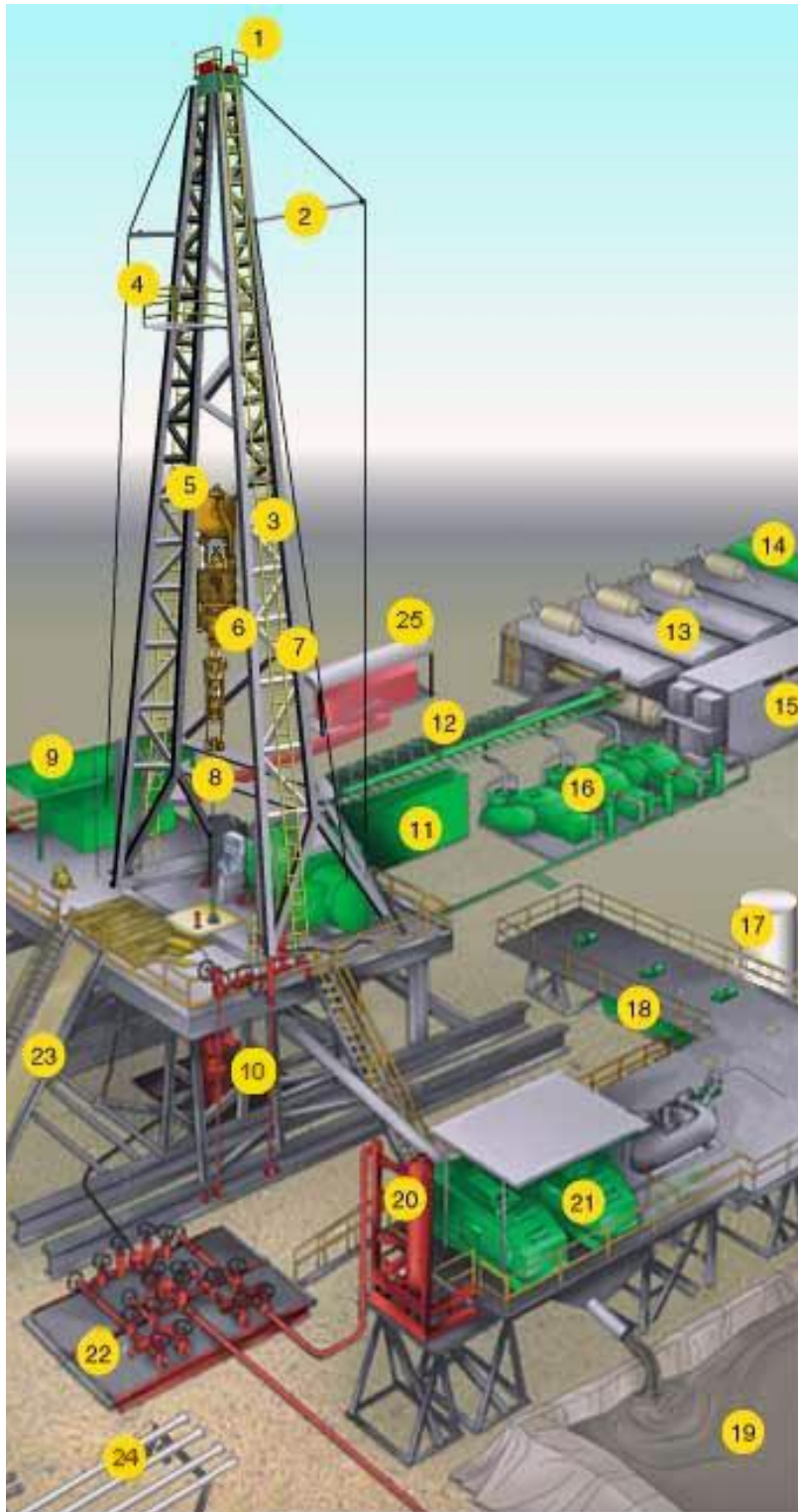


Layup of Land Based Drilling Rigs

Prepared by: Jim Holden Cortec Corporation, Ivan Rogan CorteCros



Drilling Rig Components

1. Crown Block and Water Table
2. Catiline Boom and Hoist Line
3. Drilling Line
4. Monkey bord
5. Traveling Block
6. Top Drive
7. Mast
8. Drilling Pipe
9. Doghouse
10. BOP
11. Water Tank
12. Electric Cable Tray
13. Engine Generator Sets
14. Fuel Tanks
15. Electric Control House
16. Mud Pump
17. Bulk Mud Components Storage
18. Mud Pits
19. Reserve Pits
20. Mud Gas Separator
21. Shel Shaker
22. Choke manifold
23. Pipe Ramp
24. Pipe Racks
25. Accumulator

During down turns in the oil and gas industry, land-based oil rigs are some of the first production facilities to be closed. During these periods of extended shutdown, the rig requires corrosion protection of the assets. The objective of this document is to provide recommendations for multi-year corrosion protection using environmentally friendly vapor phase and migrating corrosion inhibitors which with proper selection do not require removal prior to start-up. Being environmentally friendly coupled with not removing prior to start-up minimizes/eliminates potential EPA disposal issues/concerns.

Diesel engines



Lubrication system

- Add-M531 at 5% by volume to engine oil
- Run engine for a minimum of 1 hour after-M531 is applied.
- If engine is already rigged down, use available ports to fog M-531 at 1 oz./ft³

Cooling system

- Add-M640L to cooling system at 2.5% by volume. Run engine for a minimum of 1 hour after M-640L is applied.
- If engine is already rigged down, use available ports to fog VpCI-337W at 1 oz./ft³.
- *If currently running SPX 50/50 coolant do not treat. Treating with this coolant will void the warranty.*

Fuel system

- Add VpCI-707 at 2 % by volume to Fuel Tanks-
- Run engine for a minimum of 30 minutes
- If system has been drained, fog VpCI-707 into fuel tank, lines, and air intake to diesel engine

Mud Pumps



If still rigged up, fill slug tank with fresh water containing 1% by volume VpCI-649 liquid

- Circulate through entire mud system. This method would require each mud line and component be capped once they are rigged down.

If the rig is already stacked, fog each individual component with VpCI-337 at 1 oz./ft³ and cap.

Mud Pumps have two “sides”, the gear end and fluid end.

The gear end houses the crankshaft and is filled with a type of gear oil that will tend to require M-528

- Add M-528 at 5% to oil and operate for a minimum of 30 minutes
- If rigged down, and empty fog with M528 at 1 oz./ft³

The fluid end can be protected by flushing with treated fresh water, containing 1% VpCI-649, from the slug tank if in operation.

If rigged down

- Fog with VpCI-337 at 1 oz.ft³
- Grease caps with CorrLube VpCI Lithium EP Grease

Boiler



With boiler shut down and cold

- Remove any external rust with VpCI-423
- Remove VpCI-423 residual and neutralize with a 10% solution of VpCI-414
- Place boiler lizard in waterside of boiler (a pouch per 1000 gallons of water)
- Fog fireside with VpCI-337W

Control panels

- Deenergize
- Spray internal surfaces with ElectriCorr VpCI-239
- Place appropriate size emitter in panel
 - VpCI-105 – 5 ft³
 - VpCI-111 – 11 ft³

Valves

- Spray all stems, bonnet bushings, packing body nuts and bonnet nuts with CorShield-369

Piping (uninsulated)

- Remove any external rust with VpCI-423
- Remove VpCI-423 residual and neutralize with a 10% solution of VpCI-414
- Spray with VpCI-391

Piping (insulated)

- Inject VpCI-658 under insulation

Top Drive

This is a complex system. These top drives have multiple lubricating systems, a multitude of grease points, and piping for the mud system.



Mud lines

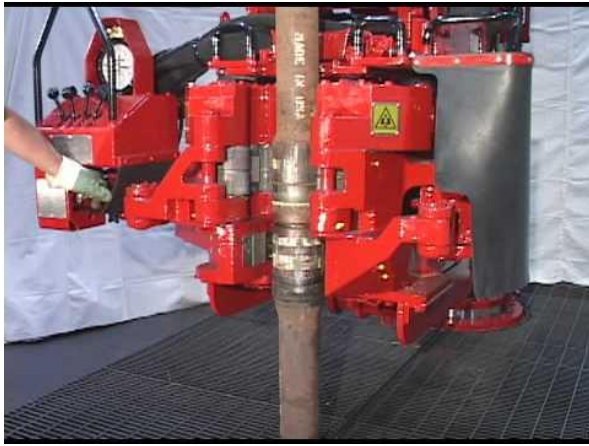


- If operational the mud lines will be treated with fresh water and 1% VpCI-649. Oil System
- If operational add one of the below additives, depending lubricant type, at 5% by volume
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO
- If non-operational, fog with one of the below additives, depending on lubricant type, at 1 oz./ft³
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO

Grease points

- Purge with CorrLube VpCI Lithium Grease

NOV ST80



Each head houses its own lubricating system for the rotating portions and is driven by hydraulic pressure. Can be treated while operating or rigged down.

- If operational add one of the below additives, depending lubricant type, at 5% by volume
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO
- If non-operational, fog with one of the below additives, depending on lubricant type, at 1 oz./ft³
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO

Draw works



The draw works is the heavy lifter. This is a large drum that houses the drill line and moves the top drive along with the drill string.

- Drill line should be treated with VpCI-369 and covered with VpCI-126 HP UV.

Lubrication system

- If operational add one of the below additives, depending lubricant type, at 5% by volume
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO
- If non-operational, fog with one of the below additives, depending on lubricant type, at 1 oz./ft³
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO

Electronic control system



- Spray all internal cabinet surfaces with ElectriCorr VpCI- 239
- Install appropriate size emitter
 - VpCI-101 – 5 ft³
 - VpCI-111 – 11 ft³

HPU several types and sizes DW brake, Rig system HPU, Brake callipers



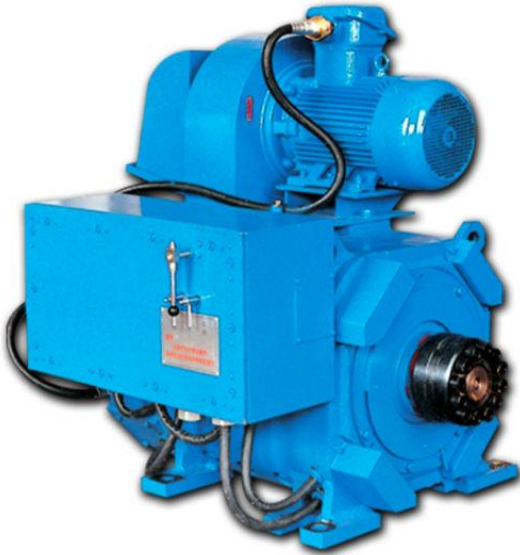
- If operational add one of the below additives, depending lubricant type, at 5% by volume
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO
- If non-operational, fog with one of the below additives, depending on lubricant type, at 1 oz./ft³
 - M-528 – PAG
 - M-529 - PAO
 - M-530 - Mineral
 - M-531 – PAO
- Callipers can be coated with VpCI-391 prior to activation of the E-Brake.

Catwalk hydraulic operated



- If operational add one of the below additives, depending lubricant type, at 5% by volume
 - M-528 – PAG
 - M-529 - PAO
 - M-530 – Mineral
 - M-531 – PAO
 - If rigged down, most have no spill connections so the oil will stay internal.
- The connections will need to be sprayed with VpCI-369 and covered.

AC traction motors 5hp to 2000hp



- Fog internals with ElectriCorr VpCI-239
- Add VpCI-101 emitter to junction box
- Coat externals with VpCI-391 and cover with VpCI-126 HP UV.

VFD electrical house, Drillers cabin, computers, touch screen HMI's, battery packs, PLC's, AC drives, Rectifiers, Transformers, Air Conditioners etc....



- Spray cabinet internals with ElectriCorr VpCI- 239
- Install appropriate size emitter
 - VpCI-105 – 5 ft3
 - VpCI-111 – 11 ft3
 - VpCI-308 – 35ft3
 - Each of these should be in a vessel that can be at least partially sealed

Mud pits (Tanks open top)

These mud pits are designed to collect and process mud. The mud can be oil or water based. Ad mud pits system there are mixers, vibrators, and at the same time made the separation of mud.



- Agitators will receive additive in the lubrication reservoirs.
- Wash tank walls with 10% solution of VpCI-414
- Coat with VpCI-391

Diesel Fuel tanks



- Should be emptied and will need to be fogged with VpCI-707 at 1 oz./ft³.

Water tanks



- Should be emptied and will need to be fogged with VpCI-337 at 1 oz./ft³.

Accumulators hydraulic operated



- Gauges and valves spray with CorShield-369.
- Fog accumulators with one of the below, depending on lubricant type, at 1 oz./ft³.
 - M-528 – PAG
 - M-529 - PAO
 - M-530 – Mineral
 - M-531 – PAO
- Gauges should be covered with VpCI-126 HP UV to prevent UV damage.

BOP's hydraulic operated



- VpCI-369 on all surfaces and completely wrap the BOP segments with MilCorr.

VFD and MCC houses



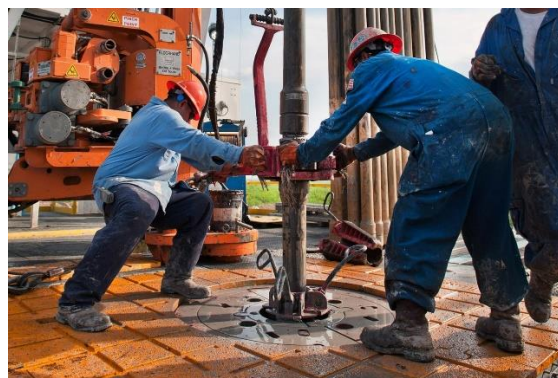
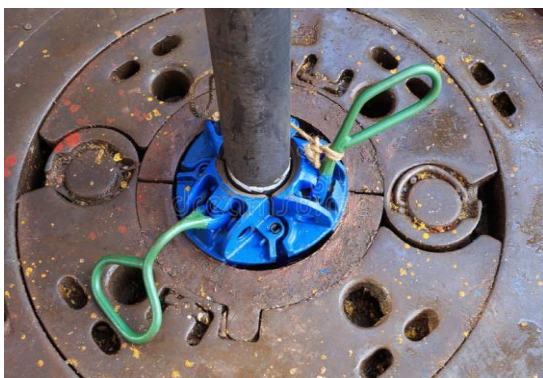
- Spray cabinet internals with ElectriCorr 239
- Install appropriate size emitter
 - VpCI-105 – 5 ft3
 - VpCI-111 – 11 ft3
 - VpCI-308 – 35ft3

Rig houses for the employees



- Recommendations will depend on size and level of preservation required.

Rotary tables



- Purge with CorrLube VpCI Lithium Grease.
- Internals will receive treated hydraulic fluid if still rigged up and operational.

Choke manifold and Gas buster



- If in operation this will be covered with the treated fresh water treated with VpCI-649 at 1% by volume.
- If rigged down, we will need to fog and cap with VpCI-337 at 1 oz./ft³

Air Compressors



- Bleed down and treat the lubricating reservoirs depending on lubricant type, at 1 oz./ft³.
 - M-528 – PAG
 - M-529 - PAO
 - M-530 – Mineral
 - M-531 – PAO
- Treat electrical panels with VpCI-111 and cover with VpCI-126 HP UV

BOP lifting winches, pneumatic and hydraulic



- Pneumatic will require VpCI-369 on moving components. Coat exterior with VpCI-391 and cover with VpCI-126 HP UV.
- Hydraulic will receive treated fluid if still operational.
- These winches do not hold fluid, they are run off air or hydraulic pressure.

Drill pipe



- Fog with VpCI-337 at 1 oz./ft³ and cap. Pipe dope should have already been applied to threads. If not, we can apply CorrLube grease or VpCI-369 before replacing thread protectors.

Choke hoses, and vibrating hoses 10k rated



- Fog with VpCI-337 at 1 oz./ft³ and wrap with VpCI-126 HP UV.

Cortec® Corporation is the global leader in innovative, environmentally responsible VpCI® and MCI® corrosion control technologies for Packaging, Metalworking, Construction, Electronics, Water Treatment, Oil & Gas, and other industries. Our relentless dedication to sustainability, quality, service, and support is unmatched in the industry. Headquartered in St. Paul, Minnesota, Cortec® manufactures over 400 products distributed worldwide. ISO 9001, ISO 14001:2004, & ISO 17025 Certified. Cortec Website: <http://www.cortecvci.com> Phone: 1-800-426-7832 FAX: (651) 429-1122