Setting new records with subsea boosting systems in fields in the Gulf of Mexico, North Sea, and offshore Angola
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Historic View
Subsea booster pumps – differential pressure

- 1997, Lufeng, 35 bar
- 2003, Ceiba, 40 bar
- 2008, Azurite, 41 bar
- 2009, Pazflor, 105 bar
- 2014, GirRI, 130 bar
- 2018, Stones, 290 bar
Subsea booster pumps – shaft power

Year


1997, Lufeng
1999, Topacio
1999, Troll
2006, Colomba E
2007, Tordis
2009, Pazflor
2010, GSC
2013, JSM
2014, Shell TQP
Fields
Chevron - Jack & St Malo, Gulf of Mexico

- 2400 m Water Depth, 13,000 psi design pressure
- Production enhancement
- Stage 1: Single phase boosting
- Stage 2: Multiphase + single phase boosting
- Chevron expectation: 50 – 150 mbo increase by boosting
Jack & St Malo pump stations

Key data:
- 60,000 bbl/d
- 3 MW shaft power
- 4,000 psi/280 bar boost
- 22 km tie-back
Installed and commissioned
OneSubsea® multiphase compressor system

- OneSubsea multiphase compressor technology has been developed over the last 25 years.
- All subsea components are based on an unparalleled experience of more than 2,5 mill. accumulated operational hours of subsea pumps.

**Main Features:**
- Contra-rotating impeller shafts
- Multiple stages without diffusers
- Surge-free blade design
- Integrated flow mixing
- Field-proven motor, seals, and bearing technologies

- Development and qualification of OneSubsea’s multiphase compressor technology was carried out in close cooperation with major operators, such as Statoil and Shell.
Gullfaks multiphase compression system – Installed 2015 - **worlds first**
Compressor station installation

**Power**
- 10 MW Shaft total power
- Controlled from Gullfaks A

**Flowrate**
- 6000 Am³/h = 406 MMScf/d
- Mix of gas and liquid

**Pressure increase from inlet to outlet**
- Up to 32 bar per compressor, 64 bar in series
GirRI - a bold multiphase pumping project
GirRI pump system

Challenge
- 15 and 7 km tie-back (P80 and P70)
- 1400 m water depth
- 130 bar differential pressure

Scope
- 2 dual pump stations
- 2 suction anchors (manuf. in Angola)
- 6-off subsea high boost pumps
- Topside power and control module
GirRI pump system - Testing
GirRI P70 pump system in operation

“These pumps allow recovery of about 42mn barrels of additional reserves.”
Sonangol said in a statement (ref: Reuters).
Why select boosting for Artificial Lift
Typical AL screening study

![Graph showing Payback, Incr. DCF wrt RBGL10"

Accumulated Discounted Cash Flow pr. Year (MMUSD)

Payback, Incr. DCF wrt RBGL10"

-200 0 200 400 600 800 1000

2020 2025 2030 2035 2040 2045

- Payback, Incr. DCF wrt RBGL10"
- Nat10"
- RBGL10"
- MPP8"
- MPP10"
Promising technology for 25 years...

- Boosting adds energy
- Increases flow/recovery rates (30 – 100% +)
- Large differential pressures (200 bar)
- Maintain plateau production
- Enabling technology
- Allows smaller ID pipelines
- Improves flow assurance
- Tie-backs 100 to 150 km available today
- 3000 m water depth
- Fully qualified technology (20 years experience)

What more does it take?