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DATE - 31 MARCH 1984

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PHASE V

MARINE SEISMIC SYSTEM (MSS) DEPLOYMENT

FINAL REPORT

12 DECEMBER 1982 - 31 MARCH 1984

An investigation of techniques and deployment scenarics for installation of triaxial seismometer in a borehole in the deep ocean.

UNCLASSIFIED/UNLIMITED DISTRIBUTION

PREPARED BY:

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SPONSORED BY:

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NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY

UNDER CONTRACT N00014-83-C-0034

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This report presents the results of the Phase V operations activities associated with the Marine Seismic System (MSS) at-sea demonstration accomplished in January-March 1983. The operations were conducted using the Deep Sea Drilling Project's (DSDP) drillship, Glomar Challenger, and Scripp's R/V Melville. The overall MSS Deployment Program Plan and associated costs estimate have been upgraded to reflect the entire MSS Deployment Development Plan.

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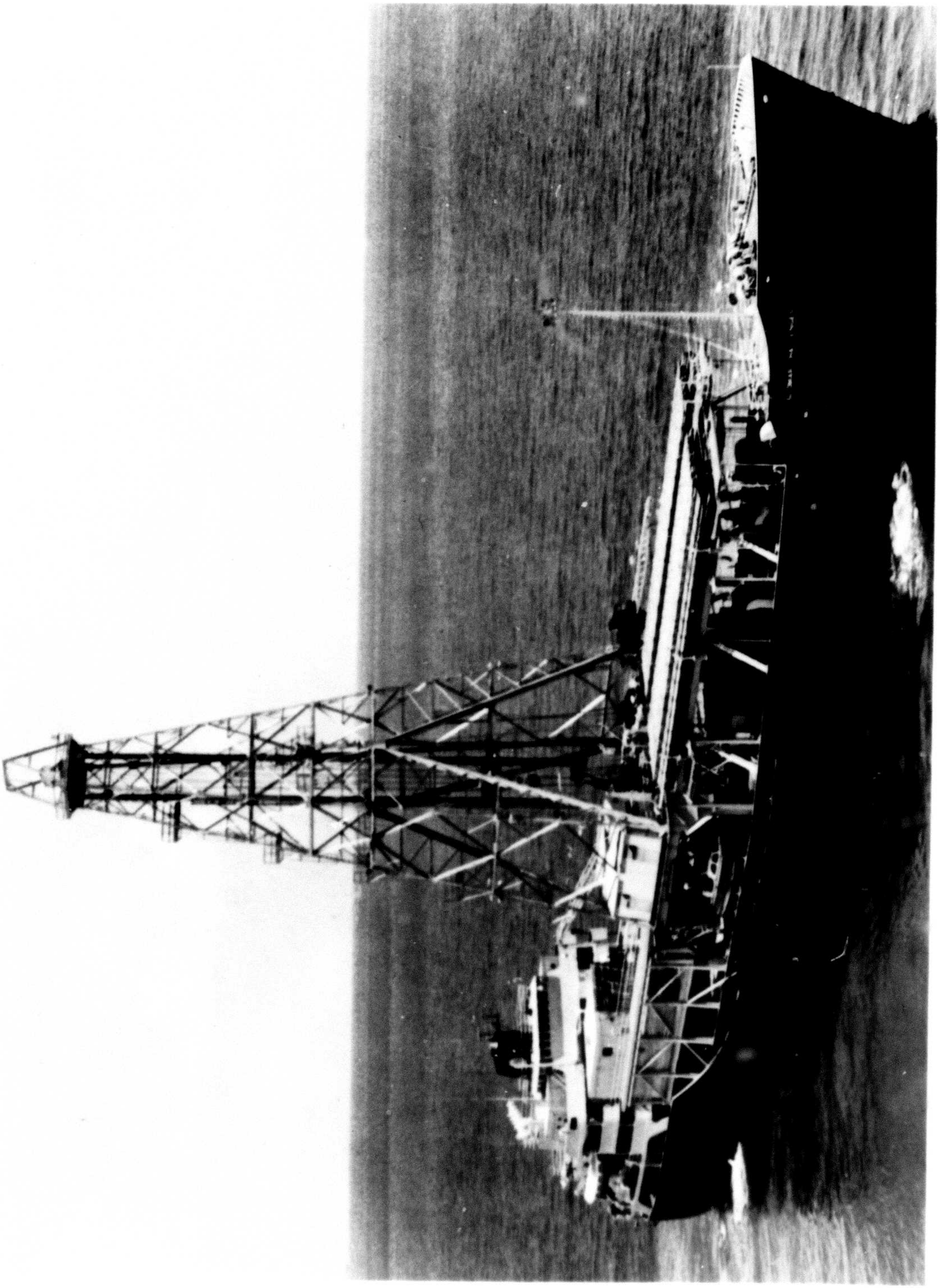
ACRONYMS

AMI	Agence Maritime Internationale
BHA	Bottom Hole Assembly
BIP	Borehole Instrumentation Package
BPP	Bottom Processing Package
CMP	Compagnie Maritime Polynesienne
DARPA	Defense Advanced Research Projects Agency
DARS	Data Acquisition Recording System
DSDP	Deep Sea Drilling Project
EM	Electro-Mechanical Cable
GBL	Government Bill of Lading
HIG	Hawaii Institute of Geophysics
ID	Inside Diameter
IRR	Installation, Recovery and Reinstallation
MAC	Military Airlift Command
MSC	Military Sealift Command
MSS	Marine Seismic System
NCEL	Naval Civil Engineering Laboratory
NORDA	Naval Ocean Research and Development Activity
OBS	Ocean Bottom Seismometers
OD	Outside Diameter
OSS	Ocean Subbottom Seismometer
ROM	Rough Order of Magnitude
TAC	Transportation Account Chargeable
TCN	Transportation Control Numbers
WBS	Work Breakdown Structure



SECTION 1.0 - SUMMARY

During the period 1979-1983, the Defense Advanced Research Projects Agency (DARPA) sponsored the Marine Seismic System (MSS) program that successfully accomplished two deepwater seismometer installations (MSS'81 Mid-Atlantic and MSS'83 South Pacific Sites) within specially emplaced seabed reentry boreholes. These deployments were accomplished by utilizing the Deep Sea Drilling Project's (DSDP) drillship, Glomar Challenger. The ship's deployment equipment and procedures as well as overall operations were developed under direction of the Naval Ocean Research & Development Activity (NORDA). The MSS'82 North Pacific deployment was not achieved due to equipment malfunctions, and the operation was eventually terminated due to the approach of a tropical hurricane.

Each of the three MSS operations contributed data, equipment refinement, and operational insight into the overall deep ocean deployment technology. Based upon this experience, large seismometers or other delicate instruments can be confidently deployed, utilizing the drillstring reentry technique, into seabed sediment or basalt formations in water depths to 6,096 m (20,000 ft).

This report describes the design features, background analyses, and operational approach associated with the MSS Deployment System. All three MSS operations are reviewed but with particular emphasis on the latest MSS'83 South Pacific deployment and recovery activities. Important development problems and/or design uncertainties are also discussed. A list of references is provided as well as a detailed listing of all applicable reports and drawings.

Future MSS-type deployments can be accomplished utilizing the basic equipment currently stored at NORDA. Alternate dynamically positioned drillships can be utilized with appropriate equipment modifications and specialized training if the Glomar Challenger is no longer available. If future deployments are considered, fly-in reentry development should be undertaken to provide an alternative drillstring type reentry deployment.

SECTION 2.0 - PROGRAM OVERVIEW

The Marine Seismic System (MSS) Program focused on developing a sensitive seismic Borehole Instrumentation Package (BIP) and associated support equipment to be deployed into the basalt layer of the ocean floor in water depths to 6,096 m (20,000 ft) (Reference 2). Deep boreholes were drilled and cased through the sediment, into the basalt layer, utilizing standard deep ocean drilling techniques and equipment which have been developed during the National Science Foundation (NSF) sponsored Deep Sea Drilling Project (DSDP). The dynamically-positioned drillship Glomar Challenger, which is operated by Global Marine Drilling Company (GMDC), was the vessel utilized for the program. The BIP deployment concept is termed "Configuration I." Deployment is accomplished by lowering a reentry sub mounted with a BIP, to the ocean floor on a drill string. The reentry sub incorporates a sonar controlled reentry tool which guides the BIP into a reentry cone which had previously been installed over the borehole as shown in Figure 2-1. The standard DSDP procedures were slightly modified to accommodate the MSS configurations.

The major operational elements of the overall MSS Deployment Program are summarized in the following subsections:

2.1 MSS '81

The MSS equipment was mobilized in San Juan, Puerto Rico, and was installed on the Glomar Challenger which departed for the test site on 14 March 1981. The reentry site was located in the mid-Atlantic at a depth of 4,484 m (14,712 ft). Within seventy-three hours, the Glomar Challenger emplanted and recovered a BIP using an existing DSDP borehole. The at-sea-test demonstration was successfully completed on 30 March 1981. Feasibility of the BIP deployment concept, using the drill string reentry technique and the basic capabilities of the seismic sensor when deployed in the deep ocean borehole, were successfully demonstrated.

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2.2 MSS '82

In August-September 1982, the Glomar Challenger crew attempted to drill a reentry borehole and to emplace a Configuration I BIP at a Northwest Pacific site. A thirty-day special DARPA operation leg was scheduled to deploy the BIP and the associated Installation, Recovery and Reinstallation (IRR) equipment in 5,608 m (18,100 ft) water depth. However, due to equipment malfunctions, drilling of the reentry borehole could not be successfully accomplished within the time period alloted.

2.3 MSS '83

The MSS '83 operation was conducted at a new DARPA site in the South Pacific in January 1983. The Glomar Challenger transited to the site and emplanted a cased reentry borehole in approximately 5,639 m (18,500 ft) of water. The BIP was deployed and five days of seismic testing were accomplished. Subsequently, the Bottom Processing Package (BPP) and its associated Installation, Recovery and Reinstallation (IRR) mooring system were then successfully deployed. During March 1983, the RV Melville returned to the DARPA site, successfully recovered the BPP, and redeployed a dummy BPP.

SECTION 3.0 - CONCLUSIONS AND RECOMMENDATIONS

Preliminary data indicate that the seismic background "noise" within a deep ocean borehole is considerably less than that experienced by OBS (Ocean Bottom Seismometers) seabed installations. A capability now exists for installing large seismometers or other delicate instrument packages within deep ocean boreholes drilled into basalt basement. Potential installation sites with water depths to 6,096 m (20,000 ft) and borehole depths to 609 m (2,000 ft) are possible with appropriate consideration of weather and currents. The MSS program successfully employed the DSDP vessel Glomar Challenger; however, other dynamic positioned drillships could be utilized for future missions which would require only adaptation of equipment plus special training of the crew.

The questions of program feasibility were resolved, and much information was derived from the three operations. However, the technical areas which should be further explored are as follows:

- Lateral response of unsupported drillstring to drilling and deployment functions.
- Accurate measurements of static and dynamic drillstring loads.
- Measurement of EM Cable loads and payout lengths.
- Improved reentry control.
- Subsea positioning accuracy

It is recommended that the above areas should be more fully evaluated in order to improve reliability and overall confidence of success particularly in very deep water conditions. A particular problem was associated with electronic interference with the data recording instrumentation. A drillship is very "noisy" and extreme care must be taken to electrically isolate all sensor and readout circuitry.

The present defined concept requires a dynamically-positioned drillship to emplace the borehole and to deploy the packaged instrument. Once the borehole is emplaced, various instrument configurations could be deployed and recovered. Considerably more flexibility for subsequent deployments could be provided if the development of cable reentry deployment is undertaken. The basic elements of such technology are available but are distributed among many diverse organizations. Thus, it is recommended that a reentry fly-in program be initiated that can direct and insert a large packaged instrument into the reentry borehole. This capability would obviate the absolute need for dynamic drillship for subsequent deployments.

SECTION 4.0 - DEPLOYMENT SYSTEM DESCRIPTION

The MSS Configuration I equipment is composed of shipboard and subsea equipment.

4.1 SHIPBOARD EQUIPMENT AND MODIFICATIONS

The shipboard equipment consisted of a dual bull wheel EM cable winch; a specially constructed over the side A-Frame; a single cylinder heave compensator, adapted from a guideline tensioner; an idler sheave; and a large swiveled sheave block. This equipment was mounted on the portside of the main deck of the *Glomar Challenger* between the derrick subbase and the casing support rack. Figures 4-1 and 4-2 show the general layout of this shipboard installation.

4.1.1 EM Cable Winch

The Electro-Mechanical (EM) Cable Winch, supplied by NORDA, was initially used during the at-sea-test deployment demonstration conducted in the mid-Atlantic in March 1981 and was refurbished at the Pengo factory early in 1982. Figure 4-3 shows the modified Pengo Winch prior to shipment.

The EM Cable Winch has a dual bull gear, is diesel powered, and is hydraulically driven.

The winch is 2.8 m high by 2.3 m wide by 5.9 m long (9 ft x 7.5 ft x 19.4 ft). Mounted to a specially welded deck foundation, the winch weighs about 17,300 kg (38,000 lbs) when loaded with cable. The reel can carry approximately 9,000 m (29,528 ft) of 1.58 cm (.62 in.) cable; maximum loading is approximately 6,800 kg (14,960 lb).

4.1.2 A-Frame

The improved A-Frame structure was of simple design, mounted on two pinned inboard pedestals and attached to a central heave compensator

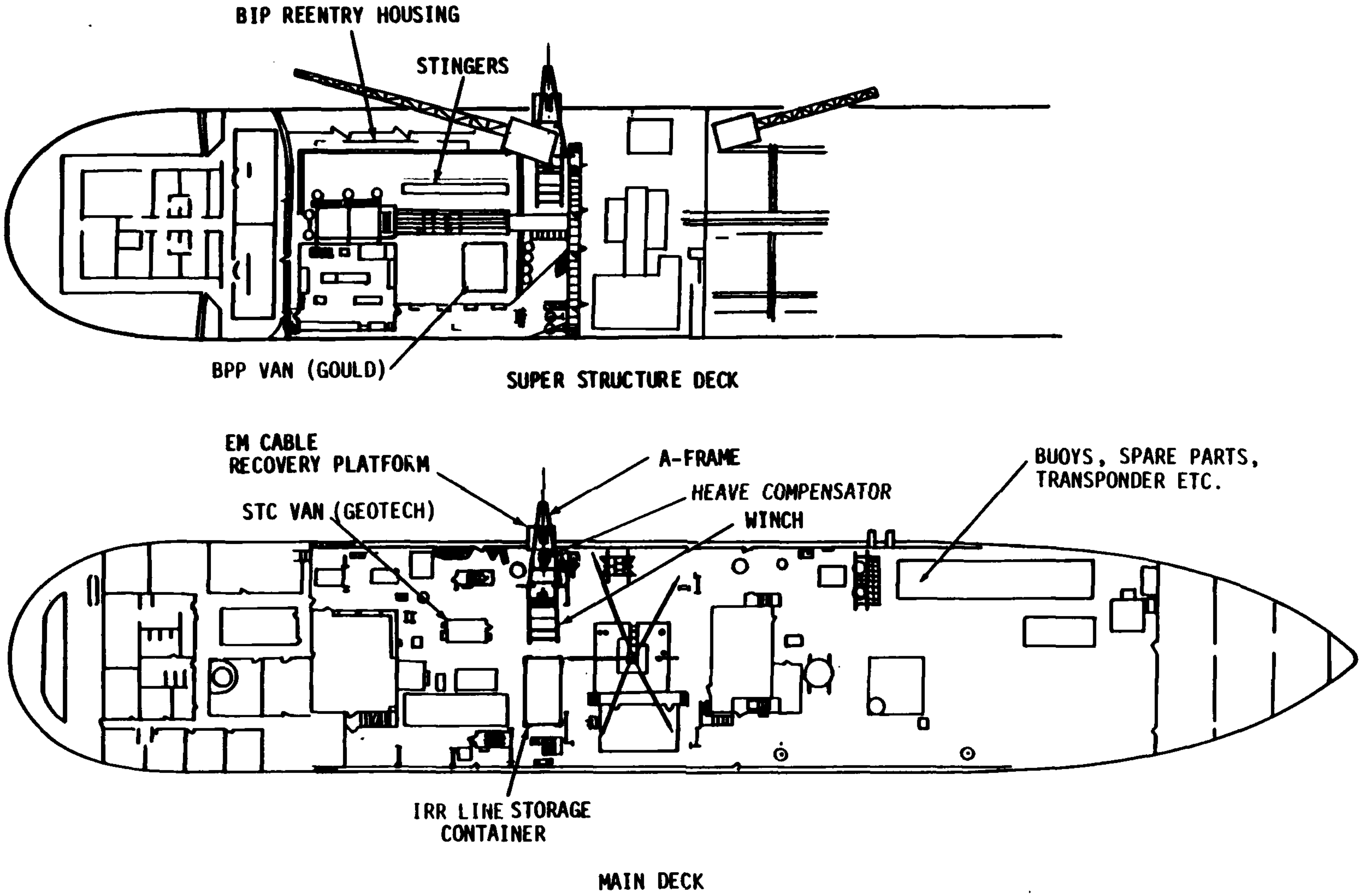

FIGURE 4-1 MSS '82/83 GLOMAR CHALLENGER ARRANGEMENT

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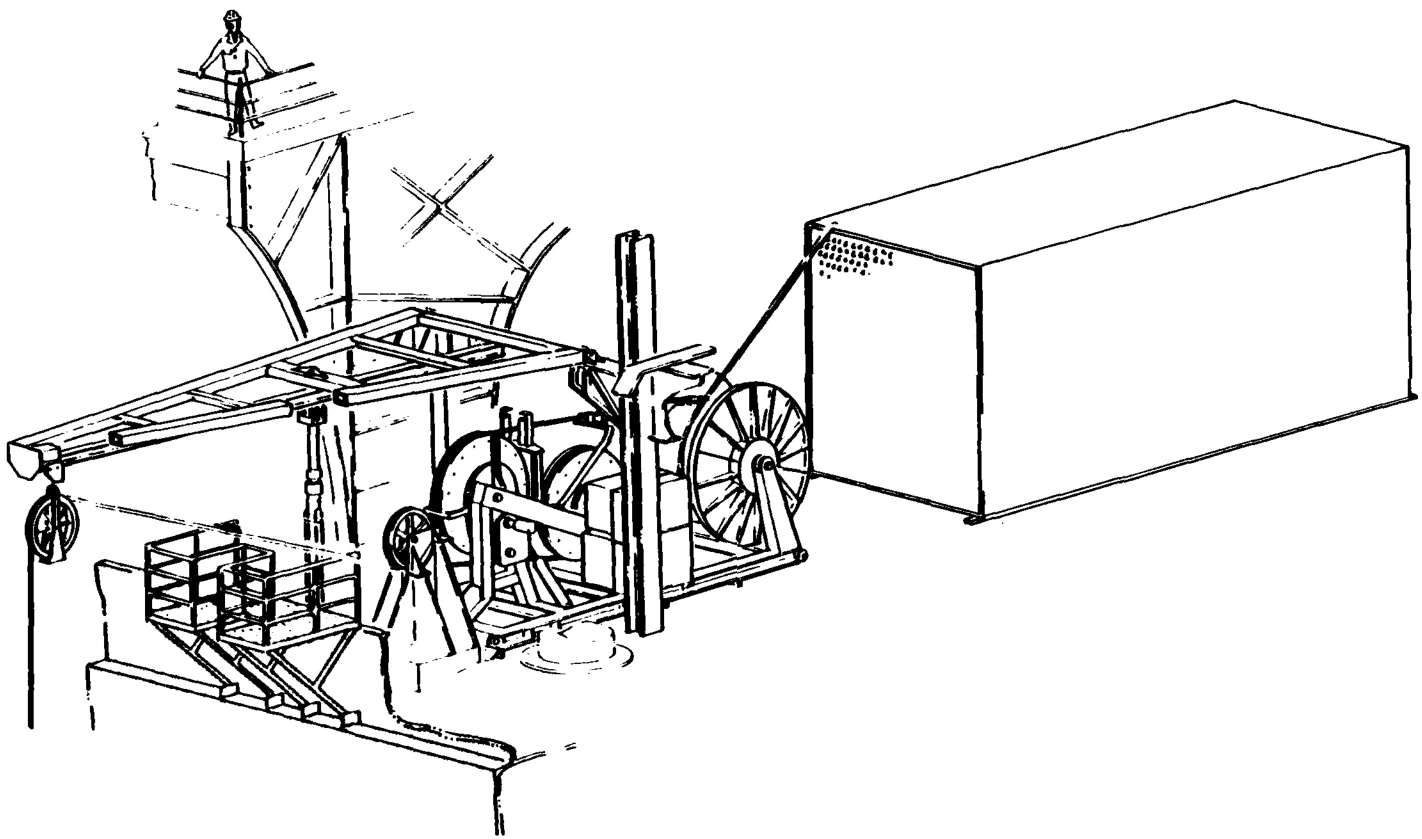

FIGURE 4-2 SHIPBOARD SUPPORT EQUIPMENT INSTALLED ABOARD THE GLOMAR CHALLENGER

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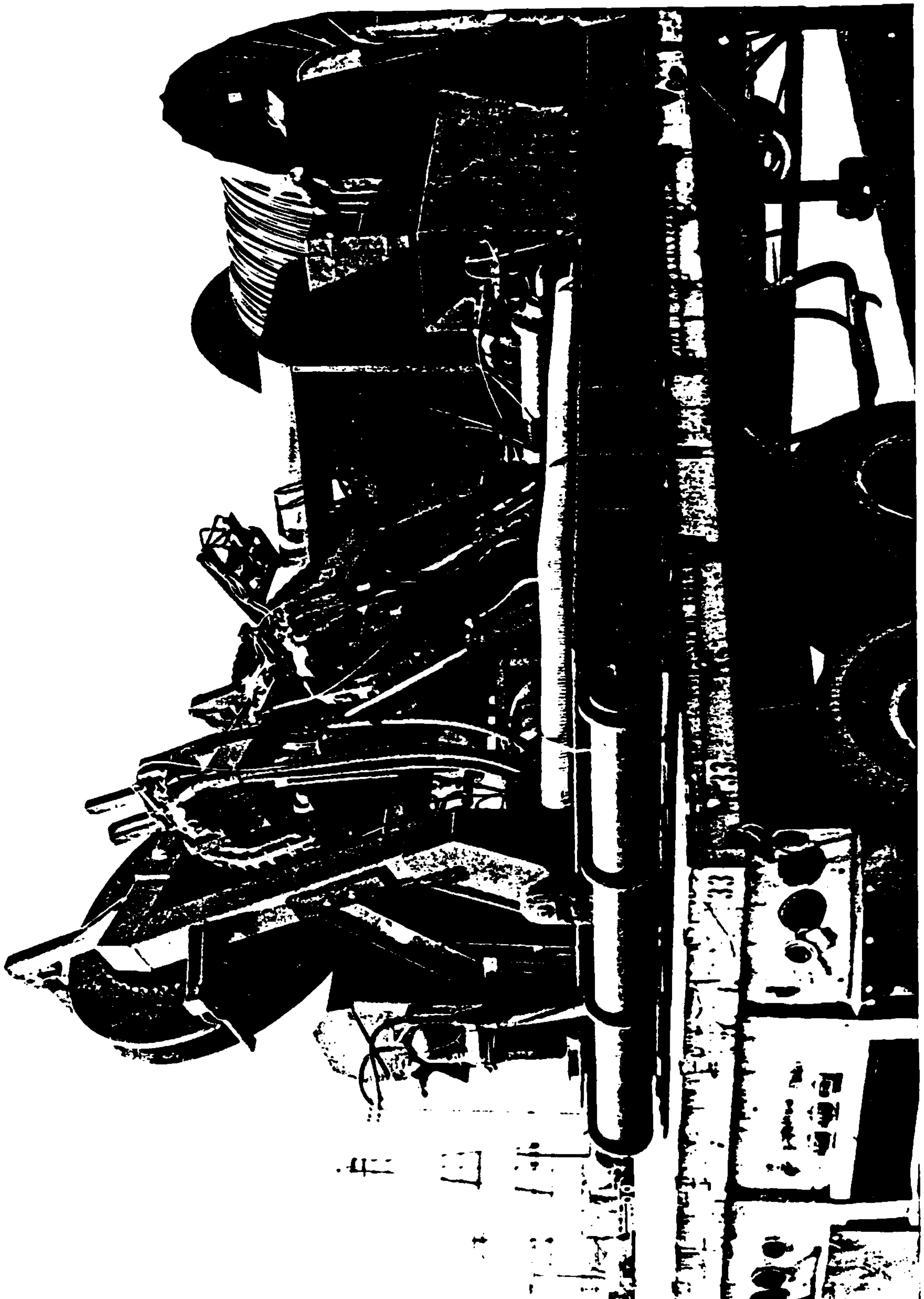


FIGURE 4-3 PENGO EM WINCH

cylinder. The A-Frame projected out above the deck about 2.4 m (8 ft) high and overhung the side approximately 4.6 m (15 ft). The A-Frame was rated at and tested to 12,700 kg (28,000 lb). The initial A-Frame and support structure was fabricated at Puerto Rico Drydock and Marine Terminals shipyard.

The improved A-Frame was a newly fabricated structure strengthened for the greater loads anticipated during the BPP Deployment and Recovery operations. During the operation it became apparent that the swivel sheave had to be changed to improve safety during deployment of the BPP Mooring System. The swivel sheave was remounted on an I-Beam trolley that could be moved inboard by a 10 ton Duff-North Jactuator jacking screw manually driven by a chain wheel. The gear ratio of the Jactuator was chosen so that the trolley could be held in any selected position without requiring a special securing mechanism. Figure 4-4 shows the early A-Frame prior to the lead screw installation.

4.1.3 Heave Compensator

The heave compensator operated off two accumulator bottles interconnected to four standard pressurized nitrogen bottles. The stroke of the heave compensator was approximately 2.3 m (7.5 ft). The system was rated at 176 kg/cm^2 (2,500 psi). The system was controlled manually at the manifold console. The stiffness could be varied by selecting gas volume availability.

An additional 41.7 L (11 gal) accumulator bottle had been added and improved the overall operational response of the system. Figures 4-5 and 4-6 show the heave compensator and the associated heave compensator control panel, respectively.

4.1.4 Idler Sheave

An idler sheave's function is to align the EM Cable off the A-Frame sheave with the winch bull gear. The idler sheave was modified by adding a strain-sert pin and load-all indicator. The indicator was calibrated to give a direct reading of the tension in the EM Cable.

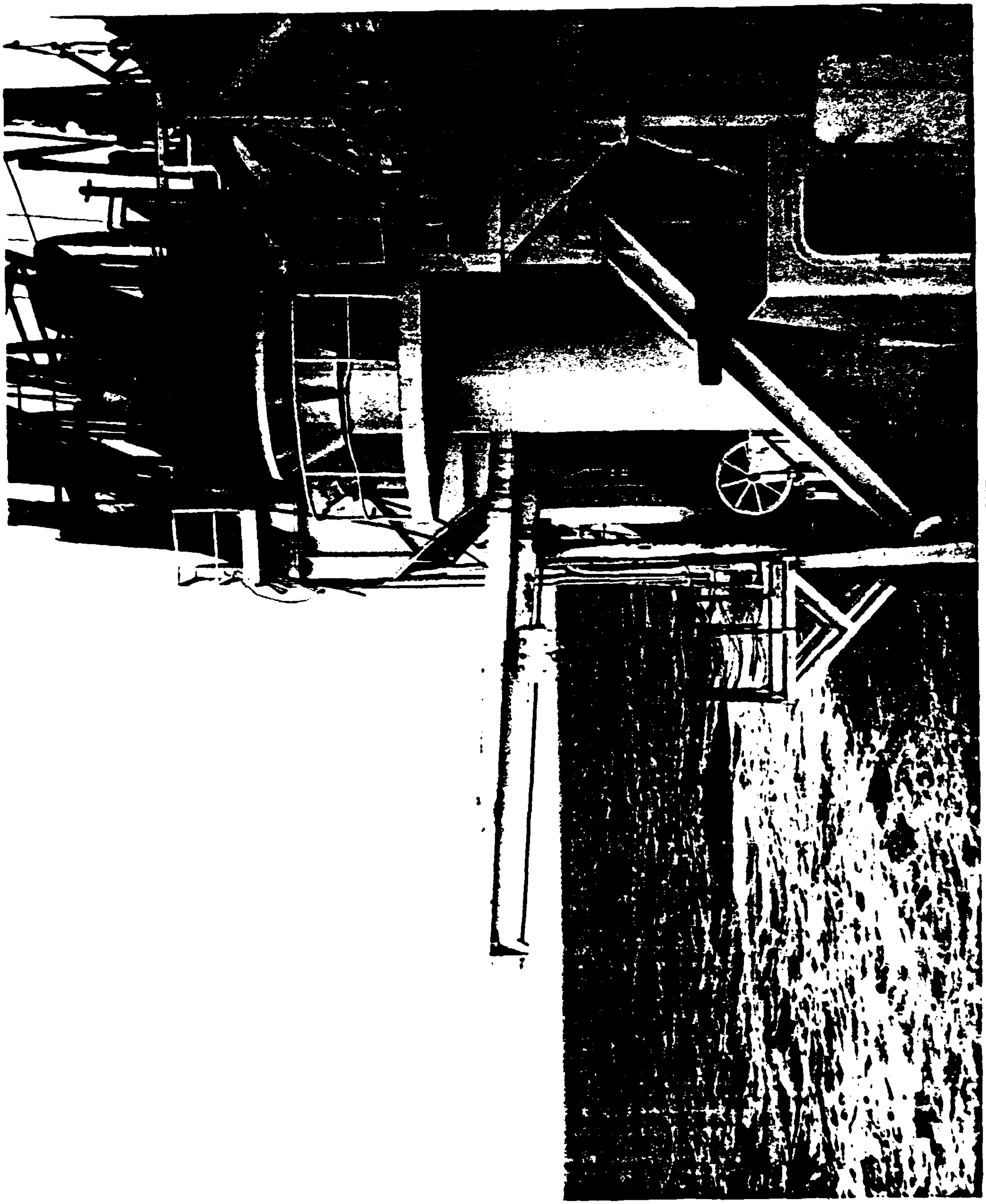


FIGURE 4-4 "A" FRAME

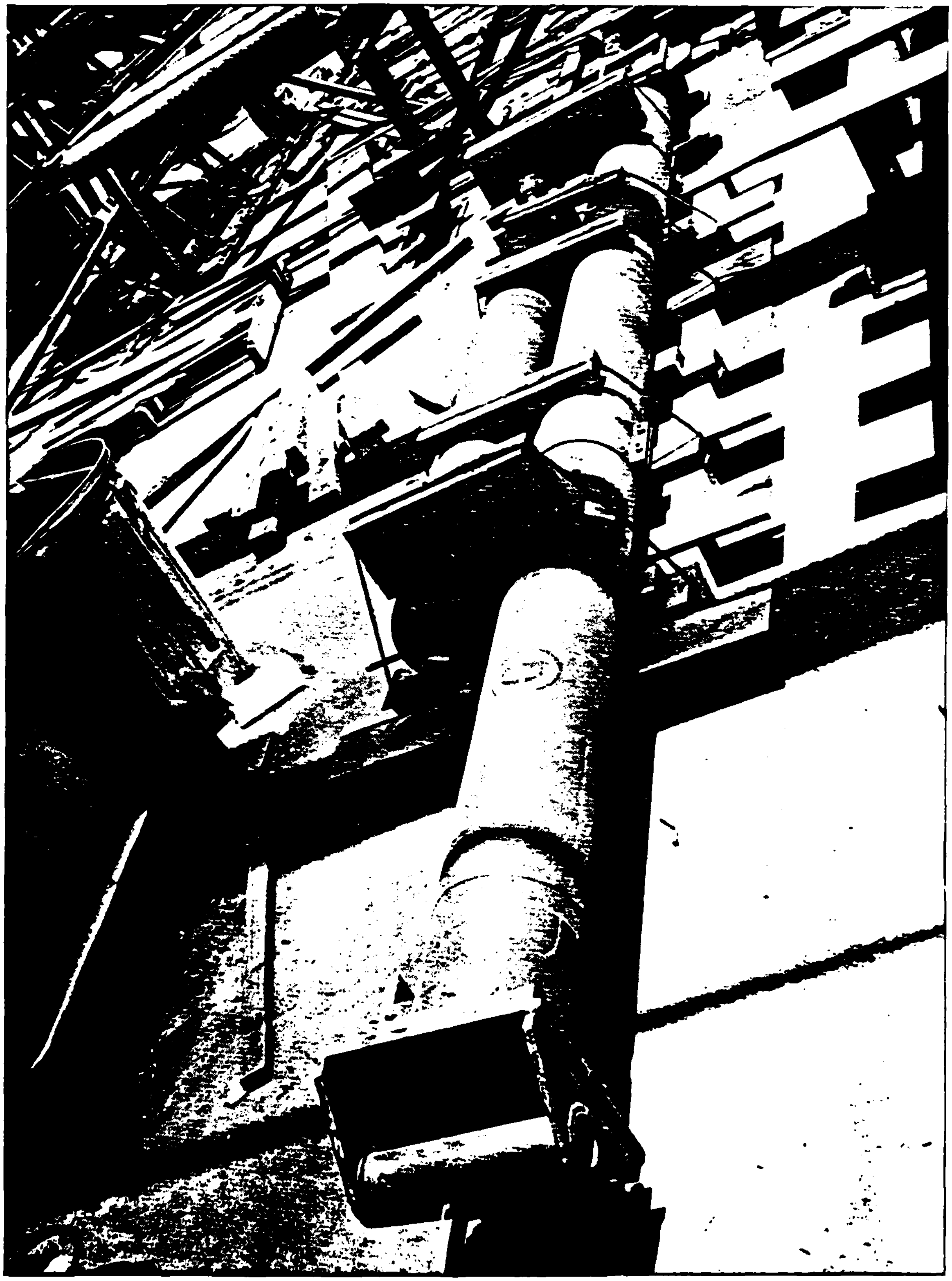


FIGURE 4-5 HEAVE COMPENSATOR

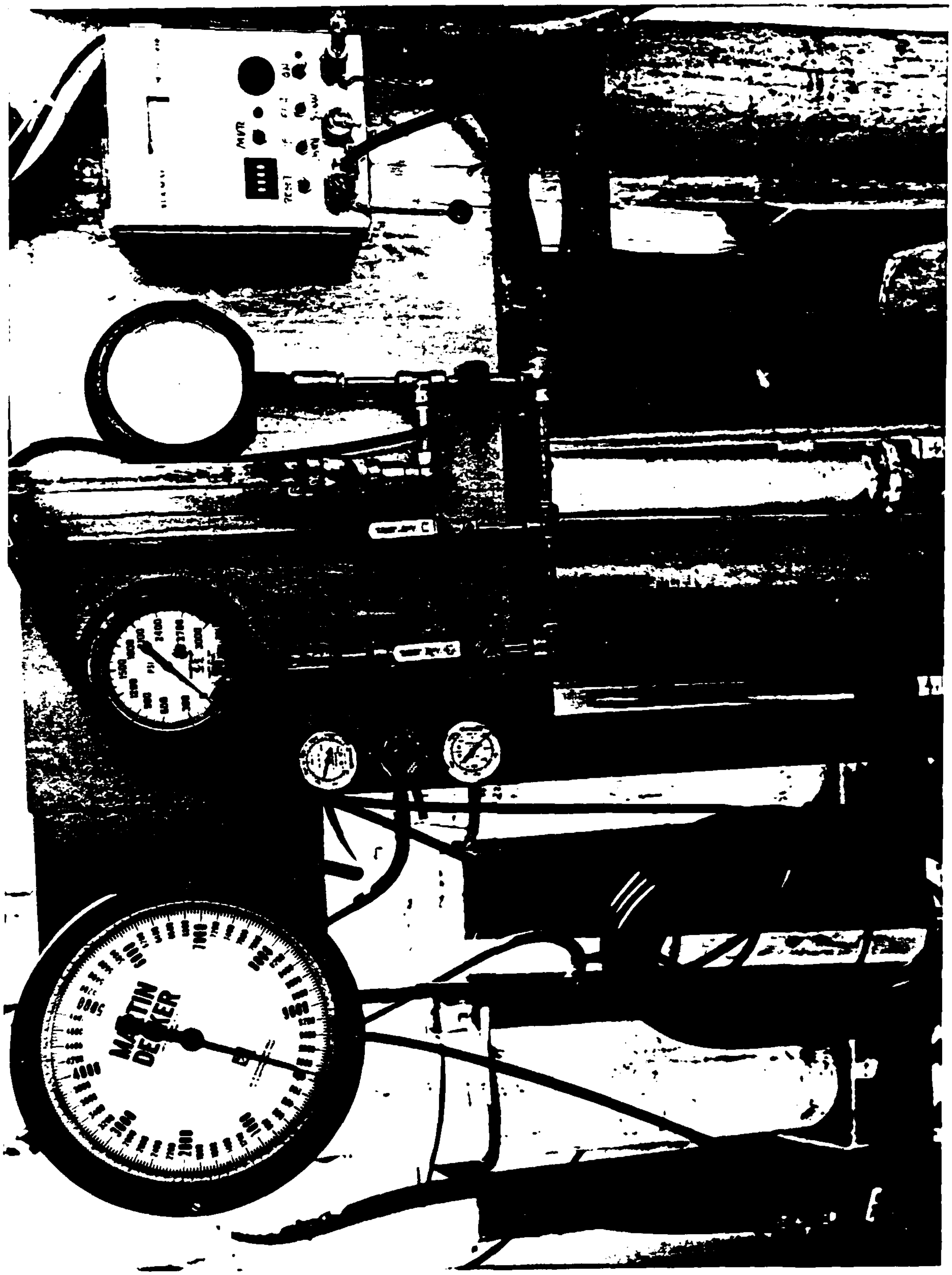


FIGURE 4-6 HEAVE COMPENSATOR CONTROL PANEL

The redesigned idler sheave also included a relocated Martin-Decker load cell. However, during the operation it was determined that this load cell functioned better in its original position, between the end of the A-Frame and the swivel sheave. Figure 4-7 is a close-up view of the idler sheave with the strain-sert load cell installed. A dampened and undampened analog recorder output was provided.

4.1.5 Work Platform

A portable platform was suspended from the bulkwark, 1.2 m (4 ft) above the main deck in the vicinity of the EM Cable. This platform was used for changing out the swivel sheave which was suspended from the A-Frame trolley. It was also used for securing the EM Cable during load transfer required for the BPP Deployment.

4.1.6 Mooring Line Container

The line for the IRR mooring was stored in a 2.4 m x 2.4 m x 6.1 m (8' x 8' x 20') steel container. The cable container was installed on the starboard side of the main deck in line with, and athwart ship of, the EM Cable winch. A foundation was made to accommodate the deck camber and to permit water to flow under the cable container.

4.1.7 BIP Carriage Stowage

Three brackets were installed on the port side of the casing rack to stow the BIP carriage housing.

4.2 SUBSEA EQUIPMENT AND MODIFICATIONS

The subsea equipment consisted of a reentry sub, which was attached to the lower end of the drill string, and a specially designed coaxial EM Cable provided by NORDA. The reentry sub was made up of a carriage housing, stinger and control sub. The reentry sub incorporated a shock mount intended to absorb the impact on the BIP during reentry into the borehole.

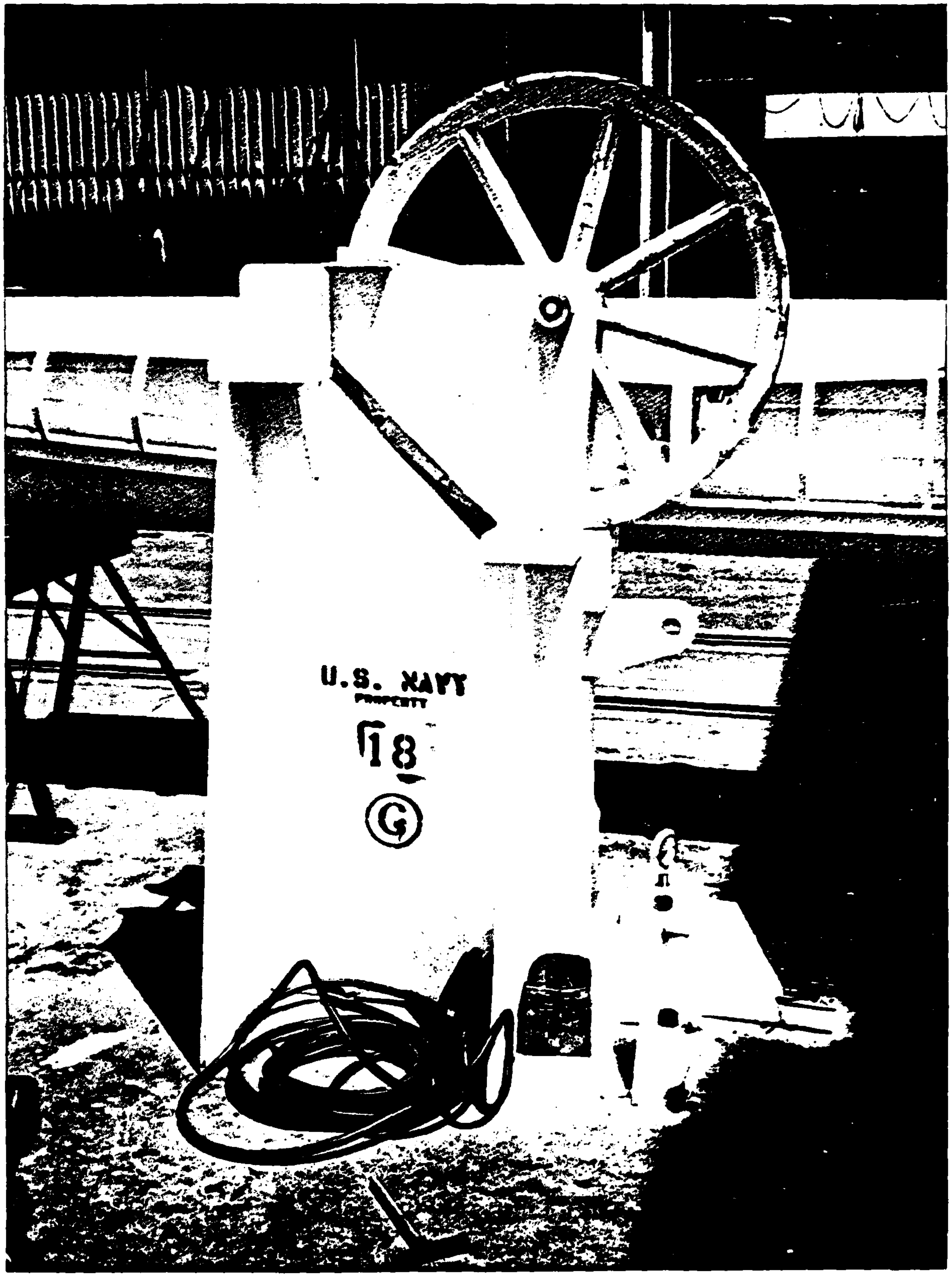


FIGURE 4-7 IDLER SHEAVE

4.2.1 Deployment of Subsea Equipment

The primary function of the reentry sub was to emplace a functional BIP into a predrilled borehole. The functional steps were to:

- Carry the BIP in a protective enclosure during drill string deployment.
- Support and position the sonar reentry tool to locate the reentry cone in the same manner as used during conventional DSDP drilling operations.
- Stab reentry tool into the reentry cone. BIP accelerations must be limited to less than 10 Gs.
- Release the BIP and allow it to be lowered into the borehole.
- Allow the EM Cable to run freely into the borehole.
- Release the EM Cable after the reentry sub is raised and removed from the reentry cone.

4.2.2 Limitations

In order to use existing shipboard equipment and procedures, the following dimensional limitations were placed on the design of the reentry sub:

- Must be similar in weight to the normal downhole assembly.
- Must be capable of passing through the existing rotary table and the moonpool guide horn on the Glomar Challenger. This limited the outside diameter (OD) of the reentry sub to 78.7 cm (31 in.).
- Must be capable of being stabbed into the existing reentry cone and casing. The inside diameter (ID) of the cone base was no more than 61 cm (24 in.).
- Stinger must support the 9.5 cm (3.75 in.) OD sonar reentry tool which is much smaller than the BIP diameter and thus requires a removable support.

4.2.3 Reentry Sub

The overall reentry assembly is 22.4 m (73.5 ft) long and when loaded weighs about 10,400 kg (22,880 lbs). The transition to the drill string is provided by four or five bumper subs plus a lightweight drill collar. The reentry assembly is composed of three major subs as described below.

The reentry control sub is a heavy wall, high strength cylinder designed to mate with a Baker internal packer plug. With the plug in place, saltwater hydraulic pressure could be provided for release actuation. The sub is also designed to support a special Edo reentry sonar tool assembly. The sub is 0.3 m (1 ft) in diameter by 2.3 m (7.5 ft) long and is fabricated of 4140 steel.

The housing assembly is a 12 m (39 ft) long welded structure which supports an internal moveable carriage. Within the carriage, the BIP is installed on shock mounts. The carriage is initially carried off the centerline to provide clearance for the reentry sonar tool. The carriage is locked in place by four shear pins. When the saltwater pressure is applied to two hydraulic cylinders, four cables shear the pins and actuate the carriage laterally into the centerline release position.

The lower stinger section is guided into and seated at the reentry cone throat. This overall section is 8.3 m (27 ft) long and is configured to deploy through the moonpool guide horn. The stinger is bolted to the housing section with eight high strength bolts. The diameter of the bottom portion is restricted to insert inside the 0.25 m (8 in.) casing. Internally, four split breakaway aluminum segments guide the reentry tool and are later ejected by the BIP.

Figure 4-8 is a layout of the complete Configuration I reentry sub, and Figure 4-9 is a picture of the complete assembly during testing.

In March 1981 during the deployment exercise, a potential problem developed when the stinger bent and the reentry stinger cable release slot partially closed at the stinger-cone interface. Although this partial closure did not inhibit operations at the time, the stinger was later redesigned to provide a better interface with the cone-stinger and to improve the section by a factor of 10 thereby reducing the possibility of the EM Cable slot inadvertently closing.

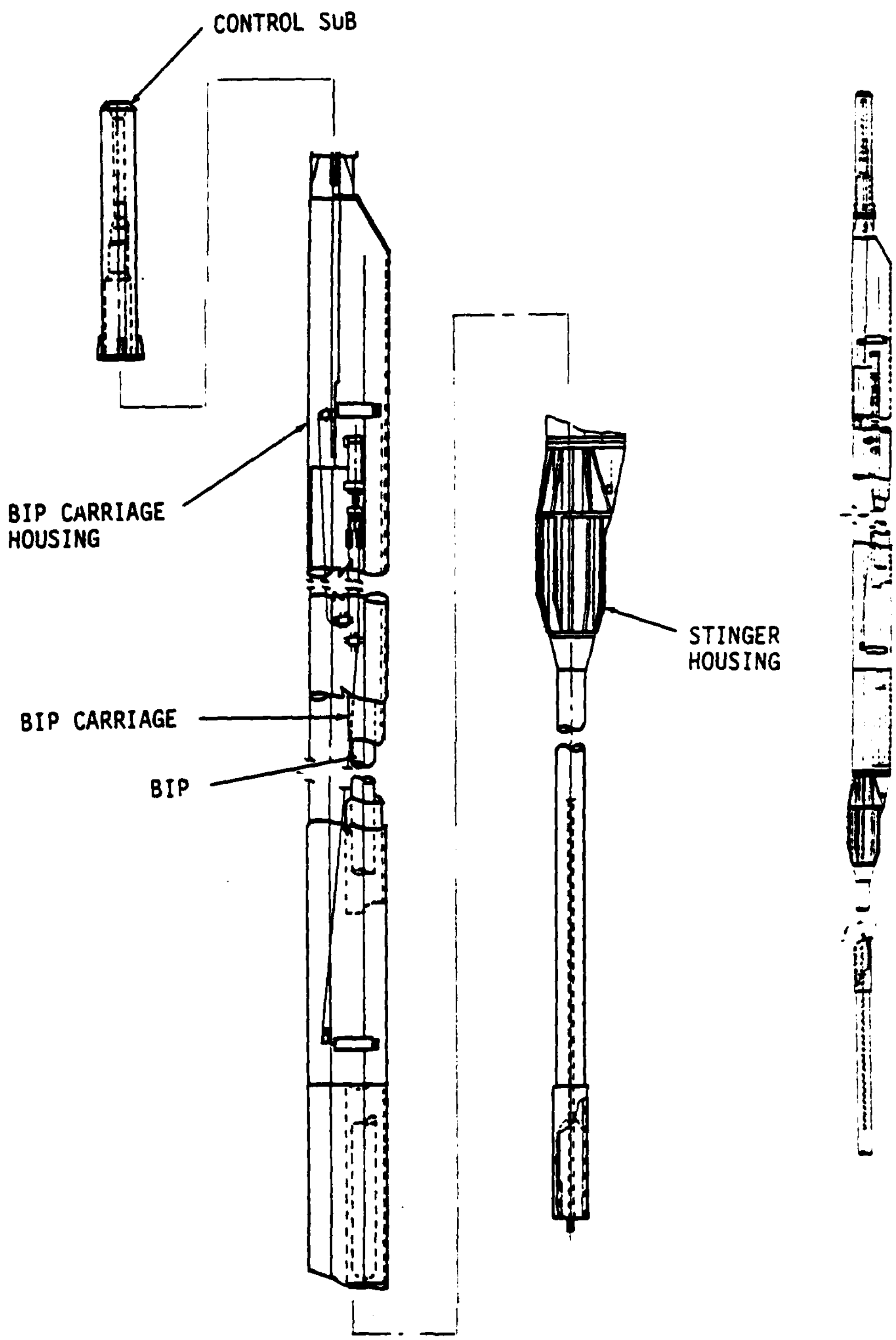


FIGURE 4-8 CONFIGURATION I REENTRY ASSEMBLY

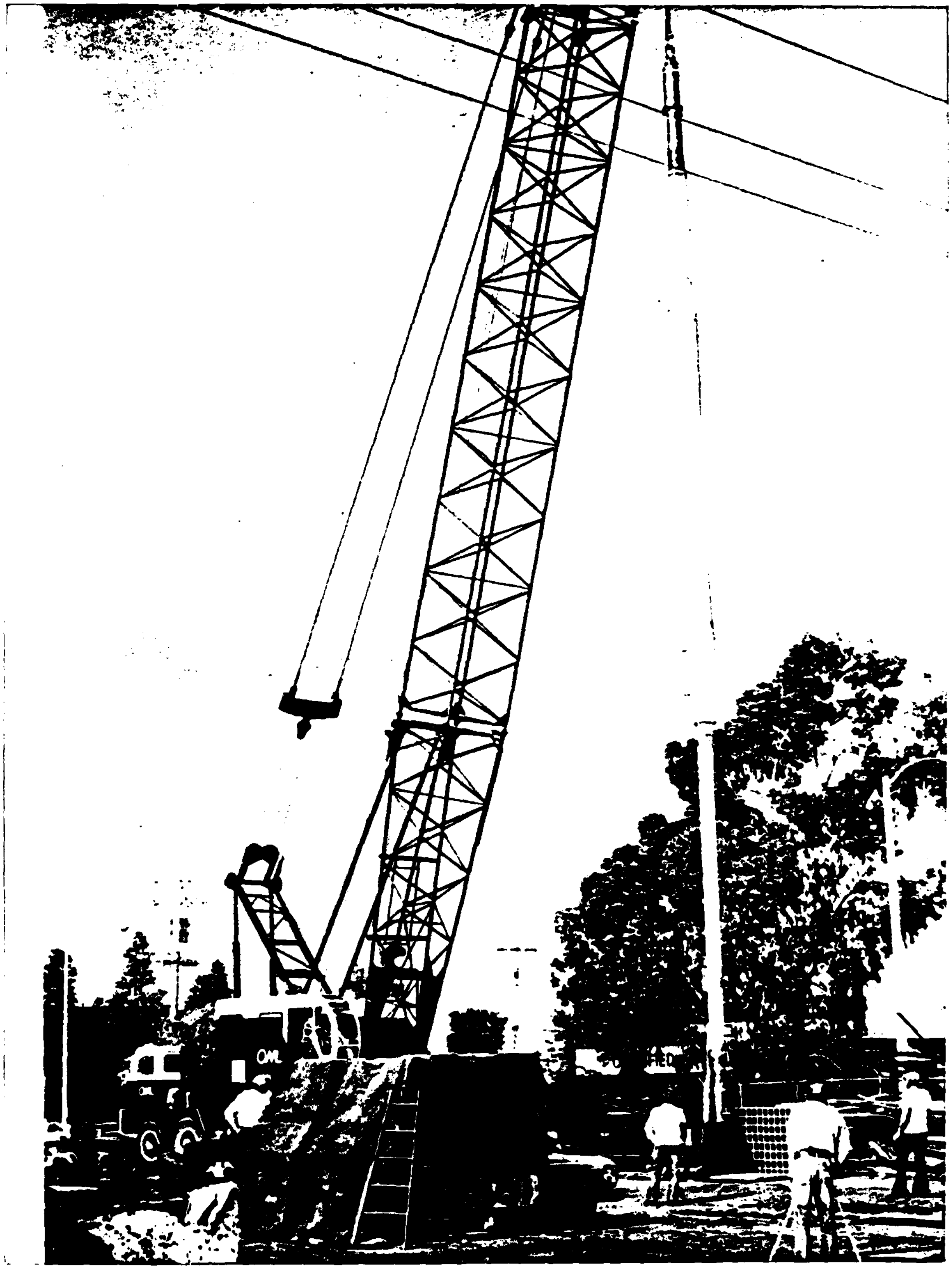


FIGURE 4-9 FIELD TEST OF REENTRY SUB

The bottom of the stinger was also modified to accommodate a sonar centering breakaway plug. This plug is supported by shear pins capable of supporting the weight of the sonar tool, but which shear when the weight of the BIP is released. Figure 4-10 shows the stinger just prior to testing.

The BIP carriage housing was lengthened by 1.52 m (5 ft) to accommodate the redesigned longer BIP. The carriage lug shear pin arrangement was also improved for easier installation of the shear pins. The reentry carriage housing is shown on Figure 4-11. The MSS '82/'83 BIP was equipped with an isolating centering device which kicks-out locking dogs when there is no load on the EM Cable. A shock absorber lined with stainless steel was installed in the BIP carriage to restrain these dogs during the BIP carriage transfer operation.

Since it is no longer necessary to use the hydraulic plug as a sonar centering device at the bottom of the stinger, the control sub was modified by permanently welding the hydraulic plug/sonar adapter in the control sub position. This centering function is now served by the sonar breakaway plug or centralizer spring. This modification eliminates the drill string trip that was necessary to move the hydraulic plug/sonar adaptor from the bottom of the stinger position up to the control sub position.

The hydraulic plug/sonar adapter was modified to supply a shoulder to support a new Baker check valve. This valve packs off the opening through the control sub when the saltwater hydraulic system is activated. The adapter had to be later reworked to fit a subsized DSDP drill string ID.

The sonar tool sinker bar assembly has an overall length of 21 m (69 ft) which includes the sonar tool, a centering spring, three lengths of 5 cm (2 in.) Schedule 80 steel pipe and a support sub. The supporting shoulder was also used to support the sonar sinker bar assembly. With the support sub resting on the hydraulic plug/sonar adaptor support shoulder, the sonar tool extends about 15 cm (6 in.) beyond the end of the stinger.

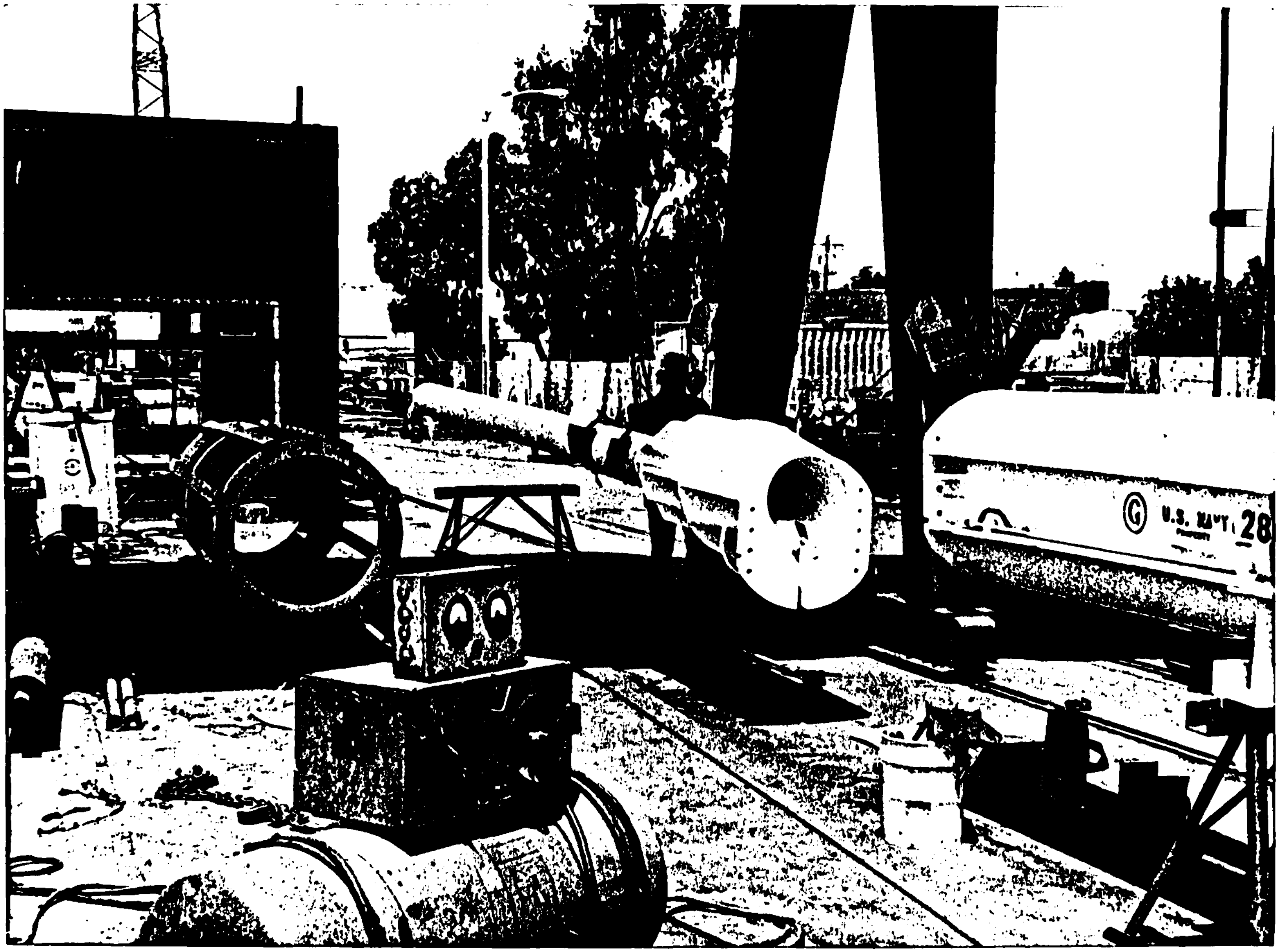


FIGURE 4-10 REENTRY STINGER

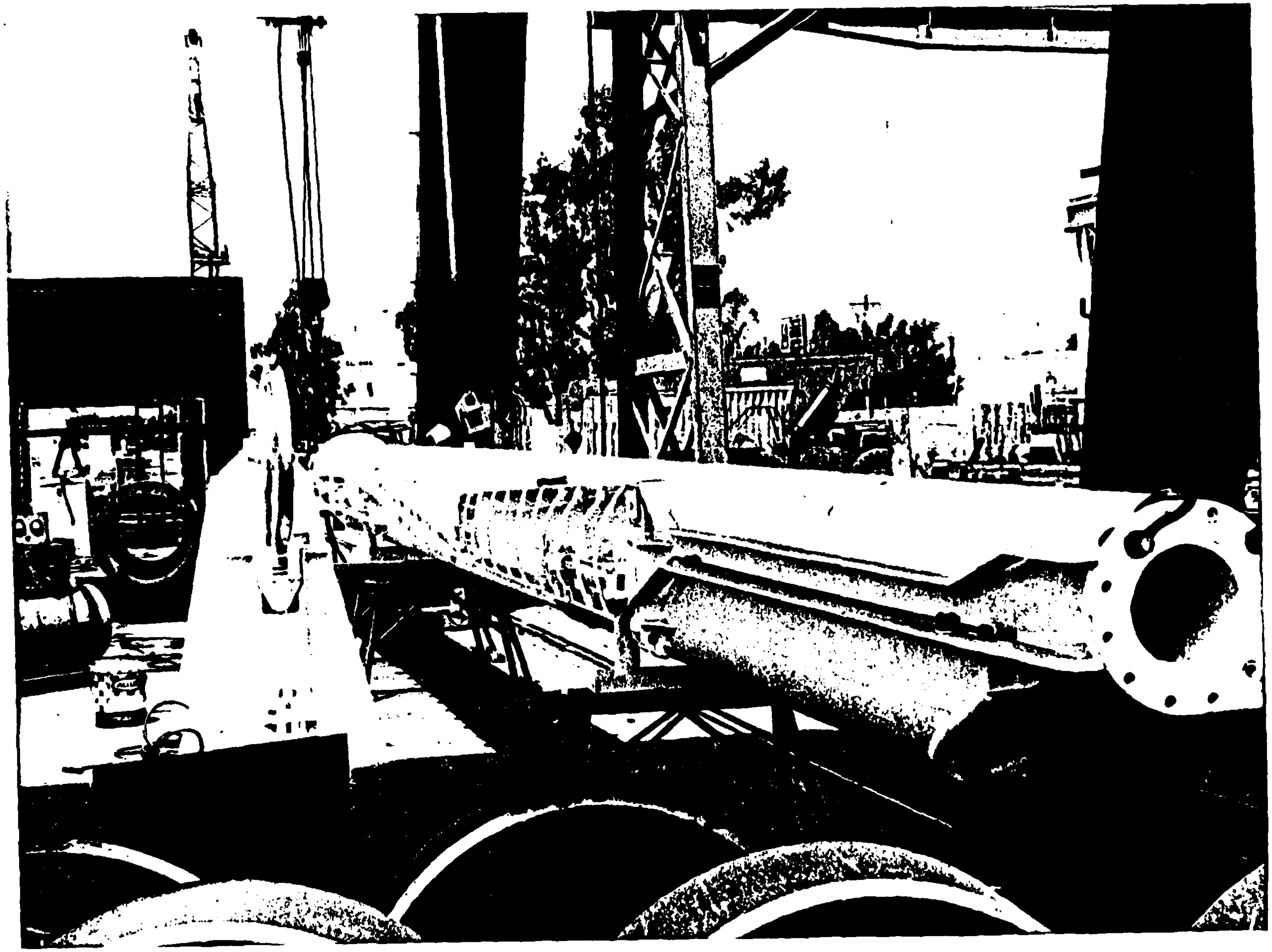
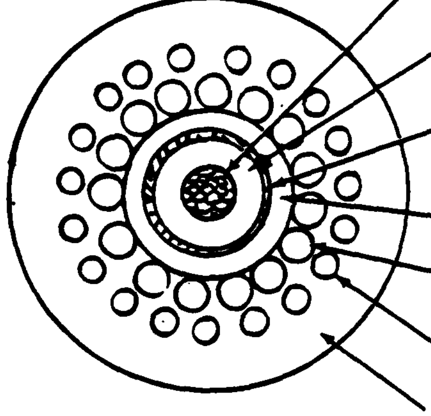


FIGURE 4-11 REENTRY HOUSING

4.2.4 EM Cable

Approximately 9,100 m (29,855 ft) of EM Cable, specially developed for NORDA, were utilized in all the operations. The center element was a No. 10 AWG stranded 18/.59 mm SBC with nylon center filament wire. Enclosing the wire were LH and RH armored low torque balanced mesh. The outside covering was 1 mm wall Hytrel sheath with OD of 17.6 mm. The wet and dry weights were 439 kg/km and 688 kg/km, respectively. Figure 4-12 shows a cross section of the EM Cable.

THE BIP EM CABLE IS A SUBMARINE TOW CABLE CONSISTING OF (10) #10 AWG COAX WITH AN OVERALL DOUBLE-CAGED ARMOR AND HYTREL JACKET.



CHARACTERISTICS

• ELECTRICAL:

NOM CONDUCTOR DC RESISTANCE @ 20°C:	@10 AWG:	1.08 OHMS/KFT
	COAX RETURN BRAID:	1.40 OHMS/KFT
VOLTAGE RATING:		2,500 VOLTS RMS
CHARACTERISTIC IMPENDANCE:		40 OHMS (REF)
ATTENUATION AT 500 KC:		1.4 DB/KFT

• MECHANICAL:

FILLED SHIELD:	TEMPLUBE BLKNG COMPOUND.
BREAK STRENGTH:	21,000#
WEIGHT IN AIR:	462 #/KFT
WEIGHT IN WATER (SG = 1.027)	295 #/KFT

TORQUE BALANCED DESIGN

FIGURE 4-12 MSS EM CABLE CROSS SECTION

SECTION 5.0 - MSS INSTALLATION, RECOVERY AND REINSTALLATION SYSTEM

5.1 BACKGROUND

In 1981, NORDA decided to add a Data Acquisition Recording System (DARS) to the MSS. The DARS electronic package, along with the silver-zinc batteries and auxiliary equipment, made up the Bottom Processing Package (BPP). To provide recovery and redeployment capability, the Installation, Recovery and Reinstallation (IRR) System was assembled. The Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California, was assigned the responsibility of designing the BPP and IRR equipment (Reference 11). The detail design and procurement were the responsibilities of GMDI.

5.2 IRR DESIGN FEATURES

The success of the MSS operation depended upon the deep ocean mooring line which is used for installation, recovery and reinstallation of the system. The IRR system was the only means of recovering the MSS data and the borehole instrumentation. The design of the IRR system reflected the importance placed on the success of the MSS project. To achieve high reliability, the IRR system had to conform to the following guidelines:

- Assurance of structural integrity through use of conservative factors of safety applied to static and dynamic loads.
- Isolation of the BPP from tensions and vibrations of the IRR system which was accomplished by employing a "soft" cable system.
- High probability of successful recovery of the BPP by providing a cable system with such flexibility in its range of operation that procedural redundancies are built into the program.
- High probability of successful offshore operations through simplification of procedures and system component parts.

The MSS/IRR system (Figure 5-1) is essentially a trapezoidal array with a 3,048 m (10,000 ft) length of line which, if necessary, can be grappled for recovery of the system. The main requirement of the array, after installation, was the retrieval of the configuration using a grapnel hook if the acoustic release failed. The main array consisted of braided synthetic line and a 457 m (1,500 ft) length of steel cable placed between the BPP and the IRR array. This arrangement acted as an isolation link with its weight providing a reaction to the static and dynamic tensions produced in the structure. The required configuration of the suspended lines was maintained by eighteen 0.5 m (1-1/2 ft) diameter glass spheres located near the surface at the upper corners of the trapezoidal shape. The array was anchored by a 910 kg (2,000 lbs) steel weight.

The BPP is an aluminum structure 2.4 m x 2.4 m x 2.3 m (8' x 8' x 7.5') high and contains the DARS sphere plus two silver zinc battery spheres as shown in Figure 5-2. The spheres are surplus OBS units rated for 704.5 kg/cm^2 (10,000 psi). The BPP weighs approximately 4,273 kg (9,400 lbs) in air and 1,800 kg (4,000 lbs) in water. A centerpost attachment connects through a Miller swivel to the riser cable. The EM Cable is attached to the bottom of the BPP through a rotating cantilevered arm. An aluminum skirt stabilized the BPP in the sediment.

The performance criteria which most directly impacted the design of the system were:

- The shape of the installed array.
- Acceptable behavior of the array in various failure modes.
- The capability to free-fall the clump anchor while maintaining acceptable load levels and final configuration.
- The ability to activate the acoustic release and guarantee that some part of the array would surface.

The static shape of the array is defined by the buoys mounted on the array, the weight of the lines, and the location of the anchor points. The lines were chosen to be as close to neutrally buoyant as

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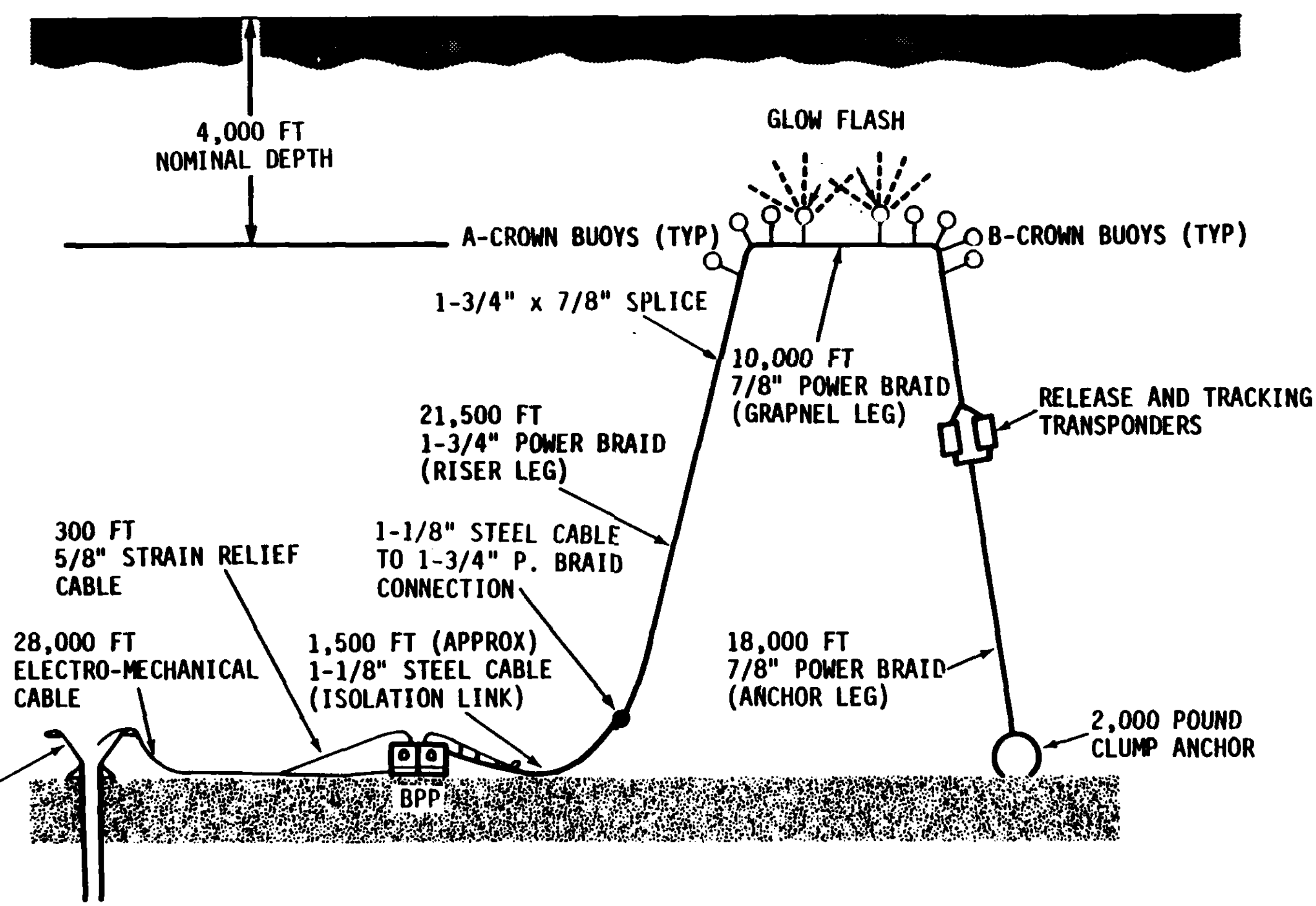

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FIGURE 5-1 INSTALLATION, RECOVERY & REINSTALLATION SYSTEM

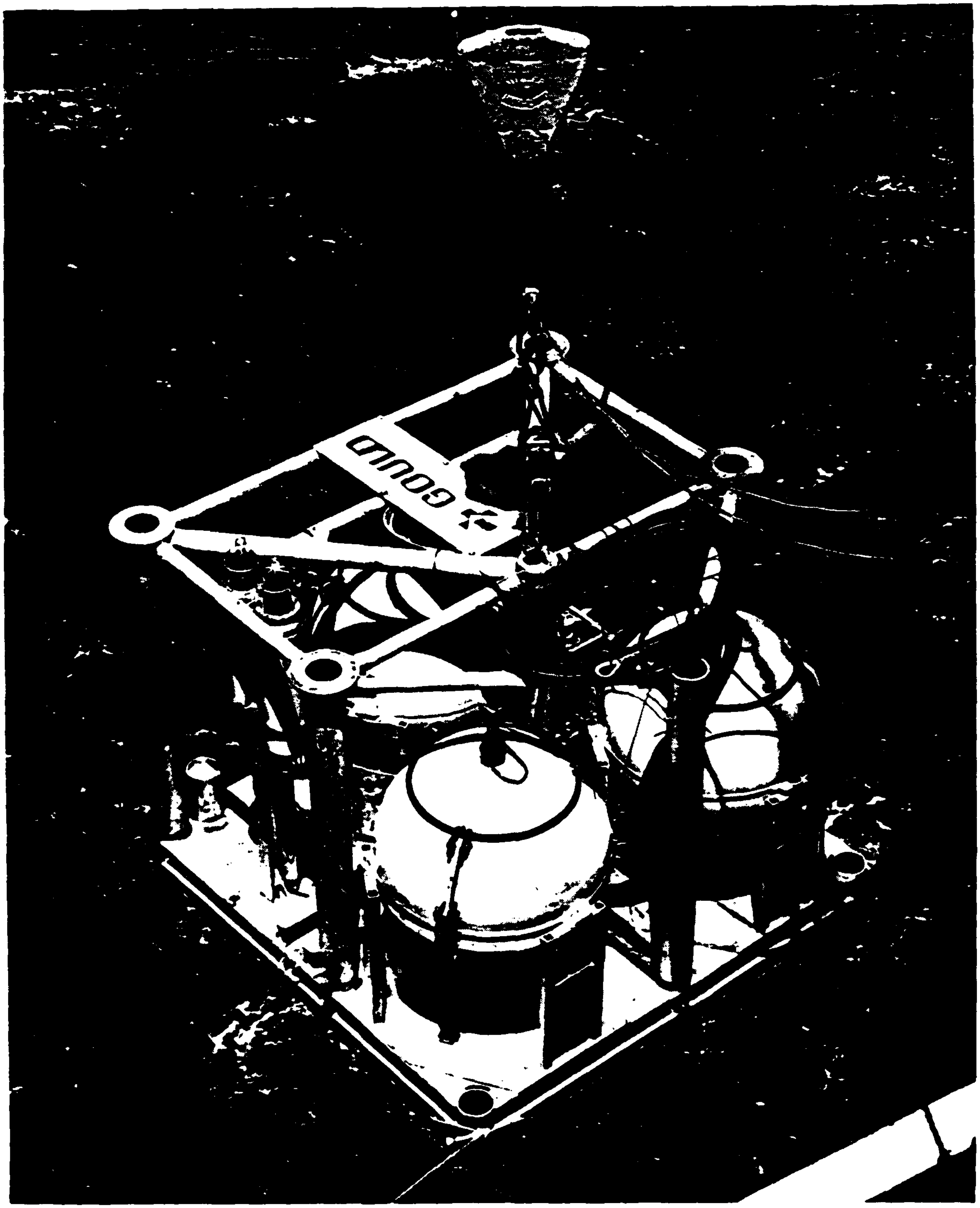


FIGURE 5-2 BPP INSTALLATION

possible, in order that the buoys have the major influence on the shape. The buoys are selected and distributed along the array in order to maintain an acceptable configuration even if several buoys at any one location fail. The buoys also provide sufficient buoyancy to lift a portion of the array to the surface after the acoustic release has been activated. Table 5.1 tabulates the major items of the IRR System.

The free-fall installation method for the system impacts the size of the isolation link installed between the BPP and the synthetic line. The weight of the clump anchor was optimized to minimize the dynamic load on the isolation link while achieving a trajectory sufficient to reach the intended anchor location.

TABLE 5.1

IRR SYSTEM WEIGHT ESTIMATE

	WEIGHT (POUNDS) DRY	WET	REMARKS
BPP	9,600	4,900	8 x 8 x 7 FT SLED (3 SKIRTS)
SWIVEL (BPP)	35	30	
WIRE CABLE	3,195	2,812	1,500 FT, 1-1/8 IN. WIRE ROPE
STRAIN RELIEF CABLE	200	176	300 FT, 5/8 IN. WIRE ROPE
LIFTING LINE	16,985	-645	21,500 FT, 1-3/4 IN. POLYESTER BRAID
A CROWN BUOY	368	-408	8, IN. DIA GLASS SPHERE BUOYS WITH HARD HATS
A FLASHER/REFLECTOR	15	-4	1, WITH HARD HAT
A BUOY PENDANT	11	8	5, 15 FT OF 1/2 IN. POLYESTER BRAID
B CROWN BUOYS	460	-510	10, 17 IN. DIA GLASS BUOYS WITH HARD HAT
B FLASHER/REFLECTOR	15	-4	1, WITH HARD HAT
B BUOY PENDANTS	13	10	6, 15 FT OF 1/2 IN. POLYESTER BRAID
GRAPNEL LINE	1,970	-79	10,000 FT, 7/8 IN. POLYESTER BRAID
DUAL ACOUSTIC RELEASE	30	20	
ANCHOR LINE	3,546	-720	18,000 FT, 7/8 IN. POLYESTER BRAID
SWIVEL (ANCHOR CLUMP)	5	4	
CHAIN & SHACKLES	30	27	10 FT, 1/2 IN. CHAIN
CLUMP ANCHOR	2,000	1,600	STEEL WEIGHT
CONNECTIONS (LIFT LINE)	25	20	
MISC HARDWARE	50	44	BOLTS, NUTS, THIMBLES, ETC.

SECTION 6.0 - MSS '83 SOUTH PACIFIC OPERATIONS

6.1 OBJECTIVES

The 1983 operation involved the coordination of the Glomar Challenger and the R/V Melville, of Scripps Institution of Oceanography, for the purpose of emplacing a MSS in the seabed in the vicinity of the Tonga Trench for seismic experiments.

The Glomar Challenger's objectives were to drill a hole, to emplace a reentry cone on the seafloor (casing it into basement rock), and to implant the BIP into the hole. Seismic experiments were recorded for five days using specially equipped vans on the Glomar Challenger's deck. Seismic events sensed by the BIP were transmitted to the van through the EM Cable. After five days, the EM Cable was switched to the BPP which was lowered to the seafloor for forty-five days of teleseismic recordings.

The R/V Melville was tasked to assist the Glomar Challenger select a suitable site for drilling, to deploy ocean bottom seismographs (OBS), to recover the BPP and OBSs after forty-five days of recording, and to reinstall a dummy BPP on the seabed.

6.2 OPERATION

6.2.1 Site Selection

The Glomar Challenger arrived in Wellington, New Zealand, on 9 January 1983 for fueling and mobilization of equipment and departed for the operational site on 16 January. The R/V Melville arrived onsite about 30 hrs ahead of the Glomar Challenger and began surveying the area for the optimum drill site.

On 21 January, Site 595 was selected, and a positioning beacon was launched. Water depth from the rig floor was 5,606 m (18,392 ft).

Testing of the seafloor sediment at the site, however, resulted in insufficient soft sediment to support the reentry cone/casing system or to provide lateral support for the Bottom Hole Assembly (BHA) during the drilling of hard material. Efforts were therefore directed to seeking a more suitable site which was determined by satellite navigation to be east of the vessel within offsetting range of the dynamic positioning system.

The Glomar Challenger was offset 457 m (1500 ft) east and 15 m (49 ft) north and was positioned at a new depth of 5,624 m (18,451 ft). When the new hole (595A) was cored from the seafloor, the basement rocks were found to be favorable for the BIP implantment except that the loose material from the upper unit kept falling into the hole indicating the need for surface casing if the reentry installation were to be made.

Extensive profiling by the R/V Melville failed to disclose a better location thus favoring an attempt to emplace the MSS at Site 595 despite the unfavorable drilling conditions. Design of a dual casing reentry installation was then undertaken. Once the suitability of the site had been demonstrated, a reentry cone (Figure 6-1) was lowered to the seafloor, cased into basement, and a hole drilled into basement rocks. This was Hole 595B into which the BIP was emplaced. The two reentries into Hole 595B were the deepest ever made. Hardware problems were few, and the cone and casing systems were installed according to design.

6.2.2 BIP Deployment

The third reentry into Hole 595B involved the reentry sub. The reentry assembly stinger was positioned on the rig floor, and the EM Cable was keehauled over the side and up through the moonpool. Assembly of the reentry sub and the testing/installation of the BIP took eleven hours to accomplish. Half of this time was spent correcting minor mechanical problems. Figure 6-2 shows the BIP final assembly.

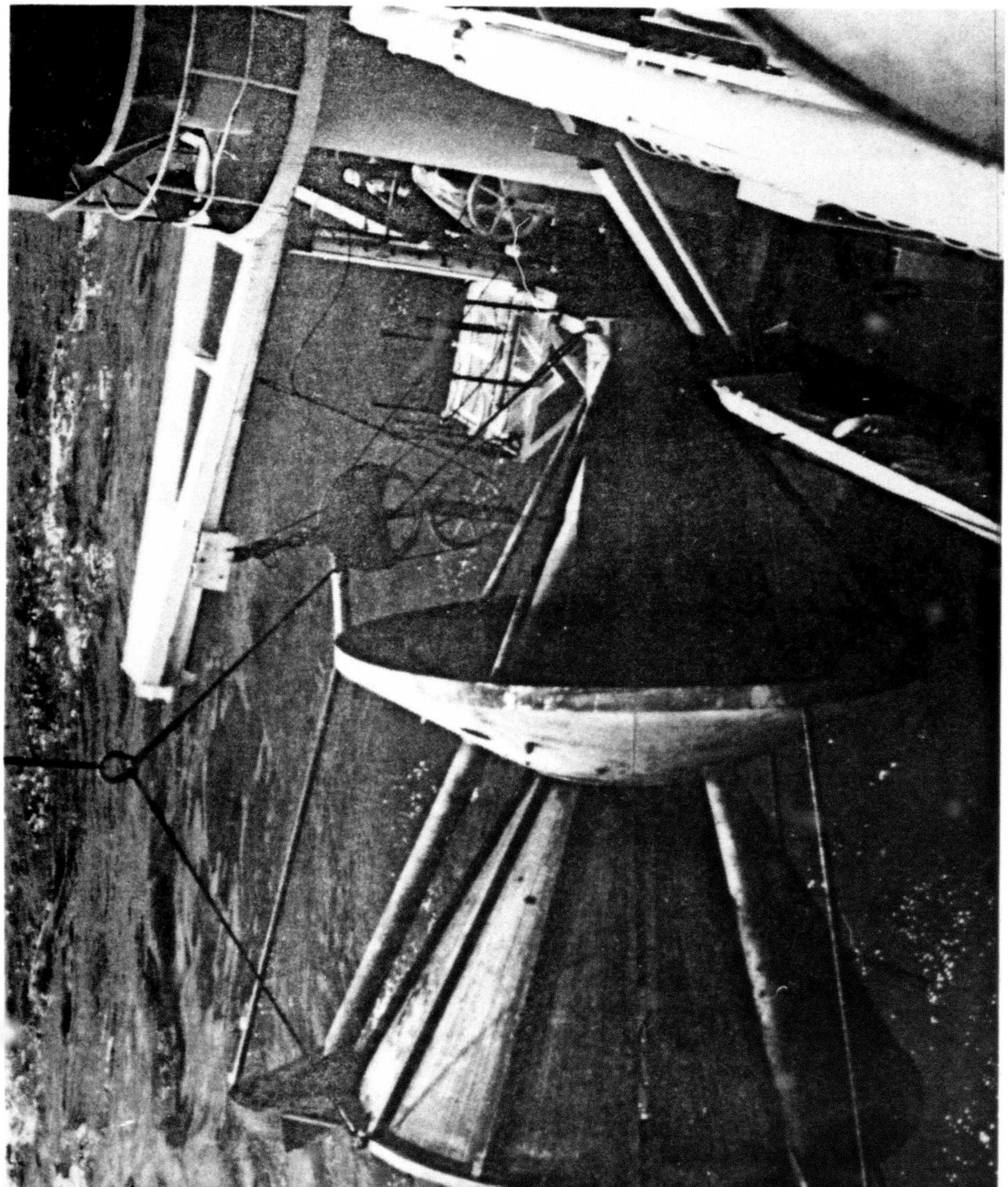


FIGURE 6-1 DSDP REENTRY CONE

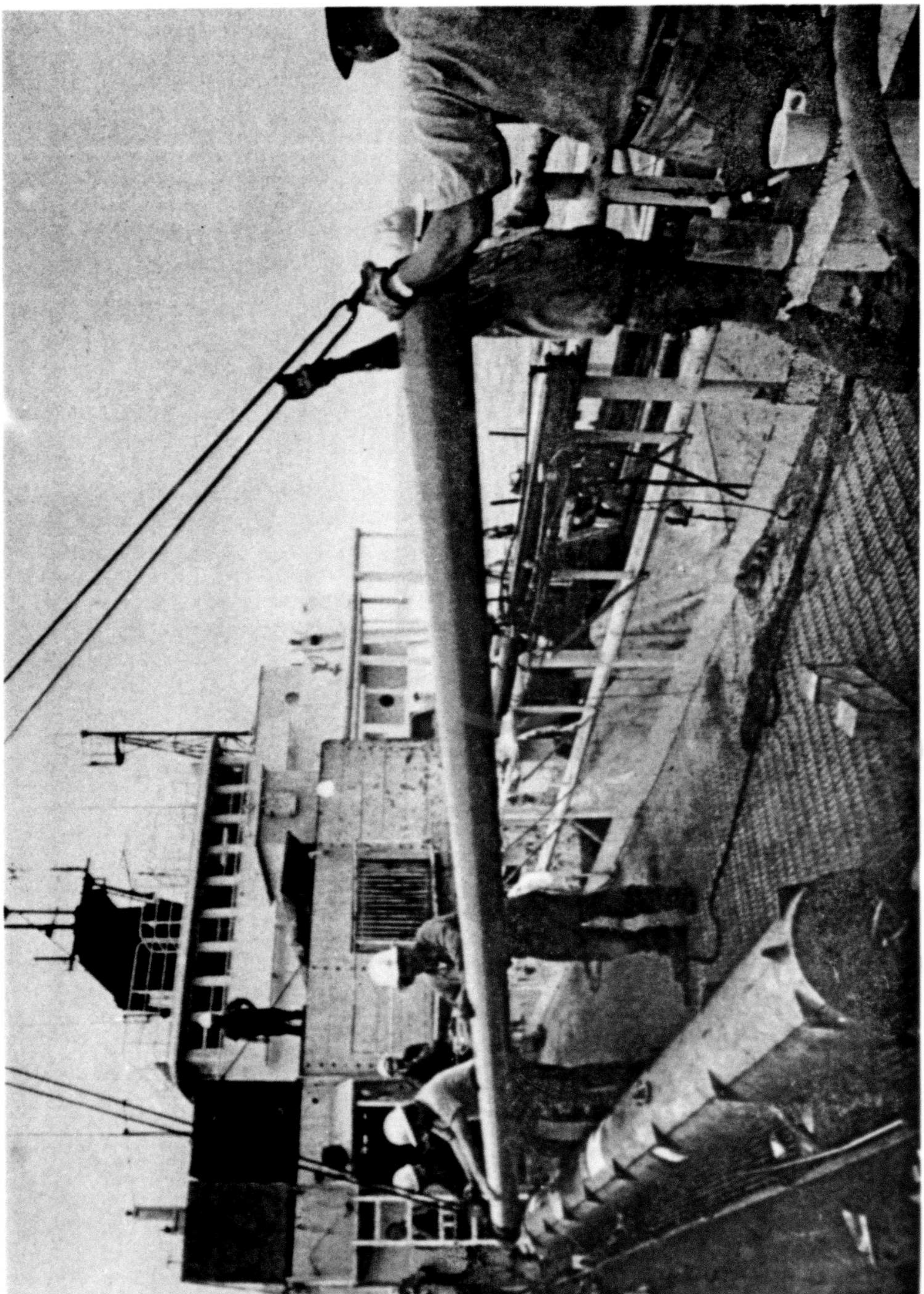


FIGURE 6-2 BIP FINAL ASSEMBLY

A reentry sonar tool was then attached to the sonar sinker bar, and the entire assembly was lowered into the assembled reentry sub for a final check of clearances and vertical spacing.

The upper portion of the BHA was then made up, and the pipe trip began. Problems with the electrical signals from the BIP began almost immediately and the pipe trip was halted after only six stands had been run. The malfunction turned out to be a serious one which was ultimately traced to a damaged cable in the uppermost (cable isolator) section of the BIP. The mechanical damage had permitted water to enter the cable which, in turn, prevented attempts to make an acceptable electrical termination. The cable isolator was modified to remove the cause of the cable damage and the EM Cable was completely reheaded, both electrically and mechanically.

When the equipment was again in readiness after a delay of 2-1/2 days, the weather had deteriorated to conditions that were marginal for handling the BIP with the drill string. An additional delay of 17 hrs ensued while wind and swell conditions abated.

Trip preparations went more smoothly the second time around, and it was established that a coordinated pipe and cable trip could be made at about half the rate of a normal pipe trip. A routine was quickly developed for orienting the pipe and feeding out cable, but interruptions for repairs to the winch totaled five hrs. The stinger reached reentry depth at 0830 hrs on 5 February.

Several difficulties were experienced with the sonar reentry tool. However, sonar function was normal on the third lowering, and the sonar seated properly in the reentry sub. After 76 minutes of scanning and maneuvering, a smooth and gentle reentry was made at 2128 hrs. The drill string was lowered cautiously for the final few meters to seat the stinger and to actuate two bumper subs.

The bumper subs were used to decouple vessel heave motion while the sonar tool was being recovered and while a Baker equalizing valve was pumped into place at the top of the reentry subassembly. The rig mud pump was then used to pressure the pipe to 176 kg/cm^2 (2,500 psi). This pressure actuated the hydraulic system of the BIP carriage to shear the restraining pins and to move the BIP into the centerline release position above the bore of the stinger/borehole. A sudden weight gain was noted on the EM Cable as the BIP was released into the stinger.

The BIP was lowered through the upper (cased) hole and into the open hole coming to rest apparently about 20 m (66 ft) short of total borehole depth. This could not be verified because of the great cable length and doubts as to the accuracy of the winch cable readout. All parties were satisfied that the BIP had been emplaced in open hole in igneous rock, and drill string recovery was initiated.

The vessel was offset 60 m (197 ft) southeast (up current), and the pipe was pressured to about 261 kg/cm^2 (3,700 psi) with the cementing pump to open the gate in the stinger for release of the cable. The reentry sub was then pulled clear of the reentry cone. The cable weight indicator showed no effect of the pipe movement, an indication that separation of cable and pipe had been accomplished. The positioning offset was increased to 150 m (492 ft) in the same direction, and four "wet" stands of drill pipe were pulled before the equalizing valve was recovered with the sandline and overshot. The ensuing pipe trip was routine until the reentry sub same into view. It was then discovered that the stinger was missing. All ten attachment bolts remained hanging in the flange at the base of the BIP carriage. All the bolts showed virtually identical tensional failures in the threaded portion.

6.2.3 IRR/BPP Deployment

Following deployment of the BIP, the Glomar Challenger remained on station and recorded seismic information for five days. Shipboard recording equipment connected to the EM Cable constantly monitored the BIP as it registered refraction shooting by the R/V Melville.

The IRR system deployment (Figure 6-3) began at 1300 hrs on 10 February. The vessel's position was offset while the EM Cable was paid out to the safe minimum on the winch drum. The winch was then modified for the IRR phase, the BPP was moved into position on the main deck, and the EM Cable tension was transferred from the winch to the ship's structure by means of a cable grip.

When the EM Cable was disconnected from the shipboard recording instruments early on 11 February and attached to the BPP for final electronic checks, it was discovered that some of the vital BIP functions could not be recorded or interfaced with the BPP due to a malfunction in the interfacing circuitry within the BIP. To remedy the situation required recovering the BIP (not a viable alternative for several reasons) and a decision was made to continue the deployment with the system not fully operational.

The BPP, which weighs over four tons in air, was lifted over the side by the ship's crane and was lowered into the water at 1400 hrs on 11 February. After a few minutes of paying out the 2.86 cm (1-1/8 in.) steel isolation cable, the system was shut down for three hours for modifications and repairs to the winch. During this time there was some interference of the state-of-health acoustic telemetering beacon with the ship's dynamic positioning system, as the BPP was hanging close beneath the vessel.

When the 450 m isolation cable had been paid out, a controlled vessel drift to the northwest was resumed as the 5,950 m (19,520 ft) of 4.45 cm (1-3/4 in.) power braid riser line was deployed. Within minutes, the Glomar Challenger was able to switch to automatic positioning and controlled offsetting on the preplaced 13.5 kHz beacon. The BPP landed on the seafloor when the vessel had passed over the beacon and moved about 500 m (1,640 ft) to the northwest.

The riser leg payout continued with frequent stops for winch repairs. Maximum north and west positioning offsets were reached,

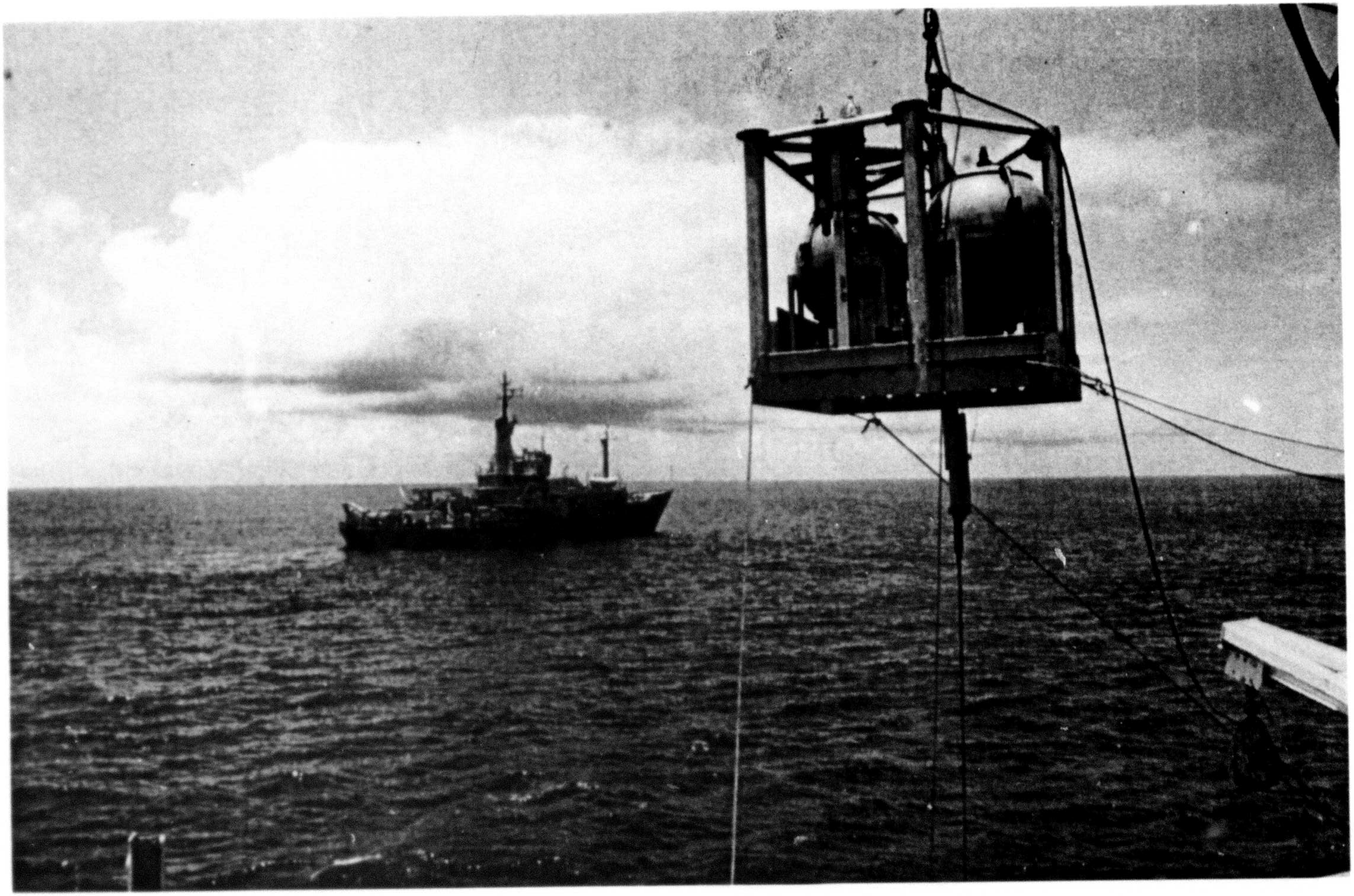


FIGURE 6-3 IRR SYSTEM DEPLOYMENT

and a controlled drift at 210° was continued in the semi-automatic mode. The deployment was complicated somewhat when the BPP grounded at an apparent depth 1 km shallower than expected. This is probably attributable to a combination of excessive stretch and incorrect line length calibration. In future deployments, this aspect must be more critically prepared. Over 7 km of the heavy braid had been paid out when the beginning of the 2.22 cm (7/8 in.) grapnel leg braid was reached and the "A" crown buoy group was attached. As payout of the 3 km grapnel leg began, the vessel moved out of range of the positioning beacon and rate of drift was controlled in semi-automatic by monitoring tension on the line. When the "B" crown buoys at the anchor end of the grapnel leg had been launched, a 16 kHz beacon was dropped to aid in fixing the position of the IRR acoustic release and in deploying the anchor leg. The beacon failed within minutes after launch and was replaced by a 13.5 kHz unit. The acoustic release/ATNAV transponder link assembly was then put over, and deployment of the 3 km anchor leg began while the beacon was falling. Unfortunately, the beacon signal became weakened, distorted and unusable approximately one hour after launch, probably on landing at the seafloor. The end of the anchor line was removed from the winch and attached to the anchor. When the slow, controlled drift of the vessel had produced the proper tension in the IRR, the anchor was released at 0858 hrs on 12 February.

The R/V Melville had been standing by to observe and report submergence of the crown buoys before departing for her scheduled port call in Tahiti. The final "B" crown buoy had disappeared at 0948 hrs. The Glomar Challenger returned to the "B" crown buoy area and began a search while interrogating the ATNAV transponder. The minimum range to the transponder recorded during the two-hour search was about 900 m, verifying the success of the deployment.

The vessel then returned to the area of the BPP for the final task of placing ATNAV transducers on either side of the BPP to be used in its recovery by the R/V Melville. This proved to be much more difficult and time-consuming than had been anticipated. The ATNAV transponder on the BPP was to be used as a reference in positioning to launch the other transponders, but thrusters and other ship's noise made effective communication with the transponder impossible in the 5,600 m water depth. Using semi-automatic DPS positioning on a distant, intermittent beacon, transponders were finally emplaced in the approximate positions of 2,750 m (9,022 ft) from the BPP on true bearings of 017° and 251°. At 1700 hrs on 12 February, MSS operations were successfully completed.

Table 6.1 describes the position of the MSS IRR components after deployment.

6.2.4 IRR/BPP Recovery

At approximately 0430 hrs on 22 March 1983, the recovery operations were initiated from the RV Melville with actuation of the ATNAV transponder release. This dual release, located downstream of the "B" buoys, provided separation from the upper anchor IRR leg, allowing the grapnel leg to float to the surface. The 5,486 m (17,998 ft) anchor leg was left tethered subsurface to its anchor. Only one of the two parallel releases functioned.

The R/V Melville was brought alongside the "B" buoys and all (5 dual buoys plus flasher) were recovered. The 2.2 cm (7/8 in.) power braid grapnel leg was then led through a sheave on the starboard U-frame through the winch then to a special snach block suspended on the ship's rope tugger which is positioned on the rope box. The 3,048 m (10,000 ft) grapnel leg was easily brought aboard in about two hours. Typically, the line bearing angle was maintained between 15° and 45° of the ship's heading. The four dual buoys plus one flasher of the "A" crown buoy were recovered.

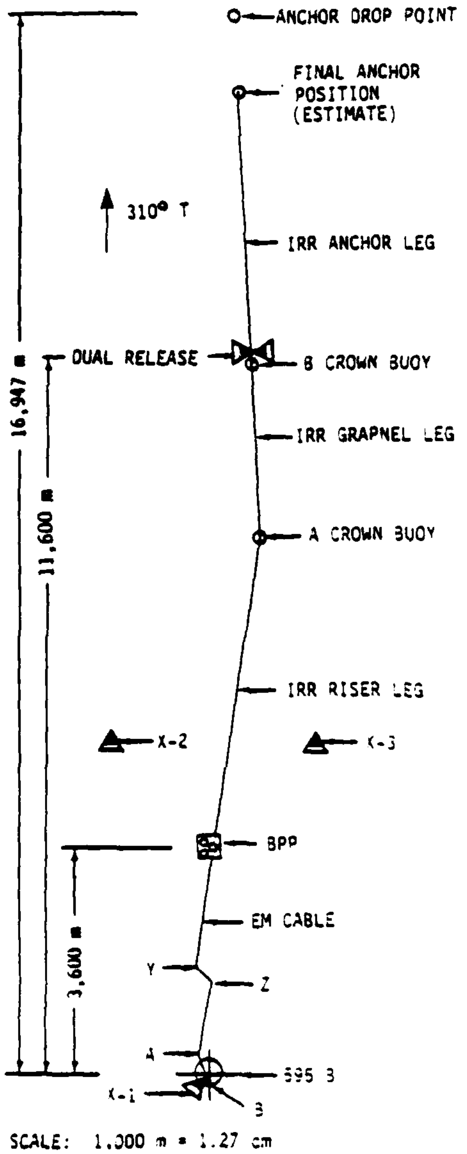
The 4.45 (1-3/4 in.) cm power braid riser leg was moved directly to the IRR stern mounted sheave and was then separated from the grapnel leg. The power braid was threaded through the idler sheave to the winch using four wraps around the reel while the top 1,500 m (4,921 ft) of the upper riser leg was being retrieved. The R/V Melville backed down in an upstream direction toward the BPP site, a distance of approximately 4,000 m (13,123 ft). With the R/V Melville over the BPP the riser leg tension was increased to approximately 1,135 kg (2,500 lbs) at which time the isolation cable link should

TABLE 6.1

MSS '83 IRR DEPLOYMENT NAVIGATIONAL LAYOUT

MSS COMPONENT LOCATIONS

-HOLE 595 B	23 - 49.34S 165 - 31.61W	(GOOD)
-POINT "A" (16 KHZ BEACON)	23 - 49.35S 165 - 31.85W	
-POINT "B"	23 - 49.39S 165 - 31.54W	
-POINT "Z"	23 - 48.83S 165 - 32.23W	(GOOD)
-13.5 KHZ BEACON (NOT SHOWN)	23 - 48.30S 165 - 33.03W	
-POINT "Y"	23 - 48.81S 165 - 32.35W	(GOOD)
-BPP	23 - 48.08S 165 - 33.27W	
-"A" CROWN BUOY	23 - 46.00S 165 - 35.22W	(EST)
-"B" CROWN BUOY	23 - 45.00S 165 - 36.55W	(EST)
-ANCHOR DROP POINT	23 - 42.40S 165 - 39.90W	(EST)
ATNAV TRANSPONDERS		
.X-1	23 - 49.38S 165 - 31.61W	
.X-2	23 - 48.60S 165 - 34.95W	(EST)
.X-3	23 - 46.58S 165 - 32.80W	(EST)
.DUAL RELEASE	SEE "B" CROWN BUOY	
.BPP X-PONDER	SEE BPP	



have been vertical. Approximately 300 m (984 ft) of braid was then brought aboard raising the tension to about 3,180 kg (7,400 lbs). At this stage, the power braid was stretched approximately 6 percent of its total length. No specific lift off pullout was noted on the Martin Decker gauge or strain-sert line tension recorder. The line was continually brought in with gradually increasing tension due to the EM Cable weight increase. The R/V Melville moved upstream a further 2,800 m (9,186 ft) at 1850 hrs; the connector to the isolation cable link was brought aboard and led carefully through the winch. Line tension reached approximately 5,450 kg (12,000 lbs). The wire cable was secured using a preformed cable clamp while the braid termination was cut. The cable end was then wrapped around the reel and dead ended to the winch. The system was secured at 2300 hrs, with a majority of cable load on the winch. Major cable oscillatory loads of 1,810 kg (4,000 lbs) were noted on the Martin Decker gauge and Strain-sert recorder. At this stage Sea State 4 conditions were being experienced.

Beginning at 0730 hours on 23 March, the remainder of isolation cable link was winched in, and the BPP surfaced with an indicated load of 5,000 kg (11,000 lbs). The coiled strain relief cable was attached to the trawling winch cable, and the EM Cable load transferred from the BPP. The BPP was raised clear of the water, transferred over the ramp using the stern U-frame hydraulic system, and then lowered gently to the special sled resting on the ramp. The sled with the BPP was then pulled up the deck where it was secured at 1150 hrs (Figure 6-4).

The BPP was discovered to have flooded after forty hours of recording on the seafloor. Once the BPP was on deck, the BIP was linked by the EM Cable to on-deck recording devices and was still operational. About eight hours of recording was completed at that time.

6.2.5 Dummy BPP Deployment

The deployment of the dummy BPP/IRR began in the early morning hours of 25 March 1983 but was quickly terminated when the EM Cable was discovered broken near the surface. The failure occurred due to

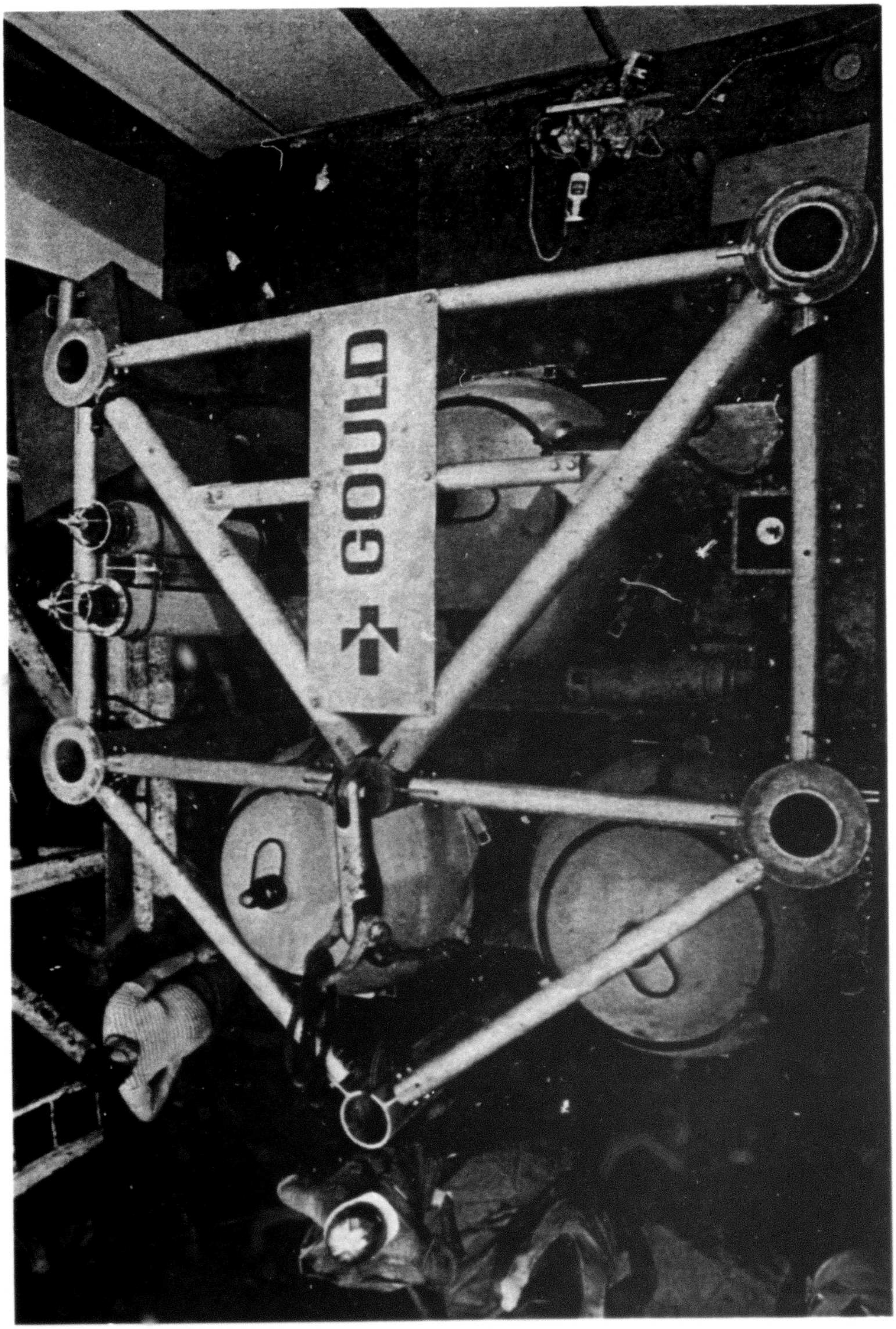


FIGURE 6-4 BOTTOM PROCESSING PACKAGE (BPP)
(AFTER RECOVERY)

torque imposed by twisting of the strain relief cable. A day was spent retrieving the EM Cable and resealing the mechanical and electrical terminations. At 1900 hrs redeployment was initiated. A new preformed cable clamp was attached to the EM Cable with Millerswivel between the clamp and the strain relief cable. Launching of the dummy BPP which included transferring the cable load to the dummy BPP took several hours, and at 2240 hrs actual lowering of the dummy BPP commenced. Two major problems encountered were the twisting of the loaded strain relief cable and the short payout length allowed by the trawling winch cable.

The R/V Melville was unable to establish position near the original BPP site due to subsea navigation problems, and, as a consequence, the new dummy site was approximately 1,500 m (4,920 ft) short of the intended site. Setdown occurred approximately at 0040 hrs on 26 March.

Payout of the riser line continued until the transition to grapnel leg was accomplished. The line was shifted to the starboard U-frame sheave but ran directly off the reel. The four dual buoys and a flasher were attached, and the 3,048 m (10,000 ft) grapnel line was deployed. The R/V Melville transited in a 300° true direction maintaining a typical load of 91 kg (200 lbs). At the end of the grapnel leg, the flasher and five dual buoys were reattached. The new anchor leg was also connected but without an ATNAV release.

The 5,486 m (18,000 ft) anchor line was released at approximately 80 m/min as the ship moved downstream toward the anchor launch position. The end of the anchor line was then taken to the 1,045.5 kg (2,300 lb) IRR anchor resting on the deck.

The R/V Melville maneuvered slowly downstream in order to pre-tension the anchor line to approximately 45 kg (100 lbs). Tension was initially maintained at this level for about two hours until the line was unslacked and the line curvature straightened out. The anchor was launched at 0801 hrs with a probable 454.5 kg (1,000 lb) line pull. The R/V Melville returned to the "B" crown position where the five buoys were observed to be completely submerged by 0915.

Deployment and/or redeployment of the IRR/BPP systems are feasible and practical. The procedures, as established, are adequate but must be specifically tailored in detail to each ship and weather conditions. To avoid damage to sensitive instrumentation, more control tag lines will assist in severe weather.

Although the IRR recovery and redeployment operational activities were satisfactorily carried out, the following areas of concern should be addressed:

- Strain Relief Attachment to the EM Cable. Severe problems with EB Cable torguing and kinking were encountered when the cable load was taken up by the strain relief line. A torque balanced wire cable plus swivels on both ends are mandatory. The strain relief cable must also be contained within an enclosure on the BPP.
- Surface Navigation during Deployment Phase. An improved procedure is required to coordinate cable pay-in/pay-out with ship movement. During the anchors launch phase, an accurate ship position verification is required particularly if a severe cross current condition exists.
- Protection/Isolation of Electronic Cable Length and Cable Tension Equipment. The present recovery operation roller sheave strain-sert transducer location is not adequate although good analog cable tension data, above 4,400 kg (2,000 lbs), was recorded during the BIP recovery phase. An independent load measurement system is required. A strain-gauged pin for the sheave attachment is recommended. The dual analog static/dynamic recorder should be compatible with either the Martin Decker hydraulic or strain-sert pin.

SECTION 7.0 - MSS '83 MOBILIZATION/DEMOBILIZATION

The objectives of the MSS '83 program were successfully concluded through the operation of specialized deep ocean drilling technology. The MSS was emplaced on the seafloor at a depth of more than three miles through a coordinated effort between the Glomar Challenger and the R/V Melville. The mobilization/demobilization activities associated with these ships contributed to the overall success of the program.

7.1 GLOMAR CHALLENGER

7.1.1 Mobilization - Wellington, New Zealand

The MSS equipment was transported from Japan via Military Sealift Command (MSC) to Wellington, New Zealand. The Gould-DED equipment was air freighted via Military Airlift Command (MAC) flights from Dover AFB in Maryland to Norton AFB in California and was accompanied by Gould personnel. The Teledyne-Geotech equipment was also air freighted via MAC flights to Norton AFB from Tinker AFB and was also accompanied by Teledyne-Geotech personnel to Norton. GMDI personnel accompanied the equipment from Norton AFB to Christchurch, New Zealand, without incident. The equipment was then trucked to Wellington. NORDA shipped the transponders and associated equipment to Norton AFB and accompanied the shipment with Teledyne-Geotech's equipment to Christchurch. The equipment was then trucked to Wellington with the other MSS '83 equipment.

The Glomar Challenger docked in Wellington Harbor, New Zealand, on 9 January 1983, two days ahead of schedule. Fueling was done first to accommodate arrangements for the extensive dockside workload. The next morning, the ship moved to Queen's Wharf where the day's activities included the offloading of DSDP cores and air freight shipments and the onloading of high priority GMI and DSDP freight.

Major work items accomplished during the port call included the loading of equipment and supplies for the DARPA experiment, the offloading of all Schlumberger well logging equipment, and assembly of the reentry cone to be used at the primary drill site. After all MSS equipment was installed a pre-operational checkout was accomplished. The instrumentation was also calibrated.

GMDI engaged McKay Shipping as its ship's agent. William Cable Ltd. provided the work for the installation of the equipment. The riggers were supplied by the waterfront industry, and this function was grouped into the same contract. The installation went well, on schedule, and the Glomar Challenger sailed as scheduled on 16 January.

7.1.2 Demobilization - Papeete, Tahiti

The demobilization of the Glomar Challenger was accomplished in Papeete, Tahiti, on 20 February 1983. The agent used was Agence Maritime Internationale (AMI). AMI contracted with a local company, CGEE Industries, for the removal of the MSS equipment that were installed in Wellington. Longshoremen were used as riggers. The offloading went well without incident. The equipment was stowed in a warehouse on the dock.

Some of the equipment that would not be used were returned to NORDA, i.e., A-Frame, BIP carriage, and associated equipment not required for IRR recovery. The equipment was sent via ocean freight, and a Government Bill of Lading (GBL) was issued to cover the freight costs.

During demobilization, the Glomar Challenger was restored to the configuration necessary to continue work on the DSDP Program. Equipment foundations and related stiffening were removed by scarfing, chipping or grinding to restore the deck to its original condition. The electric cabling, connecting boxes, controllers, etc., were removed and crated for return to the U.S.

7.2 R/V MELVILLE

7.2.1 Control System For Equipment Shipping

The GMDI logistics office was tasked with supervising the shipping of various university controlled oceanographic equipment from the

R/V Melville to and from various locations throughout the U.S. The shipment of equipment was controlled by using various control numbers which were tracked with the following codes:

- Task Numbers (M-1 through M-8)
- Transportation Control Numbers (TCN)
- Transportation Account Chargeable (TAC)
- Government Bill of Lading (GBL)

All of the equipment were listed on a DD Form 1149 with the assigned TCN and TAC numbers clearly noted. The tasks completed in support of the R/V Melville operations included:

- Task M-1 Ship two (2) 8 x 8 x 2 ft laboratory/container to the R/V Melville in Honolulu, Hawaii
- Task M-2 Ship eight (8) boxes OBS spheres and equipment to the R/V Melville in Honolulu, Hawaii
- Task M-3 Ship one (1) laboratory and two (2) 8 x 8 x 20 ft containers from the R/V Melville in Honolulu to Scripps in San Diego, California
- Task M-4 Cancelled
- Task M-5 Ship thirty-one (31) pieces of oceanographic equipment from the R/V Melville in Tahiti to Draper Laboratory in Cambridge, Massachusetts
- Task M-6 Ship one (1) oceanographic winch from the R/V Melville in Tahiti to Draper Laboratory in Cambridge, Massachusetts
- Task M-7 Ship eleven (11) boxes of oceanographic equipment from the R/V Melville in Tahiti to Scripps in San Diego, California

The shipment costs of the various tasks were absorbed by the Navy Material Command in Oakland, California, and credit is due to Mr. Steven Warkengtin, who greatly assisted GMDI by converting the shipment costs to a GBL for either ocean or air freight, as required.

7.2.2 Fabrication

GMDI had a new winch and fairlead sheave foundation fabricated in Honolulu by Pacific Marine. These were loaded on the R/V Melville during her port call and transported to Tahiti to be offloaded and put into storage until time came to mobilize the R/V Melville for the IRR recovery.

Additional fabrication in Tahiti by OGEE Industries included the BPP sled, grapnel hook, foundations for the air tuggers, and a dummy processing package and miscellaneous securing blocks as required.

7.2.3 Mobilization

The ship's agent was changed to Compagnie Maritime Polynesienne (CMP). Because maritime law allows only one ship's agent for each vessel, the Glomar Challenger used AMI and the R/V Melville used CMP as agents. The equipment was transferred to the new agent by prearrangement.

Mobilization activities for the IRR/BPP recovery operation were initiated immediately following the removal of the MSS equipment from the Glomar Challenger. Specific equipment for the R/V Melville were tagged, separated, and refurbished.

The following subtasks were accomplished during the mobilization period:

- Installation of winch, rope box, idler sheave, miscellaneous handling equipment
- Installation of ATNAV equipment
- Refurbishment of Pengo winch
- Refurbishment of strain-sert and Sea Mac electronic packages
- Fabrication of grapnel anchor
- Provision of air tuggers, foundations, hoses and portable air compressor

Ten days before departure, the Papeete field operation conducted pre-installation checkout of the equipment. This operation was hampered by a severe cyclone in the Tahiti area. On 16 March, loading of the MSS equipment onboard the R/V Melville was accomplished. In general, the installation complied with the layouts prepared with specific variances per ship crew request. CGEE Industries was contracted by the ship's agent to install the MSS/IRR recovery equipment on the R/V Melville.

7.2.4 Demobilization, R/V Melville

The demobilization of the R/V Melville was accomplished in two phases: offloading all the data equipment in Tahiti and air freighting them back to Teledyne-Geotech and Gould plants for immediate processing. Other related equipment that could not be carried on the R/V Melville without interfering with operations being conducted enroute to the U.S. were shipped via ocean freight on a container vessel, Polynesian, to Long Beach, California. A GBL was issued, and the freight was trucked to NORDA in Mississippi.

Upon arrival of the R/V Melville in San Diego, five weeks after leaving Tahiti, the remainder of the equipment was offloaded. These included the Pengo winch with related spares, transponders, ATNAV equipment, miscellaneous tools, sheaves, etc. A GBL was issued to return the winch to Roosevelt Roads and the rest of the equipment to NORDA in Mississippi.

SECTION 8.0 - ADVANCED OPERATIONS PLANNING

8.1 INTRODUCTION

Special studies were performed to evaluate future operational aspects of the MSS program. The technical and cost considerations were evaluated relative to the potential future deployment of multiple MSS type deep ocean or shallow water boreholes. In particular, the use of alternate dynamically positioned drillships to the *Glomar Challenger* and the installation of a slightly smaller BIP seismometers were investigated. These application studies are presented in a GMDI report entitled, Advanced Operations Evaluation (Reference 14). A summary of that report follows.

8.2 OPERATIONAL DEPLOYMENTS

The basic technology for deep ocean deployment of large seismometers or other instruments into specially emplaced seabed boreholes has now been verified. Installations in water depths of 6,100 m (20,000 ft) can be achieved with existing equipment. Thus, deployment of sensitive acoustic or seismic instruments can be planned for a range of seabed installation.

This capability is based upon use of the *Glomar Challenger* developed riserless drill string coring and multiple reentry technology. Reentry-type casing lined boreholes have been emplaced within the sediment/basalt to depths of 550 m (1,800 ft). Such boreholes have been successfully reentered five years after initial emplacement.

Initial deep ocean borehole emplacement and subsequent BIP deployment should require approximately 20 days on site, including a limited contingency time. For severe weather sites, approximately 30 days on site should be allocated. Most operations can be conducted in Sea State 5 conditions or less. However, the reentry cone keelhauling and casing liner reentry should prudently only be undertaken in less than Sea State 4 conditions.

The reentry borehole affords the possibility of removal and redeployment of an instrument package into the sediment/basalt. This can now be easily achieved using the drill string reentry technique. Potentially, it is also possible that such redeployment operations would be accomplished using either a cable fly-in or a guided line reentry concepts. Both concepts require a deep ocean dynamic positioning surface vessel capability but are not limited only to drillships. The guided line approach would be easier to develop but suffers from the inherent risk of entanglement. The cable fly-in approach appears to offer the most promise for ease and reliability but does require an extensive development program.

8.3 ALTERNATE DRILLSHIP

As mentioned earlier, all MSS development work has been accomplished using the <u>Glomar Challenger</u>. In the event of the <u>Glomar Challenger</u> being scrapped or otherwise not being available, various alternative dynamic positioned drillships can be utilized. Tables 8.1-1 and 8.1-2 list potential U.S. built-U.S. owned and foreign built-U.S. owned dynamic positioned drillships.

All of these ships could be utilized for the MSS type deployments. What would be required are a 127 mm (5 in.) high strength drill string (for deep water sites), special auxiliary pipe equipment, the adaptation of shipboard handling equipment, and specialized crew training. An early shallow water test would be very desirable to work out specific details.

Table 8.2 presents some typical cost factors associated with a single or multiple borehole emplacement and instrument deployment. In general, the overall deployment costs would be on the order of $6 million for a single deep ocean site and $38 million for six to eight worldwide located sites accomplished within a one year period.

TABLE 8.1-1

U.S. FLAG DP DRILLING SHIP

VESSEL NAME	OWNER	DIMENSIONS (FEET)	DP SYSTEM	PROPULSION/THRUSTER (HP)	WATER DEPTH/ DRILLING DEPTH (FEET)
1. "SEDCO 472"	SEDCO	470 x 70 x 32	HONEYWELL ASK	9,600/9,600	6,000/25,000
2. "GLOMAR PACIFIC"	GLOBAL MARINE	452 x 72 x 35	DELCO	9,600/8,375	2,000/25,000
3. "GLOMAR ATLANTIC"	GLOBAL MARINE	452 x 72 x 35	DELCO	9,600/8,375	2,000/25,000
3. "GLOMAR CHALLENGER"	GLOBAL MARINE	400 x 65 x 26.75	DELCO	4,500/3,400	25,000/25,000

TABLE 8.1-2

FOREIGN BUILT-U.S. OWNED DP DRILLING SHIP OR SEMISUBMERSIBLE

	VESSEL NAME	OWNER	DIMENSIONS (FEET)	DP SYSTEM	PROPULSION/THRUSTER (HP)	WATER DEPTH/ DRILLING DEPTH (FEET)
1.	SEDCO 445	SEDCO	445 x 70 x 32	HONEYWELL ASK	9,000/9,000	3,000/20,000
2.	SEDCO/BP 471	OVERSEAS DRILLING COMPANY	470 x 70 x 32	HONEYWELL	-	6,000/25,000
3.	DISCOVERER SEVEN SEAS	SONAT OFFSHORE DRILLING, INC.	534 x 80 x 32	HONEYWELL ASK	16,000/15,000	6,000/20,000
4.	DISCOVERER 534	SONAT OFFSHORE DRILLING, INC.	534 x 80 x 32	HONEYWELL ASK	16,000/15,000	3,000/20,000
5.	BEN OCEAN LANCER	ODECO/BP	450 x 77 x 41	HONEYWELL ASK	?/8,750	3,000/20,000
6.	SEDCO 709 (SEMI)	MARINE DRILLING	295 x 245 x 113	HONEYWELL ASK	24,000	6,000/25,000
7.	SEDCO 710 (SEMI)	SEDPEX INC.	295 x 249	-	24,000	5,000/25,000

TABLE 8.2

MSS OPERATIONS COST PROJECTIONS

SITES	1 (30 DAY CHARTER) ($M) SHALLOW WATER	8-12 (9 MONTH CHARTER) ($M) DEEP WATER	1 (40-DAY CHARTER) ($M) DEEP WATER
DEPLOYED EQUIPMENT INC DEVELOPMENT	0.50	5.40	1.30
DRILLSHIP	0.80	14.60	2.80
OPERATIONS SUPPORT	.12	2.10	0.38
MOBILIZATION/DEMOBILIZATION	.12	1.20	0.17
DRILL STRING & HANDLING EQUIPMENT	.21	3.2	0.35
RECOVERY	0.06	1.2	0.08
ENGINEERING	.10	1.5	0.25
CONTINGENCY	0.19	3.3	0.48
	2.10	37.5	5.81

8.4 SMALLER SIZE INSTRUMENT PACKAGES

Smaller size packages can also be easily deployed directly through the drill string. This eliminates the reentry borehole and allows for a direct single trip hole coring plus package deployment activities. This concept is limited to relatively shallow basalt borehole penetrations and eliminates possible instrument retrieval, as the uncased borehole will probably collapse. The associated EM Cable must be stripped out of the drill string during recovery.

Table 8.3, courtesy of Teledyne Geotech, presents some typical seismometer package configurations. In addition, there is the HIG (Hawaii Institute of Geophysics) seismometer with an OD of 96 mm (3.8 in.) which has been successfully deployed through the 108 mm (5 in.) DSDP drill string. For direct through drill string deployments, the following package pressure vessel OD limitation, strength and equivalent 6,100 m (20,000 ft) drill string length weights are listed on Table 8.4

For instrument deployments through the drill string of the 108 mm (4.25 in.) size packages, a 140 mm (5-1/2 in.) or 168 mm (6-5/8 in.) sized drill pipe would be necessary. The bore size is nominally limited by the standard API tool joint ID. If special full hole size tool joints are used, the package OD limit may be increased by approximately 13 mm (1/2 in.). Thus, the 140 mm (5-1/2 in.) drill pipe sections could be utilized but with minimal clearance. The 168 mm (6-5/8 in.) drill pipe utilization would require rework of existing pipe handling equipment but would obviously provide ample clearance.

TABLE 8.3

POTENTIAL GEOTECH SEISMOMETERS PACKAGE CONFIGURATIONS

	531000/36000	531000/44000	44000	MULTIPLE S-750 VERTICALS	MULTIPLE S-500 VERTICALS
Diameter	8 in.	8 in.	4.25 in.	4.25 in.	3.75 in.
Length	33 ft	33 ft	2-12 ft packages separated by 1,000 ft Max.	1-12 ft, 1-6 ft, or 1-8 ft 1,000 ft suspension Max. 1-6 ft sensor separated by 1,000 ft Max.	2 packages 1-14 ft signal processor
Number of Sensors	Up to 6 3 primary 3 secondary or 3 primary 2 vertical backup	Up to 6 3 primary 3 secondary or 3 primary 2 vertical backup	3 primary only	Up to 6 verticals only	Up to 6 verticals
Response	Primary 1×10^6 per M/sec^2 Secondary 200V per M/sec^2	Primary 2×10^4V per M/sec^2 Secondary 200V per M/sec^2	2×10^4V per M/sec^2	200V per M/sec^2 typical acceleration 3×10^4V per M/sec typical velocity	500 V/G typical acceleration 450V per M/sec typical velocity
Bandwidth	Primary 0 to 20 Hz Secondary .01 Hz to 100 Hz	Primary 0 to 25 Hz Secondary .01 Hz to 100 Hz	1 to 25 Hz	.01 Hz to 100 Hz	1.0 Hz to 160 Hz
Comments	Built in backup sensors. Single deployment package. Technology and hardware exist. Reentry of hole necessary.		2-12 ft packages 1,000 ft separation max Deployed through drill string	Vertical only Single or dual packages Deployed through drill string	Vertical only Disposable sensor package Through the drill string deployment

TABLE 8.4

TYPICAL API DRILL STRING CHARACTERISTICS

DS NOM SIZE MM (IN.)	127 ** (5)	140 ** (5 1/2)	168 (6 5/8)
GRADE	S-135	S-135	S-135
ID MM (IN.)	108 (4.25)	114 (4.50)	127 5.0
OD PACK LIMIT MM (IN.)	105 (4 1/8)	108 (4 1/4)	124 (4 7/8)
YS LOAD KG (LBS)	322,000 (712,000)	406,000 (895,000)	400,000 (881,000)
DS WEIGHT* KG (LBS)	193,000 (425,000)	238,000 (525,000)	260,000 (575,000)

* 6,096 m (20,000 ft) drill string length with 22,727 kg (50,000 lb) downhole assembly

** Spiral tool joints (large 10)

SECTION 9.0 - MSS '81 OPERATIONS REVIEW

9.1 OBJECTIVE

The MSS '81 operation (Reference 4) was the first at-sea demonstration of the overall MSS concept. The primary objective was to obtain actual deep borehole seismic data by deploying a BIP into an existing DSDP borehole located in the mid-Atlantic.

9.2 FABRICATION

The fabrication of the primary BIP downhole reentry sub and all handling equipment was procured from United Fabricators, Inc. in Santa Fe Springs, California, on a fixed price contract. The engineering concept, drawings, and specifications were provided by Global Marine Development Inc. in Irvine, California. Fabrication and tests were completed on 2 February 1981. The procurement consisted of the following major pieces:

- 2 ea. BIP Carriage Housing
- 2 ea. Reentry Tool Stinger
- 2 ea. BIP Carriage Control Subs
- 2 ea. BIP Carriage Assembly
- 1 lot Spares

9.3 LAND TEST PROGRAM

The land test program was conducted to confirm the functional capabilities of the MSS deployment equipment. An additional objective of the test was to demonstrate that the BIP reentry tool assembly could withstand the shock loads imposed upon it by successive reentry attempts without deformation of the stinger. The testing verified that the package could pass through the stinger without jamming or tangling into a cable. It also demonstrated that the sonar reentry tool could be positioned correctly in the hydraulic plug/sonar adaptor and that the adaptor could be moved from the bottom of the stinger to the hydraulic plug position in the BIP carriage control sub. A temporary hydraulic system moved the BIP carriage assembly from the storage position in the BIP carriage housing to the BIP deployment position proving that the transfer mechanism could survive the shock loads generated during the twelve simulated reentry attempts.

For this test program the actual BIP reentry tool assembly was used. The assembly consisted of the BIP carriage control sub, the BIP carriage housing assembly, the BIP carriage assembly and the reentry sub stinger. A dummy BIP was constructed, with a cable attached, and installed in the BIP carriage assembly which was located in the storage position of the BIP carriage housing. The dummy BIP had the same dimensions and weight as the actual BIP.

The hydraulic plug/sonar adaptor was installed in the deployment position at the bottom end of the stinger. A dummy sonar reentry tool was constructed which had the same dimensions and weight as the original. The reentry cone was simulated by fabricating a dummy angled target plate.

The testing was completed with several adjustments. The impact and swing tests were considered satisfactory, and the system was operational for an at-sea-test demonstration.

9.4 MOBILIZATION - SAN JUAN, PUERTO RICO

Puerto Rico Drydock and Marine Terminals, Inc., located in San Juan, Puerto Rico, was selected as the first mobilization site for the tasks of preplanning, fabrication, assembly and logistics staging. The drydock company provided suitable offices, work spaces and test areas. Mobilization started about 45 days prior to the Glomar Challenger's arrival. Puerto Rico Drydock and Marine Terminals, Inc. also fabricated the following major MSS '81 support equipment:

- Hydraulic Control Panel
- Steel Structure (to complete the heave compensator)
- Winch Foundation
- A-Frame Fabrication (using 10" square steel tubing)
- Winch EM Cable Fairlead
- Pengo Winch Repairs
- Miscellaneous Fabrication, Purchases and Tests, as required

Most of the MSS '81 equipment were picked up from the various vendors' plants and trucked to the port of embarkation and then by ship/barge to San Juan. The Teledyne-Geotech equipment was trucked via Ryder Truck Lines from Garland, Texas, to Lake Charles, Louisiana, in a container and transshipped to San Juan on a roll-on/off type barge, but the BIP was not in the container; it was left at Ryder's truck terminal in Houston. The BIP was taken from Ryder Trucking and loaded into a truck supplied by specialized services for a run to Miami. A DC-6 was chartered from Challenger Air Transport to transport the BIP which arrived slightly damaged in San Juan two days before the Glomar Challenger sailed. The rest of the equipment from California were trucked via Jacksonville, Florida, and transshipped on a roll-on/off type barge to San Juan without further incident.

After the arrival of the Glomar Challenger, the shipyard's labor force worked around the clock completing the installation in two days.

9.5 OPERATION

After mobilization of the equipment in San Juan, Puerto Rico, and installation onboard the Glomar Challenger, the ship departed on 14 March 1981 for the test site (DSDP reentry site 395A) located in the mid-Atlantic at latitude 22°45.34'N, longitude 46°04.90'W, approximately 90 km west of the mid-ocean ridge.

At 0200 hrs on 27 March 1981, with the ship on site and dynamically holding position, the deep ocean seafloor deployment test of the MSS began with favorable sea state and vessel movement. The original sequence of procedures for assembling the carriage and inserting the

BIP were modified to permit better control of the instrument impacts during the insertion into the carriage.

The EM Cable was initially keelhauled and tied off at the moonpool work platform. The carriage control sub was made up to the reentry housing carriage, and the attachment nuts were welded while on the casing rack. The reentry assembly was picked up on the traveling blocks, lowered and aligned to the stinger flange, bolted and all of the nuts welded. The total assembly was then deployed to the rotary table and hung on drill collar slips and safety clamp. Four 20.96 cm (8-1/4 in.) OD Baash Ross Bumper Subs, each weighing 818 kg (1,800 lbs) with 1.5 m (5 ft) of stroke, were made up to the carriage control sub tool joint and torqued to API specs. The total reentry assembly was then suspended on traveling blocks, and the drill collar slips were removed (tugger and cat lines were used to snub assembly to forward side of rotary table) while the EM Cable was passed through and rigged into a sheave hanging from the derrick on a tugger line. The carriage assembly was lifted until the top of the carriage was approximately 0.9 m (3 ft) above the rotary table.

The BIP was then placed on the catwalk, the EM Cable was connected, and systems checks were made. Figure 9-1 shows the BIP assembly. The crane and tugger picked up the BIP until load could be taken vertically on the EM Cable then carefully lowered into the carriage. Figure 6-4 is a photo of the BIP just before being lowered into the reentry sub carriage. The carriage shear pins and hydraulic connection lines were installed at the moonpool work platform. The total assembly was lowered approximately 6 m (20 ft) and snubbed off with tugger and cat line, while the EM Cable was hand fed through the rotary table.

The bight of EM Cable on rig floor was removed from the sheave, passed through the rotary down to the lower work platform and secured. The assembly was then lowered and slips set around the top bumper sub. One 9 m (30 ft), 18.42 cm (7-1/4 in.) OD drill collar weighing 1,364 kg (3,000 lbs) was made up to the bumper sub, and the assembly was lowered and landed on slips. One stand of drill pipe was then made up above the drill collar.

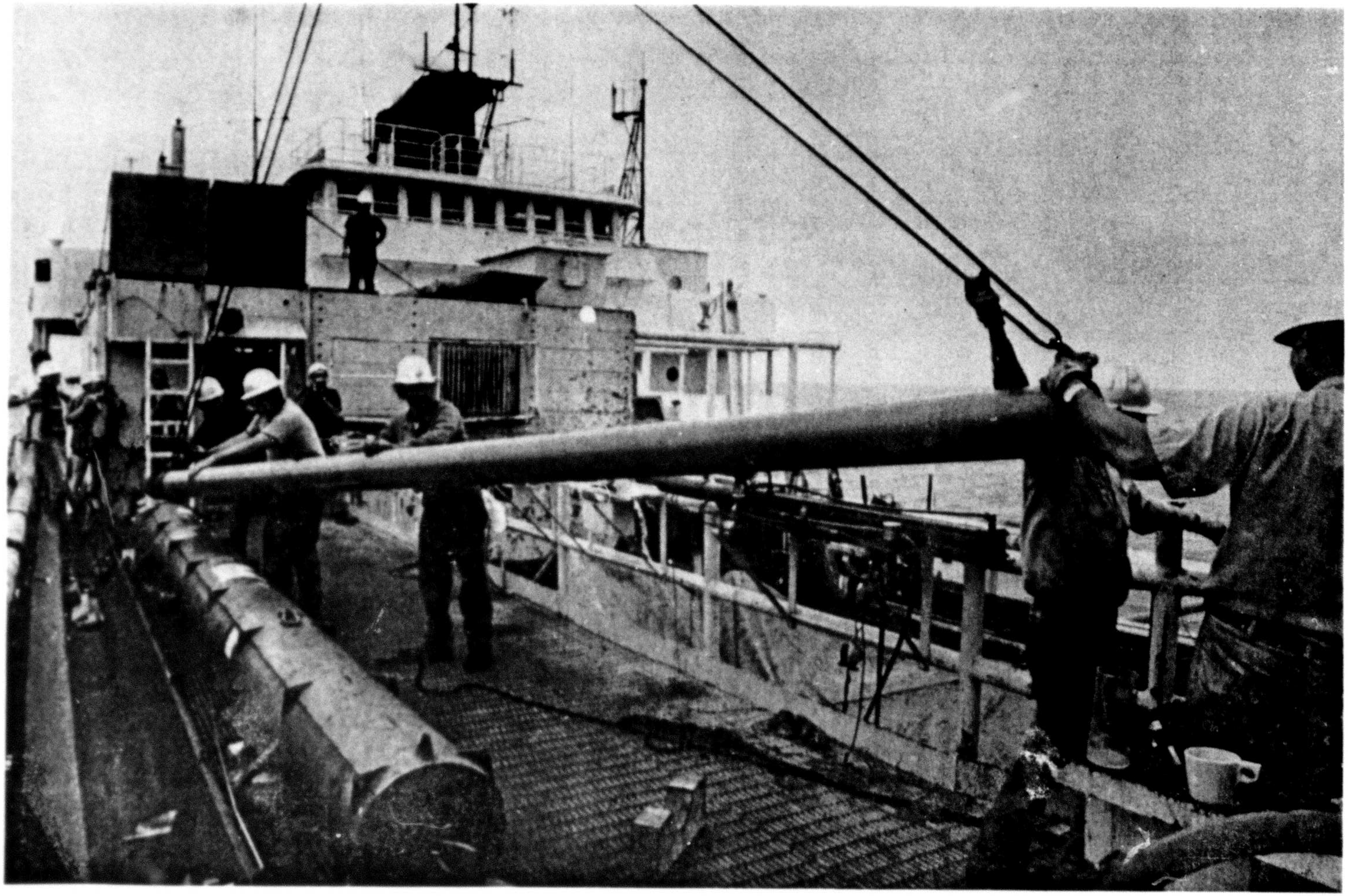


FIGURE 9-1 [illegible] ASSEMBLY

The slot in BIP carriage assembly was oriented facing the A-Frame sheave, and orientation marks were scribed on rotary table and tool joint for reference during deployment. The pipe was lowered 9 m (30 ft) where the EM Cable bight was removed from guard and passed through the piccolo base and released. The EM Cable was not tensioned during the first 359 m (1,180 ft) of deployment but was kept taut to prevent entanglement. At the 359 m (1,180 ft) depth, line counters were set to correspond with assembly measurements, weight indicators were checked, recorders were started and the heave compensator was raised to mid-stroke. The EM Cable tension was increased to 227 kg (500 lbs) during the deployment of the next nine stands of drill pipe to a depth of 615 m (2,017 ft) where it was raised to 909 kg (2,000 lbs) and then increased to 1,364 kg (3,000 lbs) at a depth of 898 m (2,947 ft). The tensions were somewhat lower than previously planned because there was no indication of current acting upon the EM Cable or drill string. Pipe deployment was continued until the sea bottom was reached while cable tension was incrementally increased to a maximum of 3,273 kg (7,200 lbs).

Thee major concerns since the beginning of the operation were (1) coordination between the driller and winch operator (2) keeping the BIP carriage oriented and (3) avoiding cable entanglement. The first two concerns were quickly relieved due to the skill and dedication of the Challenger's fine crew.

At 1900 hrs, the reentry tool was run in on the Schlumberger line and reentry scanning was started. Reentry was accomplished in the usual DSDP manner by maneuvering the Challenger using range data from the sonar reentry tool. The drill string acts as a heavily damped pendulum which tends to oscillate in a figure eight motion. After a series of iterative ship movements, the reentry sub was positioned over the reentry cone. The drill string was then lowered rapidly at the rig floor allowing a 18 m (60 ft) drop of the reentry sub into the reentry cone and inner casing. At 1257 hrs, 30 March, reentry was smoothly accomplished. The sonar tool was recovered, the Schlumberger equipment were rigged down, and line counters were reset to correspond with measurements of drill pipe and assembly deployed. This operation took about five hours to accomplish.

The tension on the EM Cable was slacked to 3,182 kg (7,000 lbs) in order to leave approximately half the weight of the BIP setting down on the carriage, thus allowing the BIP to fall a short distance when the pins were sheared. Using the cement pump, pressure was brought up slowly to approximately 155 kg/cm^2 (2,200 psi) with no indication of shear observed on pressure gauge or weight indicator. However, the accelerometer in BIP data indicated that the reentry pins had sheared, and the BIP had moved to centerline. When the winch began slowly paying out cable, the weight began to decrease indicating that the BIP was initially not falling. Then, the weight indicators stabilized and the winch smoothly began paying out indicating no entanglement and that the BIP was on its way to the bottom. The BIP was run to the bottom 5,102 m (16,738 feet) and held for data, pulled back 305 m (1,000 ft) and lowered again to take further lowering data characteristics.

The ship was moved 61 m (200 ft) upstream to the current and then the reentry assembly was pulled out of the reentry cone approximately 27 m (90 ft) above cone. The hydraulic system was repressured to 239.5 kg/cm^2 (3,400 psi) releasing the EM Cable gate. The BIP was returned to the bottom of the borehole. The running string was pulled out, and the reentry assembly was retrieved, disassembled, and returned to the storage rack. The ship was then moved 911 m (2,990 ft) downstream to current while paying out EM Cable on seafloor with approximately 610 m (2,000 ft) additional cable laid out.

On 28 March, seismic experiments began and were carried out for two days. A series of explosives were dropped from the support vessel, USNS Lynch, at various distances from the Glomar Challenger. High quality seismic data were recorded by the BIP and three ocean bottom seismographs (OBS) which provided detailed information on the velocity structure of the oceanic crust.

Recovery of the BIP was achieved without any significant difficulties and with minimal damage to the BIP, EM Cable or deployment hardware.

On 30 March, the at-sea-test demonstration was successfully concluded with the entire onsite operation being completed within seventy-three hrs.

The major accomplishments of the deployment operation were as follows:

- Demonstrated feasibility of emplacing large instrumentation packages into holes predrilled into the ocean floor.
- Demonstrated successful handling, deployment, release and retrieval of the BIP, EM Cable, and drill string.
- Proved deployment equipment design.
- Verified deployment procedures.
- Obtained high quality seismic data.
- Determined that impact forces were within design criteria.
- Determined that cable entanglement was not a problem.

9.6 DEMOBILIZATION

The vessel proceeded to Las Palmas, Grand Canary Islands, to demobilize. The selected shipyard was Astilleros Canarios, SA, also known as "Astican." Global Marine's ship agent, Menasintes International, SA, made arrangements with a local company, Mudanzas Internacionales, to pack and crate the MSS '81 equipment for shipment to the U.S.

The equipment, with the exception of the BIPs which were returned to Teledyne-Geotech, went to NOSC in San Diego for inside warehouse storage.

SECTION 10.0 - MSS '82 OPERATIONS REVIEW

10.1 OBJECTIVE

The primary objectives of the MSS '82 operation were to deploy two improved borehole seismometers in oceanic crust at a DARPA designated North Pacific site (References 6 and 9). One instrument was built by DARPA and the other by the Hawaii Institute of Geophysics (HIG). A recoverable recording package was also to be installed. A prototype Configuration I deployment reentry housing assembly was utilized.

10.2 FABRICATION ACTIVITIES

Engineering data gained during the MSS '81 operation determined that the system needed a heavier A-Frame, and much of the equipment needed to be reworked to insure a minimum of downtime. Major changes were associated with modifying the reentry sub to accommodate the longer BIP and to strengthen the stinger to housing interface.

10.3 MOBILIZATION - HAKODATE, JAPAN

Most of the GMDI equipment went to Japan via MSC from Port Hueneme, California, to Yokosuka Naval Supply Center in Japan. From there, the equipment was trucked to the mobilization site in Hakodate. The Gould equipment was accompanied by two Gould-DED personnel from Dover AFB in Maryland to Chitose Airport near Sapporo, Japan. The equipment was offloaded and trucked to the mobilization site. The Teledyne equipment was transported via MAC flight from Tinker AFB, Oklahoma, to Yokoto, Japan, and trucked to the mobilization site.

NORDA shipped the transponders and associated equipment to the USNS De Steiguer (T-AGOR 12) mobilization site in Adak, Alaska, to assist the Glomar Challenger in the MSS deployment and to do the recovery of the bottom data processing package.

The staging and mobilization area was at the Hakodate Dock Yard in Hakodate, Japan. Suitable offices and covered work areas were provided by the yard along with installation manpower and equipment.

The Glomar Challenger arrived at 0900 hrs on 18 August, and the MSS equipment installation commenced within the hour. The A-frame and working platform were load tested and U.S. Coast Guard certified by the resident American Bureau of Shipping inspector. The installation and testing of the equipment were completed thirty hours later at 1500 hrs on 19 August. Additional equipment and stores were loaded on board, and at 1200 hrs on 20 August the Glomar Challenger departed. The total time from arrival to departure was fifty-one hrs.

10.4 OPERATION

On 24 August, the Glomar Challenger arrived at 43°56'N/159°48'E in the Northwest Pacific and conducted a brief bathymetric/seismic survey to determine the topography and sediment thickness around the drill site. A pilot hole (581) had been drilled in leg 86 at this location. Due to marginal weather conditions, operations were postponed until the next day. The location for Hole 581-A was established 183 m (600 ft) south of Pilot Hole 581 at a water depth of 5,486 m (18,000 ft).

At 0500, 25 August, drilling of the reentry hole commenced. A reentry cone was keelhauled and 72.15 m (237 ft) of 40.64 cm (16 in.) casing was made up and latched into the cone beneath the vessel. The drill pipe running string with a 38.1 cm (15 in.) core bit, was made up and attached to the cone and casing, and the assembly was then run to the seafloor where the casing was jetted into the sediments. The wireline release/shifting tool was run, the casing was released, and coring operations begun. Considerable torquing and sticking of the drill bits were experienced where chert stringers were interspersed with the sediments. This experience indicated the desirability of drilling a pilot hole in close proximity to the borehole.

When the desired penetration into the basalt was reached, the hole was flushed clean and the mud spotted for a wiper trip into the casing. The drilling assembly was pulled into the 40.64 cm (16 in.) casing and operations were suspended for cutting and slipping of the drilling line. Plans to deploy the DARPA seismometer were abandoned, however, when during the trip out the drill pipe broke in the first joint above the drill collar, and the BHA was lost. The drill pipe may have broken when subjected to erratic large loads. Although recovery of the BHA was considered possible, it was quicker and more prudent to set a new reentry cone. Hole 581-A was abandoned on 27 August.

A second reentry cone and a replacement BHA were assembled less than twenty-four hours after Hole 581-A had been abandoned. After 72.27 m (237 ft) of 40.64 cm (16 in.) casing were made up and latched into the cone, the whole assembly was run to the mudline. On 29 August, a new drill site (Hole 581-B) was established about 122 m (400 ft) southwest of the original pilot hole.

Washing in of the casing and cone proceeded smoothly until the bit was 57 m below the mudline. Subsequent progress was slow and after another 3 m, the casing became stuck with the reentry cone 9 m above the seafloor. Efforts to free the casing and to start a new hole were unsuccessful, and the cone had to be released. The wireline shifting tool was run repeatedly without releasing from the cone. A possible bent bumper sub mandrel was suspected. A maximum pull was taken on the drill string while attempting to shift the sleeve. Finally the sleeve shifted, the tool released from the cone, and the drill string was pulled free. Upon retrieval, it was found that the bumper sub immediately above the tool had been bent. The damage to the bumper sub probably occured while attempting to free the stuck casing.

After some difficulties with the tools sticking in the chert zone, the hole was drilled into the basalt to the casing depth. The hole was circulated, conditioned and readied for the 29.85 cm (11-3/4 in.) casing. The tools were pulled to the top of the reentry cone while the EDO tool was run to confirm that the cone remained in a vertical position. The 39 joints of 29.85 cm (11-3/4 in.) casing, two 6.1 m (20 ft) slip joints and the 29.85 cm (11-3/4 in.) casing hanger were made up on the running tool and run into the top of the reentry cone. Reentry was difficult because a malfunctioning line wiper damaged two EDO tools. The casing was run to the bottom and landed in the normal fashion. Circulation was established and the casing cemented with 735 sacks of cement. After the cement was displaced, attempts to pull the running string from the casing were unsuccessful probably because of failure of the casing release mechnanism. With the approach of typhoon Gordon, operations were threatened. Therefore, on 5 September the drill string was severed above the running tool, the pipe was pulled from the seafloor, and the ship and equipment were secured for severe weather.

On 9 September, after typhoon Gordon passed to the north, the ship returned to Site 581 where Hole 581-C was drilled and the HIG Ocean Subbottom Seismometer (OSS) smoothly deployed into the open hole. The OSS and shipboard recording instruments were found to be in good working condition, and the testing program was terminated on 13 September.

10.5 DEMOBILIZATION - YOKOHAMA, JAPAN

The demobilization of the Glomar Challenger's MSS equipment took place in Yokohama's NKK Asano dockyard. Most of the Gould-DED and Teledyne-Geotech equipment were returned to their plant in the U.S. via military air freight. The Pengo winch, IRR handling gear, A-Frame, sheaves, heave compensator equipment, rope box and miscellaneous tools were sent to Wellington, New Zealand, via the Naval Supply Depot, Yokosuka, Japan, for the operation scheduled in January 1983.

SECTION 11.0 - MSS DEPLOYMENT PROGRAM PLAN

11.1 INTRODUCTION

An overall program plan was initially developed during Phase I and refined during Phases II, III, IV and V. The intent of the plan was to guide the technical effort and to evaluate associated costs. The program has been modified by the addition of the MSS '83 South Pacific operations. The overall program encompasses five phases covering a period of about four and one-half years and are:

Phase	I	Feasibility Study
	II	Analyses, Test Planning and At-Sea-Test Design
	III	Test Program and Final Configuration I Design
	IV	MSS '82 - Configuration I Mobilization and Operations
	V	MSS '83 - Configuration I Mobilization and Operations

The operational activities encompassed drilling the borehole; setting the borehole casing with reentry cone; deployment of the BIP; deployment of the associated mooring, power, control and communication equipment (IRR System), and subsequent recovery of the IRR System.

11.2 SCHEDULE AND WBS

Figure 11-1 shows the scope of the overall program schedule based upon the MSS '82 deployment attempt in the North Pacific area during August-September 1982 and the subsequent MSS '83 deployment and recovery operations in the South Pacific. Figure 11-2 presents a Work Breakdown Structure (WBS) for all phases of the program.

11.3 PROGRAM ELEMENTS

The Phase I feasibility study consisted of a conceptual design effort, the initial planning activity, and a Rough Order of Magnitude (ROM) cost estimate. The Phase I report summarized the work

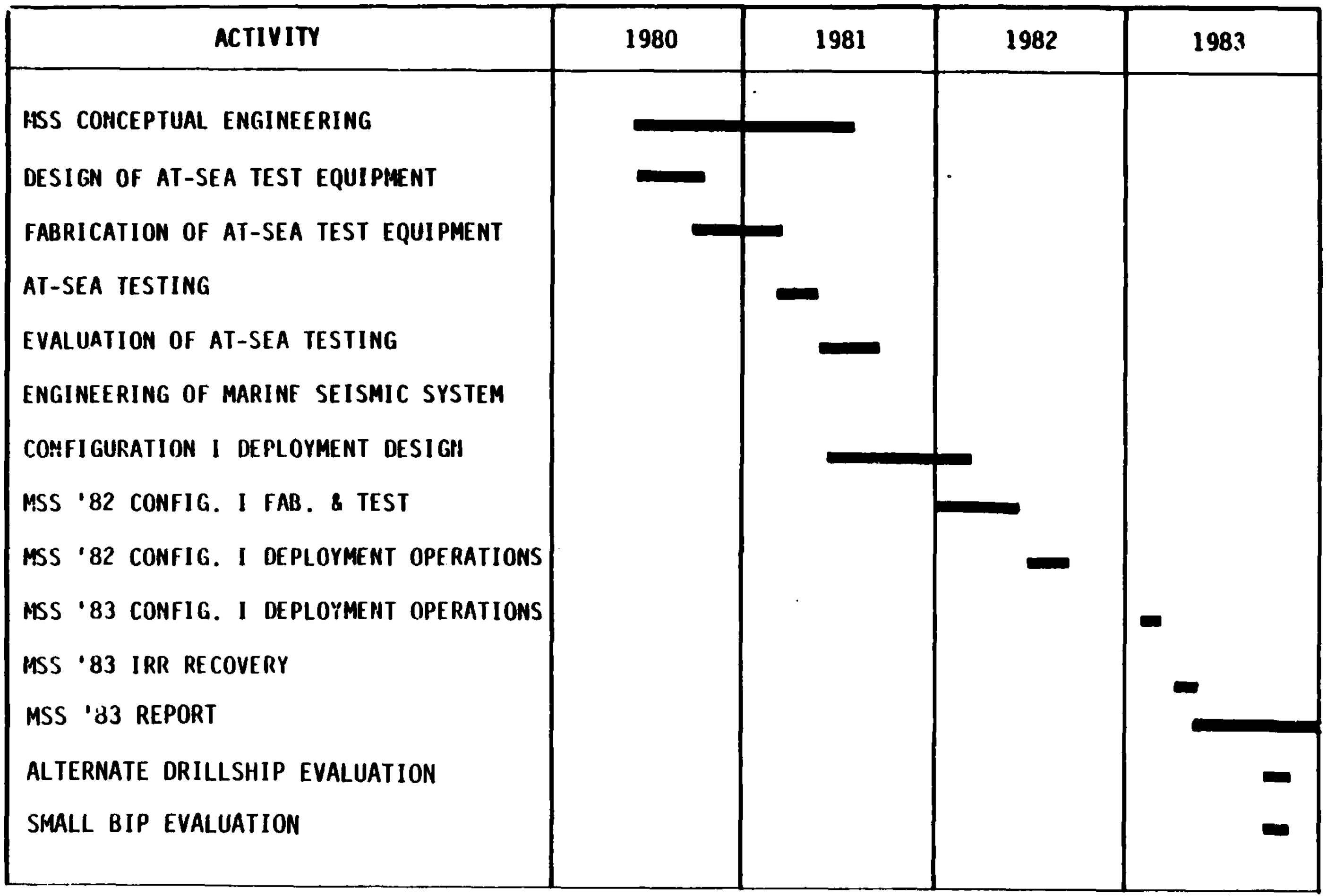


FIGURE 11-1 PROGRAM SCHEDULE

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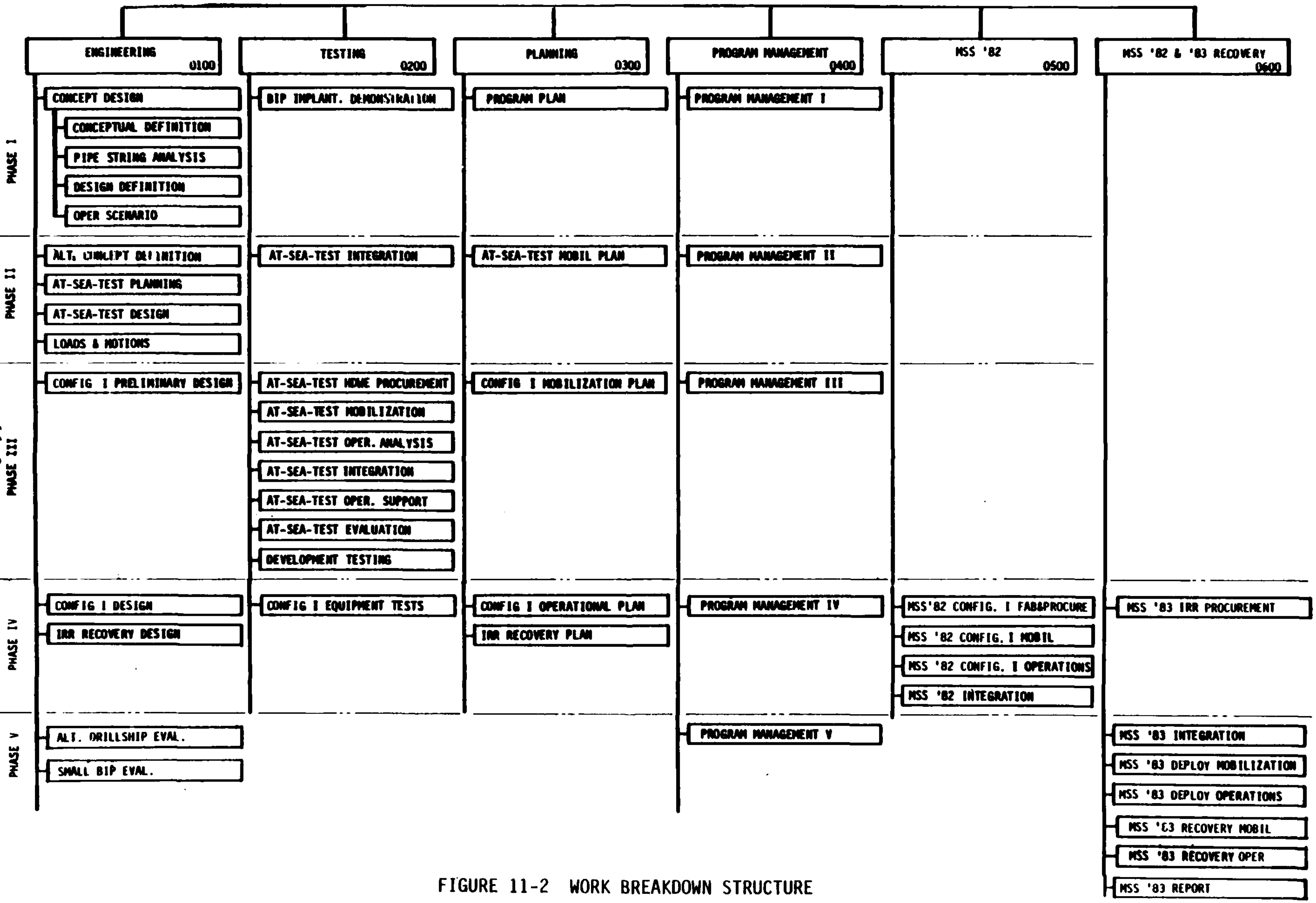


FIGURE 11-2 WORK BREAKDOWN STRUCTURE

0001-002

accomplished to date in that phase and provided overall guidance for subsequent activities (Reference 1).

The Phase II effort concentrated on the design of equipment for the initial at-sea-test demonstration using the Glomar Challenger (Reference 3). This activity started with the development of the necessary test criteria for both at-sea and onshore development tests. Based upon this criteria, detailed designs for the baseline at-sea-test concept were prepared. The baseline design addresses reentry using a drill pipe.

After review by NORDA, the final drawings and equipment specifications were released for vendor selection. In parallel, detailed planning for the at-sea-test was initiated including formulation of a fabrication, checkout, and mobilization plan. Detailed cost estimates for the at-sea-test equipment were prepared. In addition, a small analytical effort was undertaken to better determine the loads, motions, forces and pipe string stress levels for the drilling, casing installation and reentry operational subphases.

A limited alternate reentry concept evaluation assessed state-of-technology for deep ocean guideline and cable reentry deployment approaches. The cable reentry platform approach has been recommended for later Configuration II design studies.

Phase III was initiated by the authorization to procure the necessary at-sea-test equipment (Reference 5). In addition, the detailed test operational procedures plus installation requirements were developed in conjunction with the DSDP Project Office and coordinated with NSF.

The MSS '81 at-sea-test demonstration occurred during late March 1981 (References 4 and 8). From this test, final verification data concerning impact loadings, cable entanglement and operational procedures were developed. Overall planning for the MSS '82 deployment in the Northwest Pacific was initiated. The final design of the Configuration I deployment equipment was accomplished. In parallel, the preliminary fabrication and mobilization planning for Configuration I deployment has been performed.

Phase IV covered the actual fabrication, assembly and checkout of the specialized MSS '82 Configuration I deployment equipment (Reference 6). The equipment was shipped to Japan for preinstallation checkout. Final Glomar Challenger mobilization and modification procedures were determined and deployment operational procedures were finalized in conjunction with the DSDP Project Office. The shipboard installation of equipment was accomplished in Hakodate, Japan. The attempt to deploy the BIP was unsuccessful due to drill ship equipment failure (Reference 9). The MSS equipment was removed from the Glomar Challenger in Yokohama, Japan. The electronic equipment was shipped back to the U.S. and the deployment equipment was shipped directly to New Zealand for the Phase V deployment.

Phase V consisted of a second Configuration I deployment attempt at a new DARPA designated site in the South Pacific. Mobilization and installation of equipment on the DSDP Glomar Challenger took place in Wellington, New Zealand (Reference 7). A new reentry borehole was emplaced, the BIP was deployed, and five days of seismic tests were accomplished. Subsequently, the BPP and its associated IRR mooring system were successfully deployed. The Glomar Challenger transited to Papeete, Tahiti, for demobilization (Reference 10). Subsequently, a special recovery leg using the R/V Melville was mobilized to recover the BPP after an approximate period of forty-five days. The BPP was successfully recovered and a dummy BPP redeployed.

The latter portion of Phase V was expended to closing out the MSS program and providing necessary documentation for any potential follow-on activity. Two small studies were conducted evaluating alternate drillships and small BIP deployments. A final report plus an application report were issued.

SECTION 12.0 - MSS DEPLOYMENT PROGRAM COST EVALUATION

The actual and projected costs of the overall MSS Deployment Program have been reevaluated based on the present understanding of overall MSS criteria. A cost estimate for the overall MSS Deployment Program has been updated and is presented in Table 12.1.

The cost summary has been organized into a matrix to show costs by phase and by major activity. The Phase V costs cover activities from 12 December 1982 through 31 December 1983.

Actual costs for the March 1981 At-Sea-Test reentry demonstration are presented in Table 12.2; actual costs for the MSS '82 deployment operations are presented in Table 12.3; and actual costs for the MSS '83 deployment and recovery operations are presented in Table 12.4.

TABLE 12.1

MSS DEPLOYMENT PROGRAM COST PROJECTION

ACTIVITY	I Jan-Jun 1980	II Jun-Sep 1980	III Oct-Sep 1980-81	IV Oct-Dec 1981-82	V Dec-Mar 1982-84	TOTAL
Engineering	$59,000	120,200	71,700	287,200	—	538,100
Testing (including MSS '81 At-Sea-Test)	—	17,200	1,160,100	99,100	—	1,276,400
Planning	15,400	15,100	37,100	84,100	—	151,700
Program Management	11,200	35,700	108,800	148,700	106,900	411,300
Deployment - MSS '82	—	—	—	762,400	—	762,400
Deployment - MSS '83	—	—	—	103,300	582,500	685,800
Advanced Studies	—	—	—	—	65,700	65,700
TOTALS	$85,600	188,200	1,377,700	1,484,800	755,100	3,891,400

NOTE: Figures displayed are representative of the broad categories listed. They are not intended to portray the negotiated contract, or total actual cost to the government by detailed work breakdown structure.

TABLE 12.2

ACTUAL COSTS FOR THE MSS '81 AT-SEA-TEST DEMONSTRATION
MARCH 1981

ACTIVITY	COSTS
At-Sea-Test Equipment Design	$ 345,300
At-Sea-Test Equipment Procurement	369,300
At-Sea-Test Planning	21,800
At-Sea-Test Integration	86,400
At-Sea-Test Mobilization and Demobilization	265,100
Operations	83,100
Shore Testing	84,700
Evaluation	35,800
TOTAL	$1,291,500

NOTES: 1. Excludes Glomar Challenger costs
2. Excludes Program Management

Figures displayed are representative of the broad categories listed. They are not intended to portray the negotiated contract, or total actual cost to the government by detailed work breakdown structure.

TABLE 12.3

ACTUAL COSTS FOR THE MSS '82 CONFIGURATION I DEPLOYMENT SYSTEM

ACTIVITY	COSTS
Configuration I Design including IRR	$ 287,200
Configuration I Procurement including IRR	242,900
Operation Planning	84,100
Equipment Test	99,100
Mobilization and Demobilization	286,800
Operations	95,200
Integration	137,500
TOTAL	$1,232,800

NOTES:
1. Excludes Glomar Challenger costs
2. Excludes Program Management
3. Includes IRR System

Figures displayed are representative of the broad categories listed. They are not intended to portray the negotiated contract, or total actual cost to the government by detailed work breakdown structure.

TABLE 12.4

ACTUAL COSTS FOR MSS '83 DEPLOYMENT AND RECOVERY OPERATION

Activity	Costs
Deployment Mobilization/Demobilization	$ 393,600
Deployment Operations	88,700
Recovery Mobilization/Demobilization	120,600
Recovery Operations	59,800
Evaluation and Reports	88,100
Total	$750,800

Notes: 1. Excludes Glomar Challenger and RV Melville costs
2. Excludes Program Management

Figures displayed are representative of the broad categories listed. These figures are not intended to portray the negotiated contract or total actual costs to the government by detailed work breakdown structure.

SECTION 13.0 - MSS DEPLOYMENT EVALUATION

13.1 AREAS OF CONCERN

Five areas of major technological concern associated with the deep ocean deployment of a MSS seismic instrument are deployment loads, drill string characteristics, cable dynamics, cable entanglement, and borehole emplacement.

Extensive data addressing these concerns were obtained from the three operations. In general, all of the above considerations are acceptable and can be accommodated. At times marginal conditions can exist due to the combination of water depth, current and/or weather conditions.

13.2 DEPLOYMENT LOADS

A major question concerned the possible damage to the sensitive seismometer package. A 10 G impact loading requirement limitation was established covering shipboard handling, lowering and reentry impact conditions. Special procedures had to be established to reduce inadvertent handling shocks. For the reentry impact, the use of a cantilevered stinger plus BIP shock isolation supports provided adequate isolation to the impact forces.

Based upon deployment experience, the shock limits of 10 G can be achieved. The maximum shock loading observed by the BIP was 6.5 G which occurred during shipboard handling activities. Actual reentry shock levels were recorded at a maximum of approximately 5 G under good weather conditions. Accordingly, a major problem is not foreseen during the deployment of sensitive instrumentation, and an even greater degree of shock isolation can be achieved if desired.

An area that was not completely defined was the reentry trajectory after initial contact. Associated with this is the resultant bending moment distribution along the lower reentry assembly and transition areas. The localized bending stresses at the stinger end are acceptable.

13.3 DRILL STRING CHARACTERISTICS

There has been continuing concern over the specific response of the drill string as coupled to the bottom MSS deployment assembly. Longitudinally, the pipe string has been computer modeled by the DSDP, but this data has not yet been correlated with the actual data. Unfortunately, there has not been a detailed computerized analysis of the lateral dynamic characteristics. The three specific areas requiring in-depth analysis are the upper sector of the pipe string, the lower transition area, and the stinger-housing interconnection.

The upper area is probably not critical with respect to MSS operations although high axial loads plus bending and wear forces can exist. An improved definition of the combined stress forces needs to be established.

The lower transition area is a particularly critical section because of the change in stiffness going from drill pipe to bumper subs, through drill collars to the housing assembly. This area is acted upon by complex oscillatory and static lateral bending moments. It also is the weakest area of the lower pipe string.

Two failures or partial failures have shown up in the stinger-housing interconnection area. The first failure was during MSS '81 and resulted in a partial closing of the cable gap. Subsequently, this area was redesigned to signficantly increase the local stiffness. During MSS '83 operations, the ten interconnection high strength bolts failed in tension. A metallurgical and structural evaluation inferred that the bolts failed in tension probably caused by excessive bending. The records indicated that the failure occurred during the recovery process. Overtorquing and/or a tack welding embrittlement may have contributed to the failure. Fatigue fracture was not apparent.

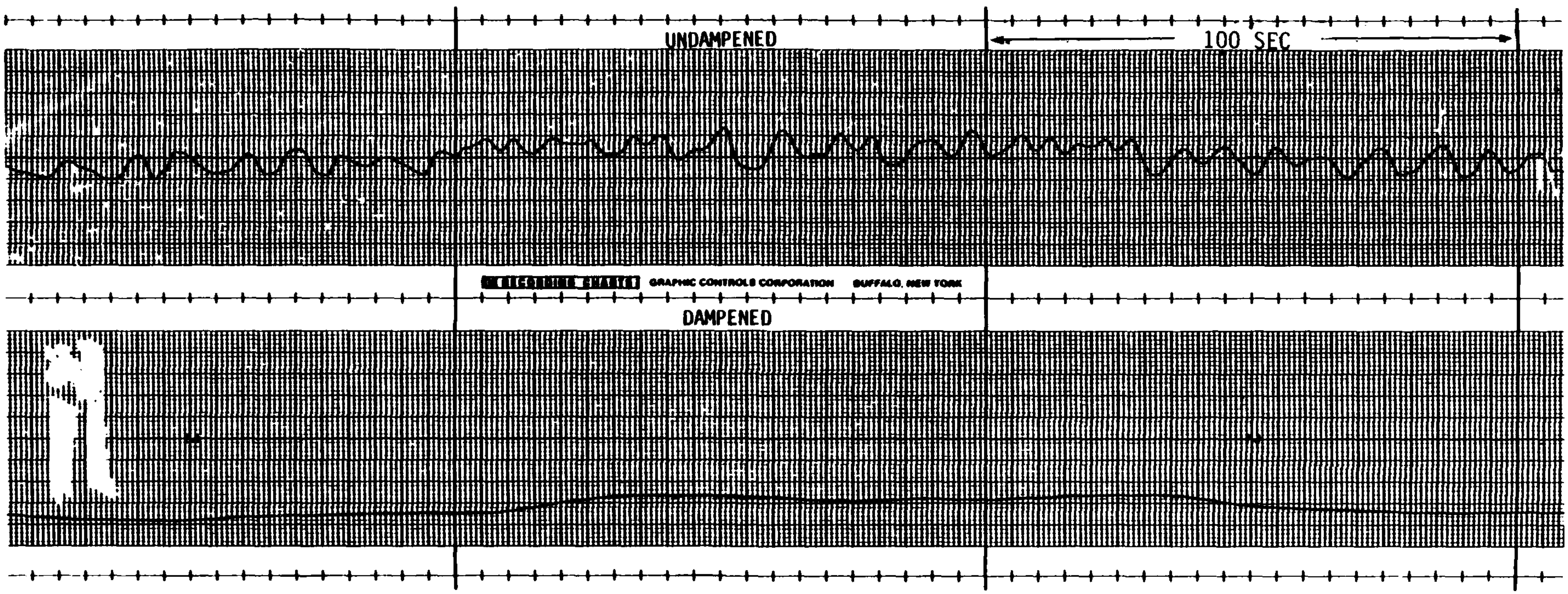
Because of the many uncertainties associated with the static plus dynamic responses of the drill string, it is necessary that detailed modeling of the pipe string be conducted. In particular, the varying sections including the reentry cone must be defined and the coupling modes established. The critical resonance areas all need to be identified. The major question with a detailed model is how to treat the damping. Structurally, the stinger-housing interconnection can be easily strengthened; however, this may shift the critical loading up to the relatively weaker lower transition area. Thus, it is essential that the interrelationships be fully understood prior to future operations.

13.4 CABLE DYNAMICS

At the start of the program, there was uncertainty concerning the dynamic characteristics of very long tensioned EM Cables. The cable analysis (axial) predicted rather well the tension levels, and unusual problems were not noted. At the suspected resonance areas, excessive characteristics were not noted indicating reasonable damping effects. Figures 13-1 (A through E) depict several cable tension records at designated depths during deployment of the BIP.

Figures 13-2 (A, B, C, and D) respectively show the cable induced load cell traces during reentry, while lowering in the borehole, when touching the bottom, and after the drill string removal.

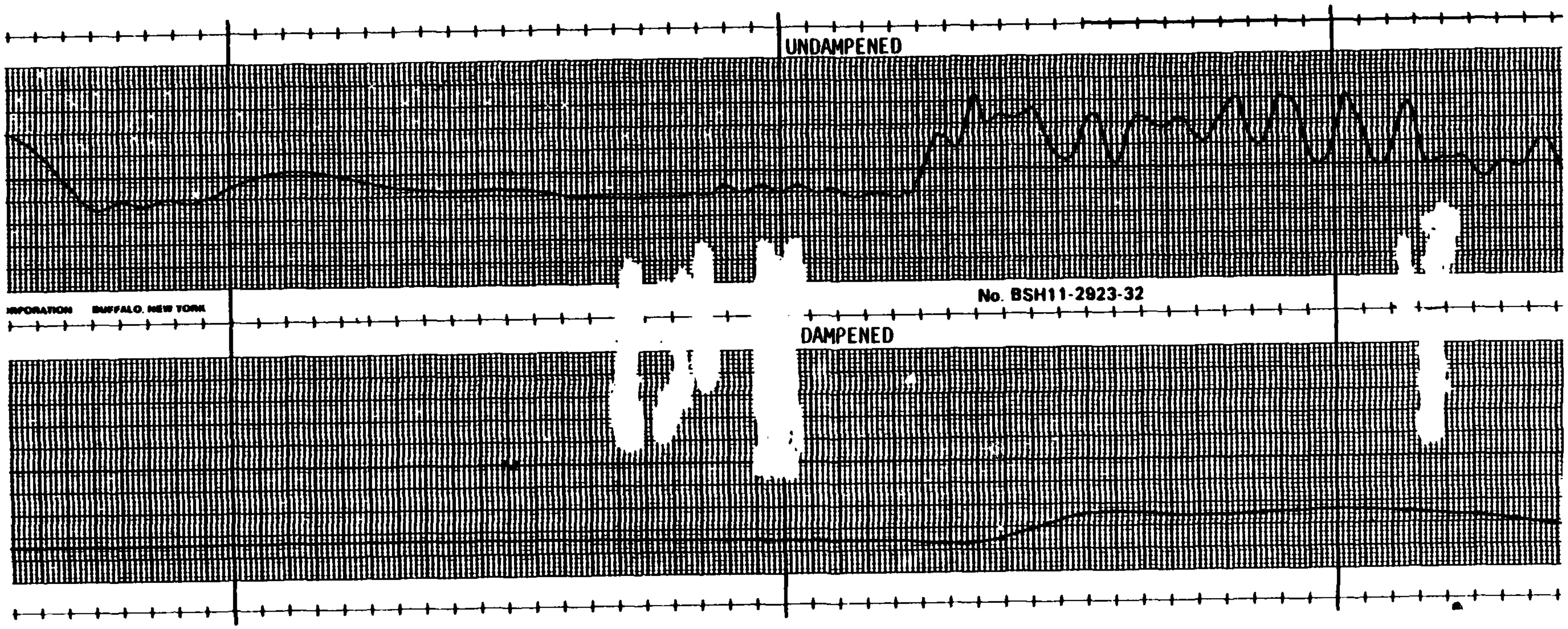
Lateral analysis correlations were not a[illegible]ed although it would have been desirable to know if [illegible] were any whipping characteristics or added axial forces pa[illegible]larly with the free end of the pipe string [illegible] eight motion. Any such analysis must take int[illegible] damping and variable drag coefficients.



CABLE TENSION 1200 LBS

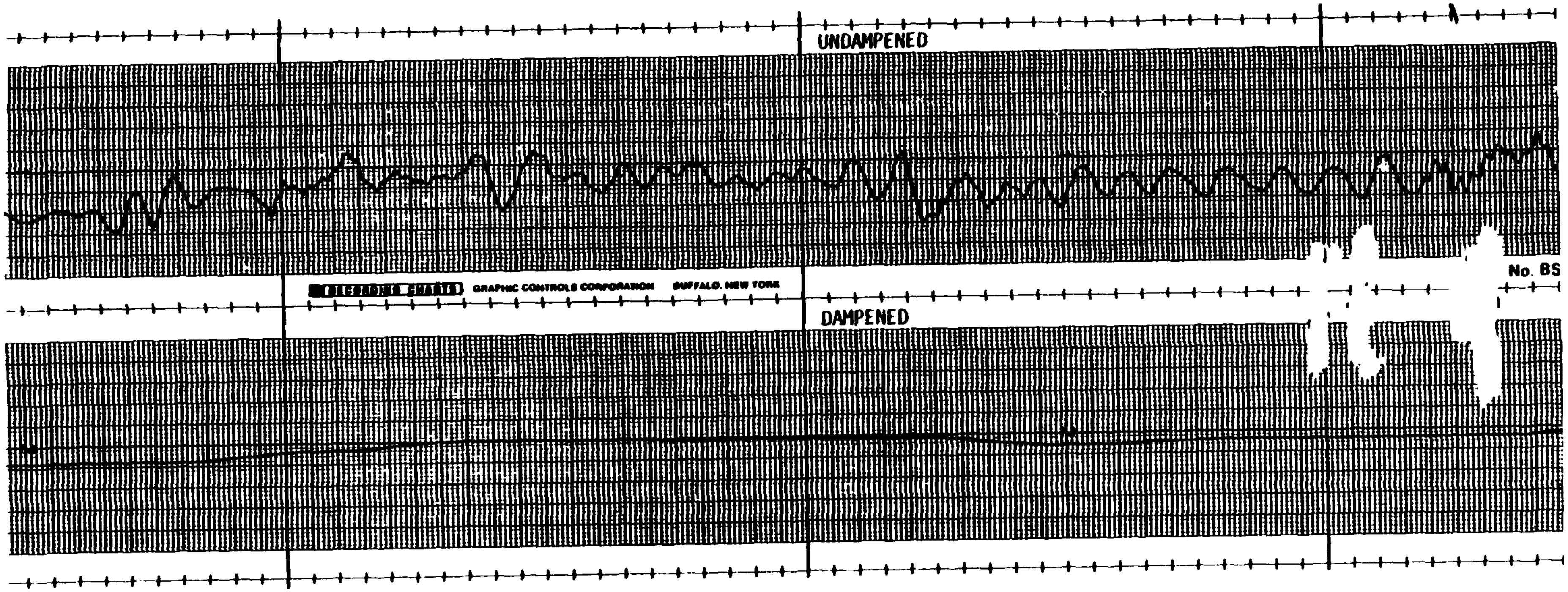
CABLE LENGTH 200 FEET

FIGURE 13-1 A MSS '83 BIP DEPLOYMENT



CABLE TENSION 2100 LBS
CABLE LENGTH 4000 FEET

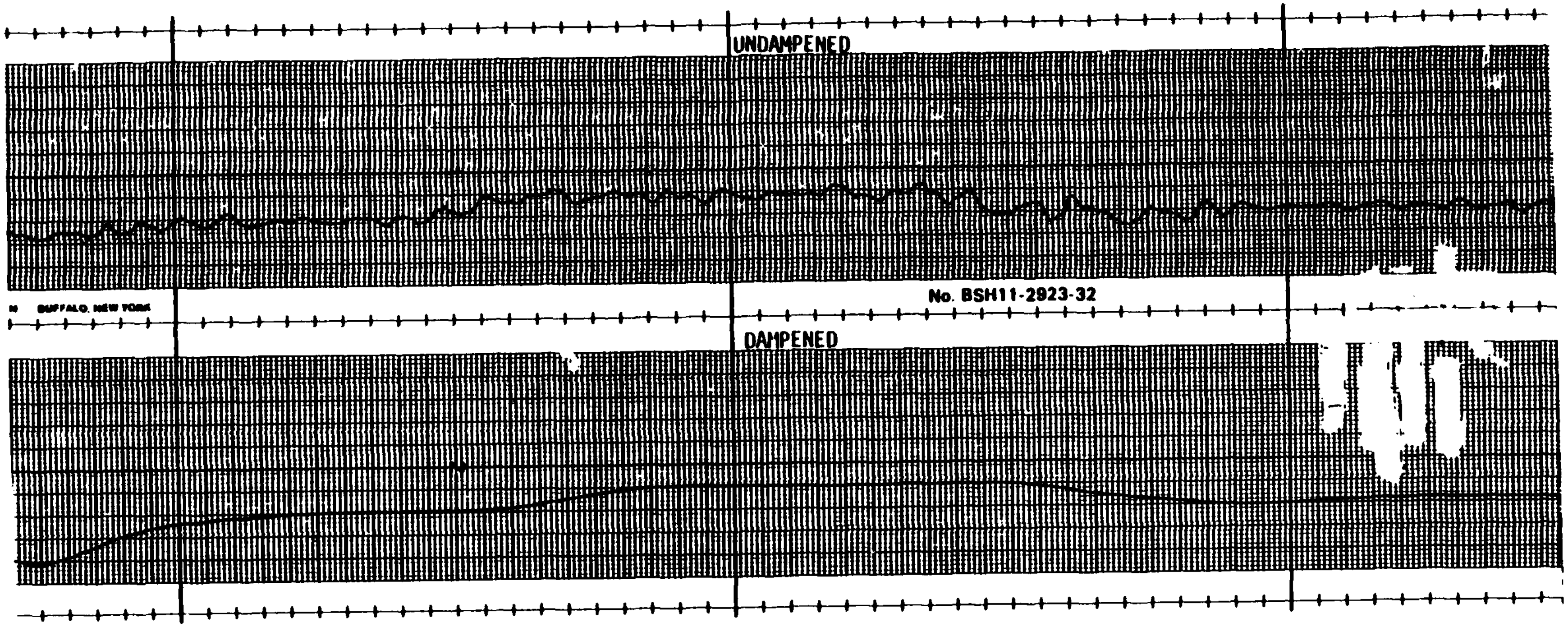
FIGURE 13-1 B MSS '83 BIP DEPLOYMENT



CABLE TENSION 3400 LBS

CABLE LENGTH 8000 FEET

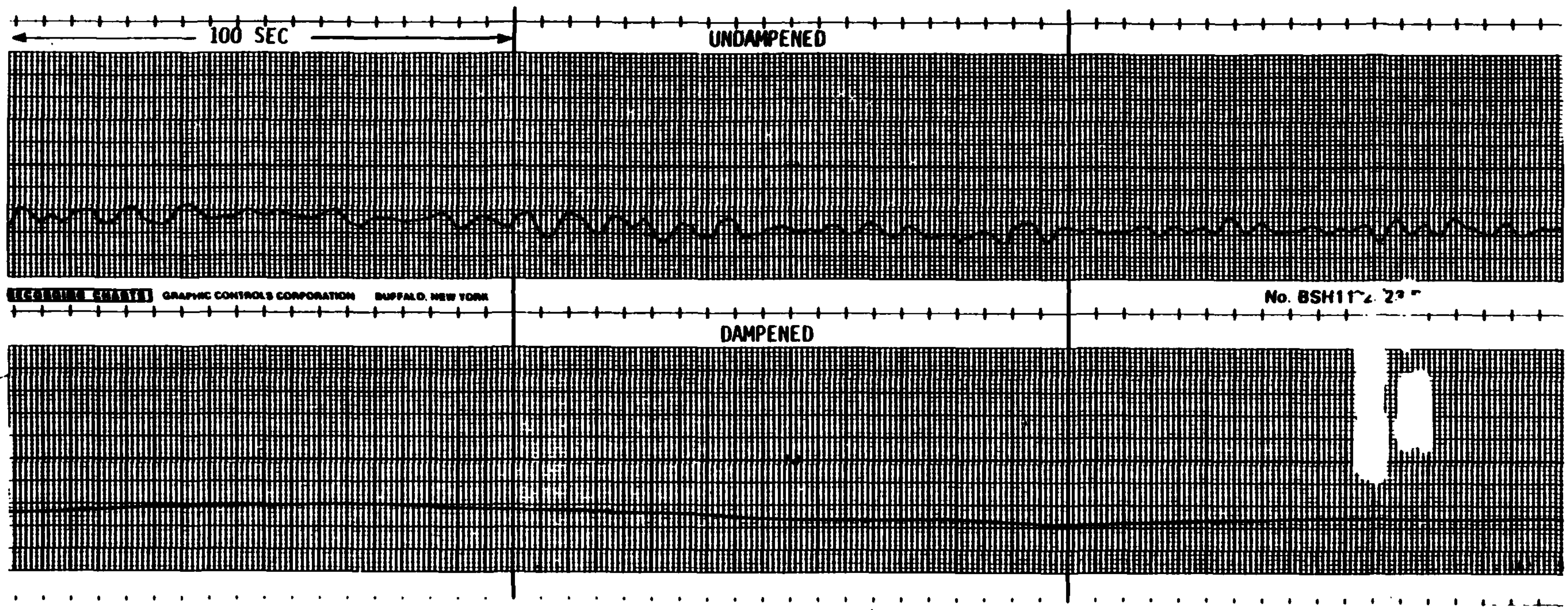
FIGURE 13-1 C MSS '83 BIP DEPLOYMENT



CABLE TENSION - 5900 LBS

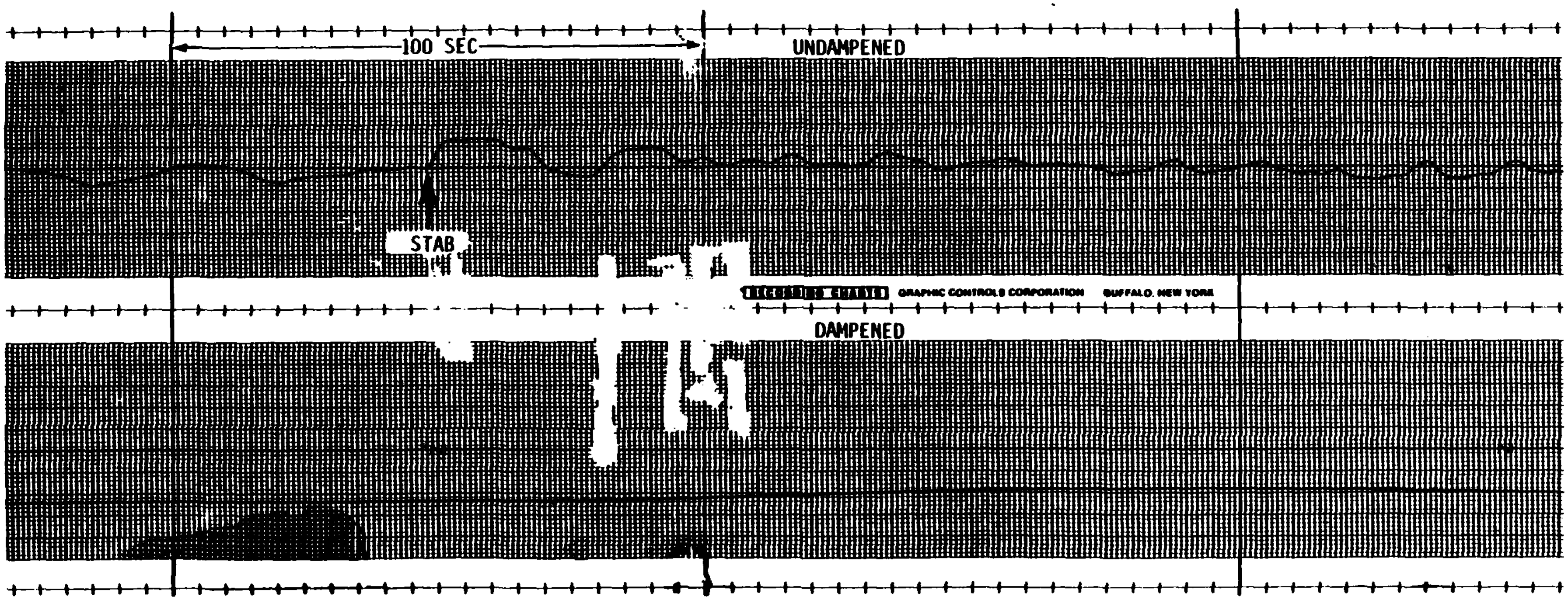
CABLE LENGTH - 16800 FEET

FIGURE 13-1 D MSS '83 BIP DEPLOYMENT



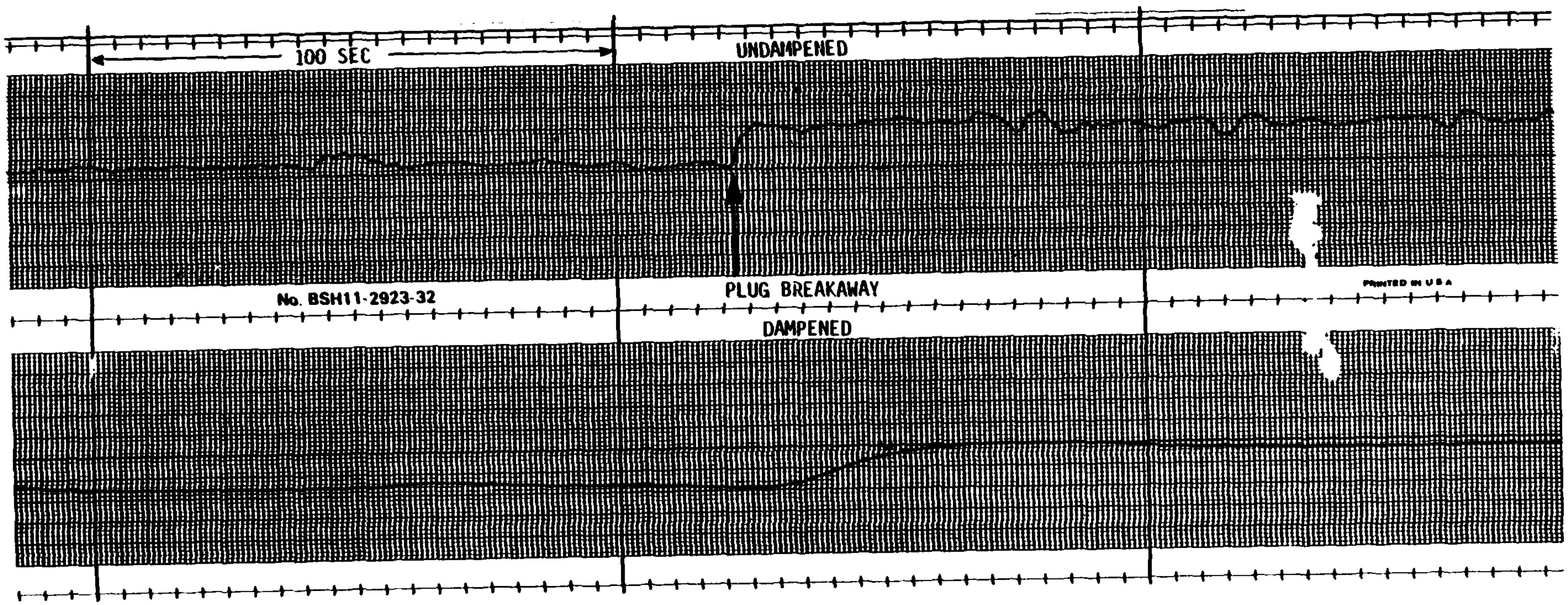
CABLE LENGTH 18200 FEET
CABLE TENSION 5800 LBS

FIGURE 13-1 E MSS '83 BIP DEPLOYMENT



CABLE TENSION 5900 LBS
CABLE LENGTH 18300 FEET

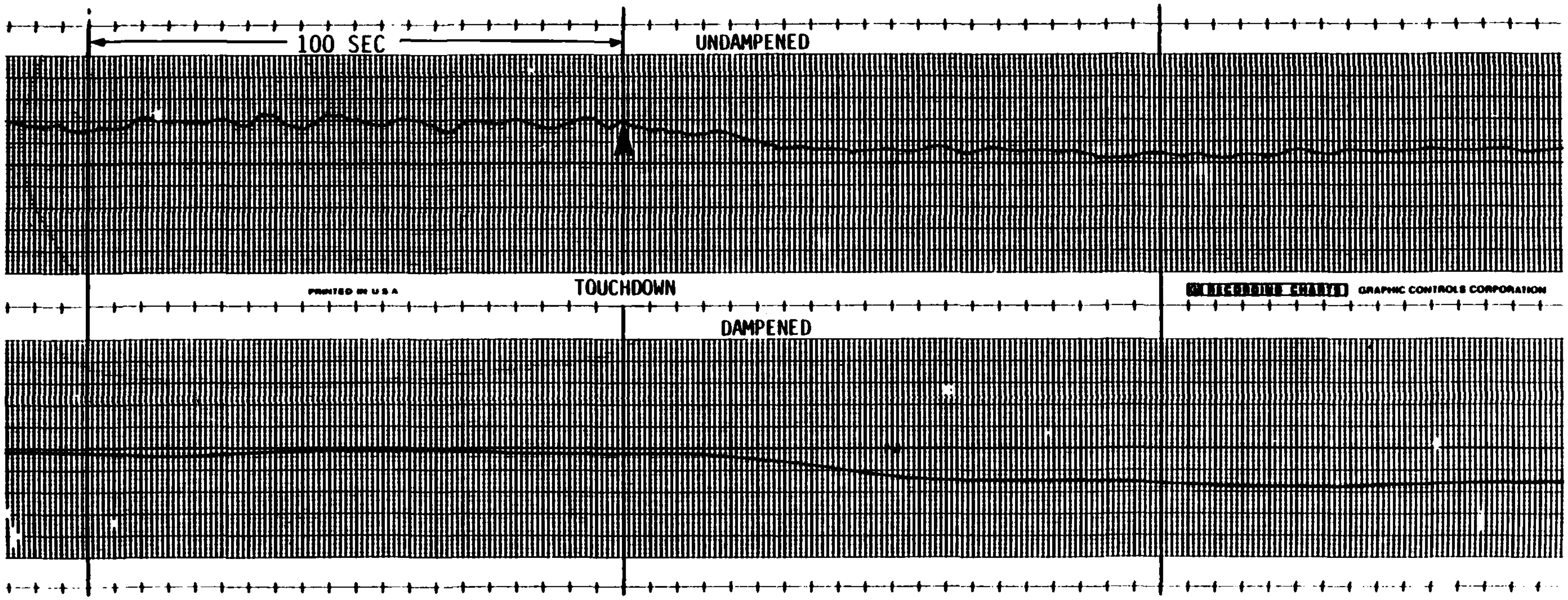
FIGURE 13-2 A MSS '82 REENTRY STAB



CABLE TENSION 8200 LBS

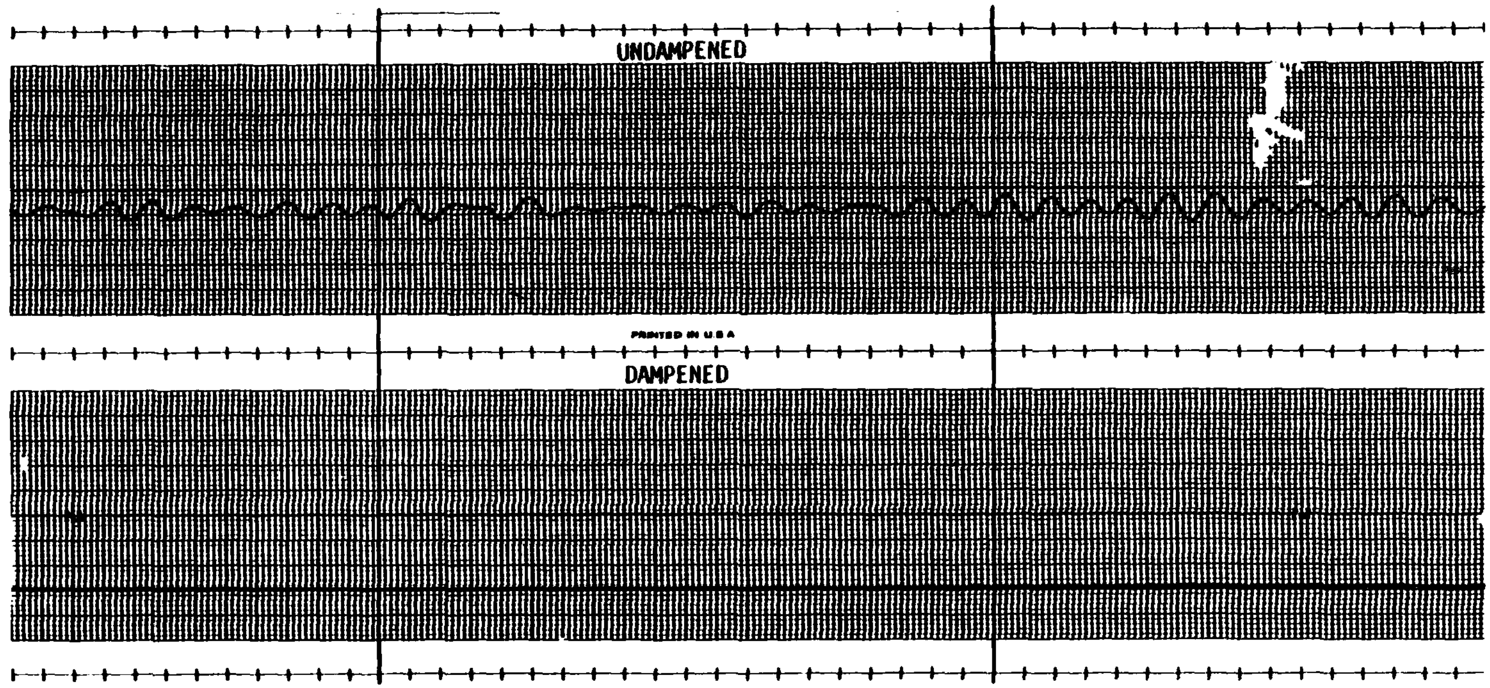
CABLE LENGTH 18700 FT

FIGURE 13-2 B MSS '83 BIP LOWERING IN BOREHOLE



CABLE TENSION 6100LBS
CABLE LENGTH 18800 FEET

FIGURE 13-2 C BIP ON BOREHOLE BOTTOM



CABLE TENSION 6500 LBS
CABLE LENGTH 18800 FT

FIGURE 13-2 D MSS '83 DRILL STRING REMOVED

13.5 CABLE ENTANGLEMENT

A major controversy concerned entanglement of a long cable and the pipe string. The early analysis indicated that entanglement would occur only under light or slack cable tension conditions. Accordingly, the minimum cable tension objective was set at 227.3 kg (500 lbs). The tension levels for the deep deployments were critical due to cable strength limitations. Precautions were also taken to attempt to maintain the cable orientation down current of the pipe string. Backup procedures were established to provide for recovery in the event of entanglement. During the MSS '81 and '83 operations, cable entanglement did not occur although there were localized momentary slack conditions.

The conclusions that have been reached regarding cable entanglement are as follows:

- The possibility of cable entanglement is always present, but the risk is small.
- Maintaining a high tension throughout the cable significantly limits the probability of entanglement.
- The cable weight itself restricts the possibility of entanglement over most of its length.
- Unfavorable currents can contribute to entanglement but are a secondary effect.

13.6 BOREHOLE EMPLACEMENT

Generally, there should be no unresolvable problems for deep water borehole emplacements of 6,096 m (20,000 ft) and borehole depths of 305 m (1,000 ft). In areas of storms and/or high currents, more time must be allocated for weather "holds" and operations. In particular, detailed information about the objective site is a necessity.

The unfortunate MSS '82 operation, in which the reentry borehole could not be emplaced at the desired DARPA Northwest Pacific site, was the result of many factors:

- Inadequate time allotment
- Adverse weather conditions
- Marginal drill string
- Difficult sediment (i.e. chert) conditions
- Equipment malfunctions

Despite the above factors, the emplacement operation was quite close to accomplishment but was terminated due to the approach of a tropical hurricane.

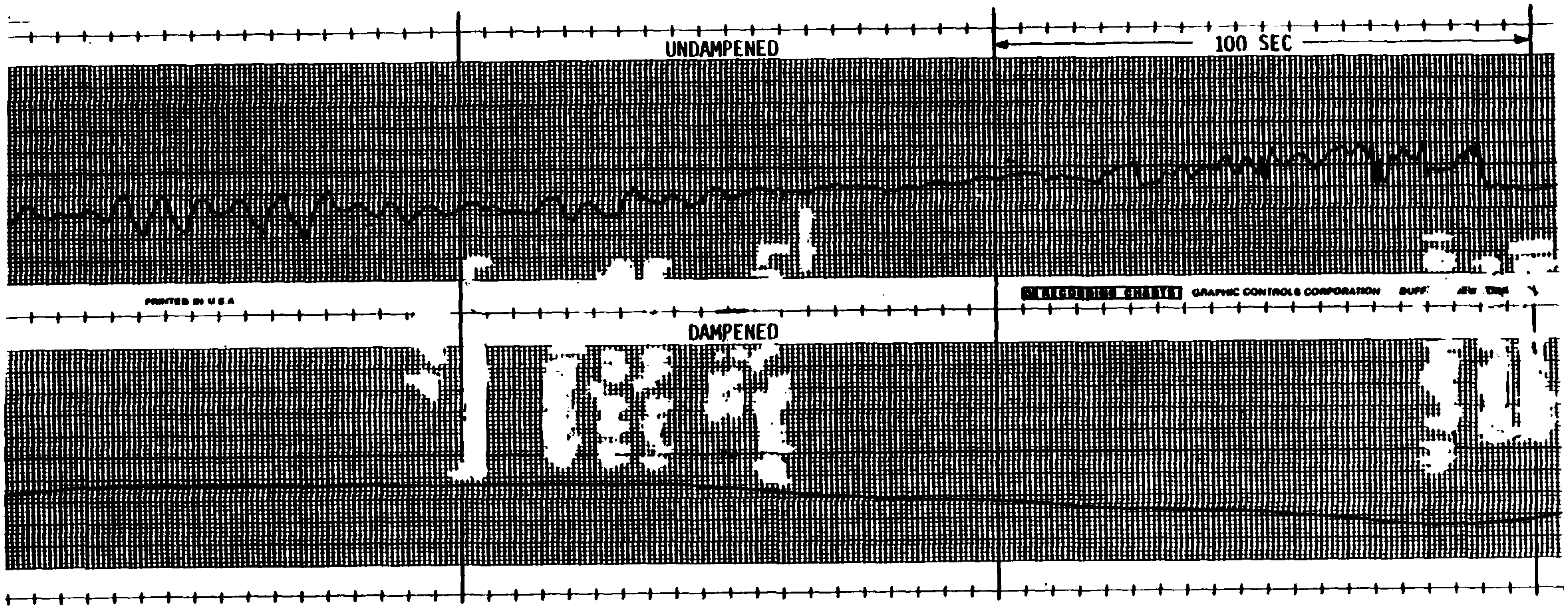
In order to proceed with a difficult deep water site emplacement, the following elements should be considered:

- Conduct detailed planning taking into account the problem areas that may be present.
- Allot adequate time for weather hold and emergencies.
- Provide full strength pipe string with the possibility of oversized upper sections.
- Utilize a heave compensator.
- Cement in chert formation or provide alternate process.
- Pretest subsea equipment.
- Provide improved load, penetration and torque measurement instrumentation.

All of the above may not be necessary, but consideration of each element increases the probability of success.

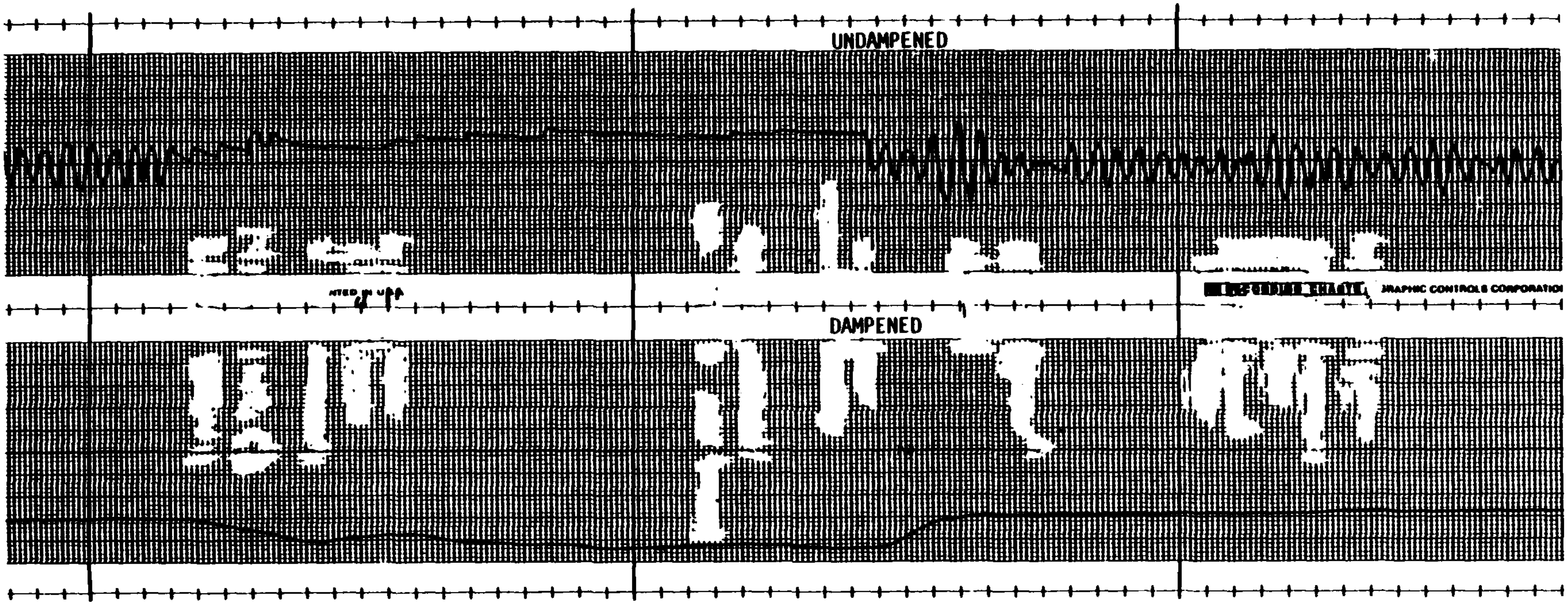
13.7 IRR DEPLOYMENT

The major considerations involved with the IRR deployment were associated with minimizing the dynamic loadings and correlating the stretch plus buoyancy characteristics. A critical response area was defined for the initial BPP lowering period with approximately 640 m (2,100 ft) of cable deployed. During the recovery leg, large oscillatory forces were displayed near the cable to the line transition point. Figures 13-3 (A, B, and C) show typical line/cable tension characteristics.



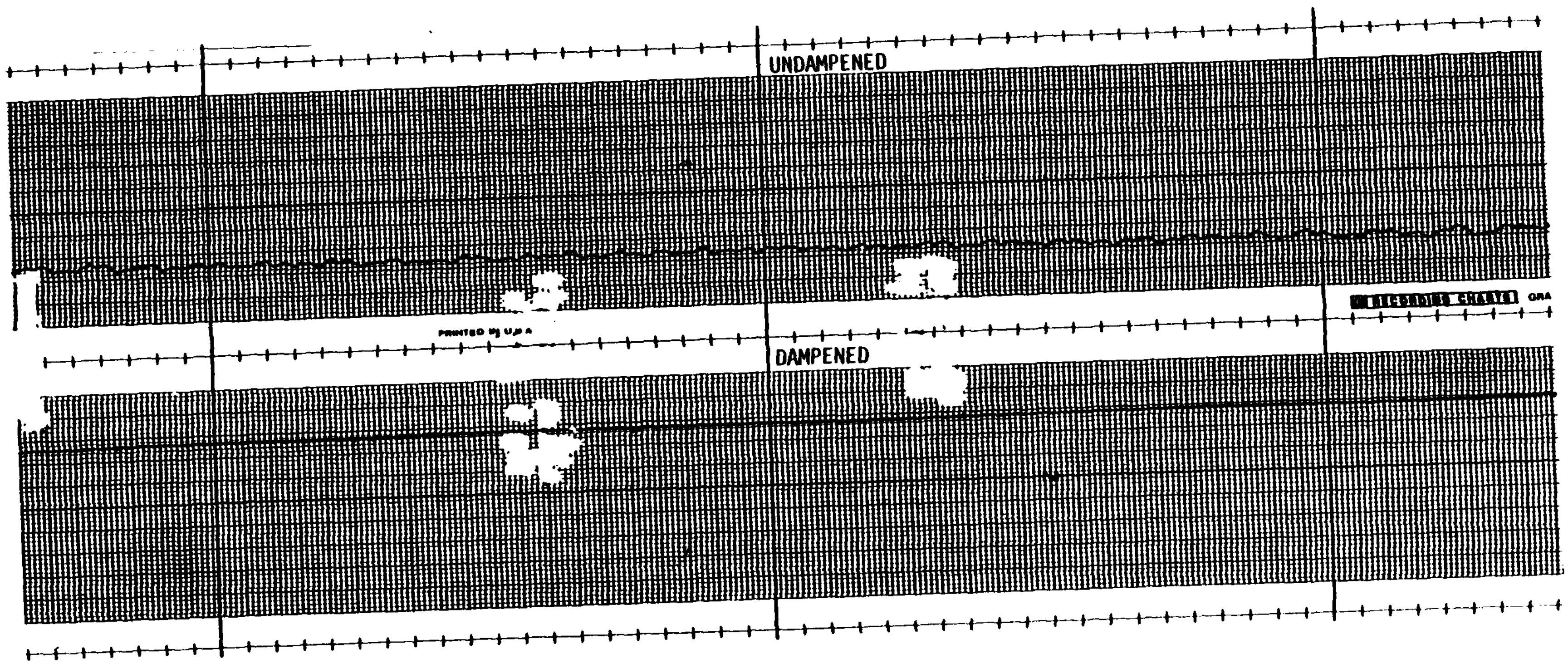
CABLE LENGTH 108 FT
CABLE TENSION 10000 LBS

FIGURE 13-3 A MSS '83 IRR/BPP DEPLOYMENT



CABLE LENGTH 2000 FT
CABLE TENSION 11000 LBS

FIGURE 13-3 B MSS '83 IRR/BPP DEPLOYMENT

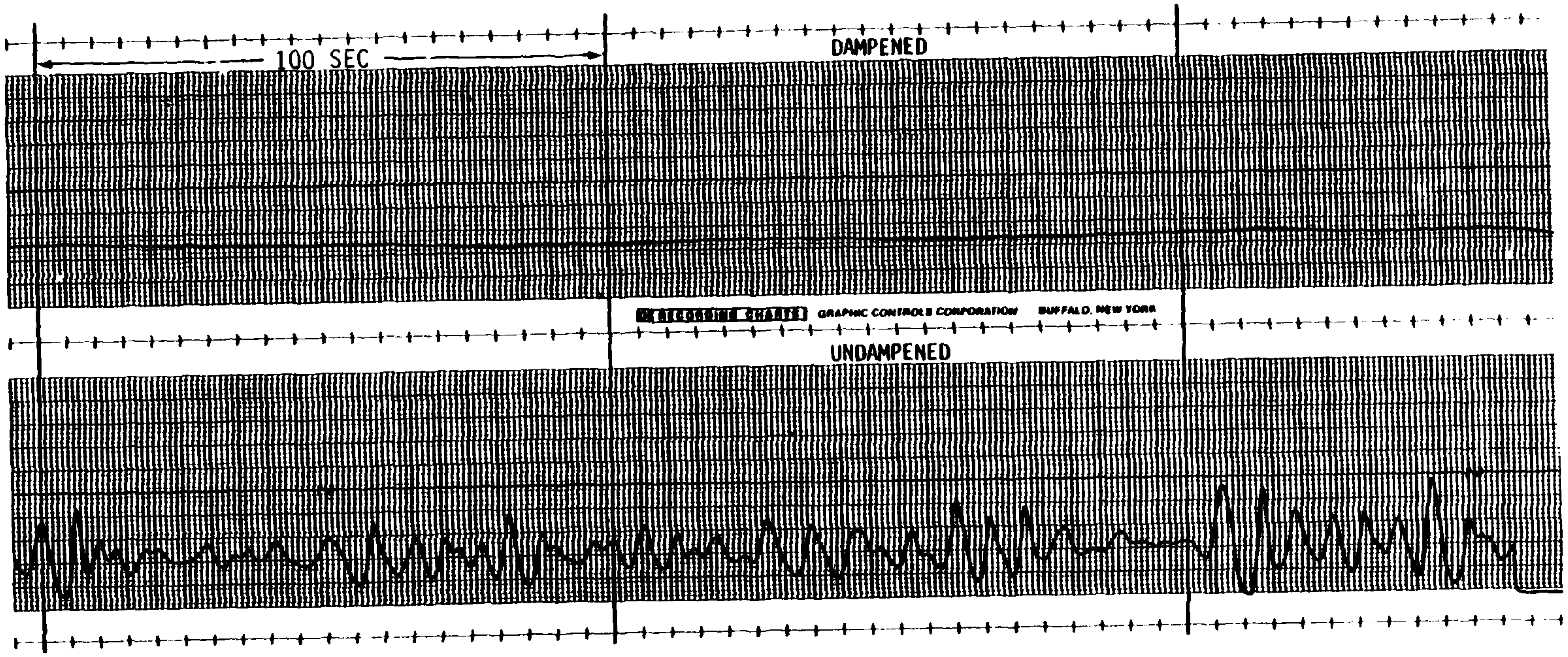


CABLE TENSION 5500 LBS
CABLE LENGTH 16000 FT

FIGURE 13-3 C MSS '83 IRR/BPP DEPLOYMENT

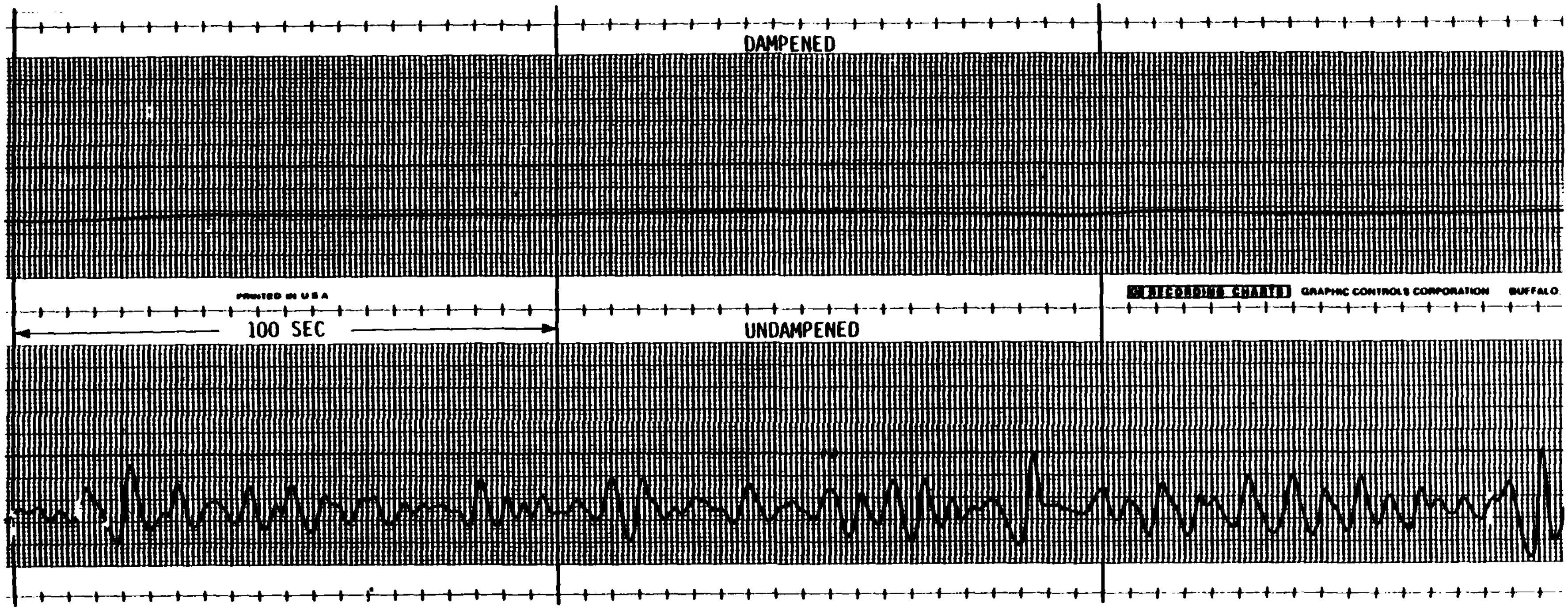
Uncertainties in the line length, stretch and buoyancy characteristics contributed to an apparent short riser line deployment length. This was attributable to a combined error in initial line length measurement and excessive EA (line modulus) stretch. The wet weight buoyancy factor appeared to be higher than originally projected. Touchdown was achieved with a total of approximately 5,334 m (17,500 ft) of line. Due to transiting drag forces, there was no definitive touchdown point visualized; however, there was a general load reduction caused by sinkage in the sediment and an accompanying riser line elongation relaxation. Figures 13.4 (A and B) depict characteristics recorded during recovery.

The overall deployment of the BPP riser leg, grapnel leg, and anchor leg was conducted as expected. Tensioning up 12,649 m (41,500 ft) of line to the desired 227-455 kg (500-1,000 lb) release range was easily achieved. After release of the anchor, it took approximately two hours for all "A" crown buoys to be pulled beneath the surface.



CABLE TENSION 9500 LBS
CABLE LENGTH 2000 FT (500FT OF LINE)

FIGURE 13-4 A MSS '83 IRR/BPP RECOVERY



CABLE TENSION 9600 LBS

CABLE LENGTH 1500 FT

FIGURE 13-4 B MSS '83 IRR/DPP RECOVERY

SECTION 14.0 - REFERENCES

1. GMDI Report 04114-001, "MSS Deployment Feasibility Study for Gould," dated 27 June 1980.

2. Gould Report CID 79111.002, "MSS Ocean Engineering Study," dated 31 December 1979.

3. GMDI Report 001-005, "MSS Deployment Program Phase II," dated 15 January 1981.

4. GMDI Report RPT-006-007, "Marine Seismic System At-Sea-Test," dated 9 October 1981.

5. GMDI Report MSSA01-001, "Marine Seismic System - Deployment Phase III," Rev 0, dated March 1982.

6. GMDI Report MSSA02-SYS-R003, "MSS Phase IV Deployment Final Report," dated 31 May 1983.

7. GMDI Report MSSA04-SYS-P007, "MSS Deployment System Final Logistic Report," dated 15 August 1983.

8. NORDA Report, "Boreholes Seismic Experiment: Engineering and Installation," dated 1982.

9. "DSDP Preliminary Scientific Report Operations Resume," Leg 88.

10. "DSDP Preliminary Scientific Report Operations Resume," Leg 91.

11. Western Instrument Report, "Design and Analysis of the MSS/IRR System," prepared for NCEL, dated April 1982.

12. GMDI Report MSSA04-SYS-R003 MSS Advanced Operations Evaluation dated March 1984.

APPENDICES

A LIST OF REPORTS/PLANS

B LIST OF SPECIFICATIONS

C LIST OF DRAWINGS

D DRAWINGS

APPENDIX A

LIST OF REPORTS/PLANS

1. "MSS Reentry Impact," Report No. 001-001, Rev 2, 10/29/80.

2. "MSS Static and Dynamic Behavior of the Drill Pipe During the Reentry Sub Installation," Report No. 001-002, Rev 1, 6/5/81.

3. "Structural Analysis for the Marine Seismic System BIP Reentry Sub Stinger," Report No. 001-003, 8/28/80.

4. "At-Sea-Test Mobilization Plan," Report No. 001-004, Rev 1, 12/12/80.

5. "MSS Deployment, Phase II," Report No. 001-005, Rev 0, 1/9/81.

6. "MSS EM Cable and Drill Pipe Interference and Cable Wrapping (Preliminary Investigation)," Report No. 001-006, 9/25/80.

7. "MSS EM Cable and Dynamic Response Due to Current and <u>Glomar Challenger</u> Motion," Report No. 006-002, Rev 1, 2/2/81.

8. "MSS At-Sea-Test Operational Procedures," Report No. 006-003, Rev 2, 2/2/81.

9. "MSS Operations Instructions for the "A"-Frame Compensator," Report No. 006-004, 2/25/81.

10. "MSS System Drill String Length, Load Cell Tension and HC Gas Pressure Relationships,"Report No. 006-005, <u>3/00/81</u>.

11. "Marine Seismic System At-Sea-Test Deployment Operation," Report No. 006-007, Rev. 0, 10/9/81.

12. "Phase I Marine Seismic System Deployment Feasibility Study," Report No. RPT-04114-001, Rev. 0, 6/27/80

13. "Marine Seismic System (MSS) Deployment Phase III, Report No. MSSA01-001, Rev. 0, March 1982.

14. "Reentry Impact Stress Analysis of Modified Reentry Subassembly," Report No. MSSA02-STR-R001, Rev. 0, 11/16/81.

15. "Impact Impulse and Mass Geometrical Characteristics of Modified Reentry Subassembly, "Report No. MSSA02-STR-R002, Rev. 0, 1/4/82.

16. "Drill Pipe Stress Analysis," Report No. MSSA02-STR-R003, Rev. 1, 4/23/82.

17. "Electro-Mechanical Cable Stress Analysis," Report No. MSSA02-STR-R004, Rev. 0.

18. "Stress Analysis of the IRR Deployment at Northwest Pacific Site," Report No. MSSA02-STR-R005, Rev. 0, 6/22/82.

19. "Reliability Assessment of "SNAPLD" Computer Program for the Prediction of Dynamic Tension in a Free-Hanging Cable System," Report No. MSSA02-STR-R006, Rev. 0.

20. "Time Sequence of Reentry Sub Motion After the Reentry Impact of Cone," Report No. MSSA02-STR-R007, Rev. 0.

21. "Environmental Data (August-September)," Report No. MSSA02-SYS-R001, Rev 1, 3/25/82.

22. "Environmental Data (October), "Report No. MSSA02-SYS-R002.

23. "Phase IV Marine Seismic System (MSS) Deployment Final Report, 1 October 1981 - 11 December 1982," Report No. MSSA02-SYS-R003, Rev. 0, 5/31/83.

24. "Marine Seismic System Program MSS '82 Test Plan Synopsis," Report No. MSSA02-SYS-P001, Rev 1, 2/26/82.

25. "MSS '82 Deployment Operational Procedures," Report No. MSSA02-SYS-P002, Rev 0, 6/7/82.

26. "Integrated Logistics Plan for Mobilization MSS '82, Phase IV Marine Seismic System Deployment, Report No. MSSA02-SYS-P003, Rev. 0, 5/25/82.

27. "Marine Seismic System Program, MSS '83 Test Plan Synopsis," Report No. MSSA04-SYS-P001, Rev. 0, 12/7/82.

28. "Marine Seismic System, MSS '83 Deployment Operational Procedures, Report No. MSSA04-SYS-P002, Rev. 0, 12/17/82.

29. "Marine Seismic System, MSS '83 Deployment Mobilization Plan," Report No. MSSA04-SYS-P003, Rev. 0, 12/10/82.

30. "Marine Seismic System, MSS '83 IRR Recovery Mobilization Plan (Tahiti), Report No. MSSA04-SYS-P004, Rev. A, 12/10/82.

31. "Marine Seismic System, MSS '83 IRR Recovery and Redeployment Operational Procedures," Report No. MSSA04-SYS-P005, Rev. 0, 3/7/83.

32. "Integrated Logistics Plan for Demobilization MSS '83, Phase IV Marine Seismic System Deployment Program," Report No. MSSA04-SYS-P006, Rev. 0, 1/26/83.

33. "Marine Seismic System (MSS) Deployment System Final Logistics Report," Report No. MSSA04-SYS-P007, Rev. 0, 8/15/83.

APPENDIX B

LIST OF SPECIFICATIONS

DOCUMENT NO.	REV	DATE	TITLE
MSSA02-SYS-S001	2		MSS PROGRAM SPECIFICATION, MSS '82 AT-SEA-TEST BASELINE DEPLOYMENT SYSTEM INTERFACE AND REQUIREMENTS
MSSA02-SYS-S002	0	11/04/81	PROCUREMENT SPECIFICATION FOR MODIFICATIONS TO THE MARINE SEISMIC SYSTEM BIP REENTRY TOOL ASSEMBLY
MSSA02-SYS-S003	0	11/04/81	MSS TEST PROGRAM (USAGE AND FUNCTION TEST)
MSSA02-SYS-S004	0	11/04/81	MSS '82 COATINGS SPECIFICATION FOR STEEL DEVICES IN MARINE ENVIRONMENT
MSSA0[illegible]-SYS-S001	0	12/16/82	MSS '83 BASELINE DEPLOYMENT SYSTEM INTERFACE REQUIREMENTS SPECIFICATION

APPENDIX C

LIST OF DRAWINGS

DRAWING NO.	REV	TITLE
MSSA02-MTL-D001	1	MSS '82 MODIFIED BIP REENTRY SUB WITH STINGER CONTROL DRAWING
MSSA02-MTL-D002	0	MSS '82 MODIFIED REENTRY ASSEMBLY CONTROL DRAWING
MSSA02-MTL-D003	0	MSS '82 BIP CARRIAGE CONTROL SUB DETAIL AND ASSEMBLY
MSSA02-MTL-D004	1	MSS '82 MODIFIED BIP CARRIAGE HOUSING ASSEMBLY AND DETAILS (SHTS 1-2)
MSSA02-MTL-D006	1	MSS '82 MODIFIED BIP CARRIAGE HOUSING MAIN ASSEMBLY
MSSA02-MTL-D007	1	MSS '82 MODIFIED BIP REENTRY SUB ASSEMBLY
MSSA02-MTL-D008	0	MSS '82 HYDRAULIC PLUG/SONAR ADAPTER MODIFICATION
MSSA02-MTL-D009	1	MSS '82 DUMMY SONAR REENTRY TOOL
MSSA02-MTL-D010	2	MSS '82 IDLER SHEAVE SUPPORT DETAIL ASSEMBLY
MSSA02-MTL-D011	1	MSS '82 SONAR SINKER BAR ASSEMBLY AND DETAILS (SHTS 1-2)
MSSA02-MTL-D012	4	MSS '82 REENTRY SUB STINGER ASSEMBLY AND DETAILS (SHEETS 1-2)
MSSA02-MTL-D013	0	MSS '82 BAKER VALVE AND SINKER BAR ADAPTOR MODIFICATIONS, DETAILS AND ASSEMBLY

LIST OF DRAWINGS

DRAWING NO.	REV	TITLE
MSSA02-MTL-D014	2	MSS '82 BIP JACKING SCREW DETAIL
MSSA02-MTL-D015	1	MSS '82 EM CABLE TERMINATION ON WINCH REEL MODIFICATION DETAIL
MSSA02-MTL-D016	3	MSS '82 HYDRAULIC PLUG/SONAR ADAPTER MODIFICATION
MSSA02-MTL-D017	1	MSS '82 BAKER EQUALIZING CHECK VALVE MODIFICATION
MSSA02-MTL-D018	1	MSS '82 GLOMAR CHALLENGER EQUIPMENT INSTALLATION ARRANGEMENT (SHTS 1-2)
MSSA02-MTL-D019	2	MSS '82 A-FRAME DETAILS AND ASSEMBLY
MSSA02-MTL-D022	0	MSS '82 EM CABLE WINCH LAYOUT OF EXHAUST SYSTEM
MSSA02-MTL-D023	1	MSS '82 CABLE PROTECTORS AND RING GAUGE ASSEMBLY DETAILS
MSSA02-MTL-D024	1	MSS '82 CENTERING SPRING SONAR SINKER BAR ASSEMBLY
MSSA02-MTL-D025	3	MSS '82 TROLLEY & JACKING SCREW DETAIL LAYOUT
MSSA02-MTL-D026	A	MSS '82 TEST INSTRUMENT INSTALLATION
MSSA02-MTL-D027	A	MSS '82 LAYOUT OF SHOCK ABSORBER FOR EXPERIMENTAL TEST
MSSA02-MTL-D028	A	MSS '82 LAYOUT OF SONAR REENTRY TOOL AND BREAKAWAY PLUG

LIST OF DRAWINGS

DRAWING NO.	REV	TITLE
MSSA02-MTL-D029	A	MSS '82 MOCK-UP LAYOUT OF NARROW SECTION OF PICCOLO
MSSA02-MTL-D030	1	MSS '82 BIP HOUSING SUPPORT BRACKETS
MSSA02-MTL-D031	2	MSS '82 IRR LINE STORAGE CONTAINER SECURING DETAILS
MSSA02-MTL-D032	1	MSS '82 REENTRY GUIDE CONE INSTALLATION LAYOUT
MSSA02-MTL-D033	A	RECOVERY TUG EQUIPMENT INSTALLATION ARRANGEMENT
MSSA02-MTL-D034	1	IRR-CUSTOM TWO PLATE CONNECTOR AND INSULATION DETAILS
MSSA02-MTL-D035	A	BPP HANDLING CONFIGURATION LAYOUT
MSSA02-MTL-D036	A	INTERFERENCE BETWEEN A-FRAME AND CRANE CAB APPLICATION OF PREFORMED DEAD END
MSSA01-MTL-D037	A	LAYOUT OF CRANE POSITION AT TRANSFER OF LOAD FROM EM CABLE TO BPP
MSSA01-MTL-D038	A	BPP CONNECT UP AND LAUNCH POSITION
MSSA02-MTL-D039	A	EM CABLE AND BPP LAUNCH SEQUENCE
MSSA02-MTL-D040	A	CONTINGENCY PLAN FOR WINCH HYDRAULIC SYSTEM FAILURE
MSSA02-MTL-D041	A	CONTINGENCY PLAN FOR WINCH BRAKE SYSTEM FAILURE
MSSA02-MTL-D042	A	REENTRY SUB STINGER RECOVERY TOOL
MSSA02-MTL-D043	A	BPP PLATFORM

LIST OF DRAWINGS

DRAWING NO.	REV	TITLE
MSSA02-MTL-D044	A	A-FRAME AND IDLER SHEAVE ASSEMBLY T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D045	A	BPP SKID T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D046	A	WINCH FOUNDATION T-ATF (STERN MOUNT ARRGT) (SHEETS 1-2)
MSSA02-MTL-D047	A	RECOVERY PLATFORM T-ATF (STERN MOUNT ARRGT) (SHEETS 1-2)
MSSA02-MTL-D048	A	ELECTRICAL INSTALLATION T-ATF (STERN MOUNT ARRGT) (SHEETS 1-2)
MSSA02-MTL-D049	2	GLOMAR CHALLENGER ELECTRICAL INSTALLATION (SHEETS 1-2)
MSSA02-MTL-D050	A	EQUIPMENT INSTALLATION ARRANGEMENT T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D051	A	A-FRAME FOUNDATION T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D052	A	HEAVE COMPENSATOR FOUNDATION T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D053	A	A-FRAME MODIFICATION T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D054	A	IDLER SHEAVE FOUNDATION T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D055	A	ELEVATED WALKWAY T-ATF (STERN MOUNT ARRGT)
MSSA02-MTL-D056	A	TESTING ARRANGEMENTS
MSSA02-STR-D001	1	EM CABLE RECOVERY PLATFORM

LIST OF DRAWINGS

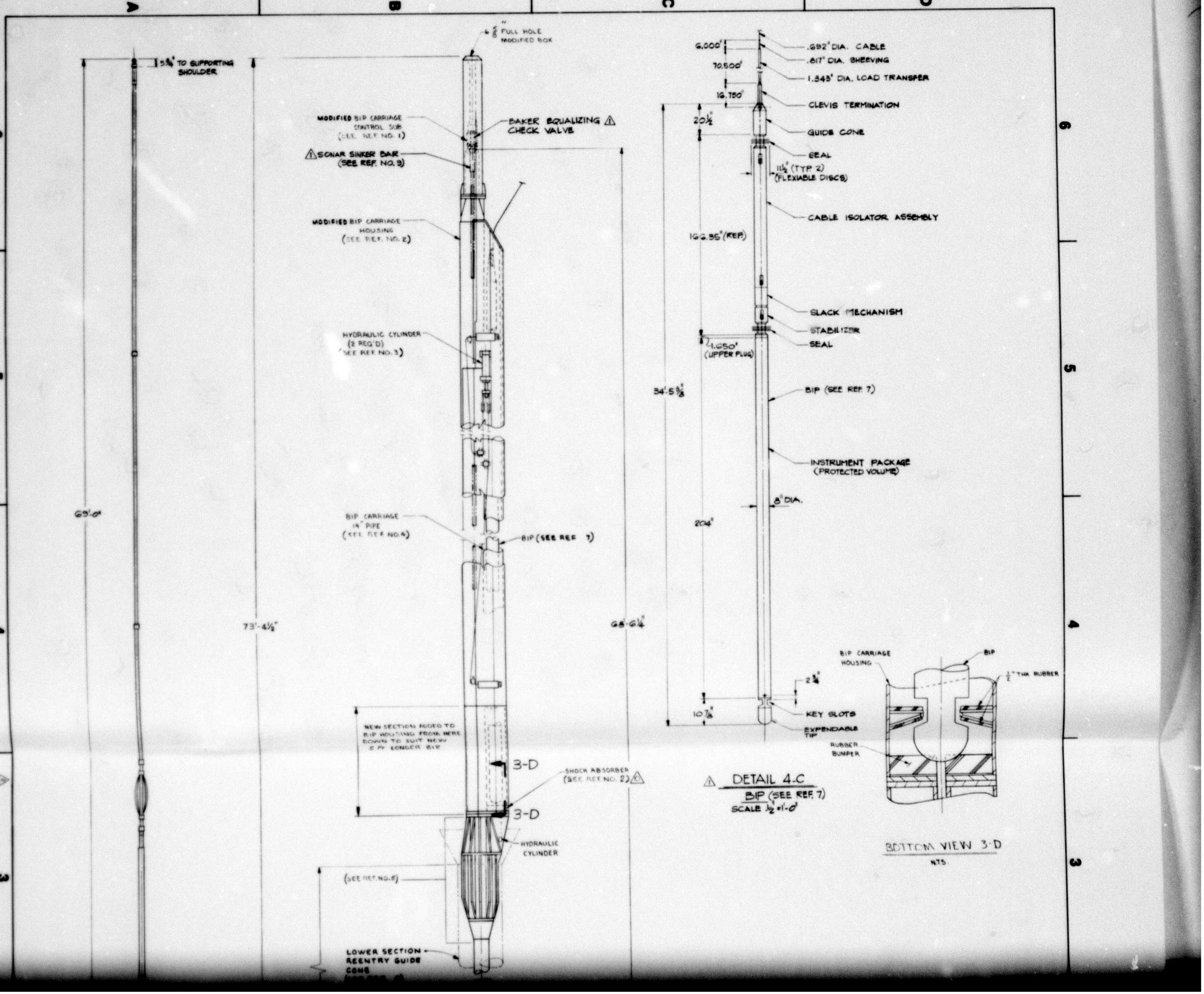
DRAWING NO.	REV	TITLE
MSSA02-SYS-D001	A	MSS '82 INSTALLATION, RECOVERY AND REINSTALLATION SYS CONTROL DWG
MSSA04-SYS-D001	0	MSS '83 GLOMAR CHALLENGER ELECTRICAL INSTALLATION
MSSA04-SYS-D002	0	MSS '83 WINCH AND IDLER SHEAVE FOUNDATIONS DETAILS
MSSA04-SYS-D003	1	MSS '83 GLOMAR CHALLENGER EQUIPMENT INSTALLATION ARRANGEMENT (SHEETS 1-2)
MSSA04-SYS-D004	0	MSS '83 IRR SYSTEM ARRANGEMENT AND ASSEMBLY (SHEETS 1-2)
MSSA04-SYS-D005	0	MSS '83 BPP SKID DETAIL ASSEMBLY
MSSA04-SYS-D006	C	MSS '83 RECOVERY INSTALLATION ARRANGEMENTS (SHEETS 1-2)
MSSA04-SYS-D007	0	MSS '83 WINCH LINE SPLITTER DETAIL (SHEETS 1-2)
MSSA04-SYS-D008	B	MSS '83 R/V MELVILLE RECOVERY SEQUENCE LAYOUT (SHEETS 1-2)
MSSA04-SYS-D009	0	MSS '83 DUMMY (BPP) BOTTOM PROCESSING PACKAGE DETAIL ASSEMBLY
MSSA04-SYS-D010	A	MSS '83 DUMMY (BPP) BOTTOM PROCESSING PACKAGE ARRANGEMENT

APPENDIX D

DRAWINGS

The following drawings are enclosed:

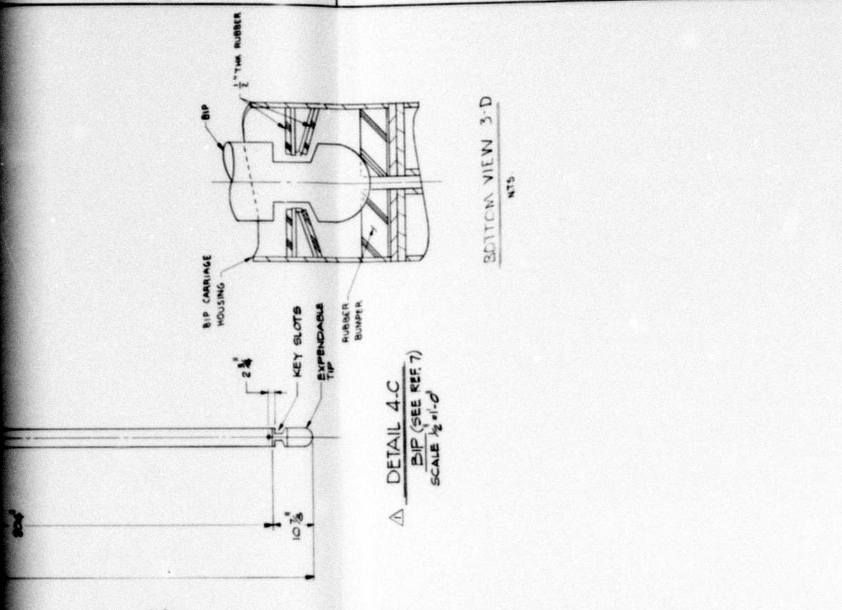
MSSA02-MTL-D001, REV 1	MSS '82 MODIFIED BIP REENTRY SUB WITH STINGER CONTROL DRAWING
MSSA02-MTL-D002, REV 0	MSS '82 MODIFIED REENTRY ASSEMBLY CONTROL DRAWING
MSSA02-MTL-D007, REV 1	MSS '82 MODIFIED BIP REENTRY SUBASSEMBLY
MSSA02-MTL-D018, REV 1	MSS '82 GLOMAR CHALLENGER EQUIPMENT INSTALLATION ARRANGEMENTS (SHTS 1-2)
MSSA04-SYS-D001, REV 0	MSS '82 GLOMAR CHALLENGER ELECTRICAL INSTALLATION
MSSA04-SYS-D003, REV 1	MSS '83 GLOMAR CHALLENGER EQUIPMENT INSTALLATION ARRANGEMENT (SHTS 1-2)
MSSA04-SYS-D004, REV 0	MSS "83 IRR SYSTEM ARRANGEMENT AND ASSEMBLY (SHTS 1-2)



5¾" TO SUPPORTING SHOULDER
69'-0"
73'-4½"
68'-6¼"
6 ⅝" FULL HOLE MODIFIED BOX
MODIFIED BIP CARRIAGE CONTROL SUB (SEE REF. NO. 1)
BAKER EQUALIZING CHECK VALVE
SONAR SINKER BAR (SEE REF. NO. 9)
MODIFIED BIP CARRIAGE HOUSING (SEE REF. NO. 2)
HYDRAULIC CYLINDER (2 REQ'D) (SEE REF NO. 3)
BIP CARRIAGE 14" PIPE (SEE REF NO. 4)
BIP (SEE REF 7)
NEW SECTION ADDED TO BIP HOUSING FROM HERE DOWN TO SUIT NEW 5 FT LONGER BIP
3-D
SHOCK ABSORBER (SEE REF NO. 2)
HYDRAULIC CYLINDER
(SEE REF NO. 8)
LOWER SECTION REENTRY GUIDE CONE
6.000"
70.500"
16.750"
20½"
166.35" (REF)
1.650" (UPPER PLUG)
34'-5⅜"
204"
10⅞"
2¾"
.692" DIA. CABLE
.817" DIA. SHEEVING
1.343" DIA. LOAD TRANSFER
CLEVIS TERMINATION
GUIDE CONE
SEAL
11½" (TYP 2) (FLEXIABLE DISCS)
CABLE ISOLATOR ASSEMBLY
SLACK MECHANISM
STABILIZER
SEAL
BIP (SEE REF 7)
INSTRUMENT PACKAGE (PROTECTED VOLUME)
8" DIA.
KEY SLOTS
EXPENDABLE TIP
DETAIL 4-C
BIP (SEE REF. 7)
SCALE ½"=1'-0"
BIP CARRIAGE HOUSING
BIP
½" THK RUBBER
RUBBER BUMPER
BOTTOM VIEW 3-D
NTS.

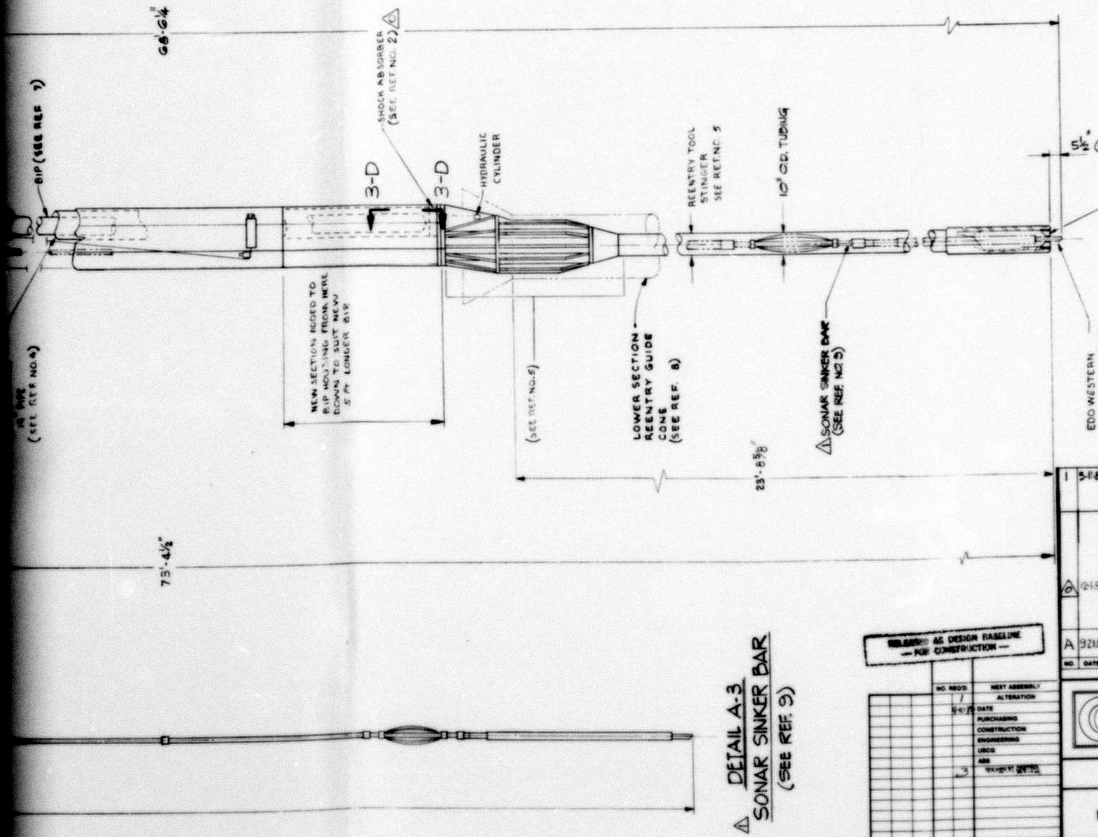
LIST OF MATERIALS

OWNER FURN.	ITEM	QTY	DESCRIPTION	MATERIAL SPEC./DWG. NO.



REFERENCE DWGS:

1. MSSA02-MTL-D003 BIP CARRIAGE CONTROL SUB, DETAILS AND ASSEMBLY
2. MSSA02-MTL-D004 MODIFIED BIP CARRIAGE HOUSING, ASSEMBLY AND DETAILS.
3. MSSA02-MTL-D006 MODIFIED BIP CARRIAGE HOUSING, MAIN ASSEMBLY
4. D-001-A004 BIP CARRIAGE ASSEMBLY AND DETAILS
5. MSSA02-MTL-D012 REENTRY TOOL STINGER, ASSEMBLY AND DETAILS.
6.
7. 990-53100 BIP (TELEDYNE GEOTECH)
8. E-001-SK06 CONE AND 11 3/4" × 16" CASING HANGER ASSEMBLY
9. MSSA02-MTL-D011 SONAR SINKER BAR, ASSEMBLY AND DETAILS.



RELEASED AS DESIGN BASELINE — FOR CONSTRUCTION —

NO. REQ'D	NEXT ASSEMBLY
1	ALTERATION
	DATE
	PURCHASING
	CONSTRUCTION
	ENGINEERING
	USCG
	ABS

NO.	DATE	BY	DESCRIPTION	JOB AUTH.	APPR.
1	5-11-82	RH	ADDED REFERENCE NOTES TO DETAILS ADDED SONAR SINKER BAR - DETAIL A-3 & IN PHANTOM ON ELEV. 2-B, PER DCN-001	011-4110	
0	12-3-81	CP	REFERENCE DWGS (ZONE 1-C): DELETED REF DWG #6 WHICH WAS C-001-A006 LATERAL SHOCK ABSORBER RING DETAIL, AND REVISED REF DWG #5 FROM MSSA02-MTL-D005 TO MSSA02-MTL-D012. ELEVATION 2-B (ZONE 3-B): REVISED SEE REF NO. 6 TO SEE REF DWG NO. 2. DESIGN RELEASE	011/4110	
A	9-21-81	GD	PRELIMINARY RELEASE	006/3100	

ALTERATIONS

	APPROVED	EXAMINED OR REVIEWED	ALT NO.	LETTER DATE	REF. NO.
A.B.S.					
U.S.C.G.					

TOTAL NET WGT MAT'L
TOTAL NET WGT EQUIP
TOTAL NET WEIGHT

GLOBAL MARINE DEVELOPMENT Inc.
Newport Beach, Calif.

MARINE SEISMIC SYSTEMS (MSS)-82
MODIFIED BIP REENTRY SUB WITH STINGER
CONTROL DRAWING

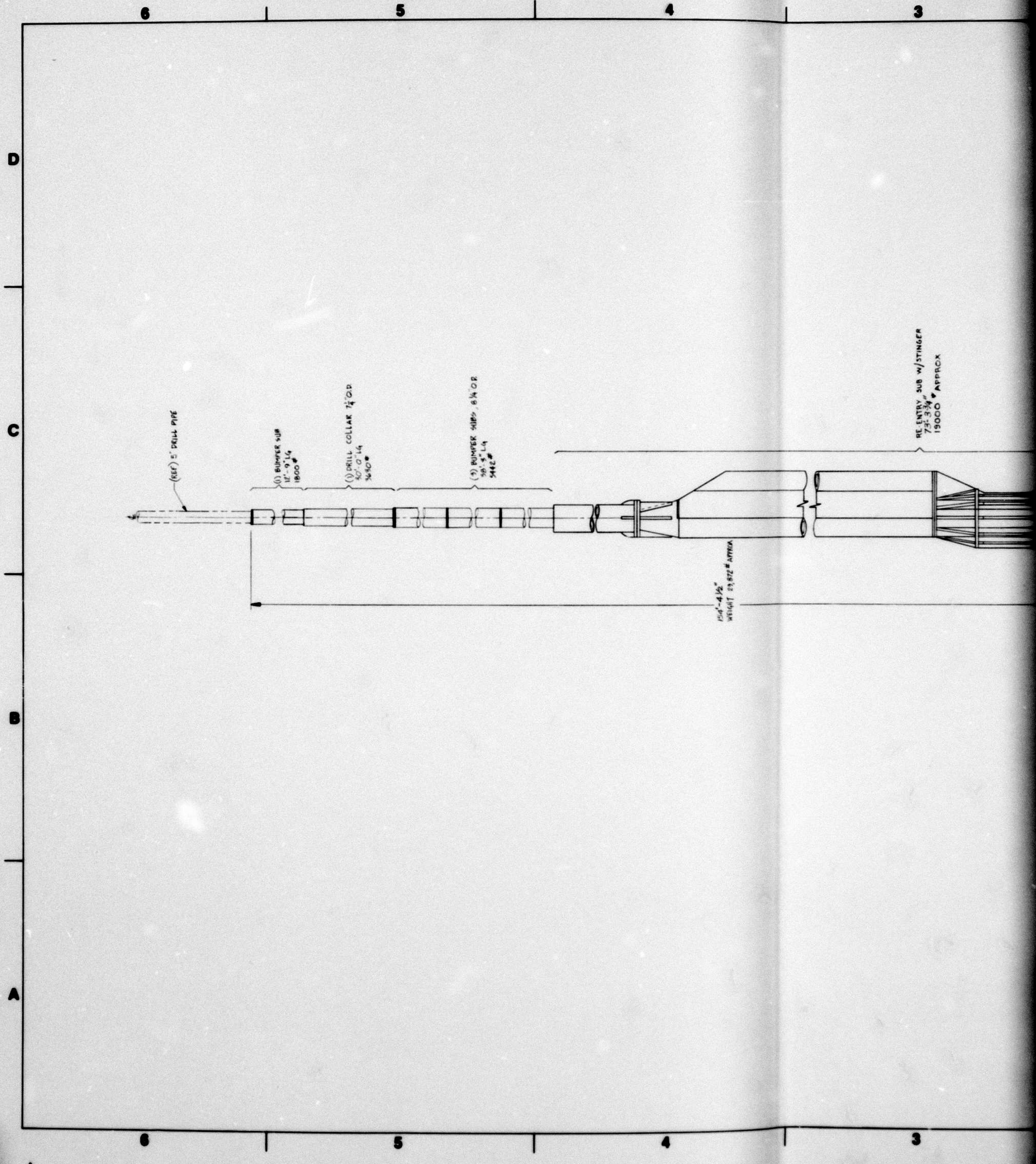
	NAME	DATE
DFT.	G. Donohue	9-17-81
ENGR.		10-23-81
CHK.	D. WEST	10-23-81
APPR.	R.S.B.	12-3-81
REL.	R.S.B.	12-3-81

SCALE: AS NOTED

TOLERANCE UNLESS OTHERWISE NOTED: FRACTION ± 1/16" ANGULAR ± ½° MILLIMETER ± 1. MM ( ) DESIGNATES MILLIMETER DIMENSIONS

SIZE	DWG.	CC	SHT.	ALT.
E	MSSA02-MTL-D001	541	1 OF 1	1

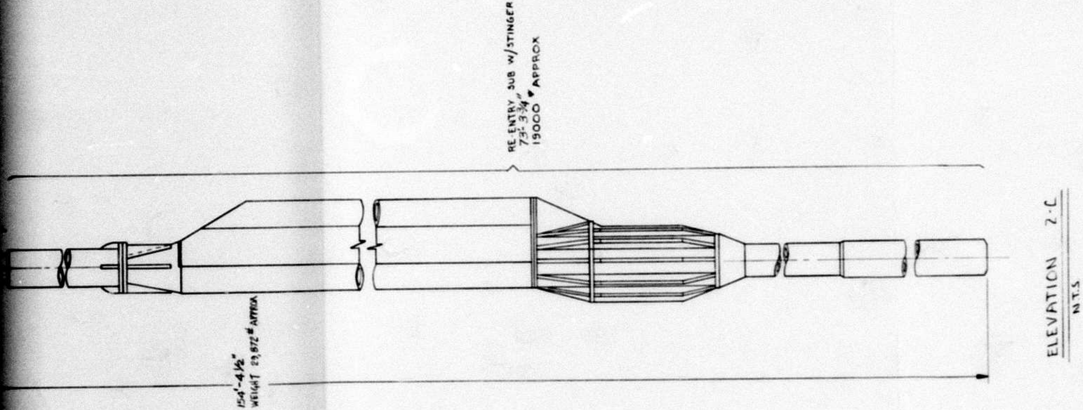
2



6
5
4
3
D
C
B
A
(REF) 5" DRILL PIPE
(1) BUMPER SUB
12'-9" LG
1800#
(1) DRILL COLLAR 7¼" O.D
30'-0" LG
3690#
(3) BUMPER SUBS, 8¼" O.D
38'-5" LG
5442#
RE-ENTRY SUB W/STINGER
73'-3¾"
19000# APPROX
154'-4½"
WEIGHT 29,872# APPROX

OWNER FURN.	ITEM	QTY	DESCRIPTION	MATERIAL OR DWG. NO.

LIST OF MATERIALS



REFERENCE DRAWINGS:

1. E-001-A003 BIP CARRIAGE CONTROL SUB DETAILS AND ASSY.
2. E-001-A012 BIP CARRIAGE HOUSING ASSY & DETAILS.
3. MSSA02-MTL-D004 MODIFIED BIP CARRIAGE HOUSING ASSY. & DETAILS.
4. MSSA02-MTL-D012 REENTRY TOOL STINGER ASSY & DETAILS

NO.	DATE	BY	DESCRIPTION	JOB AUTH.	APPR.
			ADDED "CONTROL DRAWING" TO TITLE (ZONE 1-A). REFERENCE DWG #4 (ZONE 1-B): REVISED DWG # FROM MSSA02-MTL-D005 TO MSSA02-MTL-D012.		
0	12-1-81	CP	DESIGN RELEASE EDC RELEASED 12-3-81	011/4110	
A	9-30-81	ED	PRELIMINARY RELEASE	006/3100	

ALTERATIONS

RELEASED AS DESIGN BASELINE — FOR CONSTRUCTION —

NO. REQ'D.	NEXT ASSEMBLY
0	ALTERATION
9-17-81	DATE
	PURCHASING
	CONSTRUCTION
	ENGINEERING
	USCG
	ABS
3	

GLOBAL MARINE DEVELOPMENT Inc.
Newport Beach, Calif.

MARINE SEISMIC SYSTEM (MSS)-82
MODIFIED REENTRY
ASSEMBLY CONTROL DRAWING

	APPROVED	CHECKED OR REVIEWED	ALT. NO.	LETTER DATE	REP. NO.
A.B.S.					
U.S.C.G.					

TOTAL NET WGT. MAT'L.
TOTAL NET WGT. EQUIP.
TOTAL DRY WEIGHT

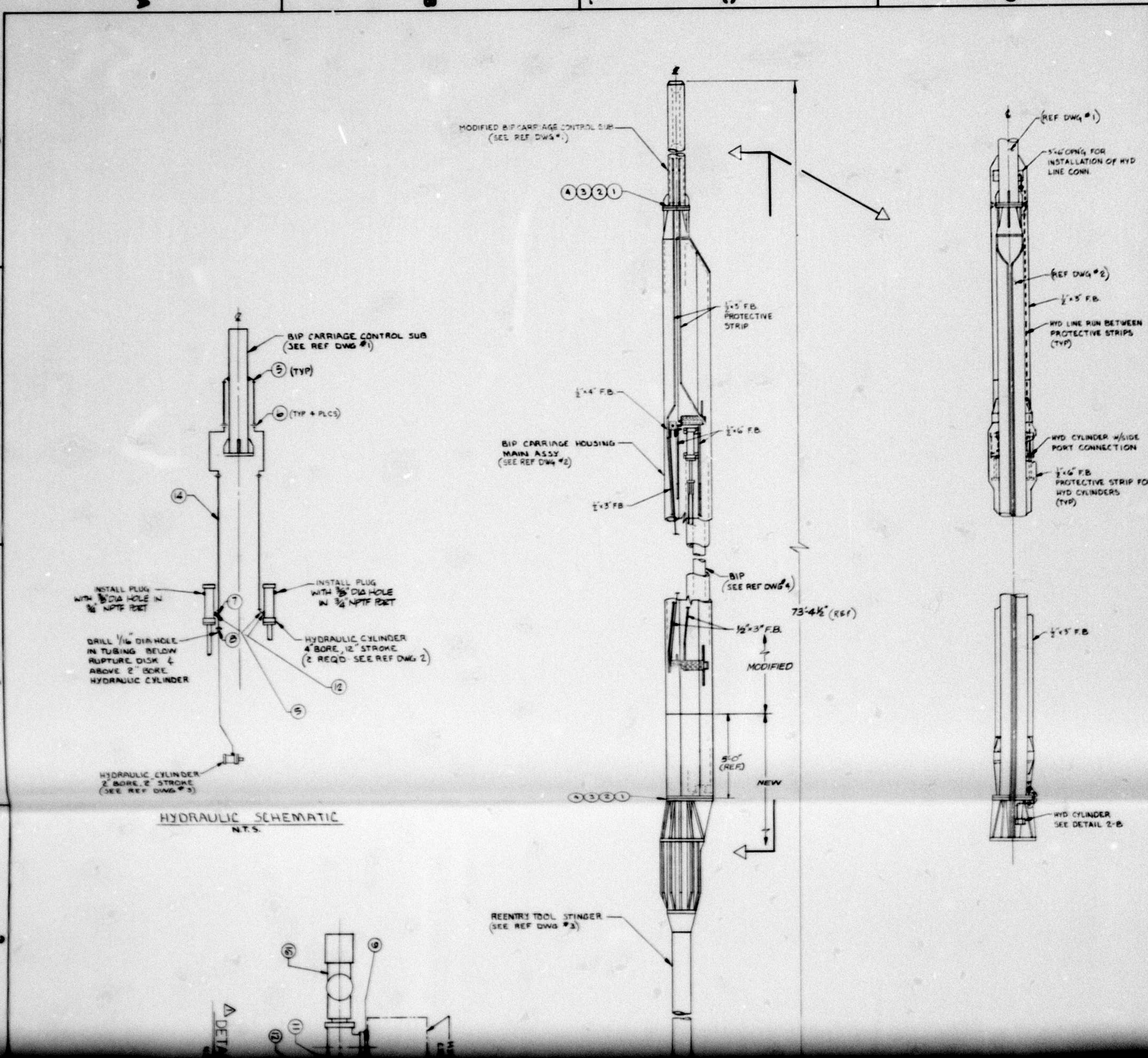
NAME	DATE
DFT. G. Donovan	9-17-81
ENGR.	10-23-81
CHK. D. WEST	10-23-81
APPR. REG	12-2-81
REL. REG	12-2-81

SCALE: NONE

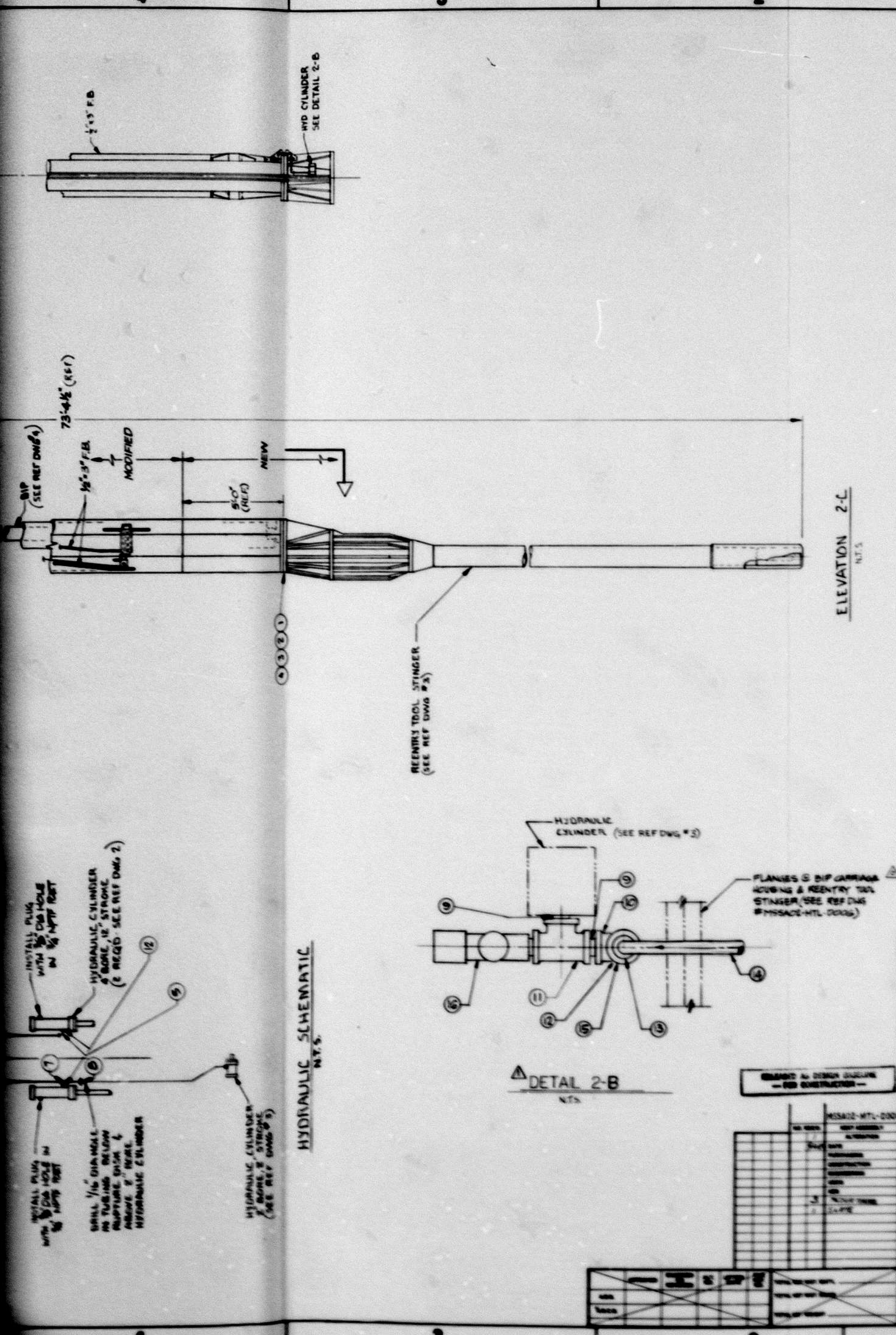
TOLERANCE UNLESS OTHERWISE NOTED: FRACTION ± 1/16" ANGULAR ± ½° MILLIMETER ± 1.588 ( ) DESIGNATES MILLIMETER DIMENSIONS

SIZE	DWG.	CC	SHT.	ALT.
E	MSSA02-MTL-D002	541	1 OF 1	0

2



HYDRAULIC SCHEMATIC
N.T.S.



LIST OF MATERIALS

	FIND NO.	ITEM	QTY	DESCRIPTION	MATERIAL OR DWG NO.
		1	24	⅞"-14UNF 2A×3¾ LG CORROSION RESISTANT BOLT	ASTM A 325 TYPE 3
		2	24	⅞" PLAIN WASHER	SST
		3	24	⅞" LOCK WASHER	SST
		4	24	⅞"-14 UNF 2B CORROSION RESISTING NUT	ASTM A 325 TYPE 3
		5	2	8-8CBTX MALE ELBOW (PARKER) WORKING PRESS 3500 PSI	SST
		6	4	8 HBTX UNION (PARKER) WORKING PRESS 3500 PSI	
		7	1	8-8-SBTX MALE BRANCH TEE WORKING PRESS 3500 PSI (PARKER)	
		8	1	½" NPTF UNION RUPTURE DISK, SOLID DISK SET AT 2800 PSI FIKE, CONTINENTAL OR EQ.	
		9	2	NIPPLE ½" NPTF × 1½" LG SCH 80 SMLS, TEE, WORKING PRESS 3500 PSI	
△1		10	1	½" NPTF 90° ELL - 3500 PSI	
△		11	1	½" NPTF TEE 3500 PSI	
△		12	3	¾" NPTF × ½" NPTF BUSHING 3500 PSI	
		13	1	PARKER HANNIFIN CONNECTOR 8-12-FBTX, WORKING PRESS 3500 PSI	
△		14		½" X .065 SEAMLESS TUBING 18-8 TYPE 304	S.ST. ASTM A450-79
		15	1	¾" NPTF INLINE CHECK VALVE CRACKING PRESS 71.4 PSI, MILLER MODEL C-8, WORKING PRESS 3500 PSI	S.ST.
△1		16	2	½" NPT RELIEF VALVE SET ABOUT 1000 PSI CIRCLE SEAL CONTROLS PART NO. 5159T-4M-1000 OR EQUAL	303 S.ST

GENERAL NOTES: (UNLESS OTHERWISE NOTED)

1. ALL TUBE FITTINGS ARE JIC 37½° FLAIR TYPE DESCRIPTION IS PER PARKER HANNIFIN'S CATALOG 4300, SEPT. 1980, INDUSTRIAL TUBE FITTINGS.
2. HYDRAULIC TUBING RUN TO BE DETERMINED BY MANUFACTURE.
3. THIS DWG IS MODIFIED AND WAS DEVELOPED FROM DWG NO. E-001-A004 PLT 1.
4. HYDRAULIC TUBING & WIRE ROPES ARE TO BE ROUTED WITHIN THE BOUNDRIES OF THE PROTECTIVE STRIPS AS SHOWN TO GIVE MAXIMUM PROTECTION FROM DAMAGE.
5. VENT PORTS OF CYLINDERS ARE TO BE COVERED WITH ADHESIVE TAPE DURING ASSEMBLY AND AFTER TEST.
6. ALL BOLTS TO BE TACK WELDED ON FINAL ASSEMBLY.
7. ALL HYDRAULIC PIPING SHALL BE ADEQUATELY STAYED & SUPPORTED.
8. BEND RADIUS OF TUBING SHALL NOT BE LESS THAN 5 TIMES THE DIAMETER OF THE TUBING.

REFERENCE DWGS:

1. MSSA02-MTL-D003 — BIP CARRIAGE CONTROL SUB DETAILS & ASSEMBLY
2. MSSA02-MTL-D006 — MODIFIED H.P. CARRIAGE HOUSING, MAIN ASSEMBLY
3. MSSA02-MTL-D012 — REENTRY TOOL STINGER ASSEMBLY AND DETAILS

TELEDYNE GEOTECH DWGS

4. 990-55100 — BIP

1			ADDED ITEM 16 AND REVISED DETAIL 2-B, PER DCN		
			REVISED ITEM 11 ... ZONE 1-D. REVISED ITEM 14 ... A450-79, ZONE 1-C. REVISED REF DWG #3 FROM MSSA02-MTL-D007 TO MSSA02-MTL-D012, ZONE 1-B. ADDED 3500 PSI TO ITEM 12 DESCRIPTION.		
0			DESIGN RELEASE		
A			PRELIMINARY RELEASE		

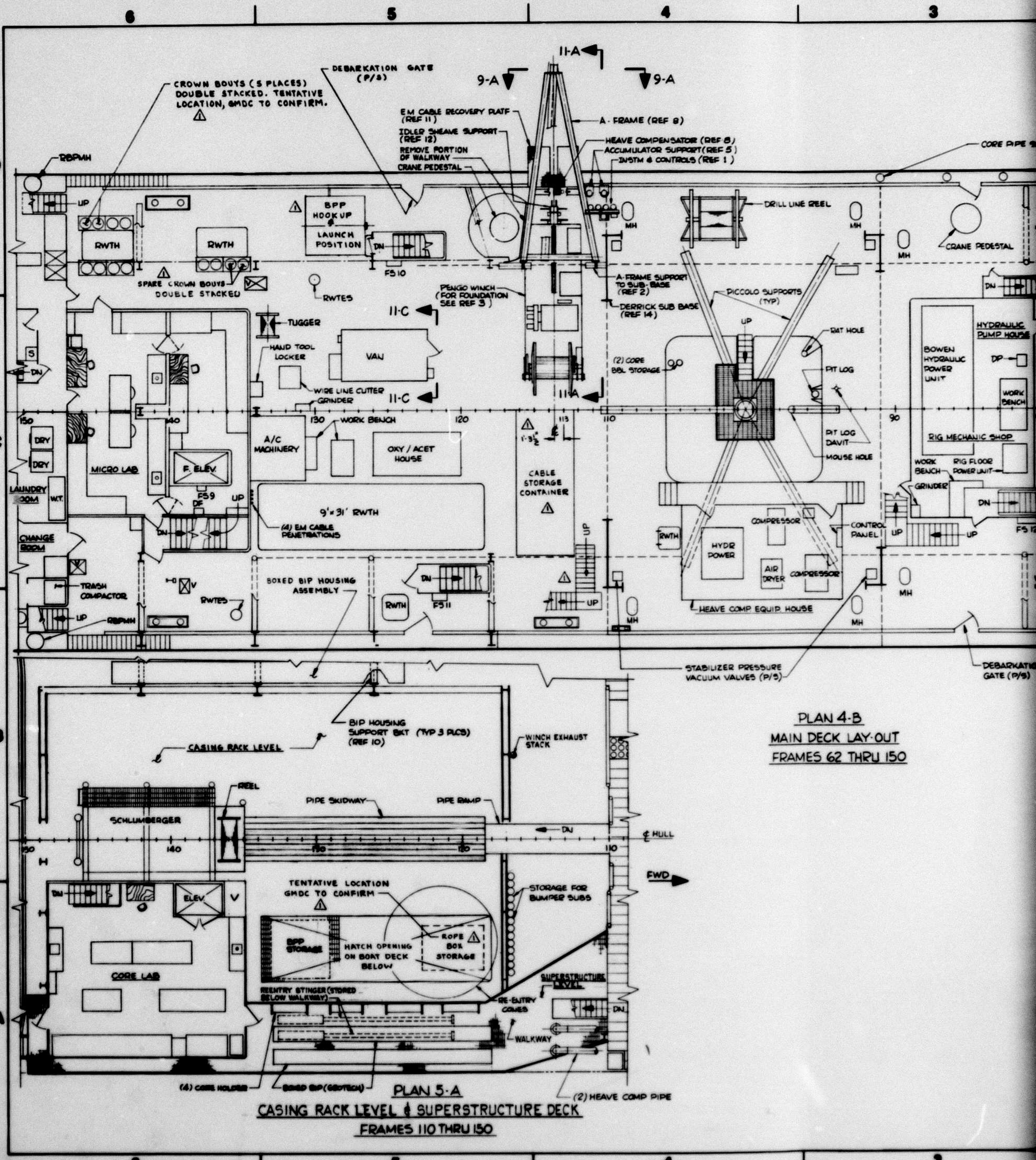
GLOBAL MARINE DEVELOPMENT Inc.

MARINE SEISMIC SYSTEM (MSS)
MODIFIED BIP REENTRY SUB ASSEMBLY

NOTED

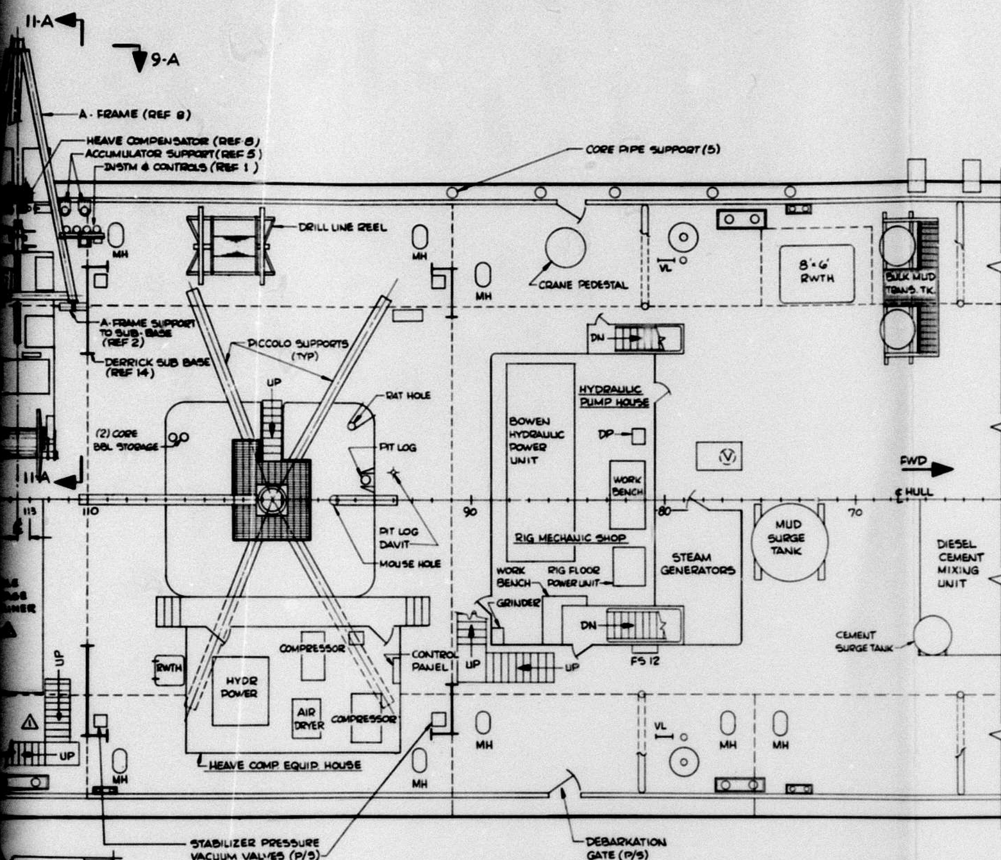
E MSSA02-MTL-D07 ... 1

2

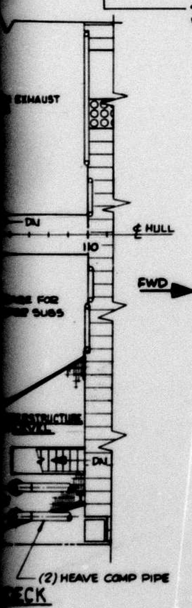


PLAN 4-B
MAIN DECK LAY-OUT
FRAMES 62 THRU 150

PLAN 5-A
CASING RACK LEVEL & SUPERSTRUCTURE DECK
FRAMES 110 THRU 150



PLAN 4-B
MAIN DECK LAY-OUT
FRAMES 62 THRU 150



LIST OF MATERIALS

CODE/IDENT	ITEM	QTY.	DESCRIPTION	MATERIAL OR DWG. NO.

REFERENCE DRAWINGS:

1) GMDI DWG: E-001-A018 MARINE SEISMIC SYSTEM (MSS) HEAVE COMPENSATOR CONTROL BOARD, DETAILS & ASSEMBLY.
2) GMDI DWG: E-001-A023 MARINE SEISMIC SYSTEM (MSS) A-FRAME SUPPORT TO SUB BASE DETAILS & ASSEMBLY.
3) GMDI DWG: E-001-A025 MARINE SEISMIC SYSTEM (MSS) WINCH FOUNDATION DETAILS & ARRANGEMENT
4) GMDI DWG: E-001-A029 MARINE SEISMIC SYSTEM (MSS) HEAVE COMPENSATOR BRACKET MODIFICATION & DETAILS
5) GMDI DWG: E-001-A030 MARINE SEISMIC SYSTEM (MSS) ACCUMULATOR SUPPORTS DETAILS & ASSEMBLY.
6) ~~GMDI DWG: MSSA02 - HOLD MARINE SEISMIC SYSTEM (MSS-82) BPP SECURING CABLES, DETAILS~~
7) ~~GMDI DWG: MSSA02 - HOLD MARINE SEISMIC SYSTEM (MSS-82) BOUY SECURING DETAILS~~
8) GMDI DWG: MSSA02-MTL-D019 MARINE SEISMIC SYSTEM (MSS-82) A-FRAME DETAILS & ASSEMBLY
9) GMDI DWG: MSSA02-MTL-D031 MARINE SEISMIC SYSTEM (MSS-82) IRR LINE STORAGE CONTAINER SECURING DETAILS
10) GMDI DWG: MSSA02-MTL-D030 MARINE SEISMIC SYSTEM (MSS-82) BIP HOUSING SUPPORT BRACKET LAYOUT
11) GMDI DWG: MSSA02-STR-D001 MARINE SEISMIC SYSTEM (MSS-82) EM CABLE RECOVERY PLATFORM
12) GMDI DWG: MSSA02-MTL-D010 MARINE SEISMIC SYSTEM (MSS-82) IDLER SHEAVE SUPPORT DETAIL ASSEMBLY
13) LEVINGSTON SHIPBUILDING CO. DWG: T-54-54-515 CASING RACK LOCATION & DETAILS
14) LEVINGSTON SHIPBUILDING CO. DWG: T-54-54-516 DERRICK SUB BASE DETAILS

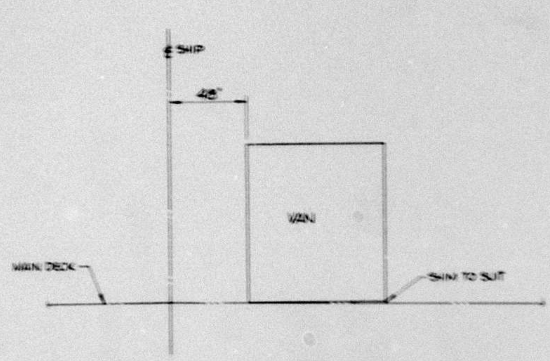
NO.	DATE	BY	DESCRIPTION	JOB AUTH.	APPR.
1	6-29-82	FH	1. CABLE STORAGE CONTAINER MOVED APPROX. 1'-0 AFT TO CLEAR INCLINED LADDER AREAS C-4 & C-9 2. INCLINED LADDER AT FR# 112 REVISED AS BUILT 3. ℄ OF WINCH LOCATION DIM 1'-3½ AFT OF FR# 113, WAS 6". SEE REF#3 4. RELOCATED CROWN BOUYS FROM CASING RACK TO MAIN DECK PORT SIDE. ADDED TENTATIVE LOCATION NOTE TO CROWN BOUYS 5. ONE ROPE STORAGE BOX REMOVED FROM TWEEN DECKS STBD SIDE. ADDED TENTATIVE LOCATION NOTE TO REMAINING STORAGE BOX 6. BPP LAUNCH POSITION MOVED FORWARD AGAINST BOOBY HATCH AT FR# 126, PORT SIDE 7. REF DWGS #6 & 7 DELETED 8. REF DWGS #9 & 10 ADDED	011-4110	
0	5-5-82		DESIGN RELEASE	011-4110	
A	3-17-82	MJA	PRELIMINARY RELEASE	011-4110	

GLOBAL MARINE DEVELOPMENT Inc.
Newport Beach, Calif.

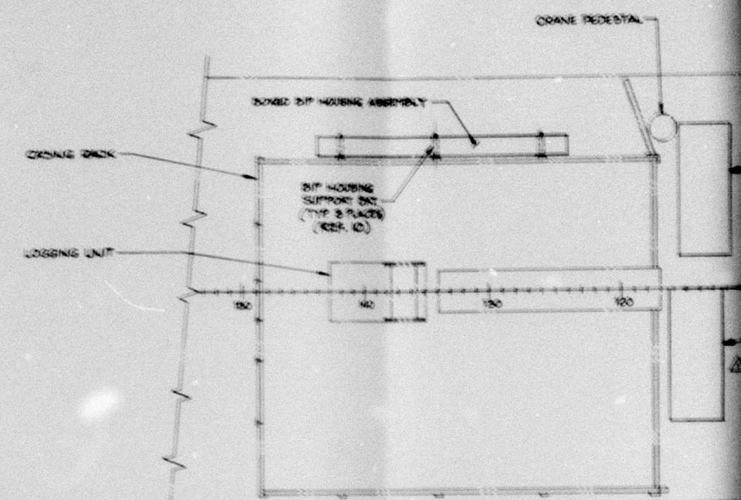
MARINE SEISMIC SYSTEM (MSS-82)
GLOMAR CHALLENGER
EQUIPMENT INSTALLATION ARRANGEMENT

DFT	M J ANTECK	2-26-82	SCALE 3/16"=1'-0" & NOTED
CHKD	W BUCHANAN	3-17-82	
CHK	L. JOHNSON	3-17-82	
APPD		5-7-82	
SIZE E	DWG. NO. MSSA02-MTL-D018	41	SHEET 1 of 2	REV 1

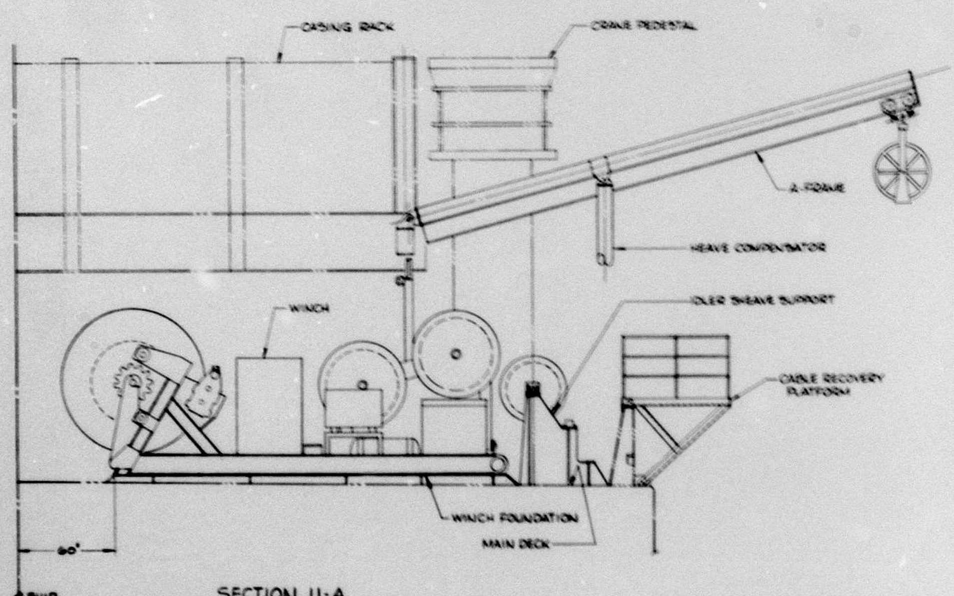
2



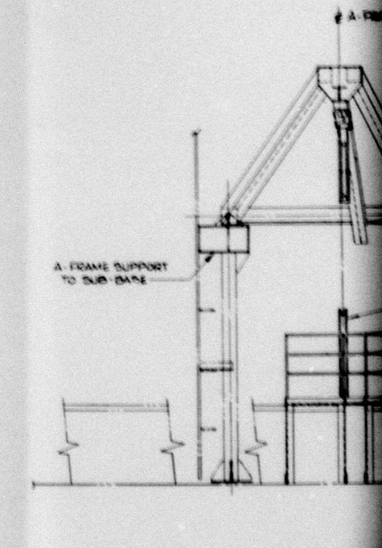
ELEVATION 11-C
SCALE 3/8" = 1'-0"
(SEE 4-B)
(VIEW LOOKING AFT)



PLAN 9-C
RE-ENTRY TOOL & MISC EQPT STORAGE
SCALE 3/8" = 1'-0"



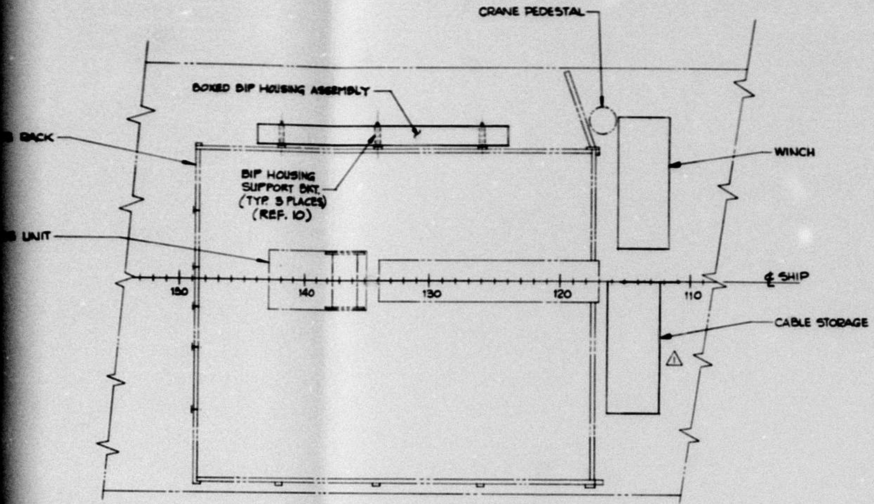
SECTION 11-A
SCALE 3/8" = 1'-0"
(SEE 4-B)
(VIEW LOOKING AFT)



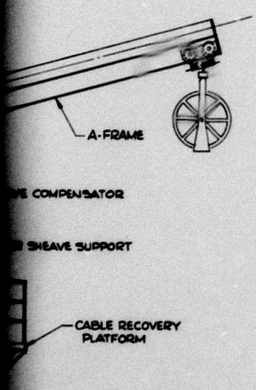
ELEVATION 9
SCALE 3/8" = 1'-0"
(SEE 4-B)
(VIEW LOOKING IN

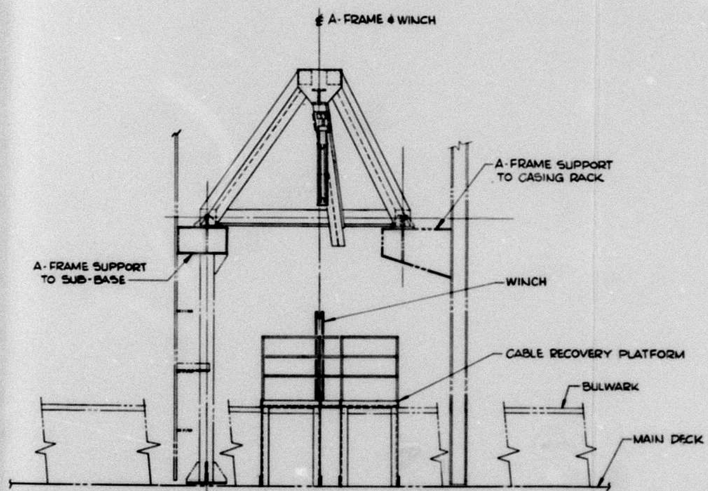
10 9 8 7

LIST OF MATERIALS



PLAN 9-C
RE-ENTRY TOOL & MISC EQPT STORAGE
SCALE: 1/8"=1'-0"





ELEVATION 9-A
SCALE: 3/8"=1'-0"
(SEE 4-B)
(VIEW LOOKING INBOARD)

D C B A

SEE SHEET 1 FOR NOTES, REFERENCES, AND ALTERATIONS

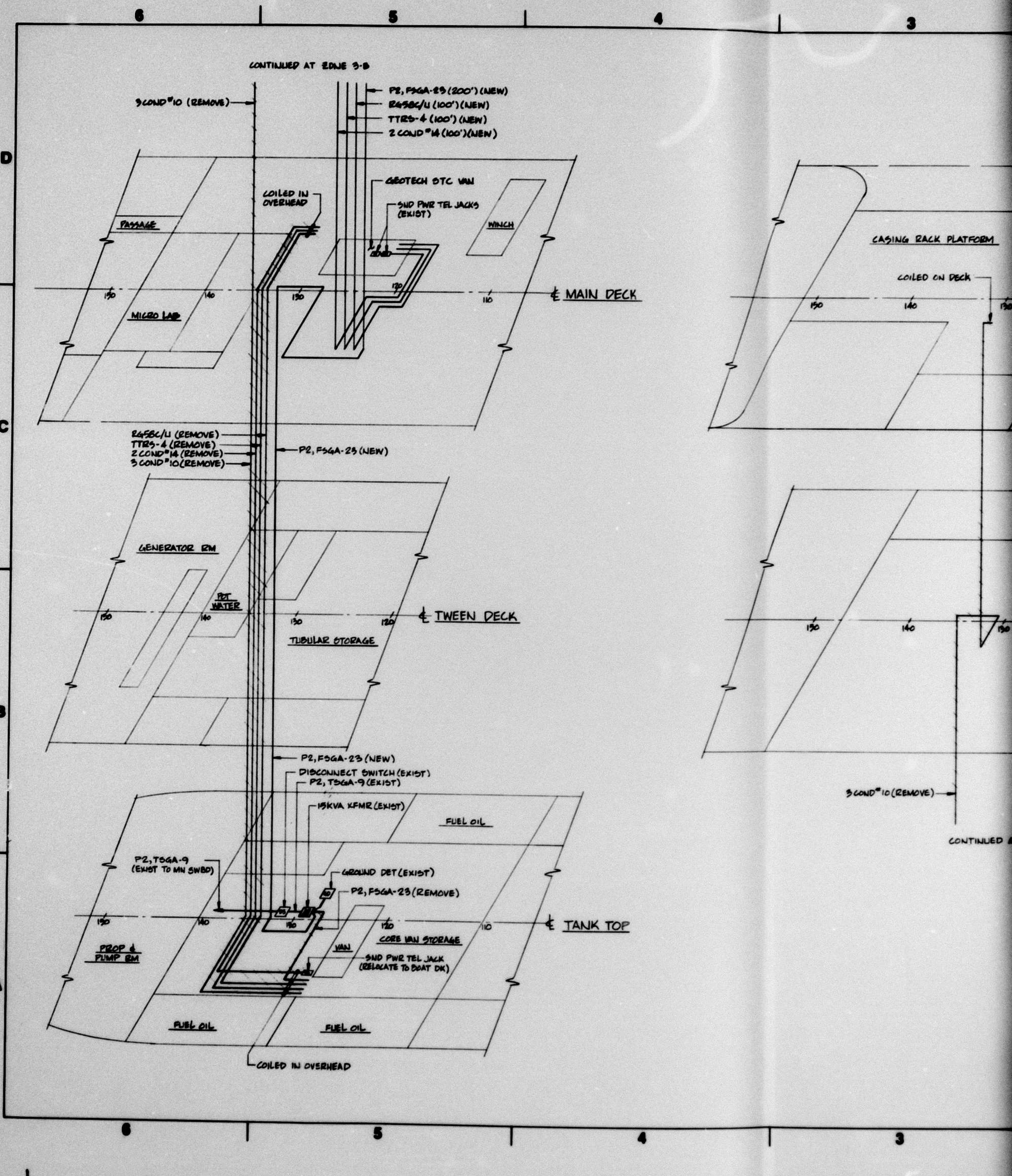
GLOBAL MARINE DEVELOPMENT Inc.
Newport Beach, Calif.

MARINE SEISMIC SYSTEM (MSS-82)
GLOMAR CHALLENGER
EQUIPMENT INSTALLATION ARRANGEMENT

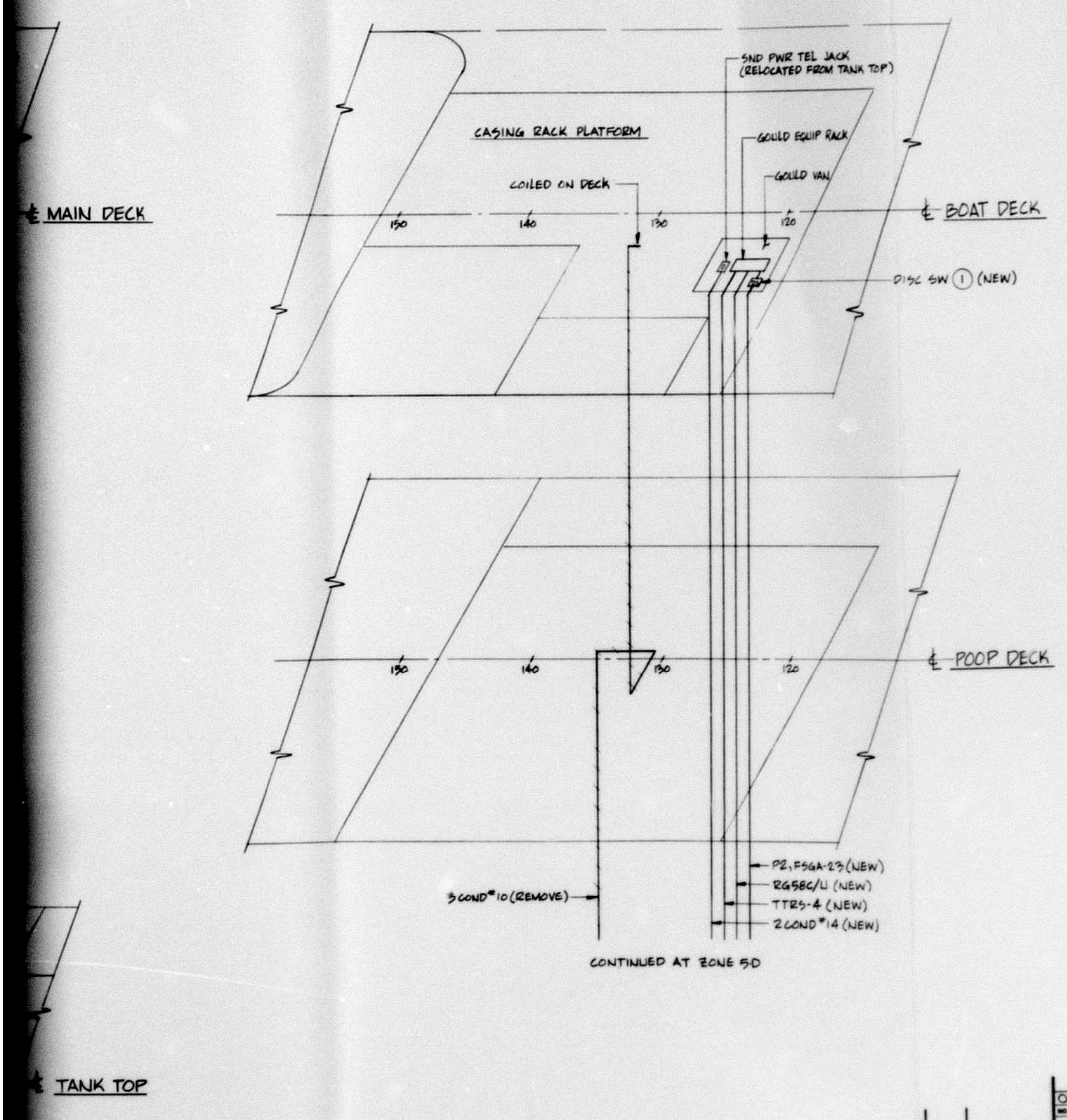
SCALE	SIZE	DWG. NO.		SHEET	ALT
NOTED	E	MSSA02-MTL-D018	41	2 of 2	1

10 9 8 7

2



CONTINUED AT ZONE 3-B
3 COND #10 (REMOVE)
P2, FSGA-23 (200') (NEW)
RG58C/U (100') (NEW)
TTRS-4 (100') (NEW)
2 COND #14 (100') (NEW)
GEOTECH STC VAN
COILED IN OVERHEAD
SND PWR TEL JACKS (EXIST)
PASSAGE
WINCH
MICRO LAB
MAIN DECK
CASING RACK PLATFORM
COILED ON DECK
RG58C/U (REMOVE)
TTRS-4 (REMOVE)
2 COND #14 (REMOVE)
3 COND #10 (REMOVE)
P2, FSGA-23 (NEW)
GENERATOR RM
POT WATER
TWEEN DECK
TUBULAR STORAGE
DISCONNECT SWITCH (EXIST)
P2, TSGA-9 (EXIST)
15KVA XFMR (EXIST)
FUEL OIL
P2, TSGA-9 (EXIST TO MN SWBD)
GROUND DET (EXIST)
P2, FSGA-23 (REMOVE)
TANK TOP
PROP & PUMP RM
VAN
CORE VAN STORAGE
SND PWR TEL JACK (RELOCATE TO BOAT DK)
COILED IN OVERHEAD
CONTINUED AT



LIST OF MATERIALS

OWNER FURN	ITEM	QTY	DESCRIPTION	MATERIAL OR DWG NO
	1	1	FUSED DISC SW 60AMP 240VAC 3POLE 4WIRE NEMA 1 ENCLOSURE	WESTINGHOUSE GF-422-N OR EQUAL
	2	1	ENCLOSURE WATERTIGHT NEMA 4 24"x20"x10" (NOTE #2)	HOFFMAN A-242010CLP OR EQUAL
	3	1	MOUNTING PANEL FOR ENCLOSURE ITEM 2 21"x17" (NOTE #2)	HOFFMAN A-24P20 OR EQUAL
	4	1	WINDOW KIT FOR ENCLOSURE ITEM 2 13"x8" (NOTE #2)	HOFFMAN A-PWK13BNF OR EQUAL
	5	4	PLUG 10AMP 125VAC 3WIRE WATERTIGHT (NOTE #3)	PAULUHN 413 OR EQUAL
	6	200'	CABLE FSGA-23	
	7	100'	CABLE TTRS-4	
	8	100'	CABLE 2COND#14 "SO"	
	9	100'	COAX RG58C/U	

NOTES:

1. THIS DRAWING MODIFIES REFERENCE Nº1 FOR THE MSS-83 INSTALLATION. ALL CABLE AND EQUIP SHALL BE INSTALLED AS SHOWN ON REFERENCE Nº1 EXCEPT AS MODIFIED HEREON.
2. NEW WATERTIGHT ENCLOSURE ITEMS 2, 3 AND 4 SHALL BE USED TO HOUSE THE WEIGHT INDICATING PANEL, ITEM 2 OF REFERENCE Nº1.
3. WATERTIGHT PLUGS ITEM 5 SHALL BE INSTALLED ON THE POWER CABLES FOR THE WEIGHT INDICATING PANEL, TWO FLOODLIGHTS AND WIRE LINE COUNTER PANEL, ITEMS 2, 28 AND 30 OF REFERENCE Nº1.

REFERENCES:

1. MSSA02-MTL-D049 MARINE SEISMIC SYSTEM (MSS)-82 GLOMAR CHALLENGER ELECT INSTL.

NO.	DATE	BY	DESCRIPTION	JOB AUTH	APPR
0	12/3/82	REE	DESIGN RELEASE	011/5510	

ALTERATIONS

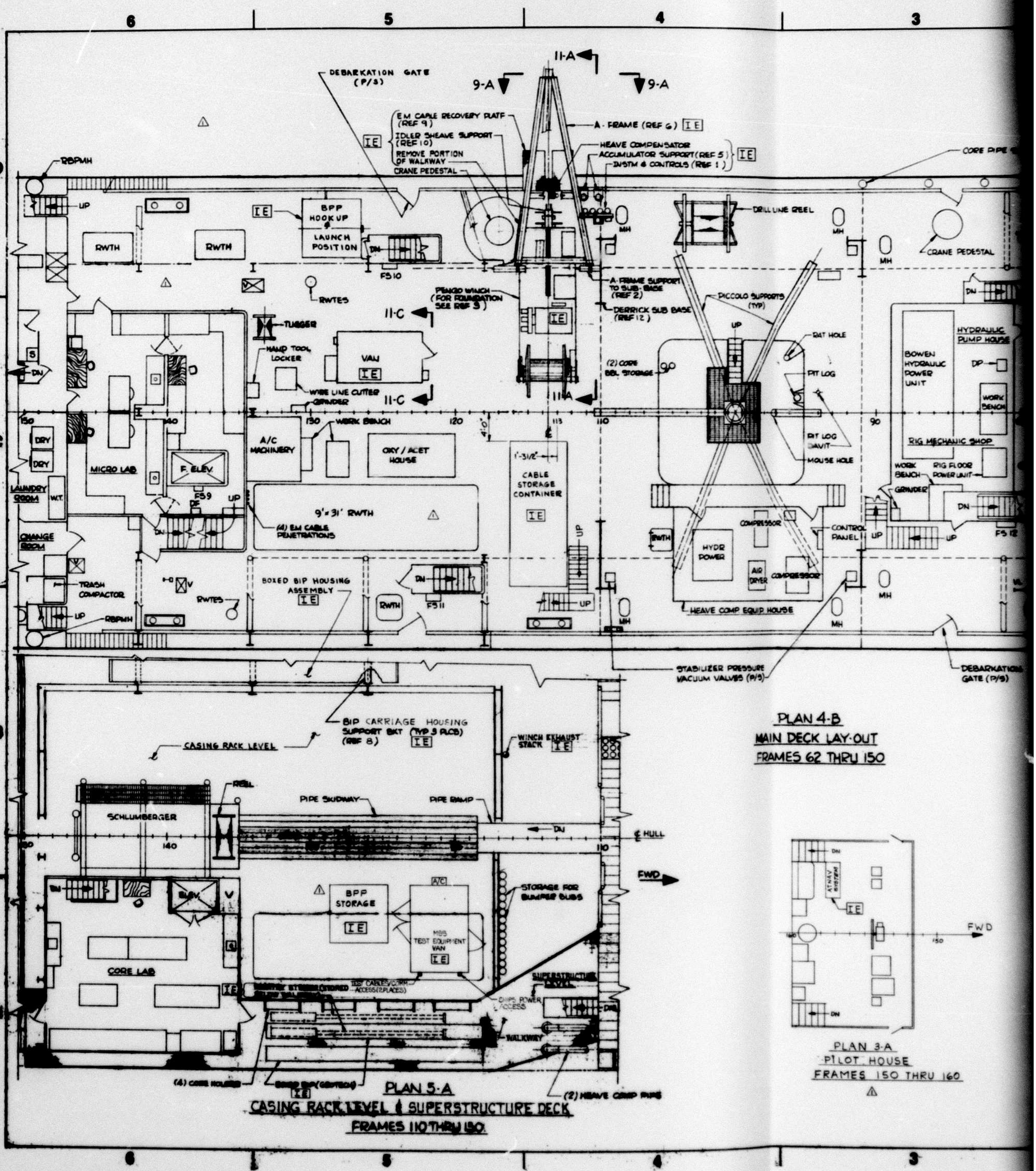
GLOBAL MARINE DEVELOPMENT Inc.
Newport Beach, Calif.

MARINE SEISMIC SYSTEM (MSS)-83
GLOMAR CHALLENGER
ELECTRICAL INSTALLATION

		Date	
DFT.	REE	11/23/82	SCALE 1/8"=1'-0" 150 ONLY
ENGR.	REE	11/23/82	
CHK.	ARK	12/2/82	
APPR.			
REL.		12/3/82	

SIZE	DWG. NO.	CC	SHT	ALT
E	MSSA04-SYS-D001	544	1 OF 1	0

2



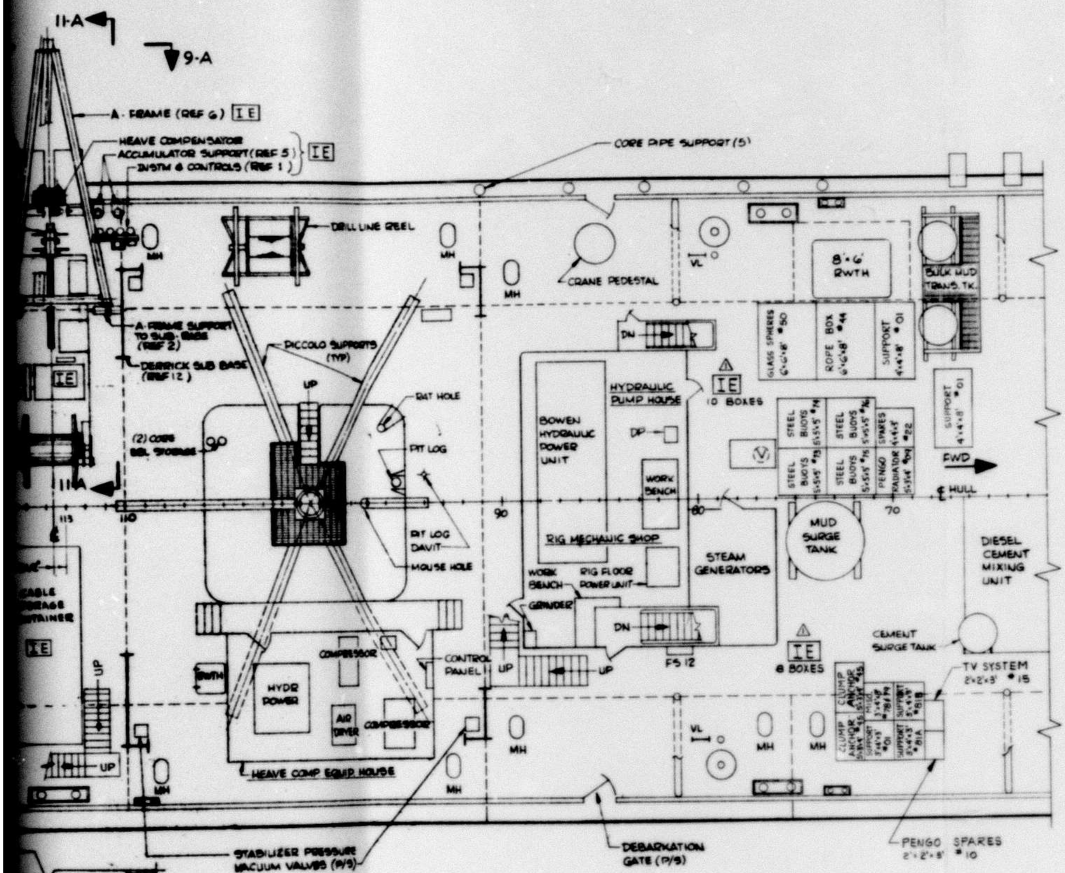
DEBARKATION GATE (P/3)
11-A
9-A
E.M CABLE RECOVERY PLATF (REF 9)
IDLER SHEAVE SUPPORT (REF 10)
REMOVE PORTION OF WALKWAY
CRANE PEDESTAL
A-FRAME (REF 6) IE
HEAVE COMPENSATOR
ACCUMULATOR SUPPORT (REF 5)
INSTM & CONTROLS (REF 1)
IE
CORE PIPE
RBPMH
UP
BPP HOOK UP & LAUNCH POSITION
RWTH
DN
FS10
DRILL LINE REEL
MH
CRANE PEDESTAL
A-FRAME SUPPORT TO SUB-BASE (REF 2)
DERRICK SUB BASE (REF 12)
PENGO WINCH (FOR FOUNDATION SEE REF 3)
RWTES
11-C
TUGGER
HAND TOOL LOCKER
VAN
WIRE LINE CUTTER
GRINDER
PICCOLO SUPPORTS (TYP)
RAT HOLE
(2) CORE BBL STORAGE
PIT LOG
HYDRAULIC PUMP HOUSE
BOWEN HYDRAULIC POWER UNIT
WORK BENCH
WORK BENCH
DRY
DRY
LAUNDRY ROOM
W.T.
MICRO LAB
F. ELEV.
A/C MACHINERY
DRY / ACET HOUSE
CABLE STORAGE CONTAINER
PIT LOG DAVIT
MOUSE HOLE
RIG MECHANIC SHOP
RIG FLOOR POWER UNIT
GRINDER
9'×31' RWTH
(4) EM CABLE PENETRATIONS
CHANGE ROOM
FS9
COMPRESSOR
HYDR POWER
AIR DRYER
COMPRESSOR
CONTROL PANEL
FS12
TRASH COMPACTOR
BOXED BIP HOUSING ASSEMBLY
FS11
HEAVE COMP EQUIP HOUSE
STABILIZER PRESSURE VACUUM VALVES (P/3)
DEBARKATION GATE (P/3)
BIP CARRIAGE HOUSING SUPPORT BKT (TYP 3 PLCS) (REF 8)
CASING RACK LEVEL
WINCH EXHAUST STACK
PLAN 4-B
MAIN DECK LAY-OUT
FRAMES 62 THRU 150
REEL
SCHLUMBERGER
PIPE SKIDWAY
PIPE RAMP
HULL
FWD
BPP STORAGE
MSS TEST EQUIPMENT VAN
STORAGE FOR BUMPER SUBS
CORE LAB
TEST CABLES/CORR ACCESS (2 PLACES)
SUPERSTRUCTURE LEVEL
WALKWAY
(4) CORE HOLDERS
(2) HEAVE COMP PIPE
PLAN 5-A
CASING RACK LEVEL & SUPERSTRUCTURE DECK
FRAMES 110 THRU 150
ATNAV SYSTEM
FWD
PLAN 3-A
PILOT HOUSE
FRAMES 150 THRU 160

LIST OF MATERIALS

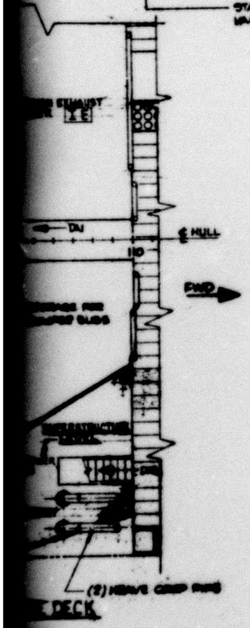
GENERAL NOTE:

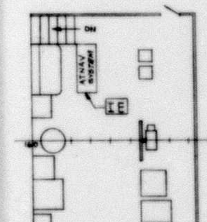
GENERAL NOTE:

1. ALL EQUIPMENT LABELLED [IE] (INSTALLED EQUIPMENT) IS PART OF THIS INSTALLATION.



PLAN 4-B
MAIN DECK LAY-OUT
FRAMES 62 THRU 150





PLAN 3-A
PILOT HOUSE
FRAMES 150 THRU 160

REFERENCE DRAWINGS:

1) GMDI DWG: E-001-A018 MARINE SEISMIC SYSTEM (MSS) HEAVE COMPENSATOR CONTROL BOARD, DETAILS & ASSEMBLY
2) GMDI DWG: E-001-A023 MARINE SEISMIC SYSTEM (MSS) A-FRAME SUPPORT TO SUB BASE DETAILS & ASSEMBLY
3) GMDI DWG: E-001-A025 MARINE SEISMIC SYSTEM (MSS) WINCH FOUNDATION DETAILS & ARRANGEMENT
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9) GMDI DWG: MSSA02-STR-D001 MARINE SEISMIC SYSTEM (MSS-82) EM CABLE RECOVERY PLATFORM
10) GMDI DWG: MSSA02-MTL-D010 MARINE SEISMIC SYSTEM (MSS-82) IDLER SHEAVE SUPPORT DETAIL ASSEMBLY
11) LEVINGSTON SHIPBUILDING CO. DWG: T-54-54-515 CASING RACK LOCATION & DETAILS
12) LEVINGSTON SHIPBUILDING CO. DWG: T-54-54-516 DERRICK SUB BASE DETAILS

NO.	DATE	BY	DESCRIPTION	JOB AUTH.
1		F.H.	FOLLOWING REVISIONS & ADDITIONS MADE PER DCN-001, PLAN 3A ADDED, CROWN BUOYS REMOVED ZONE 6-D, BPP MOVED ZONE 5-A, ADDED 18 BOXES ZONE 2C.	01/5510
0			DESIGN RELEASE	01/5510

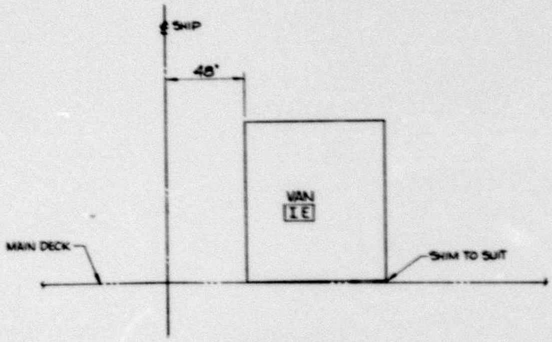
ALTERATIONS

GLOBAL MARINE DEVELOPMENT Inc.
Newport Beach, Calif.

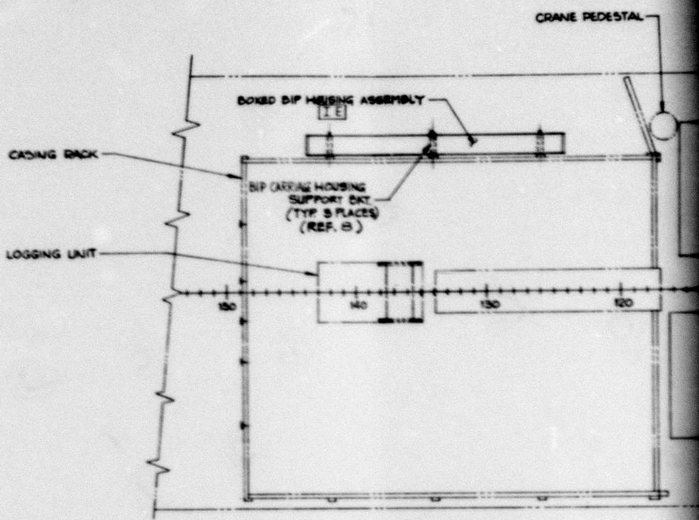
MARINE SEISMIC SYSTEM (MSS-83)
GLOMAR CHALLENGER
EQUIPMENT INSTALLATION ARRANGEMENT

DFT: R. TOPNESS
CHK: F.H.
SIZE: E
DWG NO.: MSSA04-SYS-D003

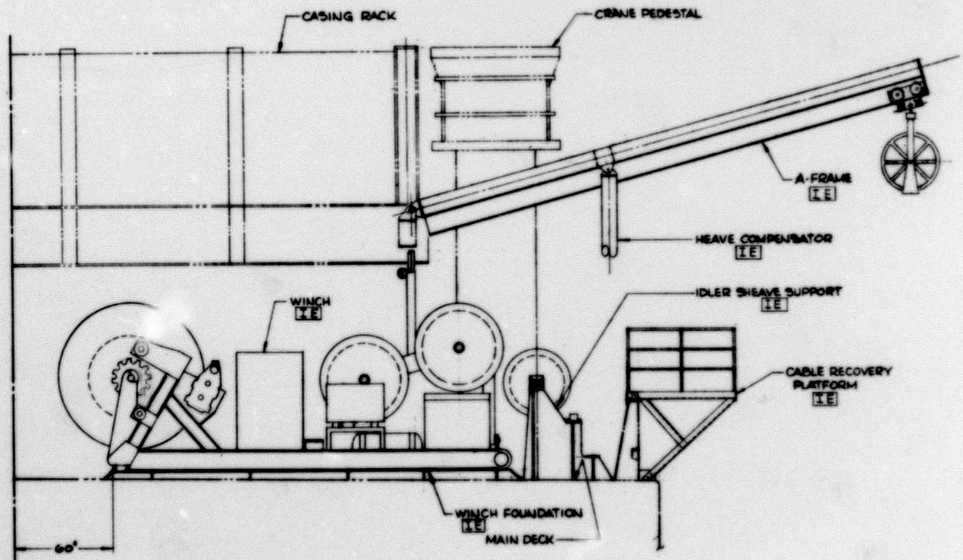
2



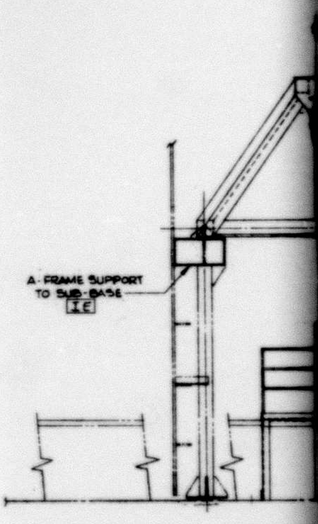
ELEVATION 11-C
SCALE: 3/8" = 1'-0"
(SEE 4-B)
(VIEW LOOKING AFT)



PLAN 9-C
RE-ENTRY TOOL & MISC EQPT STORAGE
SCALE: 1/8" = 1'-0"



SECTION 11-A
SCALE: 3/8" = 1'-0"
(SEE 4-B)
(VIEW LOOKING AFT)

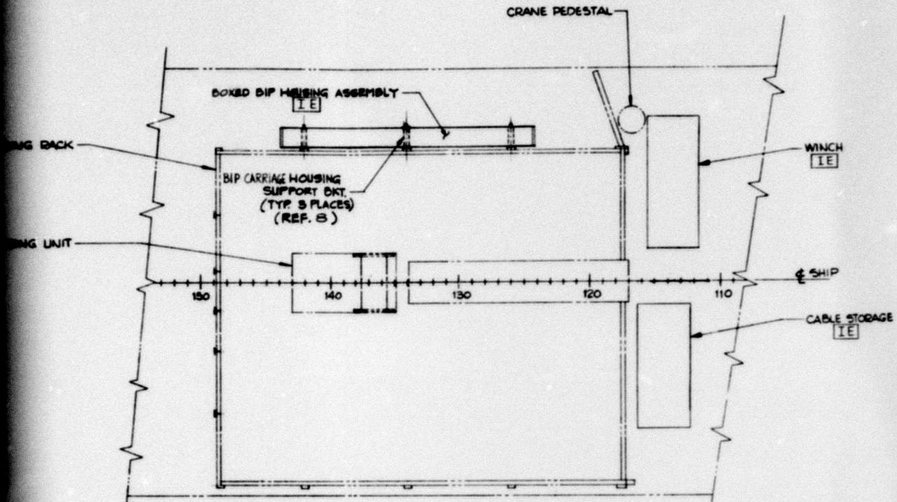


ELEVATI
SCALE: 3/
(SEE 4-
(VIEW LOOKING

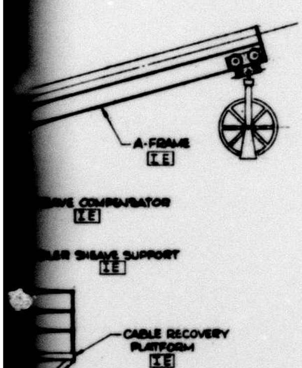
10	9	8	7

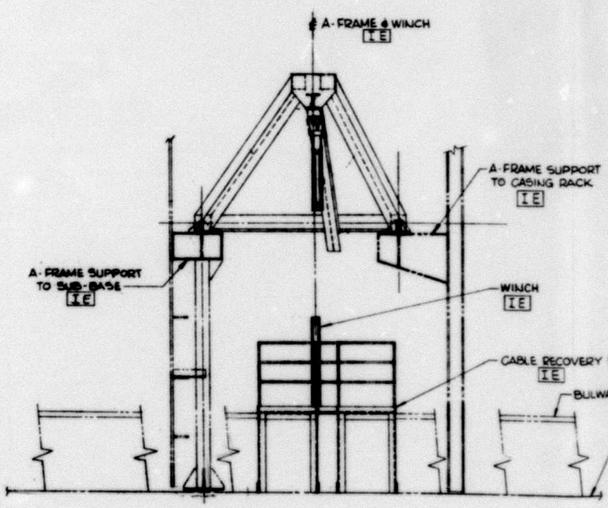
LIST OF MATERIALS

OWNER FURN.	ITEM	QTY	DESCRIPTION	MATERIAL OR DWG. NO.



PLAN 9-C
RE-ENTRY TOOL & MISC EQPT STORAGE
SCALE: 1/8" = 1'-0"





ELEVATION 9-A
SCALE: 3/8" = 1'-0"
(SEE 4-B)
(VIEW LOOKING INBOARD)

SEE SHEET 1 FOR NOTES, REFERENCES, AND ALTERATIONS

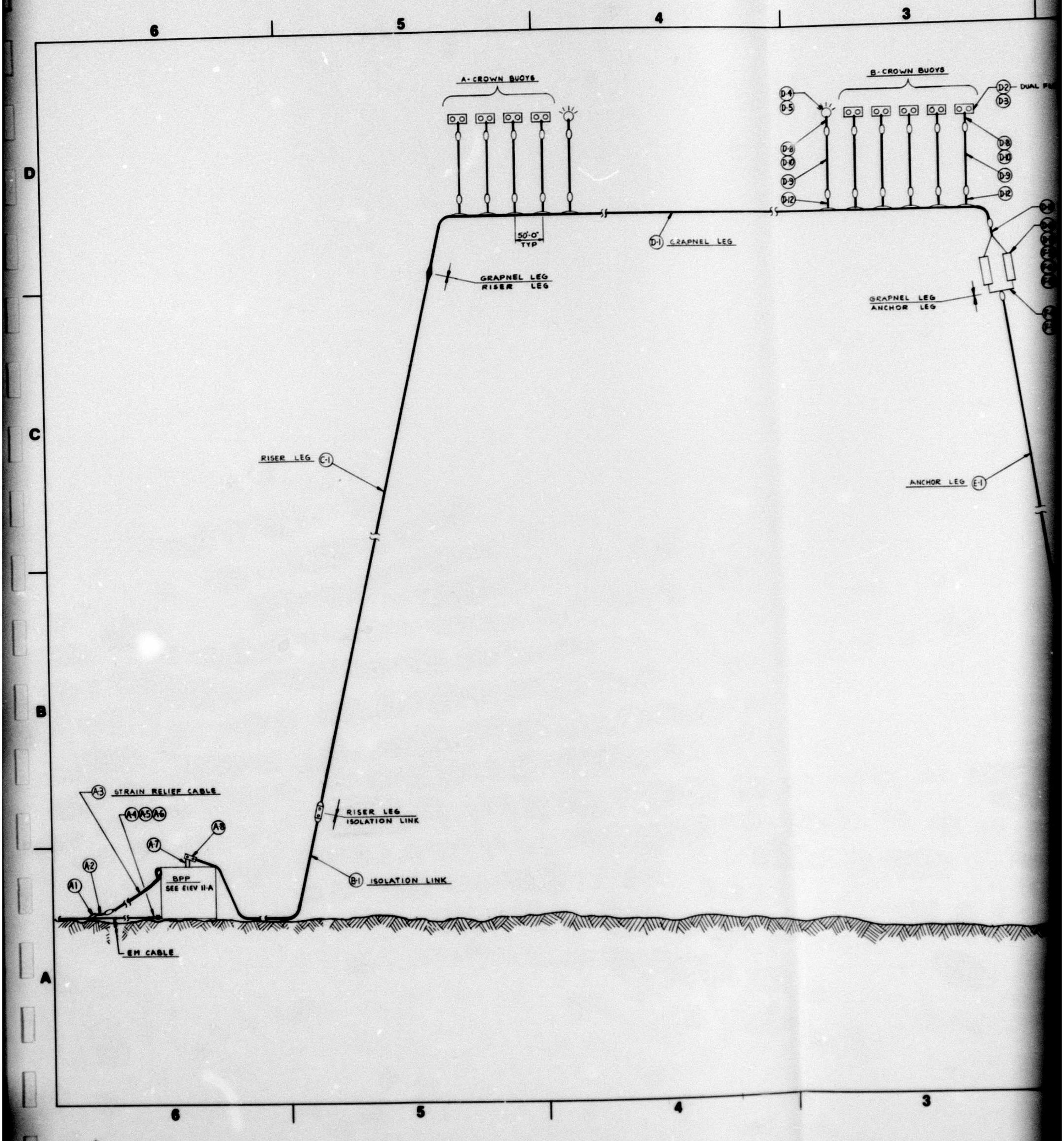
GLOBAL MARINE DEVELOPMENT Inc.
Newport Beach, Calif.

MARINE SEISMIC SYSTEM (MSS-83)
GLOMAR CHALLENGER
EQUIPMENT INSTALLATION ARRANGEMENT

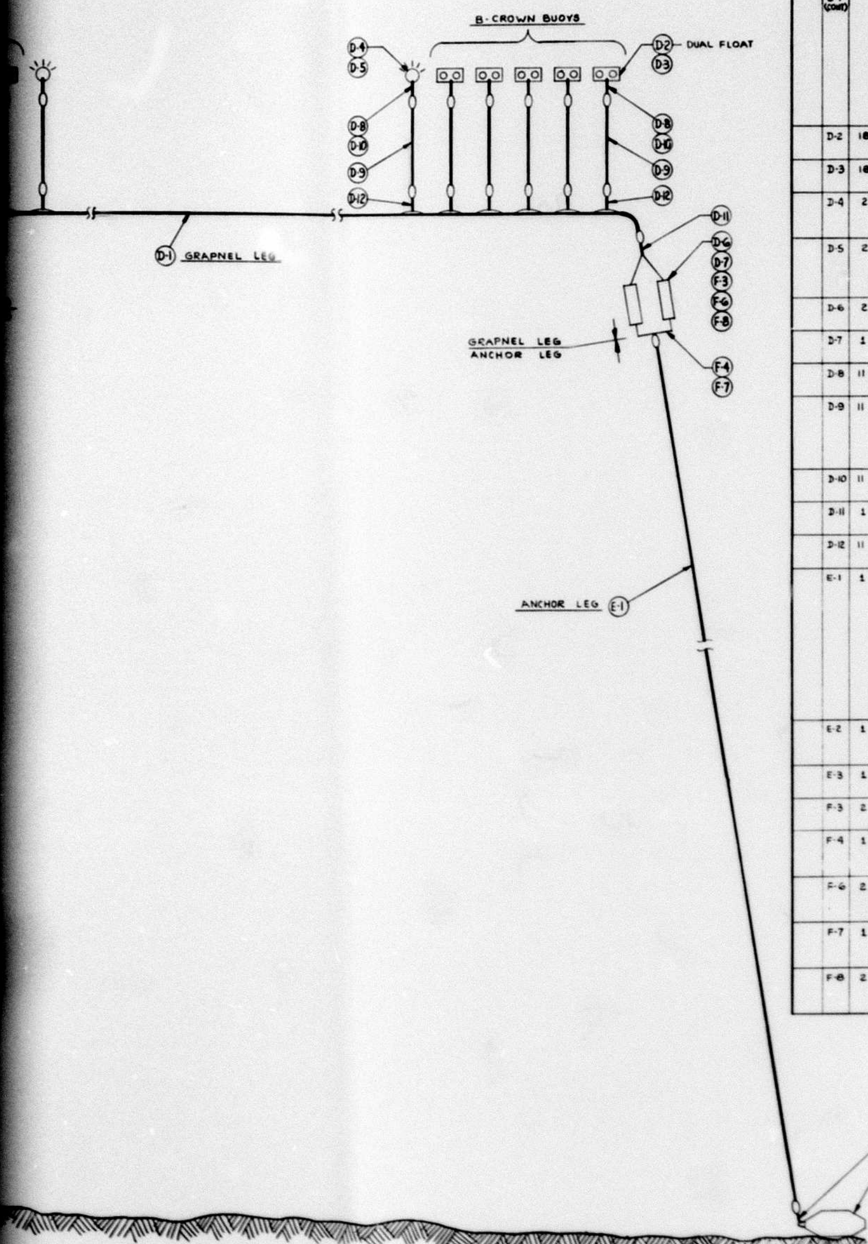
SCALE	SIZE	DWG. NO.	REV	SHT	ALT
NOTED	E	MSSA04-SYS-D003	41	2 of 2	1

10	9	8	7

2



6
5
4
3
D
C
B
A
A-CROWN BUOYS
B-CROWN BUOYS
D-4
D-5
D-2 DUAL
D-3
D-8
D-10
D-9
D-12
50'-0"
TYP
D-1 GRAPNEL LEG
GRAPNEL LEG
RISER LEG
GRAPNEL LEG
ANCHOR LEG
RISER LEG C-1
ANCHOR LEG E-1
A-3 STRAIN RELIEF CABLE
A-4 A-5 A-6
A-7
A-8
A-2
A1
BPP
SEE ELEV II-A
RISER LEG
ISOLATION LINK
B-1 ISOLATION LINK
EM CABLE



LIST OF MATERIALS

ORDER FORM	ITEM	QTY.	DESCRIPTION	MATERIAL OR DWG NO.
	D-1 (CONT)		THE FIRST AT TWO HUNDRED (200) FEET FROM THE END AND THE REMAINING SIX (6) AT FIFTY (50) FOOT INCREMENTS FROM THE FIRST. STARTING FROM THE LAST (1000) FOOT MARK ON ITEM C-1, MARK THE ROPE IN ONE THOUSAND (1000) FOOT INCREMENTS.	
	D-2	18	BENTHOS DEEP SEA GLASS SPHERE, MODEL 2040-17V.	
	D-3	18	BENTHOS RIBBED HARDHAT, MODEL 204HR-17.	
	D-4	2	BENTHOS GLOW FLASH WITH PRESSURE SWITCH OPTION MODEL 2143-PS.	
	D-5	2	BENTHOS STANDARD HARDHAT MODEL 204H-10, CUT AWAY TO PROVIDE CONNECTION POINT FOR ITEM D-4.	
	D-6	2	ATNAV TRANSPONDER MINIMUM DEPTH RATING 10,000 FEET.	
	D-7	1	DUAL RELEASE FRAMEWORK FOR ATNAV TRANSPONDER.	
	D-8	11	7/16"-14 UNC-2A × 2" SHOULDER EYE BOLTS, 304 SS.	
	D-9	11	SEVEN AND ONE HALF (7½) FEET OF ½" SAMSON POWER BRAID WITH A STANDARD METAL ROPE THIMBLE AT EACH END.	
	D-10	11	5/8" BOLT TYPE ANCHOR SHACKLE, CROSBY G-2130.	
	D-11	1	3/4" BOLT TYPE ANCHOR SHACKLE, CROSBY G-2130.	
	D-12	11	5/8" SNAP SHACKLE 17-4 SS, MERRIMAN.	
	E-1	1	EIGHTEEN THOUSAND (18,000) FEET OF 7/8" SAMSON POWER BRAID (NYLON COVER/MULTI-FILAMENT POLYPROPYLENE CORE 2-IN-1 BRAIDED ROPE) WITH A STANDARD METAL ROPE THIMBLE AT BOTH ENDS. MARK THE LINE IN ONE THOUSAND (1000) FOOT INCREMENTS.	
	E-2	1	STEEL CLUMP ANCHOR WEIGHING (2000) LBS. (IN WATER WEIGHT).	
	E-3	1	3/4" BOLT TYPE ANCHOR SHACKLE, CROSBY G-2130.	
	F-3	2	RELEASE / TRANSPONDER MODEL 723A.	
	F-4	1	DUAL RELEASE MECHANISM FOR MODEL 723A RELEASE/TRANSPONDER.	
	F-6	2	LITHIUM BATTERY SET FOR MODEL 723A RELEASE/TRANSPONDER.	
	F-7	1	RELEASE LINK FOR MODEL 723A RELEASE/TRANSPONDER	
	F-8	2	HOOK ANODES FOR MODEL 723A RELEASE/TRANSPONDER	

LIST OF MATERIALS

ORDER FORM	ITEM	QTY.	DESCRIPTION	MATERIAL OR DWG NO.
	A-1	4	PLP OR KELLEMS GRIP IN-LINE CONNECTION, 5/8" WIRE ROPE TO EM CABLE.	
	A-2	1	5/8" BOLT TYPE ANCHOR SHACKLE, CROSBY G-2130	
	A-3	1	TWO HUNDRED (200) FEET OF 5/8"-6×37 MONITOR IWRC WIRE ROPE WITH STANDARD WIRE ROPE THIMBLE BOTH ENDS.	
	A-4	1	PLP TERMINATION FOR EM CABLE. (SPECIFIED BY GEOTECH)	
	A-5	1	D.G. O'BRIEN CONNECTOR FOR EM CABLE. (SPECIFIED BY GEOTECH)	
	A-6	1	FULL PRESSURE DUMMY PLUG FOR ITEM A-5. (SPECIFIED BY GEOTECH).	
	A-7	1	MILLER SWIVEL MODEL GG TYPE 4 UW (15 TON) FOR SUBSEA APPLICATION.	
	A-8	1	CUSTOM TWO-PLATE CONNECTION BETWEEN ITEM A-7 AND ITEM B-1.	
	B-1	1	ONE THOUSAND FIVE HUNDRED (1500) FEET OF 1⅛"-6×37 MONITOR IWRC WIRE ROPE, BOTH ENDS TERMINATED WITH HEAVY WIRE ROPE THIMBLES.	
	B-2	1	CUSTOM TWO-PLATE CONNECTION BETWEEN ITEM B-1 AND ITEM C-1.	
	C-1	1	TWENTY ONE THOUSAND FIVE HUNDRED (21,500) FEET OF 1¾" SAMSON POWER BRAID (NYLON COVER/MULTI-FILAMENT POLYPROPYLENE CORE 2-IN-1 BRAIDED ROPE) SPECIALLY BUILT WITH A SPECIFIC GRAVITY OF 0.99, WITH A STANDARD METAL ROPE THIMBLE AT ONE END AND A FULL STRENGTH TAPER SPLICE TO ITEM D-1 AT THE OTHER END. MARK THE LINE STARTING AT THE THIMBLE IN ONE THOUSAND (1000) FOOT INCREMENTS.	
	D-1	1	TEN THOUSAND (10,000) FEET OF 7/8" SAMSON POWER BRAID (NYLON COVER/MULTI-FILAMENT POLYPROPYLENE CORE 2-IN-1 BRAIDED ROPE) SPECIALLY BUILT WITH A SPECIFIC GRAVITY OF 0.99, WITH A FULL STRENGTH TAPER SPLICE TO ITEM C-1 AT ONE END AND A STANDARD METAL ROPE THIMBLE AT THE OTHER END. STARTING FROM THE SPLICE TO ITEM C-1, ADD SIX (6) STANDARD RUNNING EYE THIMBLES FIFTY (50) FEET APART. STARTING FROM THE FREE END, ADD SEVEN (7) STANDARD RUNNING EYE THIMBLES, (CONT.)	

NO.	DATE	BY	DESCRIPTION	JOB AUTH.	APPD.
0	12-1-82	J.B.	DESIGN RELEASE	011/5510	

ALTERATIONS

NO. REQ'D.	NEXT ASSEMBLY
2	ALTERATION
	DATE
	PURCHASING
	CONSTRUCTION
	ENGINEERING
	USCG
	ABS
3	[illegible]
10	SHIPS
10	NAVY
5	NEW ZEALAND

GLOBAL MARINE DEVELOPMENT Inc.

Newport Beach, Calif.

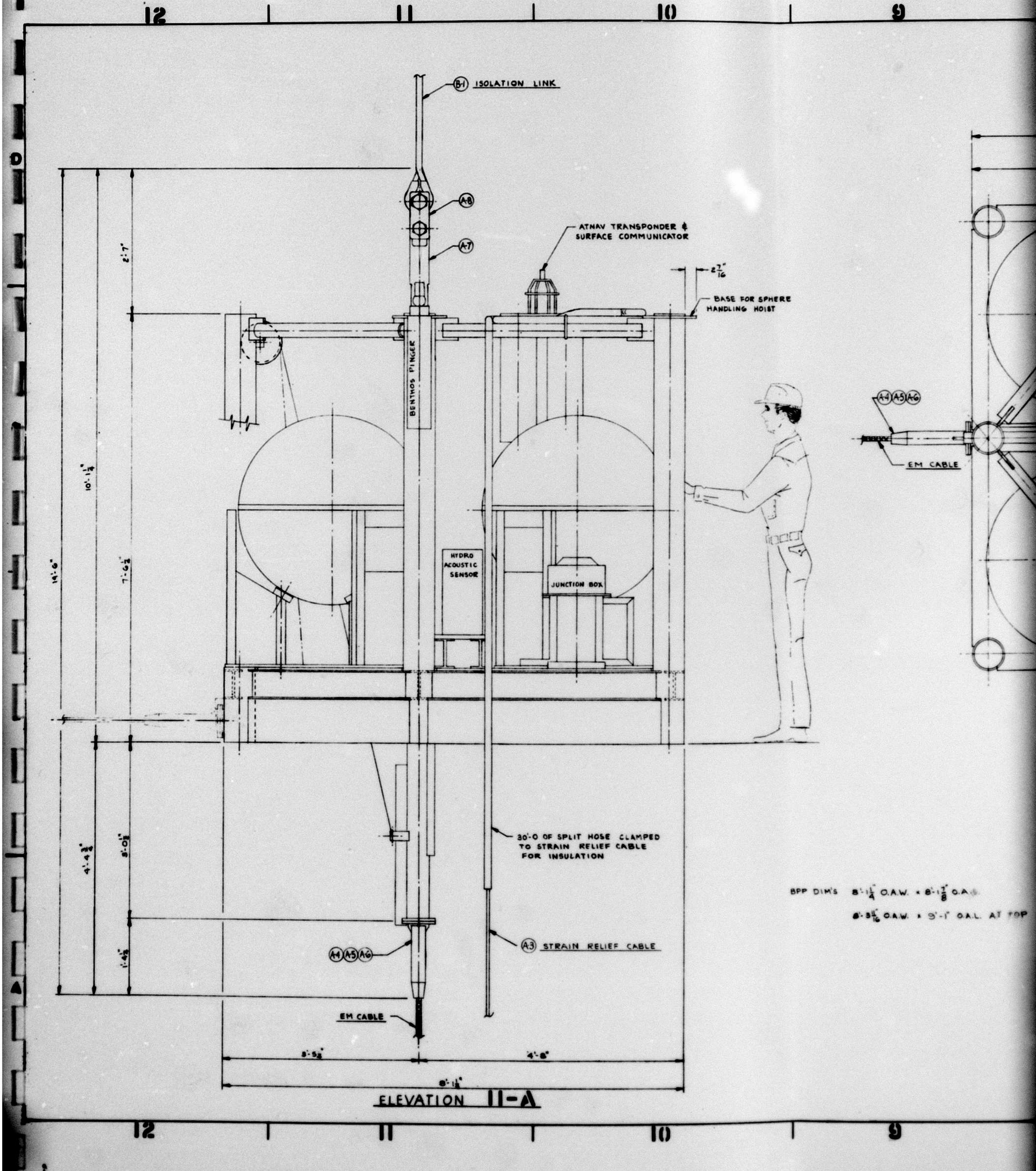
MARINE SEISMIC SYSTEM (MSS-83)
IRR SYSTEM
ARRANGEMENT & ASSEMBLY

	NAME	DATE
DFT.	J.B.	12-1-82
DSGN.	W.S.	12-9-82
CHK.	F.H.	12-6-82
APPD.		12-9-82

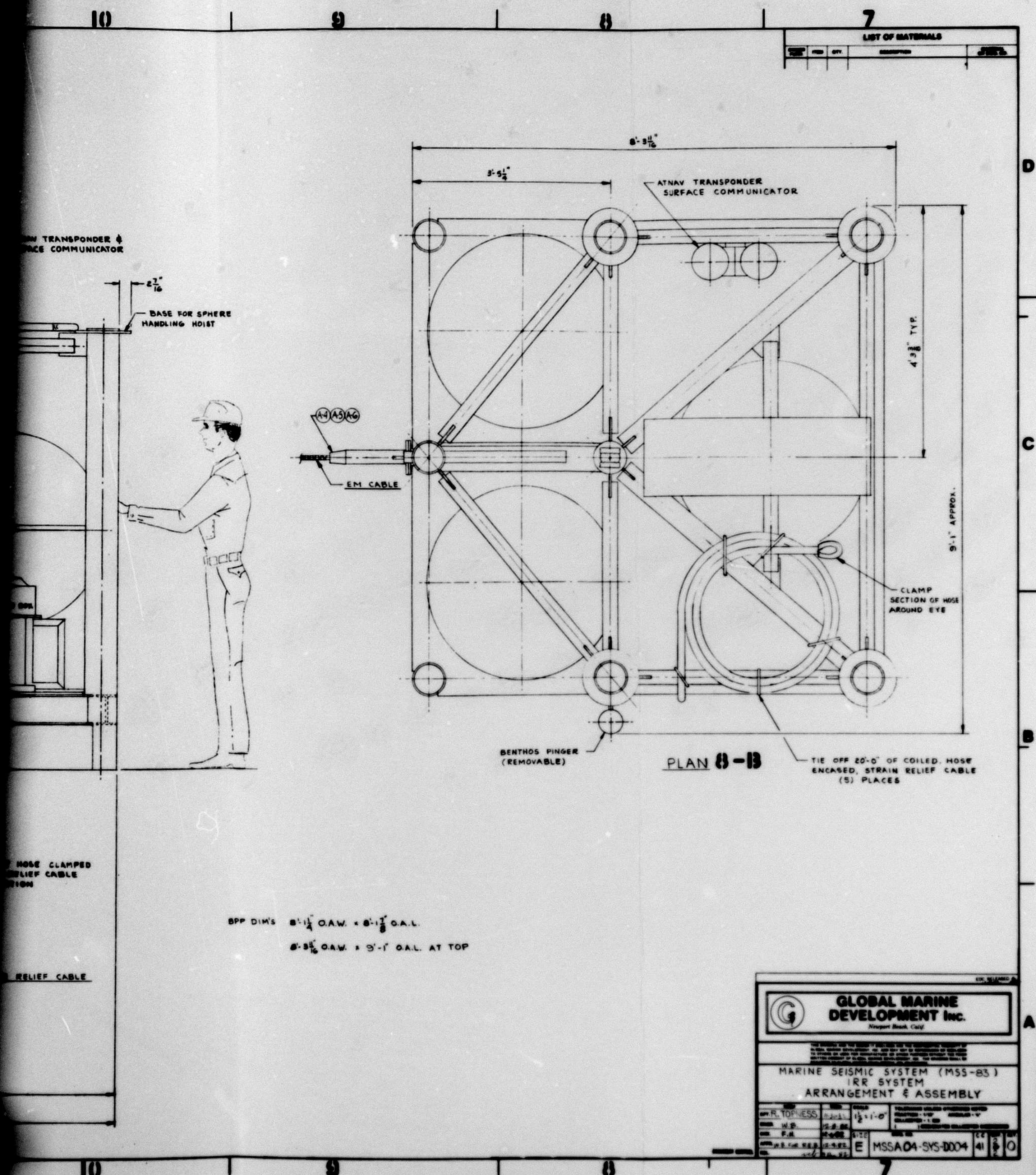
SCALE: NONE

SIZE	DWG. NO.	CC	SHT	REV
E	MSSAD4-SYS-D004	41	1/2	0

2



ELEVATION 11-A


10
9
8
7
LIST OF MATERIALS
8'-3 11/16"
3'-5 1/4"
ATNAV TRANSPONDER
SURFACE COMMUNICATOR
TRANSPONDER &
COMMUNICATOR
2 7/16"
BASE FOR SPHERE
HANDLING HOIST
4'-3 1/8" TYP.
A-4 A-5 A-6
EM CABLE
9'-1" APPROX.
CLAMP
SECTION OF HOSE
AROUND EYE
BENTHOS PINGER
(REMOVABLE)
PLAN B-B
TIE OFF 20'-0" OF COILED HOSE
ENCASED, STRAIN RELIEF CABLE
(5) PLACES
HOSE CLAMPED
RELIEF CABLE
RELIEF CABLE
BPP DIM'S 8'-1 1/4" O.A.W. x 8'-1 7/8" O.A.L.
8'-3 11/16" O.A.W. x 9'-1" O.A.L. AT TOP
GLOBAL MARINE
DEVELOPMENT Inc.
Newport Beach, Calif.
MARINE SEISMIC SYSTEM (MSS-83)
IRR SYSTEM
ARRANGEMENT & ASSEMBLY
R. TOPNESS
W.B.
F.H.
1 1/2" = 1'-0"
E
MSSA04-SYS-D004
41
0
D
C
B
A

2