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REPORT OF SURVEY

Semi-submersible DIAMOND M OCEAN EPOCH

Prepared for

SAGASCO RESOURCES LIMITED

Adelaide, South Australia

By

MODU SPEC INTERNATIONAL (L) Ltd.

Inspection dates: 1 - 13 October 1992

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REPORT OF SURVEY

Vessel	:	DIAMOND M EPOCH
Owner	:	Diamond M Offshore Inc.
Type	:	Semi-submersible Drilling Vessel.
Built	:	1977, Alabama Drydock, Mobile.
Class	:	Diamond M.
Performance	:	Water depth 1,200 ft
Maximum Variable Deckload	:	operating - 2,512 tonnes
Inspection dates	:	1 - 13 October 1992.

In accordance with the instructions received, we attended on board the DIAMOND M EPOCH to complete a condition survey of the primary, drilling, subsea, mechanical, electrical and marine equipment.

The aim of the survey was to determine the present general condition and state of maintenance of the equipment, to minimise downtime caused by mechanical breakdown during drilling operations and to ensure that the equipment is maintained in safe working order.

Items which are marked with an asterisk (*) have safety implications.

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CONCLUSION AND COMMENTS

The DIAMOND M OCEAN EPOCH was found to be a clean rig with a high standard of safety awareness concerning the day to day operation. Regular safety and toolbox meetings are being held.

The atmosphere on board was pleasant and a good professional attitude was noticed. The cooperation received, to conduct this inspection to the best of our ability, was very good.

The maintenance standard of the equipment on board the rig is generally speaking good. There is a Preventive Maintenance System onboard which seems to be working well and on an average of once a year, the rig is audited for safety, mechanical and electrical conditions by an auditing team from the Houston head office.

Several pieces of equipment are of serious concern such as; Generator no.2 which has a serious problem with its coils being swollen and cracked, and should be replaced prior to spud-in.
The swivel needs to be inspected and action undertaken to rectify the excessive clearance in the main load bearing.
Several deficiencies need to be corrected on the mud pumps, drawworks, rotary table, top Drive, drill string compensator, etc. but these are not of such a serious nature that they could slow down the start-up of the drilling operation.

The subsea equipment is due for some major overhauls. There have been several occasions of leakage past the ram operating rod seals and leaking out of the weap holes. Pitting in the sealing areas appears to be the problem. The maintenance history indicates that the ram operators have not been serviced/overhauled since the equipment was put into service in 1984-despite recent leakage having been repeated in the same areas on the same equipment.
It is therefore recommended to start an overhaul program on these operators, including both annular preventers, as soon as possible as more problems may be expected in the near future.

The upper annular which will be repaired, due to excessive keyseating, can then be fully overhauled. The space bonnet needs to be tested and possibly used to replace one of the leaking bonnets which can be sent in for repairs.

The history and filing system on the rig leaves a great deal of room for improvement. Systems need to be set up to allow for proper record keeping of certification and inspection of all lifting equipment with proper guidelines on:
which inspections are required,
inspection criteria,
inspection frequency,
certification, etc.
This registry should include ALL lifting equipment on the rig.

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The only history that can be found on equipment is a copy of the Preventive Maintenance task report. No service engineers' reports, rig audit inspection reports or major repair/overhaul reports could be found i.e. what was done to the crown- and travelling block during the installation of the Top Drive in the USA is not to be found.

17 YRS OLD The structural and systematic safety of this rig design is poor compared with today's standards. The ballast system is of a very simple design with very little redundancy built into it to cope with emergency situations.
The emergency generator has an output of 250 Kw only and is capable of driving one ballast pump in the port side pump room and nothing in the starboard pump room directly. No pump is available to feed the Haliburton unit and no BOP triplex pump can be fed from this unit.

The fire safeties such as deluge systems on the drill floor, in the moon pool area or along the accommodation are not available. A-60 bulk heads are not installed on the moon pool side of the accommodation.
The gas detection system is not self-monitoring and an H_2S gas detection system is not available.
There are vent outlets from the accommodation into the moon pool area.
The rig has no Modu Code certificate.

The current accepted safety standards of today exceed the safety concepts prevalent at the time that this unit was designed.
We feel, however that when the emergency equipment, systems and procedures are improved, concerning emergency power requirements, ballast/damage control back-up systems, gas detection systems, etc., that this rig could operate at an acceptable safety standard.

Further, when all deficiencies mentioned in this report are corrected, we believe that this will greatly enhance the rigs' safety and operational efficiency.

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16 October 1992

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DRILLING EQUIPMENT

DRAWWORKS: The oil spray nozzles were checked and the few that were blocked were repaired. All drive chains were inspected and the following was found:
The drive chain of the "B" motor has one roller missing and four broken rollers.
The drive chain of the low clutch has one broken roller and ten rollers were found with chips broken out of the roller surface. It is recommended to replace both chains.
The lubrication oil pump drive chain's idler sheave bearing has excessive play and should be replaced.
The rope drum of the spinning cathead has play on its shaft which is probably caused by a worn key, keyway or both. This should be checked and repaired.
The band brake pads on the driller's side are soaked with oil. The oil is probably leaking from the low drum clutch cover into the brake rim area. This oil leak should be repaired and these brake pads replaced.
The Crown-O-Matic keeps venting air via a panel valve when energized; this should be repaired.
The following equipment should be MPI inspected:

- Brake bands over their full length including the mounting lugs.
- Brake shaft levers and pins.

All clutches were tested and found to be working well with a few minor air leaks found and subsequently repaired on the air tubing.
It was noticed that no neutral brake or inertia brake is installed on this Oilwell drawworks which is usually a standard item.

(*) The break-out cathead cable needs to be replaced as it is damaged.

TRAVELLING BLOCK: No records are available to show when this block was last disassembled, overhauled, new bearings installed or even MPI inspected. No excessive bearing noise or play was found. It is recommended to have all load bearing areas fully NDT inspected by an independent third party inspection company.

HOOK: The hook should be fully inspected as no records are available to show when it was last fully inspected. It is recommended to subject the hook to a full load test and a complete check-out. No records show that this has ever been done by the manufacturer on a periodic basis

SWIVEL: The swivel bearing clearance was measured and found to be 0.025" which is very high as the recommended clearance is between 0.001" and 0.003".
Recommendations:

1) The swivel bearing condition needs to be checked and the bearing to be replaced or re-shimmed.
2) All load bearing areas to be MPI inspected i.e. bail, ears, lower threaded connections.

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ELMAGCO BRAKE: The angular alignment between the coupling hubs of the drawworks and Elmagco was checked and found to be up to 0.020". Manufacturer's recommendation is maximum 0.010". The offset alignment could not be checked. It is recommended to check this and correct the alignment to reduce coupling and bearing wear.

(*) The coupling engage/disengage lever is locked insufficiently by a drop-in stud with nut on the top. It is recommended to secure it with a padlock, or bolt and nut so that it cannot be accidentally released.

(*) No alarm is installed to indicate to the driller if power to the Elmagco brake is lost. As no back-up system for the Elmagco brake is installed, it is recommended that at least an alarm be available to warn the driller immediately in the case of any loss of power to the Elmagco brake.

Air gap measurements were taken and found to be well within the maximum allowable limits.

The high water-level overflow outlets in the sides of the Elmagco brake housing were found to be connected with hoses to the drain line. The overflows are meant to allow water to be dumped before it enters the bearings if an obstruction in the return line occurs and therefore they should be visible to indicate when a problem occurs.

BRAKE COOLING WATER SYSTEM: The cooling water flow through the brake rims was measured and found to be only 30 gallons per minute (GPM) and the return flow through the Elmagco brake was found to be 90 GPM.
Oilwell recommends a cooling water flow through the brake rims of 90 GPM and the recommended flow through the Elmagco brake is 150 GPM.
We recommend that both drawworks' cooling water pumps be overhauled to check their condition and that flow measurements are taken after the servicing of both pumps.
It is recommended to install a flow meter in the cooling water supply to the Elmagco brake and one in the supply to the drawworks. Further, we recommend to install a flow alarm in the discharge of the pumps and a high temperature alarm in the return line. This is to warn the driller of any malfunctioning of the cooling water system.

DRILLING INSTRUMENTATION: The deadline anchor was inspected and found to be in an acceptable condition, however no MPI records were available.
The flow indicator was functioned and the low limit was found to be not working.

Recommendations:

1) Have deadline anchor MPI inspected according to API RP 8B standards.
2) Calibrate, repair or adjust the low limit of the flow indicator.

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ROTARY TABLE: The rotary table was function tested and inspected. The rotary table locking mechanism was found to be seized, while the lockpawl was touching the turntable. The oil pump, filters and lines were also found to be removed and both transmission and rotary table now depend on the splash lubrication. The rotary RPM generator was found disconnected and therefore not operational. The rotary brake however was found to be properly working. The oil of the rotary table was checked and found to be contaminated with mud.
The coupling between the electric motor and the transmission has excessive play the grease seals of the coupling are missing.
The coupling between the rotary transmission and the rotary table also has leaking grease seals. The coupling guard is not properly secured. The gear-shifting mechanism of the rotary transmission was found seized and one of the handles broken.

During the function test, the rotary transmission was noted to be noisy and have excessive vibration. An internal inspection of the rotary transmission showed excessive internal corrosion, oil contaminated with mud and water, and an excessive amount of mud was on the bottom of the transmission, etc.
The input shaft bearing of the transmission was also found to have a clearance in excess of 0.030".
Recommendations:
1) Clean all excessive mud from around rotary table.
2) Repair the seized rotary table locking mechanism.
3) Reinstall oil pump, filters, lines, heat exchangers, etc.
4) Connect RPM generator.
5) Drain oil from rotary table, flush with diesel and clean oil and refill table with fresh oil.
6) Replace the coupling between the electric motor and transmission.
7) Repair and secure the coupling guard of coupling between transmission and rotary.
8) Repair transmission gear-shifting mechanism.
9) Overhaul the transmission.

KELLY DRIVE BUSHING: The kelly drive bushing has one roller with more than acceptable surface wear. The roller pins, and the drive pins have not been MPI inspected. The drive pin locks are no longer operational.
Recommendations:
1) Disassemble the drive bushing and have the roller pins MPI inspected.
2) The kelly bushing drive pins should also be MPI inspected.
3) The drive pin locks to be repaired.

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CROWN BLOCK: No information was available on board the rig stating the last MPI inspection of sheaves and crown block structure. It is therefore recommended to MPI inspect all accessible sheaves and parts of the crown block structure according to API RP 8B standards; this to be done by a third party company.
The following recommendations regarding the derrick apply:

1) The ladder void at monkeyboard and crown block platform to be protected by a self-closing gate.
2) All ladder back guards to be extended to the hand-railing of the various platforms in the derrick.
3) The opening between the main crown block platform and the platform leading to the ladder void to be plated over; this on both sides of the ladder void. (Opening size is 30 x 80 cm.)
4) The jumper bar of the main sheave cluster aft should be renewed due to its poor condition.
5) Crack in the jumper bar frame of the fastline sheave on starboard side should be welded.
6) The flare lines at crown block level are presently secured by a rope, installation of a bracket is recommended (this is currently in progress by the welder).
7) Two handrailings at the monkeyboard level were found to have cracked welds and the handrailing is damaged at three areas; repair is recommended.
8) There is no handrailing or similar protection fitted inside of the monkeyboard platform; this is recommended for safety reasons.
9) The turnbuckles used to secure the compensator hoses in the derrick should be lock-wired to prevent unscrewing due to vibration.
10) Air filter/oiler of Top Drive which is fitted at the monkeyboard level, was found leaking.
11) The heater in the derrickman's enclosure at the monkeyboard is badly damaged and wiring is no longer explosion-proof.
12) The air supply to the monkeyboard tugger is presently insufficiently supported and requires improvement. The air supply hose to the air winch also requires a safety pin fitted through the Chicago coupling on the air winch.
13) The following items are not available on the monkeyboard.
    - Eye-wash bottle.
    - Derrickman's escape device.
    - A ten-minute breathing apparatus (B.A.) escape set.
14) All safety slings of the sheaves in the derrick should be strung in between the lines and below the sheave. In this manner, the line and load will be retained by the safety line in the case of a sheave failure.
15) No bumper guards are installed below the water table.

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TOP DRIVE: The Varco TDS 4 Top Drive System was found in need of a thorough check after extremely severe operations whilst jarring during the last drilling operation. Several bolts were found to be either broken, stripped or loose and need to be replaced/tightened.

The gap between the tips of the splines on the safety valve and the torque tube was found to be 1", this should be adjusted to between 3/8" and 5/8". The lower plate on the torque tube is welded in place. We were assured that new parts have been ordered to replace this old plate.

The shielding hose of the aft cable bundle in the derrick is broken just below the attachment to the Top Drive unit. The shielding of the forward hose is cut for 50% and it is recommended to replace both to prevent the hydraulic hoses and electric wires from becoming damaged.

The ducting of the Top Drive motor ventilator is in a poor condition and should be replaced.
The brake quick-release valve needs to be replaced. Varco recommends to check all load bearing areas every 1,500 running hours or 6 months. With a view to all the jarring that has occurred, this should be done prior to start-up of the next drilling operation. This includes all threaded connections.

The split-load collar modification has not been carried out on this Top Drive. This modification is a result of an advice brought out by a study group consisting of representatives of North Sea Operators, Drilling Contractors and the U.K. Department of Energy. It concerns the Top Drive load support path which is now through the 6 5/8" and 7 5/8" Reg.? Connections which are continually subjected to dynamic loading condition and eventually may fail.
Ultrasonic inspections are recommended on the main shaft to detect signs of erosion and/or corrosion of the inside diameter as no records are available that this has been done in the recent past or ever been done. The rig should be supplied with a full set of Varco TDS technical bulletins.

A spare Top Drive motor was kept in Darwin for use on either this rig or the Diamond M General. It had come to our attention that this is no longer the case and therefore we recommend to replace this unit as soon as possible.

DRILL STRING COMPENSATOR: The drill string is being used with the Olmstead valves in the off position instead of in the automatic position. This caused damage during the last well when the string parted. Due to the sensitivity of the system, most drillers do not like to use the Olmstead valve in the automatic position. Vetco has a modification which makes this valve less sensitive and it is recommended to install this to allow for operation of the drill string compensator in the automatic mode to utilise the safety function should a sudden loss of hook load (string parting) occur.

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The Olmstead valve on the compensator is scheduled to be replaced as it was found to be leaking.
The piston rod packings are leaking and should be replaced. This is planned to be done prior to the arrival on location.
The control hose bundle is rubbing against the derrick at the top section of the hose.
The lock-bar brass wear bushing is planned to be replaced.
The lock-bar housing lower lock/mounting plate has fallen off and needs to be remounted.
Several cracks were found in the dolly frames and it is recommended that they be thoroughly cleaned, with all welded connections checked for cracks.
The forward (bow) 1" oil line from the top of the cylinder is loose and needs tightening.
Two loose bolts (hand-tight) were found in the lower hook frame. All bolts should be checked and tightened, with the proper torque applied.
The mounting bracket (on portside) of the oil high pressure line to the Olmstead valve has only 1 of 4 mounting bolts installed; the other three should be replaced in order to support this line properly.
All dolly rollers should be adjusted properly so that they each carry an even load. One needs to be replaced as it is seized; a new roller is on order.
All load bearing areas and dolly frames need to be MPI inspected.

RIG FLOOR AND DERRICK

TUGGERS AND SHEAVES: (*) All tuggers should have their Safe Working Load (SWL) clearly displayed.

(*) It is recommended to have a ball valve placed in the air supply lines of each air tugger as close to the operating lever as possible. This can be used as an emergency stop in the case of an operating system failure.

The starboard Red drill floor tugger needs to have a drum guard and a new cable installed.
The Blue drill floor tugger is used as the man-riding tugger as it is the only tugger with an automatic brake which engages when the air pressure is released. This tugger, however does not also have a manual brake of a simple design fitted.
Further, no sign is posted indicating which tugger is the man-riding tugger.

IRON ROUGHNECK: The iron roughneck was function tested during which several hydraulic leaks were noted:

- The forward clamp cylinder has a leaking shaft seal.
- The hydraulic connections on the pipe spinner motor were leaking.
- The oil supply hydraulic filter housing leaks.
- Several fittings at the back of the unit were found leaking.

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The aft gear train of the iron roughneck wheels requires repair as the intermediate gear bearing has excessive play and the gears are badly worn.
Recommendations:
1) Repair all oil leaks.
2) Repair gear train.

CASING STABBING BOARD: The stabbing board is lifted and lowered by means of an air powered chain winch (internal brake when the throttle is set into neutral position). At present however when the throttle is released, the winch continues running slowly in the same direction.
Safe oilfield practice is to fit two independent locking systems on the stabbing board. One of these is a hand or foot operated lock/latch mechanism and the other is an automatic free-fall brake.
The present lock/latch mechanism consists of a pair of spring-loaded 2" angle irons which set down on other angle irons 9" apart along the operational height range. These irons are held out of the way manually while the board is raised or lowered. It is obvious that these irons were left extended while trying to raise the board, they appear rather flimsy and generally fail to inspire confidence.
There is no automatic free-fall brake installed at present.
There is no stop flange on the stabbing board end of the hoist chain. One of the shackles at this end also needs its' pin locked with wire.
Recommendations:

1) Service air winch.
2) The present lock/latch mechanism could be improved upon by the use of a supporting beam of larger section angle-iron with bolts and pipe nipples (used as latch hinges) which should also be thicker.
3) In order to avoid a catastrophe in the case of winch chain failure, a spring-loaded automatic free-fall brake should be installed. An inertia reel should be attached to the track frame for use by the man stabbing the casing.

DRILL STRING: Records indicate that the last complete drill pipe inspection was in March 1992. In July 1992 some 5" E grade and heavy-wall pipe that were in a parted drill string, were inspected.
Other records indicate that 8" and 4 3/4" drill collars and many subs had been inspected since they were last used.
Detailed inventories of drill collars, subs and fishing tools were provided. Tools such as stabilizers, reamers, hole openers etc. are generally provided by the operator and the rig does not stock these lines.
Inspection as per API RP 7G is required on the S 135 drill pipe and all other used tubulars before service in the next well.

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TONGS, SLIPS, DOG COLLARS AND ELEVATORS: A visual inspection was conducted on the above equipment.

Recommendations:

1) The worn slip dies require replacement, the loose retaining plate to be fastened with the proper screws and all dies to be cleaned.
2) Inspect slips for cracks with MPI inspections.
3) Collar slips were found to have their handles secured with nails and wire. This to be corrected utilising proper spare parts. MPI inspection of the critical areas.
4) Some of the dog collar link pins were found to be secured with welding rods and some were not secured at all. It is recommended have all dog collars inspected and all above mentioned deficiencies corrected.
5) All elevators should be disassembled and MPI inspected at the elevator hinge and elevator hinge pin and at the latch hinge and latch pin.

CEMENT SYSTEM

BULK SYSTEM: The mud bulk and cement bulk lines can be combined in the bulk air receiver room in the sack store. It is recommended to remove the connection pipe and blank both sides off.
This system has only one bulk loading line on each side of the rig which is used for loading bentonite, barite and cement. It is recommended to install one more loading line on each side to allow for a complete separation of the cement and the bulk mud system. The installation of an extra loading line on each side can be easily accomplished as both systems run separately from port side to starboard side and are combined at the end of the lines on each side.

The tanks were internally inspected and found to be in a good condition, although a slight cake of cement was noticed on the walls of the cement tanks. Several valves in the system were found leaking and the crew are working to repair this.

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MUD SYSTEM

MUD SYSTEM: Swivels of mud guns in pits no.1, 2, 3 and 4 are leaking severely. Most mud guns are stuck and cannot be rotated. This needs repair. The cable needs replacing on the equalizer pipe between mud pit nos.2 and 3.

MUD PUMPS: Both mud pumps no.1 and 2 were inspected at their power- and fluid ends.

Mud pump no.1: (Forward pump)

Power end inspection: No defects were noted on gears, crankshaft and bearings. The clearance between crosshead and crosshead guide on crosshead nos.2 and 3 was found to be out of tolerance.

Crosshead no.2 0.040"
Crosshead no.3 0.035".

The crosshead extension rod seals on rod nos.1 and 2 were found to be leaking. Apart from a missing cotter-pin on each chain, no defects were noted on the drive chains and chain sprockets of this pump.

Fluid end inspection: The wear plates were removed from all three modules and no wash cutting was found. All three modules are South-West modules which we were informed are less than a year old.
Several threaded connections were noted on the discharge fluid end manifold.

The rod cooling pump was found without a coupling guard and the electric cable improperly fitted to the junction box.
The pressure gauge on top of the pulsation damper is not protected against accidental damage.

Recommendations:

1) Return the clearances of nos.2 and 3 crossheads to the Oilwell recommended amounts.
2) Replace the leaking crosshead extension rod seals in no.1 mud pump's cylinders nos.1 and 3.
3) Threaded connections to be replaced by butt-welded connections.
4) Fit a coupling guard on the rod cooling pump and rewire the motor cable connection.
5) Fit a protective cover over the pressure gauge of the pulsation damper.
6) The high pressure relief valve drain line presently is level and it is recommended to make the drain line self-draining to avoid blockage by solidified mud. The drain line should have the same pressure rating as the high pressure mud system piping and should be properly supported which is presently not the case.
7) Fit a chain across the high pressure relief valve and have the chain fitted with clamps to the piping.
8) Guards to be fitted over the pony rod seals.

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Mud pump no.2: (Aft pump)
Power end inspection: No defects were noted on bearings, gears, chains and chain sprockets. The eccentric connecting rod bearings however, were found to have twice as much clearance as the same bearings on pump no.1. No explanation for this could be found and therefore the manufacturer should be contacted in order to confirm the acceptable condition of the bearings.

	Pump no.1	Pump no.2
Bearing no.1	0.014"	0.004"
Bearing no.2	0.014"	0.006"
Bearing no.3	0.012"	0.007"

The clearance between crosshead and crosshead guide of crosshead no.1 was found to be out of tolerance with 0.041".
Fluid end inspection: The wear plates were removed from all three modules. The valve seats of the oldest module, a standard National Oilwell module were pulled to allow for a visual inspection of suction and discharge valve seat areas; all areas were found to be acceptable.
The two other modules are South-West modules and we were informed that they are less than a year old.
The discharge manifold of this pump will be replaced by a new manifold. This manifold has two threaded bull plugs installed. Threaded connections were also noted on the bleed-off line and the line to the high pressure relief valve.

The electrical wiring of the lubrication oil pump and the rod cooling pump is improperly fitted.
The chain lubrication oil pump discharge hose on the right hand side chain is in a poor condition and the chain lubrication oil pump on the right hand side chain has a worn keyway in its drive chain sprocket.
The pressure gauge on top of the pulsation damper is not protected against accidental damage.
Recommendations:

1) Return the crosshead clearance of crosshead no.1 to the recommended limits.
2) Contact the manufacturer regarding the connecting rod eccentric bearing clearances.
3) The threaded connections to be replaced by butt-welded connections.
4) The coupling guard rod cooling pump to be installed and coupling guard on the lubrication oil pump to be secured.
5) Discharge hose and chain sprocket of the right hand side chain lubrication oil pump to be repaired.
6) Fit guards over the pony rod wells.
7) Pressure gauge on top of the pulsation damper to be fitted with a protective cover.
8) Lubrication oil pump electrical connection to be rewired.
9) The high pressure relief valve drain line presently is level and it is recommended to make the drain line self-draining to avoid blockage by solidified mud. The drain line should have the same pressure rating as the high pressure mud system piping and should be properly supported.

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10) Fit a chain across the high pressure relief valve and fitted with clamps to the piping.
11) On both mud pumps: the crosshead extension rod "run out" has to be checked and adjusted as required. This because it was noted that excessive fluid end parts were used during the last operation; we suspect a misalignment.

DESILTER: The unit did not have cones installed and was not function tested. In any case, the pipe nipples on the underflow and overflow manifolds were so severely corroded as to render this unit inoperable.

DESANDER: The pipe nipples on the underflow manifold are severely corroded, with one leaking, and should be replaced.
We recommend that the degasser vacuum pump ventline be rerouted and connected to the flare line in the derrick as it discharges immediately aft of the open pit area.

PIPE DECK SHAKERS: The starboard shaker is not vibrating correctly and the port shaker produces some bearing noise. These matters should be investigated.

FLOW LINE: There are no jets entering the flow line between the deviater and the gumbo box.

GUMBO BOX: The flow line feeds a single gumbo box. If serious clay ball problems are anticipated on future wells, some modification would be in order. What may be needed in this case is a double (side by side) gumbo box with a single header. The header wall would have two lift plates, one of which is removed (feeding one side of the gumbo box) while the other lift plate is in position allowing dumping of the other side of the gumbo box.

DRAINS: The mud pit dump lines enter a manifold and are directed overboard. The starboard rig floor drains also enter a manifold and lead overboard. The port rig floor drains, trip tank dump, pipe deck shaker cuttings and gumbo box dump are all directed at the pit room shaker overboard header. Mud is lost overboard during a mouse hole connection.

MUD AGITATORS: The mud agitators no.2, 3 and 3a are in the process of being overhauled. Mud agitator no.4 is missing and should be replaced prior to spud-in. No.4a is operating but we were informed that it also planned for replacement.

CENTRIFUGAL PUMPS: All centrifugal pumps of the low pressure mud system were tested with amperage readings taken and were found to be in a good working condition.

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STANDPIPE MANIFOLD: At random two valves were opened on the standpipe manifold and we found the valve body to be in an acceptable condition.
The inserts both need to be replaced and one of the gates is in a poor condition.
It was noticed that the mud hose is rubbing against the break-out tong hang-off line and damaging the outer covering of the rotary hose.
We recommended to slide a rubber hose over this hang-off cable to protect the rotary hose from further damage.
All threaded connections on the standpipe manifold should be replaced by butt-welded connections.

(*) No pipe threaded connections should be used in high pressure systems.

Most chiksans have pipe threaded connections and will need to be replaced for those with welded connections.

(*) It was noted that of the FMC connections, fig.602, 1002 and 1502 were in use on the drill floor. Only fig.1502 should be used. All other connections should be taken out of service, removed from the rig and replaced by fig.1502 connections.

(*) It was noticed that a 5,000 psi working pressure cement hose is in use on the drill floor. This 5,000 psi hose is being used in a 10,000 psi system and could be a safety hazard if people are not aware of this fact. It is recommended to replace this by a 10,000 psi working pressure hose.

(*) A check-valve should be installed in the line running from the standpipe manifold to the kill and choke lines on the port side pipe deck as this is a connection between a 5,000 psi and a 10,000 psi system.

MIXING SYSTEM: There is one surge tank for mixing barite and bentonite. The mixing line valve to the chemical hopper is hard to work as is the trip tank fill valve. If it is necessary to simultaneously transfer active mud to the trip tank and mix chemicals, the mixing must take place at the barite/bentonite hopper.
There is no high-rate mixing system installed on this rig.
The length (athwartships) and the depth (all pits are 6 feet deep) of the largest active pit, reserve pit and kill-mud pit caused some concern; namely the possibility of large masses of mud moving up and down the length of the tank as the rig rolls from side to side. At low pit levels this could conceivably cause intermittent loss of suction at the mud pumps. Beams (3 ft deep) with web holes were placed in position 3 feet above pit floors in the large tanks. These are probably to act as baffles to prevent this phenomenon occurring.
The mud pit dump valves (plug type) and seat areas are in very poor condition because of corrosion. Not one of these valves are found fitted with an O ring, most probably because the O ring would be lost during a pit dumping operation.
The mud pit agitator blades are home-made and sets of blades vary in size from pit to pit. In addition in no case is an agitator shaft constrained to the pit bottom, leaving the shaft free to "walk" around.

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There is one flat-bottomed 67 BBL sand trap. In order to dump this while taking returns, it would be necessary to temporarily divert returns to active pit no.1 (desilter suction pit). The mud trough has no access to the setling pit which also acts as the desander and degasser pit.
There may or may not be time to completely dump the sand trap during a connection.
Pit no.3 (403 BBL) is the only active pit to provide direct mud pump suction. Active pit no.2 (also acting as the mud cleaner suction pit) is equalized with pit no.3 during the drilling operation. Although it is possible to transfer mud to pit no.2 it is not possible to circulate this pit with a mixing pump.
Total active mud pit volume available is 805 BBL. The capacities of the reserve pit, kill mud pit and slug pit are 368 BBL, 417 BBL and 64 BBL respectively.
Above the aft section of the mud pits space (active tanks nos.2 and 3) runs a cable tray (54 inches above the pit grating) causing a head room problem in this area.

WELL CONTROL EQUIPMENT

KILL AND CHOKE MANIFOLD: The manifold is equipped with one remote choke and two manual chokes. One of the manual chokes was found to have a badly pitted bean, which was replaced. The other choke was found to be in good condition. The remote choke was opened for inspection and found to be in a good condition. Two valves were opened and internally inspected, and found in good condition.

(*) As there is only one remote choke, the chance that the manual choke has to be used as the back-up choke is larger than when two remote chokes are available.

Therefore it is recommended to install a drill pipe pressure gauge beside the casing pressure gauge on the choke manifold to allow for full well killing operations by use of the manual chokes. This manifold is equipped with several threaded connections in the line to the pressure sensors in the 10,000 psi section. Screw-in type of target bull plugs and ordinary bull plugs are used in the buffer tank and bypass line. These high pressure systems should have only welded connections, not threaded and it is recommended to modify this accordingly.

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BOP CONTROL SYSTEM

SURFACE HYDRAULIC BOP CONTROL UNIT: This is quite a clean and tidy unit which uses Erifon as its bacteria-free mix fluid. Shutting down the Koomey pumps and slowly bleeding off the banks of surface accumulators led to the following deductions:

- The minimum precharge somewhere in the forward bank is 700 psi, the minimum precharge in the aft bank is 650 psi and there is at least one burst bladder.
- There is also at least one burst bladder in the spider deck bank. The last mentioned bank had bled down smoothly to zero without any sudden pressure decrement.

While working around the Koomey unit some minor problems were noticed. Triplex pump no.2 motor sprocket was free to float along the shaft axis; the suction valve in no.1 pod of no.1 triplex pump is probably defective; the forward auxiliary air pump fluid end needs overhauled; the pilot pressure tracks any falling accumulator pressure (defective check-valve?); the units accumulator pressure gauge continues to indicate about 300 psi when accumulators have been depleted. All the above mentioned deficiencies should be corrected.

BOP HYDRAULIC CONTROL SYSTEM: We were informed that each of the pod hoses are in the vicinity of 1,400 feet long and that there were no splices along the lengths of either of them.
At present, there are several feet of unprotected pilot lines immediately upstream of both pod-reel RBQ plates.
It is planned to replace the hose bundles between the reels and the accumulator pump unit with bundles on board that are earmarked for that purpose.
The RBQ plates are each set up with connections for 42 pilot lines. At present there are 32 active pilot lines and 4 spare pilot lines in each hose bundle.
Removing the Yellow RBQ plate revealed that half of the female pilot line receptacles at the reel were made of brass instead of stainless steel. The materials' brittleness allows the outer lip of the female connectors seal groove to fracture easily thus allowing control fluid leakage.
Approximately about half of the available brass connectors had pilot line connectors mated to them. The female connectors behind the Blue RBQ plate were not checked but probably the same situation exists there as well. We strongly recommend that all of the brass fittings be replaced with stainless steel fittings.
We were assured that the male and female pilot line connectors at the Blue and Yellow pod kidney plates were of stainless steel material.
Many of the pilot line hose couplings made up to the RBQ plate receptacle (inside each pod line reel) are corroded, especially inside the Yellow drum. It appears that couplings are replaced on a "have to" basis and we suggest that questionable couplings be discarded and that the pilot lines be re-terminated with new hose couplings.

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The pod hose winches are driven by pneumatic piston motors. They seem to perform satisfactorily in spite of the fact that air leaks past the pistons into the crankcase. An overhaul of each motor would allow them to operate at peak capacity.
There is a hot line reel on this rig and it contains an undetermined length of hose bundle containing 4 pilot lines. It has a 5-cylinder air motor which has not been used for a number of years, according to our information. If there are any plans to run a pin connector or to fit emergency hydraulic access to the BOP Collet connectors, then this unit requires a major overhaul. The manipulator valves, regulator, band brake and possibly the rotary seal all need attention.
Hydraulic pressure (3,000 psi) was applied to all conduits in each hose bundle. Because the LMRP has been separated from the BOP package, it was not possible to perform full function tests on both pods.
The Blue pod was latched to the BOP package and all rams were closed (after bonnet nuts removed), all failsafe valves opened and wellhead connector locked. The riser connector was locked using the Yellow pod.

Many of the stack-mounted shuttle valves had been tested as a result of testing the ram preventer, failsafe valve and Collet connector hydraulic chambers with a 3,000 psi hot line. So far, any defective shuttle valves found were at the MPR close chamber and the positive seal-cup type shuttle valves at the riser connector preventer lock/unlock dump circuits.
Both control pods are hard piped and after a fitting has been loosened it is difficult to restore pressure integrity. In addition, there are many two piece (pressure fitted) fittings and female swivel adaptors, which in our experience are notoriously unreliable. We strongly recommend changing out this plumbing with stainless-steel tubing and would like to emphasise that this small investment pays big dividends in safety, ease of maintenance and avoidance of downtime.

According to our information, all 3/4" and 1" pilot valves, manifold regulators and annular regulators in the Blue and Yellow pods were overhauled before drilling the last well. There is supposed to be some corrosion pitting inside the Yellow pod pilot valve pockets.

(*) There is an abundance of two piece (pressure fitted) fittings and J.I.C. female swivel adaptors all over the LMRP and BOP packages. We have no time whatsoever for these items and strongly recommend their removal.

In addition, some of the present fittings are so badly corroded that it is difficult to identify them e.g. connections between BOP starboard accumulator manifold and shuttle valve.
There are the beginnings of a serious pitting problem at the Yellow female hydraulic stab. So far, it does not extend across stab seals. The Blue pod is installed in the other female stab so we do not know what the situation is there. A change out will be necessary in the future and in the meantime perhaps the female stabs could be cleaned up and coated with Teflon.

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We also took note that there is no accumulator isolator system in the BOP package. By installing a (2-way, N.C.) SPM valve here, it would be possible to retain subsea accumulator storage and to avoid possible damage of stab seals during an LMRP disconnect.
There is no emergency nitrogen or reserve air storage system for the remote operation of the Koomey unit control system in the event of total loss of rig air, and we recommend installation of such a system.
The pre-charges on the LMRP and BOP mounted accumulator bottles need checking.
With the accumulator pumps shut down, Shell requires a minimum of 1,500 psi remaining accumulator pressure after the following functions are performed:

- all rams closed and opened
- one annular closed and opened
- one ram closed
- one annular closed.

At present, there are 74 x 11 gallon bottles in the system but calculations indicate that 99 bottles are required.

C.I.W. COLLET CONNECTOR: The present riser connector was fitted to the LMRP in July 1990 and there is no record of any overhaul since then. The wellhead connector was last tripped down in April 1989 when the Miller cylinders were re-hosed.
The hydraulic chambers of each connector were pressure tested to 3,000 psi. In each connector the primary unlock and secondary unlock were tested simultaneously and this was followed by the lock test.
The pressure integrity of all chambers was found to be excellent and each connector unlocked with very little effort.

ANNULAR BOP, C.I.W. DL: The operating system of the annular BOP was checked by pressure testing the opening and closing chambers individually to 3,000 psi.
While testing the close chamber the test pressure had fallen by 190 psi in the first 15 minutes, by 100 psi in the second 15 minutes and by 70 psi in the third 15 minutes. While the packer was being energised, it could be seen that the rate of pressure loss was becoming smaller and that losses would cease altogether with more time elapsed.
When the annular was opened and pressured to 3,000 psi, both telltale holes began leaking immediately after 15 minutes and a pressure loss of 730 psi was noted, the rate of leaking had decreased appreciably.
Fifteen minutes after the annular was pressure open, the packer element protruded into the bore by an estimated one inch all the way around.
In July 1991, a number of seal rings were replaced in this unit and in April 1992, the donut and packer were changed out.
It is suspected that the open chamber leak is caused by defective seal(s) in the inner and/or outer cylinder heads (or damage at the critical areas adjacent to them). Disassembly and inspection is recommended.

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BOP C.I.W. TYPE U: Pressure testing ram and wedgelock operating chambers (to 3,000 psi).
RAMS, Close Side: Middle pipe ram aft has little appreciable pressure loss, but leaking at intermediate flange/bonnet interface. This would indicate a problem at the bonnet side liner seal. We recommend dismantling this ram bonnet and checking condition of seal mentioned and also the surface inside the bonnet adjacent to this seal. The severity of any corrosion found will determine whether a reconditioned bonnet may be necessary.

RAMS, Open Side: Lower pipe ram forward, middle pipe ram aft and upper pipe rams aft. In the cases of LPR forward and MPR aft, there was dripping at the intermediate flange/bonnet interface. This points to leaking fluid past the (bore side) liner seal where it contacts the intermediate flange. We recommend dismantling both these bonnets and checking condition of this seal and appraising the surface condition of the seal contact area inside the intermediate flange. In each case, a reworked intermediate flange may be necessary.
In the case of the UPR aft, fluid was leaking out of the telltale hole in the intermediate flange. This indicates opening fluid leaking past the operating piston rod seal and its contact area in the intermediate flange. The seal may be wash cut and the resulting possibly pitted area of the intermediate flange's seal groove may have contributed to the problem. We recommend dismantling this bonnet and check for damage as above. A reworked intermediate flange may be necessary here as records indicate that this rod seal had been fluid cut and seal area was lightly pitted when inspected in March 1992.

WEDGELOCKS: Lock chambers on wedgelocks locating the lower pipe ram aft and upper pipe ram forward positions failed to hold test pressure. The most likely cause of this is failure of the stinger seal inside the wedgelock slider. We recommend dismantling and repair.

WEDGELOCK BALANCE CHAMBERS: Every balance chamber on the BOP, with the exceptions of the fore and aft middle pipe rams, require filling or bladder replacement followed by filling. We recommend dismantling of each unit to carry out necessary repairs and make them serviceable.

All ram block slots and ends of the ram operating rods still need to be checked for cracks.
The no.27 clamps will need to be removed from the BOP and inspected for cracks by NDT inspection.

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MARINE RISER SYSTEM

MARINE RISER SYSTEM: The last inspection of the riser joints for the cracks was in March 1990. It is recommended to have all riser joints, slip joints and pup joints inspected for interval wear and crack detection prior to use of this equipment.
The slip joint packer was inspected and found to be in good condition.
No records are available on the slip joint inner barrel indicating when it was last U.T. inspected to check the wall thickness and when the shoe was last inspected.
All pins and boxes need to be checked for scoring, pitting and seal condition as well as the riser locking dogs and actuating system. The pup joint with the riser fill-up valve is badly keyseated and needs repair.

DIVERTER: The diverter insert packer was found to be cracked with pieces of rubber torn out of the bore. This unit will need to be replaced. The inner packer is swollen to such an extent that the insert packer needs to be pushed down into the diverter. The diverter valves were tested and found to be operating well.

(*) When the diverter packer is closed, the flow line is not automatically closed; this would be a good safety feature as one diverter valve is always open and allows the diverter system to be automatically lined up to overboard.

RISER TENSIONERS: The six riser tensioners are Western gear Pipemasters rated at 80 kips each. The wire rope is 1 3/4", 6x41 R.H.L., IWRC and the working fluid is Quintolubric. During operation, all of the rods were noted to have a coat of working fluid and number 5 rod had the most significant scoring. The slip and cut program has involved removing 12 feet off of each line between wells, and this system appears to have worked very well.
Up to now, greasing had to be done from a work basket suspended from a crane. This is because the high sheaves are out of reach and there are no access platforms at the lower sheaves (except in the case of number 1).
Grease lines have been made up and can be fitted at any time.

(*) It is recommended to install greasing platforms to be able to conduct the greasing at the tensioners in a safe manner.

Number 2 tensioner line is terminated with bulldog clamps, apparently because a wedge socket will not fit into position on the slip joint outer barrel.
Last major work on these units was in October 1991 when number 5 rod packing was changed out. It is planned to repack number 3 and 4 and to replace leaky isolation valves on numbers 4 and 6. Four out of the nine riser tensioners APV's require handles fitted on their isolation valves.
High pressure piping in the riser tensioner control panel has been affected by corrosion and repairs are planned.

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BOP STACK

FLEX JOINT: The flex joint was found to be badly keyseated. This was 3/4" deep at the top and with a width of 30% of the circumference.
At the bottom it was found to be worn into the BX-163 gasket as deep as 1/8" and 3 1/2" wide.
This flex joint needs to be repaired and has been removed from the LMRP.
The Coflexip hose on the kill side has been removed to be replaced. It will need to be repaired as its metal shielding has come loose.

GATE VALVES: The failsafe valves were function tested and all operators were pressure tested to 3,000 psi. No leaks were found. The gates and seat were not inspected as this was done 6 months ago.

BALLAST SYSTEM: This rig was built in the mid seventies and has a ballast system that does not meet todays safety criteria:

- Free flowing between all ballast tanks in one pontoon is possible when the ballast tank valves are opened or leaking.
- Only the port side ballast pump can be fed by the emergency generator, no ballast pump in the starboard pump room can be fed directly from the emergency switchboard.
- The ballast valves are all air operated failsafe close, if the spring fails to close the valve then the valve cannot be closed manually.
- The air system for operating the valves is directly fed from the rig air system. If rig air is lost then the ballast system cannot be operated. No reserve air reservoir is available to continue operation.
- The sea-chest inlet valve is manual and its second valve is air operated open and close. This valve should also have its own air reservoir to remain operational in the case of a loss of air pressure. It will be failsafe close then as the reserve air will be used to close the valve.
- The ballast control room is located in the port side aft column at the 81 foot level. The four portholes can be blanked off during bad weather conditions with blank plates which are readily available.

The following deficiencies were also noted:

(*) Both sound powered telephones in each pump room are out of operation, these should be repaired as soon as possible and this is planned to be done on the tow to the new location.

- Ballast valve of tank no.1 port side has a cracked housing which is planned to be repaired during the tow to the new location. The air operator of this valve is leaking profusely and requires repair.
- The float/non return valve of the emergency bilge suction in the port side pump room was found to be leaking severely and requires repair.

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- The valves are not clearly marked to indicate which tank they are for.
- The coupling of the bilge pump in the port side pump room was found to have failed. This was repaired immediately.

Recommendations:

1) Split the suction/discharge manifold into two pieces by installing a manually operated valve which prevents possible interflowing between the forward tanks no.1 and 3 and the aft tanks no.5 and 7.
2) The ballast service water cooling pump in the starboard pump room should be fed directly from the emergency generator without having to be back fed via the main switchboard.
3) A means should be installed to allow for manual operation of the ballast valves in the case of an emergency.
4) An air receiver should be installed in the air supply of the ballast control/operating systems for both pump rooms with a check-valve installed in the air supply lines to allow for operation of the system during loss of rig air pressure.
5) A drawing should be made of the layout of the ballast system of each pump room, with the positions of all valves clearly marked and precise instructions of how to manually operate them during emergency situations. All valves and pumps should be clearly marked as well so they can be easily recognized.
   Special crews of two men for each pump room should be trained to operate the ballast system under emergency situations. This will be done under the responsibility of the barge master. These drills should be conducted regularly with actual manual operation of the system practised.
6) The port holes in the ballast control room should be closed off by permanently installed steel-plates.

As no secondary deballasting system is installed we feel that these recommendations are important for the safe operation of the rig as the present system has no redundancy built into it to cope with rig equipment/system failure during emergency situations.

POLLUTION CONTROL: The rig has enforced strict pollution control policies with instructions to the crew and all visitors that nothing is allowed to be thrown into the sea.
An oil/water separator is installed with all deck and rig drains led to a holding tank. A pump transfers the fluid out to a skimmer tank where the oil is skimmed off, then to a waste oil tank and later it is pumped into barrels to be sent ashore.
This system was not in operation as several plugged lines had been cut out. These lines are planned to be replaced prior to arrival on the new location.
A sewage unit is in operation.

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OVERFLOW AND VENTS: The vent on deck of port ballast tank no.7 has a sounding pipe opening attached to the ventline which cannot be closed off. This sounding opening should be modified to allow closing after each sounding.

TUBULAR WATERTIGHT INTEGRITY: All tubulars are free flooding. On most semi-submersibles these tubulars are or have been closed off and made bouyant with a leak detection system installed to allow for early warning if cracks develope in these structural connections.
We were informed that ABS has inspected these at random but inspection reports were not available on board.

WATERTIGHT COMPARTMENTS: No specific instructions in the operations manual could be found for opening and closing of watertight compartments.

ENGINE-ROOM

MAIN ENGINES: No.1 engine was overhauled in June 1990 at which time all bearings and power packs were replaced. The blowers on the right hand side were replaced for reconditioned ones in June 1991 and those on the left hand side in August 1992.
Since the overhaul in June 1990, the engine has accumulated 9,783 running hours (RHRS) and is not due for a major overhaul in the near future.
A piston and liner as well as a top-deck inspection showed no defects. The inboard blower however has a slightly leaking inner bearing seal which requires attention. This blower has only 270 RHRS.
The following safety devices were successfully tested:

- Overspeed.
- High cooling water temperature alarm.
- Low lubricating oil pressure shutdown.
- High crankcase pressure shutdown.

The crankcase under pressure of the engine was measured and found to be 4.5" water column. This is an indication for the piston ring and liner wear which in this case is acceptable.

No.2 engine
According to the available maintenance history on board the rig, no.2 engine which has 25,726 RHRS has not seen a major overhaul.
The following maintenance is due:

- Lower main bearing and thrust collar replacement, recommended by EMD at 24,000 RHRS.
- Replacement of cylinder assemblies is recommended at 16,000 RHRS, this however may vary due to engine inspection results and engine performance.

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Based upon the present running hours, the crankcase pressure and a recent valve failure of no.11 power assembly, it is recommended to plan the power assembly overhaul or unit exchange in the near future.

The measured crankcase under pressure was found to be -3/4" water column and a piston and liner inspection showed no defects.
The top-deck inspection showed no defects apart from the missing retaining spring of cylinder no.8 fuel linkage.

The following safety devices were successfully tested:
- Overspeed trip (1050 RPM).
- High cooling water temperature alarm.
- Low oil pressure shutdown.
- Crankcase over pressure shutdown.

No.3 engine
According to the available maintenance history on board of the rig, no.3 engine was overhauled 4 April 1990 at which time all cylinder assemblies were renewed and the auxiliary drive train was overhauled. Running hours at the time of overhaul were 43,741; this engine has since accumulated 14,803 RHRS.
The running hours of the turbocharger could not be established as no records were available. This model of turbocharger is due for a unit exchange every 32,000 RHRS, according to EMD recommendations.
In March 1991 a new crankshaft was fitted in this engine due to damage caused by a connecting rod failure. The cause of this failure was established and corrected.

The following safety devices were successfully tested:
- Overspeed trip (1020 RPM).
- Low lubricating oil pressure 22 psi.
- High water temperature alarm.

The crankcase over pressure shutdown was found to be faulty; a new unit has been installed and found to be properly functioning.

The crankcase under pressure measured was found to be -2 1/4" water column and a piston and liner inspection showed no defects.

ENGINE MAINTENANCE: We were informed that the major maintenance tasks are planned by the Houston maintenance department, which send out a team yearly to conduct an equipment condition inspection which is used for major maintenance task planning. This team is about due to come to the rig for its yearly inspection. The mechanical department on board the rig only conduct the service maintenance tasks.
Records regarding equipment condition inspection were not available on board the rig.

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Recommendations:
1) Investigate leaking blower bearing seal on inboard blower no.1 engine.
2) Plan power assembly overhaul or unit exchange of no.2 engine.
3) Keep copy of equipment condition surveys on board the rig, to assist with trouble shooting and for reference.

EMERGENCY GENERATOR SET: The emergency generator was function tested successfully.
A black-out was simulated and the emergency generator started up, within approximately 10 seconds it was on line and feeding the emergency switchboard.
The emergency generator is located on port side main deck, inside the Koomey unit room. The generator is started by battery power. A visual inspection of the unit showed a few minor deficiencies:
A) The engine V-belt is in a condition where replacement should be considered.
B) The emergency switchboard requires cleaning.
C) The engine electric wiring should be properly protected and fitted on cable trays.
D) The of radiator air intake duct canvas to be replaced due to its condition.

The emergency generator output is maximum 250 Kw. The following important equipment is not fed from the emergency switchboard:
- Electric driven Koomey pump.
- Mixing pump.
- Gas detection system.

It is possible to back feed the main switchboard with the emergency generator, but this can only be done when the main switchboard is operational.
Only the port side ballast pump is fed from the emergency switchboard. This pump cannot be used on the starboard side ballast system.

AIR COMPRESSOR: Two rotary type rig air compressors, one diesel driven emergency rig air compressor and one piston type bulk air compressor are available on board the rig. The diesel driven emergency rig air compressor is new; it was found properly working.
Both nos.1 and 2 rig air compressors were inspected and tested. The high temperature (air) shutdown of both compressors were tested. The shutdown of no.2 was found not working, was subsequently repaired and successfully retested.
The cooling water piping above the aft compressor is in a very poor condition and requires replacement. We were informed that material is on board and this project is on the worklist to be carried out during the tow. The bulk air system has its own compressor but, the system can also be combined via a pressure regulator with the rig air system.
Both the bulk air and the rig air system are fitted with air dryers. The dryers in the rig air system were found properly working. The drying interval in the bulk air dryer should be renewed and according to the crew this is planned.

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WATERMAKER: The rig is equipped with a Nirex watermaker which uses waste heat from the engines for water production. The average production of fresh water per day is between 28 and 35 M^3, depending on the engine load.
The watermaker was found properly operating.

ELECTRICAL

DC MOTORS: All DC motors on board the rig were megger tested (insulation resistance to ground) and the following motors were found to have a reading below those recommended by the manufacturer (minimum value of 1 M.Ω).

Anchor winch motor 5-6	1.5 M.Ω
Top Drive motor armature	0.2 M.Ω
Rotary motor field	0.1 M.Ω

The space heater of anchor winch 5-6 was found to be defect which most likely caused the low reading.
The Top Drive motor requires cleaning and drying in order to improve the low reading. A visual inspection showed a damaged (leaking) air intake duct of the motor.
Recommendations:

1) Repair/replace space heater of anchor winch motor 5-6 and recheck megger reading.
2) Clean and dry Top Drive motor and repair damaged air intake duct. Recheck megger reading.
3) Investigate low field reading of rotary motor.
4) A visual inspection showed the following defects on the drawworks motors and the rotary motor which all require repair:
   Driller's side motor: Heater connection not explosion-proof due to faulty cable gland. Field wire connection on the motor not explosion-proof. Several junction box bolts are not fitted. Air purge pressure switch is not connected.
   Off driller's side motor: Air purge pressure switch is not working. Motor field cables are not explosion-proof fitted to motor junction box.

ROTARY TABLE MOTOR: Air purge pressure switch is not working.

GENERATORS: The three generators were function tested, visually inspected and megger tested.
Generator no.1: Rotor 100 M.Ω.
Stator 50 M.Ω
Three of the coils were noted with minor cracks in the rotor coil insulation. We were informed that this rotor will be changed out, when a replacement arrives on board the rig.
The reverse power protector of the generator was successfully tested.

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Generator no.2: Rotor 0.3 M.Ω
Stator 50 M.Ω
Several coils were noted with cracks and swellings. The generator slip rings were found greasy, due to leakage out of the generator end bearing. A new rotor for this generator is on order and presently the status is unknown. The reverse power protector of this generator was successfully tested.

Generator no.3: Rotor 200 M.Ω
Stator 50 M.Ω
A visual inspection of the generator showed no defects and the reverse power protector of this generator was found properly working.

Emergency generator: Rotor 35 M.Ω
Stator 100 M.Ω
No defects were noted on the generator and the generator was found properly working.

The main switchboard layout allows for only two generators feeding the main busbar at one time, which is normally sufficient for the drilling operation.
In order to switch generators the power consumption has to be lowered to an acceptable level for one generator, before it can be taken off line and another can be connected to the busbar. In other words the drilling operation has to pause momentarily while the change over is conducted.
Recommendations:
1) Replace no.2 generator rotor prior to the start of the operation, and inspect or replace when necessary generator end bearing.
2) Plan the replacement off no.1 generator rotor.

AC MOTORS: All critical motors on board the rig were megger tested and only one pump was found to be low, namely bilge pump no.1 starboard at -0.5 M.Ω.
The starter cabinet of the emergency fire pump which is located in the mud pump room was found to be in a poor condition (holes in it and badly corroded).
Recommendations:
1) Clean and dry the electric motor of no.1 bilge pump.
2) Replace starter cabinet of the emergency fire pump.

TRANSFORMERS: The insulation resistance of all transformers was tested and the transformers were visually inspected for poor connections and cable insulation with the following results:
Main 600 - 440 volt transformer.
Primary side 100 M.Ω to ground.
Secondary side 50 M.Ω to ground.
No defects or damaged cables noted.

No.1 450 - 120 volt transformer.
Primary side 100 M.Ω to ground.
Secondary side 100 M.Ω to ground.
One cable was renewed due to poor insulation.

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No.2 450 - 120 volt transformer.
Primary side 100 M.Ω to ground.
Secondary side 100 M.Ω to ground.
Three cables were renewed due to bad insulation and all connections were checked for tightness.

Elmagco brake transformer 450 - 250 volt.
Primary side 100 M.Ω.
Secondary side 100 M.Ω.

CRANES AND MOORING EQUIPMENT

MOORING SYSTEM: No footage counters are installed on the mooring winches but parts have arrived on board to install them; this should be done as soon as possible. The mooring winches can only be operated locally from the winches and not remotely.
The emergency release system was tested. We were informed that it probably never was tested previously but after some work 7 out of the 8 anchor winch emergency release systems were working.
The operating cylinder of emergency release system on anchor winch no.1 does not move freely and needs overhaul/replacing.
All tension gauges to be calibrated.

DECK CRANES: Both port and starboard deck cranes have been function tested and the following noted:
Starboard crane: A satisfactory function test of the crane was carried out.
(*) The limit switches were tested and the whipline limit switch was found not working.
(*) This crane has no load indicator fitted as it was sent for repair.
The radiator hose at the bottom of the radiator should be replaced, due to its condition.
Port crane: The crane was satisfactorily function tested. A function test of the limit switches showed that the main block limit switch did not work. The load indicator was found properly working. The pawl mechanism requires attention as several nuts were found missing.
Record keeping: All record keeping concerning crane wire certificates, last date of change of crane wires, cut and slip records are presently insufficient.
None of the crane wire certificates could be shown; the last date of change of the pendant wires is unknown, as well as the last date of change of starboard crane main block wire.

Starboard crane

Wire	Last date of change	Certificate no.
Boom	07-10-1991	?
Whip	30-09-1990	?
Main	?	?
Pendant	?	?

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Port crane

Wire	Last date of change	Certificate no.
Boom	23-07-1992	?
Whip	10-03-1991	?
Main	26-06-1990	?
Pendant	?	?

UK regulations regarding crane rope replacement are to be done annually, or more frequently when required. Clear records should also be maintained including:

A) Original test certificate.
B) Date and crane to which rope is fitted.
C) Record of slipping and cutting.
D) Record of lubrication.

Recommendations:

1) Repair the mentioned defects (whipline limit switch and radiator hose) on starboard crane.
2) Repair the mentioned defects (main block limit switch and pawl mechanism) on port crane.
3) Improve record keeping regarding certification of crane wires and wire exchange.
4) Adopt the UK regulations regarding wire rope replacement and record keeping.
5) Replace the crane wires which have no certificate for certified wires, this also applies for the pendant wires.
6) Start an MPI inspection programm for all critical crane components and crane pedestal.

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SAFETY CHECKS

ESCAPE-ROUTES: Accommodation escape-routes to forward lifeboats are reasonably well marked, but can be improved by posting fluorescent arrows, approximately 1 foot above the floor in the alleyways and at exit doors. Escape-routes to the aft lifeboat station are insufficiently marked and illuminated. Escape-routes from machinery spaces of mud pit room, sack store and cement pump room are not marked at all and no exit signs or lights above the doors are fitted in these areas. The two means of descent to the waterlevel, located starboard forward and port aft side of the rig, are not clearly marked as such.
The escape-route from the ballast control room should have its hatch clearly marked on port aft deck and a sign should be posted stating not to obstruct this hatch.
The following emergency lighting was found not working:

- Emergency battery back-up light outside aft accommodation first level.
- Emergency battery back-up light on forward lifeboat station.
- No emergency battery back-up light is fitted at the aft lifeboat station.
- Emergency battery back-up light in control (ballast) room.
- Emergency battery back-up light above Koomey unit does not work during the test.
- Emergency battery back-up light above emergency fire pump.
- Battery back-up light in starboard pump room.
- Battery back-up light above starboard pump room hatch.
- Emergency battery back-up light above cement pump control panel should be improved.

Recommendations:

1) Post fluorescent signs in the accommodation.
2) Improve escape-route marking and illumination towards aft lifeboat and life-raft.
3) Mark and illuminate escape-routes in: machinery spaces at mud pits, mud pump room, cement pump room and sack store and post exit signs on the doors.
4) Clearly mark the two means of descent to the waterlevel.
5) Clearly mark the ballast control room escape hatch and post a sign which states DO NOT OBSTRUCT THIS AREA.
6) Correct all defects noted on the emergency battery back-up lights.

CO_2 SYSTEM: A visual inspection of the CO_2 system showed the following deficiencies:

- In the emergency generator room we found four of the six nozzles taped off with plastic.
- In the mechanic's workshop one of the nozzles above the work bench is taped off.

The CO_2 room which is located between the moon pool and the shaker area requires attention as the door cannot be fully opened, (only 1/3); this is due to a platform built above the door. The door cannot be closed as its lock is damaged. There is also no ventilation available in the CO_2 room.

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The evacuation sign fitted under the CO_2 release alarm in emergency generator room should be made more clear.
The CO_2 release station for the control room requires the installation of name plates above the control valves and the name plates of the CO_2 release station for the emergency generator room should be cleaned.
The control room release station covers the mechanics workshop, compressor room, switch gear room and also the thy-rig room. This area is only covered with one CO_2 alarm and if CO_2 is released the alarm will most likely not be heard in the ballast control room, in the thy-rig room and/or in the offices used by the mechanic and electrician which are also located inside the thy-rig room.
Recommendations:

1) Remove the obstructions of the nozzles in the emergency generator room and mechanics workshop.
2) Repair the door to the CO_2 room.
3) Provide adequate ventilation in the CO_2 room and post a warning sign on the door regarding the dangers.
4) Evacuation sign and CO_2 release alarm fitted in emergency generator room to be improved.
5) CO_2 release station for the control room requires installation of name plates above control valves, name plates of CO_2 release station plates for emergency generator room to be cleaned.
6) Two additional alarms to be fitted, one in ballast control room and one in the thy-rig room both preferably with a revolving light.

GAS DETECTION: A flammable gas detection system is fitted on board the rig and no H_2S detection system is available. There are no sensors fitted in the accommodation fresh air intake and the system is not self-monitoring for faults.
The control station is in the toolpusher's office which is not manned 24 hours per day. If a sensor is activated, only a visual alarm appears on the control panel.
When the LEL reaches the set high limit an audible alarm together with a revolving light is activated at mud pits and drill floor.

The power supply of the gas detection system is fed from a wall socket via a cable and plug. This power supply is not from the emergency switchboard.
The system was function tested and all sensors worked with the exception of the sensor near the desander.
Recommendations:

1) Permanent power supply feed from the emergency switchboard via a battery charger and batteries.
2) Audible alarm in drilling office.
3) Consider relocation of the panel or an additional panel to a 24 hours per day manned area i.e. ballast control room or radio room.
4) Sensors to be fitted into the accommodation fresh air intake, which when activated also shut the ventilation down.

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5) Make the system self-monitoring for faults.
6) Repair the faulty sensor at desander.

AUTOMATIC FIRE DETECTION SYSTEM: Smoke detectors are fitted in the sleeping quarters and heat detectors are fitted in the engine-room, machinery space and the cement unit room (one detector in each space). All other alarms on the detection panel are manual alarms.
Two of the pull stations and one of the heat detectors were function tested, all were found to be satisfactory.
The fire detection and alarm panel is self-monitoring for faults and fed from batteries which are automatically charged by a charger from the emergency switchboard.
The panel is located in the toolpusher's office and gives an audio- and visual alarm when the system is activated.
Although the toolpusher's office is not manned 24 hours per day, the radio room is and the alarm can easily be heard there.
Recommendations:
1) Next to the fire detection and alarm panel is a location reference list for the alarms which corresponds with the numbers on the panel, as this has led to confusion a schematic drawing of the sensors and alarm stations should also be posted next to the panel.

LIFEBOATS: Boat no.1: A function test of the engine showed engine and hydraulic starting mechanism in a good condition. The breathing air system in the boat was checked and the stop valve on the forward bottle was found to be leaking.
The pressure gauge on the air discharge manifold was also found not working. The aft fire extinguisher should be charged according to its indicator and the missing radio beacon normally stored next to the helmsman's seat should be reinstalled.
No.1 lifeboat station: There is no telephone and/or P.A. speaker fitted near this lifeboat station and the battery back-up light was found not working.

Boat no.2: The engine and hydraulic engine starting system were found properly working. The spray pump was found not rotating when engaged, this is due to a faulty drive belt.
The forward fire extinguisher should, according to its indicator, be recharged.
No.2 lifeboat station: There is no telephone and/or P.A. speaker fitted near this boat.
Recommendations: (Both nos.1 and 2 boats)
1) Repair and overhaul the breathing air system.
2) The last hydrostatic pressure test of these breathing air bottles is unknown. They should be tested every five years, if no proof of this is available in the office then they should be tested.
3) Certification regarding lifeboat falls is not available on board and should be made available.
4) Recharge the fire extinguishers as required.
5) Radio beacon to be fitted in no.1 boat.

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6) Replace drive belt of spray pump in no.2 boat.
7) Consider telephone and P.A. speaker installations near the lifeboat stations.
8) Repair battery back-up light no.1 lifeboat station.

LIFE-RAFTS: According to the life saving plan posted on the rig, there should be four 25-man life-rafts; presently there are two installed which are (as we were informed) sufficient to meet the regulations.

Recommendations:

1) Revise station bill drawings and emergency equipment drawing. (Both are posted near mess room).

HELICOPTER OPERATIONS: The medic is appointed as helicopter landing officier (HLO). The communication between the rig and helicopter is done via the radio room. The HLO has no means to talk with the pilot or radio room via a radio set. The HLO can only be reached on the helideck via the public address (P.A.) system. The HLO can usually not hear the P.A. as the helicopter noise is too loud.

For the safety of the operation it would be a very useful asset to have a radio with head set and microphone available for the HLO to allow him to be in contact with the radio room and pilot at all times during helicopter operations on the helideck.

(*) The heli-deck is not painted with non-skid paint. It is advisable to do this to prevent people from slipping on wet and/or moving deck. Although a non-skid walkway is painted to the circle we feel that this is not sufficient as the helicopter never lands exactly in the same place.
(*) The helideck on port and starboard aft side are not protected by a gutter and drainage system to prevent a fuel spill from spreading to other parts of the rig. This could create a serious safety hazard and should be corrected as soon as possible.
(*) There are no special applicators long enough to be readily directed into a helicopter engine space in case of an engine fire.
(*) No grab hook is available on the helideck.
(*) The quick-release knife is of the wrong type and has a very sharp point which could seriously injure people when used. The proper type of release knife is with a blunt end to avoid injury.
(*) An inventory list should be made and kept in the box to allow the HLO an easy check on completeness of the equipment.

No power source is available for starting up helicopters.
No tie down ropes are available for tying down the helicopter on the helideck; they are available on board the chopper.

HELI-DECK FOAM SYSTEM: Two valves have just been replaced as the system was found contaminated with salt water. A new change of foam has been ordered to be kept on board as reserve. This should arrive onboard before commencement of operations.

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FIRE MAIN: The rig is fitted with one designated fire pump, one emergency fire pump and one foam pump for the heli-deck foam system.
The fire pump and the emergency fire pump are fed out of the 500 gallon buffer tank in the machinery space, this tank is automatically topped up out of the salt water service system. The system can also be lined up to an 8,000 gallon drill water back-up tank. Two other pumps can be lined up to the fire main; the drill water pump and the salt water service pump in the machinery space.
The ballast/salt water service pump in the port pump room, is the only pump connected to the emergency switchboard, which means that in the event of a power failure due to a main switchboard problem, this is the only pump available to supply the emergency fire pump with water.
The fire pump, the drill water pump and the salt water service pump as well as the emergency fire pump have no check-valves fitted in the discharge lines.
The emergency fire pump was tested and the following noted;
Noisy electric motor bearings.
A leaking shaft seal.
No check-valve fitted.
The emergency fire pump is the only fire pump fed from the emergency switchboard. None of the fire pumps has a remote start-stop station, a crew member has to go down to the pump to open the valves and start the pump when it is needed. As the pumps are not fitted with check-valves in the discharge lines, they cannot be kept in the standby mode with the valves opened and ready to start.
The helideck foam pump is located on starboard side mud pit area, which is considered a hazardous area. It is not considered good practice to have major fire-fighting equipment located in a hazardous area.

Recommendations:

1) Install check-valves in all pumps connected to the fire main.
2) Then, consideration should be given to the installation of a fire pump start-stop station in the control room and the fire pumps can be kept in the standby mode.
3) Emergency fire pump motor bearings to be renewed and the leaking pump shaft seal to be replaced.

WELL TESTING: Prior to conducting a drill stem test, it is recommended to conduct a wall thickness test on the piping from the separator area on port side to the burner booms.
There is no permanent water curtain installed on the rig to protect the rig equipment from heat radiation. There is only the spray curtain on the burners themselves which can be fed by the mud pumps.
We were informed that fire hoses are usually rigged up to the fire pump to provide a water curtain for cooling of the rig. This is a poor practice and should be avoided as the fire equipment should be used for fire-fighting purposes only.
It is recommended to build a system that supplies water from a different source independent from the fire-fighting system.

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SAFETY MANAGEMENT SYSTEM: Diamond M Odeco has a safety management system in place with regular safety meetings and toolbox meetings being held. These meetings are being well documented and action is being taken on items that are brought up by the crew.
Every morning at 5:45 a safety meeting is held by all supervisors to discuss: the planned operation for that day, any unsafe practices noticed the previous day and the status on any safety improvements in progress.
All new personnel and visitors to the rig are introduced to the life-saving systems on the rig upon arrival.

Training of the crew is a weak point. Although some training material is on board such as safety and equipment videos, job skill improvement study material is almost non-existent and a structured and well documented training program is not in place covering all job positions.
No clearly defined engineering instructions could be found that could be used as a guideline for rig management of procedures to be adopted if modifications to rig i.e. systems, hull, structure, high pressure systems, etc. were required/requested.

A part of the safety management system should be a review of the rig systems and operating procedures of these systems to evaluate if they still meet todays safety standards.
Examples of such systems are ballast systems, helideck fuel spill prevention, fire-fighting and deluge systems, etc.

More operations should be described in detail, with standards set by management and with procedures in place to update these routinely.
These written procedures should be as follows:

- Compatible with the design intent.
- Easily understandable and usable.
- Readily available on the site where the operation takes place.
- Regularly reviewed and updated, including consultation with the staff who are using the procedures.
- Verifiably followed.

Recommendations:

1) Identification of the safety training needs of the individual crew members for: fire-fighting, fire team leader, offshore survival, helicopter landing/handling operations, first-aid, etc.
2) Identifying the needs for special courses to improve/update the professional skills of the crew to allow them to advance.
3) Set up a well structured and documented study program that sets the guidelines and goals to be reached prior to promotion.

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GENERAL SAFETY ITEMS

Engine-Room

(*) Hand-railing to be fitted between no.1 and no.2 engine as the present situation represents a safety hazard. The same applies for the platform next to no.3 engine on port side.

(*) The installation of an air receiver in the cement pump room should be considered. This receiver should have a check-valve fitted in the air supply and only be used for the starting system of the cement unit. Presently when rig air pressure is being lost this unit cannot be used.

(*) The cracked port hole in bulkhead next to no.1 480/120 volt transformer should be replaced.

(*) Top Drive centralizing plate has steel inserts whereas bronze inserts are recommended to avoid the danger of sparks.

(*) There is no certificate available on board for the personnel basket.

(*) There is no colour code for piping in use at the OCEAN EPOCH.

(*) Pressure vessels are not marked with their safe working pressure (SWP), nor are high pressure pipelines identified.

(*) There is no approved drawing on board the rig showing the location of the explosive storage and radioactive storage. Presently the explosives are stored between the aft lifeboat and the aft life-raft station. The radioactive material is stored near port aft anchor winch.

(*) The laundry is a designated fire hazard area and smoking should not be allowed there; a sign to be fitted. Stating NO SMOKING.

(*) Emergency escape ladders to the waterlevel are not clearly marked as such, which is recommended.

(*) It is recommended to have the watertight hatches to the pump rooms fitted with an alarm and have signs posted stating CLOSE AFTER USE or KEEP CLOSED.

(*) Doors to rooms containing a recognised fire hazard should be fitted with a door closer, this should be fitted at the battery room and the paint locker door.

(*) All doors leading to hazardous areas should be marked with red capital letters "HAZARDOUS AREA".

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Electrical

(*) It is unknown when the last injection test was done on the circuit-breakers and motor starters, as this is a means of testing the safeties of the breakers an injection test of circuit-breakers and motor starters should be considered.

(*) Most of the electric motors and switch gear are not fitted with banding straps.

(*) The Baylor drillers control panel: When panel is opened up while energized the power to it does not shutdown, nor is an alarm activated.

(*) The same as above also applies for the T.V. monitor in the driller's stand.

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NDT INSPECTION

NDT inspection to be conducted prior to commencement of the drilling operation.

- All load bearing areas of:
  - Travelling block.
  - Drill string compensator frame.
  - Hook.
  - Top Drive.
  - The dolly frames of the above equipment.
  - Bails.
  - Elevators.
  - Watertable of the crown block.
  - Deadman of the drilling line.
- On crown block sheaves which are accessible, the welds on the hubs and rims of the sheaves.
- BOP no.27 clamps.
- Ram block slots in ram operating rods.
- Bridge crane for BOP handling, load bearing areas and deadend pad-eyes.
- All crane blocks.
- All crane hooks.
- Deck crane pedestals.
- Deck crane deadend pad-eyes.
- BOP lifting pad-eyes.
- LMRP lifting pad-eyes.
- All riser connectors.
- All tensioner pad-eyes on the slip joints.
- All Swage, sockets of the riser tensioner system.
- Drawworks brake system including brake bands.
- Rig tongs, jaws and pins.
- Rig tong back-up post mounting.
- Ram blocks slot and ends of operating rods.
- All swedge sockets on the cranes.
- Slips
- All threaded connections on Top Drive.

<u>Ultrasonic inspections</u>

- Top Drive to detect any erosion.
- Standpipes and mud lines from the mud pumps to the drill floor.
- Well test gas and oil lines from separator are to the flare booms.

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