SOUTHWEST RESEARCH INSTITUTE
6220 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS 78284

Attachment 1

S-40
50-348/364-CIVP
2/19/97

Rec'd 3/15/97

February 1, 1979

Staff Exh. 40

Mr. Gene Pettit
Bechtel Power Corporation
P. O. Box 607
Gaithersburg, Maryland 20760

Subject: Testing and Irradiation of Four Inch EYS Condulet

Reference: Bechtel Purchase Order No. 9645
SwRI Project No. 03-4974-001

Dear Gene:

This letter is to document the testing performed on a four inch EYS condulet assembly tested at Southwest Research Institute. The set-up and testing of the assembly were performed as follows:

1. Four inch EYS condulet assembly with 48 coaxial cables potted with Chico X and Chico A05 potting compound. Cables used were: 44-2300 V coax (IBA), 3-1000 V coax (IB7), and 1-1000 V coax (IB6). Assembly allowed to cure for 24 hours.

2. Pressure side of each cable end sealed off with Dow Corning silicone rubber sealant. This was allowed to cure 24 hours.

3. Condulet assembly was placed in pressure test fixture and checked with 30 psig of air to check for leakage. No leakage was evident. The condulet assembly was then subjected to 3 psig of air for one hour while monitored for leakage. No leakage was recorded.

4. The condulet assembly was subjected to 30 psig of air for one hour while being monitored for leakage. No leakage was recorded.

5 The assembly was then taken to the SwRI hot lab for irradiation. The test assembly was irradiated with cobalt 60 to a total dose of 1.02×10^8 R at a dose of 0.9×10^6 R/hour. The "in air" dose rate was measured with cobalt glass chip dosimeters.

TELEPHONE P. O. 512-684-5111 • TELEX NO. 767237 • TWX NO. 910 871-1064

7597-03-E91-23-1

NUCLEAR REGULATORY COMMISSION

Docket No. 50-348/364-CivP Official Exh. No. 40

In the matter of Alabama Power Company

Staff ✓ IDENTIFIED 12:20 p.m. 3/11/92

Applicant _____ RECEIVED 12:23 p.m. 3/19/92

Intervenor _____ REJECTED _____

Cont'g Off'n _____

Contractor _____ DATE 2/19/92

Other _____ Witness _____

Reporter S. Estep

6. Condulet test assembly was subjected to further pressure tests after irradiation. Three psig of air was applied to assembly in test fixture for one hour. No leakage was recorded. Pressure was then increased to 30 psig of air and maintained for one hour. No leakage was recorded.

7. The condulet assembly was set up for steam pressure tests. The test fixture was heated to 330°F and the condulet assembly was then subjected to a steam pressure of 30 psig at 330°F. The following leak rates were established:

After One Hour

Pressure = 30 Psig
Temperature = 330°F
Leakage = .610 Cubic Inch/Hour

After Two Hours

Pressure = 30 Psig
Temperature = 330°F
Leakage = 8.542 Cubic Inch/Hour

If I may answer any questions you may have on the tests or the results please contact me. It has been a pleasure working with you on these tests and I hope we will continue to be of service to you in any future testing you may have.

Sincerely,

Jesse I. Ramon
Engineering Technologist
Special Projects

JIR:sak
cc: George K. Wolfe

APPROVED:

Edward M. Briggs, Director
Ocean Engineering and Structural Design

005563

cc: J. B. Crosby
J. F. Wueste

January 6, 1976

Mr. A. Ronald Jacobstein
Staff Engineer
WJS CORPORATION
4 Research Place
Rockville, Maryland 20850

Dear Mr. Jacobstein:

This is in answer to your letter of December 12, 1975 concerning our EYS seals, Chico X fiber and Chico A compounds.

Our Chico A compound is a mixture of hydrated oxides, similar to set portland cement. Chico A is an inorganic compound and is non-flammable.

Our current Chico X fiber is ceramic and is an alumina-silica composition. It also is non-flammable.

We have UL listing on our EYS seals with Chico A compound and Chico X fiber. The listing procedures require compliance with hydrostatic pressure tests and air leakage tests per UL Standard C86. The UL procedures do not include fire rating tests or flame retardation tests.

As to chemical stability, we consider Chico A and Chico X to be essentially chemically inert. The UL listing does not restrict the cable jacketing material and Chico A has an [illegible] years history of use with all kinds of jacketing materials. We have had no reports of incompatibility.

I trust the above information will be of assistance.

Sincerely,

CROUSE-HINDS COMPANY

J. W. Smith
Sales & Service Supervisor
Construction Materials

JWS:da

005564

(Attachment 1)

TEST PROCEDURE

1.0 General

The contents herein outline SwRI proposed test procedures and methods to meet the requirements set forth by Bechtel Power Corporation's Request for Proposal dated April 4, 1977.

2.0 Air Tests

2.1 Condulet Assemblies

(Minus cables and sealing compound) Each of the different sizes of condulets shall be assembled in the manner shown in Figure 1. The inlet end of the assembly shall be reduced to 3/4 inch pipe with a pipe nipple attaching the assembly to the inner side of the SwRI 10 inch diameter test chamber. With the specimen suspended from the seal plate and the closure ring in place, 30 psig of regulated compressed air will be applied. Any leakage occurring in the test assembly will cause an air flow out of the test chamber and into the inverted beaker in the collection device. Pressure shall be applied for one hour and the total volume of escaped air collected shall be used to establish an hourly leakage rate.

2.2 Condulet/Cable Assemblies

Each of the six different condulet/cable combinations will be assembled as shown in Figure 2. SwRI will fabricate a chamber from 8 or 10 inch pipe to serve as an autoclave and, in this case, as an air pressure chamber. The test specimen will be attached as shown, to a pipe nipple welded to a 1/2 inch thick plate. The end plate will be match drilled to mate with the autoclave chamber flange. An asbestos type seal shall be utilized to provide the pressure barrier at this junction. The outlet end of the assembly shall have a similar pipe nipple/plate fitting. The end plate of this fitting will have a welded 1/4 inch pipe coupling for insertion of a thermocouple probe and a pipe threaded outlet for plumbing to a collection vessel (see Figure 1). Regulated 10, 20 and 30 psig air will be applied to the inlet of the pressure chamber. Air leakage through the specimen will be collected and the volume utilized to determine the leakage rate for the hour of test duration at each pressure.

3.0 Steam Tests (Reference Figure 3)

3.1 SBE Tests

With the specimen in place, and the autoclave at ambient room temperature and pressure, 330° steam at 3 psig will be applied. Immediately, a temperature controller will be set to 330°F causing current to be applied to strip heaters attached to the autoclave outer walls. This method will give an initial steam pressure/temperature shock and still establish a stabilized pressure and temperature condition throughout the six hour hold period.

Strap heaters will be wrapped around the remainder of the assembly to apply controlled heat at 220°F-240°F. This will be necessary to prevent condensation of steam leakage until the escaped steam enters a condensor coil. The volume of collected condensate will be measured and utilized to establish a weight of water per hour leakage rate. Upon completion of the SBE test for each specimen, regulated 30 psig compressed air will be applied for one hour. Air leakage will be directed to the collection device (Figure 1) and the volume collected will be utilized to determine an hourly leakage rate.

3.2 DBA Tests

All DBA tests will be conducted with the same circuit arrangement as in the SBE tests. Only the conditions will be varied to provide the following:

- 30 psig steam at 330°F for one hour
- Immediate reduction thereafter to 15 psig steam at 250°F for 23 hours
- 30 psig compressed air at ambient temperature for one hour

All leakage rates will be established for each different condition.

4.0 Final Report

At the completion of testing, a final report will be submitted to Bechtel which shall include, as a minimum: (1) leakage rates for each specimen tested and for each condition the specimen was subjected to, (2) photographs of each assembled test specimen and of test equipment and facilities utilized for each test, and (3) data forms for each specimen including dates, times, conditions and results of individual tests.

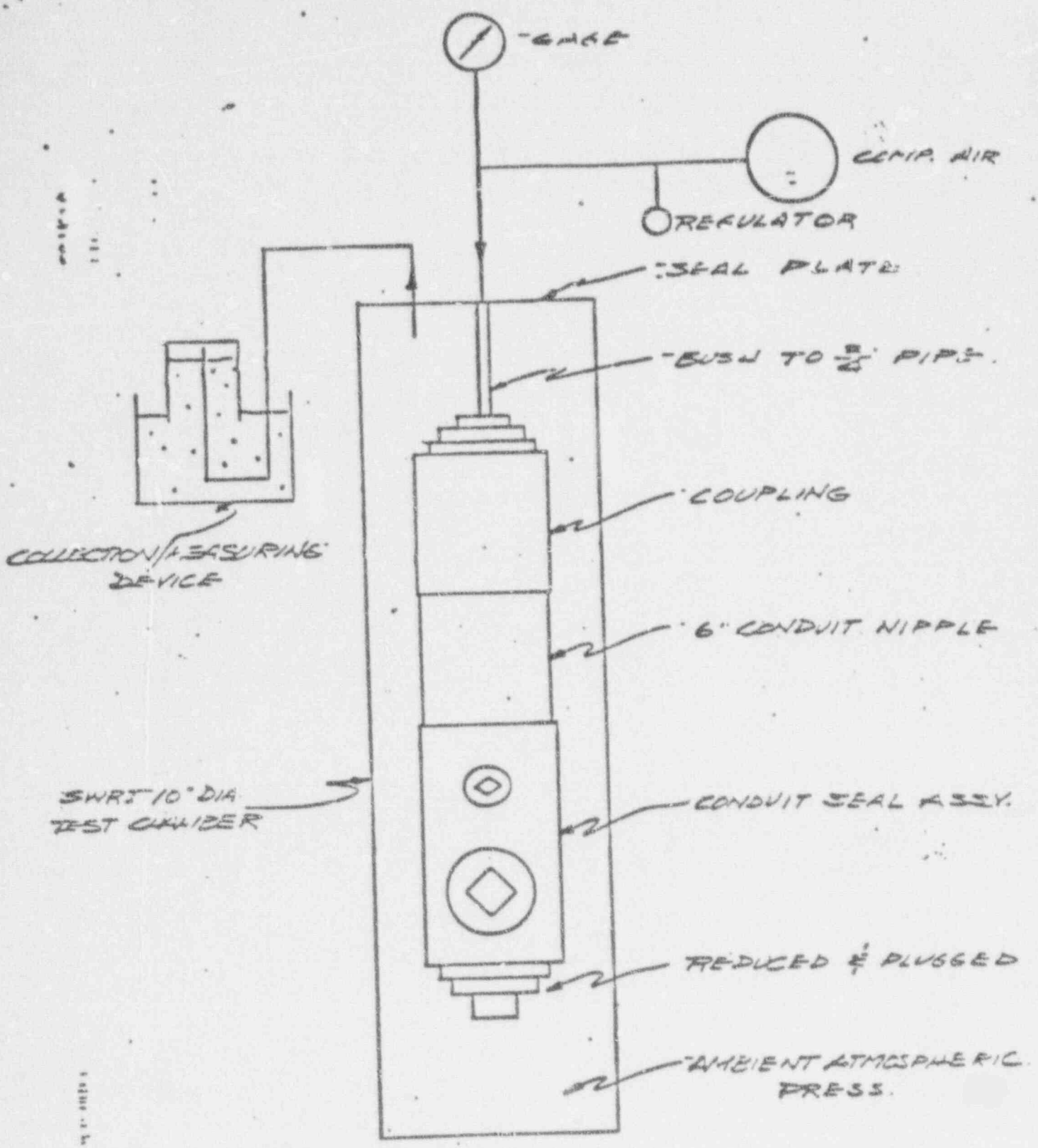

FIG 1

COMPRESSED AIR TEST SCHEMATIC

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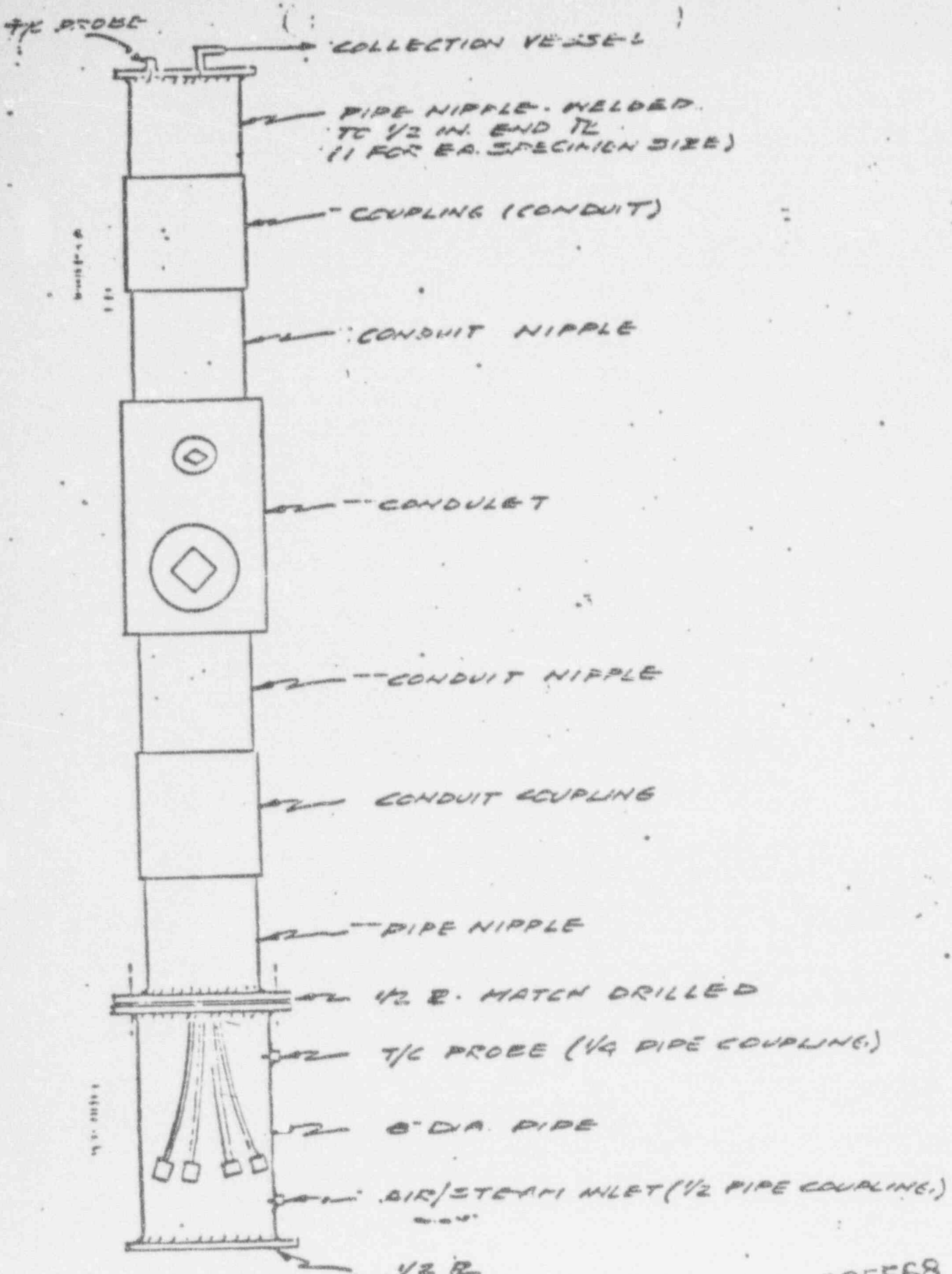

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FIG. 2
SPECIMEN & AUTOCLAVE ASSY
SCHEMATIC

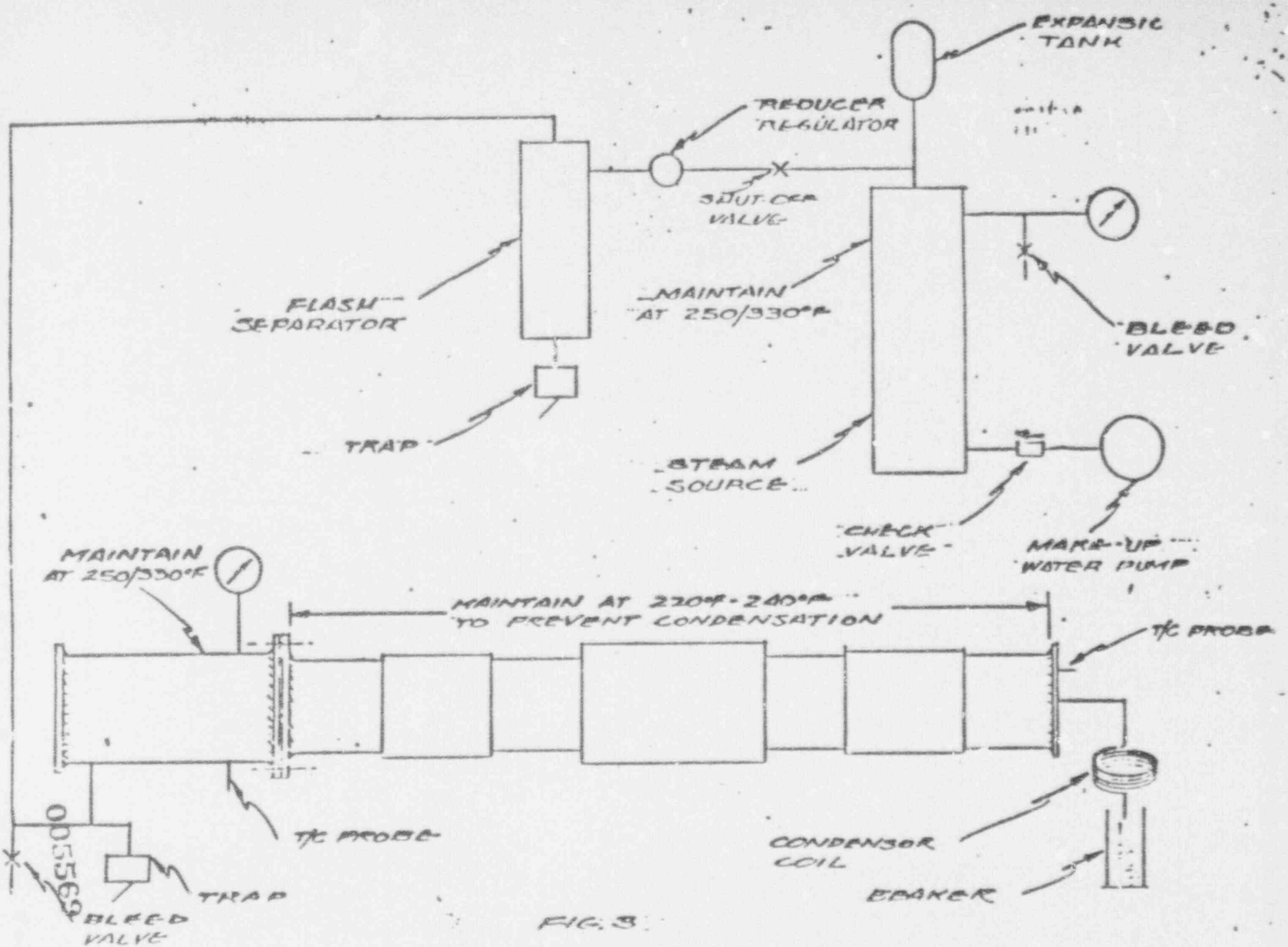
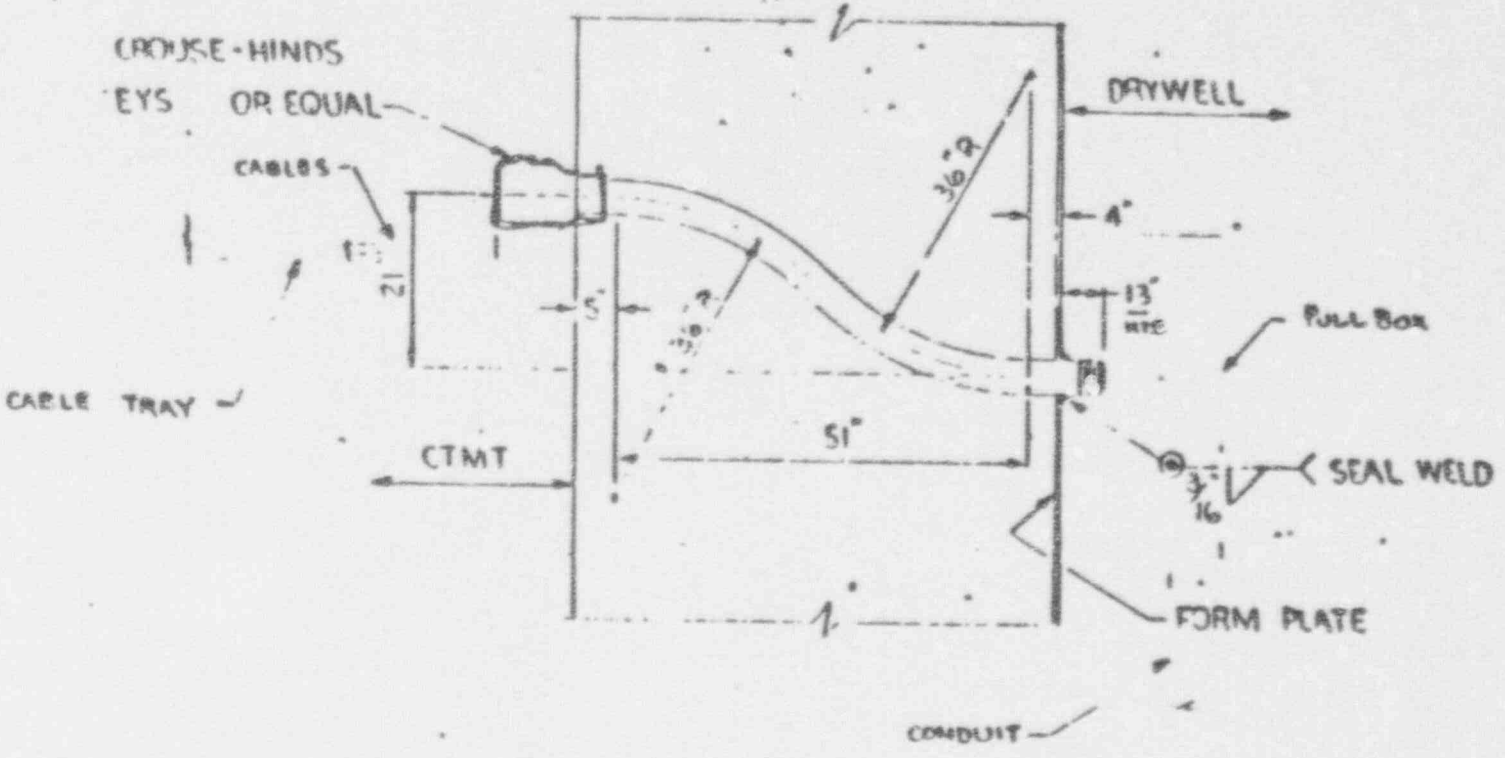


FIG. 3

SBE & DBA TEST CIRCUIT
SCHEMATIC



EMBEDDED DRYWELL WALL 3-BENT CONDUITS

OCEAN ENGINEERING AND STRUCTURAL DESIGN
SOUTHWEST RESEARCH INSTITUTE
6220 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS 78284

July 13, 1979 (ATTACHMENT 3)

Mr. D. R. Quattrociocchi
Bechtel Power Corporation
Grand Gulf Nuclear Station
15740 Shady Grove Road
Gaithersburg, Maryland 20760

Subject: Testing of EYS Condulet/Cable Assemblies

Reference: Bechtel Job No. 9645
SwRI Project No. 03-4974-001

Dear Mr. Quattrociocchi:

This letter is to document the testing performed on six EYS conculet/cable assemblies for Bechtel Power Corporation at Southwest Research Institute. All cables used for testing were furnished by Bechtel. The setup and testing of the assemblies was performed as follows:

1. Each EYS condulet assembly with the prescribed number and type of cables was potted using Chico X fiber as a daming material. The assembly was then allowed to cure for 24 hours.

2. The pressure side of each cable end was sealed off with Dow Corning silicone rubber sealant which has a useable temperature range sufficient for these tests. This was allowed to cure for 24 hours.

3. Each condulet/cable assembly was then placed in the test fixture and before any testing was started, the assembly was subjected to 3 psig air pressure and checks were made to be certain that the cable ends exposed to the pressure were not leaking.

4. Each condulet/cable assembly was then subjected to 10, 20, and 30 psig compressed air for one hour at each pressure setting. A leakage rate for each assembly was established using a precision bore florator tube S/N B4-27-10/70G standard C.F.M.-air-met. at 14.7 psia pressure and 70°F.

5. Each condulet/cable assembly was then wrapped with flexible heater tapes and subjected to 3 psig, 330°F steam for six hours. A leakage rate for each assembly was established by condensing the leakage steam into water and measuring it in ml/minute. This was then converted into cubic inches/hour.

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TELEPHONE NO 512-684 5111 • TELEX NO 767337 • TWX NO 910-871-1084

6. Each conduiet/cable assembly was then subjected to 30 psig, 330°F steam for one hour. A leakage rate was established in the same manner.

7. After one hour at 30 psig, 330°F steam, the pressure and temperature were reduced to 15 psig, 250°F for 23 hours. The leakage rate for each assembly was taken and recorded after 23 hours at this sustained pressure and temperature.

8. At the conclusion of the steam tests, the conduiet/cable assemblies were allowed to cool to room temperature. Upon reaching room temperature, the assemblies were subjected to a compressed air test of 30 psig for one hour. A leakage rate was established for each assembly.

Enclosed are photographs of the potted conduiet/cable assemblies and test setup. All leakage rate data can be found in Table I. A detailed potting procedure which was used for the test samples is given in Attachment No. 1. If you have any questions concerning any part of these tests, please do not hesitate to call me.

Sincerely,

Lee E. Ries

Lee E. Ries
Senior Technician
Special Projects

LER:sak
Enclosures
cc: E. M. Briggs
R. C. DeHart

REVIEWED:

George K. Wolfe, Manager
Special Projects

X2428

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TABLE I

CONDULET/CABLE ASSEMBLY LEAKAGE RATE DATA

Condulet/Cable Assembly Type	Compressed Air Leakage (SCFM)			3 Psig, 350°F Steam Tests Leakage Rate (Cubic Inch Per Hour)						30 Psig 350°F Steam Tests (Cubic Inch Per Hour)	15 Psig 350°F Steam Tests (Cubic Inch Per Hour)	Compressed Air Tests One Hour (SCFM)
	10 Psig For One Hour	20 Psig For One Hour	30 Psig For One Hour	One Hour	Two Hours	Three Hours	Four Hours	Five Hours	Six Hours	One Hour	Twenty Three Hours	
3-1/2 Inch CTB with 8-3/c16 Shielded Cables	None	.2	1.1	.732	.732	.703	.856	.915	.919	11.6*	3.97	2.9
2-1/2 Inch CTB with 1-3/c10 and 8-2/c14 600V Cables	None	None	None	1.09	1.08	1.12	1.19	1.25	1.36	2.86	.68	1.1
4 Inch CTB with 1-3/c8, 1-3/c10 and 1-Single 600V Cables	None	.2	2.1	1.09	1.75	1.52	2.13	2.34	2.97	1.76	2.08	3.2
4 Inch CTB with 44-[illegible] Coax, [illegible] Coax and 1-10KV Coax Cables			None							.010 8.34**	6.73	
4 Inch CTB with 25-12/c20 Shielded, 600V Cables	.3	.5	.6	12.93	10.93	12.03	10.26	14.70	13.60	20.00	73.98	5
4 Inch CTB with 3-1/c750 MCM 15 KV Cables	.3	1.75	2.90	1.48	7.32	7.32	7.40	7.42	7.45	10.77	6.35	4.3

*Data previously supplied to Bechtel.
**Leakage after two hours at 30 psig, 350°F steam.

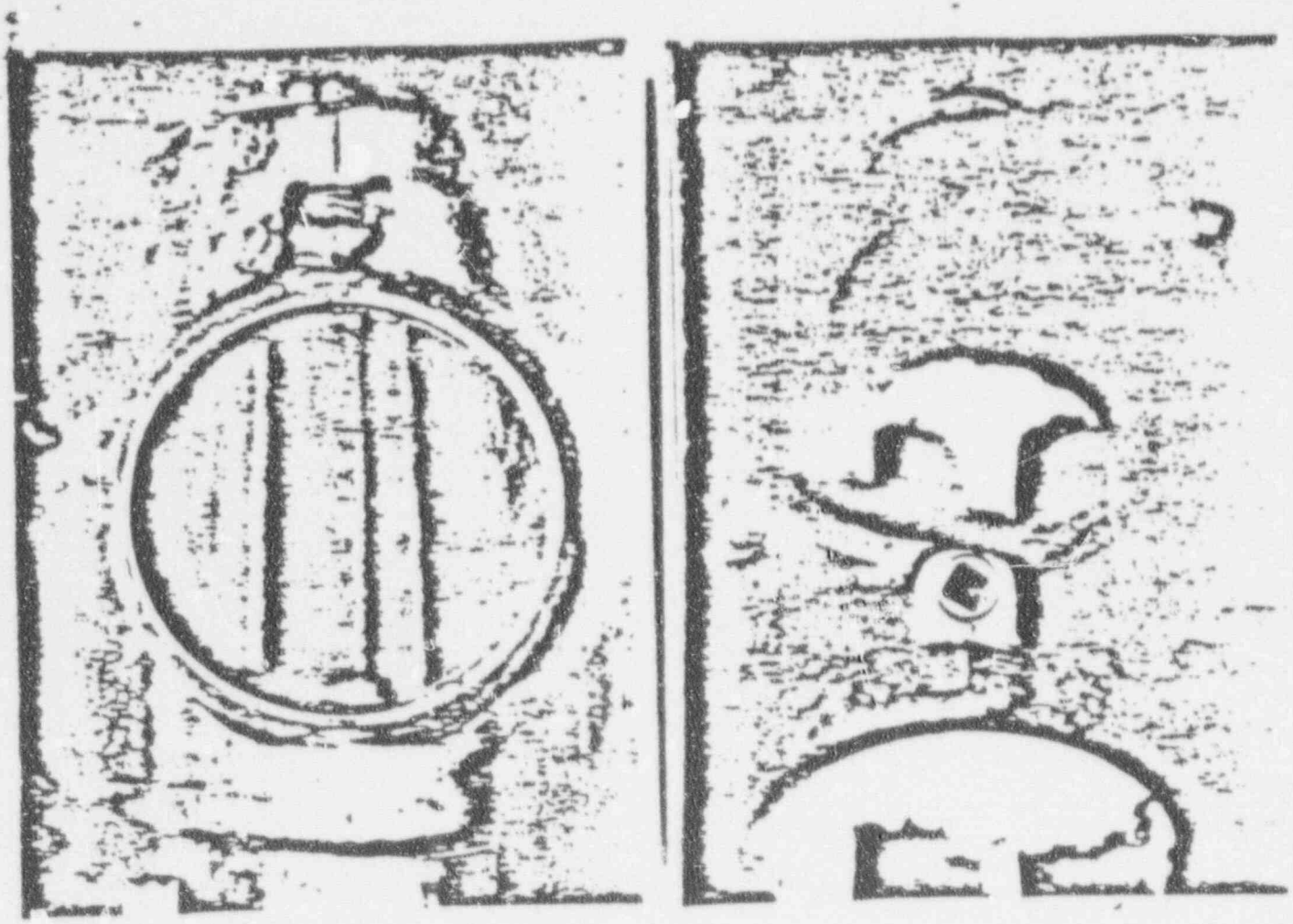

FIGURE 1. 6 INCH CONDULET/CABLE ASSEMBLY WITH 3-1/C 750 KCM 15 KV CABLES AND CHICO X FIBER INSTALLED

FIGURE 2. 2-1/2 INCH CONDULET/CABLE ASSEMBLIES AFTER POTTING WITH CHICO A05 COMPOUND
(Exposed Cable Ends were Sealed with Silicone Rubber Sealant)

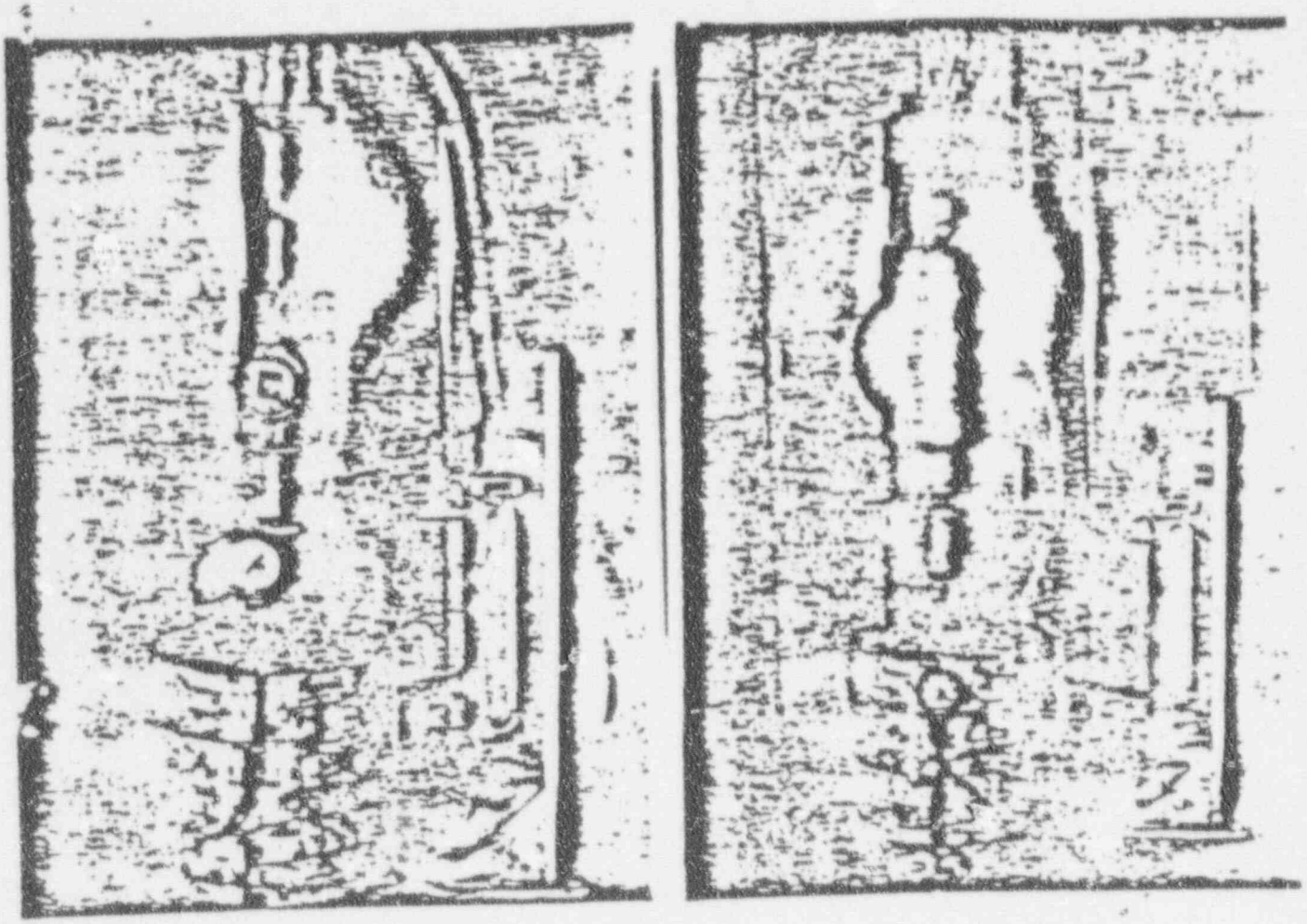

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FIGURE 3. 2-1/2 INCH AND 6 INCH CONDULET/CABLE ASSEMBLIES SET UP FOR AIR LEAKAGE TESTS

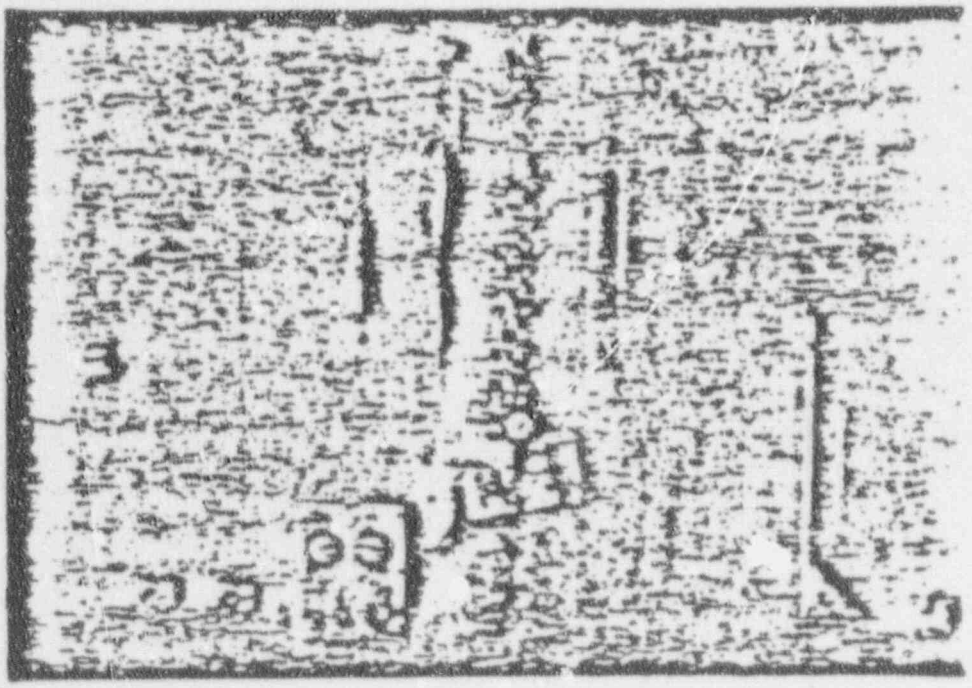

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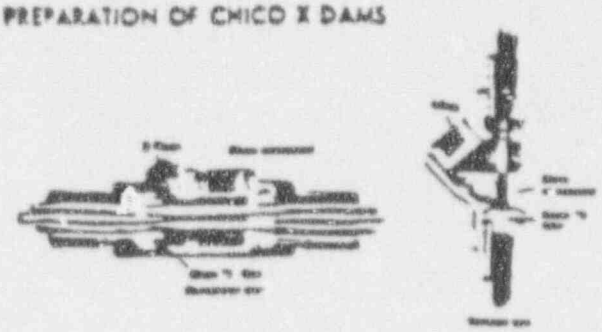
FIGURE 4. STEAM LEAKAGE TEST SET UP

INSTALLATION
INSTRUCTIONS

CHICO X FIBER
For Crouse-Hinds Seals for Hazardous Locations

PREPARATION OF CHICO X DAMS



1. Remove plug(s) from sealing fitting
2. Make dam in hub(s) of sealing fitting using Chico X in following manner.

NOTE

Vertical fittings need dam only in bottom hub
Horizontal fittings need dam in both hubs

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a) Using a hon and stick, force conductors toward filling opening DO NOT USE METAL TOOLS.

b) Pack Chico X fiber into conduit hub(s) behind conductors.

c) Push conductors away from filling opening and force them apart.

d) Pack fiber between AND around conductors in hub(s).

NOTE

If conductors are stiff insert temporary wooden wedges between conductors to aid in holding them apart. It is important that conductors be separated from each other so sealing compound will surround each conductor.

e) Pack fiber into hub(s) in front of conductors. Completed dams should be flush with conduit bushing.

CAUTION

Don't leave shreds of fiber sticking to walls or conductors. Such shreds form channels that allow leakage.

3. Mix and pour Crouse-Hinds Chico sealing compound in accordance with instructions furnished with compound.

CROUSE-HINDS COMPANY
Syracuse, N.Y. 13201

#281-REV. 9/75

ATTACHMENT NO. 1

EYS CONDULET/CABLE ASSEMBLY POTTING PROCEDURE

All potting of the EYS condulet/cable assemblies was performed in accordance with the Crouse-Hinds installation instructions furnished with the materials. A copy of the installation instructions is enclosed with this procedure.

1. All cables were cut to the appropriate lengths and cleaned with Freon precision cleaning solvent.

2. The cable ends that were to be exposed to the pressure were sealed with Dow Corning silicone rubber and allowed to cure.

3. The EYS sealing fittings were then placed in the horizontal position with the threaded plugs removed (see Crouse-Hinds Installation Instructions IF281-Rev. 9/75). The electrical cables were then run through the sealing fittings and centered.

4. Crouse-Hinds Chico X fiber was then tightly packed around and between the cables in the hubs of the sealing fitting. Care was taken to make sure that there was an air space between each conductor. Care was also taken to make sure that there were no stray shreds of fiber on the walls of the fittings or on the conductors themselves.

5. Chico A05 sealing compound was used to seal the assemblies. An amount sufficient to make one continuous pour for each assembly was mixed. The mixing ratio for Chico A05 is two parts by volume of Chico compound to one part water and it must be mixed in a clean container each time. The compound was then poured through the large opening in the fitting making sure no air pockets developed during the pour. Both plugs were then screwed in flush with the body of the fitting forcing the excess sealing compound to exert pressure on the fiber dams at each end of the fitting.

6. The condulet/cable assembly was then set aside to cure for 24 hours.

INSTALLATION
INSTRUCTIONS

CONDUIT SEALING IN HAZARDOUS LOCATIONS USE ONLY CROUSE-HINDS CHICO X FIBER FOR DAMS AND CHICO SEALING COMPOUND FOR SEALING

The National Electrical Code in Article 501, Section 501-5, Class I, Divisions 1 and 2, requires that seals be installed in specific places. This is to prevent the passage of gases, vapors, or flames through the conduit from one portion of the electrical installation to another portion.

While not a Code requirement, it is considered good practice to sectionalize long conduit runs by inserting seals not more than 50 to 100 feet apart, depending on the conduit size.

The Code in Section 502-5 requires seals in Class II locations under certain conditions. Crouse-Hinds sealing fittings can be used to meet this requirement.

In humid atmospheres or wet locations, where it is likely that water can gain entrance to the interiors of enclosures or runs, the runs should be inclined so that water will not collect in enclosures or on seals but will be led to low points where it may pass out through EZD explosion-proof drains.

Frequently the arrangement of runs makes this method impractical if not impossible. In such instances types EZD ... ain seal fittings should be used. These fittings prevent ...ormful accumulations of water above the seal. See Section 501-5c5.

In locations which usually are considered dry, surprising amounts of water frequently collect in conduit systems. No conduit system is airtight, therefore, it may "breathe." Alternate increases and decreases in temperature and/or barometric pressure due to weather changes or due to the nature of the process carried on in the location where the conduit is instal'ed will cause "breathing."

Outside air is drawn into the conduit system when it "breathes in." If this air carries sufficient moisture it will be condensed within the system when the temperature decreases and chills this air. The internal conditions being unfavorable to evaporation, the resultant water accumulation will remain and be added to by repetitions of the breathing cycle.

In view of this likelihood, insure against such water accumulations and probable subsequent insulation failures by installing EZD drain seals or EZD inspection seals even though conditions prevailing at the time of planning or installing do not indicate their need.

Sealing fittings are listed by Underwriters' Laboratories, Inc., for use in Class I hazardous locations with Chico sealing compound only. This compound, when properly mixed and poured, hardens into a dense, strong mass which is insoluble in water, is not attacked by petroleum products, and is not softened by heat. It will withstand, with ample safety factor, pressures of the exploding trapped gases or vapor.

Conductors sealed in the compound may be approved thermoplastic or rubber insulated type.

Only experienced, careful workmen should be entrusted with mixing the slow setting sealing and pouring the compound. Improperly made seals are worthless. Mixing vessel must be cleaned thoroughly before mixing new compound.

Type EYS

EYS sealing fittings can be installed in vertical or horizontal conduit runs.

Type EYS24 (¾") is intended for use with a combination vertical and horizontal conduit run. (Pouring spout is in vertical run.)

EYS1 series (½" to 1"), for vertical sealing only, have a filling opening one conduit size larger than the hub size.

EYS4 and 11 series (½" to 6"), for horizontal or vertical sealing, have separate filling and damming openings.

T85-00

Sealing Instructions for EYS4 Series and EYS11 Series

When sealing vertical conduits, compound is poured through the pipe plug opening above the cover. (See instructions provided with Chico X Fiber.)

For horizontal sealing of the ¼" through 3" sizes remove both threaded plugs from EYS.

Construct dams, per instructions provided with Chico X fiber, in both ends of the EYS.

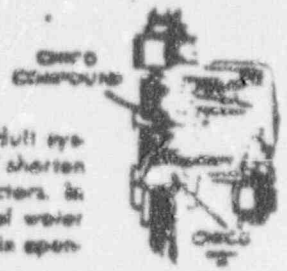
Prepare Chico sealing compound in accordance with instructions provided with Chico sealing compound. Pour the compound through the large opening.

Replace plugs, and screw in flush with body, forcing excess sealing compound to exert pressure against fiber dams at each end of seal.

Type EZS

EZS sealing fittings are for use with conduits running at any angle — vertical, horizontal, or in between.

Sizes ½ to 3-inch inclusive have round threaded cover openings of ample size for placing of dams in one or both conduit hubs. The covers have filling openings through which the compound is poured. The filling opening can be brought into position for pouring by turning the cover, regardless of the angle of the conduits. Pour sealing compound and replace pipe plug.



Type EZD

Accumulations of water in conduit systems are apt to cause trouble and shorten the life of insulation on conductors. In ordinary locations accumulation of water usually can be prevented by drain openings located at low points.

However, in hazardous locations this procedure can be followed only if the drain openings are flame-tight, that is, explosion-proof. The National Electrical Code requires that conduit systems in Class I hazardous locations be provided with means by which the systems can be drained of water, if there is likelihood of water accumulation.

Type EZD drain seals (½" to 2") and type EZD inspection seals (½" to 2") are designed so that the covers can be removed readily, permitting inspection during installation or at any time thereafter.

These fittings are for use only in vertical conduit runs. After the fittings have been installed in the conduit run and conductors are in place, the cover and baffle are removed. After the dam has been made in lower hub opening with "Chico X" fiber the baffle must be snapped into place in the groove in the opening before the "Chico" sealing compound can be poured into the sealing chamber.

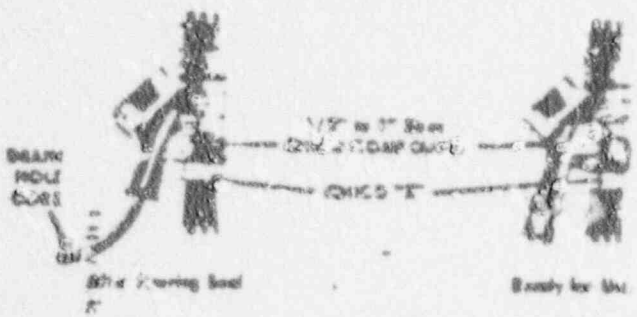
Type EZD Drain Seal Fittings provide continuous draining and thereby prevent water accumulation.

The covers should be positioned so that the drain will be at the bottom. A set screw is provided for locking the cover in this position.

Type EZD Inspection Seal Fittings are identical with those above described providing all inspection, maintenance and installation advantages except that the cover is not provided with an automatic drain. Water accumulations can be drained periodically by removing the cover. The cover must be replaced immediately.

Type EYD

EYD Drain Seal Fittings, for use in vertical conduit runs, prevent accumulation of water above seals in conduit systems. Continuous draining guards against insulation failure and other defects caused by the presence of water in the conduit system.



Install EYD and pull conductors through.

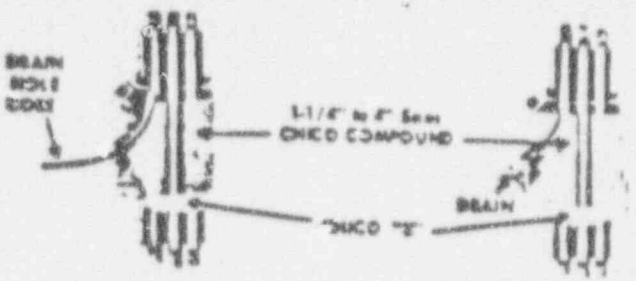
Remove pipe plug and dam the lower hub opening.

Insert rubber drain-hole-core through drain opening and washer (provided) high enough so inner end will be above sealing compound in completed seal. Make sure that the rubber drain-hole-core does not touch any of the conductors.

Pour sealing compound and replace pipe plug.

After about two hours remove drain-hole-core.

Thread ECD drain fitting into the opening and tighten securely.



Remove large cover and pipe plug and dam the lower hub opening.

Replace large cover, threading as far as possible into body, with arrow pointing directly down.

Insert rubber drain-hole-core through hole in large cover high enough so inner end will be above sealing compound in completed seal. Make sure that rubber drain-hole-core does not touch any of the conductors.

Pour sealing compound and replace pipe plug.

After two hours remove drain-hole-core.

Thread ECD drain fitting into cover drain opening and tighten securely.

CAUTION

Type EZD and EYD fittings are suitable for sealing vertical conduit runs between hazardous and non-hazardous areas, but must be so located that hazardous gases or vapors will not vent into the non-hazardous area. Conduits leaving the hazardous area from the top should have the fitting located in the non-hazardous area. Conduits leaving the hazardous area from the bottom should have the fitting located in the hazardous area.

87287-88V, 10/73
Supersedes CA19 and CA163

CROUSE-HINDS COMPANY
Syracuse, N.Y. 13201