Presentation of innovation project for radial formation penetration Blood Vessels

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Technology of formation penetration Blood Vessels (BV)

This is technology for enhanced oil recovery and well flow intensification:

- increases coverage and area of well drainage;
- removes skin-factor;
- improves conductivity of formation matrix;
- maintains initial reservoir permeability.

The product of BV technology is water jet creation of multiple long radial filtration channels in producing formation with a possibility of their branching by three times in unlimited number of levels of their creation.

Creating controlled network channels by power and distribution, BV technology provides for maximum achievable coverage and decrease of formation anisotropy, involvement in development of hydrocarbons reserves which previously could not be recovered.
Characteristics of Blood Vessels technology

Parameters
- channel diameter - 80 mm;
- channel length – up to 300 – 500m;
- outlet from casing string into formation with flexible pipe -38.1mm;
- radius of formation penetration -7 - 9 m;
- fluid rate – up to 700 l/min.;
- orientation of channel direction in space;
- geonavigation and control over trajectory and wellbore;
- number of side-tracks at one level -2 – 4;
- number of levels is not limited;
- opportunity to perform full cycle of works with drawdown;
- environmentally friendly technology.

Blood Vessels technology is a service substitute of technologies of formation hydro fracturing, side-tracking, drilling of horizontal wellbores in multi-bore and multi-bottom wells.
Equipment for implementation of BV technology

Well workover rig
Coil-tubing package
Nitrogen supply package
Tubing for high internal pressure
System to remove cuttings from drilling mud
Drill pipes
Downhole tools
Process tubing
Road tanker

Special BV equipment:
1. Deflector
2. Window milling package
3. Rotation mechanism
4. Packer
5. Sealing device
6. Water jet nozzles
7. Wellbore trajectory control system
8. Geonavigation system
9. Relief device

Tank with degasser
Centrifugal supply pumps
Multi-purpose wellhead sealing device

Equipment providing for safety of personnel work and protection of equipment.
Sequence of works by BV technology

Well preparation
Normalization of well bottom
Gauging
Scraping of intervals for anchor setting
Testing of production casing integrity
Well logging
Milling of intervals
Running of 89 tubing with BV equipment assembly

Implementation of radial formation penetration
The following is run in the hole 38.1 мм flexible pipe: water jet nozzle, systems for control of wellbore trajectory and geonavigation and other elements of downhole assembly. Creation of high pressure jet in the nozzle provides for rock destruction, flexible pipe provides for creation of channel in the formation. Upon achievement of channel design length, the working tool is retrieved from the formation, deflector is turned to the next window, and the process is repeated. For work at the second level it is required to perform mechanical action with flexible pipe in order to switch over to the next milled windows at 80 cm above. Creation of channels is repeated. For work with drawdown the technology is supplemented with injection of cryogenic nitrogen into working solution with control of bottomhole pressure and downhole equipment in order to start the well for operation without well killing.
Experience in implementation of RDS technology in Russia – prototype of Blood Vessels technology

Technology of radial drilling of lateral tracks was born in USA and Canada over 30 years ago. In Russia the first works associated with water jet creation of radial channels were performed by RDS Company since the beginning of 2000s in the fields of Tatneft, Lukoil, Rosneft, TNK-BP, Gazprom, etc.

LLC Neftegas teknologiya jointly with RDS Company developed and performed works associated with drilling of radial channels in Gazprom in Bolshoi Urengoi fields in 2007 and 2008.

44 channels were drilling with maximum length of up to 100 m, including 3 radial tracks drilled with drawdown.

Testing results
Absence of process effect in terrigenous reservoirs due to clogging of walls of radial tracks and filling of radial channels with destructed rock.
The main downsides of former technology are:

- geometry of radial track cannot be predicted due to insufficient BHA rigidity;
- small flow rate and lack of carryover of destructed rock from radial track channel;
- choking of wash fluid outcome in casing string hole.
Downsides of RDS technology

The main downsides of former technology are:

- clogging of outlet from radial track to the casing string with rock during completion;
- no opportunity to perform navigation of radial track due to small BHA diameter;
- no opportunity to develop the technology in the part of increase of fluid rate, increase of work depth.

Flow cross-section is 12 times less than wellbore cross-section.
General differences of BV technology from known technologies of radial formation penetration

Differences and unique features

1. Creation of lateral tracks with use of geonavigation and system for control of wellbore trajectory.
2. Length of lateral tracks increases up to 300 – 500m with an opportunity of branching by three times with length up to 100m.
3. Capacity of the technology is higher by 30 times.
5. Opportunity to create lateral tracks with drawdown.
6. Focused impact on the formation.
7. Maximum coverage and increase of drainage area for hydrocarbons reserves.
8. Delicate formation penetration after remedial cementing.
10. Synergy due to combination of BV technology with formation hydrofracturing and drilling of horizontal wellbores in multi-bore and multi-bottom wells.
Competitive advantages for the user

Advantages of the technology compared to use of substitute services
1. Wider boundaries of application.
2. Higher oil recovery factor.
3. Higher production growth.
4. Less unit costs for additional production of hydrocarbons.
5. Synergy due to combination of BV technology with substitute services.

With implementation of BV technology of commercial development level the Subsurface user receives earlier not available opportunities to recover hydrocarbons from the fields, which results in intensification of production, growth of recoverable reserves and capitalization of the company.
Works implementation of which is expected from the Customer in the process of testing Blood Vessels technology.

- Well preparation for implementation of Blood Vessels technology
- Electric power supply
- Medical services
- Insurance of the well and works
- Geophysical operations, including gyroscope and/or directional survey for installation of deflector
- Final operations after Blood Vessels technology
- Removal of used drilling mud and cuttings
- Communication in work implementation location
- Organization of meals in the field
- Provision of accommodation in the field
- Provision of fire unit when working with drawdown
Relevancy of Blood Vessels technology

Blood Vessels technology is a new tool for development of:

- low-permeability reservoirs of hydrocarbons;
- oil pools under gas intervals;
- water-flowing deposits of hydrocarbons;
- multi-formation deposits;
- after implementation of water-insulation works;
- non-standard pools of hydrocarbons;
- shelf fields and Arctics;
- gas condensate deposits with abnormally low formation pressure developed in depletion mode;
- emergency well stock with lost part of wellbore in producing formation.
Demand for BV technology

- Currently interest to BV technology was demonstrated by the companies PJSC LUKOIL, PJSC Gazprom, PJSC Orenburgneft, PJSC Tatneft, etc.
- Currently the scope of substitute services (formation hydrofracturing, side-tracking, horizontal wells) in Russia is estimated at the level of 350 billion Rubles a year.
- Annual growth of market demand comprises about 5%.
- With growth of portion of hard-to-recover reserves of hydrocarbons it is predicted that there will be growth in use of such services.
- Forecast need in BV technology: replacement of part of services from scope of substitute services and origination of additional scopes for rehabilitation of “old” well stock.
- Pessimistic forecast of market demand in Russia in BV technology of commercial level – it will comprise at least 10%, 35 billion Rubles a year.
- Predicted annual demand of foreign market in BV technology – at least 3 - 4 billion US Dollars.
- Commercialization scheme – sale of services to final consumers.
- Potential consumers of BV technology are all oil and gas producing companies in the world.
- Market scope – global.
Expert assessments of Blood Vessels technology

The Russian Federation Ministry of Education and Science
Federal Stage Budget Educational Institution of Higher Professional Education
The Russian State Oil and Gas University named after I.M. Gubkin
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To: Director of LLC Neftegaztehnologiya
P.I. Popov

Dear Pavel Ivanovich,

In response to your letter (outcoming No 89/15) with a request to provide expert assessment to the project of radial formation penetration please be informed on the following.

Technology of radial formation penetration has been known for over 15 years and has its place in the market. It is caused by the fact that in wells where formation hydrofracturing is not possible or side-tracking is not cost-efficient it is possible to apply only radial formation penetration technology.

If it could be possible to replace flexible pipe with steel pipe of bigger diameter and with significant increase of working fluid flow rate (up to 700 l/min) without reduction of pressure, with high probability it would be possible to avoid the main downside of the technology – stoppage of carryover of formation destruction products.

Also, development of new pump equipment (in relation to increase of working fluid flow rate), application of new pipe, cutting hard-alloy nozzle and prospective navigation equipment look justified.

On our side we are ready to develop new working fluids, for example, gelled fluids for better carryover of rock pieces and reduction of filtration, or sour fluids for carbonate reservoirs.

In general the technology presents obvious interest for processes of intensification of oil production, including hard-to-recover reserves, and has its future.

Best regards,
Pro-rector for innovations and commercialization of developments, professor Silin M.A.

Positive expert assessments were received from:

1. The Russian State University of Oil and Gas named after I.M. Gubkin
2. PJSC LUKOIL
3. PJSC Gazprom
4. PJSC NOVATEK
5. PJSC Orenburgneft (NK Rosneft)
6. PJSC Tatneft
We invite potential Clients for a dialogue.

Thank you for attention!

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