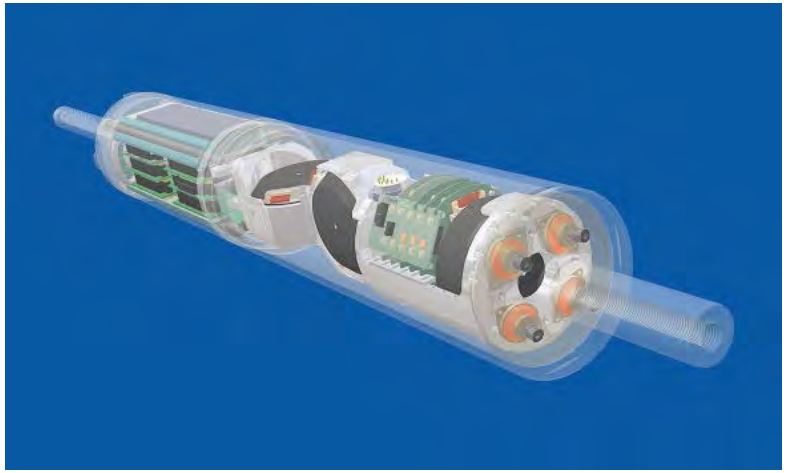
Advanced Drilling Innovations, Universal HDD

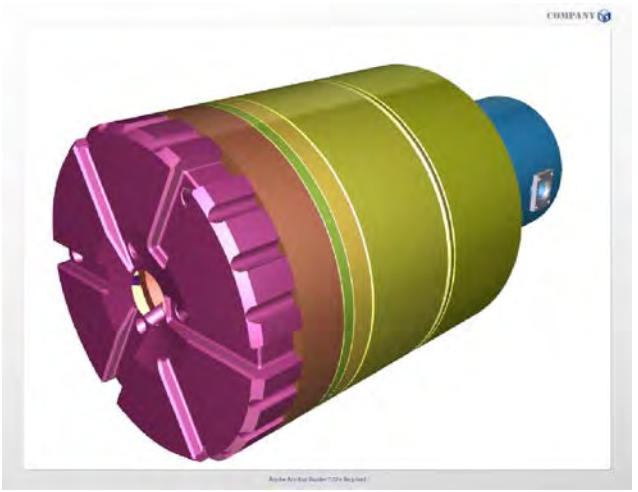
Vasily Anishchenko Alex Murovanny

HDD Emerging Technologies.

Innovations in HDD. Diversity of applications.

- **New generation of drilling rigs**
- **Most popular directions in research and development**
- **HDD contractors in new emerging markets**



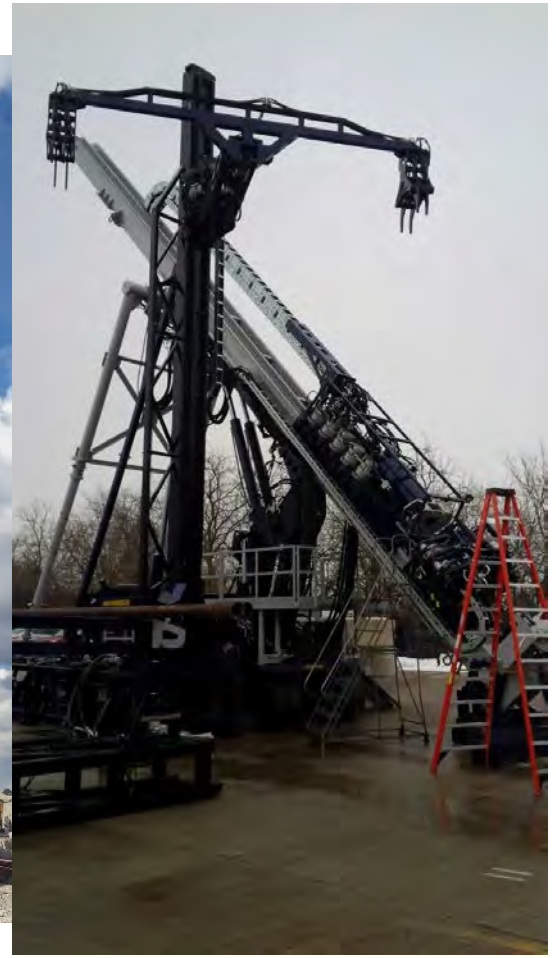


What novelties can there be? We have been in the industry long enough to know everything.

- HDD rigs for vertical, horizontal drilling and for work over operations
- Innovative navigational systems. GYRO+PULSE, no cables
- Underbalanced HDD with nitrogen and air, vertical relive wells, foam and salt water drilling fluids for HDD
- Precise positioning of tunneling face using Indoor GPS
- Small TBMs for extremely long distances

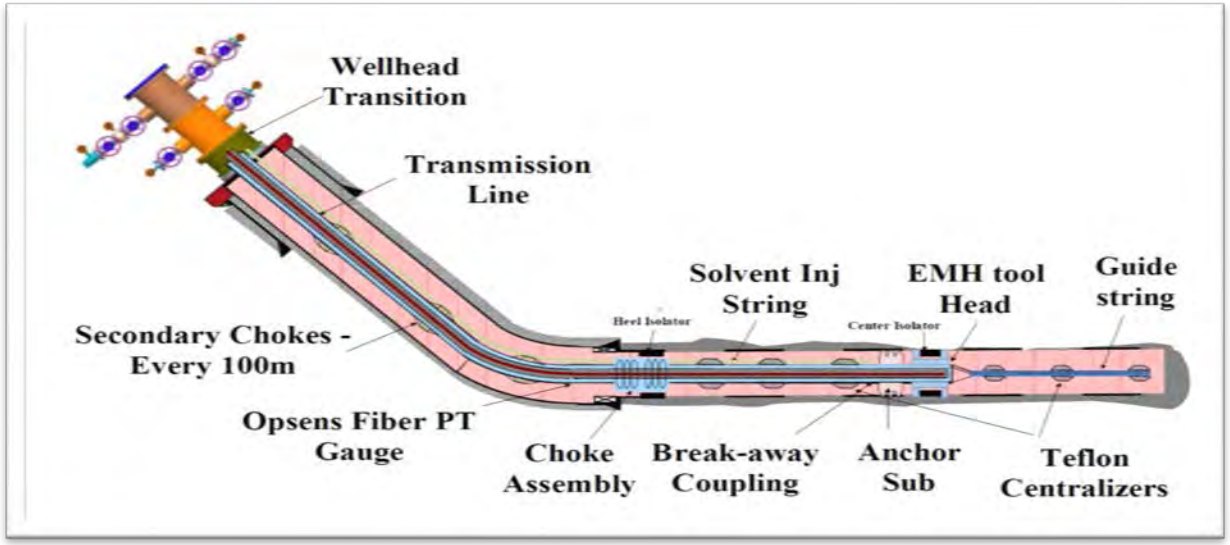
ADI Rigs offered Advanced Drilling Innovations,

- HDD
- Heavy Oil
- Work over operations
- Dead end holes
- Coal seam gas wells
- Water wells



ADI Rigs offered Advanced Drilling Innovations,

- Slant directional oil well drilling has been used in Canada, Russia, Australia, England and Norway for long horizontal wells 100-600 meters deep and 1-4 miles long. Most of the contractors are HDD companies.
- Heavy oil companies refused vertical drilling in favor of slant directional drilling (for shallow wells) due to lower costs and higher efficiency
- Rack and pinion rigs proved more effective than cable rigs in inclined position. HDD rigs were used at the first stage.
- Universal ADI has wide experience of slant directional drilling and produces rack and pinion slant directional drilling rigs.



History of Slant Directional Drilling

Inclined Cable Rig

Expensive and problematic. Is being replaced with more effective rack and pinion rigs

Redesigned HDD rig

Cheap, but not not designed for oil well drilling. Being replaced with new generation rigs.

New Generation Rack and Pinion Rig

Cheap in comparison with cable and designed after huge field experience. Technology polished now. Works best for heavy oil.

Example

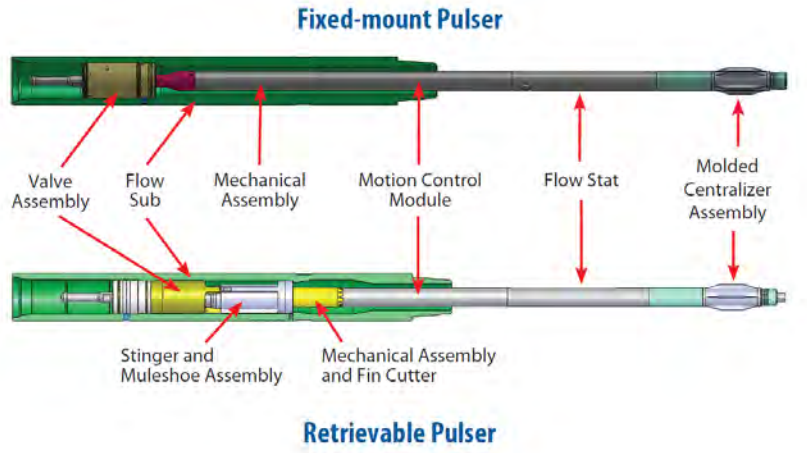
Ashalchi heavy oil field:

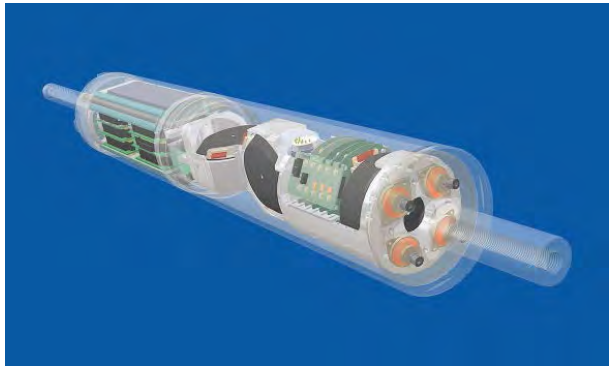
Day one: 2 inclined cable rigs and one rack and pinion

Day 365: 2 inclined cable rigs and 15 rack and pinion rigs

New generation of directional System

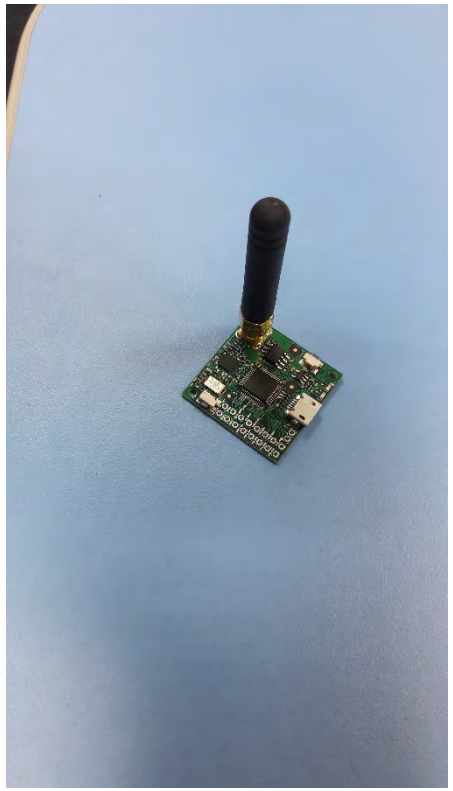
- The most economic MWD system proved to be pulse
- Some of the layers in coal and oil industry are electrically conductive and electromagnetic signals do get through
- Existing gyro systems could work, but cable is not cost effective when working with casings and measuring equipment
- Gyro+Pulse is used in oil well industry, but the systems are not for sale and are extremely expensive.





Laboratory, R&D initiative

- Position of a sensor relative to a frame of four or eight other sensors is defied with the precision of 2cm.
- Precision of logistics at the job site, effectiveness of transportation
- Cheap positioning of a TBM at a relatively short distance



How far you can go?

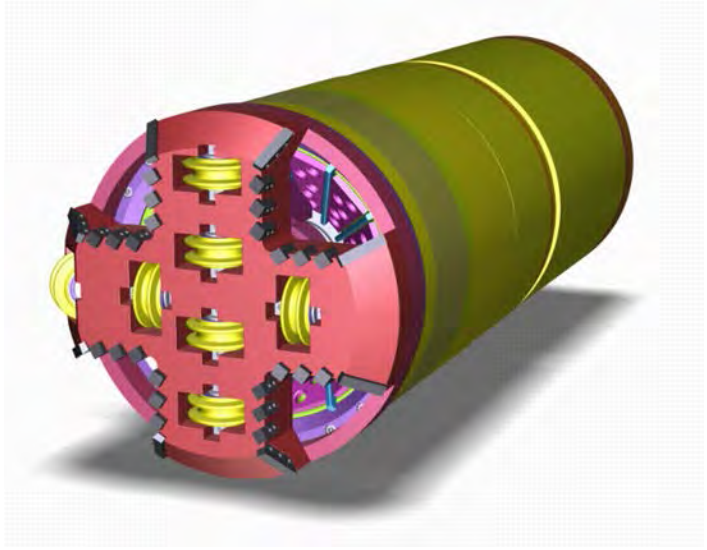
- Task: 1200 mm (48”) BP steel gas pipeline crossing 1.1 km long (0.7 miles) across a river. High dynamic water pressure and loose COBBLES.
- Solution: slurry tunneling machine for 1800 mm pipe jacking + very special engineering solutions.
- Ways to stay within a low budget: manual bentonite valves, dynamic approach to slurry (two mixing units, three storage reservoirs for three types of bentonite, used locally upgraded machine, no reception shaft, small machine for pipeline pull in, foam-concrete grouting solution, international team (British supervisors, French and Russian mechanics, Azerbaidzhan logistics managers, Turkish Supply manager, Turkish Shaft subcontractor, American consultants))

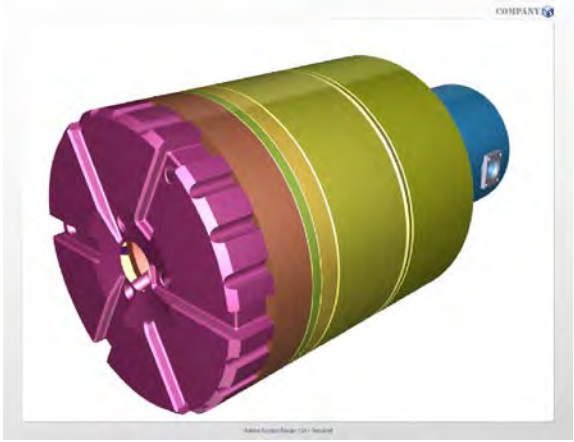
Can you afford R&D? Use our specialists at your premisses.

42” or smaller slurry TBM for pipe jacking to over 500 meters. Is it possible?

One of the solutions offered by a German company – 800 mm TBM with direct electric drive.

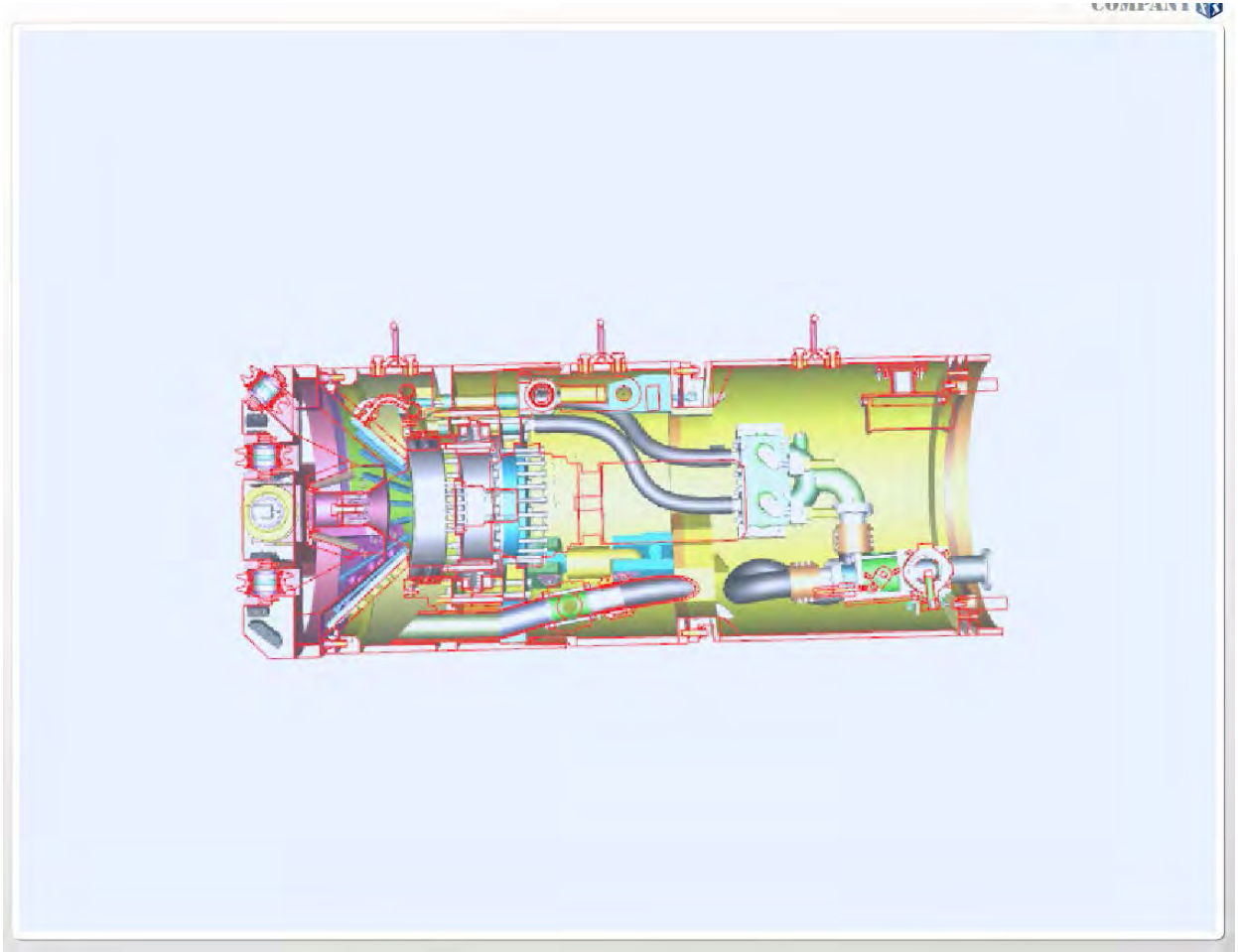
Cooperation in R&D is the only way to create a technical novelty for a small company.





Developing New Generation of Tunneling Equipment

- AVN 800 with Liebherr 57 kWt Electric Drive designed by SMP managed by Vasily Anishchenko.
- Air hammer + Auger Boring machine designed by SMP. Contract with WESU GMBH.



We offer

- Tunneling solutions. Consulting. Engineering
- HDD solutions
- Segmental lining design
- Method statements
- Prefeasibility studies
- Heavy machinery design
- Designing navigational systems
- Designing and producing parts for your machines (any parts)

Cooperation

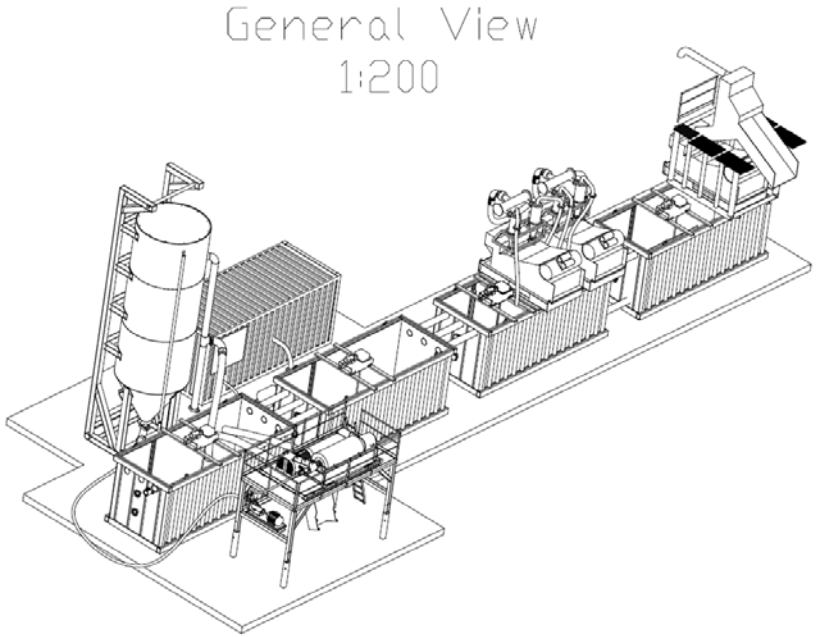
- Carrying out complete feasibility, engineering, customer support at the job site, at the customer's wish, any part of the job at the job site. (Normally TBM producers are not willing to take any responsibility for any process at the job site save responsibility for their equipment)
- Our specialists can accompany our potential clients to complex technical negotiations with their customers providing upper hand in negotiations serving as a part of our client's team
- Educating personnel at the job site. Some of tunneling companies save money on personnel. It takes from 10 to 20 days to educate unexperienced team most of the tunneling skills only if you have experienced teachers.

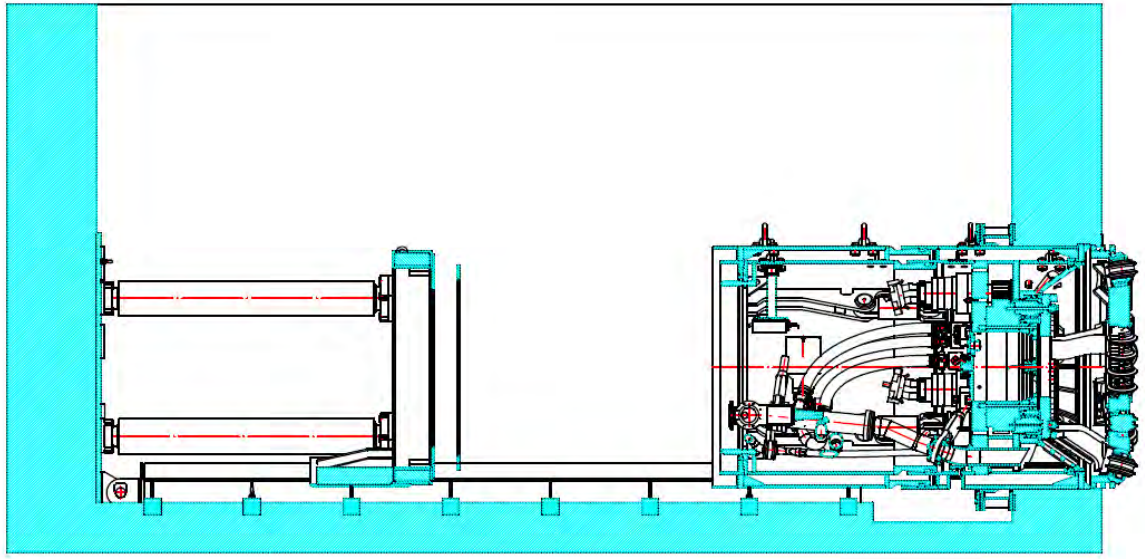
Tunneling

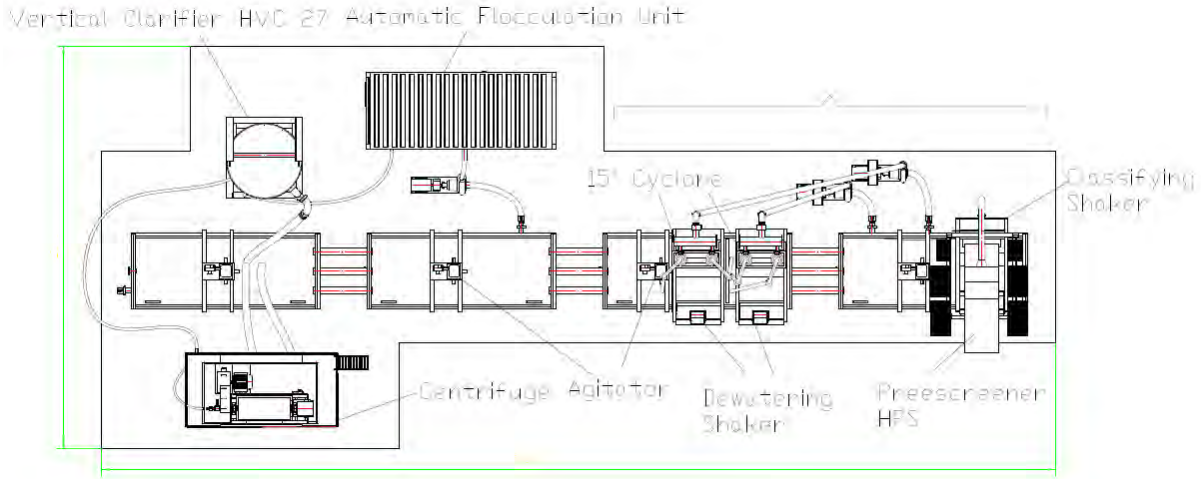
- Design of segmental lining
- Strength calculations
- Project engineering
- Trajectory calculations
- Job site layouts
- Method statements
- Experienced personnel provision (only for Bessac)
- Job site project support: trouble shooting, crisis management etc.

Project engineering

- Job site layouts (both segmental lining and pipe jacking)
- Design of individual site assemblies
- Manuals for equipment
- Manuals to technological processes
- Charts, diagrams
- Job site managements
- All drawings in the picture and other job site drawings in this presentation were accomplished personally by Vasily Anishchenko using CAD programs







Drilling

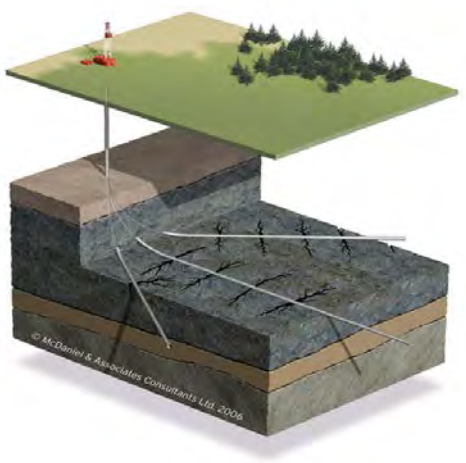
Convinced one of the biggest oil well drilling companies in Russia that using a rack and pinion rig is more effective for heavy oil reservoirs than conventional machines. Adopted Canadian SAGD technology for Russia. A paper of about 1 000 pages is available to responsible parties at a qualified request.

Vasily Anishchenko supervised the drilling of inclined 1 mile long wells at Ashalchi and Yarega heavy oil fields (Vasily lived one year in a 20 ft container at the drill site supervising all drilling processes). First successful application of technology with rack and pinion rigs in the world.

Inclined drilling and vertical oil well drilling

Yastreb (by Exon Mobile) is 10 times more expensive than an inclined rack and pinion rig, which could be used for the same purposes.

The Inclined rigs are produced in Chicago after the designs proposed by Vasily Anishchenko. Vasily supervises production and hold a managerial position at ADI.



Inclined Drilling

Vertical (since 1850)

+

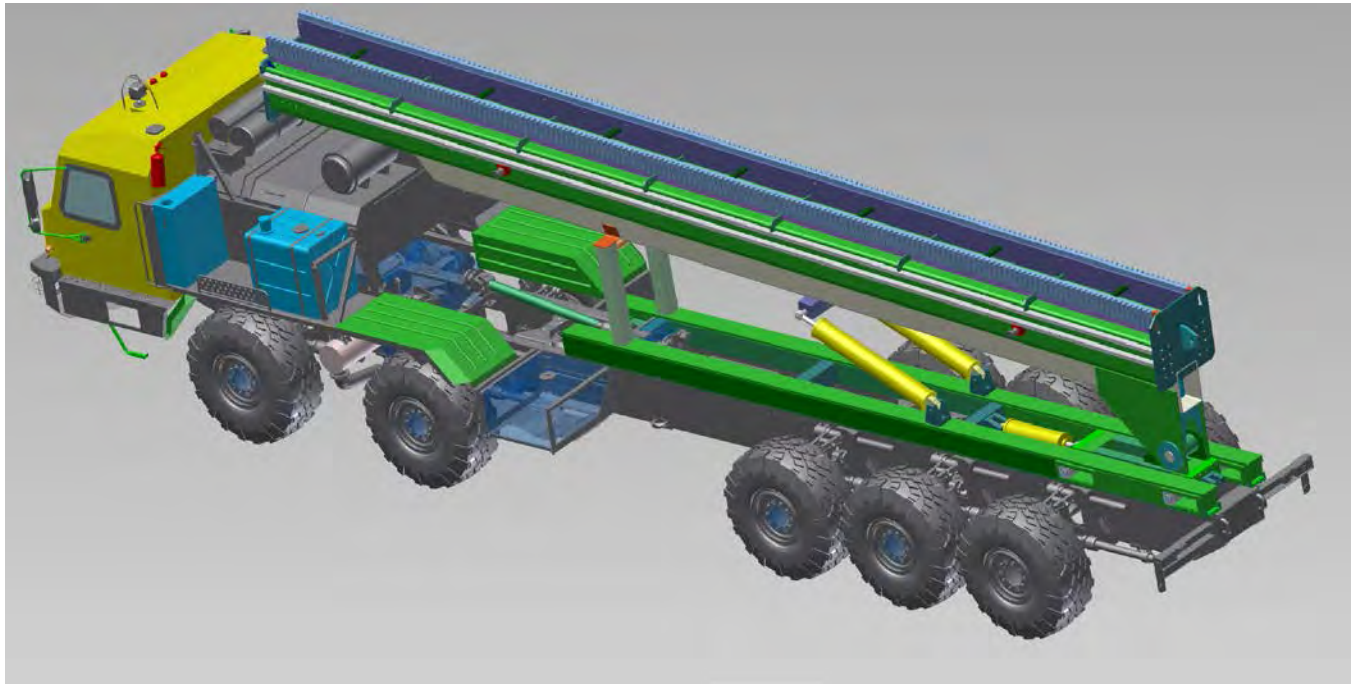
HDD (since 1972)

=

Slant directional drilling, SDD (since 2011)

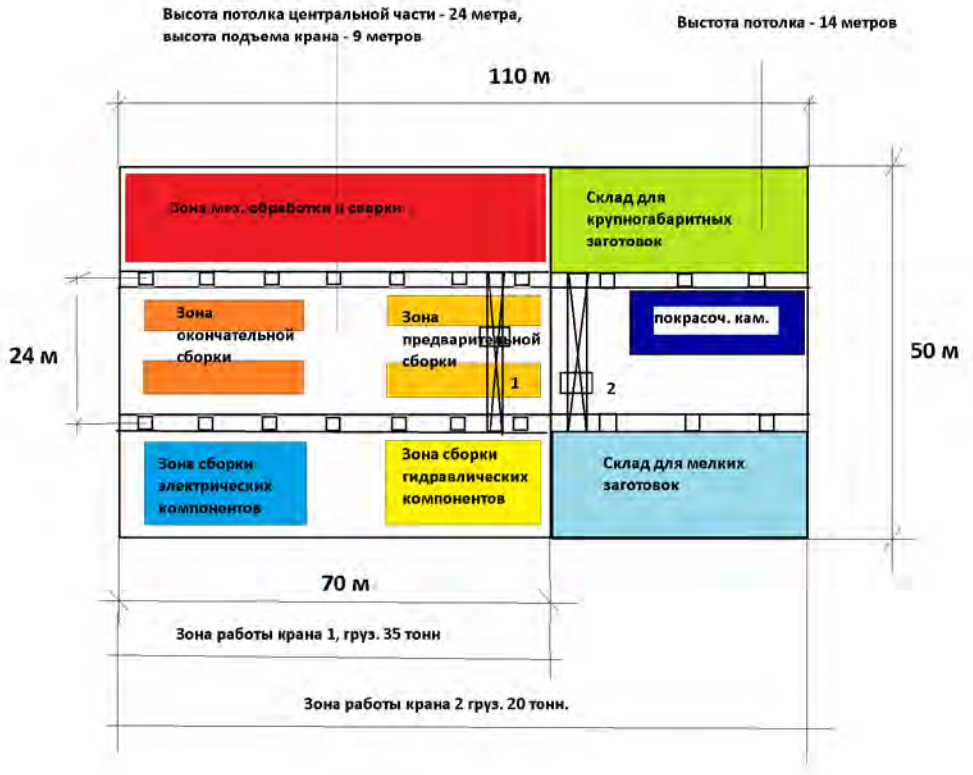
Design of New Generation of Drilling Rigs

The design was accomplished by SMP for Russian biggest coal producer, SUEK. The production is carried out in Chicago, USA (croller or truck rigs are offered to the customers).

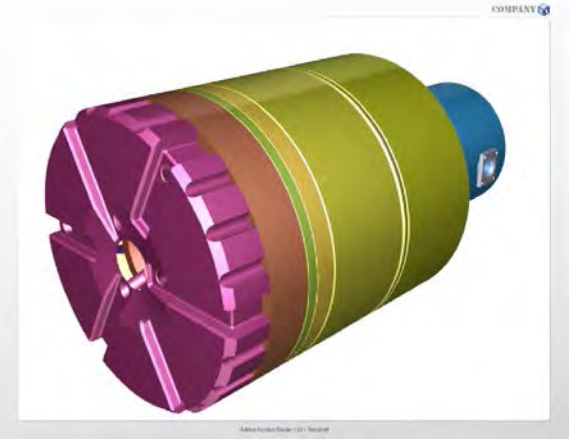


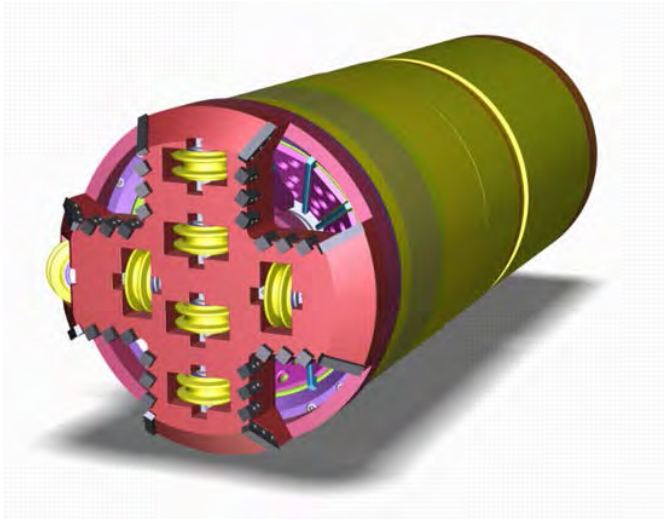
Engineering of Equipment Production Processes. Consulting

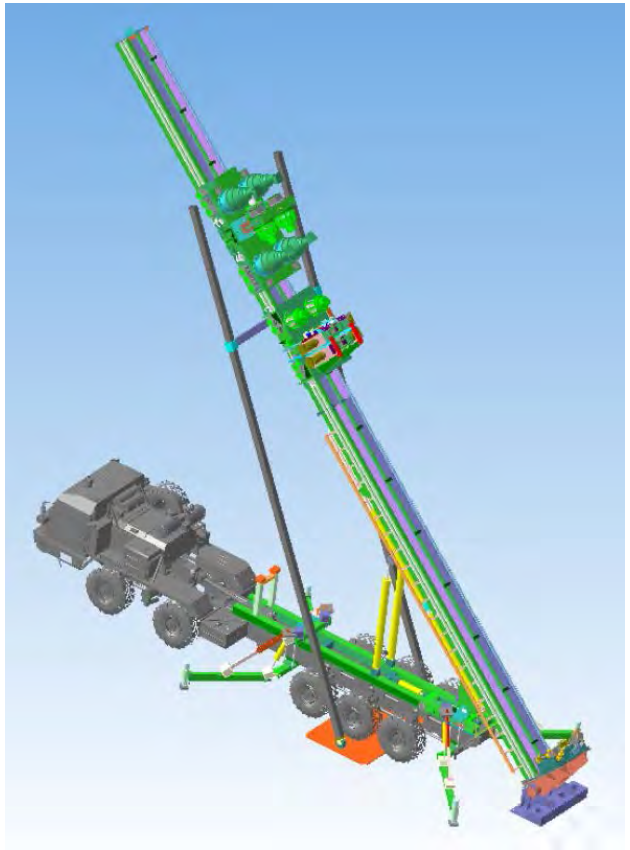
Plans of shops, technical requirements and consulting on logistics of components and production technology



Managing design department (4 people in Russia and 5 people in chicago with huge experience, our own office space)

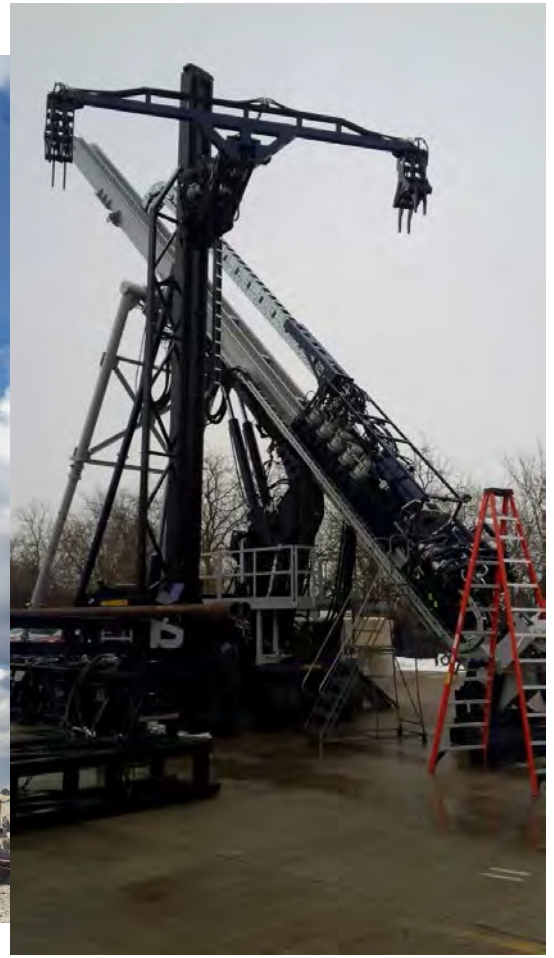




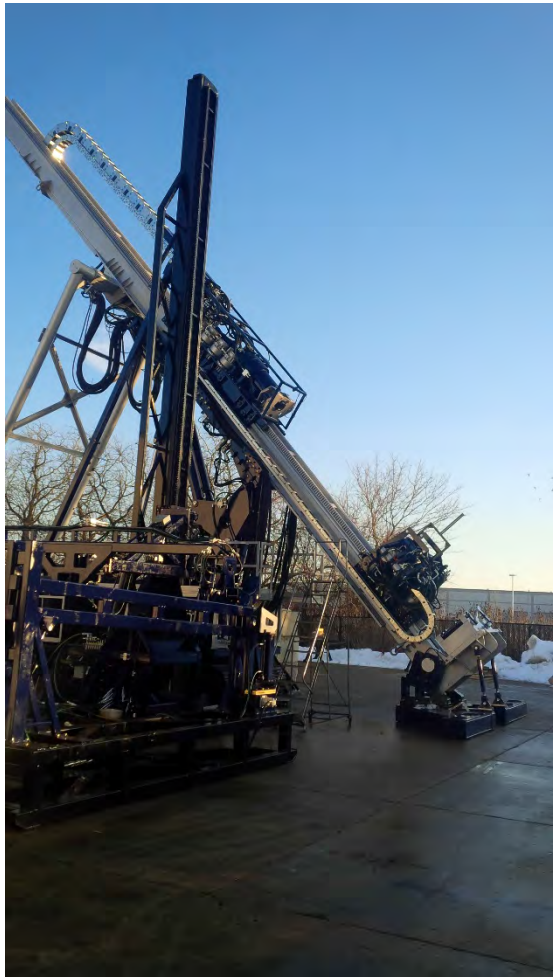


ADI Rigs produced in Chicago after Vasily Anishchenko's designs and specifications

- Concept of the rig by Vasily Anishchenko
- General design by SMP in Russia and Universal HDD, Chicago
- Detailed componential design in Chicago under the guidance of Vasily Anishchenko
- Production in Chicago
- In the photo-rig in the field.



OIL AND GAS DRILLING RIG ADI360VS
Now avaliable



NEW GENERATION - ONE RIG 10 PATENTS

Horizontal+Inclined+Vertical drilling+Money saving

- SAGD drilling (Heavy oil and bitumen)
- Oil well drilling (Ordinary oil wells)
- Coal Seam gas wells (Methane extraction from coal layers)
- HDD drilling (trenchless installation of pipes and cables)
- Geothermal (heating and cooling of buildings+energy)
- Water sinking (Getting rid of water in mining shafts and tunnels)
- Geological survey (mobile rig equally good for hard rock and alluvial soil)
- All sorts of drilling for mining industry

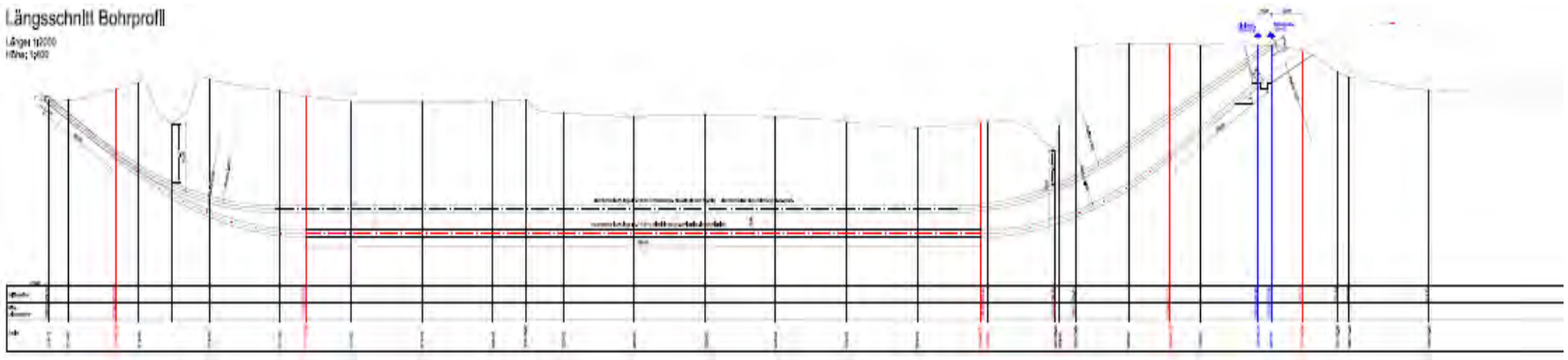
Technical characteristics ADI360VS

№	Description	Parameter
1	Rack and pinion HDD rig	+
2	Pull/push force	150 tons
3	Torque	70 kN/m
4	Type of the engine	Diesel Engine
5	Engine power	600 HP
6	RPM	2100
7	Rod length	12 meters
8	Maximum carriage speed	50 Meters a min
9	Oil heating system which diesel engine turned off, electric pump delivers warm oil to motors and valves	Winter package + Additional radiators for extra hot conditions
10	Inclination degree	10-90
11	Break out unit	127mm-477mm
12	Trucks	Steel with hydraulic drives
13	Original anchoring system	+
14	Possibility to shift the drilling axis	+
15	Force communication type	Rack and pinion
16	Visualization display monitor to control working parameters	+
17	Steering cabin with air conditioner and a heating system	20’ Container
18	Front foot	+
19	Free space in front of the rig, abi	+
20	Ability to work with front foot and rotary table	+
21	Hydraulic tank	778 liters
22	Diesel tank	756 liters
23	Axial shift of the mast (rack)	+
24	Lateral shift of the mast (rack)	+
25	Double action rack lifting parallelogram	+

Customer Support

Customers purchasing equipment for us can get a fully fledged project engineering and consulting support. I can offer the following to your customers:

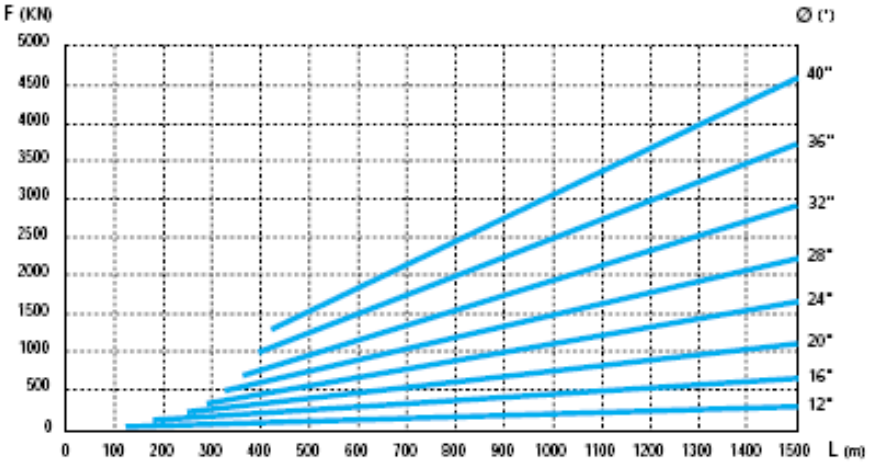
- Project analysis, geological reports, survey analysis
- Compilation of method statement
- Engineering calculations: drilling trajectory, strength, buoyancy control etc.
- Experienced drilling consultants supporting your drill sites technology
- Spare parts and after sales service
- Job site drawings and designs
- Control of the hole geometry before pipe pull in
- Drilling fluids engineering
- Education of customers' specialists

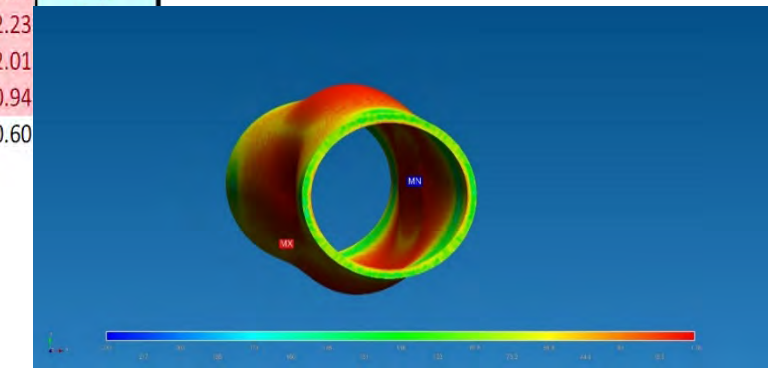


Customer Support. Choice of the rig. Pipe Stress Analysis. Trajectory Checking.

RivCross Survey Export 2.6.5
New Job
25/7/2011

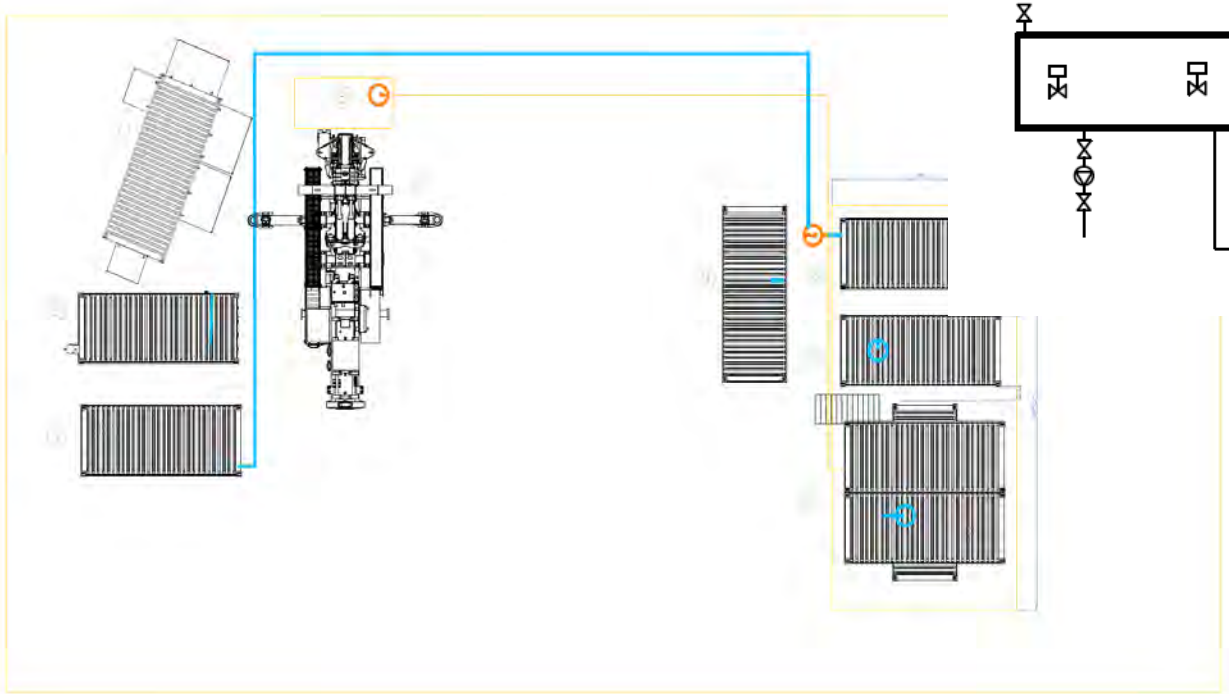
Joint	MD	Incl	Az	Away	Elev	Right	Dls	Build/Joint	3 Jt Av	Ream 3 Jt Rad (m)
23 (+1.43)	226.74	91.13	172.63	219.89	-7.32	-1.91	5.21	0.63	0.19	3069
24 (+1.56)	236.26	91.96	172.61	229.4	-7.06	-1.86	2.76	0.83	0.53	1074
25 (+1.46)	245.75	92.86	173.18	238.88	-6.67	-1.73	3.13	0.9	0.79	728
26 (+1.24)	255.16	94.44	172.4	248.27	-6.07	-1.65	6.01	1.58	1.10	519
27 (+0.9)	264.44	96.06	171.96	257.52	-5.23	-1.68	5.46	1.62	1.37	419
28 (+0.69)	273.81	98.94	171.99	266.8	-3.98	-1.73	7.62	2.88	2.03	283
29 (+0.38)	283.2	101.14	171.41	276.04	-2.33	-1.82	6.44	2.2	2.23	
30 (+0.26)	292.64	102.09	171.15	285.28	-0.4	-1.96	2.29	0.95	2.01	
31 (+0.09)	301.99	101.76	172.1	294.43	1.51	-2.09	4.97	-0.33	0.94	
31 (+9.53)	311.43	102.95	171.94	303.66	3.52	-2.15	4.58	1.19	0.60	

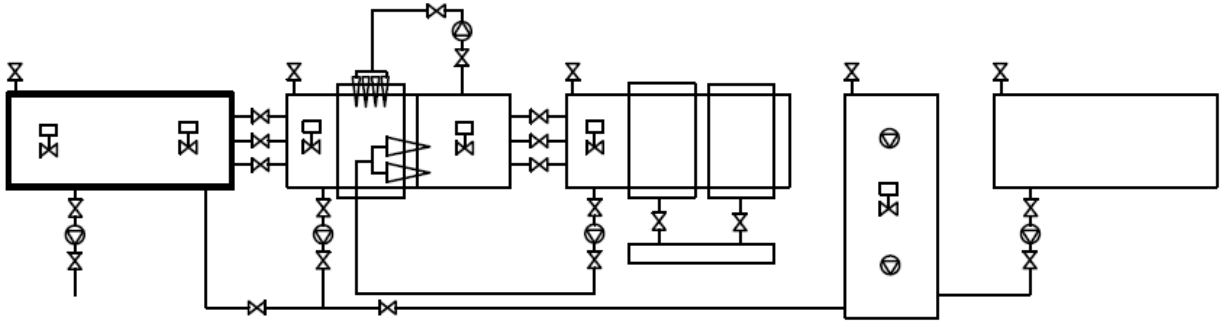




$$P_{tc} = \frac{2E}{1-\nu^2}\frac{1}{\frac{D}{t}\left(\frac{D}{t}-1\right)^2}$$

Customer Support. Job Site Layout. Separation Plants' Design. Mud Cleaning Program. Pumps. Mud Motors. RSS. Rigs of any type and any producer.





Customer Support Experience

- 890 m of 56 inch gas pipeline across The Sukhon River in the Far North
- 1000 m of 56 inch gas pipeline crossing in Vologda, Russia (gravel and small boulders in sand and clay), the pipeline was pushed, not pulled into the hole
- Ashalchi Bitumen oil Field development (supervision and engineering contract for the first 30 wells 1 - 1.5 km)
- Numerous smaller HDD projects in North Dacota, South America, Russia, Middle East, Korea etc.

Production Experience

- Mud cleaning units
- Rack and pinion lab stands
- Rack and pinion masts
- HDD rigs
- Multifuntional drilling rigs
- Upgrading used micro tunneling machines
- Outfitting micro tunneling machines for extremely long distances. Non-standard customized solutions

Wrong and right ways to save money

Right	Wrong
• Saving the money on the number of geological survey wells, but sending a qualified specialist to the site to assess the situation at the survey stage to stop the process when the information is sufficient • Getting a used, and properly refurbished and checked machine • Using unexperienced team with experienced key specialist after proper education of the team at the job site • Saving money on the number of intermediate shafts by preparing a TBM for extremely long drive (additional power packs in in the machine, extended cables and pipes) after calculating the tunneling forces and curves • Finding experienced partners for the most complicated part of the job and subcontracting them for the job	• Saving money on geological survey because modern equipment can work in any geological conditions (a lot of very modern TBMs have sunk and were lost in geology) • Getting a used machine for the cheapest price and hope for the best (Loss of project due to TBM failure is the most common thing not mentioned by TBM producers, they only show success stories) • Saving money on personnel • Just extending cables and pipes following the recommendation of TBM producer without proper calculations • Taking to an extremely complicated world record job without experienced partners or subcontractors

Thank you very much for your attention!