ELECTRIC VERSION OF MOBILE 250 TONS-CAPABLE DRILLING FACILITY ILS-250E





## **Engineering solutions**

#### The mobile drilling facility has been designed in line with two main principles:

On the one hand, to ensure mobility, rig-up/rig-down time reduction, and to consequently reduce operational costs, the electrically-actuated mobile drilling facility design shall involve engineering solutions crucially different from those involved in the stationary unit design:

- Maximally compact turnkey equipment assemblies constituting the drilling facility;
- Distributed power supply and control system;
- Various installation options;
- Some design solutions envisage potential mounting auxiliary equipment such as compressors, steam generator, alternator etc on self-movable chassis.

On the other hand, the electrically-actuated mobile drilling facility design shall maximally benefit from introduction of electrical-drivebased solution compared to diesel-based one so that to implement automatic control of operating procedures and consequently to ensure optimal interaction of any equipment constituting the drilling facility. For example, power-feed drilling mode allows use of emergency winch drive capable of 45 KW rather than main winch drive capable of 800-1000 KW.

Compliance with these principles during designing and manufacturing the mobile drilling facility allows a significant reduction in operational costs at relocation, rigging-up, and maintenance, as well as a substantial reduction in drilling-concurrent expenditures what ensures cutting down on prime costs and makes the drilling facility highly competitive.



Mobile drilling facility ILS-250E with propulsion system Cooperation of L-Start with Idel Neftemach





# Mobile drilling facility ILS-250E Equipment installation and layout options for cluster drilling





# Mobile electrically-actuated drilling rig capable of 250 tons





# Propulsion system-equipped mobile drilling facility ILS-250E installed on the cluster site of oil field





# Derrick and winch assembly mounted on self-movable chassis Main specifications





Parameter name and description	Value			
Permissible hook load as per GOST 16293-89, kN (ts)	2500 (250)			
Maximal trial hook load, kN (ts)	3060 (312)			
Maximal weight of drill column, kN (ts)	2450 * 0.6 = 1470 (150)			
Maximal weight of casing column, kN (ts)	2450 * 0.9 = 2205 (225)			
Conditional depth of drilling as per GOST 16293-89, m	4000			
MDU power supply from industrial network, optional power supply from autonomous power sources of DGP	6 kV, 50 Hz			
The drilling facility constituents configuration	Self-movable-chassis- mounted modular version			
Weight of the largest assembly unit during transportation (except DWA semi-trailer)	not more than 40 tons			
Tackle system	5x6			
Calf line diameter, mm	32			
Stand length, m	18.5; 25 (without USD)			
	89, 102, 114, 121,			
Nominal diameter of pipes, mm	127, 146, 168, 178,			
	203, 245, 324			



# Mounting base versions



Self-propelled chassis 14x14



Semi-trailer

() L-Start

# **Driller cabin**











# **Drill winch**







Parameter name and description	Value		
	Single-drum winch		
Type of winch	with calf line		
	stabilizer		
Hoisting capacity, t.	250		
Power at winch drum, kW	1000		
Traction force, kN	280		
Tupo of drivo	Electrical frequency-		
Type of unive	controllable drive		
Drill winch drive power, kW	1000		
Grooves in drum to fit calf rope, 32 mm in total length	Lebus		
	Dynamic braking by		
Main brake	means of electric		
	motor of drill winch		
Hand brake and emergency brake	Disc-type		
Hook speed, m/s	0 - 1.5		
Type of emergency drive of drill winch	Electrical frequency- controllable drive		
Power of electrical motor of emergency drive, kW	45		
Hook assembly speed under load of 250 ts, m/min (m/s)	0,8 (0.013)		



# **Rotor pedestal**

Parameter name and description	Value		
Type of rotor pedestal	Double rhomboid		
Rotary beam elevation, m	6		
Racking capacity (drill pipes with tool joint 89/127 mm), stands/meters	215/4000		
Operational space, m	8x6.2		
Type of rotor	R-700		
Rotary opening, mm	700		
Nominal diameter of pipes, air-powered slips, mm	89, 102, 114, 121, 127, 146, 168, 178, 203, 245,		
	324		
Rotor drive	Individually-driven by means of electric frequency-control motor rated for voltage of 690 V		
Electric motor power, kW	400		
Rotation speed, rpm	0-250		
Maximal rotary torque (given rotary speed of 100 rpm), kN*m	40		
Maximal transient rotary torque, kN*m	60		







# Movable platform

The platform is intended for moving the drilling equipment as assembled during cluster drilling.







Name of parameter and description	Value			
Permissible hook load of the drilling rig, not more than, kN (ts)	2451(250)			
Permission load on SLDR in motion, ts	500			
Permission load on SLDR during drilling activities, ts	750			
Weight of accommodated drilling equipment, not more than, t	736			
Movable platform base elevation, mm	900			
Movable platform top elevation, mm	1400			
Movable platform dimensions, mm	20,000x30,000x500			
Anchorage points of wind guys of the drilling rig	within movable platform			
Disposition of drill pipes when handled	in finger board			
Motion type	sliding along support beams			





## VFD / LVP module



The module is intended for **winch and rotor** operation control. The module consists of:

- Two high-voltage of simplex plenum
- Input box rated for 6 kV
- Input box rated for 0.69/0.6/0.4 kV
- Transformer rated for 6 kV/2x0.69 kV
- Transformer rated for 6 kV/0.6 kV/0.4 kV
- Rotor and winch frequency converter
- VFD/LVP control system cabinet
- Power distribution cabinet # 1
- Power distribution cabinet # 2
- Winch emergency drive cabinet
- APF active filter box
- Brake resistors

To be located in a truck-size mobile building (a HQ container-type room as large as 40 feet):





# Upper drive system





Model	BENTEC TD-250- C	SLC DQ40BQ-JH
Type of drive	Electrical frequency- controllable drive	Electrical frequency- controllable drive
Max. load	250 tons	250 tons
Voltage	575VAC/50HZ	600VAC/50HZ
Current load (max)	610A	698A
Nom. power of electrical motor	500 kW / 672 h.f.	375 kW / 503 h.f.
Rotation frequency range	0 - 200 rpm	0 -180 rpm
Operational torque	47,75 kN*m	40 kN*m
Max. uncoupling torque	60 kN*m	60 kN*m
Backup tong range	68.6 - 191 mm	86 - 206 mm
Rotary opening diameter	76 mm	76 mm
Nom. pressure of rotary opening	50 MPa	35 MPa
Operational ambient temperature	-45+ 55 °C	-45+ 55 °C
Weigh of main components	10,8 tons	9,84 tons
Dimension of main components	5534x1401x1595 mm	4830x1360x1220 (mm)



# Upper drive system





## **Purification system equipment**

The system is intended for mud purification from drilling cuttings, for maintaining preset parameters of mud, and for storage of fresh mud.

The mobile drilling facility involves **two separate modules** of purification system; these modules are interconnected with a linking quick-detachable box.





#### Head and rate specifications of plunger-type pumps KQZ-2500 with ADB electric motor capable of 1250 kW

Rpm of electric motor	60	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950
Rpm of pump	9,4	47,2	70,8	94,4	118,1	141,7	165,3	188,9	212,5	236,1	259,7	283,3	306,9
Plunger 4" in diameter (101.6 mm)													
Feed rate, L/s	1,3	6,5	9,7	13,0	16,2	19,4	22,7	25,9	29,2	32,4	35,7	38,9	42,1
Pressure, MPa	50,1	50,1	50,1	50,1	50,1	50,0	47,6	41,6	37,0	33,3	30,3	27,8	25,6
Plunger 5" in diameter (127 mm)													
Feed rate, L/s	2,0	10,1	15,2	20,3	25,3	30,4	35,5	40,5	45,6	50,6	55,7	60,8	65,8
Pressure, MPa	35,1	35,1	35,1	35,1	35,1	32,0	30,5	27,7	23,7	21,3	19,4	17,8	16,5



## Drill pump control system (DPCS)

Nominal voltage: 6 kV. Quantity of connectable electric motors: 2 pcs. Maximal power of electrical motor: 1250 kW. Equipment is accommodated in 40-feet-large HQ-container.

#### Adjustment and control

Of drill pump and auxiliary equipment					
Booster pump Rod sprinkling pump Grease pump					
Of electrical motor and its systems					
Electrical heating ele	ements	Vent	tilation		

#### Visualization

on driller's and driller assistant's control panels	on mud cleaner section
- Pressure / rate	- DPCS status and mode
- Actual stroke lengths	- IU scheme status
- Emergency/readiness	- DPCS equipment condition
- Failure alarm	- Events log and archive
- Emergency/alarm codes	



#### Monitoring and protection

Of drill pump and auxiliary equipment

- Mud pressure Protection of manifold from mechanical destruction

- Mud rate
- Thermal protection of aux. pumps of EM
- Air pressure in air clutch

Of electrical motor and its system

- Temperature of stator and bearings
- Thermal protection of fans

#### **Drilling technologies**

Mud pressure.

Programmable setpoint against overpressure: to be automatically selected subject to diameter of actual bushes of drill pump



# SWG / LVP

Switchgear of low-voltage packages of mobile drilling rig (SWG/LVP) is intended for reception and distribution of electrical energy and reactive power compensation.

Name of parameter	Value
High-voltage cells quantity	6
Nominal voltage, kV	6
Nominal current intensity in main circuit of simplex plenum, A	1000
6 kV supply input into SWG/LVP, 2 version	- from input column; - cable inlet.
Quantity of low-voltage switchgear cabinets in SWG/LVP	5
Nominal voltage, kV	0,4
Nominal current intensity in main circuit of simplex plenum, A	2000





### Inductive steam boiler room

The plant is intended for heat tracing, washing, cleaning of equipment, and for other work activities involving low-pressure steam (up to 0,8 MPa)

#### Features:

- run-up time is 30 seconds
- power costs are 2,5 times lower compared to similar electrical devices

RTN Regulations are not applicable

Name of parameter	Value
Steam-production capacity of the plant, kg/hour	500 to 4000
Overall dimensions depends on productivity	Container 20-40 feet
Ambient temperature, °C	-45 to +45
Weight of the plant depends on productivity	4500 to 12,000 kg
Maximal steam pressure at outlet, MPa	0,8
Supply voltage, V	380 +/- 5%
Power consumption, kW	320
Steam-production capacity adjustment	steppable by 200-300 kg/hour



On the basis of inductive steam generators PARRUS according to license of LLC "V-Plasma" being a RC "Skolkovo" resident (Certificate # 1120747)





В-плазма



## **Quick-detachable communication box**

It is intended for operative installation and deinstallation of process communication lines. It represents an assembly of various detachably interlinked pipes inside a winterized housing. There are cable racks envisaged to ensure erection of overhead electrical supply and control cable.





Name	Value						
KBK section overall dimensions	Not m	Not more than (LxWxH) mm, 10,500 x 830 x 650/1950					
Cable line support rack	At least 6 pieces per 1 KBK section						
Weight of one KBK section	Not more than 1700 kg						
Name	Q-ty	Q-ty Material Oper. P MPa Connection					
High-pressure manifold NKT-14	1	Steel of grade	40	QDC 4" (steel)			
	40x						
Mud channel ND-225	1 PE 1 BAUER 8" (ste						
Water duct ND-100	1	Camlock (alum.)					
Water duct ND-50	1	Rubber	1,6	Camlock (alum.)			
Steam line ND-38 (STEAM-2)	2 Rubber 0,8 Camlock (steel)						
Air duct ND-24	1	Rubber	1,6	Camlock (alum.)			



### Distributed power supply and control system

Commutation circuit with connectable equipment





## Mobile drilling facility ILS-250E with propulsion system ACS DEVELOPMENT

ACS PURPOSE	Development stages			
	Stage I	Stage II	Stage III	Stage IV
Equipment operation diagnostics	55% of equipment	90% of equipment	100% of equipment	100% of equipment
Deviations detection	For equipment under diagnostics	For equipment under diagnostics	For equipment under diagnostics	For equipment under diagnostics
Status monitoring	Partial	Partial	Partial	Full
Lockouts control	+	+	+	+
Reports generation				
Generation of equipment operation reports	+	+	+	+
Generation of reports on routine maintenance of production-involved equipment	-	-	-	+
Data archiving	+	+	+	+
Voice helper	<b>O%</b>	25%	50%	100%
Warning on potential deviations	-	+	+	+
Execution of standard commands on equipment actuation, deactuation, lockouts etc.	-	-	+	+
Complicated commands execution	-	-	-	+
Driller's digital cabin	"Stage IV +" of control system development			



# Mobile drilling facility ILS-250E with propulsion system

## **ADVANTAGES**

- Capability for both cluster and single-well drilling, and for side-tracking.
- Reduction in time and costs for carriage of transportable assemblies of the drilling facility modules.
- Reduction in erection time during rig-up/rig-down; the erection time for modules corresponds to the untrucking time plus time for modules piping by means of QDC and electric cables by means of quick-detachable connections.
- Electrically-driven drill pumps capability for gradual buildup of pressure up to 350 atm, and for reaching flow rate of 60 L/s low mud pulse amplitudes.
- The drilling facility control system software allows on-line in-operation troubleshooting.
- Protective lockouts system implemented in the drilling facility control system minimizes potential for emergencies due to ground equipment failure, and ensures protection from personnel misbehavior, and consequently cuts down on the process emergencies and accidents occurrence risk in respect of HSE.



# Mobile drilling facility ILS-250E with propulsion system

## ACHIEVEMENTS

- As at 01.09.2019, active status has been being actual for a drilling facility commissioned on 06.07.2019 and having been used for cluster drilling in West Siberia.
- 50 operating days yielded three production wells drilled, and drilling of fourth one is underway; the mean depth of the wells is 3200 m.
- Another drilling facility has been under erection supervision since 20.08.2019. Commissioning is planned on 15.09.2019.
- Three more drilling facilities are under production, and they are scheduled for commissioning in December 2019, February and April 2020, respectively.
- Post-drilling interhole relocation time of the drilling facility within a well cluster is 7 hours.
- One mobile drilling facility manufacture time allowing for delivery to operation site is 7 month.



# LLC "L-Start"









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