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## Leningrad Flood Protection

### Protection contre les inondations à Léninegrad

### Leningrader Flutschutz

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#### SUMMARY

The Leningrad flood protection system was designed and has been accomplished in such a way that its negative impact on the environment should be excluded. However, due to the poor publicity and under the influence of mass media and the false information constantly being circulated by the opponents of the construction, a considerable part of the population of Leningrad is prejudiced and therefore against the storm surge barrier. In this connection, an objective evaluation of the project by the international scientific public might be of paramount importance.

#### Protection contre les inondations à Léninegrad

##### Résumé

Le système de protection contre les inondations à Léninegrad a été conçu et réalisé de sorte que l'influence négative sur l'environnement soit réduite à zéro. Cependant, sous l'influence d'une mauvaise publicité de la part des mass media et de mauvaises informations circulant en permanence chez les opposants à la construction, une partie importante de la population de Léninegrad est opposée à la construction du barrage contre les raz-de-marée. En ce sens, une évaluation objective du projet par la communauté scientifique internationale pourrait s'avérer décisive.

#### Leningrader Flutschutz

##### Zusammenfassung

Das Leningrader Flutschutzsystem wurde entworfen und in der Weise ausgeführt, dass ein negativer Einfluss auf die Umwelt ausgeschlossen sein sollte. Infolge schlechter Oeffentlichkeitsarbeit und unter dem Einfluss der Massenmedien und der ständig zirkulierenden Falschinformationen aus Kreisen der Baugegner ist ein beträchtlicher Teil der Leningrader Bevölkerung jedoch gegenüber der Sturmflutbarriere voreingenommen. In dieser Hinsicht könnte eine objektive Bewertung des Projektes durch die internationale wissenschaftliche Oeffentlichkeit von höchster Bedeutung sein.



Leningrad is a large industrial, scientific and cultural centre of the USSR. It is one of the most beautiful cities of the world. Stately historical sites of Leningrad belong to the whole mankind.

From the early years of the city history its location in the vicinity of the sea as well as the abundance of wetlands predetermined the dangerous nature of relationship between the city and the waters. Practically every year Leningrad is subject to the sea pile up floods that cause considerable and very often unrecoverable damage to the central part of the city and to the towns of Petrodvorets, Lomonosov and Kronshtadt also.

Under the influence of the integrated meteorological and hydrodynamic processes the balance of the water bulk in the Baltic Sea and the Gulf of Finland has been disturbed and a so-called long wave has been formed which increases due to lowering the shores and reaches the Neva Bay and the delta of the Neva. In combination with the wind pile up and other water level variations (i.e. seiche-type and tidal) the long wave causes brisk and short-term water elevation in the eastern part of the Gulf of Finland and in the delta of the Neva.

Since 1703 when the city was founded about 300 floods have been registered with the water level elevation of more than 1.6 meters. The calculation show that even without taking into account the total rise of the sea level floods with water elevation up to 5.4 m may occur in Leningrad being able to submerge 30% of the city area, i.e. in fact the whole central historical part.

Typically the floods in Leningrad are sudden and short-term and are characterized by high intensity of the water build up and fall. A reliable prediction of possible floods can only be made 4-6 days in advance. The duration of a flood usually amounts to several hours and never exceeds twenty four hours. As a rule floods are accompanied by storm winds with the velocities up to 30-40 m/sec. More than once the water elevation was above 3 meters. Some of the floods were really disastrous and caused human losses.

In 1824 a flood with the water level elevation of 4.21 m took place.

Since 1979 along the line of contact between the Neva Bay and the eastern part of the Gulf of Finland, at a distance of about 30 km from the Neva estuary, the Leningrad storm surge barrier has been under construction designated to safely eliminate in future any floods in the protected water area, including the floods with the probability rate of 0.01%.

The Leningrad storm surge barrier is an integrated system of sluiceways and navigation passages connected by earth-fill dykes. The total length of the barrier is 25.4 km (Fig.1).

Along the crest of the barrier a six-row highway is supposed to be constructed. The highway will connect the northern coast of the Neva Bay with the southern one and will be the most important component of the future roundabout road encircling the city. This project is extremely important for Leningrad from the ecological point of view.

Now the construction of the barrier has entered the final

stage.

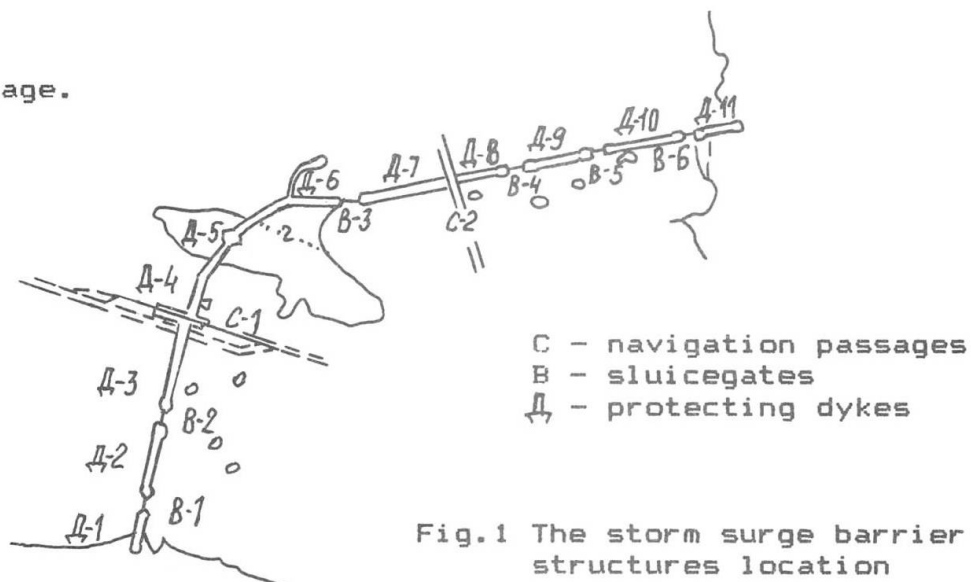


Fig.1 The storm surge barrier structures location

Out of the total length of the barrier only the fraction 0.9 km long remains undeveloped. It is there that the main navigation fairway goes. So far the construction of the main navigation passage has not been completed either. All the six sluiceways provided for by the design are in operation, the sluices are fitted with 64 big gates and spans 24 meters long (Fig.2).

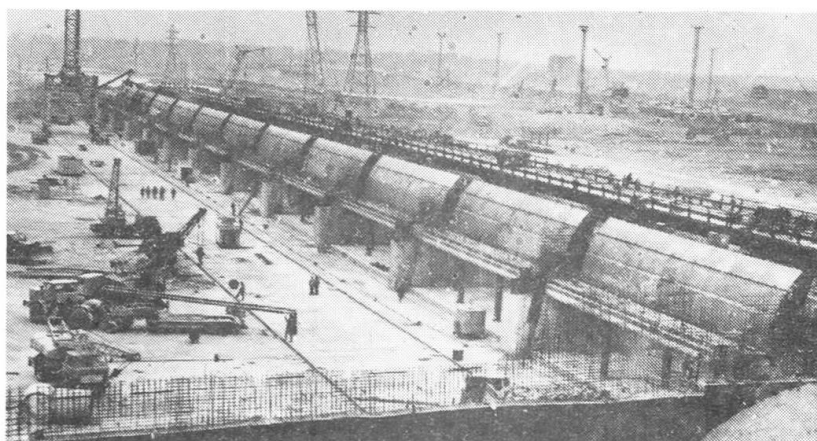


Fig.2 Storm surge barrier

The bulk of the construction include about 40 mln.m<sup>3</sup> of earth-fill embankments, 2.5 mln.m<sup>3</sup> of reinforced concrete and 45 thous.t of suitable metal structures and equipment. The cost of the whole system is 1 mlrd.rbl. A lot of new engineering and organizational solutions have been used while constructing the storm surge barrier. One can mention, for example, making use for the first time in the open water area of moraine loams with their pioneering filling up in the water at depths up to 5 m, in any season of the year. To execute engineering works under the water a floating mechanized unit has been formed and now is in successful operation. This unit includes a big floating excavating machine manufactured by the Austrian company "Osvag" (Fig.3).

Of considerable importance is draining at big depths of the foundation for the earth-fill dykes in the southern part of



the barrier. This problem is being solved successfully by means of a high-efficiency draining plant, tailor-made by the Italian company "Trevi-Soilpack" (Fig.4).

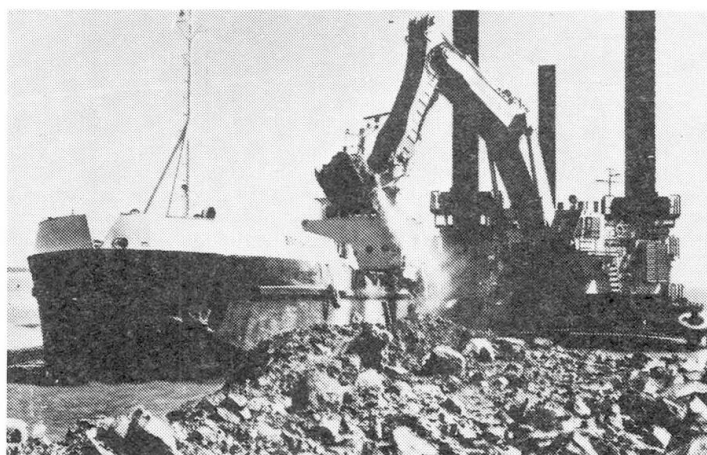


Fig.3 "Osvag" floating excavating machine

To accelerate the construction and to raise its rate of industrialization two sluiceways, i.e. N4 and N2 (the sluiceways are numbered northward) have been constructed making use of large floating units up to 130 m long, 53 m wide and 14 m high. The weight of the units amounted to 30 thous.t. The units bore basically assembled gates (Fig.5).

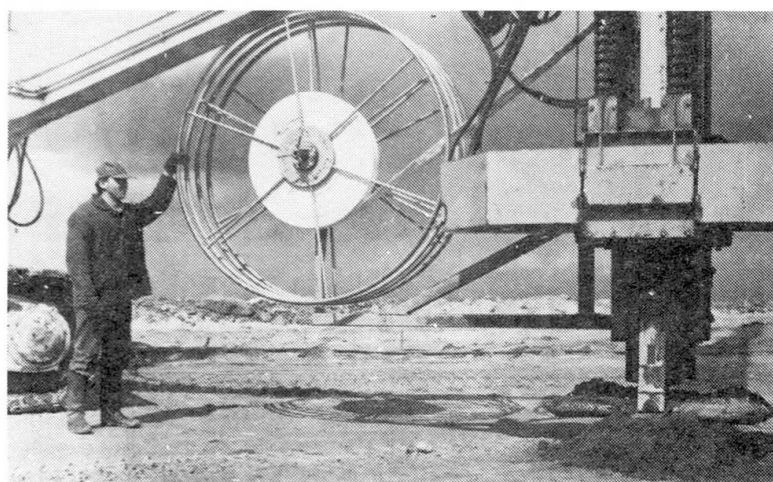


Fig.4 "Trevi-Soilmec" drainage plant

Consequently the threat to the city on the part of the sea may be eliminated in the nearest future. But during the whole period of the city history there existed the threat to the sea on the part of the city, their interaction taking place through the shallow and narrow Neva Bay. This threat was caused by the wrong and light-minded approach of the people considering the self-restoring capacity of the Neva Bay unlimited. With the growth of the city area and the



extension of the industries, constantly increasing amounts of different pollutants including toxic ones were being discharged into the small affluents and arms of the Neva and into the Neva Bay itself, in fact without any treatment. It takes usually 5-8 days for the water to cover the distance between the Neva estuary and the island of Kotlin and to reach the entrance to the Gulf of Finland, that distance amounting to 35 km and the average flow velocity being 6-8 cm/sec. During this time a considerable part of the suspended solids contained in the water are being precipitated and they gradually form the polluted bottom layer. This takes place especially in the coastal areas where the flow velocity is less and amounts to only 2-4 cm/sec.

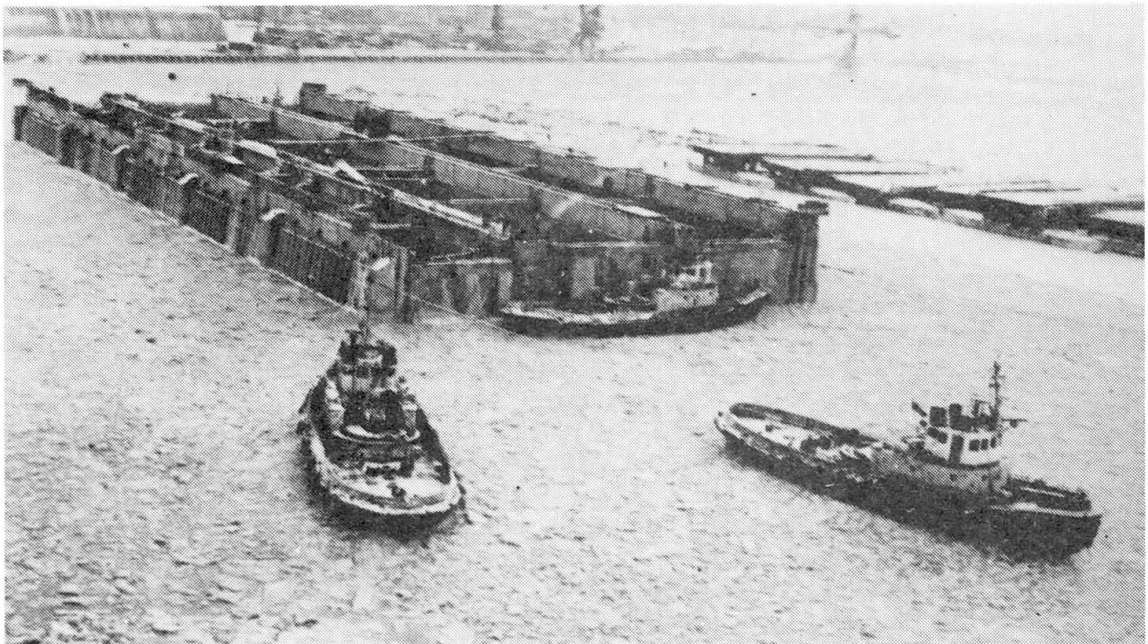


Fig.5 Transporting of floating units for sluiceways

Only after the time when it became evident that continued discharges of the untreated water would inevitably and soon lead to ecological calamity, the construction of huge waste water treatment plants with the capacities of 1.5-2.0 m<sup>3</sup>/day was started feverishly in the northern, central and southern parts of the city. Both domestic and industrial waste waters are being supplied to the treatment plants through the same sewers.

At the epoch when the decision concerning the beginning of constructing the storm surge barrier was taken and the construction itself started in the Soviet Union there existed no unconditional practice of discussing similar projects with the broad public. There was no independent system of information and the public opinion analysis. The public opinion was never taken into consideration during the



preparations of projects and on the final stage of decision-making.

However, it did not mean that the projects considered at the time did not take into account the requirements existing at those days on the basis of the standards and scientific predictions both in the Soviet Union and abroad. The design of the storm surge barrier in Leningrad was subjected to a comprehensive analysis to a greater extent than any other hydraulic engineering project in the USSR. In fact, during the whole period of the final decision preparation, i.e. for more than 10 years, two alternative versions have been worked out by scientists and design engineers. There were still other options but they soon lost their competitive ability.

The two versions, i.e. the so-called Eastern version and the Western one, as the saying has it faught dog, faught bear. Of course, it was not the versions themselves that were objectively engaged in the fight. The fight was going on between the authors and adherents of one concept and the authors and adherents of the other one. There was a threat of this fight lasting for an indefinite time since the opposing parties could not find any possible solution and, to be more honest, they did not even try to do so. In such a situation the necessity of a willed decision inevitably emerges if there are forces capable of making this decision.

The Soviet government controlling the situation at those days and capable of not only making important decisions but also of implementing them considered all the pros and contras and decided to construct the flood protection in Leningrad according to the Western version.

The adherents of the Eastern version being disappointed and angry decided to take their time waiting for a chance to discredit the decision taken, meanwhile giving rise the rumours that coul contribute to this discrediting, also provoking and supporting those rumours. In the time of glasnost and unlimited criticism of all that was implemented or was started in the past there appeared a possibility for "the insulted" to carry on their destructive activities openly being not afraid of responsibility for that. In the atmosphere of one-sided information or rather false information appearing in the press and on television which easily catch up sensations and alleged "disclosures" the opponents of the construction managed to mislead the major part of the Leningrad population as well as the broad public in the Soviet Union and throughout the world.

In their fight for power at the meetings and conferences, in the reports published by the press and on television the new-come politicians under the cover of pseudodemocratic slogans took advantage of the artificially created psychological situation in connection with the problem of the flood protection of the city. They announced their strongly negative attitude to the project being under construction and promised that if they were elected people's deputies they will provide for halting the construction works and dismantling the part of the structure already erected. And they were not in the least embarassed by their complete lack of expertise in the problems concerned.



Now that they have become the deputies of the Lensoviet and they are unable to fulfill their promises, namely, to feed and to clothe the people, to eliminate the criminality etc., making use of their majority those people managed to drag in the decision about suspending the construction of the Leningrad storm surge barrier. However, since the decision was taken corporatively, by vote, there is no one at present to bear the responsibility for the consequences.

However, to implement this decision or any other decision in connection with the said problem this decision has to be accepted or approved by the USSR government, since the barrier has been constructed according to the governmental decision and is financed by the state.

Predicting a possible negative development of the situation around the flood protection in Leningrad on the initiative of Mr. Marchuk, President of the Academy of Sciences of the USSR, supported by the State Committee of the USSR on science and technology, the State Committee of the USSR on nature protection and the Gosplan of the USSR, the USSR Council of Ministers authorized by a special direction carrying out a comprehensive state expert study of this problem involving the work of an international group of experts.

During the second part of 1990 this expert group, where renowned scientists from many countries took part, gave a thorough study to the problem taking into account the world experience, and submitted a convincing material together with conclusions and recommendations which may be summarized as follows:

1. Since the ancient times a certain negative impact on the system Ladoga-Neva has been noticed which may be accounted for by such antropogenic features as:

- Discharge of untreated or of unsufficiently treated domestic and industrial waste waters.

- Reclamation of the marshlands to construct new residential and industrial areas. It influenced considerably the functioning of the Neva Bay as the area of stay of wading birds.

- Extraction of fill-in materials, service dredging of navigation channels, construction of military defense works by dredging the bottom sediments etc.

- Dumping the polluted sediments extracted by the dredgers and the snow from the city streets into the system Ladoga-Neva.

- The inflow into the system Ladoga-Neva of different pollutants washed out on the whole surface of the Ladoga-Neva catchment including the pollution coming down from the air and caused by agricultural activities.

During the last ten years of the construction of the barrier its impact on the water quality in the Neva Bay has been negligible as compared to the effects mentioned above.

2. The International commission is of the opinion that the flood protection is necessary. At present there is no economically justified alternative solution to the completion of the barrier construction which has been almost accomplished.





3. Due to the fact that the construction has not been completed yet storm waves and flows may cause considerable damage to the barrier; its repair may cost as much as several tens of millions rubles. Damages to the barrier will influence the environment negatively.

4. The present design of the storm surge barrier, as it has been confirmed by the international commission following the inspection, is reliable. The barrier is capable of protecting Leningrad from the floods.

However, at the moment one can not be sure that political manipulations should not lead to new complications and a new threat of halting or suspending the construction in spite of the fact that the jeopardy of strong and disastrous floods objectively grows in connection with the progressing sea level rise and common lack of ecological stability in the world. Similar situations have occurred in this country and in other parts of the globe and may occur in future. It should be taken into consideration that solution of such problems is impossible without considerable money and time expenses. Very often to reconcile opposite interests it is necessary to lower the quality level of the problem under solution, though in the countries with the high culture of the society it should not be like this.

During the international meeting in Venice in 1989 I already put forward my suggestions concerning setting up under the aegis of UNO a permanent international board possessing necessary power functions, to conduct expert studies of large projects of hydraulic engineering in any region of the world. Now I am turning back to this suggestion again since the problem becomes very urgent.

The extending scope of the interaction between the mankind and the water environment requires that the coordination of this interaction on the basis of the hydroecological situation, both locally and globally, should be provided for irrespective of any regional political situation.