Development of inaccessible mines

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Present challenges and new opportunities

Challenges in the field of inaccessible mines' development:

- Extreme climatic conditions of inaccessible mines (ex.: offshore, Yamal peninsula, Arctic Circle, Amazon) and significant CAPEX for the development of transport infrastructure make the development of several large mines economically unprofitable;
- As a result – development of these mines is not possible without the introduction of new innovative solutions for infrastructure development.

UST possibilities:

- UST system is a unique solution in conditions of permafrost, snow, and low temperatures (down to –70 Celsius), ice, boreal forest, swamps, jungles, mountain landscapes, etc.;
- CAPEX is 3-4 times lower compared to conventional railway during the construction of system in extreme climatic conditions, OPEX is lower by more than 3 times;
- High level of technology's technical and economic efficiency at all stages of the project through the use of a series of know-how;
- UST track structure is located above the ground on light poles, thereby reducing the dependence on the relief, snow, floods, etc.

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UST introduction

About company:

- Group of companies “UST” is preparing the implementation of projects in several countries around the world.

About the technology:

- Technology is developed since 1977;
- Received two UN grants (UN-HABITAT);
- First test site (length 150 m) was built in 2001 in Moscow region, Russia;
- Is supported by Russian Academy of Sciences.

Portfolio of potential projects (total value of about 800 billion USD):

- Natural gas (Yamal Peninsula, Russia);
- Rare metals’ mine Tomtor (Yakutia, Russia);
- Coal mine Tavan Tolgoi (Mongolia);
- Iron ore mine Mutun mountain (Bolivia);

and others.

More than 40 patents

More than 25 international diploma and awards

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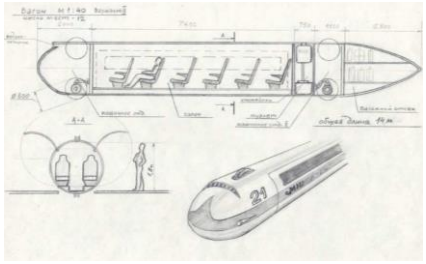
Stages of technology development

IPO



1977 – 1994

- ✓ First application by author Anatoly Yunitskiy for the invention;
- ✓ First publications in USSR scientific journals;
- ✓ Recognition of string transport technologies by USSR Federation of Cosmonautics. First grant;
- ✓ First international scientific conference on string technologies;
- ✓ Popular science film about string technologies and author Anatoly Yunitskiy;
- ✓ Grant by Soviet Peace Fund and the establishment of design bureau in Gomel.

1995 – 2000

- ✓ Creation of scientific school and first scientific monograph on string technology by Anatoly Yunitskiy;
- ✓ First operating models. Testing of rapid rolling stock (prototype) in aerodynamic tunnel;
- ✓ First UN grant (UN-HABITAT);
- ✓ Development of technology's 1st generation.

UN-HABITAT
FOR A BETTER URBAN FUTURE

Grant FS-RUS-98-S01

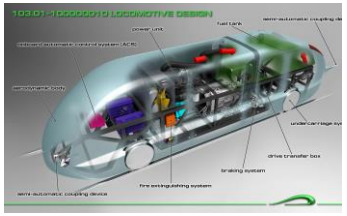
Sustainable Development of Human Settlements and Improvement of their Communication Infrastructure through the Use of a String Transportation System

2001 – 2009

- ✓ First test site in Ozyory, Moscow region (designed and constructed by "Company Yunitskiy");
- ✓ Second UN grant (UN-HABITAT);
- ✓ Creation of design company "Unitsky String Transport" in Moscow and design bureau in Minsk;
- ✓ State contract with the Administration of Khabarovsk Territory;
- ✓ State contract with the Administration of city Stavropol;
- ✓ State contract with the Administration of Khanty-Mansiysk Autonomous District-Ugra;
- ✓ Support by President of Russian Federation during the State Council, dedicated to innovations in transport sector;
- ✓ Development of technology's 2nd generation.

2010 – present time

- ✓ Creation of design companies in Australia and joint design office in Minsk. Creation of design schools for the development of technology's 3rd generation;
- ✓ First contract with Australian company STS Ltd for research;
- ✓ Creation of "UST" Group (UK), with an estimation (total project's value) of USD 800 billion;
- ✓ Development of technology's 4th generation in order to enter the world market (compliance with UN, USA and Russia regulations).



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Test site (Moscow region, Russia)

Main characteristics:

- Length — 150 m;
- String tension — 450 tons;
- Supports — up to 15 m;
- Spans — up to 48 m;
- Maximum weight of a moving load — 15 tons;
- Metal track structure — 120 kg / m;
- Slope of the route — 10%.

Hundreds of tests and experiments which received numerous expert reports, including UN reports, were conducted over 8 years on the test site. Construction methods, materials, design concepts and calculation methods were carried out during the testing. Behavior of string transport system in various loading conditions, including the influence of changing climate conditions was studied. Technology of operation, maintenance and repair of string track were optimized.

Main outcome of the test site is next generations of string transport technologies.

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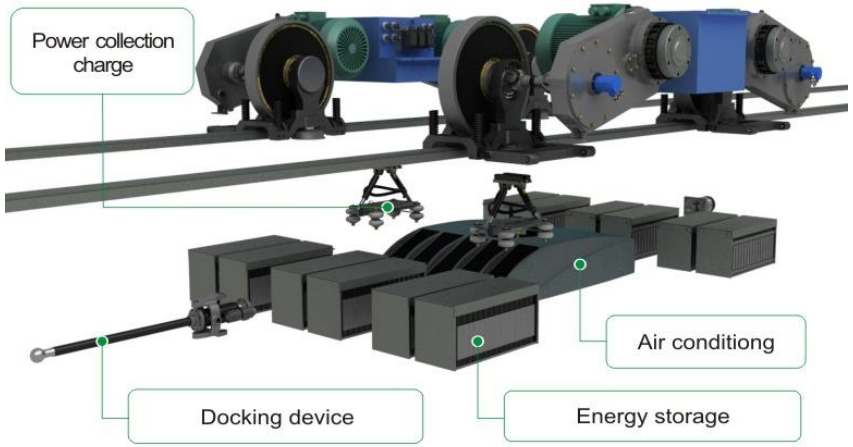
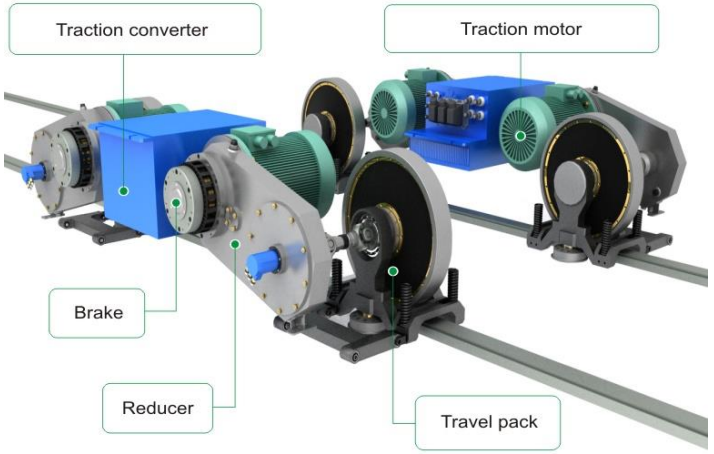
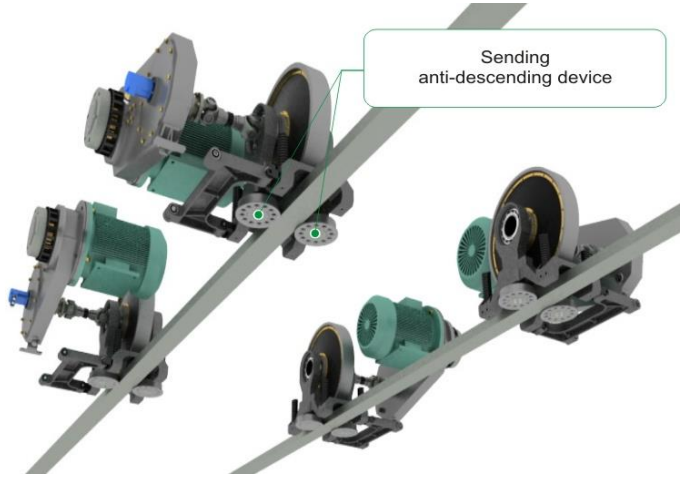
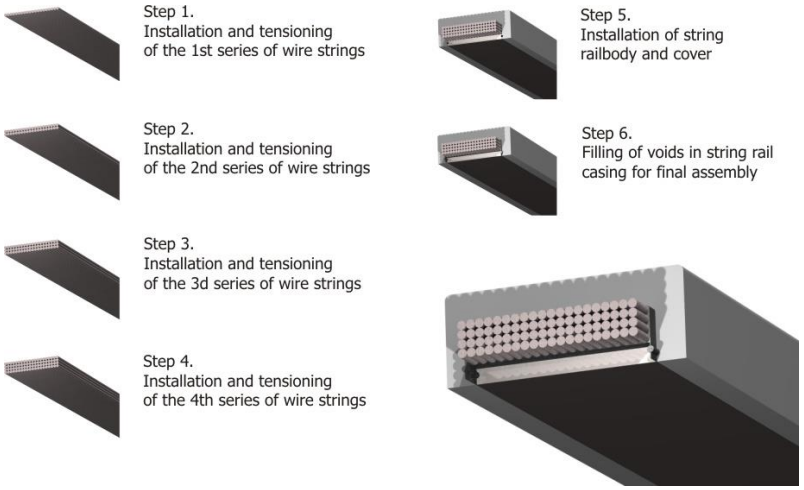
Basic units

Track structure and rolling stock design is based on existing units, materials and components produced by leaders of global industry.









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Examples of possible UST projects (1 of 5)

Development of Yamal peninsula (Russia)

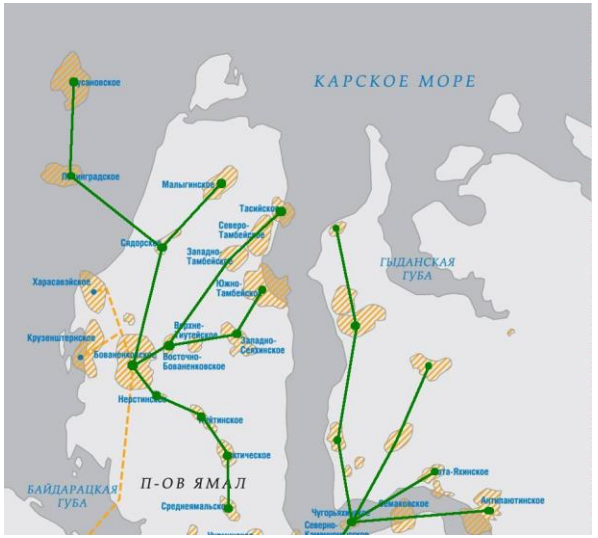
Challenges of Yamal peninsula:

- ✓ High cost or inability to construct transport infrastructure in unstable and permafrost soils, landslide areas, wetlands;
- ✓ Delivery and removal of equipment and supplies during construction and operation, including the delivery of heavy pipe, drilling equipment, etc. in a single winter season.

Benefits of UST technology:

- ✓ Independence of transport system from the terrain;
- ✓ Operation in conditions of extremely low temperatures and snow;
- ✓ CAPEX for the construction of main pipeline by the proposed technology will be 35–40% lower than by traditionally used type of construction;
- ✓ Additional expenditures in the amount of USD 100,000–150,000 per km allows the organization of transport system for heavy road traffic by the pipeline.

Map of Yamal peninsula with marked possible lines of UST



Possible partners

ГАЗПРОМ
НОВАТЭК
ТНК
ТЮМЕНСКАЯ НЕФТЯНАЯ КОМПАНИЯ
ЛУКОЙЛ
РОСНЕФТЬ

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Examples of possible UST projects (2 of 5)

Development of rare metals' mine "Tomtor" (Yakutia, Russia)

Challenges of "Tomtor":

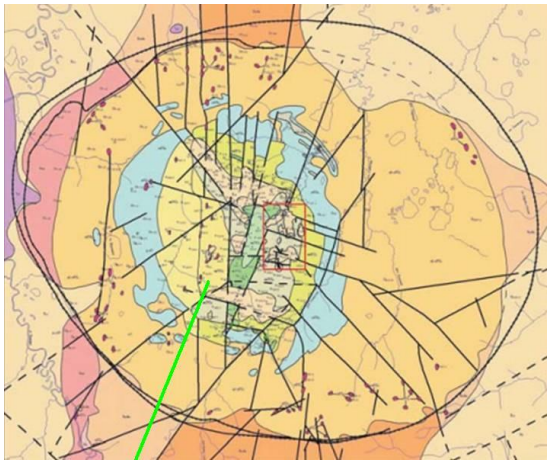
- Mine contains phosphate ore and rare metals, which have no analogues in the world for quality and highly valued by modern industry: niobium*, scandium, yttrium, etc.;
- Lack of transport infrastructure (nearest railway station is 700 km away from the mine in town Mirniy) still made economical development unprofitable;
- Temperature reaches below 70 degrees Celsius.

Benefits of UST technology:

- Development of Tomtor mine will result in substantial profits from the sale of deficit metals;
- Efficient transport and development of new areas;
- Project can be implemented only with the involvement of private financing, at no cost from the budget;
- Average cost of 1 km double-track freight route (with infrastructure and rolling stock): USD 2.8 million (for a capacity of 100 million tons per year);
- Cost of transportation of one tone of goods: USD 3.73;
- Annual volume of cargo up to 100 million tons;
- Payback (700 km, up to 50% load) is 3–5 years.

* Niobium is widely used in metallurgy, rocketry, aviation and space technology, electrical engineering, electronics and nuclear power. Need for niobium is growing quickly – up to 15% per year. Content and reserves of niobium ore in Tomtor is unique – this mine rates are several times higher than the world average value.

Map of Tomtor mine



Possible partners

АЛРОСА ALROSA

PHOSAGRO

УГМК UMMC

Russian Railways

Российские железные дороги

PETROPAVLOVSK

UST

Examples of possible UST projects (3 of 5)

Development of Tavan Tolgoi coal mine (Mongolia)

Tavan Tolgoi challenges:

- ✓ Mine contains high energy coking coal;
- ✓ Lack of transport infrastructure;
- ✓ Important environmental (and political) factors: the removal of significant pasture land.

Benefits of UST technology:

- ✓ High levels of “green” standards and fuel efficiency allow to call for the support of authorities and public;
- ✓ Project includes options in choosing a route tracing, i.e. it is possible to choose partner country and minimize the risks of transit;
- ✓ Average cost of 1 km double-track freight route (with infrastructure and rolling stock): USD 2.2 million (for a capacity of 100 million tons per year);
- ✓ Cost of transportation of one ton of goods: USD 7.04;
- ✓ Average annual volume of cargo is up to 100 million tons;
- ✓ Payback (1300 km, up to 50% load) is 3–5 years.

Map of Tavan Tolgoi mine

Possible partners

bhpbilliton · JINDAL STEEL & POWER · VALE · RIO TINTO · ГАЗПРОМ · Peabody ENERGY · РЕНОВА ГРУППА КОМПАНИЙ · Russian Railways · Российские железные дороги

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Examples of possible UST projects (4 of 5)

Development of Chiqitues iron ore mine (Mutun mountain, Bolivia)

Challenges of Mutun mountain:

- ✓ Largest iron ore (over 100 billion tons) and manganese deposit;
- ✓ Lack of transport infrastructure;
- ✓ Construction in complicated climate conditions (jungle, wetlands, mountain areas).

Benefits of UST technology:

- ✓ Independence of transport system from the terrain;
- ✓ Efficient transportation and development of new areas;
- ✓ Average cost of 1 km double-track freight route (with infrastructure and rolling stock): USD 2.8 million (for a capacity of 100 million tons per year);
- ✓ Cost of transportation of one ton of goods: USD 5.96;
- ✓ Average annual volume of cargo is up to 100 million tons;
- ✓ Payback (1550 km, up to 50% load) is 4–5 years.

Map of Chiqitues mine

Possible partners

bhpbilliton RIO TINTO JINDAL STEEL & POWER VALE

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Examples of possible UST projects (5 of 5)

Solution for local infrastructure problems

Challenges (for example, “coal mine – power station” route):

- ✓ Continuous increase in transportation tariffs by railway operator;
- ✓ Small amount of cargo.

Benefits of UST technology:

- ✓ Lower OPEX allows keeping tariffs at a lower level than traditional carriers;
- ✓ Various types of technology allow you to select and design the route most suitable for the conditions of the project (type of cargo, volume, terrain, etc.).

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Possible funding schemes

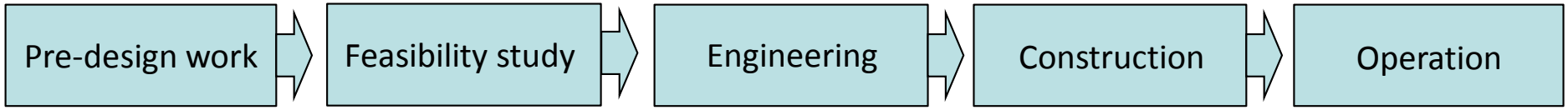
1) Project financing for long-term supply contract

2) Project financing under the contract of transportation services' provision

3) Joint Venture

4) Other terms and conditions

Stages of financing *



Share in total investment value

Up to 1%	*Up to 3%*	*Up to 10%*	*Up to 90%*

*Technology is tested in numerous scientific and research works, series of operating models, full-scale test site, so it is possible to proceed to the detailed design and construction in the practical implementation of the project, as well as to the engineering of a complete cycle (from design to maintenance and repairs).

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