OCS Report
MMS 2001-045

Investigation of Fatality
Mississippi Canyon Block 167
OCS-G 08801
September 8, 2000

Gulf of Mexico
Off the Louisiana Coast

MMS

U.S. Department of the Interior
Minerals Management Service
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David Dykes
Tom Machado

U.S. Department of the Interior
Minerals Management Service
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New Orleans
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Contents

The Investigation and Report

Authority

An accident that resulted in one fatality occurred on Marine Drilling Companies Incorporated (Marine) mobile offshore drilling unit, Marine 700, located on ExxonMobil Production Company's (ExxonMobil) Mississippi Canyon Block 167, Lease OCS-G 08801 in the Gulf of Mexico, offshore the State of Louisiana, on September 8, 2000, at approximately 0425 hours. Pursuant to Section 208, Subsection 22 (d), (e), and (f), of the Outer Continental Shelf (OCS) Lands Act, as amended in 1978, and the Department of the Interior Regulations 30 CFR 250, the Minerals Management Service (MMS) is required to investigate and prepare a public report of this accident. By memorandum dated September 14, 2000, the following personnel were named to the investigative panel:

David Dykes	New Orleans, Louisiana (Chairman)
Tom Machado	New Orleans, Louisiana

Procedures

On September 9, 2000, an inspector from the MMS New Orleans District visited the rig to assess the situation and began gathering information, thereby initiating MMS's investigation of the incident. The visit started with a meeting to discuss the incident. The following individuals attended the meeting.

Lead Inspector, New Orleans District

Marine Operations Manager

Marine Offshore Installation Manager

ExxonMobil Representatives (four present)

Marine Vice-President, Operations

Marine QA/HSE Director

Marine QA/QC Engineer

On September 22, 2000, ExxonMobil submitted their report of investigation findings to the panel; the report included statements taken by ExxonMobil and Marine from the following individuals the day of the incident:

Driller

Assistant Driller

Toolpusher

Shaker hand

Floorhand

Roughneck

Halliburton hand

The panel received various documents from ExxonMobil, Marine, and Victoria Machine Works (VMW) during the course of the investigation. Technical information was gathered from Marine and VMW records and from numerous telephone interviews with both Marine and VMW personnel.

On March 20, 2001, the panel received Marine's final incident report.

On March 29, 2001, the panel received ExxonMobil's final incident report.

The panel members met at various times throughout the investigation and, after having considered all of the information available, produced this report.

Introduction

Background

Lease OCS-G 08801 covers approximately 5,760 acres and is located in Mississippi Canyon Block 167, Gulf of Mexico, off the Louisiana coast. *For lease location, see Attachment 1.* The lease is jointly owned by ExxonMobil Corporation and BP, Incorporated. The lease was issued effective January 01, 2001, to ExxonMobil Corporation and BP Exploration & Production, Incorporated. ExxonMobil became the designated operator of the lease on September 19, 1994.

Brief Description of Accident

During routine drilling operations on the MODU Marine 700, the riser cart/carriage assembly moved forward, pinning a drilling floorhand between the riser cart/carriage assembly and the iron roughneck on the drillfloor. The floorhand received fatal injuries as a result of this accident.

Findings

Weather Conditions

At the time of the incident, the air temperature was 82 degrees Fahrenheit and the barometric pressure was 30.19 inches. The wind direction and speed were south-southwest (approximately 200^{o}) at approximately 10-15 knots. The seas were running out of the south-southwest (approximately 200^{o} heading) with a wave height of 4-6 feet. The wave period at the time of the incident was six seconds. Wave height is the measurement from mean sea level (MSL) to either the crest (top) of the wave or trough (bottom) of the wave. Under these weather conditions, the rig was experiencing a pitch of 0.1 degrees and a roll of 0.5 degrees. Pitch is the pivotal movement up and down of the rig along the centerline axis from the bow to the stern. (When the bow goes up, the stern goes down.) Roll is the pivotal movement up and down of the rig along the centerline axis from port to starboard sides. When the port side is up, the starboard side is down. The rig also had a heave of approximately 1inch. Heave is the vertical movement up or down of the rig along the surface of the water. Rig personnel stated during the initial MMS visit that the rig also had a list of 0.25 – 0.5 degrees to the bow. List is the relative leaning position of the rig with respect to the sea surface. *For weather and sea effects on Marine 700, see Attachment 2.*

Rig Activity at the Time of the Accident

The rig was conducting drilling operations and at the time of the accident; the rig crew was in the process of connecting drill pipe.

The Accident

At 0425 hours on September 08, 2000, the drill crew was in the process of connecting the last string of drill pipe with the aid of an iron roughneck. There were two floorhands operating the iron roughneck. Floorhand #1 was watching the torque gauge on the iron roughneck when the toolpusher and floorhand #2 noticed the casing cart rolling towards floorhand #1. The cart hit him, pinning floorhand #1 between the cart and the iron roughneck. *For pictures of the points of contact, see Attachments 3 & 4.* The cart rolled back a few feet and floorhand #1 fell to the floor. The toolpusher went to the cart control panel and attempted to move the cart away from floorhand #1. The cart would not move, so the toolpusher told the driller to turn on the cart hydraulics and then the toolpusher moved the cart away from floorhand #1. The medic arrived on the drill floor at 0430 hours and started tending to floorhand #1. At 0445 hours, floorhand #1 was taken to the rig hospital, where he died at 0500 hours. *For a diagram of the accident scene, see Attachment 5.*

Description of the Cart Assembly

At the time of the incident, the equipment was arranged to handle casing with the casing bed**.** The position of the riser cart assembly faces aft to bow directly behind the drill floor. *For diagram of the casing bed and cart arrangement, see Attachment 6.* Victoria Machine Works (VMW) manufactures the cart assembly in Corpus Christi, Texas; the following

equipment descriptions are based on its *Operation and Service Manual for the Riser Skate Cart Assembly* (model number – 03-530-616).

Aft Cart

The purpose of the aft cart is to drive and support the aft end of the casing bed to and from the gantry crane area. The aft cart is powered by a hydraulic drive with a rack and pinion. The drive has the ability to free wheel. There is also a spring-set hydraulic release disc brake provided on the aft cart. This is a parking brake only and can be set by pushing a button on the cart joystick panel. Note: The brake on the aft cart consists of two sets of caliper pads. One set is located on the front side of the rotor disk and the other set is located on the aft side of the rotor disk. Bumping the joystick in either direction disengages the brake. The free wheel light will be illuminated when the brake is disengaged. In the operation and service manual on page nine, VMW states, “In case of emergency, press the emergency stop button. This button will cut electrical power to the system. The Aft Cart brake is hydraulic release and spring set. Losing electrical power will cause the Aft cart brake to set.” During a followup interview with VMW personnel, one individual stated that with electrical power cut off to the cart, the aft cart brake would set eventually as hydraulic pressure bleeds off in the

system. This may take some time, anywhere from two minutes to several hours.

The aft cart is not equipped with any type of positive locking device such as a pin (dog) to prevent unwanted movement. *For an example of a pin-type positive locking system, see Attachment 7.*

Utility Cart

The purpose of the utility cart is to transport miscellaneous cargo from the riser loading area to the drill floor. There is no power to the utility cart. The cart can be moved with air tuggers. The cart is equipped to handle a safe working load of 67,000 pounds. The utility cart is used in conjunction with the aft cart to support the casing bed. The utility cart is not equipped with a parking brake or any type of positive locking device to prevent unwanted movement.

Casing Bed

The casing bed is designed to be installed between the Aft Cart and the Utility Cart. The purpose of the casing bed is to transport casing to and from the drill floor by utilizing the drive ability of the Aft Cart. The casing bed is designed to support

five 30-foot long joints of 18-inch diameter schedule 160 pipe, which equals 46,275 pounds equally distributed over any 30-foot length of the casing bed.

According to Marine's final report, the cart was last used on September 07, 2000. At 1730 hours the cart's parking brake was engaged and the hydraulic power system was deactivated. The approximate elapsed time until the incident was 11 hours.

Cart Joystick Panel

The joystick panel for the aft cart is located on the drill floor inside the drill floor wall. The joystick panel consists of one joystick, three pushbuttons, and one signal light. The joystick controls the motion of the aft cart. The top left button is the emergency stop button. The set brake button, located in the center of the joystick panel, sets the brake on the aft cart. The button is lighted to indicate the brake is set. The green signal light on the right side of the joystick panel is lighted when the aft cart is freewheeling. *For picture of cart joystick panel, see Attachment 8.*

Post-Accident Test of Cart Brakes

ExxonMobil and Marine tested the cart the night of September 08, 2000. They hooked up a tugger, started to pull very lightly, and the cart started to move. They detected that the brakes on the cart were not working.

Post-Accident Disassembly and Inspection by VMW Industries

Inspection of the failed brake system began at approximately 1900 hours on September 09, 2000. VMW representatives conducted the inspection. The following is a summary of the findings from VMW's report:

Model number for both units: 03-530-616

Serial numbers: 98c-236-& 98c-209

1. Pressure tests indicated that 1,600 psi hydraulic pressure was available at the brakes.
2. There was approximately 1/16" clearance between the aft brake adjusting screw and the motor housing at the aft brakes, and zero clearance between the forward brake adjusting screw and the motor housing.
3. A .002 feeler gauge could not be fitted under either caliper pad and the rotor of aft caliper brake when the brake was hydraulically released.
4. Inspection of the forward brake caliper found the fixed caliper pad destroyed and all four pad-retaining screws broken.
5. Inspection of the aft brake caliper found the fixed pad to be intact with exception of elongated mounting holes and broken pad mounting screws.
6. There was no obvious reason for the difference in the condition and wear of the two pads of the forward brake as compared with the aft brake.
7. The pivot pins for both brakes appeared to be well lubricated and

free moving.

8. The bearings for the drive shaft appeared to be well lubricated.
9. The mounting bolts for the brakes were corroded and difficult to remove.
10. The adjustment bolts for both calipers were corroded and very tight.
11. Inspection of the brake rotor found no major scoring of the rotor braking surface.
12. Inspection of the brake control valve found the solenoid retainer nut missing but found the solenoid to be operating properly.
13. Visual inspection of the mounting plates indicated that there may be some out-of-plane misalignment.

After removal from the drive system, the brake parts were photographed and taken to the mechanic shop for further inspection.

Disassembly and visual inspection of the brake calipers revealed the following:

1. Corrosion was apparent inside the aft spring compartments.
2. The internal spring parts appeared intact.
3. The spring stacking sequence was consistent with the manufacturer's documentation for both brakes.
4. The forward springs were found coated with a residue.
5. The aft springs were found lubricated.

6. The hydraulic piston components appeared to be intact.
7. The forward bearings pad piston was slightly tarnished but free to move.
8. The aft bearing pad piston was clean and free to move.
9. Both caliper housings were found to be wider at the mouth than at the root. This was noted to be approximately 3/16” for the aft housing and 1/4” for the forward brake housing.

After disassembly, all components were placed in marked individual bags, the individual bags were placed in a box, and the box was taken to the rig office and remains in the custody of the Marine Drilling QA/HSE Director.

The following were concluded by the VMW and Marine inspection team:

1. A pull test was conducted prior to the inspection and the brake system was determined to be ineffective.
2. The forward brake assembly was found to be in a failed state.
3. The reason the aft brake assembly was not effective was not determined at the time of the inspection and disassembly.

During a followup interview with VMW personnel, one individual stated that the brake rotor and pads were contaminated with grease. The

inspection and disassembly report does not explicitly identify contamination on the rotor and pads. However, the report does state that certain factors ought to be investigated as reasons for the brake failure and as possible design improvement: Those factors are as follows:

Possible caliper misalignment issues

Possible distortion of the caliper housing

Contamination of the caliper pads

The effectiveness of the spring assembly

The pad material.

VMW personnel also stated that, under ideal conditions, with everything functioning properly and with no contamination of the braking surfaces, the brakes (front and aft set of calipers) would hold a maximum load of 60,000 pounds at an incline angle of approximately 4-5 degrees. With only one set of brakes (front or aft set of calipers) functioning properly, the brakes could only hold to approximately a 2-degree maximum angle. Add contamination to the braking surface, and the brake holding capacity is significantly reduced.

VMW Maintenance Procedures

Maintenance procedures of the cart cover five main areas and are listed below:

Electrical Maintenance

- Monthly – Check inter-unit cabling for possible physical damage. Correct.

- Bi-Annually – Install new moisture absorption material in all electrical enclosures. Ensure cabinets are sealed tightly when closed.

Pneumatic Maintenance

- Monthly – Check hoses for fatigue, cracks, and excessive wear. Replace if needed.

Hydraulic Maintenance

- Monthly – Check hoses for leaks, fatigue, cracks, and excessive wear. Replace if needed.

Mechanical Maintenance – General

- Monthly – Visually inspect the structure for weld integrity, loose connecting hardware, and general condition. Bolted connections should be checked for proper torque by using torque values. Welds should be inspected for cracks. Should a weld be suspect, verify using the dye-penetrate method. Treat corrosion and paint effected areas.

Aft Cart and Utility Cart Mechanical Maintenance

- Lubrication as per Cart Lubrication Charts Figures 5.2 and 5.3. *For cart lubrication charts, see Attachment 9.*

The VMW *Operation and Service* manual does not identify brake inspections as part of any routine maintenance.

On pages 7 and 8 of the *Operation and Service* manual, the operation procedures make reference to "calm sea operations." The procedures state in part, "When setting the Aft Cart brake, the green freewheel light should turn off and the red brake light should turn on. (Also, during calm sea operations, the brake may not be required. However, rough sea operations require the parking brake to be set.)" VMW personnel defined calm sea conditions, during the followup interview, as near zero wave height.

According to Marine personnel on the rig, calm sea conditions are determined by the pitch and roll of the drilling rig and not necessarily by wave height. Rough sea conditions exist when there is either a pitch or roll of the rig of at least 0.5 degrees. Calm seas are therefore determined to be anything less than a 0.5 degree pitch or roll of the rig.

Marine Cart Inspection and Maintenance Procedures and Records

Marine's inspection and maintenance procedures call for both a weekly and monthly inspection of the aft powered riser cart. The procedures for the weekly routine inspection are as follows:

- Check hydraulic motor and valve and hose connections for leaks.
- Check power track for loose, missing, or damaged components.
- Check saddle and pivot bearings for any damage and

operation.

- Clean any debris from rack, and check for missing or damaged teeth. Remove any rust or corrosion and coat with "taskmaster" or equivalent corrosion preventive medium.
- Check all manual controls for freeness of operation.

Records indicate that weekly inspections occurred on

July 13, 2000

July 30, 2000

August 11, 2000

August 27, 2000

The procedures for the monthly routine inspection are as follows:

- Perform all weekly scheduled checks.
- Check brake components for wear or other operation defects.
- Visually inspect the entire cart assembly for all mounting hardware and any indication of damaged paint. Repair as necessary.
- Visually check all power track components to include covers and hinges.

Records indicate that monthly inspections occurred on:

June 26, 2000

July 30, 2000

Several attempts were made by the panel to obtain a copy of the August 2000 inspection from Marine. However, at the time of

writing of this report, the panel has not received any proof of an August inspection.

The records indicate that the steps identified above were taken; however, the records do not show the exact process undertaken, deficiencies found, or any corrective measures taken. The records show simply a check (✓) by each step, indicating that it was performed.

Conclusions

Causes

The unintentional movement of the riser cart assembly was caused by the movement and list of the rig and the lack of brake-holding capacity of the aft powered cart.

Contributing Causes

The movement of the rig was caused by the sea conditions at the time of the accident and the relative position of the rig. The sea conditions created enough pitch and heave, coupled with the list of the rig, to cause the cart to move from its stationary position toward the rig floor. This movement continued until the cart assembly fatally struck the Marine employee and pinned him against the iron roughneck. Therefore, the sea conditions and their effect on the rig at the time of the accident are considered to be contributing causes of the accident.

The loss of brake-holding capacity was caused by contamination of the brake rotor and pads with grease and also by the state of disrepair of the forward caliper pads. Therefore, the contamination of the brake rotor and pads and the state of disrepair of the forward caliper pads are considered to be contributing causes of the accident.

Marine could not provide this panel with the monthly aft powered riser cart inspection form for the month of August 2000. The monthly

inspection identifies checking the brake components for wear and other operational defects. It is possible that this inspection would have detected the contamination and the state of disrepair of the braking system. At the time of this report, the cause of the failed state for the forward caliper pads has not been determined. It is the conclusion of this panel that Marine failed to conduct a monthly aft powered riser cart inspection during the month of August. The failure of Marine to conduct the monthly aft powered riser cart inspection during the month of August is considered to be a possible contributing cause to this event.

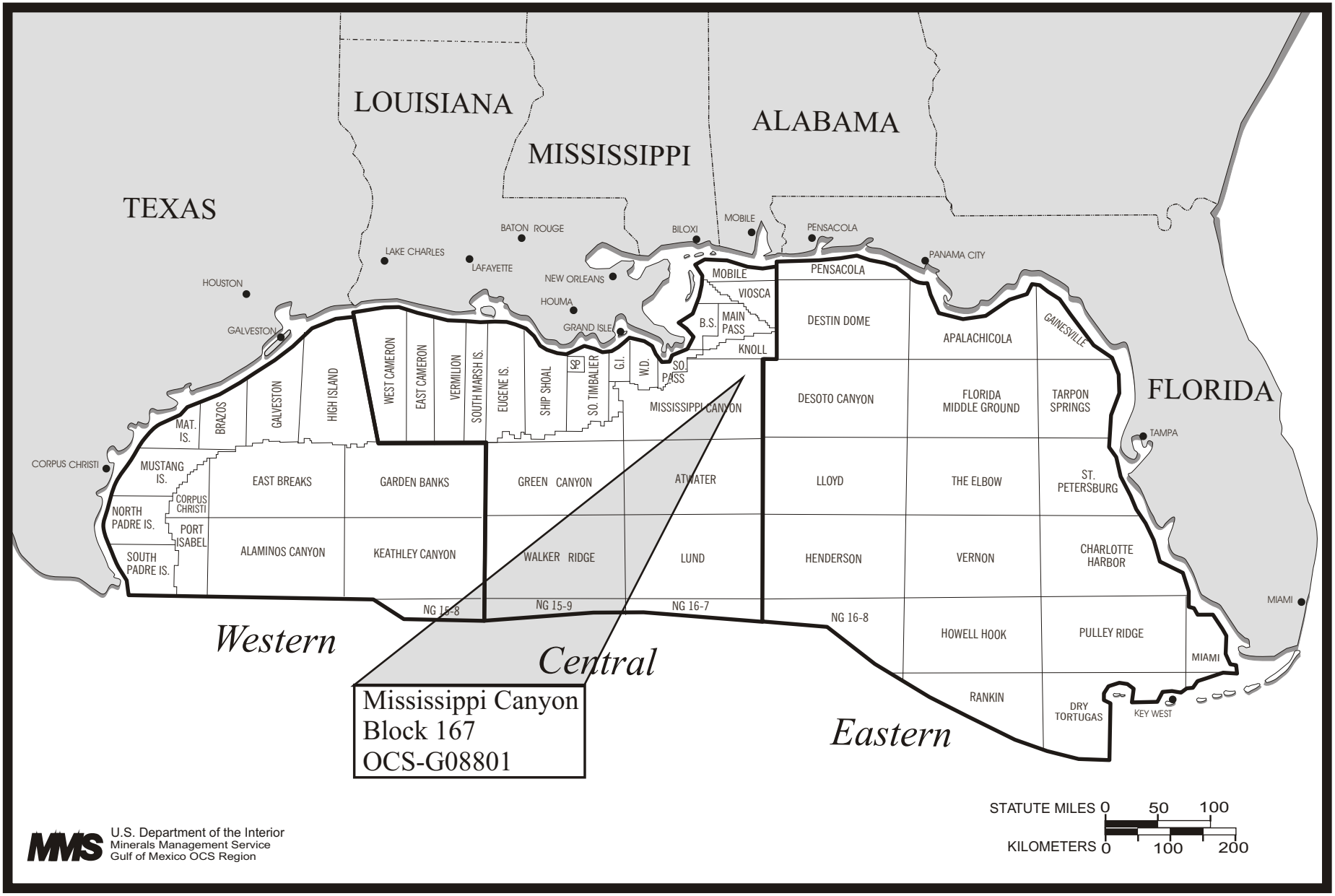
The failure of VMW to provide a secondary lockout device or a secondary procedure (as a backup to the brakes) to prevent unwanted movement of the casing cart assembly is considered to be a contributing factor. If a positive locking device such as a pin had been provided, it might have been used to prevent unwanted movement of the cart, thereby preventing the accident. However, the availability of a positive locking device does not guarantee its use.

Recommendations

Safety Alert

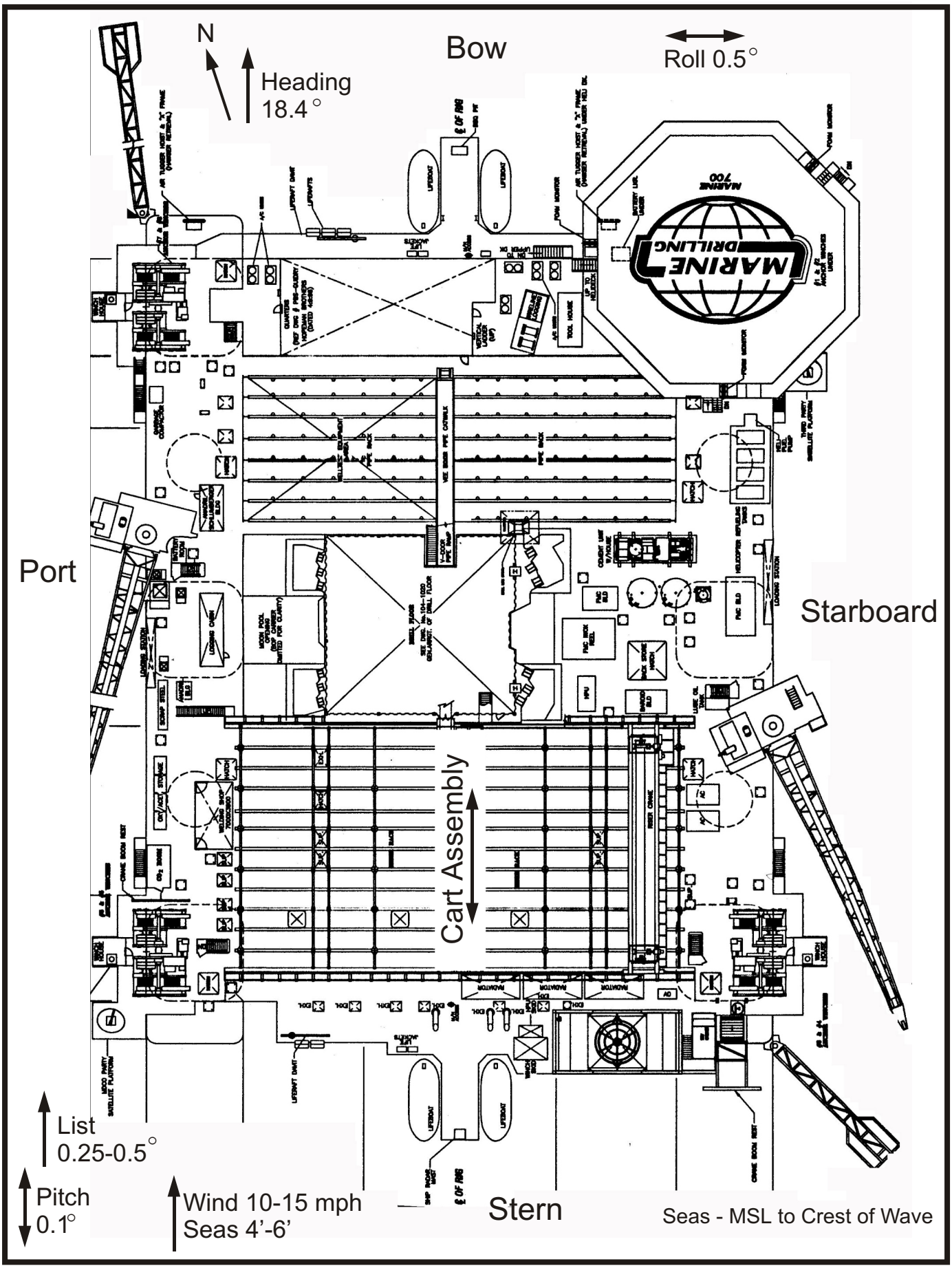
The MMS should issue a Safety Alert recommending that drilling contractors who use this type of riser and casing-handling equipment review the operations and maintenance for the purpose of identifying weaknesses. Their review should include but not be limited to the following items:

- Clearly defined procedures for the use of and storage of the riser and casing cart assemblies.
- Detailed inspection and maintenance procedures for all critical operating components.
- Detailed documentation of inspection findings and corrective measures taken.
- The use of a pin-type, positive-locking device or other method to prevent unwanted movement when the cart assembly is not in use.

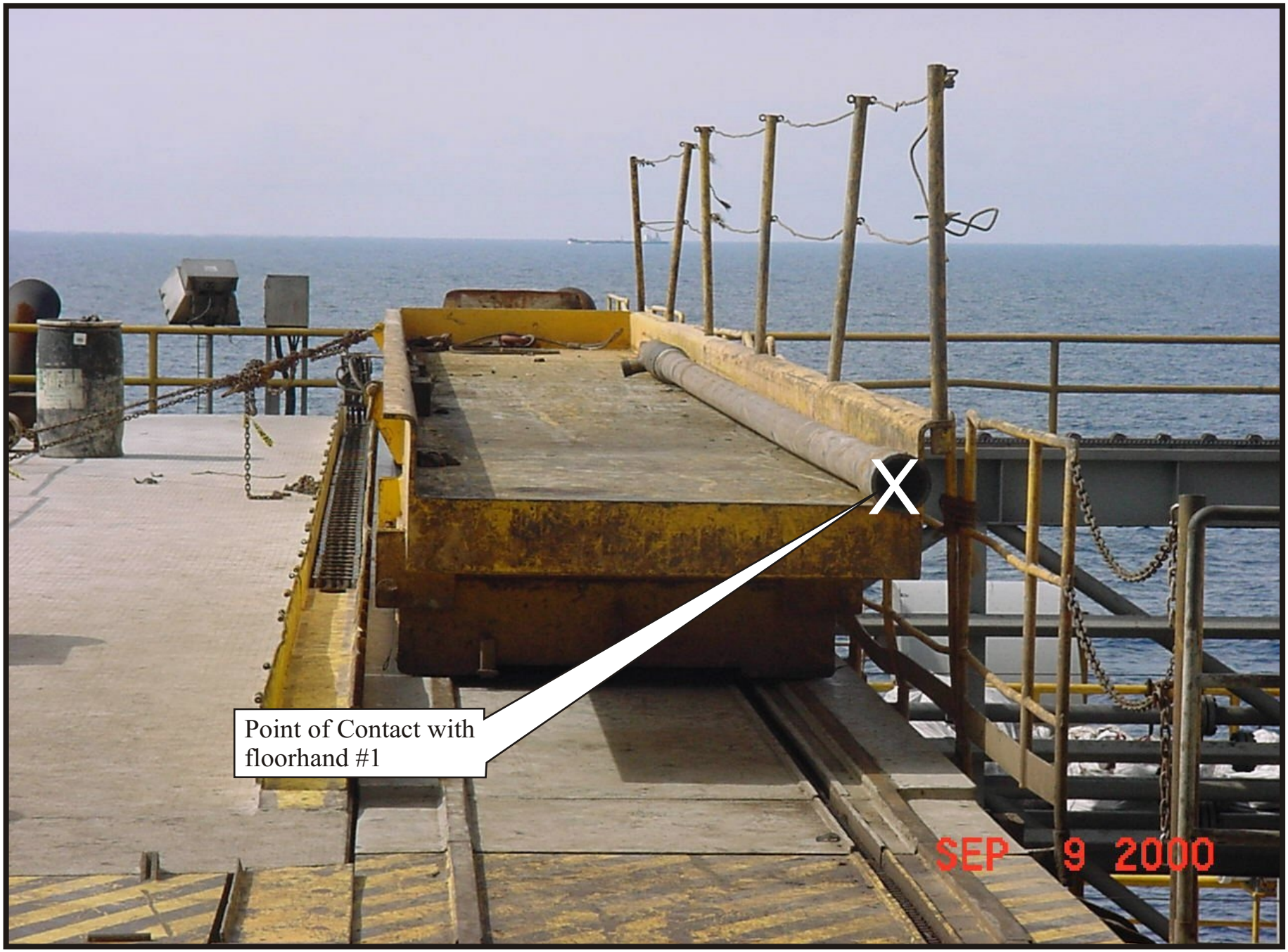


Attachment 1

Location of Lease OCS-G 08801,Mississippi Canyon Block 167

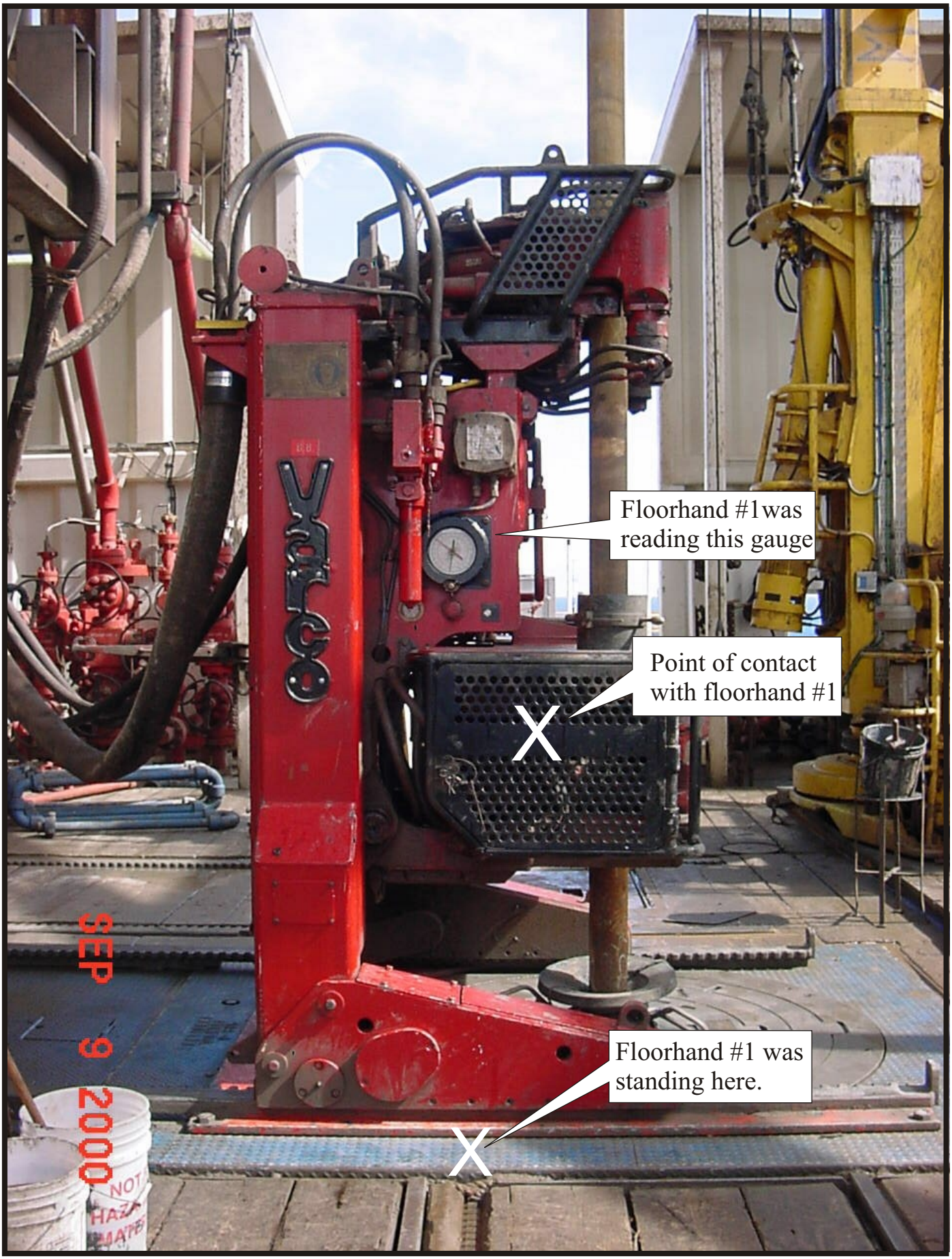


Weather and Sea Effects on Marine 700

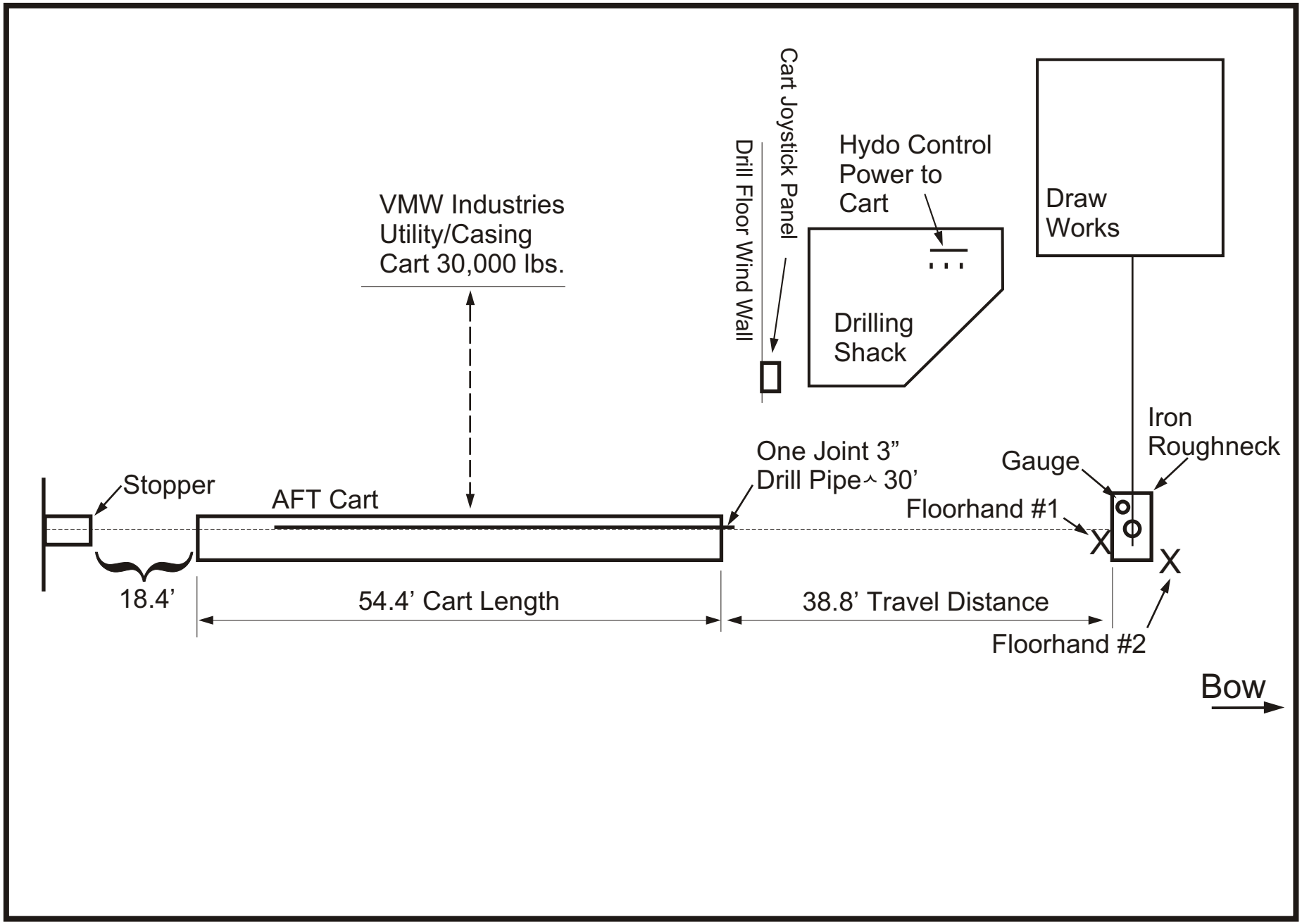


Attachment 3

Picture of Cart Assembly Point of Contact



Picture of Iron Roughneck Point of Contact



Attachment 5

Diagram of Accident Scene on 9-8-00 Marine 700

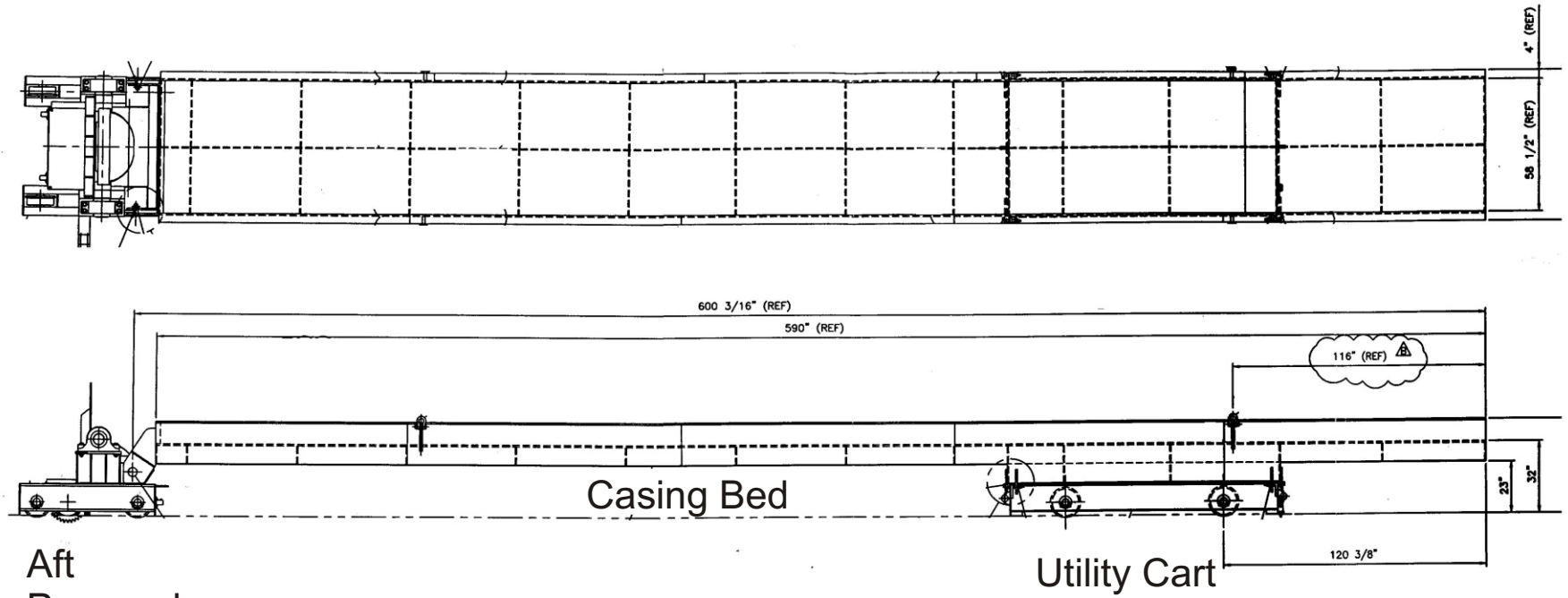
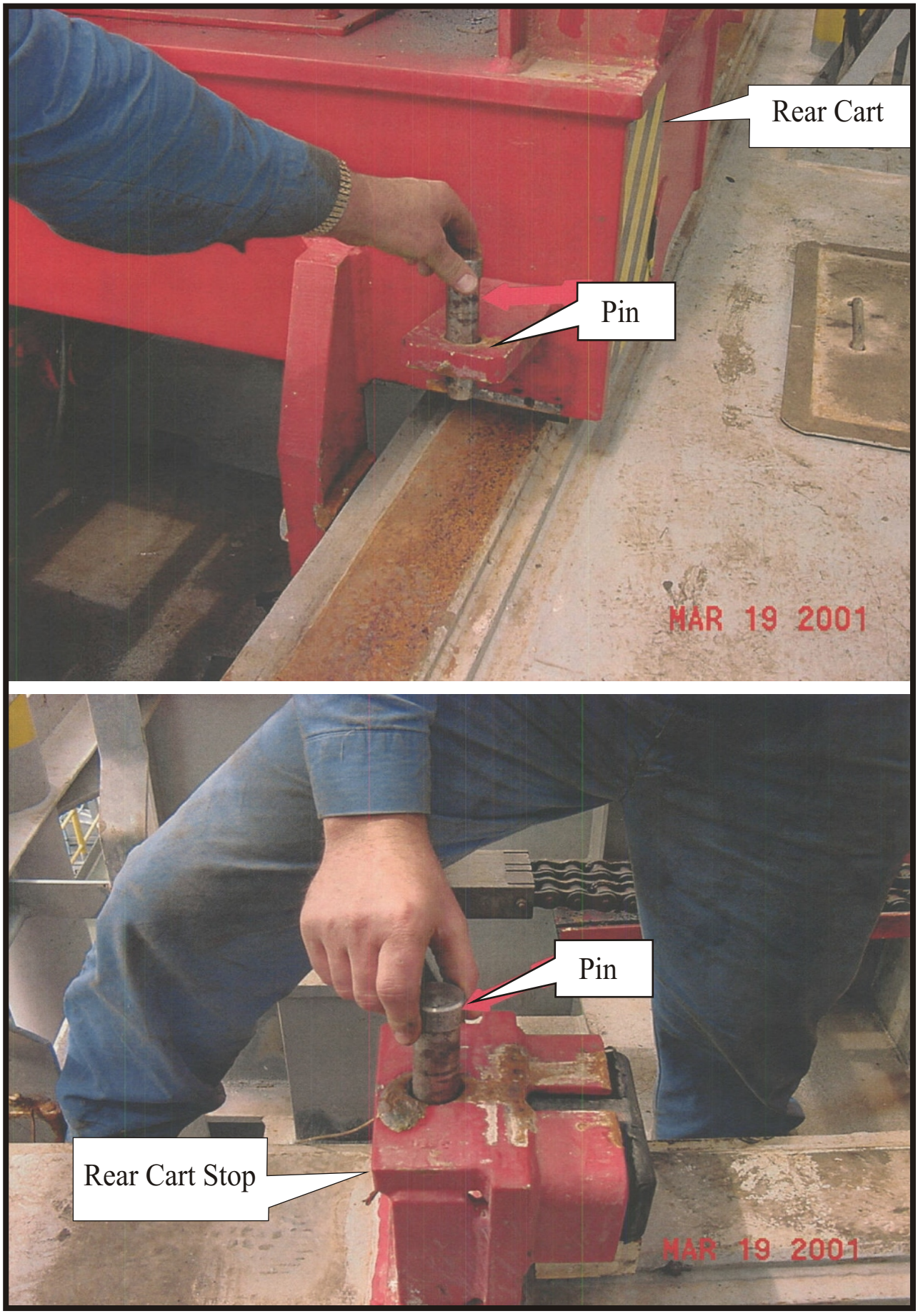
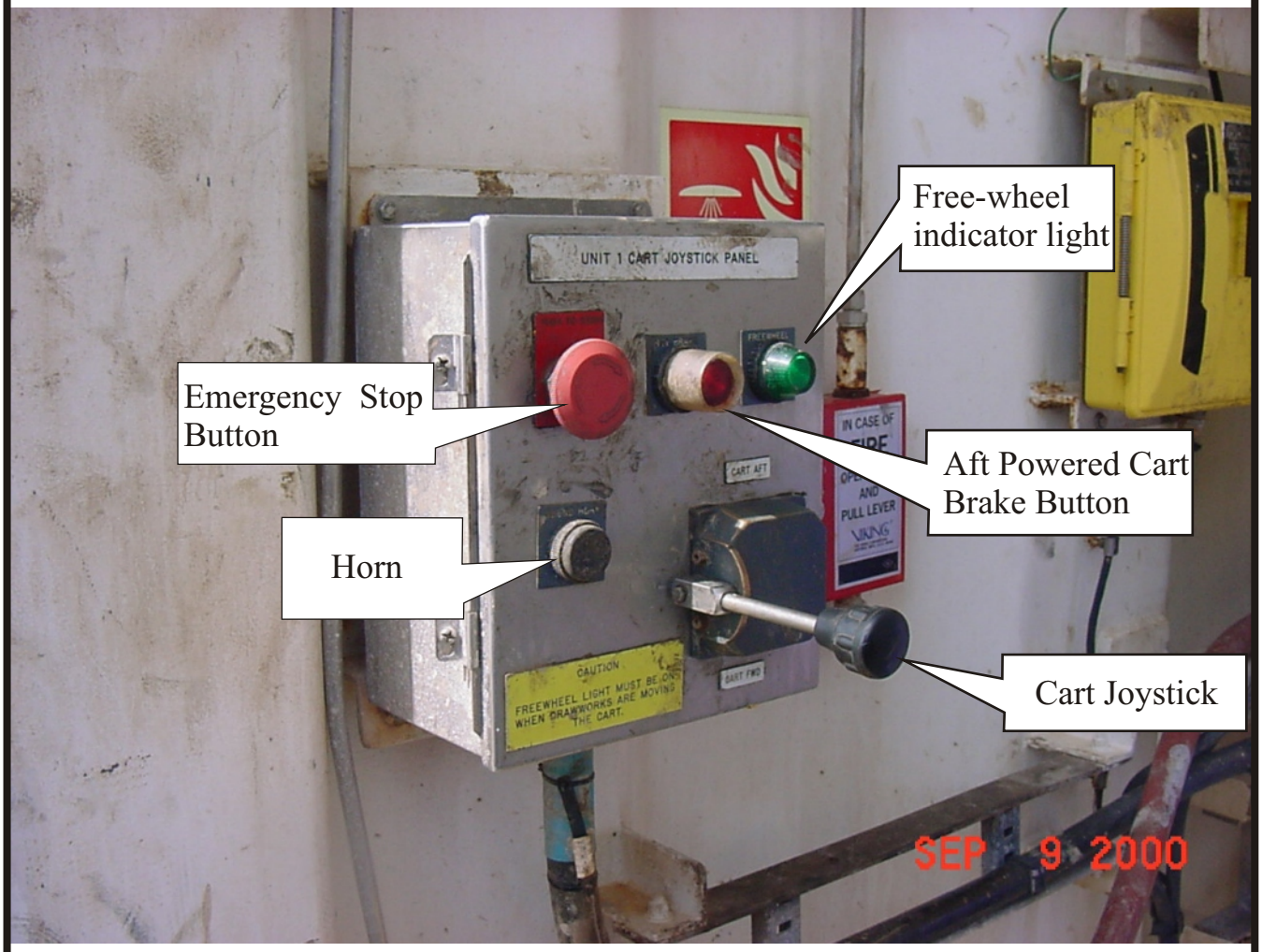


Diagram of Casing Bed and Cart Arrangement

Attachment 6



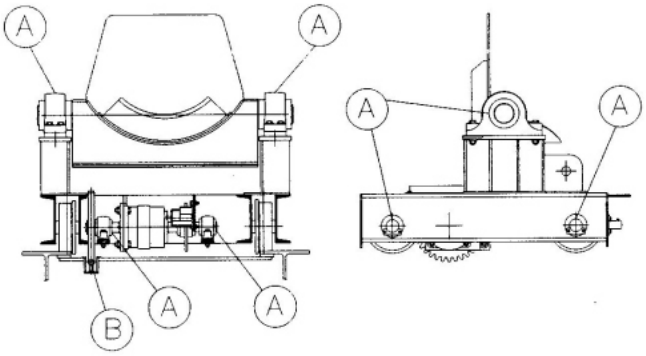
Example of Pin Type Positive Locking System



Picture of Cart Joystick Panel

5.6 Aft Cart Mechanical Maintenance

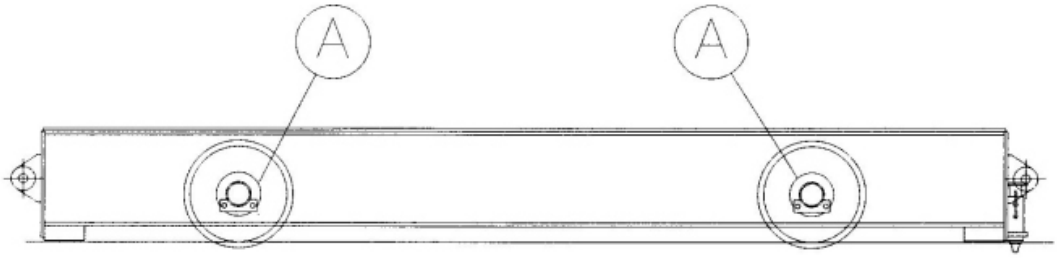
Figure 5.2 Cart Lubrication Chart



Service Point	Service Interval	Lubricant	Comments
A	3 mos.	Mobilux EP 2 or equivalent	Driveshaft brg.
B	3 mos.	Marine Moly Paste Lubricant	As required on drive pinion

5.7 Utility Cart Mechanical Maintenance

Figure 5.3 Utility Cart Lubrication Chart



Service Point	Service Interval	Lubricant	Comments
A	3 mos.	Mobilux EP 2 or equivalent	Driveshaft brg.

Cart Lubrication Charts