COMMONWEALTH EDISON COMPANY

DRESDEN STATION

2A REACTOR RECIRCULATION PUMP
4" EQUALIZING LINE REPAIR PROGRAM

50-237

9834

CONTENTS

DRESDEN STATION UNIT 2

INTRODUCTION

On Friday, September 13, 1974, a crack was discovered on the "B" recirc loop 4" equalizing line around the discharge valve. Since the crack was on the upstream side of the equalizing valve and the line could be isolated, this repair was performed relatively easily.

Subsequent ultrasonic tests of the "A" recirc loop equalizing line around the discharge valve disclosed a similar crack. The second crack, however, is on the downstream side of the valve at the 28" x 4" weldolet (reducer) where line 0203A-4" A ties into the 28" recirc riser. Because of the location of this crack, it cannot be isolated by valve manipulation. Repair procedures have been developed to isolate the cracked portion of the line with plugs so that it may be replaced.

The program which is described herein involves replacement of the cracked line, essentially a matter of maintenance. No technical specification changes are involved. There is a very small increase in the probability of leakage of reactor coolant from the four inch pipe while it is plugged for repair. However, since the reactor is in a cold shutdown condition and since any leakage which might result from failure of the plugs would be well within the makeup capability of one of the 2 core sprays or one of

4 LPCI pumps, the likelihood of damaging the core or releasing radioactivity in excess of 10 CFR 20 limits is not increased by an amount large enough to quantify. Therefore, even if the plugs were to fail, the loss of coolant accident consequences considered in the FSAR would not occur. Commonwealth Edison believed it inappropriate to determine whether the repair is within the scope of a technical interpretation of 10 CFR §50.59. Commonwealth Edison believes the spirit of the regulations suggests that matters such as this one should be brought to the AEC's attention in a timely fashion for review by the Staff. Such review will confirm Commonwealth Edison's judgment that no real considerations of increased risk are involved.

Both the Offsite and Onsite Review functions have approved this submittal.

SUMMARY OF REPAIR

The planned repair involves using a freeze plug and an expandable rubber plug to preclude the loss of primary coolant from the four inch diameter opening in the primary coolant boundary which occurs when the cracked section of pipe is removed to be replaced. By test and experience, the proposed plugs have been shown to have the capability of precluding a loss of coolant under conditions more severe than will be encountered during the actual repair program. Back-up plugging techniques to stop the minor loss of coolant that would occur in the event of a failure of a primary plug have been developed and demonstrated. Further, Commonwealth Edison has postulated and analyzed the failure of both the primary and back-up plugging techniques. It has been concluded that use of only a portion of the emergency core cooling systems will maintain the coolant level above the top of the fuel in this event. Operability of ECCS equipment and the diesel generators will have been demonstrated prior to starting the repair. Since the fuel would remain covered by coolant, no fuel damage would occur and the only radiological consequences of the failure of both primary and back-up plugs would be the release to the primary containment of radioactive materials normally contained in the reactor coolant. This release would not result in a radiological exposure rate at the site boundary in excess of those expected during routine plant operation which are only a fraction of 10 CFR 20 limits. The possible exposure to maintenance personnel would also be controllable to levels well within Part 20 limits and normal maintenance experience. On the basis of these evaluations, it is concluded that no increased risk is involved with the repair program.

ALTERNATIVE REPAIR TECHNIQUES CONSIDERED

After discovering the crack in the Unit 2(A) 4 inch equalizing line, Commonwealth Edison explored four alternative repair methods:

1. Unloading the core and draining the reactor. This procedure would have avoided the necessity of

developing plugging techniques to prevent loss of coolant. However, there is not sufficient space in the Unit 2 spent fuel pool for an additional fuel core. Therefore, it would have been necessary to tranfer about half of the fuel from the Unit 2 Pool to the Unit 3 Pool using an IF-300 cask and the reactor building crane. AEC permission to use the cask in this manner would have been required. Moving the necessary number of fuel assemblies would have required about 20 days. A scheduled refueling outage could have been combined with this procedure but the completion of the refueling would not be advanced, due to delivery schedules for critical materials such as LPRMS and CRD replacement parts which cannot be advanced. In addition, the core sipping program, to determine leaking fuel rods would be impaired by the low iodine levels resulting from a longer elapsed time between shutdown and sipping.

2. Remove the reactor vessel head, dryer and separator and plug the two rams heads on each of the five jet pumps in "A" recirc loop with a special tool designed by General Electric. Unfortunately, this tool is still being developed and tested.

3. Use a freeze-plug on the 28 inch recirculation header. This is not now feasible because at present, even under laboratory conditions, 18 inches is the largest diameter upon which freeze-plugs have been demonstrated.

4. Use freeze-plugs on the 5 - twelve inch jet pump risers in the dry well. This would allow the "A" re-

circ discharge header to be drained. The method would require 5 simultaneous plugs in the 12 inch risers. This vertical pipe technique has been proven but it is important to have no flow in order to establish the plug. Any natural circulation or isolation valve leakage would prevent a freeze. At prsent, Edison does not have an appropriate approved 12 inch pipe freeze procedure. Edison does have experience and confidence with the 4 inch size.

The four inch equalizing line freeze was chosen over alternatives 2, 3 and 4 on the basis of Commonwealth Edison's greater confidence in the proven reliability of the procedure. Alternative 1 was rejected as requiring significantly more time while offering no significant compensating advantages. As explained in the safety evaluation section of this report, it remains a fall-back procedure.

DESCRIPTION OF REPAIR PROCEDURE

A step-by-step procedure No. 5PM-19 has been developed describing the repair to be made to the weld crack on line 2-0203-4". Below is a summary of the repair procedure.

The repair involves:

1. Freeze-plugging line 2-0203A-4" as shown on Figure 3-(1).

2. Installing a back-up split clamp which can be repositioned and tightened if the freeze-plug fails while the line is being cut at the 90° elbow as shown on Figure 6.

3. Checking the leak tightness of the freeze-plug by opening a drain valve.

4. Cutting the line at the 90° elbow as shown on Figure 3-(1).

5. Removing the split clamp back-up device. A back-up seal will not be available for a period of approximately 5 minutes between steps 5 and 6.

6. Installing the hinged bail back-up plug shown in Figure 7.

7. Installing the rubber sealing plug and rod with a stuffing box over the rod and cap upstream of the freeze-plug. This rubber plug-rod-stuffing box-cap assembly is attached to the 4 inch line by a Plidco clamp as shown on Figure 3-(2).

8. Thawing the freeze-plug.

9. Advancing the rubber plug into the 28" x 4" weldolet as shown on Figure 3-(3). At this point, the end cap and stuffing box act as a seal.

10. Expanding the rubber plug to create a seal on the 28" x 4" weldolet.

11. Confirming a 100% leak tight seal by opening the tell-tale drain valve in the stuffing box-cap assembly.

12. Installing a back-up split clamp which can be repositioned and tightened if the rubber plug fails while the 28" x 4" weldolet is being cut as shown on Figure 5.

13. Grinding away the metal adjacent to the weld between the 4 inch line and 28" x 4" weldolet and removing the intact weld and section of pipe after lowering remainder of four inch pipe out of line with the opening.

14. The hinged bail plug attached to the 28 inch pipe shown on Figure 4 will be in place to serve as a back-up at this point.

15. Preparing the 4 inch end of the 28" x 4" weldolet for rewelding.

16. Installing over the rubber plug rod a new section 4 inch pipe with a stuffing box-cap assembly attached to the upstream end by a Plidco clamp as shown on Figure 3-(5). The Plidco grips the pipe with a rubber ring and will not damage it.

17. Installing the split clamp back-up plug described in step 12.

18. Welding the 4 inch line to the 28" x 4" weldolet.

19. Contracting and withdrawing the rubber plug from the 28" x 4" weldolet to the capped end of the 4 inch pipe section as shown on Figure 3-(7).

20. Freeze plugging the new section of line 0203A-4" as shown on Figure 3-(7).

21. Installing the hinged bail back-up device described in step 6.

22. Removing the rubber plug-rod-stuffing box-cap assembly.

23. Installing the split clamp back-up device described in step 2.

24. Welding the 4 inch line to the 90° elbow as shown in Figure 3-(8).

25. Thawing the freeze-plug.

This procedure has been developed so that there will nearly always be a back-up method of sealing the line should any leakage occur. Personnel trained to use the back-up seals will be members of the repair crew.

FREEZE SEAL EXPERIENCE AND TRAINING

Commonwealth Edison has considerable experience with freeze-plugs at Zion Station. Over the past eighteen months, over sixty freeze-plugs have been established for isolation purposes on stainless steel lines. Twenty four of these plugs were established in four inch pipe. Only one "failure" of a plug has resulted. This failure was the result of a poorly fabricated "open pocket" type container to hold the liquid nitrogen. Since that time, the procedure has been modified and only all-welded, "jacket", type containers have been used. Moreover, a drain in the pipe at Dresden will be opened to make certain that there is no leakage through the freeze-plug.

Pressure and temperature conditions necessary for such plugs are dependent upon several variables for each specific application. These variables include the nominal size of pipe to be frozen, the nearest heat source, and volume of water between the freeze plug and closest (limiting) point of isolation (to prevent pressure buildup). Zion Station has successfully applied freeze-plugs at initial temperatures of about 200°F and 115 psia. Naturally, minimum temperature and pressure conditions are desirable when applying freeze-plugs. The actual conditions at Dresden (110°F to 150°F and 40 psia) during the proposed freeze will be ideal for the freeze.

Five Dresden personnel recently completed training at Zion which covered the basic theory and practical aspects of freezing lines. The training culminated when the trainees established a freeze-plug in a four inch schedule 40 pipe, and the freeze-plug was hydrostatically tested to 1500 psig with no leakage or freeze-plug movement.

The present procedure and "all-welded" jacket assemblies closely resemble those used by the Newport News Shipbuilding and Dry Dock Company (ref. NNS Nuclear Construction Operating Procedure No. X42-18.9N rev. A) which is used for Naval nuclear plant construction and repair.

The application of freeze-plugs at Dresden will be in accordance with the Zion Station procedure and will be supervised by trained personnel.

Present day freeze-plug applications include up to 12 inch diameter pipes in the field and up to 18 inch diameter pipes under laboratory conditions.

TESTING AND TRAINING

Two full-scale mock-ups were constructed to develop procedures, functionally verify repair apparatus and back-up devices and to train repair crews. In addition, validation tests to determine the suitability of rubber sealing materials were made.

A freeze-plug/welding mock-up was used to verify the freeze-plug procedure and its compatability with the nearby welding procedure. A hydraulic mock-up was used to verify the satisfactory operation of all four back-up sealing devices as well as conduct of the repair beginning with the thaw of the initial freeze-plug and ending with the removal of the rubber plug after completion of the weld at the weldolet (steps 9 to 20, pages 6 & 7). Both mock-ups were used, as appropriate, to train crew members in repair procedures and use of the back-up sealing devices.

MATERIAL AND FREEZE PLUG VALIDATION TESTS

A. Material

The rubber material used in the expandable mandril-type plug used to plug the 28" x 4" weldolet requires several characteristics:

1. A high temperature capability to preclude melting during the welding of the pipe to the 28" x 4" weldolet in which it was sealing the flow. A natural polyisoprene rubber was selected and tested in the following conditions: Surfaces of the rubber were contacted with heated metal rods at succeedingly higher temperatures until the rubber surface became tacky. The selected rubber showed no tackiness up to a temperature of 500°F for a dry surface. The weld heat zone separation from the rubber sealing surface of this expanding mandril will be about 1 inch. The temperatures of the water behind the seal will be about 100°F to 130°F. The weldolet body on the pipe side will be at approximately 300°F as a result of being 1-1/2 inches from the weld center-line. On the hydraulic mock-up, a seal was made with the rubber plug inside the weldolet. A specification weld was made while the seal was active under 20 psig pressure. The rubber maintained the water seal in a temperature zone of 300°F to 130°F as measured on the surface of the reducer. Upon release of the seal, the rubber appeared to be in its initial condition and elastically returned to the unexpanded dimensions.

2. Sufficient mechanical strength and formability in a non-permeable rubber to make an internal expansion seal against a water pressure of about 40 psia, and then to return elastically without crumbling to its initial non-compressed dimensions. The sealing capability of the rubber plug was tested separately in a pressurized 4 inch pipe. The rubber plug was positioned, expanded, and monitored as it would be in the actual repair sequence. The pipe pressure on the water side was increased to 100 psig; the other face of the seal was at ambient pressure. The rubber material was visually inspected after the test. The rubber plug created a seal by mandril expansion at more than four times the 25 psi differential pressure needed for the repair job. The rubber appeared to be unaffected by this test.

B. Freeze-Plug

The freeze-plug technique of liquid line isolation, is referenced in Dresden Special Maintenance Procedure 20 which is based on Zion Generating Station Maintenance and Procedure M0131-1. The freeze plug will have approximately 25 psig on the liquid side and an ambient pressure, argon filled pipe on the downstream side. A validation test demonstrated the compatibility of the freeze-plug technique and the close-proximity specification welding on the 4 inch stainless steel pipe. A pressurized mock-up of the 28" x 4" - weldolet and 4 inch stainless steel pipe was used in this test.

A freeze-plug was made 12 inches downstream from the weldolet joint according to the referenced procedure. The freeze-plug was fully established as a pressure seal after 80 minutes. After the pipe had been drained, the specified butt-weld of the 4 inch stainless steel pipe (second closure weld) was then made at a separation distance of 9 inches. A delay time of two hours was used to simulate the time needed for radiography on the weld. The freeze-plug was maintained for this interval, then allowed to thaw.

It was conclusively demonstrated that the freeze plug seal was not compromised during the specific welding operation and that it can be maintained effectively over an extensive time period.

EQUIPMENT VERIFICATION, DEVELOPMENT OF PROCEDURES AND TRAINING

The planned repair of the crack of the 4 inch bypass line of the 2A recirc loop calls for the use of repair apparatus and back-up sealing devices. The back-up sealing devices are to be used to recover from unplanned situations and to mitigate the effects of failures of the primary apparatus. The verification testing of the repair apparatus is discussed in order of the sequence of use in the repair procedure except that functional testing of the back-up devices was performed separately.

The isolation of the 4 inch bypass pipe from the main recirculation loop requires the closure of downstream valve MO-2-0202-7A and the establishment of a freeze-plug seal between the 28" x 4" weldolet and the pre-determined point of entry into the 4 inch equalizing pipe. The primary repair apparatus was sized for an entry point 31-1/2 inches downstream from the reducer-pipe joint. The repair device used to establish a seal within the weldolet has an expanding rubber mandril mounted on the forward end of a central screw rod. This hardware requires about 8 inches of pipe length for mounting, hence a distance of 12 inches was selected for the freeze plug separation from the entry point. By use of Zion Procedure MO13-1, a freeze-plug was established to complete the isolation of the pipe around the entry point. Demonstration of the freeze-plug technique was strictly routine. The expanding rubber mandril has been functionally tested on both mock-ups.

Two back-up sealing clamp devices were installed. The parallel wall pipe split clamp sleeve was located near the upstream end of the freeze-plug to seal any potential pipe surface leaks resulting from interrupted cutting operations; and the clamped bail plug device located just downstream of the entry point for quick stopping of the pipe should the freeze-plug fail.

On the freeze-plug/welding mock-up, the cutting operation with a guillotine saw was not deemed essential for testing of the freeze-plug integrity nor for the demonstration of compatability with primary repair apparatus from which it is entirely independent.

The clamped bail plug device was removed to enable the mounting of the stuffing box with its internal screw rod and expanding rubber mandril. These operations required clearing the 4 inch line on the elbow side to provide access. The mounting operation also involves indexing measurements on the pipe and on the screw rod to assure placement of the expanding seal in the body of the weldolet. The Plidco clamps assure rigid mounting of the stuffing box to allow the screw rod to position the expanding mandril properly.

The nitrogen supply was removed to allow the freeze-plug to melt. After the freeze-plug was melted the stuffing box provided the hydraulic seal. The repair crew then drove the expandable mandril into position, expanded it to form a seal within the weldolet, then set the friction clamps on the screw rod. A tell-tale drain on the seal cap was used to pressure check the expandable seal, then to drain the 4 inch pipe of water. The rubber plug seal is monitored via this drain to insure its integrity.

The bail type clamp and plug is installed on the hydraulic mock-up to simulate its installation on the 28 inch main recirculation line. It is swung up out of the way, available for use in the event of failure of the expandable plug. Its tapered plug is aligned and positioned during initial installation.

The 28" x 4" weldolet split clamp sleeve is then installed over the 4 inch pipe just upstream of the weldolet for possible use should the grinding operation used to separate the reducer and the pipe be interrupted by a failure of the rubber plug.

Several mechanical operations used in the actual procedure such as erecting a pipe hanger and hand grinding the joint to separate the pipe and weld preparation were not done on the hydraulic mock-up since such operations are independent of the functioning of the sealing devices.

A critical step in the repair was practiced on the hydraulic mock-up. After the 4 inch pipe is separated from the weldolet, the crew manually removes the old 4 inch pipe back along the screw rod. A friction clamp is then removed from the end of the screw rod to allow removal of the old pipe and stuffing box.

The stuffing box is assembled to the new pipe section with the Plidco clamp; the entire assembly is re-installed on the screw rod and moved to the reducer. The friction clamp is re-installed on the screw rod end.

The parallel wall split clamp sleeve is now transferred from the old pipe to the new pipe to cover the same contingencies previously noted but associated with the weldment that is to be made next.

Inspections precede the welding and also follow the completed weld. These inspections were time-simulated in training. Of greater procedural importance in the welding is the strict temperature control to preclude adverse effects on the expandable seal.

Fit-up and sealing of the stuffing box having been made, the next step after completion of the weld, is to unseat the expandable seal. Pressure check the new 4 inch pipe section via the drain valve, then withdraw the expandable plug assembly into its mounting structure on the end of the pipe.

Re-establishment of the freeze-plug at a point 12 inches downstream from the final closure weld, again, is routinely accomplished by the same procedure. A drain plug pressure check is made again to assure that the freeze-plug is a complete seal.

After that check is accomplished, the primary repair apparatus is removed from the pipe. The parallel wall pipe split-clamp sleeve is installed upstream of the freeze-plug but downstream of the closure weld.

The remaining operations involve welding, inspections, thawing the freeze-plug, inspections, reinstallation of system support hardware (hangers, gratings) and final hydrostatic testing of the 2A recirculation bypass line.

The training operations included retraining of qualified maintenance personnel (Phillips-Getschow and Commonwealth Edison) in the specifics of this repair operation. It also included training opportunities which occurred during the evolution of the repair apparatus and back-up sealing devices. After several training exercises, the repair crew performed a demonstration with AEC observers present by their request.

The integrity of the repair will be established with the normal hydraulic testing of the 2A recirculation by-pass line per standard reactor preoperational procedure whose requirements are consistent with the current Technical Specifications and the approved FSAR for Dresden Unit 2.

BACK-UP MEASURES TAKEN DURING REPAIR

1. The first cutting operation will be to part the 4" line from the elbow. The primary means of providing a seal will be through the use of a freeze-plug. A back-up split clamp will be a back-up sealing device during the initial cutting and after the pipe has been parted, with a taper plug attached to a clamp around the pipe. This back-up sealing device has been tested on the hydraulic mock-up.

2. Prior to the stuffing box installation, the primary means of providing a seal will be through the use of a freeze-plug. A back-up sealing device will be provided through the use of a swing-down tapered plug mounted on a bail clamped to the 4" pipe. The tapered plug can be positioned in the opening and the leak stopped.

3. 28" x 4" weldolet to pipe cut--during the cutting of the 28" x 4" weldolet to pipe joint, the primary means of providing a seal will be through the use of a rubber plug installed in the weldolet. Initially, the system will be closed, with the stuffing box as a boundary. Before the pipe is parted, the back-up means will be a split rubber lined clamp.

After the pipe has been parted, and during the weld preparation, the back-up means will be through the use of a bail assembly on the 28" pipe with a swing-down taper plug attached. The plug can be inserted into the opening and any leakage stopped.

4. During the fit-up and root pass of the 4" pipe to the 28" x 4" weldolet, the primary seal will be through the use of the rubber seal and the back-up will be provided through the use of a split clamp sealing device.

5. During the NDE examination of the 28" x 4" weldolet pipe weld, the primary seal will be the rubber seal and the back-up will be the stuffing box-cap assembly.

6. After removal of the stuffing box-cap assembly, the primary seal will be provided by the freeze seal. The back-up will be the swing down taper plug clamped to the 4" pipe.

7. Pipe to elbow welding - the primary seal will be the freeze plug and the back-up seal will be a rubber lined split clamp.

NOTE: All primary and back-up methods of sealing have been tested on the hydraulic mock-up. In addition, every repair crew has been trained in applying these seals. Attached are sketches of concepts of the various sealing tools.

DRESDEN STATION

SAFETY EVALUATION FOR RECIRC LINE REPAIR

A. Evaluation of Postulated Plug Failures During Repair

The possibility for an accident or malfunction of a different type than any previously evaluated in the Final Safety Analysis Report is not created because a full range of coolant loss has been analyzed from a small rupture to the largest recirculation line break. System operation will in no way be modified by this repair.

The margin of safety, as defined in the basis for any Technical Specification, is not reduced because LPCI core spray and both emergency diesel generators will at all times during the repair be operable as defined by the Technical Specifications. In addition the primary system coolant and fuel will be at 100 to 120°F rather than at operating temperatures. Primary and secondary containment will be in effect. Due to the tested reliability of the primary plugging procedures, it is highly unlikely the repair will ever involve uncontrolled leakage through the four inch pipe. Considering this reliability and the capability of the backup plugging systems, any increase in the probability of a loss of coolant involving the opening of the four inch pipe for more than several minutes is extremely slight. Nevertheless, to show the absence of risk we have analyzed the condition which would occur in the unlikely event that both the primary and backup seals fail during the repair procedure. The reactor operator will initially attempt to maintain normal reactor water level using the condensate system. At normal water level the leakage from a 4" break has been calculated to be approximately 2500 gpm. In any event after a maximum of 40 minutes or when normal level can no longer be maintained, the operator will switch over to maintain water level with LPCI pump. One LPCI pump has the capacity of 5000 gpm at a discharge head of 125 psi. Considering the initial cool state of the core, one LPCI pump will maintain core coverage and allow the shutdown cooling or containment cooling system to remove decay heat satisfactorily. Operability of the LPCI pumps will be demonstrated prior to the commencement of the repair procedure. If, in spite of this testing, all of the LPCI pumps failed, any one of the core spray pumps would suffice. Onsite power supply system operability will also be demonstrated. The entire procedure is expected to require less than 2 days.

The repair crew would be initially allowed 15 min. in the drywell to attempt to establish a backup seal. After 15 min. they must report to station management or leave the drywell. At this point the station will evaluate the situation and if a program for stopping the leakage is not completed within 24 hours, begin the necessary preparations to remove reactor head and unload the core. Once this has been accomplished the reactor could be drained and the repair completed.

B. Radioactive Release to the Environment If Continual Leakage From the 4" Recirc Bypass Line Exists

If continual leakage from the recirc bypass line should occur, primary containment integrity would be maintained until the primary containment is opened to begin removing fuel. This would insure a more restrictive boundary for release to the reactor building and to the environment than that which exists during refueling outages, in which primary water is in direct contact with the reactor building atmosphere. Even after the head is removed experience has indicated that there is less than a 5% increase in reactor building airborne radioactivity during periods of refueling.

Since the primary water conditions will be similar under the circumstance of a leak as to those during a refueling outage (100-120°F, 106 pCi/l), it is expected that any increase drywell airborne activity will be minimal and thus much less than drywell airborne activities during power operation.

Drywell pressure will be maintained less than 1 psig by venting through the Standby Gas Treatment System as is normally performed. Therefore, release of airborne radioactivity during continual leakage conditions will be less than the safe release levels encountered during power operation.

C. Radiological Consequences of Plug Failure to Repair Crew

Assuming a failure of one of the plugs to hold, there is the possibility that one or more individuals in the drywell would be sprayed with reactor water. Possible consequences of this include increased external whole body dose, skin dose from gross contamination, and possible ingestion of reactor water. The following estimates have been made for such consequences assuming the present reactor water activity of approximately 5 x 106 pCi/l and an approximate isotopic composition as presented in Table 1.

1. Whole body external dose -

If a person's canvas clothing and body were completely soaked with reactor water, the estimated whole body gamma dose would be approximately 7 to 10 mRem/hr. Based on a maximum allowable time for leak repair of 15 min., this would be a minimal amount of exposure.

A more important concern is the release of any highly radioactive crud deposits in the reactor water. The probability of crud releases is negligible, however, since the leakage would be off of a verticle run of piping which normally is exposed to a large and fast water flow and also since the drainage would be from the upper water levels of the reactor vessel.

Due to the possibility of a crud release however, a radiation protectionman will be stationed at the work site and upon determination of high radiation levels will instruct all personnel to leave the area immediately.

2. Skin dose -

If a person's canvas clothing and body were completely soaked with reactor water, the estimated skin dose would be approximately 200 mRads/hr. Based on a maximum allowable time for leak repair of 15 min., and a time of approximately 45 min. for removal of clothing and reduction of a major share of bodily contamination, this would give a maximum skin dose of approximately 200 mrem which is well below the AEC quarterly allowed dose of 30,000 mrem.

3. Ingestion - Internal expose -

Based on the reactor water isotopic and dose conversion factors from ICRP Publication No. 10, it was calculated that for each milliliter of reactor water ingested, the total whole body dose would be 0.09 mrem and the total thyroid dose would be 0.3 mrem. Thus, if up to 100 milliliters of reactor water were ingested, the total whole body dose from internal contamination would only be 9 mrem and the total thyroid dose 30 mrem.

All of the above calculations assumed that the individual was unprotected. However, all work performed in the area of a plug will be done in full rubber gear with plastic hood supplied air respiratory equipment and thus all dose rates and doses mentioned above should be conservative.

TABLE 1-1

Rx H_2O ISOTOPIC

Radionuclide	uCi/ml
Co58	0.4×10^{-3}
Co60	1.6×10^{-3}
Cs134	0.8×10^{-5}
Cs137	1.8×10^{-5}
Cr51	9.8×10^{-5}
Tc99m	8.4×10^{-5}
I 131	1.6×10^{-4}
Np 239	0.4×10^{-3}
Sr 89	2.0×10^{-5}
Sr 90	0.7×10^{-5}

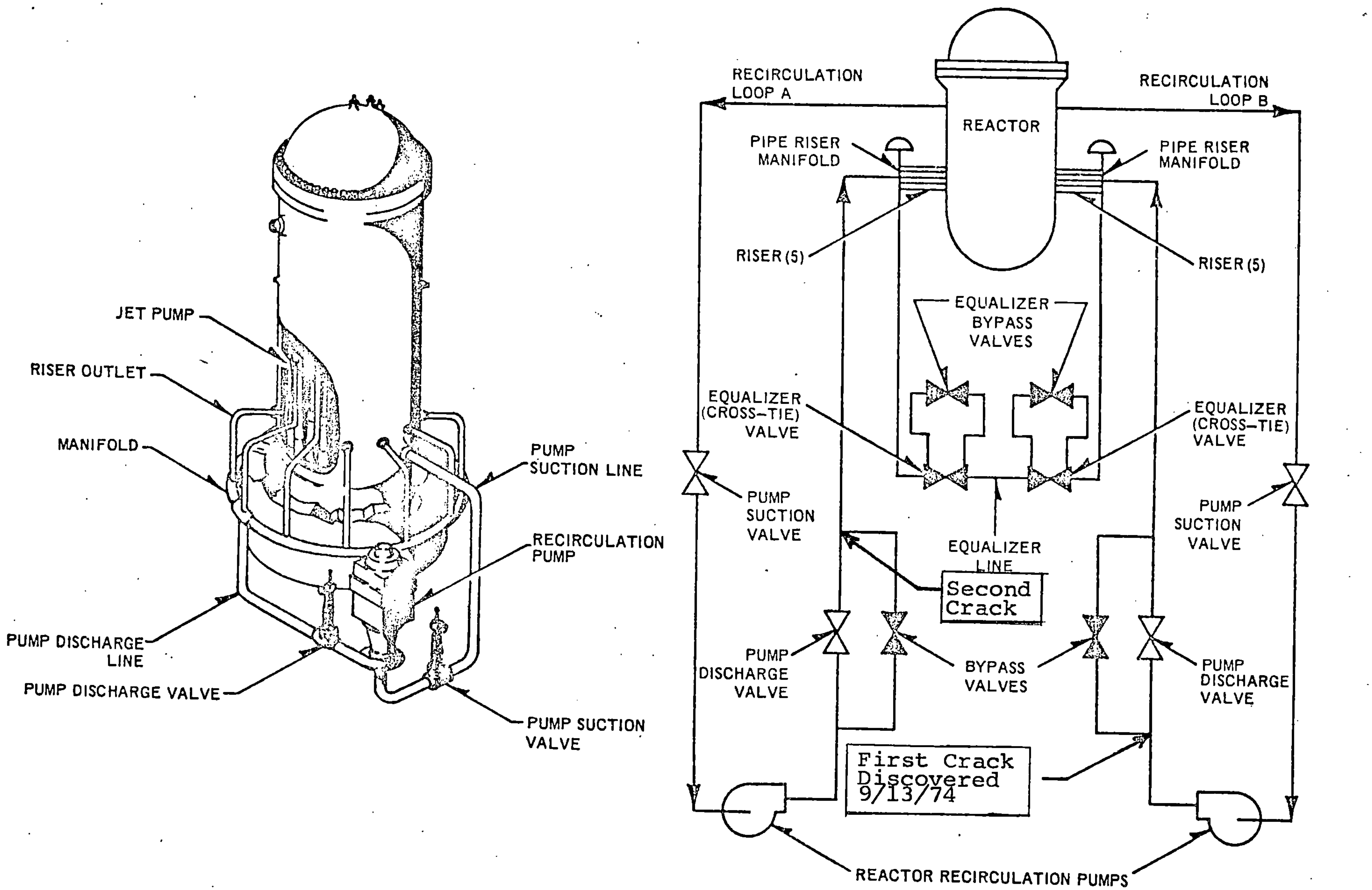

JET PUMP
RISER OUTLET
MANIFOLD
PUMP SUCTION LINE
RECIRCULATION PUMP
PUMP DISCHARGE LINE
PUMP DISCHARGE VALVE
PUMP SUCTION VALVE
RECIRCULATION LOOP A
REACTOR
RECIRCULATION LOOP B
PIPE RISER MANIFOLD
PIPE RISER MANIFOLD
RISER (5)
RISER (5)
EQUALIZER BYPASS VALVES
EQUALIZER (CROSS-TIE) VALVE
EQUALIZER (CROSS-TIE) VALVE
PUMP SUCTION VALVE
PUMP SUCTION VALVE
EQUALIZER LINE
Second Crack
PUMP DISCHARGE VALVE
BYPASS VALVES
PUMP DISCHARGE VALVE
First Crack Discovered 9/13/74
REACTOR RECIRCULATION PUMPS

FIGURE 1

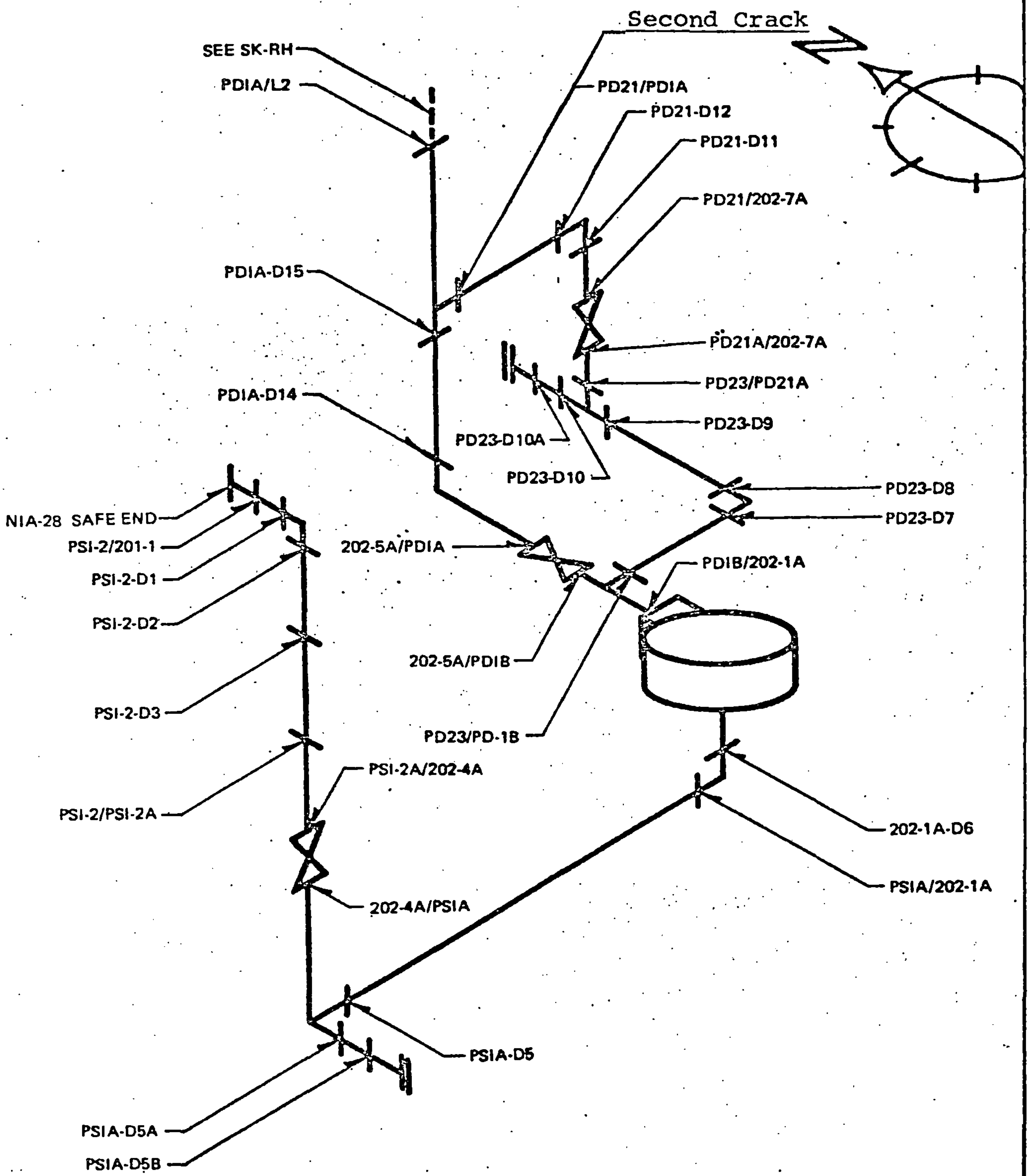


FIGURE 2

SKETCH RLA

Recirculation Loop A

Reference: UEC Job No. 928F.00

Isometrics Figure 3-1 Sheet (e)

DESCRIPTION OF REPAIR PROCEDURE

REPAIR SEQUENCE

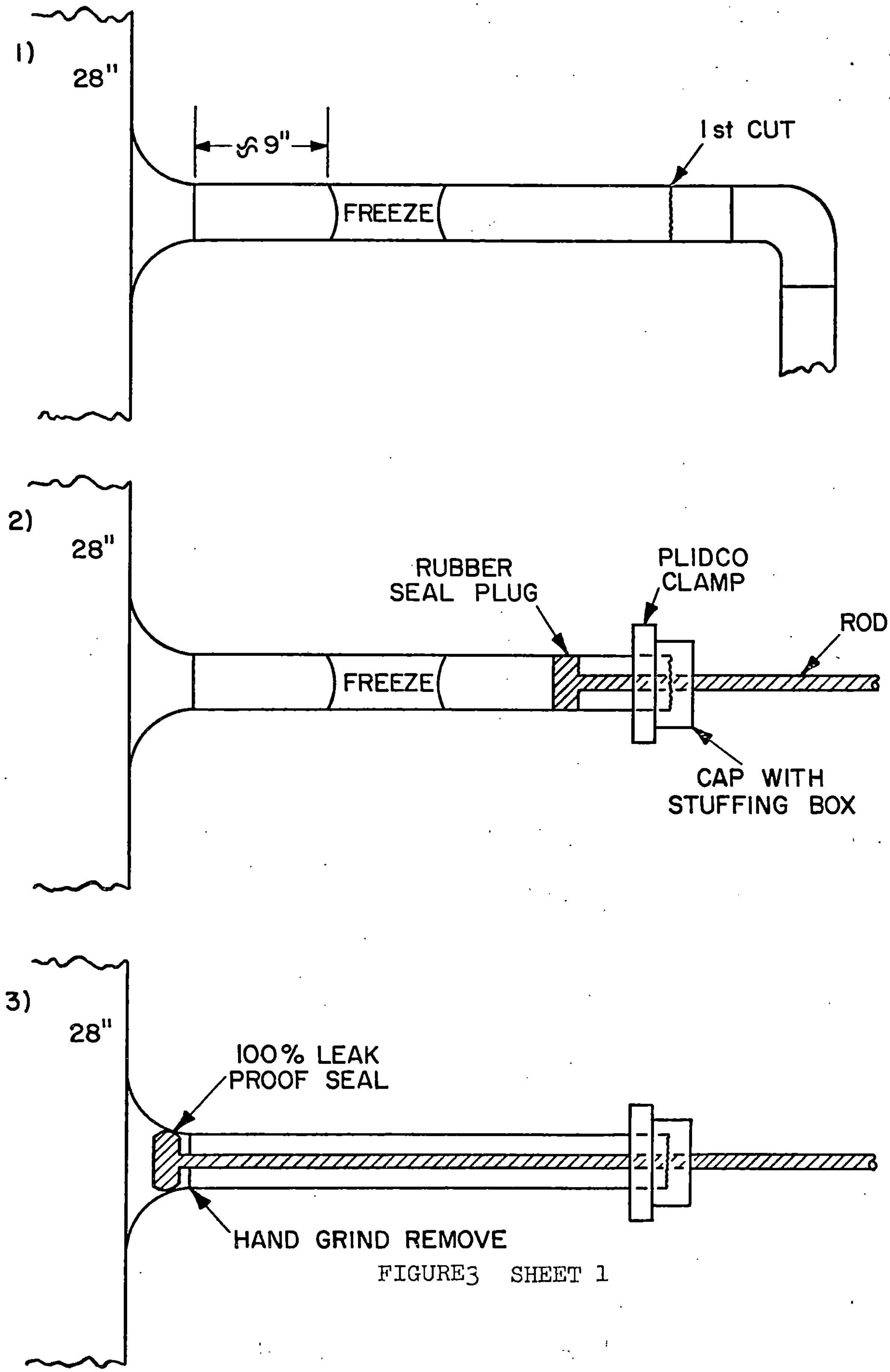


FIGURE3 SHEET 1

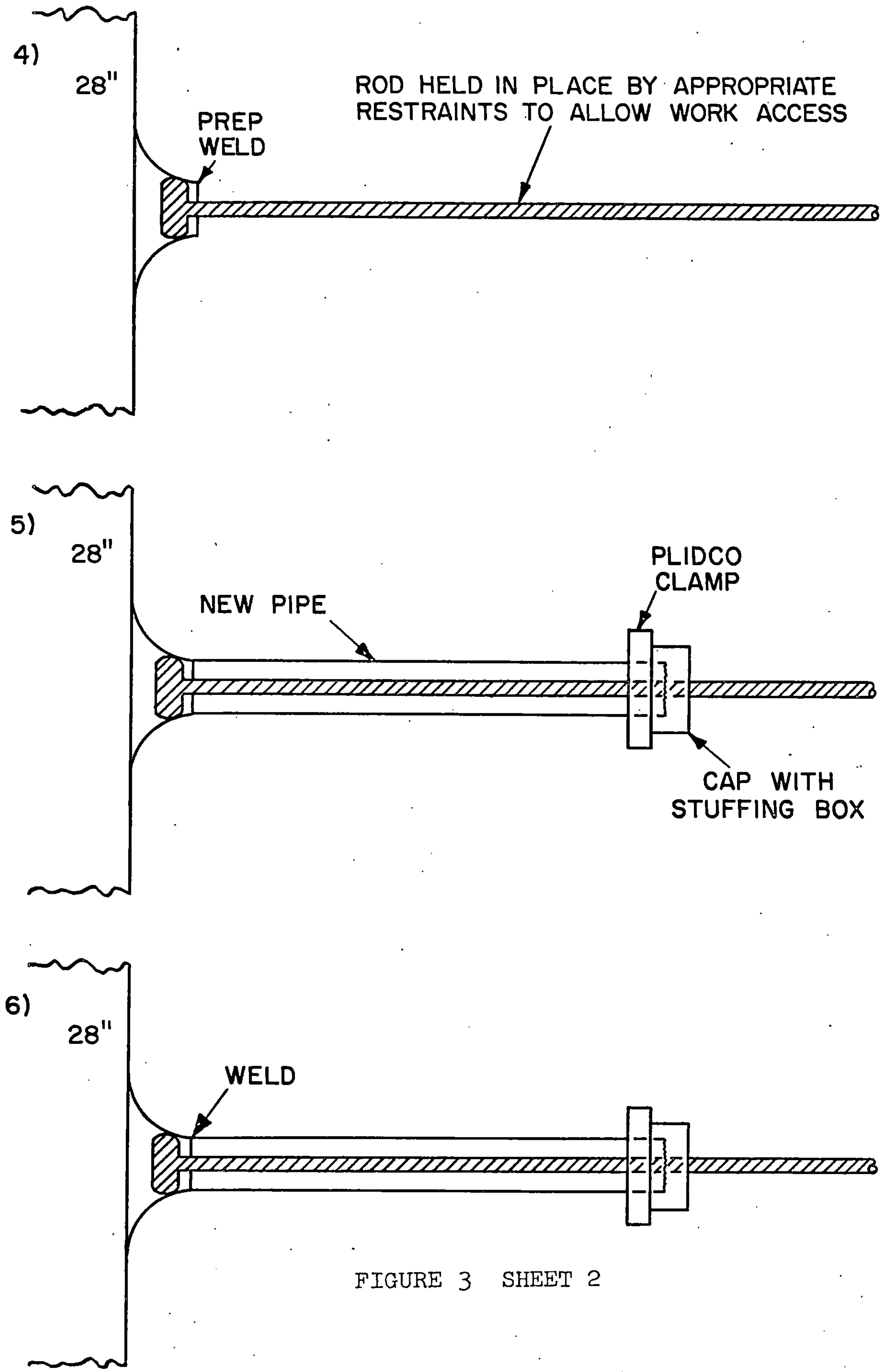


FIGURE 3 SHEET 2

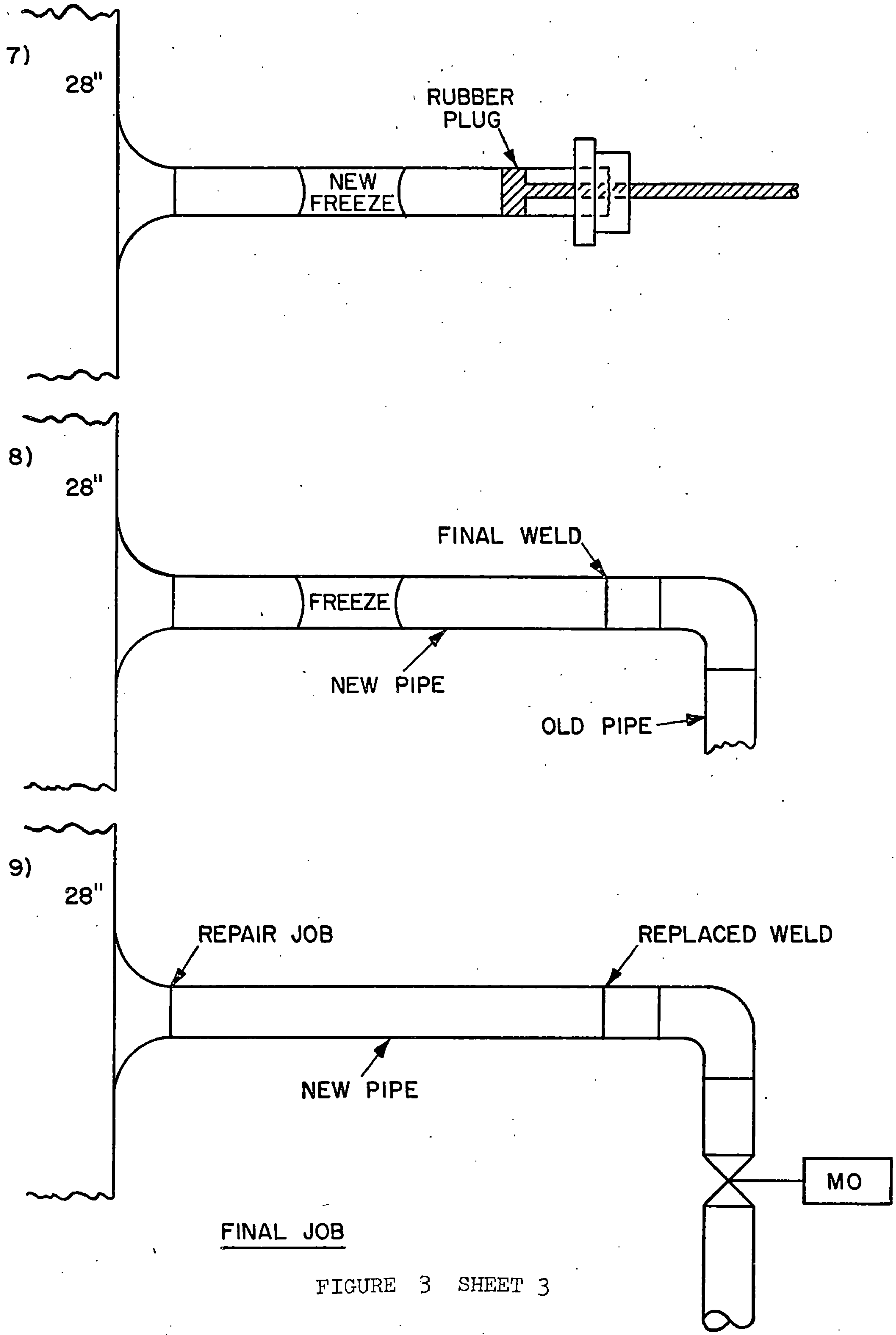


FIGURE 3 SHEET 3

BACK UP SEAL # 1

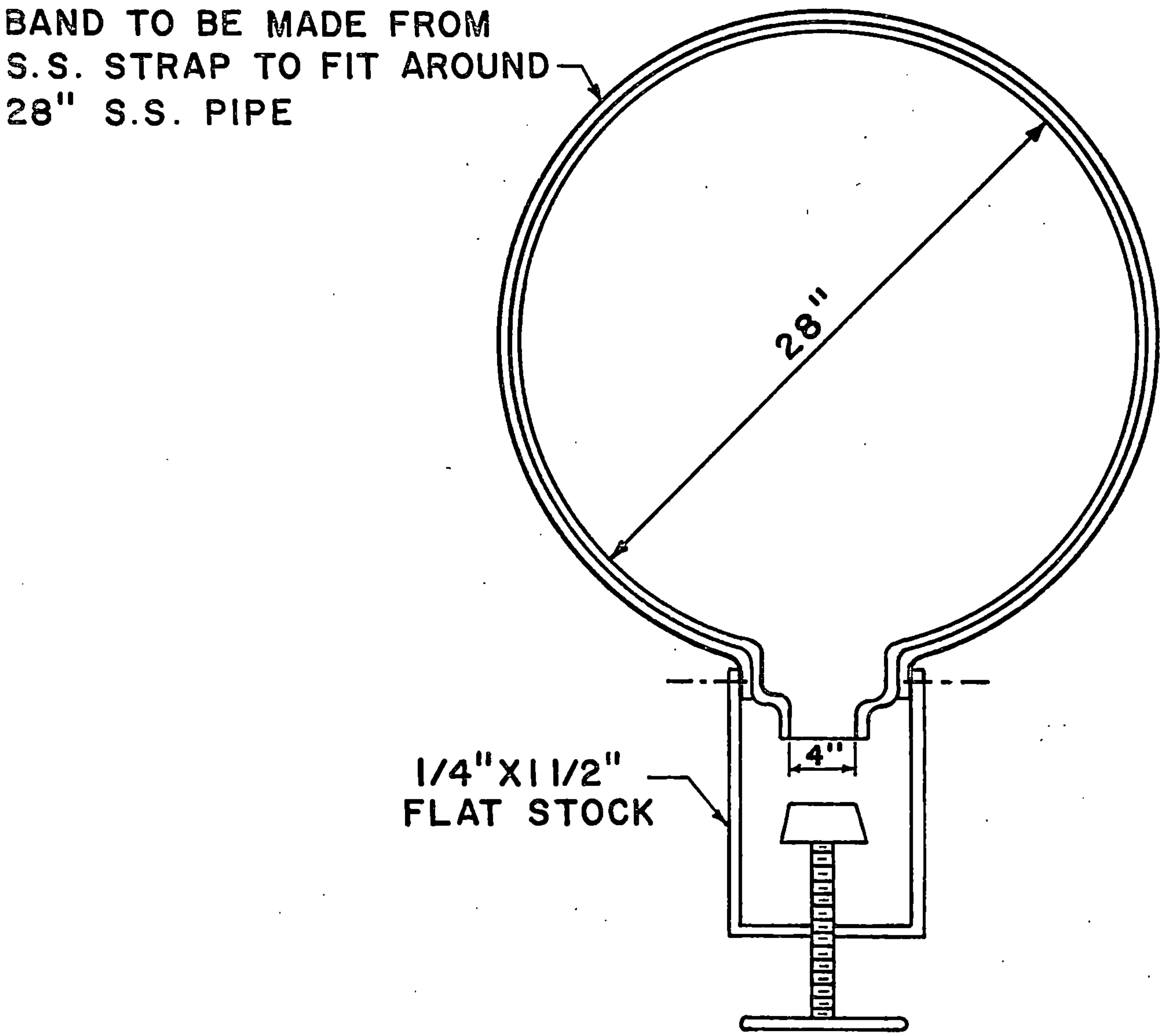
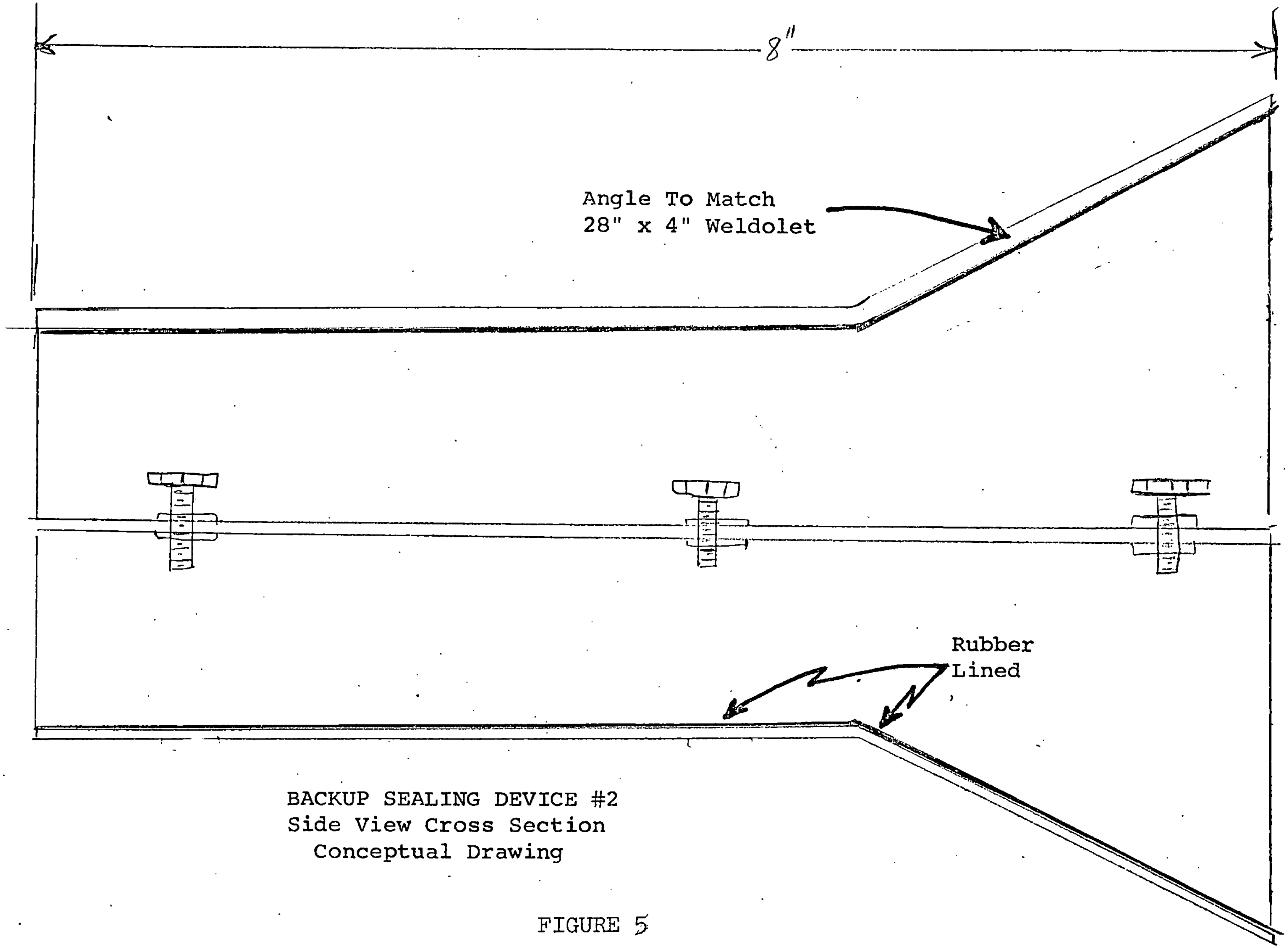
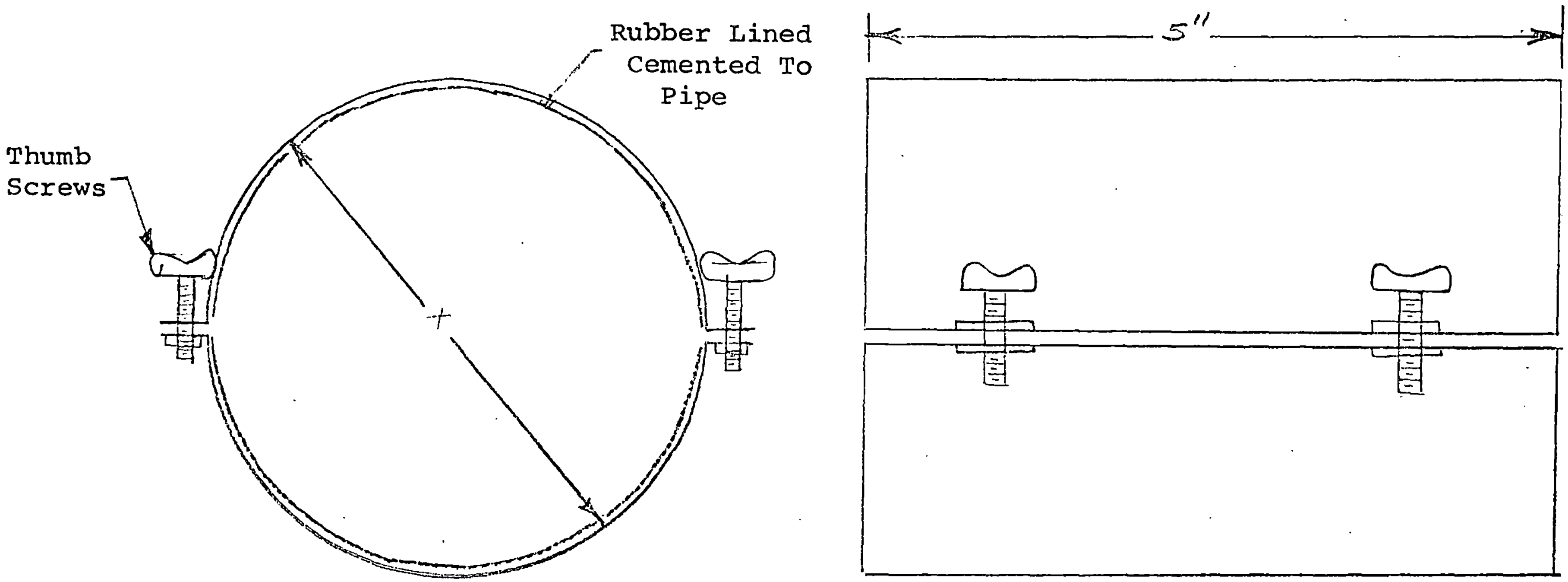


FIGURE 4



BACKUP SEALING DEVICE #2
Side View Cross Section
Conceptual Drawing

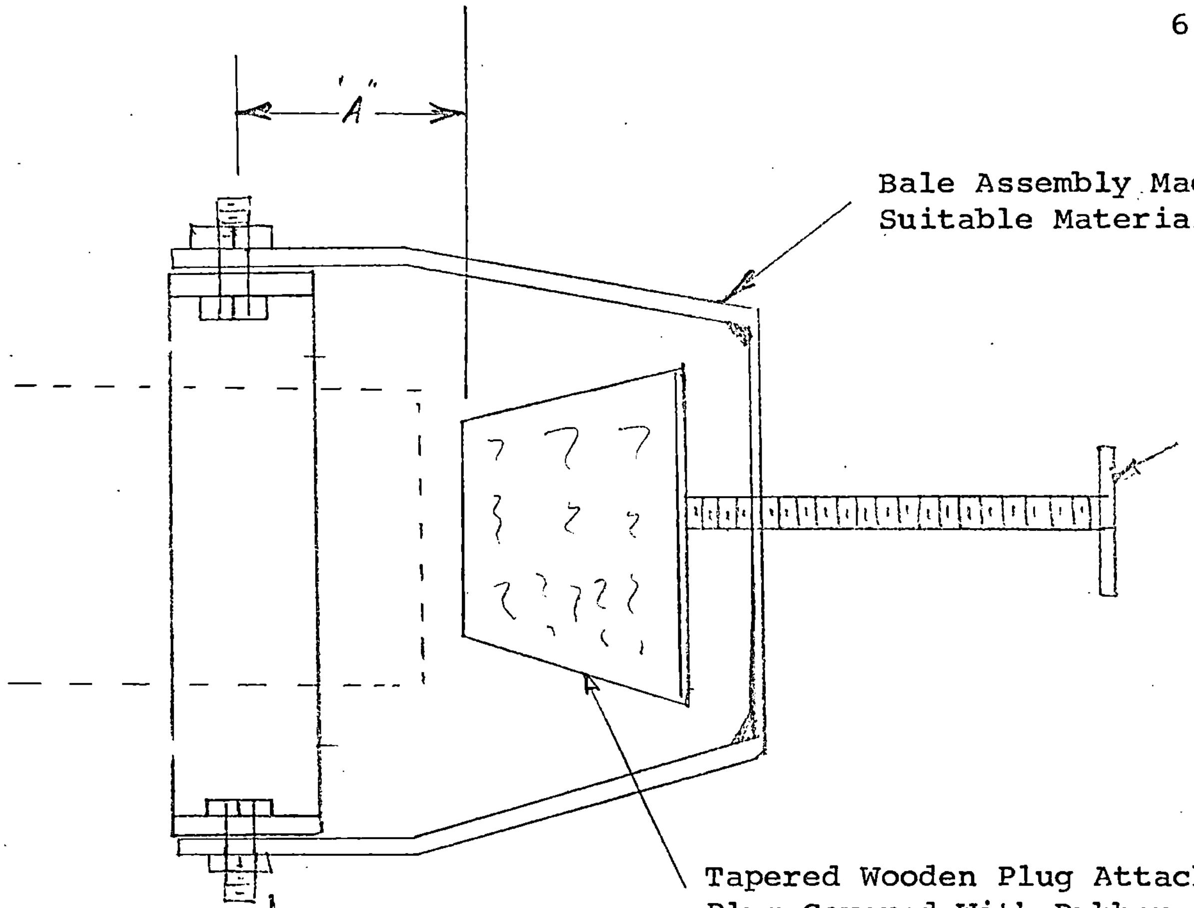
FIGURE 5



'X' - Diameter Such That When Lined With Rubber Will Fit Over Schedule 80, 4" Pipe And With Clearance So It Can Be Tightened To Seal A Leak In The Pipe.

BACKUP SEALING DEVICE #3
CONCEPTUAL DRAWING

FIGURE 6



BACKUP SEALING DEVICE #4

CONCEPTUAL DRAWING
FIGURE 7

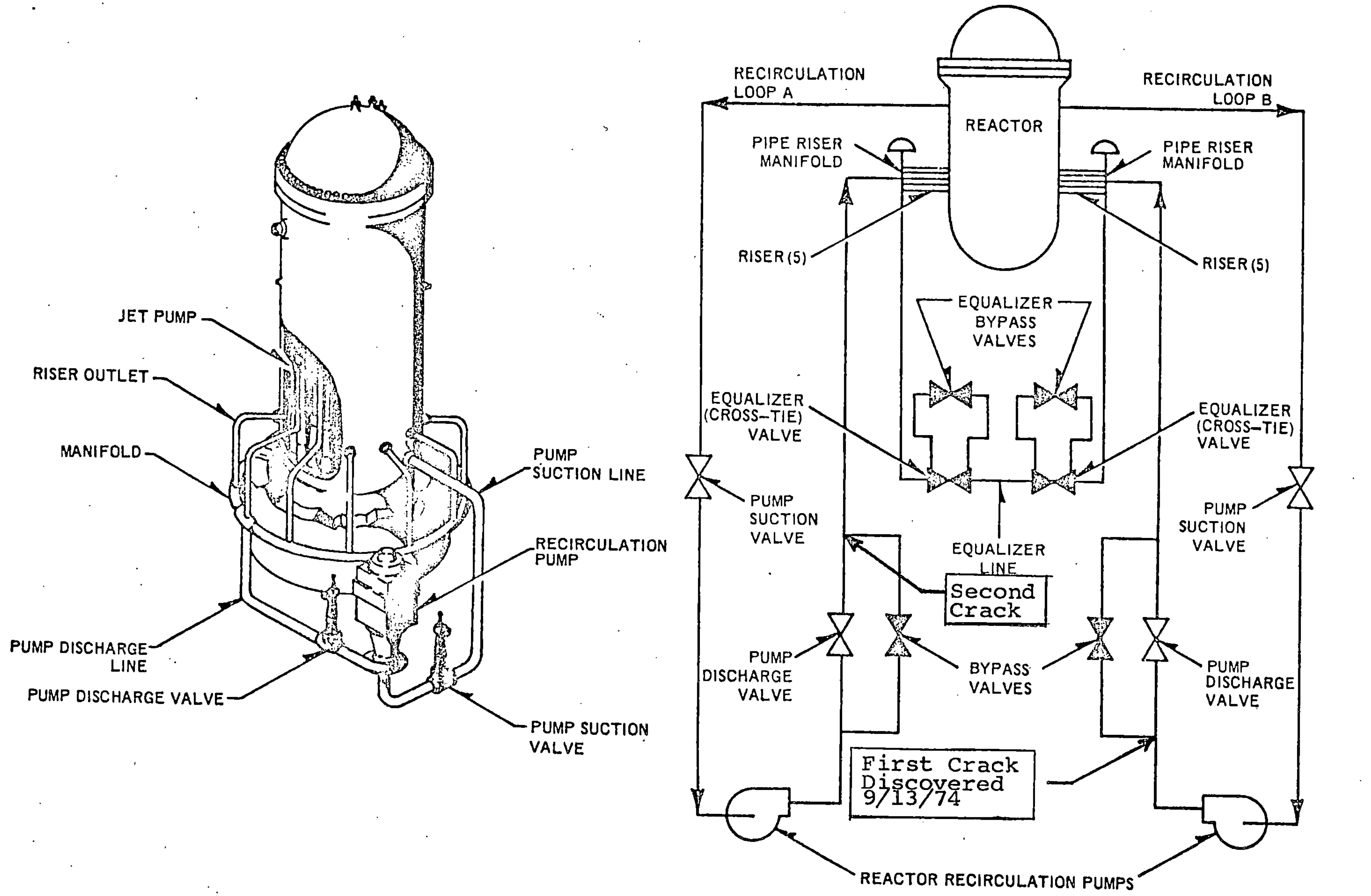

JET PUMP
RISER OUTLET
MANIFOLD
PUMP DISCHARGE LINE
PUMP DISCHARGE VALVE
PUMP SUCTION LINE
RECIRCULATION PUMP
PUMP SUCTION VALVE
RECIRCULATION LOOP A
RECIRCULATION LOOP B
REACTOR
PIPE RISER MANIFOLD
PIPE RISER MANIFOLD
RISER (5)
RISER (5)
EQUALIZER BYPASS VALVES
EQUALIZER (CROSS-TIE) VALVE
EQUALIZER (CROSS-TIE) VALVE
PUMP SUCTION VALVE
PUMP SUCTION VALVE
EQUALIZER LINE
Second Crack
PUMP DISCHARGE VALVE
BYPASS VALVES
PUMP DISCHARGE VALVE
First Crack Discovered 9/13/74
REACTOR RECIRCULATION PUMPS

FIGURE 1

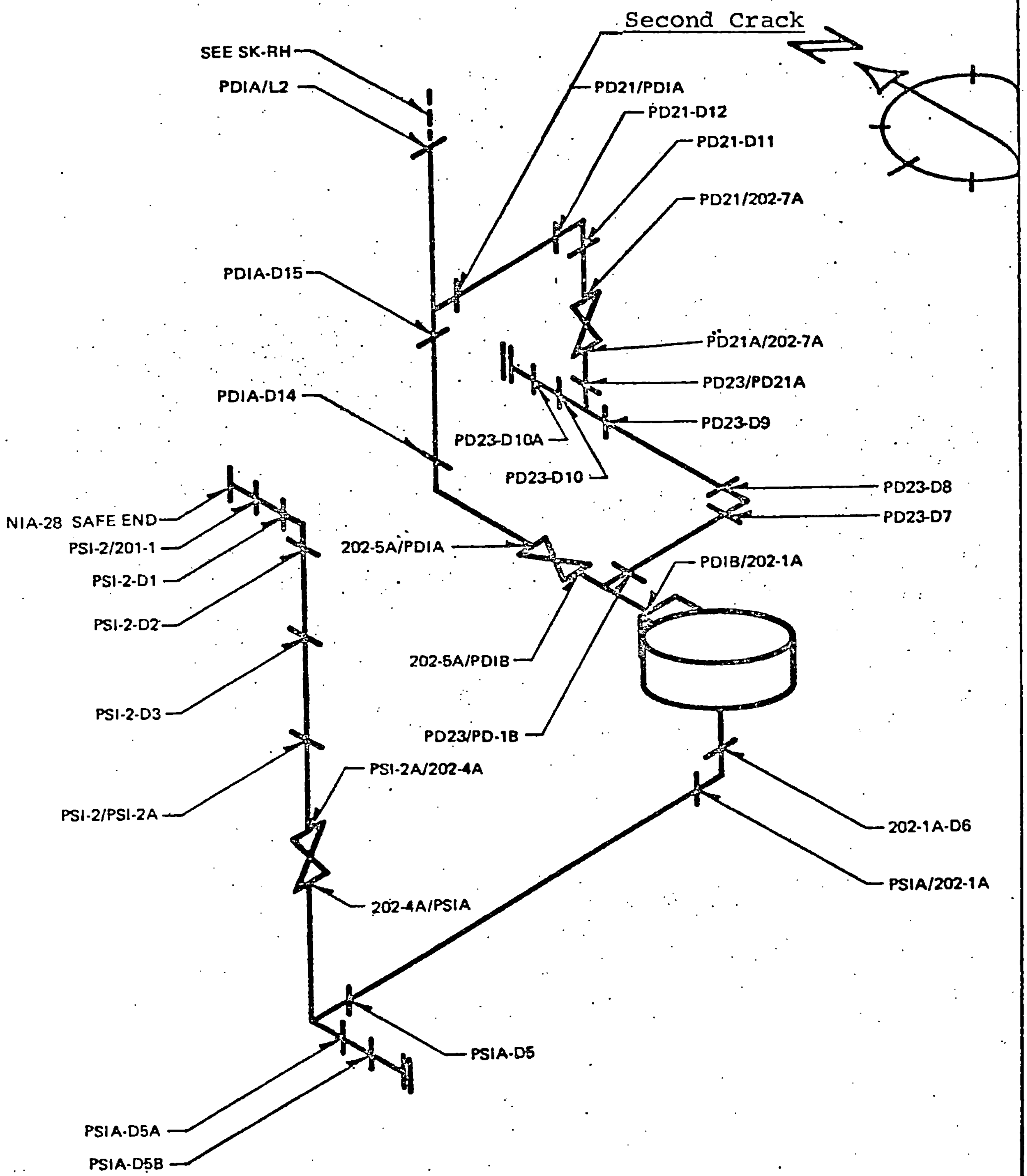


FIGURE 2

SKETCH RLA

Recirculation Loop A

Reference: UEC Job No. 928F.00

Isometrics Figure 3-1 Sheet (e)

DESCRIPTION OF REPAIR PROCEDURE

REPAIR SEQUENCE

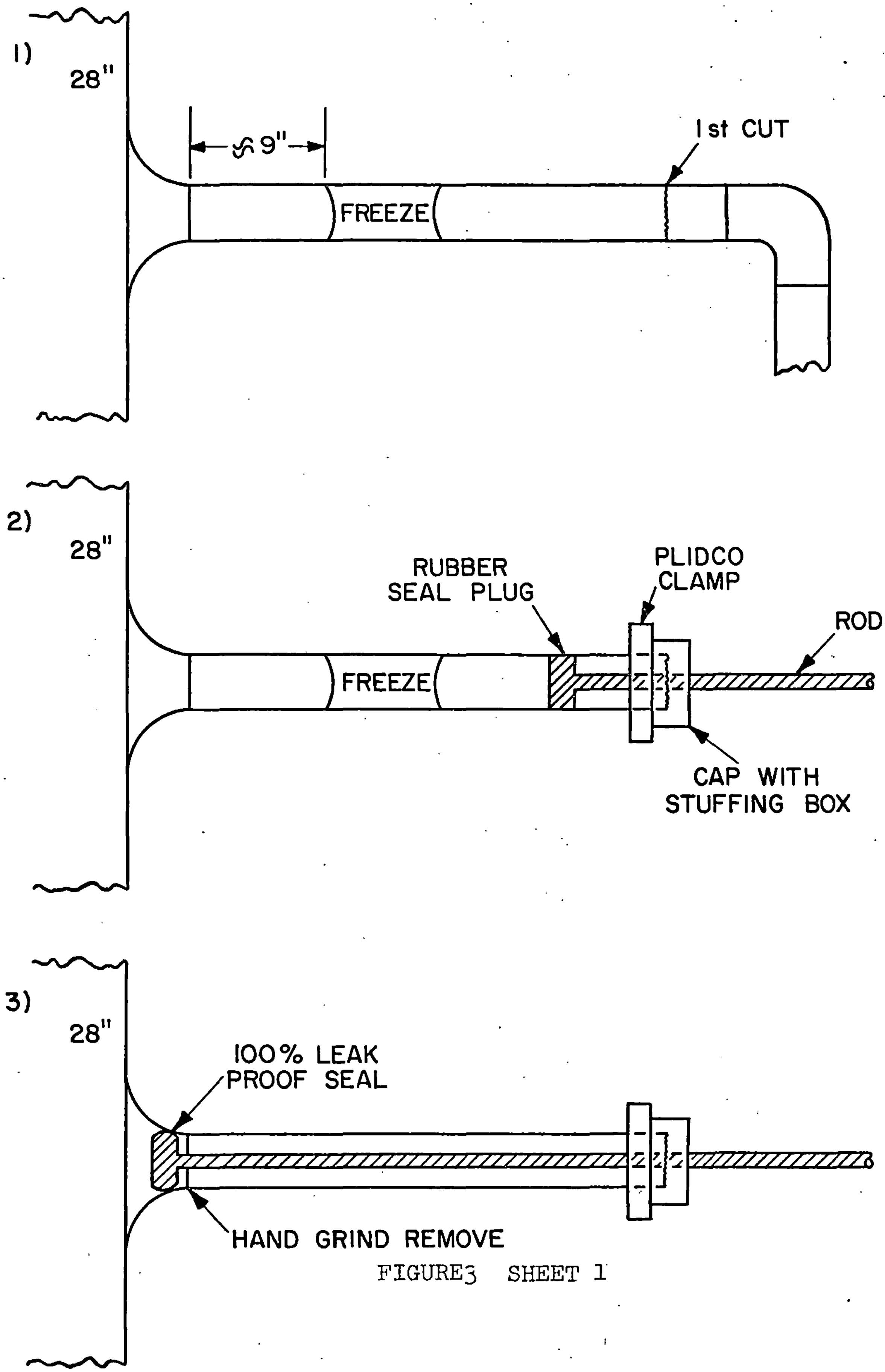


FIGURE3 SHEET 1

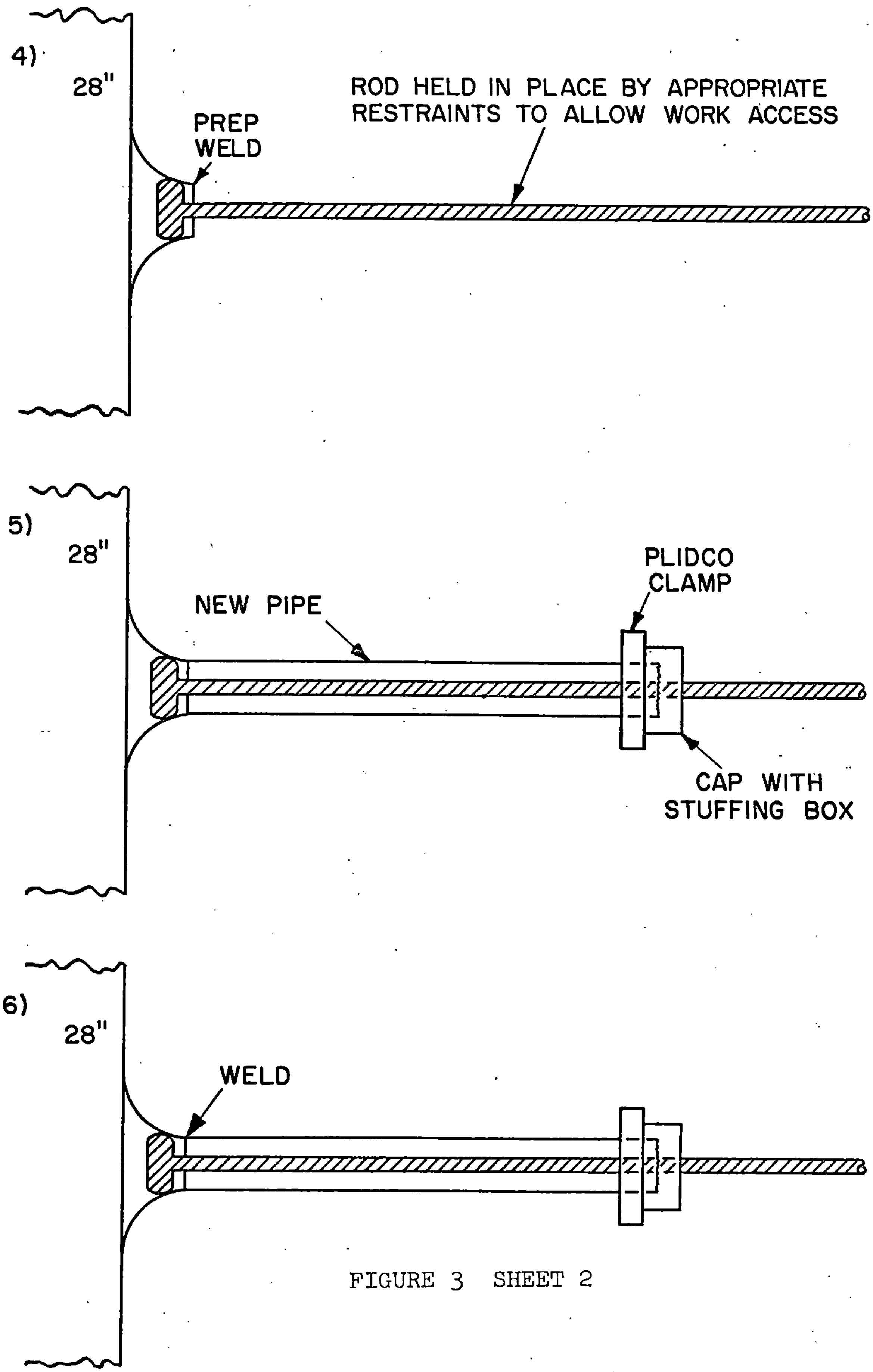


FIGURE 3 SHEET 2

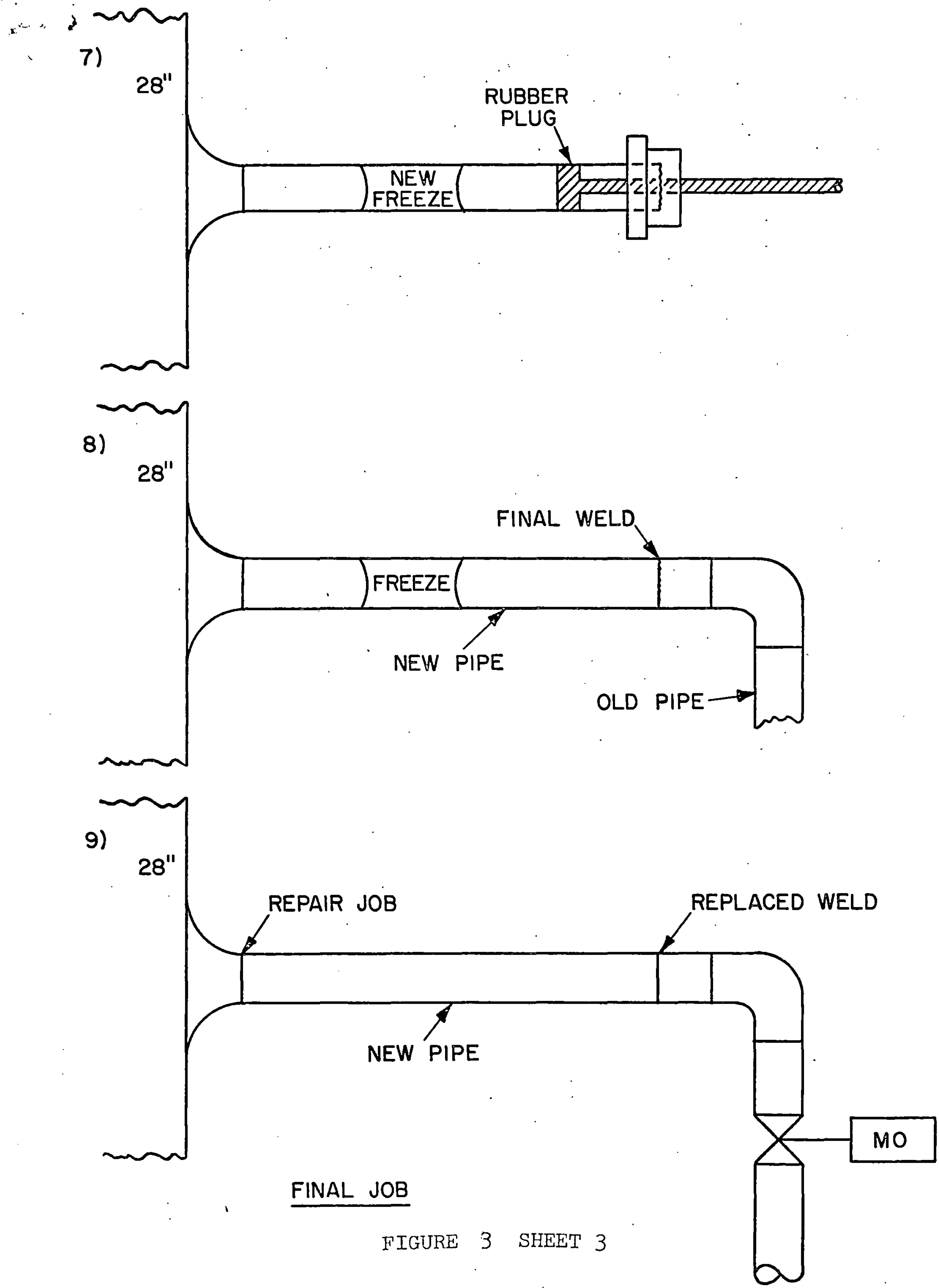


FIGURE 3 SHEET 3

BACK UP SEAL # 1

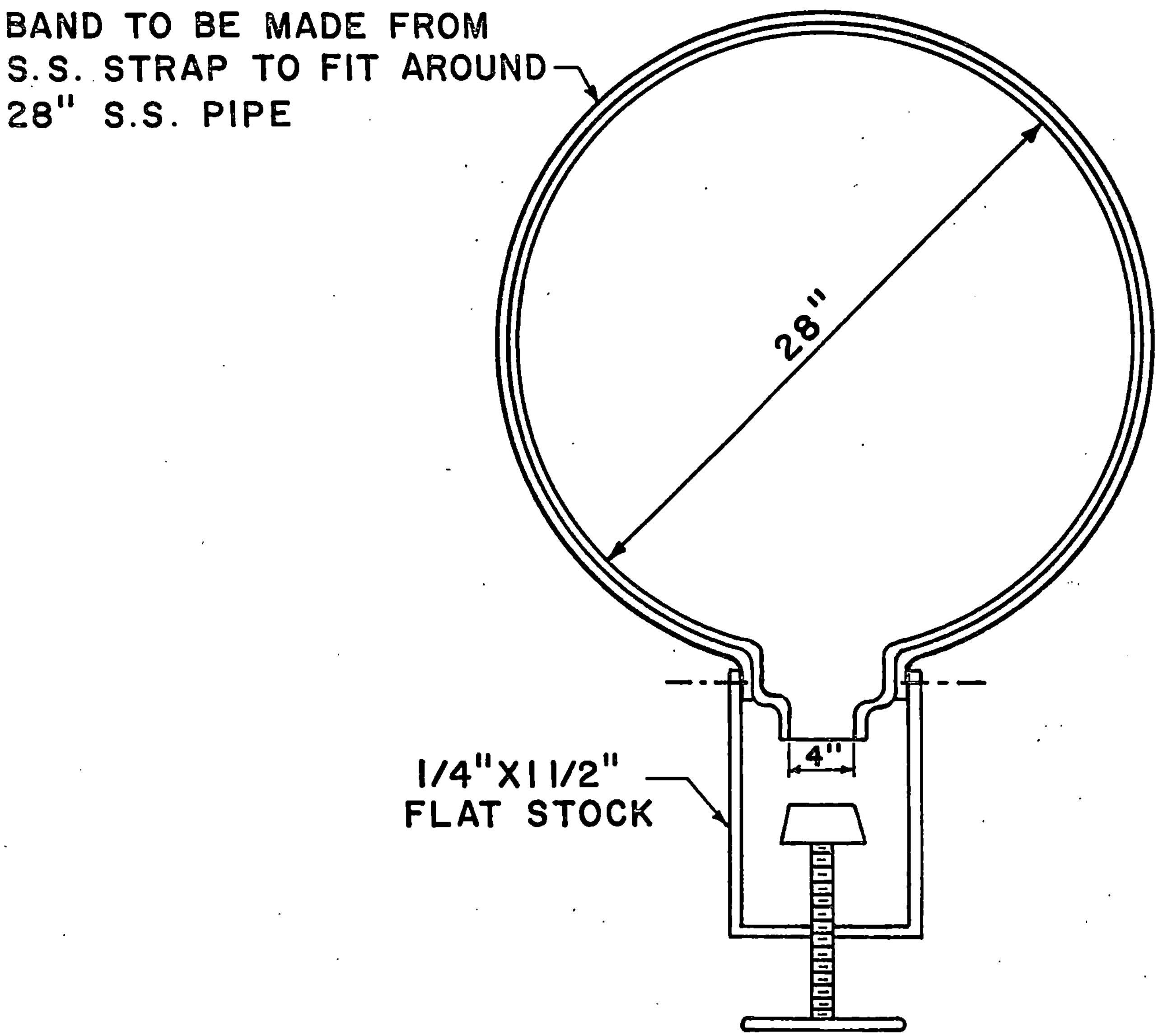
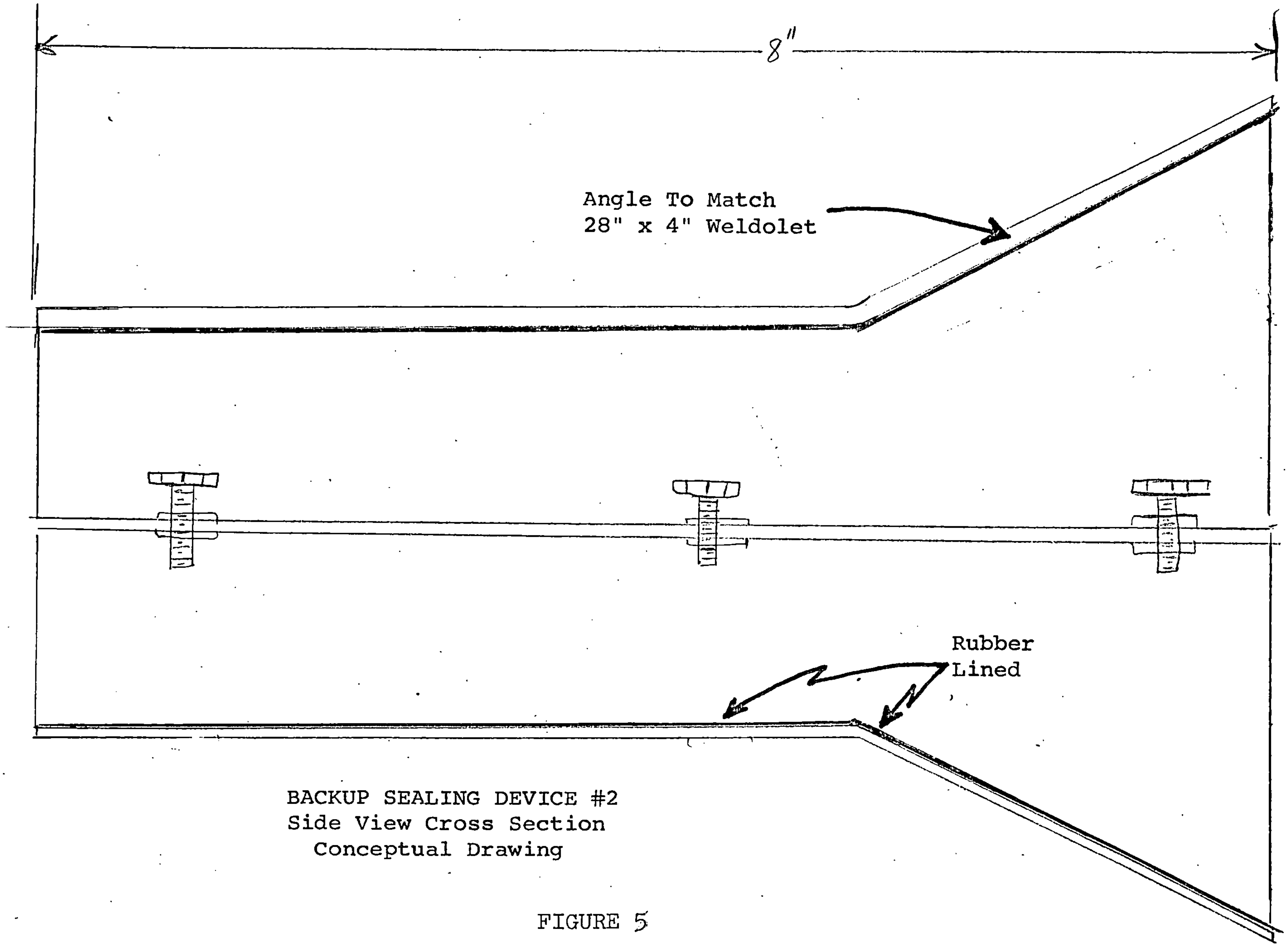
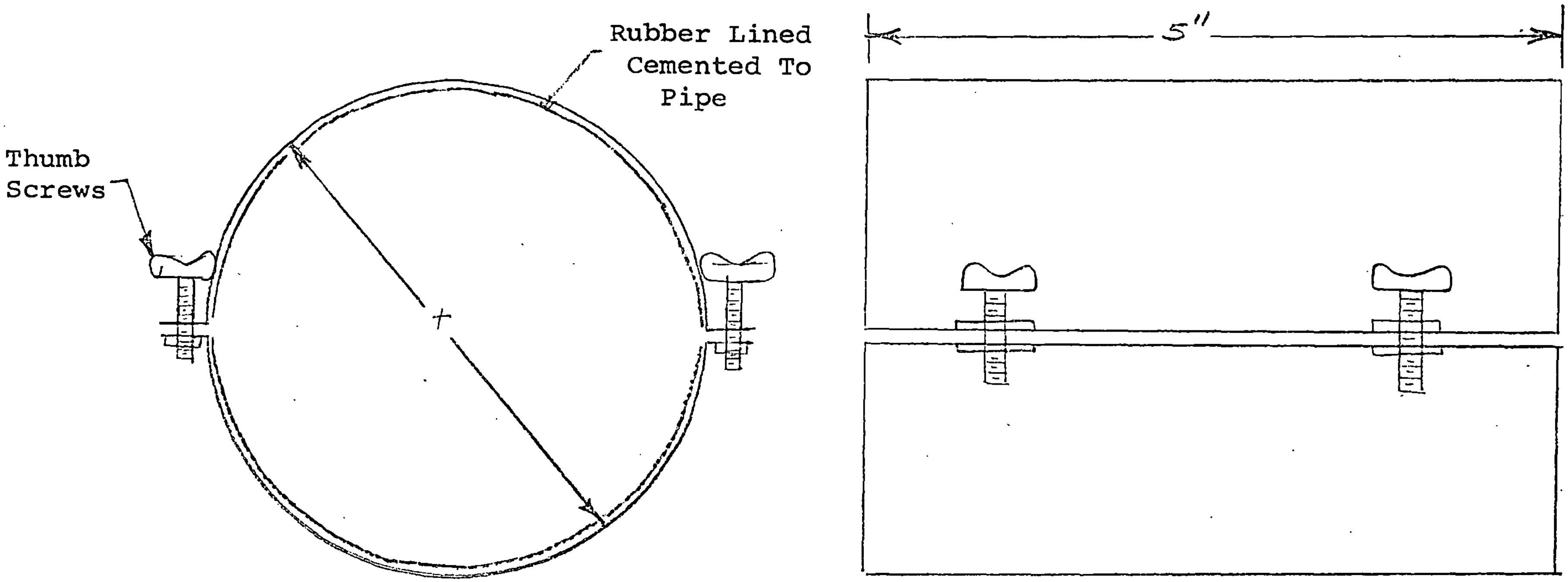


FIGURE 4



BACKUP SEALING DEVICE #2
Side View Cross Section
Conceptual Drawing

FIGURE 5

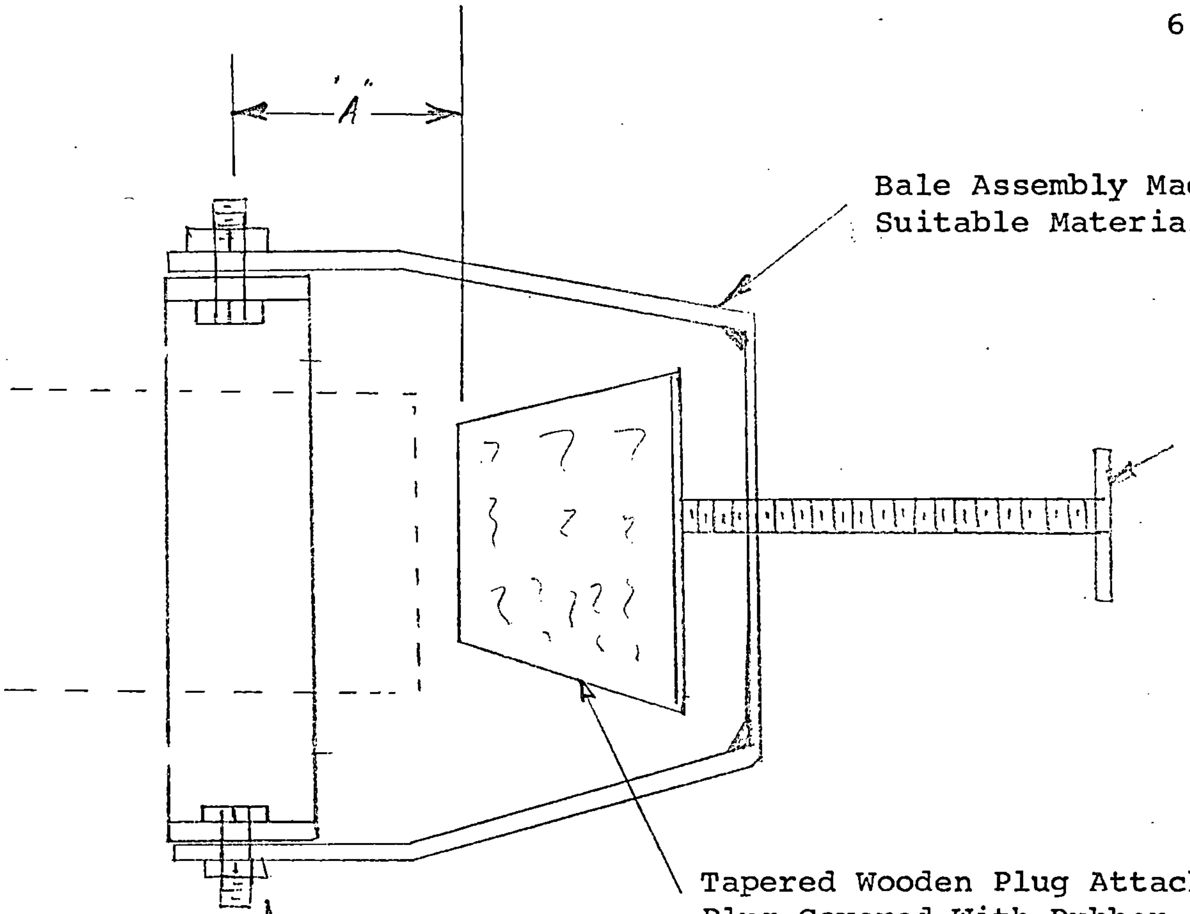


'X' - Diameter Such That When Lined With Rubber Will Fit Over Schedule 80, 4" Pipe And With Clearance So It Can Be Tightened To Seal A Leak In The Pipe.

BACKUP SEALING DEVICE #3
CONCEPTUAL DRAWING

FIGURE 6

'A' - Distance From Center of Bracket
To End Of Plug To Be Approximately
6".



Bale Assembly Made From 1" x 1/4" Stock or
Suitable Material.

Small Handwheel

Tapered Wooden Plug Attached To Metal Plate
Plug Covered With Rubber And Cemented On.
Taper Such That Covered Plug Will Fit Into
4" Schedule 80 Pipe.

Bale Assembly
To Be Hinged On Each
Side On Bolts Such That
The Plug-Bale Assembly
Will Swing Down Into
Position If Needed.

BACKUP SEALING DEVICE #4

CONCEPTUAL DRAWING
FIGURE 7