“Unconventional Artificial Lift Configurations and Deployment Methods”

SPE Applied Technology Workshop

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Slim ESP Technologies

NOVOMET®

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SPE International

Capabilities

- Wells with technical limitations due to:

  -displacement of casings,

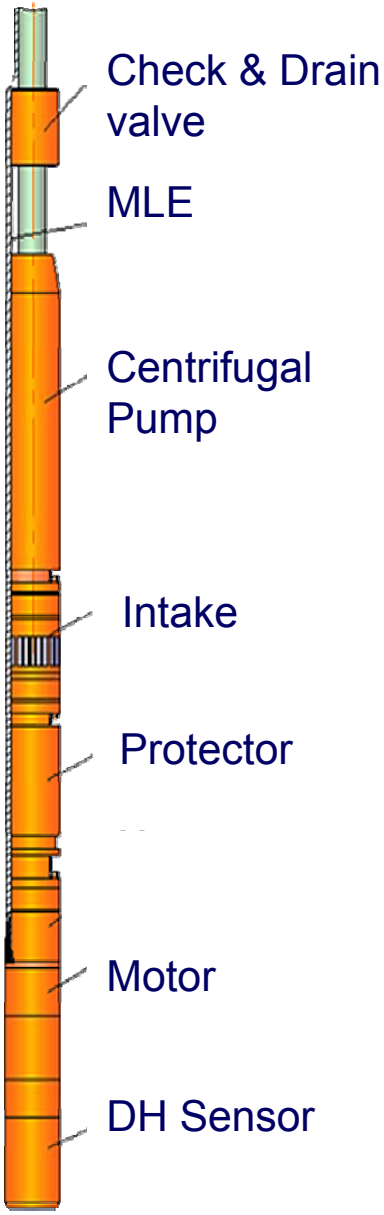
  -patched casings
- Operation in wells with dogleg severity of: 4˚/30 ft - during RIH

  15'/30 ft - at pump setting depth
- Drawdown in sidetrack wells for effective oil production

Capabilities

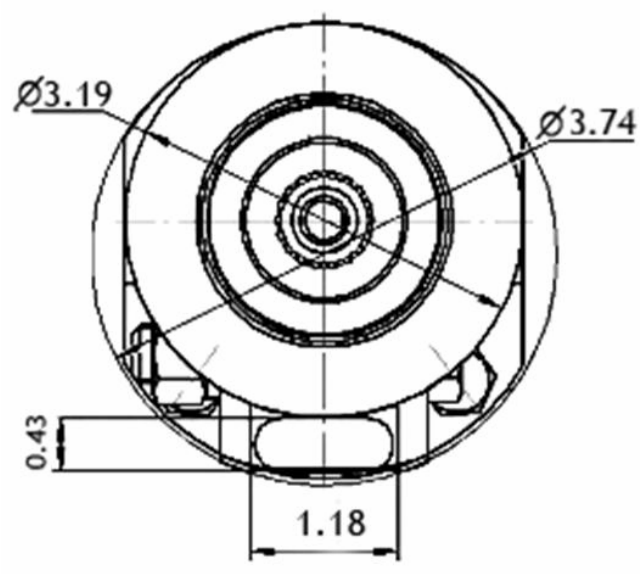
- Starting up idle wells
- Wells after WO
- Exploratory wells
- Bypass systems (Y-tool) with slim ESPs for casings:5 ¾”, 6 $^{5}/_{8}$”, 7”, 9 $^{5}/_{8}$”
- ESP operation in highly deviated wells with zenith angle of 90˚ (horizontal wells)
- Dual ESP systems for multi-zone production (casings: 5 ¾”, 6 $^{5}/_{8}$”, 7”, 9 $^{5}/_{8}$”)

B (319) series ESP in 4 ½” casing



OD series	319/B
Pump OD, in/mm	3.19/81
Motor OD, in/mm	3.19/81
Max OD of ESP system, in/mm	3.74/95

B (319) series ESP in 4 ½” casing



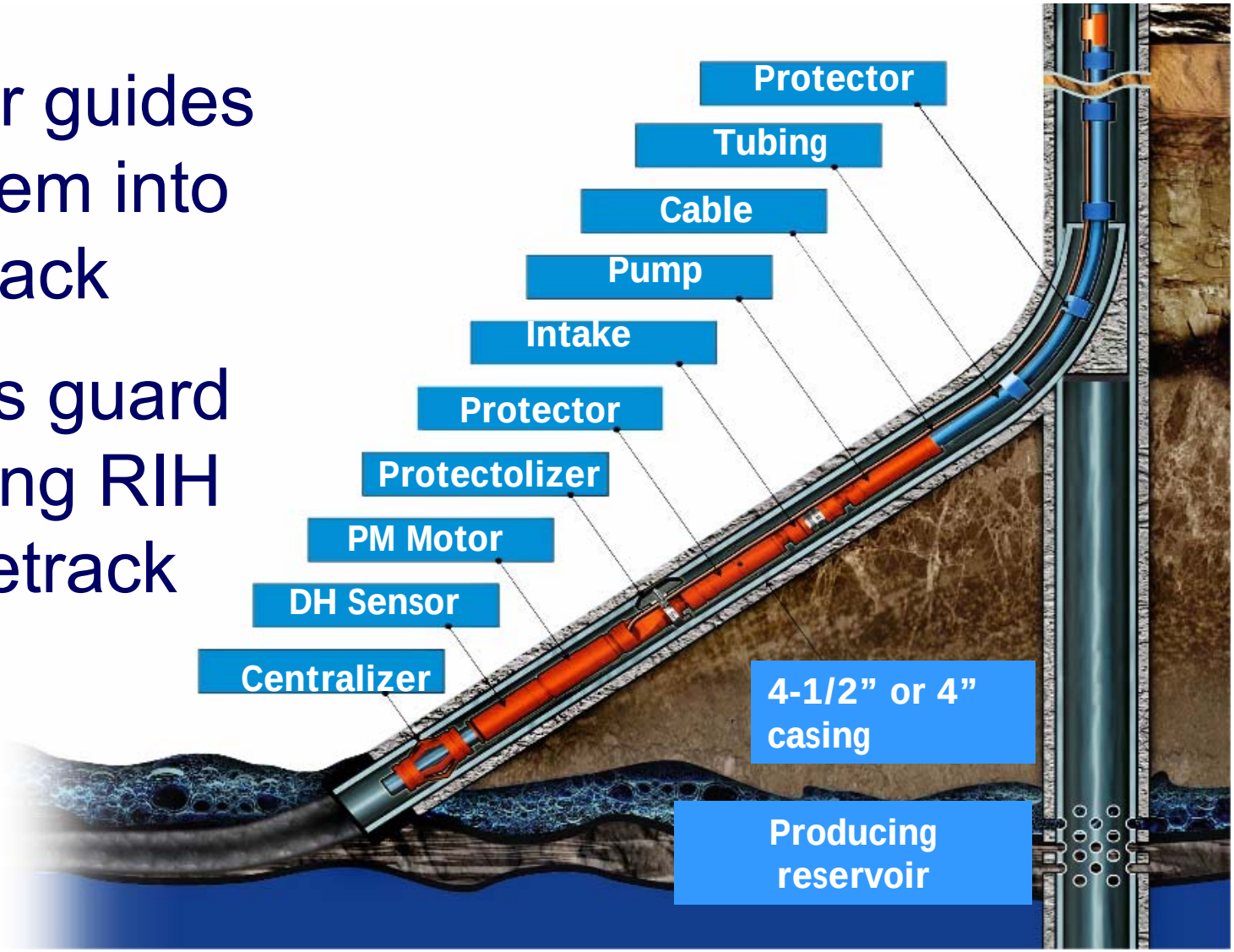
Stage (Q, BPD)	n, RPM	Eff, %
NAV(250 – 500)H	3000 ÷ 6000	52
NAV(630-1000)H		63
NAV(800-1300)H		64

Operation in wells with deviation angle from the vertical up to 90°

Slim ESP Systems in Side-track Wells

Centralizer guides ESP system into sidetrack

Protectors guard MLE during RIH into sidetrack



B (319) ESP systems

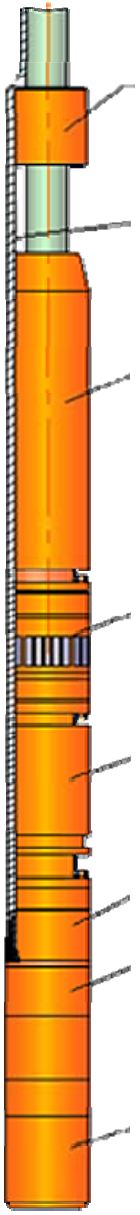
Operation results in 4 ½” Casing in Side-track wells
Oil Company: TNK-BP

Oil field	Well	System	Installation date	POOH date	POOH reason	Run life, days
Spirido-novskoye	102	NBV(250-500)H, head 7900ft	02.11.2008	30.05.2010	intervention	574
Samot-lorskoye	344	NB(630-1000)H, head 5900 ft	29.09.2010	In operation		500
Samot-lorskoye	30220	NB(630-1000)H, head 5900 ft	06.01.2011	In operation		401

Additional well and ESP data

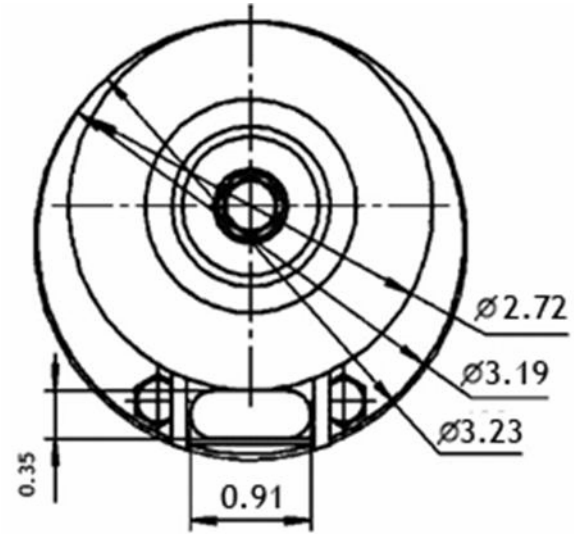
Well	Sidetrack window	Sidetrack length	ESP setting depth (measured)	ESP shaft RPM
344 (sidetrack)	7454-7463 ft	1811 ft	8021 ft	5250
30220 (sidetrack)	6312-6322 ft	2765 ft	8015 ft	5500

A (272) series ESP in 4” casing



OD series	272/A
Pump OD, in/mm	2.72/69
Motor OD, in/mm	3.19/81
Max OD of ESP system, in/mm	3.23/82

A (272) series ESP in 4” casing



Stage (Q, BPD)	n, RPM	Eff,%
NAV(190 – 380)H	3000 ÷ 6000	48
NAV(440-630)H		61
NAV(790-1260)H		48

Operation in wells with deviation angle from the vertical up to 90°

A (272) ESP systems

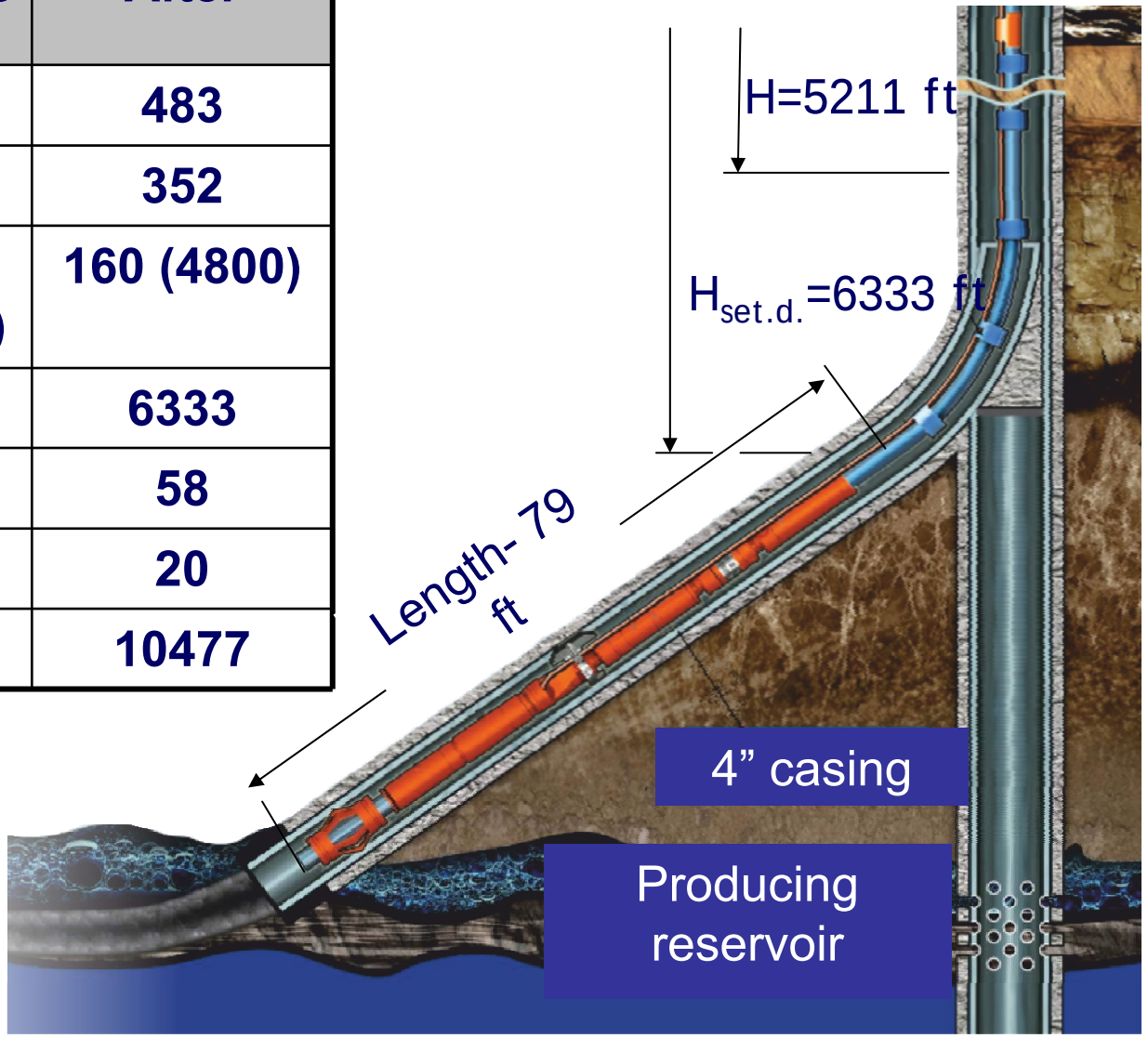
Operation results in 4” Casing in Side-track wells
Oil Company: TNK-BP

ESP System	Oilfield	Well	Installation date	POOH date, reasone	Run life, days
NAV(440-630)H, head 7540 ft	Samot-lorskoe	37207	21.02.2011	25.02.2011, No flow	4
NAV(440-630)H, head 7540 ft	Ust-Vakhskay square	75333У	20.06.2011	Still in operation	238
NAV(790-1260)H, head 7210 ft	Samot-lorskoe	4596	22.09.2011	Still in operation	143

Case Study: Application of NAV(440-630)H, head 7540 ftin side-track

Parameter	Before	After
Fluid bpd	227	483
Oil bpd	163	352
Hz (rpm)	50 (2910)	160 (4800)
Setting depth,ft	5000	6333
Load, %	56	58
Current,A	19	20
Dynamic head, ft	7534	10477

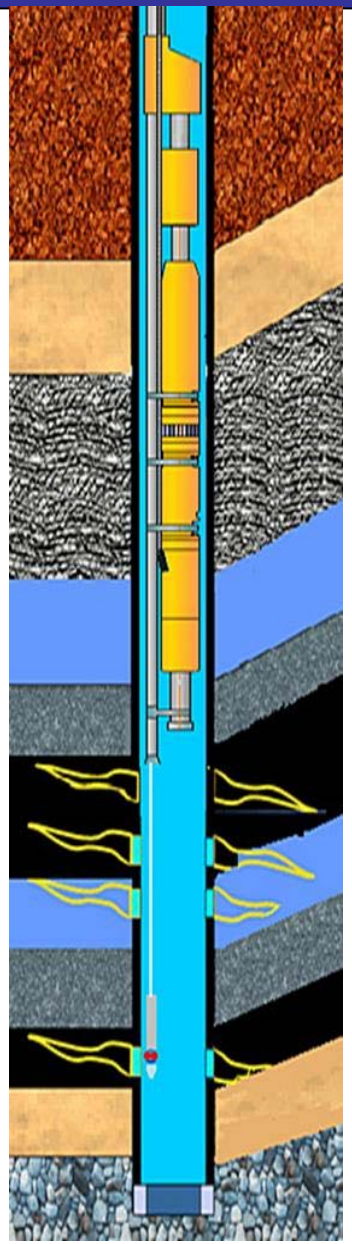
Deviation angle from the vertical is 78.3°



Application of Slim-line ESP Systems

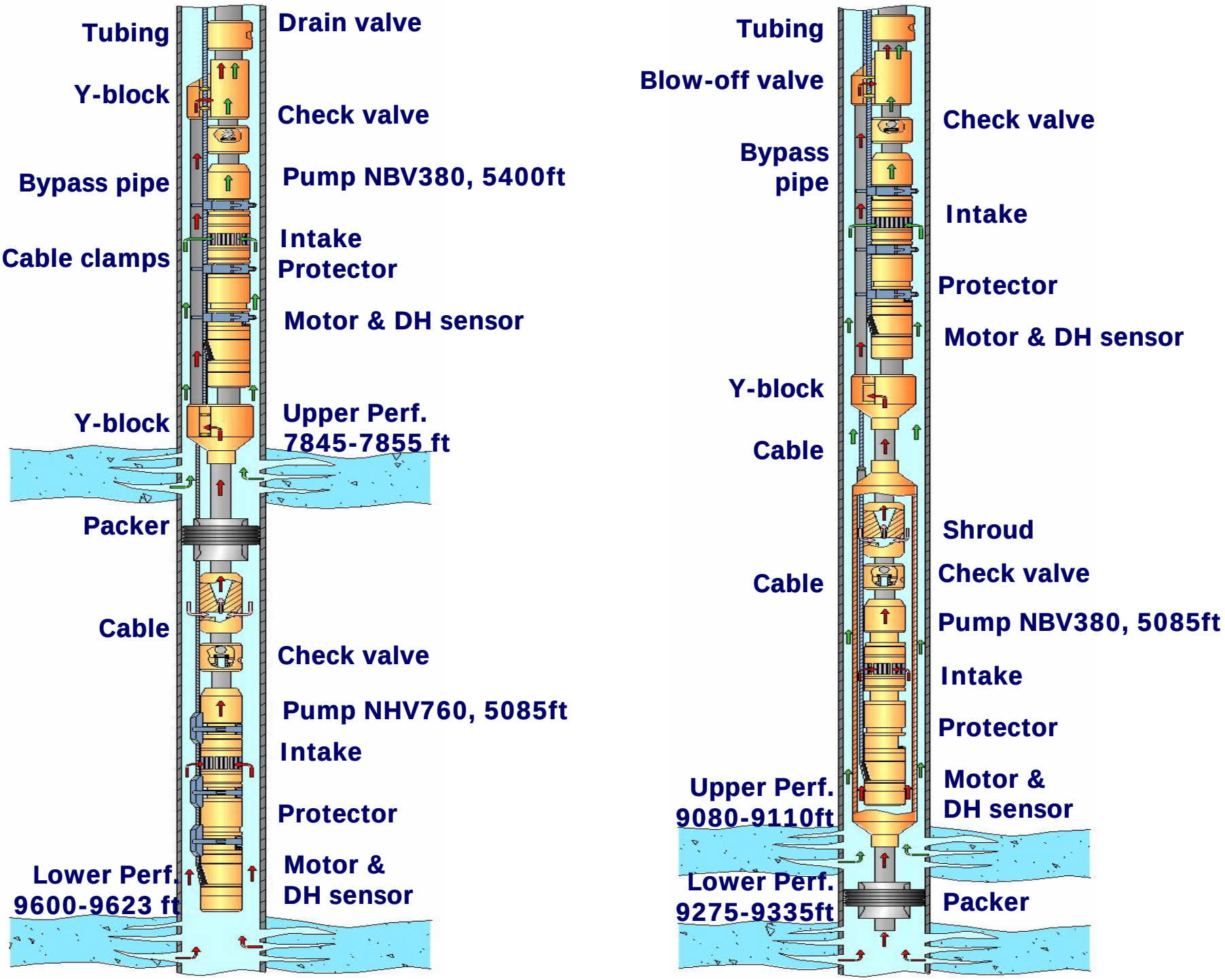
- Bypass Systems (Y-tool) in 5 ¾” (and bigger) casing for tests of multi-zone wells
- Dual systems in 5 ¾” (and bigger) casing for multi-zone production.

Bypass Systems (Y-tool)



Reservoir survey operations
with capability of logging tool RIH
inside the tubing without ESP POOH

Casing OD, inch	ESP series	Logging tool max. OD, inch	Max. Flow rate, bpd	Max. Bypass system load, Lb
5-3/4	319	1.10	1570	660
6-5/8	338	1.34	1250	660
7	338	1.65	1250	770
9-5/8	535	2.28	6300	880


Tubing
Drain valve
Y-block
Check valve
Bypass pipe
Pump NBV380, 5400ft
Cable clamps
Intake
Protector
Motor & DH sensor
Y-block
Upper Perf.
7845-7855 ft
Packer
Cable
Check valve
Pump NHV760, 5085ft
Intake
Protector
Lower Perf.
9600-9623 ft
Motor &
DH sensor
Tubing
Blow-off valve
Check valve
Bypass
pipe
Intake
Protector
Motor & DH sensor
Y-block
Cable
Shroud
Cable
Check valve
Pump NBV380, 5085ft
Intake
Protector
Upper Perf.
9080-9110ft
Motor &
DH sensor
Lower Perf.
9275-9335ft
Packer