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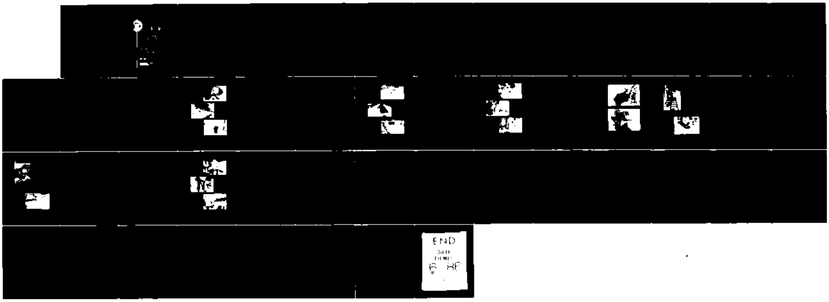

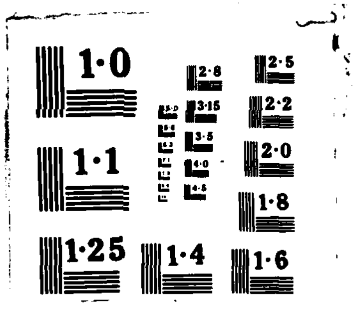
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This report describes the repairs to the Z-loop in Slip #2 at the Norfolk Deperming Facility, Naval Station, Norfolk, Virginia. The repair design and installation were the responsibility of the Ocean Engineering & Construction Project Office of the Chesapeake Division, Naval Facilities Engineering (Con't)

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NORFOLK Z-LOOP REPAIR
PROJECT COMPLETION REPORT

FPO-1-83(27)
AUGUST 1983

PREPARED BY

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FAIRFAX, VIRGINIA

FOR

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D. C. 20374

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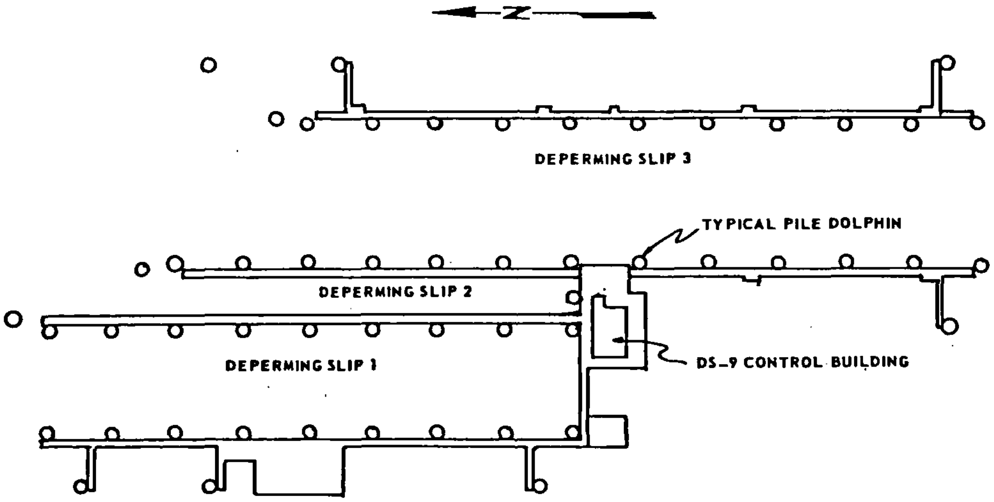
1.0 EXECUTIVE SUMMARY

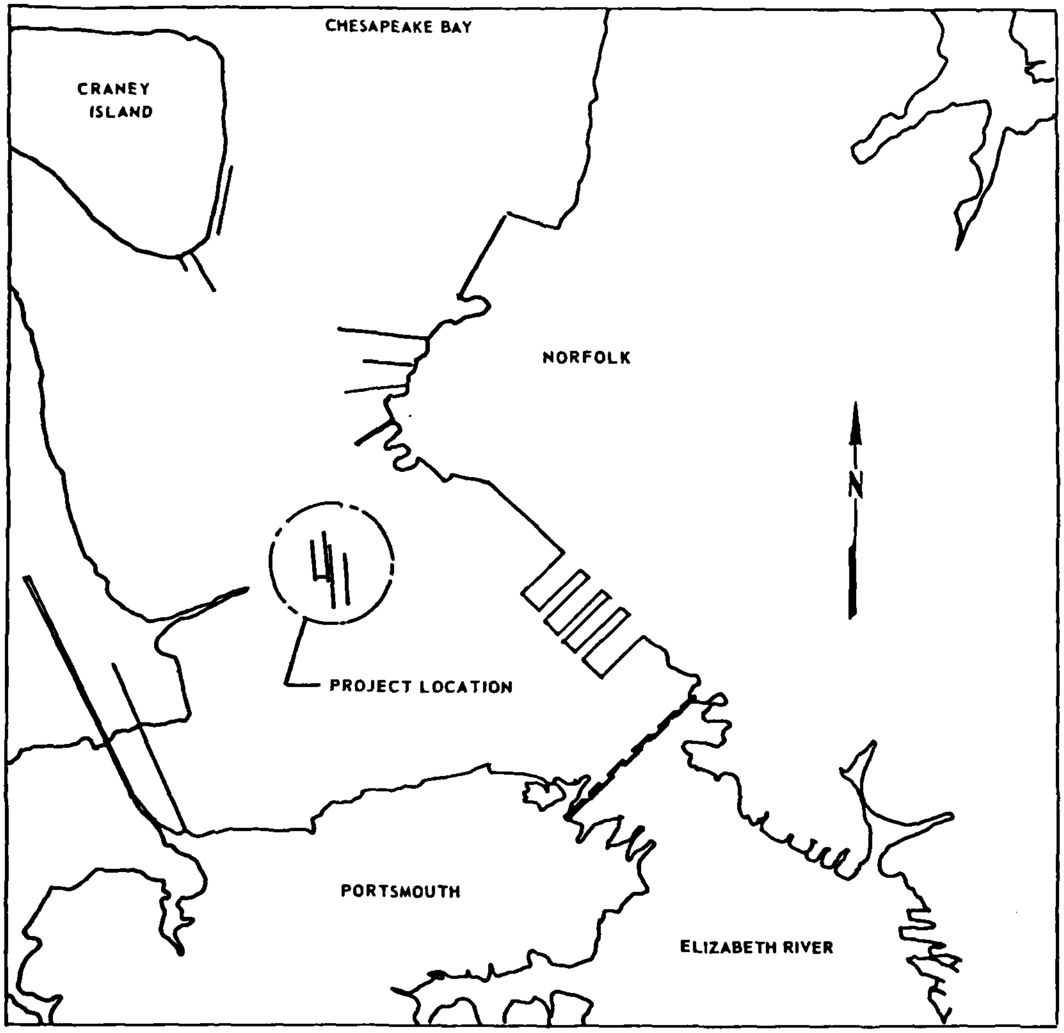
This report describes the repairs to the Z-loop in Slip #2 at the Norfolk Deperming Facility, Naval Station, Norfolk, Virginia. The repair design and installation were the responsibility of the Ocean Engineering and Construction Project Office of the Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM). The repairs were carried out by personnel of Underwater Construction Team One (UCT-ONE).

The Deperming Facility is a free-standing complex of timber piers arranged to form three slips, Figure 1-1. Its purpose is to impress magnetic fields on surface vessels and submarines in order to relieve any residual permanent magnetic field retained by the ship after initial construction, overhaul periods, and deployment periods. The facility is located in the Elizabeth River off Lamberts Point, south of the Norfolk Naval Station, Figure 1-2. The submarine deperming slip, Slip #2, is surrounded by a coil of heavy electrical cable, the Z-loop, oriented to apply a vertical magnetic field to a submarine in the slip. The coil consists of two sections: one group of 10 cables mounted under the deck of a pile-supported catwalk along each side of the slip, and a similar group installed in wooden troughs along the bottom of the slip. Nine of the twenty individual cables



DEPERMING STATION, NORFOLK, VIRGINIA

FIGURE 1-1



VICINITY MAP

FIGURE 1-2

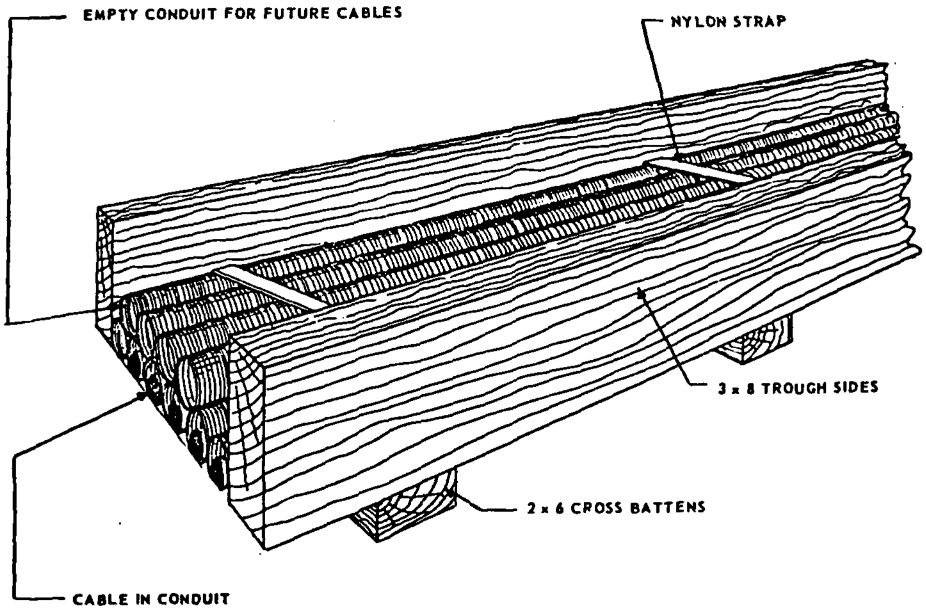
making up this lower group along the bottom of the slip were functionally unsatisfactory because of low insulation resistance; therefore, replacement of these nine cables was required.

Because of silting and marine growth on the existing cables, the failed cable sections could not be removed without damaging the cables that remained in working order. It was therefore decided that a new trough would be built and installed adjacent to the existing trough to hold the replacement cables. Consideration was also given to future cable replacement; a series of plastic conduits were installed in the new trough, through which additional cables could be pulled at some future date without extensive use of divers.

Underwater Construction Team One began operations by outfitting a barge as a work platform to support the necessary diving and construction operations. The barge was moved to the deperming facility and on-site work began on 10 September 1982. Approximately a quarter of the cable area was silt-covered to a depth of up to ten feet. Before the cable support trough could be installed, it was necessary to remove this silt by water-jetting.

The trough sections, which fitted between bents on the piers, were fabricated on site, because variations in the bent spacing dimensions precluded prefabrication. A total of sixty 20-foot sections were built and installed. The MK 12 diving gear was used for this phase. The nine conduit-enclosed cable sections, each 750 feet long, were pulled into place under the pier by SCUBA divers, lowered into the trough and secured. The eleven empty conduits for future cable were installed in the same manner, Figure 1-3.

The on-site phase of the project was completed on 12 November 1982. A log of construction activities to this point is given in Appendix A.



TYPICAL CONDUIT TROUGH

FIGURE 1-3

2.0 BACKGROUND

The process of deperming submarines requires subjecting the ship to a vertical magnetic field. The field is generated by a so-called Z-loop, a coil of wire wound in a horizontal plane surrounding the ship. At the Lamberts Point Deperming Facility, the Z-loop consists of two sections, one located under the decks of the catwalks forming the sides of the deperming slip and another directly under the first at a depth of about 28-feet below the mean low waterline, Figure 2-1. Each section of the coil consists of 10 turns of 1000 MCM copper cable, connected so as to form an effective five turn coil. Several of the lengths of wire making up the lower coil had been found to exhibit unacceptably low insulation resistance, and a repair project was initiated to replace these faulty turns.

Earlier, a private firm contracted to perform the Z-loop repairs; this contract was not completed because the faulty cables and the remaining functional cables were found to be heavily overgrown with oysters and partially buried in mud. The contract had originally contemplated removal of the faulty cables and their replacement, but on further consideration it was felt that the faulty cables could not be removed without damage to the good cables, and therefore the contract was terminated at this point.

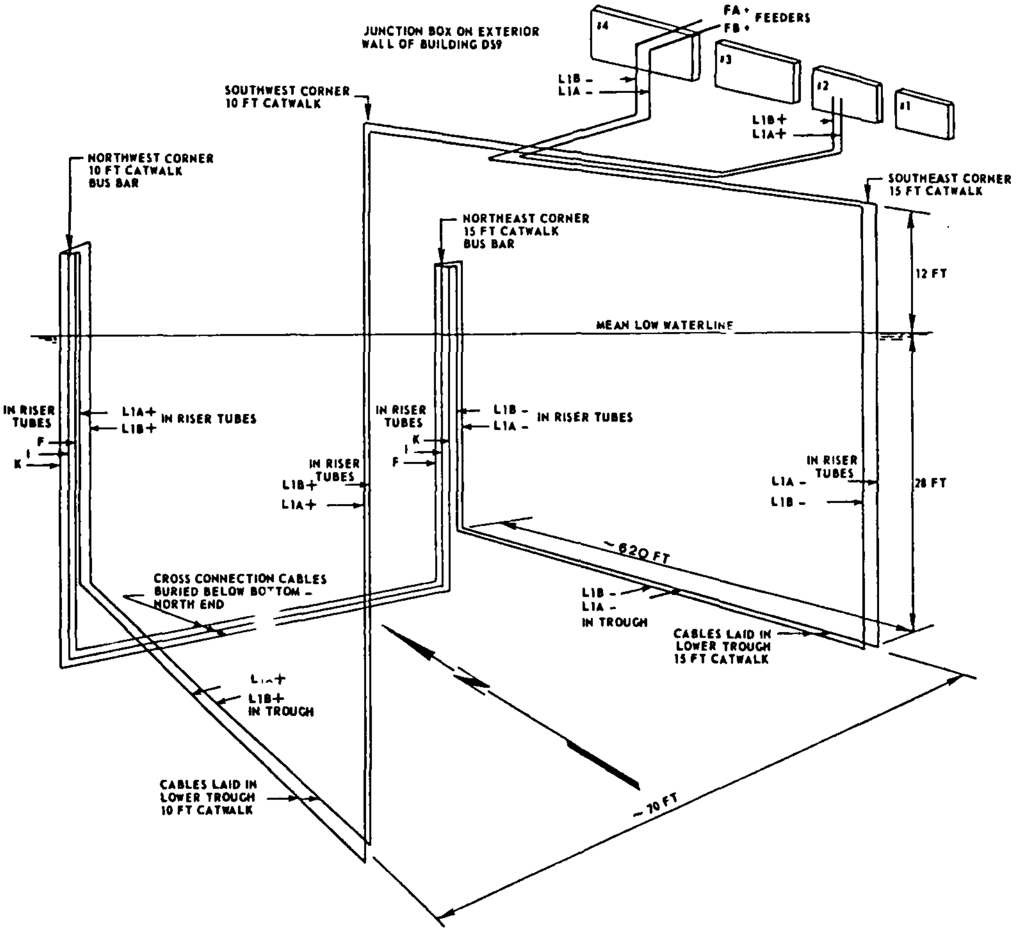
SITE LOCATION

The Lamberts Point Deperming Facility is located in the Elizabeth River south of the Norfolk Naval Station. The facility consists of several free-standing piers forming three deperming slips as illustrated in Figure 1-1. Access to the facility is entirely by watercraft.

TASKING

In November of 1981, the Atlantic Division, Naval Facilities Engineering Command tasked the Ocean Engineering and Construction Project Office (FPO-1) of CHESNAVFACENGCOM to investigate concepts for repairing the Z-loop of Deperming Slip #2 and to determine the most cost effective means of implementing the repair.

FPO-1 developed a repair concept involving the installation of a new cable trough adjacent to the existing trough, and enclosing each of the nine replacement cables in a plastic conduit to inhibit marine growth. Additional conduits were to be installed in the trough to allow future cable replacement



DIAGRAMMATIC OF ONE CABLE PAIR OF
Z–LOOP AT LAMBERTS POINT DEPERMING STATION

FIGURE 2–1

if necessary. The performance of repairs by a Navy Underwater Construction Team rather than by a civilian contractor offered the possibility of considerable cost savings.

CHESNAVGACENGCOM proposed these concepts to LANTNAVFACENGCOM and the Deperming Facility. The proposals were accepted and tasking was arranged to carry out the repairs. Underwater Construction Team One agreed to undertake the actual construction as a training project.

Task assignments for the project were:

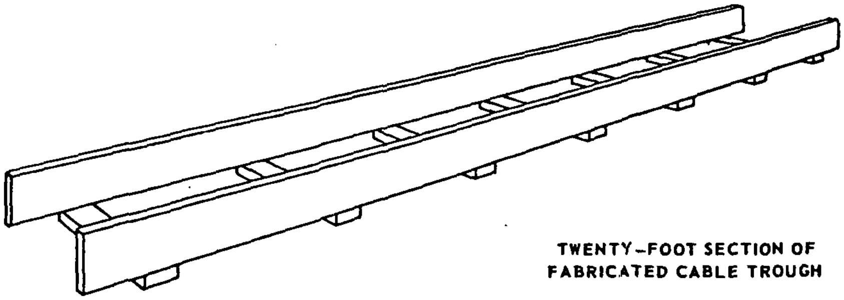
CHESNAVFACENGCOM - Design system and provide overall project management
UCT-ONE - Procure some construction material
  - Develop diving and installation techniques
  - Furnish and outfit construction platform
  - Carry out construction
Tracor Marine (under existing CHESNAVFACENGCOM contract)
  - Procure additional construction material
  - Fabricate some construction hardware
  - Provide construction logistic support

3.0 DESIGN

A design was desired which would prevent or inhibit the growth of marine organisms on the cables and allow future replacement cables to be installed with minimum use of divers. It was concluded that some form of plastic conduit enclosing the cables would meet these requirements. Several types of conduit were investigated and a flexible PVC conduit, widely used in shore electrical applications, was selected. This had the advantage that the cables could be pulled into the conduits on shore and the resulting assembly could be wound on a reel for convenient handling at the job site. If necessary, the closed conduits can be flushed periodically with fresh water to further inhibit marine growth.

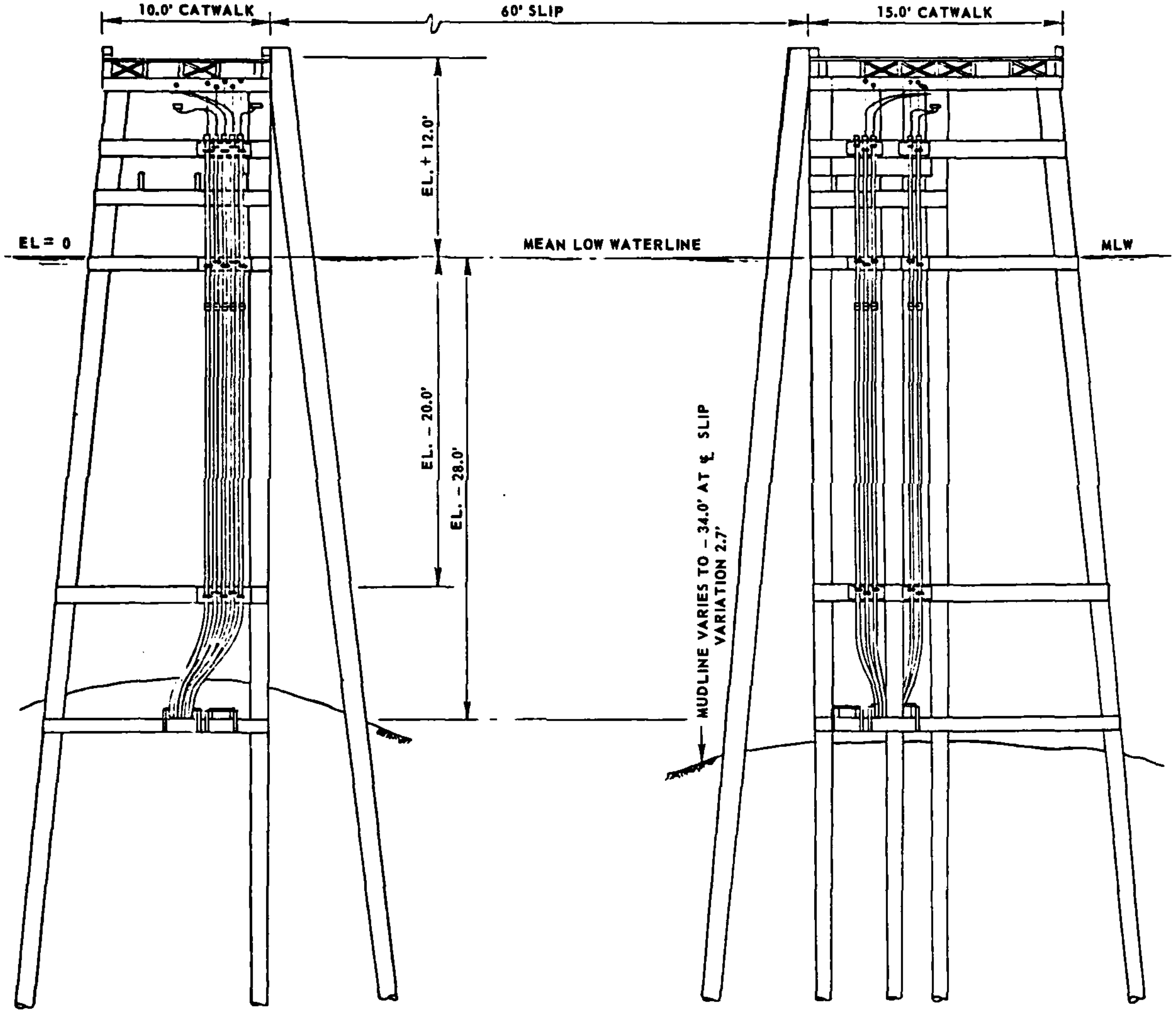
The final design, as shown in the drawings of Appendix B, called for individual conduits for the nine replacement cable lengths together with eleven empty conduit sections to be used for future cables. At a point a few feet below the mean low waterline (MLW), the flexible conduit was connected to rigid PVC conduit, which was secured to retaining clamps attached to existing cross members on the pier.

The conduits are housed in and supported by troughs of pressure-treated wood bolted to existing pier cross braces at about 28 feet below the MLW. The troughs are similar to those supporting the existing Z-loop, except that bolts instead of nailed fasteners are used. After installation, the conduits are secured to the troughs by nylon straps. A typical trough section is shown in Figure 3-1 and views of the risers from trough to catwalk are shown in Figure 3-2.



TWENTY-FOOT SECTION OF FABRICATED CABLE TROUGH

FIGURE 3-1



RISER TUBES AT ENDS OF CATWALKS/BENTS 31 AND 62 SHOWN LOOKING NORTH

FIGURE 3-2

4.0 CONSTRUCTION

CABLE PULLING

Actual construction work began in August 1982, at St. Juliens Creek Annex, with the pulling of cable into conduit. The flexible PVC conduit was procured in 250-foot lengths and was made up into the necessary 600-foot lengths with standard cemented PVC pipe couplings. The 1000 MCM cable had been procured under the previous contract and was made available by the Deperming Facility. Appendix A is a log of construction activities.

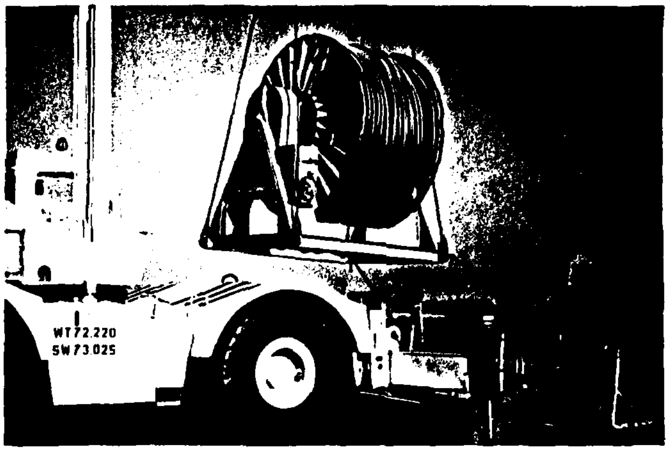
The first cable pull, considered to be in the nature of a feasibility test, was conducted by Tracor Marine personnel, with UCT-ONE personnel as observers. Subsequent operations were performed by UCT-ONE personnel. Necessary facilities for the operation, including a winch, powered reel stand with reels and a 35-ton crane, Figure 4-1A, together with the necessary working space, were provided by the CHESNAVFACENGCOM OCEI Support Facility at St. Juliens Creek Annex.

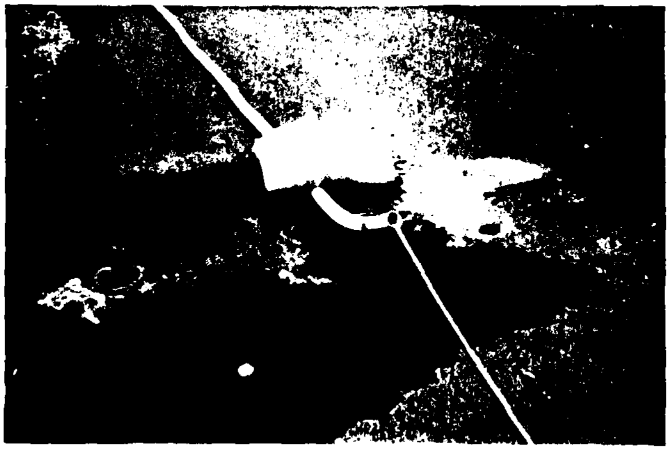
The assembled lengths of conduit were laid out on an asphalt roadway and anchored with sandbags. A Greenlee power fish-tape machine, essentially a heavy-duty vacuum cleaner, was used to pull a 3/8" polypropylene messenger line through the conduit, Figure 4-1B, and the cable was attached to this by a Kellems grip. A 20-ton winch was set on the roadway in line with the conduit and its gypsy head was used to pull the messenger line. Liberal applications of cable lubricant were used, Figure 4-1C, and a pulling speed of about 30 feet per minute was achieved, so that each pull was completed in about 20 minutes. Estimated tension on the cable was 300-500 pounds. Conduits to be installed without cables were assembled in the same manner, and a 3/8" polypropylene messenger line was pulled in and left in place.

Because the insulation resistance of the cables is a critical parameter for the deperming application, the resistance of each cable was checked after it was pulled into the conduit. This was done by filling the conduit with water and measuring the resistance between the water and the cable conductor with a 500-volt Megger. One cable was found to exhibit marginal resistance ($\approx$ 4 Megohms) and was removed from the conduit and rejected. Subsequently, two more lengths of cable, prior to pulling, were observed to have cuts in the insulation, and these were also rejected.

PENGO CABLE REEL
BEING HOISTED BY CRANE

FIGURE 4-1A





CONDUIT SANDBAGGED TO
DRIVEWAY WITH POLYPRO
PULLING LINE THROUGH END

FIGURE 4-1B

LUBRICATING CABLE
AS IT IS PULLED
THROUGH CONDUIT

FIGURE 4-1C

The cable furnished by the Deperming Facility was Anaconda "Durasheath," 1000 MCM single conductor stranded copper with neoprene-jacketed ethylene/propylene rubber insulation. It was found that this cable was no longer available; however, a replacement type was located in a vendor's stock. The replacement cable had the same electrical characteristics and Underwriter Laboratory Classification (MV-99), but had unjacketed cross-linked polyethylene insulation. As this cable had the same temperature rating and slightly higher resistance, it was considered to be a satisfactory replacement; its use was approved by the Deperming Facility and by the Naval Sea Systems Command.

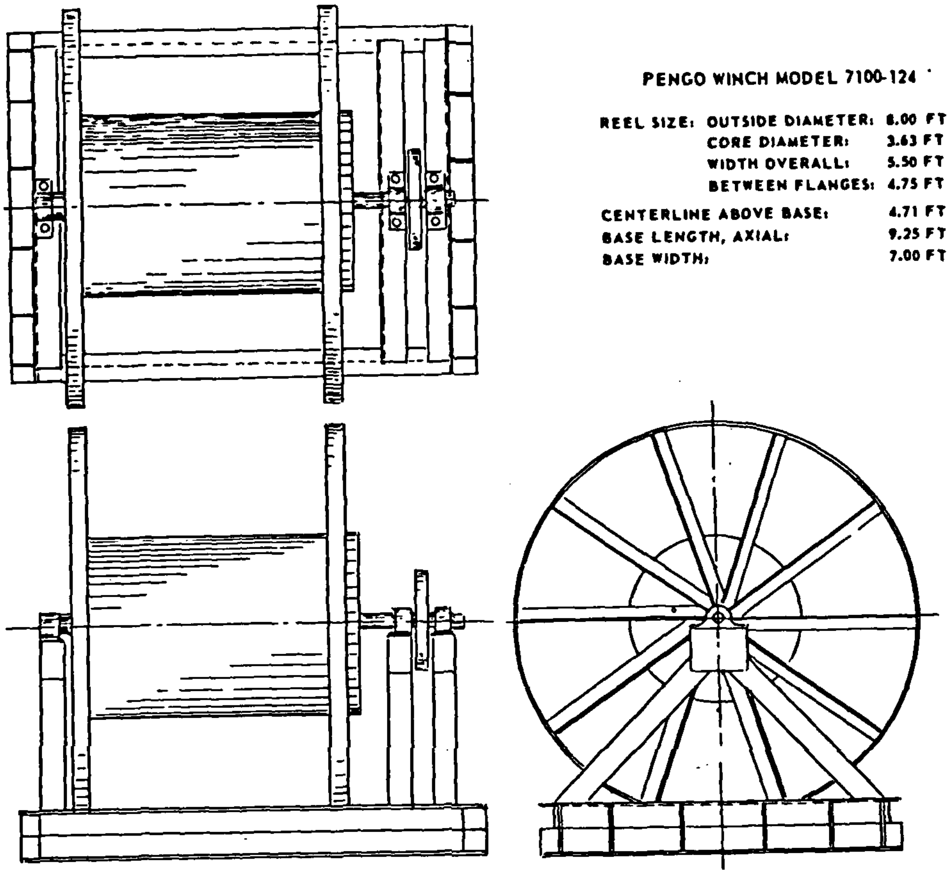
Three lengths of this cable were procured to replace those rejected. Tracor and UCT-ONE personnel performed a source inspection of the new cable at the vendor's warehouse and supervised packing and shipping it to the St. Juliens Creek Annex.

After pulling and testing, the cable/conduit assemblies were wound on two 96-inch diameter Pengo cable reels, Figure 4-2, using a Morgan powered reel stand. In order to avoid dragging the conduit along the asphalt roadway, the reel stand and its hydraulic power unit were mounted on a 5-ton truck, and the cable was wound on the reel as the truck backed along the length of the conduit. The eleven lengths of empty conduit were wound on a 126-inch diameter Pengo reel in the same manner.

CONSTRUCTION PLATFORM

In order to support the construction operation, which involved extensive diving, removal of over-burden, trough fabrication and installation, and cable installation, a movable construction platform was required. UCT-ONE obtained a warping-tug hull from the Naval Amphibious Base, Little Creek, and had it towed, by a Navy tug, to the St. Juliens Creek Annex for outfitting. This hull consisted of a 3 x 14 array of pontoon sections with overall dimensions of about 21 x 85 feet and an unloaded draft of about 1 foot. In the course of the project, it was found that a slightly larger platform would have been more convenient, but the warping-tug hull proved generally adequate.

The hull was outfitted by UCT-ONE with equipment supplied partly by the team and partly from the CHESNAVFACENGCOM Ocean Construction Equipment Inventory (OCEI). As finally configured, Figure 4-3A, the barge contained two SEABEE Equipment Shelters and a MILVAN, two compressors and surface-supplied diving systems, two hydraulic power sources, a welding machine,



PENGO WINCH MODEL 7100-124

REEL SIZE:	OUTSIDE DIAMETER:	8.00 FT
	CORE DIAMETER:	3.63 FT
	WIDTH OVERALL:	5.50 FT
	BETWEEN FLANGES:	4.75 FT
CENTERLINE ABOVE BASE:		4.71 FT
BASE LENGTH, AXIAL:		9.25 FT
BASE WIDTH:		7.00 FT

96-INCH PENGO CABLE REEL

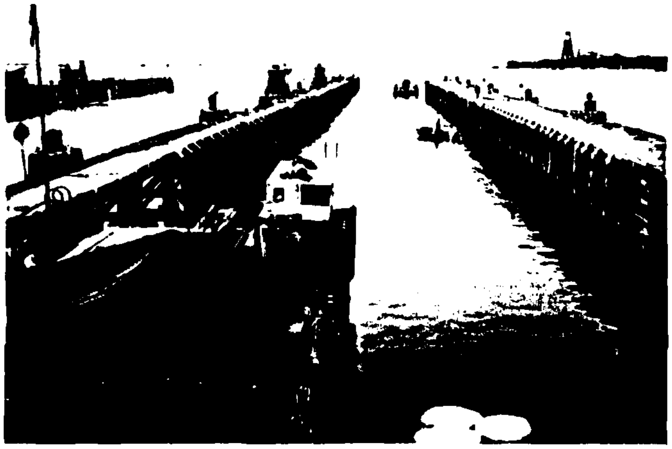
FIGURE 4-2

and two hydraulic gypsy heads. Lumber for the trough assemblies and miscellaneous assembly and installation hardware were also stored on the barge.

An LCM-8, Figure 4-4, was obtained on loan from the Shore Intermediate Maintenance Activity (SIMA) at Little Creek. This was used for towing the construction platform to the job site and subsequently as a platform for the cable reels during cable installation.

PROFILE OF WORK BARGE SHOWING CABLES AND DECK INSTALLATIONS

FIGURE 4-3A

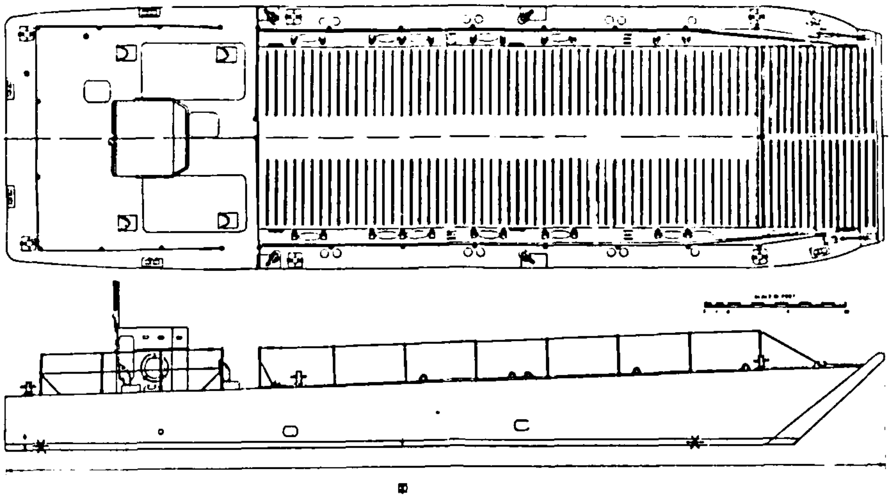


BARGE IN SLIP #2 LOOKING TOWARD *NORTH (BAY) END*

FIGURE 4-3B

BARGE BEING PUSHED INTO SLIP #2 TOWARD DS-9 CONTROL BUILDING

FIGURE 4-3C



DECK ARRANGEMENT AND PROFILE OF LCM-8

FIGURE 4-4

CONSTRUCTION OPERATIONS

On 10 September 1982, the construction platform was towed to the Deperming Facility and moored in Slip #2. Diving operations began at once, the first step being a detailed inspection of the area where the cable troughs were to be installed. Visibility at the bottom proved to be very poor, so that the inspection and many of the subsequent installation operations were carried out by touch. The MK 12 diving system was used for this inspection and for all underwater construction operations up to the cable/conduit installation phase. A diver, outfitted with this system is shown in Figure 4-5A, B, and C.

The inspection results were recorded on detailed sketches for each of the sixty spaces between bents of the two catwalks. These showed the depth of the mudline, the status of cross-braces at each bent, and any obstructions in the way of the trough sections. A numbering and lettering system for bents and pilings was devised, and a set of local coordinates was established for project use only. Directions were referred to as *Norfolk* (E), *Portsmouth* (W), *Bay* (N), and *River* (S). This proved quite effective in giving instructions to the divers. Bents were numbered sequentially from south to north

DIVER IN MK 12 GEAR
CLIMBING LADDER

FIGURE 4-5A

DIVER IN MK 12 GEAR
ENTERING WATER
FROM BARGE

FIGURE 4-5B

DIVER IN MK 12 GEAR
BEING CHECKED PRIOR
TO DIVE

FIGURE 4-5C

and piles in each bent were designated "Alfa," "Bravo," and "Charlie," from the slip out to the east and west sides.

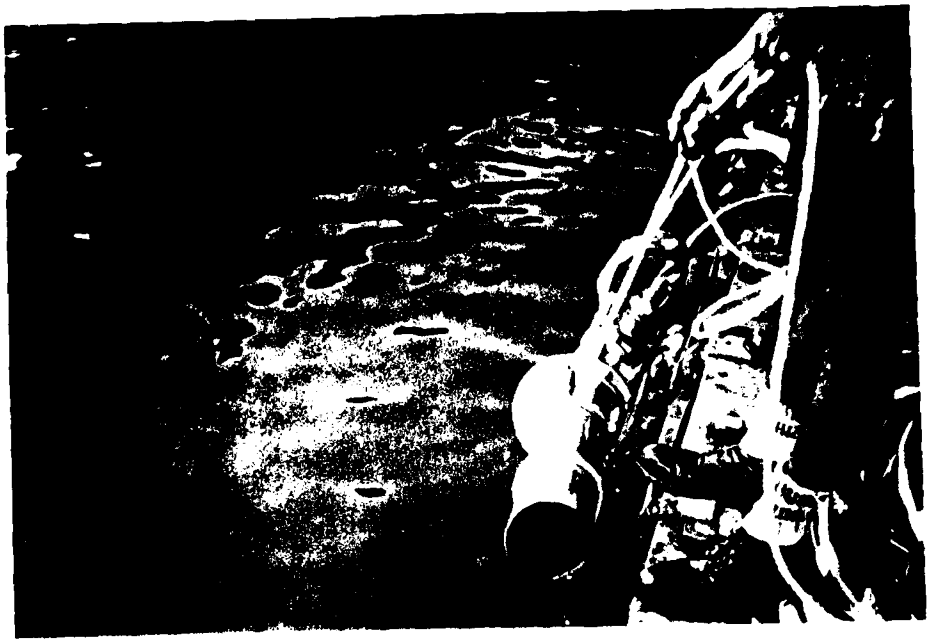
The inspection did not reveal any marked changes from earlier inspections. It showed that the existing cable troughs were buried in mud for between one-third and one-half the length of the *Portsmouth* catwalk (10-foot width), with especially heavy concentrations opposite the large cluster dolphins in the adjacent slip. Under the *Norfolk* catwalk (15-foot width), the trough was generally clear of the mudline except for one area at about the middle of the catwalk. At the outer end of the *Norfolk* catwalk, a number of fender piles had been broken and some of the broken ends were laying across the cable trough. Some miscellaneous debris and abandoned cables were reported at various locations.

In the heavily-silted area under the *Portsmouth* catwalk, it was necessary to clear the overburden before the inspection could be completed. It was therefore decided as the next step to remove all of the overburden and clear the trough area completely before beginning any trough installation. An attempt was made to use a suction dredge to remove the silt, Figure 4-6, but this proved awkward for the divers to handle and appeared to offer a slow removal rate. A homemade water jet, Figure 4-7, fabricated by UCT-ONE, was then tried and proved very satisfactory. Both of these devices were powered by a water pump.

The removal of overburden, which was up to ten feet deep in places, required about ten working days. Fortunately, the rate of silting was quite slow (8 to 12 inches per year), so that the entire area could be cleared in one operation, without concern about redeposition.

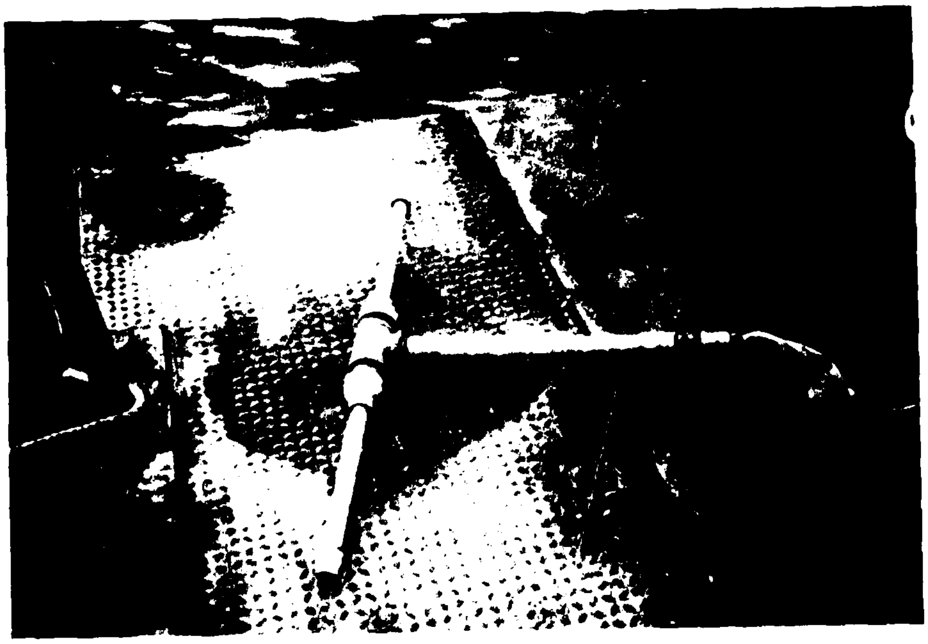
CONSTRUCTION AND INSTALLATION OF CABLE TROUGHS

On 27 September 1982, the installation of trough sections began. Because of barge space and transportation limitations, it was decided that the trough sections would be fabricated on site. Timber side sections of 3 by 8 inches by 22 feet long and precut 2 by 6 by 22-inch crossbattens were stacked on deck; the trough sections were assembled from these, in the shape of a ladder, with crossbattens bolted at 3-foot intervals, Figure 4-8. It was found that the spacing between bents in the catwalks varied enough from the nominal 20 feet that it was necessary to measure each space and cut the trough to fit. The stringers had been procured in 22-foot lengths with this possibility in mind.



SUCTION DREDGE BEING LOWERED OVERBOARD

FIGURE 4-6



HOMEMADE JET NOZZLE ON BARGE DECK

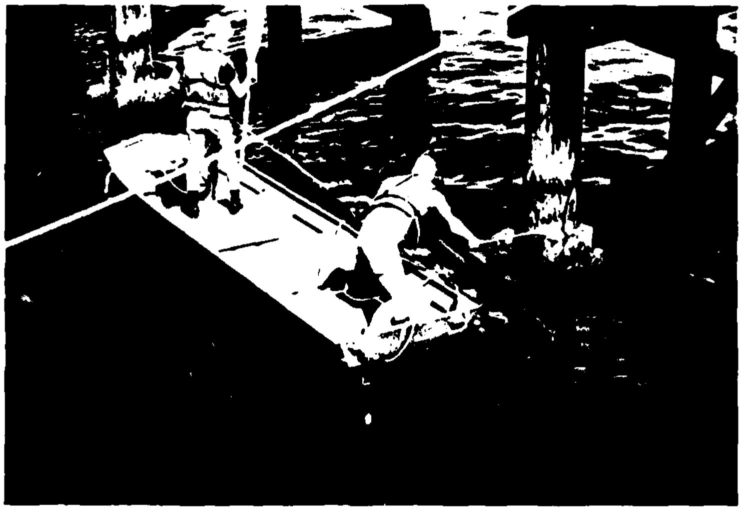
FIGURE 4-7

FABRICATING CABLE TROUGH
FROM 3 x 8 SIDE MEMBERS
AND 2 x 6 CROSS MEMBERS.
END CUT TO LENGTH MEASURED
BY DIVERS TO FIT BETWEEN
PIER BENTS.

FIGURE 4-8

FLOATING FABRICATED TROUGH BETWEEN PIER BENTS

FIGURE 4-9



After several trough sections had been installed, Figure 4-9, a routine was developed. A number of sections were fabricated and stacked on the deck of the barge. A section was cut to length and the angle iron mounting brackets and lag bolts were lashed to it. The trough section was manhandled into the water and floated into position between the pier bents. Because the trough section was longer than the space between cross-braces on the bents, it was necessary to insert it at an angle. Men working from a boat or from a catwalk under the pier (where one was present) attached descent lines and installed weights in the trough section to sink it. Divers, who had been waiting on the surface at the two adjacent bents, followed the trough as it was lowered and guided it into place. The diver at one end then bolted the angle brackets to the trough and to the pier cross-brace, using a hydraulic impact wrench and lag bolts. After one end was secured, the divers used a steel tape and a flashlight to determine the cutting length for the next trough section; this information was relayed to the surface. The divers then secured the remaining end of the trough, attached the weight to the descent lines for retrieval, and returned to the surface to wait for the next trough section.

Using this technique, it was possible to install three or four trough sections per day. On 7 October, a total of seven sections were installed, but this entailed working until midnight. Overall, the trough installation required 20 working days. Near the outer end of the *Norfolk* catwalk, as mentioned earlier, a number of fender piles had been damaged and some broken ends lay across the area were the trough sections were to be installed. Divers attached lines and the broken ends were removed by means of the capstans on the barge. One piling had to be cut with a chain saw before it could be removed. This evolution caused a construction delay of about three days.

As soon as the trough installation was completed on the *Norfolk* side, cable installation was begun while trough installation continued on the *Portsmouth* side.

CABLE INSTALLATION

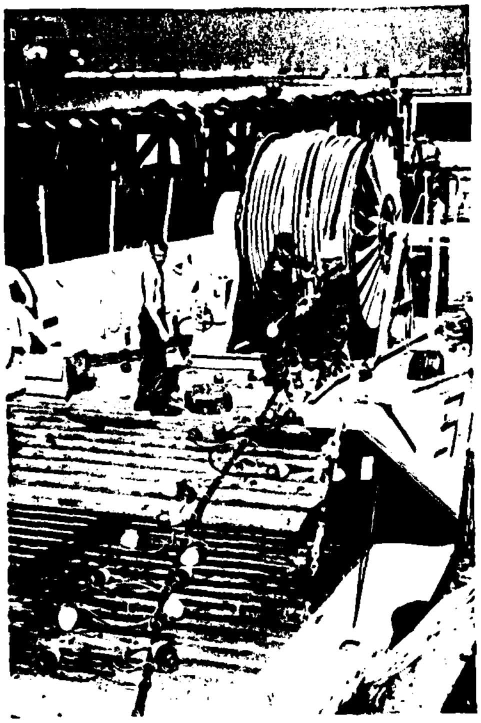
The powered cable reel, with one reel of cable/conduit, and its associated hydraulic power unit was installed in the well of the LCM-8. Thus, it was necessary to return the LCM-8 to the St. Juliens Creek Annex. The boat was moored at the outer end of the *Norfolk* catwalk, the ramp was lowered, and the cable was fed over the bow, Figure 4-10. A sheave was installed at the inboard end of the catwalk at a depth of about 25 feet below the mean low waterline and a line was fed through this and taken by divers back to the LCM-8. The diving portion of the cable-pulling operation was performed by SCUBA divers.

The inboard end of the messenger line was brought to the surface at the inner end of the catwalk and led to the gypsy winch on the barge through additional sheaves.

It was desired to pull the cable into position suspended in the water column rather than to attempt to pull it along the trough, for fear of snagging. As the cable was fed over the bow of the LCM-8, flotation in the form of small plastic floats was attached. These floats were approximately the size and shape of a football and were tied to the conduit at about three foot intervals. Swimmers in the water between the boat and the pier varied the float spacing to adjust the flotation, which had to allow the floats to pass beneath cross-braces located just below water level.

Although one cable was installed in this manner, the flotation was not successful. The hollow plastic floats were found to support only four pounds each -- the approximate weight of a foot of cable -- instead of the anticipated nine pounds. The floats also tended to collapse when only slightly submerged. A check with vendors in the area indicated that suitable floats were available and a quantity was ordered, but some delay ensued in obtaining them. An abortive attempt was made to fill the hollow floats with plastic foam, but the available aerosol foam proved to be hygroscopic.

At this juncture, UCT-ONE personnel suggested removing the cables from the conduit, pulling the empty conduit into place and then pulling the cable back into the installed conduit. This was tried. The cable/conduit assemblies were fed off the reel and laid out along the deck of the catwalk. The conduit was stopped off and the powered cable reel was used to pull the cable out of the conduit, with a polypropylene messenger line attached. The empty conduit was then wound on the reel, and fed under the catwalk by SCUBA divers. The divers found it relatively easy to handle the empty conduit. The messenger line was brought through the sheaves to the gypsy head on the

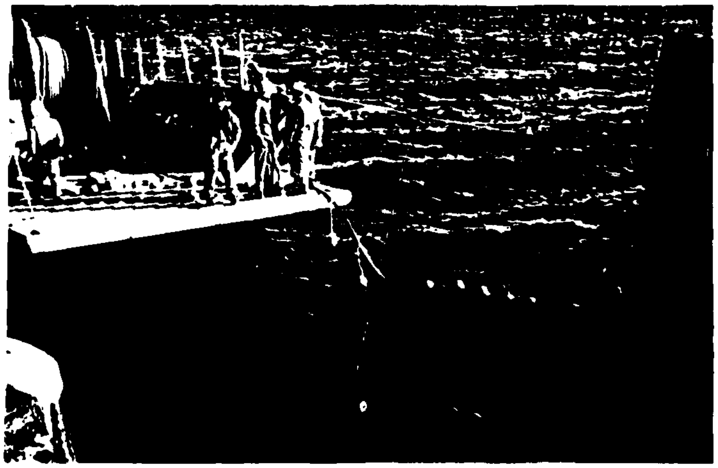


REELING CONDUIT OFF LCM-8 USING INITIAL SET OF FLOATS WHICH WERE INCAPABLE OF SUPPORTING THE LOAD

FIGURE 4-10

REELING CONDUIT OFF LCM-8 ON SECOND SET OF FLOATS WITH SATISFACTORY CABLE SUPPORT CAPABILITY

FIGURE 4-11



barge in the same manner as before and the cable was pulled into place. This proved to be very satisfactory for the two remaining cables of the new type, with the polyethylene insulation. Unfortunately, however, it proved to be very difficult to pull a rubber-covered cable out of its conduit, and it was felt that it would be equally difficult to pull it back in. This approach was therefore abandoned for the remaining cables. However, this exercise proved the potential of pulling polyethylene insulated cables into already-installed conduit.

Meanwhile, new floats of two types were delivered. These were nine-inch diameter spherical plastic foam and cast aluminum floats. Both types proved quite satisfactory. The installation technique was slightly modified and the remaining cables were installed without major difficulty. The LCM-8 was moored to the opposite side of the slip at a sufficient distance to allow 75 to 100 feet of cable to be floated in the water before reaching the pier, Figure 4-11. Several swimmers in this area adjusted the buoyancy by varying the spacing of the floats. The cables were then pulled into place and temporarily secured. After the cables were in place, the SCUBA divers released the floats and the floats were picked up by men in a boat. The divers guided the cables into place in the trough and brought the ends of the conduit into position. At the ends of the pier, the flexible conduits were clamped to a support bracket and the cable was brought to the surface through a rigid PVC tube which was coupled to the flexible conduit and supported by additional brackets. The Kellems grip used to pull the cable was left attached to the cable and was anchored to an eyebolt through one of the pier structural members.

FINAL CONDUIT AND CABLE INSTALLATION

The empty conduits were installed by the divers. No additional flotation was required; in fact, it was necessary to flood the conduits to enable the divers to position them in the troughs. The empty conduit ends were made up to rigid risers, secured by clamps, and the messenger lines were secured under the pier.

After completing the conduit installation, the divers lashed the conduits into the troughs with nylon tie-wraps. It had been intended to place top battens on the troughs both to strengthen the trough structures and to secure the cables in place. However, the demonstrated strength of the bolted trough sections (using lag bolts instead of nails) and the use of the nylon straps led to the conclusion that the top battens were redundant, and they were omitted.

Deperming Facility personnel stripped the ends of the cables, attached compression lugs, and connected the cables in the proper loop configuration, Figure 4-12. They also measured the insulation resistance of the cables, which well exceeded the minimum allowable value in each case.

COMPLETION OF CONSTRUCTION

The construction phase was essentially completed by 12 November 1982. The repaired Z-loop was used to deperm a submarine on 18 November.

Inclement weather and other commitments delayed the final inspection of the installation until 8 December 1982. At this time, some minor discrepancies were corrected which required replacement of some temporary nylon cable anchors with wire rope, and the installation of a missing rigid riser.

The time expended by UCT-ONE personnel on this construction effort is summarized in the following table.

Time Period	Time in Man-Hours		
	Direct	Indirect	On-Bottom
26 Aug - 17 Sep	484	1310	28
18 Sep - 24 Sep	241	285	22
27 Sep - 03 Oct	368	216	27
04 Oct - 11 Oct	396	302	*
11 Oct - 17 Oct	484	257	30
25 Oct - 31 Oct	436	224	45
01 Nov - 07 Nov	817	380	63
08 Nov - 14 Nov	779	231	72

*Not reported

STRIPPING CABLE END FOR CLAMP BY HEATING INSULATION

FIGURE 4-12A

CLEANING CABLE END

FIGURE 4-12B

SECURING CLAMP FITTING TO CABLE END

FIGURE 4-12C

5.0 PERSONNEL REQUIREMENTS

The Z-loop repair project was very labor-intensive. During the phases prior to actual cable installation 14 to 15 people were required. These were:

1	POIC
2	Divers
2	Tenders
1	Standby diver
1	Standby tender
1	Dive supervisor
1	Diving console operator
1	Power source operator
4	Utility men (riggers, line handling, trough fabrication, etc.)

All the SEABEES were capable of assuming any of these positions (except supervisory positions) so that none of the personnel had much standby time.

When cables were being pulled at the same time, 15 to 17 more people were required:

1	Supervisor
1	Dive supervisor
2	Divers
1	Standby diver
1	Boat operator
2-3	Swimmers
1	Reel stand operator
3-4	Buoy tiers-in
2-3	Cable pullers
1	Winch operator

6.0 LESSONS LEARNED

As in all ocean construction projects, there were a few instances where the advance planning, materials, or equipment available did not satisfactorily fulfill the project requirements. In other instances, equipment was barely adequate and under more demanding environmental conditions, or at more distant locations, problems could have occurred. Finally, this project has demonstrated the need to become more familiar with the potential problems that may arise in the field and to arrive on site better prepared for the contingencies associated with construction work in the underwater environment.

All of these factors can be grouped under the heading of "lessons learned." A few examples that resulted from working on the Norfolk Z-loop are listed below.

1. The use of individual conduits for the Z-loop cables was intended to meet two objectives:

    a) Prevent or inhibit marine growth on cables.

    b) Allow additional replacement cables to be installed without requiring divers.

    It is too early to determine whether the first objective has been met; however, it has been demonstrated that XPL-insulated cables can be pulled into already-installed conduits.

2. The 3 x 14 warping tug hull obtained by UCT-ONE from NAVPHIBASE LITTLE CREEK, proved to be a reasonably satisfactory construction platform. Anything smaller would have been inadequate; as it was, the platform was crowded when diving operations and trough-section construction were going on simultaneously.

3. All of the equipment mounted on the platform at mobilization was utilized in the course of the project. The past experience of the Underwater Construction Team proved invaluable in the outfitting and operation of the required diving and construction support platform.

4. For removal of the particular type of soft silt encountered in the deperming slip, the water jet proved to be the most effective means of clearing the area where the troughs were to be installed. The jet also spread the fine silt evenly over the bottom of both adjacent slips without the necessity of locating a suitable spot for a soil dump. Although the suction dredge has fulfilled its required function of transferring fine bottom sands in other operations, it proved to be clumsy and difficult for divers to handle in the confined areas around the Z-loop pier pilings.

5. A capability for rapid procurement of needed materials is extremely important. For this project, the proximity of the UCT-ONE home port and the OCEI support activity greatly facilitated obtaining additional and/or substitute materials, for example, replacement of the unsatisfactory cable floats.

7.0 ACKNOWLEDGMENTS

The design of the repair project was performed by personnel of the Ocean Engineering and Construction Project Office of CHESNAVFACENGCOM, which also furnished the project manager and an on-site engineering representative. The CHESNAVFACENGCOM Ocean Construction Equipment Facility at St. Juliens Creek Annex furnished logistic support and made available material handling equipment and a staging area. The ready cooperation of all personnel was a great help in keeping project operations on schedule.

Tracor Marine personnel, under contract to CHESNAVFACENGCOM, procured construction materials and fabricated installation hardware assemblies. They were highly responsive to urgent requests for odd items. Additionally, the Deperming Facility cooperated in every way, especially in furnishing excellent food for a large contingent of hungry divers and in operating boats for transportation at odd hours.

Underwater Construction Team One personnel, during their normal home port period, furnished the dedicated diving and construction skills which made execution of the project possible. UCT-ONE's preconstruction planning assured the majority of required equipment and materials were on hand at the work site. The UCT-ONE personnel involved were:

LCDR Digeorge - OIC UCT-ONE
LCDR Wagner - AOIC UCT-ONE
UTCS(DV) Calvert - DET SCPOIC
EA1(DV) Dahl - DET POIC
CM1(DV) Ossont
EO2(DV) McCleary
BU2(DV) Carr
SW2(DV) Belluzzi
SW2(DV) Taylor
CE2(DV) Watson
EO2(DV) Ingalls
CM2(DV) Sloan
CE2(DV) Dorval
CM3(DV) Snyder
CM3(DV) Wales
CE2(DV) Mienticiewicz
BU2(DV) Hierholzer
CE2(DV) Wright
EOC(DV) Sutton
CM2(DV) Heath
CE1(DV) Oliver
BU1(DV) Deems
EO2(DV) Jello
CM2(DV) Johnston
UT2(DV) Palmer
HM2(DV) Petitt

The Team worked under the supervision of Senior Chief Calvert who was also responsible for much of the preconstruction planning.

The engineering design for the project was carried out by Richard D. Beckwith, Engineering Division, and the project engineer for the construction phase was T. R. Thomas, Construction Division, Ocean Engineering and Construction Project Office, CHESNAVFACENGCOM.

APPENDIX A

LOG OF EVENTS DURING CONSTRUCTION PHASE

26 Aug.-3 Sept. 1982 -- During this period, the conduit and cable were prepared and loaded aboard the barge; all other gear was loaded aboard the barge and all major equipment was operated.

10 Sept. 1982 -- The barge was moved to the job site and an overnight watch was set based upon a request from Deperming Range personnel.

13 Sept. 1982 -- A preinspection was begun upon the piers supporting the 10 foot and 15 foot catwalks. The cable trough at the bottom of the 10 foot pier was found to be covered with a depth of mud which was too great to permit adequate inspection.

14 Sept. 1982 -- The preinspection of the 15 foot pier was completed.

15 Sept. 1982 -- Began dredging on the 10 foot pier using a gold dredge to remove the mud over the trough but the operation was unproductive due to difficulty in handling the gold dredge.

16 Sept. 1982 -- Using a homemade water jet, the mud at the bottom of the 10 foot pier was jetted away from the trough area from bent #1 to bent #9.

17 Sept. 1982 -- Continued water jetting on the 10 foot pier from bent #9 to bent #16. Also performed maintenance work on gear.

18 Sept.-24 Sept. 1982 -- Excavated path for trough under the 10 foot pier from bent #16 to bent #31. The mud depth ranged from 12 feet to 0 feet with an average depth of 5 feet. Performed maintenance work on hydraulic system, dive ladders, and diver umbilical boots.

27 Sept.-3 Oct. 1982 -- Completed inspection of 10 foot pier and sawed off excess portions of bolts protruding into path of the risers on bent #1 of the 15 foot pier. Installed four troughs between bents #1 and #5 on the 15 foot pier and worked on troughs between bent #5 and bent #6.

4 Oct.-11 Oct. 1982 -- Installed troughs on 15 foot pier from bent #5 to bent #20. Work progress improved with experience to the point where a total of four troughs could be installed per day except where unusual conditions such as mud evacuation or other obstructions interfered.

11 Oct.-17 Oct. 1982 -- Installed nine troughs from bent #20 to bent #29 on the 15 foot pier, after extracting six broken piles from bent #27 to bent #31 including one which had to be cut out with a chain saw.

18 Oct.-24 Oct. 1982 -- Completed the trough installations on the 15 foot pier and installed riser assemblies at bent #31 on both the 10 foot and 15 foot piers. Installed eight troughs on the 10 foot pier from bent #31 to bent #19. Because of interference by existing batter piles, the project engineer decided to omit troughs between bents #19 and #20, bents #21 and #22, and bents #26 and #27.

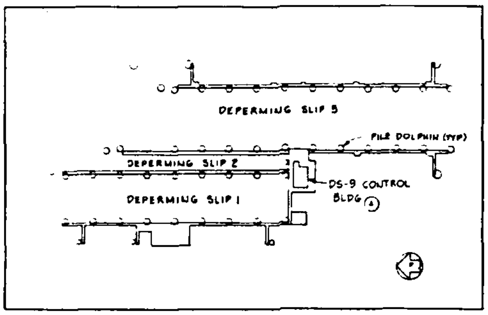
25 Oct.-31 Oct. 1982 -- Installed six troughs on the 10 foot pier from bent #11 to bent #19. Again, troughs between bent #11 and #12 and between bent #16 and #17 were omitted due to interference with existing batter piles. Installed riser assemblies on bent #1 on the 15 foot pier and also installed a temporary fairlead at the same location for use in cable-pulling operations. Prepared the LCM-8 for cable-pulling operations, moored it in the slip, and started cable-pulling operations on the 15 foot pier. Finished trough and riser assemblies on the 10 foot pier.

1 Nov.-7 Nov. 1982 -- Installed ten troughs between bent #1 and bent #11 on the 10 foot pier, completing the installation of all troughs on both piers. Placed four cables on the 15 foot pier and one cable on the 10 foot pier.

8 Nov.-14 Nov. 1982 -- Completed construction activities including pulling the four remaining cables, laying the eleven empty conduits, and strapping down all conduits in the troughs on the 10 foot and the 15 foot piers. Began barge demobilization and performed a quality control swim of the completed installation.

APPENDIX B

AS-BUILT DRAWINGS OF NORFOLK Z-LOOP



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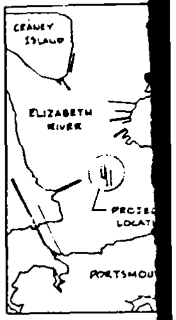

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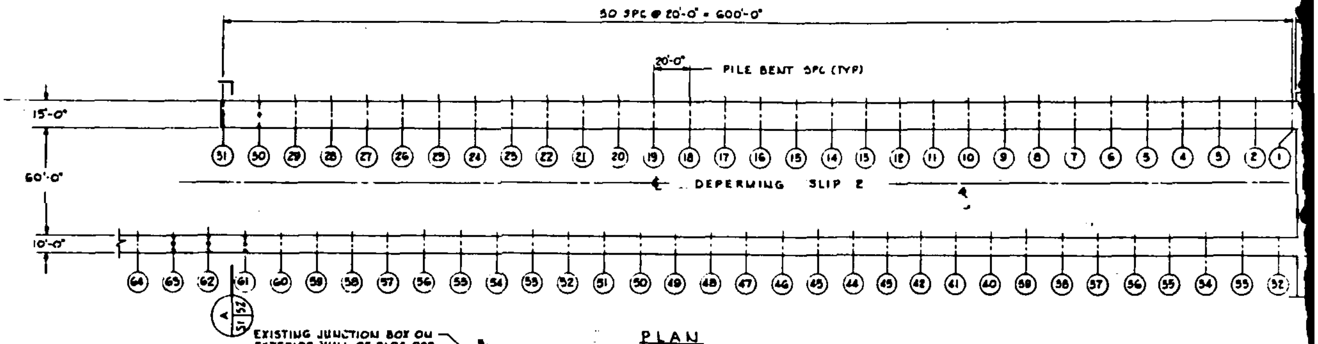

PLAN
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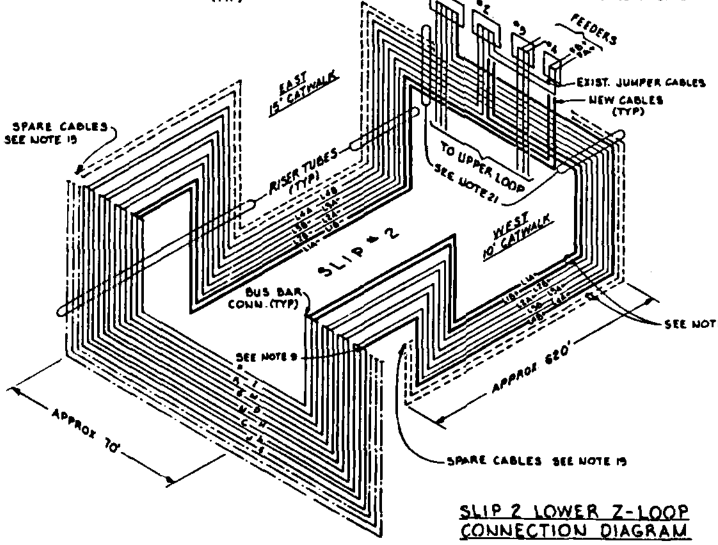
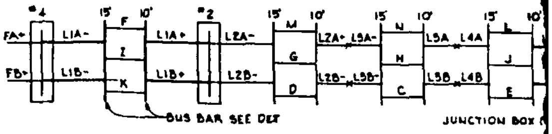


SLIP 2 LOWER Z-LOOP CONNECTION DIAGRAM
N.T.S.

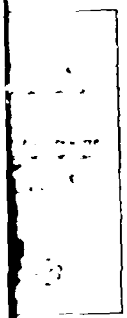


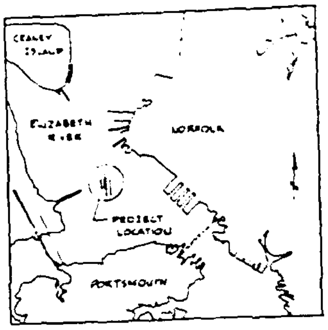
SLIP 2 LOWER Z-LOOP SCHEMATIC
N.T.S

LEGEND

EXIST	NEW	
— - —	- - -	SPARE 1000 MCM CABLE
——	——	1000 MCM CABLE
—✕—		CRIMP SPLICE
╈	╈	BUS BAR CONNECTION
	GFCI	GOVT FURNISHED CONTRACTOR INSTALLED (ALL MATL CONTRACTOR FURNISHED UNLESS OTHERWISE INDICATED)

REVISIONS





VICINITY MAP

Reproduced from best available copy

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible]
13. [illegible]
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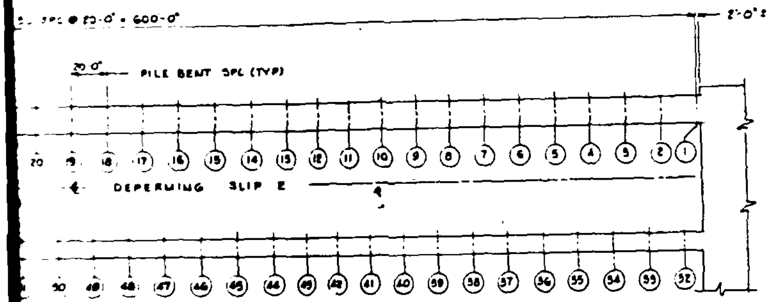
15. [illegible]
16. [illegible]
17. [illegible]
18. [illegible]
19. [illegible]
20. [illegible]
21. [illegible]
22. CABLE TROUGHS NOT INSTALLED BENTS 43-49, 47-48 50-51, 52-55, 57-58 DUE TO DOLPHIN & PILE INTERFERENCE. CABLES/CONDUIT LAID ON TOP OF OLD TROUGH



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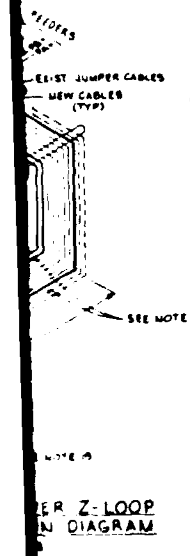

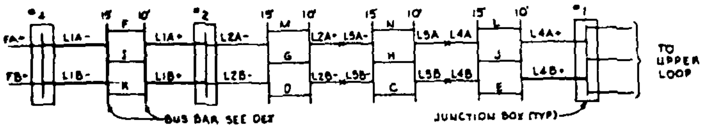

SLIP 2 LOWER Z-LOOP SCHEMATIC
N.T.S.

LEGEND

EXIST NEW
- SPARE 1000 MCM CABLE
- 1000 MCM CABLE
- CRIMP SPLICE
- BUS BAR CONNECTION
- GFCI GOVT FURNISHED CONTRACTOR INSTALLED (ALL MATL CONTRACTOR FURNISHED UNLESS OTHERWISE INDICATED)

...ER Z-LOOP
...N DIAGRAM

SHEET INDEX

SHEET NO	NAVFAC DWG NO	TITLE
1	3026157	PLAN
2	3026158	SECTION
3	3026159	SECTIONS
4	3026160	DETAILS

DESIGNED BY EOS
DRAWN BY EOS
CHECKED BY GN
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
CHESAPEAKE DIVISION
WASHINGTON, D.C.
NAVAL STATION NORFOLK, VA
REPAIR OF DEPERMING FACILITY - SLIP 2
PLAN
APPROVED DATE
SIZE F CODE IDENT NO 80091
NAVFAC DRAWING NO 3026157
REV A
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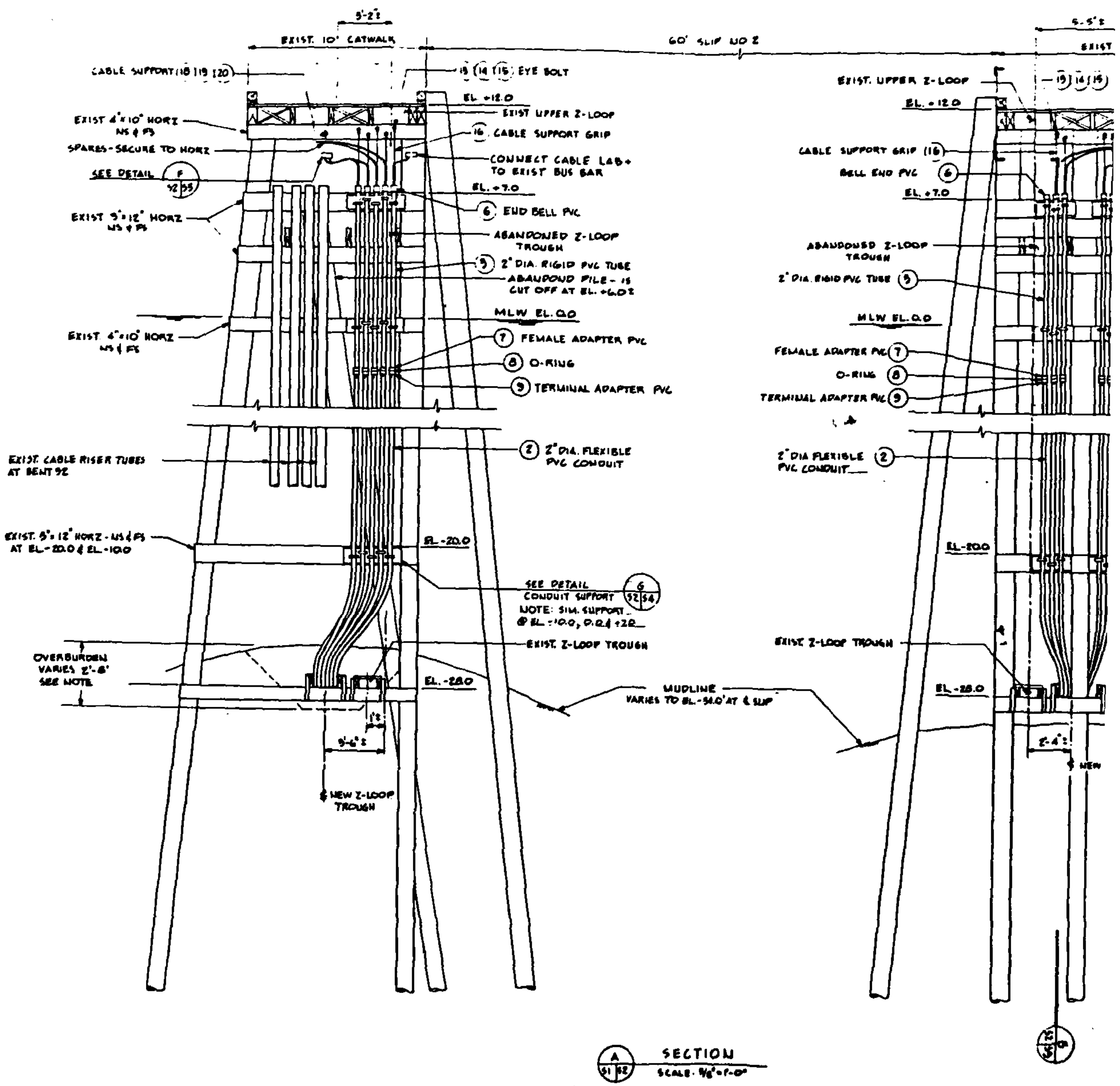
SHEET 1 OF 4



A 51|52 SECTION

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(EXIST. RISERS & CABLE NOT SHOWN FOR CLARITY)

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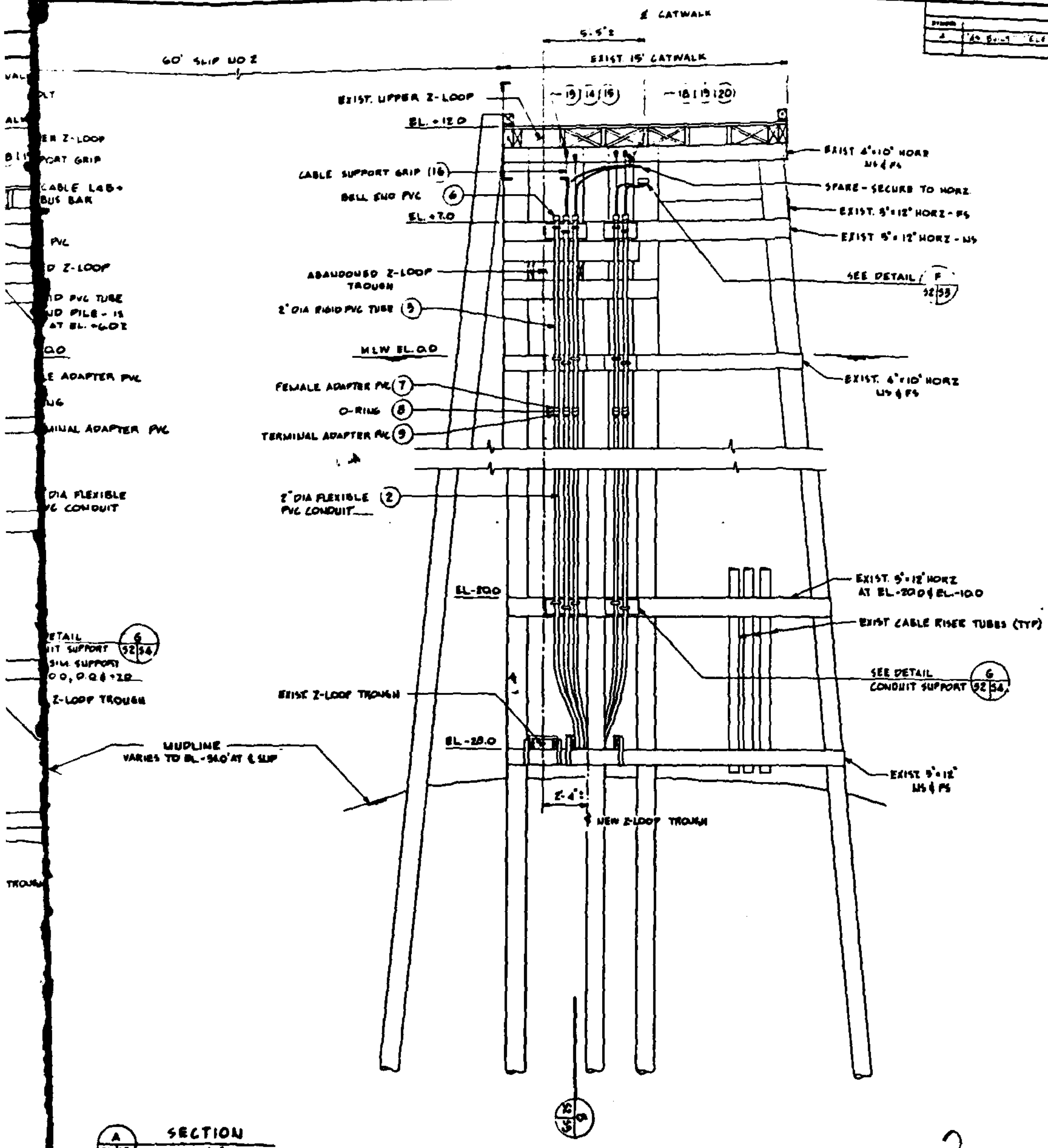

A 51 52 SECTION
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(EXIST. RISERS & CABLE NOT SHOWN FOR CLARITY)

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DESIGNED BY SYB
DRAWN BY SDB
CHECKED BY CM

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CHESAPEAKE DIVISION
WASHINGTON, D.C.

NAVAL STATION   NORFOLK, VA
REPAIR OF DEPERMING
FACILITY - SLIP 2
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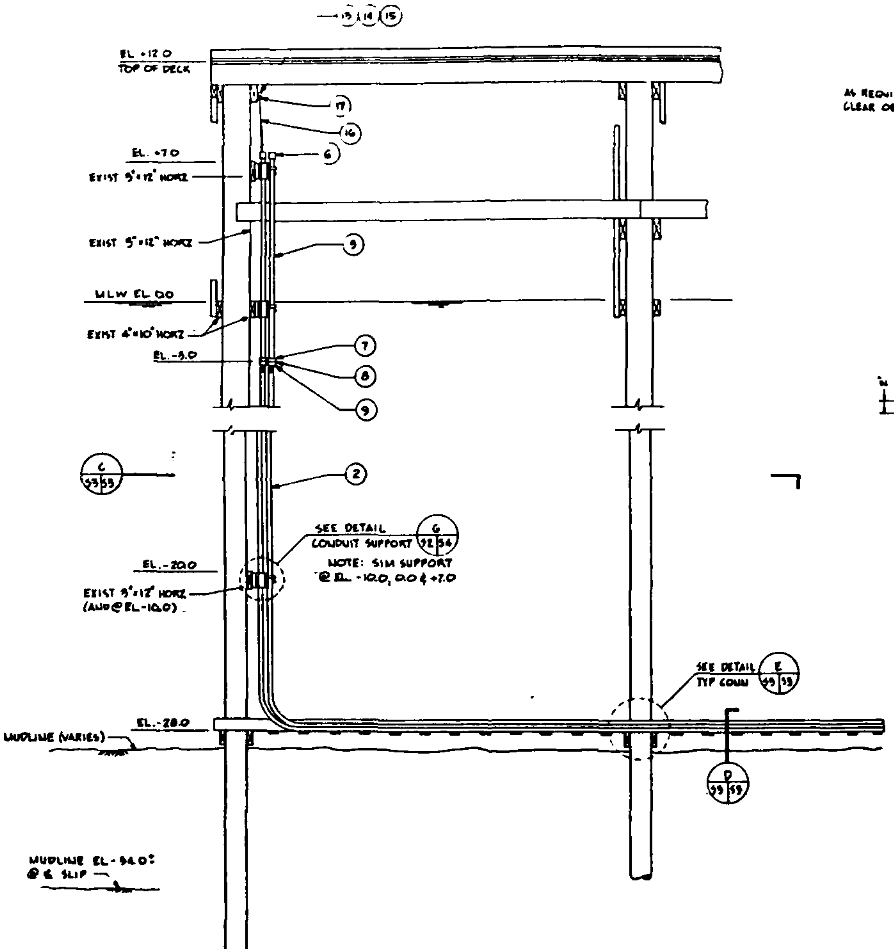
SHEET 2 OF 4



B 52 53 SECTION (BENT 51 SHOWN - BENT 62 SIM) △

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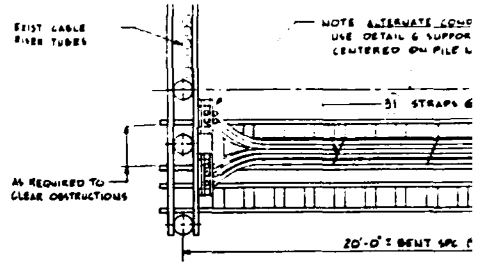

C 53 53 SECTION (BE

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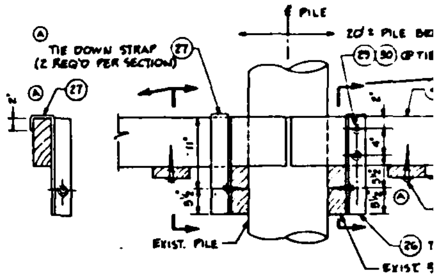

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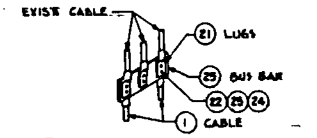

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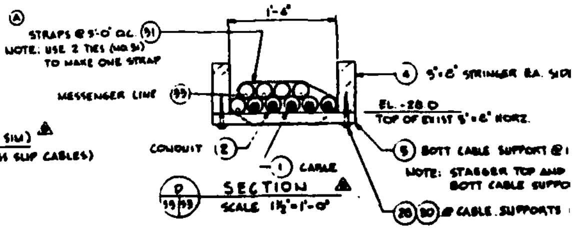

D 53 53 SECTION △

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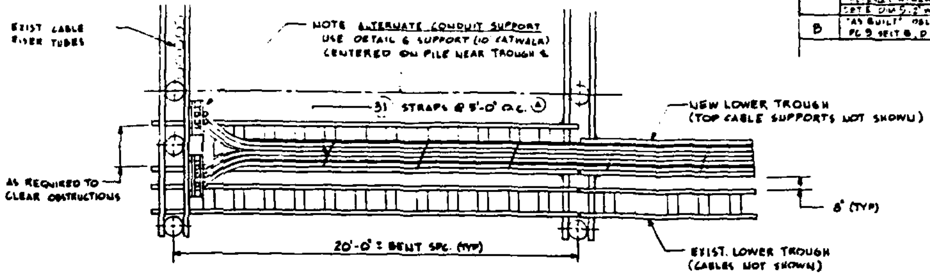

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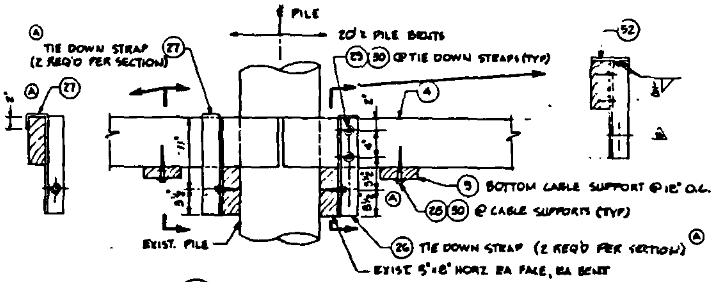

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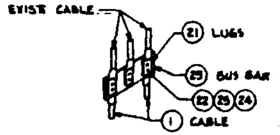

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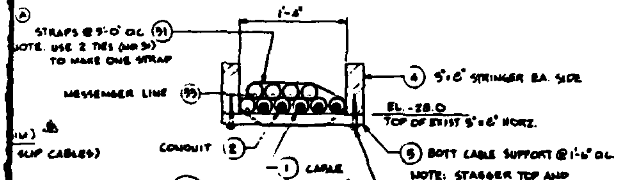

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DESIGNED BY RCB
DRAWN BY RCB
CHECKED BY CJM

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
CHESAPEAKE DIVISION
WASHINGTON, D.C.

NAVAL STATION NORFOLK, VA
REPAIR OF DEPERMING
FACILITY - SLIP 2
SECTIONS

APPROVED	DATE	SIZE	CODE IDENT NO	NAVFAC DRAWING NO	REV
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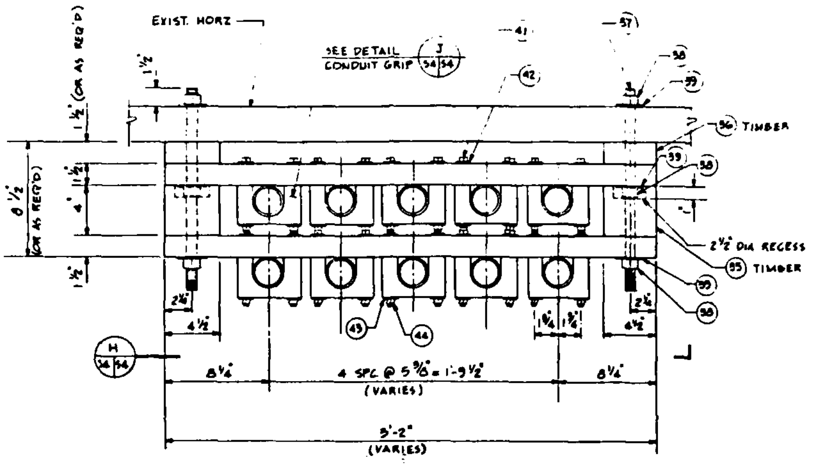

G 52|54 DETAIL - CONDUIT SUPPORT

(10' CATWALK SHOWN - FOR 15' CATWALK SEE SHEET 55)

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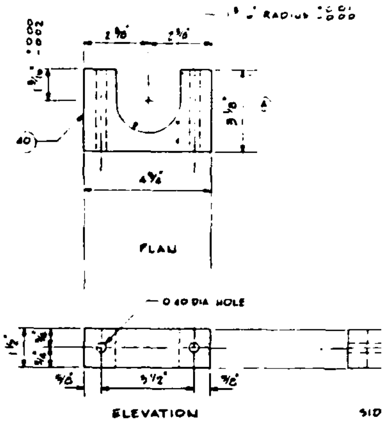

J 54|54 DETAIL - CONDUIT GRIP

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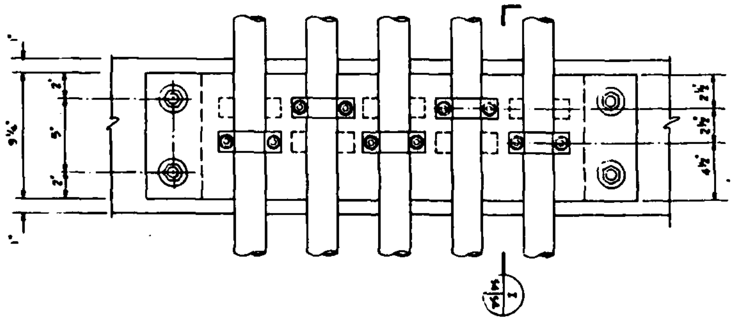

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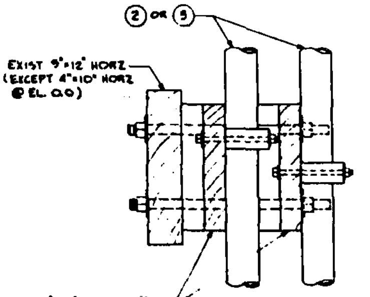

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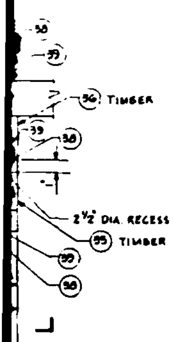
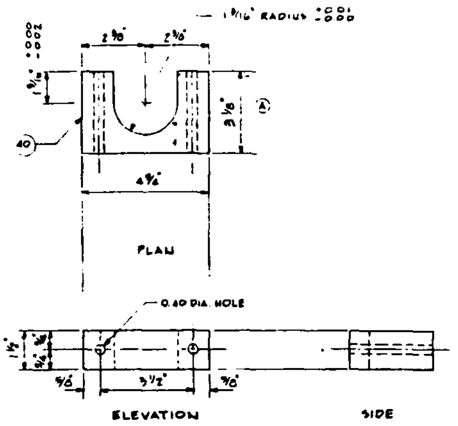
A	[illegible] WAS [illegible] [illegible] QTY WAS [illegible] WAS [illegible] PC [illegible] QTY WAS [illegible] WAS [illegible] PC 50 QTY WAS [illegible]	[illegible]	
B	"AS BUILT" ADD PC 52 [illegible]	[illegible]	





J 54/54 DETAIL - CONDUIT GRIP

SCALE: 1/2

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FIND NO.	PART NO. IDENT. NO.	QTY. REQD.	DESCRIPTION	SPEC.	MATERIAL
52	3026159	33 EA	PLATE, 5"x6"x1/4" 7.0 #		STEEL
51		16	NUT, HEX 1.000-8UNC-2B GALVANIZED		STEEL
50		32	WASHER, OGEE 1" DIA. GALVANIZED		STEEL
49		16	BOLT, HEX HD 1.000-8UNC-2A 1'-3" LENGTH GALVANIZED		STEEL
48		200LF	TIMBER, 3"x12" NOM. DIM. SEE NOTE 7		
47		10 EA	COATING, ELECTRICAL SCOTCHCOTE OR EQUAL		
46		10 EA	TAPE, ELECTRICAL VINYL PLASTIC, SCOTCH [illegible] OR EQUAL		
45		10 EA	TAPE, [illegible] HIGH VOLTAGE [illegible], NO. 3 (1"x0.030"x30') OR EQUAL		
44		320	NUT, HEX HD 0.375-16UNC-2B		SILICON BRONZE
43		320	WASHER, FLAT 0.393" I.D. 0.875" O.D.		SILICON BRONZE
42		320	WASHER, FLAT 0.397" I.D. 1.000" O.D.		SILICON BRONZE
41		320	SCREW, HEX HD 0.375-16UNC-2A 3.5" LENGTH		SILICON BRONZE
40	3026160 DET J	160	CLAMP, CONDUIT	MIL P-[illegible]	POLYPROPYLENE
39		192	WASHER, FLAT 0.813" I.D. 1.875" O.D.		SILICON BRONZE
38		192	NUT, HEX 0.750-10UNC-2B		SILICON BRONZE
37	3026160 DET G	64	ROD, THREADED 0.750-10UNC-2A 13" LENGTH		SILICON BRONZE
36	3026160 DET G	30LF	TIMBER, 5"x5" NOM. DIM. SEE NOTE 7		
35	3026160 DET G	30LF	TIMBER, 5"x5" NOM. DIM. SEE NOTE 7		
34	3026160 DET G	100LF	TIMBER, 2"x10" NOM. DIM. SEE NOTE 7		
33		[illegible]	ROPE, 3/8" DIA.		POLYPROPYLENE
32					
31	PLT6EH-00	900	CABLE TIE, 1/2" WIDTH 20 1/4" LENGTH PANDUIT OR EQUAL		NYLON
30		2972	WASHER, FLAT 0.656" I.D. 1.375" O.D. GALVANIZED		STEEL
29		480	SCREW, LAG HEX HD 0.625" DIA. 3.5" LENGTH GALVANIZED		STEEL
28		2492	SCREW, LAG HEX HD 0.625" DIA. 5.0" LENGTH GALVANIZED		STEEL
27	3026159	[illegible]	ANGLE, 3"x3"x1/4" 1'-6" LENGTH EA.		A-36 STEEL
26	3026159	[illegible]	ANGLE, [illegible] 1'-7" LENGTH EA.		A-36 STEEL
25	3026159	[illegible]	PLATE, [illegible]		COPPER
24		12	WASHER, FLAT 0.562" I.D. 1.375" O.D.		COPPER
23		12	NUT, HEX HD 0.500-13UNC-2B		SILICON BRONZE
22		12	SCREW, HEX HD 0.500-13UNC-2A 1" LENGTH		SILICON BRONZE
21	TA44-[illegible]	24	LUGS, COMPRESSION 2-HOLE 1000 MCM BURNDY OR EQUAL		COPPER
20	[illegible]	40LF	HOSE, FIRE 1½" DIA. [illegible] OR EQUAL		NEOPRENE/ FABRIC
19	[illegible]	38	CLAMP, TILLER ROPE 3/8" DIA. WITH ROPE OF MASTER CARR OR EQUAL		BRONZE
18		[illegible]	WIRE ROPE 3/8" DIA. 6x19 IWRC GALVANIZED		STEEL
17		24	SHACKLE, CHAIN 3/4" GALVANIZED		STEEL
16	[illegible]	24	CABLE SUPPORT GRIP, [illegible] SINGLE EYE 1.6" DIA. KELLEMS OR EQUAL		STAINLESS STEEL
15		44	WASHER, FLAT 1.062" I.D. 2.500" O.D. GALVANIZED		STEEL
14		22	NUT, HEX HD 1.000-8UNC-2B GALVANIZED		STEEL
13		22	BOLT, EYE 1" DIA. SHOULDER PATTERN THREADED 2" LENGTH		STEEL
12	[illegible]	1 GAL.	CEMENT, PVC CARLON OR EQUAL		
11	[illegible]	32	END PLUG, 3" DIA. CARLON OR EQUAL		POLYETHYLENE
10	[illegible]	20	COUPLING, 3" DIA. CARLON OR EQUAL		PVC
9	[illegible]	40	TERMINAL ADAPTER, 3" DIA. CARLON OR EQUAL		PVC
8	2-339	40	O-RING, 3.359 I.D. x 3.637 O.D. PARKER OR EQUAL		BUNA-N
7	[illegible]	40	FEMALE ADAPTER, 3" CARLON OR EQUAL		PVC
6	[illegible]	40	END BELL, 3" CARLON OR EQUAL		PVC
5		730LF	TIMBER, 3"x5" NOM. DIM. SEE NOTE 7		
4		2436LF	TIMBER, 3"x5" NOM. DIM. [illegible] 33" LENGTH SEE NOTE 7		
3	40011	410LF	CONDUIT, RIGID 3" NOM. DIA. SCHEDULE 40 CARLON OR EQUAL		PVC
2	11811	130LF	CONDUIT, FLEXIBLE 3" NOM. DIA. CARLON PVC FLEX OR EQUAL		PVC
1	[illegible]	[illegible]	CABLE, 1000 MCM		

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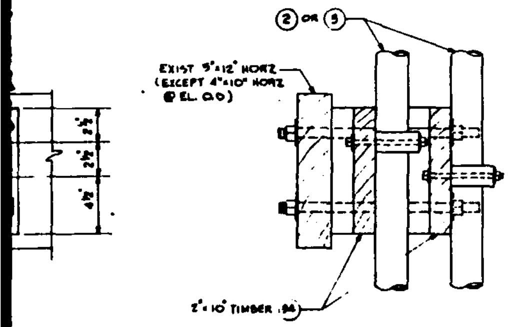

I 54/54 SECTION

SCALE: 1/2

A

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APPROVED DATE [illegible]	CONSTR. CONTR. NO.
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