KUALA LUMPUR 2012 WORLD GAS CONFERENCE

25th world gas conference

"Gas: Sustaining Future Global Growth"

Experience of Designing Natural Gas Transmission Pipelines in Super Challenging Geological and Environmental Conditions of Eastern Siberia and the Far East

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Venue: WOC-3

Patron: IGU International Gas Union / Union Internationale du Gaz

Host: Malaysian Gas Association

Host Sponsor: PETRONAS

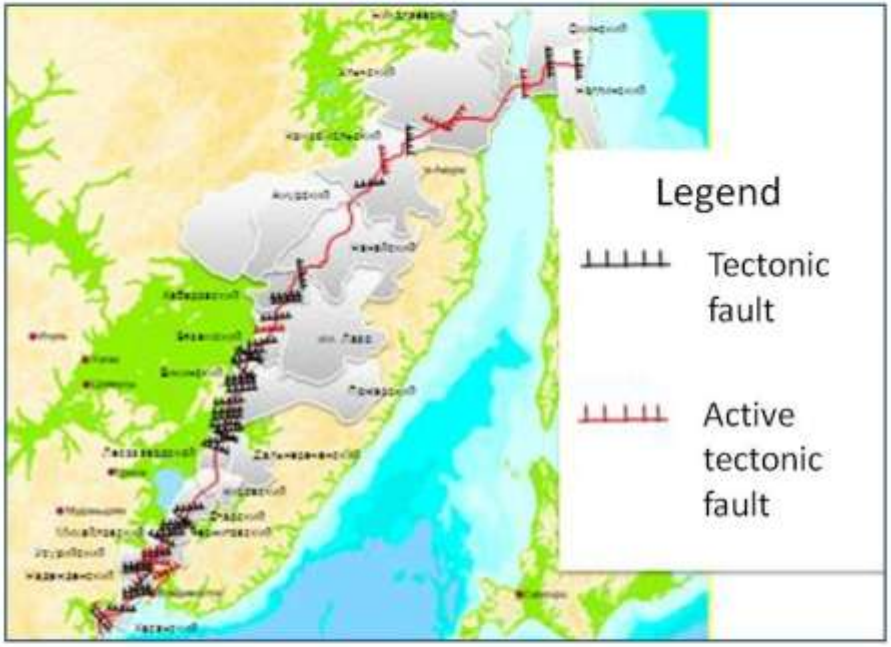
Basic Characteristics of Sakhalin – Khabarovsk – Vladivostok Gas Transmission Pipeline

Basic technical characteristics:

Route length -	1,836.7 km
- incl. the first start-up complex -	1,227.6 km
Branch length to Vladivostok -	116 km
Operating pressure -	9.8 MPa
Gas pipeline diameter - 1,220 mm	
- at crossing via Nevelsky Strait -	1,020 mm (2 lines)
Number of CS/capacity -	14/1,136 unit/MW

The first start-up complex of the gas pipeline was put into operation in September 2011

Geological and Environmental Conditions along Sakhalin – Khabarovsk – Vladivostok Gas Transmission Pipeline Route

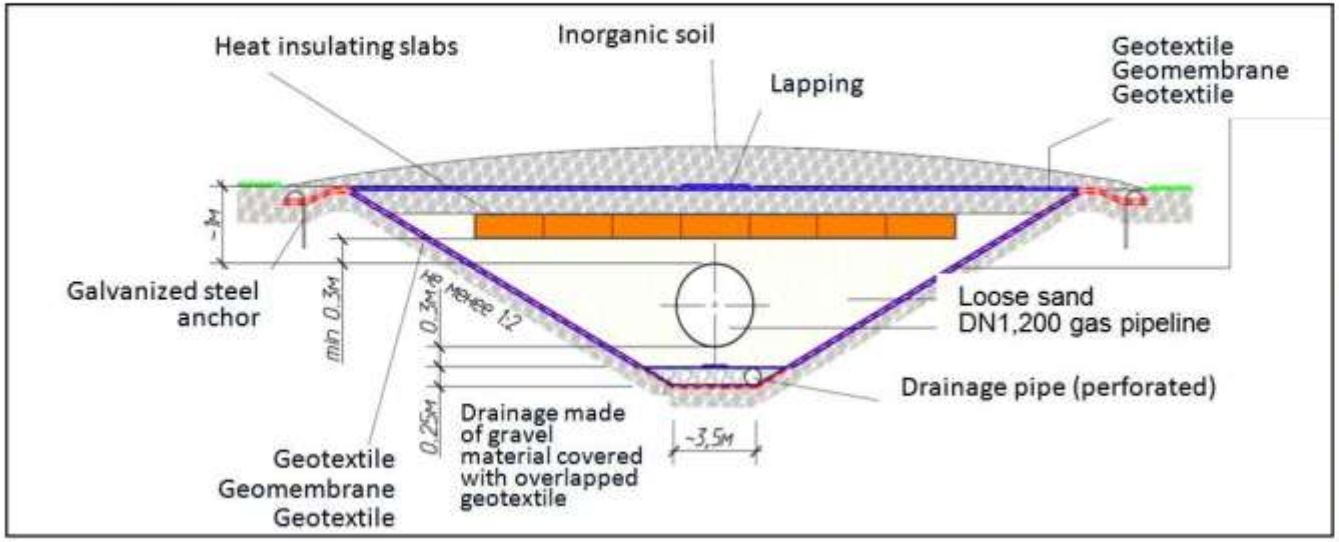


- High seismotectonic activity;
- Considerable hydrographic and ravine/draw relief dismemberment;
- Significant swampiness;
- Abundant floods in the area;
- Complexity and high variability of geologic and lithologic structures;
- Plots with close bedding of rocks and metamorphic formations;
- High activity of erosion and suffosion processes and gullying;
- Significant dynamics of lateral and vertical erosions of river valleys.

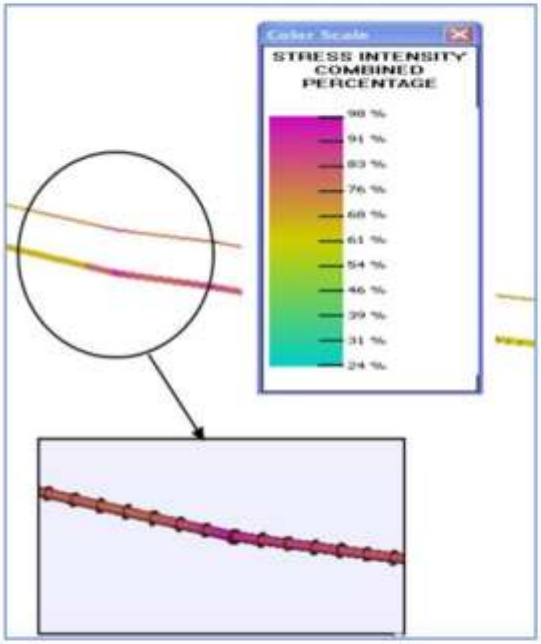
Pipeline length in areas with high seismic activity	112 km
Overall tectonic faults including areas with:	56
• High activity	16
• Medium activity	25
• Low activity	15

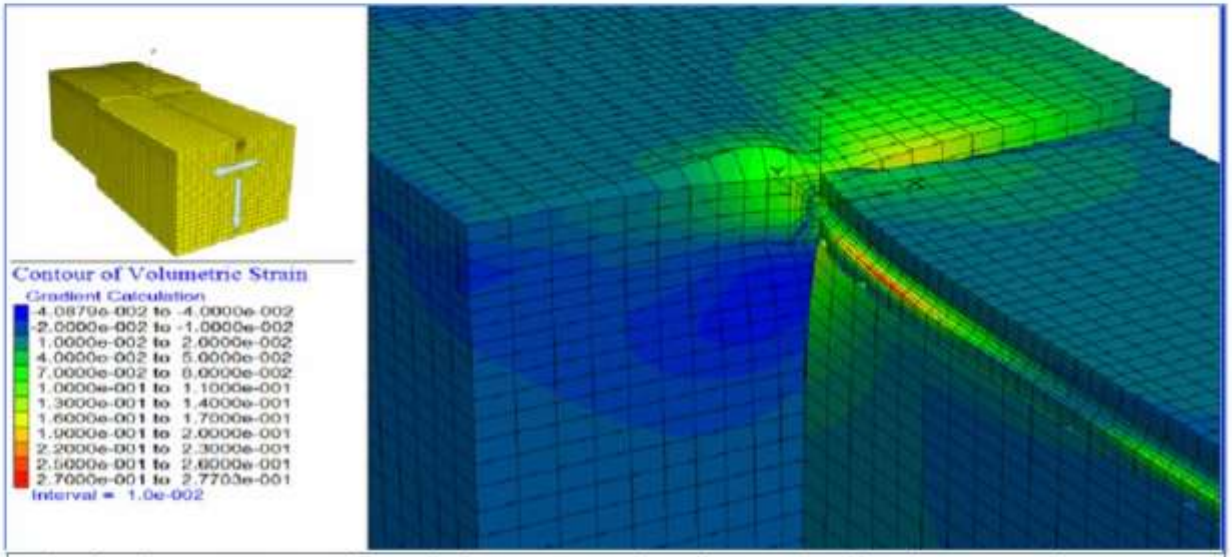
Engineering Design of Gas Pipeline Laying in Areas with Seismic Activity of 8-9 Degrees on MSK-64 Scale

- Dedicated mechanical characteristics of pipe material and its nominal sizes, taking into consideration soil deformation and type of soil mechanical displacement;
- Gas pipeline horizontal and vertical turns by elastic bending with the radius of 1,500DN (minimum);
- Special configuration of trenches at tectonic fault crossings and at 100 m (both directions) from them;
- Limitation of a gas pipeline laying depth;
- Trench filling and back filling with loose soil (coarse-grained sand, fine gravel);
- Fiber-optic system of continuous geotechnical monitoring;
- Gas pipeline design and construction in areas with tectonic faults implemented under the Special Technical Specifications approved in due order.



Computation of Gas Pipeline on Endurance Capability and Stability



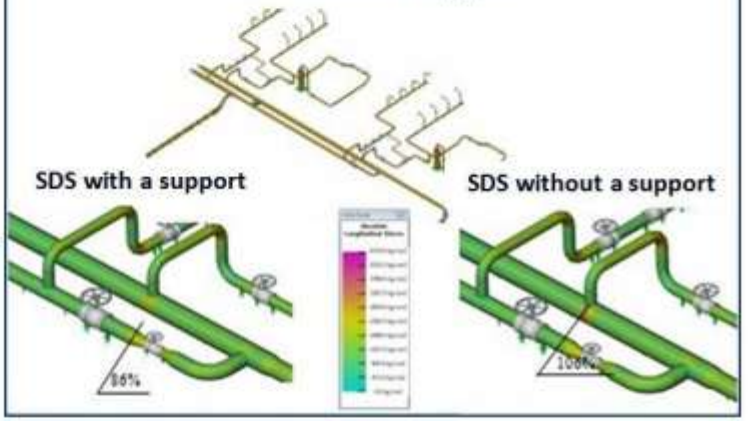


Distribution of volumetric strain in elastoplastic soil. The pipeline is perpendicular to movements plain and fixed in the soil

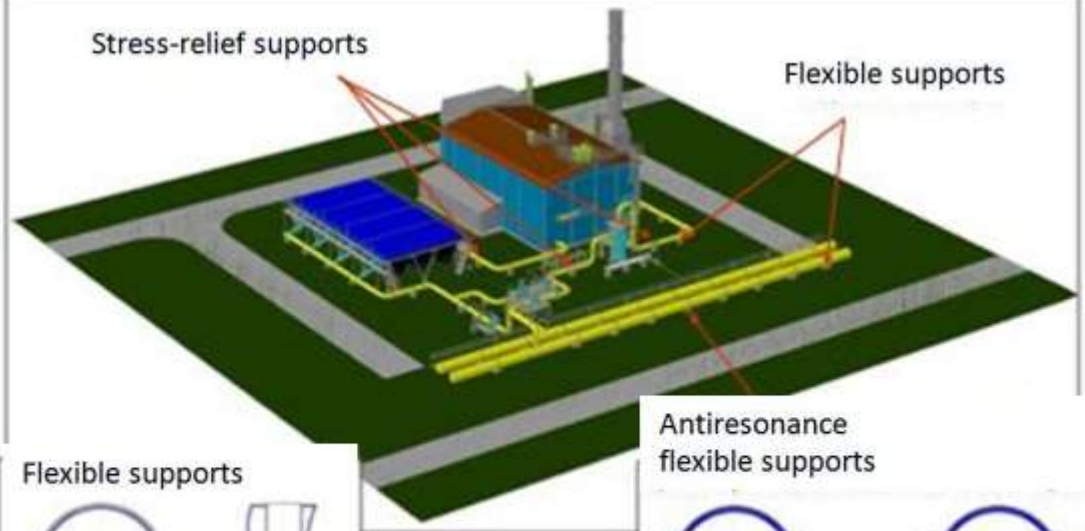
- Computation of the endurance capability, deformation characteristics and axial stability under the normal operational conditions;
- Computation of the endurance capability and axial stability under soil deformations during the tensile-and-compression axial seismic wave;
- Computation of the endurance capability and stability under the effect of transcurrent fault wall movements subject to a type of mechanical displacement and anticipated magnitude of irreversible soil displacement.

Engineering Design of Compressor Stations in Areas with Seismic Activity of 8-9 Degrees on MSK-64 Scale

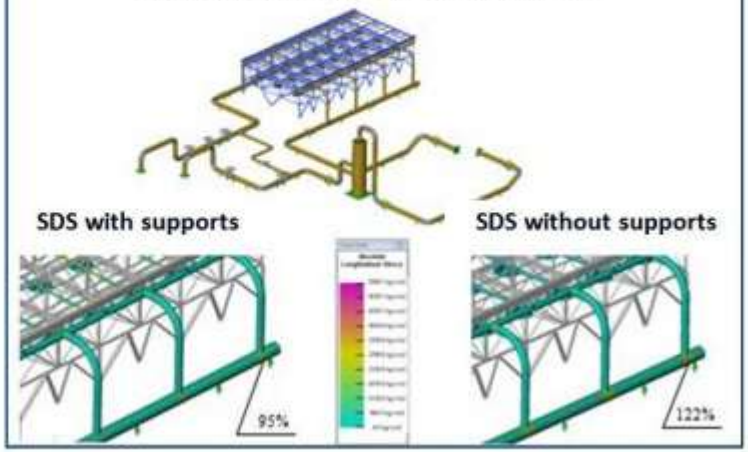
Comparison of the pipeline stress-deformed state (SDS) depending on the presence of an antiresonance support



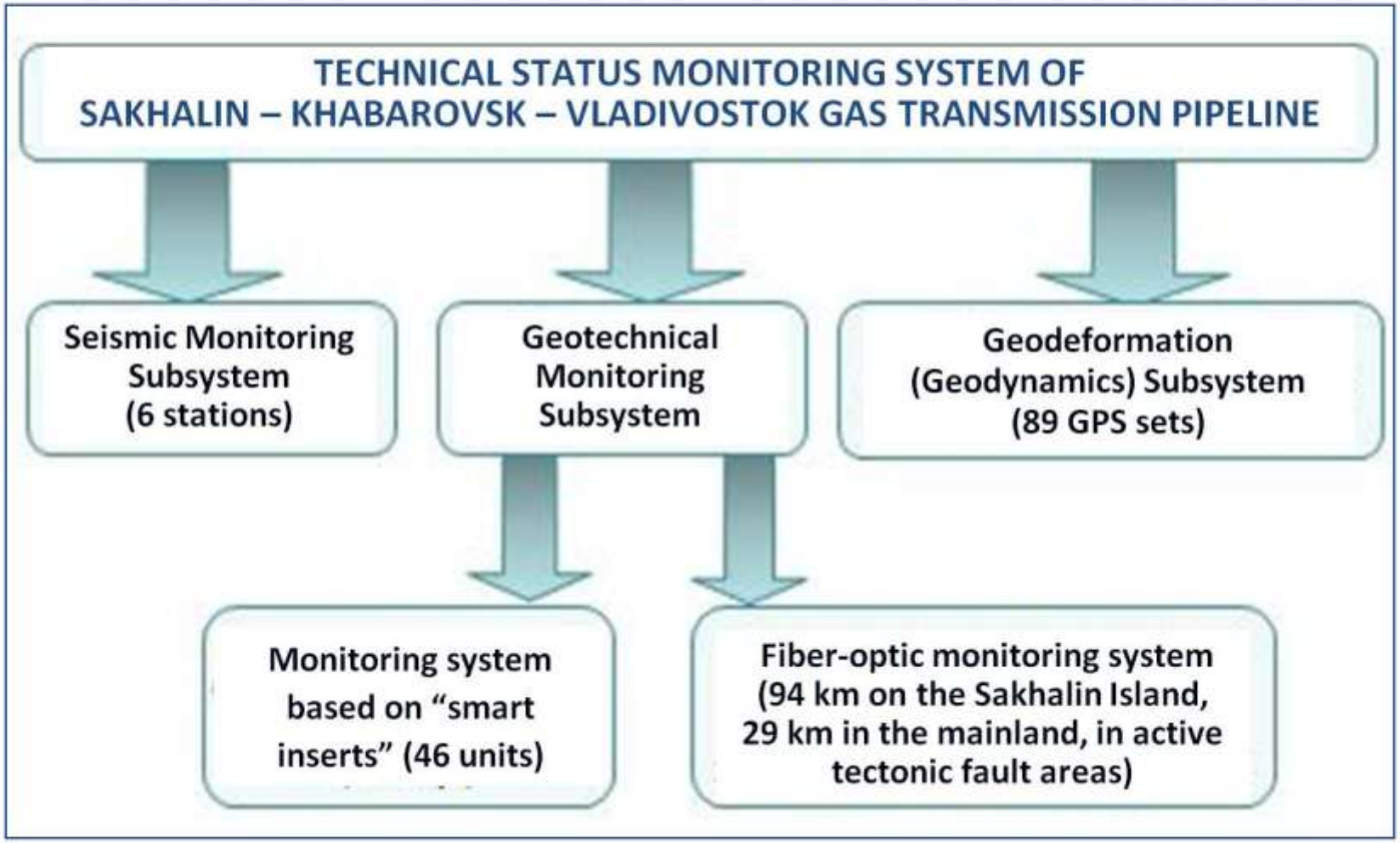
General view of a technical module



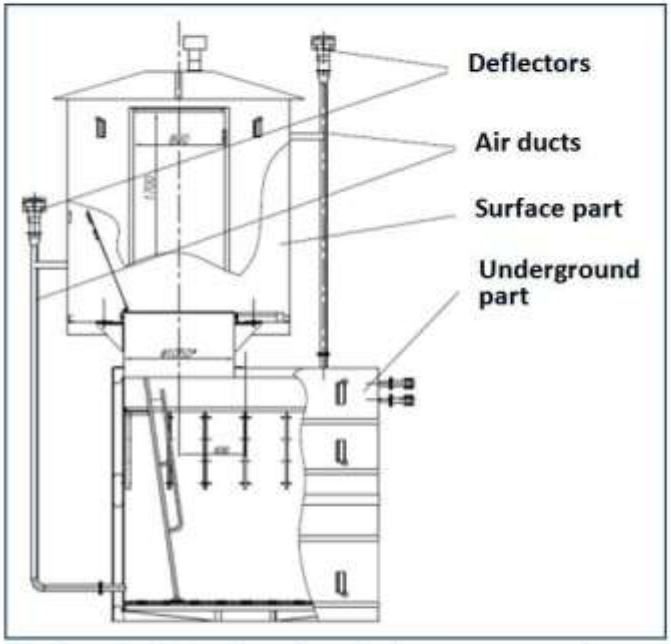
Comparison of the pipeline SDS depending on the presence of a stress-relief support



Technical Status Monitoring System of Sakhalin – Khabarovsk – Vladivostok Gas Transmission Pipeline (1)

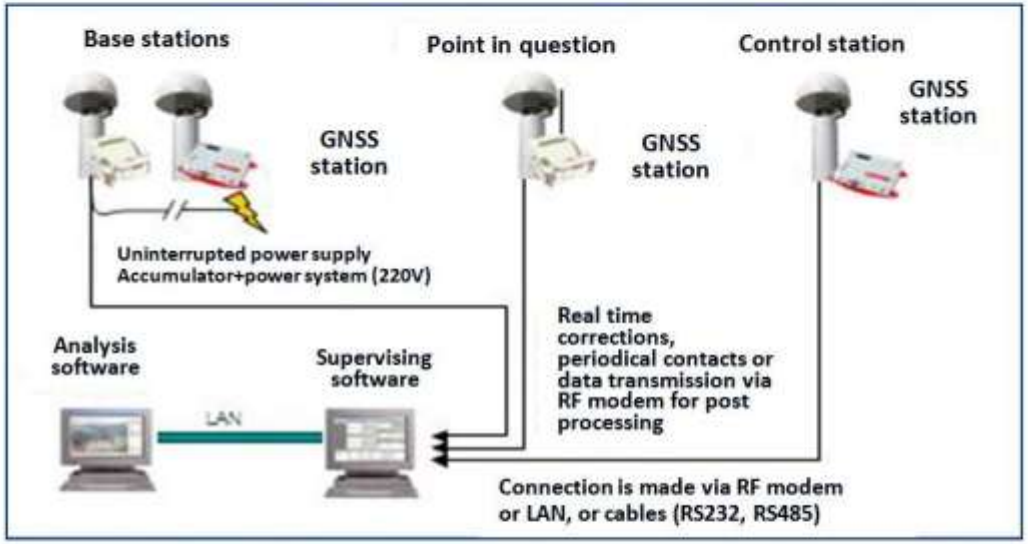


Technical Status Monitoring System of Sakhalin – Khabarovsk – Vladivostok Gas Transmission Pipeline (2)

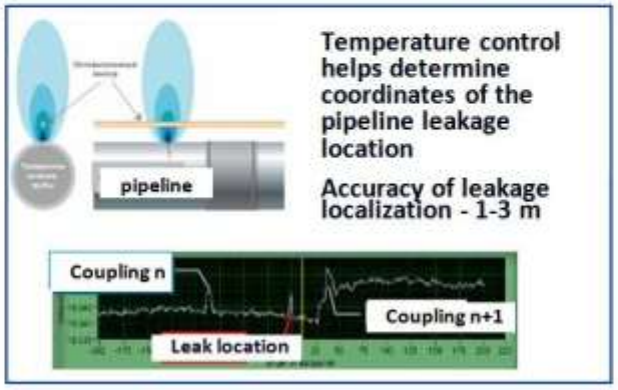


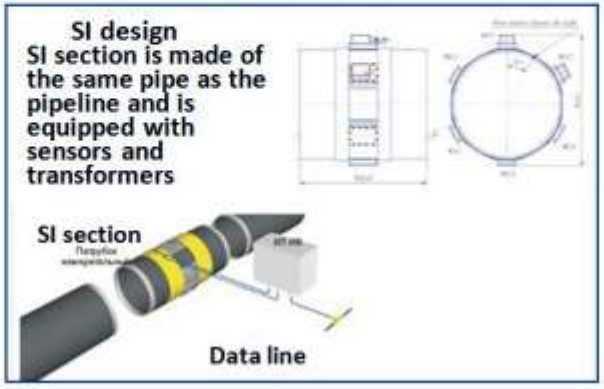
Seismic Monitoring Subsystem using seismic monitoring posts (SMP)

Geodynamic Monitoring Subsystem



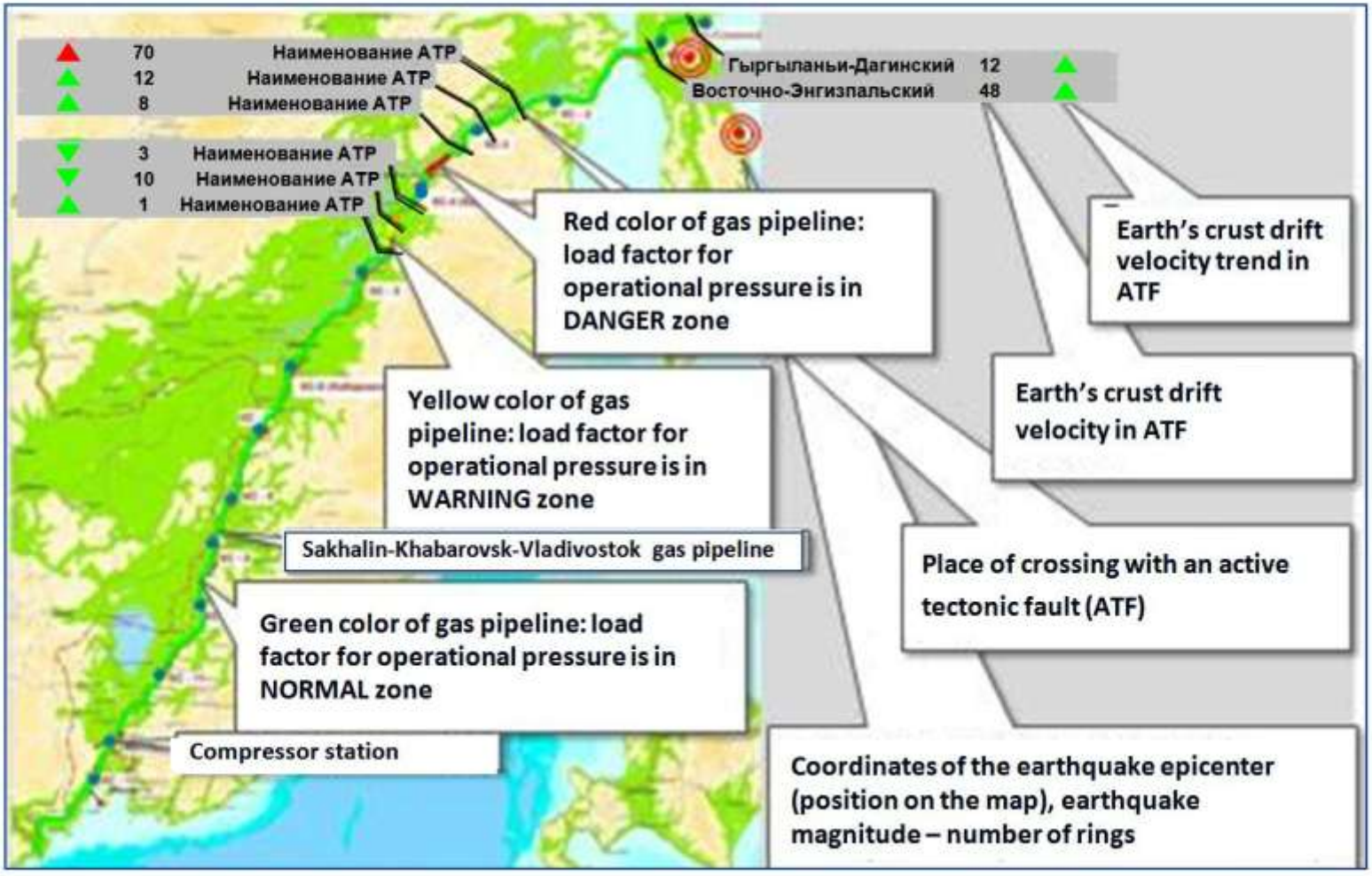
Geotechnical Monitoring Subsystem using fiber-optic sensors and "smart inserts" (SI)



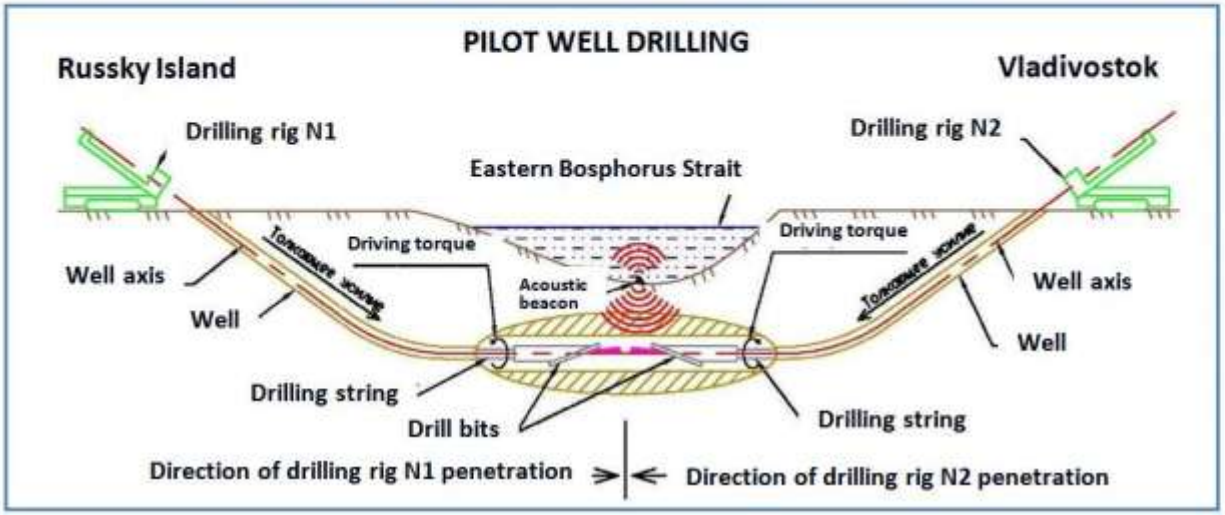


Technical Status Monitoring System of Sakhalin – Khabarovsk – Vladivostok Gas Transmission Pipeline (3)

A Snapshot of Operator's Console Image (version)

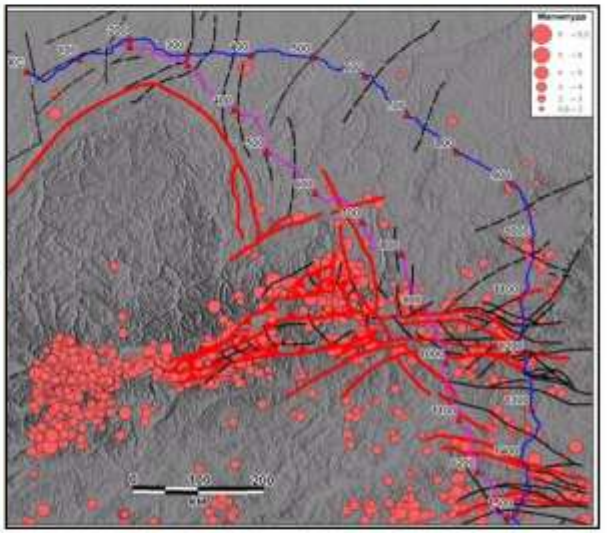


Implemented Eastern Projects of OAO Gazprom



Prospective Eastern Projects of OAO Gazprom

BASIC CONFIGURATION OF UNIFIED GAS SUPPLY SYSTEM OF RUSSIA IN EASTERN SIBERIA AND THE FAR EAST



Thank You for

Your Attention!