J.F. BRENNAN CO., INC.
820 BAINBRIDGE · BOX 2557 · LA CROSSE, WI 54602-2557 PHONE: 608 / 784-7173 FAX: 608 / 785-2090

Operations and Maintenance Plan for Dredging, Sand Covering and Capping Activities

Lower Fox River OU 2-5

Prepared for:

Appleton Papers Inc.
Georgia-Pacific Consumer Products LP
NCR Corporation

Prepared by:

J.F. Brennan Company
LaCrosse, Wisconsin

April 2009

TETRA TECH EC, INC.

Lower Fox River Remedial Action OUs 2-5

CONTROLLED DOCUMENT FORM

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THIS FORM MUST REMAIN WITH THE ASSOCIATED DOCUMENT

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Appendices

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1.0 Introduction

JF Brennan (JFB) takes great pride in its equipment condition and efficiency. This Operations and Maintenance Plan for Dredging, Sand Covering and Capping Activities (O&M Plan) has been developed based on years of experience in operating this type of equipment and has been used on several projects with great success. All of the equipment used on a project is inter-dependent for the success of the project. The items included in this O&M Plan are the main system components that are critical for the project's success. These components include the 8-inch dredges, the 12-inch dredge, booster pumps, spreading plants, excavation equipment/cranes, tug boats and miscellaneous equipment.

2.0 8-Inch Dredges

All 8-inch dredges owned and operated by JFB were designed and built by Dredging Supply Company (DSC) of New Orleans, Louisiana. They are categorized by DSC as part of their Moray line, and all exhibit the same general characteristics such as 8-inch swinging ladder layout, pump size and spud propulsion system. These dredges have the ability to operate in shallow water levels and provide the capability to remove thin faces of material either with the articulating knuckle of the cutterhead or Vic Vac attachment. Operating procedures for these units can be found in the attached 8-inch Moray dredge manual in Appendix A.

General maintenance will be performed on the 8-inch dredges on a specific schedule directed by the Equipment Manager and is performed by JFB mechanics. These maintenance schedules are provided in the dredge manual in Appendix A. The mechanic will perform all weekly fluid changes, oil sampling, and repairs that are needed on a case-by-case basis. The operator will also play a key role in maintenance and upkeep to make sure that the dredge is running as efficiently as possible. Before equipment is operated, it will be inspected to make sure that it is free of defects. During the shift the operator will be responsible for monitoring critical components during operations such as oil pressure, hydraulic oil temperature, engine coolant temperature and all other components that provide evidence that the equipment is running as efficiently as possible. In the event that repairs are needed during operations, the operator will notify the onsite JFB mechanic for further instruction. The weekly inspection checklist and daily operator log sheets are included in Appendix A.

The condition of the semi-buoyant pipeline behind the 8-inch dredges will be monitored visually on a daily basis. This pipeline is moved continuously during operation allowing the foreman and operator to inspect the pipeline while moving it for the dredge.

3.0 12-Inch Dredge

The 12-inch dredge owned and operated by JFB was built and designed by Dredging Supply Company of New Orleans, Louisiana. This dredge is categorized by DSC as part of its Barracuda line and exhibits slightly different traits than the 8-inch Moray line. It includes a larger pump and main engine, different spud arrangement and a larger, more open general layout. Operating procedures for these units can be found in the attached 12-inch Barracuda dredge manual in Appendix B.

General maintenance will be performed on a specific schedule directed by the Equipment Manager and performed by JFB mechanics. These maintenance schedules are provided in the dredge manual in Appendix B. The mechanic will perform all weekly fluid changes, oil sampling, and repairs that are needed on a case by case basis. The operator will also play a key role in maintenance and upkeep to make sure that the dredge is running as efficient as possible. Before equipment is operated, it will be inspected to make sure that it is free of defects. During the shift the operator will be responsible for monitoring critical components during operations such as oil pressure, hydraulic oil temperature, engine coolant temperature and all other components that provide evidence that the equipment is running as efficient as possible. In the event that repairs are needed during operations, the operator will notify the onsite JFB mechanic for further instruction. The weekly inspection checklist and daily operator log sheets are included in Appendix B.

The condition of the semi-buoyant pipeline behind the 12-inch dredges will be monitored visually on a daily basis. This pipeline is moved continuously during operation allowing the foreman and operator to inspect the pipeline while moving it for the dredge.

4.0 Booster Pumps

All booster pumps owned and operated by JFB were built and designed by Dredging Supply Company of New Orleans, Louisiana. JFB will employ a variety of sizes of these booster pumps, dependent on the specific application that they are used for. These sizes will likely range from 8 to 12 inches in diameter. These booster pump units will be equipped with a programmable logic controller (PLC), which allows the operator to view and control vital pump statistics through the use of a touch-screen monitor. These pumps can also be run in manual mode, in the event of PLC failure. Further specifications on these pumps are presented in the attached booster pump manual in Appendix C. Additional operating procedures for these units can also be found in the attached booster pump manuals.

Communication between the booster and project equipment will consist of two main systems. A radio communication system will be installed on each major piece of equipment. This will allow voice communication for all project personnel. The second communication system will consist of a series of wireless radio bridges that will create a secure network between the major pieces of equipment. This network will allow the connectivity of each plc and pc of the boosters and dredges for operator interface and control. The network created will allow the dredge levermen to remotely monitor each booster pump operating parameters. This will allow the leverman to adjust the operational efficiency of the system by making the necessary adjustments to the line velocity and booster plc settings.

General maintenance will be performed on these booster pumps on a specific schedule directed by the Equipment Manager and performed by JFB mechanics. These maintenance schedules are provided in the dredge manuals in Appendices A and B (for 8-inch and 12-inch dredges, respectively). The mechanic will perform all weekly fluid changes, oil sampling, and repairs that are needed on a case-by-case basis. The pump operator will also play a key role in maintenance and upkeep to make sure that the booster is running as efficient as possible. Before equipment is operated it will be inspected to make sure that it is free of defects. During the shift the operator will be responsible for monitoring critical components during operations such as oil pressure, hydraulic oil temperature, engine coolant temperature and all other components that provide evidence that the equipment is running as efficient as possible. In the event that repairs are needed during operations, the operator will notify the onsite JFB mechanic for further instruction.

Pipeline segments between booster pumps will be monitored as closely as conditions permit based on location and anchoring nature. The land based pipeline will be visually monitored and rotated periodically. The submerged pipeline will be monitored by tracking line pressure between booster pumps and when it is removed from service. Once a booster station is removed from the system, the associated pipeline will be inspected for overall wear and tear. This information will be used to predict the condition of the remaining pipeline inline in the system. If significant wear is found in the pipeline removed the remaining pipeline in the system will be inspected. This pipeline can then either be rotated or replaced with the existing spare pipe onsite.

5.0 Spreader Plants

The material spreading plants will be used by JFB for placement of cap and cover materials. These plants are an assembly of a number of pieces of equipment that work together to perform the task of sand and gravel placement. This process can be broken into two main operations. The land based slurry plant and the water-based spreading plant. The major components of the water-based spreading plant include sectional barges, material hopper, conveyor belt system, belt scale, dewatering screen, hydrocyclones, generators, back hoe and other miscellaneous equipment. The major components of the land-based slurry and staging area include material hoppers, conveyor belt system, belt scale, slurry tank, pumps, generators and a wheel loader.

Maintenance for these spreader plants will be tracked by the JFB Equipment Manager and performed by a qualified JFB mechanic as well as by the operators on a day-by-day basis. Each piece of equipment requires specific attention and maintenance, and maintenance schedules are tracked accordingly. Inspection and maintenance checklists will be maintained throughout the course of spreading operations and recorded on log sheets. Equipment hours will be logged to determine an efficient maintenance schedule throughout the course of operations. The equipment report forms and maintenance schedules for generators and pumps and are presented in Appendix F.

Pipeline involved in spreading operations will be both submerged, for the safety of recreational traffic, and semi-buoyant, to allow for movement through spreading areas. The pipeline will be submerged in the longer transport line to the spreading areas from the material pumped and/or by concrete weights. The working line or the pipeline directly behind the spreader will be floated for operations and then transition into a semi-buoyant line before being weighted to the river bottom. Semi-buoyant pipeline will be visually inspected for leaks or problems on a daily basis during movements of the barge by the operators and foreman. The submerged pipeline will be monitored through pressure in the pipeline and visually when the submerged line is moved or removed similar to the dredge pipeline. However due to the increased wear from pumping the sand and gravel this pipeline will be periodically rotated. This will allow the pipeline to wear evenly. At the completion of each spreading season the pipeline will be removed and inspected for wear.

6.0 Tug Boats

JFB will utilize a small fleet of tug boats to aide in the movement of equipment and barges throughout the course of marine work. These boats will provide safe and efficient transport of large equipment in a timely fashion. The tugs operated by JFB are shallow draft vessels and are primarily intended to be operated in the navigation channel of the river during operations to transport material loaded on the material barges. These vessels draft approximately 4 ft but to the extent practical will not operate in water depths shallower than 6 ft to protect the vessel from damage and limit the effects of prop wash on remedial areas. Operating procedures for these units are included in the attached tug boat manual in Appendix D.

Maintenance on tug boats will be performed on a daily and weekly schedule, and will be coordinated by the JFB Equipment Manager and carried out by the onsite JFB mechanic. Operating hours will be tracked closely to make sure all maintenance is performed within the manufacturer specifications. The weekly inspection checklist and daily operator log sheets are included in Appendix D.

The tug that will most commonly transport large equipment will be the tug Debra Mary. The Debra Mary was produced by a Marine Inland Fabricators of Panama City, Florida. This vessel is the "Clydesdale model", which is part of Marine Inland's "Workhorse" line.

7.0 Excavation Equipment and Cranes

JFB will utilize many different pieces of excavation equipment and cranes for use on and off the water. These different types include, but are not limited to, backhoes, front-end loaders, telehandlers, skid steers, lattice boom cranes and hydro cranes. Operating procedures vary for each piece of equipment.

Maintenance of this equipment is specific to each piece based on type of usage and duration the equipment is operated. Regardless of operational run-time, all equipment operated by JFB will be inspected on a daily and weekly basis to determine a schedule for proper fluid changes and log of engine hours. Grease and lubrication of critical parts will also be performed prior to and during all operations to make sure that all equipment is kept in peak operating condition. All scheduled maintenance is performed by the onsite JFB mechanic in accordance with the operator maintenance schedule, and will be logged on the report form. The maintenance schedule and report form are included in Appendix E.

All cranes owned by JFB will be inspected by a Certified Crane Inspector (CCI) prior to use on the jobsite. They will be operated by operators who have attained their Certified Crane Operator (CCO) certification. Records of certification of operators and inspection will be held by the JFB Equipment Manager and Safety Manager. All rental cranes will undergo inspection by a CCI prior to work being performed by a JFB CCO or the rental company's supplied certified operating crew. A certified inspection and operator certification documentation will be obtained from the crane rental company prior to operations of the crane.

8.0 Miscellaneous Equipment

Along with the above-mentioned equipment, JFB owns and operates a multitude of other equipment that requires maintenance and tracking. Many of these components are used in conjunction with the major pieces of equipment to create a system. Examples of miscellaneous equipment include boats, outboard engines, generators, misc. pumps, material hopper units, barges, etc.

Operating procedures vary for each piece of equipment and can be found in the equipment specific manual.

Maintenance of this equipment category will be tracked by the JFB Equipment Manager. The specific maintenance for each unit will be conducted by a JFB mechanic. Equipment hours will be logged to determine an efficient maintenance schedule throughout the course of operations.

Miscellaneous equipment will also cover the pipeline marker buoys, delineator buoys and signage. The condition of these floats are monitored on a day to day basis by the entire crew during operation and checks by the safety department. The major conditions checked daily are the overall condition, buoyancy of the marker, placement/location, and lighting.

9.0 Decontamination of Equipment

In an effort to reduce the spread of invasive aquatic species from one body of water to another Brennan has implemented the following inspection program. Any equipment that is relocated from or to any body of water will be inspected for evidence of aquatic plants and animals and cleaned if necessary.

During permanent shipment of any marine equipment the site safety officer or foreman will visually inspect the vessel or barge for contamination. An inspection sheet will be filed out and one copy will be stored onsite and a copy will accompany the equipment to its new destination. Any equipment that is inspected or cleaned will be included in the daily the reports.

If cleaning is required from the findings of the inspection the methods may include:

- Draining all of the lake or river water from the equipment.
- Rinsing with clean water
- Pressure washing
- Steam cleaning
- Air drying of all areas of the equipment and air drying for 5 days.

The form used for tracking and monitoring these procedures is included in Appendix F.

10.0 Winterization

At the end of each operational season, all equipment owned and operated by JFB will be properly winterized in accordance with the manufacturer's instructions to ensure longevity and efficient start up for following use. Any equipment removed from the water and transported to either the JFB, La Crosse yard or to another site will be decontaminated in accordance to section 9.0. Winterization procedures may take place onsite or at the JFB La Crosse yard depending on the specific needs and schedule of operations for the equipment. Some equipment may also be sent offsite during the winter shutdown for rebuilding or refabrication of critical parts.

The majority of the dredge pipeline segments will be left submerged in the Fox River over the winter each year. Prior to shut down for the season, the dredge pipelines will be flushed with clean river water to remove any residual sediment remaining in the system. All system flushing will be discharged to the upland water treatment plant. Once the system is free of residual sediment, booster pumps will be drained. The pipeline segment from the dredge to the first booster will be removed from the river. Booster pump stations that are no longer needed will be permanently removed from the project prior to or during seasonal shut down, or stored on site as back up pumps. All pumps needed for the following year will be secured and remain in place for start up the subsequent year. These barges will continue to be marked with the USCG required lighting through the winter. All pipeline removed at the end of the season will be inspected to characterize the quality of the remaining pipeline in the system. The remaining pipeline can then be adjusted if required as discussed in early sections.

All of the equipment that will remain in the river (boosters, barges, etc) will be locked and secured from the public access.

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APPENDIX A

OPERATIONS MANUAL AND REPORT FORMS

FOR 8-INCH MORAY DREDGE

Dredging Supply Company, Inc.

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NEW EQUIPMENT WARRANTY

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Dredging Supply Co., Inc. ("DSC") warrants that it will convey good title to the equipment, free of all security interests therein except as may be agreed between the purchaser and DSC, and for a period of one (1) year from the date of delivery of new equipment that the equipment is free from defects in workmanship and materials under normal use, subject to the following provisions:

The purchaser shall notify DSC in writing within ten (10) days of the purchaser's first knowledge of any facts which may lead to any warranty claim. DSC shall not have any further responsibility if this notice to DSC is not given.

DSC provides no warranty for any part which may be damaged or rendered inoperative or less efficient due to lack of maintenance by the purchaser. Any warranty of DSC shall be voided if the purchaser has altered, misused, neglected, overloaded, improperly operated or in any way subjected the equipment to mistreatment outside of its expected operating range.

DSC does not warrant any component part of the equipment manufactured by any other party. DSC will provide to the purchaser any warranty or other material, manuals and/or specifications provided to DSC by such manufacturer. **THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR ANY FAILURE, DEFECT OR OTHER CLAIMS RELATIVE TO SUCH COMPONENTS SHALL BE TO PURSUE ANY WARRANTY OR OTHER CLAIM DIRECTLY AGAINST THE COMPONENT MANUFACTURER AND NOT DSC.**

Should it become necessary to replace any removable part manufactured by DSC, the purchaser must return the part, transportation pre-paid to DSC. If the part is warranted by DSC, DSC will replace the part f.o.b. DSC's facility, and reimburse to the purchaser the cost of the transportation to DSC. DSC shall have no obligation to repair or replace any part at the site of the equipment. Should damaged, defective or inoperable part not be removable, at the purchaser's pre-paid expense, DSC will send a representative to the equipment site to inspect the part. If the part is covered by the DSC warranty, DSC will replace it f.o.b. DSC's facility. DSC does not warrant any labor or travel cost for removal or installation or any part.

THE PURCHASER WAIVES ANY CLAIMS OF REDHIBITION AND ACKNOWLEDGES THAT THE SOLE WARRANTY RESPONSIBILITY OF DSC SHALL BE AS SET OUT HEREIN. DSC makes no warranty whatsoever of the fitness of the equipment for any particular purpose except as may be set out in the specifications of the equipment as provided in writing by DSC. DSC makes no warranty, express or implied, except as is set out herein and no officer, employee or agent of DSC or any other party has authority to promise, extend, or warrant other than as set out herein or as may be expressly agreed to by DSC in writing signed by the President of DSC. Under no circumstances whatsoever, does DSC warranty or will be responsible of any claim of lost profits, downtime, consequential damages, punitive damages or attorney fees arising out of the operation or non-operation of the equipment.

Delivery shall be defined for purposes of this warranty to mean delivery by DSC, f.o.b. at DSC's facility unless agreed otherwise in writing by the purchaser and DSC. However, should the equipment by agreement be delivered before it is operable, then the warranty shall run from the first day after physical delivery that the equipment becomes available for operation. Should any provision of this warranty be found to be invalid for any reason, it shall not void this limited warranty but all other provisions hereof shall be deemed to be in effect.

Should the purchaser sell the equipment during the term of this warranty, the purchaser shall be responsible to provide a copy of this warranty to the new purchaser.

The sole and exclusive jurisdiction and venue for any claim arising out of the sale of the equipment, including any warranty claim against DSC, shall be the courts of the Parish of Jefferson, State of Louisiana. This warranty shall be governed by the laws of the State of Louisiana.

THIS IS ABSOLUTELY THE SOLE AND EXCLUSIVE WARRANTY OF DSC RELATIVE TO ANY NEW EQUIPMENT SOLD BY DSC AND PROVIDES THE SOLE RESPONSIBILITY OF DSC FOR THE EQUIPMENT UPON DELIVERY.

CONTACTING DREDGING SUPPLY

Dredging Supply Company operates out of two facilities to optimize working environments in its organizational and fabrication phases. General accounting, sales, clerical, parts, and engineering are located at 156 Airport Road, Reserve, LA. 70084. Normal working hours in this facility are 8:00 AM to 5:00 PM Central time Monday through Friday; however, it is common for sales and engineering to be in this office at most any hour. Personnel in this office can be contacted at (985) 479-1355 and facsimiles can be sent to (985) 479-1367. This office also operates an after hours telephone voice mail system with instructions on how to reach essential personnel at home or on a pager.

Our fabrication and field service departments are located next to the general offices:

- Dredging Supply Co. Inc.
- 172 Airport Drive.
- Reserve, LA
- 70084

Normal working hours at this facility varies with weather and workload, but average 6:30 AM to 5:00 PM Monday through Friday. Personnel in this facility can be reached at (985) 479-1355 and facsimiles can be sent to (985) 479-1367

DSC maintains a web page on the Internet the address is www.dscdredge.com.

Dredging Supply Co., Inc. E-Mail address is dredge@dscdredge.com.

INTRODUCTION

The DSC Moray Dredge is a single truckload, portable, floating platform that offers a combination of dredging features and modes of operation. The dredge operates as a swinging ladder cutterhead dredge, which uses no anchors and works on only spuds. Swinging ladder mode is advantageous in confined dredging areas or where anchor placement is restricted. The dredge hull can be put into the dredging configuration either on the truck or in the water. The dredge should only be transported on the truck with the wing tanks contracted.

The following pages of this manual will serve to familiarize and assist the operator with assembly, operation, and maintenance procedures necessary to successfully operate the dredge.

Dredging Supply Company, Inc.

SAFETY NOTES

1. Life jackets must be worn whenever handrails or kick-rails do not enclose personnel, or when boarding or departing the dredge, and when the dredge is being towed.
2. <u>All tanks that have access are confined spaces,</u> follow federal, local and company safety rules for entering or working in confined spaces.
3. Before starting the dredge, both the dredge and the area to be dredged should be carefully examined for obstructions or hidden problems.
4. Never swing the dredging ladder without the front spuds firmly rooted into the bottom or the ladder on the bottom.
5. Do not operate the dredge without the spuds reeved for power up and power down.
6. Never attempt to clean the dredge cutterhead while the cutterhead is turning.
7. Never attempt to adjust or repack the dredge pump while it is turning.
8. Do not start or operate the dredge with any guards or handrails removed.
9. Stop the engine before working on any of equipment.
10. Keep the decks and equipment compartments clean and clear of oil.
11. When working on the spuds or spud cables always, secure the spud with the safety pin.
12. Always think first and use good common sense when operating or working on the dredge. Observe all safety signs and stickers on the dredge.
13. Check daily and keep the fire extinguishers operational.

Dredging Supply Company, Inc.

ASSEMBLY INSTRUCTIONS

The Moray dredge is designed for easy assembly and transport. It has been completely assembled, shop tested, and disassembled at our facility to ensure its satisfactory operation.

The dredge hull consists of the main hull and the hinged wing tanks. The main hull with the wing tanks provides the necessary flotation for the dredging machinery and the stability for dredging.

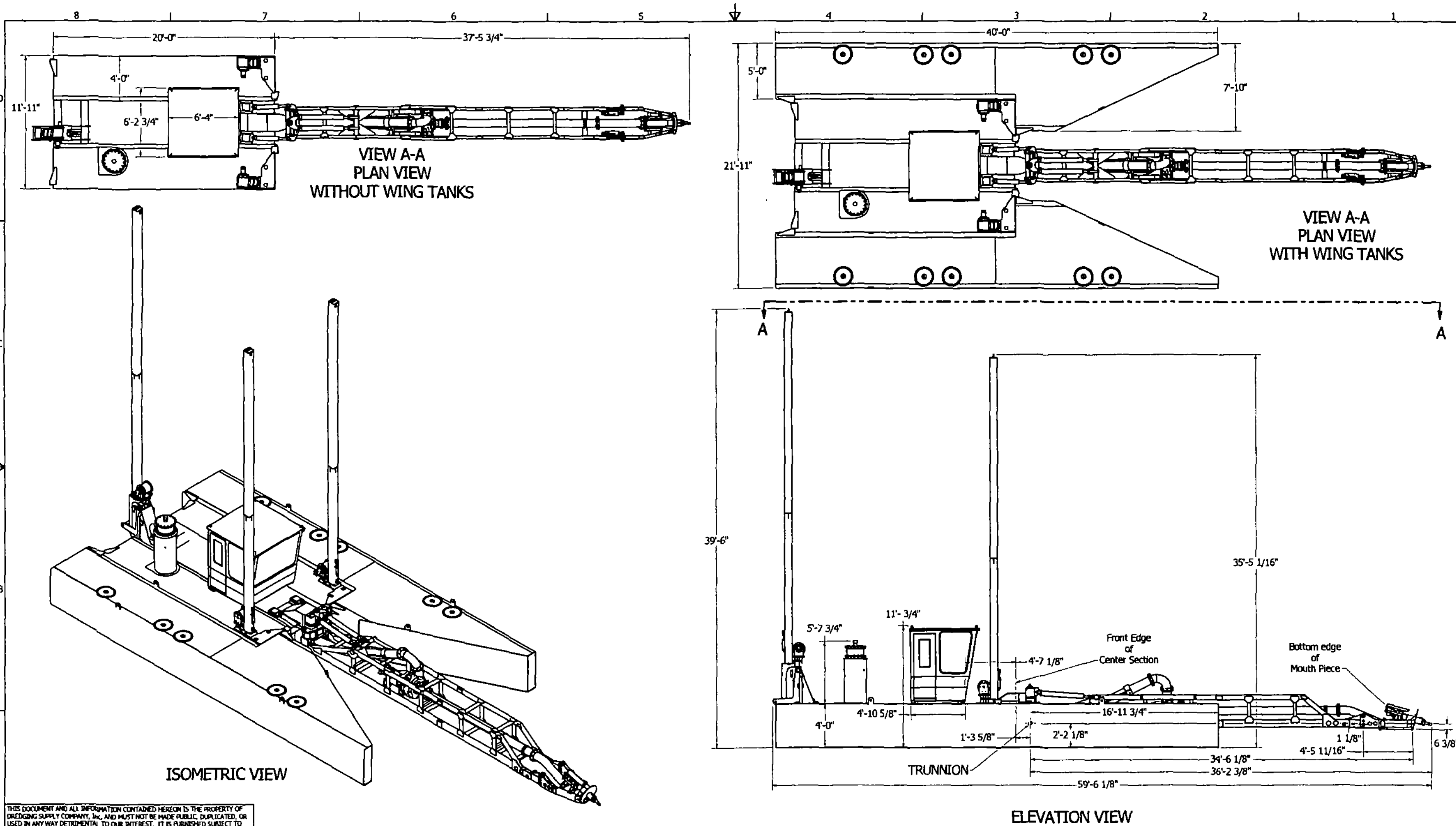
The hull has four lifting eyes, two on each side of the main hull, which are used to lift the dredge from or to the trailer or the water.

If direct launching with the unloading crane is not possible, the dredge should be assembled with the stern facing the water and launched on greased timbers, which extend into the water on a slight slope. The dredge will require water's depth of a least 30 in. for easy launching.

The dredge is shipped in contracted mode with the spuds on the deck. Dredging in the swing ladder configuration will require that the hinged wing tanks be extended into the dredging configuration. Then install the spuds, one kicking and two front spuds, launch the dredge and move to the start point of the dredging.

The spuds must be installed in the power up and power down configuration for safe operation. The dredge may not be operated with spuds in free fall type of installation. Reeve the spuds as shown on the spud reeving drawing.

Once the dredge is in the water, check that all tanks are watertight, confirm that the fuel line valves are open, and check all fluid levels and check the service water pressure. Move the dredge to the dredging site, attach the discharge line, start the engine, and prepare to begin dredging.



REV	DATE	BY	REVISIONS	REFERENCE DWG	REFERENCE DRAWING TITLE
A	5-18-06	RLP	Additional Dimensions		

DREDGING SUPPLY COMPANY

BRENNAN

General Arrangement

DRAWN	RLP
DATE	3/23/2006
SIZE	D
PROJECT #	205110
DWG #	205110001
REV	A

MORAY - DREDGE SPECIFICATIONS

GENERAL

OVERALL LENGTH	57-6"
TRANSPORTATION WIDTH	11'-11"
OPERATING WIDTH	21'- 11"
HULL DEPTH	4'
MEAN OPERATING DRAFT (WITH FUEL)2'-9"	
FUEL CAPACITY	500 gallons
DRY WEIGHT *(ESTIMATED)*	59,500 lb

OPERATING CONDITIONS:

MINIMUM DIGGING DEPTH	3'
MAXIMUM DIGGING DEPTH	25'

SWING WIDTH (SWINGING LADDER):

SWING WIDTH @ MINIMUM DIGGING DEPTH	19'-4"
SWING WIDTH @ MAXIMUM DIGGING DEPTH	13'
NOMINAL PUMP CAPACITY (WATER)	2000 gpm @ 185 TDH

Main Power:

ENGINE MAKE	CATERPILLAR
ENGINE MODEL	3126B
MAXIMUM H.P. @ 2400 R.P.M.	275 H.P.
ENGINE COOLING	RADIATOR

RESIDENTIAL GRADE SILENCER. EPA & CARB Tier II Compliant

Cutter Module:

Sealed planetary drive with alloy cutter shaft and anti-friction bearings. 24" inside diameter 5-blade basket cutter with replaceable cast serrated edges

NOMINAL DRIVE TORQUE	31,512 in-lb
CUTTER FORCE	2,626 lb
CUTTER FORCE PER LINEAR INCH109 lb/in	
CUTTER SPEED	0-40
NOMINAL DRIVE POWER	20 HP
CUTTER RATING	20 H.P.
CUTTER SPEED VARIABLE	0 to 40 R.P.M.

Swing Cylinders (swing ladder mode):

Double acting hydraulic swing cylinder for swinging ladder operation

MODEL:	Z40015136CCAZ (2)

Ladder Hoist Cylinder:

Double acting hydraulic ladder cylinders for ladder lifting operation

MODEL:	Z40034332CCAZ

Stern Spud Kicker Cylinder:

Double acting hydraulic kicker cylinder for swinging ladder operation

MODEL:	#S40006032SS

Dredge Pump:

Manufactured for DSC

SUCTION DIAMETER	8"
DISCHARGE DIAMETER	8"
IMPELLER DIAMETER	19 ½"
MAXIMUM PARTICLE CLEARANCE	3 ½"

Spud Hoist Winches:

Planetary spud winches with integral parking brake and API designed.

MANUFACTURER:	DSC
MODEL	RMLF091
WIRE ROPE LENGTHS	
Front Top:	65 ft. 8 in.
Front Bottom	53 ft. 1 in.
Kicker Top	66 ft. 8 in.
Kicker Bottom	53 ft. 5 in.

Electrical System:

- 24 VDC for starting, lighting, and controls.
- 12 VDC (8 amp maximum) for convenience and user furnished radios.
- All circuits fused for protection.
- Two 950 cold cranking amp batteries Capacities.
- Owner furnished AC generator.
- AC wiring in operator cab and for lighting.

Capacities:

FUEL	500 GAL.
HYDRAULIC	180 GAL.

Service Water Pump (Not furnished)

MANUFACTURER	Carver
SIZE	25X1X7L
MODEL	VERTICAL CANTILEVERED PUMP CAST IRON PROVIDED w/ NPT
DSC PART NUMBER	PP-00129
HYDRAULIC DRIVE MOTOR	CROSS
MODEL	40MH05-DACSC

Hydraulic System

Closed loop dredge pump circuit with infinite electronic speed control. Pressure compensated cutter, swing, and ladder/spud circuits for simultaneous operation. All circuits protected by suction strainer, return filters, and relief valves. The Moray dredge features a variable displacement hoisting and cutter hydraulic drive.

Control System

The DSC control system provides the dredge operator with a simple, ergonomic, and user-friendly interface to efficiently operate the dredge. The system is designed, manufactured, programmed, and tested in house by trained professionals with years of dredge experience. The heart of the system is its, performing automatic loop control, displaying pertinent information, and recording historical data.

The standard dredge control system protects against pump engagement and disengagement at high speed and locks out all hydraulic functions during start-up and control activation. The system also alarms on poor engine conditions and hydraulic and transmission problems. All of the alarmed conditions, along with the time and date, are logged; the last sixty-four alarms are retained for review.

The standard dredge control system provides electronic operation of the prime mover throttle; pump engagement, and all hydraulic speeds and directions. Hydraulic controls are ramped to prevent jarring when controls are started, stopped or reversed.

The standard dredge control system records and displays the operating hours of all major dredge systems including engine, dredge pump, cutter, swing winches, spud winches, and ladder winch. This data is useful for servicing and for managing dredge utilization.

Standard Features:

Fire Extinguishers (2) 5 Lbs. Abc

Handrails And Kick Rails

Cabin And Outdoors Lights

Early Warning Alarm System And Engine Shutdown System

Operator's Chair With Finger Tip Controls

Lighted Ring Buoy

Guards

Replaceable Edge Cutter

Optional Equipment

Air conditioning and Heater combination in lever room. Longer Spuds and bigger spud winches.

Custom articulated long ladder and ladder lifting and modified swinging system.

DESCRIPTION OF EQUIPMENT

The Moray - Dredge is a diesel powered pump system constructed to excavate and pump materials such as mud, silt, or sand from the bottom of a shallow body of water (up to 16 feet deep) through a pipeline to a disposal site some distance away from the dredge.

The following paragraphs describe the functions of the machinery located on the dredge. It is suggested that the reader refer to the drawings, which are enclosed, and the supplied machinery operating manuals while reading these sections.

Dredge Ladder

The dredge ladder consists of a structural steel frame that houses the dredge underwater pump, suction and discharge pipe, cutter and cutter motor and cutter drive. The ladder is supported at its aft end by trunnions and pins mounted on the ladder gimbal. It is supported midway by hydraulic cylinders, which are mounted between the ladder gimbal and the ladder. The cylinders are used to raise and lower the ladder. The dredge cutter is driven by a hydraulic motor/gearbox through a shaft with sealed bearings. A flexible rubber hose connects the dredge ladder discharge pipe elbow to the through hull discharge pipe to permit the ladder to pivot up and down, and swing side to side freely.

LADDER GIMBAL & LIFT CYLINDERS

Ladder Gimbal

The ladder gimbal consists of a hull structural section and ladder section connected together with a large steel pin. The hull gimbal, located at the forward end of the center section, remains stationary at all times. The ladder gimbal pivots from side to side to allow the dredge to operate in the swinging ladder mode. The swing gimbal houses the swing cylinders, the ladder trunnions, and the ladder lift hydraulic cylinders. For shipping, the ladder gimbal can be rigidly fixed to the hull gimbal by a locking bar between the ladder and the gimbal.

Dredge Pump

The pump consists of a custom DSC pump; bearings, bearing pedestal, and pump foundation. (See the pump section for more details of the pump arraignment).

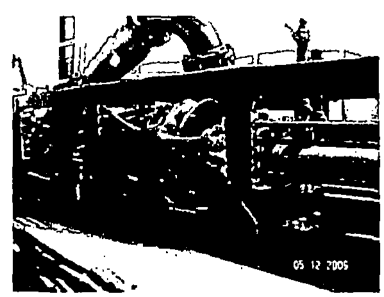
Diesel Power Source

The Caterpillar 3126B diesel engine, which drives the hydraulics, and keeps the batteries charged, is radiator cooled. For more information on the engine system, refer to the accompanying Caterpillar manual.

Dredge Pump Piping

The suction piping consists of a long flanged suction pipe mounted on the pump clean out and a short flanged rubber suction hose between it and a flanged pipe to the mouth piece. The rubber hose allows the articulation and absorbs vibration.

The ladder discharge pipe consists of a flanged elbow at the pump with a supported, eight-inch I D, flanged, rubber discharge hose that connects a straight section of eight-inch ID pipe.


UNDERWATER PUMP

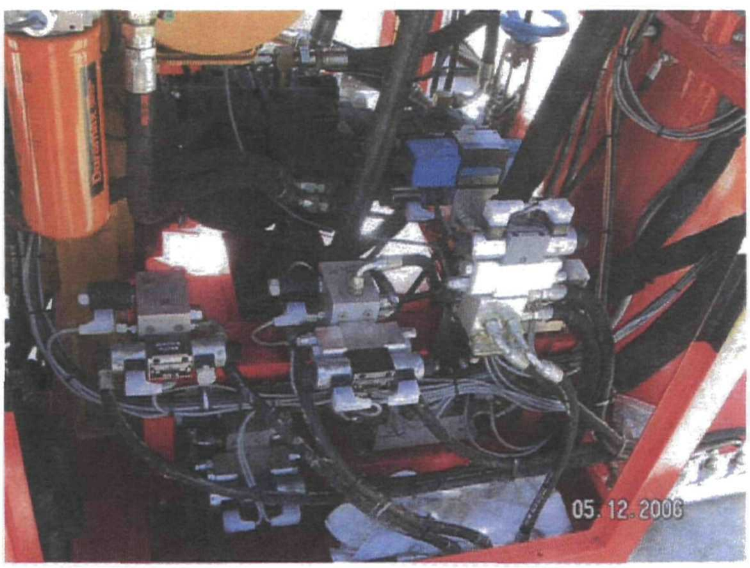
Spuds

In the swinging ladder mode, the dredge spud system consists of two square digging spuds located at the front of the hull and one square, kicking spud located at the stern of the hull. All three spuds are used to hold the dredge stable when it is operating in the swinging ladder mode. In swinging ladder operation, the kicker spud helps maintain hull stability during dredging. It also provides forward or backward movement to the hull. The spuds are raised and lowered by DSC custom hydraulic winches in a power-up power-down fashion to any depth without resetting pins.

Hydraulic Power System

Two hydraulic pumps mounted, in tandem, on a single pump drive behind the Cat. 3126, hydraulically powers the dredge's auxiliary functions and the dredge underwater pump. One pump powers the auxiliary functions, which include the dredge cutter, swing winches or cylinder, ladder lifting cylinder, spud winches and the kicker spud cylinder. The other pump is in a closed loop system that only drives the underwater dredge pump. This pump incorporates a system charge pump for the closed loop. The hydraulic system is protected from dirt and contamination by a filtered breather cap, in-tank suction strainer and return filter. All hydraulic circuits have pressure gages and relief valves to protect from spikes and large hydraulic loads. The hydraulic tank has a thermometer, sight gage, a low-level sensor alarm, and a low-level shutdown device.

NOTE: The hydraulic tank filler cap must be on and tight to keep the tank pressurized or the hydraulic pumps will be severely damaged. After an extended shut down or if the hydraulic tank has been opened, the engine must be operated at a low speed for ten minutes to re-establish the pressure in the hydraulic tank before resuming full speed operation.



HYDRAULIC VALVES

DREDGE OPERATION

STARTING THE DREDGE

Prior to attempting to start the engine, the fuel tanks should be filled with fuel oil that meets the specifications in the caterpillar operations manual. The dredge is set up to run out of both tanks all of the time. It may be filled from either side.

The hydraulic oil filler cap must be on airtight. Check the hydraulic oil level. A site glass is on the tank for checking the level.

All machinery should be checked to see that it is properly lubricated, adjusted, fastened, and in good working order. Instruction manuals and a grease diagram are furnished on the majority of the equipment in this dredge and they should be thoroughly studied prior to operating the dredge. The dredging area should be inspected for possible obstructions and debris.

Check for oil or coolant leaks, loose bolts worn belts and trash build up. Remove trash and do necessary repairs.

Check that all controls are in their neutral or off positions, including the engine throttle.

Do not start the engine or move any of the controls if there is a "DO NOT OPERATE "WARNING TAG OR SIMILAR WARNING TAG ATTACHED TO THE START SWITCH OR THE CONTROLS.

Disconnect any battery chargers that are not protected against the high current drain that is created when the electric starting motor is engaged. Check the battery cables for poor connections and corrosion. Reset any of the shutoff components or alarm components. Check the engine lubrication level. Maintain oil between the "ADD" mark and the "Full" mark on the oil level gauge. Check and maintain the coolant level to the full mark in the day tank. Check the air cleaner service indicator and change if needed.

DO NOT USE ETHER STARTING FLUIDS

Turn the start switch to the start position in order to crank the engine. Do not increase the throttle while the engine is cranked. The system will automatically provide enough fuel to start the engine. **DO NOT CRANK THE ENGINE FOR MORE THAN 30 SECONDS. ALLOW THE**

STARTER TO COOL FOR TWO MINUTES BEFORE CRANKING AGAIN. **Allow the engine to run at idle for approximately 10 minutes. This is necessary to bring the hydraulic systems to operating pressure.** For instructions that are more detailed see the Caterpillar Operation And Maintenance Manual. After the engine is idling smoothly, load and speed may be gradually increased until normal temperature is achieved. Monitor all gauges during warm-up. While the engine is at idle, check the dredge for any leaks, or loose connections. After the engine has been started, release the starter switch and allowed the engine to come up to operating temperature, and the hydraulic oil to a minimum of 70°F, before bringing the engine up to operating speed, (2400 RPM), then the dredge can be primed and dredging started. Throttle controls are on the dash in the lever room.

Assure that the service water pump suction is in the water off the stern, with the strainer, and that the switch is on for the pump. The service water pump switch is located in gage panel row of switches. Check that it is primed. The speed for this pump is pre set, but is adjustable. With the dredge pump disengaged, lower the ladder until the suction at the pump, or if possible the entire pump, is under water and increase the pump speed to approximately 700-RPM. (Pump speed control is a toggle switch on the operator chair right arm) When the differential gage reading becomes steady (1 to 2 inches of mercury) and the discharge pressure gage indicates a steady pressure, the pump should be primed. When the discharge line is filled to the end, adjust the pump speed to the desired flow rate. The dredge pump speed is controlled by a toggle switch on the starboard operator chair arm.

If the dredge pump fails to prime insure that the suction is completely submerged and, if possible, the entire pump, and vary the speed from 200 RPMS TO 1200 RPM's while raising the ladder up and down under the water.

KICKER SPUD OPERATION

The kicker spud is used in swinging ladder operation to advance the dredge into a cut or to pull the dredge backward away from the cut or obstacles. A hydraulic cylinder tilts the kicker spud. The distance that the dredge must be moved forward is a function of the material's consistency; a good rule of thumb is to step ahead the length of the cutterhead (approximately 24"). The kicker spud is tilted to its limit before it is reset. Prior to resetting the kicker spud, a stationary spud or spuds are set in the bottom. Then the kicker spud is raised and tilted to the forward position and the kicker spud is reset in the bottom. In swinging ladder mode the two stationary spuds remain set in the bottom.

KICKER SPUD SYYSTEM

MORAY- DREDGE OPERATION CONTROLS

OPERATOR CONTROLS

TYPICAL GAGE PANEL

The dredge functions are all controlled from the operator chair in the lever room. (See Control Chair Arms and Gauge Display Layout Drawing) The dredge operation is activated and controlled with the use of a PLC and the switches and knobs in the lever room after the engine has been checked and started.

Finger Tip Controls Activation

After the engine is started, the lever room controls can be activated. The control activation switch is the third switch from the left end of the row of switches on the bottom of the Operator Control Panel. All of the other dredge function switches must be in the off position to activate the controls.

Cutter Direction

The "CUTTER DIRECTION" switch on the right chair arm activates the cutter. It is a three-position switch. The cutter direction is also selected with this switch. Pressing the front of the switch will operate the cutter in forward and pressing the back of the switch will reverse the cutter. The cutter speed selection settings are set in the PLC and selected in the PLC (See PLC section). The cutter has three speed setting positions that correspond to the high, medium, and low settings in the PLC.

UW Dredge Pump Engagement

The under water dredge pump is engaged, or disengaged, by a two-position switch located on the gage and switch dash panel. Pressing the front of the switch engages the pump. Pressing the back disengages the pump.

UW Dredge Pump Speed

The pump speed is adjusted with the switch on the right operator chair arm. Press the front of the switch to increase the pump speed, press the back of the switch to decrease the pump speed.

Ladder Control

Control of the ladder vertical movement is done with the paddle switch mounted in the right operator chair arm. Pressing the front of the switch will lower the ladder and pressing the back of the switch will raise it. This switch is not maintained. The vertical movement speed is adjusted in the PLC. It is selected with a three-position switch in the row of switches, fifth from the right. This switch has three speed selections that are preset in the PLC.

Swing Direction & Speed

The swing direction is selected with a two position, maintained switch on the right arm of the operator chair. Pressing the port side swings the ladder or the dredge to the port and when the starboard side is pressed they swing to the starboard, when the speed knob is on.

This switch operates the ladder swing ram in swinging ladder mode.

The speed that the ladder swings, is controlled with the swing speed knob on the left arm. Rotating it clockwise increases the swing speed from zero to full speed.

Spud Control Switches

Mounted on the left operator chair arm are four switches for the spuds and tilting cylinder control. The kicking spud hoist and the kicker cylinder are the two middle switches in the row. The kicking spud hoist is the second switch from the left and the kicking action switch is third from left. Pressing the front of kicking spud switch lowers the spud and pressing the back raises it. Pressing the front of the kicking spud switch extends the kicking cylinder and pressing the back retracts it. These two switches are non-maintained. The control switches for both, the port and the starboard spuds are the switches on either end of the row. The port switch is for the port spud and the Starboard is for the starboard spud. Pressing the front of the switches lowers the spuds and pressing the back raises them.

The speed that the spuds and kicker operate is pre set in the PLC. One of three speeds can be selected with the corresponding switches on the dash.

FOR ADVANCED CONTROL ADJUSTMENTS SEE THE PLC SECTION

Switches one, two, and three from the right in the top row are the cab lights, Flood lights and the horn. The sixth switch from the right in the bottom switch row is for the service water pump; forward is on and back is off.

SWINGING LADDER OPERATION

Launching

Prior to operating in swinging ladder mode the dredge must be configured in the extended mode and launched. The dredge is shipped without the side tanks spuds or silencer installed. The dredge may be expanded on the truck or unloaded and blocked for expansion. Conversion on the truck will eliminate the blocking. Lift the dredge from the truck with the pad eyes on the main hull and level it on blocks **taking care not to have any blocks under the side tanks.** Bolt the side tanks to the center section. Install the ladder. **Unpin, and remove the "ladder swing-locking arm from the gimbal"** and store it. (The ladder-locking arm is on the starboard side of the ladder near the trunnions)

Some of the tools needed to make the conversion are as follows:
1. Lifting capability to handling 65,000 pounds from a truck to a launch ramp or into the dredging area pond.
2. Four part slings, minimum; ¾" cable, 25 ft. long (for lifting the entire dredge)
3. Wood blocking, 10"X10" or 12"X12" (to block center section to install the ladder and side sections or install them with the center section on the truck and no blocks are needed other then for the launch ramp).
4. Pry bars, screwdrivers, sledgehammers, shackles, and 100 ft. minimum of 38"tag line rope,
5. Rope handy line (50' 3/8")

The side tanks are bolted on before the dredge is launched.

The spuds are installed either before launching or after launching depending on the launch environment; i.e. can the lifting equipment reach the spud location after launching. (The spud winches are normally in place prior to launch)

Insert the spuds in the spud wells and pin them in the lowest spud pinhole and the in the top spud well pinhole. **The spuds must be reeved as described in the included spud-reeving diagram.** The spuds may be reeved before or after installation. When reeved prior to installation, the spud wire rope is removed from the spud winch and reinstalled after the spud is in the spud keeper. When reeved after installation the spud is inserted in the spud well and pined at the lower pinhole and then the wire rope is installed on the spud winch as shown in the spud reeving drawing. **(NOTE THE NUMBER OF WRAPS ON THE WINCH DRUM IS EXACT AND REQUIRED, AS IS THE DIRECTION OF THE WRAPS AND THAT THE SPUD IS PINED UP)**

Check the dredge; make sure that all of the hydraulic lines are connected to the proper place and do not leak. Put enough fuel on board to run the engine, and tighten and adjust the spuds wire ropes. LAUNCH!

DREDGING

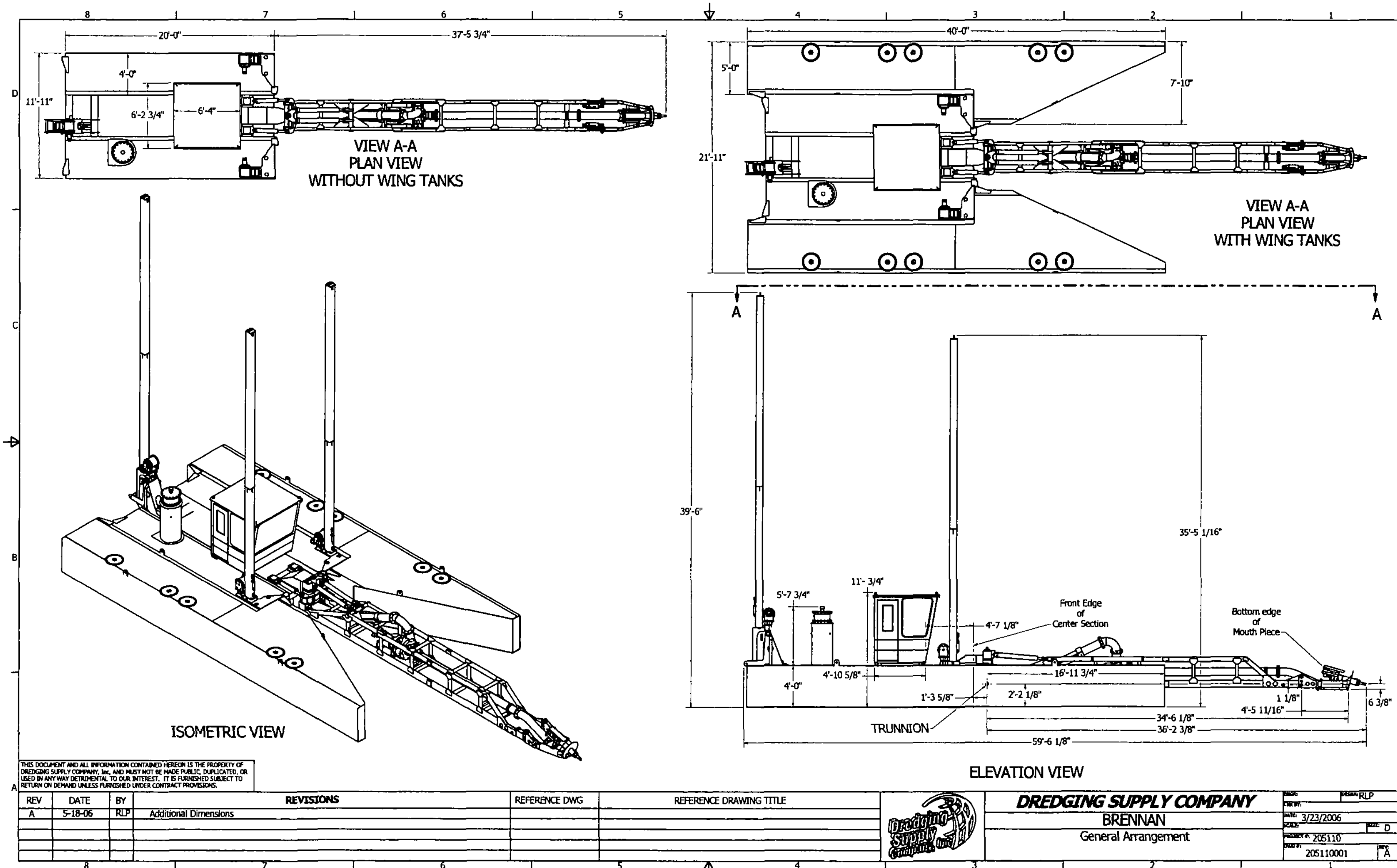
To begin the swinging ladder operation, the dredge must be located in the center of its cut with all three spuds firmly rooted into the bottom. Referring to Swing Ladder Drawing, swing the dredging ladder completely to the starboard side, as in position A. Turn the dredge cutter on making sure it is turning counterclockwise viewed from the operator's cab. Lower the ladder until a the pump is under water if possible. Keep the cutter off the bottom and engage the pump. When the discharge pressure and the vacuum differential become steady the pump is primed. With the dredge pump primed and the cutter on, lower the ladder into the material to be dredged. The cutter pressure will increase and the dredge pump differential and discharge pressures will also reflect a change.

The cutter pressure range is from 0 psi to 2200 psi. The cutter is stalled at 2200 psi and the by pass is opened. Clear this condition by raising the ladder or cleaning the cutter.

Swing the dredging ladder from the port to the starboard side, position A to B. This port to starboard swing is known as the digging swing, since the cutterhead is able to cut against the ladder motion. The cutter pressure will increase as the ladder moves into the material. Swing speed control should be used to keep the cutting action as smooth as possible.

To begin a cut it may be necessary to raise or lower the dredging ladder throughout the cut; however, once the cut is established, smooth steady cuts will leave a level bottom. When the dredging ladder has reached position B, the dredge ladder can be lowered slightly. **(Note: When lowering the dredging ladder into material, only 750 to 850 psi can be developed to prevent damage to the ladder)**. Swing the dredging ladder from starboard to pot; position B to A. The swing from starboard to port is called the clean-up swing, since its primary function is to remove the remaining material excavated from the digging swing. The swing and cutter pressure readings should be lower than that on the digging swing. When the dredging ladder reaches position A, move the swing joystick back to neutral. **Smooth operation is the key to equipment life and production. All of the ladder movements must be smooth to avoid slamming the ladder at any of its limits. Let the cutter cut the material, do not plow it with the ladder.**

Swinging of the ladder from position A to B and then back to A should be performed until the bottom has been sufficiently removed to meet the desired depth (or at least enough to float the dredge, approximately 36"). When the desired depth has been produced the dredge can be advanced forward into the next cut. The dredge can now continue its digging from position A' to B' as described above. The **bow spuds must be raised** prior to, advancing or reposition the dredge hull, or movement at an angle, or moving for cutting double widths.


VIEW A-A
PLAN VIEW
WITHOUT WING TANKS
20'-0"
37'-5 3/4"
11'-11"
4'-0"
6'-2 3/4"
6'-4"
40'-0"
5'-0"
7'-10"
21'-11"
VIEW A-A
PLAN VIEW
WITH WING TANKS
A
A
39'-6"
35'-5 1/16"
11'- 3/4"
5'-7 3/4"
4'-7 1/8"
Front Edge
of
Center Section
Bottom edge
of
Mouth Piece
4'-0"
4'-10 5/8"
16'-11 3/4"
1'-3 5/8"
2'-2 1/8"
1 1/8"
4'-5 11/16"
6 3/8"
TRUNNION
34'-6 1/8"
36'-2 3/8"
59'-6 1/8"
ISOMETRIC VIEW
ELEVATION VIEW
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REV | DATE | BY | REVISIONS | REFERENCE DWG | REFERENCE DRAWING TITLE
A | 5-18-06 | RLP | Additional Dimensions
DREDGING SUPPLY COMPANY
BRENNAN
General Arrangement
RLP
3/23/2006
D
205110
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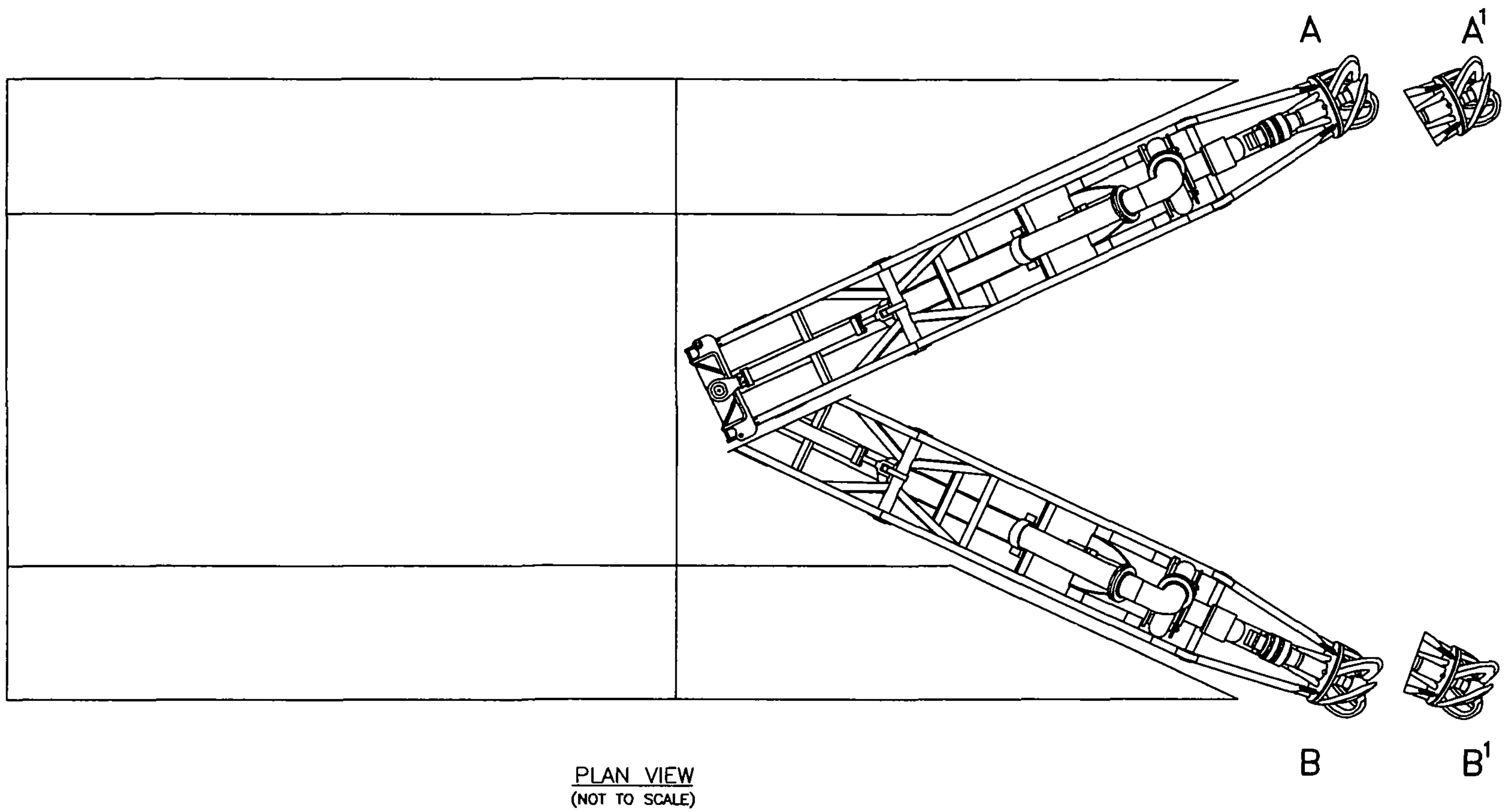
A



SWINGING LADDER SPUD OPERATION

NOTES:
1) REEVING DIAGRAM TYPICAL FOR FRONT SPUDS AND KICKER SPUD.
2) SPUD IS PINNED UP.

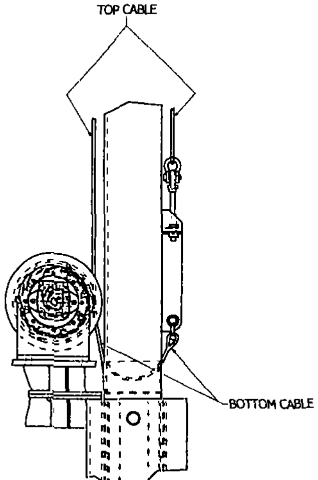
THESE TOLERANCES TO APPLY EXCEPT WHERE NOTED ON DWG						
OVER 20'	7' - 20'	3' - 7'	1' - 3'	1/2' - 1'	0 - 1/2'	SURFACE FINISH
±3/16	±1/8	±3/32	±1/16	±1/32	±1/64	MILL FINISH

MATCHING FILLER METAL REQUIREMENTS

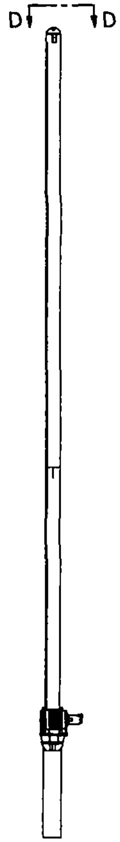
SMAW	AWS A5.1 OR A5.5 E70XX or E70XX
GMAW	AWS A5.18 E70S-X

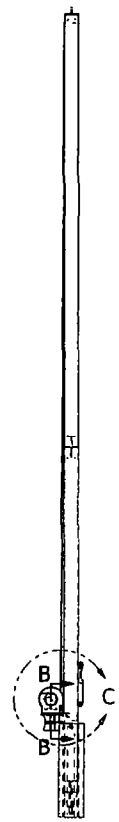
GENERAL NOTES

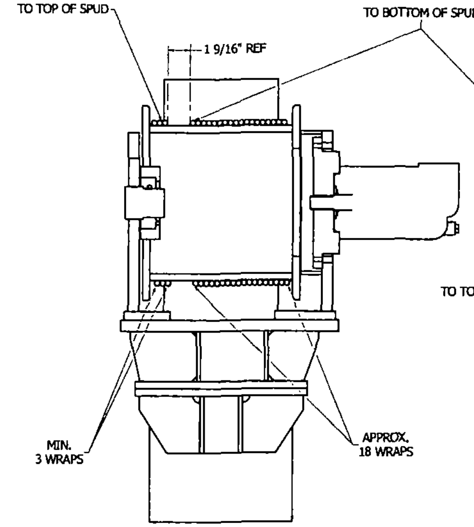
1.) All external or exposed brackets, padeyes, etc. should be cut on an automatic cutting table wherever possible.
2.) Weld slag & splatter should be removed and all welds & adjacent base material should be cleaned by brushing.
3.) All welding procedures, including workmanship & technique will meet those in ANSI/AWS D1.1-96 Structural Welding Code.
4.) All structural shapes and templates shall be ASTM-A36 unless otherwise noted.
5.) All structural tubing shal be ASTM A-500 Grade B unless otherwise noted.
6.) All structural pipe shall be ASTM A-53 Grade B unless otherwise noted.
7.) All fillet welds are to be 1/16" less than the minimum material thickness unless otherwise noted.
8.) All weights are for reference only and lengths should be field verified.
9.) Splices in structural members are not acceptable except main ladder beams. Ladder beam splices shall be reinforced with doubler plates.



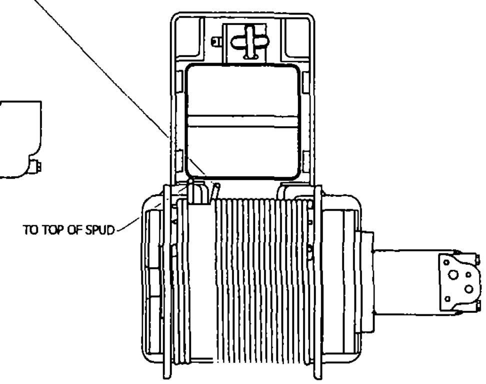
DETAIL C
SCALE 1 / 8







SECTION B-B
SCALE 1 / 4



VIEW D-D
SCALE 1 / 4

REV	DATE	BY	REVISIONS	REFERENCE DWG	REFERENCE DRAWING TITLE

DREDGING SUPPLY COMPANY
BRENNAN
Spud Reeving Diagram
(1 of 1)

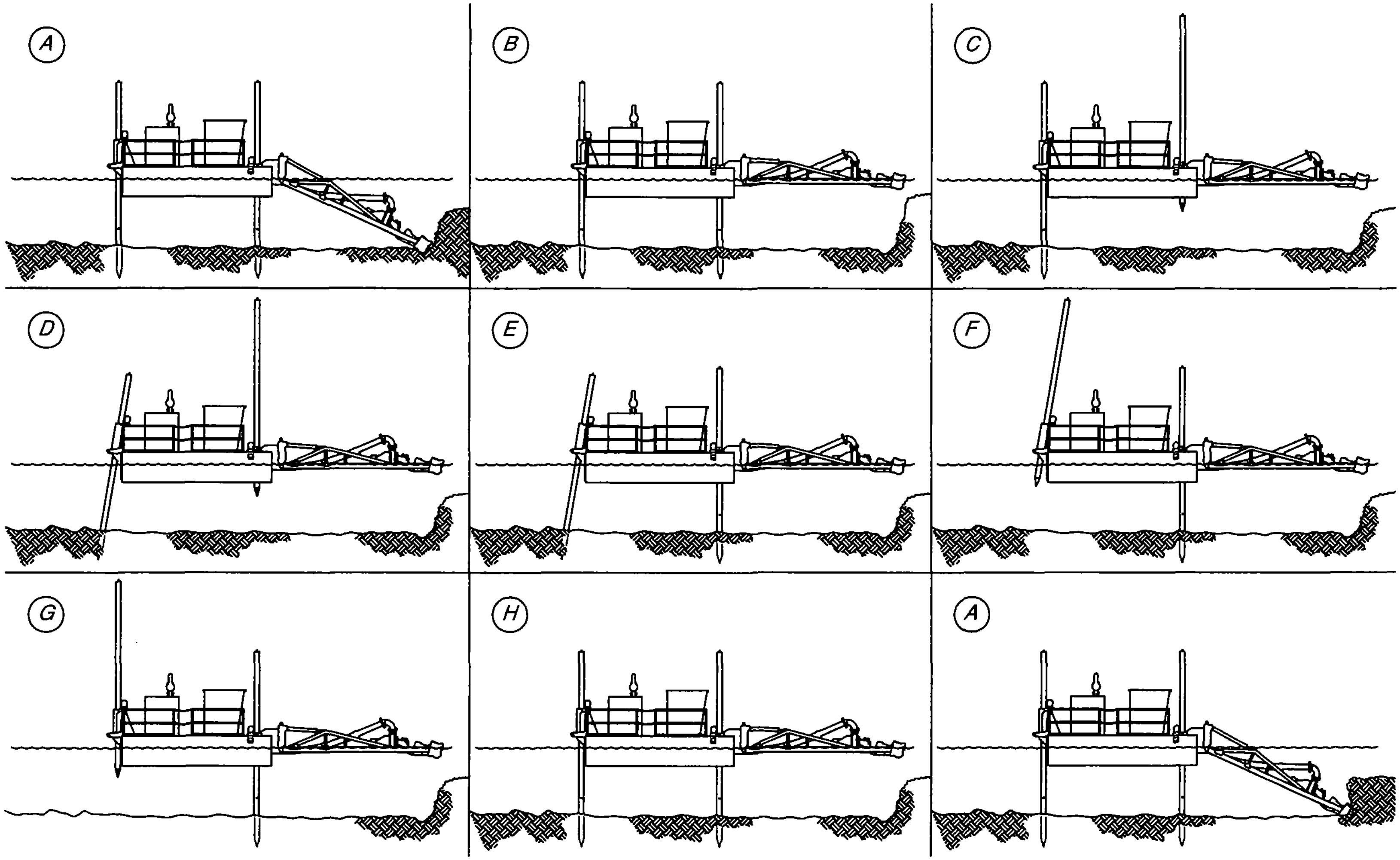
DRWN BY: DJG	DESIGN: RLP
CHK BY:	
DATE: 3/22/2006	
SCALE:	SIZE: D
PROJECT #: 205110	
DWG #: 205110037	REV:

Swinging Ladder Spud Operation

Prior to advancing the dredge, all three spuds are normally firmly rooted into the bottom as shown in position A of the swinging ladder spud operation drawing. Next the dredging ladder should be raised slightly above the bottom, as in position B (in very soft material, the dredging ladder may not need to be raised and material can be conveyed throughout the move). The two bow spuds should be raised well above the bottom as shown in position C. The kicker spud can now be tilted forward the amount necessary to shift the dredge into the next cut (position D).

The speed of the kicker and the spud winches is factory set in the PLC.

Next the two bow spuds should be lowered as shown in position E; the lowering speed of all the spuds will be approximately the same as the hoisting speed. When the kicking spud has traveled to it's limit the kicking spud can be raised out of the bottom, position F, and tilted back to a vertical position for the spud, position G. Finally, the kicker spud should be lowered into the bottom, position H, and then the ladder can be lowered back into the material to begin another digging cycle, position A'. Reverse the advancing procedure to step back with the kicking spud.



SWINGING LADDER SPUD ADVANCING
200800M519

DREDGING TECHNIQUE

Effective dredge operation requires that the operator is both knowledgeable and comfortable with the dredge system and its operation. Very few projects rely so heavily on one person as does dredging. This section is intended to familiarize the operator with some frequently encountered dredging operations, the dredging gauges and what they are measuring, and some simple short cuts for every day operation. There are two basic types of situations that will be encountered in dredging maintenance or deepening and excavating virgin land.

When beginning a deepening operation, the dredge must slowly cut a slope down to the final depth; this must be done to keep the dredge ladder from dragging along the bottom. To dredge this slope the operator should progressively dig deeper with more passes as the dredge advances forward. Once the dredge has reached the final depth, the operator can excavate the entire depth on each advance. Do not force the ladder movement, let the cutter cut the material and start and stop smoothly.

Since the dredge pump must remain primed during the excavating operation, the removal of elevated virgin material may seem to present problems. Actually, this operation can be performed easily by undercutting the bank. To do this, the operator should advance the dredge into the bank with the cutterhead just below the water level, then cut into the bank face at this level, and proceed downward. When the dredge has reached the final depth, the ladder should again be raised and advanced just below the surface. The above water material may cave in behind the cutter and the operator may have to set the dredge backward to pick up this loose material.

Although the bottom being excavated is usually not readily visible, the dredge is equipped with an array of gages to inform the operator about what is happening beneath the water and in the pipeline.

The dredge pump differential gage is the single most important dredging gage on the operator's console for this gage indicates conditions in the dredge suction pipe as they occur. A dredge pump relies on atmospheric a hydrostatic pressure to push water and material into its case. The dredge differential gage indicates the effectiveness of the use of this pressure. Three differential gage readings are of importance to the operator:

1. Indicated Differential - the differential reading directly from the gauge
2. Clear Water Differential - the differential reading when only water is being pumped
3. Effective Differential - the indicated reading minus the clear water reading

The clear water reading is a measurement of the inefficiencies built into the dredge suction at a given flow rate. Since the atmospheric and hydrostatic pressure is limited, the clear water differential should be kept as low as possible and still allow adequate velocity for conveying material. The clear water differential can be regulated by the pump speed. The effective differential, unlike the clear water differential, is a measurement of the suction losses due to conveying material. It is therefore favorable to maintain as high an effective differential as possible without causing cavitations or pipeline plugging.

The dredge pump discharge pressure gage measures the losses in the discharge line due to friction, elevation changes, and the conveying of solids. The discharge pressure gage gives a good indication of what is happening in the discharge line behind the dredge. Soon after the dredge differential rises due to the movement of solids, the discharge pressure gage rises to indicate greater restriction in the pipeline. While the discharge pressure gage reacts with increasing solids, as does the differential gage, its primary purpose is to prevent plugging in the pipeline. Pumping a mixture at a lower velocity decreases the power required as well as the wear; by watching the discharge gage, the operator can get a feel for the proper discharge velocity. If plugging does begin to occur, the discharge pressure gage will begin to rise sharply; the differential gage may begin to fall. It is up to the operator to quickly raise the dredging ladder and increase the pump speed until the conditions have stabilized.

The cutter pressure gage is an indication of both, the strength of the bottom material, and the rate at which it is being removed. Evaluation of the combination of the differential pressure, discharge pressure and the cutter pressure is used to determine the bottom conditions and the rate of swing. When digging properly the relation between the pressures should be relative to each other until the bottom conditions changes.

In addition to the use of gages to increase production, clever manipulation of the dredge can also aid in production. The dredge cutter head can be supplied with a rotating chopper ring, which may help production in rocks and sticks. Some bottom conditions do not allow the chopper to work properly. Large amounts of trash or small twigs and vines are examples. In these materials, the chopper should not be used. The cutter head is designed to cut in a counterclockwise direction. A clockwise direction can be selected, however, from the operator's cab. By reversing the cutterhead direction several times, the material trapped within or tangled about the cutter can often be shaken loose. **The cutter will stop between changing rotation directions. Do not attempt to dredge with the cutter running in reverse.**

Swinging ladder operation has the added connivance of not using anchors and is easier to set over with out any additional equipment then the conventional mode. To move the dredge transversely to the port, stop the cutter, swing the dredge ladder to the Port side and lower it to make light contact with the bottom. Raise both bow spuds and swing the ladder to starboard moving the bow of the dredge to the port. Lower the port bow spud and raise the kicking spud. With the ladder still maintaining light contact with the bottom swing the ladder to the port pivoting the stern to the port. Lower the stern spud, raise the bow spuds, and swing the ladder to the starboard moving the bow to the port. Adjust the stern and the bow to the centerline of the cut and lower all of the spuds. The dredge is ready to operate in a new cut parallel to the previous cut. This same operation can also be performed to the starboard side in a similar but opposite manner. The dredge cut direction can also be changed in the swinging ladder mode. With the ladder swung to one side, the two bow spuds are raised. By swinging the dredge ladder the opposite direction, the dredge will pivot on the kicking spud. When the desired direction change has been achieved, the bow spuds can be lowered and dredging resumed.

Clearing of all solid material from the discharge line before stopping the dredge is part of the shutdown procedure and is done whenever dredging is stopped. The operator should raise the ladder and pump only water level for several minutes until clear water is spewing from the pipeline at the spoil area. This ensures a clean pipeline whenever dredging operations resume.

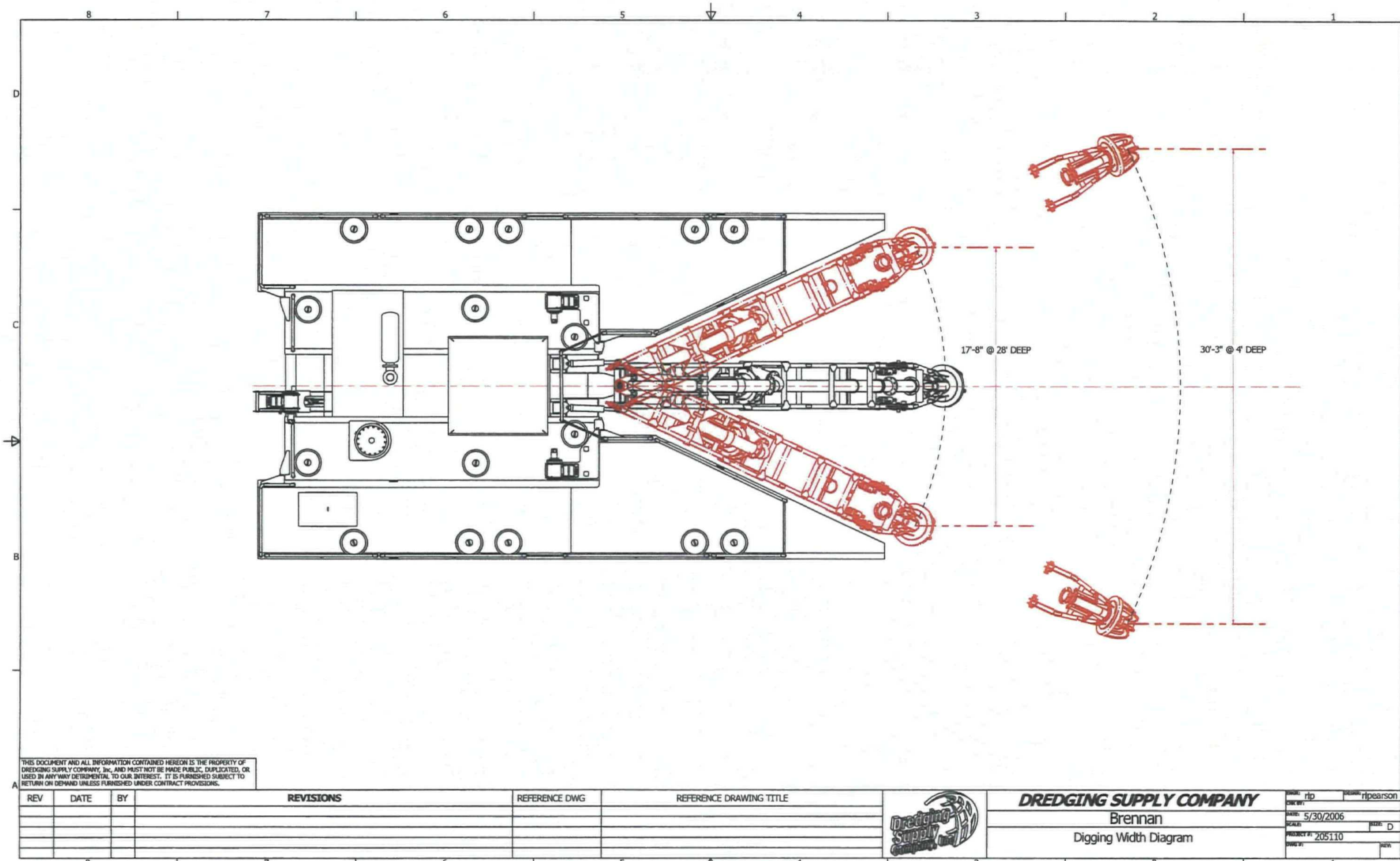
DSC MORAY UW PUMP

Dredging Supply Company, Inc.

RANGE DIAGRAMS

Maximum Swing/ Swinging Ladder Mode

Digging Depth Diagram


17'-8" @ 28' DEEP
30'-3" @ 4' DEEP
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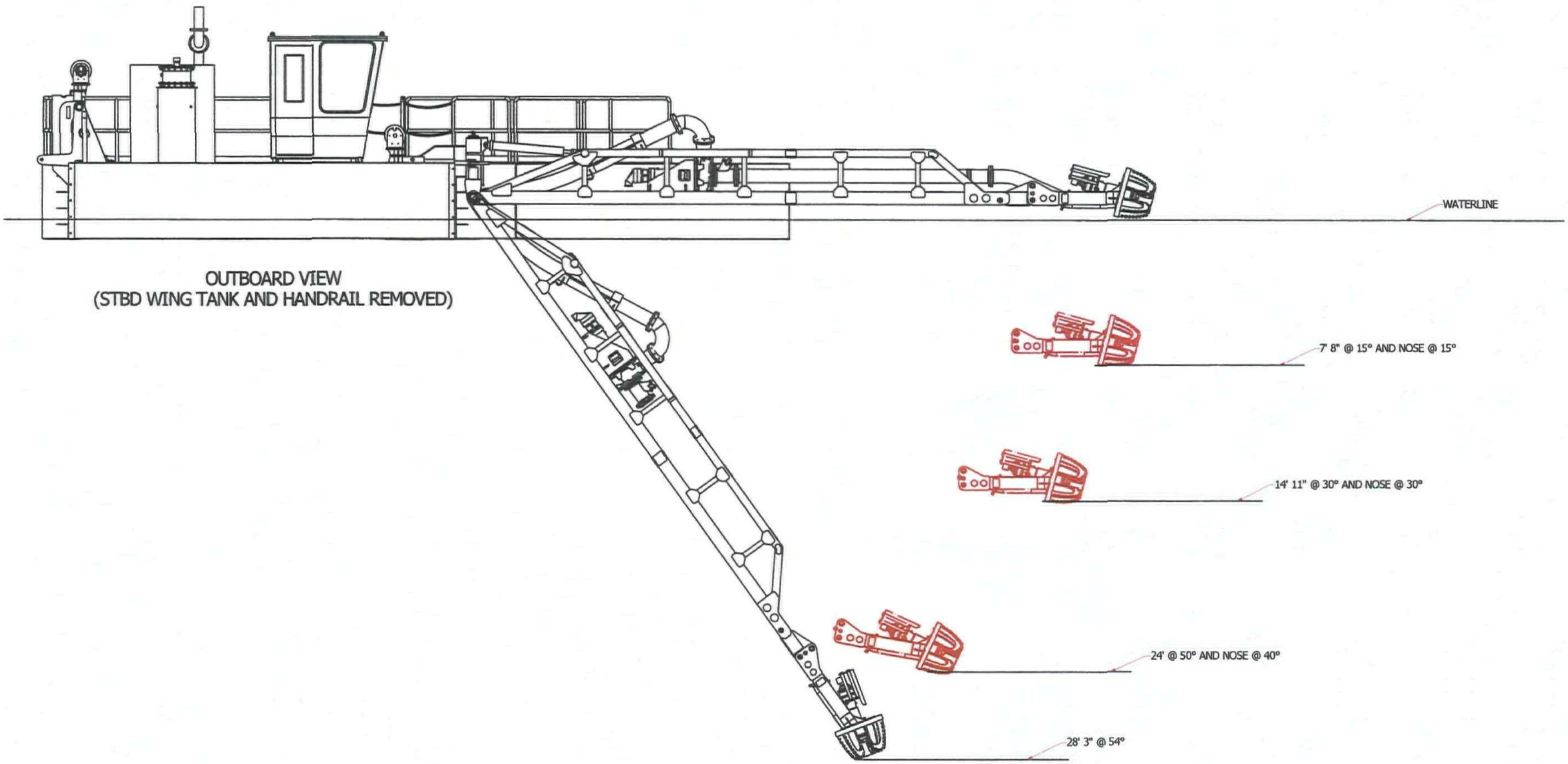
REV
DATE
BY
REVISIONS
REFERENCE DWG
REFERENCE DRAWING TITLE
DREDGING SUPPLY COMPANY
Brennan
Digging Width Diagram
rlp
rlpearson
5/30/2006
D
205110

MAY 2006



REV	DATE	BY	REVISIONS	REFERENCE DWG	REFERENCE DRAWING TITLE

DREDGING SUPPLY COMPANY
Brennan
Digging Depth Diagram

ENGR: rlp	DRAWN: rlpearson
CHK BY:	
DATE: 5/30/2006	
SCALE:	SIZE: D
PROJECT #: 205110	
DWG #:	REV:

MAINTENANCE SCHEDULE

The following items require periodic lubrication. Refer to Lubrication drawing for grease fittings and equipment locations.

GREASE - LUBRICATION

Ladder Trunnions

The grease lines are on the hull gimbal. The trunnions require lubrication on a daily basis. Use multipurpose EP 2 type grease. (Chevron Black Pearl Grease EP NLGI 2 (MULTIPURPOSE).

Ladder Articulation hinge

The hinge require lubrication on a daily basis. Use multipurpose EP 2 type grease. (Chevron Black Pearl Grease EP NLGI 2 (MULTIPURPOSE) or equal).

Ladder Gimbal Assembly

There are grease lines on the ladder gimbal assembly that allow for lubrication of the gimbal pin bushings, the ladder/hull gimbal pivot wear plates and the ladder trunnions bushings. This will require lubrication every 8 hours or at the end of each shift when the dredge is used in the swinging ladder mode. Use multipurpose EP 2 type grease. (Chevron Black Pearl Grease EP NLGI 2 (Multipurpose equal)

Dredge Pump Packing

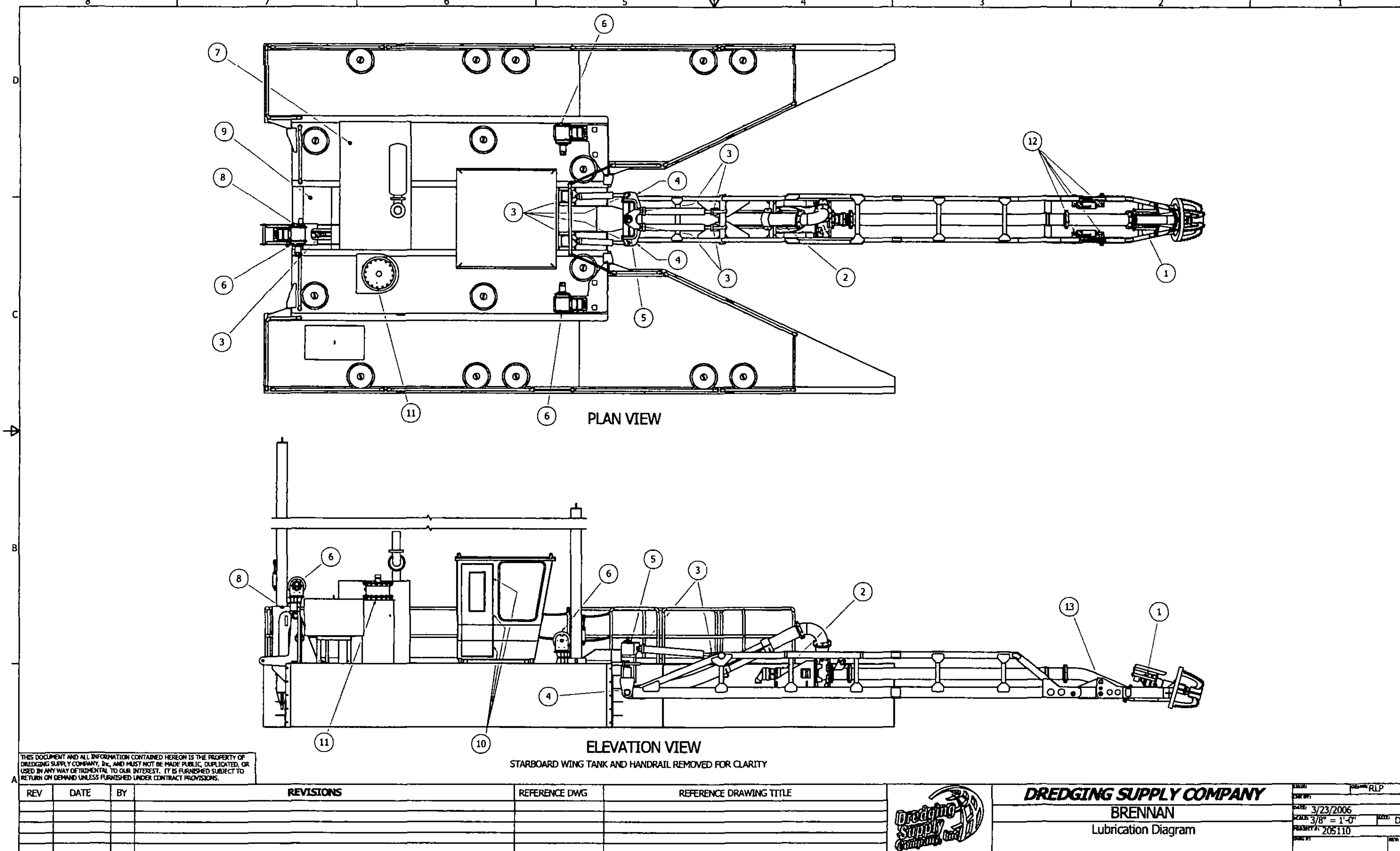
The dredge pump packing is installed well greased and grease should be added when the pump is re packed. Use Chevron Black Pearl Grease EP NLGI 2 (MULTIPURPOSE) or equal.

Control Room

There are no fittings located on the door hinges but lubricate with a light on a daily basis. The door latches should also be greased on a weekly basis.

Hydraulic Cylinder End Pins

The cylinder pins will require lubrication every day or at the end of each shift. Use multipurpose EP 2 type grease. (Chevron Black Pearl Grease EP NLGI 2 (Multipurpose equal)



PLAN VIEW
ELEVATION VIEW
STARBOARD WING TANK AND HANDRAIL REMOVED FOR CLARITY
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REV
DATE
BY
REVISIONS
REFERENCE DWG
REFERENCE DRAWING TITLE
DREDGING SUPPLY COMPANY
BRENNAN
Lubrication Diagram
RLP
3/23/2006
3/8" = 1'-0"
D
205110

Lubrication Diagram Key

ITEM #	DESCRIPTION	LUBRICANT
1	Cutter gear and cutter bearings	Chevron Hydraulic Oil AW ISO32. First change after 250 Hrs., operation then every 2,000 hrs. Operation. Sample oil the shorter interval of every 250 hrs of operating or monthly, **CHANGE SEALS EVERY SIX MONTHS.**
2	Pump drive	Chevron Hydraulic. Oil AW ISO46 Check static tank and bearing every 8 hour shift. Change oil after the first 300 hours of operation and then after every 2,500 hours.
3	Hydraulic Cylinder end pins	Chevron RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE) OR EQUAL. Grease every day
4	Ladder trunnion bushings	Chevron RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE) OR EQUAL. Grease every 8 hrs.
5	Ladder gimbal pin	Chevron RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE) OR EQUAL. Grease every 8 hrs.
6	DSC Spud winches	Use Chevron Gear Comp. ISO 150 Disassemble, drain, flush, and change oil every 2,000 hrs of winch operation or once a year, which comes first in winch reduction. Repack the bearings when changing the reduction oil or once a year
7	Caterpillar Diesel Engine	Caterpillar DEO SAE 15W40 or Chevron Delo 400 ESI Multigrade 15W-40. Change filter and oil and send in a sample to cat. S.O.S oil analysis program every 250 hrs. of operation. Check oil level every 8 hour shift. (See Caterpillar Manual)
8	Kicker pivot pin	Chevron RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE) OR EQUAL. Grease every day.
9	Service Water Pump, Carver	Check bearings Daily, Re-lubricate after 1,000 hrs. of operation. Use Chevron Black Pearl Grease EP NLGI 2 (MULTIPURPOSE) (See Carver Manual)
10	Enclosure and lever room doors latches	Light oil or grease as needed.
11	Hydraulic Oil	Use Chevron Clarity Hydraulic oil AW ISO 46, or equal. Do not mix oil types. Check and maintain the oil level daily. Look for color and or viscosity changes in oil daily. Milky color can indicate water change immediately, find, and repair cause. Change filters, after first 250 hrs operations, then a minimum of every 1,000 hrs. of operation or when they are contaminated. Change the oil when testing indicates it is contaminated. The oil must be sampled the shorter interval of every 250 operating hours or monthly and after any hydraulic component failure. Samples must be analyzed by a certified program such as EATON Hydraulics and continue to meet the specifications for the type of system being run.
12	Ladder Articulation Hinge	Chevron RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE) OR EQUAL. Grease every shift.
13	Ladder Articulation Hinge Pin	Chevron RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE) OR EQUAL. Grease every shift.

OIL LUBRICATION SPECIFICATIONS AND REPLACEMENT SCHEDULES

All lubrication levels should be checked in accordance with the following schedules. Failure to do so could cause serious damage to equipment. A program for oil sampling and analyzing at a scheduled time must be part of the maintenance program for this dredge.

Dredge Slurry Pump Bearings

The standard bearings supplied by DSC for pump bearings are Timken tapered roller bearings, one on each end of the bearing tube. The recommended lubricant is Hydraulic Oil AW ISO46. Flush and drain after the first 250 hours of operation. Sample oil every 250 operating hours or monthly. These bearings are operated under water in a sealed tube and the static oil reservoir tank should be checked for water contamination every eight hours of operation and after an extended shut down.

Cutter Gear

The cutter gear uses the same static pressure reservoir that is used for the pump bearings. Proper oil level should be at or above the center of the sight glass. If servicing is required, check the gear housing and hose lines for leaks and cracks and use Chevron Clarity Hydraulic Oil AW ISO 46, to service reservoir. The oil should be initially drained after the first 500 hours of operation, after which the oil should be drained the shorter interval of every 2000 hours or 12 months and samples taken oil every 250 hrs. or monthly.

Hydraulic Oil Tank

Proper oil level should be at or above the center of the sight glass located on the hydraulic oil tank on the port side of the dredge. Servicing the tank should only be required if a leak is present or for annual cleaning. Check all lines and fittings for leaks. If servicing is required, use Chevron Clarity Hydraulic Oil AW ISO 46. **Change filters**, after first 250 hrs operation, then every 1,000 hrs. of operation or when they are contaminated. Change the **oil** when it is contaminated or the shorter interval of: after 2,000 hours of operation or every six months. Sample oil the shorter interval of every 250 hrs of operating or monthly.

When servicing the filter, use the following procedure:

- Stop the system power.
- Allow the system to relive pressure.
- Rotate the bowl counter-clockwise and remove.
- Remove the element from the housing. Discard all of the disposable elements. These elements can not be cleaned and reused.
- Place new, element in the housing, centering it on location in the head.
- Inspect the bowl seal and replace if necessary.
- Replace the bowl. Rotate clockwise and hand tighten.

Caution: ALL HYDRAULIC OIL must be filtered through a 10-micron absolute filter before put into tank. Failure to do so will contaminate hydraulic oil circuit and cause premature equipment failure. Oil samples should be taken on a monthly basis and schedule oil changes by the test results.

DSC Winches

The planetary reduction gear sets inside the winches require an oil bath using Chevron Gear Compound ISO 150 or equal lubricating oil. Disassemble; drain, flush, and change oil every 2,000 hrs of winch operation or once a year, which comes first. The drum bearings are grease lubricated and can be re-lubricated at the same interval as the oil is changed.

WEAR COMPONENTS

Winch Wire Ropes

Visual inspection, of the swing wire ropes and tension adjustment of the spud wire ropes should be performed every operating shift. After replacement of a spud wire rope, the tension should be adjusted hourly until it stabilizes. Replace any wire ropes worn due to abrasion, fatigue, excessive strain, or has been damaged by jumping off sheave or fatigued from bending over too small of a radius, i.e., over a log etc.

Under Water Bearing Tube seals

Cutter and Underwater Dredge Pump Duo-Seals on the bearing tube must be changed every six months or if a leak is discovered. Check the bearing at this time and change if needed, also check all hoses to the bearing tube and the mounting bolts.

Hydraulic Hoses

Caution: Hydraulic oil escaping under pressure can cause severe injury or death. Visually inspect hydraulic lines every shift for leaks. Replace any worn or broken hydraulic lines with a hose having same length, diameter, fittings, and bend characteristics.

Dredge Pump

The pump impeller should be checked as often as practical. The pump-packing gland should be checked at every shut down. If there is excessive leakage at the packing gland, tighten or add packing and insure that the service water pump is working properly.

Dredge Controls

All of the dredge functions are operated electrically. They should be maintained in a matter similar to any other electric equipment. Protect the switches and relays from excessive water other type of fluids.

This dredge is not designed for use in open water or salt water. **Call Dredging Supply Company before using in a salt water environment.**

Cutter

The cutter edges will wear with time and need to be changed as they wear out. If the edges are changed before they are completely worn out the blades will last longer, but eventually the entire cutter will have to be renewed. If individual blades are broken, they may be replaced as needed.

Foundations, Couplings, And Flange Connections

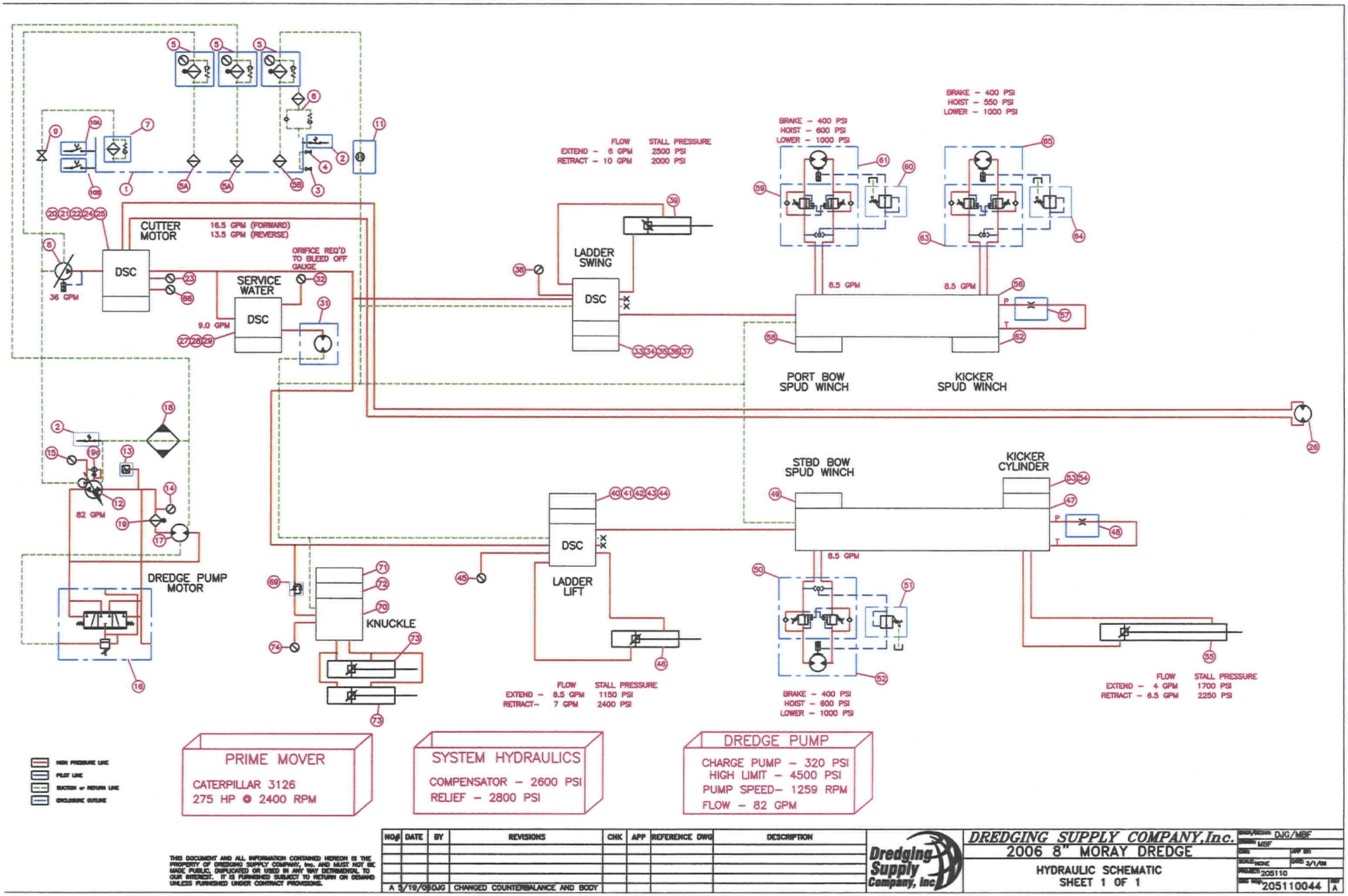
The bolts in the equipment foundations and couplings must be checked daily and the bolt torque requirements and equipment alignment maintained at all times.

Any unusual vibration or noise requires immediate inspection. Do not continue to operate the equipment with any part of the rotating equipment out of alignment. Lose coupling bolts will cause misalignment and premature equipment failure or coupling damage.

Damaged couplings and any cracks or broken welds on the equipment must be repaired or replaced before being put back in operation to prevent further accelerated equipment damage.

Dredging Supply Company, Inc.

SCHEMATICS & DIAGRAMS



CUTTER MOTOR
16.5 GPM (FORWARD)
13.5 GPM (REVERSE)
DSC
36 GPM
ORIFICE REQ'D TO BLEED OFF GAUGE
SERVICE WATER
9.0 GPM
FLOW
STALL PRESSURE
EXTEND - 6 GPM 2500 PSI
RETRACT - 10 GPM 2000 PSI
LADDER SWING
BRAKE - 400 PSI
HOIST - 600 PSI
LOWER - 1000 PSI
BRAKE - 400 PSI
HOIST - 550 PSI
LOWER - 1000 PSI
8.5 GPM
PORT BOW SPUD WINCH
KICKER SPUD WINCH
STBD BOW SPUD WINCH
KICKER CYLINDER
82 GPM
DREDGE PUMP MOTOR
KNUCKLE
LADDER LIFT
FLOW
STALL PRESSURE
EXTEND - 8.5 GPM 1150 PSI
RETRACT - 7 GPM 2400 PSI
BRAKE - 400 PSI
HOIST - 600 PSI
LOWER - 1000 PSI
FLOW
STALL PRESSURE
EXTEND - 4 GPM 1700 PSI
RETRACT - 6.5 GPM 2250 PSI
PRIME MOVER
CATERPILLAR 3126
275 HP @ 2400 RPM
SYSTEM HYDRAULICS
COMPENSATOR - 2600 PSI
RELIEF - 2800 PSI
DREDGE PUMP
CHARGE PUMP - 320 PSI
HIGH LIMIT - 4500 PSI
PUMP SPEED- 1259 RPM
FLOW - 82 GPM
HIGH PRESSURE LINE
PILOT LINE
SUCTION or RETURN LINE
ENCLOSURE OUTLINE
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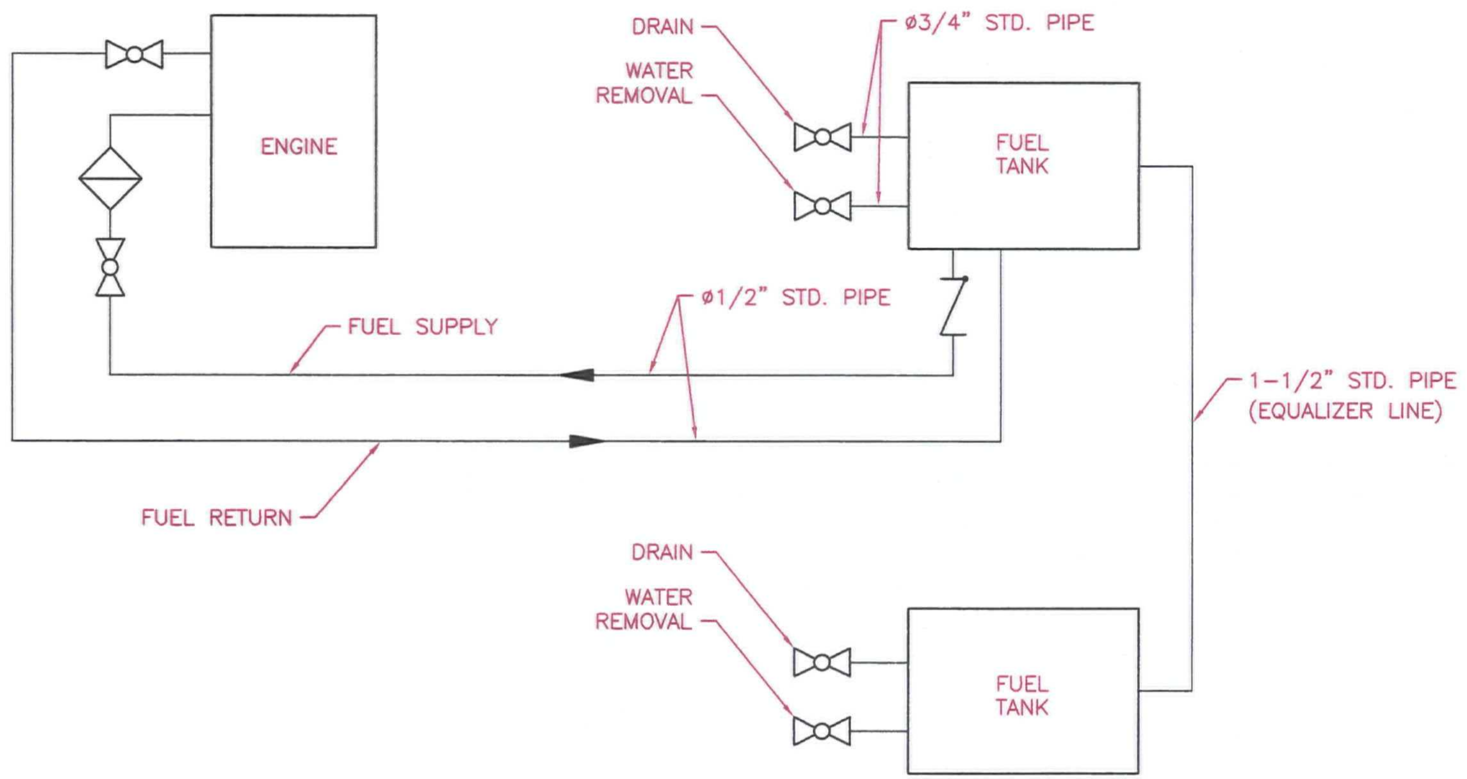
NO# DATE BY REVISIONS CHK APP REFERENCE DWG DESCRIPTION
A 5/19/06 DJG CHANGED COUNTERBALANCE AND BODY
Dredging Supply Company, Inc
DREDGING SUPPLY COMPANY, Inc.
2006 8" MORAY DREDGE
HYDRAULIC SCHEMATIC
SHEET 1 OF 1
DJG/MBF
MBF
NONE
3/1/06
205110
205110044
A

Item #	Description	Manufacturer	MAS90 P/N	Model #
1	Hydraulic reservoir	DSC		----
2	Temperature Transmitter	Wika	CS-00567	3338955
3	Reservoir drain valve	DynaQuip		3/4 VMH2-A9
4	Reservoir water removal valve	DynaQuip		3/4 VMH2-A9
5	Open loop return and pump case filter	Donaldson	(3) HD-00700 / (3) HD-00610/ (3) misc. item	HMK05 w/ P165973 (head)/P176567 (element)/P173944 (electrical service indicator)
5a	Diffuser		(2) Misc Item	DFD-120 P562290
5b	Diffuser		Misc Item	TD-100-PMI
6	Filler/vent	UCC	HD-00033	PAB. 81201
7	Suction strainer	Flow-Ezy	HD-00549	200-3-8.1-100-RV3 w/magnets
8	System hydraulic pump	Sunstrand	HD-00702	JRR060BPC25NNNNN3S1N2A1NNNNNNNNNN
9	Knife gate valve	Davis	Misc Item	Size 3"-60C
10a	Low Level Switch	Dwyer	CS-00399	OLS-10
10b	Low Low Level Switch	Dwyer	CS-00399	OLS-10
11	System flow sensor	Hedland	FT-01649	H760-040
	Dredge Pump Motor Circuit			
12	Closed loop hydraulic pump	Sundstrand	HD-00086	90R130KP1CD80L4F1F03GBA353524
13	Closed loop pressure transmitter	Wika	CS-00011	891.24-540 (8347390) 0-5000
14	Closed loop pressure gauge (Local)	Wika	CS-00106	213.53 2-1/2G 0-5000 LM
15	Charge pump pressure gauge(Local)	Wika	CS-00222	213.40 2-1/2G 0-1000 LM
16	Loop flushing valve	Sundstrand	HD-00143	8800485-24-00
17	Closed loop hydraulic motor	Volvo	HD-00324	F11-250-QF-SH-F
18	Hydraulic cooler	Thermal Transfer	HD-00114	M-25-S
19	High Pressure Filter	Donaldson		HPK04 w/ P162452 (Hsg)/P167188(element)/P170058(head)/P166298 (electrical service indicator)
19a	Charge Pressure Filter	Donaldson	HD-00629 / misc. item / misc. item	HMK04 w/ P165537 (head)/P165332 (element)/P173944 (electrical service indicator)
	Cutter Circuit			
20	Manifold Block	DSC	HD-00011	Dwg. 9705666
21	Flow Control Valve	Vickers	HD-00012	EPV16-A-060-24D-U
22	Relief Valve	Sun	HD-00061	RPEC-LAN
23	Cutter pressure gauge (Local)	Wika	CS-00100	213.53 2-1/2G 0-3000 LM
24	Pressure Compensator	Hydraforce	HD-00686	EC12-30-0-N-160
25	Directional Control Valve	Vickers	HD-00208	DG4S4-016C-H-60
26	Cutter hydraulic motor	Commercial	HD-00002	M31A897BEUF10-25
	Service Water Pump Circuit			
27	Manifold Block	DSC	HD-00007	Dwg. 9705665
28	Service water directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
29	Pressure Compensator	Hydraforce	HD-00022	EC-10-30-O-N-40
30	Proportional Flow Control	Hydraforce	HD-00021	PV70-33A-0-N-24-DG
31	Service water hydraulic motor	Gresen	HD-00696	MGG20010-BC1A3
32	Service Water pump pressure gauge (Local)	Wika	CS-00226	213.53 2-1/2G 0-3000 LM
	Ladder Swing Circuit			
33	Manifold Block	DSC	HD-00007	Dwg. 9705665
34	Pressure Compensator	Hydraforce	HD-00020	EC10-30-0-N-160
35	Proportional Flow Control	Hydraforce	HD-00021	PV70-33A-0-N-24-DG
36	Ladder swing cylinder counterbalance valve	Sun	HD-00068 (2)/HD-00147	CBCA-LHN-EB8
37	Ladder swing cylinder directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
38	Ladder swing pressure gauge (Dash)	Wika	CS-00100	213.53 2-1/2G 0-3000 CBM
39	Ladder swing cylinder	Texas Hydraulics	(2) HD-00018	Z4001516CCAZ
	Ladder Lift Circuit			
40	Manifold Block	DSC	HD-00007	Dwg. 9705665
41	Pressure Compensator	Hydraforce	HD-00020	EC10-30-0-N-160
42	Proportional Flow Control	Hydraforce	HD-00021	PV70-33A-0-N-24-DG
43	Ladder lift cylinder counterbalance valve	Sun	HD-00062 (2)/HD-00147	CBCA-LIN-EB8
44	Ladder lift cylinder directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
45	Ladder lift pressure gauge (Dash)	Wika	CS-00100	213.53 2-1/2G 0-3000 CBM
46	Ladder lift cylinder	Texas Hydraulics	(2) HD-00019	Z44034332CCAZ
	Kicker/Starboard Spud Circuit			
47	Mainfold Block	Daman	HD-00492	AD03P042S
48	Gage Bleed Orifice	DSC		
	Starboard Bow Spud Circuit			
49	Starboard bow spud directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
50	Starboard bow spud counterbalance valve	Sun	HD-00119(2)/HD-00075	CBEA-LHN-YHL
51	Spud winch brake pressure reducing valve	Sun	HD-00060/HD-00052	PBDB-LNN-EFI
52	Starboard bow spud winch and motor	DSC 091/Eaton	HD-00380	104-1198
	Kicker Cylinder Circuit			
53	Kicker cylinder directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
54	Kicker cylinder counterbalance valve	Sun	HD-00062 (2)/HD-00147	CBCA-LIN-EB8
55	Kicker cylinder	Texas Hydraulics	HD-00590	S40006032SS
	Port Bow/Kicker Spud Circuit			
56	Manifold Block	Daman	HD-00491	AD03P032S
57	Gage Bleed Orifice	DSC		
	Port Bow Spud Circuit			
58	Port bow spud directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
59	Port bow spud counterbalance valve	Sun	HD-00119(2)/HD-00075	CBEA-LHN-YHL
60	Spud winch brake pressure reducing valve	Sun	HD-00060/HD-00052	PBDB-LNN-EFI
61	Port bow spud winch and motor	DSC 091/Eaton	HD-00380	104-1198
	Kicker Spud Circuit			
62	Kicker spud directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
63	Kicker spud counterbalance valve	Sun	HD-00119(2)/HD-00075	CBEA-LHN-YHL
64	Spud winch brake pressure reducing valve	Sun	HD-00060/HD-00052	PBDB-LNN-EFI
65	Kicker spud winch and motor	DSC 091/Eaton	HD-00380	104-1198
66	System pressure gauge (Dash)	Wika	CS-00226	213.53 2-1/2G 0-3000 CBM
67	Header Block-Return	Daman	Misc. Item	AH0000612S
68	Header Block-Pressure	Daman	Misc. Item	AH0000408S
	Knuckle Cylinder Circuit			
69	PC Flow Control	Hydac		SRVR-10-01.X/5
70	Manifold Block	Daman	HD-00698	AD03P012S
71	Knuckle cylinder directional control valve	Bosch	HD-00004	081WV06P1V1004WS024/00 D51
72	Knuckle cylinder counterbalance valve	Sun	(2) HD-00062/HD-00147	CBCA-LIN-EB8
73	Knuckle cylinder	Texas Hydraulics	(2) HD-00590	S40006032SS
74	Pressure Gauge	Wika	CS-00226	213.53 2-1/2G 0-3000 LM



LEGEND

- GATE VALVE
- FUEL FILTER
- CHECK VALVE

REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG

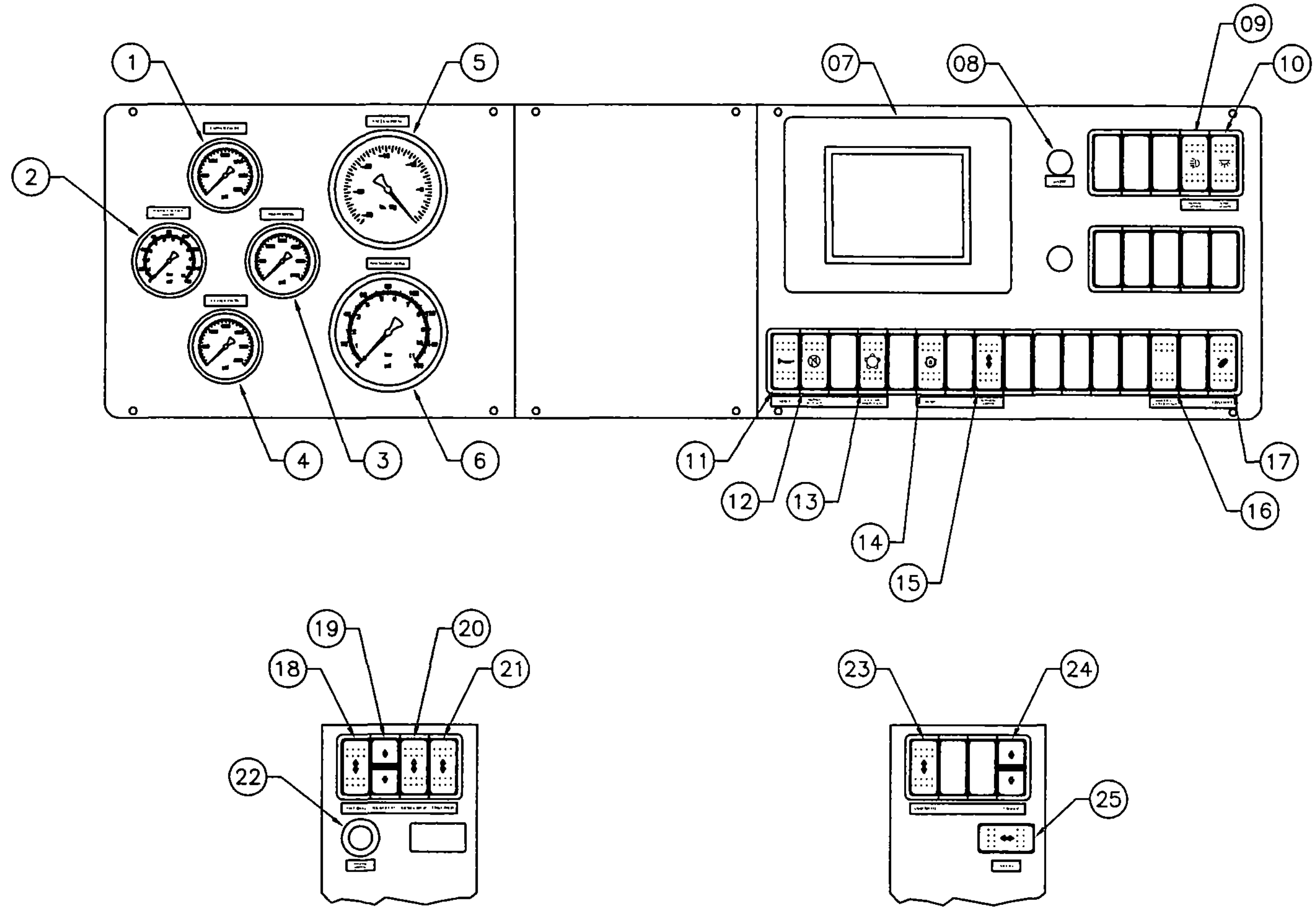
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

LAKE WILDWOOD ASSOC., INC.

FUEL SCHEMATIC

ENGR/DESNR: DJG	
DRAWN: JGD	APP BY:
CHK:	DATE: 7/29/03
SCALE: NONE	
SIZE B	PROJECT: 200800
DWG NO#: 200800068	REV –



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG
A	05/26/06	WJB	RENUMBER			

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

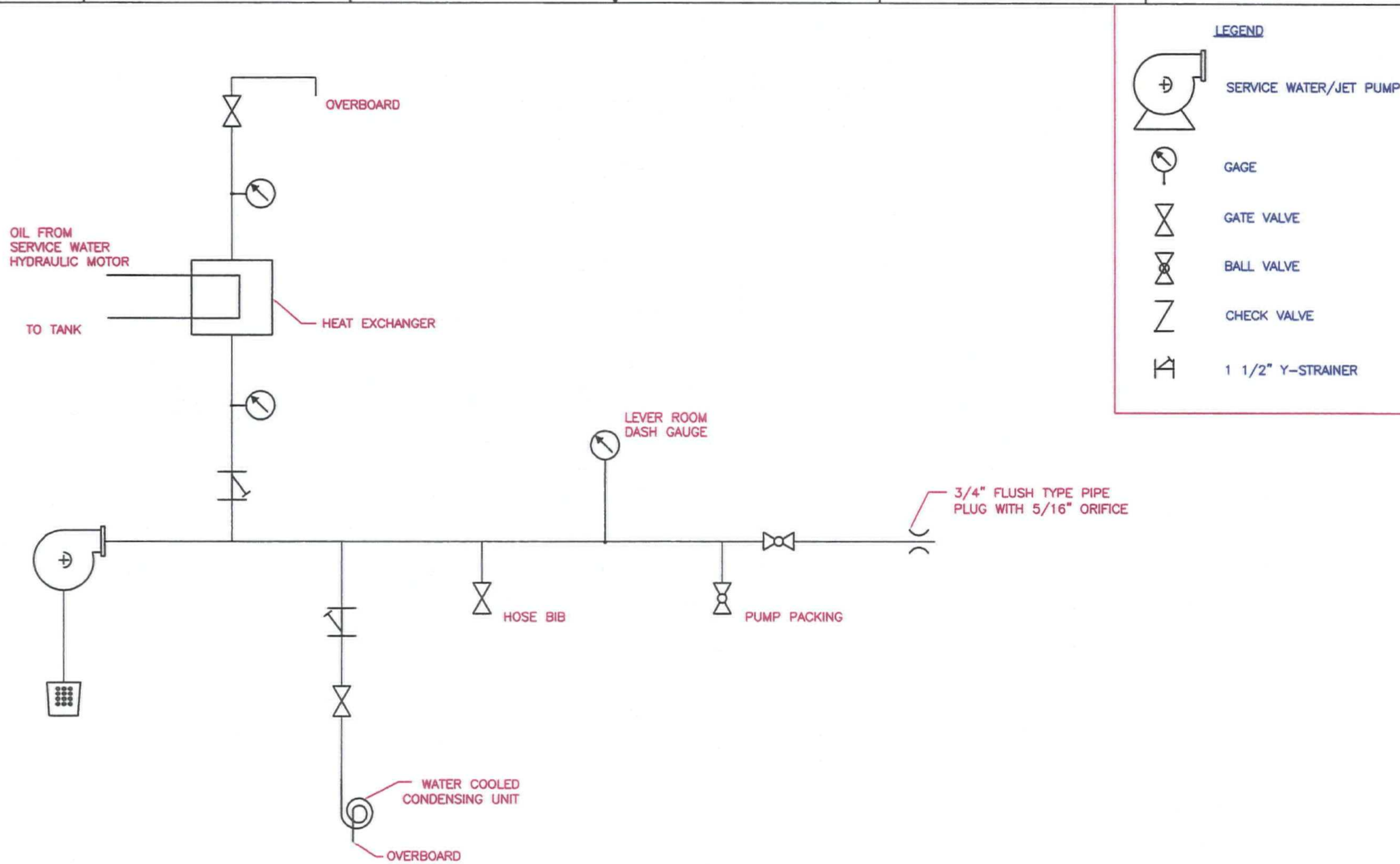
2006 8" MORAY DREDGE

CONTROL CONSOLE/CHAIR ARM LAYOUT

ENGR/DESNR: MJC	
DRAWN: CJH	APP BY:
CHK:	DATE: 8/16/05
SCALE: 3"=1'-0"	
SIZE B	PROJECT: 205110
DWG NO#: 205110E013	REV A

ARTICULATED MORAY GAGE SWITCH PANEL KEY

ITEM #	FUNCTION	LOCATION	DSC #	MANUFACTURER	PART #
1	LADDER PRESSURE	GAGE PANEL	CS-00100	WIKA	2.5"0-3000CBM-UCLAMP
2	SERVICE WATER PRESSURE	GAGE PANEL	CS-00101	WIKA	2.5"0-160CBMU-UCLAMP
3	SWING PRESSURE	GAGE PANEL	CS-00100	WIKA	2.5"0-3000CBM-UCLAMP
4	CUTTER PRESSURE	GAGE PANEL	CS-00100	WIKA	2.5"0-3000CBM-UCLAMP
5	VACUUM GAGE	GAGE PANEL	CS-00102	WIKA	NEW 4"30HGLBM-U CLAMP
6	DISCHARGE GAGE	GAGE PANEL	CS-00103	WIKA	NEW 4"0-160LBM-U CLAMP
7	OPTI-MATE	GAGE PANEL	CS-00088	PLC DIRECT	OP-640
8	E-STOP	GAGE PANEL	EL-00070	TELEMECANIQUE	ZB2BT43
9	FLOOD LIGHTS	SWITCH PANEL	EL-00260	CARLINGSWITCH	V1B1S00BAZC53-100
10	LEVERROOM LIGHTS	SWITCH PANEL	EL-00261	CARLINGSWITCH	V1B1S00BAZC50-100
11	HORN	SWITCH PANEL	EL-00253	CARLINGSWITCH	V8B1S00BAZC84-200
12	ALARM SILENT	SWITCH PANEL	EL-00256	CARLINGSWITCH	V2B1S00BAZC6K-100
13	CUTTER	RIGHT ARM	EL-00256	CARLINGSWITCH	V6B1S00BAZCF6-100
14	PUMP	SWITCH PANEL	EL-00255	CARLINGSWITCH	V6B1S00BAZC4F-100
15	ENGINE SPEED	SWITCH PANEL	EL-00253	CARLINGSWITCH	V8B1S00BAZC84-200
16	SERVICE WATER PUMP	SWITCH PANEL	EL-00253	CARLINGSWITCH	V8B1S00BAZC84-200
17	CONTROLS ACTIVATION	SWITCH PANEL	EL-00262	CARLINGSWITCH	V8B1S00BAZCP7-100
18	PORT SPUD	LEFT ARM	EL-00253	CARLINGSWITCH	V8B1S00BAZC84-200
19	KICKER CYLINDER	LEFT ARM	EL-00506	CARLINGSWITCH	V8B1S001-JZZY8-1Z1
20	KICKER SPUD	LEFT ARM	EL-00253	CARLINGSWITCH	V8B1S00BAZC84-200
21	STARBOARD SPUD	LEFT ARM	EL-00253	CARLINGSWITCH	V8B1S00BAZC84-200
22	DIGITAL SWING SPEED CONTROL ASSEMBLY	LEFT ARM	DSC CUSTOM	DSC	DSC
23	PUMP SPEED	RIGHT ARM	EL-00253	CARLINGSWITCH	V8B1S00BAZC84-200
24	LADDER	RIGHT ARM	EL-00506	CARLINGSWITCH	V8B1S001-JZZY8-1Z1
25	SWING	RIGHT ARM	DSC	CARLINGSWITCH	CUSTOM



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.
2004 8" MORAY DREDGE
SERVICE WATER SCHEMATIC

DJG
WMH
08/17/04
NONE
D
204190
204190056

Dredging Supply Company, Inc.

MAJOR DSC PARTS DRAWINGS

General Arrangement

Major Components

Control Panel Layout

Sealed Bearing Smart Pump Assembly

Suction / Discharge Assembly

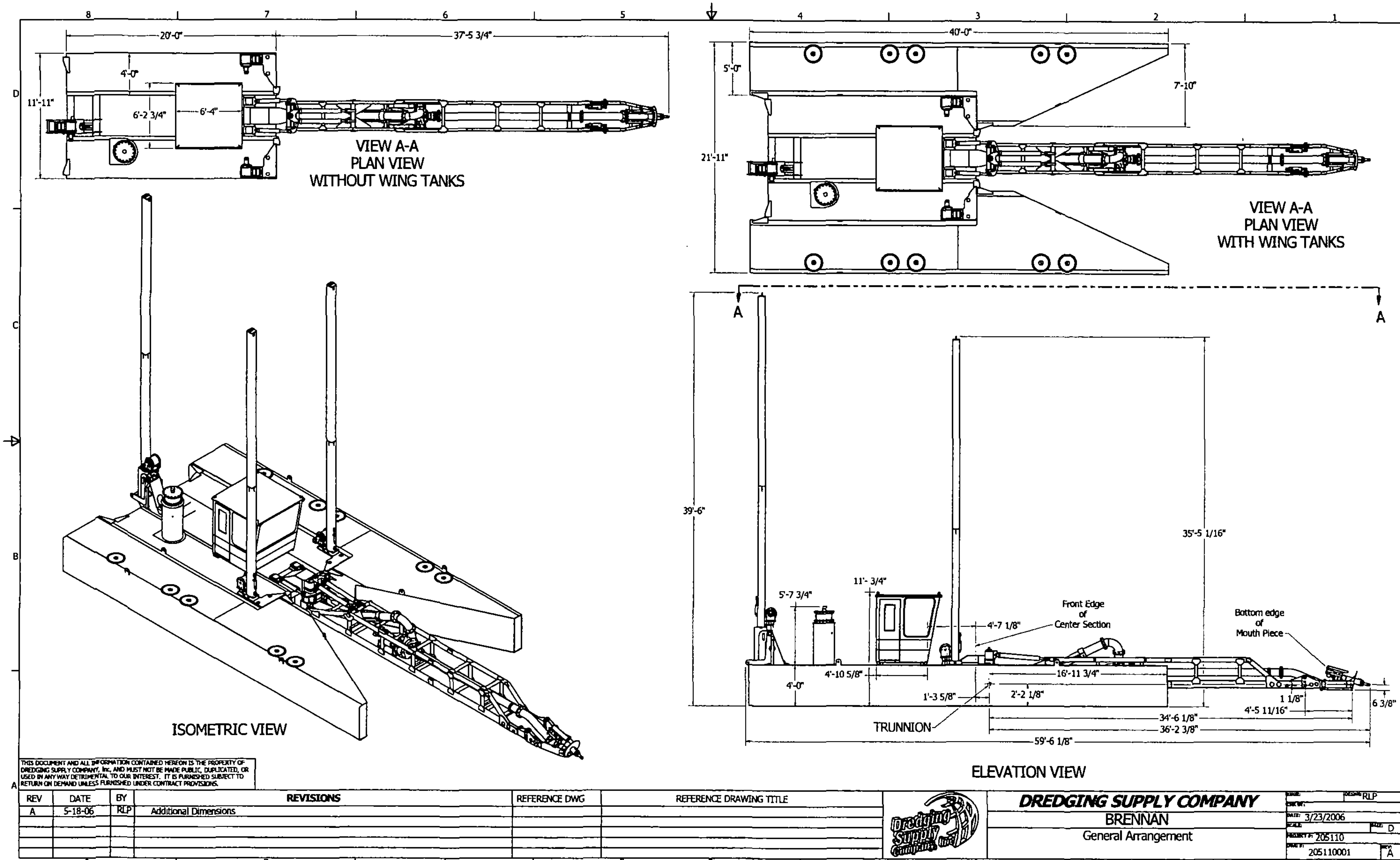
2 ½" Sealed Bearing Cutter Drive Assembly

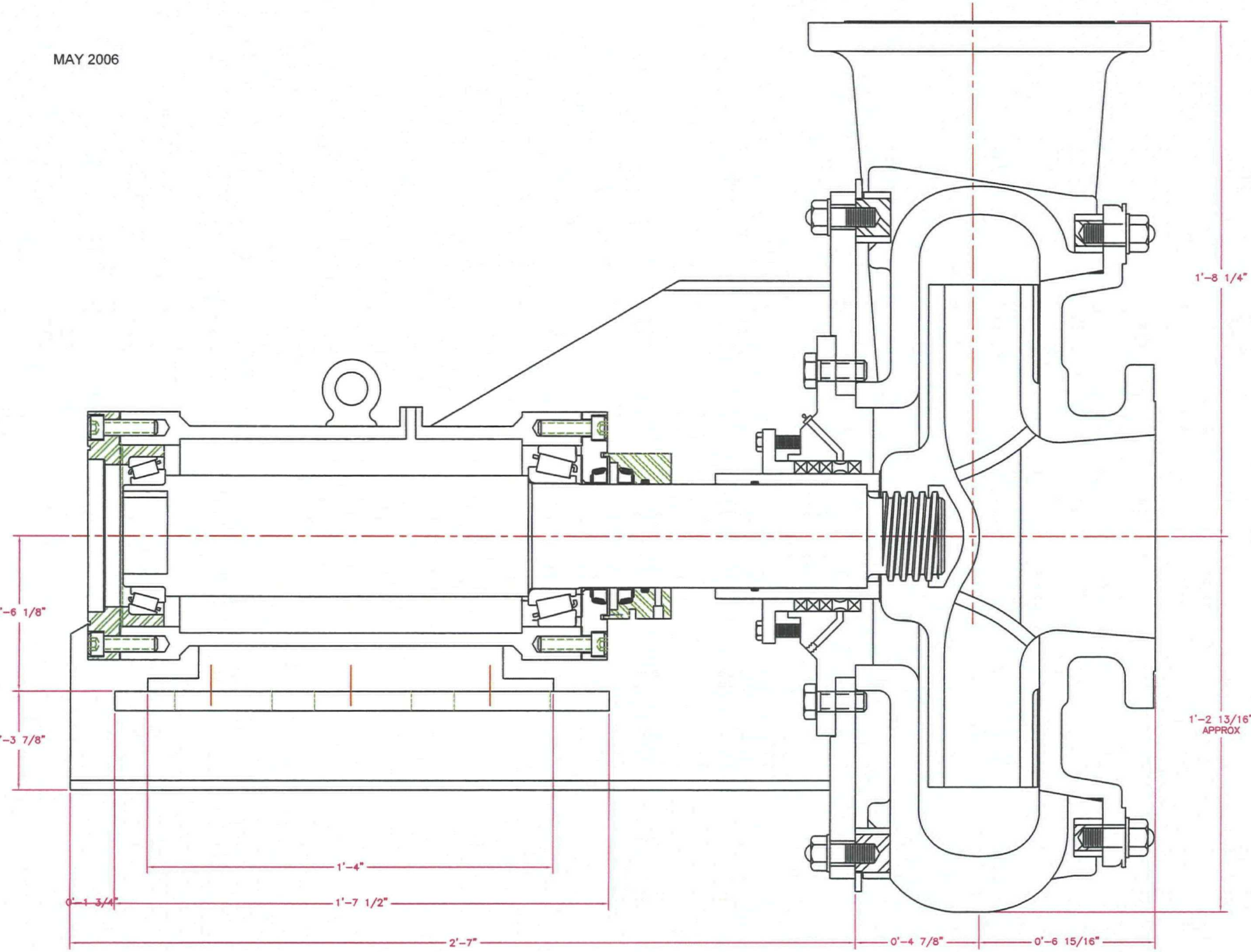
Cutter Reduction Gear Assembly

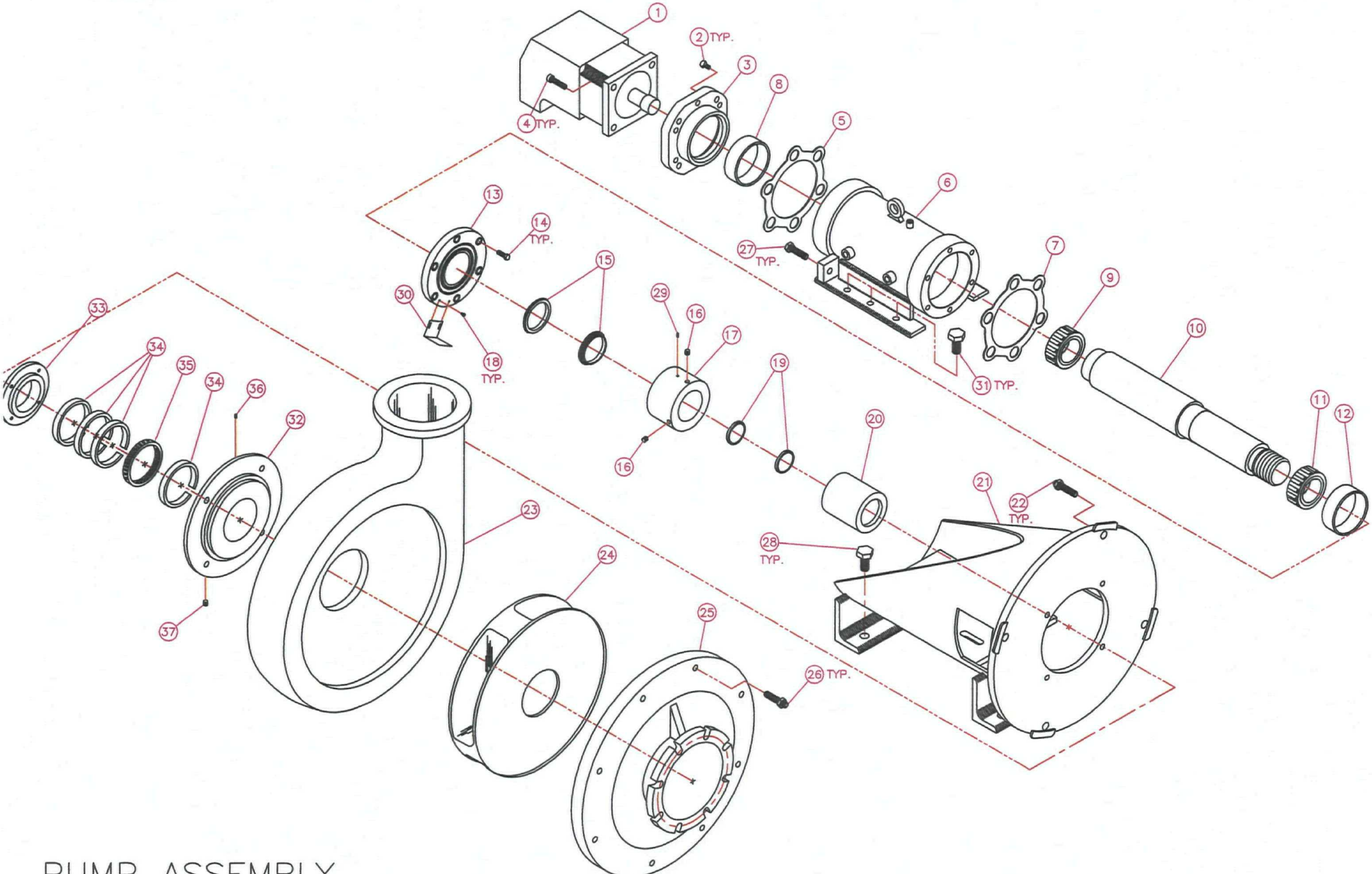
Spud Winch Assembly

Spud Winch Reduction Assembly

Service Water Pump Layout


VIEW A-A
PLAN VIEW
WITHOUT WING TANKS
20'-0"
37'-5 3/4"
4'-0"
11'-11"
6'-2 3/4"
6'-4"
VIEW A-A
PLAN VIEW
WITH WING TANKS
40'-0"
5'-0"
7'-10"
21'-11"
ISOMETRIC VIEW
A
A
39'-6"
35'-5 1/16"
5'-7 3/4"
11'- 3/4"
4'-7 1/8"
Front Edge of Center Section
Bottom edge of Mouth Piece
4'-0"
4'-10 5/8"
16'-11 3/4"
1'-3 5/8"
2'-2 1/8"
1 1/8"
4'-5 11/16"
6 3/8"
TRUNNION
34'-6 1/8"
36'-2 3/8"
59'-6 1/8"
ELEVATION VIEW
THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREON IS THE PROPERTY OF DREDGING SUPPLY COMPANY, Inc. AND MUST NOT BE MADE PUBLIC, DUPLICATED, OR USED IN ANY WAY DETRIMENTAL TO OUR INTEREST. IT IS FURNISHED SUBJECT TO RETURN ON DEMAND UNLESS FURNISHED UNDER CONTRACT PROVISIONS.
REV
DATE
BY
REVISIONS
REFERENCE DWG
REFERENCE DRAWING TITLE
A
5-18-06
RLP
Additional Dimensions
DREDGING SUPPLY COMPANY
BRENNAN
General Arrangement
RLP
3/23/2006
D
205110
205110001
A


1'-8 1/4"
0'-6 1/8"
0'-3 7/8"
1'-2 13/16" APPROX
1'-4"
0'-1 3/4"
1'-7 1/2"
2'-7"
0'-4 7/8"
0'-6 15/16"

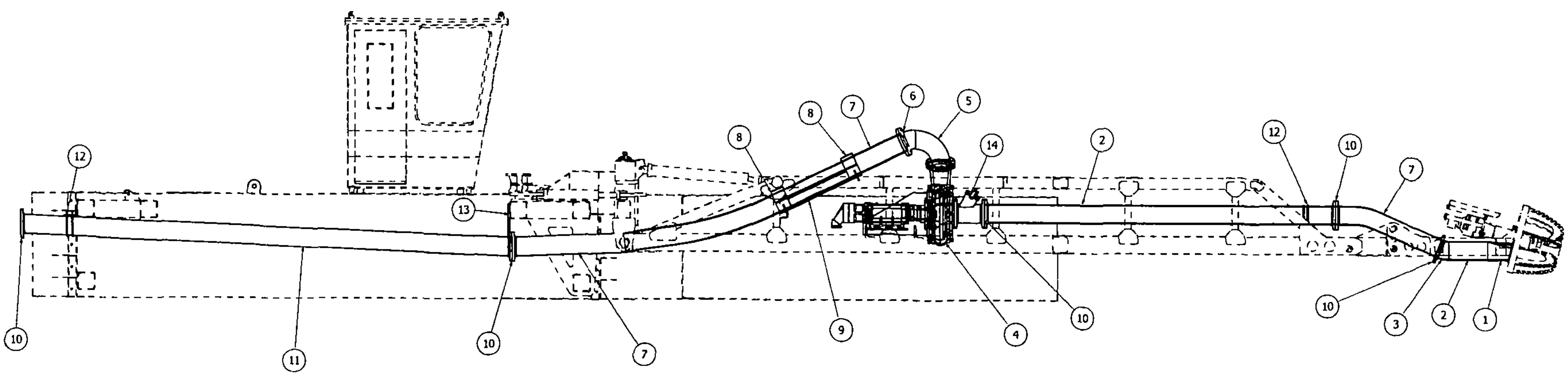


PUMP ASSEMBLY
205260M313

Pump Drive / Pump Assembly Key

Item #	Description	Quantity	Manufacturer	Model #
1	Hydraulic motor	1	Volvo	F11-250-~~Q~~F-SH-F
2	Screws	6	DSC	5/8X1 1/2 in. Socket Head
3	Bearing seal	1	DSC	9603628A-3
4	Screws	4	DSC	3/4x2 in. NF Grade 8
5	Shim	1	Timken	K22920
6	Bearing housing assembly	1	DSC	9603627
7	Shim	AS/REQ	Timken	K22920 / K22907 / K22905
8	Bearing Cup	1	Timken	52618
9	Bearing Cone	1	Timken	52400
10	Shaft	1	DSC	9603629
11	Bearing Cone	1	Timken	782
12	Bearing Cup	1	Timken	772
13	Bearing seal retainer	1	DSC	9603628A-2
14	Screws	6	DSC	5/8X2 in. Socket Head (NC)
15	Duo-cone seals	1	Duo Seal	109-0884
16	Set screws	3	DSC	3/8-16X 1/2 in. cone point Socket Head
17	Rotating seal retainer	1	DSC	9603628A-1
18	Screws	2	DSC	1/4-20 X3/4 in.
19	O-ring	2	Buna	#344
20	Impeller sleeve	1	DSC	9603628A-4
21	Bearing house mount	1	DSC	9603625,26,30,31
22	Screws	4	DSC	3/4X 2in. NC
23	Pump Shell Casing	1	DSC	200-8209D-00-0028G
24	Impeller	1	DSC	19-3/4, RH, CS3.5r,8X20-ME-4-3/8,LCC20
25	Suction Plate / Liner	1	DSC	8ME20,LCC
26	Screws	4	DSC	3/4 X 2in. NC
27	Screws	1	DSC	3/4X6NC all Thread Rod
28	Screws	4	DSC	1X2 !/2 in. NC
29	Screws	1	DSC	1/4 - 24 X3/4 in.
30	Gauge bracket	1	DSC	DSC
31	Screws	6	DSC	3/4X2 1/2 NC
32	Stuffing Box Assembly	1	DSC	616-7008X-00-0000A
33	Stuffing Box Gland	1	DSC	452
34	Packing	4 rings	DSC	13/16 square brade packing
35	Lantern Ring	1	DSC	458
36	Grease Fitting	1	DSC	1/4"NPT
37	Pipe Plug	1	DSC	1/4"NPT

ITEM #	DESCRIPTION
1	MOUTHPIECE
2	8" STD. WALL PIPE
3	ELBOW
4	DREDGE PUMP
5	ELBOW
6	ELBOW (MODIFIED)
7	8" FLEXIBLE HOSE
8	HOSE CLAMP
9	HOSE SADDLE
10	8" 150# FLANGE
11	8" STD. PIPE
12	U-BOLTS
13	PIPE SUPPORT
14	CLEANOUT



REV	DATE	BY	REVISIONS	REFERENCE DWG	REFERENCE DRAWING TITLE

DREDGING SUPPLY COMPANY

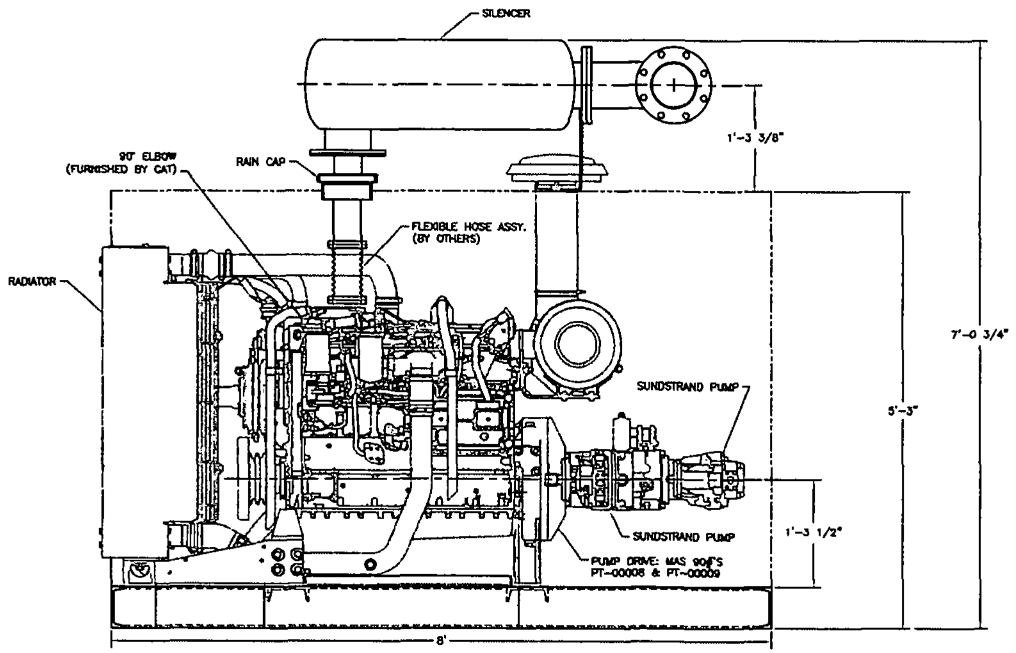
BRENNAN

SUCTION AND DISCHARGE ASSEMBLY

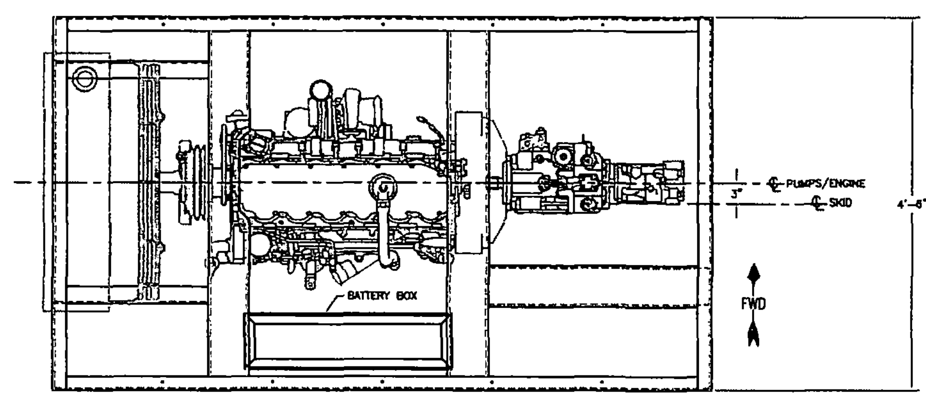
DJG RLP

DATE: 5/31/2006

SCALE: 1/2"=1' SIZE: D



SIDE VIEW



PLAN VIEW
(SOME DETAILS REMOVED FOR CLARITY)

REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

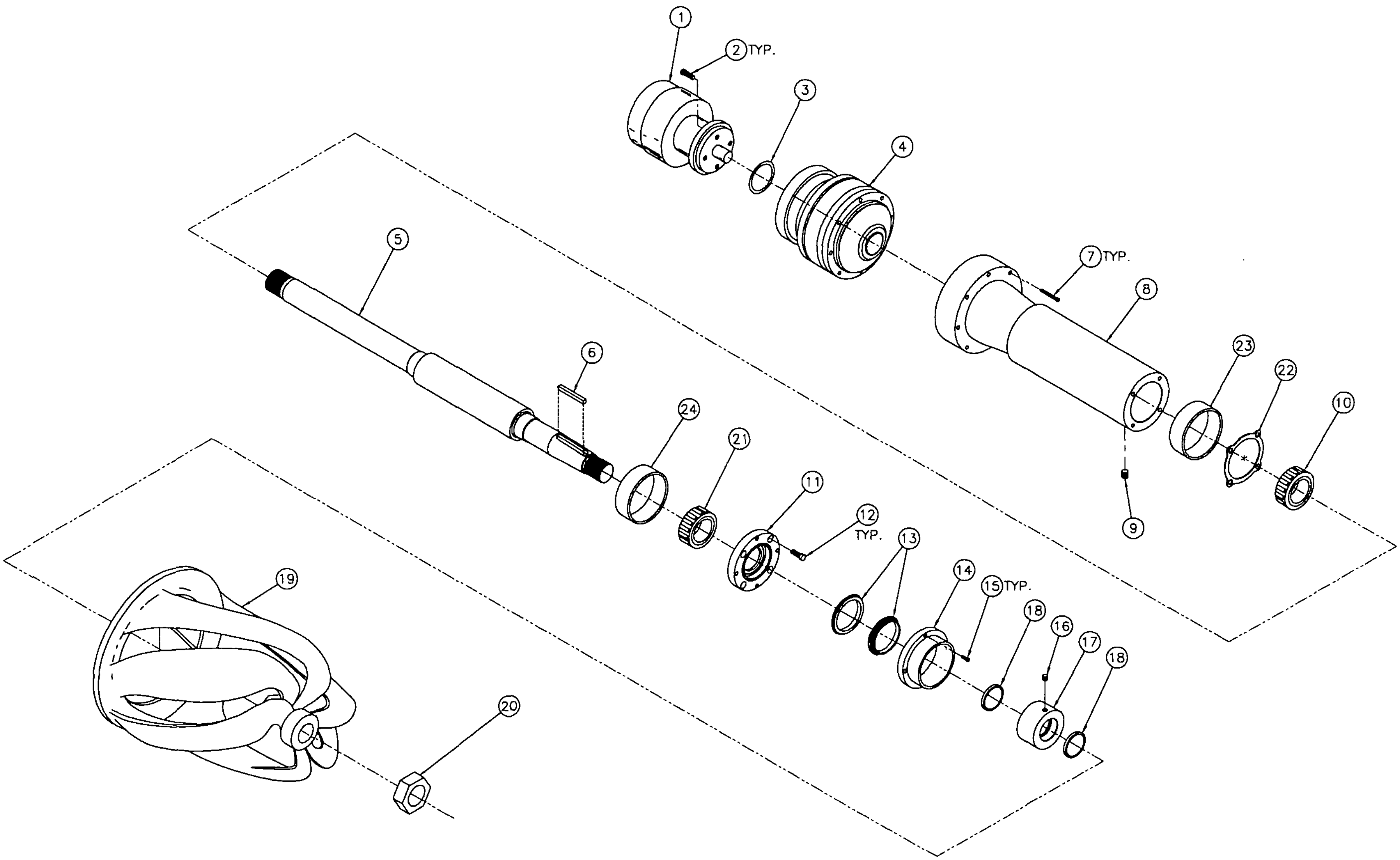
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

2004 8" MORAY DREDGE

3126 ENGINE ARRANGEMENT

DJG/JGD
JGD/DJA
05/09/04
1 1/2"=1'-0"
D
201260
201260M302



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION
A	3/08/2000	WJB	Scale up 1.5				

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

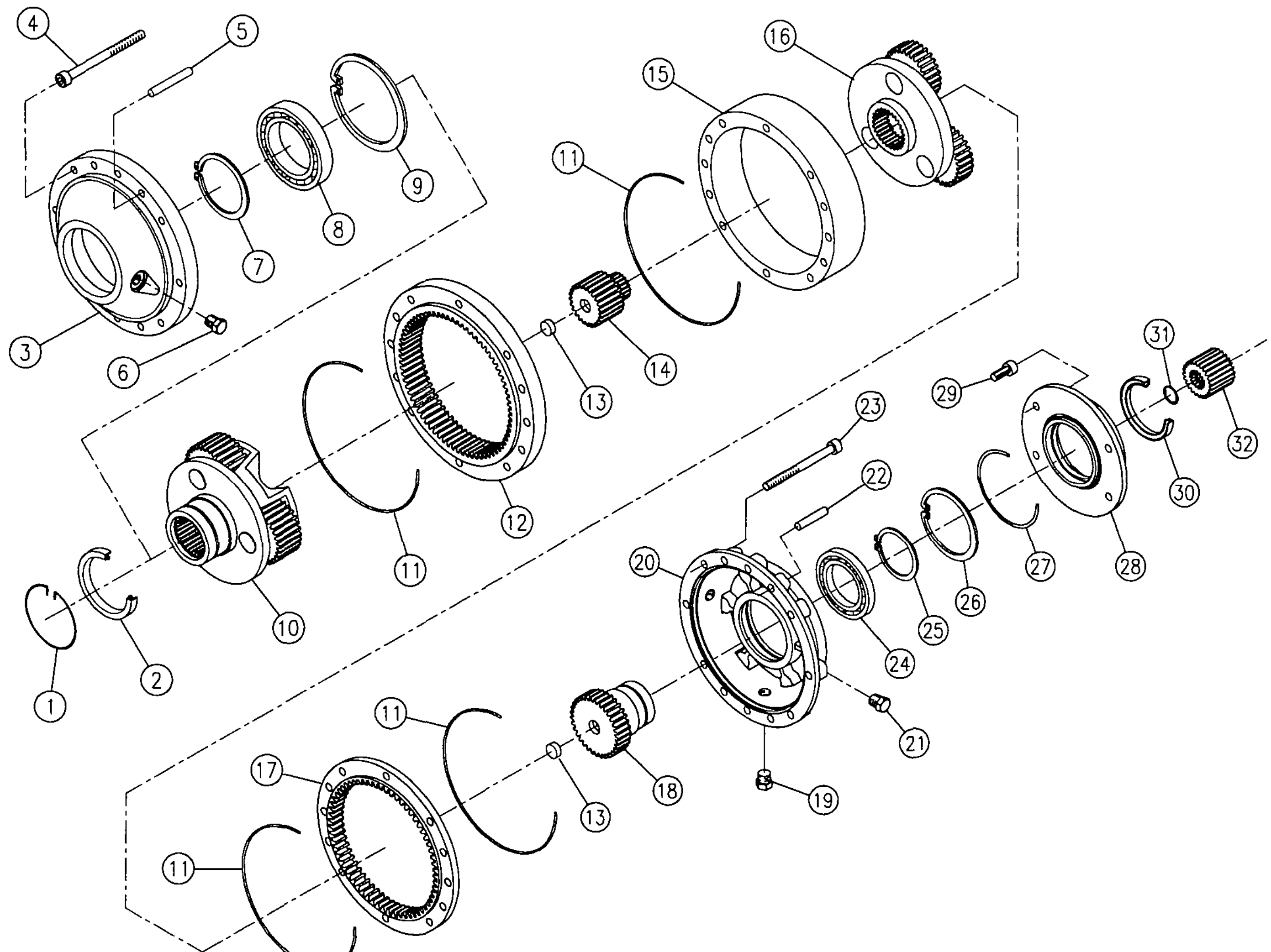
DSC 8" MORAY DREDGE

SEAL BEARING DRIVE ASSEMBLY

DRAWN/DESIGN: MJC	
DRAWN: MJC	
CHK:	APP BY:
SCALE: N.T.S.	DATE: 4/4/00
PROJECT: 98030	
DWG NO.: 9900179	REV: A

Sealed Bearing Cutter Drive Assembly Key

Item #	Description	Manufacturer	Model #
1	Cutter hydraulic motor	Commercial Shear	M31A897BEUF10-25
2	Hex head cap screw	----	12mm x 40mm x 1.5
3	'O' ring	Parker	2-265
4	Cutter gear	Reggiana	RR 500-DF/49 SAE B
5	Cutter shaft	Dredging Supply	9601534-1
6	Cutter key	Dredging Supply	9601534-2
7	Screw	----	3/8" x 9" long
8	Cutter bearing tube	Dredging Supply	9501330
9	Plug	----	1/4" NPT
10	Bearing	Timken	3984/3921XA
11	Stationary seal retainer	Dredging Supply	9501332-1
12	Screw	----	1/2" x 1 1/2" long
13	Duo-cone seal	Caterpillar	8E8338
14	Rotating retainer guard	Dredging Supply	9501332-3
15	Screw	----	1/4"-20 x 1" long
16	Set screw	----	3/8" x 3/8" w/ points
17	Rotating seal retainer	Dredging Supply	9501332-2
18	O" ring	Parker	2-333
19	Basket cutter	Cutter's Edge	----
20	Heavy hex nut	----	2" UNC-2A
21	Bearing	Timken	39590/39520
22	Shim	Timken	K21805 K21807 K21820
23	Bearing Cup	Timken	3921XA
24	Bearing Cup	Timken	39520



MODEL # 9WK943XIML-K-S-S
PART # 9WKJNMTJQNJ4JLQ-T

NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.
DSC 8" MORAY DREDGE
SEALED BEARING DRIVE REDUCTION GEAR ASSEMBLY

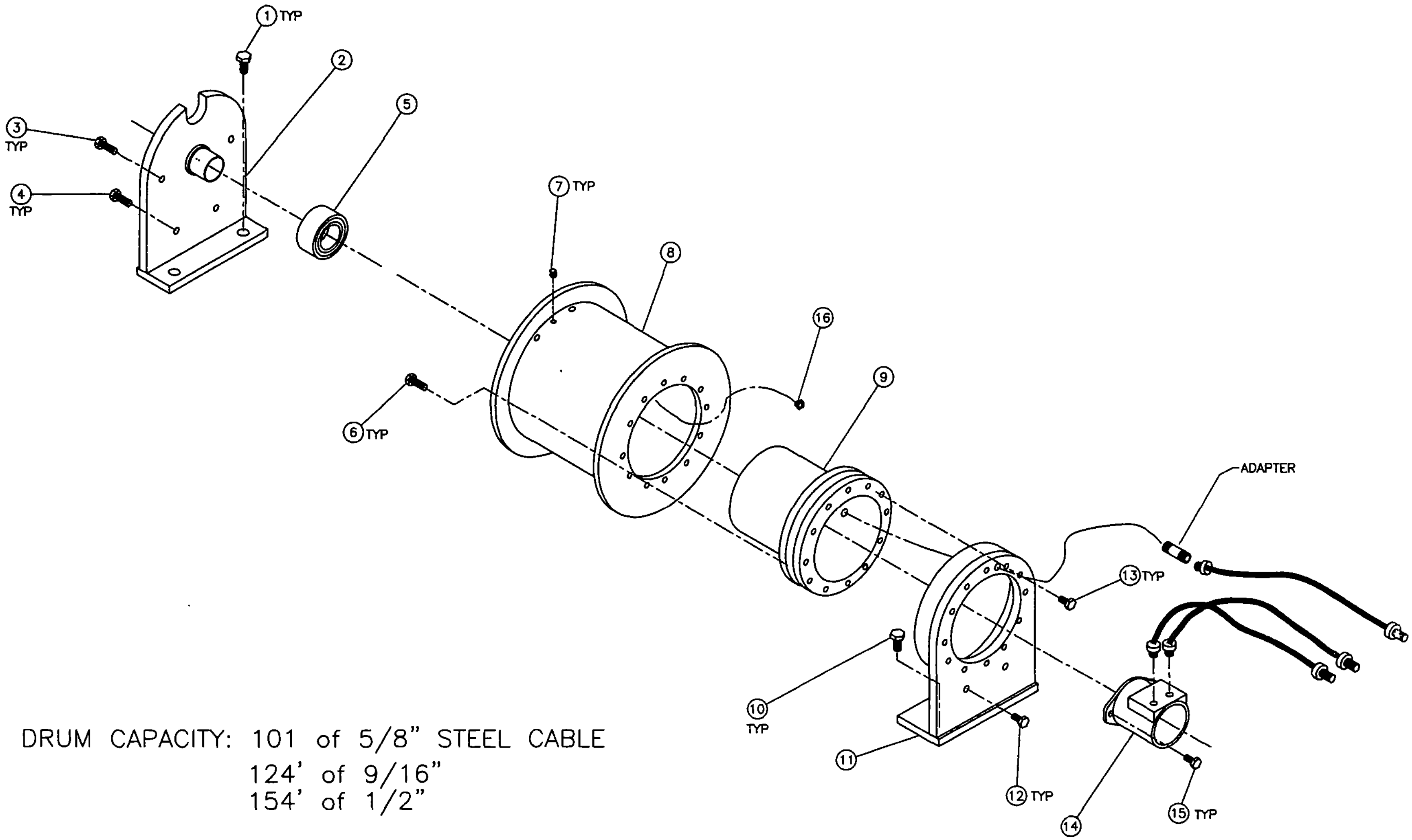
ENGR/DESIGNR: MJC	
DRAWN: MJC	
CHKD	APP BY:
SCALE: N.T.S.	DATE: 4/4/00
PROJECT: 98030	
DWG NO.: 9900181	REV

POS.	OLD P/N	NEW P/N	DESCRIPTION	QTY.
34	24-034	154B3007	SAE "B" 13T COUPLING	1
33	C080022	154-2438	RETAINING RING INT.	1
32	C030060	154-2521	SOCKET HEAD BOLT	4
31	11-028	154B2445	SAE "B" MOTOR CONN.	1
30	C120009	154B2446	RING OIL SEAL	1
29	FG0395	154-2932	GASKET	1
28	C080095	154-2459	RETAINING RING INT.	1
27	C085060	154-2489	RETAINING RING EXT.	1
26	C010024	154-2312	BALL BEARING	1
25	C173002	154-3098	OIL BREATHER PLUG	1
24	C172002	154-3099	SIGHT GAGE	2
23	C174002	154-2713	MAGNETIC TAP	1
22	C030069	154-2531	SOCKET HEAD BOLT	8
21	C092062	154-2680	SPRING PIN	4
20	26-002	154-1750	UNIV. INPUT HOUSING RR310-510	1
19	02-478	154B9104	UNIV. INPUT SUNGEAR RR310/7:1	1
18	20-017	154-1695	THRUST BEARING	1
17	06-124	154B9055	RING GEAR RR 310	1
16	P3239	154B9194	PLANETARY ASSEMBLY RR310/7:1	1
15	09-001	154-1459	SPACER RR 180-750	1
14	17-020	154B4112	SUNGEAR RR 510/7	1
13	20-016	154-1694	THRUST BEARING RR 100-750	1
12	06-005	154-1412	RING GEAR RR 510	1
11	C140051	154-3511	"O"-RING	4
10	P0100	154-1911	PLANETARY ASSEMBLY RR 510F/7	1
9	C080115	154-2464	RETAINING RING INT.	1
8	C010007	154-2327	BALL BEARING	1
7	C085075	154-2493	RETAINING RING EXT.	1
6	C171002	154-2710	STEEL TAP	2
5	C092064	154B2823	SPRING PIN	4
4	C052060	154-2605	HEXAGONAL NUT	2
3	26-035	154B3410	OUTPUT HOUSING RR 180-750F	1
2	C125003	154B3602	RING OIL SEAL	1
1	C097095		RETAINING RING	1
POS.	OLD P/N	NEW P/N	DESCRIPTION	QTY.

RR 510D FS
SAE "B" MOTOR CONN.
RATIO 49:1 **0986-1.xls**

PAGE
1 OF 1
REV. -

***** NEW P/N w/ "B" MAY INDICATE REPLACEMENT KIT ORDER NUMBER. CONTACT RR USA FOR MORE INFORMATION.**
***** NEW P/N IS A KIT NUMBER. CONTACT RR USA FOR MORE INFORMATION.***



DRUM CAPACITY: 101 of 5/8" STEEL CABLE
124' of 9/16"
154' of 1/2"

NO.#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION
						918	

Dredging Supply Company, Inc

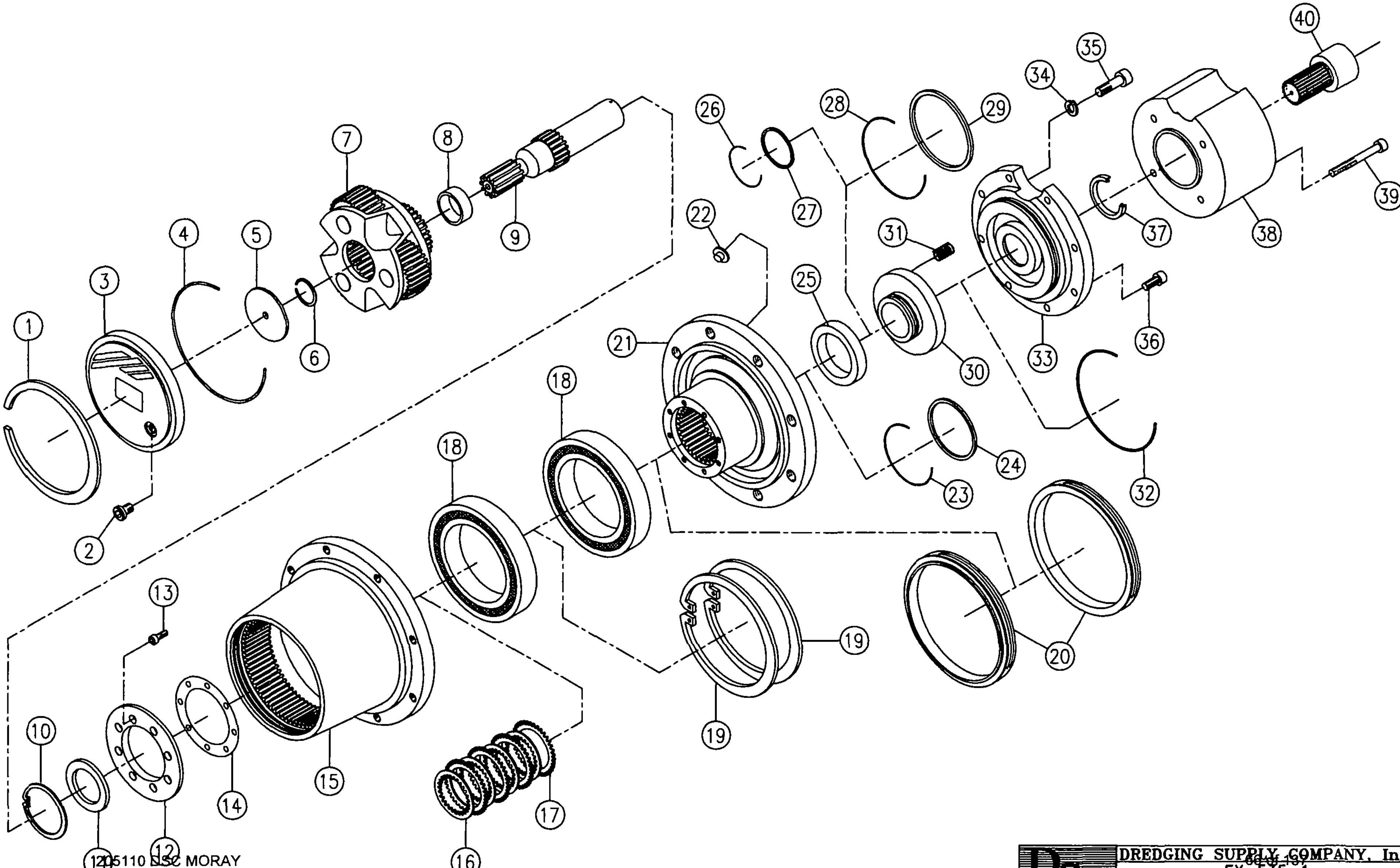
DREDGING SUPPLY COMPANY, Inc.
SWING WINCH
DSC RMLF-91WINCH
SPUD WINCH ASSEMBLY

WJB
WJB
N/S
10/28/00
MANUAL
MANUAL

DSC 91 Winch Exploded Assembly

Item #	Description	Manufacturer	Reference Drawing
1	Screw	DSC	B91
2	Pin Bracket	DSC	B91
3	Screw	DSC	B91
4	Screw	DSC	B91
5	Spherical Roller Bearing	McGill Bearing	SB-22210YSSW33
6	Screw	DSC	B91
7	Set Screw	DSC	B91
8	Drum	DSC	B91
9	Gear	RR	RMLF-091
10	Screw	DSC	B91
11	Motor Bracket	-	B91
12	Screw	DSC	B91
13	Screw	DSC	B91
14	Hydraulic Motor	-	See hydraulic schematic
15	Screw	DSC	B91
16	Internal Grease Fitting	DSC	B91
17	Bearing Bushing	DSC	B91

MAY 2006



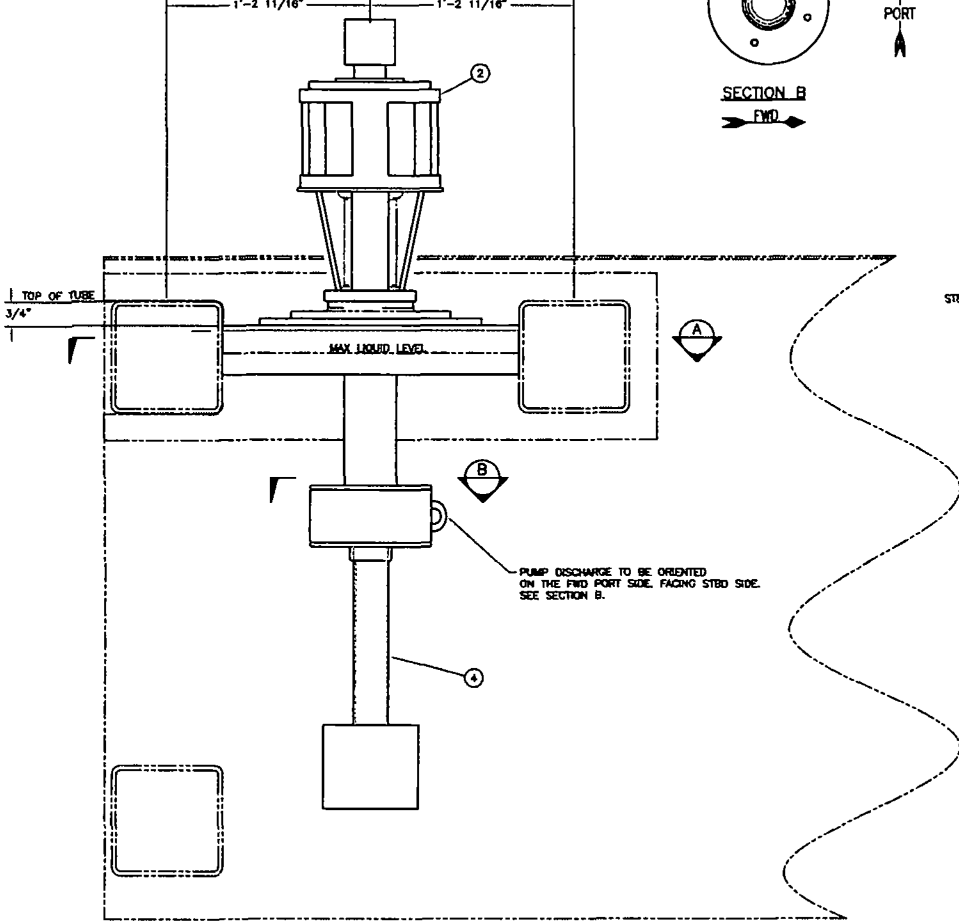
1205110 DSC MORAY

DSC	DREDGING SUPPLY COMPANY, Inc.		
	EX-535-1		
	Scale: NA	Revision:	Date: 7/28/98
	SPUD WINCH REDUCTION		
	JOB # RMLF 091-3	Drawn By: W J bull	DWG. # 9704891

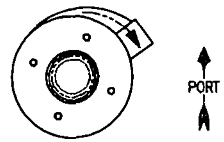
RMLF 091-3 RATIO 6:1

POS.	OLD P/N	NEW P/N	DESCRIPTION	QTY.
1	C088033	154B4035	RETAINING RING INT.	1
2	C170002		STEEL TAP	1
3	40-157	154B3470	END COVER	1
4	C140050	154B2597	"O" RING	1
5	20-146		SHIMMING	1
6	C087016		RETAINING RING INT.	1
7	P2827		PLANETARY ASSEMBLY RMFL091/6	1
8	09-442		SHAFT SPACER	1
9	02-422	154B3311	INPUT SHAFT	1
10	C080065	154-2452	RETAINING RING. INT.	1
11	20-163		SPACER	1
12	09 513		END PLATE	1
13	C030010	154-2501	SOCKET HEAD BOLT	8
14	09-514		SHIMMING	1
15	40-155	154B3468	HUB SUPPORT	1
16	20-086	154-3018	SINTERED DISC.	8
17	20-041	154-1715	STEEL DISC.	9
18	C016034	154B1005	TAPERED ROLLER BEARING	2
19	V-117	154B3189	RETAINING RING INT.	2
20	C138003	154B3618	MECHANICAL SEAL	1
21	40-151	154B3465	STUB AXLE	1
22	C169002		PLASTIC TAP	1
23	C142151	154B3649	"O" RING	1
24	C165030	154B3671	PARBAK RING	1
25	09-483	154B3372	SPACER	1
26	C142135	154B3647	"O" RING	1
27	C165037	154B3674	PARBAK RING	1
28	C142155	154B3650	"O" RING	1
29	C165048	154B3675	PARBAK RING	1
30	18-048		PISTON	1
31	14-027		SPRING	14
32	C140064	154-3514	"O" RING	1
33	40-156		COVER	1
34	C060060	154-2661	SPLIT WASHER	4
35	C030062	154-2523	SOCKET HEAD BOLT	4
36	C030039	154-2510	SOCKET HEAD BOLT	8
37	C120001	154B3483	RING OIL SEAL	1
38	F0626/P/A		CUSTOM SAE "B" MOTOR CON.	1
39	C030078	154-3531	SOCKET HEAD BOLT	4
40	C0626/P/A		CUSTOM SAE "B" 13T COUPLING	1

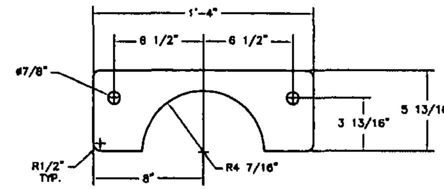
#	QTY	DESCRIPTION	WT #
1	2	L4x3-1/2x3/8"	16
2	1	CARVER - MODEL GVC 1-1/4x1x7 VERTICAL CANTILEVERED PUMP	130
3	2	1/4" PLATE	9
4	1	1-1/4" X12" STD. NIPPLE	1
		TOTAL WEIGHT	161



CL PROFILE
LKG PORT
FWD



SECTION B
FWD



ITEM 3

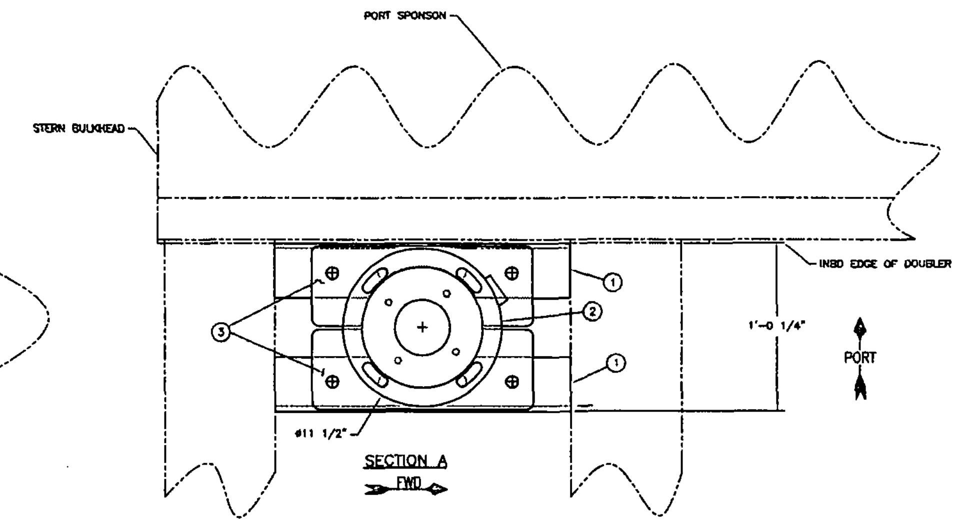
THESE TOLERANCES TO APPLY EXCEPT WHERE NOTED ON DRAWING						
OVER 20"	7"-20"	3"-7"	1"-3"	1/2"-1"	0-1/2"	SURFACE FINISH
±3/16	±1/8	±3/32	±1/16	±1/32	±1/64"	MILL FINISH

MATCHING FILLER METAL REQUIREMENTS

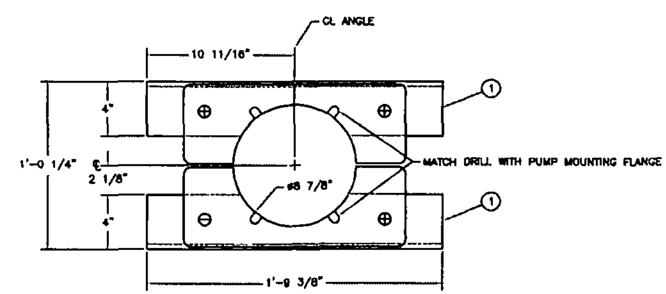
SMAW	AWS A5.1 or A5.5 E70XX or E70XX-X
GMAW	AWS A5.18 ER70S-X

GENERAL NOTES

1.) All external or exposed brackets, padeyes, etc. should be cut on an automatic cutting table wherever possible
2.) Weld slag & splatter should be removed and all welds & adjacent base material should be cleaned by brushing
3.) All welding procedures, including workmanship & technique, will meet those outlined in ANSI/AWS D1.1-98 Structural Welding Code
4.) All structural shapes and templates shall be ASTM-A36 unless otherwise noted
5.) All structural tubing shall be ASTM A-500 Grade B unless otherwise noted
6.) All structural pipe shall be ASTM A-53 Grade B unless otherwise noted
7.) All fillet welds are to be 1/16" less than the minimum material thickness unless otherwise noted
8.) All weights are for reference only and lengths should be field verified
9.) All steel members 8 feet or less in length, including angles, channels, and tubing are to be cut from a single length of steel with no intermediate welded joints.



SECTION A
FWD



PLAN VIEW
ITEM 1 ASSEMBLY

REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE
			205110 DSC MORAY				

DREDGING SUPPLY COMPANY, Inc.
2004 8" MORAY DREDGE
SERVICE WATER PUMP MOUNTING DETAILS
DRAWN: DJC / CHKD: JDH/DJA / DATE: 08/09/04 / SCALE: 3"=1'-0" / SIZE: D / PROJECT: 201260 / DWG NO.: 201260M304

COMMON PROBLEMS

Due to the different nature of sediments and water conditions, problems often occur during the dredging procedure. Some of the more common problems and some solutions are mentioned in the following pages.

Engine Fails to Turn

Check to see that the battery connections are tight - tighten as needed. Check that the batteries are in good working order; charge or replace as needed.

Engine Turns but Fails To Start

Check the fuel level in the tank; fill fuel tanks. Check the fuel filter and fuel pressure gauge. Refer to the engine-operating manual.

Dredge Pump Fails To Prime

Check the procedure used to prime the pump with the procedure listed in this manual. Check that the suction pipe is below the waterline - lower the dredging ladder. Insure that the suction is under water, all the way to the suction side of the pump if possible. Check the pump for trash and be sure the discharge is not blocked.

Engine Overheating or High Exhaust Stack Temperature

Engine speed must be reduced as the dredge pipeline shortens. Operating the engine at a high speed on short discharge lines causes the dredge pump to convey greater volumes of mixture, which greatly increases the horsepower, demand of the pump. Engine speed should be operated where the clear water differential does not exceed 6" of mercury.

Swing Winches Are Not Smooth

Check the swing brake controls on the winches; adjust the brake controls until operation is smooth. The break adjustment is accomplished by adjusting the pressure-reducing valve mounted with the winch. Check the winch brake pistons and plates - refer to the winch service manual.

High Dredge Pump Vacuum, Low Discharge Pressure

Check flow using velocity stick or portable flow meter; decrease engine speed until flow rate is equal to or below 18 feet per second. Check dredge cutter assembly - clean debris around suction inlet.

Inspect dredge pump interior through rock box; remove any foreign material lodged in pump impeller or rock box.

High Dredge Pump Discharge Pressure, Low Vacuum

This condition is normal when the discharge pipe is highly elevated. This condition may be normal for very long pipelines where discharge velocity is low. Check dredge discharge elbow; remove elbow and clean it. Check pipeline for unusual sounds or plugging; jar obstruction loose by striking pipe with hammer.

Low Dredge Pump Discharge Pressure and Vacuum

Check that the pump is primed; follow priming procedure and prime pump. Check the dredge pump interior through the rock box; remove any foreign material lodged in the pump impeller.

Vibration in Dredge Pump

This condition can be caused from trapped gas being released from the bottom into the suction pipe. This condition will be most prevalent in areas where decayed vegetation exists. Check the dredge pump interior through the rock box; remove any foreign material lodged in the dredge pump. This condition can also indicate cavitations in the pump; lower the percentage of material that the dredge is excavating or lower the dredge discharge velocity as needed. Check the pump adjustment and adjust if needed.

Erratic Differential Pressure Readings

Check the inlet pipe to the transmitter and assure that it is not plugged with sand or trash.

Check the transducer for damage or a leak in the water tight case dry and seal the case.

Dredging Supply Company, Inc.

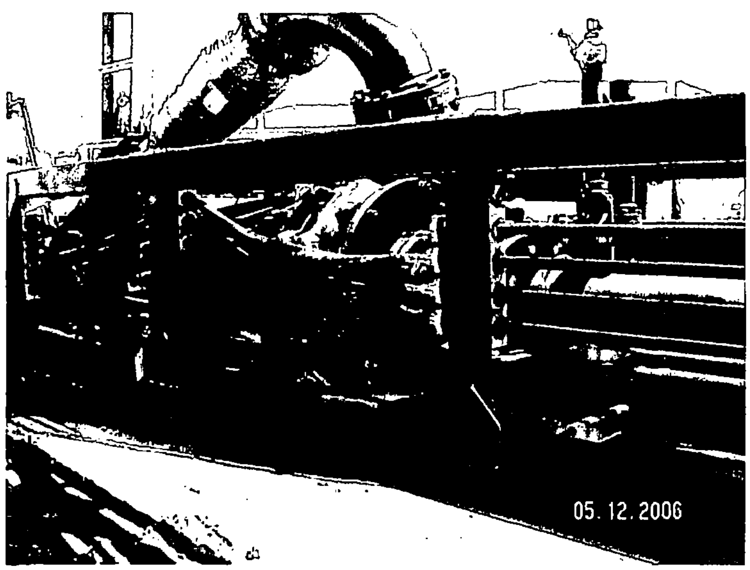
DSC CUSTOM COMPONENTS

SECTION TWO

DSC UNDERWATER PUMP

GENERAL

This pump was developed with state-of-art technology and it was manufactured with utmost care under continuous quality control for use in above water and underwater slurry pump applications in the dredging industry. The pump is primarily used as an underwater ladder pump on a dredge but may be used in other applications. The pump bearings are mounted in an oil filled sealed tube attached to the pump foundation. A static oil tank mounted at an elevation above the pump maintains the oil level in the tube. The bearing tube, with the bearings, is adjustable for adjusting the pump impeller clearances.



The underwater pump consists of a hydraulic powered rotating impeller enclosed in a pump shell (volute) which causes a low-pressure area near the inlet and a high-pressure area throughout the shell to the outlet. Atmospheric pressure and the water column above the pump forces material and water into the low-pressure inlet (the suction) and the pump pushes this material around the shell to the outlet (the discharge) and down the pipeline.

The following operating instructions are intended to facilitate familiarization with the pump and its designated use.

Important information for the reliable, proper and efficient operation of the pump unit is contained in this manual. Compliance with the operating instructions is of vital importance to ensure reliability and long service life of the pump and avoid any risks.

Local regulations are not covered in this manual and the operator must ensure that such regulations are strictly observed by all, including installation personnel.

The pump unit must be operated within the limits specified in the technical documentation for the medium handled, capacity, speed, density, pressure, temperature and hydraulic motor rating. Ensure that the operation is in accordance with the instructions in this manual. (Contact DSC, if required)

Contact DSC if any additional information or instructions exceeding the scope of this manual or in case of damage.

SAFETY

Operating contained in this manual have fundamental information for the safe installation, operation and maintenance of this pump unit. The manual must be read and understood by all operating, and maintenance personnel prior to installation and commissioning, and it must be available for easy access by them.

TRAINING AND PERSONNEL QUALIFICATION

The personnel involved with the maintenance, inspection and repair of the pump or pump bearings must be fully qualified to perform the required work.

Training and instruction are available through DSC and the operator should arrange for help if it is needed.

NON-COMPLIANCE WITH SAFETY INSTRUCTIONS

Non-compliance with safety instructions can endanger the equipment but also personnel and or the environment.

Forfeiture of all rights to claims for damage will result from failure to stay in compliance with these safety instructions.

OPERATOR SAFETY REGULATIONS

Do not remove any guards that prevent accidental contact with moving parts (i.e. over couplings) while the machine is operating.

Contain all leaks of hazardous material to insure no danger exist for personnel and or the environment. Prevailing legal provisions must be adhered to.

MAINTENANCE, INSPECTION AND INSTALLATION SAFETY INSTRUCTIONS

1. Ensure that all of the maintenance, inspection, and installation is performed by authorized and qualified personnel that are thoroughly familiar with the manual.
2. Do not work on the pump when the machine is not at standstill. All shut down procedures described in the manual must be adhered to.
3. Decontaminate pumps or pump units handling material injurious to health or the environment.
4. All safety and protective devices must be reinstalled and activated immediately on compilation of repairs or maintenance, and prior to starting the pump.
5. Refer to the chapter on "Commissioning" and observe all of the instructions before returning the pump to service.

UNAUTHORIZED MODIFICATIONS, AND SPARE PART MANUFACTURING

Alterations to the machine are permitted only after consulting with DSC on each alteration. To ensure safe use only original and authorized spare parts. The DSC liability and warranty for damage can be invalidated by the use of unauthorized parts. (see the warranty)

STORAGE AND TRANSPORTATION

INTERIM STORAGE (INDOORS) AND PRESERVATION

Store the pump in a dry location where the humidity is as constant as possible.

If the pump is stored outdoors it must be covered with a waterproof material for protection from contact with the humidity.

Protect all materials against humidity, dirt, vermin and unauthorized access.

Close all openings on the pump and bearing assembly and open only when required for installation or inspection.

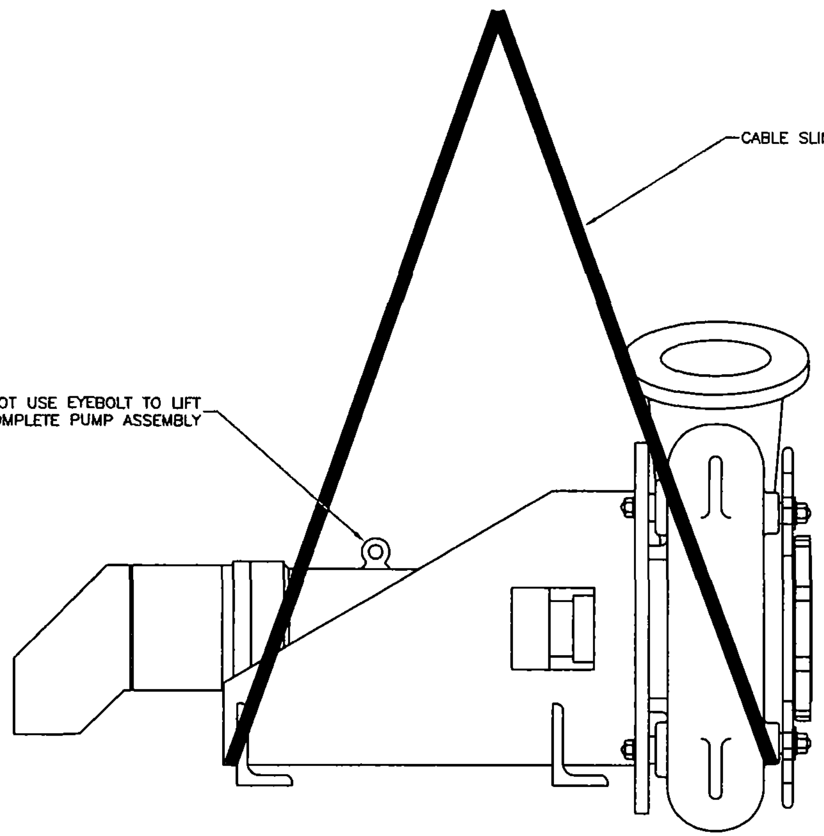
Oil or grease all bare parts to protect them from corrosion.

Maintain the bearing tube by keeping it full of oil.

The hydraulic motor should be filled with oil and sealed.

TRANSPORTING

Proper preparation and handling is required for transporting the unit. Assure that the pump or unit remains in a horizontal position when lifting, or transporting and cannot slip out of the transport suspension arrangement. Do not lift using a sling on the free end of the pump shaft. (See DWG. 201260M309)



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

2004 8" MORAY DREDGE

SMART PUMP
LIFTING DIAGRAM

WJB
DJA
08/09/04
NOT TO SCALE
D
201260
201260M309

DESCRIPTION OF PRODUCT

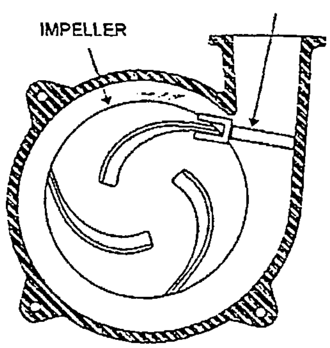
TECHNICAL SPECIFICATION

The unit is for handling coarse or fine particles from solids-laden wastewater to aggressive slurries of an abrasive or corrosive nature as may be encountered in dredging applications.

DESIGNATION

Pump Type --	-	DSC
Discharge Size in inches--------------------------------		8 inches
Suction Size in inches--------------------------------------		8 inches
Impeller Diameter--		19 1/2 inches

DESIGN DETAILS



Horizontal, end suction, modified volute-casing pump with a three-vane impeller for large solids passage.

PUMP CASING

The pump is single wall shell with a three-vane impeller and suction piece constructed of highly abrasion resistant white irons suitable for high-head discharge, mildly corrosive slurries, and all particle sizes up to the maximum sphere passage.

SHAFT SEAL

The shaft seal is a packing gland with a connection for sealing liquid.

IMPELLER TYPE

The impeller is a three vane, double shrouded type.

BEARINGS

The bearing assembly, a DSC designed sealed cartridge type, is mounted on a concentric pedestal with an adjustment mechanism for setting the impeller clearance. (See Pump drive / Pump assembly drawing)

The recommended bearing lubrication is Chevron ISO 100 Turbine oil or an equivalent.

NOISE CHARACTERISTICS

The sound pressure level for the pump alone does not exceed 75 dB at one meter when running within the normal limits of operation on clear liquid.

THE ADDITION OF COURSE SOLIDS, FROTH OR CAVITATION CONDITIONS CAN SIGNIFICANTLY INCREASE THE NOISE LEVELS

Sound pressure levels from motor and gear reducer must be added to the above in accordance with standard acoustic formulas, taking into account the distance between the units.

INSTALLATION

CHECKS PERFORMED PRIOR TO INSTALLATION

The pump foundation must be constructed to receive and support the pump aliened to receive the suction and discharge piping.

CONNECTING THE PIPING

Never use the pump as an anchorage point for the piping.

Remove any covers on the pump suction and discharge before attaching the piping.

Suction and discharge lines should be anchored close to the pump and connected to the pump without transmitting any shock, stress, or strain. Nominal pipeline sizes should be equal to the pump nozzles.

Thermal expansion of the pipelines must be compensated for to avoid any extra loads on the pump that would exceed the permissible pipeline forces and moments.

COMMISSIONING AND START–UP

Compliance with the following requirements is of paramount importance. The scope of the warranty does not cover any damage resulting from non-compliance with these requirements.

COMMISSIONING

Prior to starting the pump, make sure that the following requirements are checked.

Check the oil level in the bearing and assure that the tube is filled with clean oil and the static tank is connected and at the operating level.

If the pump has been stored for an extended length of time follow the procedures outlined in the "maintenance section" of this manual.

BEARING LUBRICATION

The bearing assembly is oil lubricated. The assembly has to be full of oil. Chevron Hydraulic Oil AW ISO 46 or Optional replacement oil, Chevron Hydraulic oil AW ISO 46, or equal. **Do not mix oil types.** and keep the static tank at the operating level. This type of oil typically displays high temperature stability, resistance to oxidation and foaming, and inhibit rust, corrosion, or the formation of deposits.

SHAFT SEAL PACKING

Use pre-stressed packing and the water ring for shaft sealing (PP-00112). Adjust the packing gland to allow for expansion (tighten to a firm fit and back off the gland adjustment nuts one turn).

PRIMING THE PUMP

Prior to startup, the pump and the suction must be primed with the liquid to be pumped by submerging the pump.

Check The Rotation Of The Pump

The correct rotation of the pump is of paramount importance. If the pump is run rotating in the wrong direction, more than momentarily, the impeller may unscrew causing extensive damage to the entire pump unit.

If there is any doubt whether or not the pump has been run in reverse check the impeller and make sure that it is screwed on tight. **If the pump stops suddenly due to motor failure etc., check that the impeller is on tight**.

Correct Direction Of Rotation

The arrow on the pump indicates the correct rotation of the pump. This can be verified observing the shaft at the packing gland on the pump while rotating the pump at minimum speed momentarily. If the pump is not rotating in the correct direction, check the hydraulic motor piping.

Start-Up

Prime the pump as described in the previous paragraphs and bring up to speed.

GENERAL INSTRUCTIONS

WHEN HANDLING LIQUIDS THAT COULD POSE A HEALTH HAZARD THE PUMP MUST BE DECONTAMINATED. WHEN DRAINING THE PUMP ENSURE THAT THERE IS NO RISK TO PERSONS OR THE ENVIRONMENT. WORK ON THE PUMP UNIT MUST BE PERFORMED WITH THE HYDRAULIC POWER TO THE PUMP SHUT DOWN OR LOCKED OUT. ENSURE THAT THE PUMP CAN NOT BE TURNED ON ACCIDENTALLY.

A regular maintenance program will aid in avoiding expensive repairs and contribute to trouble-free, reliable operation of the pump with a minimum of maintenance expense and work.

OPERATION MAINTENANCE AND INSPECTION

The pump should run quietly and vibration free at all times

THE PUMP SHOULD NOT BE RUN DRY FOR MORE THAN A SHORT PERIOD, ONE TO TWO MINUTES AT MINIMUM SPEED.

Prolonged operation against a blocked discharge or suction is not permitted. When running the pump against a closed off discharge for a short period, the permissible pressure and temperature values must not be exceeded. The bearing temperature may not exceed the ambient temperature by more than 65 C (150 F), but never rise above +100 ° C (210 ° F).

Keep the bearing tube full of oil at all times. The static tank must be connected and the oil at the required level in the site glass. (Cold level is 1/3 of the tank)

The packing gland should have a small drip during operation. The gland should be gently tightened when adjusting the flow.

Periodic inspection of the bearing tube seals and motor mount should be done to ensure that the tube is environmentally sealed.

LUBRICATION AND LUBRICATION SCHEDULES

LUBRICATION

The rolling element bearings are lubricated with Chevron Hydraulic Oil AW ISO 46 or Optional replacement oil, Chevron Hydraulic oil AW ISO 46, or equal. **Do not mix oil types.**

Under unfavorable operating conditions, e.g. high ambient temperature, high silt concentration in underwater applications, etc. the checking, replenishing, and replacing the lubricant should be shortened.

OIL CHANGES

The first oil change should be done after 500 operating hours, the following ones after every 2000 hours. Take oil samples the shorter of every 500 hrs. of operation or monthly.

If any sign of water or contamination is detected in the bearing oil, the oil should be changed and the source of the water or contamination eliminated.

Procedure

NOTE: BE SURE THAT THE BEARING TUBE IS FULL OF OIL AND ALL THE AIR IS PURGED FROM IT

Remove the oil drain plug from the bearing tube and pump out the oil and capture and dispose of it. After pumping, draining, and flushing all of the oil from the tube and the static tank, replace any plugs removed. Fill the bearing tube and static tank with fresh oil and bleed the air out of the bearing tube.

Drainage And Disposal

If the pump was used for handling liquids posing health hazards, ensure that there is no risk to persons or the environment when draining the medium. Wear protective clothing and mask if required. Enforce all relevant law.

If the media handled by the pump leaves residues which might lead to corrosion when in contact with the atmospheric humidity, or which could ignite with oxygen contact, the unit must be thoroughly flushed and neutralized.

The flushing liquid used and any liquid residues in the pump must be properly collected and disposed without any risk to persons or the environment.

DISMANTLING

Dismantling and assembly must always be performed in accordance with the relevant sectional drawing.

FUNDAMENTAL INSTRUCTIONS AND RECOMMENDATIONS

Repair and maintenance work must be performed by trained personnel, using original replacement parts.

Observe all the safety regulations for this kind of work. Dismantling and assembly must always be performed in accordance with the relevant general drawings. The general drawings are included within this manual. The dismantling sequence can be derived from the general drawing. In case the unit is damaged, contact DSC service department.

IMPELLER BREAK LOOSE JIG

DO NOT APPLY HEAT TO THE IMPELLER HUB OR NOSE.
DANGER OF EXPLOSION

Rotate the impeller unit until the tip of one blade is facing the pump discharge. Insert the jig through the eye of the impeller and attach to the trailing edge of the blade facing the discharge. Rotate the impeller shaft opposite to normal rotation. Check the brake-loose jig drawing for a description of the brake-loose jig.

Note: To ensure ease when removing the impeller always heavily coat the shaft threads with anti-seize compound and use two armada paper gaskets between the impeller and the shaft when assembling the pump.

IMPELLER LIFTING JIG

When removing or installing the impeller, grasp the impeller at the suction eye and install or remove from the shaft. If needed a lifting jig may be used (contact DSC for building suggestions). Impeller removal requires that the lifting line is tight prior to shaft thread disengagement from the impeller when using a lifting jig.

PUMP UNIT ASSEMBLY

General Instructions

The pump assembly should be done in accordance with the rules of sound engineering practice.

Clean all dismantled components and check for signs of wear. Replace damaged or worn components with original replacement parts. Make sure that the seal faces are clean and that the O-rings and gaskets are properly fitted.

New seal elements should be used whenever the pump is assembled. Make sure that the new gaskets are the same thickness as the old gaskets.

Fit gaskets made from graphite or other asbestos-free material without using lubricants, such as copper grease of graphite paste. If a mounting aid is necessary, use a contact adhesive. The adhesive should be only used as a spot adhesive and applied only in select spots and in thin layers.

Do not use cyanoacryiate adhesives (quick setting adhesives).

Reassemble (General)

Assembling the pump is conducted in the reverse order to dismantling it.

Use the general drawings and list of components for guidance. All bolts and screws must be properly tightened during assembly. For the required torque values, refer to the bolt torque chart.

Impeller

Coat the pump shaft threads heavily with anti-seize compound. Do not coat the shaft sleeve faces that contact the impeller or the step in the shaft.

Install two each, 0.5mm (0.020-inch) armada gaskets between the shaft sleeve and the impeller hub face to prevent galling and to ensure ease of impeller removal. The **gaskets are installed dry, without grease**.

Screw the impeller on by hand. Impeller lifting jigs are available to assist with handling the impeller if needed.

When the pump assembly is complete check the impeller to suction-side door clearance and adjust if necessary (See section on Axial Adjustment of Bearing Tube).

SEALED BEARING ASSEMBLY

Reference the "PUMP DRIVE / PUMP ASSEMBLY" drawing when assembling the sealed tube bearings.

Before assembly, thoroughly clean the shaft, the housing bore, and end cover surfaces with a suitable solvent to remove old grease, oil or any water, dust or grit. The following is a suggested order for bearing installation:

Install the bearing carriers in the stationary seal carrier and motor mount end cover. Bake or heat in oil the bearings and cones to a maximum temperature of 220°F (110°C). Press the bearings and cones on the shaft. (See Pump drive / Assembly drawing for bearing locations) Bolt and torque the motor-mount end-cover to the bearing tube with a 0.020 in standard metal shim between the tube and the end cover. Install the shaft through the tube, seating the bearing in the cup in the end cover and install the remaining end cover, with the cup pressed in it, on the matching bearing. Positioning the tube in a vertical position with the motor end down may help in putting the shaft in the tube. Pull the seal end cover down uniformly as the shaft is rotated slowly until a mild drag is felt. Measure the gap between the tube and the seal end plate and add.004 to.006 inch. to it. This is the amount of shims that need to be put between the bearing seal end cover and the tube. After the standard metal shims have been added, torque the bolts to the torque value in the bolt torque chart. Install the mechanical seals and the rotating seal retainer. Press the bearing sleeve with the two "O-Rings" on the pump shaft until it seats against the shoulder on the shaft. Bolting it to the slide plate on the bearing pedestal completes the sealed bearing assembly.

INSTALLING THE BEARING TUBE MECHANICAL SEALS

General

Proper installation of the mechanical seal is not difficult. This data sheet covers the basic method to be used for installation and provides helpful tips and inspection dimensions to verify an accurate assembly. Installation handbooks are available for assembly personnel to serve as a reference. Also, seal installation tools are available to facilitate a fast, accurate assembly process.

Proper care and handling practices must be followed when installing mechanical seals to insure maximum life and the positive sealing protection afforded by these precision components. The mechanical seal group is specially packaged to protect the rings during shipment. Similar care must be exercised during handling and installation. Improper care and installation can result in immediate leakage or reduced service life.

To obtain maximum performance the seals must be installed accurately to insure uniform loading at the mating faces and achieve a stable running position. Misalignment or cocking of seal rings during assembly can produce non-uniform loading and wobbling of the seals in their housing-resulting in leakage due to scoring and/or pumping of debris past the toric rings. Improper installation can also result in breakage of the metal seal rings. **Refer to the seal manufacturer's installation procedures packaged with the new seals for more detailed instructions.**

MOUNTING THE BEARING ASSEMBLY TO THE PEDESTAL

The bearing pedestal bolts on the pump foundation and the bearing tube bolts on the bearing pedestal. The bearing pedestal includes a slide plate and an adjusting screw for axial adjustment of bearing tube. Torque all of the bolts in the foundation to the maximum value in the torque chart. Adjust the pump and then torque the slide locking bolts to their maximum.

AXIAL ADJUSTMENT OF THE BEARING HOUSING

The DSC pump performance is maximized when the clearance between the suction face of the impeller and the suction liner is adjusted to a minimum clearance of 0.25mm (0.010 inch). This is accomplished by axial movement of the bearing housing / shaft assembly to which the impeller is fixed.

The pump-wetted end must be completely assembled before the impeller adjustment may proceed. The stuffing box may be packed before or after adjusting the pump.

Slightly loosen the bearing tube slide locking bolts and move the bearing tube assembly towards the impeller end by means of the adjusting screws until the impeller begins to rub the suction liner. Slowly rotating the impeller is helpful during this procedure. (Note: the hydraulic motor is not attached when adjusting the pump.)

Next, reverse the adjusting screws until the clearance between the impeller and the suction liner is a minimum of 0.25-mm (0.010-inch).

The final movement of the bearing housing during adjustment should always be away from the impeller end as described above. This ensures that the threads of the adjusting screw will contain no backlash against the forward-directed thrust loading that pump will generate.

When the clearance is correct, tighten the bolts on the bearing slid plate to lock the adjustment in place.

MOUNTING THE GLAND PACKING

Using Sealing Water

When sealing water is used to keep the stuffing box free from abrasive particles, the sealing water pressure and gland tightness should be adjusted to maintain a small flow of cool to slightly warm fluid from the stuffing box. The sealing water required for the stuffing box operations is approximately 1.7 gpm delivery for worn packing. The "Moray's" service water pump will exceed the required flow for the flushing water. Tightening the packing will adjust the pressure reading.

The stuffing box purge water should be pressure controlled, **not flow** controlled. Adjust the packing pressure to the min. amount of flow from the packing gland needed to provide the necessary cooling.

SPARE PARTS STOCK

The erosive action of some types of slurries may cause the replacement of many of the wetted components of the pump in the course of normal maintenance. Inspection or overhaul of the mechanical components may also lead to the replacement of some parts.

The list below is the recommended parts for normal maintenance and inspection. The quantity of the parts kept on hand will depend on the severity of the slurry duty and the number of units operating. Maintenance practices may require keeping a complete pump unit or fully built sub-assemblies in stock. Previous experience in similar duties usually will provide the best means of determining the quantity requirement. If assistance is needed in determining the quantities contact DSC.

Wet End

Pump Shell

Impeller

Suction-side door

Gasket Kit

Bearing Assembly

Bearings

Service water Pump

Complete Pump

Directional Control Valve

Stuffing Box

Shaft Sleeve

Seal water ring

Packing

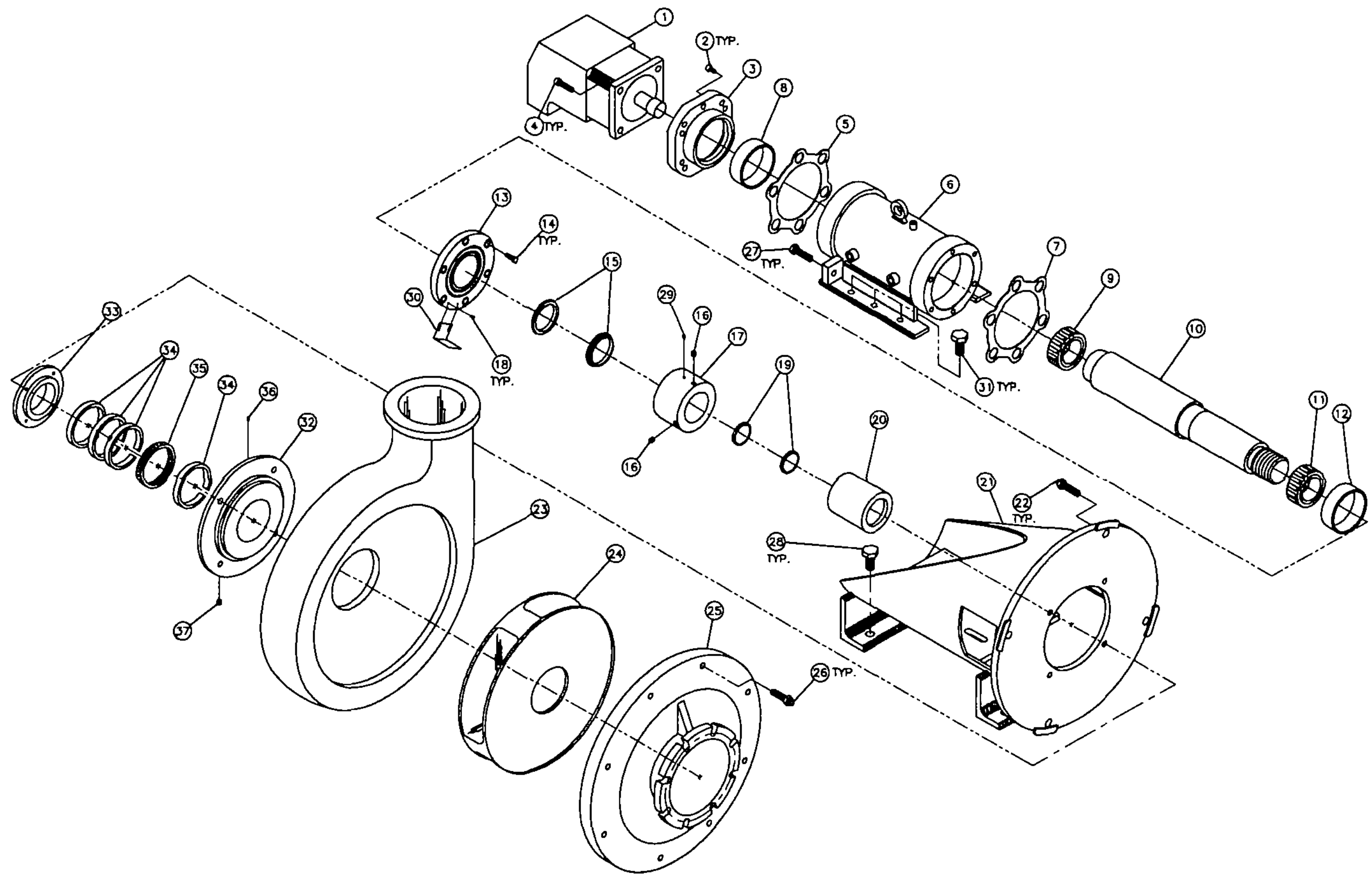
Stuffing box gasket kit

Mechanical Seals

Hydraulic Drive Motor

TROUBLE SHOOTING UWP

Trouble Shooting									
Insufficient flow rate	Motor Over Loaded	Excessive Pump Discharge Pressure	Increase in Bearing Temperature	Excessive Leakage at the Pump	Excessive Leakage at the Shaft Seal	Vibration During Pump Operation	Excessive Temperature in the Pump	**CAUSE**	**REMEDY**
X								Pump delivers against an excessively high discharge pressure.	Adjust amount of solids in slurry
X						X	X	Pump not primed or pipe line blocked	Prime pump / unblock line
X								Formation of air pockets in the piping.	alter piping layout. Fit a vent valve in the piping.
			X		X	X		Pump is warped or sympathetic vibrations in piping.	Check pipeline connections and secure pump; if required, reduce the distance between pipe clamps. Secure the pipeline with anti-vibration material.
			X					Increased axial thrust (contact DSC)	Correct rotor adjustment.
X								Air leak at shaft seal (above water installation)	Chck the sealing water pressure and flow and adjust as needed. Adjust or repack the pump.
			X					Reverse rotation.	Re-install the hydraulic motor with the proper rotation.
X								Speed too low	Increase Speed
						X		Defective bearings	Install new bearings
			X			X	X	Insufficient flow rate	Increase the pump speed to the minimum flow rate is reached
X					X			Worn internal parts	Replace the worn parts with new parts
					X			Use of unsuitable materials	Change the material combination
	X	X						Speed is too high	Reduce the pump speed
				X				The bolts and gaskets.	Tighten the bolts and install new gaskets.
					X			Worn packing, loose adjustment on packing, or Low sealing water pressure if used.	Adjust or replace the packing and, if used, check and adjust the sealing water..
X					X			Score marks or roughness on the packing shaft sleeve.	install new shaft sleeve and adjust packing to correct pressure.
					X			Stuffing box ring, Packing ring, has been tightened incorrectly, wrong packing material.	correct
					X			Vibration during pump operation.	Clean the pump. Improve suction conditions. Re-aline the pump. Re-Balance the impeller.
			X					Insufficent or excessive quantity of lubricant or unsuitiable lubricant.	Top off , reduce or change lubricant. Check seals and replace if damaged.
					X			Impeller is out of balance	Clean the impeller. Re-blance the impeller.
									NOTE: RELEASE ALL PRESSURE BEFORE WORKING ON THE PUMP.



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

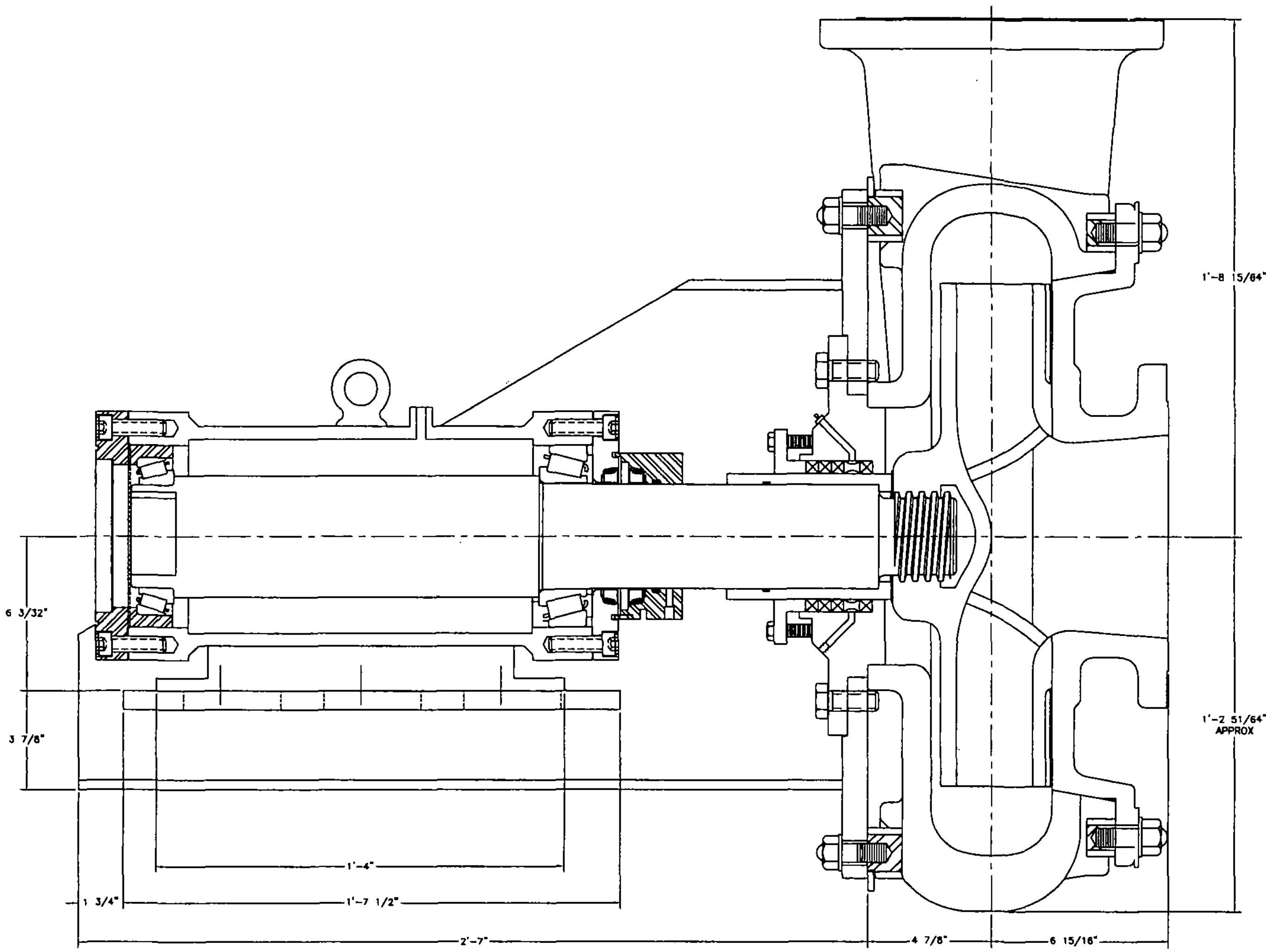
DSC 8" MORAY DREDGE

PUMP DRIVE / PUMP ASSEMBLY

DSGR/DESIGNR: MJC	
DRAWN: MJC	
CHK:	APP BY:
SCALE: N.T.S.	DATE: 4/4/00
PROJECT: 98030	
DWG NO#: 9900177	REV

Pump Drive / Pump Assembly Key 9900177

Item #	Description	Quantity	Manufacturer	Model #
1	Hydraulic motor	1	Volvo	F11-250-QF-SH-F
2	Screws	6	DSC	5/8X1 1/2 in. Socket Head
3	Bearing seal	1	DSC	9603628A-3
4	Screws	4	DSC	3/4x2 in. NF Grade 8
5	Shim	1	Timken	K22920
6	Bearing housing assembly	1	DSC	9603627
7	Shim	AS/REQ	Timken	K22920 / K22907 / K22905
8	Bearing Cup	1	Timken	52618
9	Bearing Cone	1	Timken	52400
10	Shaft	1	DSC	9603629
11	Bearing Cone	1	Timken	782
12	Bearing Cup	1	Timken	772
13	Bearing seal retainer	1	DSC	9603628A-2
14	Screws	6	DSC	5/8X2 in. Socket Head (NC)
15	Duo-cone seals	1	Duo Seal	109-0884
16	Set screws	3	DSC	3/8-16X 1/2 in. cone point Socket Head
17	Rotating seal retainer	1	DSC	9603628A-1
18	Screws	2	DSC	1/4-20 X3/4 in.
19	O-ring	2	Buna	#344
20	Impeller sleeve	1	DSC	9603628A-4
21	Bearing house mount	1	DSC	9603625,26,30,31
22	Screws	4	DSC	3/4X 2in. NC
23	Pump Shell Casing	1	DSC	200-8209D-00-0028G
24	Impeller	1	DSC	19-3/4, RH, CS3.5r,8X20-ME-4-3/8,LCC20
25	Suction Plate / Liner	1	DSC	8ME20,LCC
26	Screws	4	DSC	3/4 X 2in. NC
27	Screws	1	DSC	3/4X6NC all Thread Rod
28	Screws	4	DSC	1X2 !/2 in. NC
29	Screws	1	DSC	1/4 - 24 X3/4 in.
30	Gauge bracket	1	DSC	DSC
31	Screws	6	DSC	3/4X2 1/2 NC
32	Stuffing Box Assembly	1	DSC	616-7008X-00-0000A
33	Stuffing Box Gland	1	DSC	452
34	Packing	4 rings	DSC	13/16 square brade packing
35	Lantern Ring	1	DSC	458
36	Grease Fitting	1	DSC	1/4"NPT
37	Pipe Plug	1	DSC	1/4"NPT



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

DSC 8" MORAY DREDGE

SEALED BEARING SMART PUMP ASSEMBLY

CHKR/DESIGNER: MJC
DRAWN: MJC
CHK:
APP BY:
SCALE: 6"=1'-0"
DATE: 4/4/00
PROJECT: 98030
DWG NO.: 9900184
REV:

RECOMMENDED BOLT TIGHTENING TORQUE VALUES

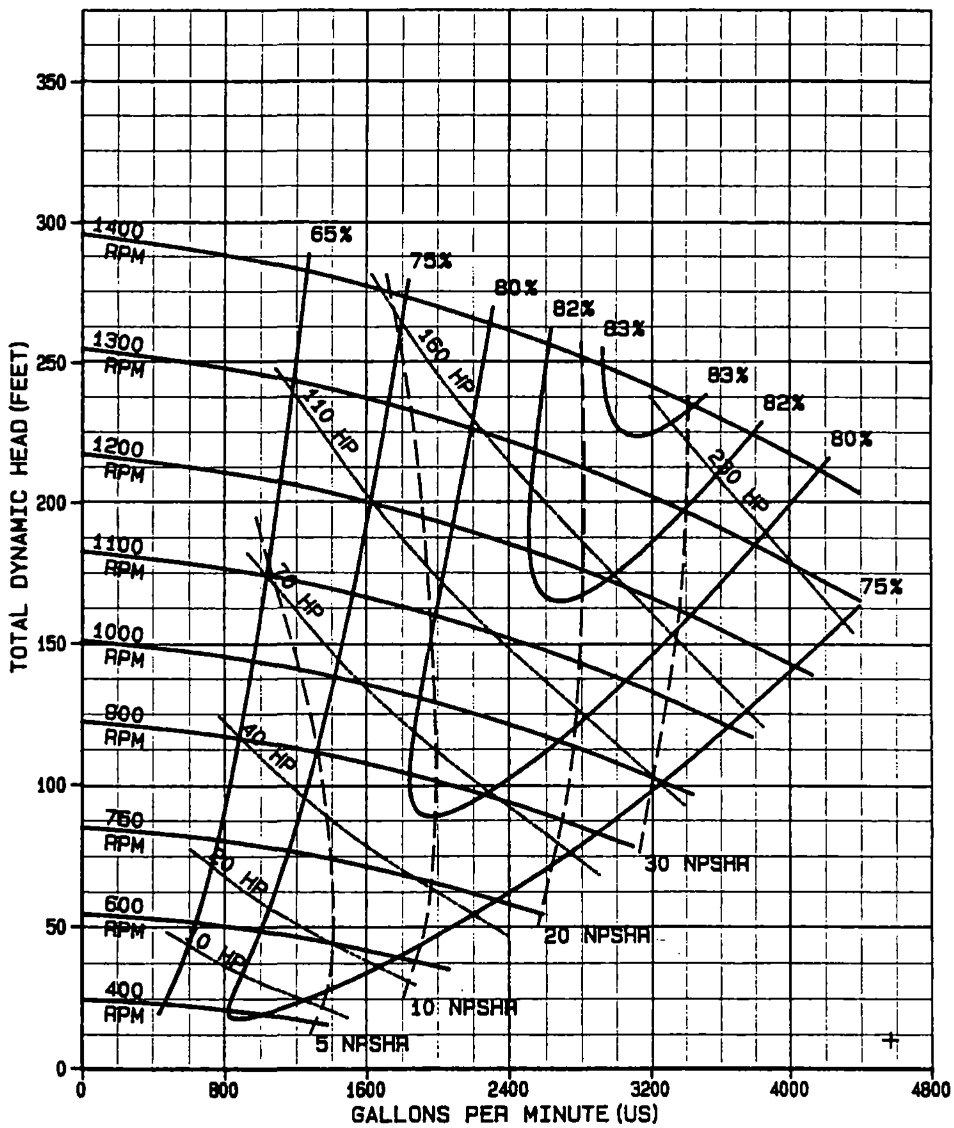
(Unless otherwise noted) Metal-to-Metal contact only

Thread Sizes (inches)	Torque (ft.-lbs.)
¼"-20	7-9
5/16"-18	13-17
3/8"-16	24-30
½"-13	60-75
5/8"-11	120-150
¾"-10	210-260
7/8"-9	320-400
1"-8	460-580
1 1/8"-7	610-800
1 ¼"-7	900-1120
1 ½"-6	1540-1940

Dredging Supply Company, Inc.

DSC MORAY DREDGE PUMP CURVE
8 X 8 X 19.75

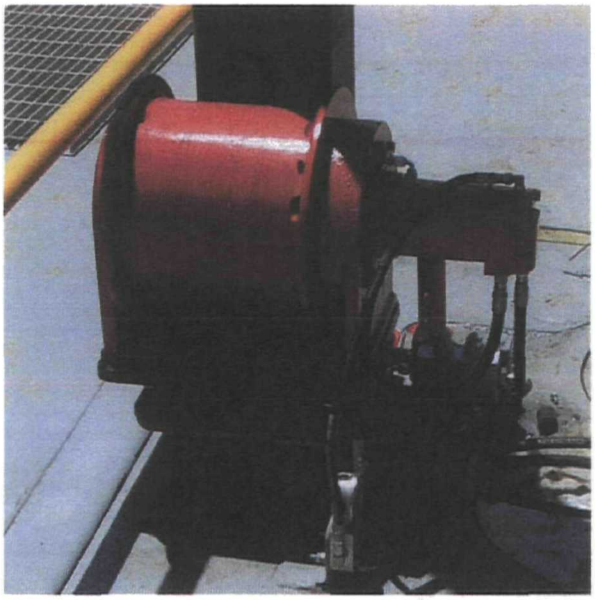
DREDGE PUMP	Vane Diameter 19.75"	Free Passage 3.5x3.0"	Dredging Supply Company, Inc.
Clear Water Performance The effects of specific gravity, viscosity and solids on performance with slurry must be accounted for. Alternate choice for frame size or seal type may also have some effects.	Frame Size 3 Seal Type P	Curve Number E 8H-87 Test Number 8300 -93	



DSC SPUD WINCHS

The DSC spud winches are custom built for use with dredges built by Dredging Supply Co, Inc. The winch is a high performance, high efficiency planetary winch, with equal speed in both directions with a static brake system. It is used primarily as a spud winch but may be adapted to other uses.

THIS WINCH IS NOT DESIGNED OR INTENDED FOR INSTALLATION ON PERSONNEL LIFTING OR MOVING EQUIPMENT.



DSC SPUD WINCH

DSC SPUD WINCH SPECIFICATIONS

Cable Drum Dimensions: DSC series 091 winch

line pull:	5,150 lb
line speed:	100 ft./min.
wire size:	3/8"

LUBRICATION SPECIFICATIONS

Hydraulic Fluid:

The hydraulic fluid selected for use with the DSC SPUD Winch should be high-grade oil with rust, oxidation and ware resistance of petroleum or vegetable base. Efficiency and service life and winch reliability depend heavily on fluid cleanliness and operating viscosity.

The recommended oil is either Chevron Hydraulic Oil AW ISO 46 or equal

REDUCTION GEAR LUBRICATION:

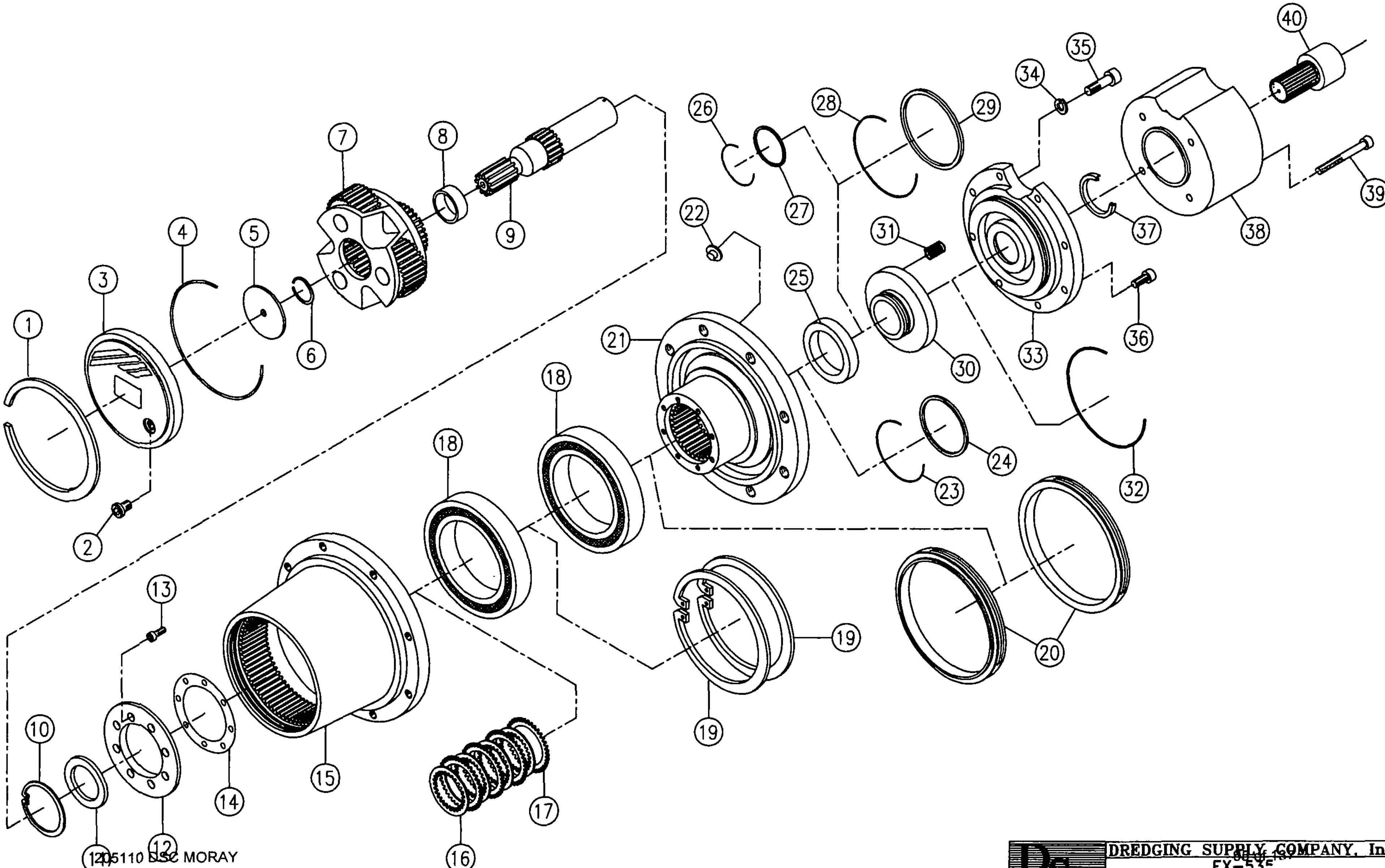
The gear train in the winch requires oil bath lubrication. Check the oil level when the winch is received. Refer to parts drawing for filler location. Oil changes are recommended after the first 500 to 1000 hours of operation, after that every 2000 hours of operation or 12 months. Use Chevron Gear compound ISO 150 or equal. The maintenance schedule may be altered to accommodate changes in the operating environment.

Hydraulic Filter:

The hydraulic circuit must have a return filter that meets the following:

Average Atmosphere:	10 microns
Dusty Atmosphere:	5 microns

The filter should have a by-pass feature to prevent accidental stoppage of the return line.



DREDGING SUPPLY COMPANY, Inc.

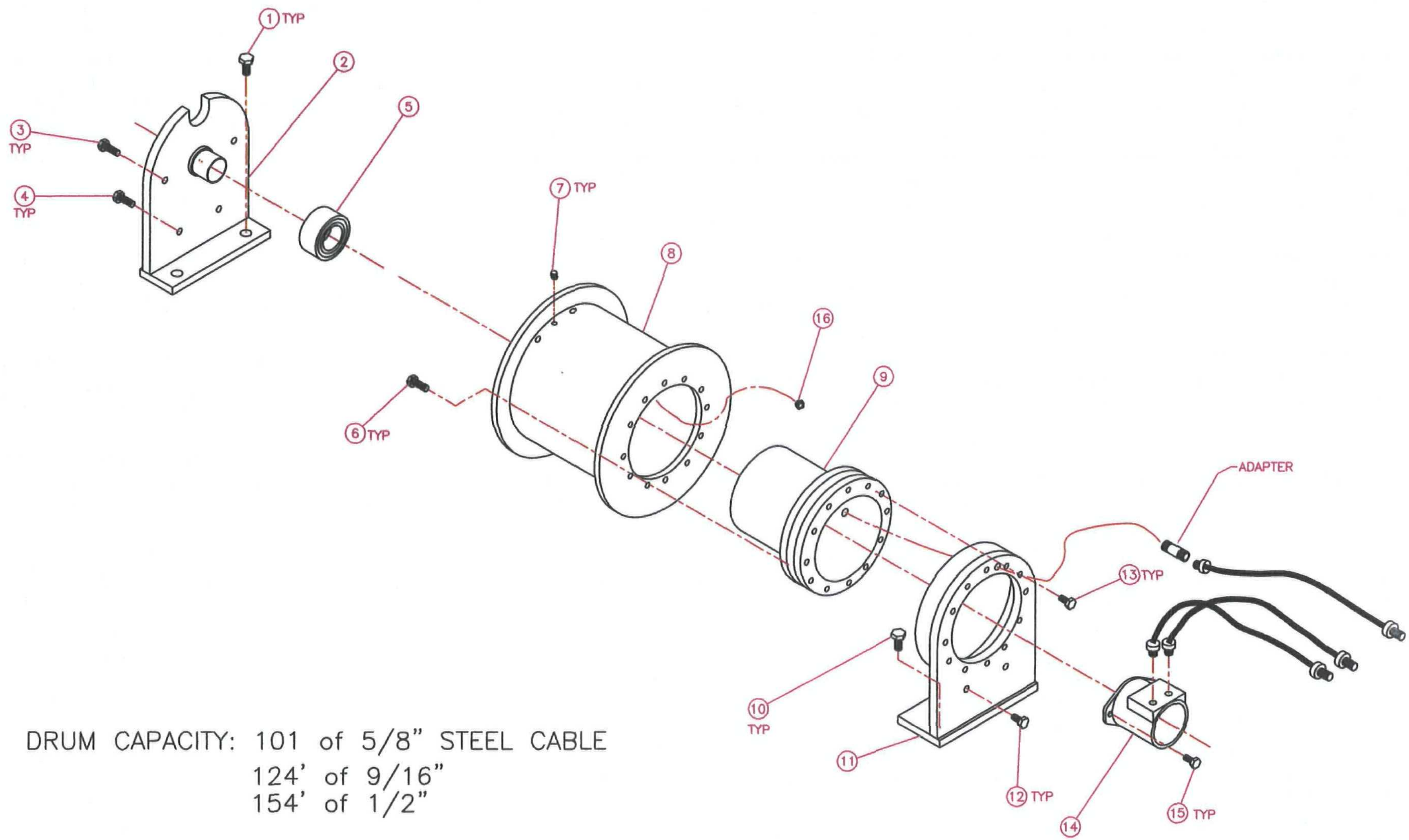
EX-535

86 of 137

Scale: NA	Revision:	Date: 7/28/98
SPUD WINCH ...ION		
JOB # RMLF 091-3	Drawn By: W J bull	DWG. # 9704891

RMLF 091-3 RATIO 6:1

POS.	OLD P/N	NEW P/N	DESCRIPTION	QTY.
1	C088033	154B4035	RETAINING RING INT.	1
2	C170002		STEEL TAP	1
3	40-157	154B3470	END COVER	1
4	C140050	154B2597	"O" RING	1
5	20-146		SHIMMING	1
6	C087016		RETAINING RING INT.	1
7	P2827		PLANETARY ASSEMBLY RMFL091/6	1
8	09-442		SHAFT SPACER	1
9	02-422	154B3311	INPUT SHAFT	1
10	C080065	154-2452	RETAINING RING. INT.	1
11	20-163		SPACER	1
12	09 513		END PLATE	1
13	C030010	154-2501	SOCKET HEAD BOLT	8
14	09-514		SHIMMING	1
15	40-155	154B3468	HUB SUPPORT	1
16	20-086	154-3018	SINTERED DISC.	8
17	20-041	154-1715	STEEL DISC.	9
18	C016034	154B1005	TAPERED ROLLER BEARING	2
19	V-117	154B3189	RETAINING RING INT.	2
20	C138003	154B3618	MECHANICAL SEAL	1
21	40-151	154B3465	STUB AXLE	1
22	C169002		PLASTIC TAP	1
23	C142151	154B3649	"O" RING	1
24	C165030	154B3671	PARBAK RING	1
25	09-483	154B3372	SPACER	1
26	C142135	154B3647	"O" RING	1
27	C165037	154B3674	PARBAK RING	1
28	C142155	154B3650	"O" RING	1
29	C165048	154B3675	PARBAK RING	1
30	18-048		PISTON	1
31	14-027		SPRING	14
32	C140064	154-3514	"O" RING	1
33	40-156		COVER	1
34	C060060	154-2661	SPLIT WASHER	4
35	C030062	154-2523	SOCKET HEAD BOLT	4
36	C030039	154-2510	SOCKET HEAD BOLT	8
37	C120001	154B3483	RING OIL SEAL	1
38	F0626/P/A		CUSTOM SAE "B" MOTOR CON.	1
39	C030078	154-3531	SOCKET HEAD BOLT	4
40	C0626/P/A		CUSTOM SAE "B" 13T COUPLING	1



DRUM CAPACITY: 101 of 5/8" STEEL CABLE
124' of 9/16"
154' of 1/2"

NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION
						91B	

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.
SWING WINCH
DSC RMLF-91WINCH
SPUD WINCH ASSEMBLY

DRN/DESGN: WJB
CHKD: WJB
SCALE: N/S
DATE: 10/26/00
PROJECT: MANUAL
DWG NO.: MANUAL

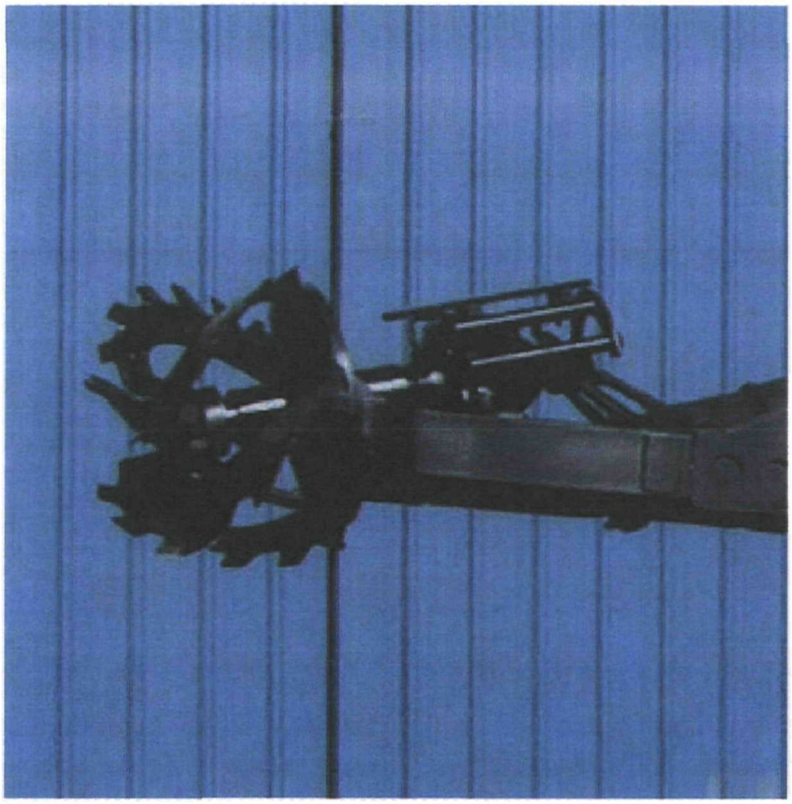
DSC 91 Winch Exploded Assembly

Item #	Description	Manufacturer	Reference Drawing
1	Screw	DSC	B91
2	Pin Bracket	DSC	B91
3	Screw	DSC	B91
4	Screw	DSC	B91
5	Spherical Roller Bearing	McGill Bearing	SB-22210YSSW33
6	Screw	DSC	B91
7	Set Screw	DSC	B91
8	Drum	DSC	B91
9	Gear	RR	RMLF-091
10	Screw	DSC	B91
11	Motor Bracket	-	B91
12	Screw	DSC	B91
13	Screw	DSC	B91
14	Hydraulic Motor	-	See hydraulic schematic
15	Screw	DSC	B91
16	Internal Grease Fitting	DSC	B91
17	Bearing Bushing	DSC	B91

DSC UNDERWATER SEALED CUTTER DRIVE

INTRODUCTION

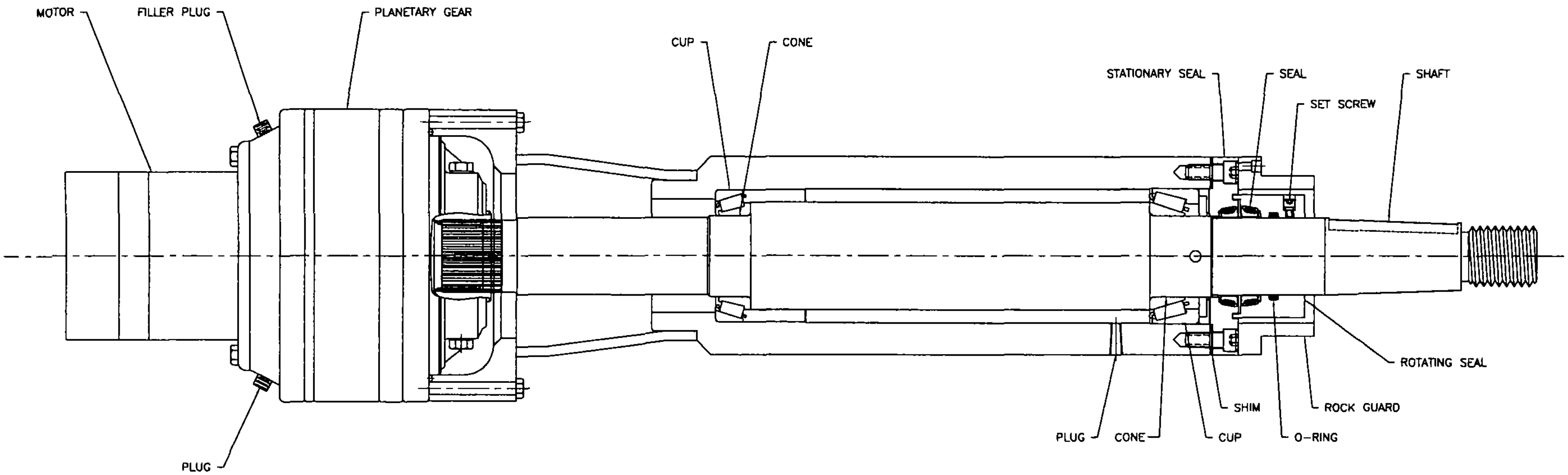
The DSC sealed cutter drive system is a highly effective, cost efficient, high torque drive system for use with cutter head dredges. The system consists of a sealed bearing tube and a hydraulic motor driving through a planetary gear reducer. The unit is designed as a complete hydraulic underwater cutter drive. The foundation is unique to the dredge ladder it is installed on and the mounting brackets are custom built to fit the ladder.



DESCRIPTION

The following specifications reflect the cutter drive as in stalled on DSC Multi-Dredges.

CUTTER DIAMETER	24"
OPERATING TORQUE	32,000 IN-LB
CUTTING FORCE PER LINEAR INCH	160 LB/IN
SHAFT DIAMETER	2 ½ in.
CUTTER RATING	18 H.P.
CUTTER SPEED VARIABLE	5 to 32 R.P.M.



NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

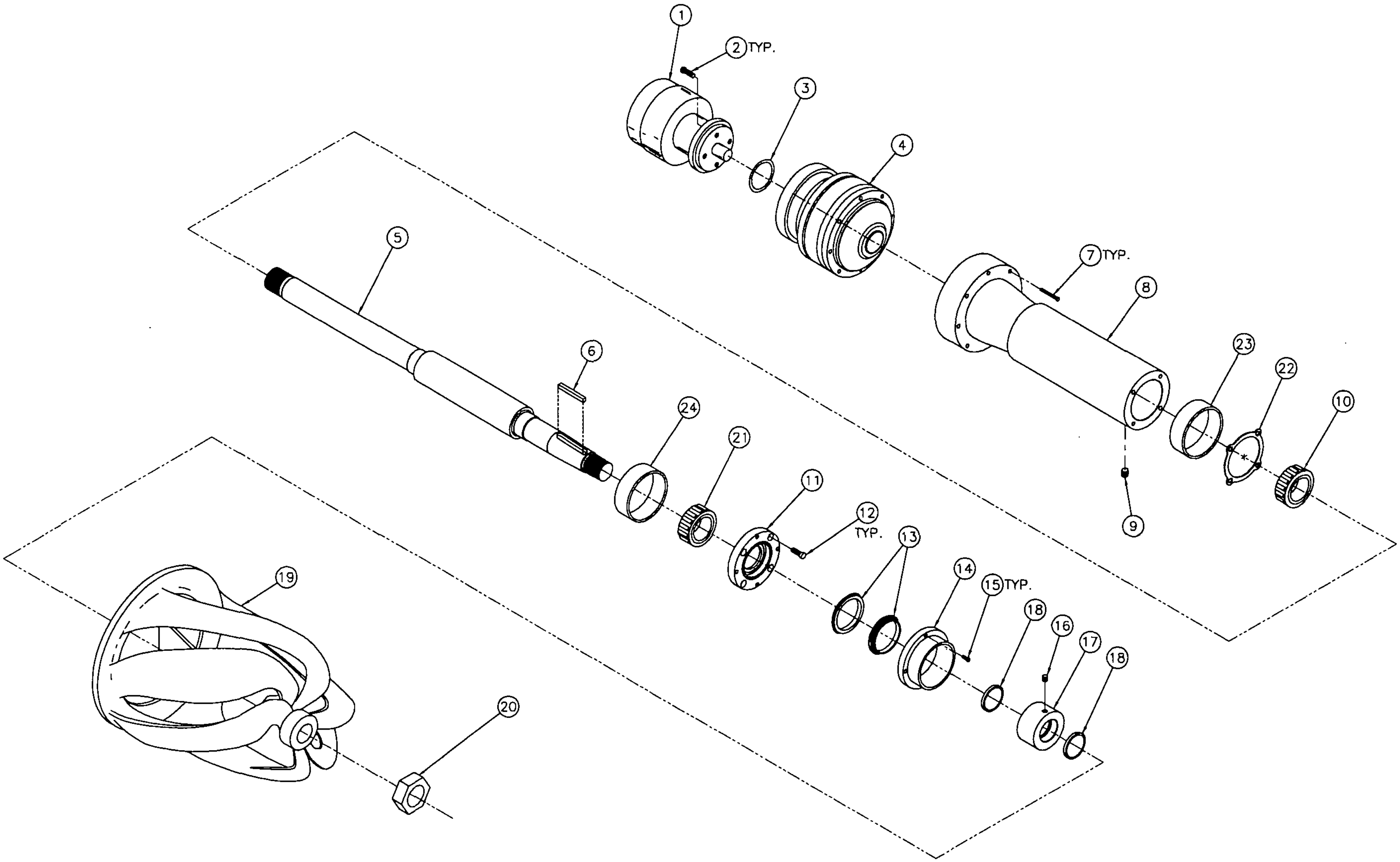
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

DSC 8" MORAY DREDGE

2 1/2" SEALED BEARING CUTTER
DRIVE ASSEMBLY

ENGR/DESGN: MJC
DRAWN: MJC
CHK:
APP BY:
SCALE: 8"=1'-0"
DATE: 4/4/00
PROJECT: 98030
DWG NO.: 9900183
REV:



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION
A	3/08/2000	WJB	Scale up 1.5				

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

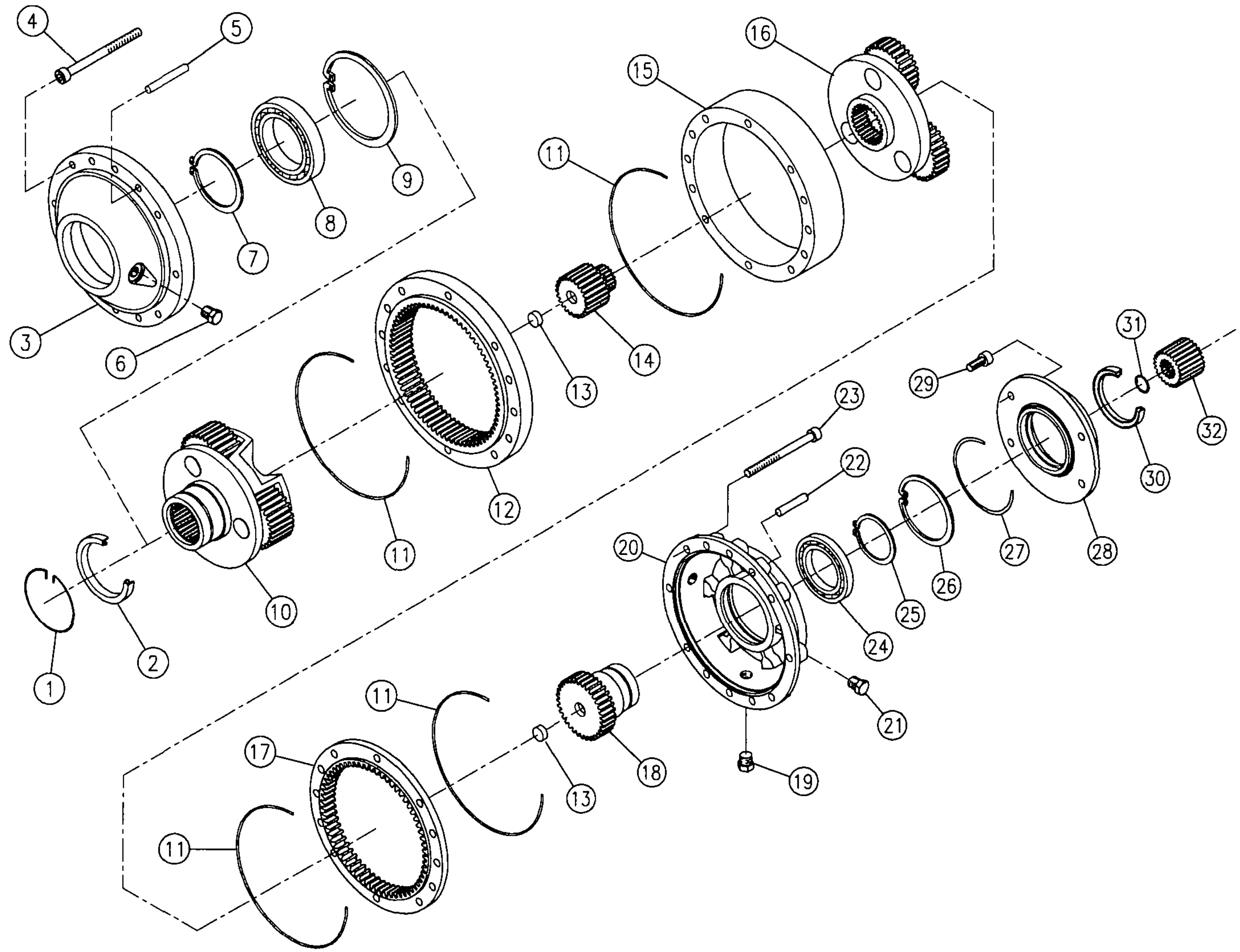
DSC 8" MORAY DREDGE

SEAL BEARING DRIVE ASSEMBLY

MJC	
MJC	
N.T.S.	4/4/00
98030	
9900179	A

Sealed Bearing Cutter Assembly Key

Item #	Description	Manufacturer	Model #
1	Cutter hydraulic motor	Commercial Shear	M31A897BEUF10-25
2	Hex head cap screw	----	12mm x 40mm x 1.5
3	'O' ring	Parker	2-265
4	Cutter gear	Reggiana	RR 500-DF/49 SAE B
5	Cutter shaft	Dredging Supply	9601534-1
6	Cutter key	Dredging Supply	9601534-2
7	Screw	----	3/8" x 9" long
8	Cutter bearing tube	Dredging Supply	9501330
9	Plug	----	1/4" NPT
10	Bearing	Timken	3984/3921XA
11	Stationary seal retainer	Dredging Supply	9501332-1
12	Screw	----	1/2" x 1 1/2" long
13	Duo-cone seal	Caterpillar	8E8338
14	Rotating retainer guard	Dredging Supply	9501332-3
15	Screw	----	1/4"-20 x 1" long
16	Set screw	----	3/8" x 3/8" w/ points
17	Rotating seal retainer	Dredging Supply	9501332-2
18	O" ring	Parker	2-333
19	Basket cutter	Cutter's Edge	----
20	Heavy hex nut	----	2" UNC-2A
21	Bearing	Timken	39590/39520
22	Shim	Timken	K21805 K21807 K21820
23	Bearing Cup	Timken	3921XA
24	Bearing Cup	Timken	39520



MODEL # 9WK943XML-K-S-S
PART # 9WKJNMTJONJ4JLQ-T

NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

DSC 8" MORAY DREDGE

SEALED BEARING DRIVE REDUCTION GEAR ASSEMBLY

DRAWN: MJC
SCALE: N.T.S.
DATE: 4/4/00
PROJECT: 98030
DWG NO: 9900181

Cutter Reduction Key

POS.	OLD P/N	NEW P/N	DESCRIPTION	QTY.
32	24-034		COUPLING	1
31	C080022	154-2438	RETAINING RING INT.	1
30	C120009	154B2446	RING OIL SEAL	1
29	C030060	154 2521	SOCKET HEAD BOLT	4
28	11-028		SAE "B" MOTOR FLANGE	1
27	C140019	154B2795	"O" RING	1
26	C080095	154-2459	RETAINING RING INT.	1
25	C085060	154-2489	RETAINING RING EXT.	1
24	C010024	154-2312	BALL BEARING	1
23	C030069	154-2531	SOCKET HEAD BOLT	8
22	C092061	154-2679	SPRING PIN	4
21	C174002	154-2713	MAGNETIC TAP	1
20	26-002	154-1750	UNIVERSAL INPUT HOUSING	1
19	C171003	154-2711	STEEL TAP	3
18	02-026	154-3309	UNIVERSAL SUNGEAR RR180/7	1
17	06-008	154-1414	RING GEAR RR180	1
16	P0050	154-1893	PLANETARY ASSEMBLY RR180/7	1
15	09-001	154-1459	SPACER RR180-750	1
14	17-020	154-1581	SUNGEAR RR500/7	1
13	20-016	154-1694	THRUST BEARING	2
12	06-005	154-1412	RING GEAR RR500	1
11	C140051	154-3511	"O" RING	4
10	P0100	154-1911	PLANETARY ASSEMBLY RR500/7	1
9	C080115	154-2464	RETAINING RING INT.	1
8	C010007	154-2327	BALL BEARING	1
7	C085075	154-2493	RETAINING RING EXT.	1
6	C171003	154-2711	STEEL TAP	2
5	C092064	154B2823	SPRING PIN	4
4	C030070	154-2532	SOCKET HEAD BOLT	2
3	40-064	154B3410	OUTPUT HOUSING RR500F	1
2	C125003	154B3602	RING OIL SEAL	1
1	C097095		RETAINING RING INT.	1

RR 510D FS
SAE "B" MOTOR CONN.
RATIO 49:1

PAGE 1 OF 1

Lubrication

The proper oil level should be at, or above the center of the sight glass in a static head oil tank mounted above the cutter. The gear and the bearing tube are maintained completely filled with oil. If servicing is required, check the gear housing and hose lines for leaks and cracks and use Chevron Clarity oil AW ISO 46, or equal, to service reservoir. The oil should be initially drained after the first 50 to 100 hours of operation, after which the oil should be drained every 2000 hours or 12 months. Oil samples should be taken on a monthly basis.

Assembly And Disassembly

The cutter drive assembly is usually shipped assembled with the dredge ladder. If it is received as a separate unit, it can be installed and put into service by bolting in place, filling with oil, attaching the hydraulic and lubricating oil lines, checking the rotation and installing the cutter.

The cutter drive is disassembled in stages. The main groups are the hydraulic motor, the planetary gear, the bearing tube, bearings, and the tube seals. These units can be further dissembled in to their individual components.

Hydraulic Motor and Planetary Gear

The hydraulic motor will vary with the application and a manufacture's manual describing its maintenance is supplied for each motor.

Refer to planetary gear drawing for a description of the reduction gear parts and for a guide to assembling and disassembling it. A qualified mechanic should maintain the planetary reduction gear.

Bearing Tube and Bearings

Disassembly of Sealed Bearing Tube

A suggested order to disassemble the bearing tube is as follows:

1. Remove the cutter.
2. Disconnect and seal the all hydraulic and lube oil lines.
3. Remove the sealed tube assembly from the slide plate and bring it to a secure work area.
4. Remove the hydraulic motor and the reduction gear as a unit.
5. Remove the Rotating seal rock guard and retainer.
6. Remove the stationary seal retainer with the mechanical seals.
7. Pull the cutter end-bearing cup from the tube.
8. Pull the shaft with the bearings and remove the bearing cup.

Sealed Bearing Tube Assembly

1.Press the bearing cones on the cutter shaft tapering to the out to the end of the shaft.

2.Press the rear-bearing cup in the bearing tube positioned to receive the bearing from the cutter end of the tube.(The cup must seat all the way against the shoulder in the tube)

3.Insert the shaft and bearings in from the cutter end of the tube and seat the bearing in the cup in the tube.

4.Slide the cutter end cup in the tube on the cutter end of the tube.

5.Adjust the bearings with the stationary seal retainer. Use a crisscrossing tightening pattern to load the bearings evenly until the shaft will not turn by hand. Measure the distance between the stationary bearing retainer and the bearing tube. Remove the stationary bearing retainer and insert shims between it and the bearing tube equal to the measured distance $\pm$0.005 inch. Torque the bolts to the values in the included bolt torque chart. The shaft must turn by hand and not have any noticeable endplay after the retainer bolted in place.

6.Check the planetary gear to be sure that the "o" ring seal is not in the output end of the gear and bolt it on the tube. Use "Locktight" gasket elimater or an equal for a seal between the gear and the bearing tube.

7.Install the hydraulic motor and torque all the bolts on the unit.

8.Install the mechanical seals in both the stationary and the rotating seal holders.(See the Mechanical Seal installation section)

9.Bolt the rotating seal retainer in place and then secure the rock guard in place with the set screws and "O" rings.

10. Move the unit to the ladder and bolt in place and install the cutter.

11. Fill the tube and planetary gear with oil and purge the air from the system including line to the static tank.

12. Connect the hydraulic hoses to the motor and check for leaks.

SECTION 3: PLC OPERATION

The PLC used on this dredge is an *Automation Direct* DL205 System, model DL250. It offers a large amount of program memory, a substantial instruction set and advanced diagnostics. The DL260 features drum timers, floating-point math, and built in PID loops with automatic tuning. The DL260, also provides a built-in master for remote I/O networks. The DL260 offers a complete range of discrete modules, which support 24vdc, and up to 4A-relay output. The analog modules provide 12 bit resolution and several selections of input and output signal ranges (including bipolar).

The operator control panel for the PLC is a six-inch touch screen monitor, Model PLC-#Z-S6C-K. The touch screen is a high performance human/machine interface with a broad range of operator input and display capabilities. The touch screen has the capability to display text messages, BCD, BCD Double, Binary and Floating Point Numbers. It can be used for input commands and for displaying equipment conditions and operating information.

TOUCH SCREEN PLC OPERATION SECTION

The 6” color touch screen operator interface displays valuable dredge operating and historical data as well as providing a means of customizing dredge performance. DSC has programmed the colors on correspond to the data provided or the input required. DSC’s screen color coding is as follows:

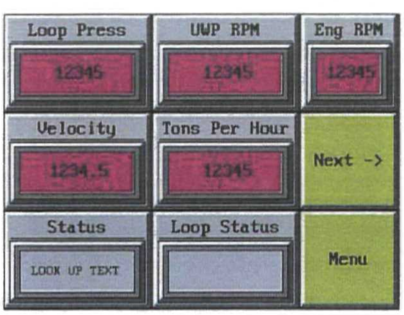
Screen Object	Color
Button	Gold (light brown)
Calculated Display	Purple (light pink)
Numeric User Input	Blue
On (OK) Indicator	Green
Off (Inactive) Indicator	Red

MAINE SCREEN #1

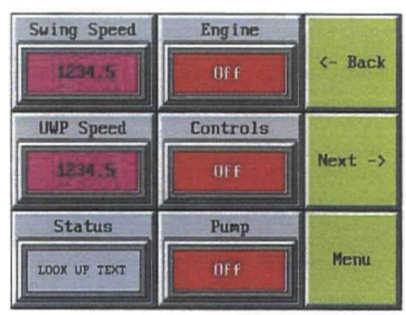
Screens provided by the display manufacturer include the numeric entry screen (similar to a calculator display) and the alarm log screen. These screens are monochrome and do not follow the DSC color system.

When the dredge operating system initially powers up the touch screen will default to MAIN screen #1 as shown below. This screen will also be displayed when an alarm or warning condition occurs and when the controls are deactivated. MAIN screen 1 can manually be displayed by selecting MAIN from the MENU. In the lower left hand corner is displayed the current dredge **status** (OK, WARNING, or ERROR).

A **status** of OK is the normal operating mode for the dredge. OK is displayed when no faults or problems are detected or when alarm or warning conditions are disabled via the DISABLE menu.



MAIN SCREEN 1



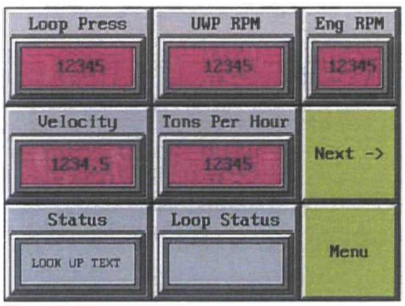
MAIN SCREEN 2

Warnings are displayed to indicate abnormal or unsafe operating conditions, for example, attempting to enable controls with the cutter forward already selected.

Warnings are not logged or recorded. When a warning is present, a beep can be heard from the touch screen and can be silenced using the alarm silence button (button with crossed-out musical note) on the console. The cause of the warning will be displayed across the bottom of the touch screen. A complete list all warnings is printed at the end of this section.

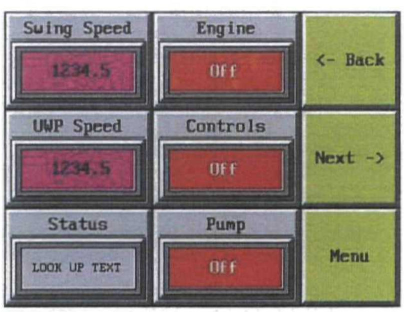
Alarms, or errors, are displayed to indicate equipment failure, or conditions that can cause equipment failure, for example, a high main engine coolant temperature. Alarms are logged on the touch screen. The ALARM menu displays the last sixty-four alarms that were encountered. When an alarm is present, a loud beep can be heard from the operator's console and can be silenced using the alarm silence button on the console. The cause of the alarm will be displayed across the bottom of the touch screen. A complete list all alarms is printed at the end of this section.

Main Screen 1



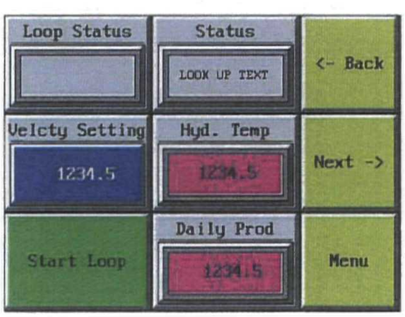
The left column of the screen displays the **Loop** pressure in psi. The **UWP RPM** display is a display of the speed of the underwater pump in RPMs. The **Velocity** is displayed in feet per second. **Tons Per Hour** is displayed in tons. **Status** is the same as previously explained. The **Loop Status** Off, On, Ready, Error is the display possibilities of the loop.The gold **<-Back** button switches to MAIN screen 2 while the Menu button switches to the main menu screen 1 where additional selections can be made.

Main Screen 2



MAIN screen 2 is a display only screen. **Swing speed** is displayed in feet per second and the **UWP Speed** is the pump speed. **Engine, Controls, and Pump** are shown ON.back ground green, or OFF with a red background. Status is as described previously.

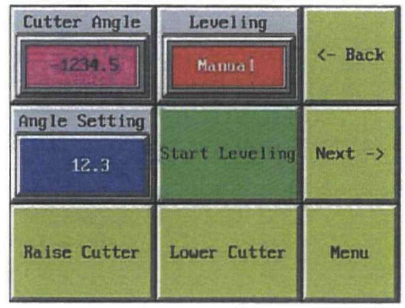
Main Screen 3



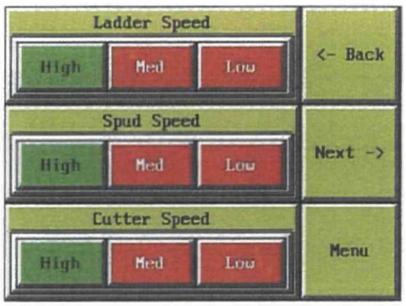
Main screen 3 is one place where the PID loop can be started or stopped by touching the start or stop display in the bottom left of the screen. The velocity setting for the PID loop can be changed by touching the velocity setting display and making the change with the on screen dropdown key pad. The status displays are displays only. The Hydraulic temperature and daily production are display only. The production is in tons and the temperature is in Fahrenheit.

Main Screen # 4

This screen is the ladder articulating screen. The cutter angle is display only. Leveling is an on screen switch that selects the leveling mode, automatic or manual. Angle setting is the angle of the cutter section is to the horizontal. The start or stop leveling on screen switch is used to start or stop the leveling in automatic mode. The gold on screen buttons do as they are labeled.



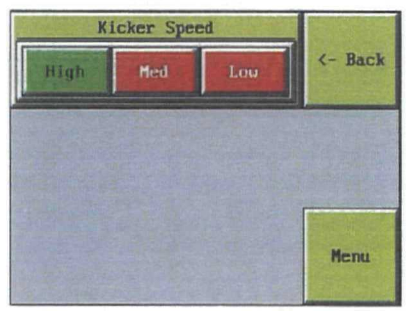
Main Screen # 5



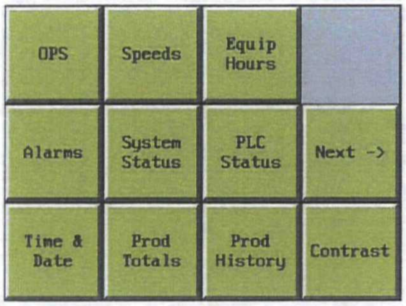
Main screen 5 is the speeds screen. This screen is used to control the ladder hoist speed, spud winch speed and the cutter speed. Each function displayed has three pre determined speed selections that are set in the PLC program. They can be modified by selecting Speeds from Menu 1 which will display the hydraulic speeds screen 1 from which hydraulic speeds screen 2 is accessed with the gold colored on screen next switch.

Main Screen # 6

This the speed screen for the Kicker spud kicker function. The speed selections are set in the PLC program and can be modified by selecting Speeds from Menu 1 which will display the hydraulic speeds screen 1 from which hydraulic speeds screen 2 is accessed with the gold colored on screen next switch.



Menu Screen 1

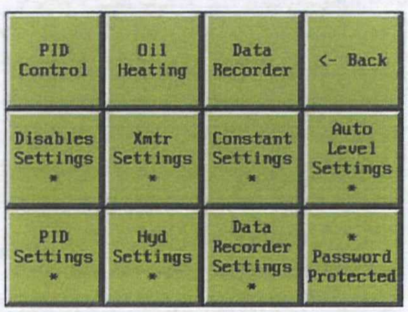


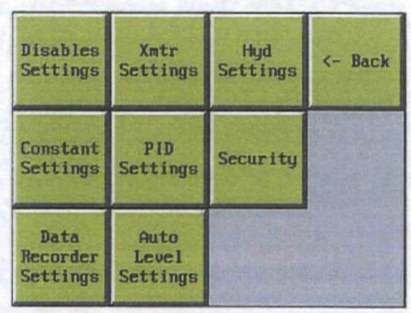
Menu screen can be accessed from any other screen by touching the gold Menu button. This screen is used to access the screens labeled on it.

Touching the buttons on menu screen 1 will display the following:

1. OPS; displays the MAIN screen 1. from which MAIN screen #2 can be displayed.
2. Speeds; displays speed screens one and two.
3. Equipment hours: displays the equipment hours screen.
4. Alarms; displays the alarm history screen.
5. System Status; displays the system status menu screens.
6. PLC status screen; Displays the PLC slot menu. The menu has six slots that can be viewed.
7. Time & Date Displays the time and date screen. This screen is where the time and date can be corrected.
8. Prod. Totals; Displays the production totals screen #1 from which screen #2 can be accessed.
9. Prod. History; Displays the Totalizer screen which is a display of the dredging production.
10. Contrast; Displays the contrast adjusting screen

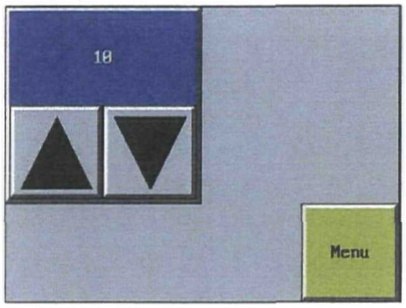
Menu 2 NP & Menu 2 WP





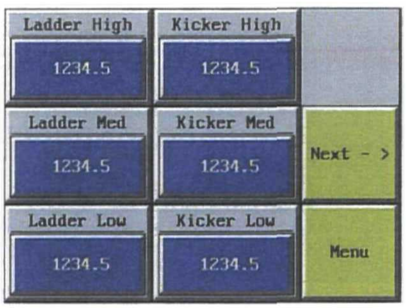
Menu screen 2 NP is the menu with out the password Menu 2 WP is the menu with the password. Touching any of the gold colored labeled squares in the menu will display the named screens. If the password is entered on Menu Screen 2 NP then Menu Screen 2 WP is displayed. From this screen the values of the protected functions can be changed.

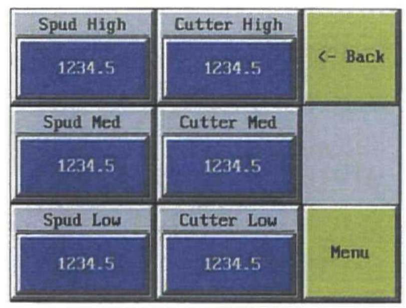
Contrast screen



This is the screen to adjust the contrast of the screen. Press the down arrow to decrease the contrast and press the up arrow to increase the contrast.

Hydraulic Speed Menu





The values in these screens are percent of full speed, with one decimal place accuracy entry for each labeled hydraulic powered function. Four functions are controlled from these screens. Screen one, column 1, is the ladder hoist speeds and column 2, is for the kicker cylinder speed. Screen 2 has two columns, Spud speed and cutter speed. Touch any blue value that is to be changed and a dropdown on screen keypad is displayed. Use the pad to enter the new set point percentages. Each column has three speed settings possible for that function. One of the three speeds can be selected with the from main screens 4 or 5.

The Following Settings can be changed in the HYDRAULIC SPEED MENU

SETTING EXAMPLES:

Ladder Speed Low Setting (40)

Ladder Speed Med Setting (70)

Ladder Speed High Set. (100)

Kicker Speed Low Setting (35)

Kicker Speed Med Setting (75)

Kicker Speed High Setting (99)

Spud Speed Low Setting (40)

Spud Speed Med Setting (70)

Spud Speed High Setting (100)

Cutter Speed Low Setting (40)

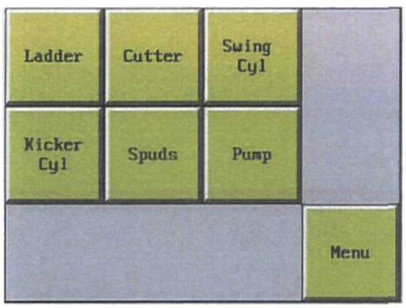
Cutter Speed Med Setting (70)

Cutter Speed High Set. (100)

Hydraulic Set Points Screen

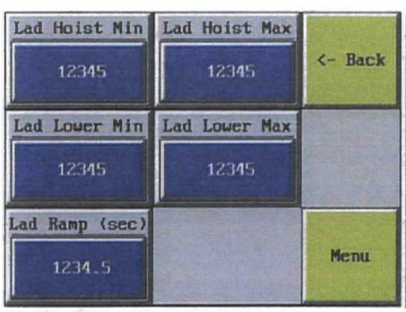
These screens are password protected and accessed from the second menu screen by entering the password on screen NP and touching the on screen Hyd. Settings button on screen WP. This will display the Hydraulic Speed setting Menu. Select the function to be changed and a keypad is displayed to make changes.

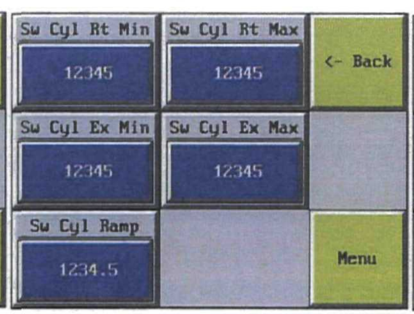
Settings are determined at DSC and should not be adjusted by unauthorized personnel. The Minimum set point is the point at which the function first starts to react to the controls. Maximum is the top speed limiter for the function. These values are in counts between 0 and 4095. Ramp is the time in seconds it will take to get from full stop to full speed for the labeled hydraulic function.

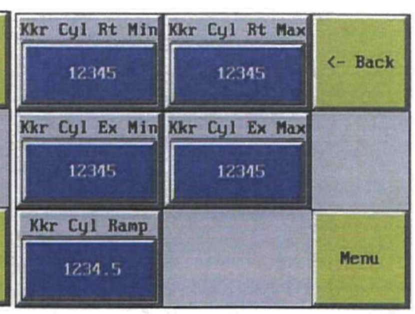


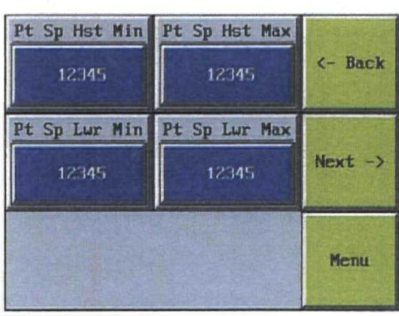
HYDRAULIC SETPOINTS MENU

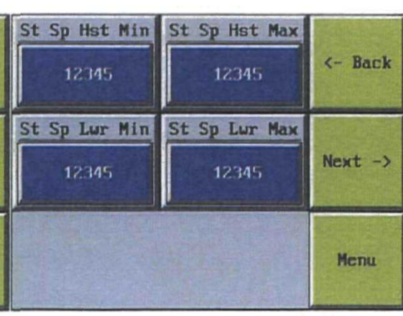
To change a value touch the on screen function button in the hydraulic set point menu screen. Then touch the blue value in the screen to be changed. An on screen keypad will drop down. Enter the password, and then enter the changed value. Each of the hydraulic functions has a separate screen that is used to change its set points. These screens are accessed from the Hydraulic Set Point Menu screen. Use the gold labels to move to the named screen. Touching the gold label, "<- Back," will display the **Hydraulic Set Point Menu screen**. Touching the gold label, "Menu," will display the **Main Menu screen**. The hydraulic equipment effected by these screens is; the ladder, swing winches, the swing cylinder, the cutter both directions, the kicker cylinder, the underwater dredge pump and all three spuds.

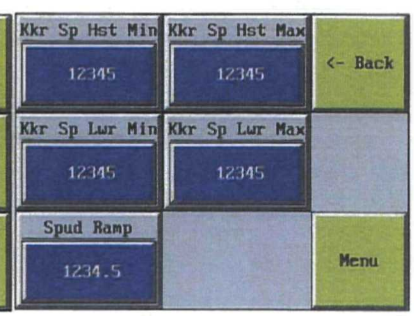




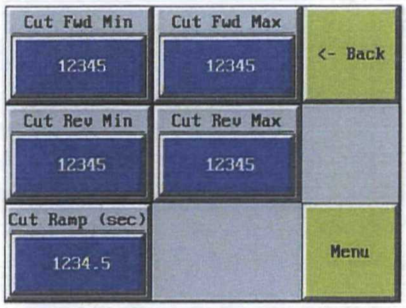


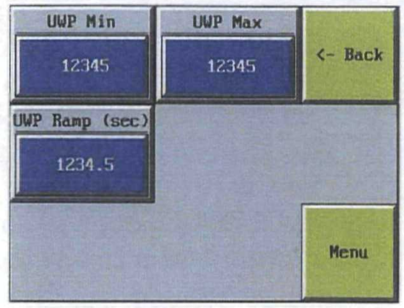






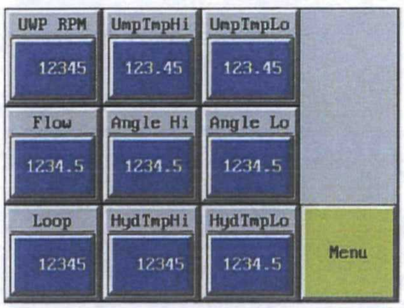
Continue hydraulic setpoints screens.





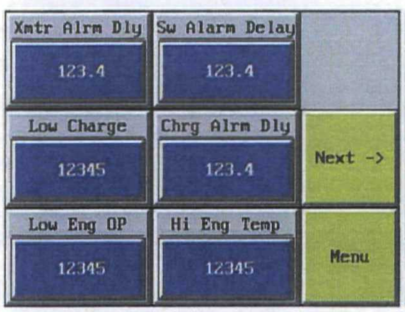
When the blue button for a particular function is touched after the password was entered from the menu screen a keyboard is displayed to enter the new values. The range is displayed on the right side of the keypad.

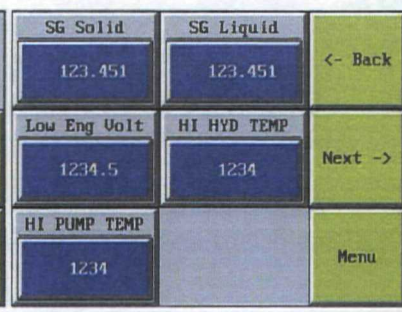
Transmitter Set Points Screen

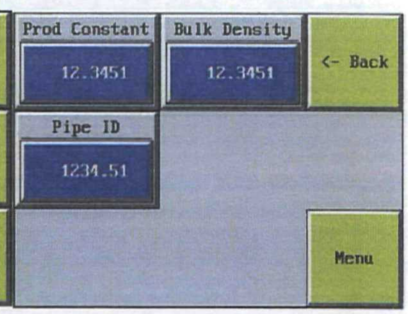


This screen is where the set points values are set for the transmitters outputs. It is password protected. It can be accessed from the man menu by touching **Xmtr Settings**. The values can be changed only if the password has been entered and then the Xmtr Setting is selected. The value entered matches the transmitter output maximum value.

Constants Screens







The values on the constants screens are used by the PLC program to control and monitor the dredge functions. These screens are password protected and only authorized personnel should change the values. To change a value touch the value, and a on screen keypad will drop down, if the password was entered at Menu 2, then enter the changed value. Button color identification is described in the first section of the "Touch Screen "Section. Use the **Next->** button and the **<-Back** button to toggle through the constant screens and the **Menu** button to go back to the main menu.

The constant settings can be changed in **constants screen 1** are as follows:

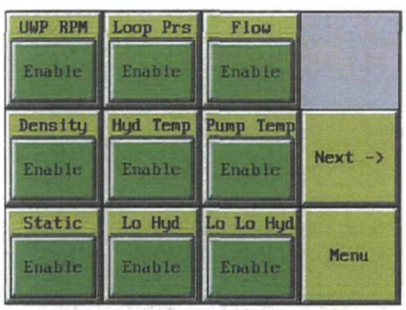
- **Transmitter Alarm Delay**: This is in seconds. It is the amount of time before the alarm will activate when its set point is reached.
- **Service Water Alarm Delay**: This is the seconds that the service water pressure can be below the set point before an alarm is activated.
- **Lo Charge:** This is the lowest pressure in psi that the hydraulic pressure on the charge pump on the cutter hydraulic closed loop must be or an alarm will sound.
- **Charge Alarm Delay:** this is in psi and is the lowest pressure that the hydraulic main pump can operate.
- **Low Engine Oil Pressure:** This is engine oil pressure, in psi that will activate an alarm.
- **High Engine Temperature:** the engine jacket water temperature that will set the alarm off.

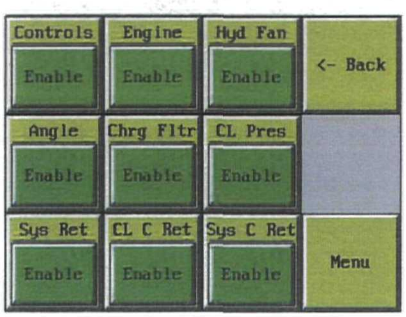
Constants Screen 2 This screen has values used by the PLC to set off alarms. The values are:

- **Specific gravity** of material.
- **Specific gravity** of the water being pumped.
- **Low Engine Voltage** setting for the alarm.
- **High hydraulic temperature** setting for the alarm.
- **High Pump temperature** setting for the alarm.

Constants Screen 3 values are used in the production calculations.

Disable Screens



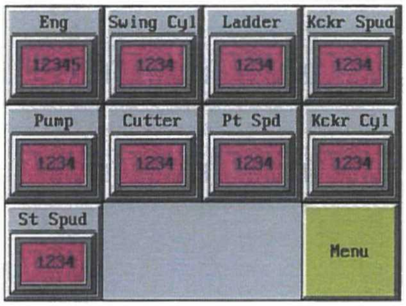


These screens are accessed from the main menu screen. Touch the **Disables Settings** button, enter the password with the dropdown keyboard, and disable screen one is displayed. The second disable screen is accessed from the first screen using the **Next->** and the **<-Back** button to go back to the first disable screen.

The labeled functions transmitters can be disabled and enabled by touching the label with the function name. The label will change colors when the function is enabled or disabled. The label is green when it is on and red when it is off.

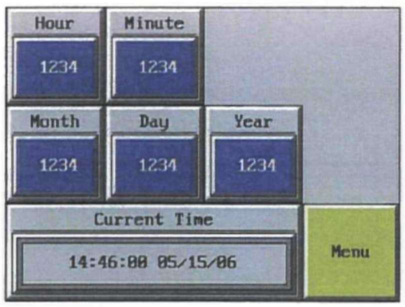
Do not disable these functions except for a very short time. This set of screens is to be used to diagnose problems with the transmitters or the PLC and should be kept on line when operating the dredge. If any of the functions transmitters are disabled all of the operating personnel must be notified. These are part of the safety and operational controls and must be put back in action as soon as possible.

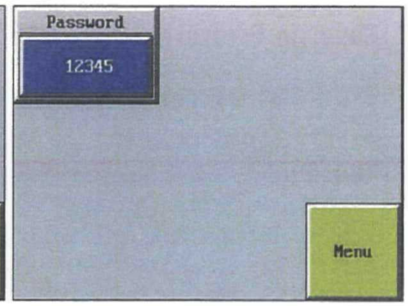
Equipment Hours Screen



This is a display only screen. The total hours a function has operated is displayed on this screen. This screen is accessed from the Main Menu Screen.

Time & Date Screen & Security Screen





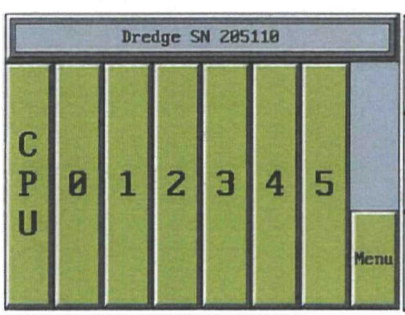
These screens are used to set the system time and date and the password. These screens are accessed from the Main Menu 1 and the Main Menu 2 WP Screens

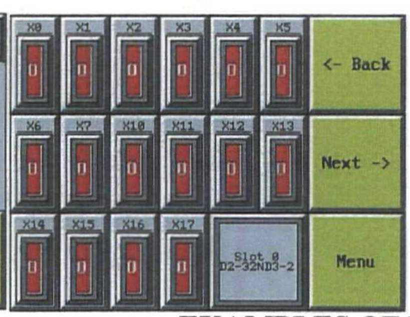
Touch the value to change and a touch screen keypad is displayed. Use the keypad to enter the correct value and then use the gold keys to access other menus. All entries are numeric form and the weekday starts with Sunday=1. Time is set in 24 hour format.

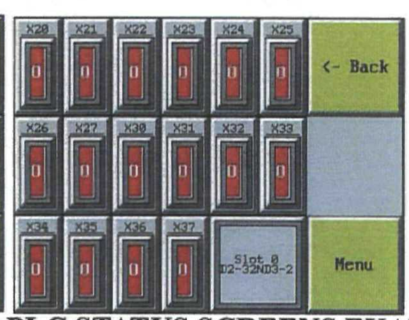
Plc Status Screens

The following screens are for use by trouble shooting personnel. They are accessed from the main menu by pressing the PLC Status button, which displays the dredge serial number and PLC slot menu screen. A particular slot screen can be displayed by touching the screen slot number in the PLC slot menu.

Each slot screen is a display only screen except for the gold buttons, which are used to navigate to a particular slot's screen. When the slots are green, they are on and when they are red, they are off. Purple values are display only numeric values, i.e. counts in the PLC status screens. The PLC Status Screens can also be accessed from each screen by using the **Next->, <-Back, or Menu** buttons.

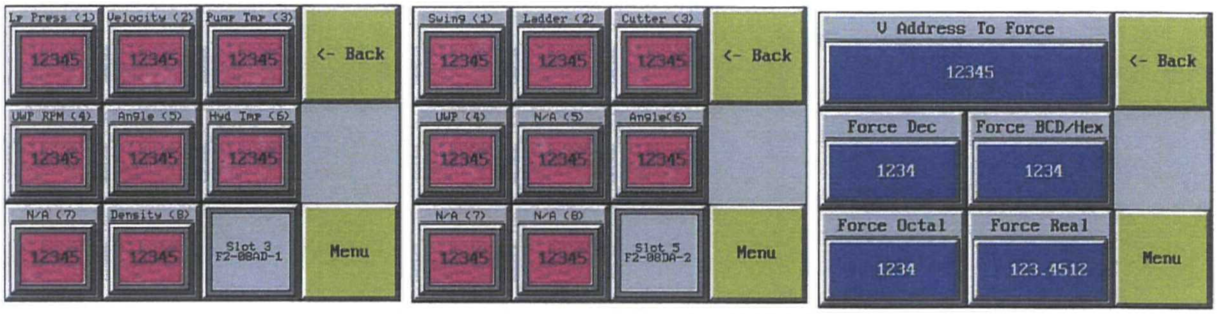






PLC STATUS MENU **EXAMPLES OF PLC STATUS SCREENS EXA**

Continue examples of PLC Status Screens



EXAMPLES OF PLC STATUS SCREENS

Dredge System Status Screens

The following screens are display only screens used to display system components status. Touch the System Status button on the Main Menu screen and the first System Status Menu screen is displayed. Touch **next** -> to display the second System Status Menu.

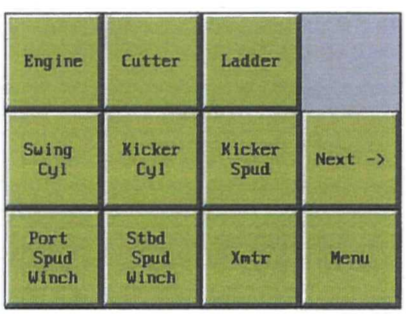
When a label is red, it is off, if it is green, it is on.

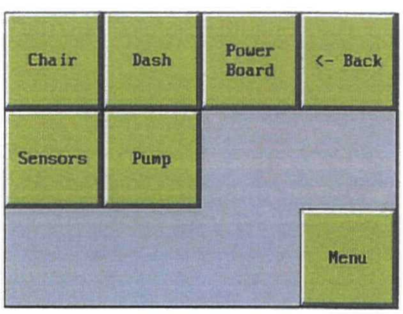
The gold labels are buttons; when they are touched, they display the screen on their label.

The purple label is a calculated numeric display only.

Status Menu Screens

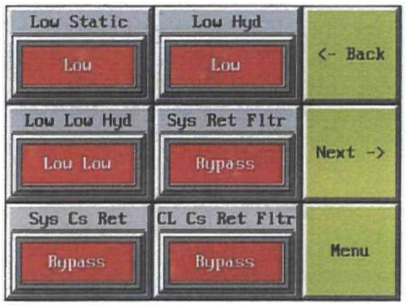
These two screens are the Status Menu Screens. Touch any button to display its labeled function status screen. Use the **Next->** and **<-Back** button to toggle between the two menu screens. (Note: Carriage is the same thing as Kicker on this dredge)

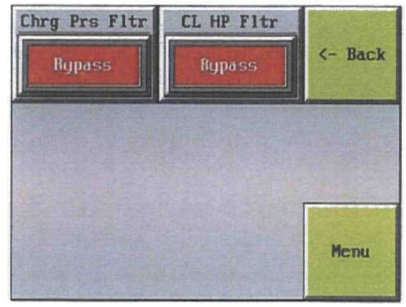




Sensor Status Screens

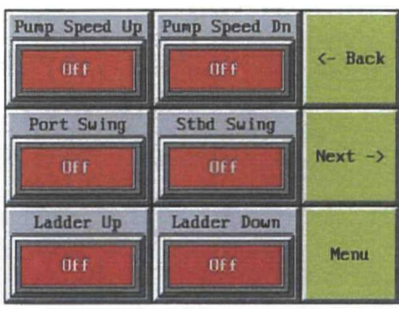
This screen is accessed from status menu #2. It is display only for the operating status of the labeled sensors. Use **<-Back** to go back to the sensor menu #2 and the **Menu** button to go the main Menu.

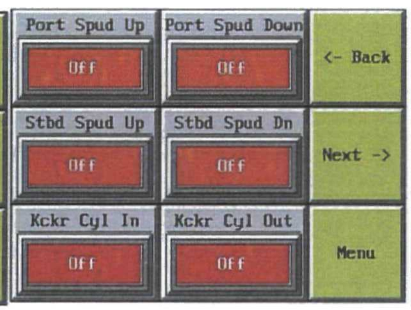


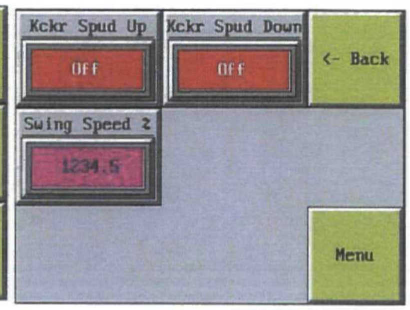


The following display only status screens are for the operating status of the labeled functions. Red is off and green is on. The purple number is a calculated output.

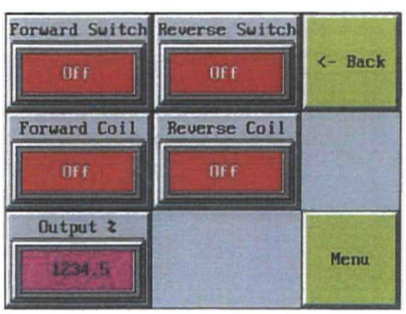
Chair Status Screens

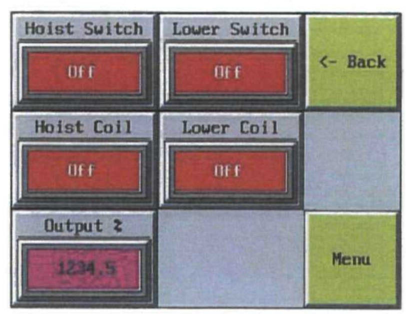






Ladder And Cutter Status Screens

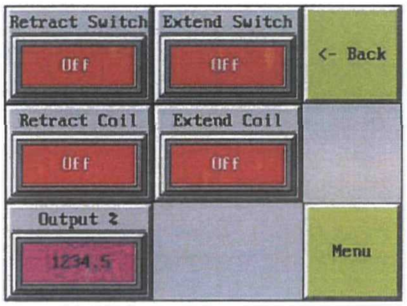


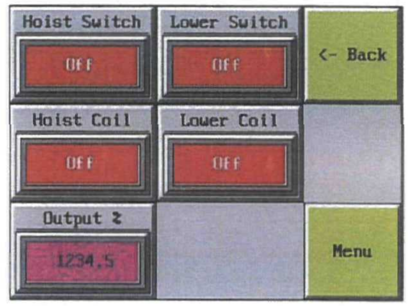


These screens are display only for the operating status of the labeled functions. **<u>Red is run and green is off for the e-stop only</u>**. The purple number is a calculated output. Use the **Next->** and **<-Back** button to toggle between the screens and use the **Menu** button to go the main Menu.

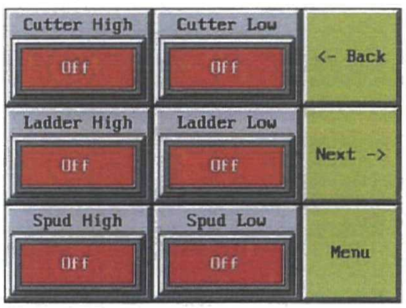
Spuds Status Screens

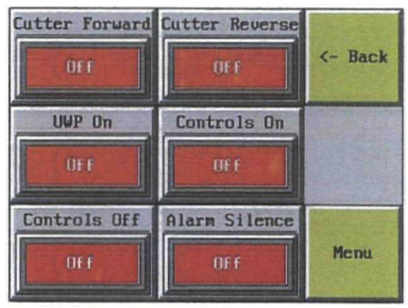
The spud status screens are are display only screens. There are three spud status screens, the starboard spud, the port spud, and the kicker spud. Examples are as shown below.



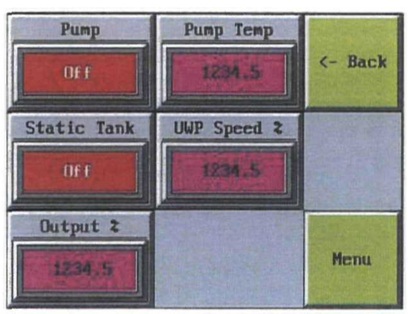


System Dash Screens



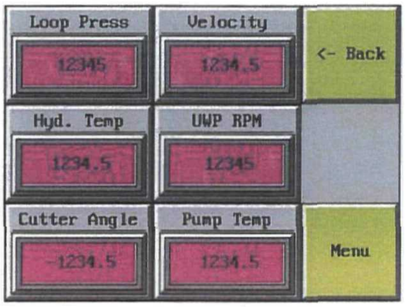


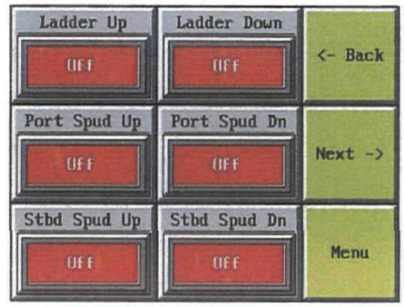
Underwater Pump Status Screen



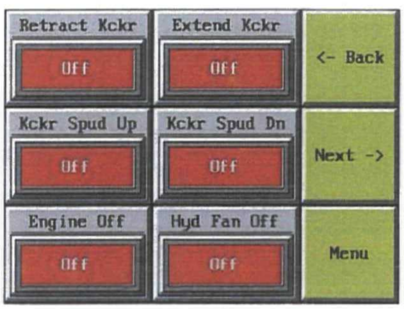
The next screens are display only for the operating status of the labeled functions. Red is on and green is off. The purple number is a calculated output. Use the **Next->** and **<-Back** button to toggle between the screens and use the **Menu** button to go the main Menu.

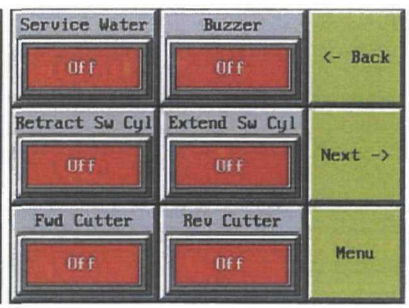
Transmitter Status Screen & Power Board Status Screen 1

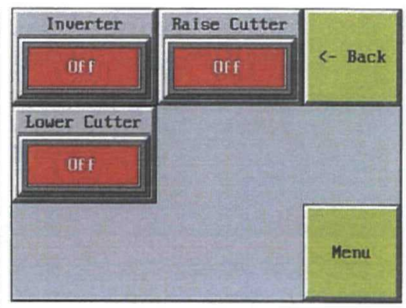




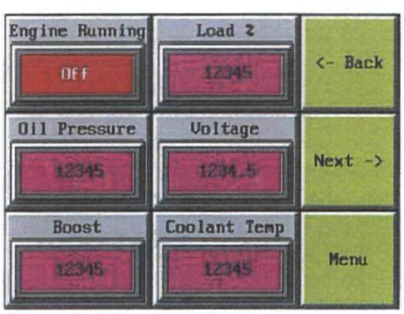
Power Board Status Screens 2, 3, 4

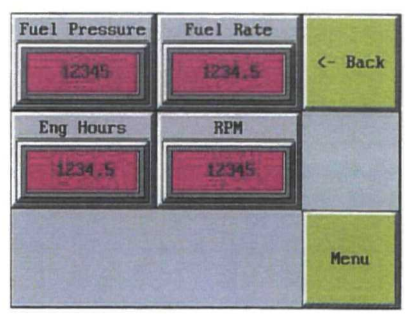




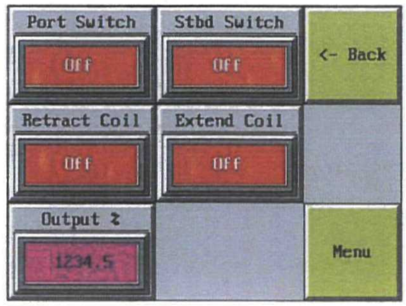


Main Engine Status Screens



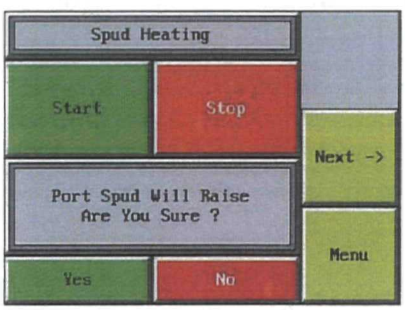


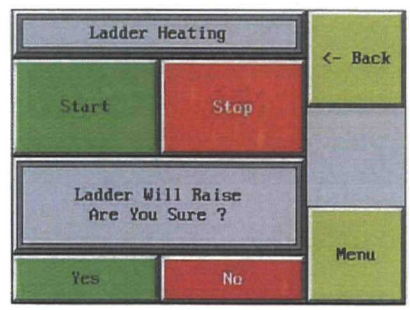
Swing Cyl Status Screen & Kicker Cyl. Status



Hydraulic Oil Heating Screens

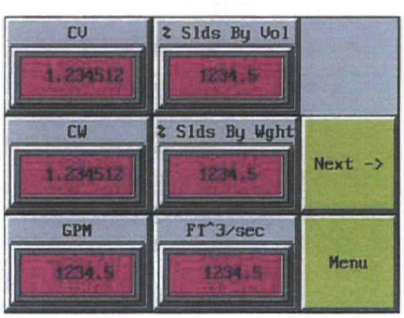
The first oil heating screen is accessed from menu # 2 NP and the second is accessed from it. These screens are used to start and stop the hydraulic oil heating when the hydraulic oil is cold. Touch the start button on the screen and a warning will appear select yes when ready and the oil heating will begin. **Do not operate any of the other hydraulic functions when heating the oil.** One or two or both of the oil heating screens can be used to heat the oil.

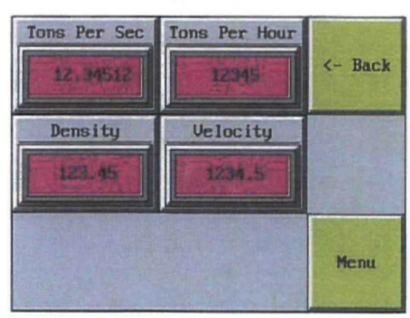




Production Totals:

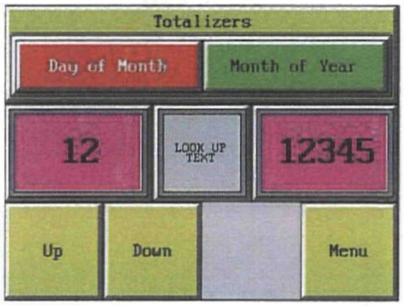
This displays the **PRODUCTION TOTALS SCREEN.** This screen shows the production for a particular day of the month and month of the year.





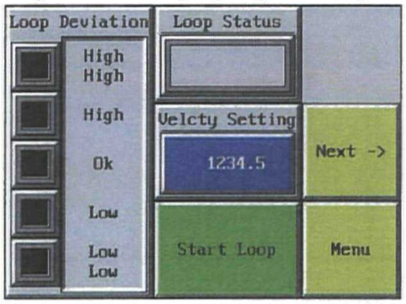
Production Totalizer Screen

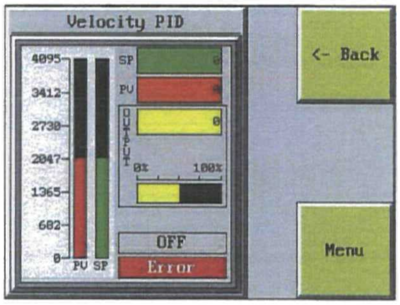
(Production History) is used to display the production history. This screen is a active display screen Accessed from Menu 1 by touching the label Prod Totals. The screen is accessed from Menu # 1 by touching the Prod History on screen button. The day and month is selected by using the on screen up or down button and the day of month or month of year button.



PID Flow Control Loop Screens

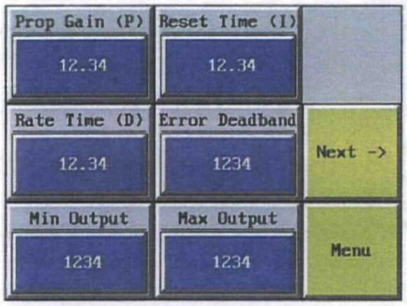
The PID control screens are accessed from Menu 2. This displays the flow control loop screen 1. The PID control screen #1 displays the loop status, loop deviation and the flow setting. It also has a loop start stop button and the flow setting can be edited from it. The PID control screen #2 is a display only screen displaying the loop status.

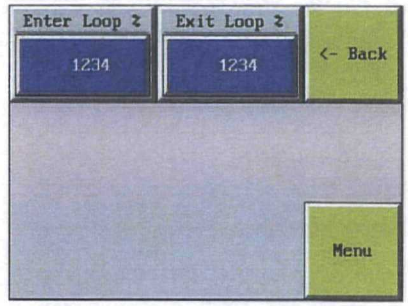




Pid Setting Screens

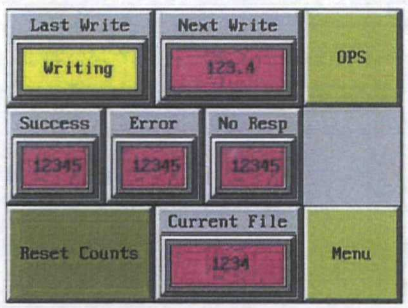
These screens are pass word protected and can be accessed from menu 2 with the pass word or viewed without it. The screens are used to control the PID loop. They were set at DSC and should not be altered by any one not qualified. These screens display the set points for the PID loop functions. The blue displays when touched after the password has been entered and the menu screen 3 WP is in effect, will display a dropdown editing screen. Screen #3 is a display only screen.





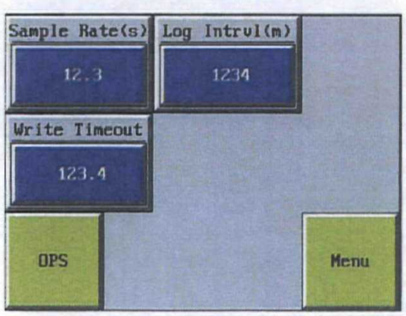
Data Recorder Screen

The data recorder screen is accessed from Menu #2. This screen is a display only screen that displays the current data recorder activity



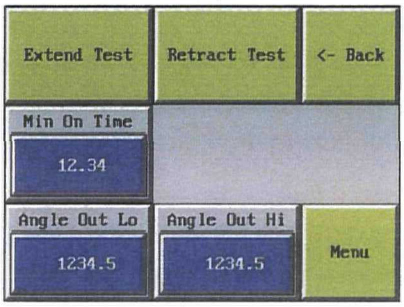
Data Recorder Setting Screen

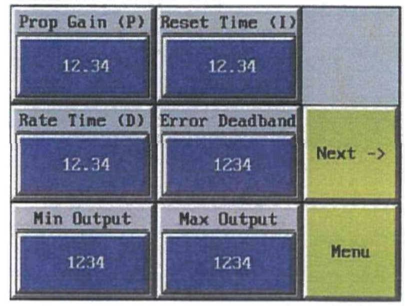
The data recorder setting screen is accessed from Menu #2 WP. It is password protected and only on menu#2 WP. This screen is where the settings for the data recorder are entered into the PLC. All entrees are in seconds.



Auto Ladder Leveling Setting Screens

The two auto level settings screens are protected and are accessed from menu #2 WP. The first screen to display is the screen used to set the constants for this operation. Contact DSC if any changes are needed. The second screen is accessed from the first screen. The top two buttons operate the articulated section of the ladder and or used for testing. Contact DSC before changing any of the values on this screen.





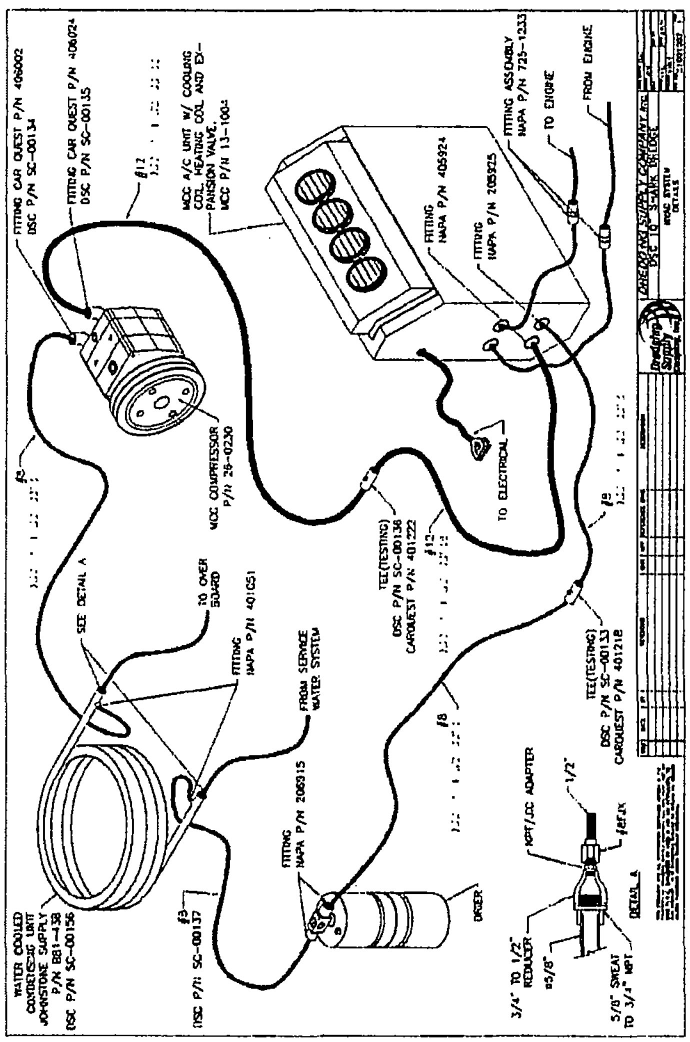
OPTIONAL AIR CONDITIONING AND HEATER

Before operating the air conditioner compressor the service water must be primed and flowing through the air conditioner coil.

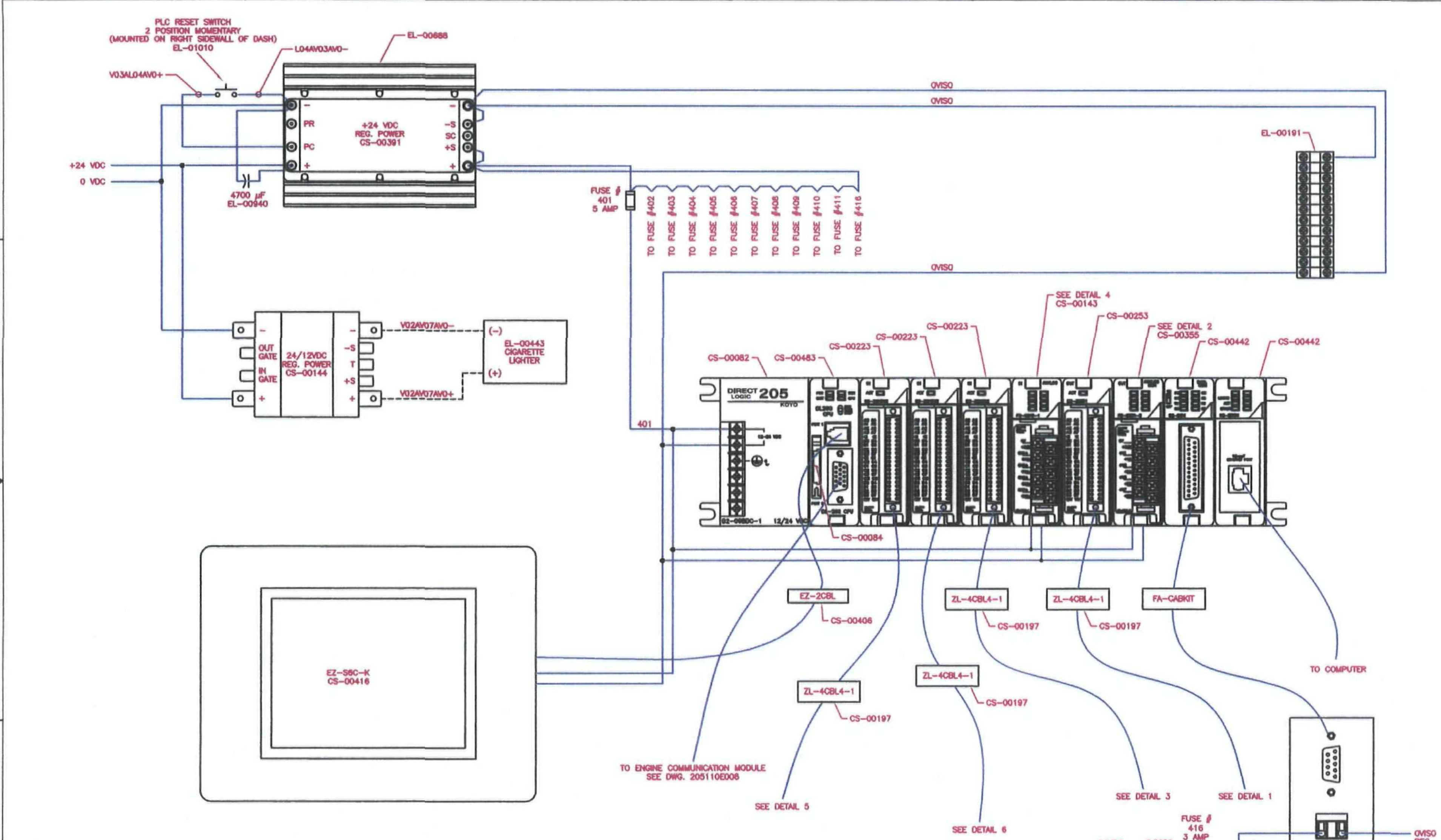
The temperature is controlled from inside the lever room but the heater valves must be open. There is a filter in the unit in the lever room that must be changed periodically as needed to maintain good flow through the unit.

The heater has hot water valves located on the main engine. The flow of the hot water is controlled with the temperature control on the lever room unit. The hot water can be turned completely off at the engine. In freezing conditions the air conditioner coils water jacket must be drained.

AIR CONDITIONER LAYOUT DRAWING



ELECTRICAL DRAWINGS



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE
A	06/15/05	KJR	ADDED DCM, ECOM, & SNITCH BOX				

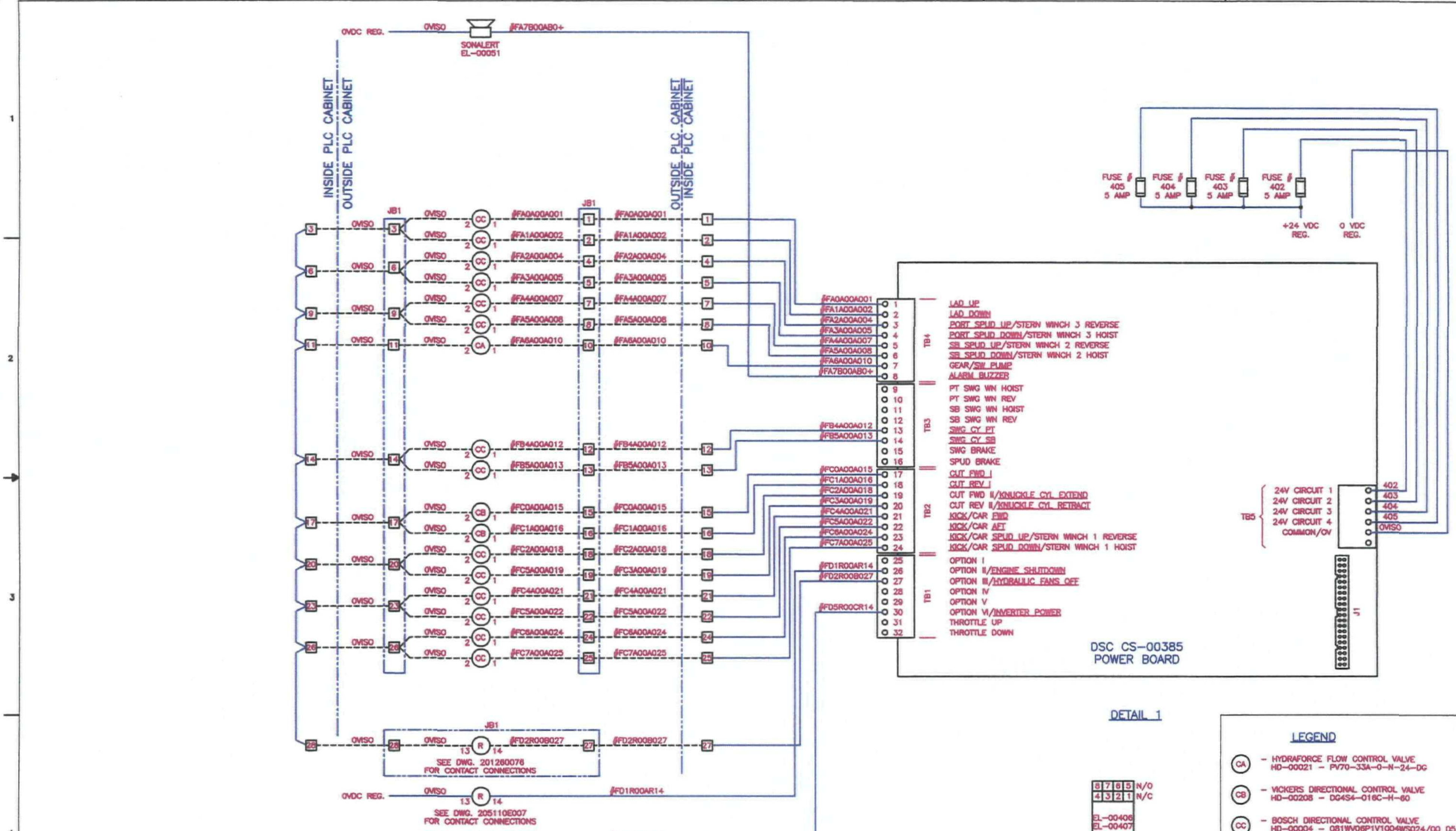
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

2006 8" MORAY DREDGE

PLC WIRING DIAGRAM (1 OF 8)

DRWN: MJC
CHK: CJH
DATE: 3/06/06
SCALE: FULL
SIZE: D
PROJECT: 205110
DWG NO: 205110E001



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE
A	06/16/05	KJR	ADDED KNUCKLE CYLINDER & DISCHARGE VALVE				

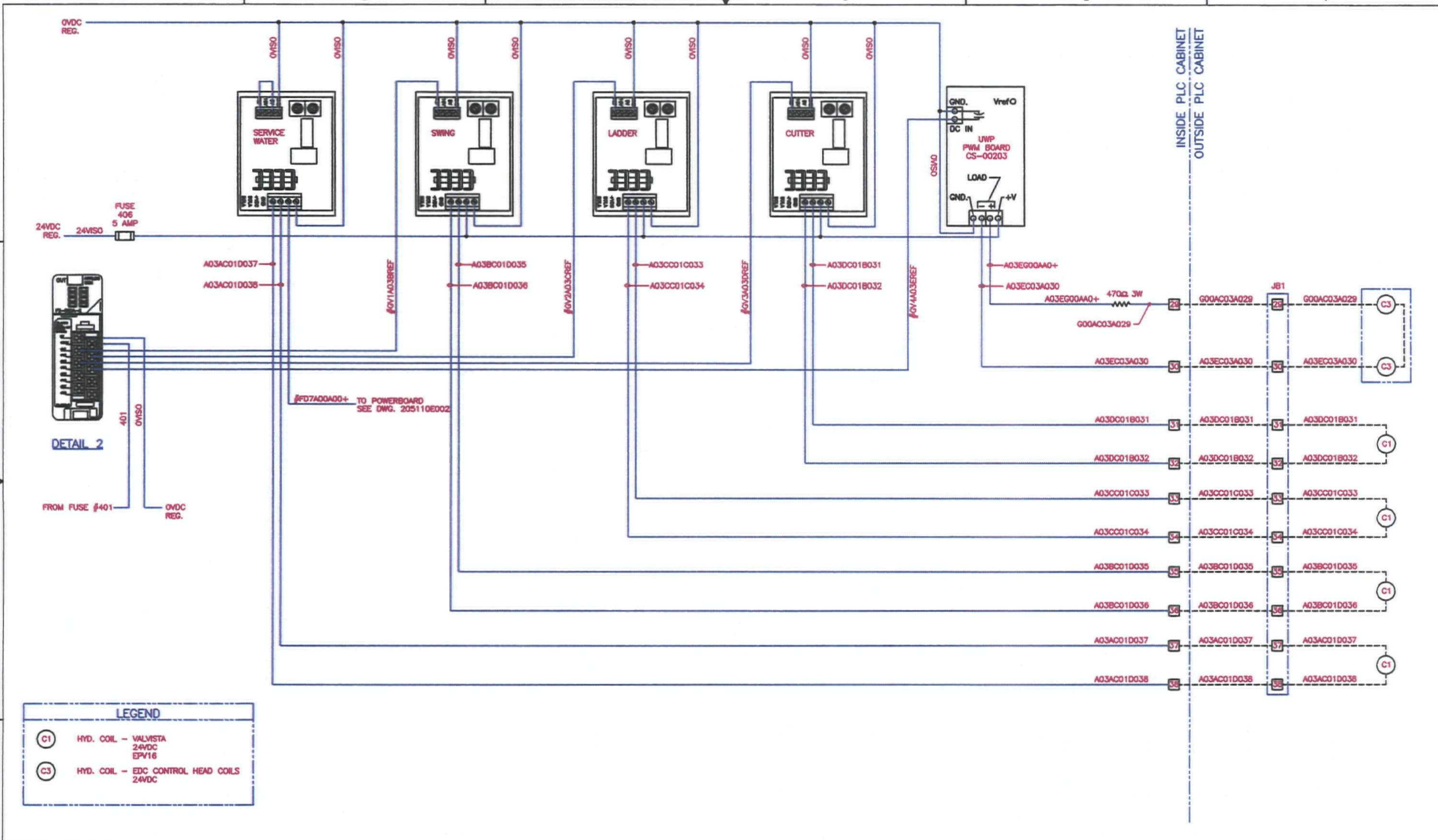
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

2006 8" MORAY DREDGE

PLC WIRING DIAGRAM (2 OF 8)

MJC
CJH
3/05/06
FULL
D
205110
205110E002



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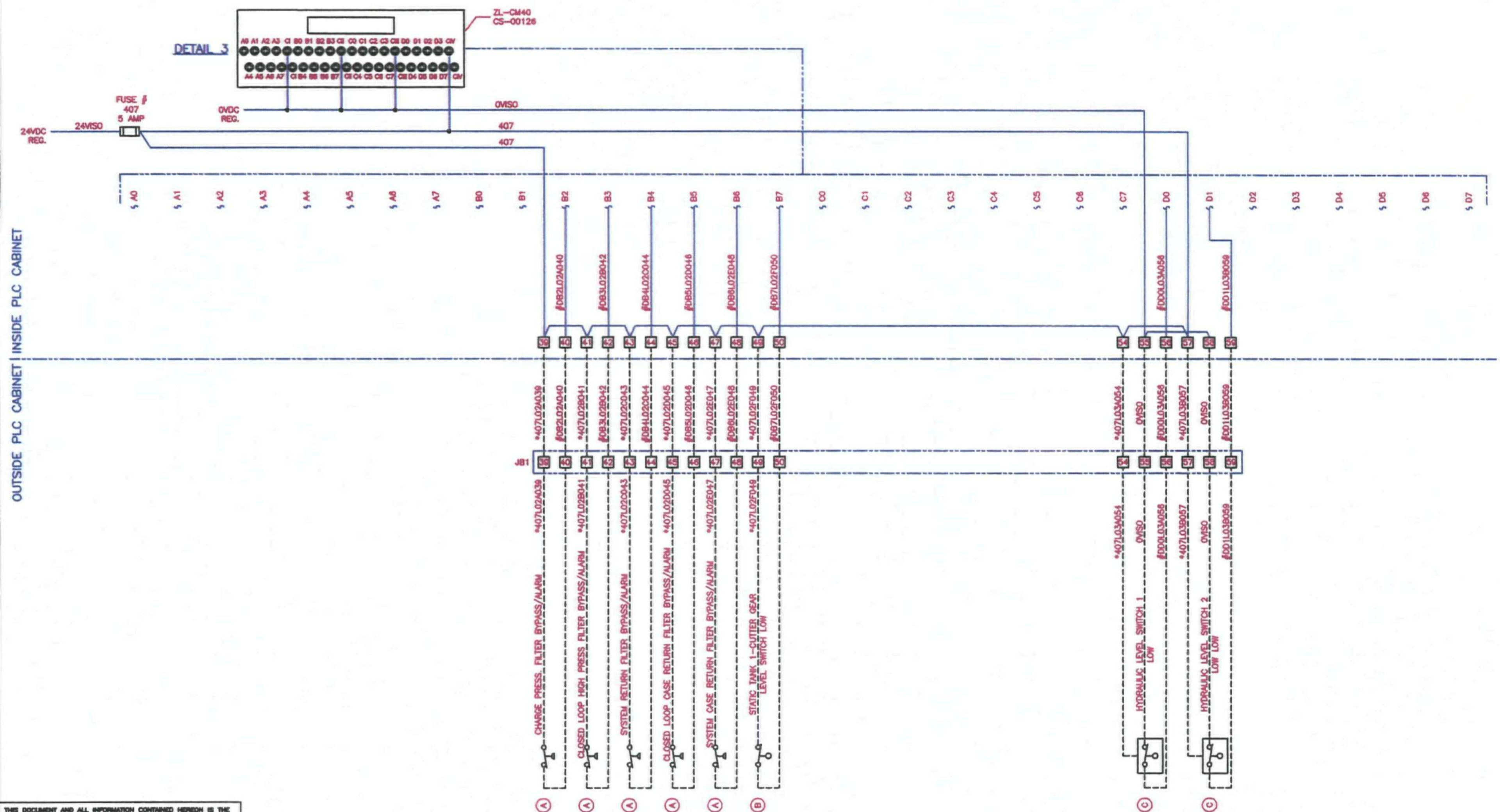
REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.
2006 8" MORAY DREDGE
PLC WIRING DIAGRAM (3 OF 8)

MJC · CJH · 3/15/06 · FULL · D · PROJECT 205110 · 205110E003

#	QTY	DESCRIPTION	WT #
A	2		-
B	1	PB-00360	-
C	2	CS-00309	-

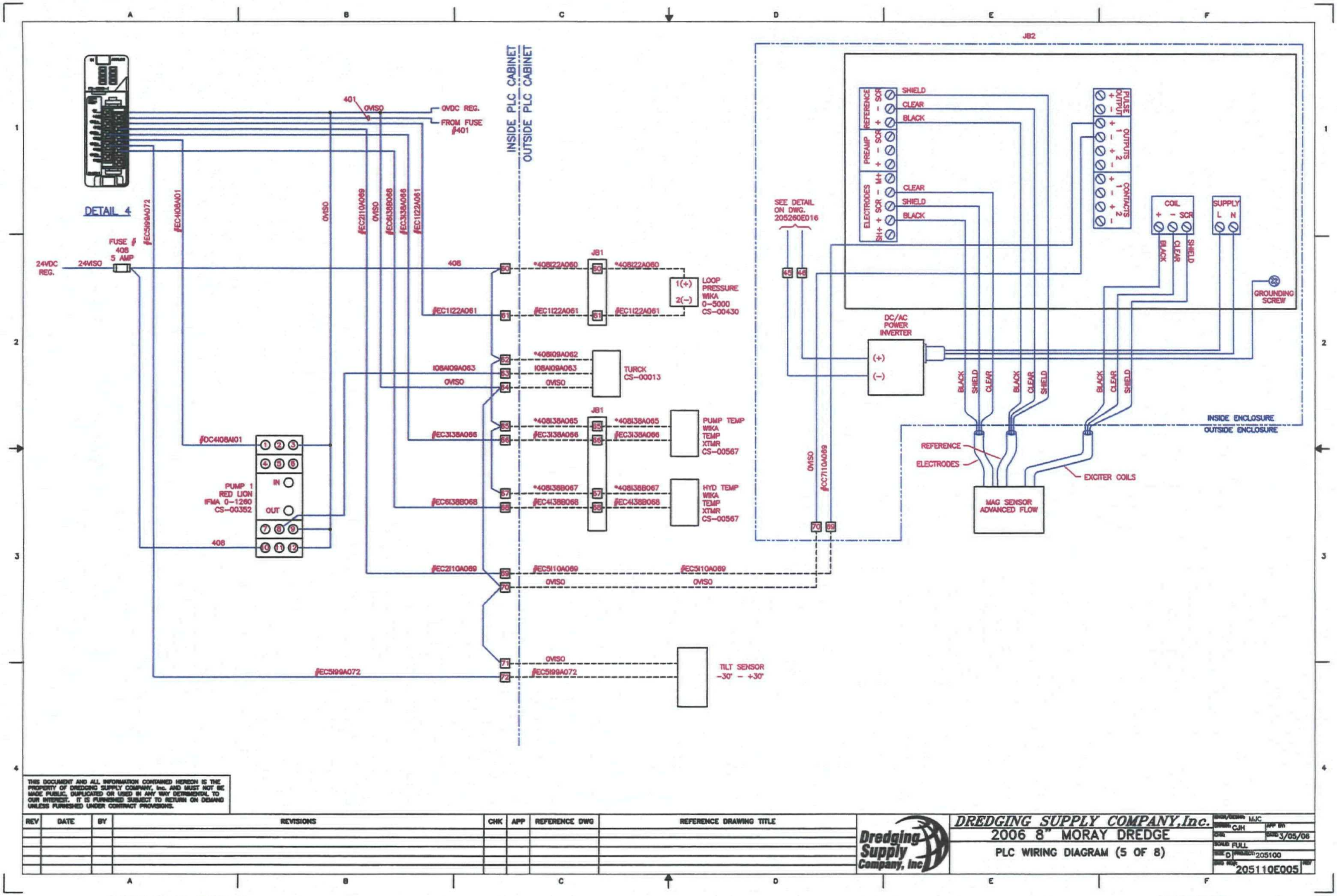


REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.
2006 8" MORAY DREDGE
PLC WIRING DIAGRAM (4 OF 8)

MJC
CJH
3/07/06
FULL
D
205110
205110E004


DETAIL 4
24VDC REG.
24VISO
FUSE # 406 5 AMP
INSIDE PLC CABINET
OUTSIDE PLC CABINET
JB1
JB2
LOOP PRESSURE WIKA 0-5000 CS-00430
TURCK CS-00013
PUMP TEMP WIKA TEMP XTMR CS-00567
HYD TEMP WIKA TEMP XTMR CS-00567
PUMP 1 RED LION IFMA 0-1260 CS-00352
TILT SENSOR -30° - +30°
SEE DETAIL ON DWG. 205260E016
DC/AC POWER INVERTER
MAG SENSOR ADVANCED FLOW
REFERENCE
ELECTRODES
EXCITER COILS
INSIDE ENCLOSURE
OUTSIDE ENCLOSURE
GROUNDING SCREW
COIL
SUPPLY
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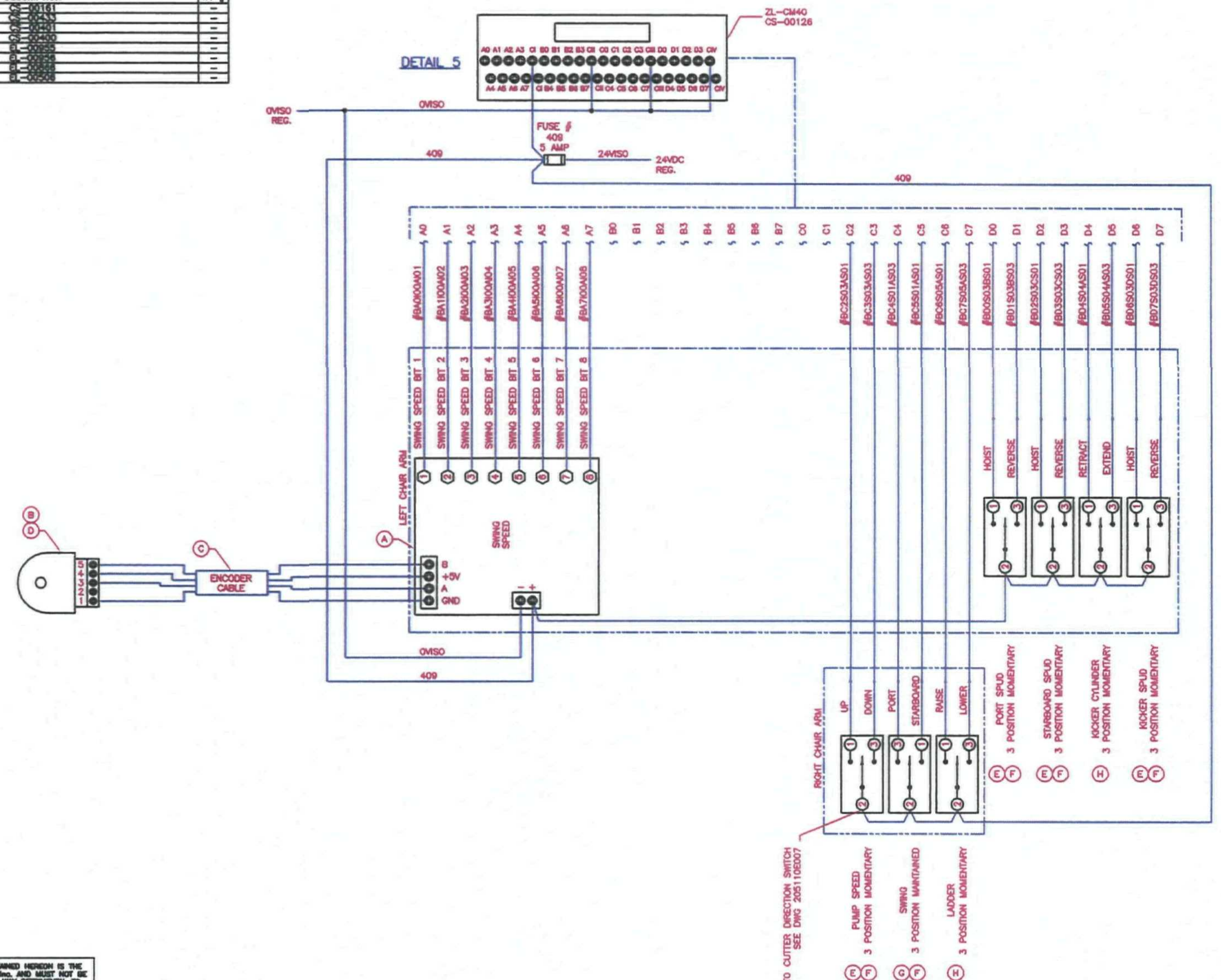
REV DATE BY REVISIONS CHK APP REFERENCE DWG REFERENCE DRAWING TITLE
DREDGING SUPPLY COMPANY, Inc.
2006 8" MORAY DREDGE
PLC WIRING DIAGRAM (5 OF 8)
MJC
CJH
3/05/06
FULL
D
205100
205110E005

#	QTY	DESCRIPTION	WT #
A	1	CS-00161	-
B	1	CS-00[illegible]	-
C	1	CS-00401	-
D	1	CS-00400	-
E	4	EL-00255	-
F	5	EL-00256	-
G	1	EL-00[illegible]	-
H	2	EL-00506	-



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE
A	06/16/05	KJR	ADDED CONNECTION TO CUTTER SWITCH				

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

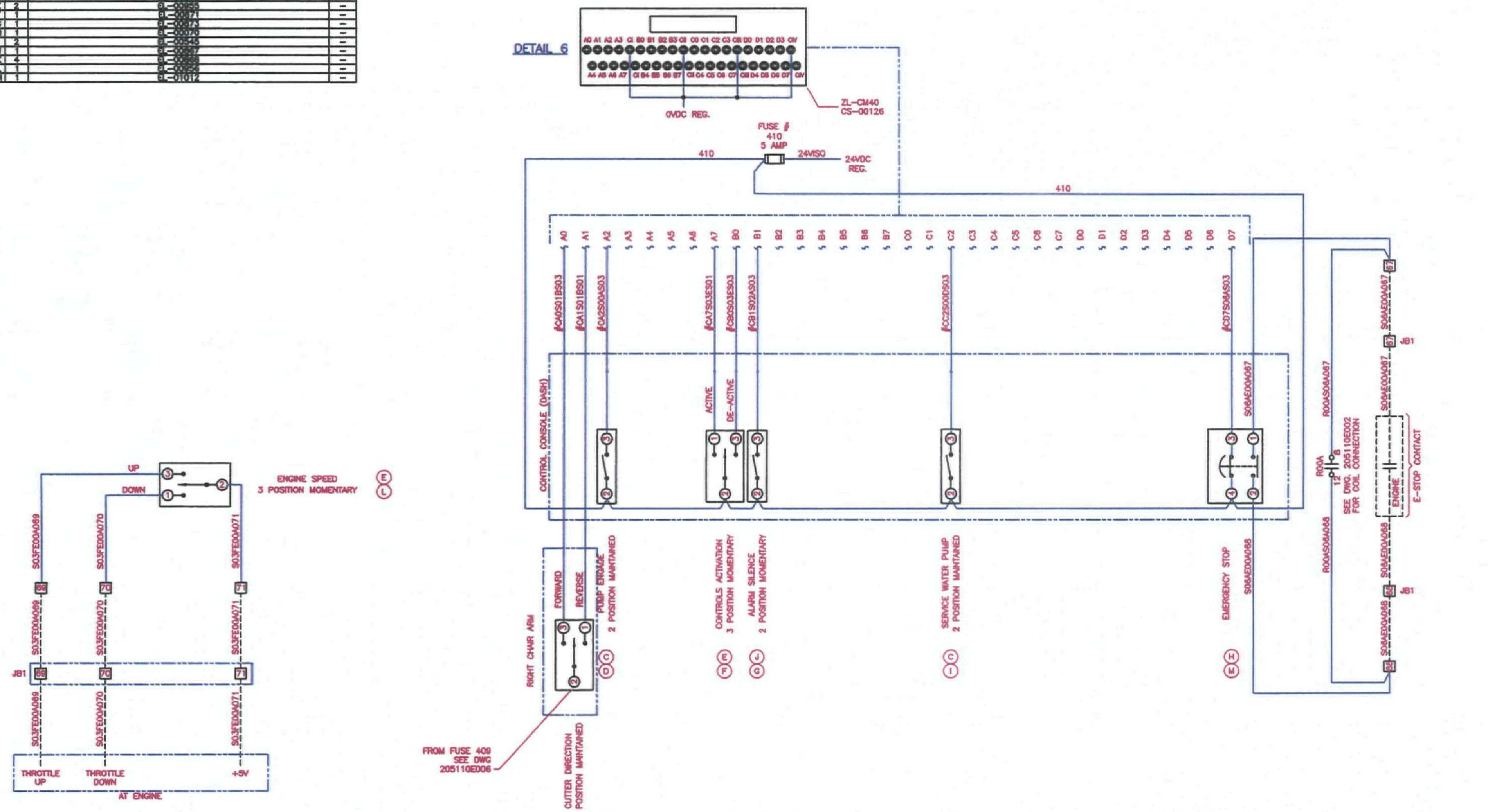
2006 8" MORAY DREDGE

PLC WIRING DIAGRAM (6 OF 8)

MJC	
CJH	3/05/06
FULL	
D	205110
205110E006	

MAY 2006

#	QTY	DESCRIPTION	WT #
A	5	EL-00566	–
B	1	EL-00569	–
C	3	EL-00565	–
D	1	EL-00570	–
E	2	[illegible]	–
F	1	[illegible]	–
G	1	[illegible]	–
H	1	[illegible]	–
I	2	EL-00545	–
J	1	[illegible]	–
K	4	[illegible]	–
L	1	[illegible]	–
M	1	EL-01012	–



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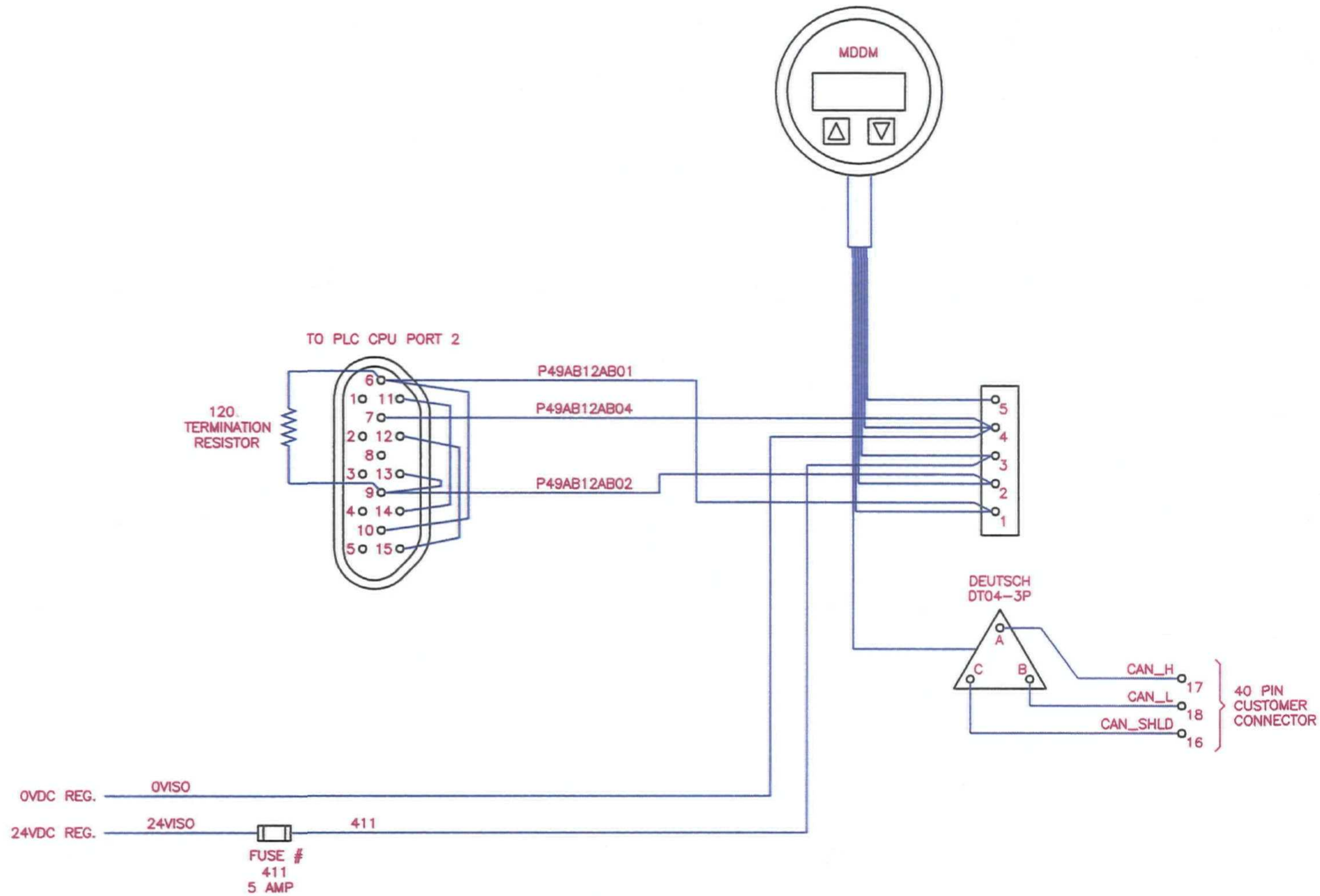
REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE
B	06-16-05	KJR	ADDED DISCHARGE VALVE SWITCH & MOVED CUTTER SWITCH TO CHAIR				
A	10/18/04	ARB	REMOVED DISCHARGE VALVE SWITCH				

DREDGING SUPPLY COMPANY, Inc.
2006 8" MORAY DREDGE
PLC WIRING DIAGRAM (7 OF 8)

MJC CJH 3/05/06 FULL D 205110
205110E007



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

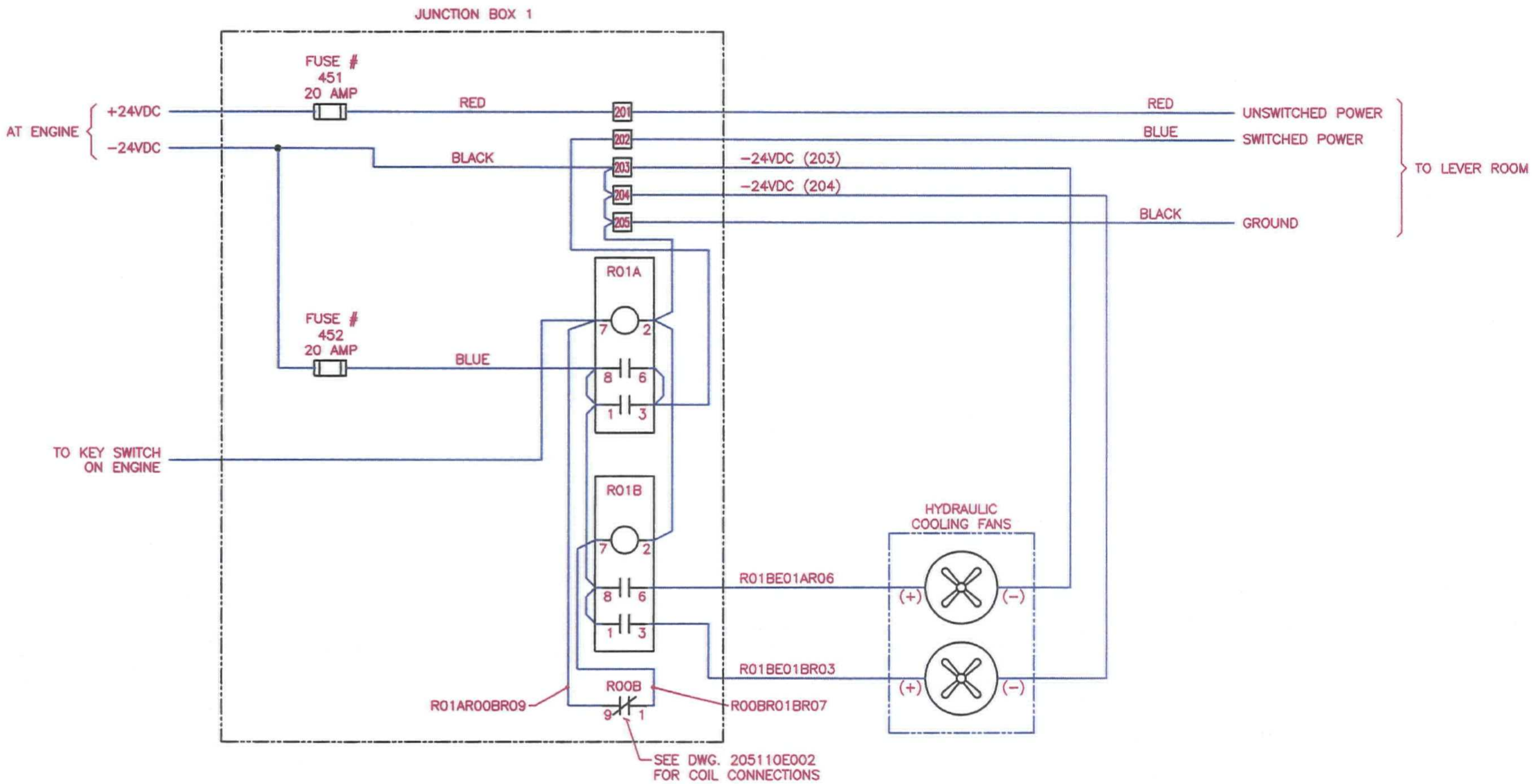
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

2006 8" MORAY DREDGE

PLC WIRING DIAGRAM (8 OF 8)

MJC
CJJ
3/05/06
FULL
D
205110
205110E008



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

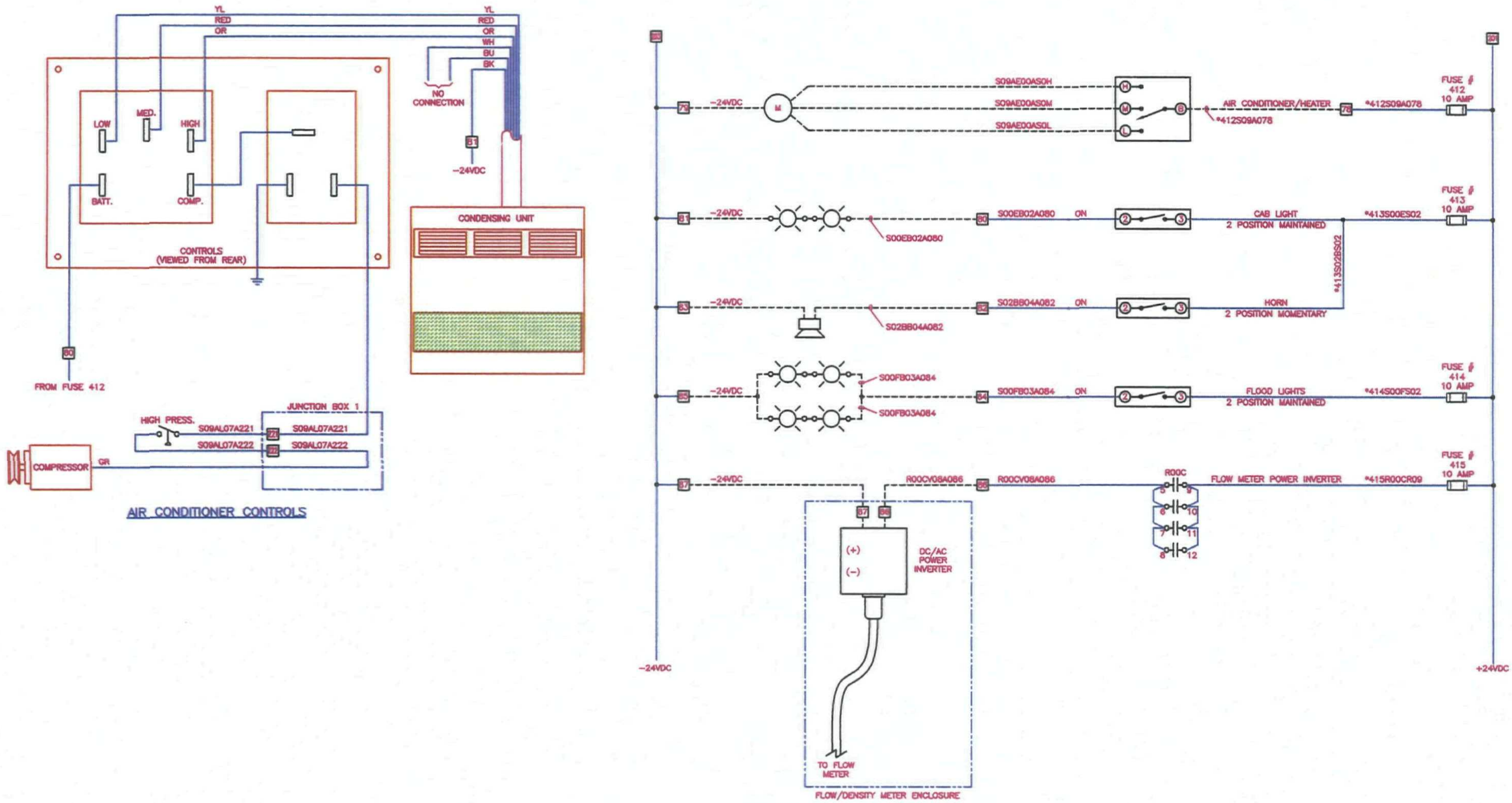
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

2006 8" MORAY DREDGE

DC WIRING DIAGRAM (1 OF 2)

MJC
CJH
3/5/06
FULL
D
205110
205110E009



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

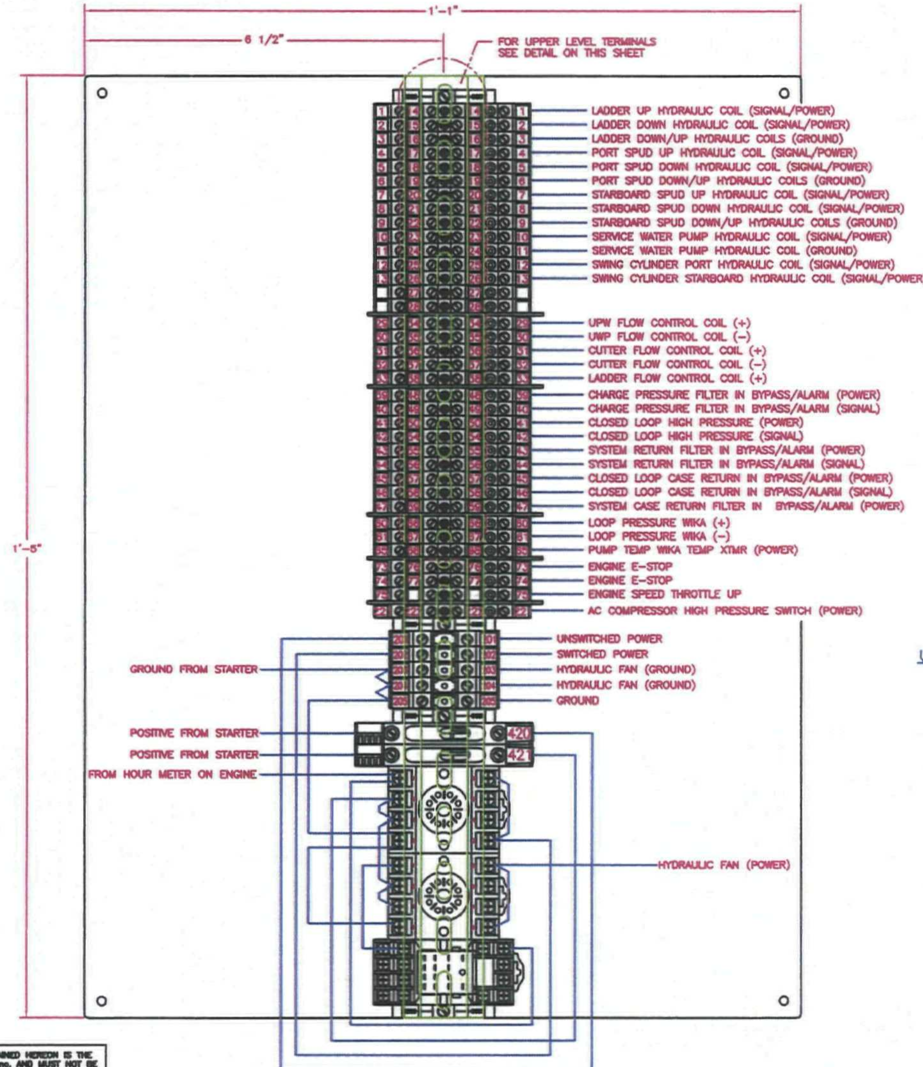
Dredging Supply Company, Inc

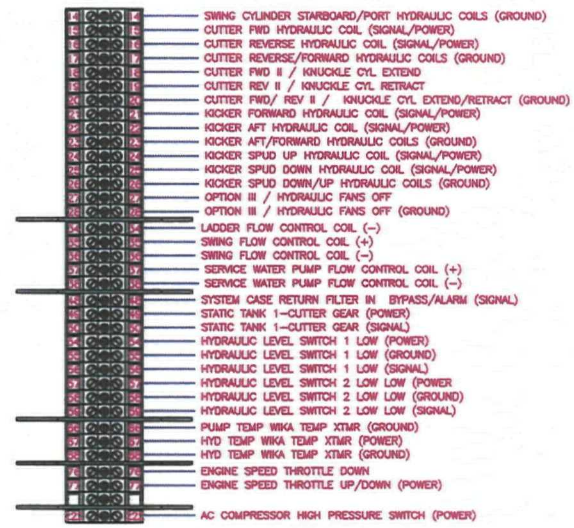
DREDGING SUPPLY COMPANY, Inc.

2006 8" MORAY DREDGE

DC WIRING DIAGRAM (2 OF 2)

ENGR/DESIGN MJC	
DRAWN CJH	APP BY
CHK	DATE 3/28/06
SCALE FULL	
SIZE D	PROJECT 205110
DWG NO. 205110E009	REV A





UPPER LEVEL TERMINAL WIRING DETAIL

REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

2006 8" MORAY DREDGE

JUNCTION BOX #1
BACK PANEL LAYOUT

MJC
CJH
3/20/06
FULL
D 205110
205110E012

BRENNAN

"Marine Professionals"

8" Dredge Fox River Operators Daily Report

Asset # JFB4935

Week Ending ____________________

Job # ____________________

Operator ____________________

Dredge Pump & Main Engine Hourly Operating Data

4 Hour Log Values Per Shift	**12 - 4 AM.**	**4- 8 AM.**	**8 - 12 PM.**	**12- 4 PM.**	**4 - 8 PM.**	**8 - 12 PM.**
Engine RPM						
Hydraulic Oil Temperature						
Engine Oil Temperature						
Engine Oil Pressure						
Engine Coolant Temperature						
Engine Fuel Pressure						

Comments ____________________

Operator 1st shift ____________________

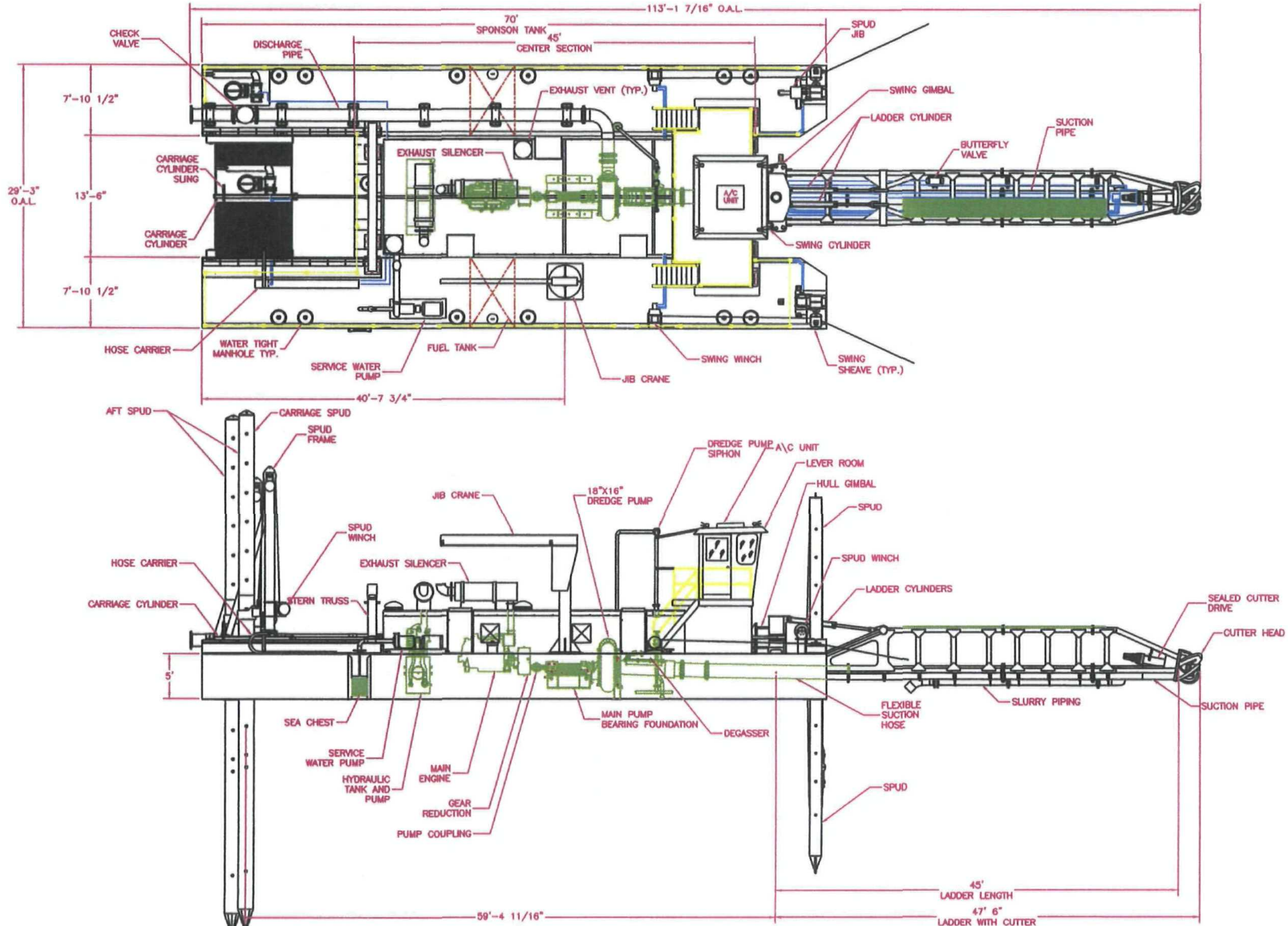
Operator 2nd shift ____________________

Operator 3rd shift ____________________

J.F. BRENNAN CO., INC.
820 BAINBRIDGE · BOX 2557 · LA CROSSE, WI 54602-2557 PHONE: 608 / 784-7173 FAX: 608 / 785-2090

APPENDIX B

OPERATIONS MANUAL FOR 12-INCH BARRACUDA DREDGE AND PULLMAN WINCH AND OPERATOR REPORT FORMS



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

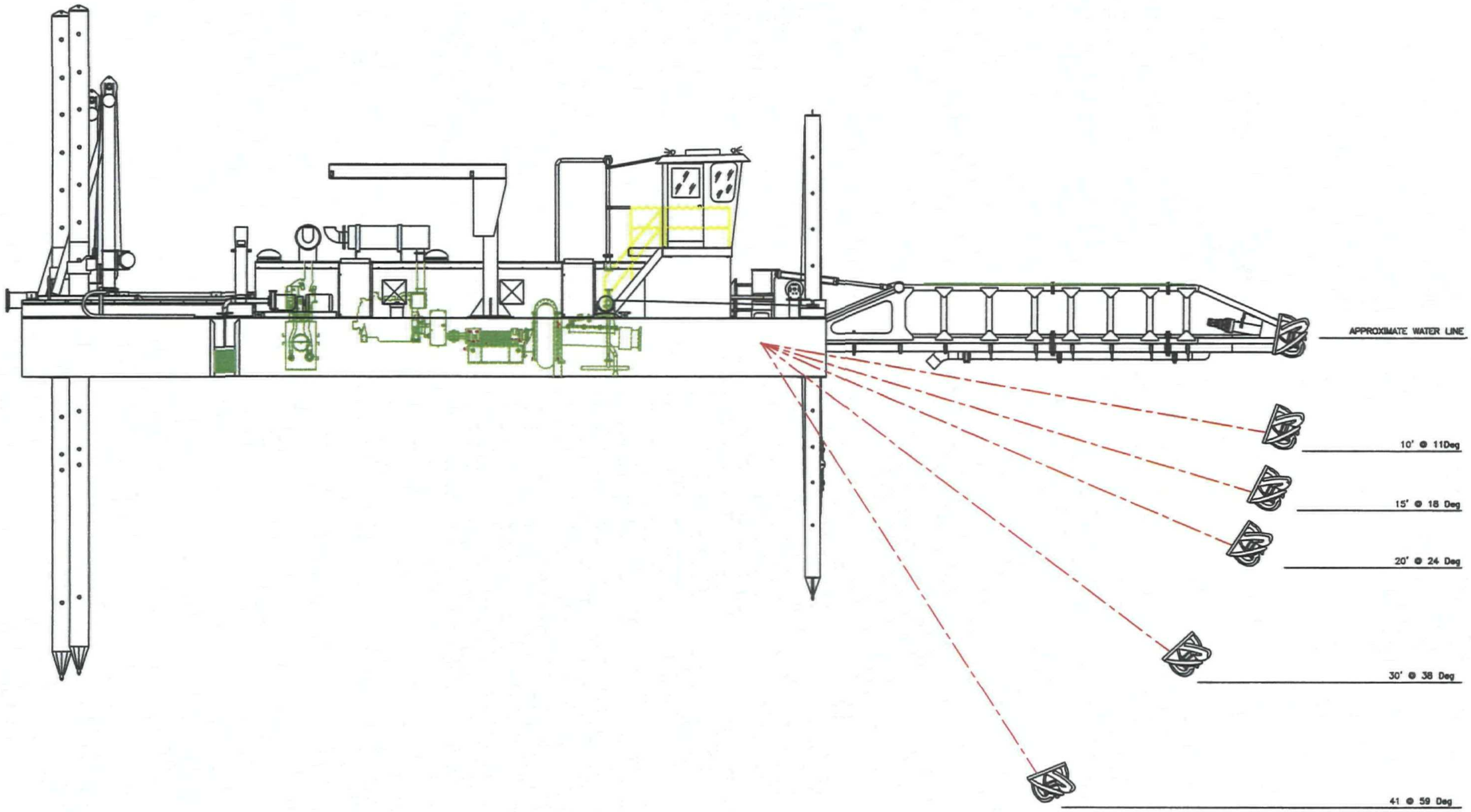
DSC

DREDGING SUPPLY COMPANY, Inc.

18x16 MOD. BARRACUDA DREDGE

J. F. BRENNAN
GENERAL ARRANGEMENT

ENGR/DESIGN: NJG
DRAWN: NJG
CHK:
APP BY:
SCALE: 3/16"=1'-0"
DATE: 6/16/99
PROJECT: 99020
DWG NO.: 9902001F
REV: F



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

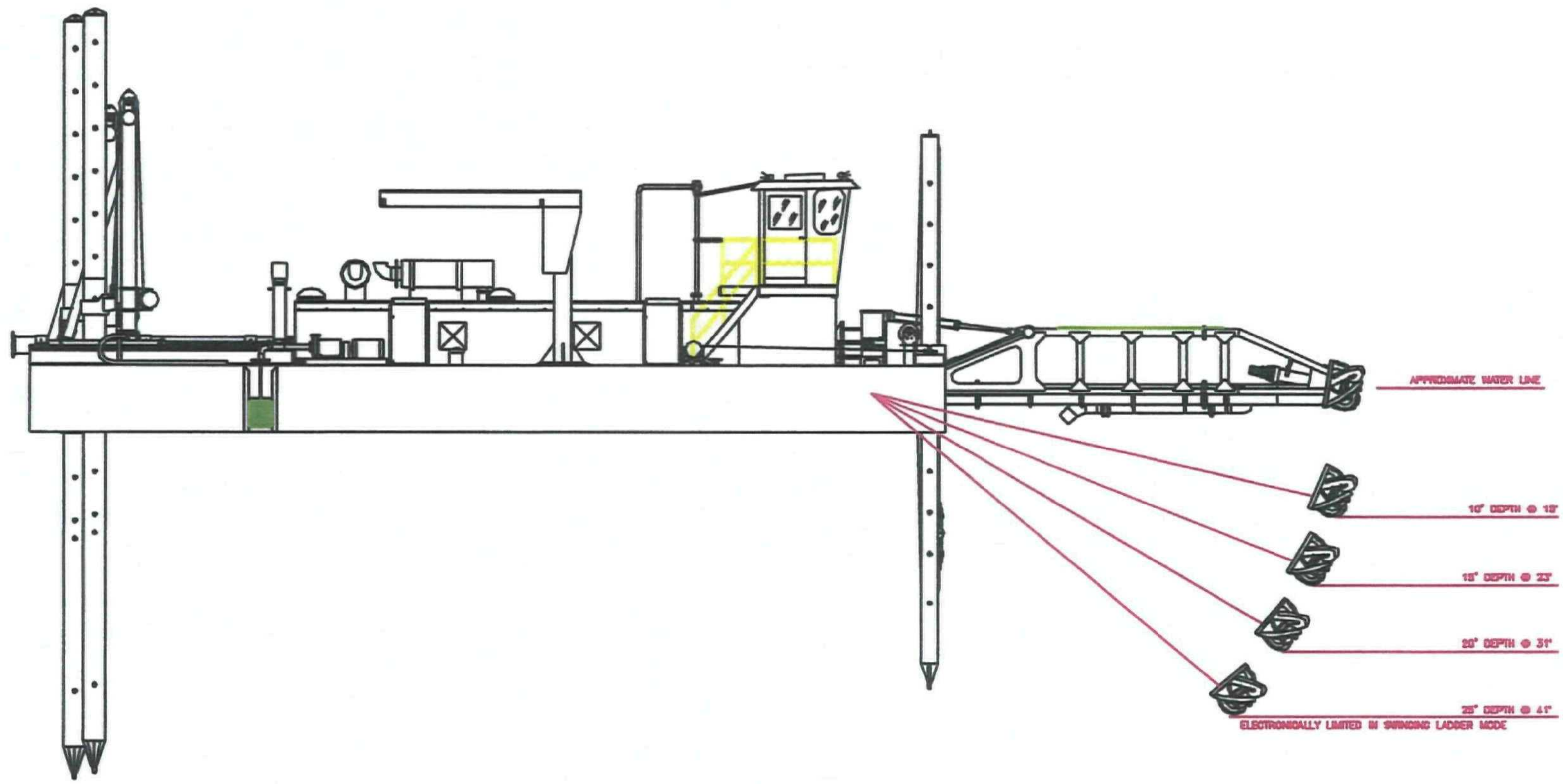
DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

DIGGING DEPTH DIAGRAM

ENGR/DESIGNER: MC	
DRAWN: wjb	
CHK:	APP BY:
SCALE: N.T.S.	DATE: 9/17/99
PROJECT: 99020	
DWG NO#: 99020121A	REV: B

16 (SL)



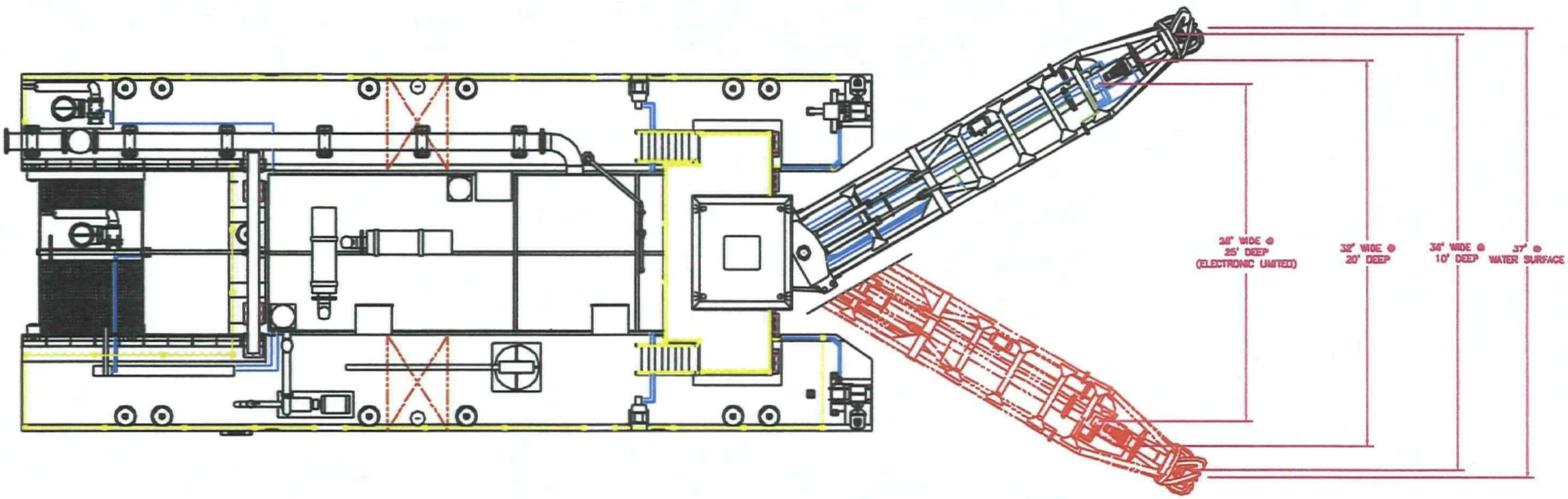
NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.

J.F. BRENNAN MOD. BARACUDA

DIGGING DEPTH DIAGRAM
(SHORT LADDER)

99020148



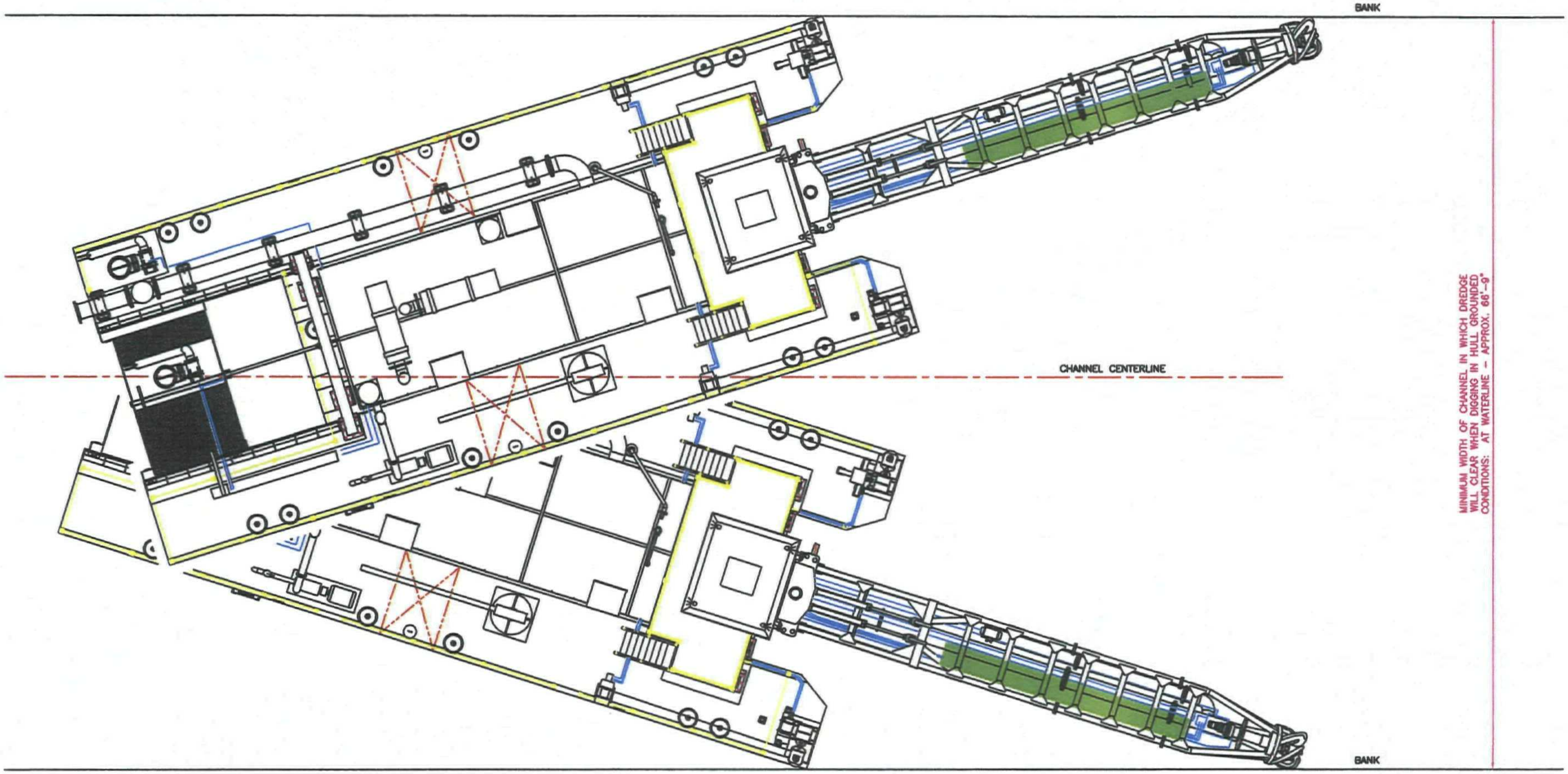
NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

MAXIMUM SWING
(SWINGING LADDER MODE)

WJB
WJB
WJB WJB
N.T.S. 10/14/99
99020
99020122



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DSC

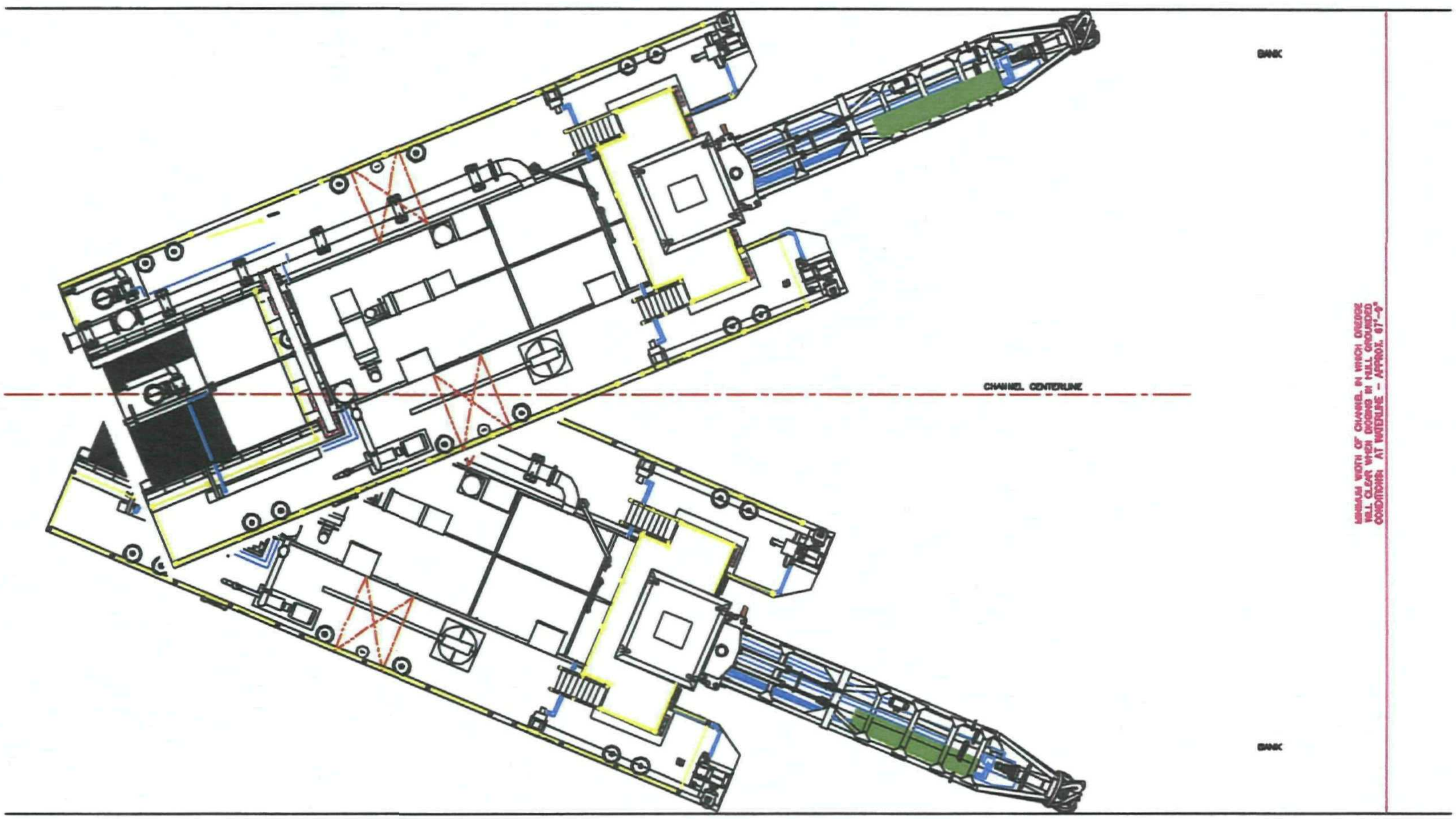
DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

MINIMUM SWING (CONVENTIONAL MODE)
HULL GROUNDED

ENGR/DESGN: WJB	
DRAWN: JJM	
CHK:	APP BY:
SCALE: N.T.S.	DATE: 6/14/99
PROJECT: 99020	
DWG NO: 99020123	REV:

18 (SL)



NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

Dredging Supply Company, Inc.

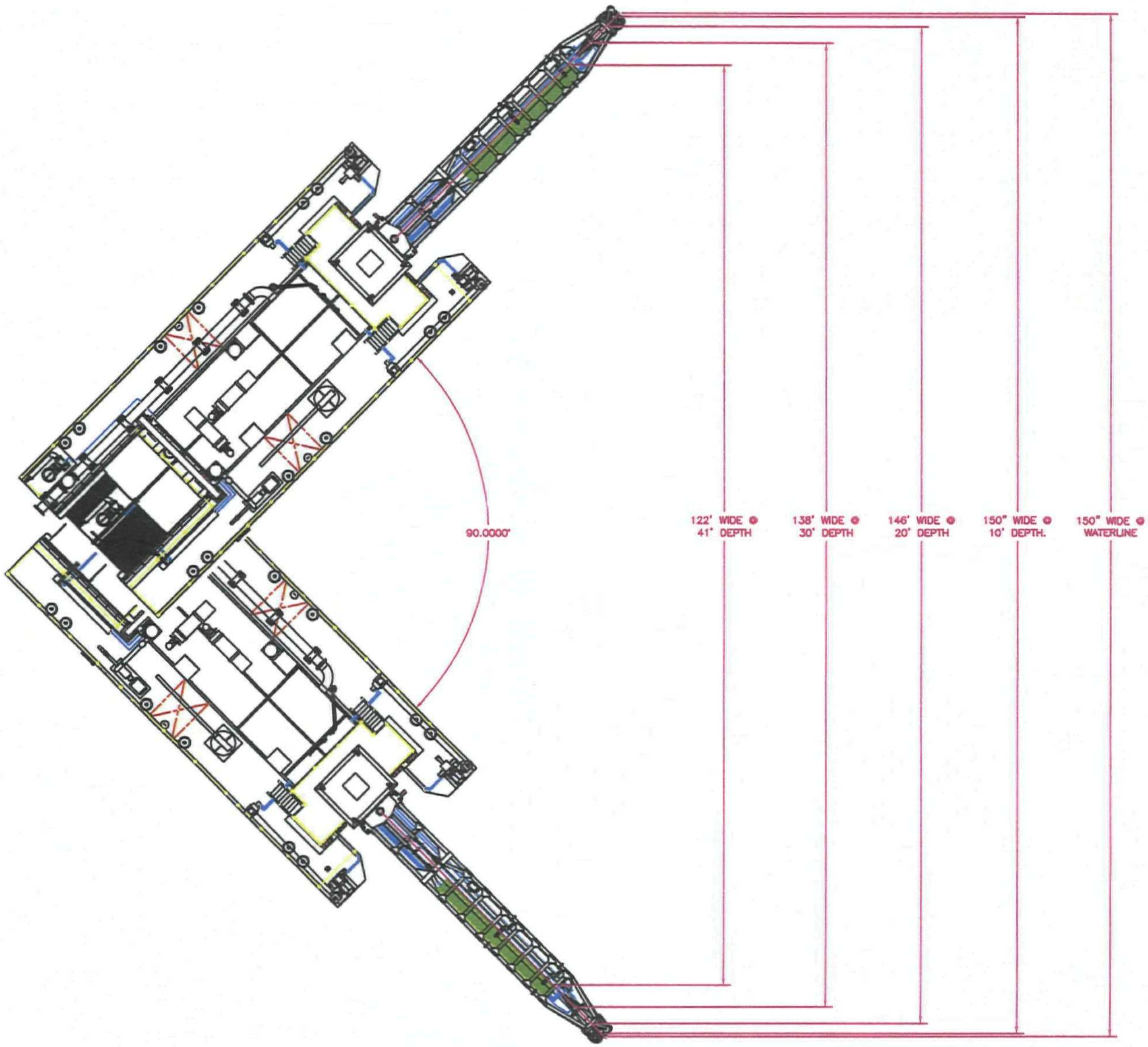
DREDGING SUPPLY COMPANY, Inc.

J.F. BRENNAN MOD. BARRACUDA

MINIMUM SWING (CONVENTIONAL MODE)
HULL GROUNDED W/SHORT LADDER

WJB

99020149



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DSC

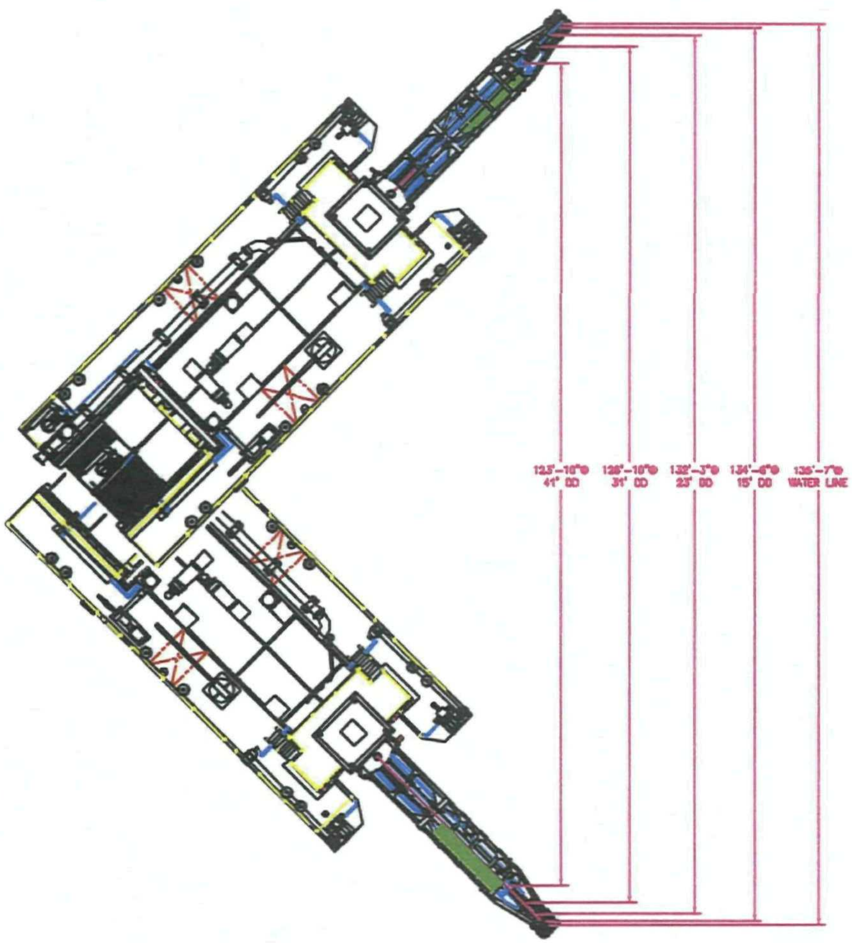
DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

MAXIMUM SWING
(CONVENTIONAL MODE)

ENGR/DESGNR: WJB	
DRAWN: JJM	
CHK: WJB	APP BY: WJB
SCALE: N.T.S.	DATE: 8/21/99
PROJECT: 99020	
DWG NO.: 99020124	REV: A

19 (SL)



NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION
						A	

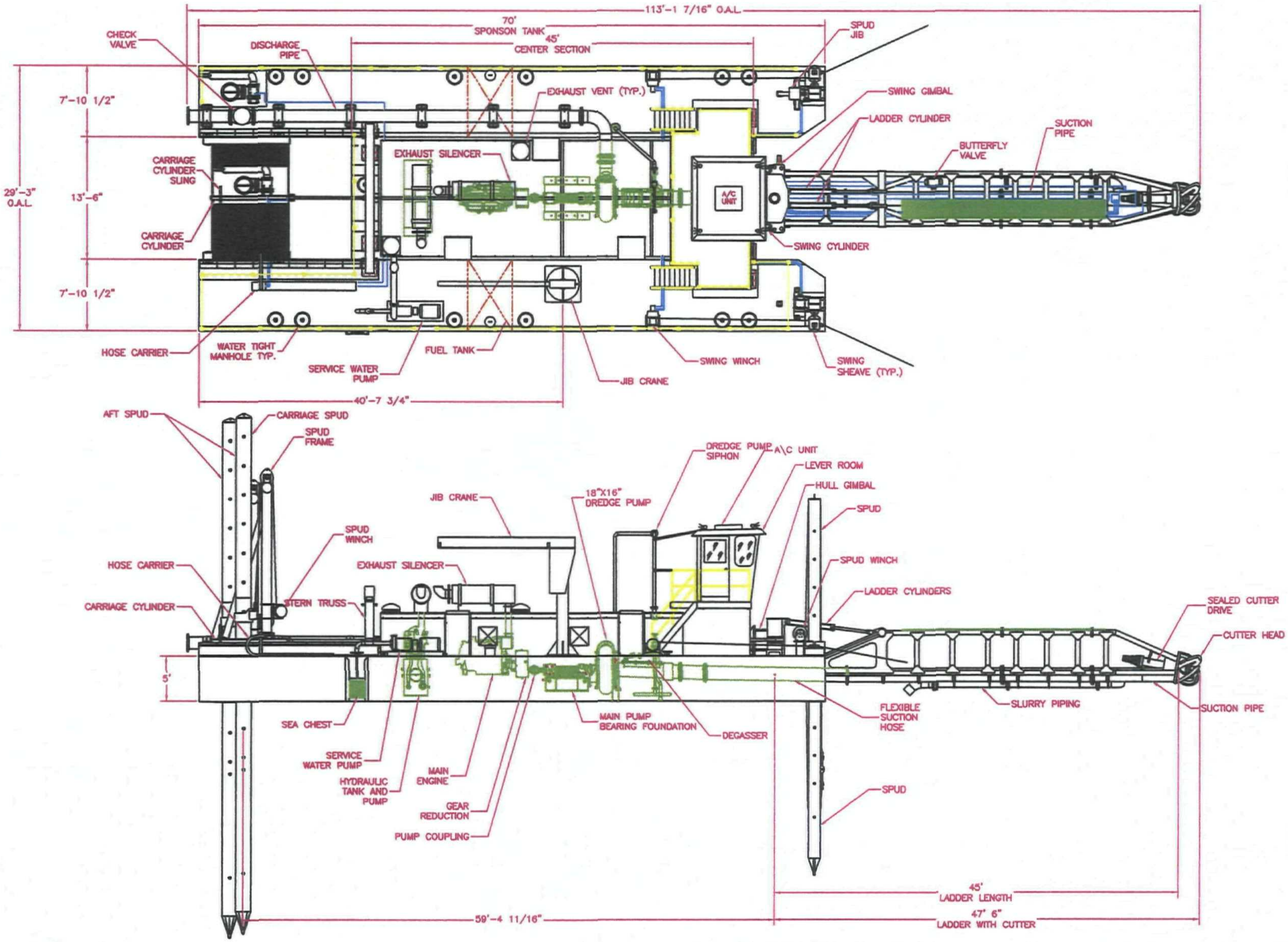
Dredging Supply Company, Inc.

DREDGING SUPPLY COMPANY, Inc.

J.F. BRENNAN MOD. BARRACUDA

MAXIMUM SWING (CONVENTIONAL MODE)
W/SHORT LADDER

99020150



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DSC

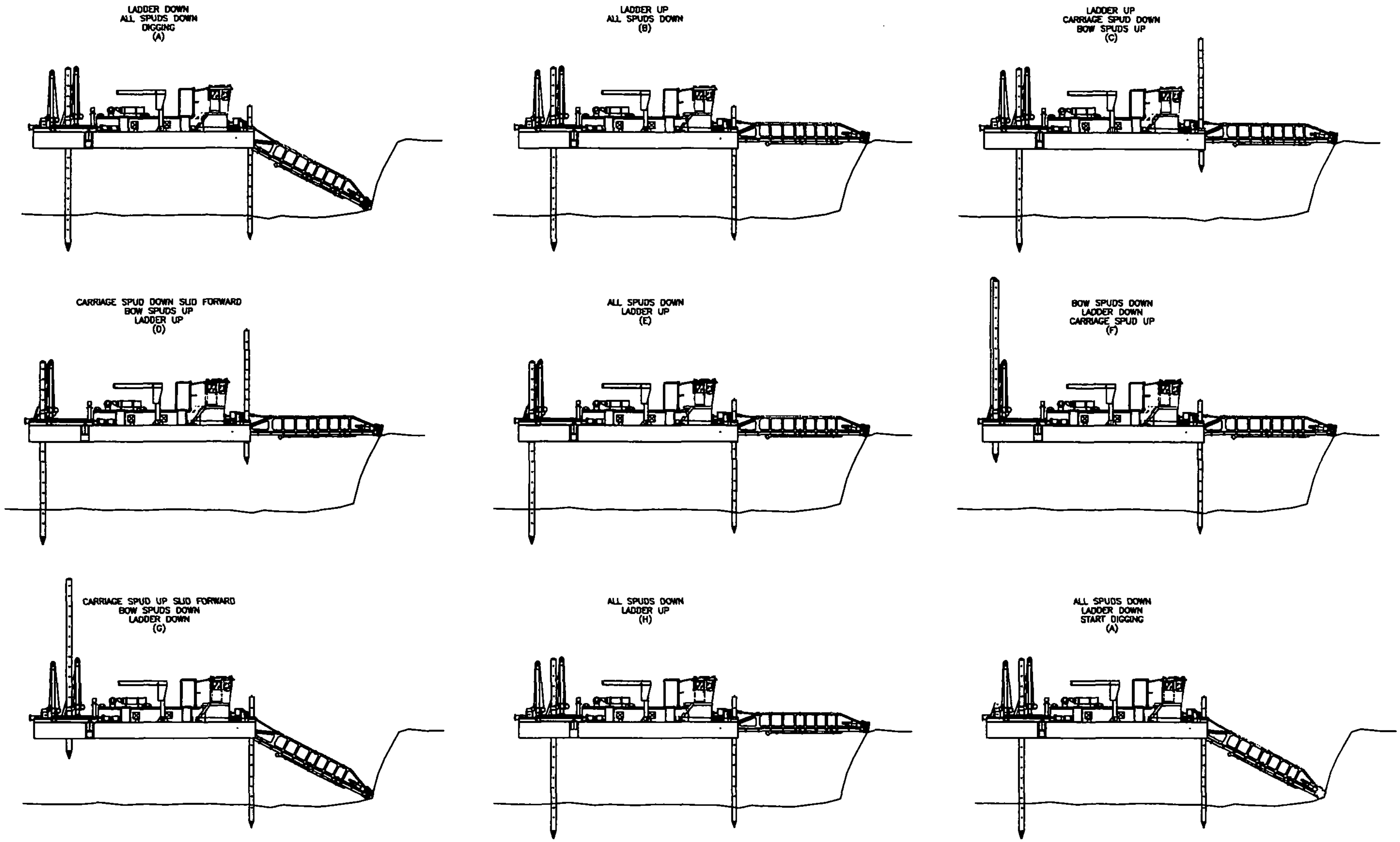
DREDGING SUPPLY COMPANY, Inc.

18x16 MOD. BARRACUDA DREDGE

J. F. BRENNAN

GENERAL ARRANGEMENT

ENGR/CUSTMR: NJG
DRAWN: NJG
CHK:
APP BY:
SCALE: 3/16"=1'-0"
DATE: 6/16/99
PROJECT: 99020
DWG NO.: 9902001F
REV: F



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

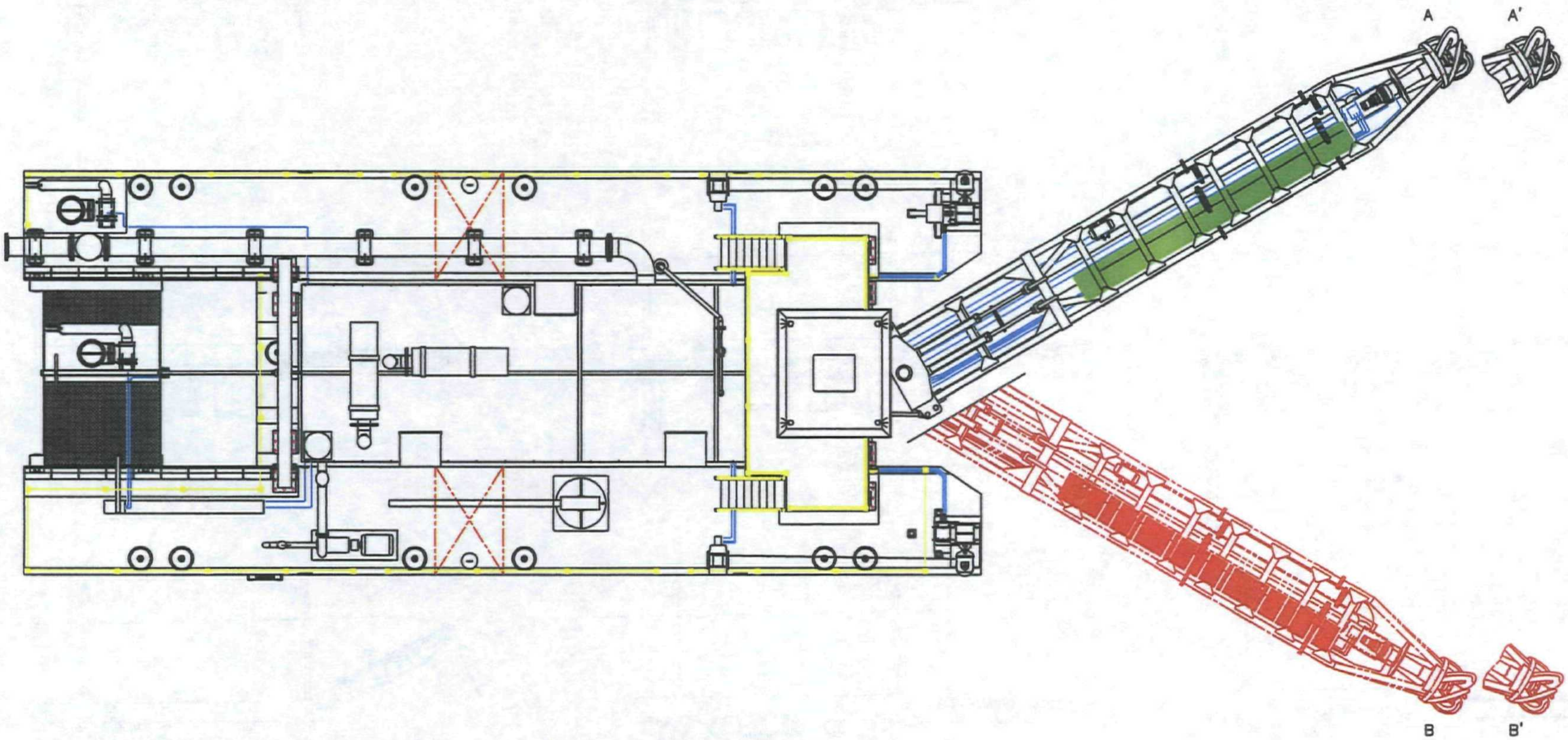
DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

SWINGING LADDER SPUD OPERATION

DESIGNED: WJB	
DRAWN: JJM	
CHK: WJB	APP BY:
SCALE: N.T.S.	DATE: 6/21/99
PROJECT: 99020	
DWG NO: 99020125A	REV: A



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

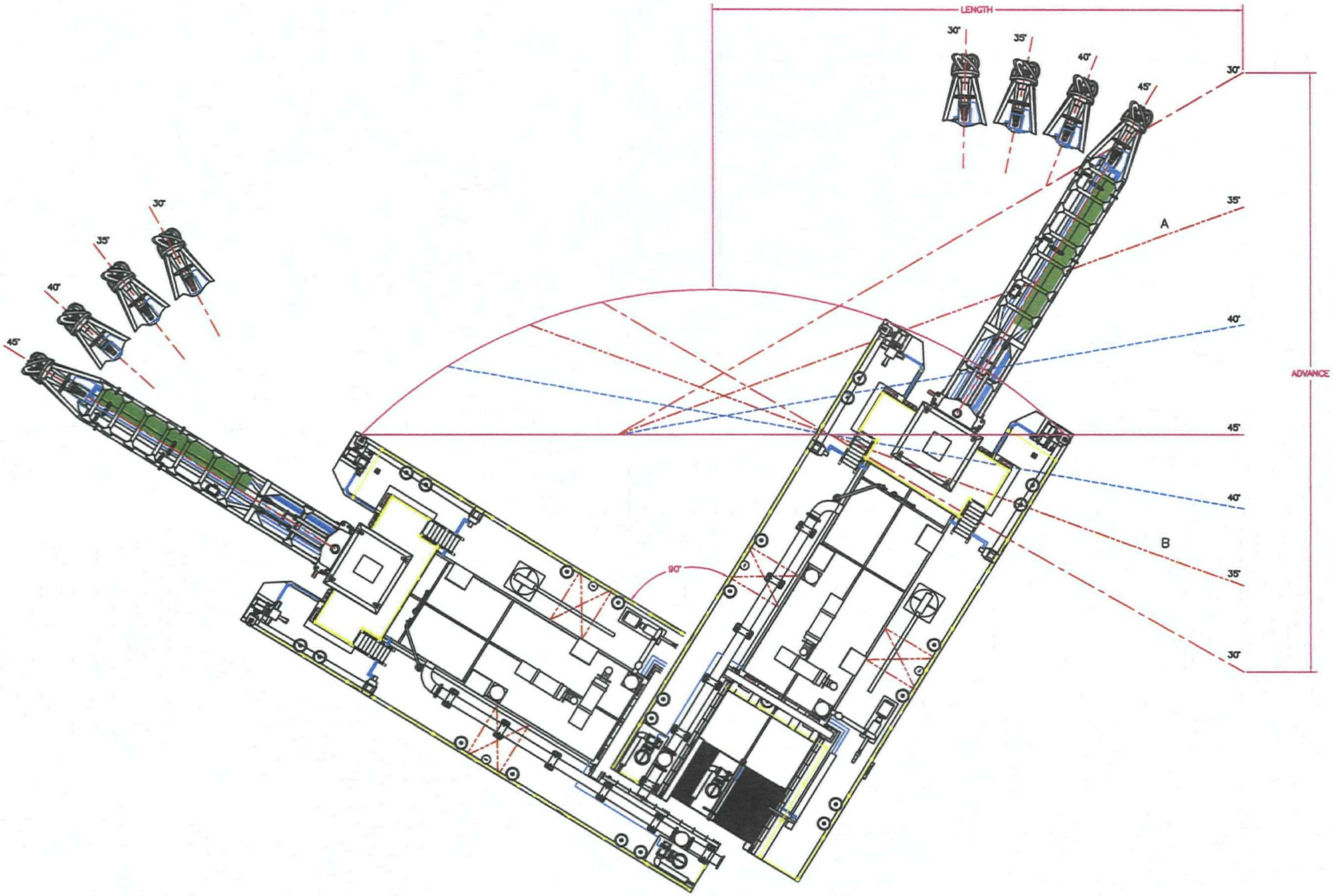
DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

SWINGING LADDER OPERATION

ENGR/DESIGN: WJB	
DRAWN: JJM	
CHK:	APP BY:
SCALE: N.T.S.	DATE: 6/14/99
PROJECT: 99020	
DWG NO.: 99020126	REV

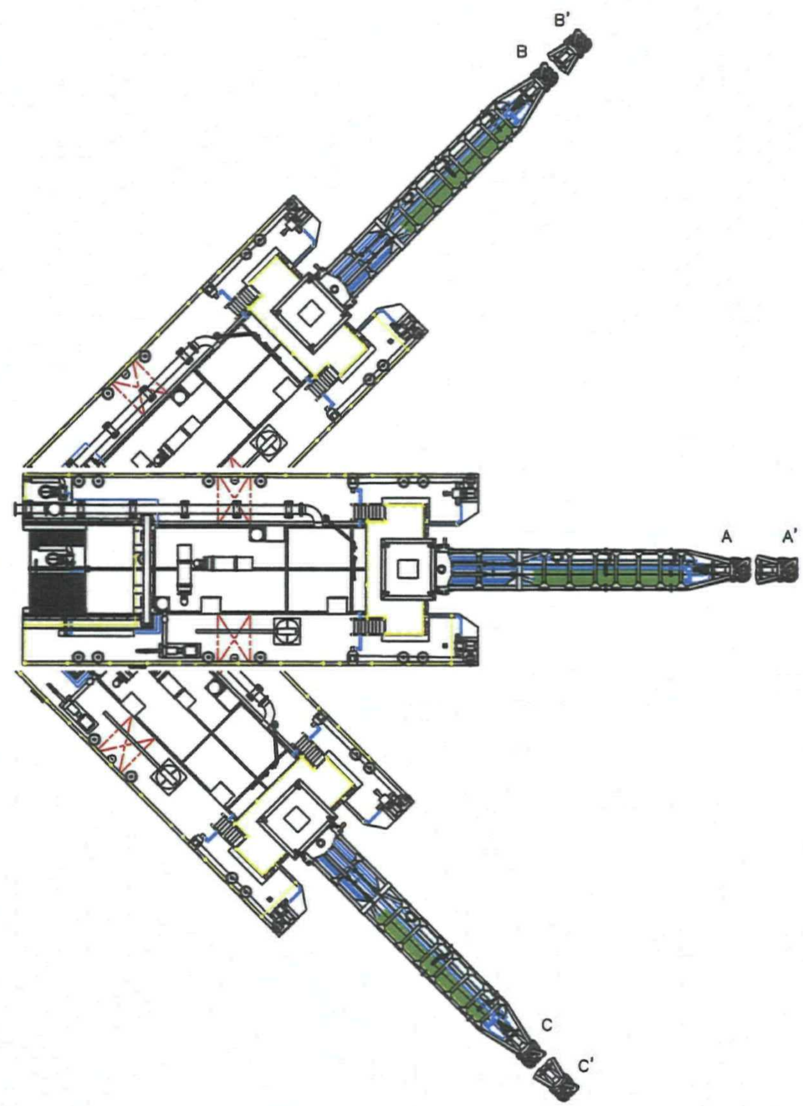


NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DSC

DREDGING SUPPLY COMPANY, Inc.
J. F. BRENNAN MOD. BARRACUDA
CONVENTIONAL ANCHOR LOCATION & ADVANCE

ENGR/DESGN: WJB
DRAWN: JJM
CHK:
APP BY:
SCALE: N.T.S.
DATE: 6/16/99
PROJECT: 99020
DWG NO.: 99020127
REV:



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NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

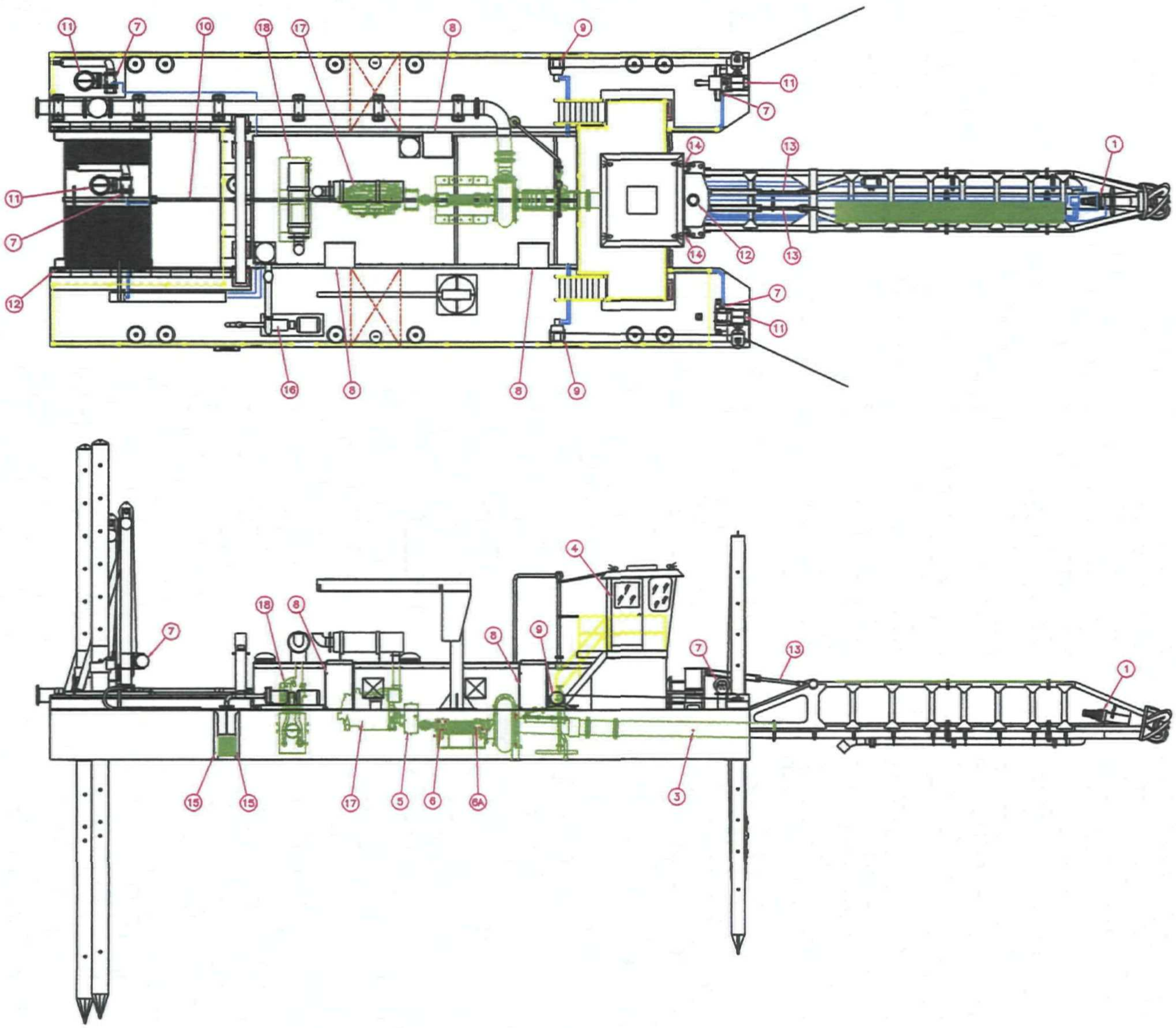
DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

CONVENTIONAL DREDGING OPERATION

WJB	
JJM	
	APP BY:
N.T.S.	6/16/99
99020	
99020128	REV



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

LUBRICATION DIAGRAM

WJB

JJM

wjb

APP BY:

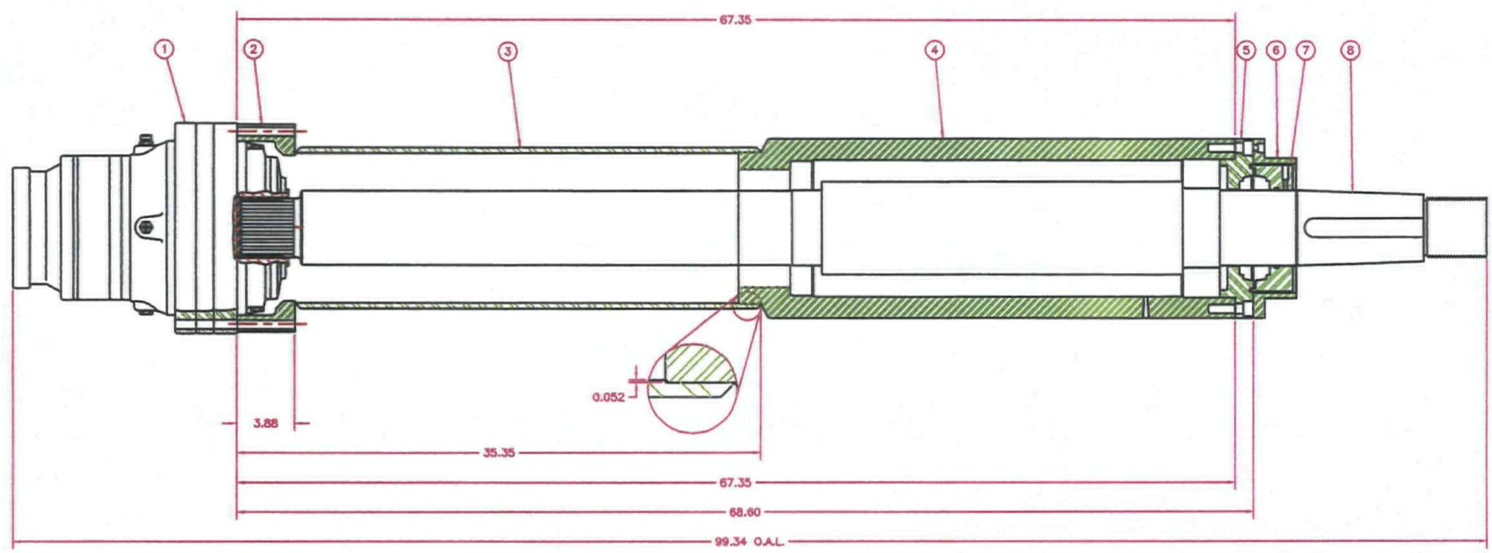
N.T.S.

6/17/99

99020

99020129A

A



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

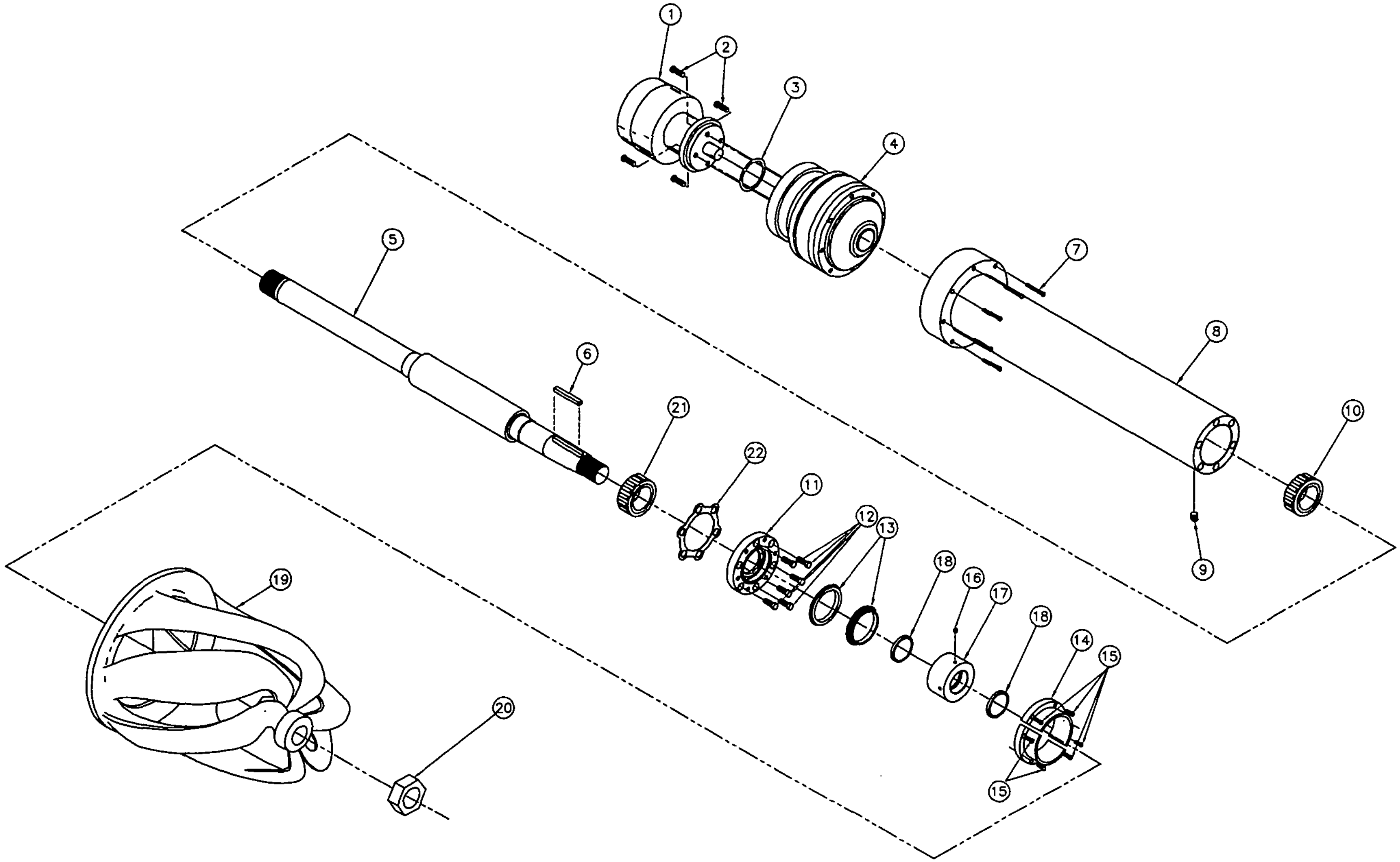
DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

CUTTER BEARING TUBE ASSEMBLY

ENGR/DESIGN: WJB	
DRAWN: JJM	
CHK:	APP BY:
SCALE: N.T.S.	DATE: 6/16/99
PROJECT: 99020	
DWG NO.: 99020130	REV



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NO.#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

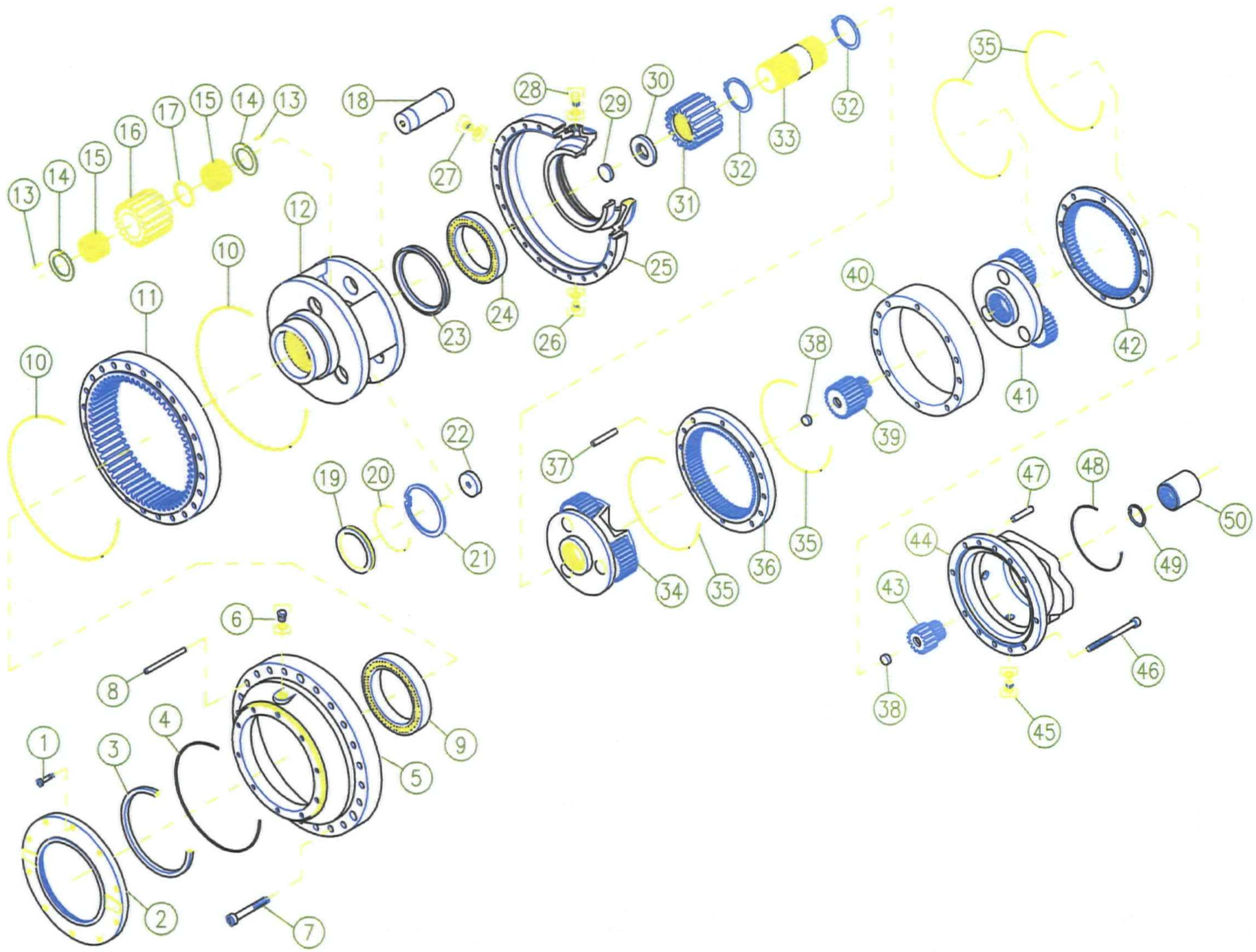
DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

CD50 SEALED CUTTER DRIVE ISO

ENGR/DESIGN: WJB	
DRAWN: JJM	
CHK:	APP BY:
SCALE: N.T.S.	DATE: 6/16/00
PROJECT: 99020	
DWG NO.: 99020131	REV



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

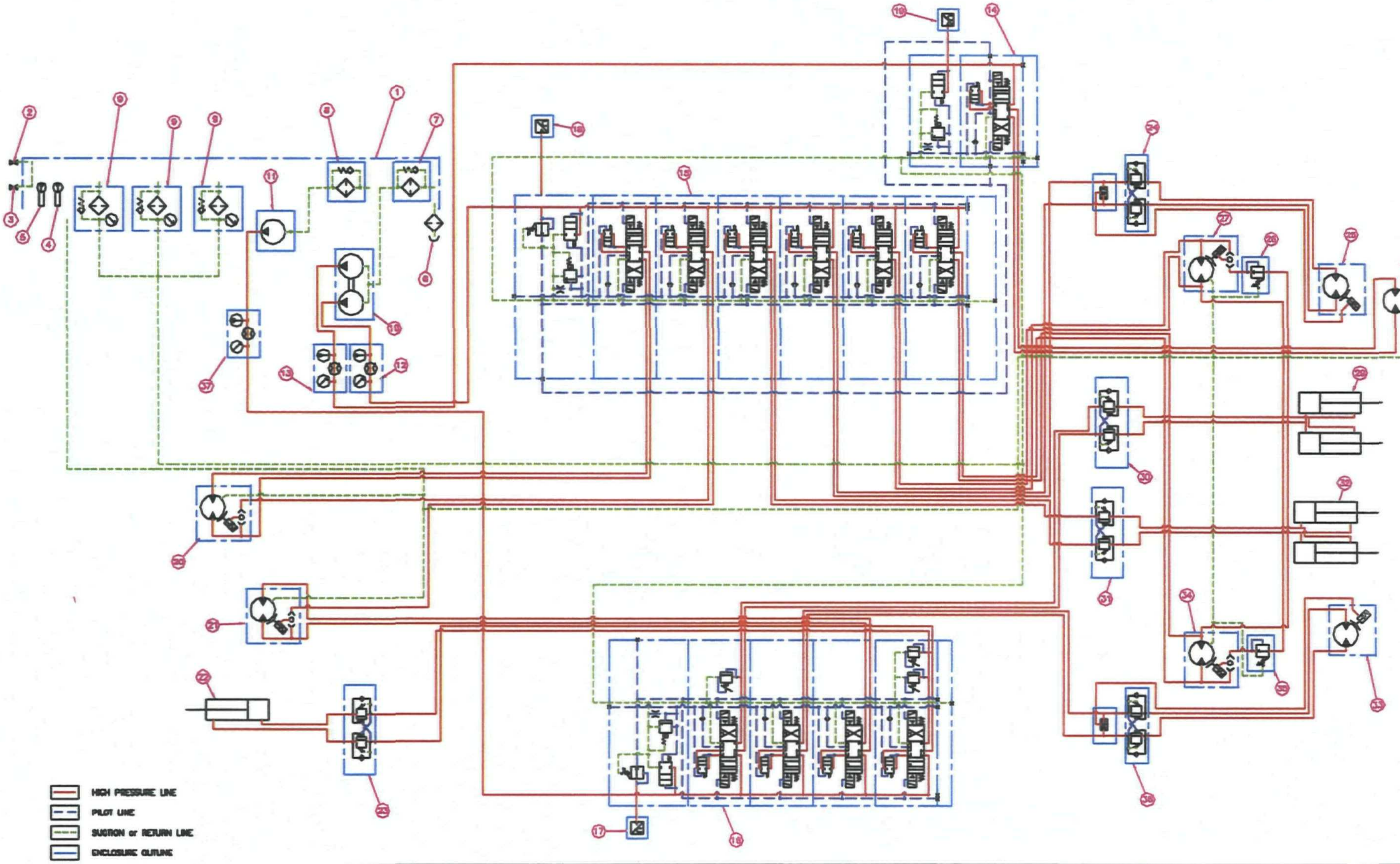
DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

CUTTER REDUCTION RR2300TF

WJB
JJM
N.T.S.
6/16/99
99020
99020132



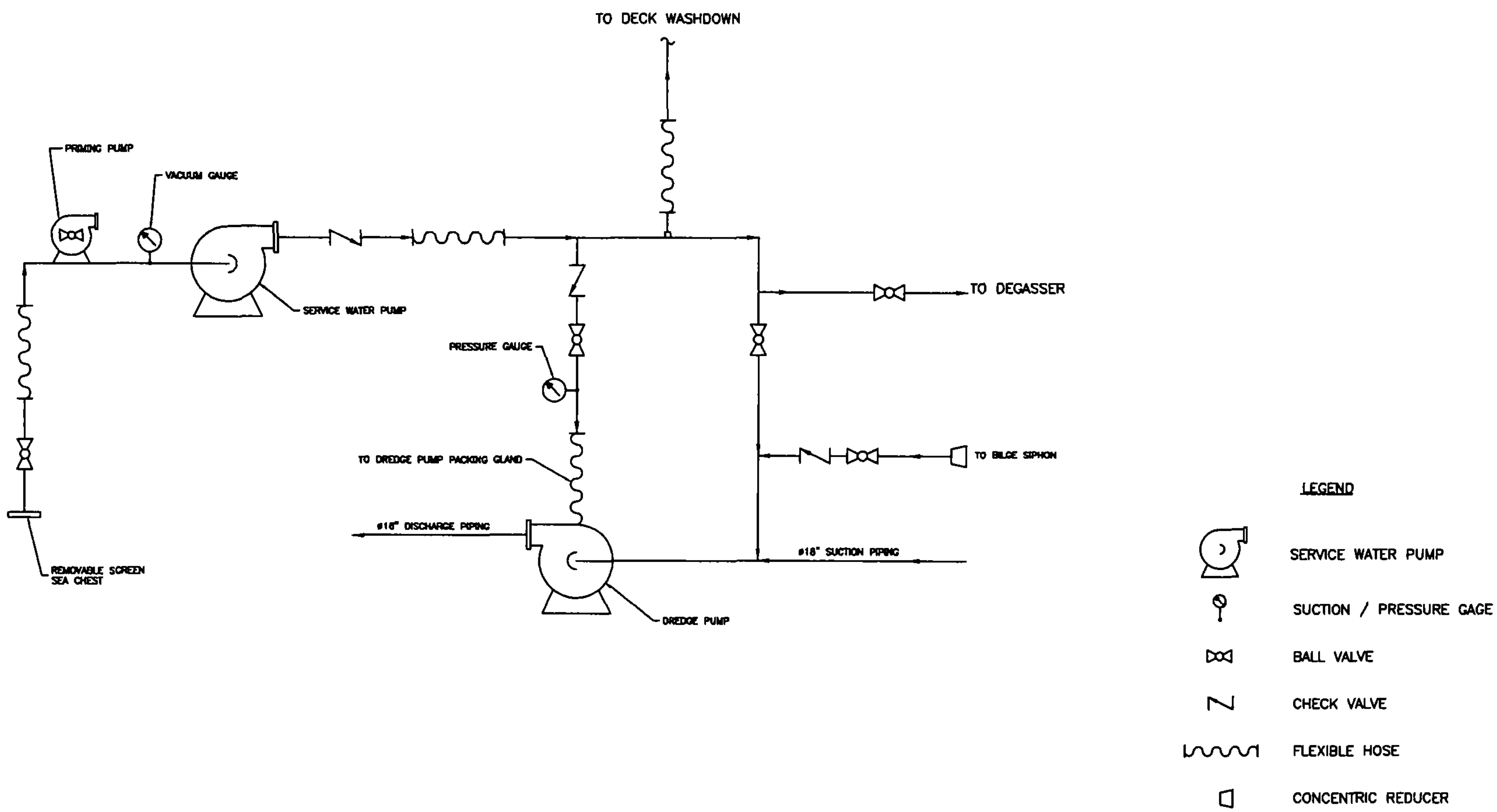
NO.#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.

18 x 16 MOD. BARRACUDA DREDGE

HYDRAULIC SCHEMATIC

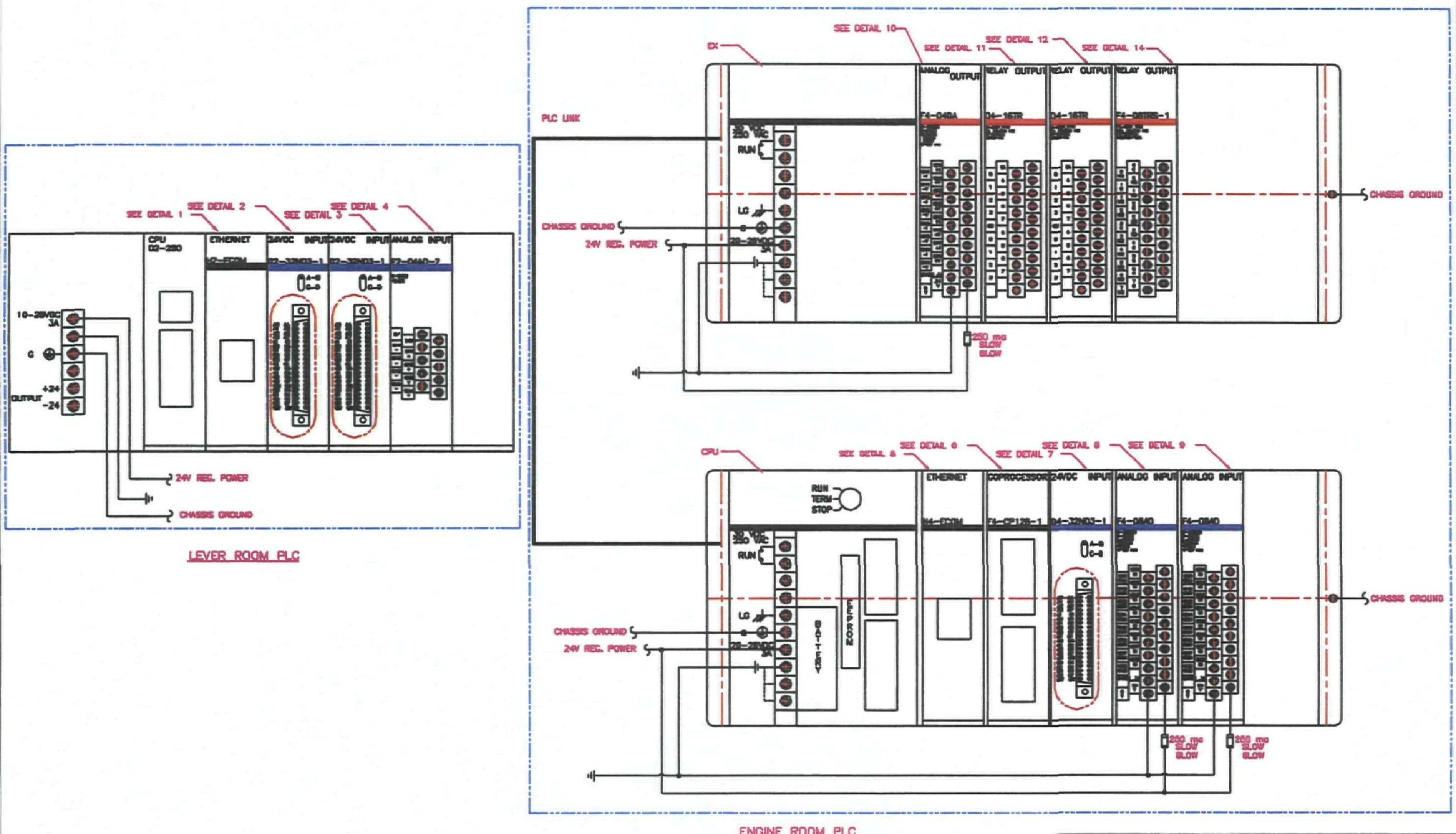
MJC
MJC
NONE
5/17/99
99020
9902092A
A



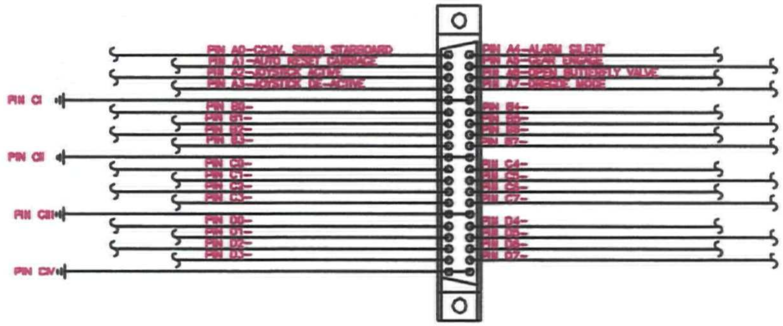
NO.	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION
B	10/27/99	JKM	ADD PRIMING PUMP & CHECK VALVE				

DREDGING SUPPLY COMPANY, Inc.
J.F. BRENNAN MOD. BARRACUDA
SERVICE WATER SCHEMATIC

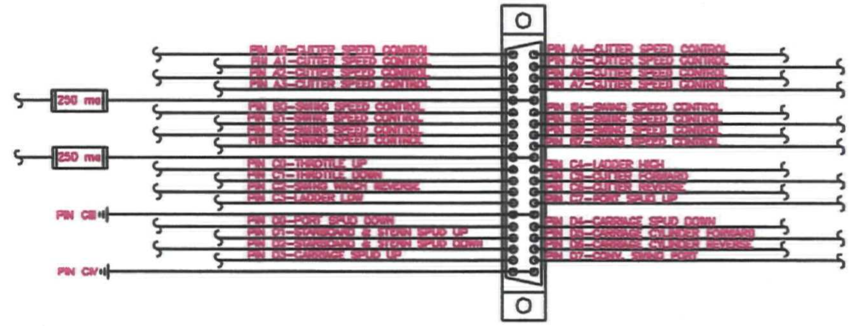
WJB
JKM
10/27/99
99020
99020133B
B



DREDGING SUPPLY COMPANY, Inc.		
18 X 16 BARRACUDA DREDGE		
Scale: NONE	Revision:	Date: 5/11/99
ELECTRICAL SCHEMATIC (1 OF 5)		
JOB # 99020	Drawn By: MJC	DWG. # 99020110



DETAIL 3



DETAIL 2

FUSE THE FOLLOWING INPUTS AS GROUPS

GROUP 1

THROTTLE UP
THROTTLE DOWN
SWING WINCH REVERSE
LADDER LOW
LADDER HIGH
CUTTER FORWARD
CUTTER REVERSE
OPEN BUTTERFLY VALVE

GROUP 2

PORT SPUD UP
PORT SPUD DOWN
STARBOARD SPUD UP
STARBOARD SPUD DOWN
CARRIAGE SPUD UP
CARRIAGE SPUD DOWN
CARRIAGE CYLINDER FORWARD
CARRIAGE CYLINDER REVERSE
CONV. SWING PORT
CONV. SWING STARBOARD

GROUP 3

AUTO RESET CARRIAGE
JOYSTICK ACTIVE
JOYSTICK DE-ACTIVE
ALARM SILENT
GEAR ENGAGE
DREDGE MODE SWITCH

GROUP 4

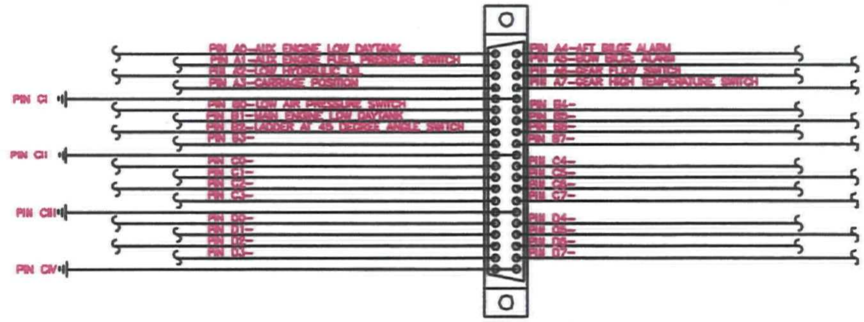
AUX. LOW DAYTANK
AUX. FUEL PRESSURE SWITCH
LOW HYDRAULIC OIL
CARRIAGE POSITION
AFT BILGE ALARM
BOW BILGE ALARM
GEAR FLOW SWITCH
GEAR TEMPERATURE SWITCH
AIR PRESSURE SWITCH
MAIN LOW DAYTANK
LADDER AT 45 DEGREE ANGLE SWITCH

GROUP 5

CUTTER SPEED CONTROL

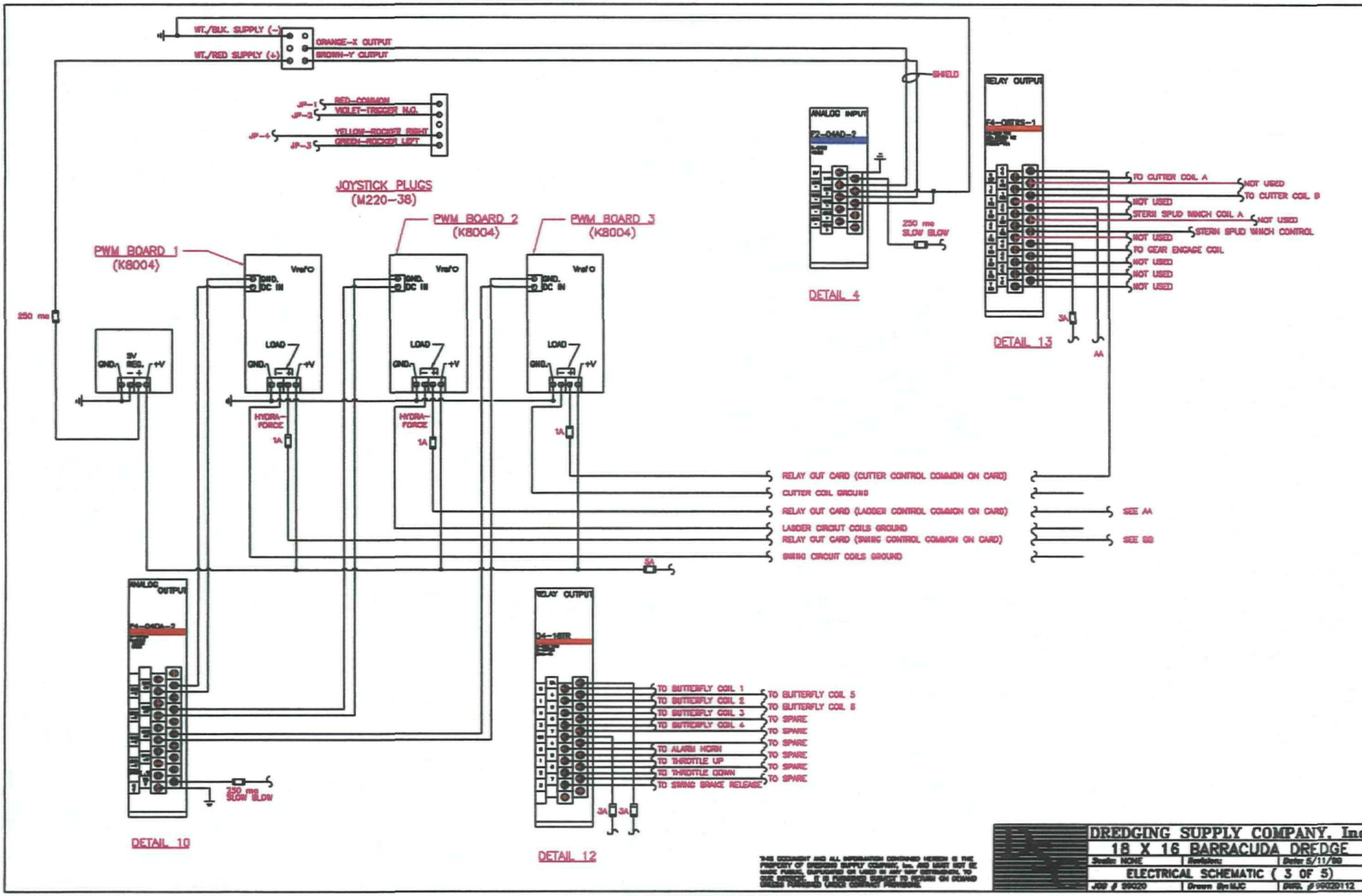
GROUP 6

SWING SPEED CONTROL



DETAIL 7

DREDGING SUPPLY COMPANY, Inc.		
18 X 16BARRACUDA DREDGE		
Scale: NONE	Revision:	Date: 5/11/99
ELECTRICAL SCHEMATIC (2 OF 5)		
JOB # 98020	Drawn By: MJC	DWG. # 98020111


WT./BLK. SUPPLY (-)
WT./RED SUPPLY (+)
ORANGE-X OUTPUT
BROWN-Y OUTPUT
SHIELD
JP-1
JP-2
JP-4
JP-3
RED-COMMON
VIOLET-TRIGGER N.O.
YELLOW-ROCKER RIGHT
GREEN-ROCKER LEFT
JOYSTICK PLUGS
(M220-38)
PWM BOARD 1
(K8004)
PWM BOARD 2
(K8004)
PWM BOARD 3
(K8004)
Vref
GND.
DC IN
LOAD
+V
HYDRA-FORCE
1A
250 ma
5V REG.
ANALOG INPUT
F2-04AD-2
250 ma SLOW BLOW
DETAIL 4
RELAY OUTPUT
F4-08TRS-1
TO CUTTER COIL A
NOT USED
TO CUTTER COIL B
NOT USED
STERN SPUD WINCH COIL A
NOT USED
STERN SPUD WINCH CONTROL
NOT USED
TO GEAR ENGAGE COIL
NOT USED
NOT USED
NOT USED
3A
AA
DETAIL 13
RELAY OUT CARD (CUTTER CONTROL COMMON ON CARD)
CUTTER COIL GROUND
RELAY OUT CARD (LADDER CONTROL COMMON ON CARD)
SEE AA
LADDER CIRCUIT COILS GROUND
RELAY OUT CARD (SWING CONTROL COMMON ON CARD)
SEE BB
SWING CIRCUIT COILS GROUND
3A
ANALOG OUTPUT
F4-04DA-2
250 ma SLOW BLOW
DETAIL 10
RELAY OUTPUT
D4-16TR
TO BUTTERFLY COIL 1
TO BUTTERFLY COIL 2
TO BUTTERFLY COIL 3
TO BUTTERFLY COIL 4
TO ALARM HORN
TO THROTTLE UP
TO THROTTLE DOWN
TO SWING BRAKE RELEASE
TO BUTTERFLY COIL 5
TO BUTTERFLY COIL 6
TO SPARE
TO SPARE
TO SPARE
TO SPARE
TO SPARE
TO SPARE
TO SPARE
3A
3A
DETAIL 12
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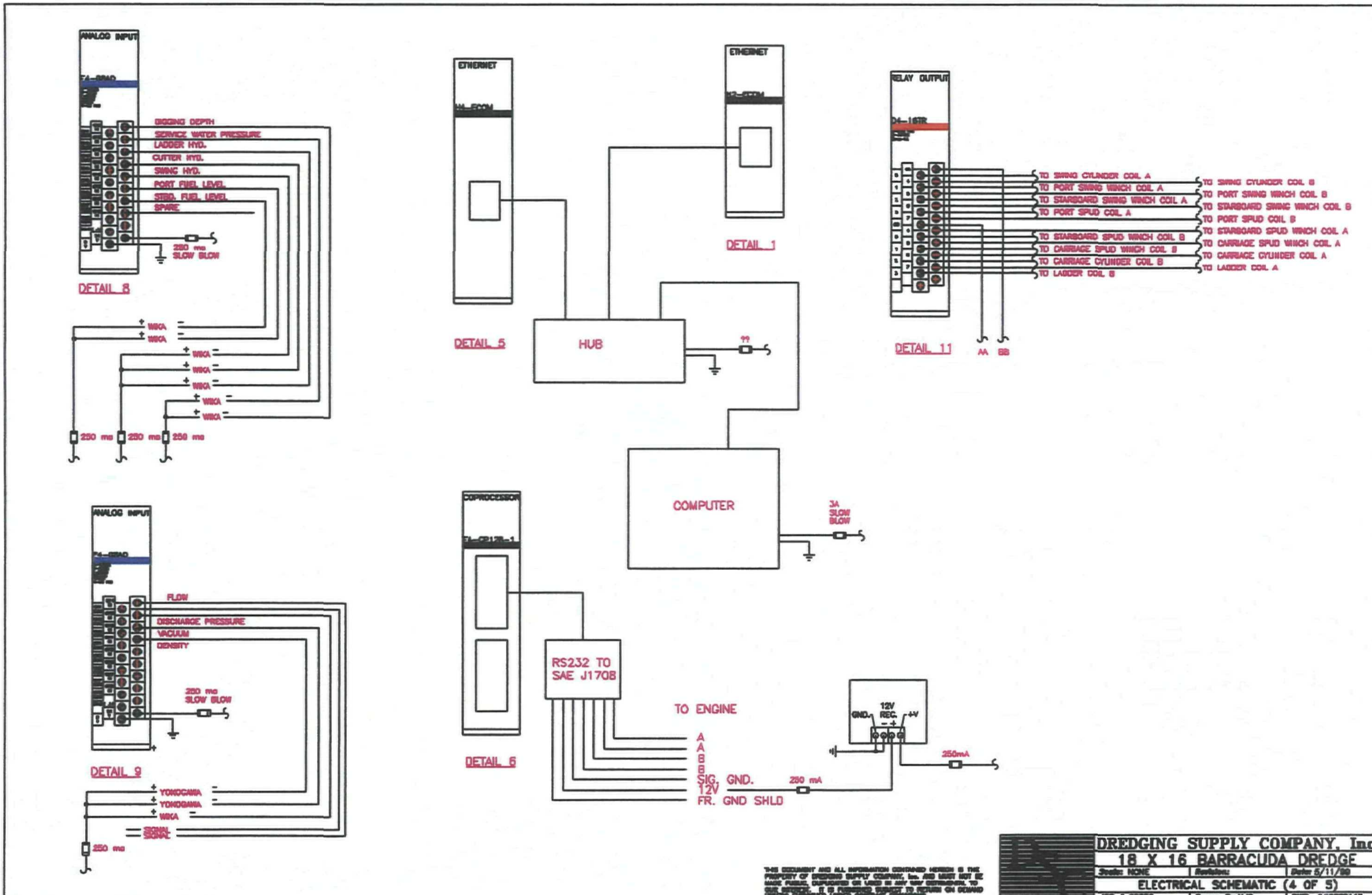
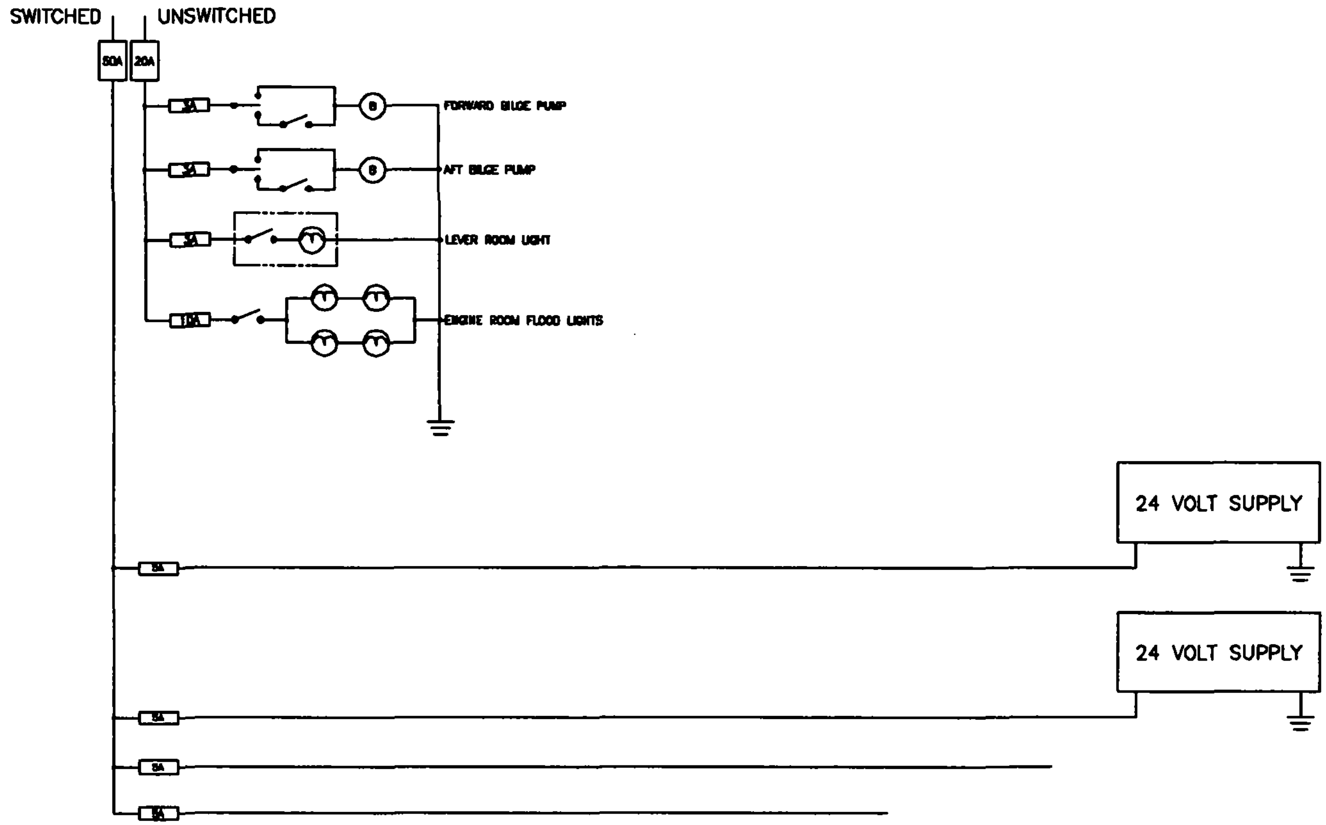
DREDGING SUPPLY COMPANY, Inc.
18 X 16 BARRACUDA DREDGE
Scale: NONE
Revision:
Date: 5/11/99
ELECTRICAL SCHEMATIC (3 OF 5)
JOB # 99020
Drawn By: MJC
DWG. # 99020112



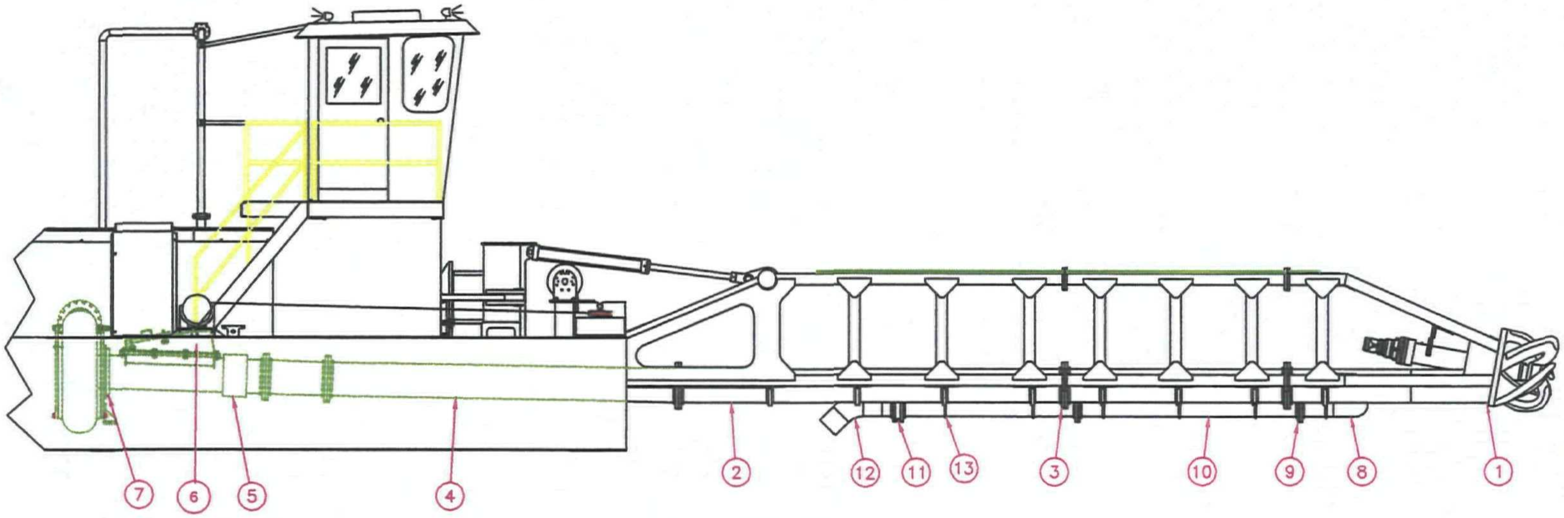
ANALOG INPUT
DIGGING DEPTH
SERVICE WATER PRESSURE
LADDER HYD.
CUTTER HYD.
SWING HYD.
PORT FUEL LEVEL
STBD. FUEL LEVEL
SPARE
250 ma SLOW BLOW
DETAIL 8
WIKA
250 ma
ETHERNET
DETAIL 5
ETHERNET
DETAIL 1
HUB
COMPUTER
3A SLOW BLOW
RELAY OUTPUT
TO SWING CYLINDER COIL A
TO PORT SWING WINCH COIL A
TO STARBOARD SWING WINCH COIL A
TO PORT SPUD COIL A
TO STARBOARD SPUD WINCH COIL B
TO CARRIAGE SPUD WINCH COIL B
TO CARRIAGE CYLINDER COIL B
TO LADDER COIL B
TO SWING CYLINDER COIL B
TO PORT SWING WINCH COIL B
TO STARBOARD SWING WINCH COIL B
TO PORT SPUD COIL B
TO STARBOARD SPUD WINCH COIL A
TO CARRIAGE SPUD WINCH COIL A
TO CARRIAGE CYLINDER COIL A
TO LADDER COIL A
DETAIL 11
AA
BB
ANALOG INPUT
FLOW
DISCHARGE PRESSURE
VACUUM
DENSITY
250 ma SLOW BLOW
DETAIL 9
YOKOGAWA
YOKOGAWA
WIKA
SIGNAL
SIGNAL
250 ma
COPROCESSOR
DETAIL 6
RS232 TO SAE J1708
TO ENGINE
A
A
B
B
SIG. GND.
12V
FR. GND SHLD
250 mA
GND.
12V REC.
+V
250mA
DREDGING SUPPLY COMPANY, Inc.
18 X 16 BARRACUDA DREDGE
Scale: NONE
Date: 5/11/99
ELECTRICAL SCHEMATIC (4 OF 5)
JOB # 99020
Drawn By: MJC
DWG. # 99020113



DREDGING SUPPLY COMPANY, Inc.

18 X 16 BARRACUDA DREDGE

Scale: NONE	Revision:	Date: 5/11/09
ELECTRICAL SCHEMATIC (5 OF 5)		
JOB # 99020	Drawn By: MJC	DWG. # 99020114



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

SUCTION PIPING ASSEMBLY

WJB

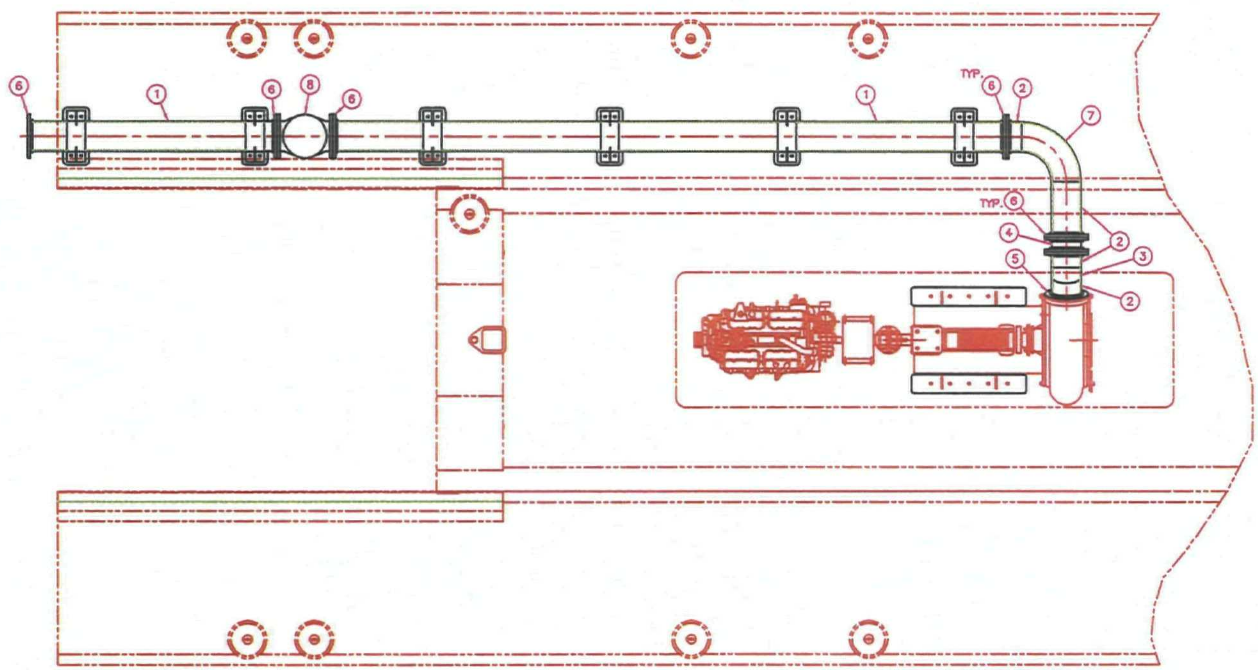
JJM

N.T.S.

6/17/99

99020

99020136



PLAN VIEW

NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

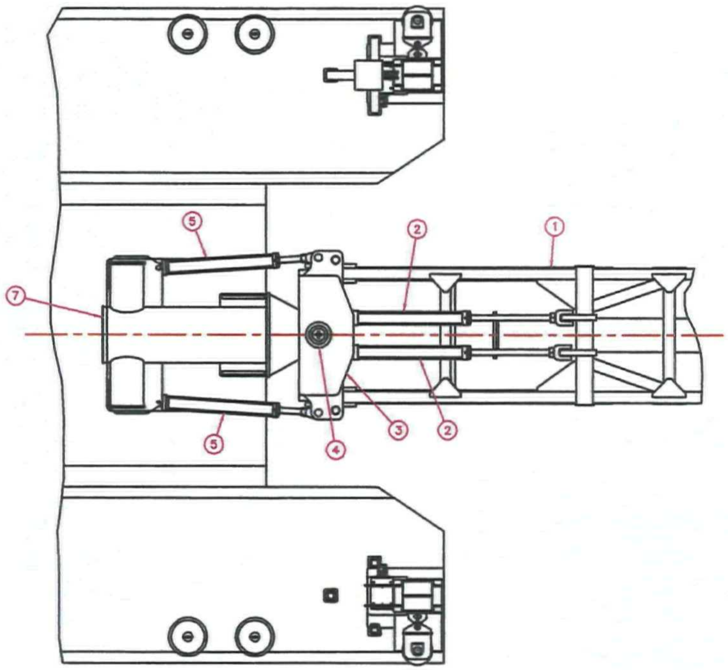
DSC

DREDGING SUPPLY COMPANY, Inc.

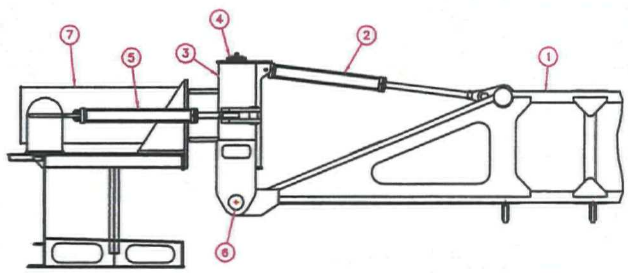
J. F. BRENNAN MOD. BARRACUDA

DISCHARGE PIPING ASSEMBLY

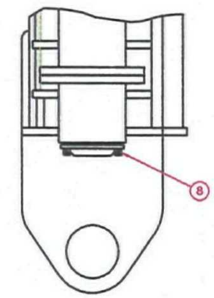
WJB
JJM
N.T.S.
8/17/99
99020
99020137



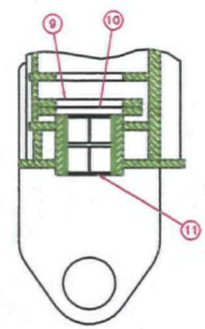
PLAN VIEW



SIDE VIEW



PIN RETAINER DETAIL



BUSHING/WEAR PLATE DETAIL

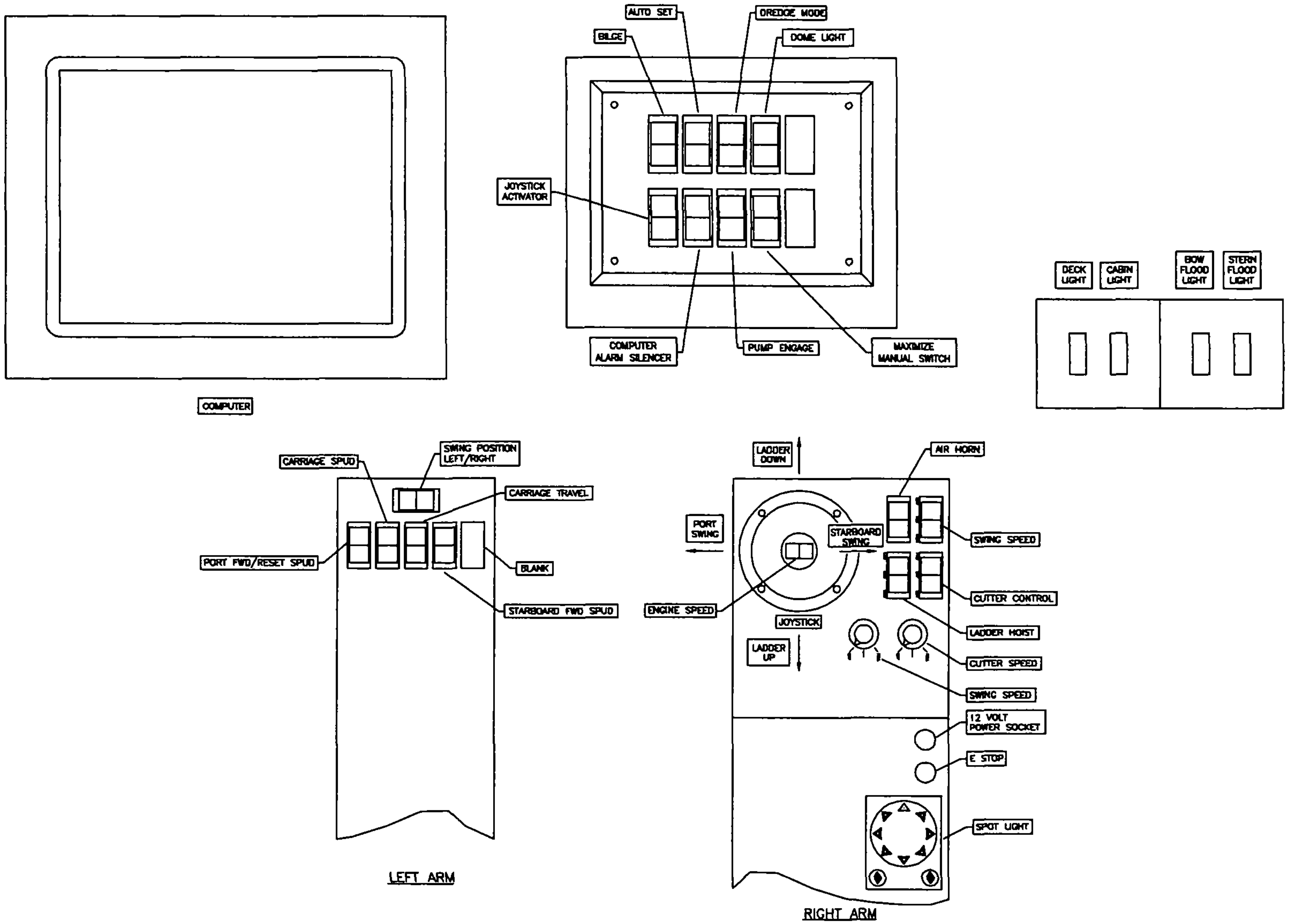
NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

LADDER GIMBAL

WJB	
JJM	
N.T.S.	6/18/99
99020	
99020138	



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

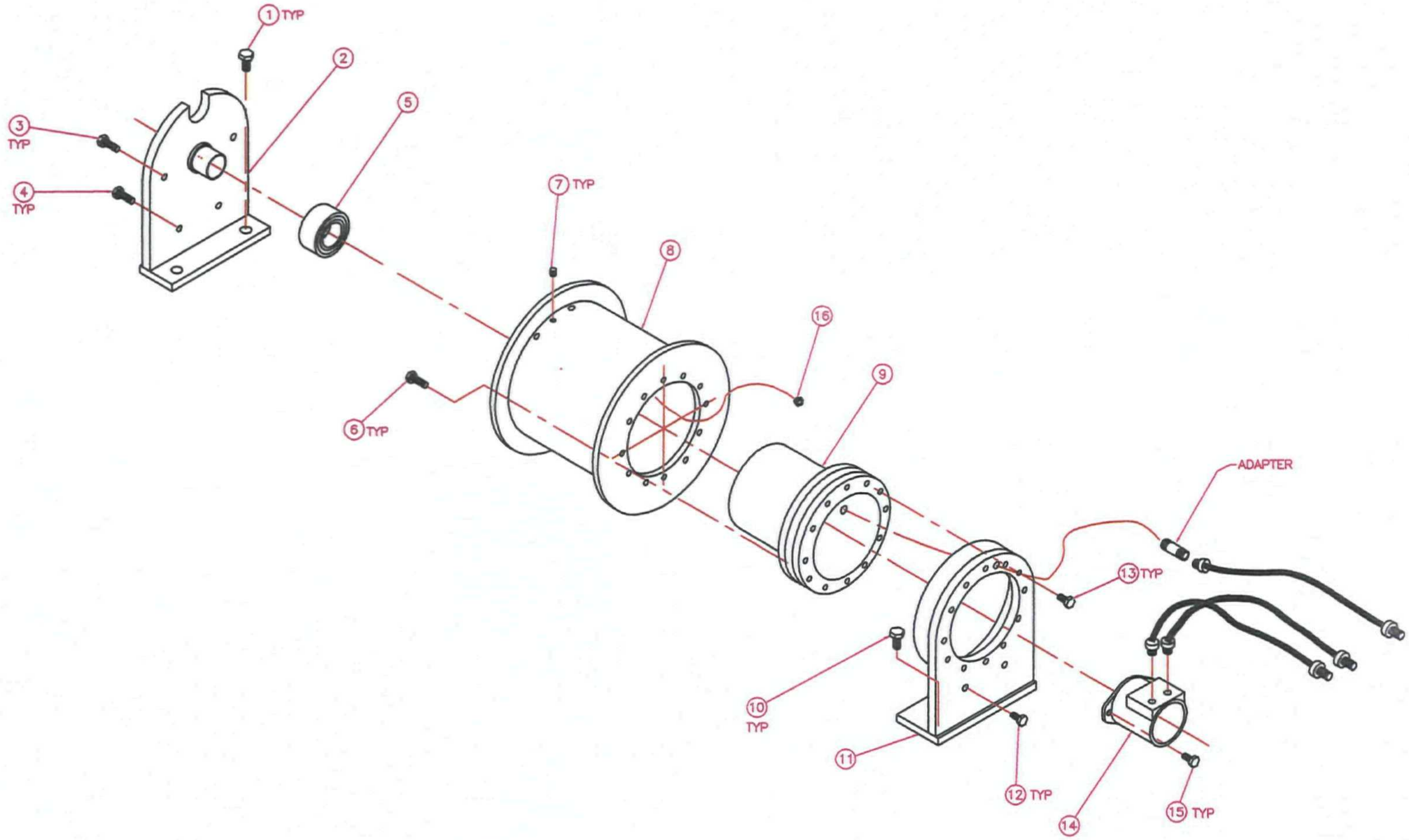
DSC

DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

CONTROL CONSOLE LAYOUT

WJB
JJM/COC
N.T.S.
DATE 9/30/99
99020
99020139A
REV A



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

DSC

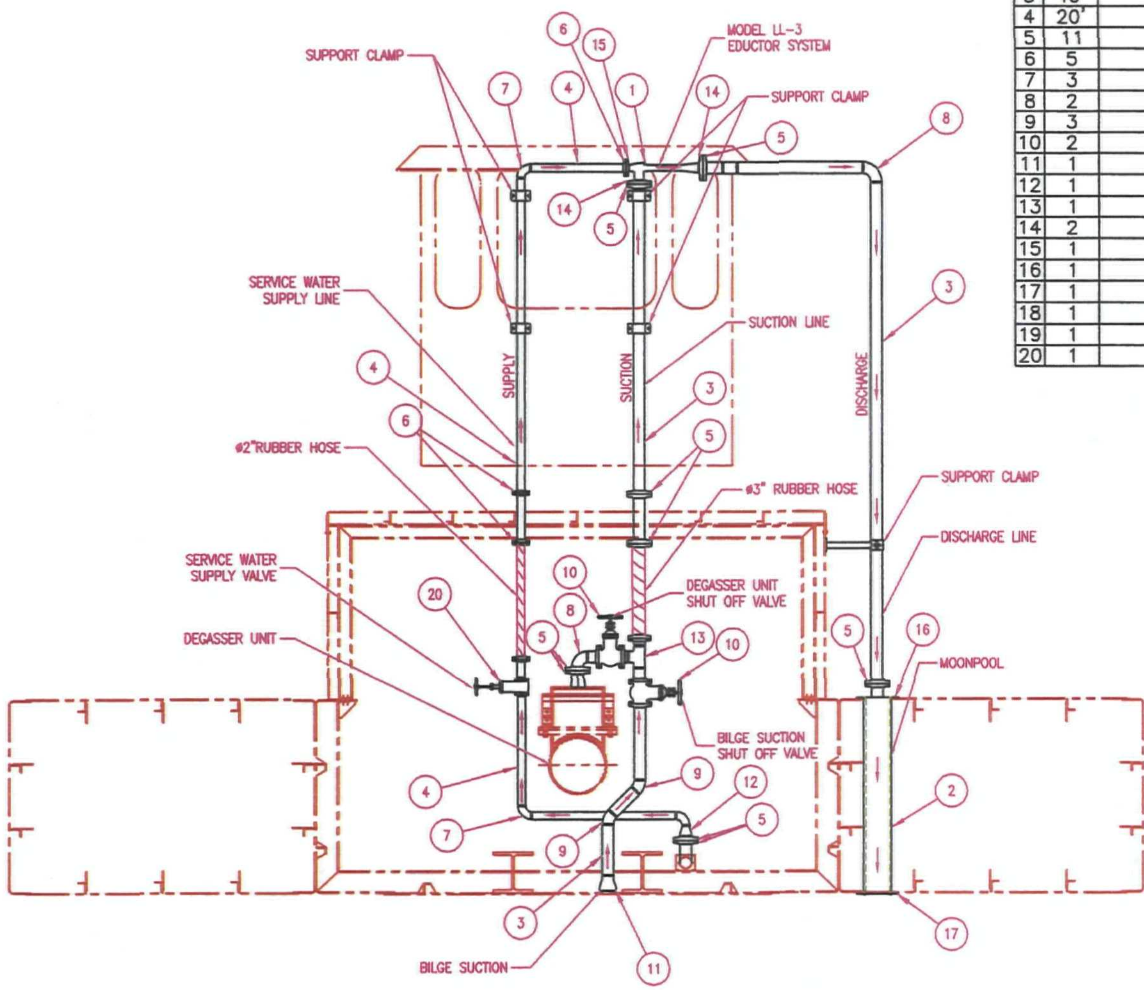
DREDGING SUPPLY COMPANY, Inc.

J. F. BRENNAN MOD. BARRACUDA

FRONT SPUD WINCH ASSEMBLY (DSC95)

ENGR/DESGN: MJC
DRAWN: WJB
CHK:
APP BY:
SCALE: N.T.S.
DATE: 9/21/99
PROJECT: 99020
DWG NO.: 99020140A
REV: A

#	QTY	DESCRIPTION	WT #
1	1	MODEL LL-3 EDUCTOR SYSTEM	–
2	5'	8"ø SCH XH PIPE	–
3	40'	3"ø SCH 40 PIPE	–
4	20'	2"ø SCH 40 PIPE	–
5	11	3" 150# RF SLIP-ON-FLANGE	–
6	5	2" 150# RF SLIP-ON-FLANGE	–
7	3	2" 90° ELBOWS	–
8	2	3" 90° ELBOWS	–
9	3	3" 45° ELBOWS	–
10	2	3" WEDGE GATE VALVES CLASS 125 NON-RISING STEM	–
11	1	3"x4" CONCENTRIC REDUCER	–
12	1	2"x3" CONCENTRIC REDUCER	–
13	1	3"x3" STRAIGHT TEE	–
14	2	3" 150# RF THREADED FLANGE	–
15	1	2" 150# RF THREADED FLANGE	–
16	1	3/8" INSERT PLATE	–
17	1	3/8" DOUBLER PLATE	–
18	1	1/4"x2" FLAT BAR	–
19	1	1"ø SCH 40 PIPE	–
20	1	2" WEDGE GATE VALVES CLASS 125 NON-RISING STEM	



PLAN VIEW
SCALE: N.T.S.

NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION
						99020115	DEGASSER PIPING (1 OF 2)
						99020116	DEGASSER PIPING (2 OF 2)

DSC

DREDGING SUPPLY COMPANY, Inc.
18x16 MOD. BARRACUDA DREDGE
DEGASSER PIPING ASSEMBLY
(1 of 1)

DESIGN/DESIGNER: MJC
DRAWN: CCC
CHK:
APP BY:
SCALE: 3/8"=1'-0"
DATE: 9/21/99
PROJECT: 99020
DWG NO: 99020141
REV

Dredging Supply Company, Inc.

18"X16" BARRACUDA COMBO DREDGE

TABLE OF CONTENTS

Dredging Supply Company, Inc periodically changes the information in the manuals; changes are incorporated into revisions or new editions. Dredging Supply Company, Inc. reserves the right to change product specifications without notice.

Dredging Supply Company, Inc. shall not be liable for technical or editorial errors or omissions contained herein, nor for incidental or consequential damages resulting from the furnishing, performance, or use of this material.

Printing Date:March 2, 2007

Dredging Supply Company, Inc.

NEW EQUIPMENT WARRANTY

Dredging Supply Co., Inc. ("DSC") warrants that it will convey good title to the equipment, free of all security interests therein except as may be agreed between the purchaser and DSC, and for a period of one (1) year from the date of delivery of new equipment that the equipment is free from defects in workmanship and materials under normal use, subject to the following provisions:

The purchaser shall notify DSC in writing within ten (10) days of the purchaser's first knowledge of any facts which may lead to any warranty claim. DSC shall not have any further responsibility if this notice to DSC is not given.

DSC provides no warranty for any part which may be damaged or rendered inoperative or less efficient due to lack of maintenance by the purchaser. Any warranty of DSC shall be voided if the purchaser has altered, misused, neglected, overloaded, improperly operated or in any way subjected the equipment to mistreatment outside of its expected operating range.

DSC does not warrant any component part of the equipment manufactured by any other party. DSC will provide to the purchaser any warranty or other material, manuals and/or specifications provided to DSC by such manufacturer. **THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR ANY FAILURE, DEFECT OR OTHER CLAIMS RELATIVE TO SUCH COMPONENTS SHALL BE TO PURSUE ANY WARRANTY OR OTHER CLAIM DIRECTLY AGAINST THE COMPONENT MANUFACTURER AND NOT DSC.**

Should it become necessary to replace any removable part manufactured by DSC, the purchaser must return the part, transportation pre-paid to DSC. If the part is warranted by DSC, DSC will replace the part f.o.b. DSC's facility, and reimburse to the purchaser the cost of the transportation to DSC. DSC shall have no obligation to repair or replace any part at the site of the equipment. Should damaged, defective or inoperable part not be removable, at the purchaser's pre-paid expense, DSC will send a representative to the equipment site to inspect the part. If the part is covered by the DSC warranty, DSC will replace it f.o.b. DSC's facility. DSC does not warrant any labor or travel cost for removal or installation of any part.

THE PURCHASER WAIVES ANY CLAIMS OF REDHIBITION AND ACKNOWLEDGES THAT THE SOLE WARRANTY RESPONSIBILITY OF DSC SHALL BE AS SET OUT HEREIN. DSC makes no warranty whatsoever of the fitness of the equipment for any particular purpose except as may be set out in the specifications of the equipment as provided in writing by DSC. DSC makes no warranty, express or implied, except as is set out herein and no officer, employee or agent of DSC or any other party has authority to promise, extend, or warrant other than as set out herein or as may be expressly agreed to by DSC in writing signed by the President of DSC. Under no circumstances whatsoever, does DSC warranty or will be responsible of any claim of lost profits, downtime, consequential damages, punitive damages or attorney fees arising out of the operation or non-operation of the equipment.

Delivery shall be defined for purposes of this warranty to mean delivery by DSC, f.o.b. at DSC's facility unless agreed otherwise in writing by the purchaser and DSC. However, should the equipment by agreement be delivered before it is operable, then the warranty shall run from the first day after physical delivery that the equipment becomes available for operation. Should any provision of this warranty be found to be invalid for any reason, it shall not void this limited warranty but all other provisions hereof shall be deemed to be in effect.

Should the purchaser sell the equipment during the term of this warranty, the purchaser shall be responsible to provide a copy of this warranty to the new purchaser.

The sole and exclusive jurisdiction and venue for any claim arising out of the sale of the equipment, including any warranty claim against DSC, shall be the courts of the Parish of Jefferson, State of Louisiana. This warranty shall be governed by the laws of the State of Louisiana.

THIS IS ABSOLUTELY THE SOLE AND EXCLUSIVE WARRANTY OF DSC RELATIVE TO ANY NEW EQUIPMENT SOLD BY DSC AND PROVIDES THE SOLE RESPONSIBILITY OF DSC FOR THE EQUIPMENT UPON DELIVERY.

CONTACTING DREDGING SUPPLY COMPANY

Dredging Supply Company operates out of two separate facilities to optimize working environments in its organizational and fabrication phases. General accounting, sales, clerical, parts, and engineering are located at 5700 Citrus Blvd. Suite A2 in Harahan, Louisiana 70123. Normal working hours in this facility are 8:00 AM to 5:00 PM Central time Monday through Friday but, it is common for sales and engineering personnel to be in this office at most any hour. Personnel in this office can be contacted at (504) 733-7400 and facsimiles can be sent to (504) 733-0500. This office also operates an after hours telephone voice mail system with instructions on how to reach essential personnel at home or on a beeper.

Dredging Supply Company may also be contacted via our Internet address at **http://www.dscdredge.com.** Information on our complete line of dredges, client projects, engineering personnel, and sales and service is available on our corporate site.

Our fabrication and field service departments are located in LaPlace, Louisiana at the junction of state highways 628 and 636-1. Normal working hours at this facility varies with weather and workload, but average 6:30 AM to 5:00 PM Monday through Friday. Personnel in this facility can be reached at (504) 652-2493 and facsimiles can be sent to (504) 651-3840. This office also offers a limited telephone answering service.

REMOVE THIS PAGE AND REPLACE WITH:

GENERAL ARRANGEMENT DWG. # 9902001

Dredging Supply Company, Inc.

INTRODUCTION

The Barracuda Combo Dredge is a highly portable floating platform that offers the combined features of a conventional dredge which digs using anchors (wide dredge swings for open areas) and a swinging ladder or canal dredge which uses no anchors (narrow dredge swings with high mobility for confined areas).

The following pages of this manual will serve to familiarize and assist the operator with assembly, operation, and maintenance procedures necessary to successfully operate the dredge.

SAFETY NOTES

1. Life jackets should be worn whenever handrails do not enclose personnel, when boarding or leaving the dredge and when dredge is under tow.
2. Before starting the dredge, both the dredge and the area to be dredged should be carefully examined for obstacles or hidden problems.
3. Never swing the ladder without the spuds firmly rooted into the bottom.
4. Do not swing the dredge in conventional mode with the bow spuds down.
5. Never attempt to clean the dredge cutterhead while it is turning.
6. Never attempt to adjust or repack any pump while is turning.
7. Do not operate the dredge with any guards or walkways removed.
8. Stop the engine before working on any moving equipment.
9. Keep the decks and equipment compartment clean and clear of oil.
10. Observe all safety signs and stickers on the dredge.
11. Before removing the rock box cover, raise ladder above the waterline and turn the pump de-gasser off.
12. Always think first and use good common sense when operating or working on the dredge

Dredging Supply Company, Inc.

BARRACUDA SPECIFICATIONS

GENERAL:

OVERALL LENGTH (WITH LADDER EXTENSION)	113 FT.
OVERALL WIDTH (OPERATIONAL MODE)	29 FT. 3 IN.
HULL DEPTH	5 FT.
HEIGHT - OVERALL (LESS SPUDS AND SPUD FRAMES)	19 FT. 10 IN.
MEAN DRAFT (WITH FUEL EST.)	22 IN.
LADDER LENGTH (WITH EXTENSION & CUTTER)	47 FT. 6IN.
SPUD LENGTH (EACH STERN SPUD INCLUDES POINT)	58 FT
SPUD SIZE (STERN SPUDS)	20 IN. Diameter
SPUD LENGTH (EACH BOW SPUD, INCLUDES POINT)	42 FT. 6 IN.
SPUD SIZE (BOW SPUDS)	16 IN. X16 IN Tub.
TOTAL DREDGE DRY WEIGHT - EST.	325,000 LB

OPERATING CONDITIONS:

DIGGING DEPTH

MINIMUM	3'
MAXIMUM (conventional mode w/ extension)	41'

MAXIMUM CUT OF DREDGE (SINGLE CUT)

@ MINIMUM DIGGING DEPTH (SWINGING LADDER)	24'
@ MAXIMUM DIGGING DEPTH (SWINGING LADDER)	18'
@ MINIMUM DIGGING DEPTH (conventional w/extension)	150'

@ MAXIMUM DIGGING DEPTH (conventional w/extension)	122'

PRIME MOVER:

ENGINE MAKE	CATERPILLAR
ENGINE MODEL	3412 E-Series
MAXIMUM H.P @ 2100 R.P.M.	860 H.P.
SERIAL NUMBER	4CR01037

AUXILIARY ENGINE:

ENGINE MAKE	CATERPILLAR
ENGINE MODEL	3306DITA
MAXIMUM H.P @ 2200 R.P.M.	300 H.P.
SERIAL NUMBER	64Z27195

CUTTER MODULE:

CUTTING FORCE	8,794 LB
OPERATING TORQUE	203,500 IN-LB
CUTTING FORCE PER LINEAR INCH	204 LB/IN
CUTTER DIAMETER	43"
SHAFT DIAMETER	5"
CUTTER RATING	90 H.P.
CUTTER SPEED VARIABLE	0 - 28 R.P.M.

SWING WINCHES:

MANUFACTURER	Pullmaster
MODEL	H18
LINE PULL (1ST LAYER)	18,000 LB
LINE SPEED (1ST LAYER)	121 FT/MIN
WIRE	9/16"
DRUM CAPACITY	310'

LADDER HOIST CYLINDERS (2):

MANUFACTURER	Hydro-Line
MODEL	N5C 70X75.3
EXTENDING FORCE	65,000 LB
RETRACTING FORCE	125,000 LB

DREDGE PUMP:

MANUFACTURER	Svedala Tomas
MODEL	P40-WD-L4V
SERIAL NUMBER	3-16274
SUCTION	18"
DISCHARGE	16"
IMPELLER DIAMETER	40"

DREDGE PUMP REDUCTION GEAR

MANUFACTURER	Rexnord
MODEL	B280-44VS-DC-3.375
RATIO	3.313:1
SERIAL NUMBER	H99X-08421-A1

DREDGE PUMP CLUTCH

MANUFACTURER	Wichita
MODEL	ATD214H-DUCTIL IRON

BOW SPUD WINCHES:

MANUFACTURER	DSC
MODEL	DSC-095
LINE PULL	4,000 LB
LINE SPEED (1ST LAYER)	100 FT/MIN
WIRE SIZE	9/16 IN.

STERN SPUD WINCHES

MANUFACTURER	Pullmaster
MODEL	H18
LINE PULL (1ST LAYER)	18,000 LB
LINE SPEED (1ST LAYER)	122FT/MIN
WIRE	9/16"
DRUM CAPACITY	310’

ELECTRICAL SYSTEM:

BATTERY (24 VDC)

STANFORD AC GENERATOR mounted on the auxiliary engine. 120/208 ACV three phase, 60Hz

CAPACITIES:

FUEL	3,000 GAL
HYDRAULIC	455 GAL

STANDARD AND CUSTOM FEATURES:

SIPHON PRIMING SYSTEM

OPERATOR'S CHAIR

FIRE EXTINGUISHERS (2) 5 LBS. ABC

LIGHTED RING BUOY

HANDRAILS AND KICK RAILS

ELECTRONIC DEPTH GAUGE

ELECTRONIC PROPORTIONAL CONTROL

GUARDS

EARLY WARNING ALARM SYSTEM AND ENGINE SHUTDOWN SYSTEM

CABIN LIGHTS

BILGE PUMP - ELECTRIC

REPLACEABLE EDGE CUTTER

DREDGE WASH DOWN SYSTEM

HI-CAPACITY SERVICE PUMP

HYDRAULIC PUMP/ENGINE CLUTCH DISCONNECT

PUMP/ENGINE REDUCTION GEAR (NO BELTS REQUIRED)

PAINT: HULL - BLAST WITH COAL TAR EPOXY PAINT

SUPERSTRUCTURE AND STRUCTURAL - BLAST WITH

PRIMER AND TOP COAT OF PAINT

CARRIAGE SPUD SYSTEM

CUTTER ROTATING RING

STERN PULLING EYES

TOUCH SCREEN COMPUTER WITH OPERATING GAUGE DISPLAY SOFTWARE.

JOYSTICK SWINGING AND LADDER OPERATION

OPTIONAL TOGGLE SWITCH AND KNOB FOR SWING CONTROL

AIR CONDITIONED AND HEATED LEVER ROOM

Dredging Supply Company, Inc.

RANGE DIAGRAMS

DIGGING DEPTH DIAGRAM DWG. 99020121A

MAXIMUM SWINGING LADDER SWING DWG. 99020122

MAXIMUM SWING CONVENTIONAL MODE (Hull Grounded) DWG. 99020123

MAXIMUM SWING (Conventional Mode) DWG. 99020124

Remove this page and install the following:

DIGGING DEPTH DIAGRAM DWG. 99020121B

Remove this page and install the following:

MAXIMUM SWINGING LADDER SWING DWG. 99020122

Remove this page and install the following:

MINIMUM CONVENTIONAL SWING (HULL GROUNDED) DWG. 99020123

Remove this page and install the following:

MAXIMUM CONVENTIONAL SWING WIDTHS DWG.99020124

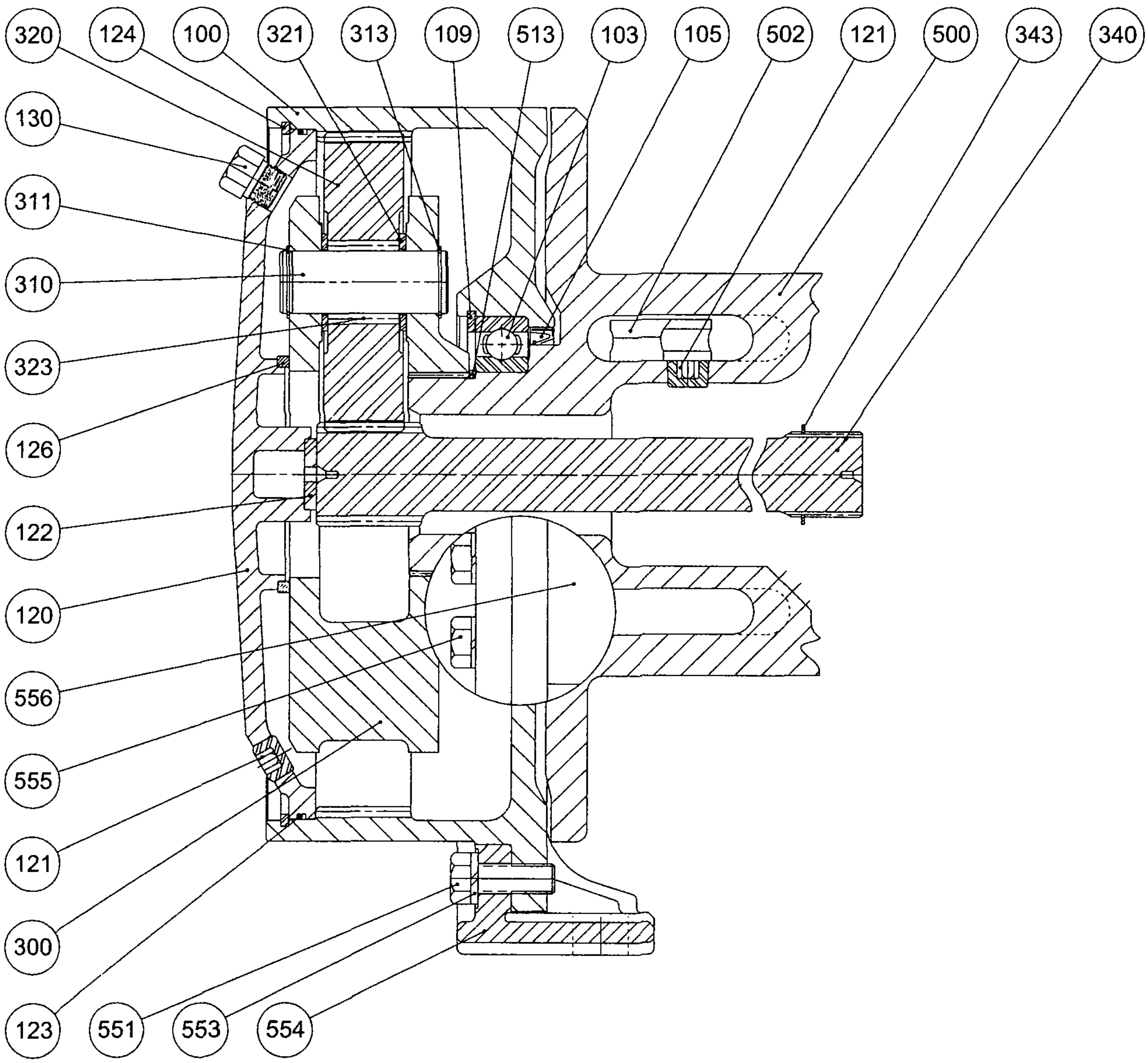
PARTS REFERENCE - FINAL DRIVE

ITEM NO.	QTY.	PART NO.	DESCRIPTION
100	1	*	FINAL HOUSING
103	1	25150	BALL BEARING #6022
105	1	25148	OIL SEAL
109	1	25153	CIRCLIP ROTOR CLIP HO-662
120	1	21968	END COVER
121	3	25032	PIPE PLUG 1/2 - 14 NPT
122	1	19036	SUNGEAR STOPPER
123	1	25488	O-RING -280 14" ID 1/8" CS
124	1	21923	RETAINING RING INT 5/32 X 1/4 X 15.5 OD
126	1	21180	PLANET HUB STOPPER
130	1	20458	BREATHER RELIEF ASSEMBLY 1/2 NPT
300	1	21925	FINAL PLANET HUB
310	3	21940	FINAL PLANET PIN
311	3	25960	CIRCLIP ROTOR CLIP SH-131
313	3	25960	CIRCLIP ROTOR CLIP SH-131
320	3	21937	PLANET GEAR
321	6	25965	THRUST WASHER TORRINGTON #TRD 2233
323	66	25308	LOOSE ROLLER 7/32 DIA X 1.50
340	1	*	FINAL SUNGEAR
343	1	25963	CIRCLIP ANDERTON #N1400 - 0181
500	1	*	CABLE DRUM
502	1	21960	CABLE ANCHOR 3/8" TO 3/4" WIRE
513	1	25489	CIRCLIP ANDERTON #N1400 - 0425
551	*	25139	CAPSCREW - HEX HEAD 5/8 - 11NC X 1.50 GRADE 5
553	*	25359	LOCKWASHER 5/8"
554	2	*	BASE PLATE
555	16	*	CAPSCREW - HEX HEAD 5/8 - 11NC GRADE 5
556	2	*	TIE BAR
			* These parts and quantities vary according to drum code. Refer to APPENDIX B.

Refer to PAGE 22 for winch seal kit and PAGE 28 for ASSEMBLY DRAWING.

FINAL DRIVE GROUP

G1043-A



Groups drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

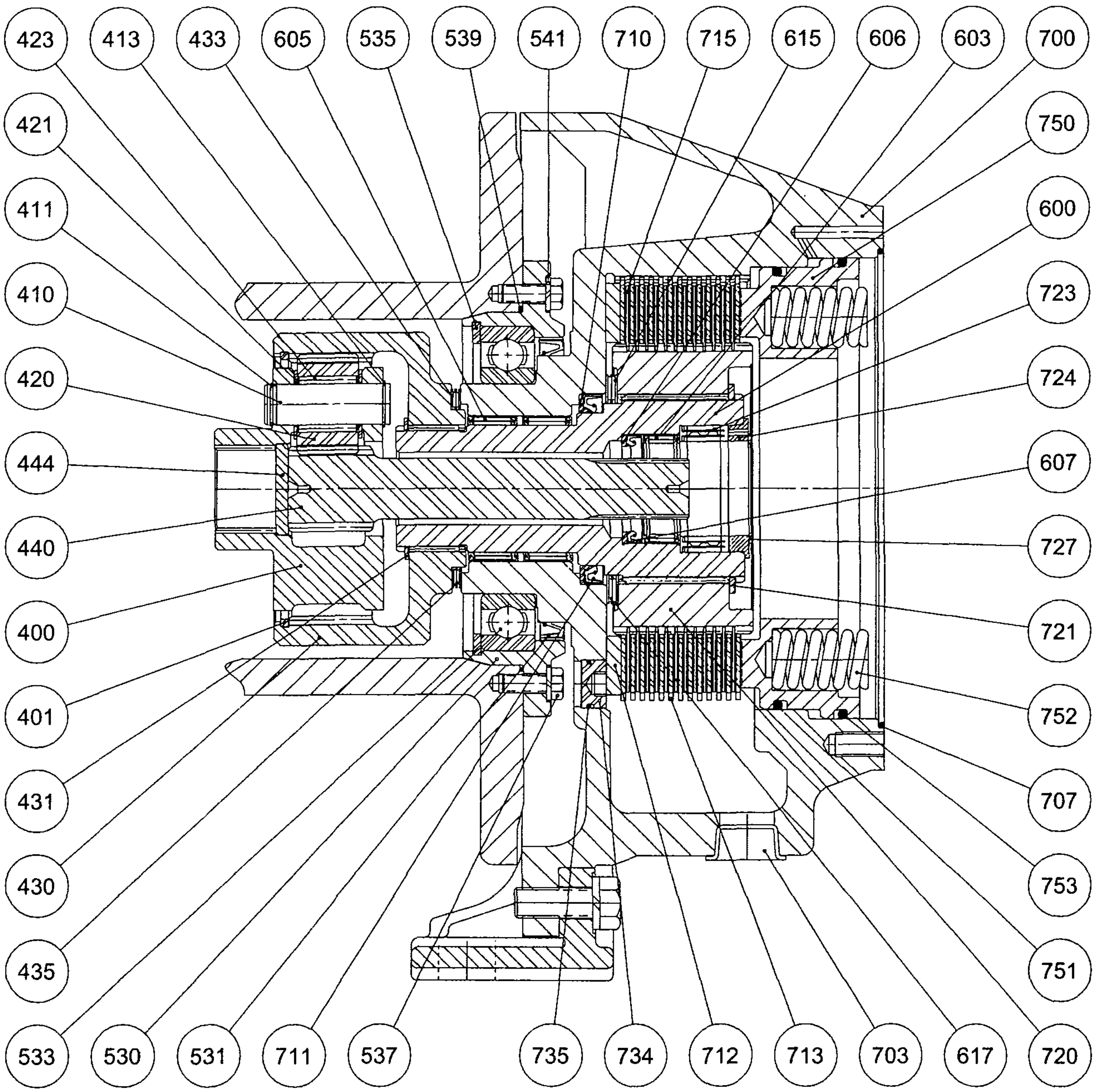
PARTS REFERENCE - BRAKE GROUP

ITEM NO.	QTY.	PART NO.	DESCRIPTION
400	1	21944	PLANET HUB
401	1	22093	RETAINING RING INT
410	3	21966	PLANET PIN
411	3	25961	CIRCLIP ROTOR CLIP C-81
413	3	25962	CIRCLIP ROTOR CLIP SH-81
420	3	21957	PLANET GEAR
421	6	25964	THRUST WASHER TORRINGTON #TRB 1423
423	60	25270	LOOSE ROLLER 5/32 X 1.25 TOR. #E151-Q
430	1	21943	INTERNAL GEAR
431	1	25971	CIRCLIP ROTOR CLIP SH-255
433	2	25176	THRUST WASHER TORRINGTON #TRA 5266
435	1	25177	THRUST BEARING TORRINGTON #NTA 5266
440	1	21963	PRIMARY SUNGEAR
444	1	21962	PRIMARY SUNGEAR STOPPER
530	1	21947	BEARING FLANGE
531	1	25148	OIL SEAL
533	1	25150	BALL BEARING #6022
535	1	25153	CIRCLIP ROTOR CLIP HO-662
537	8	25118	CAPSCREW - HEX HEAD 3/8 - 16NC X 1.25 GRADE 5
539	1	25966	O-RING -168 7-1/4" ID 3/32" CS
541	8	25037	LOCKWASHER 3/8"
600	1	21998	CONNECTING SHAFT
603	1	25361	NEEDLE BEARING TORRINGTON #B - 3012
605	2	25200	NEEDLE BEARING TORRINGTON #B - 4216
607	1	26009	* * OIL SEAL
615	2	25365	THRUST WASHER INA #AS 90120
617	1	25364	THRUST BEARING INA # AXK 90120
700	1	*	BRAKE HOUSING
703	1	25347	PLASTIC CAPLUG 1 - 11.5 NPT THR'D
707	1	25033	O-RING -271 9-1/4" ID 1/8" CS
711	1	25933	* * OIL SEAL
712	1	21965	BRAKE SPACER
713	13	25953	DIVIDER PLATE
715	12	25952	FRICTION PLATE
720	1	21955	BRAKE HUB
721	1	25369	CIRCLIP ROTOR CLIP SH-387
723	1	25303	SPRAG CLUTCH BORG WARNER #140373 "B"
724	1	20421	SPRAG CLUTCH ALIGNER
727	1	25335	CIRCLIP ROTOR CLIP SH-196
734	1	21984	ACCESS PLUG
735	1	25967	O-RING -117 13/16" ID 3/32" CS
750	1	21936	PISTON
751	1	25968	O-RING -90 DURO -372 8-3/4" ID 3/16" CS
752	14	20413	BRAKE SPRING
753	1	25969	O-RING -90 DURO -373 9" ID 3/16" CS
		23135	WINCH SEAL KIT, CONTAINS ITEM: 105, 123, 531, 539, 607, 707, 711, 735, 751, 753 AND 801
			* These parts vary according to drum code. Refer to APPENDIX B.
			* * Do not substitute. Available from PULLMASTER or Authorized Dealer only.

Refer to PAGE 28 for ASSEMBLY DRAWING.

BRAKE GROUP

G1044



Group drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

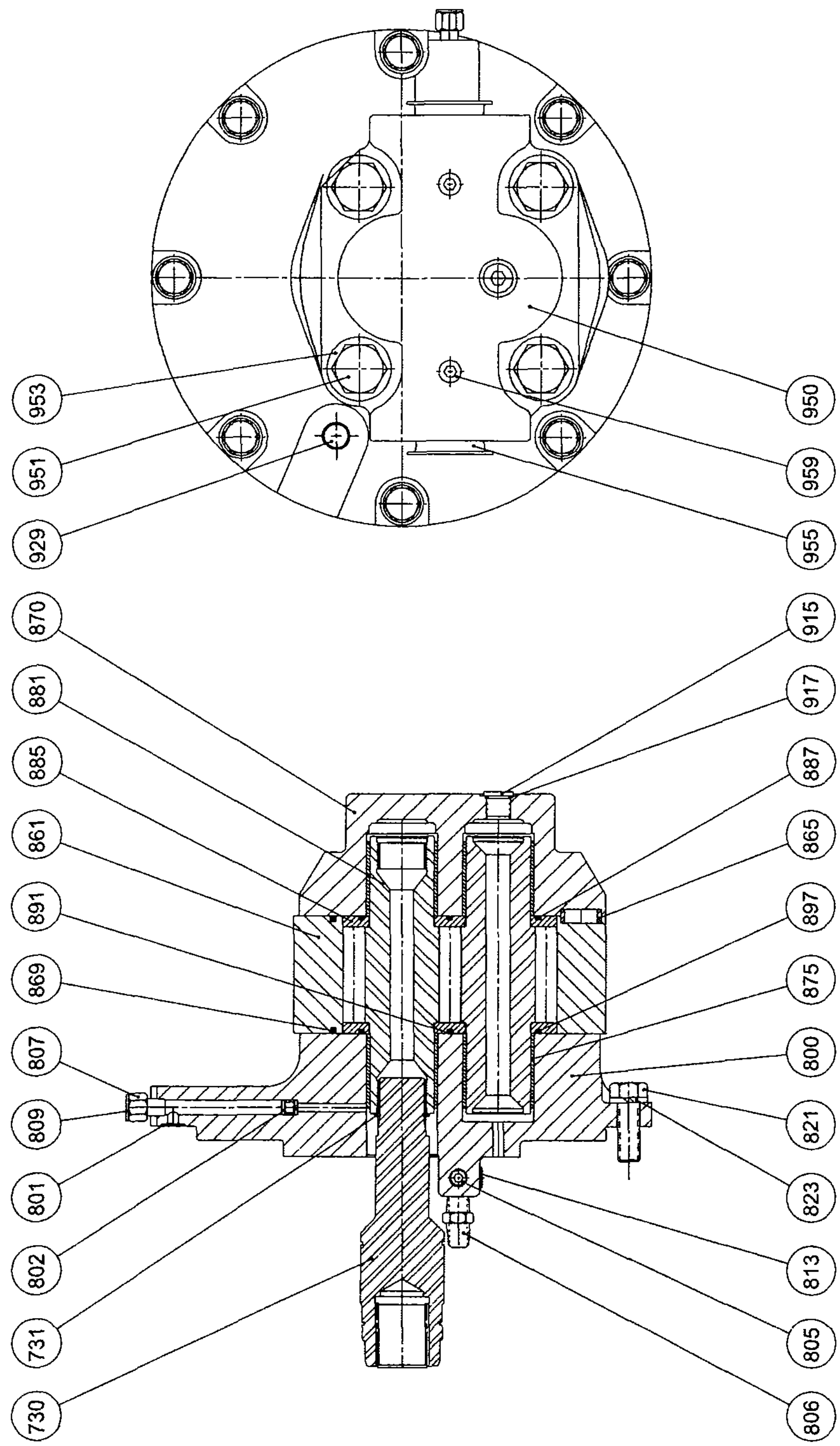
PARTS REFERENCE - MOTOR GROUP

ITEM NO.	QTY.	PART NO.	DESCRIPTION
730	1	21322	MOTOR DRIVE SHAFT
731	1	25288	CIRCLIP ROTOR CLIP C-112
800	1	21952	MOTOR ADAPTOR
801	3	25127	O-RING 90 DURO - 013 7/16"ID 1/16" CS
802	1	*	*
805	2	25040	PIPE PLUG 1/8 - 27 NPT
806	1	*	*
807	1	*	*
809	1	*	*
813	1	25031	PIPE PLUG 1/4 -18 NPT
821	8	25081	CAPSCREW - HEX HEAD 1/2 - 13NC X 1.50 GRADE 5
823	8	25014	LOCKWASHER 1/2"
861	1	25795	GEAR HOUSING -101 COMM. #322 8222 100
865	4	25779	DOWEL PIN - HOLLOW COMMERCIAL #391 2082 069
869	2	25780	SEAL - GASKET COMMERCIAL #391 2884 023
870	1	21993	PORT END COVER M365 (INCLUDES ITEMS: 875 (x 2), 955 (x 2) & 959 (x 2)
875	4	25782	BUSHING COMM. #391 0482 307
881	1	25794	GEAR SET -101 COMM. #322 2822 000
885	2	25774	THRUST PLATE COMM. #391 2185 060
887	4	25775	SEAL - END CHANNEL COMM. #391 2885 070
891	4	25776	SEAL - SIDE CHANNEL COMM. #391 2885 069
897	2	25787	SEAL - BACKUP COMM. #391 2885 071
929	1	*	*
950	1	*	SUB-ASSY MOTOR -101 COMM. M365-2.25
951	4	25793	CAPSCREW - HEX HEAD 3/4 -10NC X 6.0" GRADE 5
953	4	25784	WASHER COMM. #391 3782 114
955	2	25585	PLASTIC CAPLUG 1.625" -12
959	2	25031	PIPE PLUG 1/4 - 18 NPT
		23139	MOTOR SEAL KIT, CONSISTS OF ITEMS: 869, 887, 891 AND 897
			NOTE: ITEM 950 MOTOR SUB-ASSY, CONSISTS OF ITEMS: 800, 802, 805, 806, 807, 809, 813, 861, 865, 869, 870, 875, 881, 885, 887, 891, 897, 929, 951, 953, 955 AND 959
			* These part numbers and descriptions vary according to brake code. Refer to APPENDIX C.

Refer to PAGE 22 for winch seal kit and PAGE 28 for ASSEMBLY DRAWING.

MOTOR GROUP

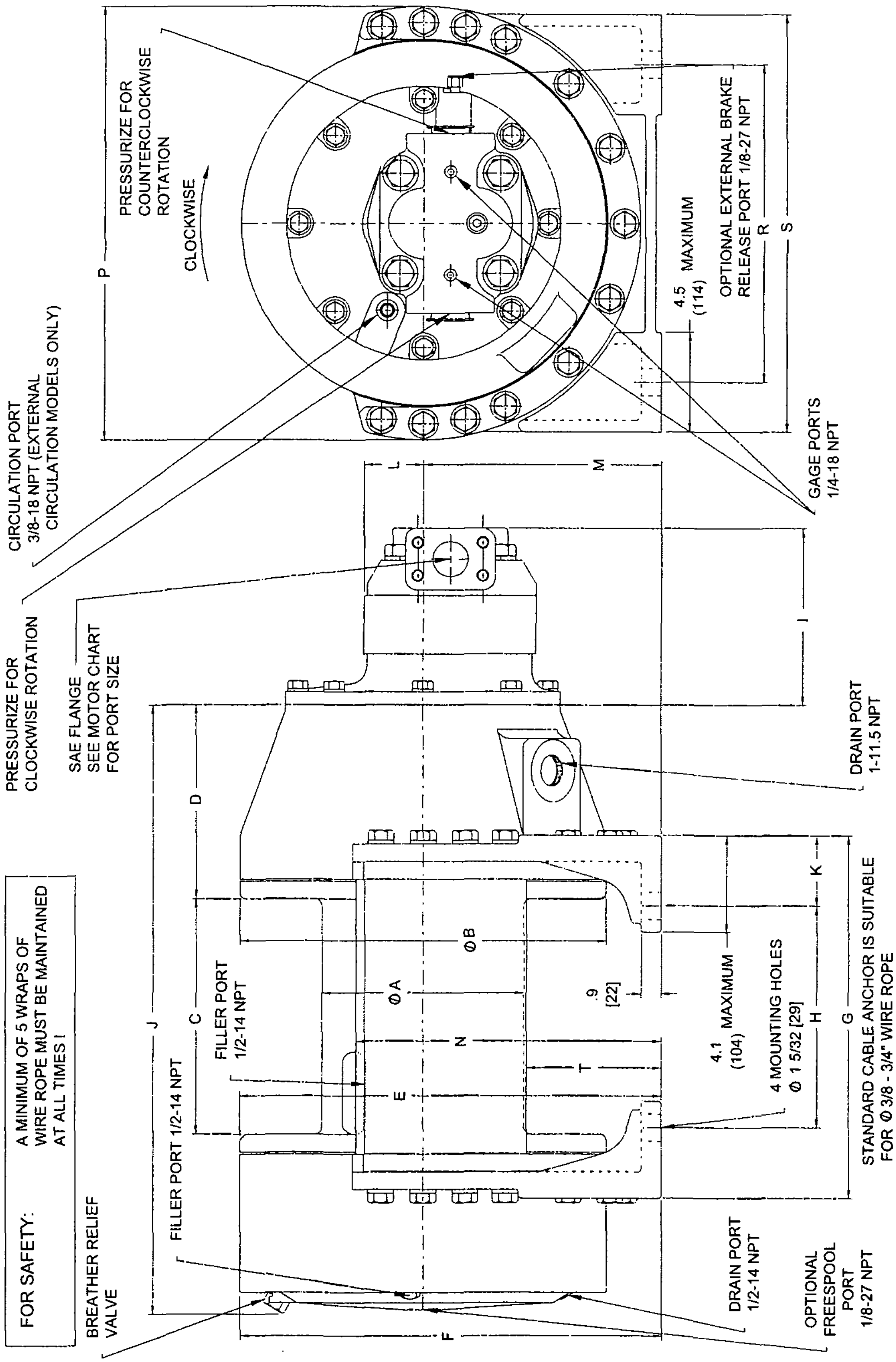
G1017



Group drawings may reference more parts than are actually present in a specific assembly. Parts that are referenced on the drawing but are not on the PARTS REFERENCE list should be ignored.

INSTALLATION DIMENSIONS

I1068



INSTALLATION DIMENSIONS

I1023-2-F

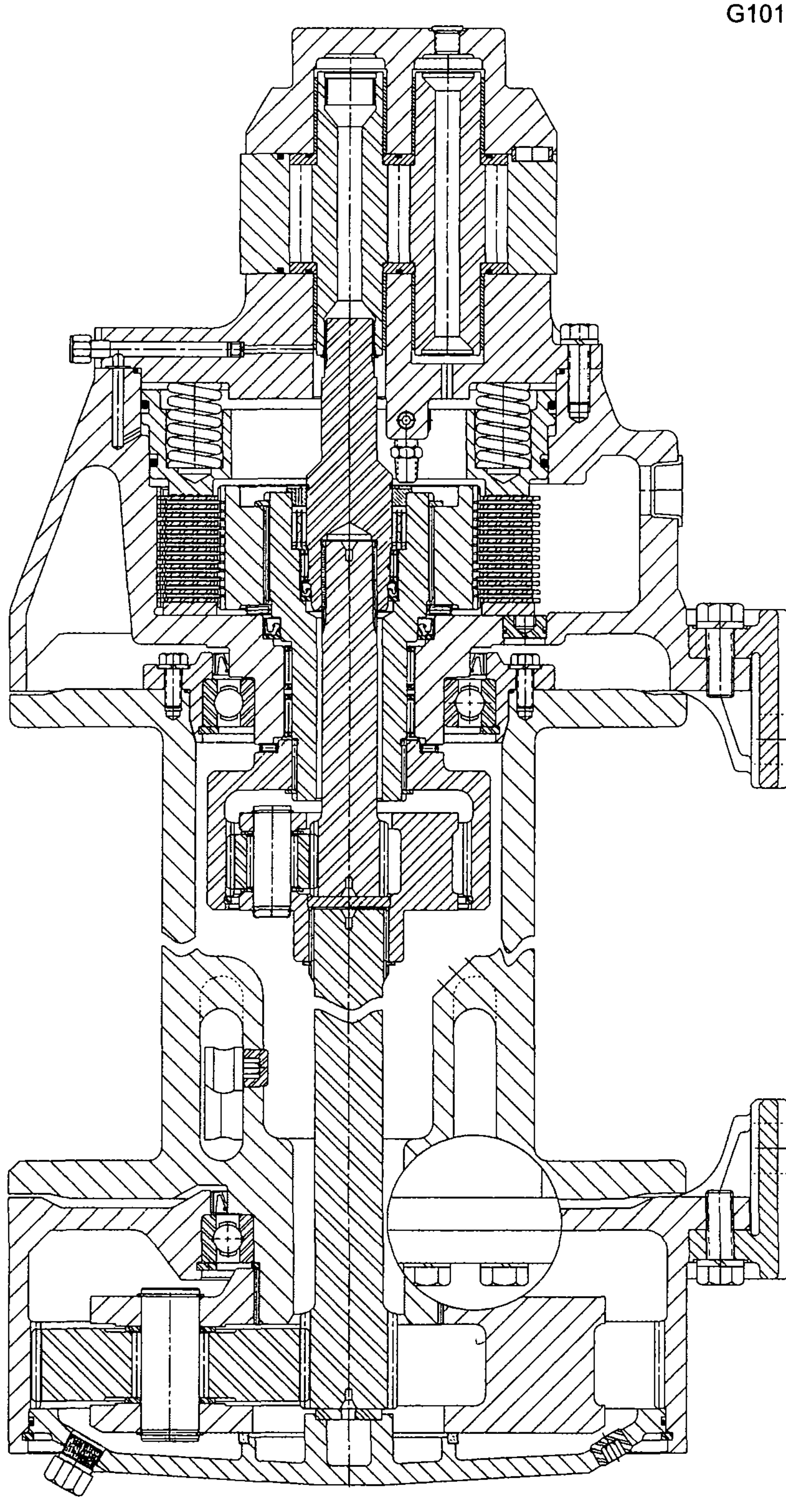
Dimensions in inches
(Dimensions in millimeters)

DRUM CODE	A	B	C	D	E	F	G	H	J	K	M	N	P	R	S	T
-1	8.5 (216)	15.5 (394)	10.0 (254)	8.3 (210)	17.9 (454)	17.9 (454)	15.4 (392)	9.430 (239.52)	25.9 (659)	3.0 (76)	10.13 (257.2)	12.9 (329)	18.4 (468)	13.500 (342.90)	17.8 (451)	5.8 (147)
- 2	13.0 (330)	20.0 (508)	16.0 (406)	8.4 (214)	20.8 (527)	18.5 (470)	22.0 (559)	18.500 (469.90)	32.2 (817)	1.8 (44)	10.75 (273.1)	13.5 (342)	23.3 (591)	17.250 (438.15)	21.6 (546)	6.3 (159)
- 3	8.5 (216)	20.0 (508)	16.0 (406)	8.4 (214)	20.8 (527)	18.5 (470)	22.0 (559)	18.500 (469.90)	32.2 (817)	1.8 (44)	10.75 (273.1)	13.5 (342)	23.3 (591)	17.250 (438.15)	21.6 (546)	6.3 (159)
- 4	8.5 (216)	28.0 (711)	21.3 (540)	8.8 (225)	28.8 (730)	22.5 (572)	28.1 (714)	24.187 (614.35)	38.3 (977)	1.9 (49)	14.75 (375)	16.0 (405)	31.3 (795)	20.500 (520.70)	25.0 (635)	8.8 (223)
- 6	10.0 (254)	16.0 (406)	16.0 (406)	8.4 (214)	18.8 (478)	18.5 (470)	22.0 (559)	18.500 (469.9)	32.2 (817)	1.8 (44)	10.75 (273.1)	13.5 (342)	23.3 (591)	17.250 (438.15)	21.6 (546)	6.3 (159)

Dimensions in inches
(Dimensions in millimeters)

HYDRAULIC MOTORS				
COMMERCIAL M365 GEAR MOTORS				
MOTOR CODE	GEAR WIDTH	MOTOR PORT SIZE SAE 4 BOLT FLANGE	I	L
- 042	2.50 (63.5)	1.50 inch Code 61	8.1 (205)	2.5 (64)
- 101	2.25 (57.2)		7.8 (198)	2.5 (64)
-102	2.00 (50.8)		7.6 (192)	2.5 (64)
- 128	1.75 (44.5)		7.3 (186)	2.5 (64)
- 161	1.00 (25.4)		6.6 (167)	2.5 (64)
- 163	1.25 (31.2)		6.9 (173)	2.5 (64)

G1017 & G1043-A & G1044



APPENDIX A

DRUM	CABLE DRUM SIZES INCHES (MILLIMETERS)			WIRE ROPE STORAGE FEET (METERS)			LINE PULL AT MAXIMUM PRESSURE - HOISTING* POUNDS (KILONEWTONS)		HOISTING LINE SPEED AT MAXIMUM VOLUME* FEET/MINUTE (METERS/MINUTE)		MAXIMUM ALLOWABLE LINE PULL - LOWERING* POUNDS (KILONEWTONS)		LOWERING LINE AT MAXIMUM VOLUME* FEET/MINUTE (METERS/MINUTE)		LUBRICATING OIL VOLUME REQUIRED U.S. GALLONS (LITERS)
	BARREL	FLANGE	LENGTH	7/8 in	3/4 in	5/8 in	BARE DRUM	FULL DRUM	BARE DRUM	FULL DRUM	BARE DRUM	FULL DRUM	BARE DRUM	FULL DRUM	
-1	8.5 (216)	15.5 (394)	10.0 (254)	113 (34)	170 (52)	239 (73)	18000 (80.1)	11288 (50.2)	122 (37)	195 (59)	3913 (17.4)	2506 (11.1)	563 (171)	897 (273)	1.3 (5)
- 2	13.0 (330)	20.0 (508)	16.0 (406)	251 (77)	375 (114)	528 (161)	12109 (53.9)	8649 (38.5)	182 (55)	255 (78)	2632 (11.7)	1910 (8.5)	836 (255)	1171 (357)	3.7 (14)
- 3	8.5 (216)	20.0 (508)	16.0 (406)	372 (113)	500 (152)	747 (228)	18000 (80.1)	8649 (38.5)	122 (37)	255 (78)	3913 (17.4)	1973 (8.8)	563 (171)	1171 (357)	2.1 (8)
- 4	8.5 (216)	28.0 (711)	21.3 (541)	1068 (326)	1479 (451)	2130 (649)	18000 (80.1)	6110 (27.2)	122 (37)	360 (110)	3913 (17.4)	1385 (6.2)	563 (171)	1657 (505)	2.9 (11)

* Performance specifications are based on standard hydraulic motor with 3/4 inch rope.

APPENDIX B

DRUM CODE

ITEM NO.	PART DESCRIPTION	- 1		- 2		- 3		- 4	
		PART NUMBER	QTY.	PART NUMBER	QTY.	PART NUMBER	QTY.	PART NUMBER	QTY.
100	FINAL HOUSING	21916	1	22047	1	22047	1	22047	1
340	FINAL SUNGEAR	21964	1	22050	1	22050	1	22212	1
500	CABLE DRUM	21953	1	22036	1	22398	1	22194	1
551	CAPSCREW 5/8 - 11NC x 1.5	25139	10	25139	26	25139	26	25139	26
553	5/8 LOCKWASHER	25359	26	25359	42	25359	42	25359	42
554	BASE PLATE	21926	2	22046	2	22046	2	22195	2
555	CAPSCREW 5/8 - 11NC x 2.5	25797	16	N/A	-	N/A	-	N/A	-
555	CAPSCREW 5/8 - 11NC x 2.0	N/A	-	25419	16	25419	16	25419	16
556	TIE BAR	21954	2	22045	2	22045	2	22196	2
700	BRAKE HOUSING	21950	1	22048	1	22048	1	22048	1

APPENDIX C

ITEM NO.	PART DESCRIPTION	BRAKE CODE - 3	- 4	- 5	- 6	- 7	- 8	- 9	- 10
		PART NUMBERS							
802	SHUTTLE	N/A	20849	20849	N/A	N/A	20849	20849	N/A
806	CIRCULATION VALVE	20456	20456	20456	20456	N/A	N/A	N/A	N/A
806	1/4-18 NPT PIPE PLUG	N/A	N/A	N/A	N/A	25031	25031	25031	25031
807	1/8-27 NPT PIPE PLUG	25040	N/A	N/A	25040	25040	N/A	N/A	25040
807	1/8-27 NPT PIPE ADAPTOR	N/A	25622	25622	N/A	N/A	25622	25622	N/A
809	1/8 NPT CAPLUG	N/A	25374	25374	N/A	N/A	25374	25374	N/A
929	3/8 NPT CAPLUG	N/A	N/A	N/A	N/A	26276	26276	26276	26276
929	3/8-18 NPT PIPE PLUG	25085	25085	25085	25085	N/A	N/A	N/A	N/A
950	MOTOR SUB-ASSY	22032	22290	22291	22033	22034	22305	22306	22035

BOLT TORQUE CHART

BOLT DIAMETER Inches	TORQUE lb-ft	TORQUE Nm
1/4	9	12
5/16	18	24
3/8	32	43
7/16	50	68
1/2	75	102
9/16	110	149
5/8	150	203
3/4	265	359
7/8	420	569
1	640	868
1 1/8	800	1085
1 1/4	1000	1356
1 3/8	1200	1627
1 1/2	1500	2034

NOTE: Unless otherwise specified, torque bolts per above chart.

J.F. BRENNAN CO., INC.

820 BAINBRIDGE · BOX 2557 · LA CROSSE, WI 54602-2557 PHONE: 608 / 784-7173 FAX: 608 / 785-2090

APPENDIX C

OPERATIONS MANUAL FOR BOOSTER PUMPS

BRENNAN

"Marine Professionals"

Booster Operators Weekly Report

Asset # JFBXXXX

Week Ending ____________________

Job # ______________________________ Operator ____________________

Hours at end of week on engine ______________________________

Daily Fluid Checks	Sun	Mon	Tues	Wed	Thur	Fri	Sat
Engine Oil							
Reduction-Gear Fluid							
Coolant							
Main Hydraulic System							
Gallons Of Fuel Pumped							
Other Fluids Added							
Packing--Quan. Added							

Comments: ____

____

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DREDGE PUMP LUBRICATION & INSPECTION SCHEDULE:

Inspect, Lubricate every 8 Hours	Sun	Mon	Tues	Wed	Thur	Fri	Sat
Inspect Water Flow To Stuffing Box Gland							
Inspect For Loose Bolts & Broken Parts							
Grease Shaft Bearings							
Inspect Cutter Reduction Gear Housing							
Inspect Hyd. Hoses for Leaks & Cracks							
Lubricate Ladder Gimbal Assembly (4 fittings)							
Lubricate Ladder Trunions Pin							
Lubricate Kicker Spud Cylinder Pins							
Inspect The Winch Cables							

Inspect, Lubricate every 24 Hours

Lubricate the Service Water Pump							
Check Service water pump packing							

Inspect, Lubricate every 40 Hours

Adjust Impellor / Front Liner Clearance:							
Note The Number of Flats on Adjuster Moved							

BRENNAN

"Marine Professionals"

Booster Operators Daily Report

Asset # JFBXXXX

Week Ending ______________________________

Job # ____________________

Operator ______________________________

Dredge Pump & Main Engine Hourly Operating Data

4 Hour Log Values Per Shift	12 - 4 AM.	4- 8 AM.	8 - 12 PM.	12- 4 PM.	4 - 8 PM.	8 - 12 PM.
Engine RPM						
Hydraulic Oil Temperature						
Engine Oil Temperature						
Engine Oil Pressure						
Engine Coolant Temperature						
Engine Fuel Pressure						

Comments ______________________________

Operator 1st shift ______________________________

Operator 2nd shift ______________________________

Operator 3rd shift ______________________________

DSC AUTOMATED BOOSTER CONTROL SYSTEM

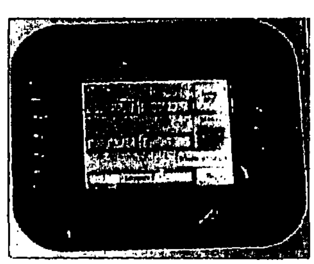
Eight Inch DIESEL AUTOMATIC BOOSTER PUMP

START UP PROCEDURE (AFTER THE PID LOOP IS SETUP)

1. **Turn the power off and then on** to the PLC to reset the gear to off. Use the power switch in the control box to power the PLC back on.
2. Confirm that the suction for the service water pump and the priming pump are in the basket and are clear of trash or debris.
3. Check the engine following the startup procedures in the Caterpillar Manual for starting the engine.
4. Start the engine and then turn the power on the PLC.
5. If PID loop is used, choose either RPM or INLET as the mode the PID will operate.
6. Select either PID loop on or operate the booster manually.
7. .To operate manually, use the buttons in the control box. When the dredge pushes enough slurry to the booster adjust the booster speed to fit the dredging environment.

> Note: If the gear is engaged when the PLC loses power it will remain engaged until the PLC is re-powered.

CONTENTS



Touch Screen

DSC AUTOMATED BOOSTER CONTROL SYSTEM

INTRODUCTION

The DSC automated booster control system represents the state of the art in dredge booster pump control. While this system grants complete manual control, it also provides automatic control for two types of programmed speed loops, one for constant engine speed and the other for constant inlet pressure. Additionally, this system provides the user with valuable booster information in an easy to operate control panel with a touch screen.

NOTE: **THE POWER SWITCH MUST OFF IN THE PLC BOX BEFORE STARTING THE ENGINE.**

The local control panel consists of a large control box mounted on the booster. The control box houses the PLC, relay banks, terminal blocks, touch screen display, and the on off switch, the mode switch and throttle increase, and throttle decrease, and switches for manual/automatic operation.

AUTOMATION SYSTEM INSTALLATION

The system installation consists of installing the sensors on the booster and the throttle and gear actuator on the booster engine. Wiring them to the booster control panel, and connecting the control panels to 24 VDC power on the dredge. (See picture on page 18 and drawings 200720008 & 200720009 & 200720010)

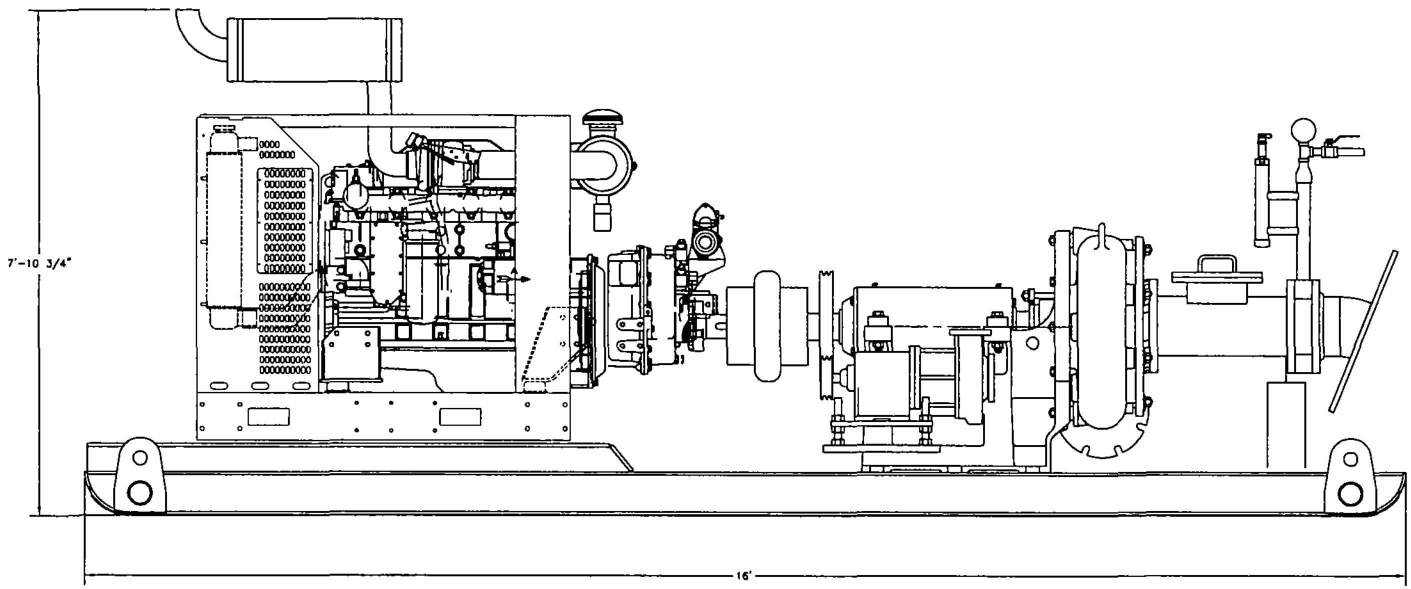
EXTERNAL SWITCHES

Each of the external switches controls a unique function of the booster unit. The On/Off switch toggles the PLC system on and off, THIS SWITCH MUST BE OFF BEFORE STARTING THE BOOSTER ENGINE OR THE POWER WILL HAVE TO BE TURNED OFF AND BACK ON TO RESET THE PLC. The PID/ON, PID/ OFF switch controls how the booster will operate if it is in PID mode. With the switch in PID OFF, the operator must control the booster because the system is off line. In PID ON mode, the booster will operate in a fixed speed mode or a variable speed mode. These loop set points are entered in the set points Menu on the data panel. Local control of the throttle is still provided even in automatic operation and **the clutch is engaged and disengaged by the program in either mode**.

The **Inlet or RPM switch** controls how the automatic system controls the engine throttle. The speed of the engine will be varied to maintain the inlet pressure set in the PLC in the Inlet Mode. The speed can vary between an idle to a maximum as set in the PLC. The engine speed is maintained at a preset RPM when the RPM mode is selected. In this mode, the engine runs at the predetermined speed or is brought down to idle speed when the set points are met.

NOTE:

1. SKID WIDTH = 6'-8"
2. BOOSTER O.A.W. = 8'-10"
3. BOOSTER O.A.L. = 16'-0"
4. BOOSTER O.A.H. = 7'-10 3/4"
5. CONSERVATIVE ESTIMATED BOOSTER WEIGHT = 10,000 LBS



SIDE PROFILE

PUMP DRIVE EQUIPMENT

ENGINE CUMMINS 6CTA 8.3
MARINE GEAR-TWIN DISC 5075 SC 2.05:1 SAE#3 FLYHEEL
STUB SHAFT-REF. DWG. 200710002
FLEXIBLE COUPLING-OMEGA E80 TAPER-LOCK HUBS 100mm x $3\frac{7}{16}$"
SERVICE PUMP DRIVER SHEAVE-REF. DWG. 200710007
SERVICE PUMP DRIVER SHEAVE LOCKING DEVICE-B-LOC B103 (100x145)
SERVICE PUMP SHEAVE-2-5Vx5.5 w/ SK $1\frac{1}{4}$" QD BUSHING
SERVICE PUMP BELT-5VX800
SLURRY PUMP-GIW 8x8 LCC

REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE
C	10/31/02	NJG	CHANGED O.A.H. DIM.				
B	10/30/02	NJG	ADDED DIM.'S AND NOTES				
A	10/15/02	DJA	ADDED 8" CLEAN-OUT				

Dredging Supply Company, Inc

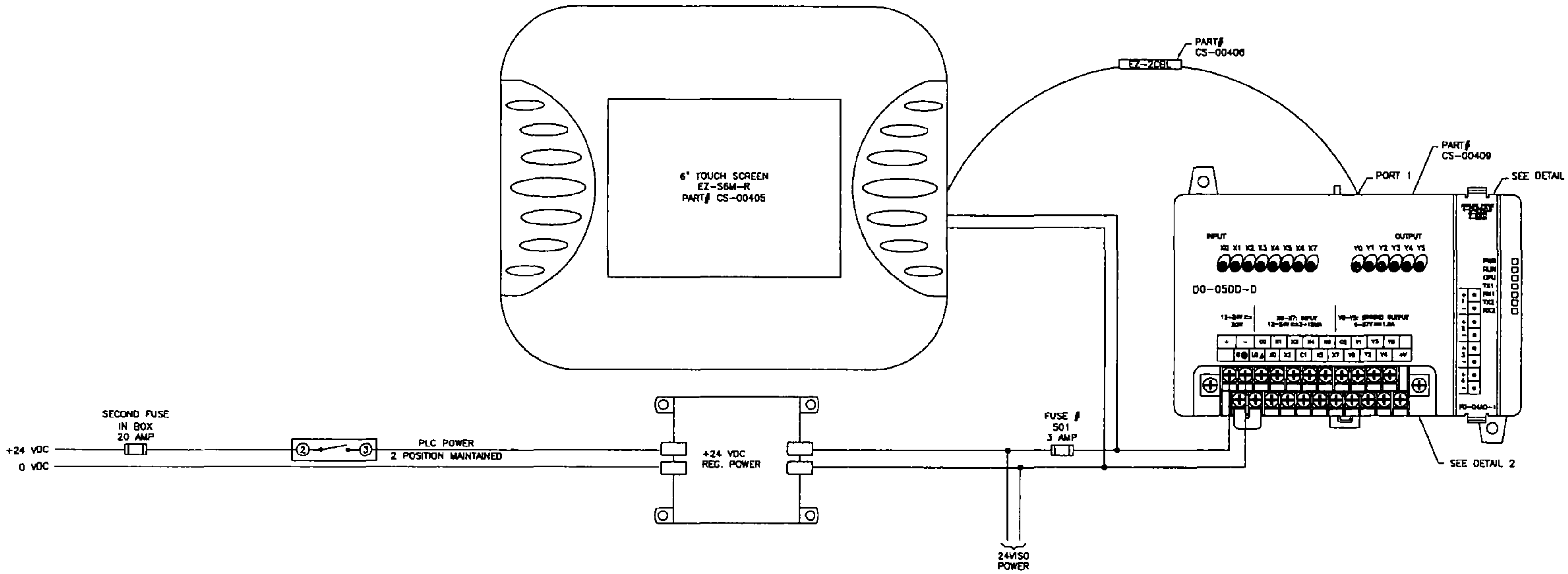
DREDGING SUPPLY COMPANY, Inc.

JF BRENNAN 8" BOOSTERS

GENERAL ARRANGEMENT

ENGR/DESIGN: DJG	
DRAWN:	APP BY:
CHK:	DATE:
SCALE: 1 1/2"=1'-0"	
SIZE: D	PROJECT: 200710
DWG NO: 200710001	REV: C

A	–	CS-00391	–
B	–	CS-00085	–
C	–	CS-00404	–
D	–	CS-00223	–
E	–	CS-00355	–
F	–	CS-00142	–
G	–	CS-00097	–
H	–	CS-00406	–
I	–	CS-00125	–
J	–	CS-00197	–



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

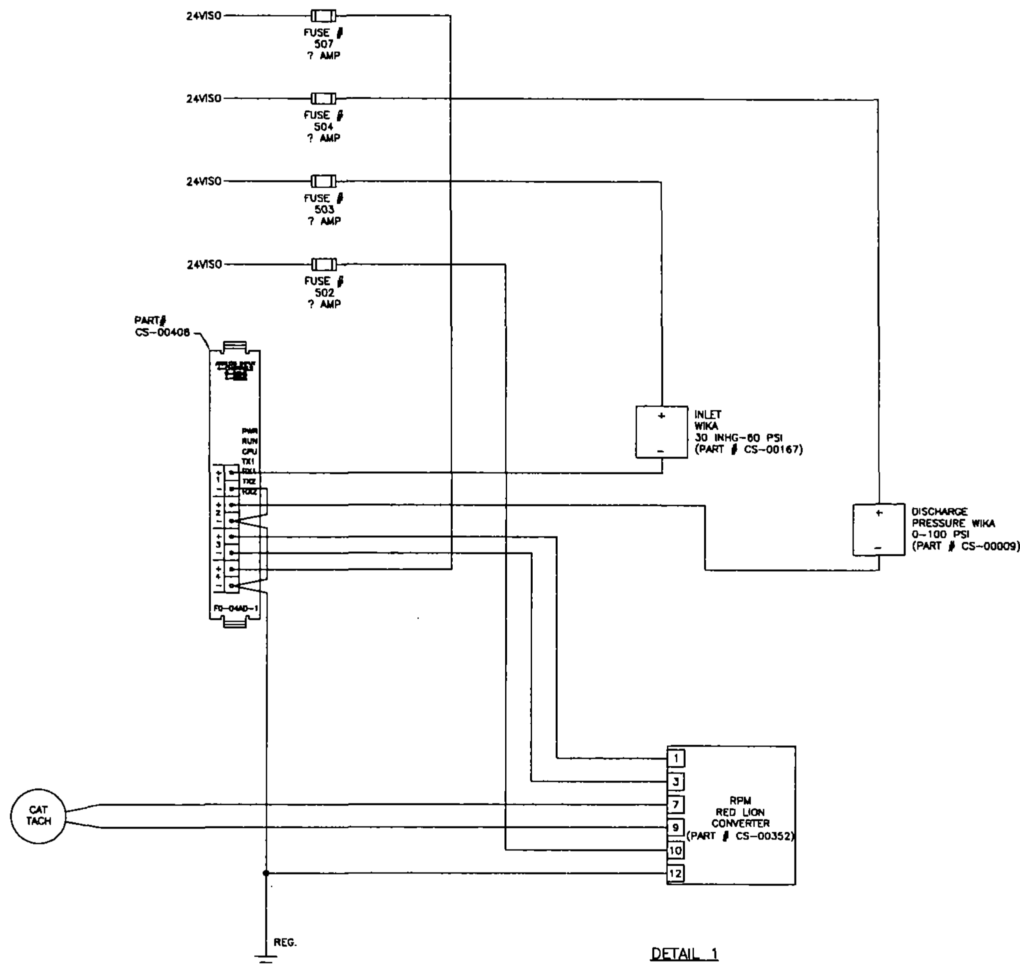
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

JND THOMAS COMPANY, INC.

PLC WIRING DIAGRAM (1 OF 3)

ENGR/DESIGNER: MJC
DRAWN: DJA
APP BY:
CHK:
DATE: 9/23/02
SCALE: FULL
SIZE: D
PROJECT: 200720
DWG NO: 200720008
REV:



DETAIL 1

REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

Dredging Supply Company, Inc

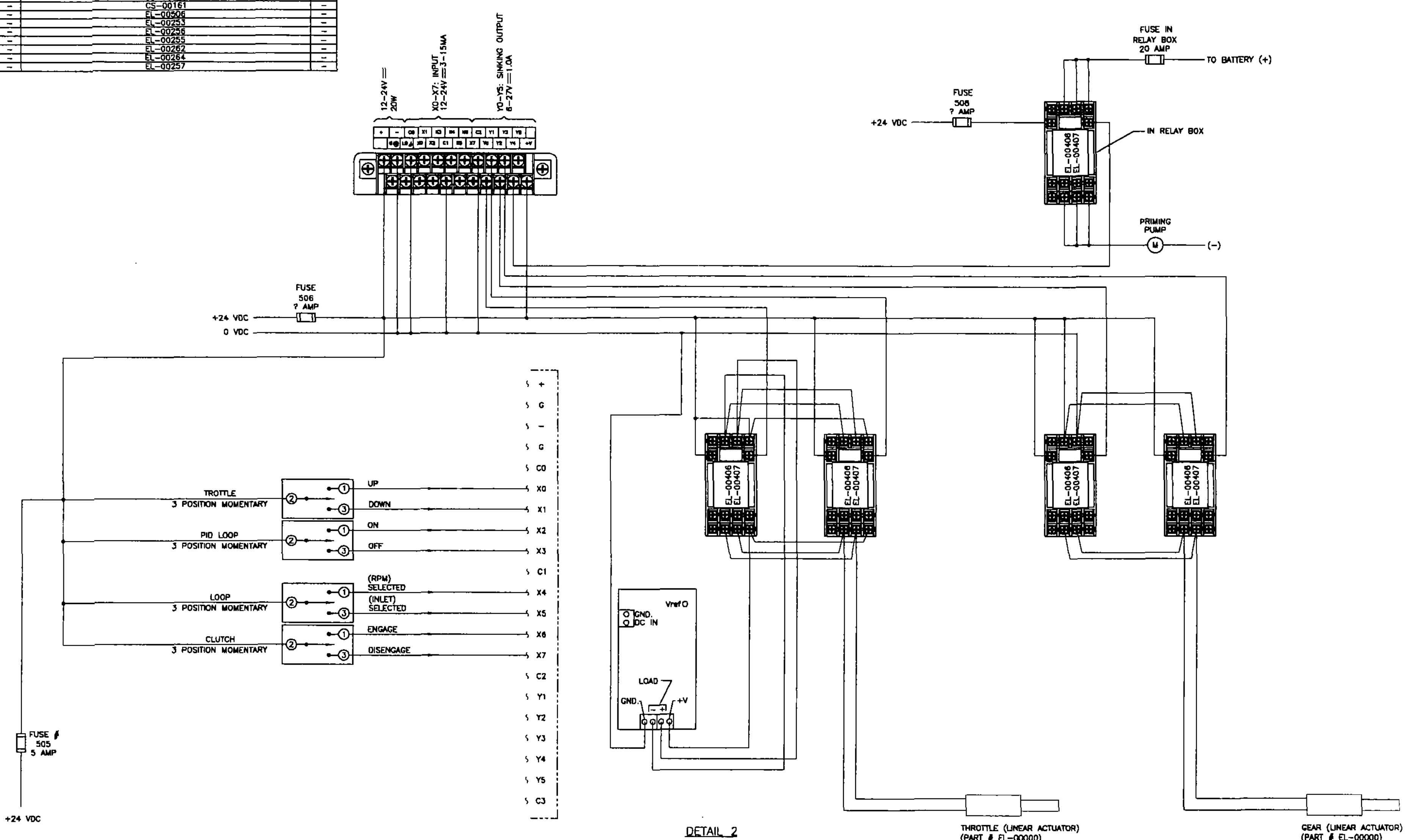
DREDGING SUPPLY COMPANY, Inc.

JND THOMAS COMPANY, INC.

PLC WIRING DIAGRAM (2 OF 3)

DRGR/DESNR: MJC	
DRAWN: DJA	APP BY:
CHK:	DATE: 9/23/02
SCALE: FULL	
SIZE: D	PROJECT: 200720
DWG NO: 200720009	REV:

A	-	CS-00126	-
B	-	CS-00161	-
C	-	EL-00506	-
D	-	EL-00253	-
E	-	EL-00256	-
F	-	EL-00255	-
G	-	EL-00262	-
H	-	EL-00264	-
I	-	EL-00257	-



REV	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	REFERENCE DRAWING TITLE

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

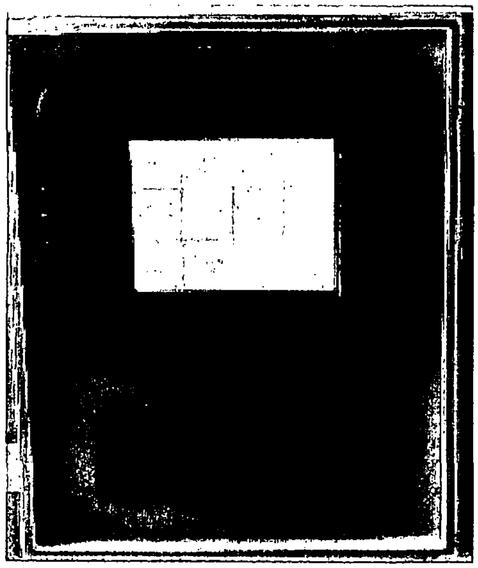
JND THOMAS COMPANY, INC.

PLC WIRING DIAGRAM (3 OF 3)

CHKR/DESIGNR: MJC	
DRAWN: DJA	APP BY:
CHK:	DATE: 9/23/02
SCALE: FULL	
SIZE: D	PROJECT: 200720
DWG NO: 200720010	REV:

BOOSTER

PLC CONTROL SWITCHES AND TOUCH SCREEN



BOOSTER OPERATION PANEL

The switches on the bottom of the booster display/control panel are, left to right are as follows:

1. Top On / Bottom Off
2. Throttle: Top / up, Bottom /down
3. Mode: Top/ PID ON, Bottom / PID OFF
4. Pid mode: Top / RPM, Bottom / Inlet pressure.
5. Gear Engagement: Top/Engaged, Bottom/Disengaged.

MANUAL MODE

The manual mode provides a remote operator station from which the operator can monitor the booster. From this station the engine throttle can be adjusted up or down and the inlet pressure the outlet pressure and the engine R.P.M. can be monitored and adjusted.

Select the manual mode with the mode switch in the control box at the booster.

The dredge main screen #2 will display: RPM Loop Off, Inlet Loop Off when in the manual mode.

Note: The throttle control is always active no matter what mode the booster is operating. The throttle can be raised or lowered at any time with the manual switch, but if the booster is in any of the auto modes they will take over when it is released.

"PID ON" STANDBY MODE (INLET OR R.P.M.)

When one of the auto modes are selected and the starting conditions have not been met the system will stay in auto mode standby. The touch screen will display the auto mode selected, either "INLET LOOP SELECTED", or "RPM LOOP SELECTED".

The PID mode is selected with the switch on the control panel. It will activate when the inlet pressure is equal to or greater than the start loop inlet pressure set point.

"PID ON" OPERATIONAL (INLET OR R.P.M.)

When auto mode is selected and the inlet pressure has reached and/or exceeded the start loop pressure set point the speed of the booster is controlled automatically. The touch screen will display the auto mode selected either, "INLET LOOP ON", or "R.P.M. LOOP ON" on the booster.

"PID ON " MODE STOPPING (INLET OR R.P.M.)

When the loop is active but has encountered a discharge pressure less then or equal to the loop discharge pressure and the timer has timed out the loop will start stopping. The booster main screen will display will display "Loop Disengaging". When the loop has stopped the system switches to auto mode stand by and the booster main screen displays loop off.

OPERATING EXAMPLES

Manual Mode - In manual mode the operator controls the booster.

Inlet Auto Mode – With the Inlet pressure loop set point as 20 psi, the start loop set point set at 30 psi, and the discharge pressure set point at 60 psi. The booster will remain at idle until the inlet pressure reaches 30 psi (start loop set point). The booster will then increase rpm until inlet pressure reaches 20 psi (inlet pressure loop set point). If then the discharge pressure is not equal to 60 psi (discharge pressure set point) the booster will disengage the loop and the whole process starts over again.

Rpm Auto Mode – With the Engine Speed Loop set at 1500 rpm, start loop set point set at 30 psi and the discharge pressure set point at 60 psi. Once the inlet pressure reaches 30 psi (start loop set point) the booster will increase the rpm until it reaches 1500 rpm (engine speed loop set point). If the discharge pressure is not equal to 60 psi, (discharge pressure set point) the booster will disengage the loop and the whole process starts over again.

NOTE: Do not to set a discharge value that is too high.

SETTING THE SET POINTS

Inlet pressure loop set point – With the dredge running at standard production and the booster in manual raise the rpm until the inlet pressure is between 5 – 10 psi. If this pressure cannot be reached without getting within 15% of max rpm, set the rpm to 15% of max rpm. Note the inlet pressure and the discharge pressure. The inlet pressure will be your inlet pressure loop set point.

Start loop set point – As a rule of thumb set this to around 5 – 10 psi more than the inlet pressure loop set point.

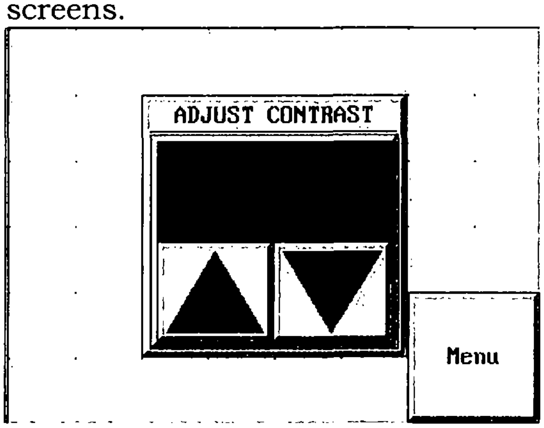
Discharge pressure set point – Set this at half of what the discharge pressure was at the time you were setting the inlet pressure loop set point.

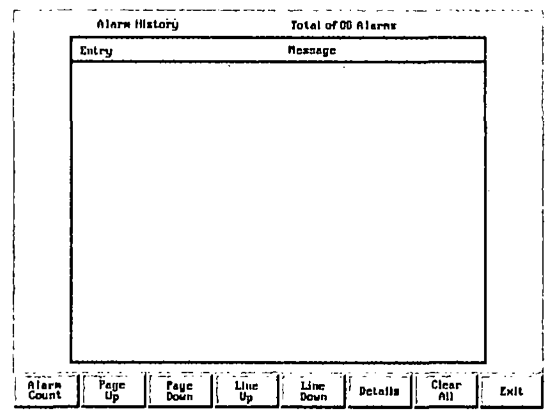
TOUCH SCREEN OPERATION

The touch screen is an Automation Direct EXTouch panel, Model EZ-S6M-R on the booster and Model EZ-S6C-K on the dredge. The manuals for this screen and the programming soft wear are available on the web at http://www.automationdirect.com/. The program for the booster system is a DSC custom program that is saved in the EXTouch panel.

Touch Screens (Booster)

The display screens allow the user to access and edit items in the program. Many of the screens operate in a similar fashion but some are displayed only on the booster panel and others only on the dredge touch screen. The rectangle labeled “Menu” will advance to the menu screen from any screen. The screens for the dredge display operate the same as the booster but only for the dredge screens.



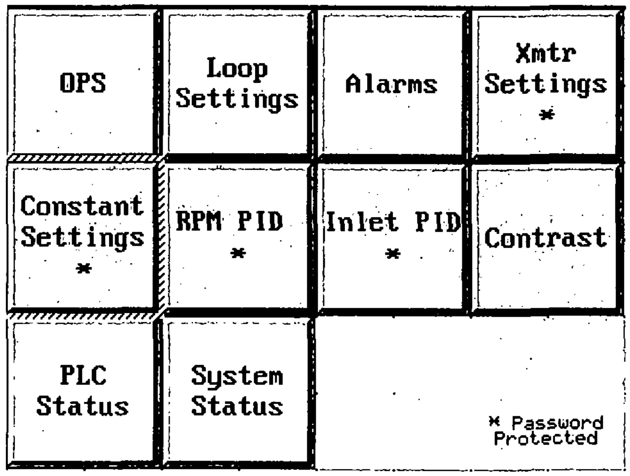


CONTRAST ADJUSTMENT SCREEN & ALARM HISTORY SCREEN

Both of these screens are available from the dredge and the booster display and are accessed from the menu screen. .

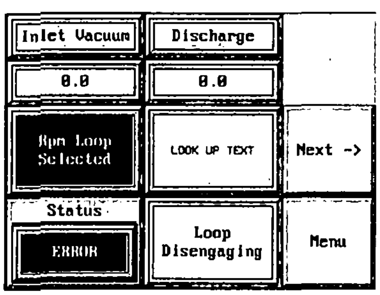
The contrast can be adjusted by touching the arrow on the screen to increase it or to decrease it.

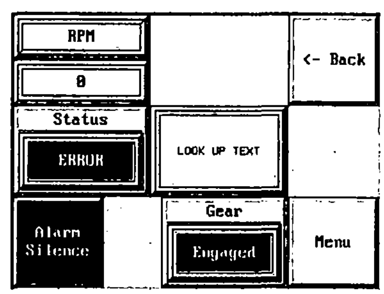
The alarm history is a log of the latest sixty four alarms or warnings. This record is maintained in the display unit with the program using a Lithium battery for power when the unit is off. The battery typical life is five years. The battery is in the uper left hand corner of the display from the back. Replace it with a new ½ AA, 3.6 V Lithium Battery. (See EZTouch manual)



BOOSTER MENU SCREEN

Touching the screen over a label will display that screen. Note that the labels with a * are password protected and cannot be accessed with out the password. When the label is touched a dropdown on screen keypad is displayed. Use the keypad to enter the password and then to change the value that needs correction.

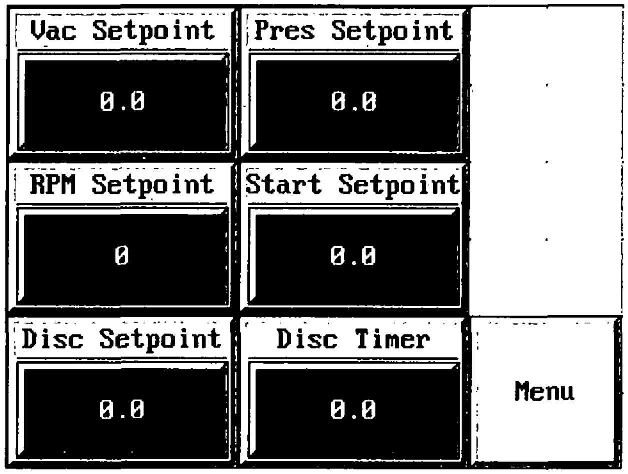




BOOSTER MAIN SCREENS

This screen is a display only screen. The screen displays the Inlet pressure and discharge pressure on the booster pump. The engine RPM, the loop operational condition, the loop that is active and the loop status are also displayed on this screen. Errors and warnings are displayed at the bottom of the screen and loop disengaging or engaged can be displayed. The alarm silence button on the screen when touched will stop the audio alarm.

Touching the menu button on the screen will display the menu screen.



BOOSTER & DREDGE LOOP SET POINT SCREEN

The "Loop set points" screen is accessed with the menu screen allows the user to change the active and inactive point and where the booster pump will automatically adjust its operating speed. This screen can be displayed at both the dredge and the booster.

To enter a new value touch the value and a keyboard will appear. Use it to enter the new value.

Vacuum Set point/ Pressure Set point – The value the PLC will raise and lower the rpm to achieve this setting. If you want a vacuum, you must enter 9999 in for the pressure set point, but if you want pressure, you must enter 9999 as the vacuum set point.

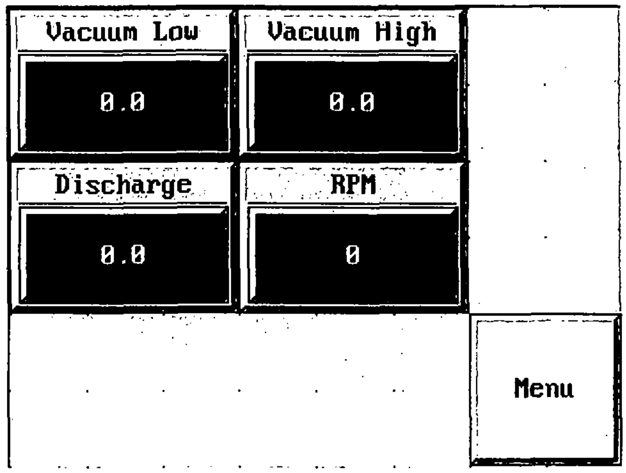
RPM Set point –The value the PLC will raise the rpm to in RPM Loop Mode.

Start Set point – The value at which point the PLC will start the PID loop.

Disc. Set Point – The PLC will stop the PID loop if the discharge is less than this value.

Disc. Timer – Time-period to which the PLC will allow the discharge to drop below the Disc. set point before stopping the PID loop.

The transmitter set points are dependent on what type of transmitter used. The values are usually located on the transmitters themselves or with the documentation supplied by the transmitter manufacturer.



BOOSTER TRANSMITTER SET POINT SCREEN

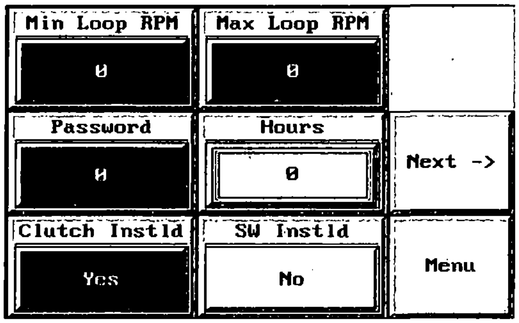
Max Vac./Max Pressure – (in. of Hg)/(psi) Combination transmitter. Maximum vacuum/pressure the transmitter can read.

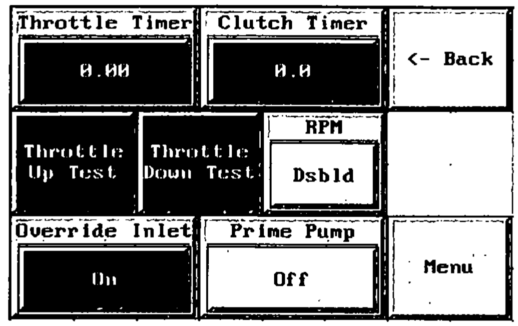
Max Disc. – (psi) Maximum discharge pressure the transmitter can read.

Max Rpm. – Maximum number of revolutions the transmitter can read in one minute.

Max Service Water -(psi) Maximum pressure the transmitter can read.

To enter a new value touch the value and a keyboard will appear. Use it to enter the new value.





BOOSTER CONSTANTS SCREENS

To enter a new value touch the value and a keyboard will appear. Use it to enter the new value.

Screen Password - Password used to access protected touch screen menus.

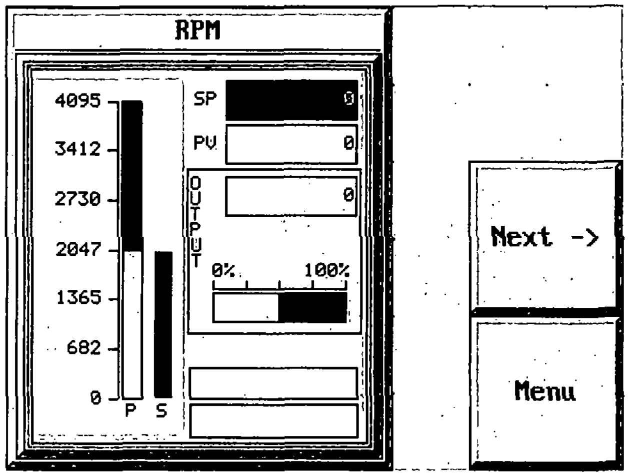
Min on Timer – Minimum amount of time the throttle will stay on, and the loop will stay engaged before disengaging. May need to be adjusted if the throttle reaction time needs to be changed.

Min Loop Rpm – The lowest rpm the loop can decrease the engine speed.

Max Loop Rpm – The highest rpm the loop can increase the engine speed.

Test Throttle Up/Down –This is used to increase or decrease the engine speed to the loop maximum and, or minimum.

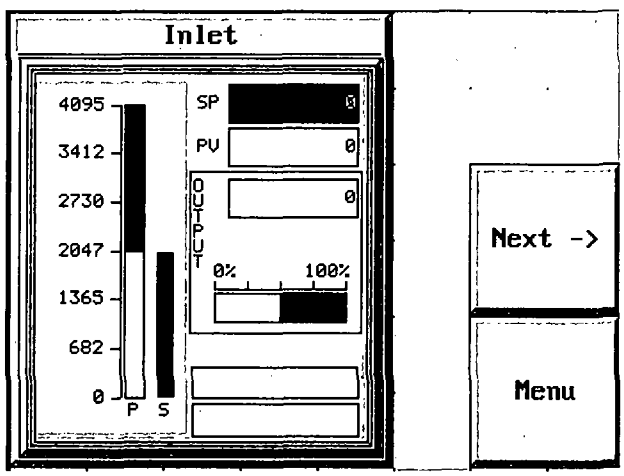
Hours – This displays the hours that the dredge has had power to the PLC.



BOOSTER RPM PID SCREEN

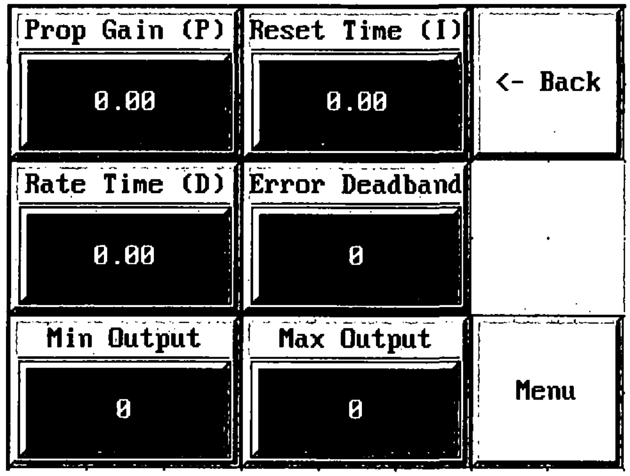
This is a display screen with access to the **RPM Loop Screen** by touching the label "Next". The RPM Loop Screen is password protected.

SP is the set point value and PV is the present value. Output is the counts being out put, maximum counts 4095. P is the present value and S is the set point value. Alarm will flash if there is an active alarm. Auto is displayed if the RPM system is active.



This is a display screen with access to the **Inlet Loop Screen** by touching the label "Next". The Inlet Loop Screen is password protected.

SP is the set point value and PV is the present value. Output is the counts being out put, maximum counts 4095. P is the present value and S is the set point value. Alarm will flash if there is an active alarm. Auto is displayed if the inlet system is active.



BOOSTER INLET LOOP/ RPM LOOP SCREENS

This screens password protected and all of the set points have been set at the factory. Adjustment should be done by authorized personnel. Contact DSC engineering before changing any of the set points.

To enter a new value, touch the value and a keyboard will appear enter the password then the new value. Use it to enter the new value.

Prop Gain (P) – The ratio of change in output to change in input.

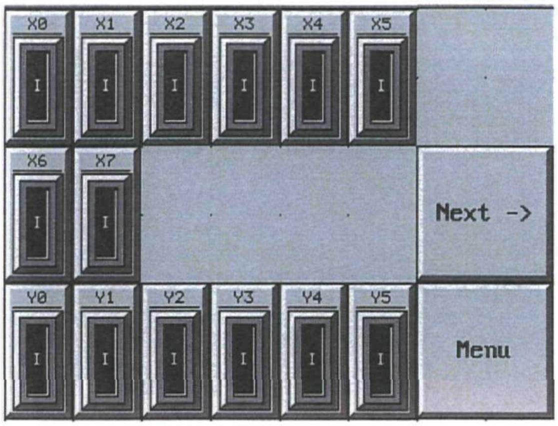
Reset Time (I) – The rate of change of output proportional to error in input.

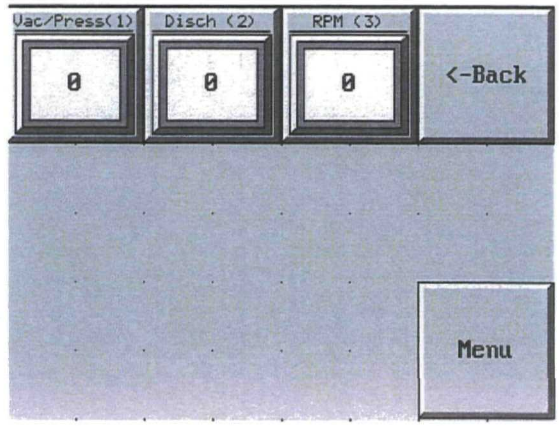
Rate Time(D) – The amount of time after an input that a change in output will occur.

Error Deadband – The range an input can change before there is an ouput.

Min. Output – The minimum output the PLC will output at one time.

Max. Output – The maximum output the PLC will output at one time.





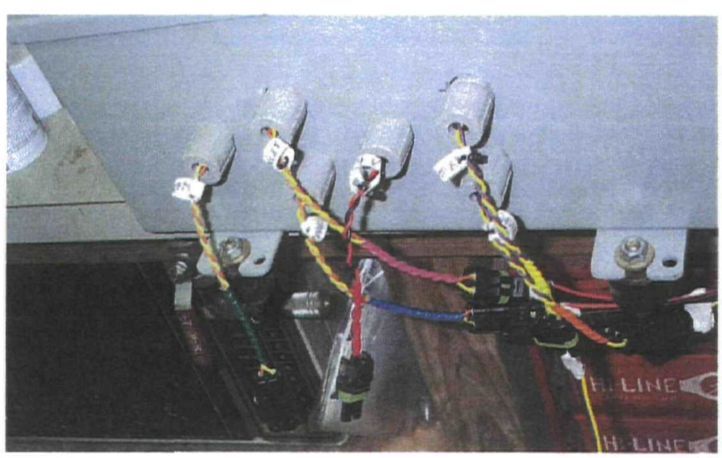
PLC DIAGNOSTIC SCREENS

The diagnostic screens are display only screens that are accessed from both menus screen by touching "PLC Diag". on that screen. The diagnostic screens can be toggled between each other by touching the labels "Next" And "Back". These screens are used by DSC to trouble shoot the automatic systems.

MESSAGE DATABASE

1. Loop Off
2. Inlet Loop Selected
3. Inlet Loop Active
4. Inlet Loop Stopping
5. RPM Loop Selected
6. RPM Loop Active
7. RPM Loop Stopping

These messages are displayed on the Main screens for both the booster and the dredge.

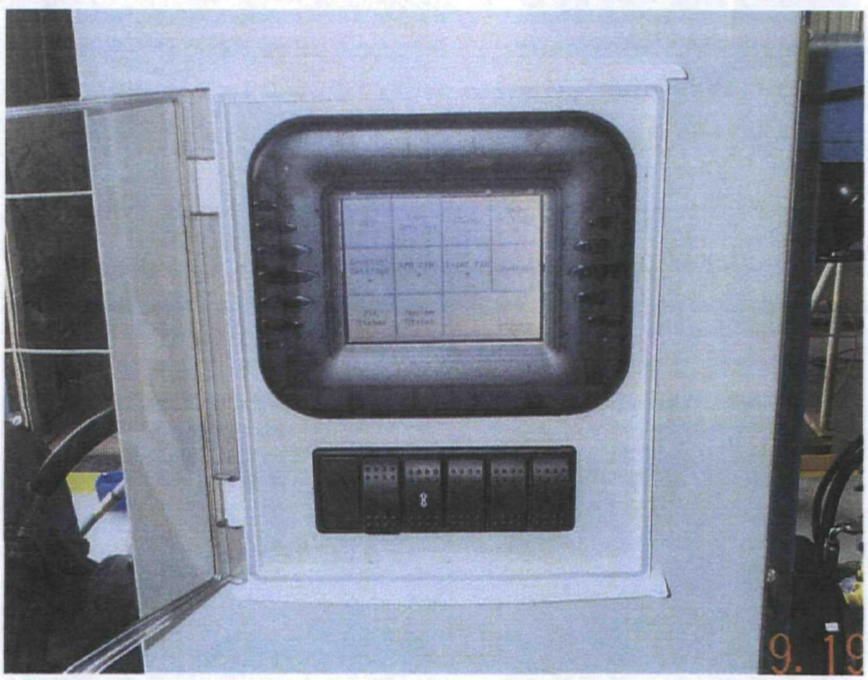


BOOSTER PANEL WIRE CONNECTIONS

TYPICAL TRANSMITTER MOUNTINGS

The transmitter for the engine RPM is part of the engine's instrumentation. The other transmitters, suction side vacuum or pressure and discharge pressure, are mounted on the inlet pipe and discharge pipe. They must be mounted on a manifold mounted on the pipes to avoid premature destruction. (See pictures)

TYPICAL DISCHARGE & SUCTION TRANSMITTER MANIFOLDS



BOOSTER OPERATION PANEL

ALARMS

1. CPU Critical Error
2. CPU Warning
3. CPU Diagnostic Error
4. CPU Program Memory Error
5. CPU I/O Error
6. CPU Comm Error
7. CPU Fault Instruction
8. CPU Watchdog Timeout
9. CPU Grammatical Error
10. CPU Solve Error
11. CPU Read Write Error
12. CPU Table Overrun

Errors one through twelve are CPU errors call DSC for instructions to clear the error

---

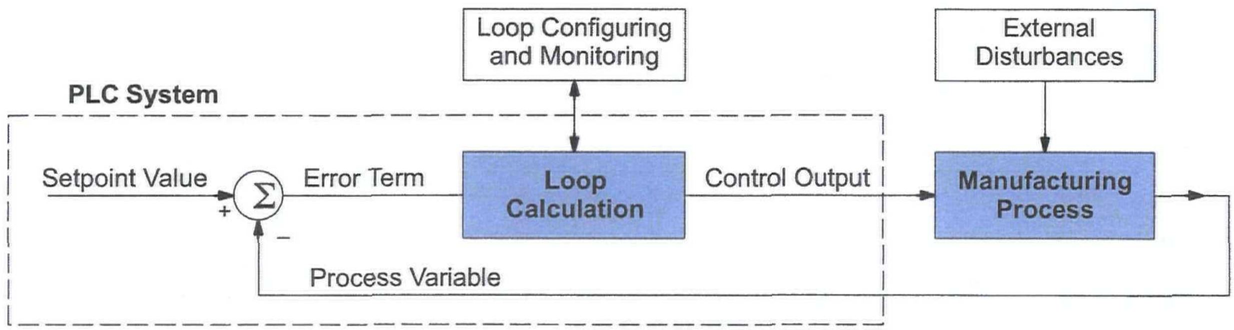
13. Inlet Pressure Malfunction
14. Discharge Pressure Malfunction
15. Engine RPM Malfunction

Errors thirteen through fifteen indicate a problem with the transmitters for the function described. Check, the transmitters and the wiring to them and correct any deficiency found.

ENGINE ACTUATOR

Getting Acquainted with PID Loops

As an introduction to key parts of a control loop, refer to the block diagram shown below. The closed path around the diagram is the "loop" referred to in "closed loop control".



Manufacturing Process – the set of actions that adds value to raw materials. The process can involve physical changes and/or chemical changes to the material. The changes render the material more useful for a particular purpose, ultimately used in a final product.

Process Variable – a measurement of some physical property of the raw materials. Measurements are made using some type of sensor. For example, if the manufacturing process uses an oven, we will have a strong interest in controlling temperature. Therefore, temperature is a process variable.

Setpoint Value – the theoretically perfect quantity of the process variable, or the desired amount which yields the best product. The machine operator knows this value, and either sets it manually or programs it into the PLC for later automated use.

External Disturbances – the unpredictable sources of error which the control system attempts to cancel by offsetting their effects. For example, if the fuel input is constant an oven will run hotter during warm weather than it does during cold weather. An oven control system must counter-act this effect to maintain a constant oven temperature during any season. Thus, the weather (which is not very predictable), is one source of disturbance to this process.

Error Term – the algebraic difference between the process variable and the setpoint. This is the control loop error, and is equal to zero when the process variable is equal to the setpoint (desired) value. A well-behaved control loop is able to maintain a small error term magnitude.

Loop Calculation – the real-time application of a mathematical algorithm to the error term, generating a control output command appropriate for minimizing the error magnitude. Various control algorithms are available, and the DL250 uses the Proportional-Derivative-Integral (PID) algorithm (more on this later).

Control Output – the result of the loop calculation, which becomes a command for the process (such as the heater level in an oven).

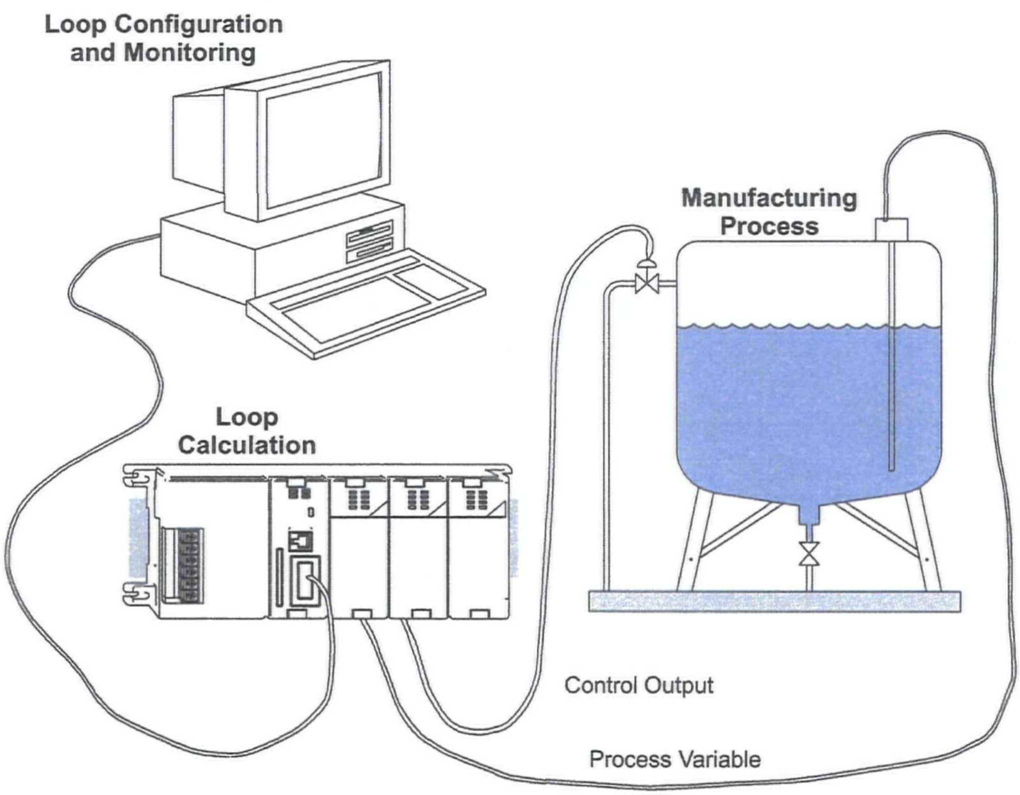
Loop Configuring – operator-initiated selections which set up and optimize the performance of a control loop. The loop calculation function uses the configuration parameters in real time to adjust gains, offsets, etc.

Loop Monitoring – the function which allows an operator to observe the status and performance of a control loop. This is used in conjunction with the loop configuring to optimize the performance of a loop (minimize the error term).

While developing an understanding of process control loops, it is important to associate each loop element with its real-world physical component. Refer to the following figure. The example manufacturing process involves some amount of liquid in a reactor vessel. A sensor probe measures a process variable which may be pressure, temperature, or another parameter. The sensor signal is amplified through a transducer, and is sent through the wire in analog form to the PLC input module.

The PLC reads the PV from an analog input. The CPU executes the loop calculation, and writes to the analog output module location.

The control output signal may be analog (proportional) or digital (on/off), depending on loop setup. This signal goes to a device in the manufacturing process which amplifies it in order to effect a physical or chemical change on the liquid in the reactor. The amplifier may drive a heater, valve, pump, etc. Over time, the liquid begins to change enough to be measured on the sensor probe. The process variable changes accordingly. The next loop calculation occurs, and the loop cycle repeats in this manner continuously.



The personal computer shown is to run ***Direct*SOFT**, the PLC programming software for ***Direct*LOGIC** programmable controllers. ***Direct*SOFT** Release 2.1 or later can program the DL250 CPU. The software features a forms-based editor to configure loop parameters. Most importantly, it features a PID loop trending screen which will be invaluable during the loop tuning process. Details on how to use that software are in the ***Direct*SOFT** Manual.

Ten Steps to Successful Process Control

Modern electronic controllers such as the DL250 CPU provide sophisticated process control features. Automated control systems can be very difficult to debug, because a given symptom can have many possible causes. We recommend a careful, step-by-step approach to bringing new control loops online:

**Step 1:
Know the Recipe**

The most important knowledge is – how to make your product. This knowledge is the foundation for designing an effective control system. A good process "recipe" will do the following:

- Identify all relevant Process Variables, such as temperature, pressure, or flow rates, etc. which need precise control.
- Plot the desired Setpoint values for each process variables for the duration of one process cycle.

**Step 2:
Plan Loop
Control Strategy**

This simply means choosing the method the machine will use to maintain control over the Process Variable(s) to follow their Setpoints. This involves many issues and trade-offs, such as energy efficiency, equipment costs, ability to service the machine during production, and more. You must also determine how to generate the Setpoint value during the process, and whether a machine operator can change the SP.

**Step 3:
Size and Scale
Loop Components**

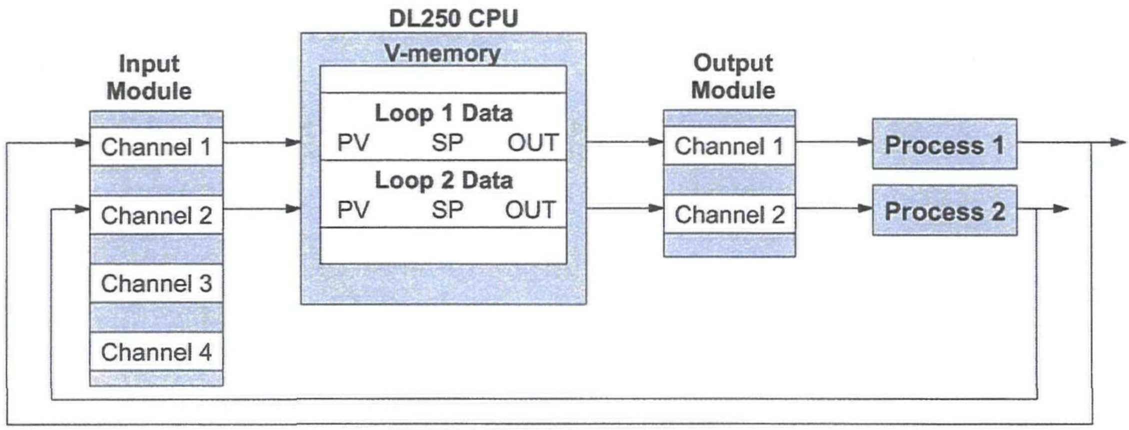
Assuming the control strategy is sound, it is still crucial to *properly size the actuators and properly scale the sensors.*

- Choose an actuator (heater, pump. etc.) which matches the size of the load. An oversized actuator will have an overwhelming effect on your process after a SP change. However, an undersized actuator will allow the PV to lag or drift away from the SP after a SP change or process disturbance.
- Choose a PV sensor which matches the range of interest (and control) for our process. Decide the resolution of control you need for the PV (such as within 2 deg. C), and make sure the sensor input value provides the loop with at least 5 times that resolution (at LSB level). However, an over-sensitive sensor can cause control oscillations, etc. The DL250 provides 12-bit and 15-bit, unipolar and bipolar data format options. This selection affects SP, PV, Control Output, and Integrator sum.

**Step 4:
Select I/O Modules**

After deciding the number of loops, PV variables to measure, and SP values, we can choose the appropriate I/O modules. Refer to the figure on the next page. In many cases, you will be able to share input or output modules among several control loops. The example shown sends the PV and Control Output signals for two loops through the same set of modules.

Remember that PLC***Direct*** offers DL205 analog modules with 2, 4, and 8 channels per module in different signal types and ranges. Refer to the sales catalog for further information on specific modules. The analog modules have their own manual, which will be essential during most installations.



Step 5: Wiring and Installation

After selection and procurement of all loop components and I/O modules, we can perform the wiring and installation. Refer to the wiring guidelines in Chapter 2 of this Manual, and to the DL205 Analog I/O Module manual as needed. The most commonly overlooked wiring details in installing PID loop controls are:

- It's easy to reverse the polarity of connection on sensor wiring.
- Pay attention to signal ground connections between loop components.

Step 6: Loop Parameters

After wiring and installation, we can choose the loop setup parameters. The easiest method for programming the loop tables is ***Direct*SOFT** (2.1 or later), using the PID Setup dialog boxes. Be sure to study the meaning of all loop parameters in this chapter before choosing values to enter.

Step 7: Check Open Loop Performance

With the sensors and actuator wiring done, and loop parameters entered, we must manually and carefully check out the new control system (use Manual Mode).

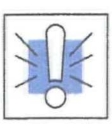
- Verify the PV value from the sensor is correct.
- If it is safe to do so, gradually increase the control output up above 0%, and see if the PV responds (*and moves in the correct direction!*).

Step 8: Loop Tuning

If the open loop test shows the PV reading is good and the control output has the proper effect on the process, we can do the closed loop tuning procedure (Automatic Mode). In this most crucial step, we tune the loop so the PV automatically follows the SP. Refer to the section on Loop Tuning in this chapter.

Step 9: Run Process Cycle

If the closed loop test shows PV will follow small changes in the SP, we can consider running an actual process cycle. Now we must do the programming to generate the desired SP in real time. In this step, you may run a small test batch of product through the machine, while the SP changes according to the recipe.



WARNING: Be sure the Emergency Stop and power-down provision is readily accessible, in case the process goes out of control. Damage to equipment and/or serious injury to personnel can result from loss of control of some processes.

Step 10: Save Loop Parameters

When the loop tests and tuning sessions are complete, be sure to save all loop setup parameters to disk. Loop parameters represent a lot of work in loop tuning, and are well worth saving.

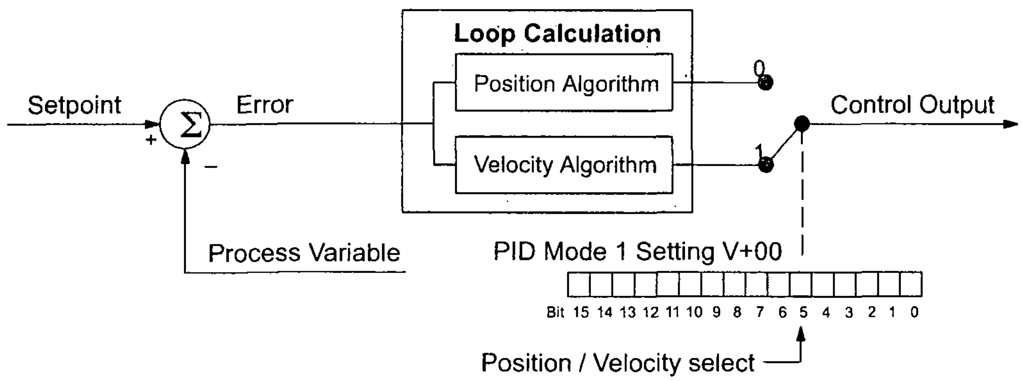
PID Algorithms

The Proportional–Integral–Derivative (PID) algorithm is widely used in process control. The PID method of control adapts well to electronic solutions, whether implemented in analog or digital (CPU) components. The DL250 CPU implements the PID equations digitally by solving the basic equations in software. I/O modules serve only to convert electronic signals into digital form (or vise-versa).

The DL250 features two types of PID controls: “position” and “velocity”. These terms usually refer to motion control situations, but here we use them in a different sense:

- PID *Position* Algorithm – The control output is calculated so it responds to the displacement (position) of the PV from the SP (error term).
- PID *Velocity* Algorithm – The control output is calculated to represent the rate of change (velocity) for the PV to become equal to the SP.

The vast majority of applications will use the position form of the PID equation. If you are not sure of which algorithm to use, try the Position Algorithm first. Use ***Direct***SOFT’s PID View Setup dialog box to select the desired algorithm. Or, use bit 5 of PID Mode 1 Setting V+00 word as shown below to select the desired algorithm.



NOTE: The selection of a PID algorithm is very fundamental to control loop operation, and is normally never changed after the initial configuration of a loop.

Position Algorithm The Position Algorithm causes the PID equation to calculate the Control Output M_n:

$$M_n = K_c * e_n + K_i * \sum_{i=1}^{n} e_i + K_r * (e_n - e_{n-1}) + M_o$$

In the formula above, the sum of the integral terms and the initial output are combined into the “Bias” term, Mx. Using the bias term, we define formulas for the Bias and Control Output as a function of sampling time:

$$Mx_o = M_o$$

$$Mx_n = K_i * e_n + Mx_{n-1}$$

$$M_n = K_i * \sum_{i=1}^{n} e_i + M_o$$

$M_n = K_c * e_n + K_r * (e_n - e_{n-1}) + Mx_n$.....Output for sampling time “n”

The position algorithm variables and related variables are:

T_s = Sample rate
K_c = Proportional gain
$K_i = K_c * (T_s/T_i)$ coefficient of integral term
$K_r = K_c * (T_d/T_s)$ coefficient of derivative term
T_i = Reset time (integral time)
T_d = Rate time (derivative time)
SP_n = Set Point for sampling time "n" (SP value)
PV_n = Process variable for sampling time "n" (PV)
$e_n = SP_n - PV_n$ = Error term for sampling time "n"
M_0 = Control Output for sampling time "0"
M_n = Control Output for sampling time "n"

Analysis of these equations will be found in most good text books on process control. At a glance, we can isolate the parts of the PID Position Algorithm which correspond to the P, I, and D terms, and the Bias as shown below.

$$\underbrace{M_n}_{\text{Control Output}} = \underbrace{K_c * e_n}_{\text{Proportional Term}} + \underbrace{K_i * \sum_{i=1}^{n} e_i}_{\text{Integral Term}} + \underbrace{K_r * (e_n - e_{n-1})}_{\text{Derivative Term}} + \underbrace{M_0}_{\text{Initial Output}}$$

Bias Term

The initial output is the output value assumed from Manual mode control when the loop transitioned to Auto Mode. The sum of the initial output and the integral term is the bias term, which holds the "position" of the output. Accordingly, the Velocity Algorithm discussed next does not have a bias component.

The resulting equations for the Velocity Algorithm form of the PID equation are:

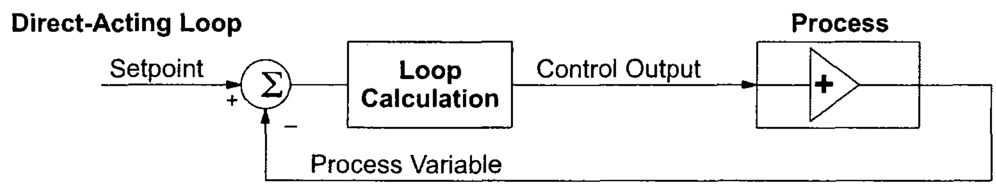
$$\Delta M_n = M_n - M_{n-1}$$

$$\Delta M_n = K_c * (e_n - e_{n-1}) + K_i * e_n + K_r * (e_n - 2*e_{n-1} + e_{n-2})$$

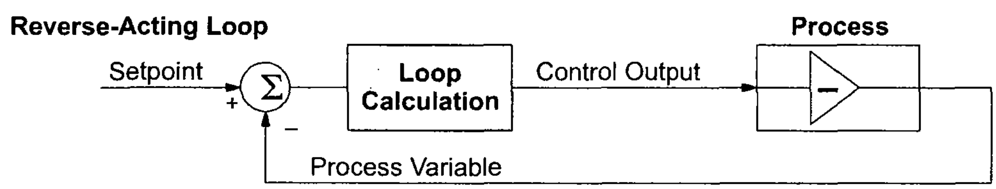
Direct-Acting and Reverse-Acting Loops

The gain of a process determines, in part, how it must be controlled. The process shown in the diagram below has a positive gain, which we call "direct-acting". This means that when the control output increases, the process variable also eventually increases. Of course, a true process is usually a complex transfer function that includes time delays. Here, we are only interested in the direction of change of the process variable in response to a control output change.

Most process loops will be direct-acting, such as a temperature loop. An increase in the heat applied increases the PV (temperature). Accordingly, direct-acting loops are sometimes called *heating loops.*



A "reverse-acting" loop is one in which the process has a negative gain, as shown below. An increase in the control output results in a decrease in the PV. This is commonly found in refrigeration controls, where an increase in the cooling input causes a decrease in the PV (temperature). Accordingly, reverse-acting loops are sometimes called *cooling loops.*

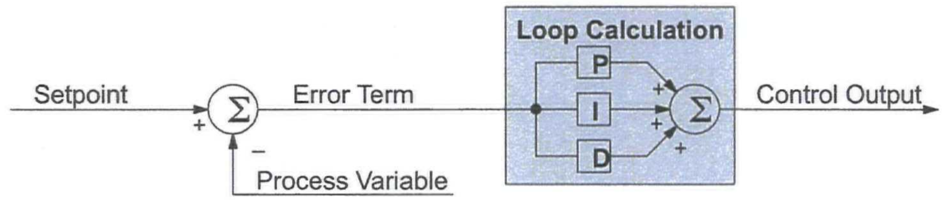


It is crucial to know whether a particular loop is direct or reverse-acting! Unless you are controlling temperature, there is no obvious answer. In a flow control loop, a valve positioning circuit can be configured and wired reverse-acting as easily as direct-acting. One easy way to find out is to run the loop in Manual Mode, where you must manually generate control output values. Observe whether the PV goes up or down in response to a step increase in the control output.

To run a loop in Auto or Cascade Mode, the control output must be correctly programmed (refer to the previous section on Control Output Configuration). Use "normal output" for direct-acting loops, and "inverted output" for reverse-acting loops. To compensate for a reverse-acting loop, the PID controller must know to invert the control output. If you have a choice, configure and wire the loop to be direct-acting. This will make it easier to view and interpret loop data during the loop tuning process.

P-I-D Loop Terms

You may recall the introduction of the position and velocity forms of the PID loop equations. The equations basically show the three components of the PID calculation. The following figure shows a schematic form of the PID calculation, in which the control output is the sum of the proportional, integral and derivative terms. On each calculation of the loop, each term receives the same error signal value.

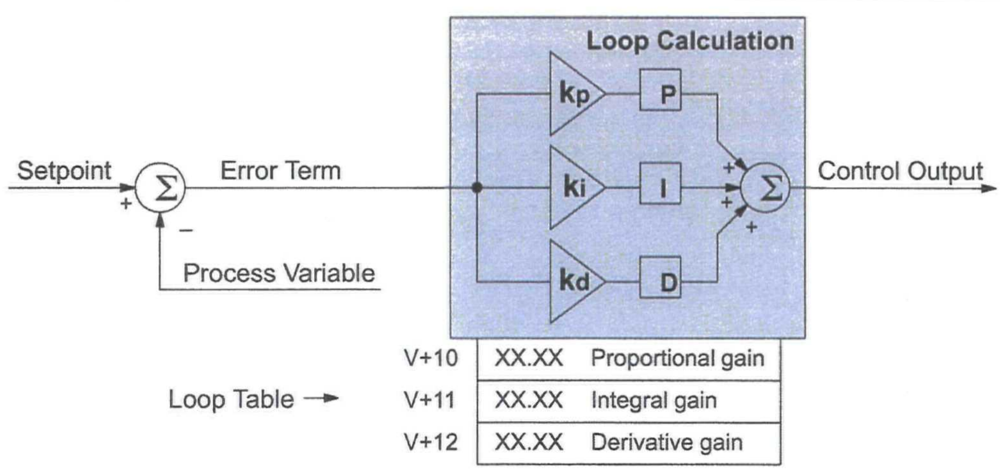


The role of the P, I, and D terms in the control task are as follows:

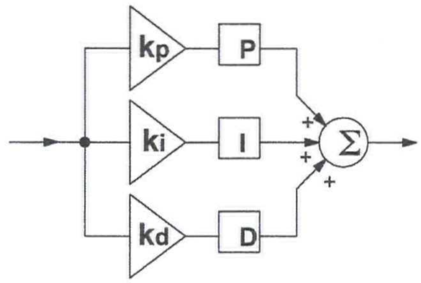
- **Proportional** – the proportional term simply responds proportionally to the current size of the error. This loop controller calculates a proportional term value for each PID calculation. When the error is zero, the proportional term is also zero.
- **Integral** – the integrator (or reset) term integrates (sums) the error values. Starting from the first PID calculation after entering Auto Mode, the integrator keeps a running total of the error values. For the position form of the PID equation, when the loop reaches equilibrium and there is no error, the running total represents the constant output required to hold the current position of the PV.
- **Derivative** – the derivative (or rate) term responds to change in the current error value from the error used in the previous PID calculation. Its job is to anticipate the probable growth of the error and generate a contribution to the output in advance.

The P, I, and D terms work together as a team. To do that effectively, they will need some additional instructions from us. The figure below shows the P, I, and D terms contain programmable **gain** values k_p, k_i, and k_d respectively. The values reside in the loop table in the locations shown. The goal of the loop tuning process (covered later) is to derive gain values that result in good overall loop performance.

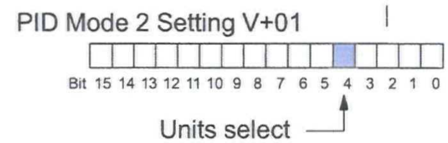
NOTE: The proportional gain is also simply called "gain", in PID loop terminology.



The P, I and D gains are 4-digit BCD numbers with values from 0000 to 9999. They contain an implied decimal point in the middle, so the values are actually 00.00 to 99.99. Some gain values have units – Integral gain may be in units of seconds or minutes, by programming the bit shown. Derivative gain is in seconds.



V+10	XX.XX P gain	–
V+11	XX.XX I gain	0=sec, 1=min.
V+12	XX.XX D gain	sec.



In *Direct*SOFT's trend view, you can program the gains values and units in real time while the loop is running. This is typically done only during the loop tuning process.

Proportional Gain – This is the most basic gain of the three. Values range from 0000 to 9999, but they are used internally as xx.xx. An entry of "0000" effectively removes the proportional term from the PID equation. This accommodates applications which need integral-only loops.

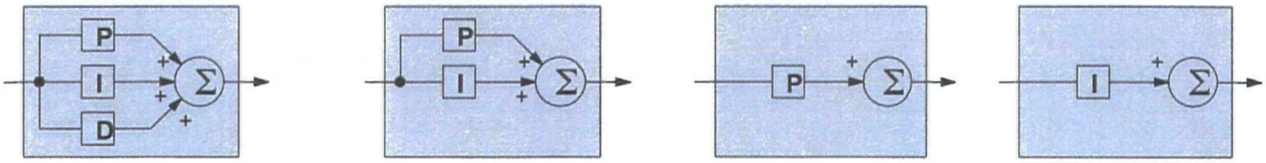
Integral Gain – Values range from 0001 to 9998, but they are used internally as xx.xx. An entry of "0000" or "9999"causes the integral gain to be "∞", effectively removing the integrator term from the PID equation. This accommodates applications which need proportional-only loops. The units of integral gain may be either seconds or minutes, as shown above.

Derivative Gain – Values range from 0001 to 9999, but they are used internally as xx.xx. An entry of "0000" allows removal of the derivative term from the PID equation (a common practice). This accommodates applications which need proportional and/or integral-only loops. The derivative term has an optional gain limiting feature, discussed in the next section.

NOTE: It is very important to know how to increase and decrease the gains. The proportional and derivative gains are as one might expect... smaller numbers produce less gains and larger numbers produce more gain. However, the integral term has a reciprocal gain(1/Ts), so smaller numbers produce more gain and larger numbers produce less gain. *This is very important to know during loop tuning.*

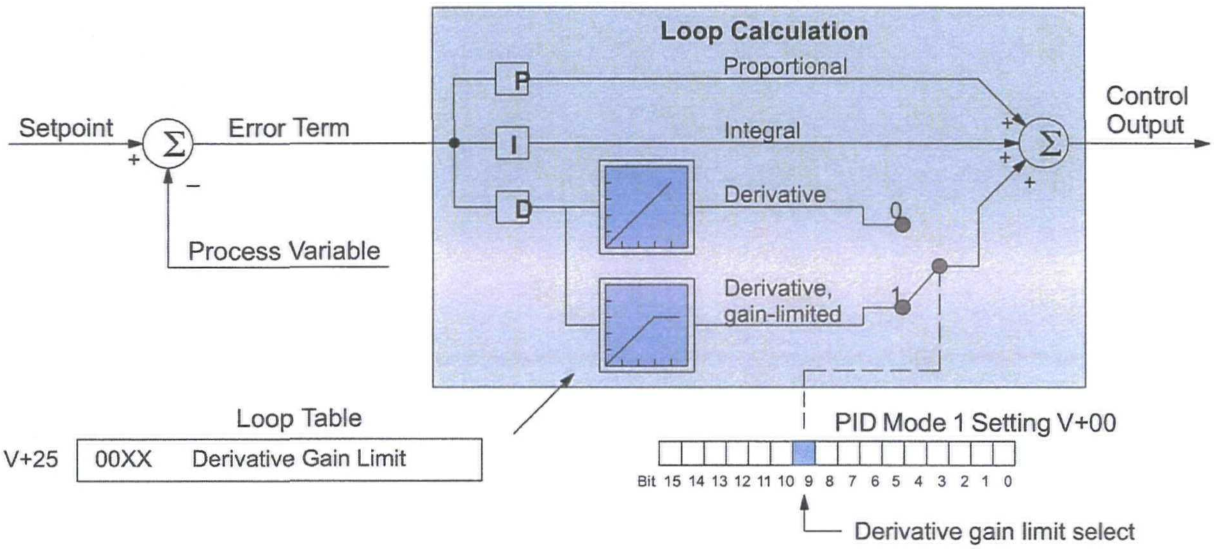
Using a Subset of PID Control

Each of the P, I, and D gains allows a setting to eliminate that term from the PID equation. Many applications actually work best by using a subset of PID control. The figure below shows the various combinations of PID control offered on the DL250. We do not recommend using any other combination of control, because most of them are inherently unstable.



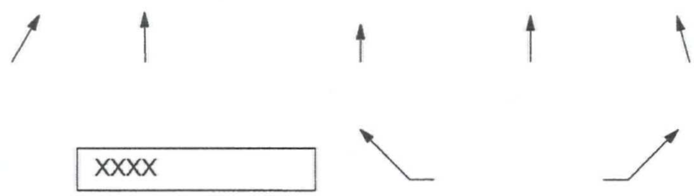
Derivative Gain Limiting

The derivative term is unique in that it has an optional gain-limiting feature. This is provided because the derivative term reacts badly to PV signal noise or other causes of sudden PV fluctuations. The function of the gain-limiting is shown in the diagram below. Use bit 9 of PID Mode 1 Setting V+00 word to enable the gain limit.



The derivative gain limit in location V+25 must have a value between 0 and 20, in BCD format. This setting is operational only when the enable bit = 1.

The gain limit can be particularly useful during loop tuning. Most loops can tolerate only a little derivative gain without going into wild oscillations.



Loop Tuning Procedure

This is perhaps the most important step in closed-loop process control. The goal of a loop tuning procedure is to adjust the loop gains so the loop has optimal performance in dynamic conditions. The quality of a loop's performance may generally be judged by how well the PV follows the SP after a SP step change.

Auto Tuning versus Manual Tuning – you may change the PID gain values directly (manual tuning), or you can have the PID processing engine in the CPU automatically calculate the gains (auto tuning). Most experienced process engineers will have a favorite method, and the DL250 will accommodate either preference. The use of the auto tuning can eliminate much of the trial-and-error of the manual tuning approach, especially if you do not have a lot of loop tuning experience. However, note that performing the auto tuning procedure will get the gains *close* to optimal values, but additional manual tuning changes can take the gain values to their optimal values.

WARNING: Only authorized personnel fully familiar with all aspects of the process should make changes that affect the loop tuning constants. Using the loop auto tune procedures will affect the process, including inducing large changes in the control output value. Make sure you thoroughly consider the impact of any changes to minimize the risk of injury to personnel or damage to equipment. The auto tune in the DL250 is not intended to perform as a replacement for your process knowledge.

Open-Loop Test

Whether you use manual or auto tuning, it is very important to verify basic characteristics of a newly-installed process before attempting to tune it. With the loop in Manual Mode, verify the following items for each new loop.

- **Setpoint** – verify the source which is to generate the setpoint can do so. You can put the PLC in Run Mode, but leave the loop in Manual Mode. Then monitor the loop table location V+02 to see the SP value(s). The ramp/soak generator (if you are using it) should be tested now.
- **Process Variable** – verify the PV value is an accurate measurement, and the PV data arriving in the loop table location V+03 is correct. If the PV signal is very noisy, consider filtering the input either through hardware (RC low-pass filter), or using a digital S/W filter.
- **Control Output** – if it is safe to do so, manually change the output a small amount (perhaps 10%) and observe its affect on the process variable. Verify the process is direct-acting or reverse acting, and check the setting for the control output (inverted or non-inverted). Make sure the control output upper and lower limits are not equal to each other.
- **Sample Rate** – while operating open-loop, this is a good time to find the ideal sample rate (procedure give earlier in this chapter). However, if you are going to use auto tuning, note the auto tuning procedure will automatically calculate the sample rate in addition to the PID gains.

The discussion beginning on the following page covers the manual tuning procedure. If want to perform only auto tuning, please skip the next section and proceed directly to the section on auto tuning.

Manual Tuning Procedure

Now comes the exciting moment when we actually close the loop (go to Auto Mode) for the first time. Use the following checklist **before** switching to Auto mode:

- Monitor the loop parameters with a loop trending instrument. We recommend using the PID view feature of ***Direct***SOFT.

NOTE: We recommend using the PID trend view setup menu to select the vertical scale feature to *manual,* for both SP/PV area and Bias/Control Output areas. The auto scaling feature will otherwise change the vertical scale on the process parameters and add confusion to the loop tuning process.

- Adjust the gains so the Proportional Gain = 10, Integrator Gain = 9999, and Derivative Gain =0000. This disables the integrator and derivative terms, and provides a little proportional gain.
- Check the bias term value in the loop parameter table (V+04). If it is not zero, then write it to zero using ***Direct***SOFT or HPP, etc.

Now we can transition the loop to Auto Mode. Check the mode monitoring bits to verify its true mode. If the loop will not stay in Auto Mode, check the troubleshooting tips at the end of this chapter.

CAUTION: If the PV and Control Output values begin to oscillate, reduce the gain values immediately. If the loop does not stabilize immediately, then transfer the loop back to Manual Mode and manually write a safe value to the control output. **During the loop tuning procedure, always be near the Emergency Stop switch which controls power to the loop actuator in case a shutdown is necessary.**

- At this point, the SP should = PV because of the bumpless transfer feature. Increase the SP a little, in order to develop an error value. With only the proportional gain active and the bias term=0, we can easily check the control output value:

$$\text{Control Output} = (\text{SP} - \text{PV}) \times \text{proportional gain}$$

- If the control output value changed, the loop should be getting more energy from the actuator, heater, or other device. Soon the PV should move in the direction of the SP. If the PV does not change, then increase the proportional gain until it moves slightly.
- Now, add a small amount of integral gain. **Remember that large numbers are small integrator gains and small numbers are large integrator gains!** After this step, the PV should = SP, or be very close.

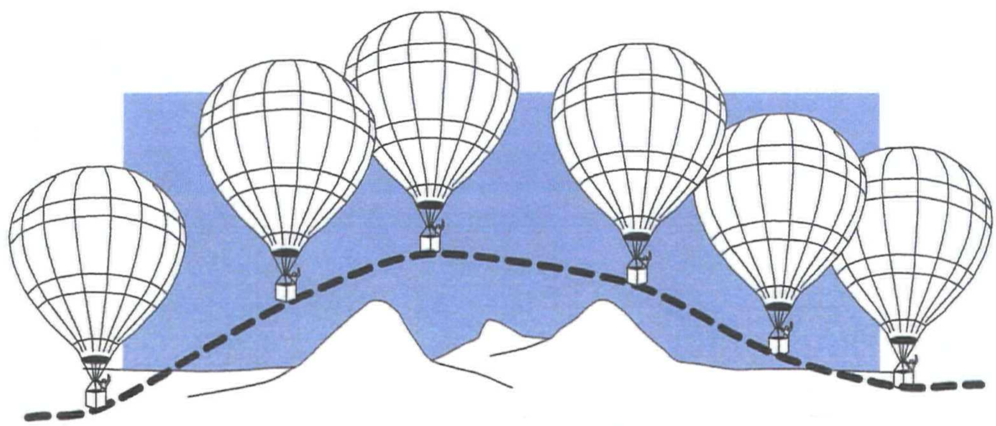
Until this point we have only used proportional and integrator gains. Now we can "bump the process" (change the SP by 10%), and adjust the gains so the PV has an optimal response. Refer to the figure below. Adjust the gains according to what you see on the PID trend view. The critically- damped response shown gives the fastest PV response without oscillating.

Time-Proportioning Control

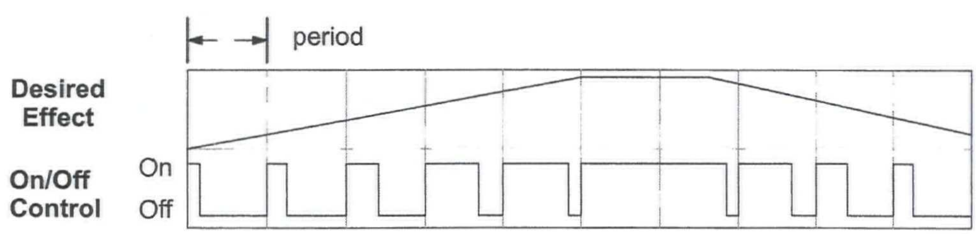
The PID loop controller in the DL250 CPU generates a smooth control output signal across a numerical range. The control output value is suitable to drive an analog output module, which connects to the process. In the process control field, this is called *continuous control*, because the output is on (at some level) continuously.

While continuous control can be smooth and robust, the cost of the loop components (such as actuators, heater amplifiers) can be expensive. A simpler form of control is called *time-proportioning control*. This method uses actuators which are either on or off (no in-between). Loop components for on/off-based control systems are lower cost than their continuous control counterparts.

In this section, we will show you how to convert the control output of a loop to time-proportioning control for the applications that need it. Let's take a moment to review how alternately turning a load on and off can control a process. The diagram below shows a hot-air balloon following a path across some mountains. The desired path is the *setpoint*. The balloon pilot turns the burner on and off alternately, which is his *control output*. The large mass of air in the balloon effectively averages the effect of the burner, converting the bursts of heat into a continuous effect: slowly changing balloon temperature and ultimately the altitude, which is the *process variable*.



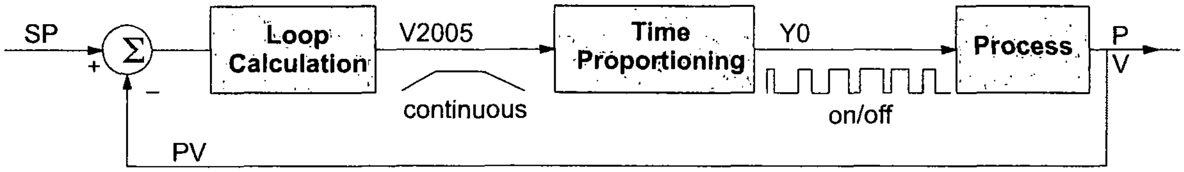
Time-proportioning control approximates continuous control by virtue of its duty-cycle – the ratio of ON time to OFF time. The following figure shows an example of how duty cycle approximates a continuous level when it is averaged by a large process mass.



If we were to plot the on/off times of the burner in the hot-air balloon, we would probably see a very similar relationship to its effect on balloon temperature and altitude.

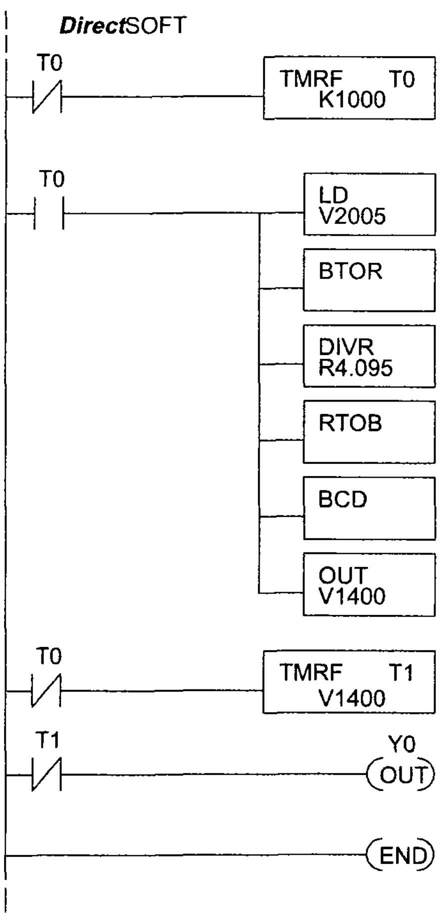
On/Off Control Program Example

The following ladder example program does the time proportioning function as shown below. It converts the continuous output in V2005 to on/off control on Y0.



The example program uses two timers to generate On/Off control. It makes the following assumptions, which you can adapt to your application:

- The loop table starts at V2000, so the control output is at V2005.
- The data format of the control output is 12-bit, unipolar (0 – FFF).
- The time base (one cycle time) for the On/Off waveform is 10 seconds. This number should be approximately equal to the loop's sample rate. We use a fast timer (0.01 sec/tick), counting to 10.00. This gives the on/off output a resolution of 1 part in 1000. If your loop sample rate is much faster than this, you will have proportionately less resolution on the control output (and probably need to use continuous control).
- The On/Off control output is Y0. The duty cycle of the waveform on Y0 matches the value of the control output at V2005, with a period of 10 seconds.



Use a fast timer (0.01 sec. resolution) for the main time base. The K1000 provides a preset of 10 seconds. The Not T0 contact makes this self-resetting. T0 is true for one scan each 10 seconds.

At the beginning of the 10 second period, T0 is true. Load the binary control output value from loop table V+05 location, V2005.

Change this value to a real number, because we need to do some scaling.

Divide the control output by 4.095. This converts our 0 – 4095 range to 0 – 1000, in order to match our timer range for 10 seconds.

Convert the real number back to binary. We insert this step, because there is no real-to-BCD instruction.

Convert the number in the accumulator to BCD format, to satisfy the timer preset format required.

Output our result to V1400. This is our arbitrary location of the timer preset for the second timer.

The second fast timer also counts from 0 to 1000, in 10 seconds. However, its output, T1, goes from on to off when the preset is reached.

We invert the timer output, so the On/Off control output is On at the beginning of the 10-second timebase. Y0 goes to the actuator, heater, etc. for the loop.

END coil marks the end of the main program.

Troubleshooting Tips

Q. The loop will not go into Automatic Mode.

A. Check the following for possible causes:

- A PV alarm exists, or a PV alarm programming error exists.
- The loop is the major loop of a cascaded pair, and the minor loop is not in Cascade Mode.

Q. The Control Output stays at zero constantly when the loop is in Automatic Mode.

A. Check the following for possible causes:

- The Control Output upper limit in loop table location V+31 is zero.
- The loop is driven into saturation, because the error never goes to zero value and changes (algebraic) sign.

Q. The Control Output value is not zero, but it is incorrect.

A. Check the following for possible causes:

- The gain values are entered improperly. Remember, gains are entered in the loop table in BCD, while the SP and PV are in binary. If you are using ***Direct***SOFT, it displays the SP, PV, Bias and Control output in decimal (BCD), converting it to binary before updating the loop table.

Q. The Ramp/Soak Generator does not operate when I activate the Start bit.

A. Check the following for possible causes:

- The Ramp/Soak enable bit is off. Check the status of bit 11 of loop parameter table location V+00. It must be set =1.
- The hold bit or other bits in the Ramp/Soak control are on.
- The beginning SP value and the first ramp ending SP value are the same, so first ramp segment has no slope and consequently has no duration. The ramp/soak generator moves quickly to the soak segment, giving the illusion the first ramp is not working.
- The loop is in Cascade Mode, and is trying to get the SP remotely.
- The SP upper limit value in the loop table location V+27 is too low.
- Check your ladder program to verify it is not writing to the SP location (V+02 in the loop table). A quick way to do this is to temporarily place an end coil at the beginning of your program, then go to PLC Run Mode, and manually start the ramp/soak generator.

Q. The PV value in the table is constant, even though the analog module receives the PV signal.

A. Your ladder program must read the analog value from the module successfully and write it into the loop table V+03 location. Verify the analog module is generating the value, and the ladder is working.

Q. The Derivative gain doesn't seem to have any affect on the output.

A. The derivative limit is probably enabled (see section on derivative gain limiting).

Q. The loop Setpoint appears to be changing by itself.

A. Check the following for possible causes:

- The Ramp/Soak generator is enabled, and is generating setpoints.
- If this symptom occurs on loop Manual-to-Auto Mode changes, the loop automatically sets the SP=PV (bumpless transfer feature).
- Check your ladder program to verify it is not writing to the SP location (V+02 in the loop table). A quick way to do this is to temporarily place an end coil at the beginning of your program, then go to PLC Run Mode.

Q. The SP and PV values I enter with *Direct*SOFT work okay, but these values do not work properly when the ladder program writes the data.

A. The PID View in ***Direct*SOFT** lets you enter SP, PV, and Bias values in decimal, and displays them in decimal for your convenience. For example, when the data format is 12 bit unipolar, the values range from 0 to 4095. However, the loop table actually requires these in hex, so ***Direct*SOFT** converts them for you. The values in the table range from 0 to FFF, for 12-bit unipolar format.

Q. The loop seems unstable and impossible to tune, no matter what I gains I use.

A. Check the following for possible causes:

- The loop sample time is set too long. Refer to the section near the front of this chapter on selecting the loop update time.
- The gains are too high. Start out by reducing the derivative gain to zero. Then reduce the integral gain, and the proportional gain if necessary.
- There is too much transfer lag in your process. This means the PV reacts sluggishly to control output changes. There may be too much "distance" between actuator and PV sensor, or the actuator may be weak in its ability to transfer energy into the process.
- There may be a process disturbance that is over-powering the loop. Make sure the PV is relatively steady when the SP is not changing.

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PID Controllers: Theory, Design, and Tuning, 2nd Edition Author: K. Astrom and T Hagglund Publisher: Instrument Society of America ISBN 1–55617–516–7	Fundamentals of Temperature, Pressure, and Flow Measurements, Third edition Author: Robert P. Benedict Publisher: John Wiley and Sons ISBN 0–471–89383–8
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Process Control, Third Edition Instrument Engineer's Handbook Author (Editor-in-Chief): Bela G. Liptak Publisher: Chilton ISBN 0–8019–8242–1	Process Measurement and Analysis, Third Edition Instrument Engineer's Handbook Author (Editor-in-Chief): Bela G. Liptak Publisher: Chilton ISBN 0–8019–8197–2

Glossary of PID Loop Terminology

Automatic Mode An operational mode of a loop, in which it makes PID calculations and updates the loop's control output.

Bias Freeze A method of preserving the bias value (operating point) for a control output, by inhibiting the integrator when the output goes out-of-range. The benefit is a faster loop recovery.

Bias Term In the position form of the PID equation, it is the sum of the integrator and the initial control output value.

Bumpless Transfer A method of changing the operation mode of a loop while avoiding the usual sudden change in control output level. This consequence is avoided by artificially making the SP and PV equal, or the bias term and control output equal at the moment of mode change.

Cascaded Loops A cascaded loop receives its setpoint from the output of another loop. Cascaded loops have a major/minor relationship, and work together to ultimately control one PV.

Cascade Mode An operational mode of a loop, in which it receives its SP from another loop's output.

Continuous Control Control of a process done by delivering a smooth (analog) signal as the control output.

Direct-Acting Loop A loop in which the PV increases in response to a control output increase. In other words, the process has a positive gain.

Error The difference in value between the SP and PV, Error=SP – PV

Error Deadband An optional feature which makes the loop insensitive to errors when they are small. You can specify the size of the deadband.

Error Squared An optional feature which multiplies the error by itself, but retains the original algebraic sign. It reduces the effect of small errors, while magnifying the effect of large errors.

Feedforward A method of optimizing the control response of a loop when a change in setpoint or disturbance offset is known and has a quantifiable effect on the bias term.

Control Output The numerical result of a PID equation which is sent by the loop with the intention of nulling out the current error.

Derivative Gain A constant that determines the magnitude of the PID derivative term in response to the current error.

Integral Gain A constant that determines the magnitude of the PID integral term in response to the current error.

Major Loop In cascade control, it is the loop that generates a setpoint for the cascaded loop.

Manual Mode An operational mode of a loop, it which the PID calculations are stopped. The operator must manually control the loop by writing to the control output value directly.

Minor Loop In cascade control, the minor loop is the subordinate loop that receives its SP from the major loop.

On / Off Control A simple method of controlling a process, through on/off application of energy into the system. The mass of the process averages the on/off effect for a relatively smooth PV. A simple ladder program can convert the DL250's continuous loop output to on/off control.

PID Loop A mathematical method of closed-loop control involving the sum of three terms based on proportional, integral, and derivative error values. The three terms have independent gain constants, allowing one to optimize (tune) the loop for a particular physical system.

Position Algorithm The control output is calculated so it responds to the displacement (position) of the PV from the SP (error term)

Process A manufacturing procedure which adds value to raw materials. Process control particularly refers to inducing *chemical* changes to the material in process.

Process Variable (PV) A quantitative measurement of a physical property of the material in process, which affects final product quality and is important to monitor and control.

Proportional Gain — A constant that determines the magnitude of the PID proportional term in response to the current error.

PV Absolute Alarm — A programmable alarm that compares the PV value to alarm threshold values.

PV Deviation Alarm — A programmable alarm that compares the difference between the SP and PV values to a deviation threshold value.

Ramp / Soak Profile — A set of SP values called a profile, which is generated in real time upon each loop calculation. The profile consists of a series of ramp and soak segment pairs, greatly simplifying the task of programming the PLC to generate such SP sequences.

Rate — Also called differentiator, the rate term responds to the *changes* in the error term.

Remote Setpoint — The location where a loop reads its setpoint when it is configured as the minor loop in a cascaded loop topology.

Reset — Also called integrator, the reset term adds each sampled error to the previous, maintaining a running total called the bias.

Reset Windup — A condition created when the loop is unable to find equilibrium, and the persistent error causes the integrator (reset) sum to grow excessively (windup). Reset windup causes an extra recovery delay when the original loop fault is remedied.

Reverse-Acting Loop — A loop in which the PV increases in response to a control output decrease. In other words, the process has a negative gain.

Sampling time — The time between PID calculations. The CPU method of process control is called a sampling controller, because it samples the SP and PV only periodically.

Setpoint (SP) — The desired value for the process variable. The setpoint (SP) is the input command to the loop controller during closed loop operation.

Soak Deviation — The soak deviation is a measure of the difference between the SP and PV during a soak segment of the Ramp / Soak profile, when the Ramp / Soak generator is active.

Step Response — The behavior of the process variable in response to a step change in the SP (in closed loop operation), or a step change in the control output (in open loop operation)

Transfer — To change from one loop operational mode to another (between Manual, Auto, or Cascade). The word "transfer" probably refers to the transfer of control of the control output or the SP, depending on the particular mode change.

Velocity Algorithm — The control output is calculated to represent the rate of change (velocity) for the PV to become equal to the SP.

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RED LION CONTROLS

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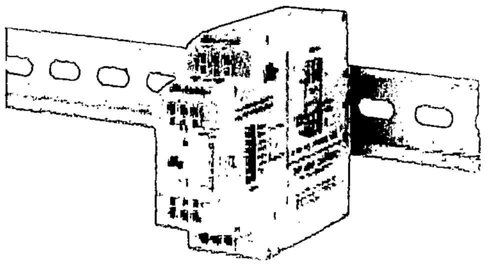
MODEL IFMA - DIN-RAIL FREQUENCY TO ANALOG CONVERTER



- *SIMPLE ON-LINE RANGE SETTING (Using Actual Input Signal or Signal Generator)*
- *USER SETTABLE FULL SCALE FREQUENCY FROM 1 Hz to 25 KHz*
- *FOUR OUTPUT OPERATING RANGES (0 to 5 V, 0 to 10 V, 0 to 20 mA, and 4 to 20 mA)*
- *PROGRAMMABLE INPUT CIRCUIT ACCEPTS OUTPUTS FROM A VARIETY OF SENSORS*
- *85 to 250 VAC and 9 to 32 VDC POWERED VERSIONS AVAILABLE*
- *LOW FREQUENCY CUT-OUT AND OVERRANGE INDICATION*
- *3-WAY ELECTRICAL ISOLATION (POWER/INPUT/OUTPUT)*
- *INPUT AND OUTPUT INDICATION LED's*

and **UL Recognized Component, File #E137808**

DESCRIPTION

The Model IFMA accepts a frequency input, and outputs an analog voltage or current in proportion to the input frequency, with 0.1% accuracy. The full scale input frequency can be set to any value from 1 Hz to 25 KHz, either with a frequency source, or digitally with the on-board rotary switch and push-button.

The IFMA utilizes a seven position DIP switch, a rotary switch, a push button and two indication LED's to accomplish input circuit configuration, operational parameter set-up, and Input/Output indication. The input circuitry is DIP switch selectable for a variety of sources.

The indication LED's are used during normal operation to display the input and output status of the IFMA. These LED's are also used to provide visual feedback to the user of the existing parameter settings during parameter set-up.

The IFMA operates in one of four output modes. The programmable minimum and maximum response times provide optimal response at any input frequency.

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including top hat profile rail according to EN 50 022 - 35 x7.5 and 35 x 15, and G profile rail according to EN 50 035 - G 32.

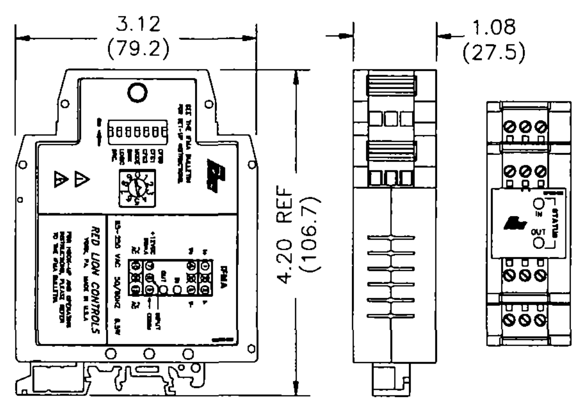
SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

SPECIFICATIONS

1. **POWER:**
   AC Operation: 85 to 250 VAC, 48 to 62 Hz; 6.5 VA
   DC Operation: 9 to 32 VDC; 2.5 W
   Power Up Current: Ip = 600 mA for 50 msec. max.
2. **SENSOR POWER**: (AC version only) +12 VDC ±25% @ 60 mA max.
3. **OPERATING FREQUENCY RANGE:**
   From 0 Hz to 25 KHz; user selectable.
4. **SIGNAL INPUT:** DIP switch selectable to accept signals from a variety of sources, including switch contacts, outputs from CMOS or TTL circuits, magnetic pickups, and all standard RLC sensors.
   Current Sourcing: Internal 1 KΩ pull-down resistor for sensors with current sourcing output. *(Max. sensor output current = 12 mA @ 12 V output.)*
   Current Sinking: Internal 3.9 KΩ pull-up resistor for sensors with current sinking output. *(Max. sensor current = 3 mA.)*
   Low Bias: Input trigger levels V_{IL} = 0.25 V, V_{IH} = 0.75 V; for increased sensitivity when used with magnetic pickups.
   Hi Bias: Input trigger levels V_{IL} = 2.5 V, V_{IH} = 3.0 V; for logic level signals.
   Max. Input Signal: ±90 V; 2.75 mA max. *(With both Current Sourcing and Current Sinking resistors switched off.)*
5. **SIGNAL VOLTAGE OUTPUT (Selectable):**
   0 to 5 VDC @ 10 mA max.
   0 to 10 VDC @ 10 mA max.
6. **SIGNAL CURRENT OUTPUT (Selectable):**
   0 to 20 mA @ 10 VDC min.
   4 to 20 mA@ 10 VDC min.
7. **OUTPUT COMPLIANCE:**
   Voltage: 10 V across a min. 1KΩ load (10 mA). Factory calibrated for loads greater than 1 MΩ.
   Current: 20 mA through a max. 500Ω load (10 VDC).
8. **ACCURACY:** ±0.1% of full scale range (±0.2% for 0 to 5 VDC range).

DIMENSIONS "In inches (mm)"



CAUTION: Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBERS FOR AVAILABLE SUPPLY VOLTAGES	
		9 to 32 VDC	85 to 250 VAC
IFMA	Pulse Rate to Analog Converter	IFMA0035	IFMA0065

For more information on Pricing, Enclosures & Panel Mount Kits refer to the RLC Catalog or contact your local RLC distributor.

SPECIFICATIONS (Cont'd)

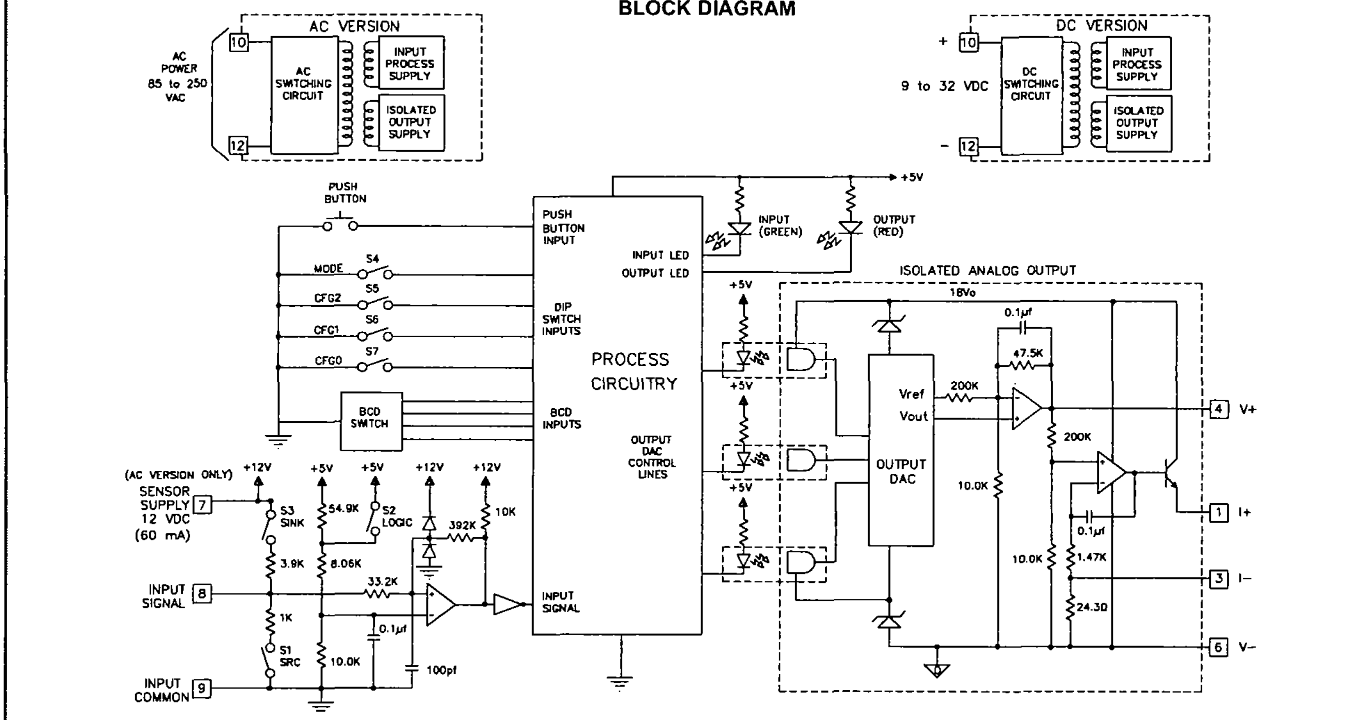
9. **RESOLUTION:**
   Voltage : 3.5 mV min.
   Current: 5 µA min.
10. **RESPONSE TIME:** 5 msec +1 period to 10 sec +1 period; user selectable
11. **INPUT IMPEDANCE:** 33 KΩ min. with the sink and source DIP switches in the OFF position (See Block Diagram).
12. **INPUT AND POWER CONNECTIONS:** Screw in terminal blocks.
13. **ISOLATION BREAKDOWN VOLTAGE (Dielectric Withstand):** 2200 V between power & input, and power & output; 500 V between input & output for 1 minute.
14. **CERTIFICATIONS AND COMPLIANCES:**
    UL Recognized Component, File #E137808
    Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.
    EMC EMISSIONS:
    Meets EN 50081-2: Industrial Environment.
    CISPR 11 Radiated and conducted emissions
    EMC IMMUNITY:
    Meets EN 50082-2: Industrial Environment.
    ENV 50140 - Radio-frequency radiated electromagnetic field [1]
    ENV 50141 - Radio-frequency conducted electromagnetic field
    EN 61000-4-2 - Electrostatic discharge (ESD) [2]
    EN 61000-4-4 - Electrical fast transient/burst (EFT)
    EN 61000-4-8 - Power frequency magnetic field

Notes:
1. *For operation without loss of performance:*
   Unit is mounted on a rail in a metal enclosure (Buckeye SM7013-0 or equivalent) and I/O cables are routed in metal conduit connected to earth ground.
2. *This device was designed for installation in an enclosure. To avoid electrostatic discharge, precautions should be taken when the device is mounted outside an enclosure. When working in an enclosure (ex. making adjustments, setting switches, etc.) typical anti-static precautions should be observed before touching the unit.*

Refer to the EMC Installation Guidelines section of this bulletin for additional information.

15. **ENVIRONMENTAL CONDITIONS:**
    Operating Temperature: 0 to 50°C
    Storage Temperature: -40 to 80°C
    Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
    Altitude: Up to 2000 meters
16. **CONSTRUCTION:**
    Case body is green, high impact plastic. Installation Category II, Pollution Degree 2
17. **WEIGHT:** 6 oz. (0.17 Kg)

BLOCK DIAGRAM



OVERVIEW

The Model IFMA continuously monitors a frequency input and outputs a voltage or current signal in proportion to the input signal. The output is accurate to ±0.1 % of full scale for Operating Modes 2, 3, and 4. Operating Mode 1 is accurate to ±0.2% of full scale. The green Input LED blinks at the rate of the input frequency. At about 100 Hz, the Input LED will appear to be solid on. At very low frequencies, the Input LED blinks slowly and may also appear to be solid on. A loss of signal may also cause the Input LED to remain on, depending on the DIP switch set-up. In this case, the red LED also turns on.

The Minimum Response Time parameter sets the minimum update time of the output. The actual response time is the Minimum Response Time plus up to one full period of the input signal. The IFMA counts the negative edges occurring during the update time period, and computes the average frequency value for that time. This action filters out any high frequency jitter that may be present in the input signal. The longer the Minimum Response Time, the more filtering occurs.

The Maximum Response Time parameter sets the Low Frequency Cut-out response time for the unit. If a new edge is not detected within the time specified by the Maximum Response Time setting, the unit sets the output to the existing Low Frequency Cut-out Value setting depending on the selected range and calibration setting.

The unit also indicates Low Frequency Cut-out by turning ON the output LED. The Maximum Response Time can be set shorter than the Minimum Response Time. In this case, as long as the input signal period is shorter than the Maximum Response Time, the unit continues to indicate the input frequency at its output. But, if the input period at any time exceeds the Maximum Response Time, the unit immediately takes the output to the Low Frequency Cut-out Value, regardless of the Minimum Response Time setting.

The IFMA is calibrated at the factory for all of the selected ranges. However, the user can adjust the minimum calibration to any value less than the Full Scale value, and the Full Scale value to any value greater than the minimum value. If the minimum and full scale values are brought closer together, the accuracy of the unit decreases proportionate to the decreased range of the unit (See Calibration).

EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into the unit may be different for various installations. The unit becomes more immune to EMI with fewer I/O connections. Cable length, routing, and shield termination are very important and can mean the difference between a successful installation or troublesome installation.

Listed below are some EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the rail where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
2. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:

   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0
   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3

   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.

WIRING CONNECTIONS

All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit (AC or DC) be protected by a fuse or circuit breaker.

POWER AND OUTPUT CONNECTIONS

AC Power

Primary AC power is connected to terminals 10 and 12 (labeled AC). For best results, the AC Power should be relatively "clean" and within the specified variation limits. Drawing power from heavily loaded circuits or from circuits that also power loads that cycle on and off, should be avoided.

DC Power

The DC power is connected to terminals 10 and 12. The DC plus (+) power is connected to terminal 10 and the mius (-) is connected to terminal 12.

It is recommended that separate supplies be used for sensor power and unit power. Using the same supply for both will negate isolation between input and power.

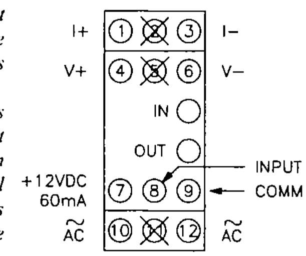
Current Output

When using Operating Mode 3 or 4, the output device is connected to terminals 1(I+) and 3 (I-).

Voltage Output

When using Operating Mode 1 or 2, the output device is connected to terminals 4 (V+) and 6 (V-).

***Note:** Although signals are present at voltage and current outputs at the same time, only the selected mode is in calibration at any one time.*
Example: Operating Mode 2 is selected. The voltage level present at the voltage terminals is in calibration, but the signal appearing at the current terminals does not conform to either of the current output modes.



INPUT CIRCUITS, SENSOR CONNECTIONS AND CONFIGURATION SWITCH SET-UP

The Model IFMA uses a comparator amplifier connected as a Schmidt trigger circuit to convert the input wave form into the pulse form required for proper circuit operation. Three set-up switches are used to configure the input circuit to accept signals from a wide variety of sources, as follows:

S1 - ON: Connects a 1 KΩ pull-down resistor for sensors with sourcing outputs. (Maximum sensor output current is 12 mA @ 12 VDC output.)

S2 - ON: For logic level signals. Sets the input bias levels to V_{IL} = 2.5 V, V_{IH} = 3.0 V.

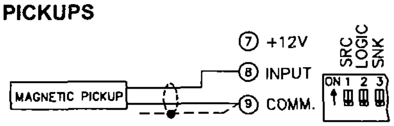
OFF: For increased sensitivity when used with magnetic pickups. Sets the input bias levels to V_{IL} = 0.25 V, V_{IH} = 0.75 V.

S3 - ON: Connects a 3.9 KΩ pull-up resistor for sensors with current sinking output. *(Max. sensor current = 3 mA.)*

CONNECTIONS & CONFIGURATION SWITCH SET-UP FOR VARIOUS SENSOR OUTPUTS

Note: Separate power supplies must be used for sensor power and input power to maintain the isolation breakdown voltage specification. If isolation between power and input is not needed, then a single supply can be used for both unit and sensor power.

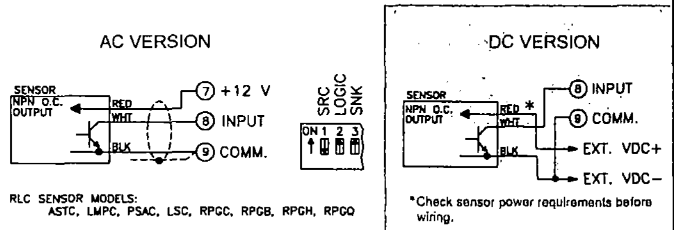
MAGNETIC PICKUPS



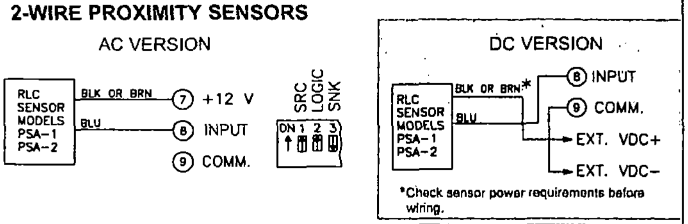
RECOMMENDED RULES FOR MAGNETIC PICKUP CONNECTIONS

1. Connect the shield to the common Terminal "9" at the input of the IFMA. DO NOT connect the shield at the pickup end. Leave the shield "open" at the pickup and insulate the exposed shield to prevent electrical contact with the frame or case. (Shielded cable, supplied on some RLC magnetic pickups, has open shield on pickup end.)

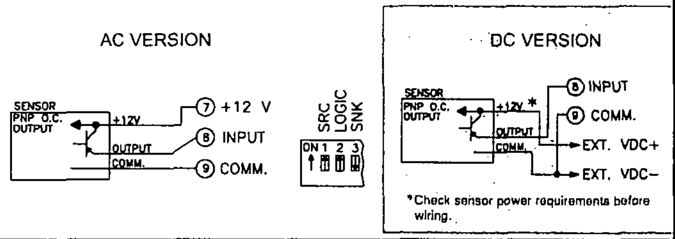
SENSORS WITH CURRENT SINK OUTPUT (NPN O.C.)



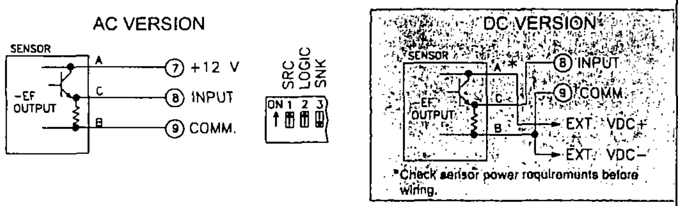
2-WIRE PROXIMITY SENSORS



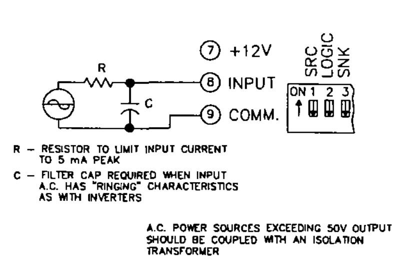
SENSORS WITH CURRENT SOURCE OUTPUT (PNP O.C.)



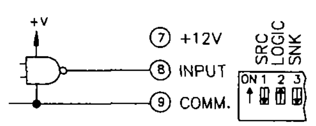
OLDER STYLE RLC SENSORS WITH -EF OUTPUT

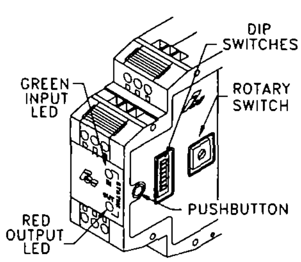


A.C. INPUTS FROM INVERTERS, A.C. TACHOMETERS, GENERATORS, ETC.



INPUT FROM CMOS OR TTL





CONFIGURING THE IFMA

To begin set-up, place DIP switch 4 to the on (up) position. DIP switches 5, 6, and 7 access unit configuration settings. Upon entry to a set-up parameter, the Input LED blinks the current numerical value of a setting at a 1 Hz rate. A setting of "1" is indicated by one blink (½ sec on, ½ sec off), through a setting of "9", which is indicated by nine blinks. A setting of "0" is indicated by a single short flash (40 msec on, 1 sec off). The decimal point position is the last number blinked. After the entire value is indicated, the IFMA pauses two seconds and repeats the value.

During entry of a new value, if the Mode switch (S4) or any of the CFG DIP switch positions are changed before the push button is pressed, the IFMA aborts the entry process and retains the previous setting.

DIP SWITCH	DESCRIPTION	SECTION
4 5 6 7	Operating Mode	(1.0)
4 5 6 7	Input Range Setting Using an Input Signal or Frequency Generator	(2.0)
4 5 6 7	Input Range Setting Using the Rotary Switch	(3.0)
4 5 6 7	Minimum Response Time	(4.0)
4 5 6 7	Maximum Response Time (Low Frequency Cut-Out Setting)	(5.0)
4 5 6 7	Analog Output Minimum Value	(6.0)
4 5 6 7	Analog Output Full Scale Value	(6.0)

Note: To return to normal operation, place DIP switch 4 in the down (RUN) position.

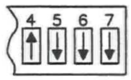
( ) Indicates Configuration Section

OUTPUT INDICATION

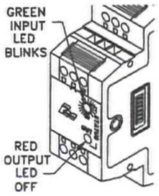
Over range on the output : The Output LED (red) turns on and the Output is "clamped" at the maximum level.
Low Frequency Cut-Out : The Output LED (red) turns on to indicate the input frequency is below the Zero Frequency setting.
Invalid Entry during Set-up : The Input LED (green) and the Output LED (red) alternately blink until a valid entry is made.

FACTORY SETTINGS		
Parameter	Setting	Value
Operating Mode	4	4 to 20 mA
Input Range	10.000	10 KHz
Minimum Response	0	5 msec
Maximum Response	0	1024 times Input Range Period (102 msec, 9.8 Hz)

1.0 Operating Mode (Analog Output)



Step 1.1

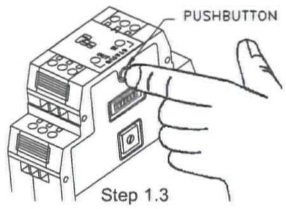


Step 1.2

1.1 Place DIP switch 4 to the ON (up) position and DIP switches 5, 6, and 7 as shown.
1.2 Green input LED blinks the Setting corresponding to the Operating Mode shown below, pauses and repeats the value.

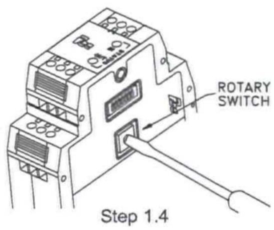
Setting	Operating Mode
1	0 to 5 VDC
2	0 to 10 VDC
3	0 to 20 mA
4	4 to 20 mA

- ***Factory calibration values are restored when the Operating Mode is changed.***
- ***If existing operating mode setting is your desired requirement, this section is complete*. Otherwise, continue with Step 1.3.***

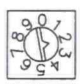


Step 1.3

1.3 Press the push-button. The Green input LED blinks rapidly to indicate the Operating mode setting is now accessed
1.4 Turn the rotary switch to the selected numerical value for the output desired (see the list in Step 1.2).
1.5 Press the push-button. The Green input LED blinks value entered, pauses, and repeats the new Operation setting.



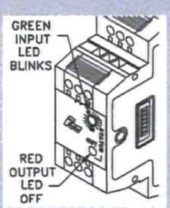
Step 1.4


Setting '2' Selected

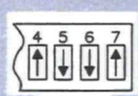
- ***If the new Operating mode setting is acceptable, this section is complete*.***
- ***If the new Operating mode setting is not the desired setting, repeat from Step 1.3.***
- ***If the Red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 1.4 and 1.5.***

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

2.0 On-Line Input Range Setting Using Actual Input Signal Or Frequency Generator



Step 2.2



Step 2.1

2.1 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown.
2.2 The Green input LED blinks the existing Input Range setting as shown in the examples below. Six full digits of numerical information blink with a short pause between digits and a longer pause before repeating. The first five digits are the existing input range setting of the frequency magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

Factory Setting Example

1 blink	1	Frequency setting
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	Resolution
4 sec pause		

Frequency: 1 0 0 0 0 — Resolution: 0

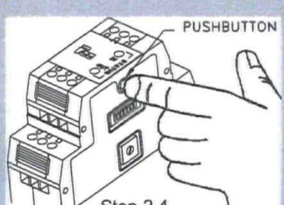
Result: 10.000 KHz

Additional Example:

2 blinks	2	Frequency setting
2 sec pause		
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		
2 blinks	2	Resolution
4 sec pause		

Frequency: 2 5 0 5 0 — Resolution: 2

Result: 250.50 Hz



Step 2.4

- ***If the existing Input Range setting is your desired requirement, this section is complete*. Otherwise, continue with Step 2.3.***

2.3 Apply the maximum input signal.
2.4 Press the push-button. The Green input LED blinks rapidly. The acquisition process takes two seconds plus one period of the input signal.

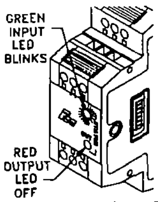
PREFERRED METHOD

- ***If the new input range setting is valid, the Green input LED turns on solid. Continue to Step 2.5.***
- ***If Red output LED blinks, the new input range setting is invalid, outside the acceptable 1 Hz to 25 KHz range. Repeat Steps 2.3 and 2.4.***

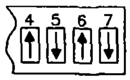
2.5 Press the push-button. The Green input LED blinks the new Input Range setting. This section is complete*. Verify the Input Range setting as shown in Step 2.2.

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

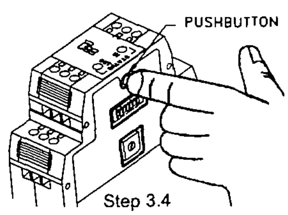
3.0 Input Range Setting Using The Rotary Switch



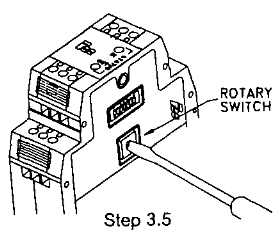
Step 3.2



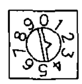
Step 3.1



Step 3.4



Step 3.5


Setting '2' Selected

3.1 Place DIP switch 4 to the ON(up) position and DIP switches 5, 6, and 7 as shown

3.2 The Green input LED blinks the existing Input Range setting, pauses and repeats. Six full digits of numerical information blink with a short pause between digits and a longer pause at the end, before repeating. The first five digits are the existing input range setting magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

◆ ***If the existing Input Range setting is your desired requirement, this section is complete*. Otherwise, continue with Step 3.3.***

3.3 Determine the Input Range frequency and record in the space provided below.

Input Range Frequency — First 5 of 6 digits; Resolution — 6th digit

Example: 95.5 Hz

9	5 .	5	0	0		3
0	9	5 .	5	0		2
0	0	9	5 .	5		1

Example: 15,500 Hz

1	5	5	0	0 .		0

3.4 Press the push-button. The Green input LED blinks rapidly. Input Range setting is now accessed

3.5 Turn the rotary switch to the first selected numerical value. Press the push-button. The Green input LED continues to blink rapidly. First of six digits is entered.

3.6 Turn the rotary switch to the second selected numerical value. Press the push-button. The Green input LED continues to blink rapidly. Second of six digits is entered.

3.7 Repeat Step 3.6 three more times, then go to Step 3.8. This enters a total of five of the required six numerical digits.

3.8 Turn the rotary switch to the selected numerical value for resolution requirement. Press the push-button. The Green input LED blinks the new Input Range setting (as described in Step 2.2), pauses, and repeats the value.

ALTERNATIVE METHOD IF INPUT SIGNAL IS NOT AVAILABLE

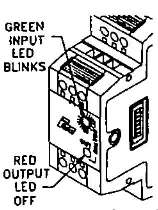
◆ ***If the new Input Range setting is acceptable, this section is complete*.***

◆ ***If the new Input Range setting is not the desired setting, repeat Steps 3.4, through 3.8.***

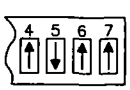
◆ ***If the Red output LED blinks, the numerical value entered is invalid. Repeat Steps 3.3 through 3.8.***

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

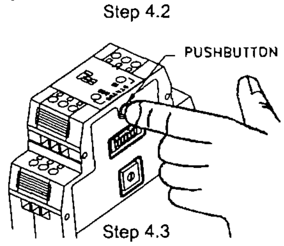
4.0 Minimum Response Time Setting



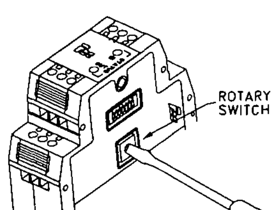
Step 4.2



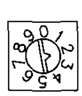
Step 4.1



Step 4.3



Step 4.4


Setting '2' Selected

4.1 Position DIP switch 4 to the ON(up) position and DIP switches 5, 6, and 7 as shown.

4.2 The Green input LED blinks the corresponding Minimum Response Time Setting (see following list), pauses and repeats.

Setting	Time
0	5 msec
1	10 msec
2	20 msec
3	50 msec
4	100 msec

Setting	Time
5	200 msec
6	500 msec
7	1 sec
8	5 sec (not valid for input range > 3906 Hz)
9	10 sec (not valid for input range > 3906 Hz)

◆ ***If the existing Minimum Response Time setting is your desired requirement, this section is complete*. Otherwise, continue with Step 4.3.***

4.3 Press the push-button. The Green input LED blinks rapidly. Minimum Response Time setting is now accessed.

4.4 Turn the rotary switch to the selected numerical value for Minimum Response Time desired (see list in Step 4.2).

4.5 Press the push-button. The Green input LED blinks the value entered, pauses, and repeats the new Minimum Response Time setting.

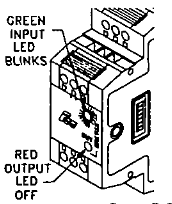
◆ ***If the new Minimum Response Time setting is acceptable, this section is complete*.***

◆ ***If the new Minimum Response Time setting is not acceptable, repeat from step 4.3.***

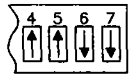
◆ ***If the Red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 4.4 and 4.5.***

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

5.0 Maximum Response Time Setting (Low Frequency Cut-Out Setting)



Step 5.2



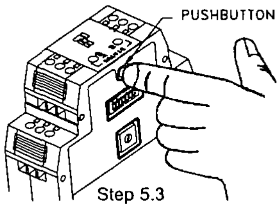
Step 5.1

5.1 Place DIP switch 4 to the ON (up) position and DIP switches 5, 6, and 7 as shown.

5.2 The Green input LED blinks the corresponding Maximum Response Time Setting (see following list), pauses and repeats.

Setting	Time
0	1024 times Input Range period (40 msec min., 10 sec max.)
1	10 msec (100 Hz)
2	20 msec (50 Hz)
3	50 msec (20 Hz)
4	100 msec (10 Hz)
5	200 msec (5 Hz)
6	500 msec (2 Hz)
7	1 sec (1 Hz)
8	5 sec (.2 Hz)
9	10 sec (.1 Hz)

◆ ***If the existing Maximum Response Time setting is your desired requirement, this section is complete*. Otherwise, continue with Step 5.3.***



Step 5.3

5.3 Press the push-button. The Green input LED blinks rapidly. Maximum Response Time setting is now accessed.

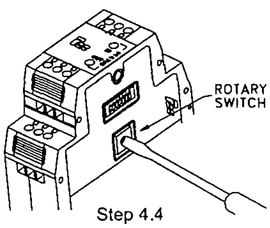
5.4 Turn the rotary switch to the selected numerical value for Maximum Response Time desired. (see list in Step 5.2)

5.5 Press the push-button. The Green input LED blinks the value entered, pauses, and repeats the new Maximum Response Time setting.

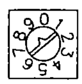
◆ ***If the new Maximum Response Time setting is acceptable, this section is complete*.***

◆ ***If the new Maximum Response Time setting is not acceptable, repeat from Step 5.3.***

◆ ***If the Red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 5.4 and 5.5.***



Step 4.4


Setting '9'
Selected

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

6.0 Calibration

The IFMA is factory calibrated for all operating modes. These settings are permanently stored in the unit's configuration memory. The IFMA automatically selects the proper calibration setting for the selected Operation mode.

The Minimum and Full Scale output values established at the factory can be changed using the calibration routines. The Minimum output value can be adjusted to any value less than the Full Scale output value, and the Full Scale value can be adjusted to any value greater than the Minimum value.

Changing the factory calibration settings does affect the accuracy of the unit. Specified accuracy for modes 2, 3, and 4 holds until the factory calibration range has been halved. This does not apply to mode 1, since it already uses only half of the IFMA's output range. When increasing the output range, the new calibration settings can not exceed the factory Full Scale value by more than 10%. The 0 to 5 VDC range can be doubled.

The IFMA can store user calibration settings for only one mode at a time. If calibration is changed for one operating mode, and the user then selects a different operating mode, the unit reverts to factory calibration settings. Calibration steps can be combined (added) to obtain a total calibration change. This is done by repeated push-button entries of the same value, or different values, before saving the change. The calibration steps as shown in the table at right are approximations. A current or volt meter should be connected to the appropriate output pins to verify the actual calibration setting.

Approximate Calibration Increments

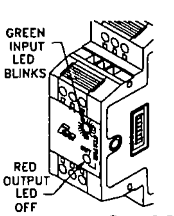
ROTARY SWITCH	VOLTAGE	CURRENT
1	3 mV	5 μA
2	5 mV	10 μA
3	10 mV	25 μA
4	25 mV	50 μA
5	50 mV	100 μA
6	100 mV	200 μA
7	200 mV	400 μA
8	400 mV	800 μA

Calibration Direction

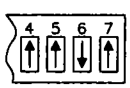
The default direction for calibration changes is up (increasing values) on entry to either calibration routine. This direction can be toggled from within the routine with the following steps:

1. Enter the calibration routine you wish to change (Minimum or Full Scale).
2. Press the push-button. The Green input LED blinks rapidly.
3. Turn the rotary switch to position 9. Press the push-button.
4. The Output LED indicates the direction of calibration:

OFF = Increasing Value
ON = Decreasing Value

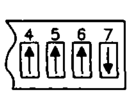


Step 6.2



Step 6.2

Analog Output Minimum Value

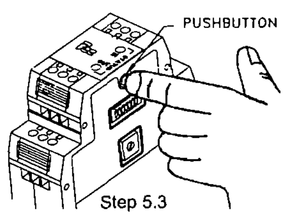


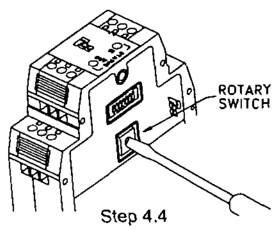
Step 6.2

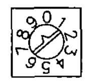
Analog Output Full Scale Value

6.1 Connect a current or voltmeter of appropriate accuracy to the desired output pins (voltage or current)

6.2 Place DIP switch 4 to the ON position and DIP switches 5, 6, and 7 as shown. The Green input LED blinks slowly.







Setting '9' Selected

6.3 Press the push-button to enable the rotary switch. The Green input LED now blinks at a faster rate, indicating that calibration values are accessible.

6.4 Turn rotary switch to appropriate numerical setting for calibration (see list in Step 6.0), while monitoring the output signal. Press the push-button. Calibration is raised or lowered by this approximate value, depending on calibration direction.

- ***If this setting meets your requirements, go to step 6.5. If more calibration is required, repeat step 6.4 until the calibration meets your requirements.***
- ***If you overshoot your desired value, reverse calibration direction as shown in 6.0 and continue calibration until the value meets your requirements.***

6.5 Turn the rotary switch to 0 and press the push-button. This saves the new user calibration setting.

- ***If you want to return to factory calibration, exit Calibration and then re-enter. Turn rotary switch to 0 and press push-button twice. This reloads the factory calibration setting for the selected mode of operation.***
- ***When calibrating the Minimum output value, if the red output LED blinks while in the down direction, the requested calibration setting is beyond the output's absolute minimum value. The calibration setting is held at the absolute minimum value. Reverse calibration direction and repeat from step 6.4***
- ***When calibrating Full Scale, if the red output LED blinks while in the up direction, the requested calibration setting is beyond the output's absolute maximum value. The calibration setting is held at the maximum value. Reverse calibration direction and repeat from step 6.4***
- ***If an attempt is made to calibrate the Full Scale value lower than the Minimum value, or conversely, the Minimum value higher than the Full Scale value, the red output LED blinks, and the IFMA sets the two values equal. Reverse calibration direction and repeat from step 6.4.***

Calibration Example (Scaling):

A customer using the 0 to 10 VDC output range of the IFMA wants the Minimum value to be at 1 VDC. To do this, connect a voltmeter to the output of the IFMA to monitor the output voltage. Access Configuration Mode by placing DIP switch 4 to the ON (up) position. Access Analog Output Minimum value by placing DIP switches 5 and 7 up, and DIP switch 6 down. Press the push-button to enable changes to the calibration value. Turn the rotary switch to position 8 and press the push-button. The voltmeter should reflect an increase of about 400 mV. With the rotary switch still at position 8, press the push-button again. The voltmeter should now read approximately 800 mV. Turn the rotary switch to a position lower than 8 to effect a smaller change in calibration. Continue adjusting the rotary switch and pressing the push-button until 1 VDC is displayed on the voltmeter. Turn the rotary switch to position 0 and press the push-button. This action saves the new calibration setting for the Minimum value.

TROUBLESHOOTING

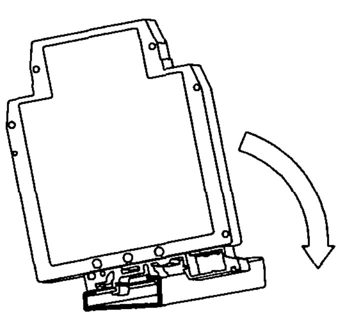
For further technical assistance, contact technical support at the appropriate company numbers listed.

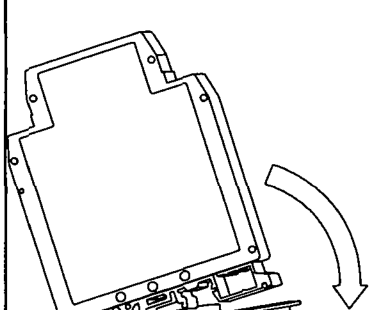
INSTALLATION

The unit is equipped with a universal mounting foot for attachment to standard DIN style mounting rails, including G profile rail according to EN50035 - G32 , and top hat (T) profile rail according to EN50022 - 35 x 7.5 and 35 x 15. The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

G Rail Installation

To install the IFMA on a "G" style DIN rail, angle the module so that the upper groove of the "foot" catches under the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, push up on the bottom of the module while pulling out and away from the rail.





T Rail Installation

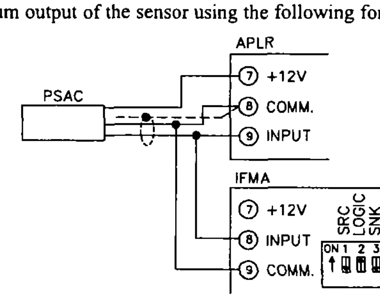
To install the IFMA on a "T" style rail, angle the module so that the top groove of the "foot" is located over the lip of the top rail. Push the module toward the rail until it snaps into place. To remove a module from the rail, insert a screwdriver into the slot on the bottom of the "foot", and pry upwards on the module until it releases from the rail.

APPLICATION

A customer needs a unit to output a signal to a chart recorder for a flow rate system. There is an existing APLR rate indicator receiving an input from a PSAC inductive proximity sensor. The IFMA Frequency to Analog Converter is connected in parallel with the APLR to output the signal to the chart recorder.

The flow rate is measured in gal/min. and needs to be converted to a 0 to 10 VDC signal. The Operating Mode of the IFMA is set for a 0 to 10 VDC output signal. The PSAC measures 48 pulses/gal. with a maximum flow rate of 525 gal/min. The Maximum Response Time is set to setting '9' (10 sec). The chart recorder will record 0 VDC at 0.125 gal/min, and 10 VDC at 525 gal/min.

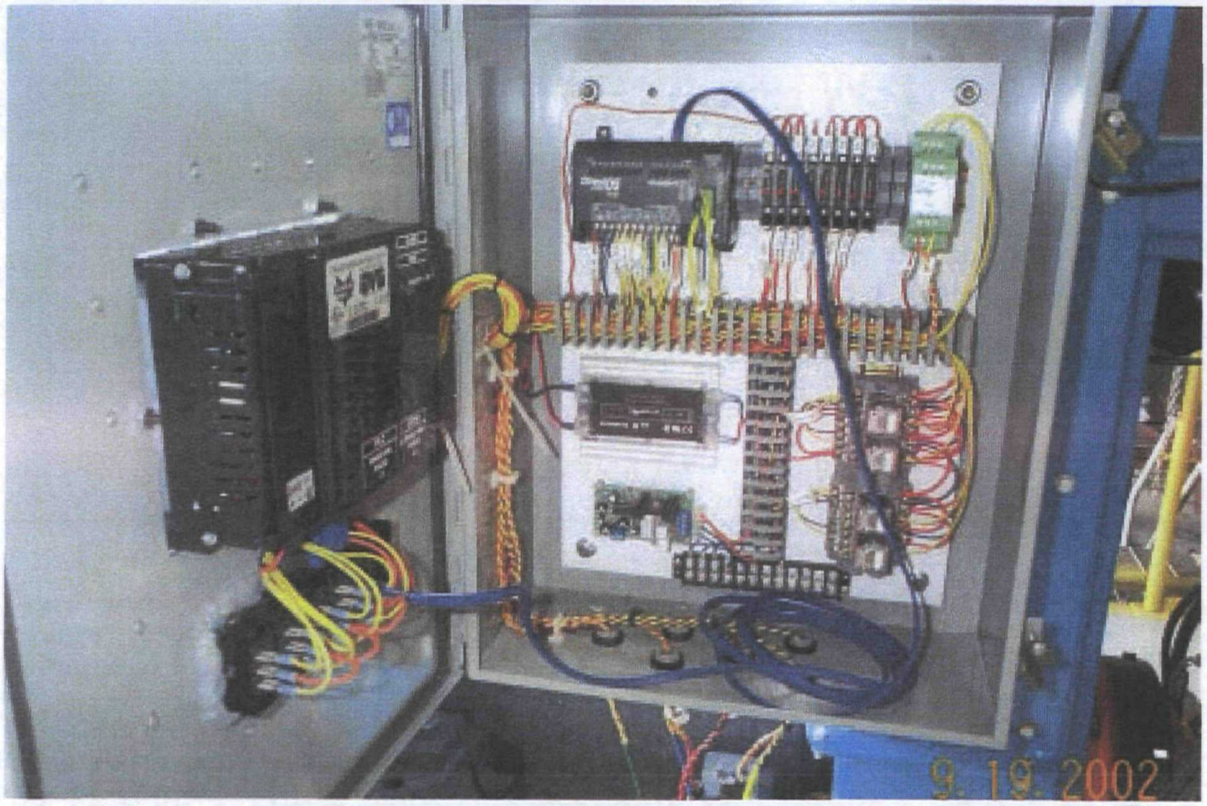
The Input Range can be set one of two ways. By entering the calculated maximum frequency with the rotary switch, or by applying the maximum frequency signal of the process to the input of the IFMA. To set the input with the rotary switch, first determine the maximum frequency generated by the maximum output of the sensor using the following formula:



$$\text{Max. Freq.} = \frac{\text{unit/measure x pulses/unit}}{\text{seconds/measure}}$$

$$\text{Max. Freq.} = \frac{\text{525 GPM x 48 PPG}}{\text{60 sec.}} = \text{420 Hz}$$

Set the Input Range with the rotary switch to 420 Hz.



PLC CONTROL BOX INSIDE

NEW EQUIPMENT WARRANTY

Page 1 of 2

Dredging Supply Co., Inc. ("DSC") warrants that it will convey good title to the equipment, free of all security interests therein except as may be agreed between the purchaser and DSC, and for a period of one (1) year from the date of delivery of new equipment that the equipment is free from defects in workmanship and materials under normal use, subject to the following provisions:

The purchaser shall notify DSC in writing within ten (10) days of the purchaser's first knowledge of any facts which may lead to any warranty claim. DSC shall not have any further responsibility if this notice to DSC is not given.

DSC provides no warranty for any part which may be damaged or rendered inoperative or less efficient due to lack of maintenance by the purchaser. Any warranty of DSC shall be voided if the purchaser has altered, misused, neglected, overloaded, improperly operated or in any way subjected the equipment to mistreatment outside of its expected operating range.

DSC does not warrant any component part of the equipment manufactured by any other party. DSC will provide to the purchaser any warranty or other material, manuals and/or specifications provided to DSC by such manufacturer. **THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR ANY FAILURE, DEFECT OR OTHER CLAIMS RELATIVE TO SUCH COMPONENTS SHALL BE TO PURSUE ANY WARRANTY OR OTHER CLAIM DIRECTLY AGAINST THE COMPONENT MANUFACTURER AND NOT DSC.**

Should it become necessary to replace any removable part manufactured by DSC, the purchaser must return the part, transportation pre-paid to DSC. If the part is warranted by DSC, DSC will replace the part f.o.b. DSC's facility, and reimburse to the purchaser the cost of the transportation to DSC. DSC shall have no obligation to repair or replace any part at the site of the equipment. Should damaged, defective or inoperable part not be removable, at the purchaser's pre-paid expense, DSC will send a representative to the equipment site to inspect the part. If the part is covered by the DSC warranty, DSC will replace it f.o.b. DSC's facility. DSC does not warrant any labor or travel cost for removal or installation of any part.

THE PURCHASER WAIVES ANY CLAIMS OF REDHIBITION AND ACKNOWLEDGES THAT THE SOLE WARRANTY RESPONSIBILITY OF DSC SHALL BE AS SET OUT HEREIN. DSC makes no warranty whatsoever of the fitness of the equipment for any particular purpose except as may be set out in the specifications of the equipment as provided in writing by DSC. DSC makes no warranty, express or implied, except as is set out herein and no officer, employee or agent of DSC or any other party has authority to promise, extend, or warrant other than as set out herein or as may be expressly agreed to by DSC in writing signed by the President of DSC. Under no circumstances whatsoever, does DSC warranty or will be responsible of any claim of lost profits, downtime, consequential damages, punitive damages or attorney fees arising out of the operation or non-operation of the equipment.

Delivery shall be defined for purposes of this warranty to mean delivery by DSC, f.o.b. at DSC's facility unless agreed otherwise in writing by the purchaser and DSC. However, should the equipment by agreement be delivered before it is operable, then the warranty shall run from the first day after physical delivery that the equipment becomes available for operation. Should any provision of this warranty be found to be invalid for any reason, it shall not void this limited warranty but all other provisions hereof shall be deemed to be in effect.

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The sole and exclusive jurisdiction and venue for any claim arising out of the sale of the equipment, including any warranty claim against DSC, shall be the courts of the Parish of Jefferson, State of Louisiana. This warranty shall be governed by the laws of the State of Louisiana.

THIS IS ABSOLUTELY THE SOLE AND EXCLUSIVE WARRANTY OF DSC RELATIVE TO ANY NEW EQUIPMENT SOLD BY DSC AND PROVIDES THE SOLE RESPONSIBILITY OF DSC FOR THE EQUIPMENT UPON DELIVERY.

Dredging Supply Company, Inc.

DREDGING SUPPLY,

172 & 156 Airport Road

P.O. Box 534

RESERVE, LA

70084

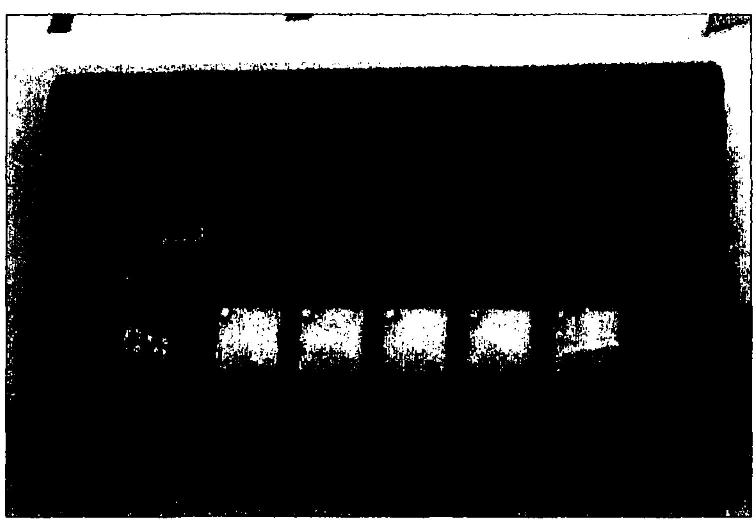
(985) 479 1355 Voice Telephone

(985) 479 1367 Fax Telephone

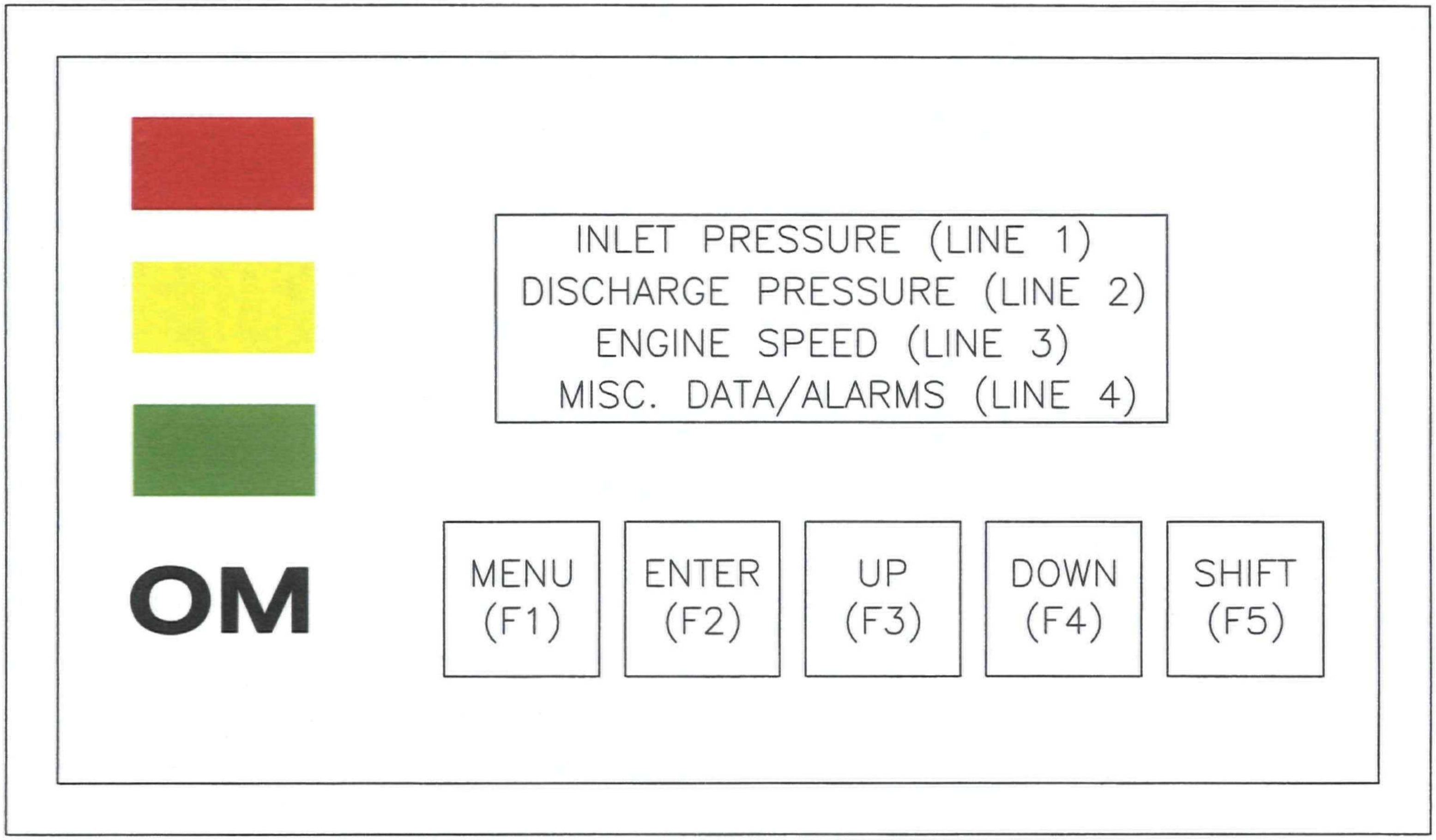
Dredging Supply Company, Inc.

DSC AUTOMATED BOOSTER CONTROL SYSTEM WITH RADIO TELEMETRY OPTION

CONTENTS



HMI DISPLAY



DEFAULT SCREEN SHOWN

NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

J.F. BRENNAN 16" BOOSTER PUMP

HMI DISPLAY DIAGRAM

DG/
DG
APP BY: DG
NS
DATE: 11/03/99
99190
9819022

DSC AUTOMATED BOOSTER CONTROL SYSTEM WITH RADIO TELEMETRY OPTION

INTRODUCTION

The DSC automated booster control system represents the state of the art in dredge booster pump control. While this system grants complete manual control, it also provides automatic control for clutch engagement and disengagement as well as two programmed speed loops, one for constant engine speed and the other for constant inlet pressure. Additionally, this system provides the user with valuable booster information in an easy to operate control panel. The radio telemetry option allows this data to be sent to a master controller for display.

The local control panel consists of a large and small control box mounted together. The large control box houses the regulated DC power supply, PLC, relay banks, terminal blocks, display panel, mode switch, and optionally a radio modem and modem power supply. The small box houses buttons for clutch engage, clutch disengage, throttle increase, and throttle decrease, and switches for manual/automatic operation and optionally local/remote operation.

DATA PANEL OPERATION

The control data panel consists of three lights (red, yellow, and green) stacked vertically on the right side, a four line by twenty character LCD display in its center, and five control buttons spaced horizontally under the LCD display. For ease of description, the control buttons will be called F1, F2, F3, F4, and F5 from left to right.

MANIPULATING SCREENS

The display buttons allow the user to scroll through and edit items on the data panel. Many of the screens operate in a similar fashion. The F1 (Menu) button will advance to the next menu from any screen. The available menus are:

1. Default Screen – Main data is displayed.
2. Alarm Log Screen – record of last 64 alarms.
3. Setpoints Menu – controls automatic operation.
4. Transmitter Menu – sets and calibrates all non-temperature sensors.
5. Alarm Setpoints Menu – controls when an alarm is activated.
6. Constants Menu – controls shutdowns, operational settings and sets the password.
7. Disable Menu – disables sensors and switches to prevent alarms and errors.

The F1 button does not store the currently displayed data.

The F2 (Enter) button allows the user to store a data point, password, or switch into PLC memory. The F2 buttons also scrolls through all options within a menu.

The F3 (Up) button, scrolls up alarms in the Alarm Log, raises the digit with the ↑ under it by one in the Setpoints, Alarm Setpoints, and Constants Menus, as well as all password entering, and enables transmitters and switches in the Disable Menu.

The F4 (Down) button, scrolls down alarms in the Alarm Log, lowers the digit with the ↑ under it by one in the Setpoints, Alarm Setpoints, and Constants Menus, as well as all password entering, and disables transmitters and switches in the Disable Menu.

The F5 (Shift) button moves the ↑ from the current digit to the next leftmost digit. When the ↑ is under the fourth digit, pressing the F5 button returns it to the first digit. Pressing and holding the F5 button will also clear the alarm scroll from the bottom of the Default screen so that the data values can be seen if an alarm is present.

DEFAULT SCREEN

The default data screen displays all booster information as follows:

- The uppermost line (line 1) displays the booster inlet pressure or vacuum (the text will change from INLET PRESS to INLET VAC if a vacuum is present).
- Line 2 displays booster pump discharge pressure.
- Line 3 displays engine RPM.
- Line 4 scrolls through the remaining booster information.

Line 4 information can contain the following information depending on the disable settings:

Service water pressure.

Air pressure.

Engine oil pressure.

Gear oil pressure.

Gear air pressure.

Engine coolant temperature.

Gear oil temperature,

Booster pump radial bearing temperature,

Booster pump thrust bearing temperature, During normal operation, the green light should be illuminated, indicating that no alarms are active. When an alarm condition becomes active, the green light will go out and the red light will illuminate; additionally, line 4's information is replaced with scrolling alarm messages (if only one alarm is present, it will be displayed without scrolling). The operator may force the normal line four data to be displayed by depressing and holding the F5 (Shift button) button. Once the F5 button is released, the normal line four data will be replaced with alarm messages. Once all alarm conditions cease, the data panel will again display the normal line four data and the green normal light will replace the red alarm light. If no control buttons are depressed within a thirty-second period, the data panel will revert to the default screen.

ALARM LOG SCREEN

The alarm log can contain up to sixty-four records numbered from zero to sixty-three. Alarms are recorded sequentially (zero, one, two, ..., sixty-two, sixty-three, zero, one, etc.). The alarm log screen can be activated from the default screen by pressing the F1 (Menu button) button once. The default screen data is replaced with an alarm log. Line 1 shows the alarm event number. An asterisk prior to the event number indicates that the last alarm recorded is displayed. The alarm description is shown on line 2. The initial alarm time is recorded on line 3. This time is shown as XXXXXX, where the first two X's are hours (1 to 24), the middle two X's are minutes (0 to 59), and the last two X's are seconds (0 to 59). Line 4 shows the initial alarm data. This date is shown as XXXXXX, where the first two X's are the month (1 to 12), the middle two X's are the day (1 to 31), and the last two X's are the year (0 to 99). While the alarm log screen is active, buttons F3 (Up button) and F4 (Down button) scroll forward and backward through the alarm log respectively.

SETPOINTS MENU

The setpoints menu allow the user to change the points at which the booster pump will automatically engage and disengage the clutch, and the speed at which it will operate. While in the alarm log, depressing the F1 button once will display ---Setpoints Menu--- on line 1 with the remaining lines blank. When this text is displayed, pressing F2 (Enter button) enters the setpoint screen. Line 2 now displays Loop Setting (indicating that these setpoints are running setpoints). Line 3 shows Engine RPM (the fixed loop setting) and the current value of the setpoint. Line 4 shows Add/Sub with an ↑ under the current digit to be modified. Simply pressing the F2 button enters the setpoint and brings up the next setpoint. The setpoint can be changed by placing the arrow under the digit to be modified using the F5 button, and the pressing the F3 or F4 buttons to raise or lower the value respectively. This same procedure is used for modifying all setpoints and entering passwords. Pressing the F1 button jumps to the next menu without entering the current data. Following the Engine RPM loop setpoint is the Inlet Vac setpoint followed by the Inlet Press setpoint. One of these setpoints must be zero. These setpoints control the variable loop setting. Following these setpoints are the inlet vacuum and inlet pressure setpoints that control the clutch engaging. Line 2 indicates this by displaying Gear Setting. The clutch will engage immediately upon the inlet point picked. Again, one of the setting must be zero. The next setpoints are discharge pressure and discharge timer setpoints. These setpoints control when the clutch will disengage. When the discharge pressure falls below the discharge pressure setting for the length of time selected with the discharge pressure timer, the engine will return to idle and the clutch will disengage. After the discharge timer is set, the menu will revert to the fixed loop setpoint and the entire procedure can be repeated.

TRANSMITTER MENU

The transmitter menu will allow the user to change the ranges and calibration on all of the non-temperature sensors on the booster which included inlet vacuum and pressure, discharge pressure, engine speed, service water pressure, air pressure, engine oil pressure, gear oil pressure, and gear air pressure. While in the setpoints menu, depressing the F1 button once will display --Transmitter Menu-- on line 1 with the remaining lines blank. When this text is displayed, pressing F2 (Enter button) requests the password, which must be entered in order to enter the transmitter menu. Passwords are entered exactly as setpoints, which is described in the previous section. When the password is correctly entered with the F2 button, the data panel will display ------------------- on line 2, INLET VAC with its current value on line 3, and Add/Sub with an ↑ under the first digit of the current value. This number can be modified as described above, or the F2 button can be used to scroll to the next setting. Following INLET VAC, is INLET PRESS, DISCH PSI, ENGINE RPM, S W Pressure, Air Pressure, Eng. Oil Press, Gear Oil Press, Gear Air Press. When the gear air pressure is entered, the display returns to the inlet vacuum. All of these values were preset from the factory and should only be modified if a transmitter is replaced in the field.

ALARM SETPOINTS MENU

The Alarm Setpoints Menu allows the user to control the setting at which he or she should be alarmed of a transmitter reading. With Alarm Setpoints Menu displayed on line 1, pressing the F2 button brings up the password request. After the password is properly entered with the F2 button, line 2 will display blanks, line 3 shows S W Pressure with its current setting, and line 4 shows Add/Sub with the ↑ under the first digit of the current value. This service water alarm is only to indicate priming not operating pressure – the operating pressure is constantly compared to the discharge pressure and will be alarmed if it is low. Entering this value with the F2 button brings up the next setpoint.

The remaining alarm setpoints are: air pressure, engine oil pressure, gear oil pressure, gear air pressure, engine coolant temperature, gear oil temperature, booster radial bearing temperature, and booster thrust bearing temperature. These setpoints may require periodic adjustments due to pipeline changes.

CONSTANTS MENU

The Constants Menu allows the user to set the running engine oil pressure, engine running speed, engine idle speed, control booster pump disengaging for high gear temperature and low gear air pressure, set the time for the radio telemetry small throttle change and large throttle change (in 1/100's of a second), set the line 4 scroll seconds timer for data and alarms, and lastly to set a new password. The default password is 372; this password can be changed in the constants menu. If the password is forgotten, 9999 can be entered and the password will be reset to the default. The user will then have to enter 372 to enter any password screen until a new password is entered. These data points are entered exactly as shown in the above sections.

DISABLE MENU

The Disable Menu allows the user to customize the booster control to units which may not have all of the sensors that can be detected and to temporarily eliminate data from faulty sensors. The Disable Menu can be entered when the ----**Disable Menu**---- is displayed on line 1 by pressing the F2 key and entering the correct password. Each sensor can be enabled by using the F3 key or disabled using the F4 key. The F2 button enters this data and brings up the next sensor. It should be noted that disabling the inlet pressure, discharge pressure, or engine rpm sensors might result in uncontrollable automatic operation. Manual operation will be unaffected.

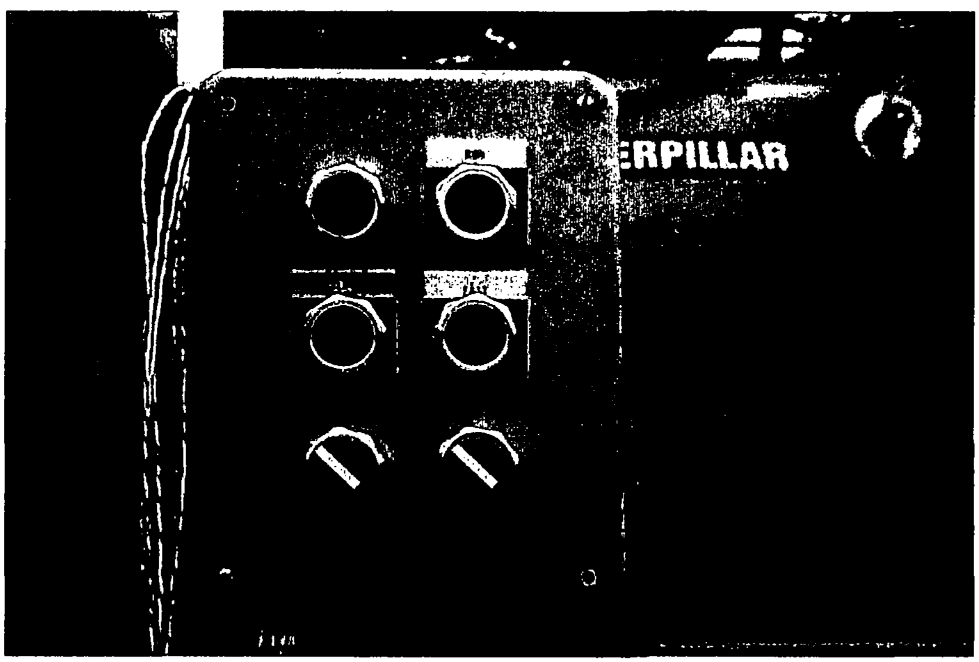
EXTERNAL SWITCHES AND BUTTONS

Each of the three external switches controls a unique function of the booster unit. The optional Remote/Local switch allows the booster to be controlled remotely via radio telemetry when it is in the Remote setting. The booster can still be controlled locally. With the switch in Local mode, no radio communication is allowed.

The Manual/Auto switch controls how the booster will operate if it is in Local mode. This button does not affect remote operation. With the switch in Manual, the operator must engage and disengage the clutch as well as control the engine speed. In Auto mode, the booster will operate in either a fixed speed mode or a variable speed mode depending on the setting of the Fixed/Variable switch. These loop setpoints are entered in the Setpoints Menu on the data panel. Local control of the throttle is still provided even in automatic operation.

The Fixed/Variable switch allows the user to select whether a fixed engine RPM or a fixed inlet pressure should be used to control the engine throttle.

The gear engage and disengage buttons will operate only if the engine speed is below the engine idle speed setting in the Constants Menu. The throttle increase and decrease operate in any mode whether the engine is running or not.

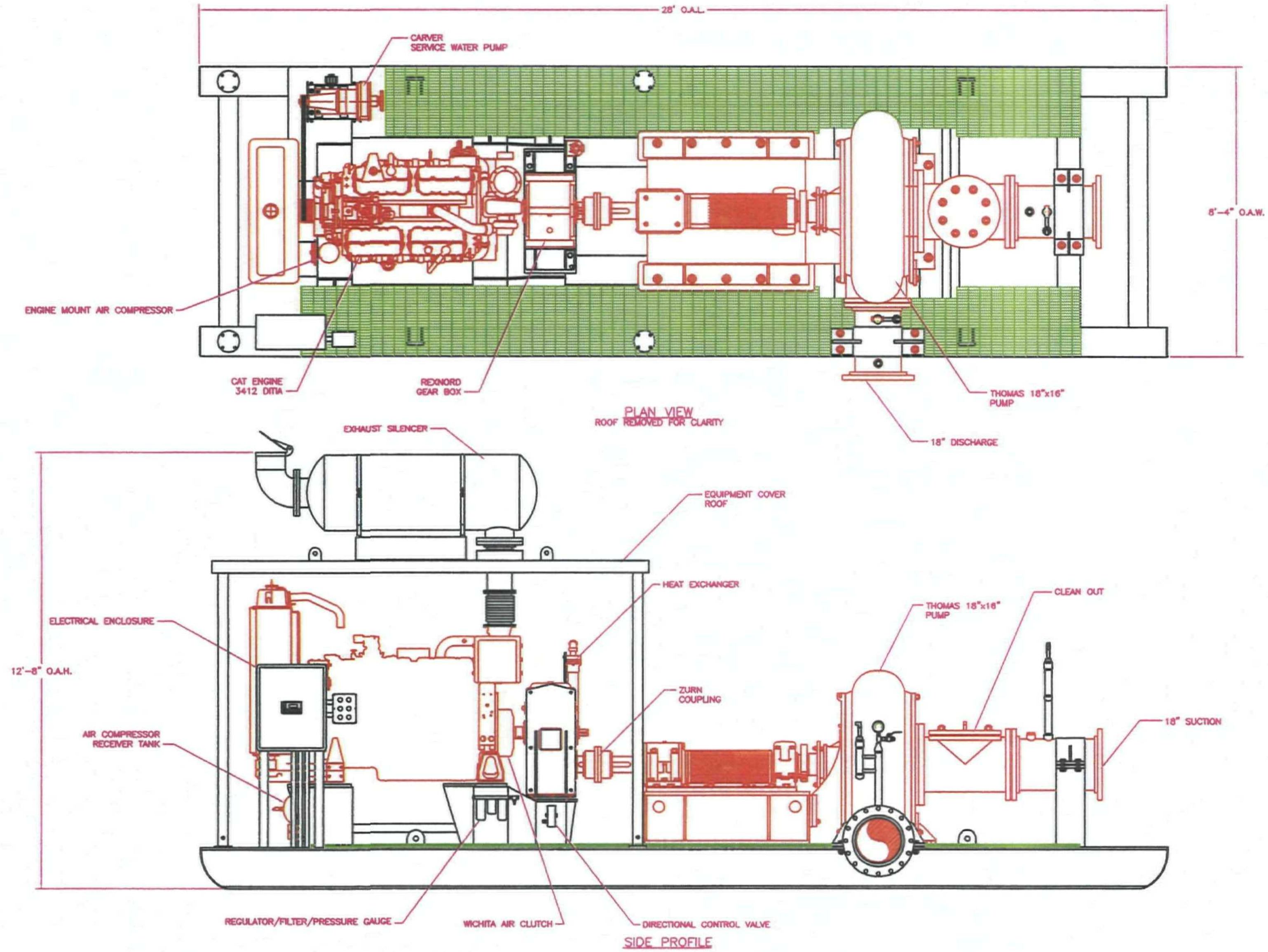


EXTERNAL SWITCHES AND BUTTONS

ALARMS

This control system provides extensive alarming features for protection and good operation. The following is a list of the possible alarms that can be displayed.

CPU critical Error
CPU Warning
CPU Battery Low
CPU Pgm Mem Error
CPU I/O Error
CPU Comm Error
CPU I/O Config Error
CPU Fault Instruct
CPU Watchdog Timeout
CPU Gram Error
CPU Intel I/O Error
Inlet Pressure Error
Disch Pressure Error
Engine Speed Error
S W Pressure Error
Air Pressure Error
Engine Oil Press Error
Gear Oil Press Error
Gear Air Press Error
Engine Water Tmp Err
Gear Oil Temp Error
Radial Brg Temp Error
Thrust Brg Temp Error
Fuse 101 Open
Fuse 103 Open
Fuse 104 Open
Fuse 105 Open
Fuse 106 Open
Fuse 107 Open
Fuse 108 Open
Fuse 109 Open
Fuse 110 Open
Fuse 111 Open
Fuse 112 Open
Fuse 114 Open
Fuse 115 Open
Fuse 116 Open
Eng Cool Switch Error
Eng Oil Switch Error
Low Low S W Pressure
Low S W Pressure
Low Air Pressure
Low Engine Oil Press
Low Gear Oil Press
Low Low G Air Press
Low Gear Air Press
High Eng Cool Temp
High Gear Oil Temp
High High G Oil Temp
High Radial Brg Temp
High Thrust Brg Temp



NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

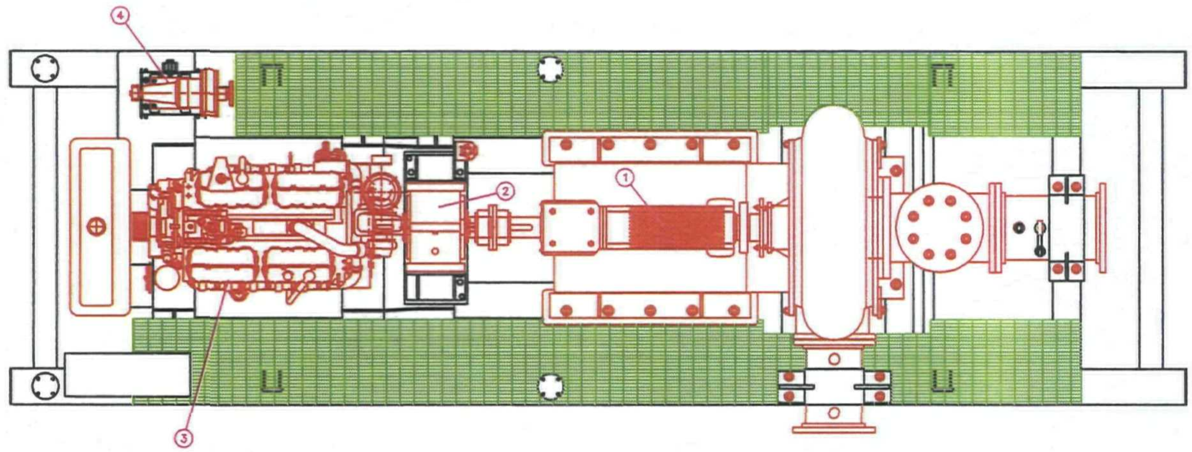
Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

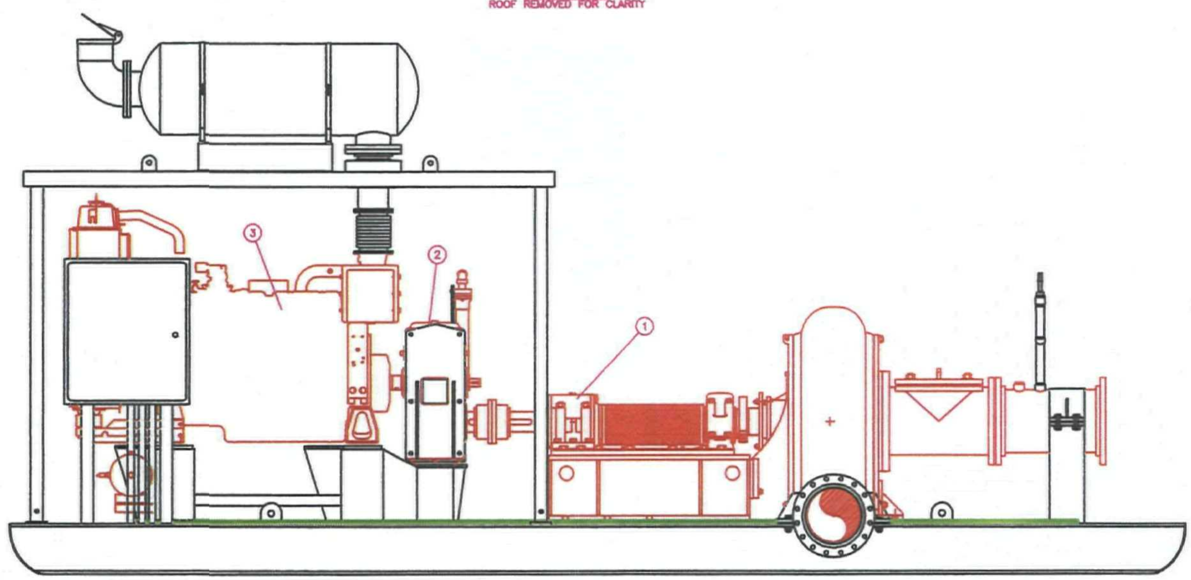
J.F. BRENNAN 16" BOOSTER PUMP

GENERAL ARRANGEMENT

DB/JKM
DB/JKM
NTS
10/13/99
99190
9919001B
B



PLAN VIEW
ROOF REMOVED FOR CLARITY



SIDE PROFILE

NO#	DATE	BY	REVISIONS	CHK	APP	REFERENCE DWG	DESCRIPTION

Dredging Supply Company, Inc

DREDGING SUPPLY COMPANY, Inc.

J.F. BRENNAN 16" BOOSTER PUMP

LUBRICATION DIAGRAM

ENGR/DESIGN: DB/JKM
DRAWN: DB/JKM
CHK:
APP BY:
SCALE: NTS
DATE: 10/11/99
PROJECT: 99190
DWG NO: 9919021
REV:

LUBRICATION DIAGRAM KEY

ITEM #	DESCRIPTION	LUBRICANT	INTERVAL
1	Dredge Pump Bearings (Thomas)(HD Thrust)	Chevron Delo 300 SAE30 Motor Oil	Change initialy after 500 hours of operation then every 3,000 hours of operation
1A	Dredge Pump Bearings (Thomas)(Radial)	Chevron Black Pearl Grease EP **NLGI, 1** (MULTIPURPOSE)	Grease every 8 hours of operation
2	Pump Reduction Gear	AGMA 3 EP oil, Chevron Gear Compound EP ISO 100	Change after first 50 to 100 hours operation then every 1000 hours operation or yearly.
3	Caterpillar Diesel Engine	Caterpillar DEO SAE 15W40 or Chevron Delo 400 ESI Multigrade 15W-40	Check daily, First change every 1,500 gal. Of fuel used or 250 hours of operation
4	Harrisburg Service Water Pump	Chevron Turbine Oil GST ISO 100 Grease packing with multipurpose grease daily	Check daily, change every 2,000 hours of operation

NEW EQUIPMENT WARRANTY

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THE PURCHASER WAIVES ANY CLAIMS OF REDHIBITION AND ACKNOWLEDGES THAT THE SOLE WARRANTY RESPONSIBILITY OF DSC SHALL BE AS SET OUT HEREIN. DSC makes no warranty whatsoever of the fitness of the equipment for any particular purpose except as may be set out in the specifications of the equipment as provided in writing by DSC. DSC makes no warranty, express or implied, except as is set out herein and no officer, employee or agent of DSC or any other party has authority to promise, extend, or warrant other than as set out herein or as may be expressly agreed to by DSC in writing signed by the President of DSC. Under no circumstances whatsoever, does DSC warranty or will be responsible of any claim of lost profits, downtime, consequential damages, punitive damages or attorney fees arising out of the operation or non-operation of the equipment.

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Dredging Supply Company, Inc. periodically changes the information in the manuals; changes are incorporated into revisions or new editions. Dredging Supply Company, Inc. reserves the right to change product specifications without notice.

Dredging Supply Company, Inc. shall not be liable for technical or editorial errors or omissions contained herein, nor for incidental or consequential damages resulting from the furnishing, performance, or use of this material. Printing

BRENNAN

"Marine Professionals"
La Crosse, WI

Environmental Inspetion of Marine Equipment

Date of Inspection:

Job Location:	Equipment Going To:
Type of Equipment/Equipment Number:	Inspected by: (Signature)

Inspection of all marine equipment for the presence of invasive species and aquatic vegetation prior to its removal from the site is required.	Yes	No	N/A
1. Has all water been drained from the floating equipment?			
2. Have the bilges been checked?			
3. Have all visible plants, animals and mud been removed?			
4. Have the trailers been inspected?			
5. Was pressure washing required?			
6. Was steam cleaning required?			
7. Was a swipe test performed?			
8. Did the swipe test meet the requirements?			
9. Has the equipment been out of the water 5 days?			
9a. Date Removed and dried-			
9b. Date OK to be placed in new body of water-			
10. Has a copy of the inspection report been sent with the equipment?			
11. Has the inspection report arrived with the new equipment?			

Please keep a copy of this inspection on file at the new jobsite

Remarks:

J.F. BRENNAN CO., INC.
820 BAINBRIDGE · BOX 2557 · LA CROSSE, WI 54602-2557 PHONE: 608 / 784-7173 FAX: 608 / 785-2090

APPENDIX D

OPERATIONS MANUAL, EQUIPMENT MAINTENANCE SCHEDULE AND REPORT FORMS FOR TUGBOATS

MARINE INLAND FABRICATORS

MARINE INLAND FABRICATORS

"WORKHORSE" WORKBOAT OPERATORS MANUAL

J.F. Brennan Co., Inc.

Hull #123

PUBLISHED BY:
MARINE INLAND FABRICATORS,
A DIVISION OF
SISCO MARINE LLC
PANAMA CITY, FLORIDA

October 2008

MARINE INLAND
FABRICATORS

"WORKHORSE" WORKBOAT
OPERATORS MANUAL

CONTENTS

1.0 INTRODUCTION

Thank you for buying a Marine Inland Fabricators "WORKHORSE" workboat. We feel sure that your vessel will provide you with many years of service. The efficient operation and longevity of any vessel is, however, dependent upon proper and regularly scheduled maintenance.

It is the purpose of this manual to provide the owners of the 'WORKHORSE" work boats produced by Marine Inland Fabricators with information needed to properly operate and maintain these boats. This information is intended only as a guide, and does not substitute for information necessary for the operation or maintenance of equipment provided and manufactured by other parties. Rather, this document is intended to guide the user to the information required, and to provide information not available elsewhere. "WORKHORSE" workboats manufactured by Marine Inland Fabricators can be of various sizes, with customized contents and options. It is not the intent of this document to address all of these options. Only those options which are part of the "standard boat" will be covered.

The "WORKHORSE" boats are designed and built to be rugged and powerful workboats which are small enough to be transported easily and economically by truck over the highways to the work site. Since these boats often experience rough environmental conditions it is important that operators take care to maintain the equipment properly to prevent unnecessary or needless damage. Although we have attempted to include as much information in this document as possible, we are aware that we may have omitted some information that the operator may require. We will welcome your suggestions for inclusion in future issues of this manual.

2.0 Preparation for Delivery

Workboats built by Marine Inland Fabricators are constructed of quality materials. Construction of each boat is begun with the hull upside down. When the bottom of the boat including the engine keel coolers is completed, the boat is rolled over and the structure is completed. Pilot houses are built separately, including their outfitting. The boats are sand blasted to gray metal, and primer is applied to the surfaces. Engines and related hardware are then installed. Water and anti-freeze is added to the engine cooling system. Care is taken to remove air bubbles from the cooling system by opening the docking plug in the keel cooler to insure the complete filling of the cooler channels. When the cooler is full, the plug is replaced, and the engine water jacket is filled. The cooling water tank is filled, and water is added until a steady stream of water emits from the petcock on the top of the engine cooling manifold. Hydraulic oil is added to the steering system. Lubricating oil is added and the engine is started using fuel from an outside source. Steering, electrical, and propulsion systems are tested. After the systems test, the boats are cleaned up and finished. Marine Inland does not normally place the boat in the water for test prior to shipment. Should conditions require, or the owner desires such testing, this option is available.

Workboats are prepared for shipment by removing the pilot house and tagging all connections.

2.1 Job Site Assembly

When the boat is received, the owner must assemble the boat. The pilot house is to be bolted to its foundation with bolts supplied with the boat. Electrical wires from the bilge pump and the power cable from the battery to the pilot house fuse panel must be connected. These connections are tagged for ease of identification. The tagged Morse control cables for engine throttle, clutch, and steering must also be connected. Check all liquid levels to ensure that all systems are ready to operate. This can be accomplished as follows:

1. Check engine lubrication oil level, and transmission oil level.
2. Check hydraulic oil reservoir.
3. Check cooling water reservoir.

4. Loosen the external pipe plug on the after part of the keel cooler, observe water flow.
5. Loosen the internal pipe plugs to the keel coolers in the engine room, observe water flow.
6. Fuel the boat and Include biocide. Carefully inspect the fuel system for leakage.

2.2 Engine Start-Up

A separate operator's manual from the engine manufacturer has been enclosed for vessels equipped with new engines.

Prior to starting the engine, ensure that the propeller(s) and rudder(s) are clear of obstructions. It is recommended that the boat be started and tested prior to launching. It is good practice to wet the shaft bearings utilizing a water hose prior to turning the shaft. Place the engine control lever in neutral, and start the engines. With the throttles at idle, observe the water temperature and oil pressure gauges. Normal engine coolant operating temperature range is 170˚F to 202˚F. (Our experience is that testing can go on for more than 45 minutes without temperatures rising to more than 180°F. Temperatures should not be allowed to rise over 220°F.). Oil pressure should immediately rise. Normal oil pressure is rated at 55psi. ±15psi). Engines are set to idle at 700 RPM. After the water temperature has risen, and all checks are satisfactory, speed the engine to 1800 RPM. Slow back down to idle speed prior to engaging the clutch. Clutch is engaged by moving the single lever control valve forward. Observe the rotation of the propeller. Propellers should turn in the forward direction. Marine Inland boats normally are "inboard turning" for twin screw applications, and turn clockwise (looking from the rear) for single screw boats. Should a propeller turn in the wrong direction, shut the engine down, and determine the cause of the wrong direction rotation. The solution is a simple fix in most cases. Twin Disc marine transmissions, usually installed in Marine Inland Fabricators' boats, are built to run in either direction. If the control has been reversed, rotation can be corrected by switching the control cable connections.

After proper ahead rotation is observed, bring the engine to idle speed, move the clutch lever to neutral, and then to reverse. Ensure that the motion of the control lever on the transmission is fully engaged in each direction. It is possible that an adjustment to the control cable may be required.

The steering system should also be tested. The movement of the steering control lever causes the control valve to open, allowing hydraulic fluid to pass into the hydraulic cylinder, moving the rudder(s) in the direction of the steering lever motion. Release of the steering lever closes the control valve, locking the rudder(s) in position. It is advisable for an operator to get used to this action prior to boat operations. In boats where the flanking rudders are controlled independently, the flanking rudder system works in the same fashion as described above.

The propeller shaft passes through a packing gland which prevents water from leaking into the boat. When the boat is assembled, this gland is not pulled up tightly. This is done to allow the running of the propulsion system prior to launching. If it is pulled up too tightly, the shaft will rub on the packing, causing the shaft to heat up, and the packing will smoke. If this occurs, loosen the packing gland bolts. Prior to launch, the bolts should be tight. Prior to starting the shaft in water, loosen the packing gland bolts until the gland starts to leak. During operation, there should always be a small amount of leakage to prevent damage to the shaft and excess packing wear.

The engine is ready for normal operation. However, extra care during the first 100 hours will result in more satisfactory long-term engine performance and life. On John Deere engines, DO NOT exceed 100 hours of operation with break-in oil. After the first 100 hours maximum, change engine oil and replace engine oil filter. (See engine operator's manual for complete details.)

Marine Inland Fabricators does not normally apply "anti-fouling" paint to boats prior to shipment due to the length of time prior to launching and paint cure time requirements. Application of anti-fouling paint is recommended prior to launching. Installation of sacrificial zinc anodes for corrosion protection for boats operating in salt water is also recommended. When the owner is satisfied that all systems are operational, and all preparations are complete, the boat is ready to launch and operate.

3.0 OPERATION AND MAINTENANCE

The following sections are intended to describe the operation and maintenance of the installed equipment and systems. This information does not substitute for other manufacturers' equipment information. When there is any question concerning other manufacturer's equipment, that manufacturer should be contacted directly.

3.1 Electrical System

The electrical system is a 12 volt grounded system. The power is supplied by a 65 amp alternator to a 12 volt marine battery. The basic system is illustrated in Figure 3-1. Table 3-1 is a list of electrical components.

Table 3-1: Electrical Components

Spot light (CLY, STA, MUS)	7 inch, sealed beam, 250,000 CP, Perko fig. 314
Spot light (COL)	5 inch, sealed beam 100,000 CP remote control Jabsco Ray-Line 135SL
Dome light	4 inch 15W double contact bayonet bulb
Running lights	1-Red, 1-Green, 2-Amber, 2-White (Perko fig. 170)
Fuse Panel	6 Gang, 12V
Starter button	Key operated
Engine stop button	Key operated
Water Temperature gauge	electronic
Oil pressure gauge	electronic

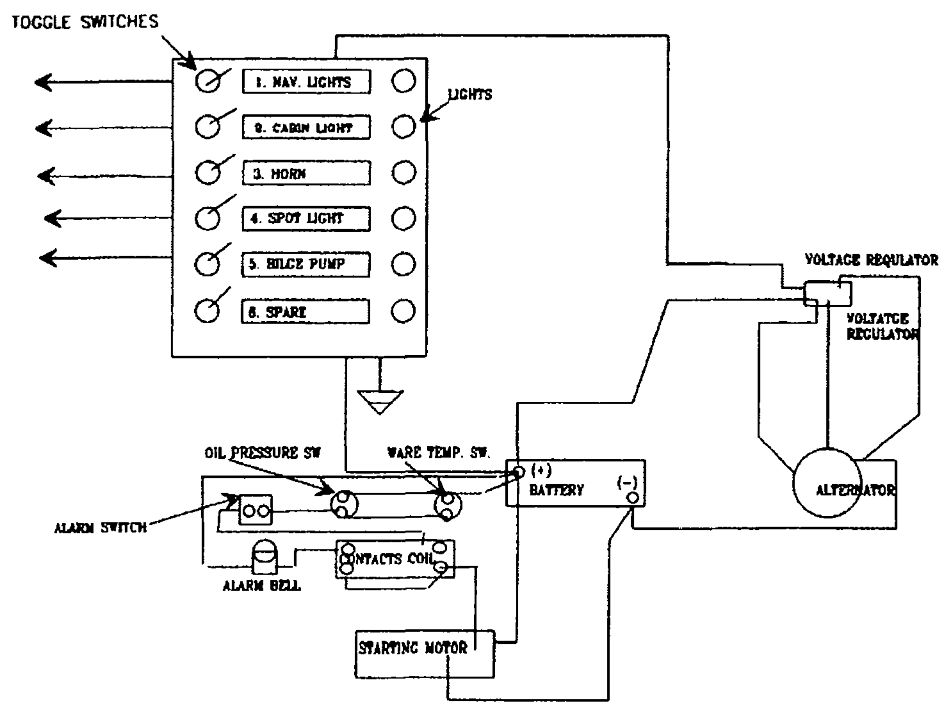

FIGURE 3-1: ELECTRICAL SYSTEM

3.2 Control System

The standard engine controls consist of a control head with Morse 43C cables. An option available is "single lever" controls manufactured by Morse Control. For twin screw applications, 2 single head controls are installed. The control heads are connected to the engines via Morse 43 C cables. Parts for the standard system are listed in Table 3-2.

The engine controls are common to the boating industry. The operation consists of starting the engine utilizing the key start switch, generally located on the John Deere control panel, while the engine control lever is in neutral position and throttle is at minimum setting. Care should always be taken to place the throttle(s) at minimum speed, until the engine has actually slowed prior to shifting the propeller direction from ahead to reverse, or from reverse to forward direction. This is important to prevent damage to the transmission. Required maintenance of the engine controls is minimal. Prevention of corrosion should be accomplished through the regular application of petroleum oil or grease products to the cables and exposed fittings. Periodically, the adjustment of the clutch control lever on the transmission and the throttle and steering links should be confirmed to insure full travel in the engaged positions.

Steering control is provided through the hydraulic system. Figure 3-2 illustrates a typical installation. Parts for the standard system are also listed in Table 3-2.

The boats built by Marine Inland are equipped with variations of the standard steering system. Variations include a single rudder, or dual rudders ganged together, or a single rudder ganged to flanking rudders, or dual rudders and a set of flanking rudders independently controlled. When the rudders and the flanking rudders are controlled separately, the systems work identically. Rudder position indicators are not normally installed. Experience has shown that rudder and flanking rudder positions are easily observed from the operator position. Care must be taken during operations to return flanking rudders to desired positions.

System operations can be easily analyzed. The hydraulic pump is in operation when the engine is running, delivering high pressure (2000 psi, minimum) through the control valve. While the control lever calls for no rudder motion, the hydraulic fluid flows freely between the reservoir, the control valve, and the engine driven hydraulic pump. When rudder motion is required, the control lever is pushed in that direction. This moves the control valve, opening the valve port to the cylinder. As long as the control valve is held open, the rudder will continue to move until it reaches the desired position, or runs into the positive stop. When the rudder reached the end of its travel, pressure increases in the system, and the bypass valve opens. When the control lever is returned to neutral position, the control valve is closed, and the rudder is locked in place. To return the rudder to center position, the process is reversed, and the control lever is moved in the opposite direction. Rudder position is easily observed by looking at the steering mechanism, or at the wake.

Hydraulic systems are rugged. However, care must be taken to maintain proper operating conditions.

The hydraulic oil supply must be maintained. Prior to engine startup, check the liquid level, insuring that the tank is full. Always operate with the cover tightly installed to prevent contamination. After every 100 hours of operation change the hydraulic filter element.

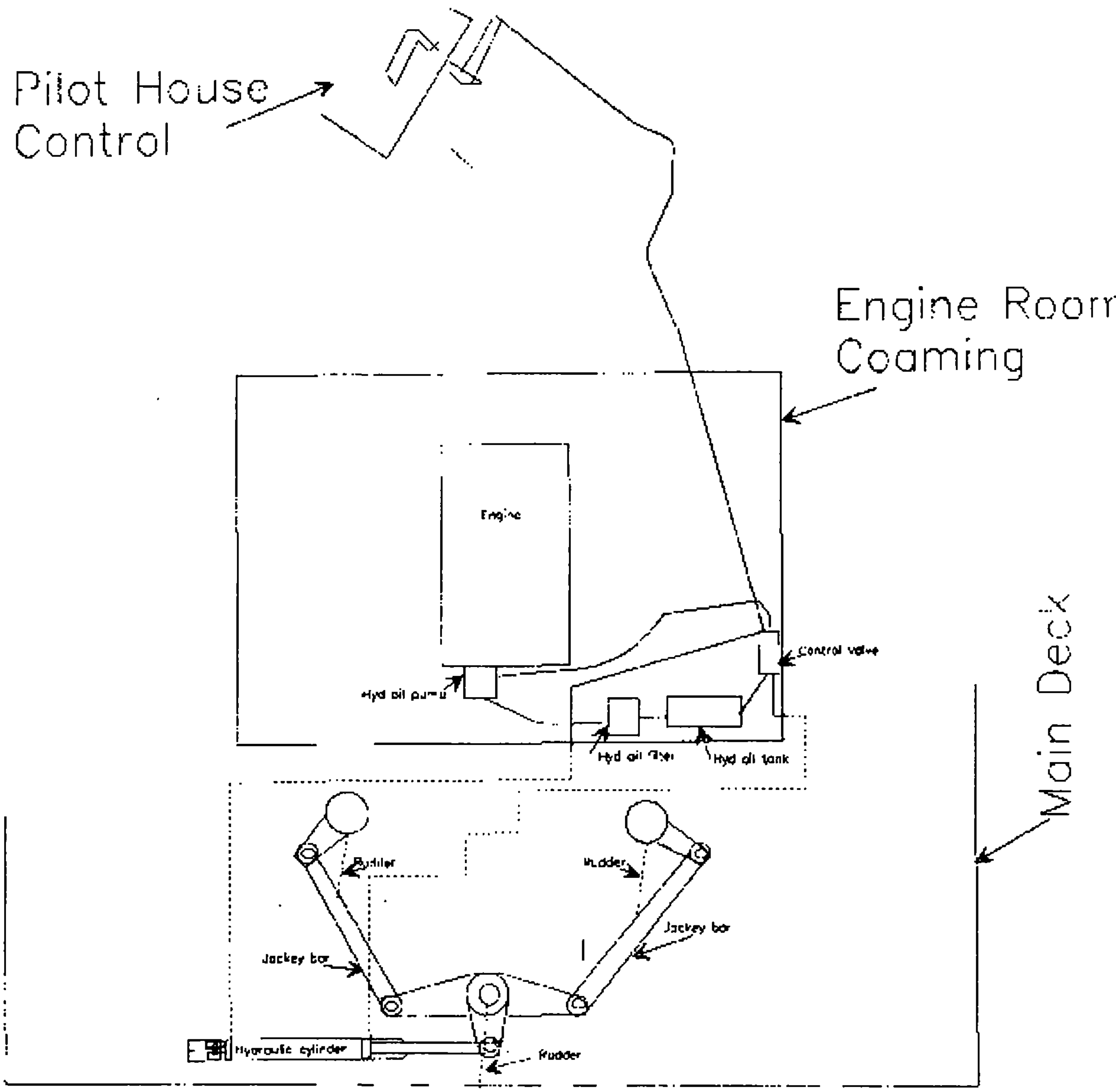

Figure 3.2 Steering Control System

Table 3.2 Steering Control Components

Component	Manufacturer	Identifier
Engine Controls		
Twin lever control	White Cliff	
Single Lever Control	Morse	
Control cable	Morse	43C (Various lengths)
Pilot House Options:		
Top steering stations		
Throttle Unit	Morse	DS
Clutch Unit	Morse	DS
Selector Lever	Morse	
Adapter Kit	Morse	for 43C
Clevis	Morse	
Pivot fitting	Morse	
Steering Control System		
Hydraulic Pump	Rexroth	11 GPM
Control Valve	Gresen	Single Spool, SP, open center. Built in load checks.
For Twin Screw Boats		
Control Valve	Gresen	"SP", 2 spool
Hydraulic Cylinders For 14Ft 12Ft, and 1O Ft wide Boats		
Cylinder	Prince Hydraulics	2" bore, 18" stroke, 1-1/8" rod, double acting
For 8 Ft wide Boats		
Cylinder	Prince Hydraulics	2" bore, 16" stroke, 1-1/8" rod, double acting
Hydraulic Filter	Prince Hydraulic	20 GPM, built in bypass, mat pressure 100 psi 33 micron
Shut off valve		3/4" Gate Valve

3.3 Engine Room Equipment

Marine Inland Fabricators' boats are constructed to be powered by diesel engines manufactured by various suppliers. Most of the boats are equipped with John Deere engines that were purchased new by Marine Inland Fabricators for the express purpose of powering the boats built by MIF. The procedures found in this manual were obtained from the manufacturers operator's manual, which is supplied by Marine Inland Fabricators.

3.3.1 John Deere Engines.

The John Deere engines used by Marine Inland Fabricators were specifically designed and built for marine use.

Coolant is circulated through the engine by a centrifugal water pump. Heat is removed from the coolant, which circulates to the keel cooler installed on the bottom of the boat.

Trouble shooting and repair procedures are published in the engine manufacturers manuals produced for that purpose. The following maintenance chart is provided for operator convenience only. The time intervals are those provided by John Deere for their engines, and are repeated here for the convenience of the boat operator. See engine operator's manual for detailed maintenance procedures for your particular engine model.

LUBRICATION AND MAINTENANCE CHART
(REFERENCE TO NOTES BELOW)

ITEM	DAILY	250 HR./6 Month	500 HR./12 Month	2000 HR./24 Month	As Required
Check Engine Oil and Coolant Level	■				
Check Fuel/Water Separator Bowl	■				
Check Air Filter	■				
Visual Walk-around Inspection	■				
Service Battery		■			
Change Engine Oil and Filter (a)		■			
Check Coolant Pump Weep Hole Foam Filter		■			

ITEM	Daily	250 HR./6 Month	500 HR./12 Month	2000 HR./24 Month	As Required
Check Engine Mounts		■			
Inspect and Replace Zinc Plugs		■			
Clean Crankcase Vent. System			■		
Replace Closed Crankcase Vent Filter (if equipped)			■		
Check Air Intake Hoses, Connection and System			■		
Replace Primary and Secondary Fuel Filter Elements (b)			■		
Service Fuel Tank (c)			■		
Check Belt Wear			■		
Check Cooling System			■		
Coolant Solution Analysis-Add SCAs as required			■		
Check Engine Speeds			■		
Check Crankcase Vibration Damper (d)			■		
Pressure Test Cooling System			■		
Inspect and Clean Heat Exchanger Core (if equipped)			■		
Check Engine Electrical Ground Connection			■		
Flush and Refill Cooling System (e)				■	
Test Thermostats				■	
Adjust Engine Valve Clearance				■	
Drain Water Separator Bowl When Alarm Sounds (f)					■
Add Coolant					■
Service Air Cleaner Element					■
Replace Alternator Belt					■
Check Fuses					■
Bleed Fuel System					■

NOTES

(a) Change the oil for the first time before 100 hours maximum of (break-in) operation, then every 250 hours thereafter. If PLUS-50 or ACEA E4/E5 oil is used along with a John Deere oil filter, the oil change interval may be extended by 50 percent to 375 hours.

(b) Also replace fuel filter elements anytime audible alarm sounds and trouble codes indicate plugged fuel filters (low fuel pressure). If no alarm sounds during the 12 month service interval, replace elements at that time, or after 500 hours of operation, whichever comes first.

(c) Check fuel level. Keep tanks filled to reduce condensation. Open the drain every 500 hours to drain off water or sediment. Tighten all fuel tank mounting brackets and fittings. Check seal of the tank fill cap. Replace damaged parts as necessary.

(d) Replace crankshaft damper at 4500 hours or 60 months, whichever occurs first.

(e) If John Deere COOL-GARD is used, the flushing interval may be extended to 3000 hours or 36 months. If John Deere COOL-GARD is used and the coolant is tested annually AND additives are replenished by adding supplemental coolant additives (SCAs), the flushing interval may be extended to 5000 hours or 60 months, whichever occurs first.

(f) Replace fuel filter element when audible alarm sounds and trouble codes indicate plugged fuel filter (low fuel pressure). If no alarm sounds during the 12 month interval, replace element at that time, or after every 500 hours of operation.

3.4 Transmission

3.4.1 Twin Disc Marine Gears

Marine Inland Fabricators includes as standard equipment "Twin Disc" made marine transmissions. Refer to the transmission "Users Manual" for information pertaining to the use and maintenance of the transmission.

3.4.2 General Maintenance

The following section is intended as only a general guide to maintenance. For procedures specific to your particular model of transmission, refer to the manufacture's manual.

Many daily maintenance checks can be made by the operator. It is recommended that anything the operator is not sure about or has not been trained for, other than the simple daily checks, should only be accomplished by authorized personnel. Proper care and maintenance will ensure long service with a minimum of operating expense.

Preventive Maintenance is performed to reduce the possibility of any problem in operation. These procedures include checks to determine if the equipment is in good condition. Daily checks should be performed before operation of the boat.

General Maintenance

1. Check oil level daily or every 10 hours of engine operation. Check with engine running at low idle and with marine transmission in neutral. Transmission oil temperature should be in normal operating range prior to checking oil level. See Owner's Manual.
2. If your unit is equipped with a lubrication fitting, grease the oil seals at the output end of the transmission output shaft with water pump grease through the lubrication fitting. See Owner's Manual for location of fitting. Apply grease every 100 hours or when boat is docked. No other lubrication is required.
3. With a new transmission, change the oil and filter element within first 50 hours of operation. Change oil and filter element after each 1000 hours of operation, or six months, whichever comes first. The oil may need to be changed more frequently if conditions warrant. See Owner's Manual for Filter and Oil Change Interval for a rebuilt transmission.
4. See lubrication plate for oil capacity. Capacity will be internal quantity required to fill transmission to proper level, but may NOT include quantity to fill external hoses and heat exchanger.
5. Do not obstruct the flywheel housing vents preventing the free flow of air for cooling the coupling. Life of the coupling may be reduced if the ambient temperature of the air around the coupling is outside the operating range. Operating air temperatures above 22°F and below

180°F should be maintained. If possible, visually inspect the coupling after the first 100 hours of operation and every 2000 hours thereafter, or every six months, whichever occurs first.

6. At the engine overhaul interval, or more frequently, inspect all transmission bearings and replace as necessary.
7. Overhaul the transmission at the same time the engine is overhauled.
8. See Marine Transmission Owner's Manual for more detailed and additional information.

3.5 Shaft and Stern Tube

The propulsion shafting installed in Marine Inland Fabricators boats is manufactured from cold drawn steel round stock, machined to fit the propeller hub and the coupling. If a replacement shaft is ever required, a local machine shop should be contacted.

The shaft is installed in a stern tube that penetrates the hull. This tube contains the stern tube bearing which supports the weight of the shaft and propeller. Marine Inland Fabricators installs a Cutlass bearing fitted in the stern tube. These are sized as follows:

SHAFT SIZE	CUTLASS BEARING SIZE
2″	2″ x 3″
2-¼″	2-¼″ x 2-15/16″
2-½″	2-½″ x 3-3/8″

The bearings will wear and the staves will need to be periodically replaced.
Seasonal inspection, and inspection whenever the propeller is removed, is recommended.

Water is prevented from entering the boat from around the shaft by a Stuffing Box. Packing is installed around the shaft, preventing water from flowing in around the shaft it is important to understand that this type of sealing device is designed for some leakage during operation. If the gland is too tight, and no water is allowed to flow around the shaft, friction between the shaft and the packing will wear the shaft, and may cause the shaft to heat. If this condition is allowed to continue, smoke may be observed from the packing, and damage to the shaft and the packing gland may occur. Proper adjustment of the packing gland is to allow a small amount of water to flow into the boat. If desired, when the boat is scheduled to sit idle for a period of time, the gland may be tightened to prevent leakage. It must then be adjusted to allow leakage prior to start up of the engine.

Maintain proper operation of the shaft packing gland. Check the gland adjustment prior to and just after engine startup. Check for excessive leakage after each shutdown and prior to securing the boat. Repack the packing gland on a regular basis, depending on usage and wear.

3.6 Propellers

Marine Inland Fabricators installs propellers supplied by various manufacturers. Those normally supplied are the "Workhorse Style" propellers manufactured by Michigan Wheel Corp.

When a replacement propeller is required, it is important to match the diameter, pitch, and rotational direction to the original installation. Local environmental and working conditions may make different propeller diameter and pitch dimensions more desirable. If there are such considerations, contact Marine Inland Fabricators and/or the propeller manufacturer for advice.

Marine Inland Fabricators normally installs bronze propellers as listed.

Table 3-6. Propeller Sizes and Rotational Direction

VESSEL	BEAM	Propeller Size	Diameter x Pitch	DIRECTION
COLT	8 Ft.	24" x 12"	4 blade, 1-¾" bore	Right Hand
MUSTANG	10 Ft.	26" x 22"	4 blade, 2" bore	Right Hand
STALLION	12 Ft.	30" x 16"	4 blade, 2-¼" bore	Right Hand
CLYDESDALE	14 Ft.	2- 30" x 16"	4 blade, 2-¼" bore	Right Hand and Left Hand

3.7 Rudders

The rudders installed on Marine Inland Fabricators' boats are fabricated from 1/4" thick steel plate. They are reinforced by 3/8" by 2" flat-bar stock, welded to both sides of the plate. The rudder stocks are made from 2" cold drawn round stock, welded into the rudder structure. These rudders are installed into position through a tube, which is welded into the hull structure, penetrating both the boat shell, and the deck. This type of construction does not require any packing glands. Oil impregnated bronze bushings are installed in rudder tubes and rudder shoes.

Care should be taken to maintain the rudder installation in good working condition. Should damage occur, good practice would dictate common straightening procedures, or replacement if necessary.

3.8 Deck Equipment

Marine Inland Fabricators builds boats for many applications. Consequently deck equipment may vary widely depending on owner preference. It is also recognized that no matter how simple the installation may be, the proper operation and maintenance of that equipment is essential to the safety of the crew and of the boat.

Normal deck equipment installed includes manual deck winches, rub bars on the sides, lifting eyes, push knees, and bulwarks.

Push Knees

Push knees are installed for various purposes, and may be constructed of various heights, depending on the application. They are intended for use in pushing other craft on the water. They are not built for impact against other craft. Care must be taken to ensure gradual contact with the pushed craft to prevent damage to either craft. Rubber pads are installed to help prevent damage in towing operation. The pads installed are 2" thick rubber bonded to 1/2" steel plate. The plates are welded to the structure.

Bitts

Depending on the boat size and application, various bitts are installed. The double towing bitts, and single quarter bitts installed by Marine Inland Fabricators are fabricated from 4" Schedule 40 pipe, and 1-¼" cold drawn steel round stock

Rub Bars

Rub bars are generally installed 4" below the deck edge, down each side. The purpose of the rub bars is to make contact first with any other craft, dock or piling.

Lifting Eyes

Four permanent straps, made from ½" plate are welded to the hull in position to act as lifting attachments for the boat. These eyes are sized for handling the boat in its "as constructed" configuration. Should modifications be made to the boat, or unusual heavy weight is added to the boat, care should be taken to insure that the lifting eyes are adequate for safe operation.

Bulwarks

Bulwarks are installed in various configurations, depending on owner preferences and boat applications. In most cases they are intended to retain loose tools and lines during normal operation. They are not intended for use as life lines, or life saving equipment.

Hand Winches

Marine Inland Fabricators normally provides 1, 2 or 3 ton capacity manually operated deck winches. These winches are intended for tensioning the wires attaching the boat to its tow. These winches are rugged pieces of equipment, but they do have limited capacity. It is possible under certain conditions to overload this equipment. Care should be taken to operate this equipment properly.

3.11 Pilothouse Equipment

Pilot houses supplied with Marine Inland Fabricators' boats are built to provide the operator with the equipment required to operate the boat. Various applications may require additional equipment, which can be supplied at owner's discretion. Pilot houses may be installed on a pedestal to increase the eye level to a more desirable height. Some Pilot houses are installed on top of the engine room cover. If additional height is desired, a control position may be installed on the top of the pilot house. The equipment normally provided is listed in section 4, table 4.0.

4.0 Vessel Specifications and Parts List

The hulls of the "WORKHORSE" boats are rectangular in shape, raked at the bow with a head log and transom. Shell plating is generally 1/4-inch steel plate. Pilothouses are placed on a pedestal above the deck or on top of the engine house. Options are offered for single or twin, new or rebuilt engines which may be of increased horsepower. Options for flanking rudders are also offered. The boats are generally built in accordance with the information listed in Table: 2.0

Table 4.0

Marine Inland Fabricators "WORKHORSE" Workboats with Standard Options

MODEL:	**CLYDESDALE**	**STALLION**	**MUSTANG**	**COLT**
Dimensions	25′ 3″ x 14′ x 5′	25′ 3″ x 12′ x 4′	25′ 3″ x 10′ x 3′ 6″	20′ 3″ x 8′ x 3′
Displacement	25,000# approx.	20,000# approx.	18,000# approx.	9,500# approx.
Deck Frames	Longitudinally 3″ x 3″ x ¼″ angle 24″ centers	Longitudinally 3″ x 2″ x ¼″ angle on 24″ centers	Longitudinally 3″ x 2″ x ¼″ angle on 24″ centers	Longitudinally 3″ x 2″ x ¼″ angle on 19″ centers
Side Frames	Longitudinally 3″ x 3″ x ¼″ angle 20″ centers	Longitudinally 3″ x 2″ x ¼″ angle on 24″ centers	Longitudinally 3″ x 3″ x ¼″ angle on 21″ centers	Longitudinally 3″ x 2″ x ¼″ angle on 18″ centers
Bottom Frames	Transverse 4″ x 3″ x ¼″ angle 20″ centers	Transverse 4″ x 3″ x ¼″ angle on 20″ centers	Transverse 3″ x 3″ x ¼″ angle on 20″ centers	Transverse 3″ x 3″ x ¼″ angle on 20″ centers

MODEL:	CLYDESDALE	STALLION	MUSTANG	COLT
Engine	2- John Deere 6081 diesel engines	1- John Deere 6068 diesel engine	1- John Deere 6068 diesel engine	1- John Deere 4045 diesel engine
Engine Options	New Cummins, Caterpillar, Detroit Diesel or equivalent	2-John Deere 4045 diesel engines or New Cummins, Cat, Detroit Diesel or equivalent	New Cummins, Caterpillar, Detroit Diesel or equivalent	New Cummins, Caterpillar, Detroit Diesel or equivalent
Reduction Gear	2-Twin Disc MG-5075 w/ 2.43:1 reduction	1- Twin Disc MG-5061 w/ 2.43:1 reduction	1- Twin Disc MG-5061 w/ 2.43:1 reduction	1- Twin Disc MG-5011 w/ 2:1 reduction
Propeller Shafts	Two 2-¼″ diameter cold drawn steel	One 2-¼″ diameter cold drawn steel	One 2″ diameter cold drawn steel	One 1-3/4″ diameter cold drawn steel
Propeller	2- 30" x 16" 4-blade bronze propellers	1- 30″ x 16″ 4-blade bronze propeller	1-26" x 22″ 4-blade bronze propeller	1-24″ x 12″ 4-blade bronze propeller
Stern Bearings	Two 2¼″ x 2-$^{15}/_{16}$″ x 9″ Cutlass, Johnson code name: CARE	One 2¼″ x 2$^{15}/_{16}$″ x 9″ Cutlass, Johnson code name: CARE	One 2″ x 3″ x 8″ Cutlass, Johnson code name: CALM	One 1¾″ x 2$^{3}/_{8}$″ x 7″, Johnson code name: BROW
Stuffing Box	Two PYI drip less shaft seals	One PYI drip less shaft seal	One PYI drip less shaft seal	One PYI drip less shaft seal
Exhaust	Through stacks	Through stack(s)	Through main deck	Through main deck
Exhaust Options	None	None	Stack	Stack

MODEL:	CLYDESDALE	STALLION	MUSTANG	COLT
Fuel Tank	350 gallons	250 gallons	180 gallons	110 gallons
Engine Cooling	Closed fresh water keel cooling system, 30 gallon capacity per engine.	Closed fresh water keel cooling system, 30 gallon capacity.	Closed fresh water keel cooling system, 30 gallon capacity.	Closed fresh water keel cooling system, 20 gallon capacity.
Rudders	2 main steering, ¼" plate, 3/8″ x 2″ flat bar bracing. Rudder shafts 2″ cold drawn steel.	1 main steering and 2 flanking rudders of ¼" plate with 3/8″ x 2″ flat bar bracing. Rudder shafts of 2″ cold drawn steel.	1 main steering and 2 flanking rudders of ¼" plate with 3/8″ x 2″ flat bar bracing. Rudder shafts of 2″ cold drawn steel.	1 main steering and 2 flanking rudders of ¼″ plate with ¼″ flat bar bracing. Rudder shafts 1-½″ cold drawn steel.
Rudder Options	Four flanking rudders of ¼″ plate braced 3/8″ x 2″ flat bar. Rudder shafts 2″ cold drawn steel.			
Electrical System	2 12-volt marine batteries mounted in battery box	1 12-volt marine batteries mounted in battery box	1 12-volt marine batteries mounted in battery box	1 12-volt marine batteries mounted in battery box

MODEL:	CLYDESDALE	STALLION	MUSTANG	COLT
Bilge Pump	1-12 volt "Rule" 1000 GPH pump	1-12 volt "Rule" 1000 GPH pump	1-12 volt "Rule" 1000 GPH pump	1-12 volt "Rule" 1000 GPH pump
Hydraulics	2 hydraulic pumps, one driven off each engine. "Gresen SP" control valve and "Prince" flow regulator in engine room. Single 2″ x 18″ double acting hydraulic cylinder controls main steering rudders.	1 hydraulic pump driven off main engine, "Gresen SP" control valve and flow regulator in engine room. Single 2″ x 18″ double acting hydraulic cylinder controls main and flanking rudders.	1 hydraulic pump driven off main engine, "Gresen SP" control valve and flow regulator in engine room. Single 2″ x 18″ double acting hydraulic cylinder controls main and flanking rudders.	1 hydraulic pump driven off main engine, "Gresen SP" control valve and flow regulator in engine room. Single 2″ x 16″ double acting hydraulic cylinder controls main and flanking rudders.
Hydraulics Options	Single cylinder with twin spool hydraulic control valve controls main and flanking rudders			
Engine Controls	"Morse MT-3" Control head with Morse 43C cables	"Morse MT-3" Control head with Morse 43C cable(s)	"Morse MT-3" Control head with Morse 43C cable	"Morse MT-3" Control head with Morse 43C cable

MODEL:	CLYDESDALE	STALLION	MUSTANG	COLT
Pilot House	4′ x 4′ 6″ x 7′ Elevated on 7 ft. pedestal or mounted on top of engine box	4′ x 4′ 6″ x 7′ Elevated on 7 ft. pedestal or mounted on top of engine box	4′ x 4′ 6″ x 7′ Mounted on top of engine box	46′ x 36′ x 78″ Mounted on top of engine box
Height of Eye	15′ 6″ from pilothouse	15′ from pilothouse	9′ from pilothouse	8′ 6″ from pilothouse
Pilot House Equipment	1-Overhead cabin light, 15W double contact bayonet bulb 1-Six gang 12-volt fused switch panel. 1-Front window 4′ x 3′ horizontal slide, tempered safety glass 2-Side windows 3′ x 3′ horizontal slide, tempered safety glass 2-Rear windows 15″ x 30″ vertical slide, tempered safety glass(one mounted in steel door) 1-7″ seal beam 250,000 CP search light, Perko fig. 314 1-single bugle horn.	1-Overhead cabin light, 15W double contact bulb 1-Six gang 12-volt fused switch panel. 1-Front window 4′ x 3′ horizontal slide, tempered safety glass 2-Side windows 3′ x 3′ horizontal slide, tempered safety glass 2-Rear windows 15″ x 30″ vertical slide, tempered safety glass (one mounted in steel door) 1-7″ seal beam 250,000 CP search light, Perko fig. 314 1-single bugle horn.	1-Overhead cabin light, 15W double contact bayonet bulb 1-Six gang 12-volt fused switch panel. 1-Front window 4′ x 3′ horizontal slide, tempered safety glass 2-Side windows 3′ x 3′ horizontal slide, tempered safety glass 2-Rear windows 15″ x 30″ vertical slide, tempered safety glass (one mounted in steel door) 1-5″ remote control seal beam 100,000 CP Jabsco Ray-Line 135SL search light, 1-single bugle horn.	1-Overhead cabin light 1-Six gang 12-volt fused switch panel. 1-Front window 4′ x 3′ horizontal slide, tempered safety glass 2-Side windows 2′ x 3′ horizontal slide, tempered safety glass 1-5″ remote control seal beam 100,000 CP Jabsco Ray-Line 135SL search light 1-Single bugle horn.

MODEL:	CLYDESDALE	STALLION	MUSTANG	COLT
Pilot House Framing	-3/16″ plate -Side frames 3/8″ x 2″ flat bar. -Overhead framed 2″ x 2″ x 1/4″ angle. -Bottom framed 3″ x 2″ x 1/4″ angle.	-3/16″ plate -Side frames 3/8″ x 2″ flat bar. -Overhead framed 2″ x 2″ x ¼″ angles. -Bottom framed 3″ x 2″ x ¼″ angle	-3/16″ plate -Side frames 3/8″ x 2″ flat bar. -Overhead framed 2″ x 2″ x 1/4″ angle.	-3/16″ plate -Side frames ¼″ x 2″ flat bar. -Overhead framed 2″ x 2″ x 1/4″ angle.
Winches	2- 5 ton Nabrico manual winches	2- 2 ton Nabrico manual winches	2- 2 ton Nabrico manual winches	2- 1 ton "Wintech BM6" hand operated winches
Bitts	1-Double towing bitt. 1-Double head bitt. 4-Single quarter bitts	1-Double towing bit, 1-Double head bitt 4-SIngle quarter bitts	1-Double towing bitt 1-18″ kevel at head log 4-18″ kevels on quarters	1-Double towing bitt 1-18″ kevel at head log 4-18″ kevels on quarters
Rub Bars	20′ x ½″ x 4″ flat bar down each side of hull	20′ x ½″ x 4″ flat bar down each side of hull	20′ x ½″ x 4″ flat bar down each side of hull	18′ x ½″ x 4″ flat bar down each side of hull
Lift Eyes	4-Permanent straps welded to hull	4-Permanent straps welded to hull	4-Permanent straps welded to hull	4 -Permanent straps welded to hull
Bulwarks	Continuous all around hull, 14″ high, capped with ¼″ x 2″ flat bar.	Continuous all around hull, 12″ high, capped with ¼″ x 2″ flat bar.	Continuous all around stern and forward 5′. Extend 10″ above deck, capped with ¼″ x 2″ flat bar.	Continuous all around stern and forward 4′ 6″. Extend 10″ above deck, capped with ¼″ x 2″ flat bar.

MODEL:	CLYDESDALE	STALLION	MUSTANG	COLT
Push Knees	12″ x 20.7# channel extends 54″ above deck. Braces are ¼″ plate finished with 3/8″ x 2″ flat bar. Pads are 2″ thick rubber bonded to ½″ x 10″ steel backing plate.	12″ x 20.7# channel extends 54″ above deck. Braces are ¼″ plate finished with 3/8″ x 2″ flat bar. Pads are 2″ thick rubber bonded to ½″ x 10″ steel backing plate.	12″ x 20.7# channel extends 36″ above deck. Braces are ¼″ plate finished with 3/8″ x 2″ flat bar. Pads are 2″ thick rubber bonded to ½″ x 10″ steel backing plate.	12″ x 20.7# channel extends 33″ above deck. Braces are ¼″ plate finished with 3/8″ x 2″ flat bar. Pads are 2″ thick rubber bonded to ½″ x 10″ steel backing plate.

4.1 Paint

Marine Inland Fabricators thoroughly prepares each boat for the application of paint. The paint system, manufactured by Jotun Paints (formerly PRS), is a hard marine epoxy suitable for salt or fresh water environments and abrasion resistant. The paint is capable of long life but surface damage from daily boat operation is inevitable. To assist the operator in maintenance, the following information is provided:

Location	Preparation	Application
Exterior Hull, Main Deck and below	Sand blast	Apply one coat of High Build Hydrocarbon, two part epoxy Color -Black
Bulwark, Bitts, Winch Mounts, Tow Knees	Sand blast	Apply two coats High Build Hydrocarbon, two part epoxy topcoats Color –Black
Engine Room Interior		Sprayed 2-part epoxy anti-corrosive steel Apply one coat High Build Hydrocarbon 2 part epoxy topcoat Color -Light gray
Above Main Deck, Inside and Outside	Sand blast	Apply two coats High Build Hydrocarbon, two part epoxy topcoats Color-White

5.0 Vessel Characteristics

The workboats are built for industrial utility service. They are regularly used for many different tasks in inland and protected waters. They are not built for ocean service, and generally they are not "built to class" by the American Bureau of Shipping. The general characteristics are listed in table 5-0.

Table 5-0: Workboat Characteristics

MODEL	CLYDE5DALE	STALLION	MUSTANG	COLT
Length (molded)	25 feet	25 feet	25 feet	20 feet
Beam(molded)	13 ft. 10-3/4 in.	11 ft. 10-3/4 in	10 ft.	8 ft.
Depth(molded)	5 ft.	4ft.	3 ft. 6 in.	3 ft.
Displacement (All weights approximate)	25,000	20,000	18,000	9,500
Draft (Navigational)	3′ 9″	3′ 3″	3′	2′ 8″
Speed (Max)	7 knots	7 knots	7 knots	6 knots
Freeboard (at Stem)	12″	10″	9″	8″
Longitudinal Center of Buoyancy (from Head log)	12.3 ft.	12.3 ft.	12.3 ft.	10.2 ft.
Center of Gravity (From Head log)	12.3 ft.	12.3 ft.	12.3 ft.	10.2 ft.

The characteristics listed in Table 5-0 are applicable to Marine Inland boats in general. However, the centers of buoyancy and gravity are applicable to the configurations listed in the tables, and may differ for a particular configuration. They are supplied for reference information. Care should be taken when loading the boat with high weights, particularly forward, where the transom may be raised above the water, reducing longitudinal and transverse stability, and reducing the propeller efficiency. Conditions may require the placement of ballast weight in the stem compartment to ensure a seal over the propeller, and to ensure adequate stability.

The navigational draft is different from the depth of the boat hull. The boat normally floats, as outfitted, slightly down by the stem. The bottom of the shoe under the rudder is the deepest point, and would normally ground first. The keel Coolers are also mounted under the hull, extending approximately 2 inches below the hull plate. If the boat strikes a hard object in this area, the boat bottom should be inspected for cooler damage.

OPERATORS

MANUAL
**
HULL

123

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APPENDIX E

MAINTENANCE SCHEDULES AND REPORT FORMS

FOR EXCAVATION EQUIPMENT AND CRANES

BRENNAN

"Marine Professionals"

Excavator Case 9050B
Operators Weekly Report

Week Ending ____________________

Operator ____________________

Job # ____________________

Serial # 47H11511

JFB Asset # 1010

Hours at end of week ____________________

Daily fluid checks

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
Engine Oil, added							
Hydraulic oil, added							
Coolant, added							
Gallons of fuel pumped this shift							

Grease and Inspection Schedule

These items must be checked every 8 Hours of operation, note damage or excessive wear

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
Bucket and Bucket Control Likage							
Track - Inspect For Proper Tension / Adjust							
Track Guiding guards - Inspect For Loose or missing bolts							
Engine Area - Inspect For Leaks & Remove Trash							
Engine Dust Valve & Dust Cup							
Engine Precleaner Screen - Remove any dirt or debris							
Check Tension Of The Three Drive Belts							

These items must be greased or checked every 50 hours of operation

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
Grease Boom Pivot Area							
Grease Boom Cylinders							
Grease Arm Pivot Area							
Grease Bucket Pivot							
Grease Bucket Linkage Pivots							
Air Pressure Reservoir - Drain Water							
Check Battery Condition & Fluid Level							

Repairs Needed / Comments

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Backhoe Meters

Hyundai 450 JFB1035	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
lubricate turntable bearings (3 fittings)	250h	7-May-08	399	533	3-Oct-08	134
change engine oil and filter	250h	7-May-08	399	533	3-Oct-08	134
replace coolant filter	250h	7-May-08	399	533	3-Oct-08	134
replace fuel filter	250h	7-May-08	399	533	3-Oct-08	134
drain water from the fuel tank	250h	7-May-08	399	533	3-Oct-08	134
check swing gearbox oil level	250h	7-May-08	399	533	3-Oct-08	134
clean/replace inner, outer and cab air filters	250h	7-May-08	399	533	3-Oct-08	134
inspect fan,alternator, belts, and batteries	250h	7-May-08	399	533	3-Oct-08	134
lubricate swing ring gear	500h	7-May-08	399	533	3-Oct-08	134
change swing gear reducer oil	1000h	5-Jun-07	399	533	3-Oct-08	134
change final drive oil	1000h	5-Jun-07	399	533	3-Oct-08	134
Sample hydraulic oil	1000h	5-Jun-07	399	533	3-Oct-08	134
replace hydraulic pilot line filter	1000h	5-Jun-07	0	533	3-Oct-08	533
replace hydraulic return filter	1000h	5-Jun-07	0	533	3-Oct-08	533
[illegible]n hydraulic suction filter	1000h	5-Jun-07	0	533	3-Oct-08	533
replace hydraulic drain filter	1000h	5-Jun-07	0	533	3-Oct-08	533
replace inner air filter	1000h	29-Sep-04	0	533	3-Oct-08	533
replace outer air filter	1000h	29-Sep-04	0	533	3-Oct-08	533
replace nephron (ultra clean) filter	1000h	5-Jun-07	0	533	3-Oct-08	533
Inspect undercarriage	2000h	5-Jun-07	0	533	3-Oct-08	533
change hydraulic oil	2000h	24-Jul-07	0	533	3-Oct-08	533
repalce hydraulic suction filter	2000h	5-Jun-07	0	533	3-Oct-08	533
change radiator system coolant	6000h	29-Sep-04	0	533	3-Oct-08	533

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Liebherr Crane HS895HD
Operators Weekly Report

Date ______________________

Operator ______________________

Job # ______________________

Serial # 188 184

JFB ASSET # 2310

Hours at end of week

Hoist #1 rear drum ______________________

Hoist #2 front drum ______________________

Hoist #3 aux drum ______________________

Hoist #4 boom ______________________

Swing ______________________

Travel ______________________

Engine ______________________

Fluids Added	Mon	Tues	Wed	Thur	Fri
Engine Oil					
Coolant					
Hydraulic					
Gallons of fuel pumped this shift					

Comments: ______________________

8 Hour Maintenance Checklist	Mon	Tues	Wed	Thur	Fri
Grease 8 hours lube points					
Check for leaks					
Water separator, drain condensate					
Splitterbox, check oil					
Check Hydraulic oil level					
Clean magnetic rod in return filter					
Swing Gear, check oil level					
Winch gears, check oil level					
Wire rope, check for cracks, deformation, beckets, connection points					
Check hoist liimt switch					
Check inclination transmitter					
Cab, check glass, doors, and mirrors					
Inspect hooks					

40 Hour Maintenance Checklist (perform every other day)					
Grease all 40 hours lube points					
Dry Air Filter, empty dust collection container					
Clean travel gear					
Pulley, check for free movement					

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Crane Meters

Liebherr HS895HD #2310	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
Change oil & oil filter	500	6-Aug-08	1390	1475	2-Oct-08	85
Open fuel petcock to check for water	500	6-Aug-08	1390	1475	2-Oct-08	85
Replace gearoil in splitterbox	500	6-Aug-08	1390	1475	2-Oct-08	85
Inspect, adjust fan and alternator belts	500	6-Aug-08	1390	1475	2-Oct-08	85
check battery and cables	500	6-Aug-08	1390	1475	2-Oct-08	85
Grease all sheaves	500	6-Aug-08	1390	1475	2-Oct-08	85
DCA check/adjust, Replace water filter	500	6-Aug-08	1390	1475	2-Oct-08	85
Replace hydraulic tank breather	500	6-Aug-08	1390	1475	2-Oct-08	85
Replace hydraulic tank return filter	500	6-Aug-08	1390	1475	2-Oct-08	85
Clean magnetic rod in Hyd. return filter	500	6-Aug-08	1390	1475	2-Oct-08	85
Replace fresh air filter	500	6-Aug-08	1390	1475	2-Oct-08	85
Check counterwieght connections	500	6-Aug-08	1390	1475	2-Oct-08	85
Change fuel filter	1000	6-Aug-08	1390	1475	2-Oct-08	85
Replace oil in travel gear	1000	6-Aug-08	1390	1475	2-Oct-08	85
Check idler gears and chain tension in travel gear		6-Aug-08	1390	1475	2-Oct-08	85
Check valve clearance in engine	1000	15-Nov-06	0	1475	2-Oct-08	1475
Inspect,clean/replace air filters	1000	6-Aug-08	1390	1475	2-Oct-08	85
Lubricate spur gear on flywheel	1000	6-Aug-08	1390	1475	2-Oct-08	85
Sample hydaulic oil	2000	6-Aug-08	1390	1475	2-Oct-08	85
Replace hydaulic oil	3000	15-Nov-08	0	1475	2-Oct-08	1475
Replace engine oil separator	4000	15-Nov-06	0	1475	2-Oct-08	1475
change cooling system fluid	4000	15-Nov-06	0	1475	2-Oct-08	1475
PLANETARIES						
Hoist #1, Rear Drum, 36mm	1000	6-Aug-08	210	230	1-Oct-08	20
Hoist #2, Front Drum, 36mm	1000	6-Aug-08	20	25	1-Oct-08	5
Hoist #3, Aux Drum,	1000	15-Nov-06	0	0	1-Oct-08	0
Hoist #4, Boom	1000	6-Aug-08	160	175	1-Oct-08	15
Swing #1, Port Bow	1000	6-Aug-08	191	212	1-Oct-08	21
Swing #2, Port Stern	1000	6-Aug-08	191	212	1-Oct-08	21
Swing #3, Stbd	1000	6-Aug-08	191	212	1-Oct-08	21
Travel	1000	15-Nov-06	0	4	1-Oct-08	4

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APPENDIX F

EQUIPMENT MAINTENANCE SCHEDULE AND REPORT FORM FOR MISCELLANEOUS EQUIPMENT

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Dredge Meters

DREDGE ULTRA 8" Fox River JFB Asset # 4935	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
change oil	**250**	27-Sep-08	11065	11065	27-Sep-08	0
changed oil filters	250	27-Sep-08	11065	11065	27-Sep-08	0
changed fuel filter primary	250	27-Sep-08	11065	11065	27-Sep-08	0
inspect,clean/replace air filters	250	27-Sep-08	11065	11065	27-Sep-08	0
inspect,adjust,alternator & fan belts,grease fan pulley	250	27-Sep-08	11065	11065	27-Sep-08	0
inspect,clean,battery,battery cable,disconnect switch	250	27-Sep-08	11065	11065	27-Sep-08	0
DCA check/adjust clng sys.aditative	500	27-Sep-08	11065	11065	27-Sep-08	0
change hydraulic oil filter	1000	14-Aug-08	10473	11065	27-Sep-08	592
diesel engine tune-up	2000	1-Jan-08	8909	11065	27-Sep-08	2156
Change oil in cutter drive tube and gear reduction	2000	1-Jan-08	8909	11065	27-Sep-08	2156
change hydraulic oil	2000	1-Jan-08	8909	11065	27-Sep-08	2156
winch system maintenance	2000	1-Jan-08	8909	11065	27-Sep-08	2156
change the cooling system fluid	3000	1-Jan-08	8909	11065	27-Sep-08	2156

DREDGE Fox River Generator JFB Asset # 4935	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
change oil, Delvac 1	**250**	27-Sep-08	3861	3861	27-Sep-08	0
change oil filter	250	27-Sep-08	3861	3861	27-Sep-08	0
changed fuel filter primary	250	27-Sep-08	3861	3861	27-Sep-08	0
inspect,clean/replace air filters	250	27-Sep-08	3861	3861	27-Sep-08	0
inspect,adjust,alternator & fan belts	250	27-Sep-08	3861	3861	27-Sep-08	0
inspect,clean,battery,battery cable,disconnect switch	250	27-Sep-08	3861	3861	27-Sep-08	0
DCA check/adjust clng sys.aditative	500	12-May-08	3706	3861	27-Sep-08	155

Mark Anthony II 12" Dredge #4950 Main Engine	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
change oil, Delvac 1	**500**	25-Mar-07	9814	9814	25-Mar-07	0
change oil filter	250	25-Mar-07	9814	9814	25-Mar-07	0
changed fuel filter secondary	250	25-Mar-07	9814	9814	25-Mar-07	0
checked or cleaned the fuel strainer	250	25-Mar-07	9814	9814	25-Mar-07	0
inspect,clean/replace air filters	250	25-Mar-07	9814	9814	25-Mar-07	0
inspect,adjust alternator & fan belts,grease fan pulley	250	25-Mar-07	9814	9814	25-Mar-07	0
inspect,clean,battery,battery cable,disconnect switch	250	25-Mar-07	9814	9814	25-Mar-07	0
Grease radial bearing	250	25-Mar-07	9814	9814	25-Mar-07	0
DCA check/adjust clng.sys.aditative	500	25-Mar-07	9814	9814	25-Mar-07	0
changed fuel filter primary(fuel/water separtor)	500	25-Mar-07	9814	9814	25-Mar-07	0
clean/change gear reduction screen	1000	25-Mar-07	9814	9814	25-Mar-07	0
change gear reduction oil	1000	25-Mar-07	9814	9814	25-Mar-07	0
change hydraulic oil filter	1000	23-Jun-06	9322	9814	25-Mar-07	492
service winches planatary,change oil, 80/90 gear lube	1000	23-Jun-06	9322	9814	25-Mar-07	492
diesel engine tune-up	2000	28-Mar-05	8723	9814	25-Mar-07	1091
Change oil in cutter gear reduction	2000	28-Mar-05	8723	9814	25-Mar-07	1091
Change oil in cutter drive tube	2000	28-Mar-05	8723	9814	25-Mar-07	1091
Change hydraulic oil	2000	24-Mar-06	8950	9814	25-Mar-07	864
change the grease in the radial bearing	2000	28-Mar-05	8723	9814	25-Mar-07	1091
Change oil in thrust bearing	3000	25-Mar-07	9814	9814	25-Mar-07	0
change the cooling system fluid	3000	1-Oct-03	7057	9814	25-Mar-07	2757

Mark Anthony II #4950GS ...erator	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
c...ge oil, Delvac 1	**500**	25-Mar-07	3648	3648	25-Mar-07	0
changed oil filter	250	25-Mar-07	3648	3648	25-Mar-07	0
changed fuel filter	250	25-Mar-07	3648	3648	25-Mar-07	0
changed air filter-inner	250	25-Mar-07	3648	3648	25-Mar-07	0
changed air filter-outter	250	25-Mar-07	3648	3648	25-Mar-07	0
inspect,adjust,alternator & fan belts	250	25-Mar-07	3648	3648	25-Mar-07	0
inspect,clean,battery,battery cable,discon	250	25-Mar-07	3648	3648	25-Mar-07	0
DCA check/adjust clng sys.aditative	500	17-Jul-04	3648	3648	25-Mar-07	0
diesel engine tune-up	2000	28-Mar-05	2463	3648	25-Mar-07	1185
Change oil in Funk Gear Box	2000	25-Mar-07	3648	3648	25-Mar-07	0
change the cooling system fluid	3000	1-Oct-03	771	3648	25-Mar-07	2877

Mark Anthony II #7392 **90 kw Generator**	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
change oil, Delvac 1	**500**	25-Mar-07	2640	2640	25-Mar-07	0
changed oil filter	250	25-Mar-07	2640	2640	25-Mar-07	0
changed fuel filter	250	25-Mar-07	2640	2640	25-Mar-07	0
changed air filter-inner	250	25-Mar-07	2640	2640	25-Mar-07	0
changed air filter-outter	250	25-Mar-07	2640	2640	25-Mar-07	0
inspect,adjust,alternator & fan belts	250	25-Mar-07	2640	2640	25-Mar-07	0
inspect,clean,battery,battery cable,discon	250	25-Mar-07	2640	2640	25-Mar-07	0
DCA check/adjust clng sys.aditative	500	25-Mar-07	2640	2640	25-Mar-07	0
diesel engine tune-up	2000	10-Nov-03	0	2640	25-Mar-07	2640
change the cooling system fluid	3000	10-Nov-03	0	2640	25-Mar-07	2640

BOOSTER 4940, 16" Booster 3412C	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
change oil, Delvac 1	**500**	27-Sep-08	9346	9346	27-Sep-08	0
change oil filter	250	27-Sep-08	9346	9346	27-Sep-08	0
changed fuel filters	250	27-Sep-08	9346	9346	27-Sep-08	0
checked or cleaned the fuel strainer	250	27-Sep-08	9346	9346	27-Sep-08	0
clen the cleanable fuel screen	250	27-Sep-08	9346	9346	27-Sep-08	0
inspect,clean/replace air filters	250	27-Sep-08	9346	9346	27-Sep-08	0
inspect,adjust alternator & fan belts,grease fan pulley	250	27-Sep-08	9346	9346	27-Sep-08	0
inspect,clean,battery,battery cable,disconnect switch	250	27-Sep-08	9346	9346	27-Sep-08	0
grease fan	250	27-Sep-08	9346	9346	27-Sep-08	0
clean fuel/water separator filter	500	27-Sep-08	9346	9346	27-Sep-08	0
DCA check/adjust clng.sys.aditative	500	27-Sep-08	9346	9346	27-Sep-08	0
clean/change transmission screen	1000	27-Sep-08	9346	9346	27-Sep-08	0
change gear reduction oil	1000	27-Sep-08	9346	9346	27-Sep-08	0
diesel engine tune-up	2000	29-Sep-06	7811	9346	27-Sep-08	1535
change grease in the radial bearings	2000	29-Sep-06	7811	9346	27-Sep-08	1535
Change oil in Thrust Bearing	3000	29-Sep-06	7811	9346	27-Sep-08	1535
change the cooling system fluid	3000	29-Sep-06	7811	9346	27-Sep-08	1535

JFB4946, 8" Booster DSC#2007710A	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
change oil	**500**	13-Sep-08	10299	10587	27-Sep-08	288
changed oil filters	250	27-Sep-08	10587	10587	27-Sep-08	0
changed fuel filters	250	13-Sep-08	10299	10587	27-Sep-08	288
inspect,clean/replace air filters	250	13-Sep-08	10299	10587	27-Sep-08	288
inspect,adjust alternator & fan belts,grease fan pulley	250	13-Sep-08	10299	10587	27-Sep-08	288
inspect,clean,battery,battery cable,disconnect switch	250	13-Sep-08	10299	10587	27-Sep-08	288
DCA check/adjust clng.sys.aditative	500	23-Aug-08	10113	10587	27-Sep-08	474
Change oil and filter in gear, clean screen	500	13-Sep-08	10299	10587	27-Sep-08	288

JFB4965, Godwin Hyd power pack	Service Interval	Date of last Service	Meter at last Service	Current Meter	Current Date	Hours Since Last Service
change oil	**500**	27-Sep-08	2627	2627	27-Sep-08	0
changed oil filters	250	27-Sep-08	2627	2627	27-Sep-08	0
changed fuel filters	250	27-Sep-08	2627	2627	27-Sep-08	0
inspect,clean/replace air filters	250	27-Sep-08	2627	2627	27-Sep-08	0
inspect,adjust alternator & fan belts,grease fan pulley	250	27-Sep-08	2627	2627	27-Sep-08	0
inspect,clean,battery,battery cable,disconnect switch	250	27-Sep-08	2627	2627	27-Sep-08	0
Change hyd oil	1000	19-May-07	0	2627	27-Sep-08	2627

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Misc Equipment Readings

Job# ____________________

Week Ending ____________________

Machine ____________________ Hours at end of week ____________________

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Oil							
Coolant							
Hydraulic							

Comments ____________________

Machine ____________________ Hours at end of week ____________________

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Oil							
Coolant							
Hydraulic							

Comments ____________________

Machine ____________________ Hours at end of week ____________________

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Oil							
Coolant							
Hydraulic							

Comments ____________________

Machine ____________________ Hours at end of week ____________________

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Oil							
Coolant							
Hydraulic							

Comments ____________________

Machine ____________________ Hours at end of week ____________________

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Oil							
Coolant							
Hydraulic							

Comments ____________________

Machine ____________________ Hours at end of week ____________________

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Oil							
Coolant							
Hydraulic							

Comments ____________________

TETRA TECH EC, INC.

Lower Fox River Remedial Action OUs 2-5

CONTROLLED DOCUMENT FORM

CONTRACTOR:	Tetra Tech EC Inc.
PROJECT NO.:	106-3876
PROJECT NAME:	Lower Fox River Remediation of OUs 2-5
DOCUMENT CONTROL NO.	LFRR-09-0299
WORK PHASE:	2B
DATE OF DOCUMENT:	August 2009
DOCUMENT TITLE:	Final Spill Control and Countermeasures (SPCC) Plan
RECIPIENT GROUP:	US Environmental Protection Agency
SPECIFICATION SECTION AND PARAGRAPH NO. OF REQUIREMENT:	
RECIPIENT:	Name Jim Hahnenberg – USEPA
	Address Chicago, IL 60604
	Phone (312) 353-4213
METHOD OF DELIVERY:	Paper Copy
SUBMITTED MATERIALS:	Plan and Attachments
FILE NO.:	17.0 Environmental Compliance

CONTROLLED DOCUMENT NO.: LFRR-09-0299-006

THIS FORM MUST REMAIN WITH THE ASSOCIATED DOCUMENT

SPILL PREVENTION, CONTROL, AND COUNTERMEASURES PLAN LOWER FOX RIVER OU2-5 REMEDIAL ACTION PROJECT GREEN BAY, WISCONSIN

Prepared for
Lower Fox River Remediation LLC

LFRR-09-0299

Prepared by

TETRA TECH EC, INC.
Tetra Tech EC, Inc.

August 2009

WISCONSIN
RICHARD J. FEENEY
E-39792
MORRIS PLAINS, NJ
PROFESSIONAL ENGINEER

Richard J Feeney
8/12/09

TABLE OF CONTENTS

ATTACHMENTS

LIST OF TABLES

ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
EHS	Environmental Health and Safety
EPA	U.S. Environmental Protection Agency
LLC	Limited Liability Corporation
OU2-5	Operable Units 2-5
P.E.	Professional Engineer
POL	petroleum, oil and lubricants
SDI	Stuyvesant Dredging Inc.
SPCC	Spill Prevention, Control, and Countermeasures
TtEC	Tetra Tech EC, Inc.

1.0 INTRODUCTION

This Spill Prevention, Control, and Countermeasures (SPCC) Plan was developed for the Lower Fox River Operable Units 2-5 (OU2-5) Sediment Processing Facility located in Green Bay, Wisconsin. The purpose of the Plan is to describe the measures implemented by Tetra Tech EC, Inc. (TtEC) to prevent oil (includes petroleum and non petroleum products) discharges from occurring and prepare TtEC to respond in a safe, effective, and timely manner to mitigate the impacts of a discharge from the facility.

This SPCC Plan has been prepared and implemented in accordance with the substantive requirements of 40 Code of Federal Regulations [CFR] Part 112 (Oil Pollution Prevention). The SPCC regulation requires that a facility storing oil in quantities above a threshold volume, and located such that it could potentially impact navigable waters of the United States, prepare and implement a SPCC Plan.

In addition to fulfilling requirements of 40 CFR 112, this SPCC Plan is used as a reference for oil storage information, as a tool to communicate practices on preventing and responding to discharges with TtEC employees and subcontractors, as a guide on facility inspections, and as a resource during emergency response.

2.0 MANAGEMENT APPROVAL

TtEC is committed to preventing discharges of oil to navigable waters and the environment through the implementation of this SPCC Plan. This SPCC Plan has the full approval of TtEC management. TtEC's management has committed the necessary resources to implement the measures described in this Plan.

Ray Mangrum, TtEC Project Manager is the designated person accountable for oil spill prevention at this facility and has the authority to commit the necessary resources to implement the Plan as described.

Authorized Facility Representative: Ray Mangrum

Signature: Ray Mangrum

Title: Sr. Project Manager

Date: 8/12/09

3.0 PROFESSIONAL ENGINEER CERTIFICATION

The undersigned Registered Professional Engineer is familiar with the requirements of Part 112 of Title 40 of the CFR and has visited and examined the facility, or has supervised examination of the facility by the appropriately qualified personnel. The undersigned Registered Professional Engineer attests that this SPCC Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR Part 112; that procedures for required inspections and testing have been established; and that this Plan is adequate for the facility.

This certification in no way relieves the owner or operator of the facility of his/her duty to prepare and fully implement this SPCC Plan in accordance with the requirements of 40 CFR Part 112.

Name of Professional Engineer: Richard J. Feeney

Registration Number: E-39792 Issuing State: Wisconsin

Signature: Richard J Feeney Date: 8/12/09 Seal

WISCONSIN
PROFESSIONAL ENGINEER
RICHARD J.
FEENEY
E-39792
MORRIS PLAINS,
NJ

4.0 PLAN REVIEW

In accordance with 40 CFR 112.5, TtEC periodically reviews and evaluates this SPCC Plan for any change in the facility design, construction, operation, or maintenance that materially affects the facility's potential for an oil discharge. TtEC reviews this SPCC Plan at least once every 5 years. Revisions to the Plan, if any are needed, are made within 6 months of this 5-year review. TtEC will implement any amendment as soon as possible but not later than 6 months following preparation of any amendment. A Registered Professional Engineer certifies any technical amendment to the Plan in accordance with 40 CFR 112.3(d).

Scheduled 5-year reviews and Plan amendment are recorded in Table 1. This log must be completed even if no amendment is made to the Plan.

Table 1. SPCC Plan Record of Review and Changes

Date	Authorized Person	Review Type	P.E. Certification	Summary of Changes

5.0 LOCATION OF SPCC PLAN

In accordance with 40 CFR 112.3(e) a complete copy of this SPCC Plan is maintained at the Lower Fox River OU2-5 Sediment Processing Facility located at 1611 State Street, Green Bay, Wisconsin.

6.0 GENERAL FACILITY INFORMATION

6.1 Company Information

Facility Name: Lower Fox River OU2-5 Sediment Processing Facility

Property Owner: Georgia Pacific Consumer Products LLC

Facility Operators: Tetra Tech EC, Inc. on behalf of the Lower Fox River Remediation LLC

Address: 1611 State Street
City/State/Zip: Green Bay, Wisconsin / 54304
Phone: 920-445-0720
Contact: Mr. Ray Mangrum, TtEC Project Manager

6.2 Contact Information

The designated person accountable for overall oil spill prevention and response at the facility, also referred to as the facility's Response Coordinator, is the TtEC Project Manager, Ray Mangrum. Table 2 provides 24-hour contact information for key personnel at the facility, fuel and used oil recycling vendors servicing the facility.

Table 2. Facility Contact Information

Name	Title	Telephone	Address
Ray Mangrum	TtEC Project Manager	713-876-8528	1611 State St., Green Bay, WI
Brian Delaney	TtEC Deputy Project Manager	803-646-0160	1611 State St., Green Bay, WI
Michael Estess	TtEC Operations Manager	803-646-0938	1611 State St., Green Bay, WI
Greg Smith	JF Brennan Project Manager	608-792-0465	1611 State St., Green Bay, WI
Martijn Luth	Stuyvesant Dredging Inc.	540-400-3125	1611 State St., Green Bay, WI
Steve Vandeyacht	New Energy LLC	920-735-8246	558 Carter Ct. Kimberly, WI
Jeff Lawson	Fox River Remediation LLC Representative	508-751-9502	20 Trafalgar Square, Nashua, NH

6.3 Facility Layout

Attachment A of this Plan contains a facility layout that identifies the locations of oil storage and the direction of storm water flow at the facility (Figure 1). Noted on the figure are the contents of all oil storage containers greater than 55 gallons in capacity.

6.4 Facility Location and Operations

TtEC operates the Lower Fox River OU2-5 Sediment Processing Facility under contract to the Lower Fox River Remediation LLC. The facility is located in the city of Green Bay within Brown County, Wisconsin. The facility processes polychlorinated biphenyl (PCB) contaminated sediment dredged from the Lower Fox River each year as required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Amended Record of Decision for the Lower Fox River OU2-5 Remediation.

The facility is comprised of three processing buildings, an administrative office, an outdoor material staging area, and an employee parking lot, as shown on Figure 1. The facility has four outdoor portable oil storage containers, eight filter press units containing hydraulic oil housed inside Building A, and a centralized indoor petroleum, oil and lubricants (POL) storage area located in Building B. From May through November the facility is manned 24 hours a day and operates 5-6 days a week. The movable above ground oil tanks are removed from the facility during the months the facility ceases operations, from December through April.

6.5 Oil Storage and Handling

Oil is stored and handled at the facility by TtEC, JF Brennan (JFB), Stuyvesant Dredging Inc. (SDI), New Energy LLC and Safety Kleen. Movable above ground storage tanks for fuel are installed and are serviced and maintained by New Energy LLC, a Wisconsin Certified Tank Installer. Used oil filters generated by JFB are collected and recycled offsite by Safety Kleen. The oil storage inventory for the facility is summarized in Table 3.

Table 3. Oil Storage Inventory

Number/Material	Intended Use	Maximum Amount Stored Onsite (Gallons)	Staging/Storage Location	Location and Distance to Runoff Areas
Outdoor Oil Storage				
Diesel (Movable Aboveground Storage Tank)	TtEC Equipment Fueling	1,000	Gravel/Asphalt East of Building C	25 feet from catch basin for on-site detention pond
Diesel (Tank Wagon)	TtEC Equipment Fueling	250	Asphalt Northwest side of Building B	25 feet from catch basin for on-site detention pond
Diesel (Movable Aboveground Storage Tank)	JFB Equipment Fueling	1000	Soil East of Processing Buildings	South side of the north perimeter drainage swale; 130 feet west of the Lower Fox River shoreline
Gasoline (Movable Aboveground Storage Tank)	JFB Equipment Fueling	500	Soil East of Processing Buildings	South side of the north perimeter drainage swale; 130 feet west of the Lower Fox River shoreline
Petroleum, Oils and Lubricants (Containers in Connex Box)	JFB Barge Maintenance	200	Connex Box at north side shoreline	25 feet from Lower Fox River shoreline
Used Oil Filters (Containers)	JFB Barge Maintenance	55-100	Soil East of Processing Buildings	South side of the north perimeter drainage swale; 130 feet west of the Lower Fox River shoreline
Indoor Oil Storage				
Hydraulic Oil (Oil-Filled Equipment)	SDI Filter press operations	2, 113 (264 gallons per press)	Building A	Runoff area contained inside Building A

Petroleum, Oils and Lubricants (Containers)	SDI Equipment Maintenance	75-100	Building A	Runoff area contained inside Building A
Petroleum Oil and Lubricants (Containers)	TtEC Equipment Maintenance	75-100	Building B	Runoff area lined and bermed inside Building B

6.5.1 Transfer Activities

Above ground storage tanks are used by TtEC and JF Brennan to fill construction equipment and fuel vehicles. New Energy LLC delivers fuel oil to the site and fills the tanks on a monthly or less frequent basis depending on usage. Equipment and vehicles are filled at the tank locations shown on the facility diagram (Figure 1) except where tank wagons are used to bring fuel to the equipment.

SDI handles hydraulic oil, which is required for operation of the filter press equipment housed inside Building A. Oil is not anticipated to require frequent filling over the life of the processing operations. Should filling be required, SDI will follow the procedure described in the Operations and Maintenance Plan for the Sediment Dewatering and Desanding Plant (TtEC, 2009).

6.6 Proximity to Navigable Waters

The facility is located within the Lower Fox River Basin which encompasses 638 square miles in northeastern Wisconsin. The closest outdoor portable oil storage container at the facility is situated within 25 feet of the Lower Fox River. Runoff from the facility is designed to drain to the river via northern and southern perimeter drainage swales and an onsite retention pond. In the event of an uncontrolled discharge from outdoor portable fuel oil storage containers, fuel oil would follow the man-made topography of the site, flowing towards the river. The river flows north and discharges into Green Bay.

6.7 Conformance with Applicable State and Local Requirements

This SPCC Plan was prepared to conform to 40 CFR Part 112 requirements for this type of facility. The facility also conforms to the requirements for flammable and combustible liquids storage tanks contained in Wisconsin Department of Commerce Chapter Comm. 10 (Wisconsin, 2009). As required by state regulation, the above ground storage tanks containing fuel (greater than 110 gallons) meet requirements for temporary (less than 24 months) movable above ground storage tanks at construction sites which include environmental remediation sites (Wisconsin, 1996). Additionally these tanks meet the City of Green Bay Chapter 24 Fire Prevention Code, which adopts and incorporates by reference the standards contained in Wisconsin Chapter Comm.10.

All discharge notifications are made in compliance with local, state, and federal requirements.

7.0 SPILL RESPONSE AND REPORTING

7.1 Discharge Discovery and Reporting

Several individuals and organizations must be contacted in the event of an oil discharge. All discharges shall be reported to the TtEC Project Manager, who is responsible for ensuring that all required discharge notifications have been made. In his absence this responsibility is assumed by the TtEC Deputy Project Manager, or in his absence the TtEC Operations Manager. All discharges will be reported as described in the Project Contingency Plan (Attachment B).

7.2 Verbal Notification Requirements (Local, State, and Federal)

For any discharge that reaches navigable waters, or threatens to reach navigable waters, immediate notification must be made to the National Response Center Hotline (800-424-8802) and to the U.S. Environmental Protection Agency (EPA), Region V.

In the event of a discharge that does not present an emergency situation, verbal notification must be made in accordance with the Project Contingency Plan (Attach. B).

Tetra Tech will also notify the A/OT of any spills, incidents or emergency actions.

7.3 Written Notification Requirements (State and Federal)

A written notification will be made to EPA for any single discharge of oil to a navigable water or adjoining shoreline waterway of more than 1,000 gallons, or for two discharges of 1 barrel (42 gallons) of oil to a waterway in any 12-month period. This written notification must be made within 60 days of the qualifying discharge, and a copy will be sent to the Wisconsin Department of Natural Resources, which is the state agency in charge of oil pollution control activities. This reporting requirement is separate and in addition to reporting under 40 CFR Part 112.

Tetra Tech will also notify the A/OT of any spills, incidents or emergency actions.

7.4 Spill Response Materials

Boom, sorbent, and other spill response materials are stored in Building B and adjacent to outdoor fuel storage tank locations and are accessible to facility personnel. Equipment inventory is checked monthly by operations personnel to ensure that used material is replenished. The response equipment inventory for the facility includes:

- Four (4) empty 55-gallon drums to hold contaminated material
- Three (3) 50-foot absorbent socks
- Two (2) 50-foot floating booms
- One hundred (100) pounds oil-dry loose absorbent material
- Two (2) boxes, 2-foot x 3-foot absorbent pads
- Two (2) boxes Nitrile gloves
- Two (2) boxes Neoprene gloves
- Six (6) pairs vinyl/polyvinyl chloride pull-on boots
- Three (3) brooms
- Ten (10) sand bags

7.5 Spill Mitigation Procedures

This section summarizes the actions that must be taken in the event of a discharge, including responsibilities of facility personnel and procedures to follow during a discharge event.

In the event of a discharge, TtEC, JF Brennan and SDI operations personnel and the TtEC Project Manager shall be responsible for the following actions:

7.5.1 Shut off Ignition Sources

Facility personnel must shut off all ignition sources, including motors, electrical circuits, and open flames.

7.5.2 Stop Oil Flow

Facility personnel should determine the source of the discharge, and if safe to do so, immediately shut off the source of the discharge.

7.5.3 Stop the Spread of Oil

If safe to do so, facility personnel must use resources available at the facility to stop the spilled material from spreading. Measures that may be implemented, depending on the location and size of the discharge, include placing sorbent material or other barriers in the path of the discharge (e.g., soil berm, sand bags or catch basin covers). Should a discharge reach the Lower Fox River, only physical response and countermeasures should be implemented, such as the deployment of booms or use of sorbent pads. Sorbent material and/or boom(s) should be placed immediately downstream of the discharge to recover any sheen from the water. Facility personnel should remove oiled vegetation and debris from the river bank and place them in bags for later disposal. Additional cleanup to remove oil trapped in the river bank may be required. At no time shall any surfactants, dispersants, or other chemical be used to remove oil from the river.

7.5.4 Gather Spill Information

The TtEC Project Manager will ensure that notifications have been made to the appropriate authorities. The TtEC, JF Brennan or SDI Operations Manager will gather the following information:

- Name of person reporting discharge
- Location of spill
- Date and time of spill discovery
- Material spilled
- Total volume spilled and total volume reaching the river or adjoining river banks
- Weather conditions
- Source of spill
- Actions being take to sop, remove, and mitigate the effects of the discharge
- Need for evacuation
- Spill impacts (injuries, damage, environmental media contaminated)
- Name of agencies and organization that have been contacted

7.6 Disposal Plan

TtEC, JF Brennan and SDI operations personnel will respond to spills and containerize any recovered product, contaminated soil, contaminated materials and equipment, decontamination solutions, sorbents, and spent chemical collected during response to a discharge event. Containerized material will be stored in the Building B waste storage area.

Any recovered product that can be recycled will be separated and recycled at a designated recovery facility. Any recovered product not deemed suitable for recycling will be disposed of with other oil cleanup wastes. Disposal will occur at Lower Fox River Remediation LLC-approved offsite disposal facilities licensed to accept petroleum-contaminated materials. Used oil filters generated by JF Brennan maintenance activities will be recycled offsite by Safety Kleen.

7.7 Spill Prevention, Control, and Countermeasure Provisions

The facility is designed to minimize the likelihood of a discharge reaching navigable waters. This section of the Plan describes the likely spill scenarios and how the facility is designed and operated to prevent a discharge from reaching the Lower Fox River.

7.7.1 Facility Drainage

Drainage from the facility is designed to direct storm water runoff from the facility to an onsite detention pond and several grass-lined swales (see Figure 1 in Attachment A) except for building roof drainage which discharges directly to the river. The detention pond is designed to discharge to the Lower Fox River when a 100-year design storm event occurs by flowing over an emergency weir. The two perimeter drainage swales are sloped to drain directly to the river and bypass the onsite detention pond.

7.7.2 Potential Discharge Volume, Direction of Flow and Containment

If unimpeded, oil from above ground tanks would follow the site topography and flow to the two perimeter drainage swales. Although manufacturer-provided overfill shut-off nozzles are installed on tanks, a failure of one of these devices during transfer (loading/filling) activities is anticipated to be the primary type of failure that could result in a discharge of oil to the environment. The estimated volume during an overfill event is approximately 50 gallons of oil.

7.7.3 Containment and Diversionary Structures

Given the distance between the tanks and the Lower Fox River, an oil discharge is not expected to reach the river under the likely spill scenario described above. Flow would enter the north or south perimeter drainage swales, which have capacity to contain and reduce the rate of flow to the river that would be anticipated to occur during an overfill event. Flow could also enter the stormwater catch basins which flow to the onsite detention basin where oil would be captured and removed before it could flow out of the basin into the Lower Fox River.

7.7.4 *Secondary Containment for Aboveground Storage Tanks*

The above ground storage tanks provided to the facility by New Energy LLC are manufactured with double-wall construction to contain any leakage due to container corrosion. Monthly New Energy LLC inspects the interstitial space within the double walled tanks for presence of oil and provided TtEC with documentation.

7.7.5 *Practicability of Secondary Containment*

Double-walled tank construction meets the requirements for secondary containment for above ground storage tanks. Containment during transfer activities is addressed by use of active secondary containment measures in accordance with 40 CFR 112.7(c). Active measures are implemented to prevent a discharge to navigable waters or adjoining shoreline. EPA SPCC Inspection Guidance (EPA, 2005) describes active measures as follows:

> *Active containment measures are those that require deployment by the owner/operator of the facility. These measures are deployed either before an activity involving the handling of oil starts, or in reaction to a discharge so long as the active measure is designed to prevent an oil spill from reaching navigable water or adjoining shoreline.*

7.7.6 *Active Containment Measures During Transfer Activities*

The following active containment measures are proposed for use by TtEC and JF Brennan during oil transfer activities that occur at the facility:

- Place booms or temporary soil dams in the two perimeter drainage swales to contain and prevent oil released during a discharge event from flowing to the Lower Fox River or the adjoining shorelines.

- Place stormwater catch basin covers in the oil flow path to prevent oil from entering the onsite detention basin.

- Use spill kits in the event of an oil discharge, are strategically located and ready for deployment, to prevent a spill from reaching navigable waters or adjoining shorelines. The spill kit is sized to effectively contain a 50 gallon oil spill that could be potentially released during an overfill event.

7.7.7 *Other Spill Prevention Measures*

The following work practices will be implemented by TtEC and JF Brennan personnel when handling oil stored in <u>outdoor</u> storage areas:

- Manual control of all outdoor oil transfer operations. The personnel performing the transfer shall remain in the area during the transfer to monitor the operation and check for any leaks and overflows.

- Grounding and bonding for transfer of liquids with a flash point of less than 140° Fahrenheit or whose flash point is unknown.

- Regular inspection of containers for leaks, structural damage, and corrosion. Tanks are elevated 6 inches above the ground surface to allow for visual inspection for leaks.

- Limiting placement of tanks and containers to areas that are paved or otherwise protected to prevent oil leaks from contacting soil and in areas not subject to flooding.

- Oil transfer operations, such as loading/unloading and fueling of equipment, will be monitored at all times for leaks or spills. Sorbent pad or drip pans will be used at hose connections during transfer operations.

- A warning sign shall be provided in the transfer area as a reminder to stop engines, install grounding protection, and ensure no smoking.

- Prior to departure of any New Energy LLC tank truck, the lower most drain and all outlets will be closely examined for leakage, and if necessary, tightened, adjusted, or replaced to prevent product leakage while in transit.

The following work practices will be implemented by TtEC, JF Brennan and SDI when handling oil stored <u>inside</u> the processing buildings:

- Building A. Hydraulic oil is housed within reservoirs, which are an integral part of the hydraulic systems for the filter press equipment. Spill prevention measures for this oil include regular inspection of line/hose connections to identify and correct any leaks that may occur.

- Building A. Containers of POL, including virgin oil, used oil, and oil spill clean up residues, will be stored in a central location inside Building A. Containers will be staged on pallets with plastic liners or on portable secondary containment devices so that leaks and spills can be observed, contained, and removed

- Building B. Containers of POL, including virgin oil, used oil, and oil spill clean up residues, will be stored in a central location inside Building B. Containers will be staged on pallets with plastic liners or on portable secondary containment devices so that leaks and spills can be observed, contained, and removed.

7.7.8 Inspections and Records

Monthly Inspections

Inspections of above ground storage tanks are conducted and documented by TtEC and JF Brennan personnel for leaks, corrosion, and condition of nozzles, hoses, and gauges (Attachment C). Maintenance and repairs will be made immediately or if necessary a new tank will be delivered to the facility by New Energy LLC or other qualified vendor.

Additionally, as part of TtEC's facility-wide monthly Environmental Health and Safety (EHS) inspection, both indoor and outdoor oil storage areas are inspected for evidence of leaks/spills, location of spill kits, and fire extinguishers. Inspections are documented in the EHS monthly inspection report.

7.7.9 Personnel, Training, and Discharge Prevention Procedures

TtEC, JF Brennan, and SDI operations personnel involved in oil handling activities receive training on the proper handling of oil products and procedures to respond to an oil discharge prior to working at the facility. The training ensures that operations personnel understand the procedure described in this SPCC Plan and are informed of the requirements under applicable pollution control laws, rules, and regulations. All operations personnel receive initial 40-hour HAZWOPER training and 8-hour annual refresher training as required by Occupational Safety and Health Administration.

Operations personnel are familiar with the facility operations, safety procedures, and spill prevention and control procedures described in this SPCC Plan prior to working at the facility.

Spill prevention is a topic presented in a briefing to facility operations personnel annually to ensure adequate understanding and effective implementation of this SPCC Plan. The briefing covers the following topics:

1. Roles and Responsibilities
2. SPCC Plan requirements
3. Policies and procedures related to spill prevention, control and notification
4. Procedures for routine handling of products (loading, unloading, transfer)
5. Lessons learned

8.0 REFERENCES

Code of Federal Regulations, Title 40: Protection of Environment – Chapter I – Environmental Protection Agency, Part 112, Oil Pollution Prevention.

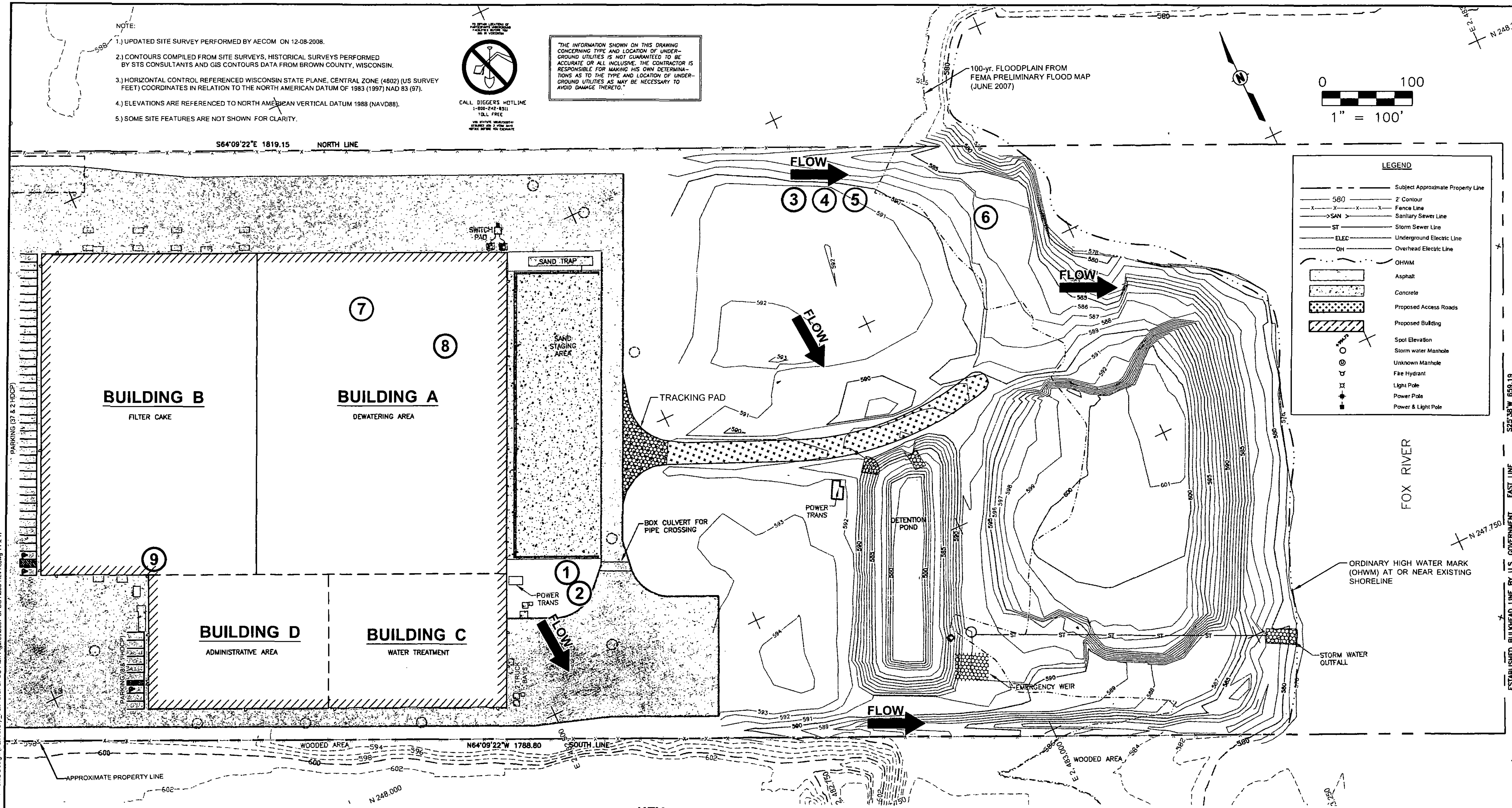
EPA (U.S. Environmental Protection Agency), 2005. Spill Prevention, Control, and Countermeasure (SPCC) Guidance for Regional Inspectors.

TetraTech, EC, 2009. Operations and Maintenance Plan for the Sediment Dewatering and Desanding Plant.

Wisconsin Department of Commerce, 2009. Chapter Comm10, Flammable, Combustible and Hazardous Liquids

Wisconsin Department of Commerce, 1996. Fuel Storage and Dispensing at Construction Sites (Program Letter, ERS 10493-E).

ATTACHMENT A
Figure 1



KEY

1. DIESEL (1,000 GAL)
2. DIESEL (~ 250 GAL)
3. GASOLINE (500 GAL)
4. DIESEL (1,000 GAL)
5. USED OIL FILTERS
6. P.O.L. (CONTAINERS)
7. FILTER PRESS HYDRAULIC OIL
8. P.O.L. (CONTAINERS)
9. P.O.L. (CONTAINERS)

FLOW → SURFACE WATER FLOW DIRECTION

ISSUED FOR REFERENCE ONLY
(CONTACT STS/AECOM FOR OFFICIAL UPDATED CIVIL PLANS)

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STS | AECOM

LOWER FOX RIVER SPCC PLAN

FACILITY LAYOUT / PETROLEUM STORAGE LOCATIONS
1611 STATE STREET
GREEN BAY, WI

FIGURE 1

SHEET NO. 1 OF 1

CAD FILE: 3667-SPCC-A005-Rev A.dwg

ATTACHMENT B
Project Contingency Plan

ATTACHMENT B

CONTINGENCY PLAN

VOLUME I

At the

LOWER FOX RIVER
OPERABLE UNITS 2 THROUGH 5

In

Brown, Outagamie, and Winnebago Counties, Wisconsin

Prepared for:

Appleton Papers Inc.
Georgia-Pacific Consumer Products LP
NCR Corporation
CBC Coatings, Inc.
U. S. Paper Mills Corporation

For Submittal to:

Wisconsin Department of Natural Resources
U.S. Environmental Protection Agency

Prepared by:

Tetra Tech EC, Inc.
Anchor Environmental
J. F. Brennan
Boskalis Dolman

June 2008

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Section **Page**

List of Tables

LIST OF FIGURES

Acronyms and Abbreviations

ACP	Access Control Personnel
ACS	Access Control Station
AED	Automatic Electronic Defibrillator
AHA	Activity Hazard Analysis
CM	Construction Manager
CPR	cardiopulmonary resuscitation
DOT	U.S. Department of Transportation
EC	Emergency Coordinators
EHS	Environmental, Health and Safety
EPA	Environmental Protection Agency
ER	emergency response
ESS	Environmental Safety Supervisor
MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association
NRC	National Response Center
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PCB	polychlorinated biphenyl
PEL	Permissible Exposure Limit
PESM	Project Environmental and Safety Manager
PM	Project Manager
PPE	personal protective equipment
PRT	Project Response Team
RQ	reportable quantity
SHSP	Site-Specific Health & Safety Plan
Tetra Tech	Tetra Tech EC, Inc.
WDNR	Wisconsin Department of Natural Resources

1.0 INTRODUCTION

This Contingency Plan has been developed to define the procedures in order to minimize hazards to human health and the environment to be followed in the event of a fire, explosion, and spills of hazardous substances to the environment during the implementation of the Phase 2A activities at the Lower Fox River Operable Units (OUs) 2 through 5. This project has many hazards due to the nature of the activities being performed and due to existing site conditions (as well as changing site conditions due to the work activities). Emergencies that may occur include the following:

- Personnel injuries or other medical emergencies/incidents
- Natural disasters such as severe weather, flood, volcanic fallout, or earthquakes
- Fire or explosion
- Spills of hazardous substances
- Unauthorized entry, trespass, or site intruders
- Potential bomb threats or other terrorist related incidents
- Needs for personnel rescue operations
- Emergencies related to hazardous materials that are stored and used on site or hazardous wastes, which could under certain circumstances, pose a chemical, fire, spill, or explosion hazard

This Plan functions as an administrative tool for managing events and emergencies to safeguard human health and the environment for emergency preparedness and response purposes. The Plan addresses the minimum requirements outlined in the Administrative Order of Consent:

- Description of actions to be taken in response to fires or explosions (Section 8.4), or any unplanned sudden or non-sudden release of hazardous substances or toxic constituents to air, soil, or surface water on site (Section 9.0)
- An up-to-date list of names, addresses, and telephone numbers of primary and alternate Emergency Coordinators (ECs), who have the responsibility for responding in the event of an emergency by implementing this Plan (refer to Tables 7-1 and 7-2)
- Descriptions of arrangements agreed to by local police and fire departments, hospitals, contractors, and emergency response teams to coordinate emergency response services (Section 7.0)
- A list of emergency response (including first aid) and decontamination equipment, as well as location, description, and outline of capabilities where this equipment is required (Section 11.0)

1.1 SCOPE AND EMERGENCY CLASSIFICATIONS

This Plan applies to all personnel working at the Lower Fox River OUs 2 through 5 site including approved visitors and subcontractors. This Plan meets the requirements for emergency response and notification in accordance with the U.S. Environmental Protection Agency (USEPA), the Wisconsin Department of Natural Resources (WDNR), U.S. Department of Transportation (DOT), and the Federal Occupational Safety and Health Administration (OSHA).

It is anticipated (per potential hazards identified during project planning) that most site emergencies would result in the use of two classifications:

Event. For the purposes of this project, an event is:

- A minor injury or illness not requiring emergency response from local emergency response agencies
- Spills of hazardous substances to the environment (less than the reportable quantity [RQ]) resulting from site activities, including spills or releases from previous operations at the site of which site employees have become aware, and can be contained and cleaned up without assistance from local emergency response agencies
- A property, vehicle, or equipment damage case that results in minor damage not requiring local emergency response agencies
- A "near miss" or an event that has a reasonable probability of resulting in one of the outcomes described above if the circumstances were different and for which modifications to management programs shall reduce the probability of occurrence or the severity of the outcome

Emergency. An emergency shall be declared when events occur that represent a significant degradation in the level of safety or a threat to human health or the environment and that require time-sensitive / urgent response efforts and assistance from outside agencies. For the purpose of this Plan, an emergency is identified as an unexpected sudden situation requiring prompt action by specially trained personnel in order to prevent or mitigate severe injury to individuals, adverse impacts to the environment, or major damage to property.

Examples of some plausible emergencies include:

- Discovery of hazardous material contamination from past facility operations that is causing or may reasonably be expected to cause uncontrolled personnel exposure exceeding Permissible Exposure Limits (PELs)
- A spill of a hazardous substance to the environment that exceeds the RQ or is otherwise unable to be controlled adequately or safely by site personnel and site resources
- A person trapped in debris, at heights, in confined spaces, or in a hazardous atmosphere, requiring rescue
- An off-site hazardous material event not associated with the site activities that is observed to have or is predicted to have an impact on this site such that protective actions are required to protect workers
- An occurrence that causes or may reasonably be expected to cause significant structural damage, with confirmed or suspected personnel injury, death, or degradation in health and safety
- Any site evacuation in response to an actual occurrence that requires time-urgent response by specialist personnel or mutual aid groups not normally assigned to the site (e.g., fire department)

The plan prescribes preparedness, prevention, and response for plausible site emergencies including:

- Medical Emergencies (Section 8.2)
- Natural Emergencies such as Earthquakes or Severe Weather (Section 8.3)
- Fires and Explosions (Section 8.4)
- Unauthorized Entry, Trespass or Site Intruders (Section 8.5)
- Threat of Terrorist Activities (Section 8.6)
- Personnel Rescue (Section 8.7)
- Confined Space Rescue (Section 8.7.1)
- Spills of hazardous substances to the environment (Section 9.0)

Non-emergencies involving incidental response to minor incidents do not have the severity or damage potential of emergencies and can be controlled by site employees with basic first aid training or additional training for site-specific incidents such as small spill containment and clean-up.

Project emergencies involve further escalation of risks that potentially require outside assistance to respond and manage the emergency due to impact on site personnel, structures, site evacuation, off-site property, public, and the environment.

1.2 MAINTENANCE

The Project Manager (PM) has overall responsibility for ensuring this Plan is in place and implemented.

This Plan and contained procedures shall be reviewed and updated as required as the project transitions. At a minimum this Plan shall be reviewed on an annual cycle or immediately if implementation, audit, or change in site conditions or response to an emergency or drill demonstrates a need for revision. Revised copies of this Plan will be provided to emergency responders (e.g., local fire departments, local police or county sheriff, and local hospitals) by return receipt, certified mail.

2.0 SITE DESCRIPTION

The project study area includes the Lower Fox River and Green Bay aquatic systems. Approximately 270,000 people live in the communities along the river. The Lower Fox River is located in northeastern Wisconsin within the eastern ridges and lowlands of the state. The Lower Fox River is defined as the 39-mile portion of the Fox River, beginning at the outlet of Lake Winnebago and terminating at the mouth of the river into Green Bay, Lake Michigan. The river flows north and drains approximately 6,330 square miles, making it a primary tributary to Green Bay and a part of the Great Lakes system. Green Bay is a freshwater system approximately 120 miles long that drains into Lake Michigan, and is located on the state border between Wisconsin and Michigan along a northeast-to-southwest-trending axis. The bay portion of the site includes all of Green Bay from the city of Green Bay to the point where Green Bay enters Lake Michigan. The site has been divided into five discrete OUs by WDNR and USEPA. The river and the bay OUs are:

- OU 1 – Little Lake Butte des Morts
- OU 2 – Appleton to Little Rapids
- OU 3 – Little Rapids to De Pere
- OU 4 – De Pere to Green Bay
- OU 5 – Green Bay

The river has 12 dams and includes the highest concentration of pulp and paper mills in the world. During the 1950s and 1960s, these mills routinely used polychlorinated biphenyls (PCBs) in their operations, which ultimately contaminated the river.

Two facilities will be established as part of the remedial action. The former Shell site will be used for support facilities, dewatering operations, wastewater treatment operations, and material handling. A second upland facility will be necessary to support the capping and cover material placement south of the De Pere Dam. This site will be used for staging of sand and armored cap material.

2.1 ACCESS/EGRESS AND UTILITIES

There is limited public access to the site due to access controls in place, including fences and locking gates. Access controls to the facility minimize the possibility of uncontrolled access to the site. A site layout map has been developed for the former Shell site and is provided in the Volume I Work Plan. However, it has not been finalized. Once finalized, this site layout map will be revised to show the roadways, gates, emergency evacuation routes, as well as utilities such as power and water.

3.0 EMERGENCY MANAGEMENT ORGANIZATION AND RESPONSIBILITIES

The following sections describe the roles and responsibilities of key project personnel in relation to emergency responses. Contact information is summarized in Tables 7-1 and 7-2.

3.1 PROJECT MANAGER

The Tetra Tech EC, Inc. (Tetra Tech) PM has overall responsibility for the maintenance, implementation and enforcement of this Plan and ensures that all project personnel implement this Plan. Additionally, the PM shall:

- Identify the EC and alternates.
- Ensure that resources are available for proper training of emergency response personnel and that appropriate emergency response equipment is available.
- Ensure that this plan is rehearsed as necessary.

3.2 CONSTRUCTION MANAGER

The Tetra Tech Construction Manager (CM) is responsible for managing the work execution by the subcontractors, craft workers, and suppliers to achieve conformance with the project plans and procedures. The CM will have direct responsibility for the implementation of this Plan through project operations including project implementation and staff direction. Additionally, the CM shall:

- Serve as the alternate EC and have the ability and authority to commit resources to manage an emergency event and mitigate consequences to workers, the public, and the environment.
- Designate and coordinate response actions, as appropriate or necessary, including assistance of the Project Response Team (PRT).
- Contact/activate the Emergency Response (ER) personnel/agencies, as necessary.

The Environmental Safety Supervisor (ESS) will serve as the EC and the CM as the alternate EC. The EC is responsible for:

- Implementing this Plan utilizing available resources and experts as needed
- Providing, when necessary, information about the nature and duration of work expected on the site, types of contaminants or hazards, possible health or safety effects, and anticipated emergency conditions to emergency services personnel (e.g., fire department, police, hospital, emergency response)
- Determining the content and frequency of drills
- Reviewing this Plan whenever audit, implementation, site conditions, personnel, or management identifies need or opportunity for improvement
- Ensuring that this Plan is critiqued after actual implementation or drills
- Coordinating responses during an emergency

The EC shall have a detailed understanding of response actions to secure and control emergencies, evacuation of on-site and off-site individuals and disaster planning.

The EC will be contacted for all emergencies and events on site. The EC phone numbers and home addresses will be maintained at the on-site office trailer, dewatering building, and wastewater treatment plant. The EC will activate the emergency response, as appropriate, and request assistance from the PRT and other site personnel as required.

The EC determines and directs the level of response required including the implementation of emergency evacuation and disaster recovery. The EC is responsible for ensuring that appropriate project personnel are contacted and kept informed. Follow-up coordination will be conducted as needed including assisting the PM with regulatory agency notification, incident documentation, review for process improvements, and adequacy of training or review of emergency response mechanisms.

The EC will be the primary point of contact for outside response authorities. The EC will maintain coordination with the local response agencies (local fire departments, local fire department HAZMAT team, etc.) prior to their arrival and during the response.

The EC will assume control of all emergency events upon arrival at the scene. The EC will relinquish control of emergency scene only to more highly trained or specially trained responders upon their arrival as appropriate (i.e., confined space rescue or fire). The EC will have competency in the following areas:

- Know how to implement this Plan and other applicable project plans.
- Know and understand the hazards and risks associated with project activities and specific site areas and equipment.
- Know and utilize PRT members as necessary, for incident and emergency response.
- Know the state and local agencies available for emergency response and their capabilities.

3.3 Access Control Personnel

At the main entrance of the former Shell Site, a security guard booth (i.e., Access Control Station [ACS]) will be constructed and staffed by local personnel to restrict access to the site. The ACS is the initial contact and communications center for site emergencies. Access Control Personnel (ACP) will be trained to immediately respond as directed and as outlined in this Plan. Their responsibilities will include:

- Monitoring of the site radio and telephone communications for emergencies
- Notifying the EC and Project Manager in the event of access by unauthorized person(s)
- Notifying emergency response units as directed by the EC and directing the units to appropriate location(s)
- Controlling access to the site and maintaining a log of authorized site visitors

3.4 Environmental Safety Supervisor

The site ESS is Mr. Bill Welch who will provide pre-emergency task analyses prior to initiating field activities and at each new and discernible feature of work, and functions as the health and safety as well as environmental compliance lead for the project. The ESS reports through the project organization to both the CM and the Project Environmental and Safety Manager (PESM). The ESS is responsible for:

- Confirming the posting of emergency telephone numbers
- Maintaining and posting site maps marked with evacuation routes and on-site location of emergency response equipment and supplies
- Maintaining inventories of on-site emergency response equipment and supplies and capabilities
- Reviewing emergency response plan(s) and in the event of a plan failure, submitting revision comments to the EC, PM, and PESM
- Providing assistance to the EC during an emergency event
- Providing, in the event that an emergency or incident involves the exposure of project personnel to hazardous or toxic materials, Material Safety Data Sheets (MSDSs) to emergency personnel to accompany the worker to the medical facility
- Inspecting and evaluating hazardous substance storage and handling operations
- Understanding and implementing requirements of the Site-Specific Health and Safety Plans (SHSPs)
- Maintaining a log of incident communications
- Documenting accurately and completely all emergency notifications

3.5 Project Response Team

The PRT consists of the PM, CM/EC, and ESS who have specialized training, experience, knowledge, and skills in initial emergency response, safety, environmental compliance, waste management, and construction. They will assist the EC to provide both guidance and applied field response to incidents and emergencies, as required or indicated.

3.6 Project Environmental and Safety Manager

The PESM is a Tetra Tech senior specialist assigned to assist the PM in the development of the project-specific Environmental, Health and Safety (EHS) plans and in the implementation of EHS programs. The PESM has approval authority for EHS issues and reports to both the Project and the Tetra Tech Director of EHS Services. The PESM shall:

- Assist in the development, implementation, oversight, and enforcement of project ESQ plans
- Review incident reports and results of inspections
- Conduct periodic (e.g., quarterly) inspections
- Assist in major incident investigations
- Perform audits and assessments to determine that project ESQ plans are being fully implemented

3.7 SITE PERSONNEL

All site personnel are responsible for understanding how to respond in the event of an incident or emergency. These actions are addressed in this Plan and discussed in site orientation training. Site personnel are expected to notify their supervisor of impending or actual incidents and emergencies and to cooperate fully with the requirements of this document. Information obtained shall be immediately communicated to the EC. All employees shall participate in site-specific safety orientation. All other personnel entering the site (e.g., visitors, vendors) will be given a modified briefing on this Plan. Modified details will be determined by the visitor's status (escorted or unescorted access) and the stated reason for site access.

Emergency preparedness, prevention, and response are core elements included in the site-specific safety orientation curriculum.

3.8 PROJECT FIRST AID/CPR RESPONDERS

Minor first aid and medical response stabilization will be available on site. Various project personnel are required to have up-to-date first aid and cardiopulmonary resuscitation (CPR) training. A list of First Aid and CPR trained personnel will be maintained in the project files. Off-site medical care will be used if the medical injuries or illnesses require further evaluation or treatment. The routes to the nearest hospital (and alternate) will be posted in the office trailer, dewatering building, wastewater treatment plant, and elsewhere as required.

4.0 EMERGENCY MANAGEMENT

4.1 GOALS AND OBJECTIVES

The primary objective of this Plan is to ensure consistent implementation of emergency response during the life of the project, and includes:

- Pre–emergency planning, including the identification of hazards and threats and hazard mitigation
- Actions to take in the event of an emergency
- Identification of personnel and maintenance of resources needed for an effective response

4.2 PRE-EMERGENCY PLANNING

Pre–emergency planning will be conducted to identify potential hazards and threats, define hazard mitigation strategies, and prescribe the appropriate response(s) as discussed within this Plan. Reviewing the hazards at each level or stage of the project or task is critical to effective pre–emergency planning. Additionally, the SHSP and Activity Hazard Analysis (AHA) developed for on-site activities identify, evaluate, and propose the appropriate hazard controls.

Pre–emergency protective actions assure worker safety is implemented consistently across the project. Some of these protective actions include:

- Use of administrative controls, including development and implementation of task- or area-oriented work plans, such as AHAs, to be used in the field which are based on actual site conditions and hazards of the work area
- Use of engineering controls
- Use of qualified and trained personnel
- Use of readily available spill containment and clean-up materials and emergency equipment

All site personnel shall be trained to applicable requirements of this Plan during site orientation training and shall be provided with updates as the Plan is updated or changed.

The procedure for assessing chemical hazards in the workplace during an emergency or incident (including the need for evacuation) includes the determination of the hazardous properties of released materials by the following:

- Reviewing MSDSs for commercial chemical products or materials
- Reading container labels
- Process knowledge
- Sampling and analysis (if needed)

Determination of potential danger to human health and the environment during an emergency shall include evaluation of the following factors:

- Proximity of the emergency location to other hazardous sources
- Compatibility with other materials

- Potential routes for hazardous run-off or exposure
- Environmental conditions and transport mechanisms for airborne releases (for example, wind speed, wind direction, temperature)
- Delineation of hazard boundaries
- Amount, concentration, or rate of release of material

The initial assessment of chemicals and hazardous materials in the workplace will be made for contingency planning purposes. In the event of an actual emergency, the EC will evaluate the above factors and determine a suitable response.

5.0 FIRE PREVENTION AND PROTECTION

The primary protective measures implemented to manage the threat of fire or explosion during project implementation include:

- Project plans and procedures, SHSP, AHAs, etc.
- This Plan
- Employee awareness and training
- Safe work practices including selection of the appropriate tools for the task
- Proper use, storage, and labeling of flammable liquids and gases
- Appropriate postings in areas where flammable liquids and gases are used or stored
- Fire extinguishers readily accessible in the work area
- MSDSs available *on site* for flammable materials in the workplace
- Hot Work Permits for cutting, welding or other spark-producing activities and fire watch (if required). Hot Work Permits must be obtained through the ESS.

5.1 HOUSEKEEPING

- Work areas shall be kept reasonably clean.
- Trash, refuse, and scrap materials shall be removed and placed in the proper containers for disposal.
- Containers shall be provided for the collection and separation of waste, trash, oily or used rags, and other refuse.
- Containers will be marked as to their contents.
- Containers shall be appropriate for the material being placed in them and shall have appropriate lids.
- If hot work is performed, combustible materials will be removed or protected from a radius of 50 feet from the hot work area, and the area will be clear of flammable vapors and dusts.
- Compressed gas cylinders will be stored and handled properly in accordance with the SHSP.

5.2 MATERIAL STORAGE, HANDLING & USE

- Materials shall be stored, handled, or stockpiled with due regard to their fire characteristics.
- Cabinets for storage of flammable materials shall be appropriately labeled to indicate the flammables storage.
- Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids.

- Portable fuel tanks (if used), not exceeding 660 gallons, shall be provided with emergency venting and other devices, as required by chapters II and III of *The Flammable and Combustible Liquids Code*, NFPA 30-2000.
- Leakage or spillage of flammable or combustible liquids shall be contained, cleaned up, and disposed of promptly and safely.
- Flammable liquids may be used only where there are no open flames or other sources of ignition within 50 feet of the operation, unless conditions warrant greater clearance.
- Tank trucks shall comply with the requirements covered in the *Standard for Tank Vehicles for Flammable and Combustible Liquids*, NFPA No. 385—2000.
- A Hot Work Permit system will be used for welding, cutting, grinding, and related activities that pose a potential ignition source hazard.

5.3 MAJOR WORKPLACE FIRE HAZARDS

The major fire hazards in the workplace are:

- Small quantities (i.e., a few gallons or less) of flammable materials stored in flammable cabinets
- Portable gas cans that may be in service and used during work hours
- Flammable gases (oxygen and acetylene)
- Fuel tanks on heavy equipment
- Flammable waste in waste accumulation areas (e.g., waste aerosol cans)
- Propane gas for forklifts, space heaters, steam cleaners, etc.
- Combustible materials stored close to heaters in office areas or in hot work zones

Personnel are required to handle fire hazards in accordance with site practices. Small quantities of flammable materials are required to be stored in Flammable Storage Cabinets, and cabinets will be available for use at the site. Periodically, the site ESS will inspect these cabinets to ensure rated storage capacities are not exceeded.

Portable flammable liquid containers shall be approved by Underwriters Laboratories and will be clearly labeled to identify contents. Containers of gasoline and diesel shall be of steel construction.

Flammable gases shall be stored in bottle racks when not in service. In-service bottles shall be appropriately secured in the service vehicles or to weld carts. Empty bottles shall be stored in bottle racks and properly secured.

Heavy equipment refueling (diesel and/or gasoline) will be conducted using a delivery truck equipped with the required protective equipment and/or having bulk storage on site. Bulk storage containers will be stored in secondary containment that meets 110 percent of the largest container, or double-walled storage tanks may be used instead of secondary containment. A properly rated fire extinguisher will be located adjacent to the fuel storage facility. The tank and containment will be inspected regularly (i.e., during the weekly EHS Inspections or monthly if double-walled tanks are used) to verify that the tank is in good condition and that rainwater is emptied from the containment area. MSDSs for on-site fuels will be made available to all site personnel. When refueling, personnel will place a drip pan or spill pads underneath the pump to catch any spillage or overflow. Smaller equipment will be driven off site for fueling at a service station.

5.4 Potential Ignition Sources and Hazards

Potential ignition sources at the site are minimized to the extent practical. Primary sources of ignition are grinding operations, welding and hot cutting operations, and personnel smoking.

Fire hazards are controlled through the use of engineering and administrative controls. Engineered controls include use of Flammable Storage Cabinets, use of internally grounded fill nozzles on the fuel tank pumps, use of fire-resistant materials under welding, cutting, grinding areas, and the use of fire rated materials or distance to separate flammable gases. Portable battery-powered lighting equipment, used in connection with the storage, handling, or use of flammable gases or liquids, shall be of the type approved for the hazardous locations/material.

Administrative controls that are utilized include use of Hot Work Permits with a fire-watch, and good housekeeping. Smoking is prohibited except in approved areas designated by the CM and ESS. Areas with operations that constitute a fire hazard shall be conspicuously posted with signs stating "No Smoking or Open Flame." Laydown areas shall be regularly inspected for fire hazards, and hazards shall be removed as appropriate.

Equipment fueling shall be performed per manufacturers' recommendations with special care taken to prevent splashing or otherwise allowing fuel to come into contact with hot surfaces, such as mufflers or exhaust pipes. Fuel delivery trucks and bulk fuel storage areas will be posted with conspicuous and legible signs prohibiting smoking in the vicinity and during refueling. Grounding and bonding will be utilized during dispensing of fuels.

Electrical wiring and equipment for light, heat, or power purposes shall be installed in compliance with the requirements of current electrical codes.

Equipment powered by internal combustion engines shall be located so that the exhausts are away from combustible materials.

Open yard storage of combustible materials shall be stockpiled with due regard to the stability of piles and in no case higher than 20 feet.

5.5 Actions to Prevent Spread of Fire

Actions to prevent the spread of fires include:

- Prompt notification
- Accessible fire extinguishers of the correct type and size within a work area or piece of equipment (incipient-stage use)
- Fire-fighting services are provided by the local fire department
- Collecting and properly containing released material(s)
- Segregated storage of flammable materials

5.6 Site Fire Extinguishing Equipment

All on-site fire extinguishing equipment is expected to be used only for the control or extinguishing of early-stage or incipient-stage fire situations. Incipient fires are those that have just begun and are small enough not to reduce visibility, create a smoke inhalation hazard, or pose high-temperature risks. Fire control or extinguishing efforts should be conducted to aid escape, extinguish burning clothing, and stop a small fire. All fire extinguishing training procedures should be followed to minimize additional risks. The local fire department will be called to respond to and control the situation for any fires beyond the incipient stage.

Portable fire extinguishers are located throughout the active project work areas, in hot work areas, and on operating equipment, and are inspected on a regular basis.

As part of the design of the former Shell site a fire protection system will be constructed for the facility. Currently, there are no on-site fire hydrants. This will be addressed as part of the design of the facility.

6.0 TRAINING

Site personnel will receive awareness training to ensure understanding of those elements of this Plan that are pertinent to their correct and timely actions. This training will be given initially and refresher training shall be conducted at least annually (if the project duration exceeds one year). Training initially will be given during the site orientation training.

A few of the pertinent elements of the required training for site personnel are as follows:

- Responsibilities for reporting of events or accidents
- Spill notification requirements
- Location of the assembly areas/staging area
- Sound of the evacuation alarm
- Initial actions to take when the evacuation alarm sounds

Additional emergency or awareness training that may occur is as follows:

- Subject-Specific Training Classes (as necessary for site personnel)
- Supervisors and safety representatives are currently trained on first aid, CPR, and blood-borne pathogen precautions
- Fire extinguisher usage for incipient fires
- Hazardous material and hazardous waste awareness-level and function-specific training

In addition to the above training, site personnel also will be trained on the following topics:

- An understanding of the types of activities in their work area(s) that pose a significant potential risk in case of an incident or accident and potential outcomes of those events
- How to recognize that a potentially hazardous event is occurring and the hazards that could be encountered during an incident or accident
- The appropriate actions to take to mitigate the potential hazards that may occur from an incident or accident
- Understanding of roles/functions in an incident or emergency, with a primary focus on personal safety and safety of others through prompt notification, securing of operations (if possible), proper evacuation (if necessary), and appropriate measures for control, containment, and clean-up dependent on the type of incident/emergency
- As appropriate for type of work area and potential incident/emergency, the use of equipment for response to, and control of, incidents/emergencies (e.g., fire extinguishers, spill control equipment)
- The ability to recognize and report when additional resources may be necessary to more effectively mitigate or control an event

The PRT is comprised of the PM, the CM, and the ESS, all of whom have specialized training, experience, and skills in health and safety, environmental compliance, engineering, and construction, who can supervise and coordinate a response to assist the EC in the event of an emergency.

6.1 Respiratory Protection

Employees who may use respiratory protection shall be properly trained, medically reviewed, and fit tested.

6.2 Confined Space

There is no confined space entry allowed on this project at the present time. No person will enter or break the plane of any confined space for any reason unless confined space procedures are developed, personnel are trained, and an AHA has been developed and put into place with the proper monitoring and supervision.

Confined spaces present at the site include, but may not be limited to:

- Wastewater treatment storage and process tanks
- Stormwater and sanitary sewers and manholes
- Pits or vaults (if present)
- A covered roll-off box

Should the need for confined space entry be required, this Plan will be amended to include confined space entry requirements. Personnel who perform confined space entry must be trained. Should a person not adhere to the "no entry" requirement and become trapped, any rescue response would be performed by the local fire department. No confined space rescue equipment is being maintained on the site and no person is authorized to enter a confined space for rescue purposes.

6.3 Refresher Training

All project staff shall receive refreshers of required training as required or indicated. Training may include formal classroom training, tabletop simulations, and emergency response drills (discussed in following section).

6.4 Training Records

The ESS will ensure that applicable training records are kept for site personnel. Examples of applicable training records are:

- Employee orientation and attendance records
- Contingency Plan training documentation
- First Aid/CPR documentation
- Hazardous materials and waste management training as well as function-specific training
- OSHA HAZWOPER training, medical clearance, and fit test results
- Specialized training (mobile equipment, fall protection, etc.)

6.5 Drills

This Plan will be tested periodically. Drills shall be used to ensure site and emergency response support organizations have a clear understanding of their roles and responsibilities, and to ensure required capabilities are available and operable. Emergency drills shall be planned and documented to test the total system or components of the system. A drill will be conducted at project startup and as needed should conditions change. The procedures will be critiqued (both in drills and after actual or perceived emergencies) to verify that the procedures work; if the procedures do not work, the Plan will be modified. The critique should include:

- The date of the drill or plan activation
- A chronological summary of the incident or exercise
- Description of activities taken or decisions made by site personnel
- Types of monitoring performed during the event
- Injuries, illnesses, or potential exposures during the emergency
- Deficiencies noted and recommended corrective action

7.0 NOTIFICATIONS AND LINES OF COMMUNICATION

7.1 ON-SITE COMMUNICATION AND NOTIFICATIONS

Tables 7-1 and 7-2 lists applicable site contact information. In the event of an imminent or actual emergency situation, site personnel discovering the emergency situation shall immediately notify the EC. The EC shall then notify all site personnel by voice, radio, or telephone. Personnel shall be informed about the hazard and the appropriate response. The EC shall communicate emergency status (i.e., to be on heightened awareness, proceed to assembly areas, or to evacuate the facility and report to the staging area).

Should a project worker be the first to observe an emergency, the worker shall notify his/her supervisor by the best means available and take appropriate action(s). The appropriate action(s) shall be commensurate with the degree of hazard associated with the emergency situation and the emergency response training of the individual. The supervisor shall immediately notify the EC and ensure that the work crews are accounted for and evacuated if necessary.

Of prime concern during any emergency is clear communication regarding the nature of the emergency such as: location of incident, type of incident (fire, explosion, injury [if any]), number of affected personnel or potentially impacted site and off-site personnel, and any current or planned activities in progress to mitigate the emergency. The proper information regarding the nature of the incident is paramount in order to get the proper level and type of emergency response. The ACP when directed by the EC will assist in contacting the off-site emergency responders and reporting the conditions (e.g., fire, hazardous releases).

The primary form of communication at the project site during an emergency between field groups and the EC is by via two-way radios. The EC and ESS shall be accessible by telephone (land and cellular) or radio. The emergency telephone list shall also have the off-site emergency phone numbers of key site personnel and emergency responders. If the EC will be off site, the alternate EC will be designated and on-call.

Routine activities require project management personnel, the EC, ACP, and other project personnel (teams) to carry two-way radios. A radio unit is also located in the ACS. In the event of an emergency, everyone will be instructed to "**clear the channel except for emergency use only.**" Evacuation notices and information will be broadcast over the radio at the site.

Cellular phones are located in the project office trailer and the ACS. Emergency contact phone numbers are posted at the ACS and office trailer, as well as in other buildings.

The EC shall immediately notify the CM, PM, and PESM for any major incidents:

- Evacuations of any part of the site
- Local medical response for project personnel
- Fatalities or hospitalization of project personnel
- Fire department response for rescue or to extinguish fire
- Hazardous materials team response
- Notification of regulatory agencies

Contingency Plan Volume 1 Lower Fox River (OUs 2-5) Table 7-1 Emergency (and Non-Emergency) Telephone Numbers				
EMERGENCY CONTACT	**LOCATION**	**PHONE NUMBER**	**OUs**	**NOTIFIED**
HOSPITALS				
Bellin Hospital	744 S. Webster Avenue Green Bay, WI 54301	911 or 920-433-3500	2,3,4,5	
St. Vincent Hospital	835 S. Van Buren Street Green Bay, WI 54301	911 or 920-433-0111	3,4,5	
Work Care Facilities				
Theda Care at Work Contact: Mary Schrader or Cheryl Marx	2009 Memorial Drive Appleton, WI 54915	920-380-4999	2,3	
Prevea Workmed Voyager Contact: Debbie	3021 Voyager Drive Green Bay, WI 54311	920-496-4760	3,4,5	
Fire Department/EMS				
Green Bay Fire Department	501 S. Washington Street Green Bay, WI 54301	911 or 920-448-3280	3,4,5	
Ashwaubenon Fire and Rescue	2155 Holmgren Way Green Bay, WI 54304	911 or 920-492-2312	3,4,5	
De Pere Fire/EMS	400 Lewis Street De Pere, WI 54115	911 or 920-339-4087	2,3	
Wrightstown Fire Department	961 Broadway Street Wrightstown, WI 54180	911 or 920-532-4556	2,3	
Kaukauna Fire Department	206 West 3rd Street Kaukauna, WI 54130	911 or 920-766-6320	2	
Kimberly Fire Department	515 W. Kimberly Avenue Kimberly, WI 54136	911 or 920-788-9805	2	
Police				
Brown County Sheriff's Department	300 East Walnut Street Green Bay, WI 54301	911 or 920-448-4219	2,3,4,5	
Green Bay Police Department	307 South Adams Street Green Bay, WI 54301	911 or 920-448-3200	2,3,4,5	
U.S. Coast Guard				
Station Green Bay	P.O. Box 8486 Green Bay, WI 54308	920-435-7042 VHF Radio Channel 16 for distress calls	2,3,4,5	
Poison Control Center				
Poison Control Center		800-222-1222		
Hazardous Materials Spill Response Units				
Fire Department/EMS				
Appleton Fire Department	700 N Drew St Appleton, WI 54911	911 or 920-832-5813	2	
Green Bay Fire Department	501 S. Washington Street Green Bay, WI 54301	911 or 920-448-3280	3,4,5	
Ashwaubenon Fire and Rescue	2155 Holmgren Way Green Bay, WI 54304	911 or 920-492-2312	3,4,5	

Contingency Plan
Volume 1
Lower Fox River (OUs 2-5)
Table 7-1
Emergency (and Non-Emergency) Telephone Numbers

EMERGENCY CONTACT	LOCATION	PHONE NUMBER	OUs	NOTIFIED
De Pere Fire/EMS	400 Lewis Street De Pere, WI 54115	911 or 920-339-4087	2,3	
Wrightstown Fire Department	961 Broadway Street Wrightstown, WI 54180	911 or 920-532-4556	2,3	
Kaukauna Fire Department	206 West 3rd Street Kaukauna, WI 54130	911 or 920-766-6320	2	
Kimberly Fire Department	515 W. Kimberly Avenue Kimberly, WI 54136	911 or 920-788-9805	2	
CHEMTREC[1] Chemical Transportation Emergency Center	1300 Wilson Boulevard Arlington, VA 22209	800-424-9300 (703-741-5525)		
National Response Center[2]	United States Coast Guard (G-OPF) 2100 2nd Street, Southwest – Room 2611 Washington, DC 20593-0001 USA	800-424-8802 (202-267-2675)		

Notes:

1. CHEMTREC® (Chemical Transportation Emergency Center) is a public service of the Chemical Manufacturers Association. However, CHEMTREC® is not intended nor equipped to function as a general information source.
   - CHEMTREC® DEALS ONLY WITH CHEMICAL TRANSPORTATION EMERGENCIES!
   - In the event of chemical transportation emergency, CHEMTREC® provides immediate advice for those at the scene of emergencies, then promptly contacts the shipper of the chemicals for more detailed assistance and appropriate follow-up.
   - OPERATES AROUND THE CLOCK – 24 HOURS A DAY, 7 DAYS A WEEK TO RECEIVE EMERGENCY CALLS. IN CASE OF CHEMICAL TRANSPORTATION EMERGENCIES, CALL ONE OF THE FOLLOWING NUMBERS:
     - Continental United States: (800) 424-9300 direct dial, toll free (WATS) number
     - Outside of Continental USA: (703) 527-3887 (This number may be called collect.)
   - CHEMTREC® provides hazard information warnings and guidance when given the NAME OF THE PRODUCT and the NATURE OF THE PROBLEM. For more detailed assistance, provide the following information:
     - Name of caller and call-back number; Location of problem; Shipper or manufacturer; Container type; Rail car or truck number; Carrier name; Consignee; Local conditions.

2. The National Response Center (NRC) maintains a 24-hour-per-day, 7-day-a-week, 365-day-a-year Operation Center where all information is received via the toll-free number, entered directly into an on-line data base system, and electronically disseminated as part of the National Response System. Once contacted, the NRC Duty Officer will guide the caller through a detailed series of questions based on the Standard Report Form to gather as much information as possible concerning the spill or release. The information is immediately entered into the Incident Reporting Information System (IRIS) and based on several pre-established criteria including material involved, mode of transportation, injuries, damage, and fatalities, select federal agency notification will take place within 15 minutes of receipt. When any of the following incidents occur, the NRC should immediately be contacted by the responsible party via the toll free number. If you see or discover and oil spill or release of chemicals and are NOT the responsible party, you should contact the NRC with whatever information you have.

Chemical Releases

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that all releases of hazardous substances exceeding reportable quantities be reported by the responsible party to the National Response Center. Title 40 of the Code of Federal Regulations Part 302 promulgates reportable quantities and reporting criteria. All the Extremely Hazardous Chemicals (EHC) that overlap with the CERCLA listed chemicals table (40 CFR 302.4) should be reported to NRC.

Other Releases

Discharges from a hazardous waste treatment or storage facility must be reported by the emergency coordinator at the facility. Abandoned dump or waste sites should be reported by anyone having knowledge of such a site.

Contingency Plan Volume I Lower Fox River (OUs 2 through 5) Table 7-2 Site Contact Numbers		
CONTACT	**PHONE NUMBER**	
Project Manager– Ray Mangrum	C (713) 876-8528	
CM/Alternate EC – Mike Estess	C (803) 646-0938	
ESS/EC – Bill Welch	C (330) 208-5630	
PESM – Grey Coppi	(973) 630-8101	C (215) 327-0751
Tetra Tech Director EHS Services - Phil Bartley	(509) 372-5818	C (509) 521-4898
Medical Consultant (Dr. Greaney)	(800) 455-6155	

- Other emergency situations requiring outside notification/response
- Injury-free event with significant damage to property, equipment, or the community (fire, explosion, release, damage > $2,000, or that generates media or law enforcement activity)

Tetra Tech will notify the PESM within 24 hours of the following:

- All injuries
- Industrial illnesses
- Injury-free events
- Property damage incidents

7.2 Medical Support and Facilities

First Aid/CPR trained personnel will administer minor first aid on site. Non-emergency medical treatment will be provided at local urgent care/occupational medicine providers. Medical emergencies requiring additional evaluation/treatment will be provided by local emergency services, which can be contacted by calling 911. The nearest hospital with emergency services and the nearest Work Care facility will be identified for site personnel prior to the start of work activities. The Work Care facility will be used for illnesses or injuries that are not life threatening, but require medical care. Local emergency service providers (including medical facilities and fire departments) will render emergency response assistance for the project site. Victims of serious injuries shall be transported by ambulance to the primary or secondary emergency medical facility.

Tetra Tech shall ensure that specific employees on site hold current cardiopulmonary resuscitation (CPR) certifications, including Automatic Electronic Defibrillator (AED) training and first aid training as specified by corporate training requirements. First aid kits shall be located on site for minor injuries. AEDs will be available in the Support Zone. All injuries and near misses shall be reported promptly to the Tetra Tech ESS for evaluation and proper case management through WorkCare (Tetra Tech's corporate medical consultant).

Location maps to the emergency medical facilities (hospital) and Work Care facility are given in Appendix A. The closest emergency medical facility and Work Care facility will be posted in the office trailer (or in site vehicles or site boats if no office trailer is located nearby), the ACS, and other buildings on site. Directions to the closest facility will be determined and posted along with the location maps.

7.3 OUTSIDE RESPONDERS

Depending on the nature of the emergency, the EC may determine that it is necessary to contact outside emergency responders and/or 911 (police, fire department, ambulance service). Organizations and project personnel will be contacted by the EC as site events require and allow.

Location maps for the local fire departments are provided in Appendix B. Additional supporting stations are also available to respond if necessary for services such as hazardous material responses or rescue operations.

Emergencies require an increased alert status for on-site personnel and off-site authorities. Other organizations and project personnel will be contacted by the EC as site events require and allow. Emergency contact numbers are posted in the office trailer, the ACS, and the other buildings on site.

7.4 INCIDENTS REQUIRING REGULATORY AGENCY REPORTING

There are mandatory notification requirements for certain types of hazardous substance spills to the environment. A spill is defined as an unanticipated release of a hazardous substance, including oils, to the environment. This includes releases to soil, water, and air. The State of Wisconsin guidelines will be used to determine reportable quantities for releases as noted in Table 7-3. If it involves PCBs, the spill or release may require notification to EPA and in some instances, a direct phone call to the EPA Region 5 Administrator. The Regulatory Specialist will assist the EC, CM, and PM to determine reporting requirements. Should a reportable spill/emission occur, site personnel are required to immediately notify the onsite EC and CM. The PM or designee will be responsible for notifying the regulatory agencies identified in Table 7-3.

To the best of his/her ability, the person notifying the regulatory agencies should be able to provide the following information:

- Location of the spill
- The substance spilled
- Quantity spilled
- Concentration of the spilled substance
- Responsible entity for the spilled the substance
- Status of spill clean-up
- Any resource damages immediately discernible (e.g., dead fish or oiled birds)
- Contact information (name and phone number of person reporting spill)

Contingency Plan
Volume I
Lower Fox River (OUs 2 through 5)
Table 7-3
Release Notification Requirements and Contact Information

Contact	Phone Number	Time Frame	Release Notification Requirement

National Response Center	1-800-424-8802	As soon as possible, but no later than 12 hours	Transportation –related (including loading/unloading, and temporary storage) incidents involving hazardous materials (including hazardous wastes)
			• Hazardous Materials are listed under 49 CFR 172.101
			• As a direct result of hazardous material
			  o A person is killed,
			  o A person receives an injury requiring admittance to a hospital.
			  o The general public is evacuated for 1 hour or more;
			  o A major transportation artery or facility is closed or shut down for 1 hour or more
			  o The operational flight pattern or routine of an aircraft is altered
			• There has been a release of a marine pollutant in a quantity exceeding 119 gallons for liquids or 882 pounds for solids
			• Release of a hazardous substance equal to or exceeding the reportable quantity (see 40 CFR 302 – Table 302.4)

National Response Center (or if direct notification to the NRC is not practical, reports can be made to the Coast Guard)	NRC: 1-800-424-8802 Coast Guard District 9: 216-902-6073	As soon as there is knowledge of the spill.	Report oil spills into or upon the navigable waters of the United States or adjoining shorelines. Reportable discharges of oil include quantities that: • Violate applicable water quality standards • Cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines • Cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines
EPA Regional Office Region V	77 West Jackson Blvd Chicago, IL 60604 312-353-2000	Immediate reporting	• Spills of 10 pounds or more by weight of PCBs (any concentration greater than 50 ppm) • Spills of 1 pound or more by weight of PCBs (i.e., total volume spilled times concentration $\geq$ 1 pound) are also reportable to the National Response Center
Wisconsin Emergency Management	1-800-943-0003	Immediate reporting	All discharges to the environment of a hazardous substance (including petroleum products such as diesel, gasoline, oil) *except* the following: • A discharge of gasoline or another petroleum product that is completely contained on an impervious surface • A discharge of gasoline if < 1 gallon is discharged onto a surface that is not impervious or runs off an impervious surface • A discharge of a petroleum product other than gasoline if < 5 gallons is discharged onto a surface that is not impervious or runs off an impervious surface • A discharge of hazardous substances (e.g., PCBs) specifically listed in 40 CFR 117 or 302 if the amount discharged in any 24-hour period is less than the RQ listed in 40 CFR 117 or 302 (e.g., RQ for PCBs = 1 pound)

7.5 Incidents Requiring NRC Notification

If the EC determines that the emergency situation could threaten human health or the environment outside the facility, the PM will be notified and the NRC at **1-800-424-8802** shall be contacted (if applicable). The NRC must be notified for hazardous substance or hazardous material releases that exceed the hazardous substance RQ. Reports to the NRC must include the following information:

- Name and telephone number of the reporter
- Name and address of the facility
- Time and type of incident (for example, release, fire)
- Name and quantity of material(s) involved, to the extent known

7.6 Notification to OSHA

Injuries, accidents, and incidents that require OSHA notification within **8 hours** include:

- A death
- A probable death
- The in-patient hospitalization of two or more employees within 8 hours

The following information shall be provided to OSHA within **30 days** concerning any accident involving a fatality or hospitalization of two or more employees:

- Name of the work place
- Location of the incident
- Time and date of the incident
- Number of fatalities or hospitalized employees
- Contact person
- Phone number
- Brief description of the incident

The EC shall notify the ESS of the above injuries/illnesses/fatalities as soon as possible. The ESS shall immediately notify the PESM and Tetra Tech's Director of EHS Services.

7.7 Public Notification

While it is unlikely that the project will experience an emergency requiring evacuation of adjacent properties, such an emergency is possible. If it occurs, the PM with assistance from the EC will work with Tetra Tech's Public Information Officer and the regulatory agencies to determine the appropriate actions. The EC will implement the evacuation. The Public Information Officer will work with the news media, outside businesses, and company public relations officers to assure the notification of potentially impacted neighbor(s). Responsible risk assessment and prevailing weather conditions will determine which neighbors will be evacuated. Examples of incidents potentially impacting the adjacent public include:

- Fire or explosion
- Large chemical release

8.0 EMERGENCY RESPONSE

8.1 GENERAL

In the event of an incident or emergency the site personnel shall immediately:

- Note the current wind direction, speed, abnormal noise, odors, and observable smoke conditions on site.
- Contact the EC and provide all requested information. Bomb alerts, terrorist actions, or certain other risks may require controlled response or release of information. Site personnel will follow the directions outlined by the EC.
- Promptly notify the EC or designee of the location of any injured or missing personnel. The EC will notify the PM and the ESS of the emergency.
- Keep EC informed of the evacuation status, if required, and any other related information.
- Be prepared to implement all possible directions, including:
  1. Notify additional Tetra Tech contacts, if directed by the EC.
  2. Activate the emergency alarms and appropriate alert status.
  3. Make emergency announcements over the radio (remembering to speak slowly and clearly).
  4. Clear the gate area and entry roadway for exiting site workers and responding emergency vehicles.
  5. Print out and/or assemble list of visitors, truck drivers, and contractors.
  6. Control site and gate access from non-required personnel and the media.
  7. The ACP, in conjunction with the EC, will coordinate an escort for any incoming emergency vehicles directly to the location of the emergency and arrange to unlock gates for alternate evacuation routes, as needed.
  8. Gate control during emergencies may be assigned to a trained employee if additional assistance is needed. The assigned employee must understand this Plan and associated activities (e.g., gate control, emergency alarm/air horn activation, radio announcements, response contacts, and the conditions under which to evacuate).
- The EC will inform site personnel when the emergency situation is terminated and instruct ACP to make an "All Clear" radio announcement for the site.
- ***OR*** call **9-1-1** to request assistance for any of the following emergencies:
  1. Medical injuries (heart attack, loss of breathing, electrical burns, chemical inhalation, broken bones, etc.)
  2. Severe fire or explosion
  3. Personnel rescue
  4. Releases of chemicals or wastes

8.2 MEDICAL EMERGENCY AND NON-EMERGENCY RESPONSE

8.2.1 Emergency Response

Some physical signs/symptoms that require emergency medical treatment and a call to 911 include: chest pain, difficulty breathing, uncontrolled bleeding, bone fracture, loss of consciousness, severe head injury, poisoning, shock, loss of limb, and sudden and prolonged dizziness.

In cases of personal injury at the site, the following response actions shall be undertaken (refer to Figure 8-1):

- The injured employee is discovered and the EC is signaled by the best means available (e.g., air horn, hand signal, voice, or radio) that an injury has occurred.
- The EC will evaluate extent of injuries reported and dispatch first-aid-trained personnel or direct site personnel to contact the emergency response organization for ambulance services if needed, and shall notify the PM and the CM.
- Call 911 for initial employee evaluation and transport to the hospital. A designated Tetra Tech employee shall accompany the injured worker to the hospital. If the incident involves exposure to a hazardous substance (or chemical) the ESS shall provide a copy of the relevant MSDS to travel with the victim to the hospital. Also some decontamination may be required depending on victim's exposure.
- Administer first aid to minimize the injury effects.
- **Call WorkCare at 1-800-455-6155** for a triage call/discussion with an Occupational Health Nurse or physician. Mention as soon as possible that the call is regarding an emergency injury. The Occupational Health Nurse will assist the supervisor in determining the best treatment plan.
- Provide the following information to WorkCare:
  - Name of Supervisor calling
  - Phone number
  - Location calling from
  - Name of individual injured and Social Security number
  - Date and type of injury
- During WorkCare off-hours, dial the 800 number and identify yourself. A WorkCare health care representative will call you back shortly. Do not delay treatment while awaiting a return phone call.
- The CM is responsible for making certain that an incident report is completed within 24 hours of the incident and is submitted to the PM and the PESM. The ESS will assist in the incident report preparation. The PESM will distribute the report within Tetra Tech for further review, action, and trending.

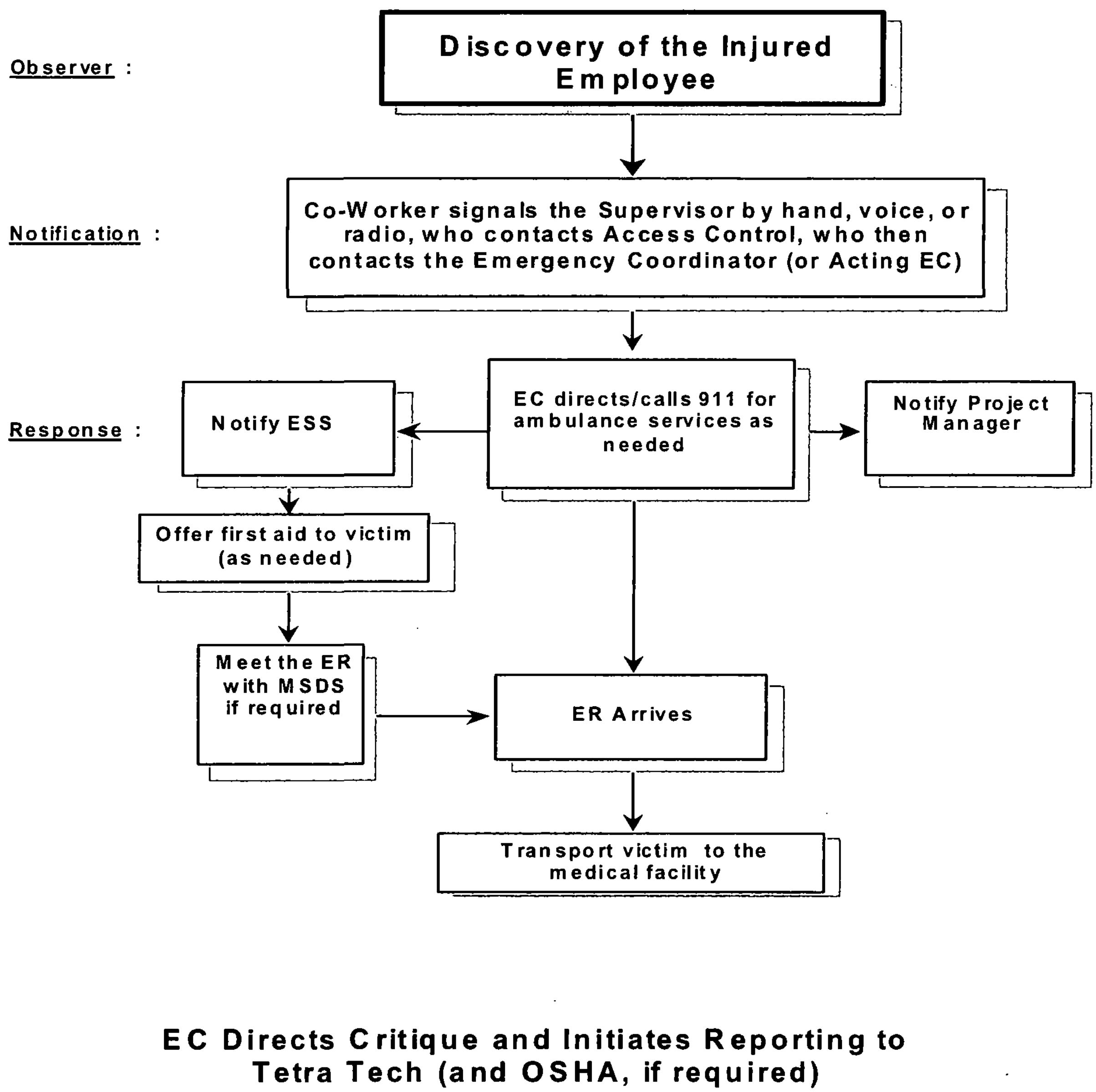


Figure 8-1. Injury or Medical Emergency Flow Chart

8.2.2 Non-Emergency Response

In a non-emergency situation:

- The injured employee is discovered and the EC is signaled by the best means available (e.g., air horn, hand signal, voice, or radio) that an injury has occurred.
- The EC will evaluate extent of injuries reported and dispatch first-aid-trained personnel or direct site personnel to contact the emergency response origination for ambulance services if needed, and shall notify the PM and CM.
- Administer first aid to minimize the injury effects.
- Call WorkCare at 1-800-455-6155 for a triage call/discussion with an Occupational Health Nurse or physician. Mention as soon as possible that the call is regarding an injury. The Occupational Health Nurse will assist the supervisor in determining the best treatment plan.
- Provide the following information to WorkCare:
  - Name of Supervisor calling
  - Phone number
  - Location calling from
  - Name of individual injured and Social Security number
  - Date and type of injury
- During WorkCare off-hours, dial the 800 number and identify yourself. A WorkCare health care representative will call you back shortly. Do not delay treatment while awaiting a return phone call.
- Call the local WorkCare clinic (360-891-4900) to notify that you are bringing an injured worker to the clinic for evaluation.
- You may transport the injured employee to the local clinic in a privately owned vehicle. A designated Tetra Tech employee must accompany the injured worker to the local clinic.
- The CM is responsible for making certain that an incident report is completed within 24 hours of the incident and is submitted to the PM and the PESM. The ESS will assist in the incident report preparation. The PESM will distribute the report within Tetra Tech for further review, action and trending.

8.2.3 After Emergency and Non-Emergency Treatment

After emergency and non-emergency treatment:

- Obtain treatment and medical release records for the injured worker and forward to WorkCare.
- Contact Tetra Tech worker's compensation carrier (ESIS at 1-866-615-5923) within 24 hours of injury.
- Seek ways to ensure the worker can work, including alternate work.
- Regularly follow up with WorkCare and ESIS case representatives.

8.3 SEVERE WEATHER EVENT OR NATURAL DISASTER

Response to an emergency event caused by severe weather or natural disaster (tornadoes, floods, damaging winds, etc.) shall be carried out under the direction of the EC. The EC shall notify the PM and CM immediately. Refer to Figure 8-2 for a summary of emergency response procedures.

Depending on the nature of the event, emergency response and support services (fire, ambulance, or police) may respond via a priority basis. Hospitals, schools, nursing homes, etc., will receive a higher priority and quicker response. The project site must prepare as if it may **not** receive any emergency response services for up to three days. Other emergencies will be responded to based on the actual/potential damage(s) or in a similar fashion as a fire, tornado, or earthquake.

All U.S. Weather Service-declared Watch, Warning, or Emergency announcements, emergency alarms, weather or natural conditions shall be promptly relayed to all personnel.

8.4 FIRE OR EXPLOSION

The extent of each employee's emergency response training shall be factored into the appropriate response activities. Project personnel receive specific emergency response training, including response to fires, explosions, and spills, as part of their introductory and annual review of required training.

If safe to do so, trained project personnel shall use fire extinguishers available on site to control or extinguish a small localized fire; remove or isolate flammable or other hazardous materials that may contribute to the fire; and contain or recover spilled materials. The EC shall assess the hazard associated with the emergency situation and shall determine the appropriate response. The EC's initial response to an emergency shall be the protection and safety of human health.

The general response to a fire or explosion is as follows (refer to Figure 8-3):

- The discoverer of the fire or explosion shall notify his/her immediate supervisor. The supervisor will then notify the EC. Attempts to extinguish a fire or otherwise respond to the emergency shall then be made if it can be accomplished safely; otherwise, withdraw to the designated assembly area and wait for directions.
- The EC shall notify PM, CM, and other appropriate personnel of the emergency situation and the response needed, which could include verbal instructions or alarm patterns.
- Work in the affected area shall be shut down. Non-essential personnel shall be removed from the affected area.
- A head count of workers will be taken for employee accountability and to determine if any rescue or recovery operations are necessary.
- Established emergency procedures shall be followed if the unit requires evacuation or if personnel require medical treatment.

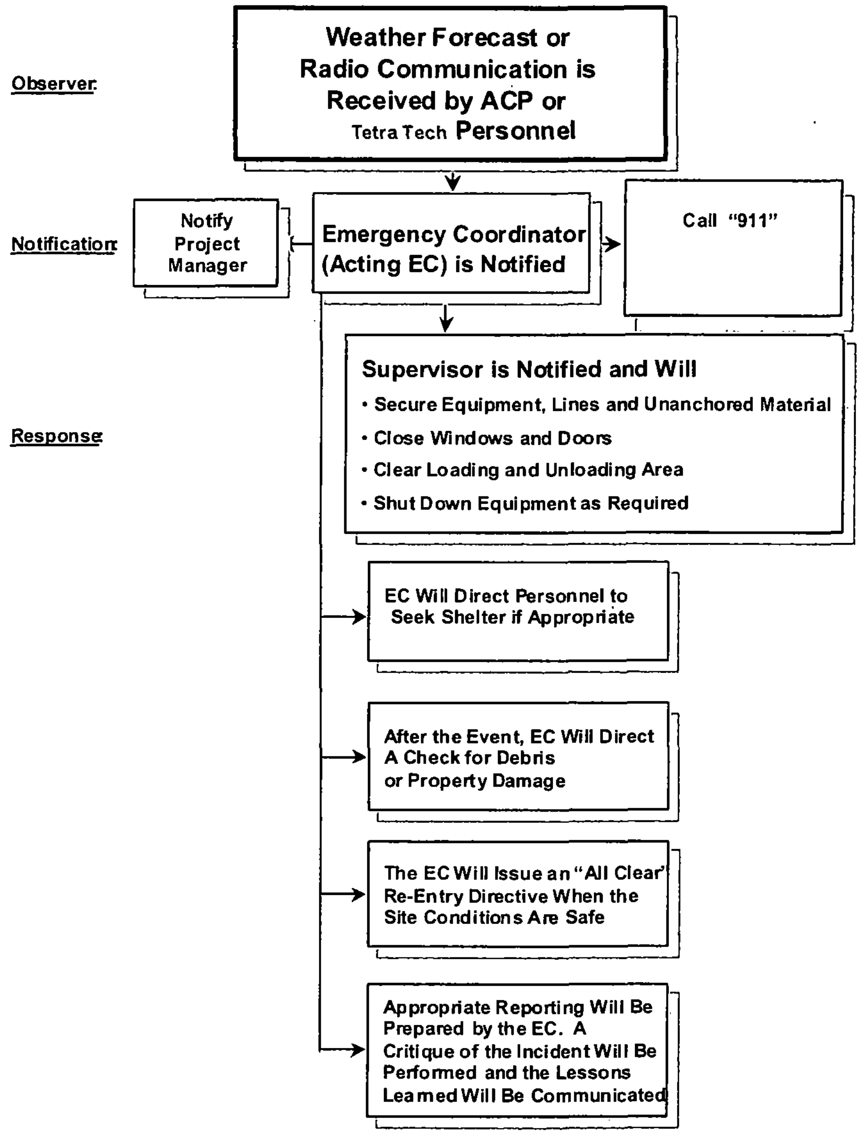


Figure 8-2. Weather Events and Natural Disasters Emergency Response Flow Chart

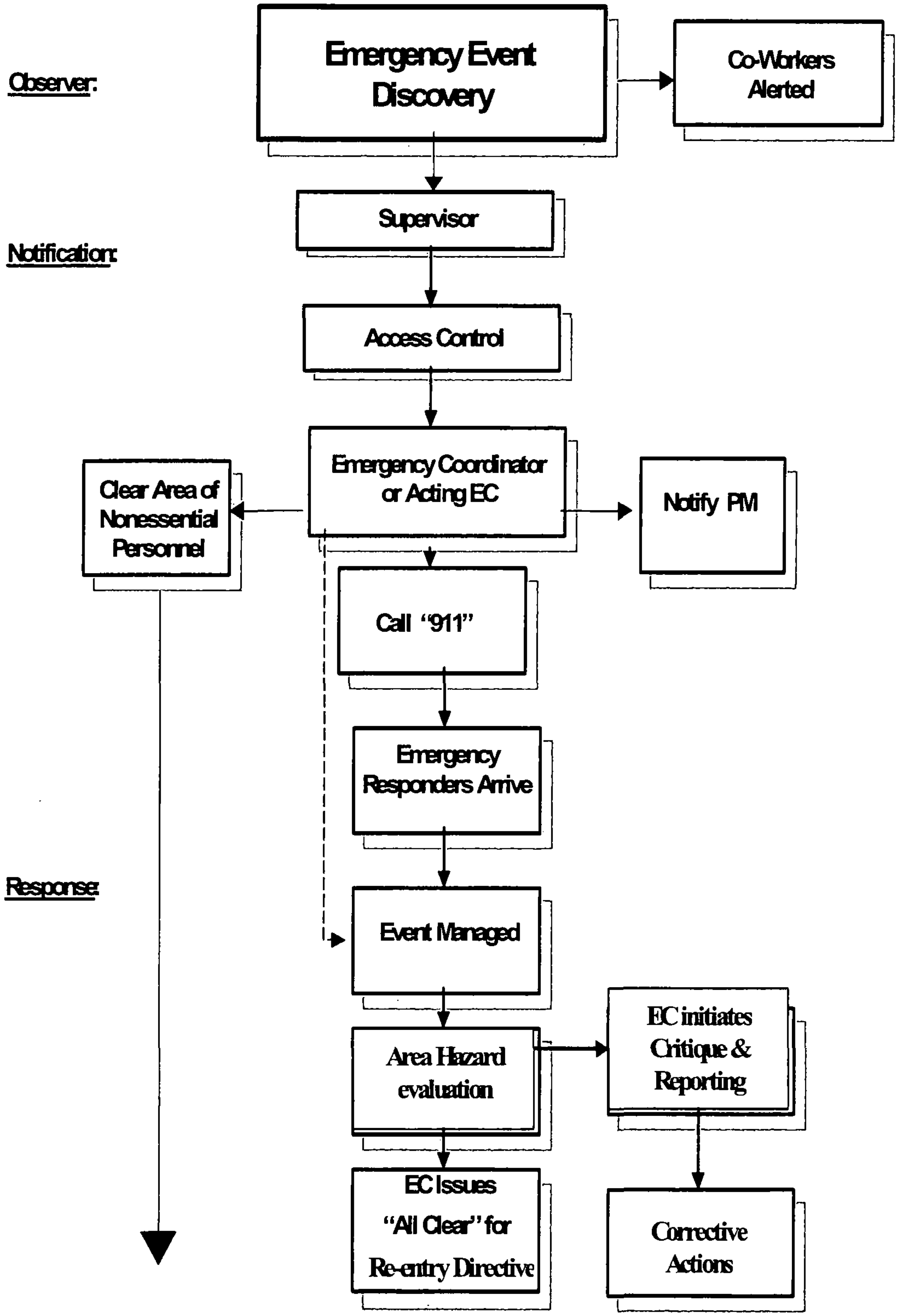


Figure 8-3. Fire or Explosion Emergency Flow Chart

- The area where a fire or explosion has occurred will be protected from entry and disturbance to allow for investigations and evaluations to determine if area is safe to return to work.
- After the fire has been extinguished and no further threat to human health exists, the "All Clear" signal shall be given by the EC. Equipment employed during the emergency shall be cleaned, inspected, and placed back into standby status for future use.

8.5 UNAUTHORIZED ENTRY, TRESPASS OR SITE INTRUDERS

Site personnel shall report observation of unauthorized entries or trespassing to their supervisor or, if not available, the EC. In the event of vandalism, the person discovering the vandalism shall report it immediately to his/her supervisor. The supervisor shall report the vandalism to the EC, and he shall report it to the PM. The police shall be called to report the damage. The CM with the ESS shall investigate the damages and ensure that the area or equipment is safe to use. If the area or equipment is deemed unsafe, an evaluation shall be made to ensure that personnel on the property are properly protected. The CM or designee shall complete an incident report. Refer to Figure 8-4.

8.6 BOMB THREATS OR TERRORIST ACTIVITIES

Bomb threats or terrorist activities will be evaluated based on the information collected while yielding maximum protection to the staff. Area-specific evacuation or total evacuation decisions will be evaluated. Refer to Figure 8-5.

The person receiving the bomb threat on the telephone shall:

- Remain calm.
- Listen without interrupting the caller. If possible, keep the caller talking.
- Obtain as much information as possible, for example:
  - When is the bomb going to go off?
  - Where is it located?
  - What kind of bomb?
  - Where is the caller located?
  - How does the caller know about the bomb?
  - What is the caller's name and address?
- Keep the line open and notify supervision.
- Write down details about the call that can be remembered (sex, estimated age of caller, voice quality, accent, speech impediments, and background noise).

The EC shall:

- Evacuate the facility.
- Direct or call "911."
- Notify PM and CM.
- Direct employees to immediately evacuate the area.

- Cooperate with investigators.
- Support the Emergency Response investigation by police and other responding agency personnel as needed.
- Issue an "All Clear" re-entry direction after the emergency response team completes its investigation and communicates that the site is safe and re-entry is appropriate.

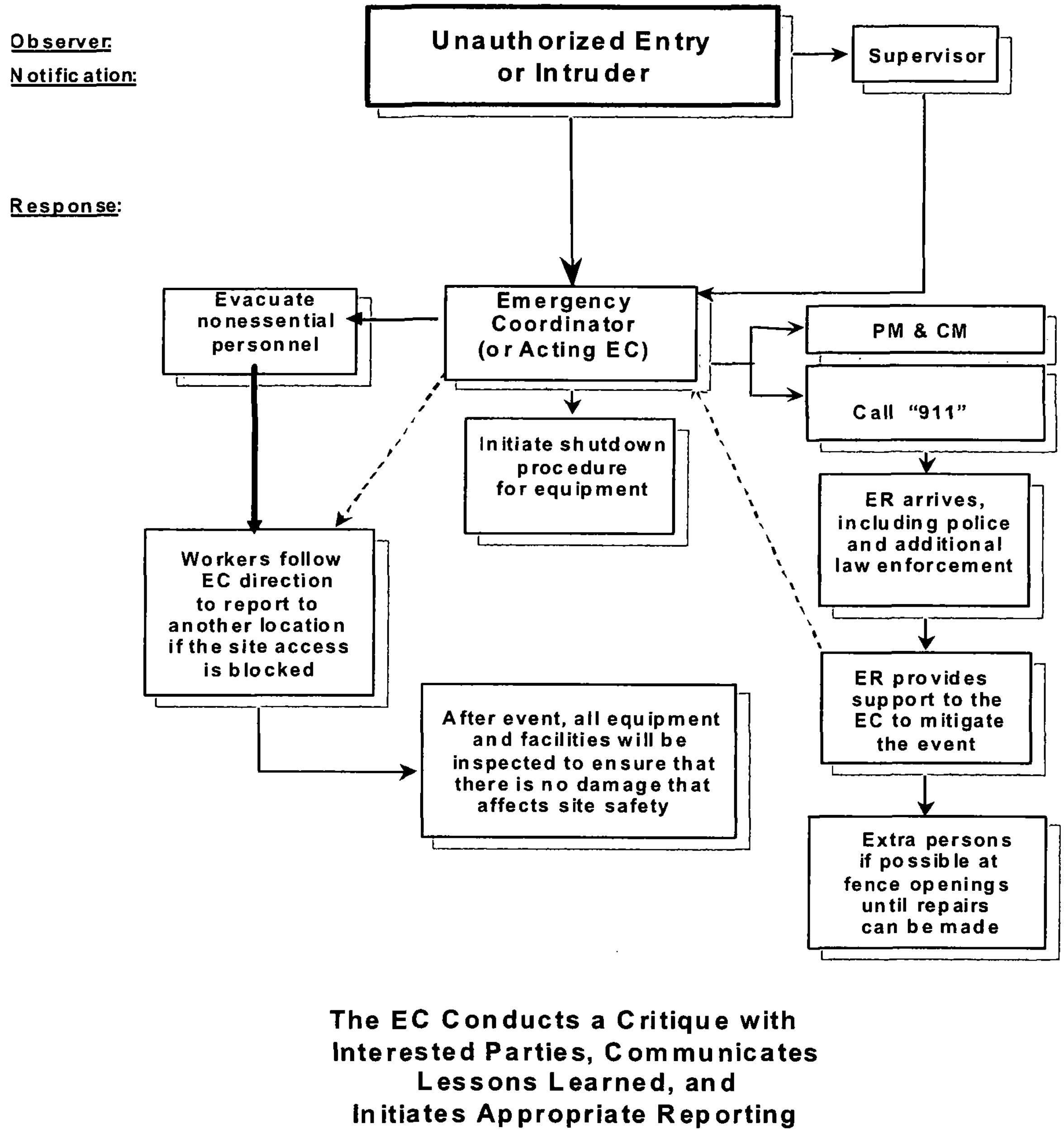


Figure 8-4. Unauthorized Entry, Trespass, or Site Intruder Emergency Response Flow Chart

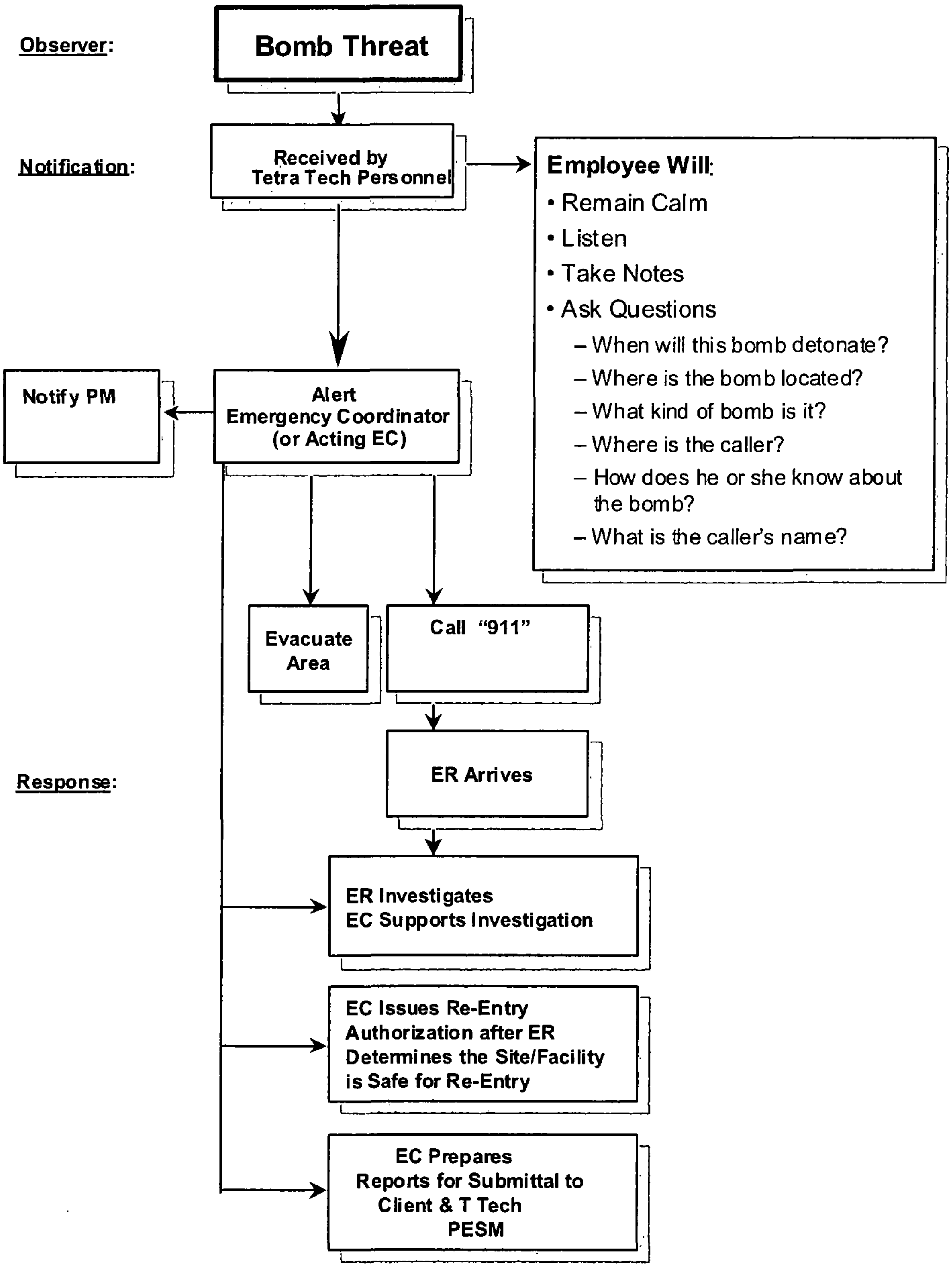


Figure 8-5. Bomb Threat Flow Chart

8.7 PERSONNEL RESCUE

Successful personnel rescue relies on prompt notification. At no time should a rescue attempt be made if the rescuer could become in danger himself/herself and at no time shall an employee enter a confined space to attempt a rescue unless specifically approved in an AHA after training and using the appropriate equipment and monitoring requirements. Training must include recognition and anticipation of hazardous areas and situations. Capable and trained site workers under the supervision of the EC and CM can conduct limited rescue of personnel if deemed safe and if approved by this Plan. If not deemed safe, not approved by this Plan, or if additional equipment and resources are necessary, the local fire department will be contacted to provide this assistance. Refer to Figure 8-6.

8.7.1 Confined Space Rescue

No Tetra Tech personnel are currently permitted to enter any confined space on this project. Confined spaces at this site may include, but are not limited to: wastewater treatment storage and process tanks; stormwater and sanitary sewers and manholes; some pits or vaults that could be encountered; and covered roll-off boxes. All work will be engineered to avoid entry into these spaces to conduct the required work. Entry is defined as the act of a person passing through an opening into a confined space whereby any part of the body breaks the plane of the opening. This NO ENTRY policy will be clearly communicated to all persons working on this project. If a person is found to be in a confined space and that person is unable to exit, Tetra Tech will not attempt a rescue. In an emergency involving a confined space, the local fire department will be called upon to provide a confined space rescue.

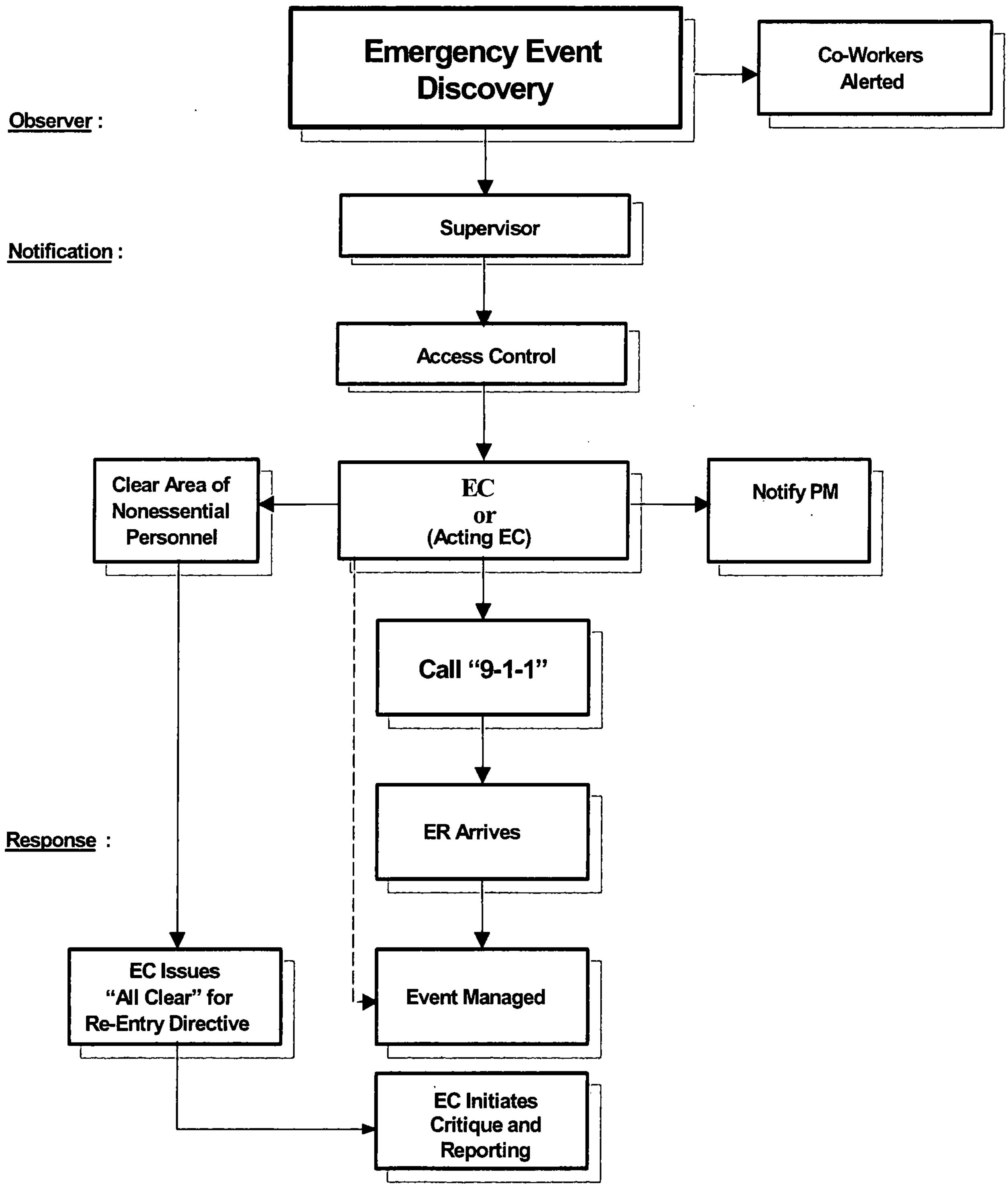


Figure 8-6. Other Emergency Response Flow Chart

9.0 CHEMICAL SPILLS, HAZARDOUS WASTE AND MATERIAL RELEASES

A spill is defined as an unanticipated release of a hazardous substance, including oils, to the environment. This includes releases to soil, water, and air. Spills can potentially occur when transporting, storing, or handling hazardous substances. Common hazardous substances anticipated to be handled at the project site include:

- **Gasoline** – project vehicles, generators, portable fuel containers
- **Diesel** – project vehicles and heavy equipment, generators, portable fuel containers
- **Used oil and oil products** – project vehicles and heavy equipment, used oil storage areas
- **Remediation wastes** – sediment and debris containing PCBs that are handled during dredging, pumping, dewatering, staging, and off-site transportation activities

All employees have received hazardous material training and hazardous waste awareness level training for their work place as a portion of their Hazard Communication training. MSDSs are available for the chemicals in the work area and can be found in the ESS's office. Employees are trained to clean up small spills in accordance with their Hazard Communication training. Refer to Figure 9-1 for a summary of spill/release response procedures.

- Any spill or air emission release, regardless of amount, should be reported **immediately** to immediate Supervisor. The Supervisor reports the spill or release to the EC and the EC works with the Regulatory Specialist. The Regulatory Specialist assists the EC in determining reportability of the spill, safety concerns for the clean-up crew, and waste disposal. The information reported to the Supervisor and up the chain must include: the location of the spill or release; what was spilled or released; how much was spilled or released and/or the duration of the release; and the receptor for the release (soil, secondary containment, concrete, stormwater, etc.).
- The safe clean-up of spills and releases depends on the material or waste spilled, the amount released, and conditions of the area (hot surfaces, containment, other materials present, ventilation, etc.).
- After notification to their Supervisor, properly trained site personnel will handle "small" spills not requiring additional personnel. In all cases, the ESS must be notified of any spill clean-up in progress in order to ensure and document proper clean-up, notification of personnel, and waste management/disposal.
- If site crews are unable to effectively handle a large spill, such as from transformer failures, large-volume fuel oil spill, oil spill impacting surface waters, etc., the spill will be immediately reportable to the NRC and State as listed in Table 7-3 above.

To prepare for releases of oil (including hydraulic oil), fuel, and other petroleum product spills, spill response materials are located in areas where there are potential points of release such as refueling or active work areas. The spill materials are maintained regularly and provide the basic personal protective equipment (PPE) and spill containment equipment (absorbents, booms, containers, equipment, etc.) for an immediate response. Other appropriate storage locations on site will contain additional spill and emergency response equipment.

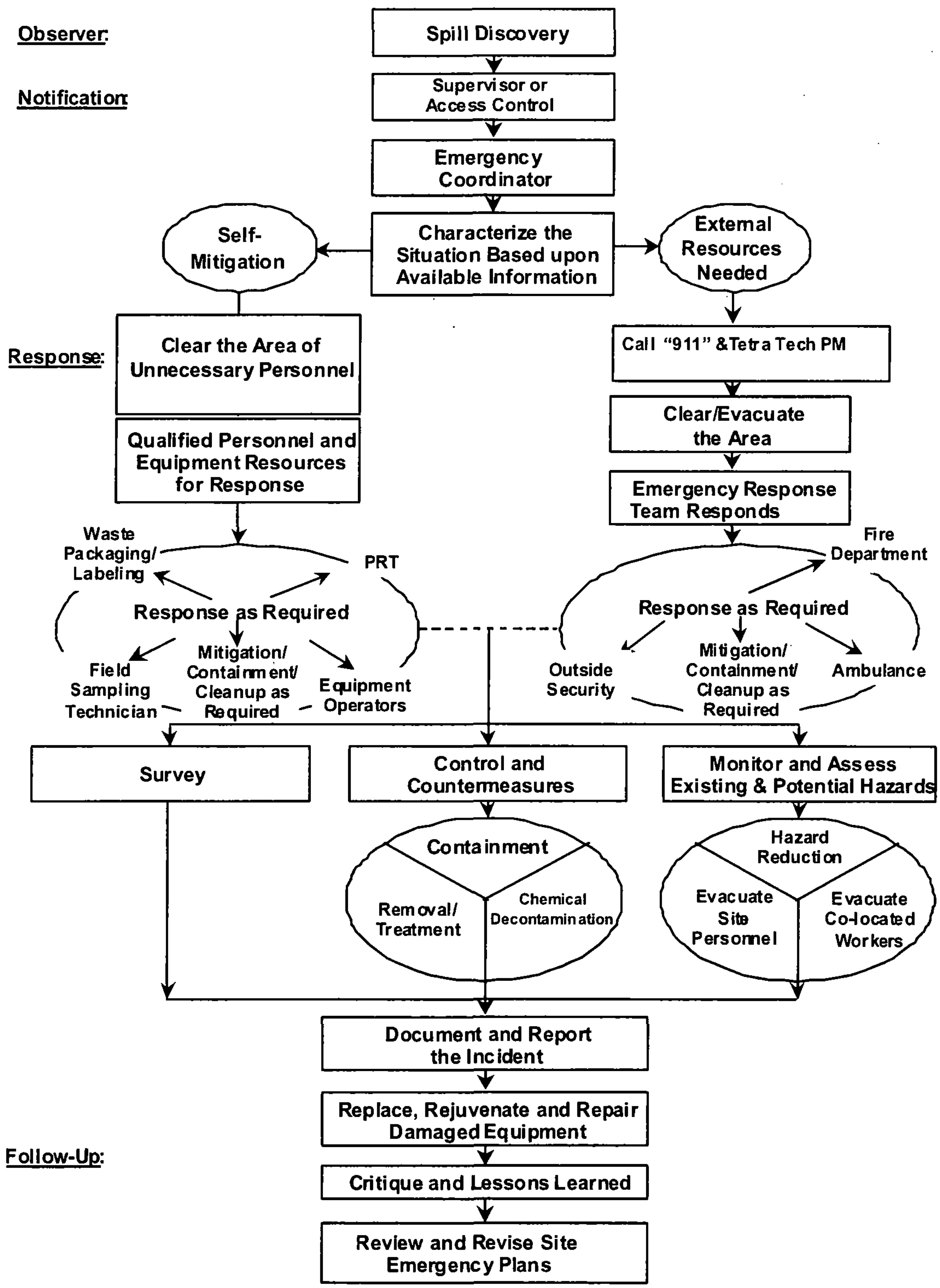


Figure 9-1. Hazardous Material or Waste Release Emergency Response Flow Chart

The emergency equipment list for the site is shown in Table 11-1. In the event of a spill, site personnel shall:

- Alert co-workers.
- Inform their supervisor immediately.
- Follow instruction(s) from the EC or designated EC to clear the affected area.
- Stop the release if it can be safely accomplished (upright a leaking drum, shut off a valve or hose, etc.).
- Remove surrounding materials that could be reactive with the released material and review MSDSs and other information as needed to address this issue.
- Use hand tools and absorbent pads, booms, earth, sandbags, sand, kitty litter, and other inert materials to contain, divert, and clean up a spill.
- If the spill reaches or is probable to reach a stormwater runoff system, take measures necessary to intercept this material.
- Place clean-up materials and containment in appropriate containers for safe retention and final disposition.
- Some special spill and material release conditions and appropriate emergency response actions are identified below:
  - Toxic fumes or vapors – If the spill or material release could result in the emission of vapors or fumes that pose a threat to facility personnel or to persons in the surrounding area, evacuation shall be initiated for facility personnel and the people in the affected surrounding area. The EC shall notify the PM and ESS, and contact appropriate outside authorities to request assistance in the evacuation of people in the surrounding area when appropriate. Personnel shall not be allowed in the affected area until the problem has subsided and it is determined that it is safe to re-enter the area. Evacuation is covered further in Section 10.0.
  - Large-quantity spills – Spills that occur are expected to be small and should be contained and controlled by site personnel. However, when external support is required to mitigate or clean up a spill, the EC (or designee) shall mobilize additional response support by contacting the appropriate agencies.

Authorities and agencies shall be appropriately notified of RQ spills or air emissions as directed by the ESS. Internal notification and client notification shall follow the standard prescribed in the Tetra Tech Incident Reporting and Investigation Procedure, EHS 1-7 (Incident Reporting & Investigation).

If work operations are stopped in response to a release, fire, or explosion, personnel shall monitor for leaks, pressure buildup, or other equipment failures. If an abnormal condition is observed, appropriate action shall be taken by operations personnel to terminate or minimize the amount of material being released. After the emergency, arrangements shall be made for the safe treatment, storage, or disposal of recovered waste, contaminated soil, surface water, or other contaminated material resulting from the emergency. The EC shall notify the PM and ESS and oversee the management and handling of contaminated materials, which shall include the following:

- Identification of released materials to assure that they are compatible with other stored materials and with the containers or tanks in which they shall be stored
- Clean-up, packaging, characterization, and labeling of the material
- Storage of the material
- Proper treatment or disposal of the material (in permitted facilities)

If the ESS determines that contaminated water, materials, or soil is to be sent off site for treatment and disposal, only EPA-approved and permitted facilities, which are also Tetra Tech approved, shall be used. Methods used to store and treat released materials due to an emergency shall be determined on a case-by-case basis.

10.0 EMERGENCY EVACUATION AND SHELTER

Small or limited hazard incidents may not require a complete evacuation. Limited evacuations or shelter in place procedures may require that only adjacent work areas evacuate to their designated assembly area. Depending on the situation, shelter in place procedures may be utilized to prevent exposure to transient outside contaminants. This may include closing windows, loading bays and doors. Proper considerations are needed prior to turning off any ventilation systems.

The assembly points must **not** be at risk or involved in the emergency situation. If the assembly points are at risk, supervisors shall direct personnel to proceed to an alternate location and inform the EC.

During an emergency, protective actions that may be taken to ensure worker safety include evacuation or shelter. In some instances, evacuation may be limited to evacuation of a particular work area or crew only; in other instances, evacuation of the site may be necessary.

The Project Site Evacuation Area for all emergencies that require full site evacuation will be field determined based upon the locations they are working. All site personnel and visitors will be informed of the Project Site Evacuation Area during site-specific training. The Site Evacuation Area is the most commonly known location by all personnel and visible to incoming emergency response crews. The distance away from most hazards and typical prevailing winds should protect the Evacuation Area. If a site evacuation is announced and the Evacuation Area is at risk, supervisors will instruct personnel to proceed to an alternate evacuation area as designated by the EC. In the event that a particular work area must be evacuated in an emergency, but that emergency does not affect the entire site, there are designated Assembly Points to which workers will evacuate. The workers who evacuate a work area will, unless otherwise instructed, proceed to the main Assembly Point and await further instruction. A head count will be done at the main Assembly Point before proceeding to the Evacuation Area. Other intermediate Assembly Points may be designated on individual AHAs along with instructions, including alternate evacuation routes, in the event of an emergency, as needed. For each of the facilities established, a map will be developed and posted that shows the main site Assembly Point, main Evacuation Area, and Evacuation Routes.

In the event of a severe weather event (e.g., lightning, tornado), personnel will be alerted where to take shelter. Workers will be informed using word-of-mouth and two-way radios. Supervisors and the EC will perform an accountability check of on-site personnel.

In the event that all personnel cannot be accounted for, the EC will take appropriate actions, including searching for missing personnel. Any search or recovery plans shall include contingency planning to ensure safety of personnel. If necessary, 9-1-1 may be contacted for situations where an incident is deemed unsafe (e.g., fire, earthquake-damaged building, or structure collapse).

The EC evacuates the project work area whenever it is believed that the health and welfare of personnel in the area are being threatened due to chemical release(s), fire, or a natural disaster, such as a tornado. In the event that the EC determines that evacuation of personnel is required, the following actions are taken:

- An air horn blast shall be sounded (5 – 10 seconds) by EC and by supervisory personnel in major work areas. Air horns are located at ACS and at control/support zones of each major work area. The evacuation signal shall be repeated every 15 – 20 seconds until site personnel start to respond. Further instructions shall be broadcast over the internal site work area via two-way radios and by word-of-mouth. For those areas of the facility where the air horn cannot be heard, supervisors will monitor radios and advise personnel in their area of any emergency.

- Personnel in work areas being evacuated should safely stop work operations, place equipment/tools in a safe shutdown condition, and immediately proceed to their respective assembly point. Directions for alternate routes of evacuation and assembly shall be broadcast over the internal, work area radio frequency or by word-of-mouth, as necessary, or if the designated assembly point or evacuation routes to the evacuation area are deemed unsafe.
- The crew/area supervisor will conduct an attendance check at that time for personnel under his/her direction. Any discrepancy in number or identity of personnel will immediately be conveyed to EC.
- After this initial attendance check, personnel will proceed directly to the main plant Evacuation Area.
- The EC, using the day's Site Access Log and daily sign-in briefing sheet as an accountability roster, will then perform a follow-up accountability check. Unaccounted-for personnel will be reported to the EC. The EC shall attempt to reconcile the accountability check.
- During an evacuation, attempts shall be made to locate unaccounted personnel as long as such attempts do not endanger the lives of others by re-entry into the emergency area.
- Personnel who are assigned to look for unaccounted personnel or perform limited emergency response duties will be designated by the EC.
- Personnel without specific emergency response assignments shall remain in their designated assembly areas.
- General re-entry into the work area shall be allowed only after the EC announces "*all clear*" and provides re-entry instructions.
- If necessitated by the emergency event, personnel will be notified by radio or word-of-mouth to "shelter." Personnel will move to or stay within designated areas for an accountability check.

During a "shelter" event, attempts shall be made to locate unaccounted personnel as long as such attempts do not endanger the life of others.

11.0 ESSENTIAL EMERGENCY EQUIPMENT AND SUPPLIES

A supply of dedicated or easily accessible emergency equipment is maintained on site for response to a variety of minor emergencies including spills and releases, fires, explosions, and injuries. Supplies include: portable fire extinguishers and equipment; spill response materials; tools and support materials; PPE; alarm and communication equipment; and decontamination equipment. This equipment shall be maintained at the site for use in emergencies. Tetra Tech has established accounts with local vendors to support immediate replenishment of depleted supplies.

In addition to dedicated emergency equipment that is stored on site and available for use in an emergency, active work areas as well as areas where oil or fuel is handled or stored have emergency equipment such as fire extinguishers and oil spill kits or materials staged for use. Fire extinguishers are located in work areas and flammable material storage areas in accordance with National Fire Protection Association (NFPA) requirements. These kits and equipment are inspected regularly. Some emergency equipment is dedicated for emergency response, meaning it is not available for use in routine work operations; some emergency response equipment (e.g., water truck) is in use during work but in an emergency can be made available for use. Due to the nature of work at the site, active work locations often change. New work areas are evaluated for the type and quantity of emergency response equipment that must be located, and the necessary equipment is then staged conspicuously and inspected regularly.

Table 11-1 lists of the examples types of emergency equipment maintained on site in accordance with EPA, OSHA, and WDNR requirements, which are briefly described in the following sections. This table will be revised and amended as appropriate during site activities. The list includes a description of the equipment, its location, and its capabilities. The following sections discuss the basic types of emergency equipment available. A map depicting the location of emergency spill response equipment will be developed for both the former Shell site and the other upland facility.

11.1 SPILL CONTAINMENT AND CLEAN-UP

Various chemical and oil spill containment materials, such as absorbent booms, socks, pads, and kitty litter, as well as tools and equipment are available for use in cleaning up small spills of hazardous materials, substances, and wastes known to be present on site. Spill kits are located in areas where oil and petroleum products are stored, on all boats > 25 feet, and in hazardous waste storage areas. Additionally, spill kits are staged in various areas on site where active work is being performed. The spill kit locations change as work locations change. Examples of this type of equipment are provided in Table 11-1.

11.2 PERSONAL PROTECTIVE EQUIPMENT

PPE use is addressed in detail in the SHSP. PPE is designed to provide physical and chemical barriers for the head, body, hands, feet, and respiratory protection. PPE is maintained to respond to anticipated chemical releases on site and for use in work areas where a higher level of protection is necessary based on site conditions (dusts, work with chemicals, etc.). Examples of this type of equipment are provided in Table 11-1.

11.3 EMERGENCY EYEWASH/SHOWER AND DECONTAMINATION

Emergency eyewash units and emergency showers will be located in specific work areas in accordance with OSHA standards as necessary based on need. Specific AHAs for those activities/areas identify the need for staging these items. All units must be accessible and operational. Emergency eyewash units and showers will be used to decontaminate personnel in the event of chemical exposure. Additionally, other materials are available for the setup and staging for decontamination (personnel and equipment) in the event that it is necessary.

11.4 FIRE EXTINGUISHERS AND EQUIPMENT

Portable fire extinguishers are located in active work areas and hazardous material storage areas that contain flammable materials, including hazardous wastes, in accordance with NFPA and OSHA standards. Additionally, heavy mobile equipment (i.e., excavators, dozers) carry portable fire extinguishers. Additional fire extinguishers of several types are available and on hand at Supply and Supply Storage in the event of a small fire on site. The type of fire extinguisher used for fire fighting depends on the type of material (i.e., ordinary combustibles, oil or grease, combustible metal, or energized equipment). If performing hot work, a 20-lb. or larger dry chemical extinguisher will be present in the hot work area and a fire watch will be provided for a minimum of 30 minutes after completion of the hot work.

11.5 CONFINED SPACE ENTRY AND RESCUE EQUIPMENT

No persons are presently allowed to enter a confined space on this project. Should a person not adhere to the site rules on confined spaces and be unable to get out of a confined space, the local fire department provides the only on-site confined space rescue support using its own equipment.

11.6 PERSONNEL FALL PROTECTION RESCUE EQUIPMENT

Personnel fall protection rescue equipment, including ladders, harnesses, lifelines, and retrieval systems, are routinely used, available, and stored on site. All rescues must be planned, coordinated, and directed by the EC; however, the local fire department provides the primary rescue support such as high angle rescue, live electrical, or structure collapse.

11.7 WEATHER INFORMATION AND TRACKING

Local weather conditions will affect the drift and dispersion of chemical releases or smoke. The proximity to buildings and equipment will affect immediate area wind patterns and turbulence. Steam release, smoke, flags, survey tape, or blowing leaves can help determine the direction of the wind. The National Weather Service Website will be routinely checked to determine wind speed, direction, rainfall, or severe weather hazards expected.

Table 11-1. List of Emergency Response and Decontamination Equipment on Site

GEAR	EXAMPLES OF EQUIPMENT TYPES	USE & CAPABILITY	LIMITATIONS	LOCATIONS
Personal Protective Equipment				
Body Protection – Outer Wear	Dupont Nexgen Coverall NG 122S 002500 (various sizes) or equivalent	Spills of Gasoline (less than 5 gallon), Diesel, Used oil, Hydraulic fluid, PCBs	Permeable to liquids and vapors; intended for protection from contact with soil, dusts, and light, incidental contact with the materials listed or contact with contaminated soils; Health & Safety to determine adequacy of this ensemble at the time of response.	Supply Conex near Tetra Tech field office
Body Protection – Inner Liner with Outer Wear Above	Dupont Tyvek, polypropylene 543253, 543254, 543255 or equivalent (various sizes)	Use as inner layer	Permeable to liquids and vapors; intended for protection from contact with soil, dusts, and light, incidental contact with the materials listed or contact with contaminated soils; Health & Safety to determine adequacy of this ensemble at the time of response.	Supply Conex near Tetra Tech field office
Body Protection – Outer Wear	Dupont Saranex 44428 (various sizes) or equivalent	PCB spill response	Impermeable ensemble – presents potential heat stress concerns. Must be inspected prior to and during use for evidence of cuts, abrasions, or other wear that may affect permeability.	Supply Conex near Tetra Tech field office
Body Protection – From Flame or Torch Weld	Flame-Retardant Coveralls. Orange jumpsuits or equivalent	Torch cutting or spot welding	Does not offer chemical protection	Supply Conex near Tetra Tech field office
Hand Protection – Chemical	N-Dex Nitrile Gloves or equivalent	Gasoline, Diesel, Used oil, Hydraulic fluid, PCBs	No limitations for expected on-site materials	Supply Conex near Tetra Tech field office
Hand Protection – Chemical	Ansell Sol-vex 37-175, CE0493 or equivalent	Gasoline, Diesel, Used oil, Hydraulic fluid, PCBs	No limitations for expected on-site materials	Supply Conex near Tetra Tech field office
Hand Protection – Chemical	PVC Rubber Industrial Work Gloves – Posigrip RN78477 or equivalent	Gasoline, Diesel, Used oil, Hydraulic fluid, PCBs	Not suitable for gross clean-up of gasoline – use of nitrile glove for gasoline is recommended.	Supply Conex near Tetra Tech field office
Respiratory Protection – air-purifying respirator	North 760008A Full face, negative pressure (various sizes) or equivalent	Used in areas with respiratory hazards. Provides eye protection	Not for use in an Immediately Dangerous to Life or Health (IDLH) or oxygen-deficient environment, requires fit test and medical clearance. Must be used with appropriate cartridge. Not for use for potential exposure above the Protection Factor of 50.	Supply Conex near Tetra Tech field office
Respiratory Protection – air-purifying	North 770030S Half mask, negative pressure (various sizes) or equivalent	Used in areas with respiratory hazards.	Not for use in an IDLH or oxygen deficient environment, requires fit test and medical clearance. Must be used with appropriate cartridge. Not for use	Supply Conex near Tetra Tech field office

Table 11-1. List of Emergency Response and Decontamination Equipment on Site				
GEAR	**EXAMPLES OF EQUIPMENT TYPES**	**USE & CAPABILITY**	**LIMITATIONS**	**LOCATIONS**
respirator			for potential exposure above the Protection Factor of 10.	
Respiratory Protection – Cartridges	North 7583P100 HEPA / Organic stack (negative pressure respirator) or equivalent	Respirable dusts, diesel, gasoline, solvent, PCBs	Not for use in an IDLH environment	Supply Conex near Tetra Tech field office
Respiratory Protection – Cartridges	North 7580P100 HEPA (negative pressure respirator) or equivalent	Respirable dusts	Not for use in an IDLH environment	Supply Conex near Tetra Tech field office
Respiratory Protection – Cartridges	3M R012 PAPR HEPA or equivalent	Respirable dusts, PCBs	Not for use in an IDLH environment	Supply Conex near Tetra Tech field office
Rain or Splash Suits	Lacrosse PVC / poly (size L, XL, 2X, 3X) or equivalent	Outdoor rain protection, diesel or gasoline splash	Not to be worn without Tyvek or Saranex layer underneath suit in areas where Tyvek or Saranex is required	Supply Conex near Tetra Tech field office
Foot Protection – Work boots	Ranger Rubber boot (steel toe and shank) [size 6-15] or equivalent	Gasoline, Diesel, Used oil, Hydraulic fluid, PCBs	May require disposal if not properly decontaminated or if not wearing over-booties to protect the primary boot; primary example – PCB clean-up	Supply Conex near Tetra Tech field office
Foot Protection - Overshoes	M-Wear Disposable yellow rubber boot covers, slip-on, natural rubber or equivalent	PCBs – primary use; also for gasoline, diesel, and used oil	May degrade if extended contact occurs with gasoline, diesel, used oil, hydraulic fluid	Supply Conex near TtEC field office
Eye Protection - Goggles	American All Safe Company 2-11 Monogoggle or equivalent	Offers some protection from splashes to eyes and flying debris to eyes	Fogs up easily. Should be used in conjunction with face shield for maximum protection	Supply Conex near Tetra Tech field office
Eye Protection – Face Shields	Bullard 840MG Flat Acetate Shield or equivalent	Helps protect against splash hazards and flying debris	Should be worn with protective eyewear or goggles for maximum protection	Supply Conex near Tetra Tech field office
Spill Clean-up Materials				
Sorbent Booms	Sorbent Products, Inc. ENV810 Polypropylene Boom 8' X 10' or equivalent	Oil spills on water, floats	Use limited to oil. Does not absorb other liquids. Does not offer complete protection for blocking drains unless used with other material to dike, but helps	Supply Conex near Tetra Tech field office
Sorbent Pads	Absorbent pads 16" X 20", SPC100, 954570 or equivalent	Oil and grease spills on land or on puddles	Use limited to oil. Does not absorb other liquids. Good for small spill clean-ups only	Supply Conex near Tetra Tech field office
Sorbent Granular	NAPA Diatomite, Kitty Litter, or equivalent	Oil, grease, water and other liquids – absorbs well and can be placed easily over large area	Not to be used for spills in water or in puddles – soaks up water, sinks	Supply Conex near Tetra Tech field office
Sorbent Socks	Moltan Sock Absorber or Equivalent	Oil spill on land	Oil (including PCB oil) only.	Supply Conex near

Table 11-1. List of Emergency Response and Decontamination Equipment on Site				
GEAR	**EXAMPLES OF EQUIPMENT TYPES**	**USE & CAPABILITY**	**LIMITATIONS**	**LOCATIONS**
				Tetra Tech field office
Alarm Systems and Emergency Communications				
Emergency Notification – Employees, On Site	Site Radios	Notification and Communication	May not work well at opposite ends of the site or in some buildings	ACS, PM, CM, ESS, Operator and labor crew teams (1 per team min.)
Emergency Notification – Off Site/On Site	Cellular Phones	Notification and Communication	Limited to use at Access Control and Supervisory Personnel	ACS, PM, CM, ESS
Emergency Notification – Localized areas on site	Air Horns	Notification and Warning System for Evacuation	Localized Use, can't reach all areas of the site, vehicle horns to be used in lieu of air horns if the air horns are not available	ACS, CM, ESS, 1 per team
Fire Extinguishing Systems				
Fire Extinguishers – Portable	Dry Chem, Purple-K, Type ABC	Class A (ordinary materials), class B (oils and grease), class C (energized electrical fire)	Not for use on Class D metal fires. Limited size of fire they can be used on and incipient stage only	Active Work Areas, Building 428, Office, and Supply Conex (CM will maintain list of locations and inspections)
Fire Extinguishers – Portable	Type A Water Filled	Class A (ordinary materials)	Not for use on class B, C, or D fires	Active work areas on site (CM will maintain list of locations and inspections)
Decontamination Equipment				
Equipment Decon (and Spill Response) – Support Equipment	Polyethylene bags, 6-mil, large size	For use in containerizing spill clean-up materials and used PPE waste from spill or from decon	Weight limit. Not for use with liquids or sharp objects that can pierce the bag. Some waste bags may require additional containerization after clean-up depending on the material.	Supply Conex near Tetra Tech field office and Building 428
Personnel Decon – Eyewash	Portable eyewash stations	Flushing of eyes in case of contact with chemical or splash of chemical	Must be cleaned and inspected on routine schedule. Emergency use may require assistance of second person.	Active work locations where chemical hazards

Table 11-1. List of Emergency Response and Decontamination Equipment on Site				
GEAR	**EXAMPLES OF EQUIPMENT TYPES**	**USE & CAPABILITY**	**LIMITATIONS**	**LOCATIONS**
				exist and Building 428
Equipment Decon – Support Equipment	Kiddie Pool	For use as boot wash or personnel decontamination, or as secondary containment	Limited size. Plastic. Can break easily. Set on hard even surface.	Supply Conex near Tetra Tech field office
Equipment Decon – Support Equipment	Scrub Brush	For use in boot wash or personnel or small equipment decontamination	N/A	Supply Conex near Tetra Tech field office
Equipment Decon – Support Equipment	Detergent	For use in boot wash or personnel, equipment decontamination	N/A	Supply Conex near Tetra Tech field office
Personnel Decon – Showers	Shower stations	Removal of chemicals on clothing and skin in emergency	Personnel decontamination facility will be located in the Processing Plant. Person must be transferred to this building to take shower.	Processing Plant
Direct Reading Monitoring Equipment				
Hazardous Atmosphere	RAE Systems Photo-ionization device (PID) MiniRAE 2000 or equivalent	Indication of relative organic vapor concentration for spills involving fuels	Will not measure methane; unable to identify specific compounds	Tetra Tech Safety Office
Hazardous Atmosphere	MSA Solaris 10047228 O_2, LEL, H_2S, CO Monitor or equivalent	Low oxygen concentrations can result in erroneous flammability / explosivity readings	Monitoring for oxygen level; lower explosive limit (flammability of vapor –e.g., from fuel spills, measure oxygen in ambient air; carbon monoxide (from events involving combustion),	Tetra Tech Safety Office
Hazardous Atmosphere	RKI Instruments O_2, LEL, H_2S, CO Monitor Eagle 4-Gas Monitor or equivalent	Monitoring for oxygen level; lower explosive limit (flammability); hydrogen sulfide; carbon monoxide (from events involving combustion)	Low oxygen concentrations can result in erroneous flammability / explosivity readings	Tetra Tech Safety Office

Notes:
Locations of spill kits for use on small petroleum spills (diesel, gasoline, hydraulic fluid, etc.) are subject to change in response to the daily schedule and crew locations. Typical contents of these small spill kits are listed below. Those items shown in italics are supplied in spill kits where warranted due to potential chemical hazards in that area.

Typical Contents:
2 face shields
10 oil absorbent towels
1 bag absorbent (granular, dehydrated clay)
1 plastic shovel
1 roll of Caution Tape
1 boom – absorbent for acids, caustics, and solvents

Contents (cont.):
1 boom – water, grease solvent
4 Ansell Solvex gloves
2 Tyvek suits (size 3X)
1 roll duct tape
2 Saranex Suits
2 pair rubber overshoes

12.0 POST-EMERGENCY EQUIPMENT MAINTENANCE

After an emergency, the equipment used during the event shall be cleaned or replaced, readied, and inspected for its intended use before operations are resumed in the affected areas of the facility. The type of cleaning, maintenance, or replacement necessary shall be determined on a case-by-case basis. Primarily, cleaning shall consist of wiping off equipment with disposable cloths until no residual waste material can be seen or flushing with an appropriate solvent (normally water) until clean. If a solvent other than water is used, a water flush may follow. Should sampling be necessary to ensure residues are removed; a sample of the solvent rinse water shall be collected and analyzed. Analytical parameters shall be based on process knowledge of the materials and equipment involved.

Fire extinguishers are refilled and depleted stocks of neutralizing materials, protective clothing, and safety equipment are refilled, replenished, and cleaned as necessary to be readied for future service. The ESS is responsible for inspecting the supply of emergency equipment and the CM is responsible for assuring that adequate supply is maintained. Operations shall resume after post-emergency critical equipment maintenance has been performed.

13.0 ASSESSMENT, REPORTING, CRITIQUE AND FEEDBACK

Once an emergency situation is brought under control, a full review of the incident is conducted to determine the course of action necessary to remedy the effects and to prevent event recurrence. It is the responsibility of the EC to convene a meeting of the emergency participants within seven working days. The PM or designee shall invite the client and local emergency response agencies to provide input and to participate in a detailed evaluation.

The critique shall review:

- Overall strategy and tactics employed
- Effectiveness of response elements
- Successful operations and identification of problems
- Establishment of root cause or plan or procedure failure(s)
- Review of lessons learned
- Suggestion of improvements and amendments to the Plan and the SHSP
- Conclusion with the communication of lessons-learned information to Tetra Tech personnel

The EC shall prepare a written summary of the critique and assessment within 30 days of the incident. The PM shall distribute the written summary to the client. The client may forward copies of the written summary to local emergency response agencies.

Needed corrective actions shall be entered into the project's non-conformance tracking system and shall be scheduled and tracked through closure.

Changes made to the Plan as a result of the critique and lessons learned shall be documented and communicated to site personnel.

14.0 DOCUMENTS AND RECORDS

The emergency management program shall be documented to demonstrate conformance with the requirements of this Plan. Project records are maintained in a formal document control system.

Emergency readiness assurance shall include assessments and documentation to ensure that stated emergency capabilities are sufficient to implement this Plan.

Program documentation includes the following:

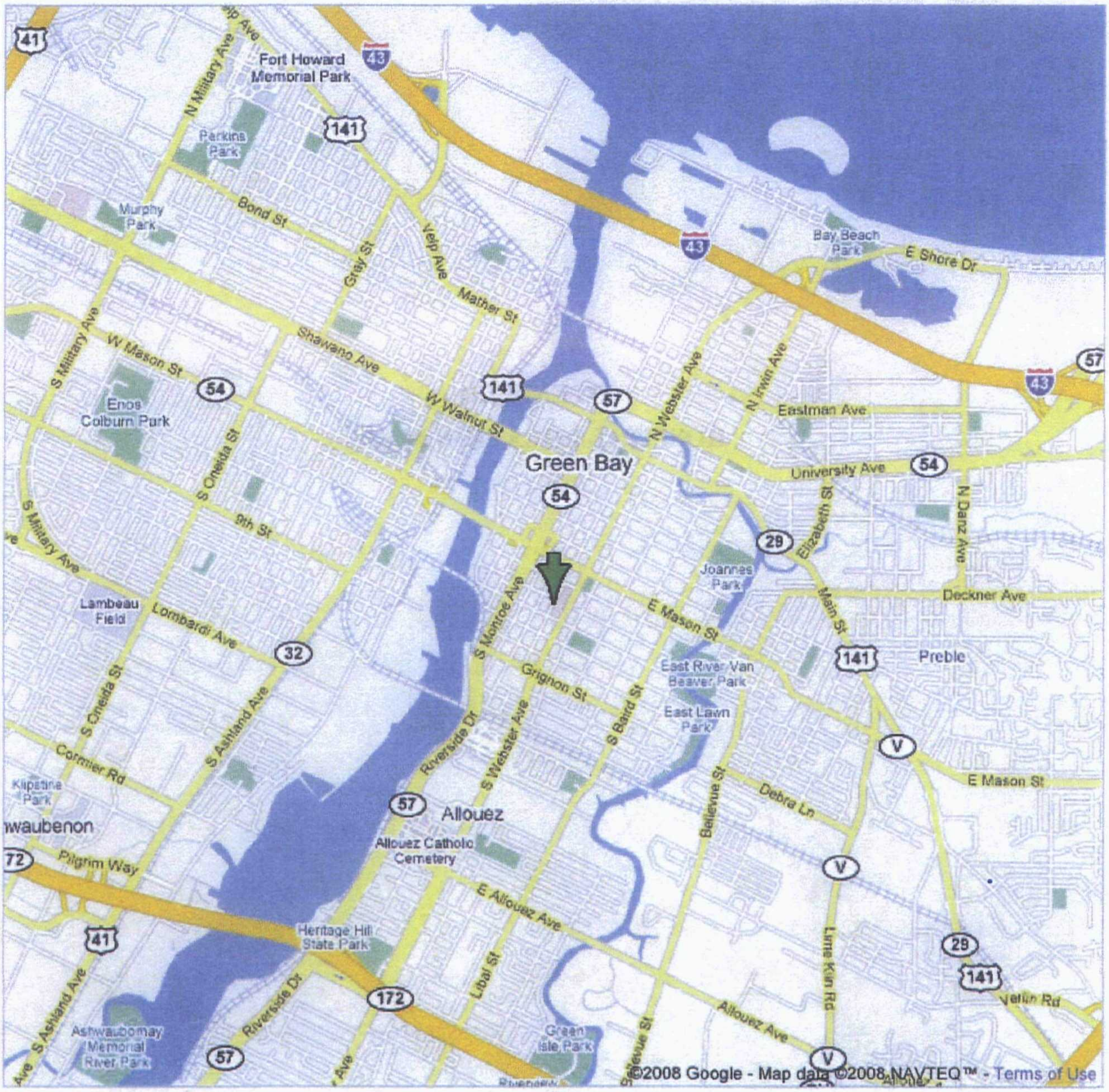
- Emergency drill records
- Incident reports, critiques, and corrective action reports
- External reports for emergency incidents
- Plan revision records

APPENDIX A
HOSPITAL LOCATION MAPS

Google Maps

Address **835 S Van Buren St**
Green Bay, WI 54301

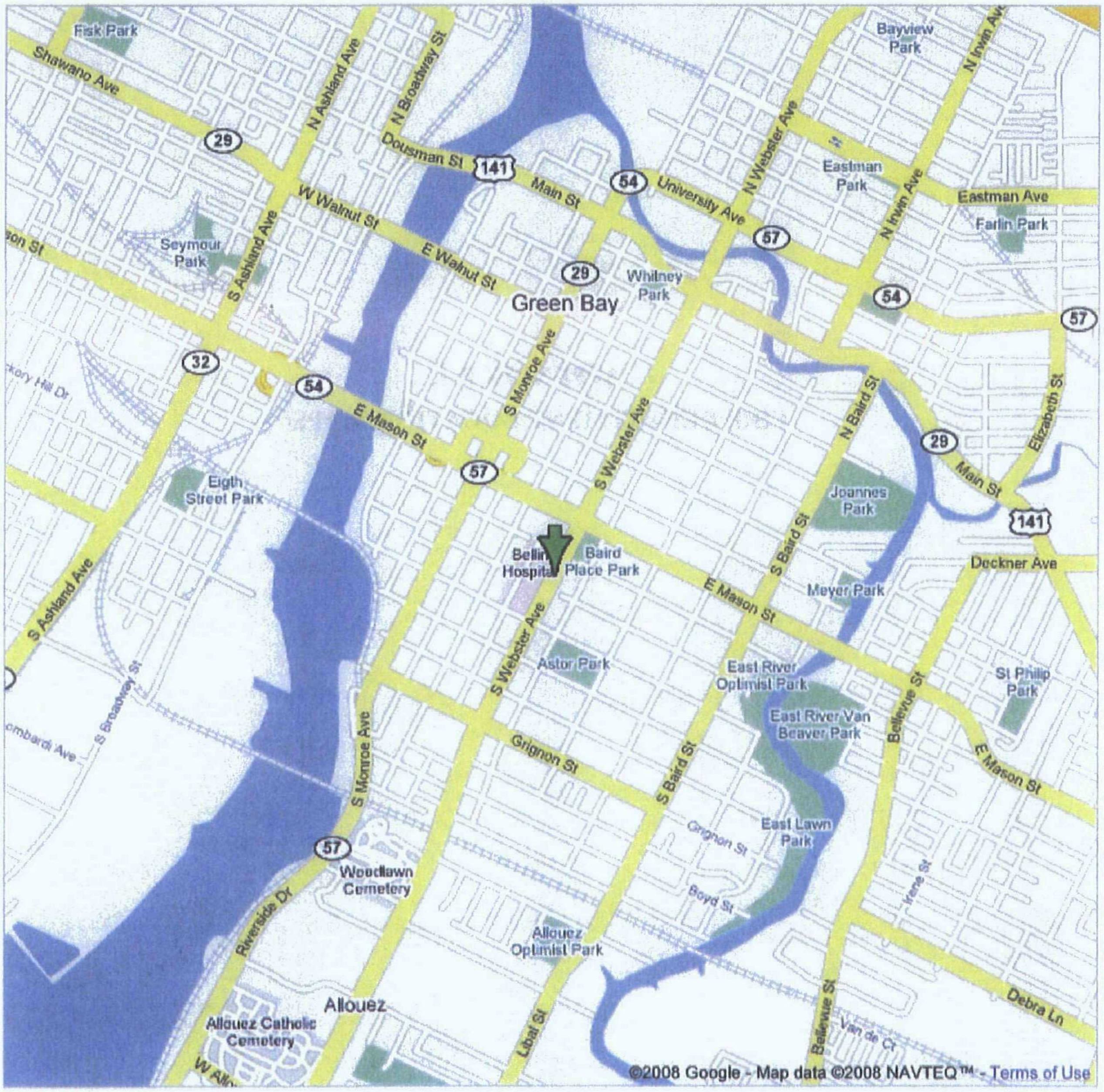
Notes Saint Vincent Hospital
Green Bay, WI
Phone (920) 433-0111



Google Maps

Address **744 S Webster Ave**
Green Bay, WI 54301

Notes Bellin Hospital
Green Bay, WI
Phone (920) 433-3500



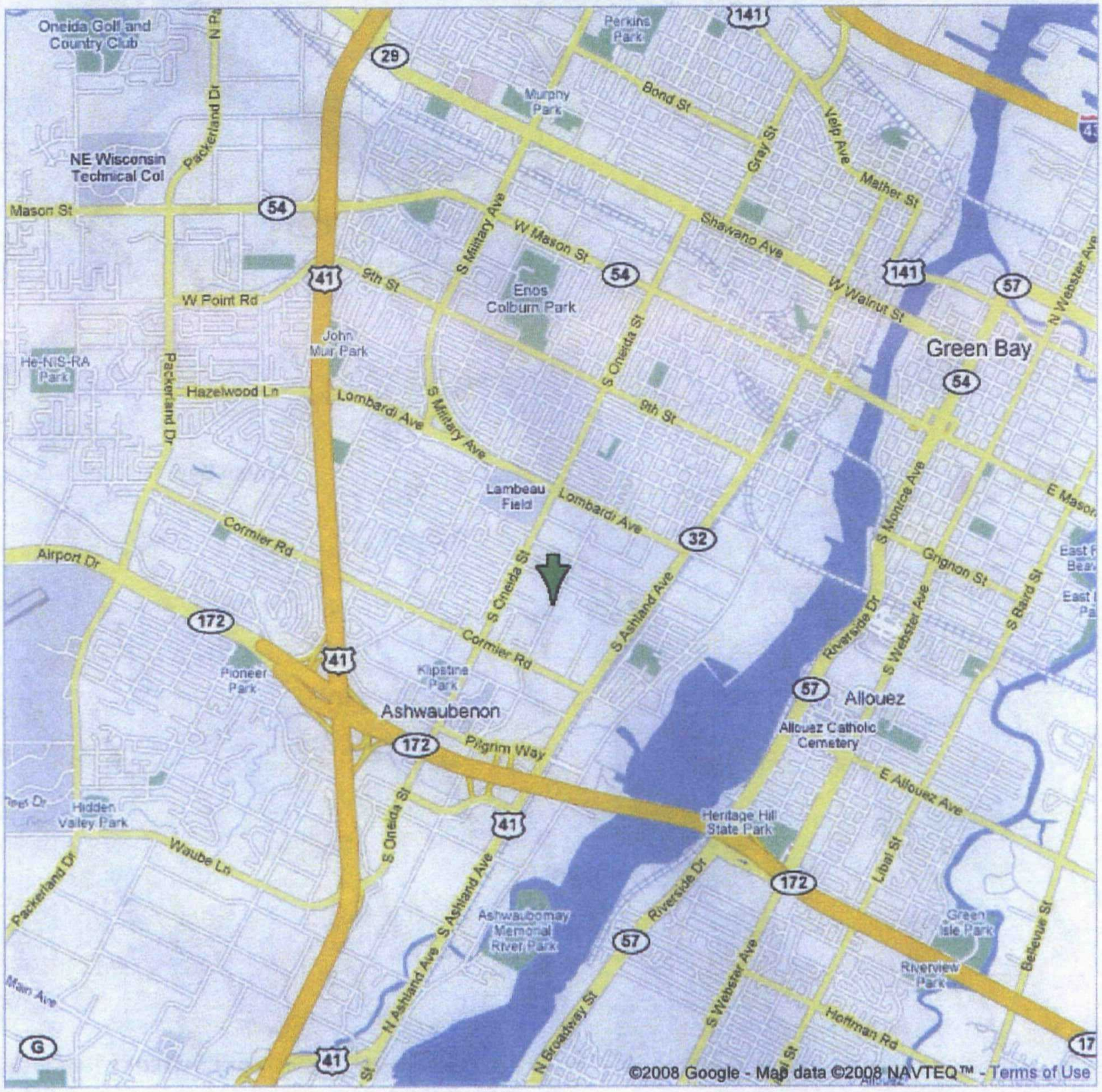
APPENDIX B

FIRE DEPARTMENT LOCATION MAPS

Google Maps

Address **2155 Holmgren Way**
Green Bay, WI 54304

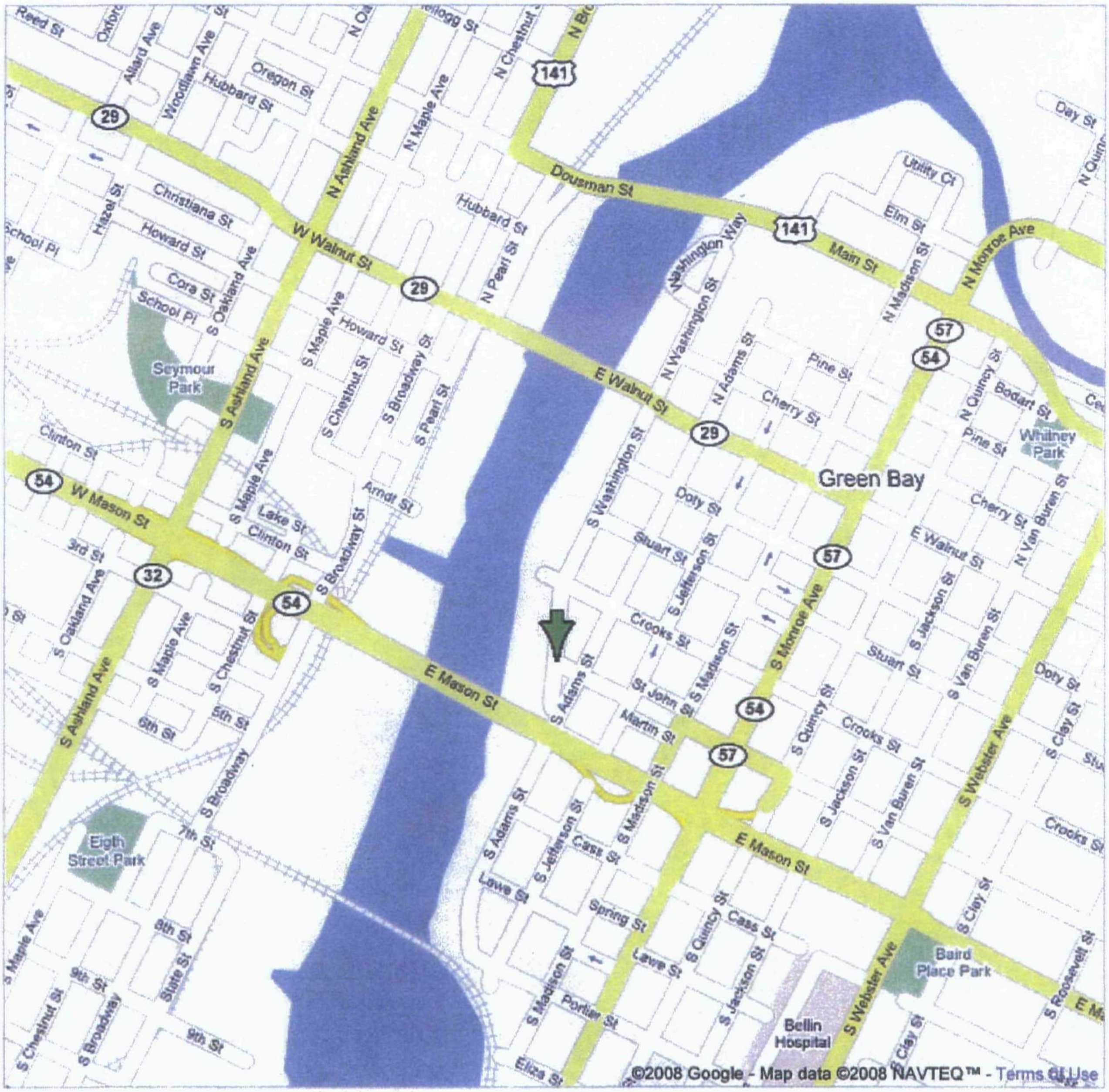
Notes Ashwaubenon Fire / Rescue
Operable Unit 4 and 5 Location



Google Maps

Address **501 S Washington St**
Green Bay, WI 54301

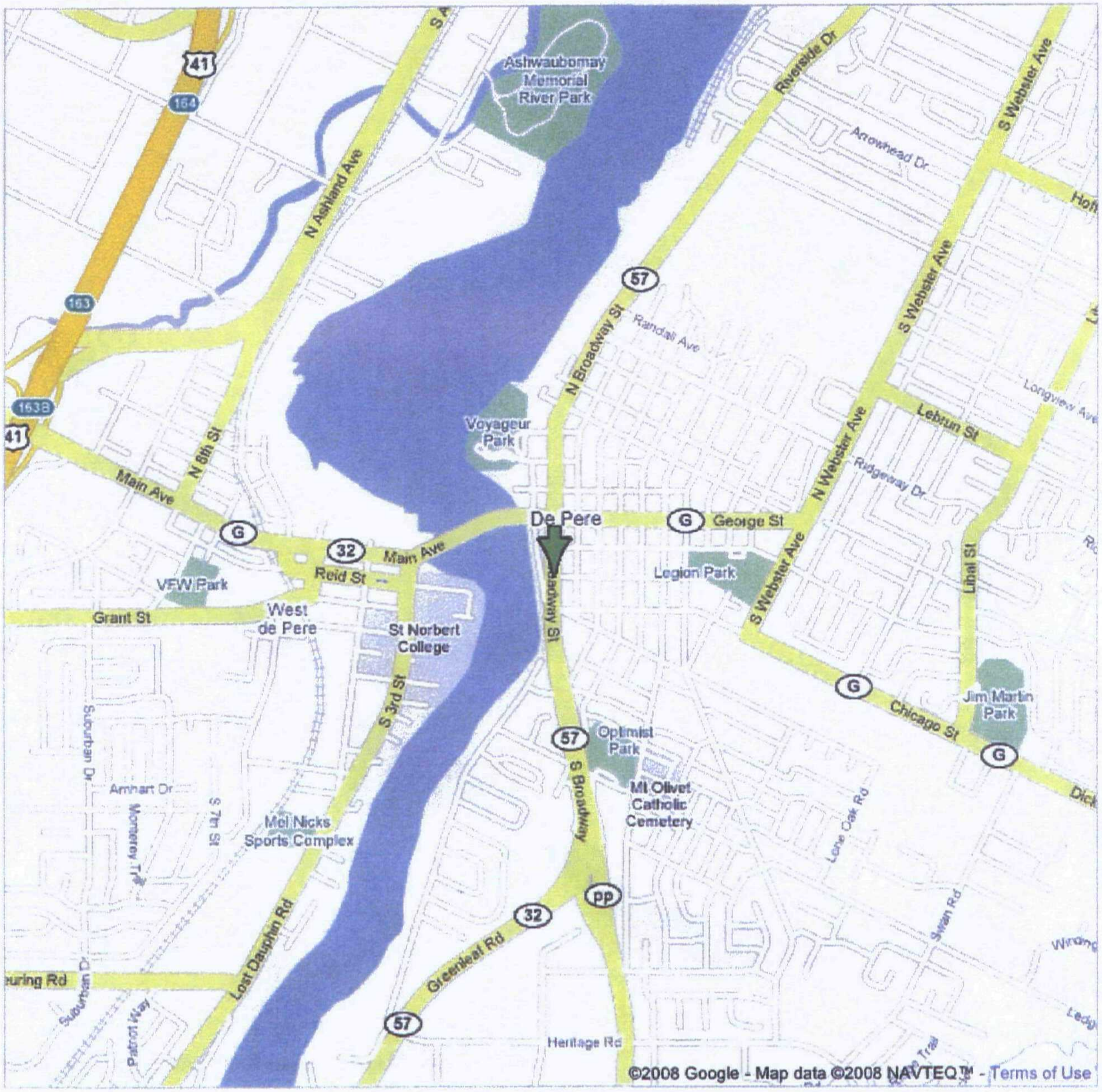
Notes Green Bay, WI Fire Department / EMS
Operable Unit 5 Location



Google Maps

Address **400 Lewis St**
De Pere, WI 54115

Notes De Pere, WI Fire Department / EMS
Operable Unit 3 Location



Google Maps

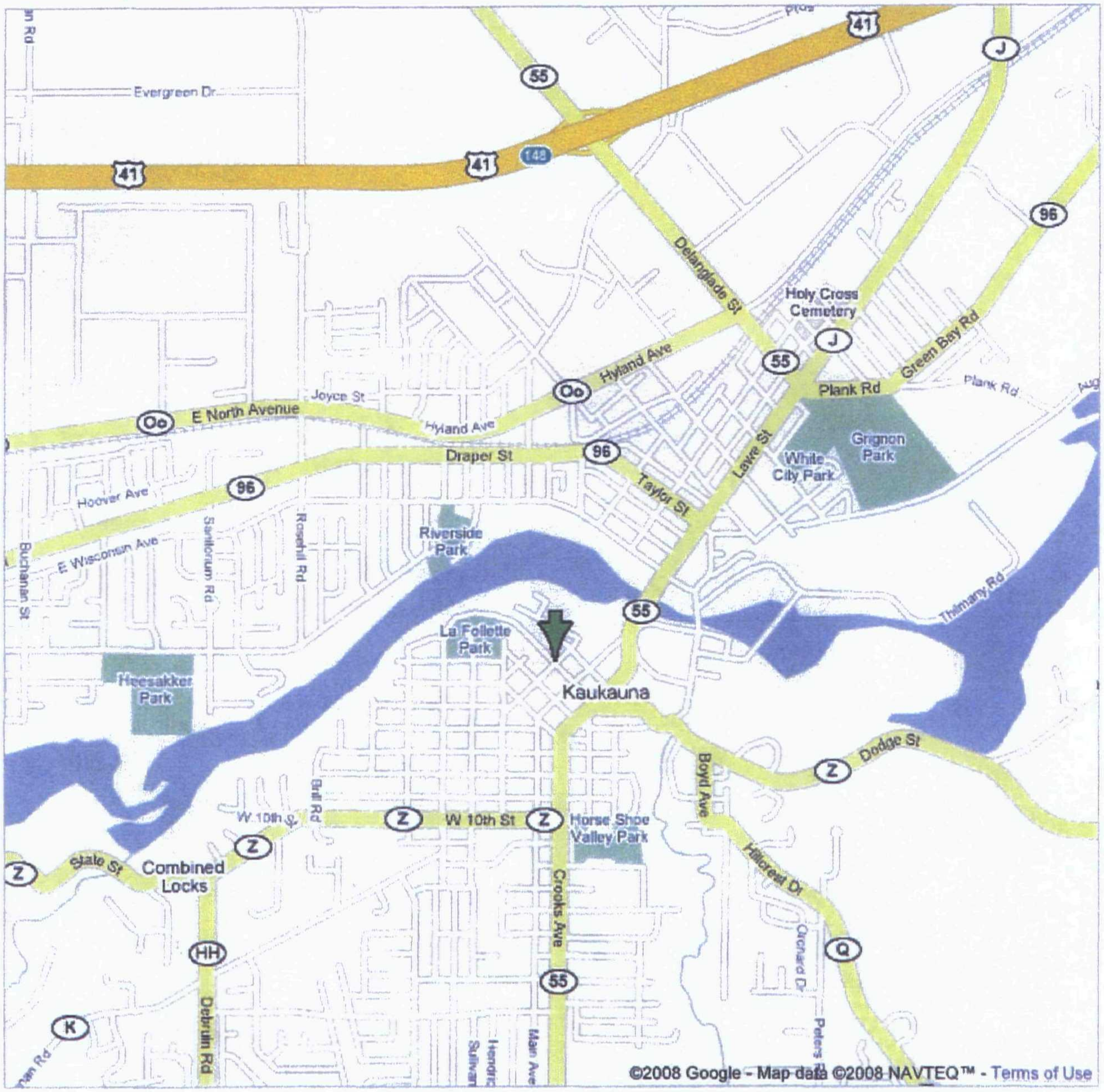
Address 961 Broadway St
Wrightstown, WI 54180

Notes Wrightstown, WI Fire Department / EMS Operable Unit 2 Northern Location

Google Maps

Address 206 W 3rd St
Kaukauna, WI 54130

Notes KauKauna Fire Department / EM:
South Operable Unit 2 Location



Google Maps

Address **515 W Kimberly Ave**
Kimberly, WI 54136

Notes Kimberly Fire Station
South Operable Unit 2 Location

ATTACHMENT C
Monthly Storage Area Inspection Form

ATTACHMENT C

Monthly Fuel Storage Area Inspection Checklist

Further description and comments, if needed, should be provided on a separate paper and attached to this sheet. Any item answered "YES" needs to be promptly reported, repaired or replaced. Records are maintained with the SPCC Plan at the Green Bay, WI processing facility.

Date:______________________ Signature:________________________

Conditions	**Yes**	**No**	**Description and Comments (Note Tank Type and Location)**
Tank surfaces show signs of leakage			
Tanks show signs of damage, rust or deterioration			
Vents are obstructed			
Tank area clear of trash and vegetation			
Equipment protectors, labels, or signs are missing			
Loading/unloading lines are damaged or deteriorated			
Secondary containment is damaged, stained or contains water			
Interstitial monitoring (1,000 diesel tank) shows a change in steady-state conditions, indicative of a potential leak			
Spill kit material is missing, damaged or needs replacement			
Fire extinguishers is missing			