

**ARRANGEMENT AND CARRYING OUT GEOEKOLOGY RESEARCH
AT INVESTIGATION, DEVELOPMENT AND EXPLOITING OIL-FIELDS
AT TERRITORIES UNDER SPECIAL NATURE MANAGEMENT
(by the example of the Western Ural oil and gas bearing areas)**

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In this work we have classified the specially managed nature territories (SMNT). We have shown that oil-field objects within SMNT should be arranged with taking special nature saving measures during oil production. We have reviewed examples of geoecological predication for planning and exploiting oil-fields at territories where economic activities, within oil and gas bearing areas of the Perm Oblast in the Western Ural.

Oil production, special nature reserves, water protection zones; geoecological studies, ecomonitoring.

Specially managed nature territories (SMNT) are categorized as follows: special nature reserves (SNR); water protection zones of rivers, lakes, water reservoir and bogs (WPZ); woods of the first group; housing areas; sanitary control zones of various objects (SCZ); sanitary zones of water supply intakes (SZW); objects of cultural heritage, mining leases for exploiting other mineral resources; man-caused pollution areas within developed oil-fields where environmental quality standards (MCL – maximum concentration limit) are exceeded (Table 1).

Main reasons to use SMNT:

- hydrocarbon reserves are fair and initial ratings of oil survey and exploration wells are rather high;
- there are temporarily abandoned oil wells at SMNT (over 15 years);
- new jobs will be established, additional funds will be paid to the Oblast and the Rayon budgets;
- if the works permit is granted it will be possible to establish strict environmental control at SMNT.

Our study is of current importance because we suggest increasing oil production volumes in the Perm Oblast by intensifying development of old oil-fields and starting development of new hydrocarbon reservoirs at territories where economic activities are limited by different reasons. The target program “Developing and Exploiting The Mineral Resources of the Perm Oblast in 2003-2005 and with future prospect till 2010” among its other directions on stabilizing oil production in the Oblast suggests starting development of the oil-fields in the reserved zones.

During our studies we have reviewed the experience of foreign and Russian oil producers in developing oil-fields located in SMNT. We have also taken into account general requirements of ISO 14000 international standard.

Let's take as an example LUKOIL company's developing hydrocarbons fields in the reserved part of the northern part of the Caspian Sea. The licensed water area is very close to the water-bog reserve "Delta of the Volga-River" and the Astrakhan State Biosphere Reserve.

Due to the Caspian Sea natural features, special ecological and industrial fishing requirements have been developed for that area of the Sea. Those requirements establish rules, special conditions and limits for geological surveying, exploring, producing and transporting hydrocarbon raw materials in the reserved zone of the northern part of the Caspian Sea in order to maintain biovariety and efficiency of water and coastal ecosystems and fishing potential of the Caspian Basin, which is a unique fishery region of the country.

LUKOIL ecological policy for the Northern Caspian Sea is based on the "zero waste burial" principle and determines the spectrum of scientific studies and as their result - the corresponding nature protection technical and technological solutions. They are following the "zero waste burial" principle in designing the exploratory wells construction, in choosing technical means and technologies, in developing ecological monitoring programs and with that purpose they have studied the hydrometeorological, hydrophysical, hydrochemical, hydrobiological, geochemical, microbiological, teriological and ichthyological parameters of the ecosystem. As an example of foreign oil producers operation in SMNT we can describe construction and exploitation of pipeline systems in Alaska. Thus, while constructing the Tansalaska Pipeline they applied land reclamation and planted specially selected sorts of fast-growing grass. The pipeline rout at some places avoids animals and birds dwelling areas, fish spawning areas, former settlements of ancient peoples etc. At points of natural migration paths of wild animas (deer, lambs, snow rams etc.) they constructed more than 800 crossings by raising the tube for 4-5 m or burying it even at overground places. Construction works may not be carried out closer than 800 m to reserves, recreation zones, registered national historic places or national parks.

Or, for example, when *Western Geophysical Company* was planing the seismic three-dimensional exploration in ecologically sensitive transference area in Louisiana in 1998, they developed the Program of Ensuring Ecological Safety based on monitoring and proper training its personnel. The Program was developed according to the private land owners, state management organizations and naturalists requirements to activities in ecologically vulnerable zones. Should the producer have not observed those requirements, they might have suffered substantial losses, penalties, activities suspension or even forbiddance. In order not to find themselves in such unpleasant situation and considering growing effect on environment, the seismic contractors focused on environmental monitoring and correcting personnel ecological training. With that purpose the companies *Western Geophysical* and *Coastal Environments Inc.* (ecological division of the company *Baton Rouge*) developed the two-phase program of environmental protection after their examination of the reserve at the Mississippi delta in the southeast part of the USA. The program was developed to create the systematic approach to regional environmental

protection, which meant that ecologically trained members of the seismic crew took all care of the environment in their activities etc.

Table 1

Classification of territories under special nature management

Extent of economic activities ecological limitation		Purpose of creating a territory under special nature management
1 category (activities are impossible)	2 category (possible with limitations)	
Natural block of territories		
SNR		SNR are permanently or temporarily excluded from economic circulation and reserved for conserving natural environmental characteristics
Reserves; Nature sanctuaries;	Reserves; Natural parks; Protected landscapes	
	Water protection zones	Special regulations are established for economic activities with the purpose to prevent waters pollution.
	Woods of the first group	Conservation of the wood fund
Anthropogenous block of territories		
Sanitary zones of water supply intakes		SZW purpose is to maintain drinking water quality
1 zone	2 zone	
Objects of cultural heritage		Arranged to protect territories connected with major historic events, development of society, science, culture etc
	Housing blocks territories	Maintaining living conditions within housing territories
Technogenous block of territories		
	Sanitary zones of various objects	Meant to reduce harmful effects down to the required hygienic specifications.
	Mining leases of minerals	Maintaining geologic environment for production developing various mineral resources
	Technogenically polluted areas	Economic activities may be suspended in areas, where environment quality standards are not observed

Our study is very new from scientific point of view because:

- location of hydrocarbon deposits and SMNT in the Perm Oblast have been analyzed for the first time;
- SMNT classification has been developed;
- principles of perfecting environmental protection measures during oil production in SMNT have been grounded;
- we have considered examples of ecological reasoning the location of oil production sites in SMNT areas where hydrocarbon minerals are found.

More than twenty oil-fields and about 30 perspective structures are located in SMNT of the Perm Oblast. Total mineable oil reserves of opened fields count for about 30 mln. tons. Even if developed partially, those reserves will be an contribution to stabilize oil production in the Perm Oblast. Right now, due to various ecological requirements some oil-fields (Belskoe, Zhilinskoe etc.) are not developed, but others (Ozerno, Aptugayskoe etc.) are operated intensively (Table 2).

Analysis of oil-field and exploration works in SMNT of the Russian Federation shows the following.

1. Where the exploration works show that the oil-pool outline extends out of the territories with economic activities limitation, than as a rule, such block is practically not considered for further developing the oil-field, or the procedure of operating the territory is changed.

2. As a rule, state ecological expertise bodies, numerous ecological, scientific and public organizations etc., are negative to oil exploration in SMNT (especially in SNR).

Special measures are required for starting oil production in SMNT.

Therefore, oil-fields within SMNT should be developed with taking following actions:

- working out nature protection requirements to ensure minimization of damage to environment during construction, exploitation of wells and industrial objects;
- . developing a complex of actions to protect water resources, atmospheres, bioresources during construction, exploitation of wells and industrial objects;
- improving principles of forming the production ecological control system during construction of wells and industrial objects and ensuring its performance during their further operation;
- . developing recommendations for ecological training the personnel for wells and industrial objects operation.

Observance of the above conditions helps to ensure environmental safety of oil production works: to reduce atmosphere pollution, water pollution and waste. Oil-field objects should be located with taking into account specific natural-climatic and mining-geological conditions of the territory, as well as current ecological limitations under environmental laws of the Russian Federation and its subjects.

According to item. 4.90 of SP (Construction Rules) 11-102-97 “Engineering-ecological surveys for construction”, construction works in ecologically vulnerable areas, such as SNR and WPZ shall be done with stationary ecological monitoring, including:

- regular registration and control of current environmental parameters at places of potential sources affecting environment and areas of possible exposure;
- forecast of possible environment conditions changes on the basis of the revealed tendencies;

- working out recommendations and offers to reduce and prevent negative environmental effect of construction objects;
- controlling use and efficiency of the adopted recommendations on normalizing the ecological situation.

Table 2

Examples of Territories Where Oil-Fields Are Found In Specially Managed Nature Areas of the Perm Oblast

Oil-Field		Specially Managed Nature Territory	
Name	Development Stage	Type	Reason for Limitation
Ozerno	Exploitation	Reserve “Nizhnevishersky” Nature sanctuary Lake Niukhti Adjoining to the Lake Niukhti area	SNR SNR Water-protection zone
Aptugayskoe	Exploitation	Reserve “Kuedinsky”	SNR
Osinskoe (the Northern Block)	Conservation	Guarded landscape “Monastyrsky Bor” Adjoining to the Votkinskoe Reservoir Drinking wells of populated areas	SNR Water protection zone Sanitary zone
Belskoe, Zhilinskoe	Conservation	Drinking water intake “Usolka”	Sanitary zone
Unvinskoe, Sibirskoe and others	Exploitation	Verkhnekamskoe potassium salts field	Mining lease for potassium deposit
Blocks of Maykorskoe, Shatovskoe and others	Exploitation	Adjoining to the Kamskoye Reservoir area	Water protection zone
Krasnokamskoe	Conservation	Town of Krasnokamsk	Populated area

Thus, basis of the geoecological predication for locating, constructing and further operating oil-field objects in SMNT, is complex of geoecological studies (GS) to estimate the current environmental situation.

GS should be carried out with the purpose to obtain current information on different environmental conditions: atmosphere, hydrosphere, soils, vegetative and fauna. They include: natural atomic-chemical and hydrochemical studying the territory, top-soils, fauna and vegetation, laboratory works, analysis of current environmental conditions and estimation of environmental effect.

GS results at the given stage should show, that:

- . harmful matters actual concentrations in air, waters and soils do not exceed quality standards for those environment components (MCL - maximum concentration limit);
- current ecological limitations (water-protection zones, sanitary zones, especially guarded natural objects, sanitary zones of populated areas etc.) shall be observed in design solutions;
- atmospheric emission, water pollution from the designed objects will not exceed environmental quality standards in the sanitary zone of the oil-field objects and will not affect negatively resident zones and SMNT;
- ecological control system will ensure monitoring condition of transporting and depositing media during operating the oil-field objects.

As an example of ecological predicating location oil-field objects in SMNT, let's consider the GS for construction design of gas line rout "Utilization and Marketing the Associated Oil Gas of Verkhnekamie in the Perm Oblast" (OF Ozernoe – OF Logovskoe), which have been approved by the state ecological expertise.

The projected gas line is supposed to be constructed in the north of the Perm Oblast, in territory of Solikamsky and Krasnovishersky Rayons. Ecological studies along the rout have never been carried out before, as the considered object is a new construction kind. The gas line will join up a number of fields in the north of the Perm Oblast. The Northern site is located on the right coast of the Yazva river, a large inflow of the Vishera. The rivers network is rather well advanced and the territory is rich in wood landscapes.

Environmental conditions of the central site are most complicated and the site is the largest in area. The geomorphological and landscape shape of the terrain depends first of all on the surface deposit of ancient saline karst. It causes surfaces deformations and peat bogs development in lake-and-ice sands. Physically and geographically the territory is specific due to a great number of bogs and cutoff lakes. The largest bogs are: gagarinskoe, Gubdorsko-Kolyvenskoe, Mosvinskoe. Bogs cover considerable areas.

The southern part covers some area of Verkhnekamskoe potassium salts field (VKMKS). Logovskoe field is rather close to the Solikamsk town and consequently is most developed. Landscapes there are most changed by anthropogenous activities compared to other territories.

Exploration works in those areas are difficult to carry out as they are close to specially managed nature territories, where economic activities are completely forbidden or limited under current ecological laws.

The explored territories contain significant hydrocarbon reserves, and the suspended wells located there have high initial rate of yields. Full forbiddance of oil exploration and production works in some areas, which are under special conditions of nature management, can cause considerable losses because of oil and gas production reduction. At the same

time, where technological norms are strictly observed and nature protection actions are taken, probability of environmental pollution will be minimum.

Northern part of the gas line runs in the territory of the regional landscape “Nizhnevishersky”. Within the reserve there are the oil-fields: Ozernoe, Gagarinskoe, Yu-Raevskoe, Magovskoe etc.. Oil exploration, development, production and transport operations in the reserve “Nizhnevishersky” are allowed with some limitations of economic activities.

List of oil and gas fields exploration and exploitation conditions in the territory of the landscape reserve Nizhnevishersky:

1. For oil-field works there shall be leased grounds, proved by the technological diagram and the design for construction of the fields for exploiting wells and constructing pipe lines, but not more than 5% of the reserve territory.

2. For exploiting a field, the producer shall perform a system of nature protection actions with purpose to maintain the landscapes and their components, which are around the oil-field.

2.1. Oil-field objects shall be located with consideration for water-protection zones of reservoirs and water flows.

2.2. Oil-field objects shall be equipped with storm sewage and the drilling sites shall be banked in order to prevent polluting the surrounding territory environmental.

2.3. Vehicles lines shall be under the authorized scheme.

2.4. Warehouses with aggressive fluids shall be equipped with pressure-tight tanks, which will exclude polluting the surrounding landscape.

2.5. Pipe lines, electric mains and other communications shall be laid out along the designed roads.

2.6. For oil and water pipelines there shall be used special corrosion resistant pipes.

2.7. Operation wells shall be constructed only with applying the technologies that exclude polluting fresh surface and underground waters. Casings shall be well cemented.

2.8. Oil-fields shall be constructed with developing and performing a system of actions for maintaining hydro-geological conditions of permanent and temporary water-flows from the Lake Niukhti.

3. There shall be developed and performed a complex of actions for qualitative restoration of the temporarily negotiated territory.

4. To monitor the basic environmental conditions (atmosphere, hydrosphere, vegetation, soils and fauna) and to observe the above requirements during all the period of operating the oil-field, there shall be developed a complex system of production ecological control.

5. Any other actions for protecting the landscape reserve Nizhnevishersky shall be suggested additionally during the ecological expertise of the design for developing oil and gas fields in the given territory.

The lake Niukhti is a hydrological nature sanctuary. The considered gas line passes in the reserve territory, but does not cross the water-protection zone of the lake Niukhti and the nature sanctuary "Lake Niukhti". Constructing and developing the oil-field objects located out of the Lake Niukhti water-protection zone are allowed by the Perm Regional Committee on Nature Management on the basis of the conclusion of the state ecological expertise of the design "Construction of the Ozernoe Oil-Field" and the individual regulation "On the Landscape Reserve Nizhnevishersky".

Most of the water intake area of the lake is smooth and boggy. The lake turns gradually into an upstream bog, and then – into transitive or low-lying. Lake banks are low and boggy. The bank line is strongly twisting and forms numerous bays and capes. The lake and the bog complex is a uniform unique landscape formation. The water-protection zone of the Lake Niukhti is 300 m. Permissions for works in water-protection zones are given for wells of the Ozernoe field. The sanction was obtained after the State ecological expertise of the construction design, which, besides the standard documentation, included the "Regulations On Exploiting the Oil-Wells In the Water-Protection Zone of the Lake Niukhti".

In the water-protection zone of the Lake Niukhti there are located oil exploration wells No. 39, 40, 41, 42, 43, 44, 45, 46, 47, 48 of the Ozernoe Oil-field (constructed more than 15 years ago). Tests of those wells showed significant hydrocarbon mineral resources. Emergency situations would be more probable if those wells are not controlled during introducing the system of maintaining the reservoir pressure in the rest territory of the Ozernoe field, because there is no permit for works with those wells.

Realization of the "Regulations..." has allowed to carry out a complex of special geophysical studies to estimate the condition of the casings of the given wells and consider repair works, which will improve ecological safety of locating oil-wells in the water-protection zone of the Lake Niukhti.

Exploitation of the wells located in the water-protection zone of the Lake Niukhti, as by calculations and predications of the Regulations, is carried out with minimum environmental effect (no atmosphere and water pollution, storm waters are transported out and the storm sewage tank at the wellhead platform is permanently emptied).

Environmental damage is minimized by means of:

- . applying pressure-tight production tree of the wells mouth;
- . coating the wellhead platform of wells and territories inside the drilling site banking by impermeable shields;
- . using pipes of high-quality steel with enameled inner coating and cathodic protection;
- using special tanks for gathering and storing fluids during repair operations.

The “Regulations...” realization suggests creating and ensuring the ecological control system that would allow:

- to estimate the performance of the oil-field objects from the point of view of modern ecological requirements and conformity to the current normative documents on protecting the atmosphere, fresh waters etc.;
- to provide the engineering services of the company with trustworthy information on the contaminants content in water and aerial environment of the oil-field in order to perform operative nature protection actions.

Exploiting the Ozernoe field with overall control for the Regulations observance by the nature protection bodies has allowed to ensure:

- ecologically safe exploitation of the oil-wells located currently in the water-protection zone of the Lake Niukhti;
- monitoring the conditions of the reserve Nizhnevishersky;
- protecting the nature sanctuary “Lake Niukhti”.

Results of the geocological studies of the surface water-flows along the gas line rout have shown that the chemical composition of the river and stream waters corresponds to the background, the basic components concentrations are within the permissible norms. By the chemical composition the waters are hydrocarbonate-calcium, calcium-sodium, sodium. General mineralization value varies within 73-622 mg/l, chlorides content varies within the natural limits, mineral oils amount does not exceed the established norms. The Lake Niukhti water is hydrocarbonate-sodium, ultra fresh (general mineralization is 73,7 mg/l). Results of the Lake Niukhti water chemical tests in 2003 compared to the results of the tests done in 2001 show that the content of basic components has practically not changed for the two years.

Results of chemical analysis of underground waters from wells and springs show that waters are fresh, mainly hydrocarbonate-calcium with mineralization 166-569 mg/l, chlorides content is within the natural limits, mineral oils are within maximum concentration limit.

On the basis of the geocological studies of the gas line rout we can make following conclusions:

- the gas line rout passes in the territory, where economic activities are limited under the laws of the Russian Federation and the Perm Oblast (northern part of the gas line passes in the territory of the reserve Nizhnevishersky, final point of the object – Pumping Station Ozernaya – is immediately close to the nature sanctuary Lake Niukhti);
- fir woods of the middle taiga and the bogs complexes, which are widely spread in the viewed territory, are of weak self-cleaning ability;
- results of examining the current condition of atmosphere, fresh surface and underground waters and soils show that concentrations of the basic contaminants in

waters, air and soils do not exceed maximum concentration limit and correspond to the natural background values;

- to prevent negative consequences of constructing the gas line, with consideration for specific features of the ecosystems in the territory, there shall be developed and performed a complex of actions on restoring the temporarily negotiated territory;

- condition of the surface and underground waters will be carried out by realizing the system of local ecomonitoring the oil-fields, through which territories the viewed gas line passes and the results will be submitted to the supervising bodies;

- on the basis of the analyzing the available information on current environment conditions and visual examination of the terrain, we may say that the background anthropogenous load does not exceed the permitted level for taiga complexes normal performance.

Putting into operation well No.13 of the Maykorskoe field, which is in the water-protection zone of the Kamskoe water reservoir, is another example of locating oil-field objects within SMNT.

Deconservating and constructing well No.13 is based on observing following technological norms and nature protection actions:

- at the initial stage the well mouth equipment is upgraded with the purpose to achieve absolute control over its performance during exploitation;

- all deconservation works will be carried out according to the standards and regulations, with use of the blowout equipment and the sealing head mounted on the well for preventing emergency oil blowout;

- the well is deconserved according to the standards and regulations, which also require that in the supplementary reservoir there are available additional 25 m³ of volume for trapping oil before the well is under control;

- geophysical studies are carried out in the well located in the water-protection zone of the Kamskoe water reservoir for evaluation the quality of fixing the production casing and the conductor;

- where the production casing and the conductor are poorly cemented, additional cementation works under high pressure shall be done;

- additionally to the production casing cementation test, the whole casing shall be pressure tested;

- each well shall be equipped so that not to allow for leaks into the Kamskoe water storage, i.e. the risk of emergency situation and oil penetration into the water reservoir shall be minimized to zero;

- the ground surface the inside the banking is covered with special water-oil-tight material excluding fluid infiltration in the groundwaters horizon;

- the well site shall be constructed with the incline to the side reverse to the crossing over the banking. The banking shall be kept in operating condition;
- near the well there is the local gravity tank for trapping oil or other fluids washed off the well territory.

The well shall be operated with observing following technological norms and nature protection actions:

- every two years, irrespectively of the wells overhaul schedule, the well shall be tested for the cementation quality;
- sanitary waste waters shall be removed by special vehicles out of the water-protection zone of the water reservoir;
- household waste shall be removed to the dump etc.

To minimize environmental damage during emergency oil overflows there shall be ensured:

- plan of liquidating oil overflows in emergency situations;
- training the personnel in quick reaction to an emergency situation using available means to fight with oil overflows;
- equipping the oil-field with materials and machinery for quick and efficient reaction to liquidate the oil overflow;
- arranging direct 24-hours radio communication of an emergency object with the company, as well as the communication within the object for carrying out emergency works.

During constructing and exploiting well No.13 the technological norms and rules were fully observed; nature protection actions were taken and changes of the environmental conditions (atmosphere, hydrosphere, soils, vegetation and fauna) were monitored, therefore we have all basis to make following conclusions:

- results of analysis of atmosphere, fresh surface and underground waters current condition show that concentrations of basic contaminants in water and air do not exceed the background values limits;
- complex of technical actions taken during wells construction would exclude surface and underground fresh waters pollution;
- control over condition of the pre-surface hydrospheres should be carried out by means of local hydromonitoring systems and the results should be submitted to the supervising bodies under the established procedure;
- ecological estimation of the actions to protect atmosphere, fresh surface and underground waters, soils, fauna and vegetation shows that the recommended complex of works would allow to minimize damage caused during the well construction.

The Bereznikovsko-Solikamsky industrial region is most difficult area, where there are located oil-fields, perspective structures and SMNT. Near the mining lease of the Verkhnekamskoe potassium salts field (VKMKS) there are being developed Yurchukskoe, Chashkinskoe, Unvinskoe, Sibirskoe and Logovskoe fields.

At the same time in that territory there are located intakes for Berezniki and Solikamsk towns drinking water supply: “Surmog”, “Usolka”, “Izver”, Bygel-3”, Verkhnekamsky, Borovitsky, the biological reserve заказник and the guarded landscapes.

In territory of the Bereznikovsko-Solikamsky industrial they are developing subsalt oil and gas reservoirs. Right now in the VKMS territory oil is being produced at 6 fields; at 4 fields oil deposits are being exploited, 8 structures have been prepared for deep drilling and 4 perspective structures have been found. Subsalt oil deposits in potassium salts deposits territories should be developed with monitoring, which should include hydro-geological studies of underground waters and brines of persalt complex with the purpose of indirect control over presence of vertical cross-flows of deep fluids from the subsalt part of the section.

Similar observations are conducted in territory of Yurchukskoe, Unvinskoe, Chashkinskoe and Sibirskoe oil-fields, where the observational hydro-geological wells network has been constructed for hydro-geological observations. As a result of the observations it has been established that as a whole the basic hydro-chemical parameters of the fields vary within the background values.

Special hydrogeochemical and microbiological observations over the technical condition of the deep oil wells operating subsalt hydrocarbons reservoirs have been carried in the VKMKS territory since 1978. Results of long-term hydrogeochemical studies show that in the territory of the oil-fields developed in VKMKS there was used the technology of mounting the casing strings of the wells and there are no signs of rising vertical cross-flows from the developed oil deposits through the salt thickness into underground fresh waters horizons.

Drilling parametrical well No.1p located in the sanitary area of the 2nd zone of the Chusovoy town drinking water intake is one more example of ecological predicating the location of oil production objects in territories where nature management is limited.

As a result of studying and analyzing the materials on how the drilling operations were done in the viewed territory we may make following conclusions.

1. Purpose of drilling a deep parametrical well is to study perspectives of oil-bearing parameters of the Permian, Coal, Devonian and Vendian deposits in the Perm Oblast.

2. There are no limitations to the projected well construction considering nature and climatic conditions at the place, not populated area with no infrastructure and production enterprises. .

3. The well site is located out of the water-protection zones, woods of the 1st group and other protected territories. The site is located in sanitary area of the 2nd zone of Chusovoy town drinking water intake, thus, economic activities there subject to certain

limitation and drilling operations may be carried out only under special sanction of the sanitary bodies.

4. The drilling site is located in the territory of fresh water bearing complex in Kungur terrigenous deposits, and during wells construction special attention should be taken to qualitative insulation of the wells mining annuity in the fresh waters deposits interval. Geologic simulation (GS) application is purposed to obtain more exact three-dimensional structure of the geologic environment (GE) - zones of aeration and fresh waters. GS is based on the engineering-geological studies data and detailed electrotrial works. GS results allow to arrange the equipment in the drilling site territory with accounting for natural safety of fresh underground waters from surface pollution, thus reducing considerably the risk of contaminants penetration into waters (Fig. 1,2).

5. During well drilling it is the atmosphere air which is polluted, as the technologies applied during parametrical drilling exclude polluting surface and underground fresh waters.

6. special restoration actions are to be taken to recover the soil and vegetative stratum after drilling operations and they are viewed in the special section of the design.

7. The forecast of the atmosphere condition changing during simultaneous operation of several sources in winter time (the worst variant) shows no emissions within the sanitary zone would exceed maximum concentration limits for populated areas (Table 3).

Pollutants penetration (mass transfer) processes in air and water are simulated under the programs advised by the Goskomecologia (State Committee on Ecology). The ECOLOG program calculates the forecasted pollution emissions into atmosphere and gives basis for determining the sanitary zone limits.

8. Forecasted pollutants penetration in water at emergency situation within well 1p drilling site have been calculated for the worst probable variant (well banking break > break located below on the trap relief) with use of computer mathematical simulation and the results show that main pollutant (chlorides) contents up to the MCL_{x.p.} level would decrease in the mouth of the Talitsa river already, i.e. in the distance of 45 km (upstream the Usva river) of the strict sanitary zone of the Chusovoy water intake. Consequences of probable emergencies caused by drilling mud spills in the river Talitsa basin have been forecasted on the basis of one-dimensional model of pollutants penetration model for water receiving tanks. Calculations have been done with use of imitating computer model "AVARIA".

9. Ecological estimation of actions to protect atmosphere, fresh surface and underground waters, soils, vegetation and fauna shows that the recommended complex of operations would allow to minimize damage caused by the explorative process.

10. Results of studying current condition of atmosphere, soils, fresh surface and underground waters prove that concentrations of basic pollutants in air, water and soils would not exceed maximum concentration limit and would correspond to the natural background values.

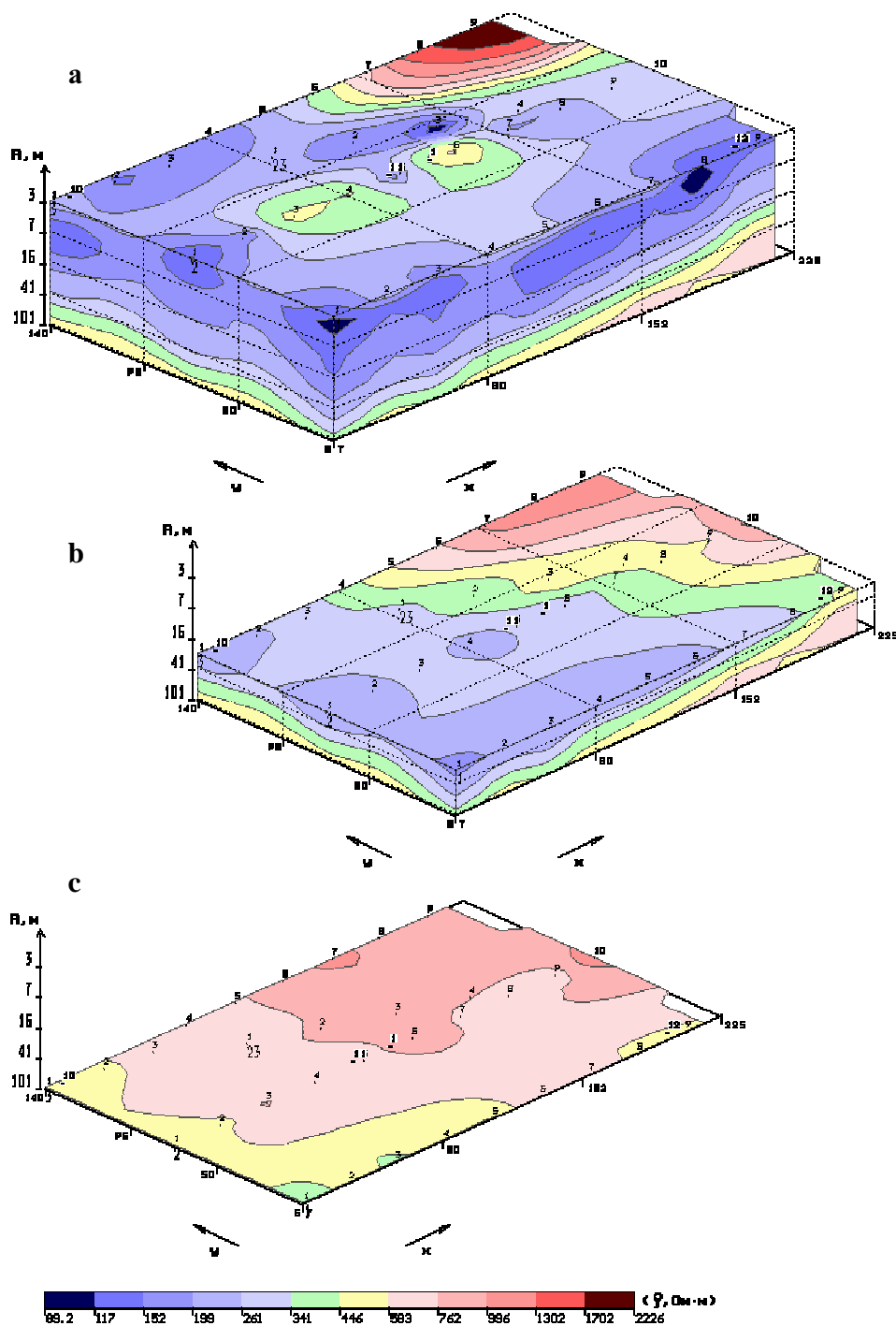


Fig. 1 Horizontal sections of the field of the apparent resistances, describing electric properties of formations in the depths corresponding to $AB/2=2.7$ m (a), 27 m (b), 101 m (c).

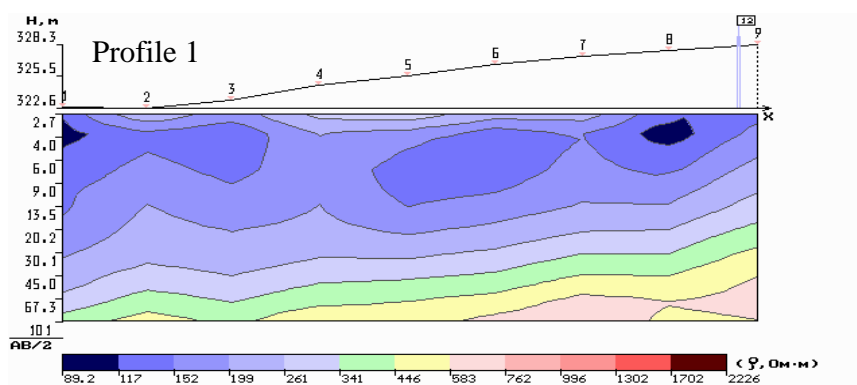
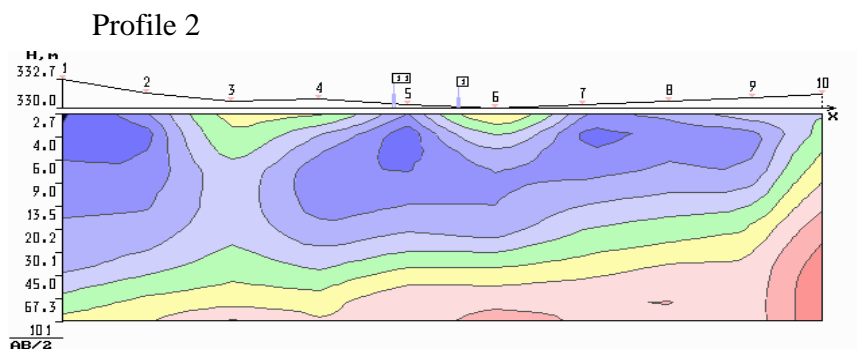
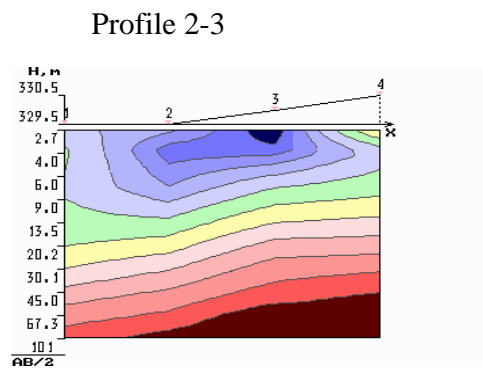
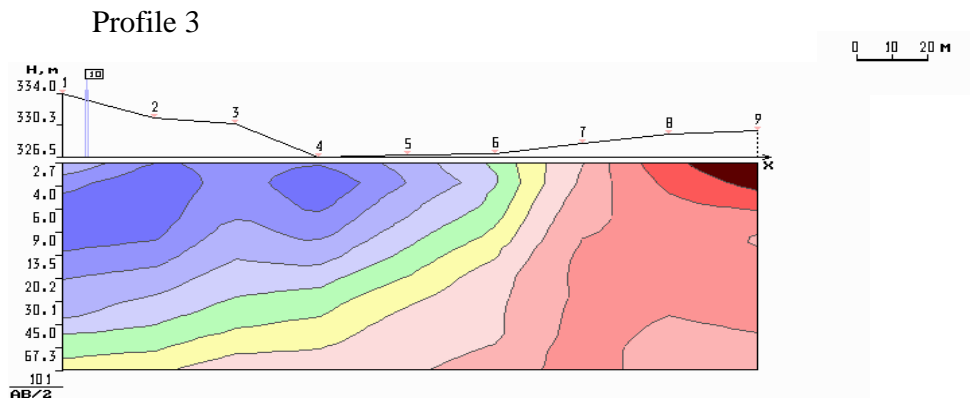


Fig. 2. Sections of apparent resistances on profiles 3, 2-3, 2, 1.

Results of simulation of the components spreading in the aerial environment
(the program “Ecolog”)

Table 3

VALUES OF HARMFUL SUBSTANCES MAXIMUM CONCENTRATIONS

Harmful Substance	MCL, mg/m ³	Maximum Calculated Concentration, cm, mg/m ³ (MCL)	Coordinates of the Point Where MCL is exceeded, m		Source Character
			X	Y	
Maximal Concentrations					
Nitric Dioxide	0,085	0,124 (1,46)	1100	1100	Diesel
Nitric Oxide	0,4	0,004 (0,01)	1300	800	Boiler-House
Carbon Black	0,15	0,018 (0,12)	1400	800	Boiler-House
Sulfur Dioxide	0,5	0,205 (0,41)	1300	800	Boiler-House
Carbon Monoxide	5	0,1 (0,02)	1100	1100	Diesel
Formaldehyde	0,035	0,0014 (0,04)	1300	900	Diesel
Carbons (Kerosene)	1,2	0,036 (0,03)	1300	900	Diesel
Oil Ash (Vanadium)	0,002	0,00026 (0,13)	1300	800	Boiler-House
Sanitary Zone Limits (400 m)					
Nitric Dioxide	0,085	0,065 (0,77)	1500	555	Diesel
Nitric Oxide	0,4	0	1500	555	Boiler-House
Carbon Black	0,15	0,0075 (0,05)	1500	555	Diesel
Sulfur Dioxide	0,5	0,09 (0,18)	1500	555	Boiler-House
Carbon Monoxide	5	0,05 (0,01)	1500	555	Diesel
Formaldehyde	0,035	0,0007 (0,02)	1500	555	Diesel
Carbons (Kerosene)	1,2	0,012 (0,01)	1500	555	Diesel
Oil Ash (Vanadium)	0,002	0,00006 (0,03)	1500	555	Boiler-House

11. Drilling parametrical well 1p (Shirokovskaya site) in the sanitary territory of the 2nd zone of the Chusovoy water intake has been designed with minimum negative environmental effect under condition of the special water-protection actions taken:

- gathering and transporting all waste products of drilling out of the sanitary area of the 2nd zone;
- oil products and chemicals storage is designed out of the sanitary area of the 2nd zone;
- the drilling site shall be banked;
- the site shall be constructed with incline to the side reverse to the crossing over the banking. The banking shall be permanently maintained in operating condition;
- at the most low point of the site there will be a gravity trap for fluids washed off from the well site. That trapping tank will be water-tight. Collected storm waters will be timely pumped off and transported out of the sanitary area of the 2nd zone;
- an observational hydro-geological well will be constructed right behind the banking of the site and will be used for monitoring underground waters condition;
- banking of the site will be monitored;
- cementation of the production casing and conductor will be controlled;
- basic pollutants penetration into air and their concentration in 300 m radius will be monitored;
- basic pollutants penetration into surface water-currents and their concentrations will be monitored monthly at the water-posts and the observation hydro-geological well;
- emergency plan of the slick bars in the river Talitsa mouth for catching mineral oil will be developed.

Geoecological studies as an obligatory element of production ecological control should be carried out during whole period of exploiting oil-field in order to monitor the technogenoc processes occurring in transporting

and depositing biosphere media.

Oil production development within SMNT requires to improve methodical and environmental standards, develop new and more environmental safe technical solutions and technologies.

We need to note, that current Russian laws do not directly forbid developing oil deposits within some SMNT (reserves, national parks), but the operations are allowed only if based on the design documentation agreed in due order and approved by the state expertise.

Therefore, every case of developing oil-fields in conditions of economic activities limitation should be approached individually with geocological proving possibility of exploration, development and exploitation operations at the oil-fields.

The individual approach shall be based on observing following conditions:

- oil production sites should be designed and constructed with considering climatic and mining-geological conditions at the area of operations;
- regulations for the SMNT protection shall be observed;
- environmental actions to minimize air and waters pollution, remove the operational waste out of the SMNT shall be taken;
- production environmental control system shall perform during all the period of developing the oil-field (sampling, research and laboratory operations, estimating the basic pollutants condition and forecasting their change etc.);
- oil companies personnel should be specially trained and re-trained with the purpose to ensure that they have proper knowledge of the Russian environmental laws and observe them.