“Unconventional Artificial Lift Configurations and Deployment Methods”

SPE Applied Technology Workshop

13-14 March 2012
Amwaj Rotana Hotel, JBR Dubai, UAE

Multi-reservoir production systems

NOVOMET®

Enver Smailov

Benefits

Multi-reservoir production technologies enable to reach the following benefits:

1. Increase oil production
2. Extract fluid from different production reservoirs
3. Make accurate flow measurement from each production reservoir

Variants of multi-reservoir production

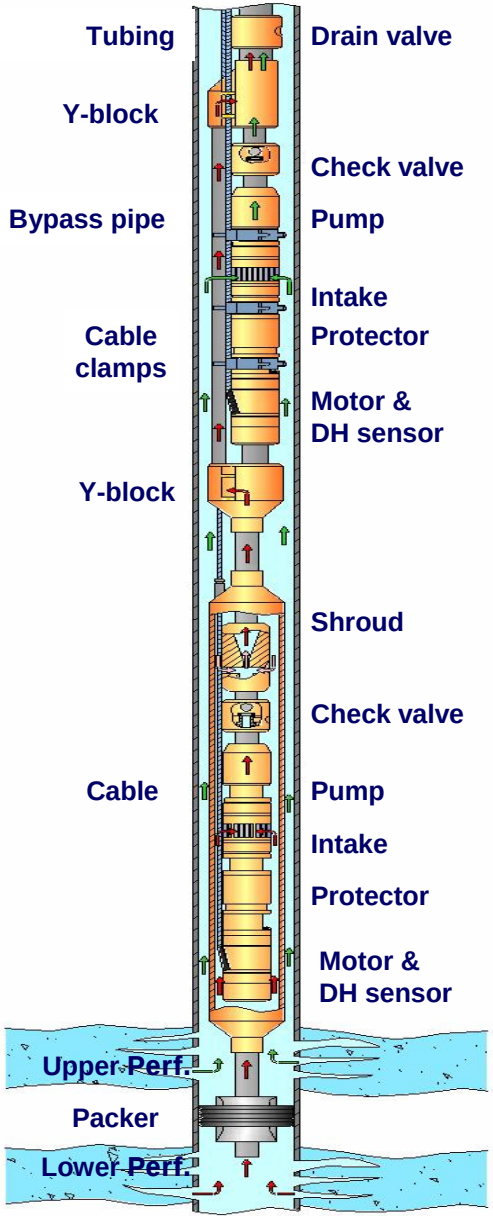
1. Various combinations of dual ESP systems
2. Single ESP system with flow control valve ensuring simultaneous operation of two reservoirs
3. ESP+Bypass (Y-tool) system for logging tests

Various combinations of dual ESP systems for multi-zone production

Combination #1: One tubing lift, reservoirs are close to each other

- Both ESP systems are set on the packer
- Fluid is produced through one tubing lift
- Measurement of flow rate can be made only when one ESP doesn’t work
- Such configuration includes leakproof shroud
- Design includes special gas discharge device from under-packer zone

Combination #1: One tubing lift, reservoirs are close to each other



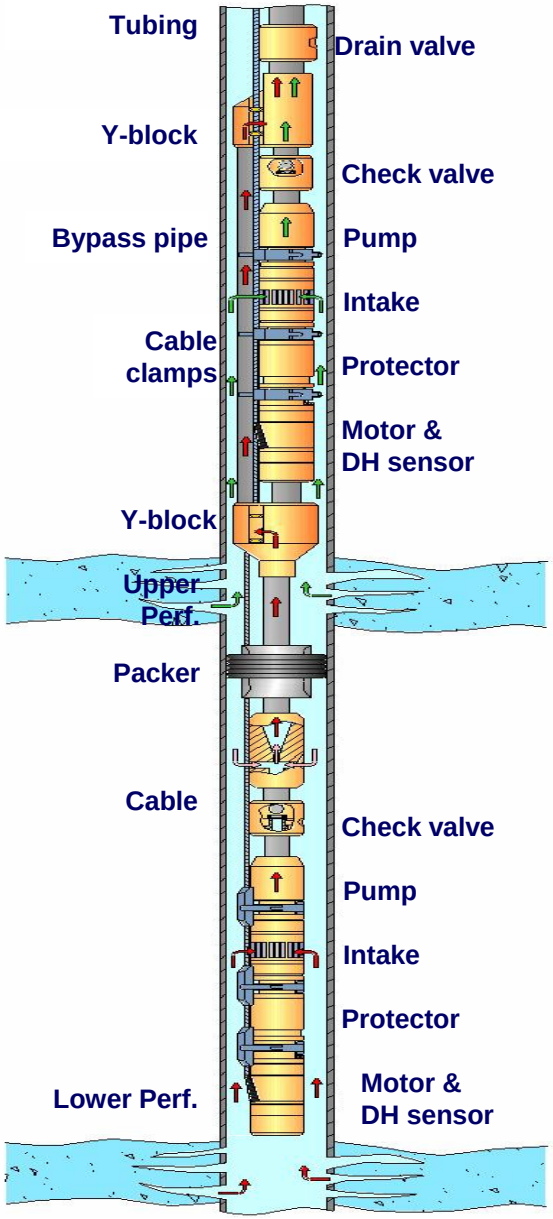
Casing OD	Parameter	5 ½”	5 ¾”	6 5/8”	7”
Upper ESP	Series	319	319	319	319, 338, 362
	Max Flow rate, bpd (m^3/day)	1900 (300)	1900 (300)	1900 (300)	3100 (500)
Lower ESP	Series	319	319	319	319, 338, 362
	Max Flow rate, bpd (m^3/day)	1900 (300)	1900 (300)	1900 (300)	3100 (500)

Patented technology

Combination #2: One tubing lift, reservoirs are far from each other

- Configuration with packer: one ESP is set under packer, another above
- Fluid is produced through one tubing lift
- Measurement of flow rate can be made only when one ESP doesn’t work
- Design includes special gas discharge device from under-packer zone

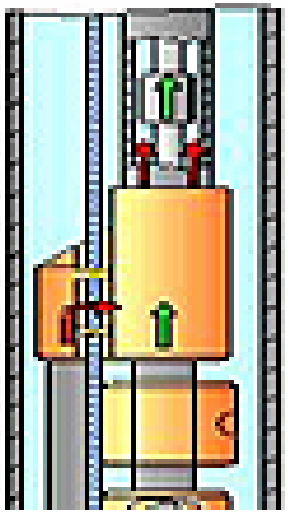
Combination #2: One tubing lift, reservoirs are far from each other



Casing OD	Parameter	5 ½”	5 ¾”	6 5/8”	7”
Upper ESP	Series	319	319	319	319, 338, 362
	Max Flow rate, bpd (m^3/day)	1900 (300)	1900 (300)	1900 (300)	3100 (500)
Lower ESP	Series	319, 362	362, 406	362, 406, 449	362, 406, 449
	Max Flow rate, bpd (m^3/day)	1900 (300)	2500 (400)	3750 (600)	5000 (800)

Patented technology

Production through two tubing lifts

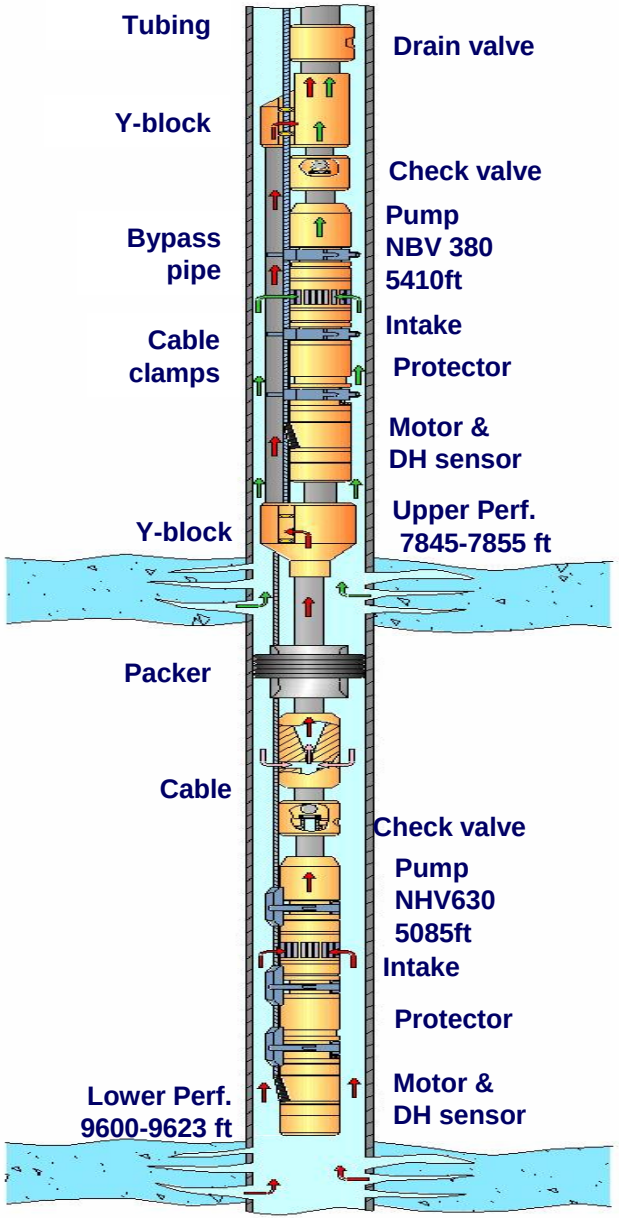


Design:

"One tubing lift inside the other" to enable the following:

- separate measurement of flow rate from different reservoirs during production (there is no need to stop operation of the systems)
- separation of flow to prevent mix of fluids from different reservoirs

Case study #1 1/5



- Customer: Surgutneftegas
- Location: Vostochno-Surgutskoye oilfield
- Well: #2081
- Casing: 6 5/8” (168 mm)
- Commissioned on: 02.11.2011-06.11.2011

Case study #1 2/5

ESP design: Dual ESP, packer between systems

Upper ESP:	series	319	
	flow rate	380 bpd	50 m^3/day
	head	5410 ft	1650 m
Lower ESP:	Series	406	
	flow rate	630 bpd	100 m^3/day
	head	5085 ft	1550 m

In operation since: 06.11.2011

Status: still in operation

Case study #1 3/5

- Project achieved results:
- Based on the information received from the customer payback period of the project (including costs of the systems, running-pulling operations) amounts to **39 days**
- Flow rate was increased by two times
- It is strictly prohibited by the customer to provide operation data publicly

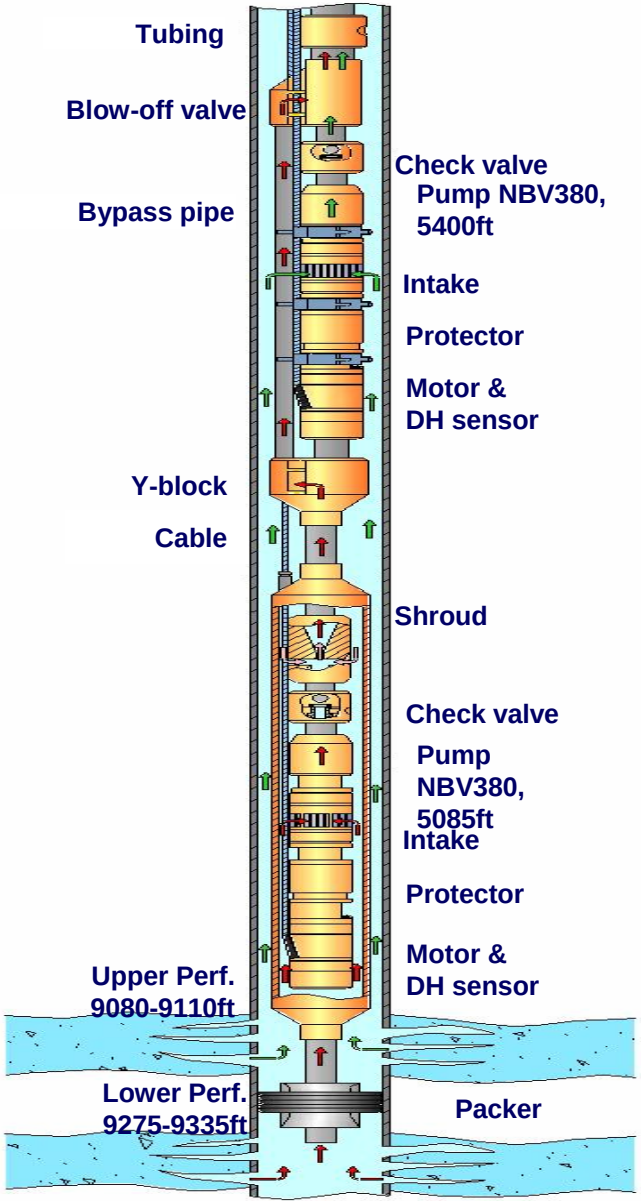
Case study #1 4/5

Installation

Case study #1 5/5

Installation

Case study #2 1/2



- Customer: Surgutneftegas
- Location: Vostochno-Surgutskoye oilfield
- Well: 4463r
- Casing: 5 ¾” (146 mm)

Case study #2 2/2

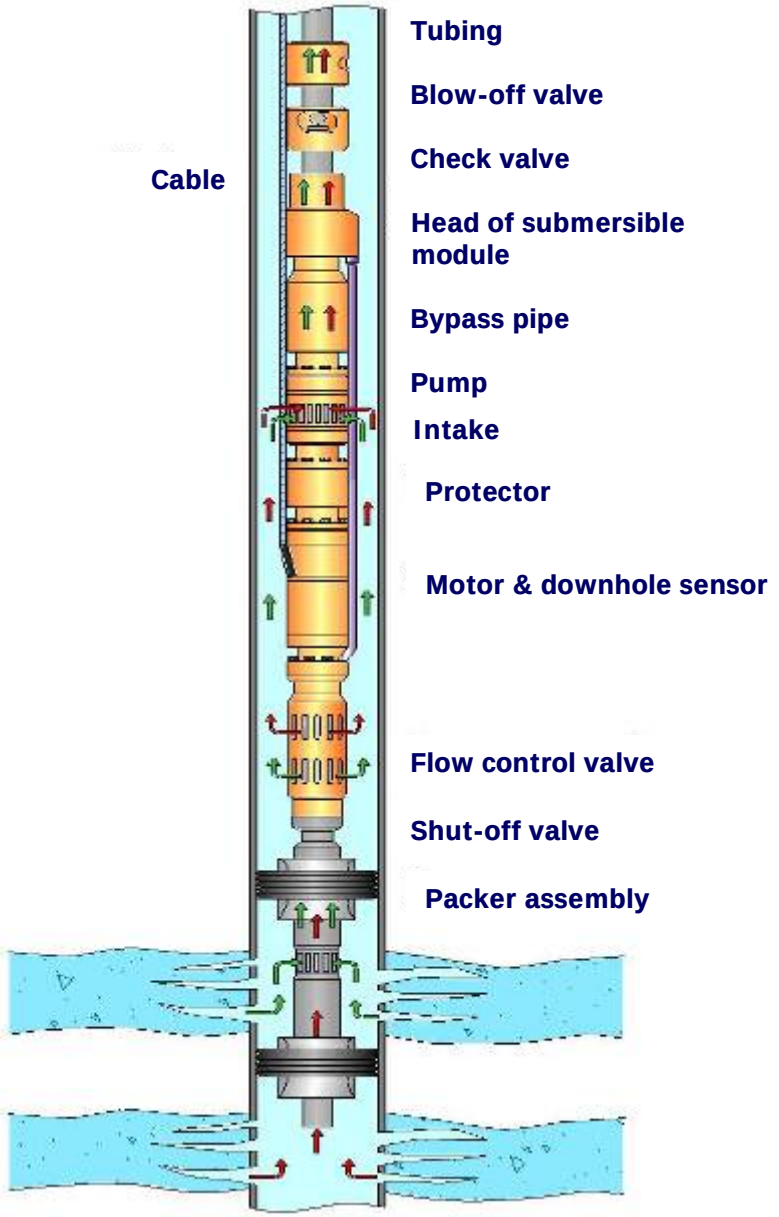
ESP design: Dual ESPs set on the packer with leakproof shroud

Upper ESP:	series	319	
	flow rate	380 bpd	50 m^3/day
	head	3350 ft	1020 m
Lower ESP:	series	319	
	flow rate	380 bpd	50 m^3/day
	head	5410 ft	1650 m

In operation since: 02.02.2012
Status: being commissioned

Single ESP system with flow control valve ensuring simultaneous operation of two reservoirs

Single ESP system with flow control valve



Min Casing OD	5 ¾”
Max ESP series	362
Total flow rate	125-1575 bpd (20-250 m^3/day)

Single ESP system with flow control valve

- Ratio of fluid flow during operation is regulated by means of the choke system
- Regulation is successive: 0/100 %, 10%/90%, etc.
- Regulation can be done by: increase/decrease of ESP rotation speed and/or tubing pressure boosting
- In comparison with dual systems, such configuration is needed to reduce costs as only one system is required
- Packer design enables separate fluid flow from two reservoirs
- Ratio of fluid flow is tuned prior running into hole and can be regulated during operation

Case study

- Customer: Rosneft
- Casing: 5 ¾” (146 mm)

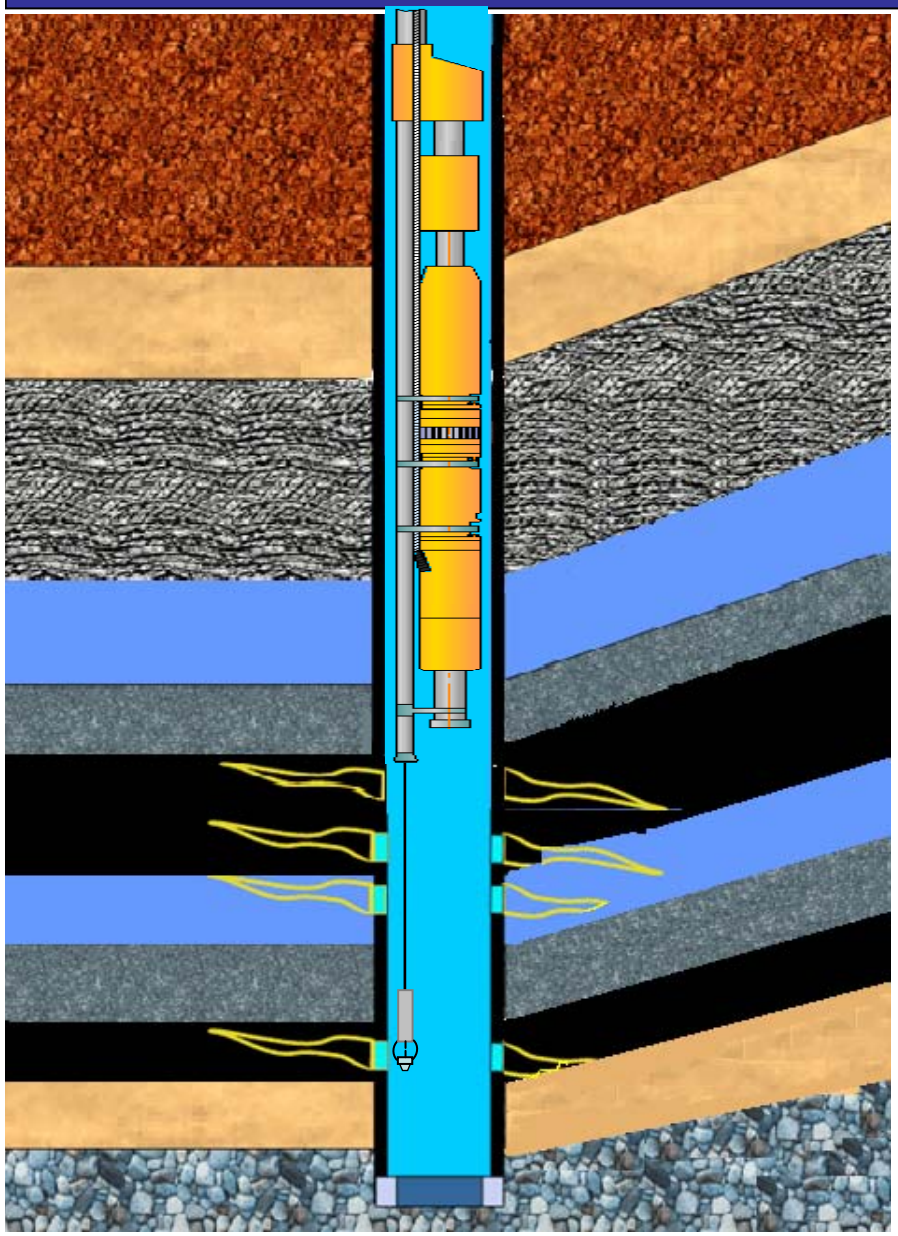
ESP design:

ESP series	362
ESP flow rate	450 bpd (59 m^3/day)

Status: ESP testing will be carried out in May’ 2012

ESP+Bypass (Y-tool) system for logging tests

Bypass (Y-tool) systems



- Novomet Bypass (Y-tool) system is a tool to enable access and logging below an ESP without pulling and workover.
- Measured parameters:
  - ✓Pressure
  - ✓Temperature
  - ✓Flow rate
  - ✓Water cut

Case study 1/3

- Customer: RN-Yuganskneftegas
- Location: Priobskoye oilfield
- Well: 5436
- Casing: 5 ¾” (146mm)

Case study 2/3

ESP design: ESP with logging tool

ESP series	319	
ESP flow rate	410 bpd	65 m^3/day
ESP head	8530 ft	2600 m
Logging tool setting depth	8730 ft	2660 m

- In operation since: 02.02.2011
- Status: still in operation

Case study 3/3

MLE with motor assembly

MLE clamp assembly

Bypass tube and pump

PLT Experience in Sudan 1/3

- Two companies from Kuwait: Asbar and Eastern subcontracted NALS for production logging tests (PLT) job for PDOC.

- Asbar and Eastern – provided logging tools

PLT Experience in Sudan 2/3

NALS performed the following operations:

- ✓ Provision of downhole and topside equipment
- ✓ Installation, commissioning and pulling
- ✓ Measurement of various operating modes of ESP system at different depths and frequencies

PLT Experience in Sudan 3/3

Bypass (Y-tool) systems specifications

Casing OD, in	5¾	$6^{5}/_{8}$	7	$9^{5}/_{8}$
ESP series	319	338	338	535
Logging tool max OD, in	1.10	1.34	1.65	2.28
Max.flow rate, bpd	1575	1250	1250	2950
Bypass tube OD, in	1.65	1.77	2.12	2.76
Bypass tube ID, in	1.26	1.46	1.77	2.44
System OD with bypass system, in	4.88	5.63	6.02	8.46