
INNORIG
LAND DRILLING UNIT
HUISMAN PRODUCT BROCHURE

INNORIG

GENERAL INTRODUCTION

Over the last several years, the oil and gas exploration and production industry has seen a shift towards the exploitation of resources from unconventional sources such as shale, tight formations and other sources requiring horizontal drilling. A large part of this shift is towards increasing safety, reducing personnel on the rig, reducing costs in any way possible such as through drilling multiple wells from a single location. At the same time, operators are required to meet safety targets and environmental regulations in a cost constrained and competitive environment.

To meet today's demand for faster and more flexible operations in unconventional environments, Huisman has taken lessons learned from operating their LOC series of land rigs and through discussions and interviews with operators and contractors and used them to redesign the InnoRig land drilling units.

INNORIG

LAND DRILLING UNIT

INNORIG 250 AND INNORIG 400

The InnoRig is and automated rig designed to move quickly between multiple wells on a single pad or between multiple locations. The rigs handles super-single joints of 45 [ft] long and is capable of automatic tripping at speeds greater than 2000 [ft/hr]. The rig handles both drill pipe and casing in the same fashion, eliminating the need for separate casing running services which reduces well costs and time spent drilling. The rig was designed to be automated as much as possible to reduce the need to place people in harm's way. Safety is a key factor in the rig design, incorporating reduced work at heights, higher automation of pipe handling, no cranes required for moves and fewer loads.

The InnoRig 250 and the InnoRig 400 are Huisman's flexible drilling solution specifically designed for lower operating costs in unconventional resources.

AUTO-DRILLING

The InnoRig is equipped with an auto-driller which is used to keep a constant Weight on Bit (WOB) and or a constant Standpipe Pressure. The measurement of the hook load is not done at the dead end as on conventional rigs, but in the connection pins of the lower block, eliminating friction and hysteresis in the measured load signal. The control of the drawworks is extremely accurate with exact speed control, even down to zero speed, without using mechanical brakes. This results in an improved drilling performance.

The rig will also have the ability to make-up connections automatically as part of the normal operation. All rig parameters can be set based on the operators' experience in such a way that the rig repeats the performance of the best driller and the best crew.

AUTO-TRIPPING: > 2000 ft/hr

The rig allows for ‘auto-tripping’; tripping in and out of the hole without physical interference of the driller. When in automated tripping mode the InnoRig has a maximum speed up to 53 joints an hour which equals 2400 feet per hour of range 3 drill pipes. At 8 falls the load capacity is higher with a tripping speed of 45 joints an hour, which equates to 2000 ft/hour. The driller oversees the operation and, when necessary, can intervene at any time.

In auto-tripping mode the pipe handler picks up a joint of drill pipe, or casing, from the horizontal pipe rack and places it vertically directly over the well centre where it is handed over to the top drive. Power tongs are then used to automatically spin in the drillpipe and make-up the connection. For casing, make-up will be done using the top drive, which is equipped with a casing running tool. Automated power slips are integrated into the rotary table and can provide back-up torque to pipe or casing. The entire tripping process is controlled from the driller’s cabin, making personnel on the drill floor unnecessary.

INTEGRATED DESIGN

Most conventional rigs are combinations of components and systems that are developed and maintained by different suppliers. The InnoRig, however, is a fully integrated drilling rig that is provided as one complete package. All components, including the drawworks, top drive, mud pumps, power unit, mud treatment system, pipe handling, and BOP, are tested prior to delivery to ensure trouble free operations. All systems are combined into a fully integrated control and monitoring system. This means full control of all equipment from a single control desk made by one single supplier.

The monitoring system is prepared for satellite/linked remote diagnosis, which enables Huisman engineers to help solve customer’s specific needs.

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LAND DRILLING UNIT

TRANSPORT

Two of the most important features of the InnoRig are its compact, flexible size and its ability to break down into small, easy to transport modules, which fit on a standard trailer. To move the InnoRig 250, transport permits are not required. If overweight loads are not an issue, the rig can be moved quicker with fewer, but heavier, loads. The complete rig is designed to fit various international transport load dimensions and weights, including DOT sizing and weights in the USA.

CRANELESS INSTALLATION

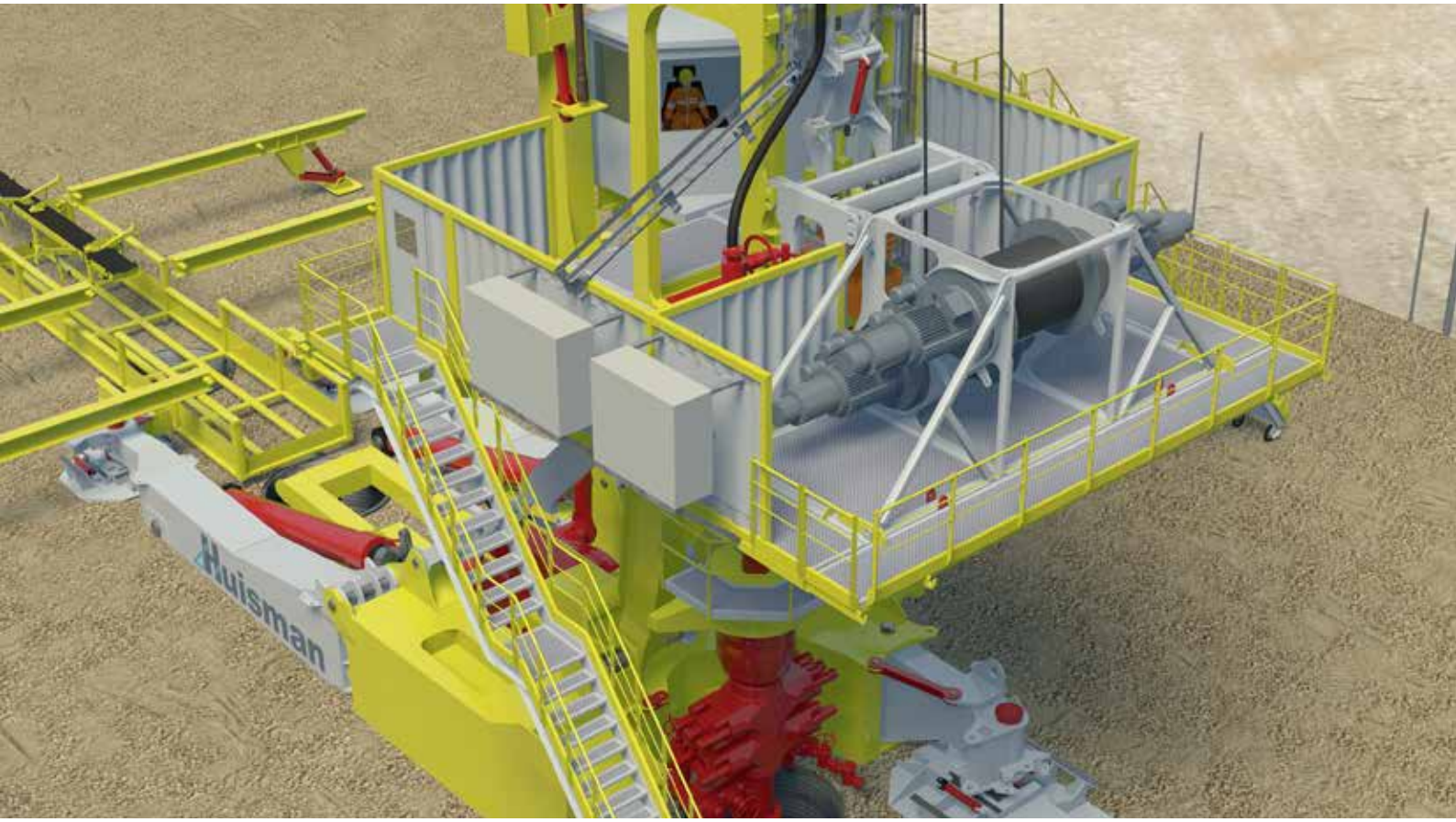
The InnoRig has the ability to rig-up without the use of a crane, using oilfield trucks or a heavy forklift. All modules are configured such that they latch on to each other. After installing the rigs base, the drilling mast is erected. No counter weights or cranes are required for this operation. The drawworks and other items are then installed without the use of cranes. The modules forming the stationary back yard can be placed alongside the drilling rig. The shakers can be installed with a forklift. No additional lifting of equipment is required for the back yard installation. As an alternative, a trailerized backyard can be installed.

WALKING RIG

The InnoRig is fitted with a rig walking system that allows the rig to move quickly between wells on multi-well pads in both X and Y directions. With the open cellar arrangement the rig can easily walk between wells without removing any major components. The cellar is arranged such that it is completely open on one side. This allows the rig to move around existing infrastructure such as well heads. The pipe handler is locked to the rig and is walked with the rig.

SAFETY

The InnoRig is designed with safety in mind. All items on the rig can be built up from ground level reducing work at heights. Items that need rigging up at difficult to reach locations are hydraulically actuated wherefore the crew does not need to put themselves at risk. The high degree of automation makes it unnecessary to work directly on the drill floor for most operations. This minimizes the exposure time of the crew to moving pipe.



MAIN ADVANTAGES OF THE INNORIG

- Lower well costs:
  - X-Y Walking capabilities make it easy to drill multiple wells.
  - Automated casing handling removes the casing crew.
  - Repetition of best practice and consistent operations through rig automation.
- Designed to incorporate modern drilling techniques such as:
  - On board Casing While Drilling capabilities.
  - Space for a Rotating Control Device.
  - Automated drilling through rig automation or third party control system.
- Fast rig moves with light weight road transportable loads.
- Safer operations:
  - Reduction of human exposure through high degree of automation.
  - Craneless Rig up procedures.
- Offline BOP testing.
- Remote acces.
- Low environmental impact with a footprint of approximately 100ft by 200ft.

ITEMS THAT IMPROVE RIG PERFORMANCE

- Dual drum drawworks.
  - Improved performance by fast accelerating drums.
  - Lower nonproductive time through redundancy and extended wire life.
  - No slip and cut needed.
- Casing running capability.
  - Casing is handled the same as drillpipe.
- Powerslips.
  - Fast and safe clamping drillpipe and casting.

Though the rig is designed for range 3 pipe, there will be adequate space for handling some tools that other super singles rigs cannot fit.

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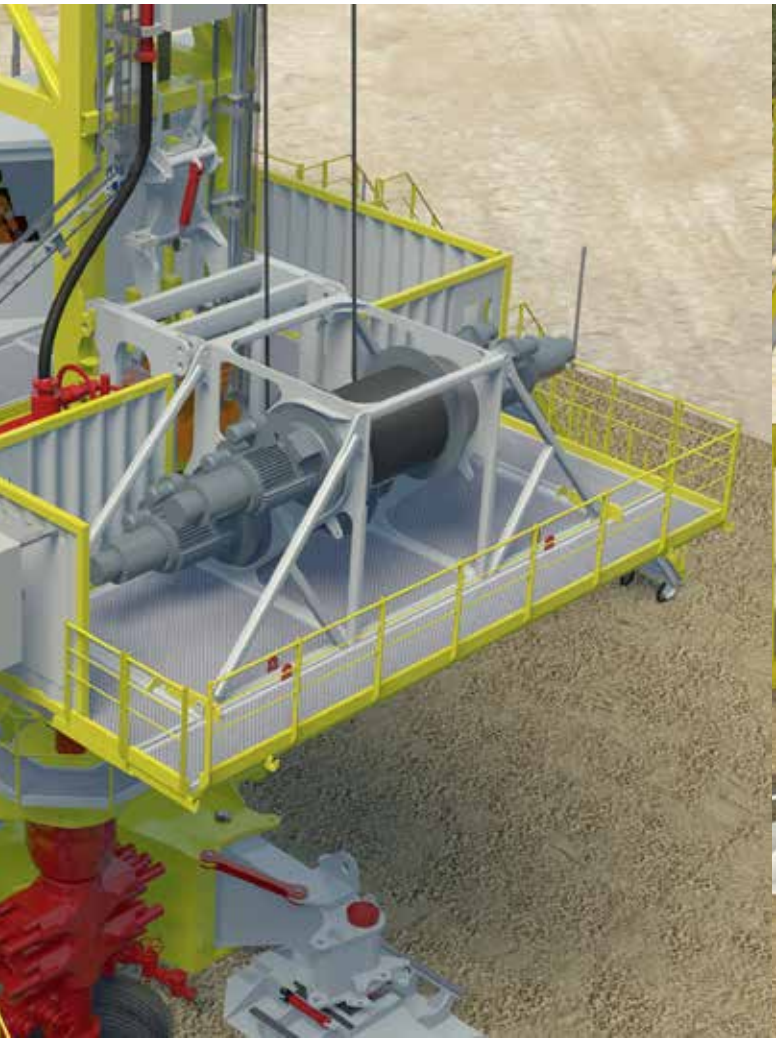


SPLITABLE BLOCKS

The reeving arrangement of most rigs are designed for the heaviest lift that the rig must carry. The InnoRig comes with splittable blocks which allow push-button re-reeving of the blocks. This enables the rig to run on 4 falls (max 100 sht under block) at 50% higher block speed. In the case heavier loads are required the rig can work at 8 falls (max 250 sht under block) at nominal speed and 12 falls for up to 400sht loads.

DOUBLE DRUM DRAWWORKS

The rig is equipped with a double drum drawworks. It operates at half the wire speed of that of a conventional single drum drawworks, which result in a lower tear and wear of the wire. The standard time consuming cut and slip method is not needed any more. By a one push button control, wire is slipped from one drum to the other, which changes the position of the wire fatigue points. No cutting and clamping is required.

The design has a lot of redundancy features which maximizes it's reliability. Each of the two drums is equipped with two electric AC motors and two brakes. In case of a motor malfunction, one can stop this drum and continue operation with the other drum, at half the block speed.
During normal operations, the drums are stopped by the variable frequency controlled motors.

OPEN CELLAR ARRANGEMENT

The InnoRig is fitted with a walking system that allows the rig to walk quickly between wells. With the open cellar arrangement the rig can skid easily from well to well without having the remove any large components. The cellar is arranged such that it is completely open on one side. This allows the rig to walk around existing infrastructure such as well heads.

OFFLINE BOP TESTING

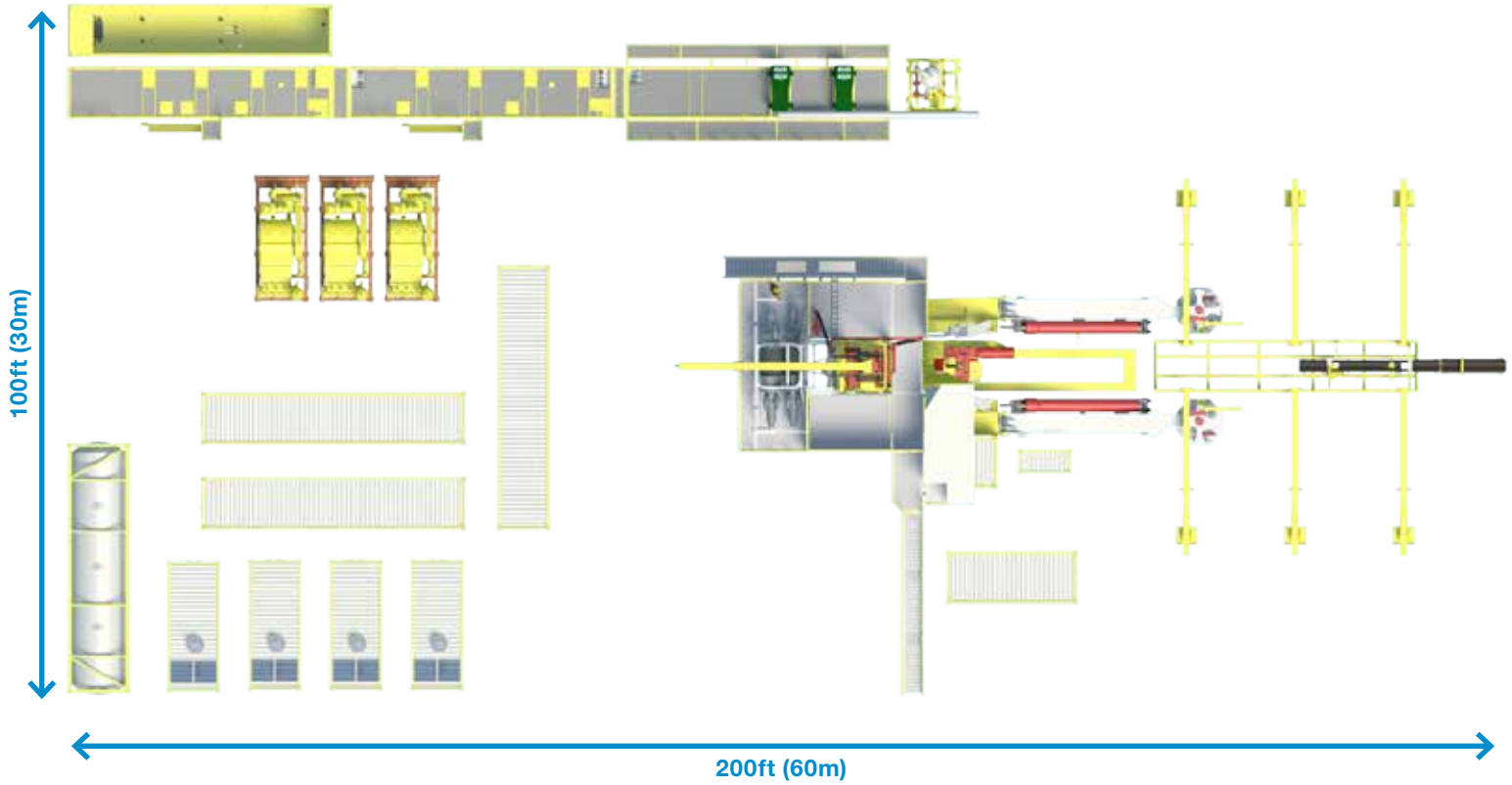
To reduce non-productive time, BOP's can be pressure tested offline on a dedicated test stump that also serves as a support of the BOP. The control hoses do not have to be disconnected after testing to move the BOP onto the wellhead. The rig has two BOP hoist which are placed under the drill floor. The BOP hoists are used to transfer the BOP from the test stump onto the well head.

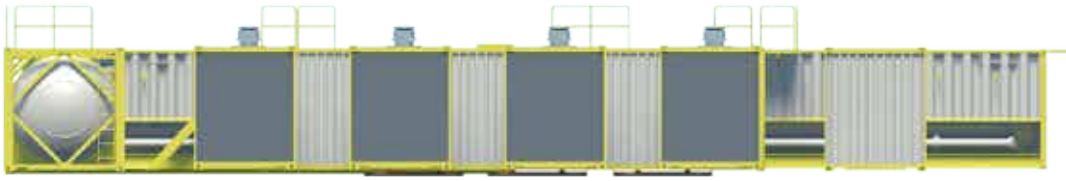
EMERGENCY BACKUP SYSTEMS

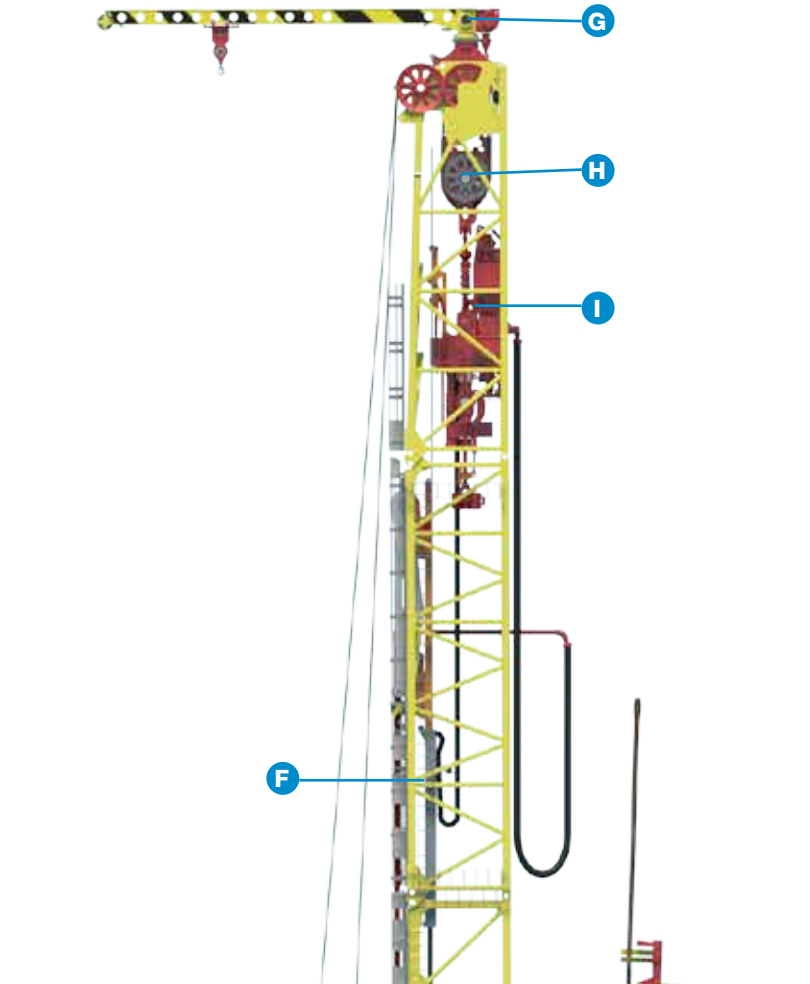
Even the most reliable systems can encounter interruptions. Thus all vital systems on the rig have a back-up. The drawworks and top drive can be equipped with hydraulically operated motors, powered by a separate diesel driven hydraulic power unit. This can prevent stuck pipe and can save the well should power be interrupted while drilling. Most equipment is designed fully redundantly either by design or provision of extra items. This means that even if key components are down, the rig can still be operated.

INNORIG

SPECIFICATIONS







INNORIG OVERVIEW

A	Open cellar arrangement
B	Walking units
C	BOP hoist trolleys
D	Dual drum drawworks
E	Automated power tong
F	Mast
G	Service crane
H	Splittable blocks
I	Top drive
J	Automated pipe handler
K	Power slips
L	Drillers cabin
M	Automated pipe racks

INNORIG

SPECIFICATIONS

INNORIG SPECIFICATIONS	INNORIG 250		INNORIG 400	
SUBSTRUCTURE				
Height drill floor above ground level	27.8 [ft]	8.5 [m]	27.8 [ft]	8.5 [m]
Free height under rotary table	24,5 [ft]	7,5 [m]	24,5 [ft]	7,5 [m]
MAST				
Static rated load (under crown)	250 [sht]	226 [mt]	400 [sht]	362 [mt]
Clear height, drill floor to bottom water table	95 [ft]	29 [m]	95 [ft]	29 [m]
Total height from ground level	132 [ft]	40.4 [m]	132 [ft]	40.4 [m]

HOISTING	INNORIG 250		INNORIG 400	
DUAL DRUMS DRAWWORKS WITH AUTODRILLER				
Total installed drawworks power	1200 [hp]	890 [kW]	1500 [hp]	1120 [kW]

TRAVELLING BLOCK

- 2/4 or 4/6 sheave splittable block assembly with room for wireline passage in the centre line.
- Thread saver cylinders incorporated.
- One push button control to choose the amount of falls used.

Maximum hook travel	67 [ft]	20.5 [m]	67 [ft]	20.5 [m]
Block speed @ 12 falls full load (320sht)			73 [ft/min]	22 [m/min]
Block speed @ 12 falls, reduced load (120sht)			182 [ft/min]	55 [m/min]
Block speed @ 8 falls full load (200sht)	100 [ft/min]	30 [m/min]	110 [ft/min]	33 [m/min]
Block speed @ 8 falls, reduced load (86sht)	245 [ft/min]	75 [m/min]	275 [ft/min]	83 [m/min]
Block speed @ 4 falls, full load (110sht)	194 [ft/min]	59.2 [m/min]		
Block speed @ 4 falls, reduced load (45sht)	485 [ft/min]	148 [m/min]		
SERVICE CRANE				
Maximum capacity at 26 ft radius (8mtr)	8,8 [sht]	8 [mt]	8,8 [sht]	8 [mt]

ROTATING EQUIPMENT	INNORIG 250		INNORIG 400	
ROTARY TABLE/POWER SLIPS				
Power slips inside the rotary table. A standard API master bushing can be inserted.				
Hang off capacity	220 [sht]	200 [mt]	350 [sht]	317 [mt]
Table opening, (slips removed)	27.5 [inch]	700 [mm]	37.5 [inch]	953 [mm]
Powerslips maximum size	13 3/8 [inch]	339 [mm]	18 5/8 [inch]	473.1 [mm]

TOPDRIVE	INNORIG 250		INNORIG 400	
Integrated swivel. Link tilt function for P/U tubulars				
Design load according API 8C	350 [sht]	317 [mt]	500 [sht]	435 [mt]
Power	600 [HP]	447 [kw]	800 [HP]	596 [kw]
Max. torque (breakout)	45000 [ft-lbs]	61010 [Nm]	62000 [ft-lbs]	84000 [Nm]
Continuous torque	30000 [ft-lbs]	40670 [Nm]	42000 [ft-lbs]	56900 [Nm]
Max speed	220 [rpm]		230 [rpm]	
Optional with external/internal casing drive assemblies				

PIPE HANDLING	INNORIG 250		INNORIG 400	
AUTOMATIC PIPE HANDLER				
Maximum capacity	3.3 [sht]	3.0 [mt]	3.3 [sht]	3.0 [mt]
Maximum length of tubular	47* [ft]	14.3 [m]	47* [ft]	14.3 [m]
* lengths<25 ft are handled by pipe ramp				
POWERTONG, CANRIG				
Pipe diameter	2 3/8 - 8½ [inch]	60.3 - 215.9 [mm]	2 3/8 - 8½ [inch]	60.3 - 215.9 [mm]
Maximum break out torque	80,000 [ft-lbs]	108.460 [Nm]	80,000 [ft-lbs]	108.460 [Nm]
AUTOMATED PIPE TUB (OPTIONAL)				
Pipe length range	30-47 [ft]	9.2-14.3 [m]	30-47 [ft]	9.2-14.3 [m]
Amount of 5“ pipe stored	33		33	

AUXILIRAIRIES	INNORIG 250		INNORIG 400	
Tuggers	2 x 6 [sht]	2 x 5.4 [mt]	2 x 6 [sht]	2 x 5.4 [mt]
Catheads	2 x 6 [sht]	2 x 5.4 [mt]	2 x 6 [sht]	2 x 5.4 [mt]
BOP hoists	2 x 22 [sht]	2 x 20 [mt]	2 x 22 [sht]	2 x 20 [mt]

GENERAL	INNORIG 250		INNORIG 400	
Typical rig up time		48 [hrs]		48 [hrs]
Walking speed	60 [ft/hr]	18 [mtr/hr]	60 [ft/hr]	18 [mtr/hr]
Typical well spacing (30ft)	1 x 4		2 x 4	
Maximum tripping speed @ 8 falls (eq. 7500ft of 5” range III pipe)	2000 [ft/hr]	610 [m/hr]	2000 [ft/hr]	610 [m/hr]
Maximum tripping speed @ 4 falls (eq. 2600ft of 5” range III pipe)	2400 [ft/hr]	730 [m/hr]		
Number off modules rig + backyard		32 [pcs]		32 [pcs]

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SPECIFICATIONS

MUD SYSTEM	INNORIG 250		INNORIG 400	
Mud treatment tank	155 [bbl]	24.8 [m³]	255 [bbl]	41.3 [m³]
Active mud tank	340 [bbl]	54 [m³]	340 [bbl]	54 [m³]
Mud mix tank	255 [bbl]	41.3 [m³]	255 [bbl]	41.3 [m³]
Trip tank	50 [bbl] +	8 [m³] +	50 [bbl] +	8 [m³] +
Total capacity	800 [bbl]	128.1 [m³]	900 [bbl]	144.6 [m³]
Optional reserve tank			315 [bbl]	50 [m³]
Centrifugal degasser Mi-Swaco CD 1400 or eq.		1 pcs		1 pcs
Shakers Mi-Swaco PT mongoose or eq.		2 pcs		3 pcs
75 [hp] Centrifugal pumps for charging, mud transfer and mixing		4 pcs		4 pcs

All tanks (except sand trap) are fitted with agitators and level transducers
Additional reserve mud tanks on request

WELL CONTROL	INNORIG 250		INNORIG 400	
BLOW OUT PREVENTER				
▪ The unit can be offline pressure tested on a test stump.				
▪ The BOP can be controlled from the cabin, tool pushers office or from the BOP control unit.				
Bore size	11 [inch]	279 [mm]	13 5/8 [inch]	[mm]
Pressure	5,000 [psi]	344 [bar]	10,000 [psi]	[bar]
Rams	2 rams		3 rams	
CHOKE & KILL				
Size	3 1/16 [inch]	77 [mm]	3 1/16 [inch]	[mm]
Pressure	5,000 [psi]	344 [bar]	10,000 [psi]	[bar]
Optional 5K choke & kill available				

OPTIONAL EQUIPEMENT	INNORIG 250		INNORIG 400	
WIRE LINE WINCH				
Capacity at surface	16.8 [sht]	15.3 [mt]	16.8 [sht]	15.3 [mt]
Hoisting speed at reduced load <=6 [mt]	230 [ft/min]	70 [m/min]	230 [ft/min]	70 [m/min]
Max depth.	20000 [ft]	6000 [m]	20000 [ft]	6000 [m]

MUD PUMPS INNORIG 250

Rated pump power	745[kW]	1000[HP]
Pressure / flow with smallest liner	345 @ 1090[bar @ ltr/min]	5000 @ 289[psi @ GPM]
Pressure / flow with largest liner	163 @ 2464[bar @ ltr/min]	2370 @ 651psi @ gpm]

MUD PUMPS INNORIG 400

Rated pump power	1190[kW]	1600[HP]
Pressure / flow with smallest liner	345 @ 1620[bar @ ltr/min]	5000 @ 518[psi @ gpm]
Pressure / flow with largest liner	186 @ 3649[bar @ ltr/min]	2700 @ 964[psi @ gpm]

3rd pump is optional
7500 psi available on request

POWER

POWER CONSUMERS

Main consumers (Draw works, top drive, mud pumps)	Electrical inverter controlled
Centrifugal pumps, shakers, agitators, BOP control, HPU etc.	AC Electrical

GENERATORS

Required generator power	4x 1500 [hp]	4x 1492 [KVA]

No generator load sharing or synchronization needed

HYDRAULIC POWER

Consumers: Powertong, rotary table, cylinders	Hydraulic	
Required electric power	147 [hp]	110 [kw]
2nd HPU: diesel powered for rig up	72 [hp]	55 [kw]

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