRED

FOR

INSTALLATION BI-METALLIC STEAM GENERATOR

1. Truck Crane - 35 ton capacity - 80' min. boom (22,500# load).
2. Ratchet Action Pipe Cutter for 12" stainless steel pipe.
3. Two chain hoists - one 1-ton and one 2-ton. APPR-1 has (2).
4. Electric or Air Driven Hand Grinder. APPR-1 has (2).
5. Welding equipment for Inert Gas Shielded Arc and Metallic Arc Weld. See specifications for welding attached herewith.
6. Welding rod and Tungston electrode in accordance with specification.
7. Helium Leak Detector - Consolidated Engineering or equal.
8. Stainless steel wire brushes.
9. Cleaning solvents (alcohol and acetone, etc.)
10. Lint free cleaning cloth.
11. Dyecheck kit.
12. Necessary 12" and 4" EB. inserts for pipe welds.
13. Four in. stainless steel sch. 80 pipe for making test welds. 6' required.
14. Two foot piece of primary pipe (as specified in Appendix 2).
15. Replacement insulation for steam generator and misc. piping.
16. Misc. scaffold planking 2" x 10" x 16' 2" x 10" x 10'
    2" x 10" x 18' 2" x 10" x 6'
17. Miscellaneous blocking (wood).
18. Miscellaneous small tools.