

ENVIRONMENTAL PROBLEMS OF POWER TRANSMISSION BETWEEN RUSSIA AND THE KOREAN PEOPLE'S DEMOCRATIC REPUBLIC

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1. Purpose and peculiarity of power transmission

Recently the 3rd International Conference held under the aegis of the UNO discussed issues on the creation of a united power system of the North-East Asian countries (NEA). The united power system allows using power resources in the best way, reducing needs in new electric power plants, improving an ecological situation of the region, increasing the reliability of power supply.

The creation of the power transmission between Russia and the Korean People's Democratic Republic has been the subject of discussion since 2001 at various levels, including at the level of leaders of both countries. It is required to soften up an acute shortage of electric power in the DPRK, and it may also be used to transmit power of the DPRK hydroelectric power plants to Primorsky region in case of emergencies.

During a number of meetings of power engineering specialists of the two countries the basic parameters of power transmission have been determined:

- length of 380 km from the 500 kV substation of Vladivostok planned for construction to Chôngjin, DPRK;
- voltage of 220 kV, then 500 kV of alternating current;
- transmitted power of 300 MVA, then 500 MVA;
- potential term of commissioning – 2006. By that time the United power system of the East of Russia will possess necessary power capacity and grid scheme. Conversion of the power transmission to the voltage of 500 kV is planed by 2010.

The above-mentioned Conference marked that the power transmission between Russia and the DPRK may be the 1st real link of the future power system of NEA. The second step to the united power system of NEA is the power transmission between Russia and the Republic of Korea (RK).

The basic effect of the power transmission is in the use of seasonal discrepancy of electrical peaks in both countries: in Russia – in the winter and in the RK – in the summer. According to assessments of research institutes of Russia and the RK it permits to reduce the commissioning of new generators in both countries by 5-6 thousand MVA in the future, for this purpose the design power should be considerably more than the line of the DPRK has. For a number of reasons DAENERGOSETPROJECT can discuss a power transfer not more than 2000 MVA. However, this value requires a critically alternative decision to transfer direct current of ± 500 kV.

Thus, the two power transmissions are under consideration simultaneously:

1. In the DPRK on an alternating current, voltage of 500 kV.
2. In the RK on a direct current, voltage of ± 500 kV.

The independent implementation of two projects represents economic and ecologic losses:

- construction of two lines is more expensive than one common line;
- two routes occupy more land and require more deforestation;

A number of unresolved problems prevents the combination of highly different projects.

However, the complexity of the overhead line route actuates to combine the projects.

In order to investigate technical, economic and ecological problems it is necessary to fulfill a pre-feasibility study. At this stage it is required to develop a type of towers that permit in the future to convert the overhead lines in Chôngjin from alternating current to direct one or to place the both systems of current.

2. Peculiarities of the overhead line route in the territory of Russia

The length of the overhead line is about 250 km from the substation of Vladivostok to the border near the settlement of Khasan. The route is planned with bypassing settlements, structures and recreation areas along the seashore.

The route conditions are hard: influence of the sea, glaze of ice, wind up to 40 m/s, mountains, swamps, streams. But the main complexity is the ecology. In the overhead line zone there are valuable forests, preserves and refuges with the species of plants, birds and animals included in the Red Book.

The overhead line route is determined around the refuge “Borisovskoye Plato” and preserve “Kedrovaya Pad”. It is impossible to bypass the refuge “Barsovy” with the inhabitation of the Far-Eastern leopard and “Khasan Park” with assemblage of various birds.

One of the tasks of our meeting is to discuss the route together so that the damage of the environment be minimal.

When financing of the feasibility study will begin DAENERGOSETPROJECT will attract specialists from the Far-Eastern Branch of the Wild World Fund and other organizations to the detailed elaboration of the route and recommendations concerning the fauna protection. Ways of birds' migration in the Khasan Park will be studied in order to choose the least dangerous route.

Alternative schemes of the route are limited by a narrow strip of the Chinese territory along the Tumannaya River. This strip divides Russia and the DPRK and gives no way of bypassing the Park over mountains.

House-building, summer cottages and plowed fields at the origin of the route do not allow planning it directly towards to the settlement of Barabash. In case of bypassing this zone the length of the overhead line will be 27 km more.

In order to decrease an impact on the environment, the route is basically planned near existing railways and roads, power transmission lines and populated areas. The alternative scheme of the route along the sea coast is not proposed because of the recreation areas, harder climatic and geological conditions.

3. Impact of the overhead line on the environment

Impacts of the super high voltage overhead line on the environment in the construction and operation, as well as measures for its reduction are given in Table 1.

IMPACTS OF THE SUPER HIGH VOLTAGE OVERHEAD LINE ON THE ENVIRONMENT

Table 1

| Objects of impact | Types of impact | Ways of impact reduction |
|-------------------------------|--|--|
| 1 | 2 | 3 |
| I. In the construction | | |
| 1. Forest | Reduction of forest resources while cutting through forest | <ul style="list-style-type: none"> - Choice of the optimal route of the overhead line - Construction of several overhead lines in the common passage - Maximum usage of timber in the construction of the overhead line - Sale of excess timber to other organizations and population - Combination of the cut forest strip with the fire protection - Preservation or planting of bush up to 4 meters in height |
| | Forest fire | <ul style="list-style-type: none"> - Observance of regulations of work in forests - Burning of cut forest waste only in the summer or in the winter |

| | | |
|--|---|---|
| 2. Soil | Erosions, creeps, formation of gullies and swamps | <ul style="list-style-type: none"> - Construction of tractor driveways at hillsides and mountain areas with slopes according to norms - Plank roads over swamps - Planning of slopes, covering with vegetable earth, grass sowing, bush planting - Gravel envelope of sites for installation of towers and construction camps |
| | Loss of vegetal layer at sites and driveways | <ul style="list-style-type: none"> - Cutting and storage of vegetal layer. Further re-cultivation |
| | Oil and waste pollution | <ul style="list-style-type: none"> - Infrastructure of sites - Waste collection, removal and disposal - Observance of sanitary regulations |
| 3. Plowed areas and meadows | Reduction of useful areas, loss of a part of crop | <ul style="list-style-type: none"> - Minimum of towers installed at valuable lands - Prohibition of construction during vegetative period - Re-cultivation - Payment of compensation |
| 4. Mineral and building materials deposits | Deposit development problems | <ul style="list-style-type: none"> - Bypassing of deposits or crossing by one span |
| 5. Air | Vehicle and machinery exhausts | <ul style="list-style-type: none"> - Observance of machinery operation regulations |
| 6. Surface and ground water | Contamination, exhaustion | <ul style="list-style-type: none"> - Maximum preservation of soil, vegetation and forest - Sanitary arrangements of constructor |

| | | |
|----------|---|---|
| | | <p>camps, collection and removal of domestic waste to designed places</p> <ul style="list-style-type: none"> - Small clarifying facilities at machinery parking areas - Minimum of towers in water protection zones, installation of towers in the winter - Preservation of bush on breakthroughs in water protection zones - Construction of temporary driveways and bridges over steams |
| 7. Fish | <ul style="list-style-type: none"> - Streams and bottom land contamination - Reduction of nutritive base | <ul style="list-style-type: none"> - According to item 6 - Payment of compensation for reproduction of fish |
| 8. Fauna | <ul style="list-style-type: none"> - Deforestation - Violation of migration ways - Machinery noise, closeness of people - illegal hunting | <ul style="list-style-type: none"> - Choice of an optimal route around habitats of valuable species of animals and beasts - Payment of compensations and penalties |
| 9. Birds | <ul style="list-style-type: none"> - Collision with towers and machineries - illegal hunting | <ul style="list-style-type: none"> - Bypassing of places of the assemblage of valuable species of birds during migration - Payment of compensations and penalties |

II. In the operation

| | | |
|---------------|--|--|
| 1. Population | Electromagnetic field | <p>- Route and structure of the overhead line that ensure the electric field intensity at a height of 1,8 m from the ground within the norms (kV/m):</p> <p style="margin-left: 40px;">house-building – 1</p> <p style="margin-left: 40px;">populated area – 5</p> <p style="margin-left: 40px;">crossing with roads – 10</p> <p style="margin-left: 40px;">unpopulated area – 15</p> <p style="margin-left: 40px;">hard-to-reach terrain - 20</p> <p>- Diversion of a sanitary-guard band 30 m wide to both sides from projection of outer wires</p> |
| | Short-circuit current and drain current | - Tower grounding according to norms |
| | Noise from electric spark of wires (corona discharge) | <p>- Noise regulation in the zone of housing estate – 45 dBA</p> <p>For 500 kV overhead lines, the norm is ensured by moving them away from the housing estate at 250 m and more</p> |
| 2. Birds | <p>- Collision with towers and wires</p> <p>- Electric shock through excrements when sitting over an insulator chain</p> | <p>- Bypassing of habitats and assemblage of valuable species of birds during migration</p> <p>- Frightening off devices</p> |
| 3. Radio, TV | Corona | - Observance of norms for electromagnetic |

| | | |
|--|-----------------------------|---------------------------------------|
| | discharge on field wires | - Moving away from receiving stations |
|--|-----------------------------|---------------------------------------|

The impact on the people and animals has been studied completely and their safety is ensured when the design satisfy.

It is also well known that the overhead line may affect birds, and a number of measures for their protection is proposed. But the efficiency of such measures is insufficient, therefore, the basic measure is to bypass the areas of the assemblage of birds.

The most impact on the environment is made in the construction of the overhead line: breakthrough cutting, digging, travel of machinery over swamps and streams, construction and domestic waste. The projects provide measures for the reduction of each impact. A case in the point is the project of 500 kV overhead line – Bureiskaya hydroelectric power plant – Khabarovskaya substation worked out by DAENERGOSETPROJECT. Four organizations have participated in the development of the environmental section, it has recently passed a state environmental examination and has been approved.

The basic indices of the project are given in Table 2.

The highest expenses are required for the construction of temporary structures which protect the land and water, as well as for damage to forest.

An example of river protection is given in plan 2: the overhead line route is chosen with minimum passing along the bottom land, the water protection zone has only 4 towers.

In order to completely implement the environmental protection measures the project provides monitoring.

During the construction mobile laboratories should carry out an analysis of soil, water and air. The quality of re-cultivation, stabilization of hillsides, state of passages over streams, removal of waste and geological processes should be controlled.

During the first three years of operation it is necessary to follow the dynamics of restoration of vegetation and density of the settlement of animals, and places of possible wash-out of shores and bottom lands.

Table 2

**Environmental indices of project of 500 kV overhead line
Bureiskaya Hydroelectric Power Plant – Khabarovskaya Substation**

| Index | Measurement unit | Value |
|--|-------------------------|--------------|
| 1 | 2 | 3 |
| 1. Length of overhead line | km | 435 |
| 2. Cost of construction | thousand \$ | 160,000 |
| 3. Costs of environmental protection | “ | 2110 |
| Including | | |
| - construction operations | “ | 460 |
| - compensation for pollution and waste | “ | 250 |
| - compensation for forest damage | “ | 1350 |
| - payment for land | | 137 |
| 4. Temporary structures | | |
| - passages over streams and gullies | pieces | 150 |
| - bridges | “ | 30 |
| - foundation sites for towers | “ | 260 |
| - plank roads on swamps | km | 91 |
| - ice crossings | “ | 1,2 |
| - tractor driveways | “ | 241 |
| 5. Waste and rubbish | | |
| - construction waste | tons | 2400 |
| - solid waste | cubic m | 5800 |
| - liquid waste | “ | 40000 |

| | | |
|---------------------|----|------|
| 6. Grant of lands: | | |
| - for permanent use | ha | 30 |
| - for temporary use | “ | 1580 |

5. Specific impact of direct current transmission

The influence of the electrical and magnetic fields of direct current lines on live organisms is less than the influence of the electric and magnetic field of alternating current lines. These fields do not practically influence outside of the protective zone of the overhead line.

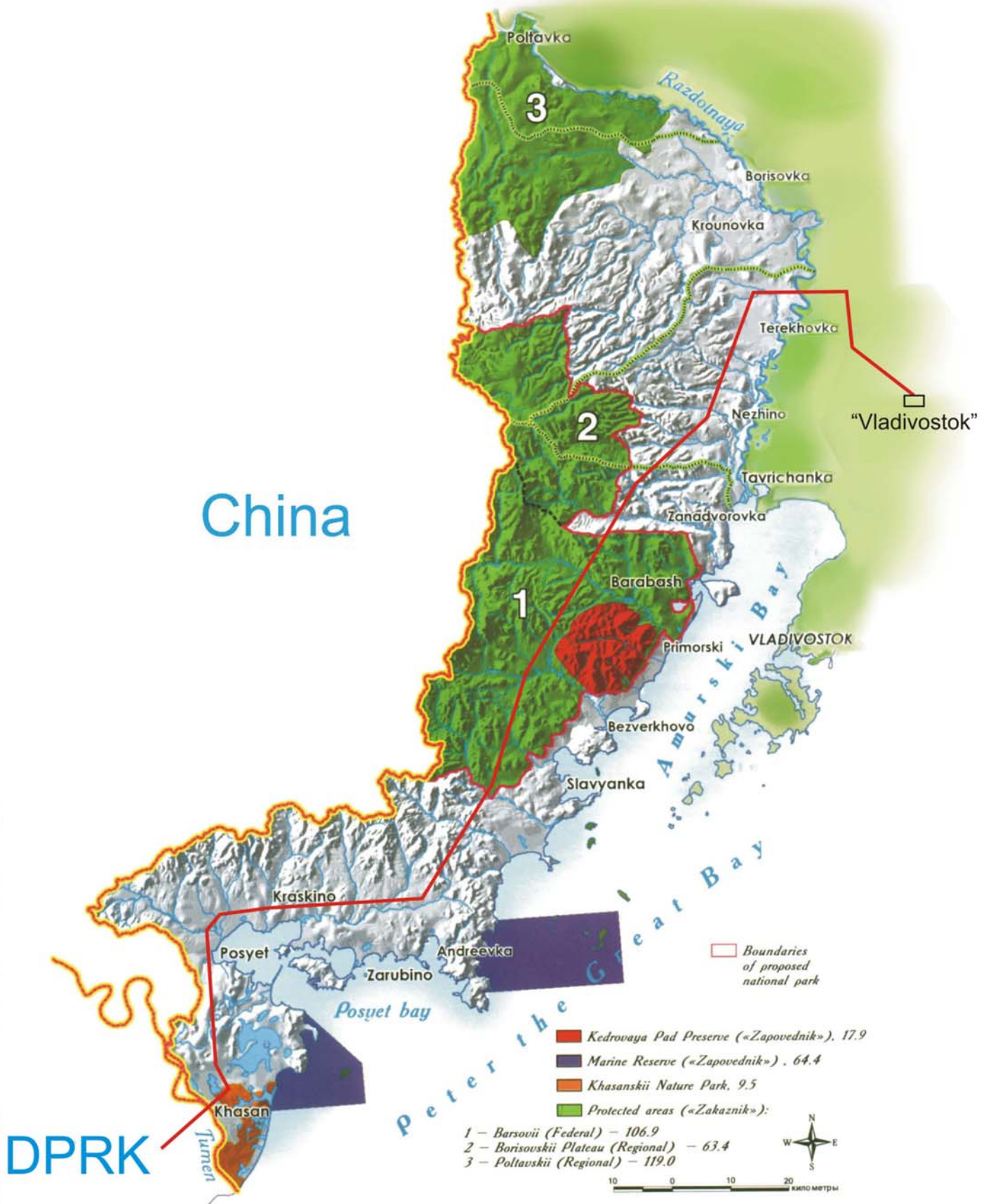
The influence on the radio, television and communication takes place not only because of corona discharge on wires but also because of harmonic components of the current. With the purpose of reducing the harmonic components substations are equipped with filters.

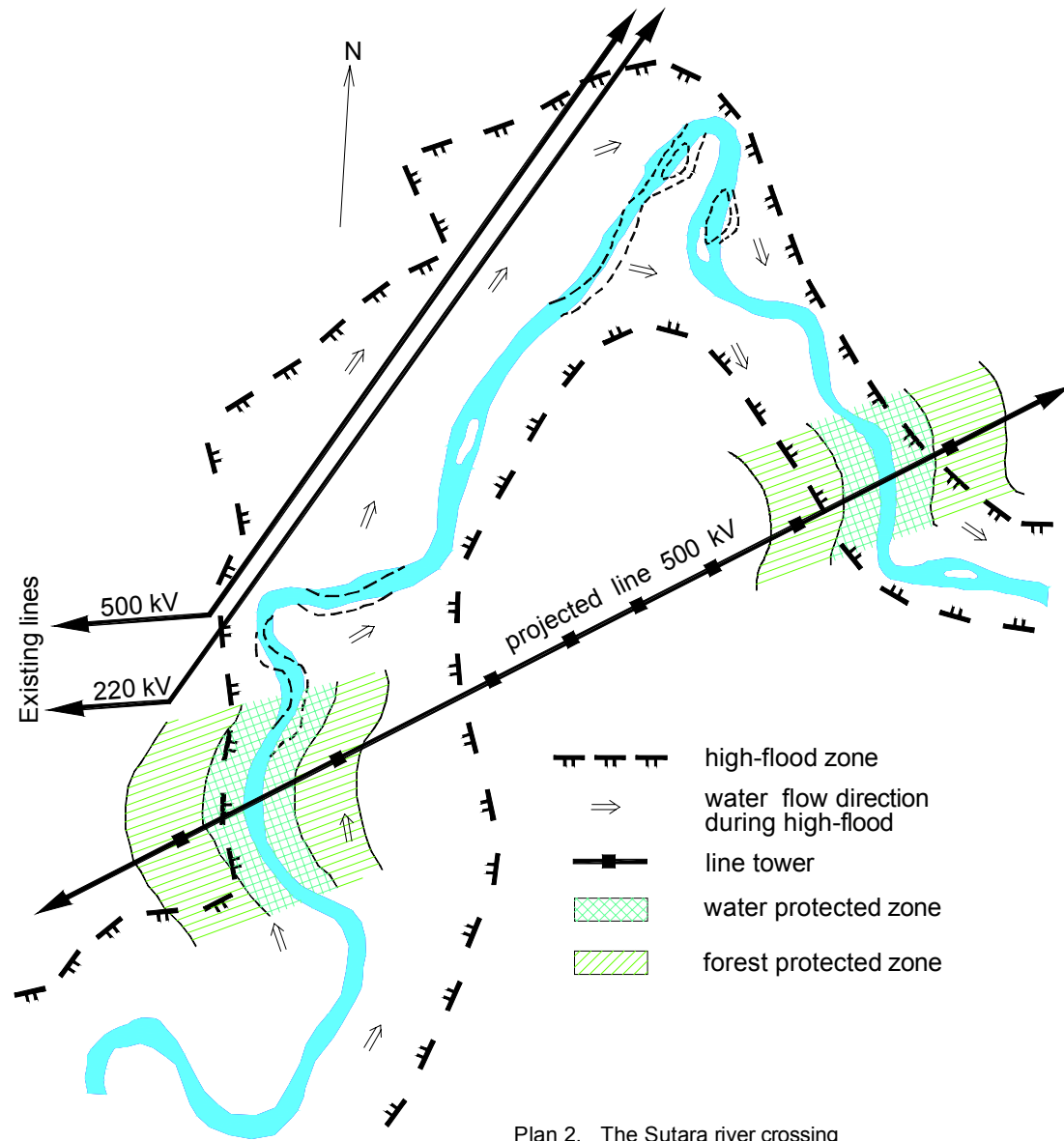
Metal corrosion of underground pipes and cables is more dangerous if the ground is used for backward current. In order to avoid corrosion, wires for the backward current are suspended on lines. At the same time these wires are used as a screen for attenuating the electrical field near the ground.

The line under consideration should have backward wires because a route of piping is planned in the zone of power transmission influence.

Conclusion:

The modern level of science, technology and designing as well as cooperation with ecologists make it possible to create power transmission between Russia and the DPRK with minimum damage to the environment.





Plan 2. The Sutara river crossing