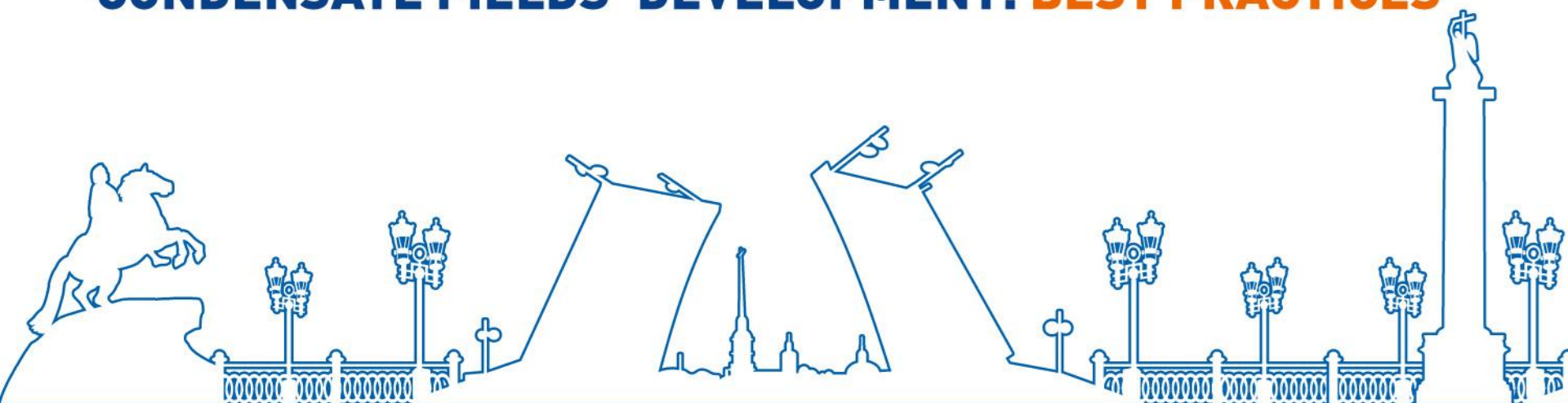


INTEGRATED MANAGEMENT OF OIL AND GAS CONDENSATE FIELDS' DEVELOPMENT: **BEST PRACTICES**



Advancement of the Completion Technologies for High-Tech Wells Drilled to Develop Under-Gas-Cap Oil Rims
Philipp Brednev, Gazpromneft Science and Technology Centre

Agenda

- Gazprom Neft Drilling and Workover Function History
- Relevance of Under-Gas-Cap Oil Rims
- Completion Challenges
- Completion Technologies
- Gazprom Neft Experience and Results
- Summary

Gazprom Neft Drilling and Workover Function History

Foundation of Drilling and Workover Function

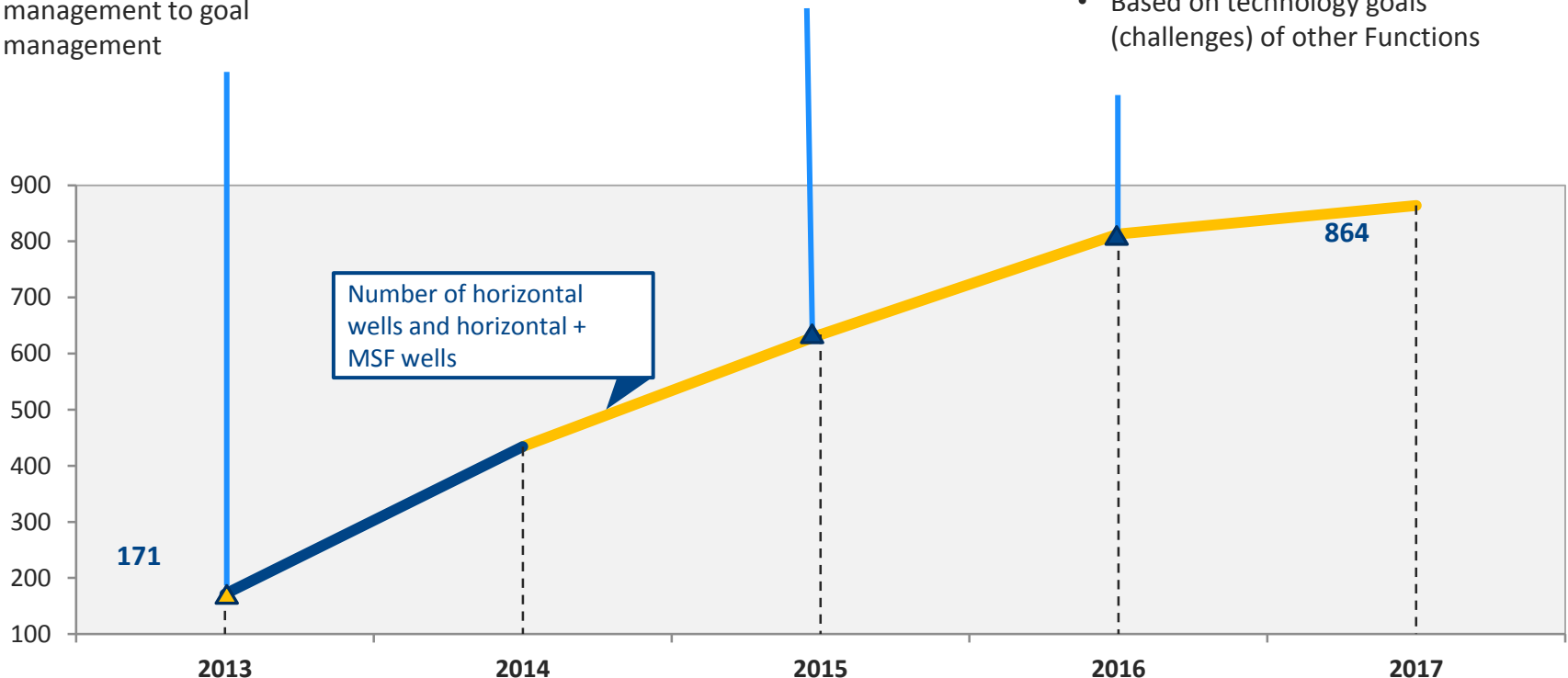
- Transition from operation management to goal management

Drilling and Completion Long-Term Technology Development Program

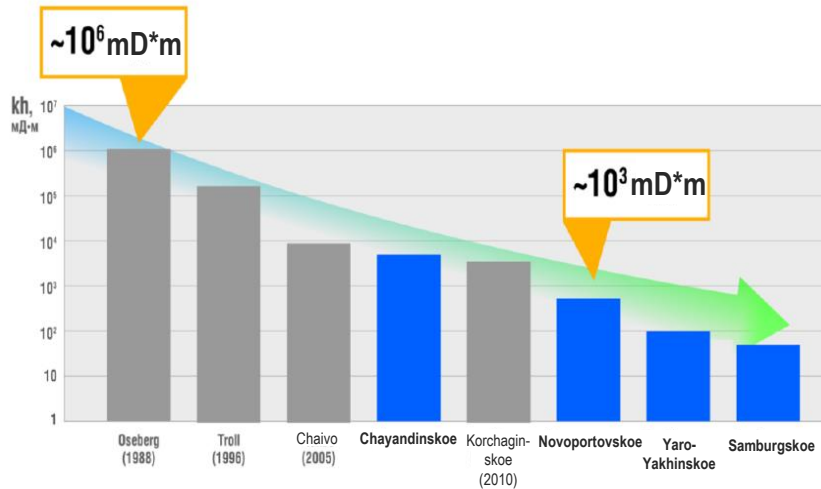
- Partial correlation with goals of other Functions
- Trial of single solutions

Drilling and Completion Long-Term Technology Development Program – V. 2.0

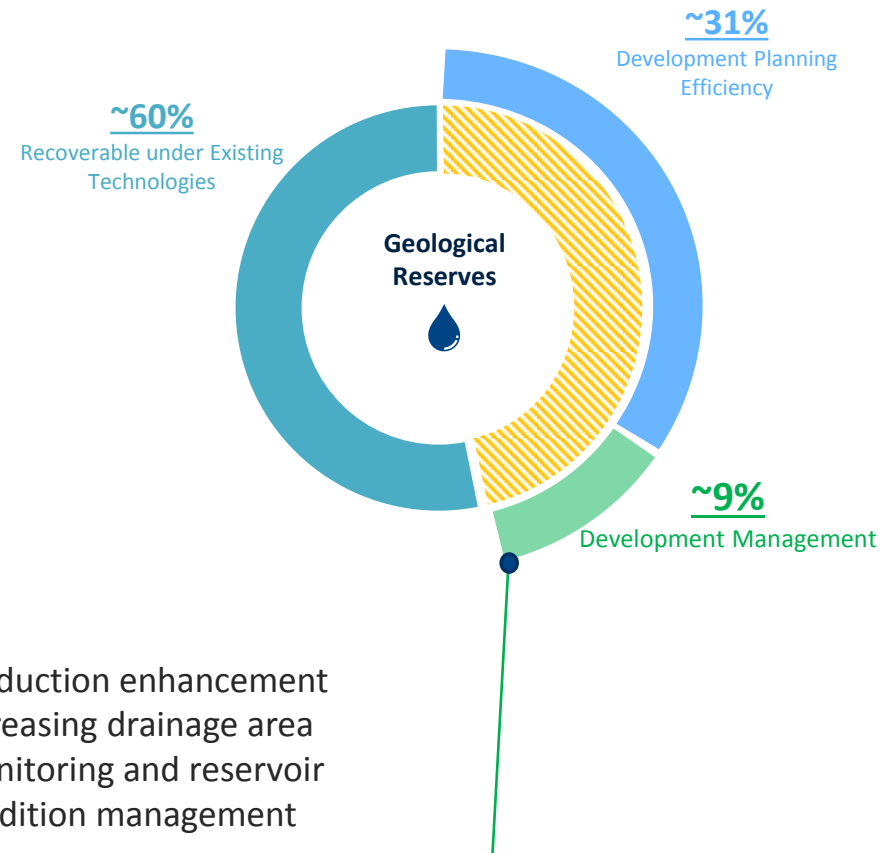
- Transition from single to addressed complex solutions
- Based on technology goals (challenges) of other Functions



Relevance of Under-Gas-Cap Oil Rims

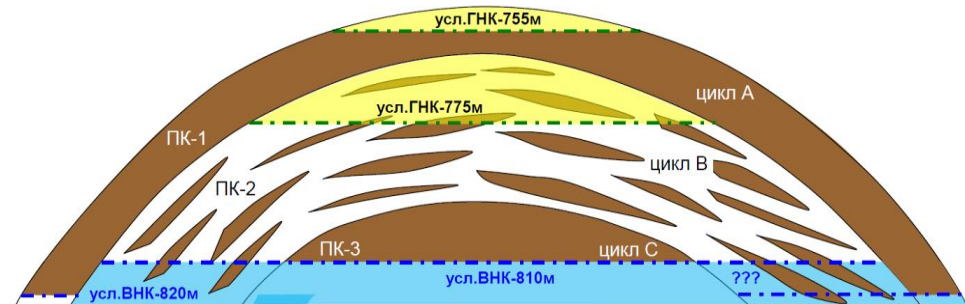
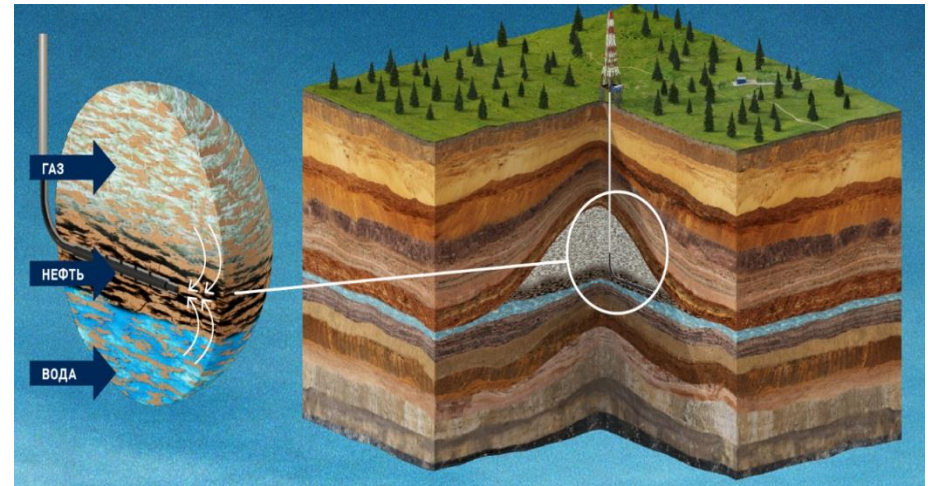


In 95% assets (including Novy Port and Messoyakha) KH/μ does not allow producing wells at $dP_{critical}$ with $NPV > 0$



Completion Challenges

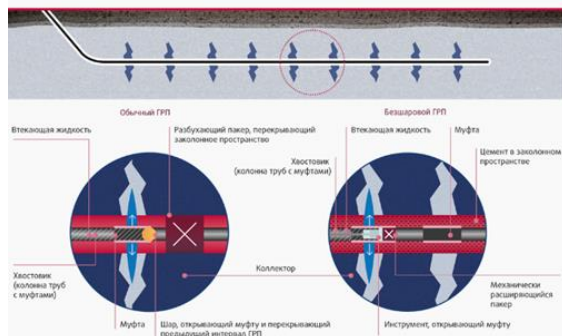
- Close gas-oil and water-oil contacts (gas or water breakthroughs)
- Low permeability layers
- High reservoir compartmentalization
- Borehole stability in wells with open bottom-hole
- Poorly consolidated sandstones



Completion Technologies for Under-Gas-Cap Oil Rims

1 Multi-Stage Hydrofrac Systems

МНОГОСТАДИЙНЫЙ ГИДРОРАЗРЫВ ПЛАСТА



Goals for 2017-19:

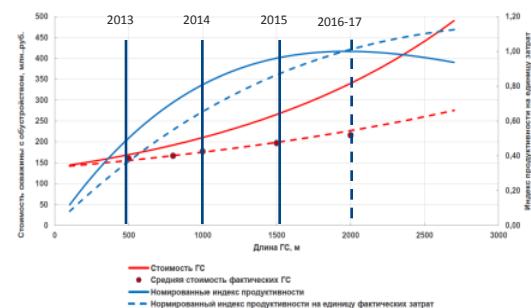
- MSF system replication
- Testing of MSF with 30+ stages
- CAPEX optimization

2

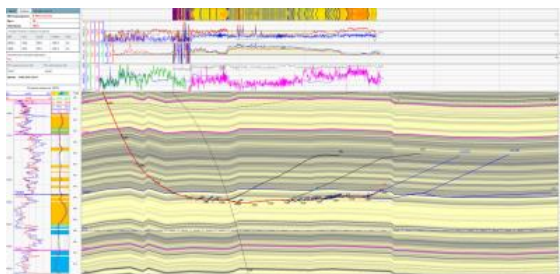
Drilling Wells with Horizontal Part Longer than 1500 m

Goals for 2017-19 :

- Horizontal wells >2000 m
- ERD >3,00, DDI>7,00



3 Multi-Lateral Wells

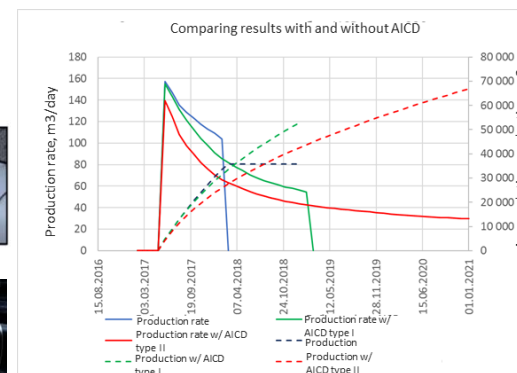


Goals for 2017-19:

- MLT TAML-1 replication
- Testing of TAML 3-4 with 4+ qnt of lateral holes

4

Intelligent Well Control and Production Systems



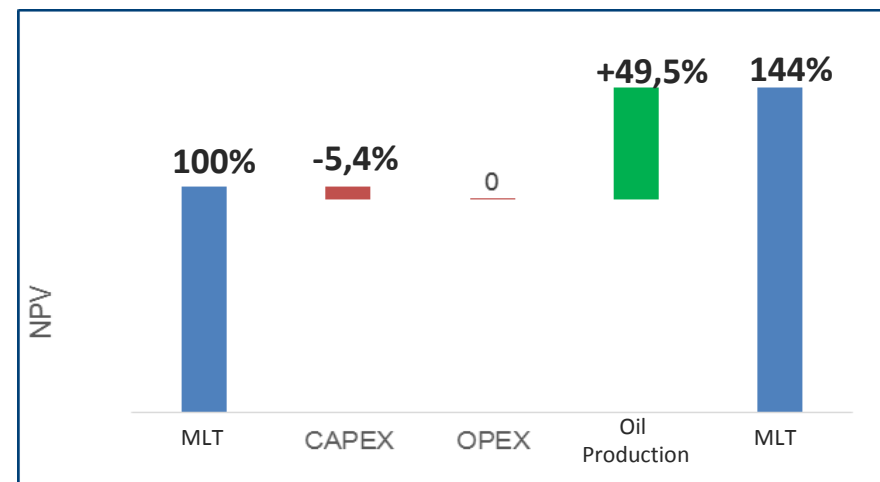
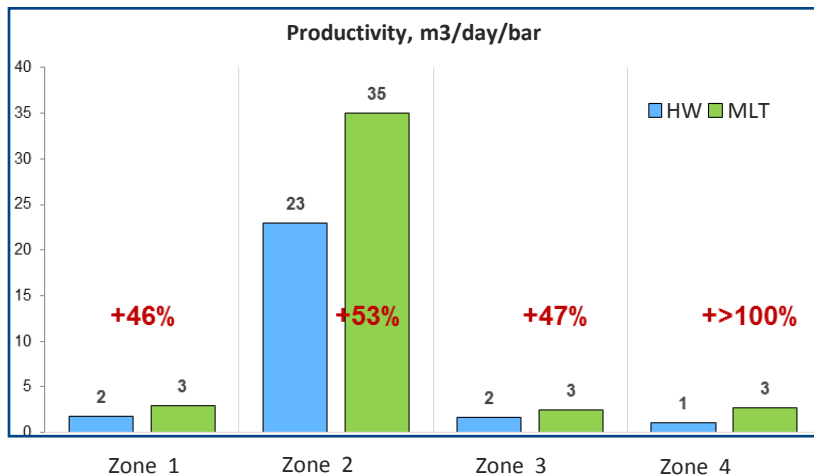
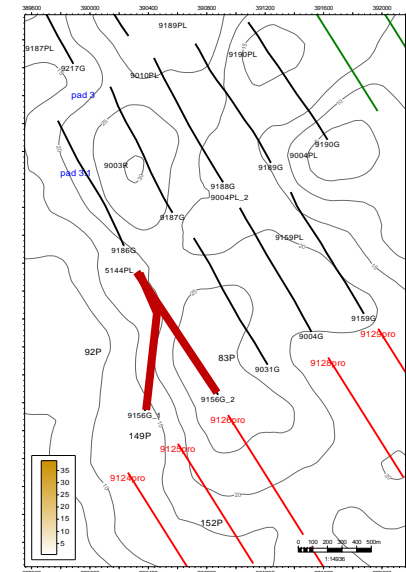
+9%



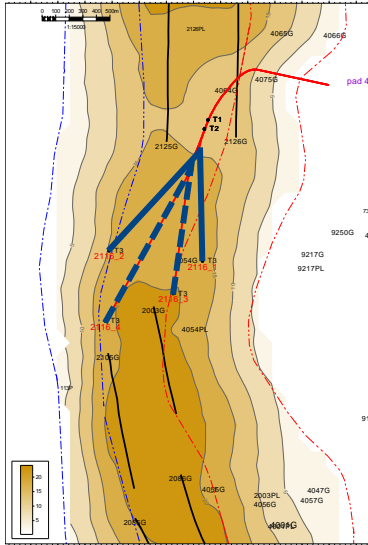
Gazprom Neft Experience and Results (1/3)

MLT wells ensure wider drainage area and, compared to horizontal wells, allow:

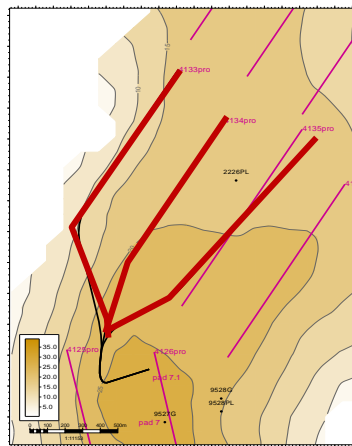
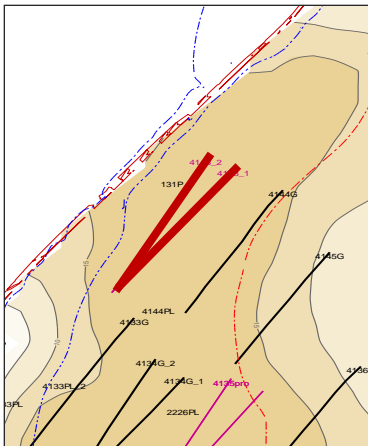
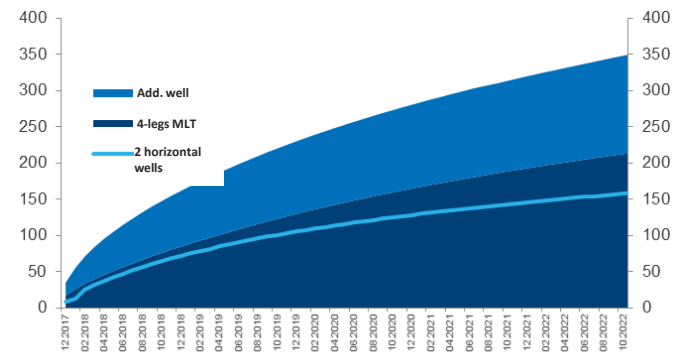
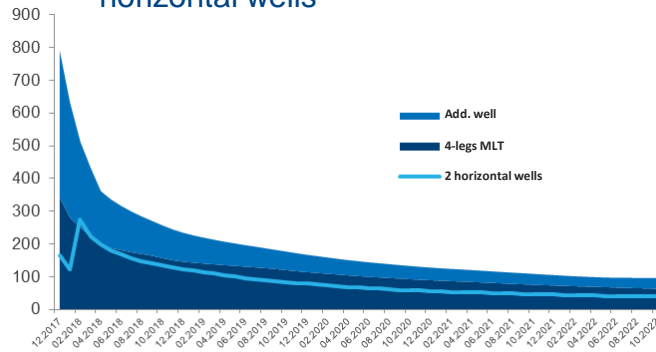
- Producing oil from low drawdown zones in under-gas-cap oil rims avoiding or holding up gas breakthroughs
- Increasing well productivity
- Maintaining planned production parameters of wells under the low drawdown conditions
- Increasing cumulative oil production by up to 30%
- Increasing economic efficiency by up to 40%



MLT Wells Drilling and Production Perspectives at one of Oil-Gas-Condensate Fields



- A 4-hole well drilled to penetrate target zones planned for **two horizontal wells**
- Another horizontal well drilled to penetrate **additional target zones** from a free slot
- **Drilling time** of one 4-hole well + one horizontal well for additional targets **20 days longer** than drilling time of two horizontal wells
- Planned cumulative oil production of MLT + additional well **58% higher** than production of two horizontal wells



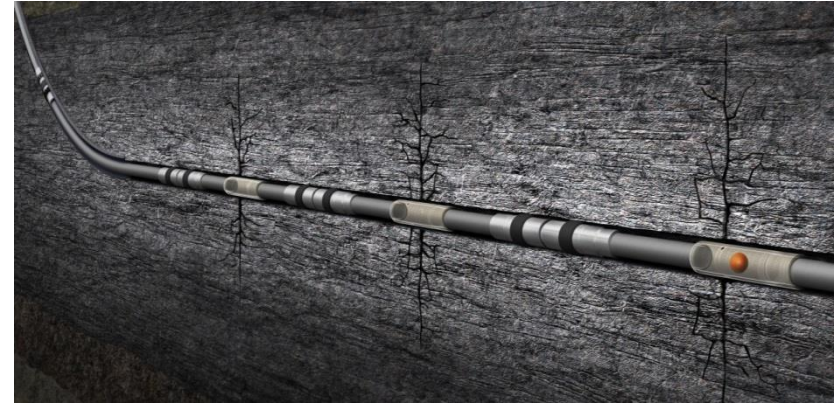
In 2017-2018, drilling of TAML 4 MLT wells is planned, which will allow:

- Drilling MLT wells to penetrate different production zones
- Hydrofracing each hole of a multi-lateral well
- Drilling 3-4-hole wells with access in each hole when required

Gazprom Neft Experience and Results (2/3)

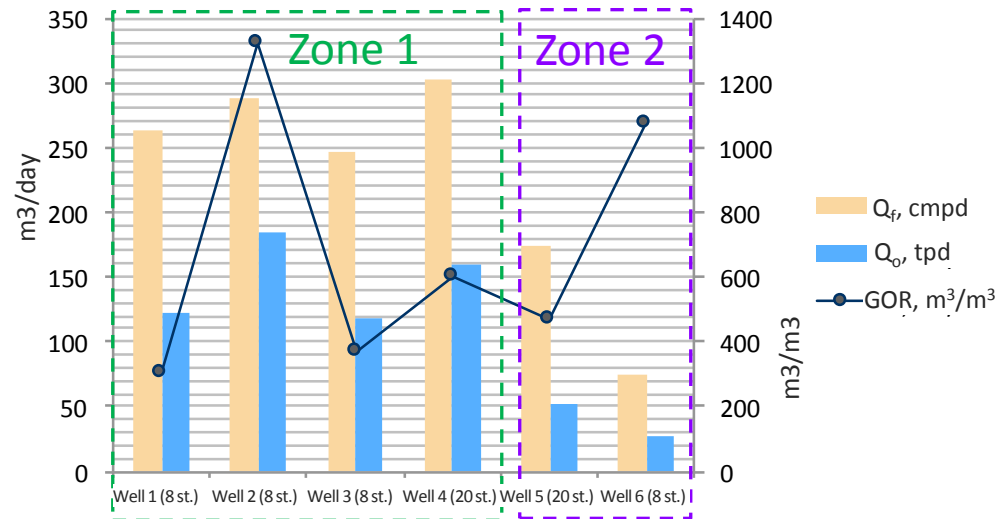
Drilling MSF horizontal wells to develop under-gas-cap oil rims allows:

- Applying the MSF technology in low permeability zones
- Increasing the number of hydrofrac stages to 20+
- Reducing the volume of proppant down to 6 t per stage
- Under-flushing proppant to control hydrofrac parameters



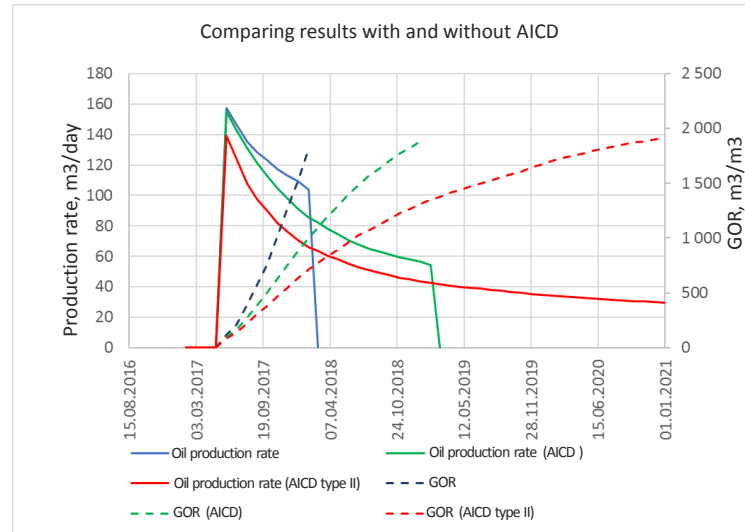
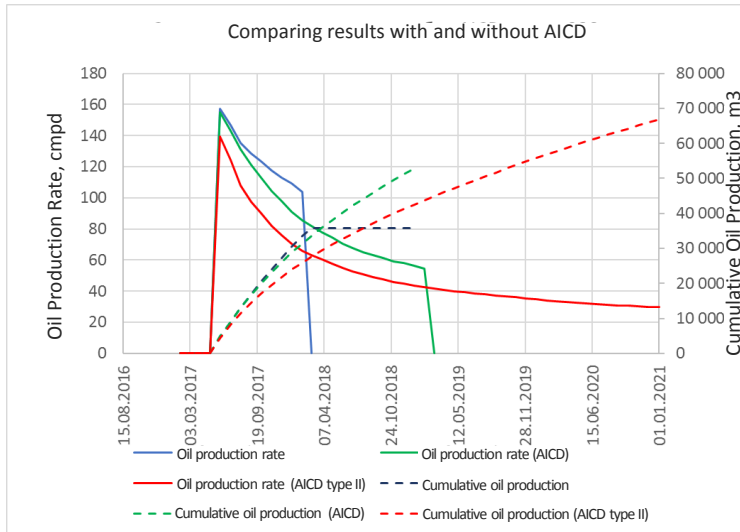
Results:

- Increased initial oil production rate
- Reduced GOR
- Production decline rate in a well with 20 hydrofrac stages similar to a well with 8 hydrofrac stages



Gazprom Neft Experience and Results (3/3)

Applying AICD to Horizontal Wells in Under-Gas-Cap Oil Rims



- Production forecast assumes bottom-hole pressure of 50 bars and well shutting down at $GOR > 2000 \text{ m}^3/\text{m}^3$
- Despite lower oil production rates, thanks to lower GOR numbers AICD wells work much longer and ensure a cumulative oil production increment of more than 20%

Summary

- By developing route of well completion, Gazprom Neft achieves 9% higher production from oil rims
- When analyzing high-tech drilling options, the high drilling risks, well operation complications and increased REVEX should be considered
- At present, Gazprom Neft is taking energetic efforts to test and introduce multi-lateral drilling technologies to develop its under-gas-cap oil reservoirs
- Gazprom Neft is aimed to implement new efficient technology solutions in order to develop under-gas-cap oil rims in difficult geology
- Full-scale implementation of the new technologies is one of the way to manage CAPEX