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ECONOMIC COMMITTEE

THE DRUZHBA OR "FRIENDSHIP PIPELINE"

Note by the French Delegation

The Druzhba or "Friendship Pipeline", which is the longest such installation in the world, runs for 5,000 kilometres and links the Bashkirskaya and Ukrainian oil deposits and, indirectly, for the time being, those of Western Siberia, with the refineries in Czechoslovakia, Hungary, Poland and the GDR. The first pipeline was planned in 1959 and terminated in 1964. In 1969 a duplicate line was started and is scheduled for completion at end-1973.

The Druzhba is an essential element in Soviet control of the energy industries in the COMECON countries(1), and in the coming years it will supply 90% of the petroleum requirements of the four Communist countries of "North Central Europe".

As well as being a prime factor in the economic development of these countries, the pipeline, which today can move 50 million tons of product at low cost, is also of strategic and logistic importance.

When in 1974 it is linked directly with the vast deposits of Western Siberia and has a yearly capacity of 100 million tons, it will guarantee secure and continuous supplies for the refineries of the East. Indirectly, it provides logistic support for the extensive Warsaw Pact system of POL depots in Central Europe. The relative vulnerability of the above-ground sections of the line and of the electrical power supply to the pumping stations are the Achilles' heel of the system.

This document includes: 6 Annexes

(1) Council for Mutual Economic Aid

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1. Background and description

In Moscow, on 18th December 1959, the Soviet Union, Poland, the GDR, Czechoslovakia and Hungary signed an agreement for the joint construction of the Druzhba international pipeline. Completed in autumn 1964, the pipeline runs for 5,327 kilometres (3,000 of them in Russia) and crosses 49 railways, 153 roads, 38 rivers and streams, including the Volga, the Don, the Desna and the Dnepr, and 42 kilometres of marshlands.

There are two distinct parts in the infrastructure of the pipeline. The first section is essentially Russian up to Mozyr'(1). After Unecha, the pipeline divides into two with one branch going towards Central Europe and the other towards the Baltic. The second section of the line, although part of it is situated in Russia, is intended to supply the Communist countries of "North Central Europe"(2). This section splits into two at Mozyr', with one arm running to Brest, Poland and the GDR and the other to L'vov, Uzhgorod, Czechoslovakia and Hungary. A detailed description of the Druzhba route will be found in Annexes A, B, C and D.

It takes a little over three weeks for product to travel from Kuybyshev to Schwedt in the GDR, over a route which has 50 pumping stations (1 every 80 or 100 kilometres) some of them with a storage capacity of 30,000 cubic metres. There are 4,500 people to run this fully automated pipeline, which has a monitoring station every 200 kilometres (22 in all) and a despatching centre in Moscow.

In mountainous country, the line rises to an altitude of 1,100 metres but it crosses the Volga at a depth of 25 metres. It is the longest pipeline in the world, exceeding the trans-American pipeline (2,190 kilometres) and the trans-Arabian tapline (1,800 kilometres).

The result of co-operation between five members of COMECON(3), the pipeline is owned by the countries whose territory it crosses. The Soviet Union acted as project manager for the construction and supplied the bulk of the pipes. The GDR was responsible for all the starting and control equipment in the pump stations. Czechoslovakia produced the large high-pressure valves, while Hungary developed the automatic communications and control system.

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- (1) See attached sketch map
(2) Poland, GDR, Czechoslovakia and Hungary
(3) Council for Mutual Economic Aid

The Druzhba was finally completed, from end to end, in September 1964. It was scheduled to come into service in 1963 but was held up because of the NATO embargo on the supply of large diameter pipes.

Between February 1962, when it became partially operational, and autumn 1972, the pipeline moved 200 million tons of oil, a third of which went to Czechoslovakia, a quarter to Poland, a fifth to the GDR and a sixth to Hungary.

The increased requirements of the COMECON countries for POL products meant that, as soon as the Druzhba was completed, its maximum annual flow rate of 40 million tons was considered inadequate. In 1969 work began on a duplicate pipeline. With a larger diameter than the original pipe (1,220 mm as against 1,030 mm for the Soviet section and 820 mm as against 529 mm for the Central Europe section), this second pipeline should bring the yearly maximum capacity to 100 million tons for the pipeline as a whole.

The laying and fitting out (particularly pump stations) of this second pipeline are almost finished in Central Europe. There is a final section to be completed in the USSR beyond the Volga, for which the crossing works were completed in December 1972. The whole of the second pipeline will be laid and operational by the end of 1973. The Hungarian stretch of the first Druzhba has not been duplicated but, since November 1972, the Soviet Uzhgorod line has been directly connected with the Hungarian Szazhalombatta refineries by means of a special pipeline known as Druzhba II.

2. The economic factor

This pipeline system is of major economic importance to the Soviet Union and to the other countries concerned. It provides the Soviet Union, for the smallest outlay on transport, with a powerful instrument for dominating the satellite countries. In return for this dependence in the energy sector, the latter are guaranteed a secure source of supply which has already enabled their industries to make regular progress and will continue to do so.

2.1 Importance for the Soviet Union

The Soviet Union maintains a strong hold(1) over the satellite COMECON members; the GDR, Poland, Czechoslovakia, Hungary, Bulgaria and Rumania. In the first four of these

(1) See background note 10,092/SGDN/CER/C/CD of 27th January, 1972: "Logistic dependence of the COMECON countries on the USSR"

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countries, where it has a powerful military presence, Moscow has not hesitated during the last 15 years to repress by force all attempts at ideological independence. At the same time, within COMECON, it has successfully monopolized and controlled those modern energy products, oil and natural gas, which are supplied through the oil and gas pipelines it runs. With regard to electrical power distribution, rail and air transport and the development of nuclear power stations (still in their infancy), the Soviet Union plays a decisive rôle in COMECON.

The pipeline network in Central Europe is a major instrument of Soviet energy policy within COMECON. Most of the crude oil supplies of the countries of North Central Europe are delivered through the network. Between 1966 and 1970, the Soviet Union delivered 135 million tons to the satellite countries taken as a whole (except Rumania). For the period 1971 to 1975, it is planned to supply 256 million tons, or well nigh twice the figure for the previous five year period. All in all, between 1965 and 1975, these deliveries will have amounted to 90% of the petroleum requirements of the receiving countries.

Given the inadequate transport facilities and the overloaded rail network in the Soviet Union and the satellite countries, an oil pipeline was the only possible means of moving hundreds of millions of tons of oil from the Soviet Union to Central Europe. Not only is the pipeline an economic form of transport in itself, but it also takes the pressure off the railways. The cost of moving one ton of crude oil one kilometre by pipeline is four or five times less than it would be by railway and three times less than the cost of shipping it by tanker. On the Soviet section alone, the Druzhba replaces sixty thousand rail tankers drawn by five thousand locomotives(1).

2.2 Advantages for the countries served by the Druzhba

These countries are perfectly aware that they depend on the Soviet Union for their energy supplies. This dependence is just another aspect of the ideological and political dependence which is spelt out in numerous bilateral treaties and given concrete expression by a strong Soviet military presence and membership of COMECON and the Warsaw Pact. But although they have to rely on the Soviet Union for energy, the satellite countries do at least have a secure source of supply which has enabled their

(1) It also reduces transport times by avoiding the need to transfer cargo in ports and obviating the delays caused by trans-shipment in railway stations on the Western borders of the Soviet Union where the Soviet and Western gauge railways meet.

economies to expand. Deliveries of oil to the COMECON countries are not subject to changes of mood in the Middle East producing countries, to fluctuations in world prices and to demands of the Western operating companies.

On the other hand the COMECON countries do depend on the goodwill of the Soviet Union, which pursues a "capitalistic" policy by imposing prices favourable to itself for goods supplied by the satellites in compensation for Soviet oil deliveries. However, since enlightened self-interest demands that Moscow should back up the economies of the East European Communist countries, the latter do at least have the assurance that their energy requirements will be met on a continuing basis.

This regularity of supplies has greatly increased the potential of the East European oil industries. In the four countries served by the Druzhba alone, refining capacity increased fourfold between 1965 and 1973 (5 to 6 times between 1965 and 1975)(1). The petro-chemical industry and all other industries have gained from these improvements. One ton of crude oil produces 410 kilos of fuel, 410 kilos of oil, 60 kilos of bitumen and grease and 55 kilos of organic raw materials(2).

3. Strategic and logistic aspects

The Druzhba is of strategic importance since it is instrumental in supplying four countries with a raw material essential for their economies. Moreover, it indirectly supports the vast network of Warsaw Pact fuel depots in Central Europe. Its relative vulnerability makes it an interesting strategic and logistic target.

3.1 Strategic importance

The Druzhba provides 80% of the requirements(3) of the East German, Czechoslovak and Hungarian refineries and three-quarters of those of the Polish refineries. The economies of these countries (oil industry, industry in general and power stations) depend directly on the regular supply of the biproducts obtained from these refineries. The Druzhba is strategically important because it constitutes a continuous source of supply.

(1) 10.9 million tons a year in 1965, 33.4 in 1973, 50 in 1975; see Annex E for details

(2) Which can provide 30 kilos of detergent, 1,000 pairs of stockings, 40 plastic pails

(3) The rest comes by railway or sea

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3.2 Logistic importance

The Soviet Union has established an imposing network of fuel depots capable of supporting a land and air deployment of eighty divisions and four thousand tactical aircraft for one month of nuclear type warfare(1). There is no pipeline to carry refined product from the Soviet Union. All the national or Russian fuel depots, both civilian and military, in the North Central European countries are supplied by the refineries linked to the Druzhba. The bulk of these depots are in the forward area situated in the GDR, Bohemia and Western Poland. The military depots can provide about 20 days support for the land and air forces and the civilian depots from 10 to 15 days while the stocks held by the refineries amount to between 25 and 30 days supply(2).

The Druzhba is also of indirect logistic importance in the transport field(3). It takes a lot of pressure off the railways and makes them available in time of crisis for the bringing up of reinforcements in men and equipment from European Russia, since the railways carry 70% of the traffic connected with a military theatre of operations.

3.3 Vulnerability

As a strategic and logistic target, the Druzhba is vulnerable at several points along its route and at the pumping stations.

Most of the pipeline is between 1 m and 1.50 m underground. It crosses the Volga submerged, but an overhead system has been used for crossing the Vistula and the Bug. Similarly, the 130 kilometres across the Carpathians between Uzhgorod and

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- (1) See background notes - Soviet and national fuel depot system in the Warsaw Pact countries: 10,935/SGDN/CER/C/CD of 17th September, 1971 - Importance of the Warsaw Pact logistics system: No. 11,120 SGDN/CER/C/CD of 19th September, 1972
 - (2) Assuming that the refineries keep a permanent stock of refined product amounting to 10% of their yearly refining capacity of which half, i.e. 5%, is instantly available for military purposes; for refining capacities see Annex F
 - (3) The possibility of using a crude oil pipeline to move refined product should be mentioned in passing. Soviet technicians are certainly able to avoid a mixing of different petroleum products by using rubber separators which adhere to the sides of the pipe, but the preparation of a crude pipeline to take refined product requires, in the opinion of the experts anything from 5 days to 2 or 3 weeks

Dolina comprises numerous overhead sections including 5 kilometres of particularly vulnerable infrastructure(1). The second Druzhba runs parallel to the first and there is only about 20 m between them(2).

In addition to the overhead sections of the pipeline, the pump stations also constitute weak spots. They are small structures (some 50 m x 50 m) but the more important ones have storage facilities for 30,000 cu.m and more of product(3). Moreover, the pipeline monitoring system and the pump stations rely on electrical power (alternating current) and if this were cut off the whole network would be brought to a standstill(4).

Marshal Sokolovsky in his book "Military Strategy" writes that "the impressive Druzhba pipeline would play a major rôle in supplying oil and petroleum products to possible areas of operation and key industrial zones and is not seriously vulnerable to nuclear strikes". The vulnerability of the pipeline as a whole is certainly not great but this is not true of the overhead sections and the pumping stations.

4. The medium and short-term outlook

In 1973, the Bashkirskaya and Tatarskaya oilfields will be directly connected with the GDR. Already, oil from Tyumen in Siberia can follow the same route indirectly by means of the pipeline between Tyumen and Omsk and then via Kuybyshev. In 1975 there will be direct links between Tyumen and the Druzhba. In the likely event of a major development of the vast Western Siberian oil resources taking place, thanks to the assistance of the United States in particular, the Communist countries will be assured of secure supplies of Soviet petroleum products for a long time to come.

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- (1) For the vulnerable points along the pipeline, see Annex D
 - (2) The Bratsvo and International gas pipelines also follow the same route, from L'vov onwards, across the Carpathians and the whole of Czechoslovakia
 - (3) In Russia. In Poland and Czechoslovakia the storage capacity is between 10,000 and 20,000 cu.m
 - (4) The monitoring system comprises panels with warning lights which give the location and nature of any damage occurring. All the pumping stations run on electric motors which get their power from the local grid system. In some places there are loopings 20 to 40 kilometres long which make it possible to close off sections of the pipeline. However, the duplicate Druzhba is loop-linked in places to the first.

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Admittedly, British investments in Poland(1) will undermine the Soviet monopoly after 1975. Oil from the Middle East, particularly Iraq, could start flowing after 1975 to Hungary, Poland and Czechoslovakia through the "Adria" pipeline which it is planned to build across Yugoslavia. However, even when they are fully operational, these new facilities will provide only 15 to 20% of the oil requirements of the countries concerned and the Soviet Union will continue to supply between 80 and 85%.

There is every reason to believe that in the short and medium-term the Druzhba will continue to provide the bulk of the oil requirements of the North Central European Communist countries from Soviet oilfields. The fact that its peak capacity is limited to 100 million tons a year should ensure that it will be required for some time to come. In the 1960s the satellite countries had little refining capacity but this has since expanded rapidly and should level out around 1975. Moreover, the change in the balance of fuels and the growing part played by natural gas will help to prevent the rise in petroleum requirements outstripping the capacity of the existing pipelines.

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The building of the Druzhba and its duplication, which is now in the course of completion, is a logical step in the general process of Soviet expansionism. By maintaining a virtual monopoly in the supply of petroleum products, the Soviet Union strengthens its hold over the satellite countries, which constitute the outer defences of the Communist fortress. The additional supplies from the Middle East come from countries like Iraq, in which Moscow is pursuing an insidious policy of penetration with the long-term aim of ousting the multinational Western firms. Such supplies often represent the repayment of Soviet investments in the oil industry infrastructure of the Middle East producer countries, and sometimes even of loans, such as those extended by Hungary on Soviet "advice".

Russia also provides most of the COMECON countries' natural gas requirements and this year it will be making natural gas deliveries to the Federal Republic of Germany and, later on, to Italy, France and Finland. Although, in order to meet the pressing needs of its economy, the Soviet Union is obliged to

(1) Starting in 1975, the British Petroleum Company will deliver 3 million tons of oil a year to the new Gdansk refinery which was built with British help. In 1975 British oil will amount to 15% of Poland's yearly requirements.

encourage large-scale investment, particularly by the United States and Japan, the opening up of the Siberian resources will guarantee it a place as a leading exporter of primary energy products in the years to come.

NATO,
1110 Brussels.

List of Annexes

Annex A - Infrastructure

Annex B - Pump stations

Annex C - Length of pipeline and diameter of pipe

Annex D - Crossing of major obstacles

Annex E - Refineries located along the Druzhba

Annex F - Refinery depots and pump stations located along
the Druzhba

INFRASTRUCTURE

1. The pipeline up to Mozyr' and Soviet branch-lines

The Druzhba pipeline starts in the region of Al'met'yevsk where the crude oil arrives from four different sources:

- local deposits;
- the Tatariskaya oilfields (Alkiezheva);
- the deposits known as the Romaskino oilfields at the foot of the Urals behind the Volga and the Kama (Aznakazheva);
- the Siberian oilfields via Tuymazy.

At Al'met'yevsk, the crude oil undergoes summary processing (removal of salt and water) before being moved through the pipeline at a speed of one metre a second.

1.1 From Al'met'yevsk to Unecha, the diameter of the first pipe is 1,020 mm and it extends for a length of some 1,500 kilometres; the second pipeline has a diameter of 1,220 mm.

From Al'met'yevsk the Druzhba runs to Kuybyshev and Novokuybyshevsk. It then crosses the Volga, south of Syzran, and links up with this town. Between Syzran and Penza, it goes through Kalynovy Klyutshy, Kuznetzk and Seliksa.

After Penza, the pipeline crosses the Sura and reaches Michurinsk and Nikol'skoe via Sosedka and Tambov.

At Nikol'skoe it is planned to provide a branch-line with a diameter of 722 mm which will go as far as Odessa and supply the Kremencug refinery on the way.

From Nikol'skoe, by way of Stanovaya and Stal'noy'kon, north of Orel, the Druzhba reaches Bryansk. This section of the pipeline crosses the Don and the Oka.

The last section, with a diameter of 1,020 mm and 1,220 mm, connects Bryansk with Unecha and crosses the Desna.

1.2 At Unecha, the Druzhba divides into two

The first branch, which runs north-west as far as Novopolotsk has a diameter of 720 mm. Over this route, which is 420 kilometres long, duplication is apparently in progress (diameter unknown).

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The line goes through Kostyukovici, Gorki, Mogilev, crosses the Dnepr between the latter town and Senno and reaches Novopolotsk where it supplies the refinery.

Afterwards, the pipeline has a diameter of 630 mm up to Siauliai and then of 529 mm to Ventspils. At one time, it was thought that a branch-line of 410 mm diameter would be built between Siauliai and Klaipeda, but the idea has now been dropped. The project may not have been completely abandoned, but it certainly seems to have been put off for the time being, although the port of Klaipeda has the advantage of being ice-free for a longer period than Ventspils. It is planned to build a branch-line, between Siauliai and the future refinery at Mazhikiyay.

The second branch of the Druzhba from Unecha has a diameter of 820 mm and 1,020 mm up to Mozyr', some 289 kilometres away.

It runs through Vysokoe, which is right next to Unecha so both places probably use the same facilities. It then runs on to Mozyr' by way of Novozybkov and Gomel.

2. The pipeline after Mozyr'

At Mozyr', the Druzhba splits in two, with the first arm running north across Poland to the GDR and the second arm running south to Czechoslovakia and Hungary.

2.1 The northern arm

With a diameter of 630 mm and 820 mm up to Plock, this branch leads from Mozyr', goes through Pinsk and Kobrin and on to Brest 441 kilometres from Mozyr'. It crosses the Polish frontier at Tokary, then the river Bug and so to Jablonna.

After Jablonna, it crosses the Narew and runs south of Plock, 248 kilometres from Brest, where it crosses the Vistula on a special bridge.

It is interesting to note that between Gomel and Brest the Druzhba crosses the White Russian marshes. For the marshland crossing, use was apparently made of mechanical shovels mounted on very wide amphibious caterpillar tracks.

After the Plock area and as far as Schwedt in the GDR, 427 kilometres away, the diameter of the pipeline is only 529 mm and 620 mm. It crosses the Vistula south of Plock. The subsequent known itinerary is Biedrusko, north of Poznan, Kamionna, Wierzbno, Skwierzyna and then Bielinek, close to the Polish-German border.

After crossing the Oder, the Druzhba runs for 27 kilometres inside the GDR to Schwedt, by way of Lunow.

From Schwedt, a 426 mm diameter pipe runs to the Leuna refinery in the Halle area. From there, a number of small branch-lines of unknown diameter supply the local refineries.

The duplication of this section is in progress but the diameter of the new pipes is not known.

2.2 The southern branch

2.2.1 from Mozyr' to Sahy

From Mozyr' to Sahy in Czechoslovakia, the pipeline has a diameter of 529 mm and 720 mm. Its length between these two points is 1,336 kilometres.

It runs through Michalky, which is apparently also known as Mozyr' II, and then goes on to Brody, L'vov, Joulino and Kozovo after which it crosses the Dnepr before reaching Dolina.

It then crosses the Carpathians, reaches Uzhgorod, crosses into Czechoslovakia near Cierna and then runs on to Budkovce, Kosice, Moldava, Rimavska Sobota, Lucenec and Sahy.

From Sahy:

- runs the Hungarian branch of the Druzhba, and
- the two Czech branches, one to Bratislava and the other to Most.

2.2.2 From Sahy to Szazhalombatta (Hungary)

The section of pipeline which runs from Sahy and terminates at Szazhalombatta has a diameter of 414 mm and is 123 kilometres long. It runs through Vac and Godollo and reaches Szazhalombatta after crossing the Danube at Dunaharaszti.

2.2.3 From Sahy to points in Czechoslovakia

Two pipelines have been laid:

- one towards Bratislava, with a diameter of 529 mm, running through Sala;

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- one towards Most, with a length of 416 kilometres and a diameter of 426 mm, running as follows: Sahy, Levice, Nitra, Trnava, Brno, Jihlava, Havlickuve Brod, Caslav.

It is at the last mentioned point that it is planned to link up the Druzhiba with the Pardubice refinery, but there is no news of this project having been started yet.

After Caslav the Druzhiba goes through Kolin, crosses the Elbe, continues on to Mochov, where a relay has been provided, then to Roudnice and finally to Most.

PUMP STATIONS

Location	Technical characteristics		Miscellaneous information and observations
	Pump	Power consumption	
(1)	(2)	(3)	(4)
<u>USSR</u>			
AL'MET'YEVSK (also known as KALEYKINO	4 main pumps 2 auxiliary pumps	11/64:2,730,480 kwh 1/65: 3,170,60 kwh	Directed from Romachkino Inaugurated on 29.12.69 Auxiliary station
KALINOVY/ KLYUTCH			
ROMACHKINO/ ELIZAVENTINKA			
SERGIEVSK			
LOPATINO	4 pumps	11/64:4,053,600 kwh 2.65:3,796,364 kwh	
KRASNOSELKI	5 pumps	2.67:2,101,410 kwh	
SYZRAN	4 main pumps	22.65:2,238,540 kwh	
KLIN			
KUZNIETS	4 pumps	1.65:1,904,800 kwh	
SELIKSA			
PENZA			Auxiliary station
ROSTOVKA			
SOSIEDKA			
TAMBOV			Auxiliary station

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(1)	(2)	(3)	(4)
MALINOVKA			Auxiliary station
NIKOLSKOE/ MITCHURINSK	4 pumps		Exact site unknown
LUBNO			
STANOVAYA	4 pumps		
VIERKHOVE			
OREL/ SUKHAYA			Auxiliary station
STALNOY KON	4 pumps		
BRIANSK			
AKSININO			
UNETSHA/ VYSOKOE	6 pumps including 4 main and 2 auxiliaries		
KOSTYUKOVITSHI			Branch pipe to Ventspils
BESED			Auxiliary station to Ventspils
GORKY			Branch pipe to Ventspils
SENNO			Branch pipe to Ventspils
NEVOPOLOTS			Branch pipe to Ventspils

(1)	(2)	(3)	(4)
NOVOZIBKOV			Between Nevopolots and Ventspils, there are 6 more pump stations, the location of which is unknown (except for that of Chyaoulyai)
GOMEL	3 pumps		Auxiliary station
BOBOVITSHI			
MOZYR'	3 pumps		Auxiliary station
MIKHALKI	(2 stations) each equipped with 4 main pumps numbered 1 to 4 and 2 auxiliary pumps numbered 1 and 2		Station also known as Mozyr' II Northern branch of the pipe-line
TUROV			"
PINSK			"
KOBRIN			"
BREST ZHABINKA			"
VYSOKOE			"

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(1)	(2)	(3)	(4)
OVRUTCH			Southern branch of the pipe- line
TSHISHAVKA			"
ROVNO			"
BRODY			"
L'VOV			"
JOULINO			"
KOSOVO			"
DOLINA (near UZHGOROD)			Operational on 6.2.65 (site uncertain)
KARPATY			
<u>POLAND</u>			
TOKARY			
DEBE			
JABLONNA			
KOSEWO			
PLOCK			
WERZBNO			
POZNAN (near)			
SKWERZYNA			
WITNICA			
BELINEK			

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(1)	(2)	(3)	(4)
<u>GDR</u> LUNOW LEUNA			
<u>CZECHOSLOVAKIA</u> BUDIKOVCE MOLDOVA SAHY TUPA NITRA BRNO SLAPANOV H. BROD CASLAV/POTEHY KOLIN V. BITES MOCHOV			
ROUDNICE			
<u>HUNGARY</u> RETSZAG			Completed in 1971. Increase in capacity of Druzhiba I by one million tons/ year

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(1)	(2)	(3)	(4)
GODOLLO			Operational in 1965; second station was added in 1969
FENYESLITKE			On Druzhba II

ADDITIONAL INFORMATION ON THE PUMP SYSTEM

1. General

The pump system is based on a "pump to pump" diagram, so that intermediate pump stations do not require intermediate depots.

However, provision is made for oil storage capacity at pump stations located at the head of export sections (terminal stations).

2. Tank farms at terminal stations

In determining the volume of tanks on terminal sections account was taken of the requirement to pump two kinds of oil alternately.

On the Soviet section, the system comprises 6 terminal stations (Vyssokoye, Mozyr' I, Mozyr' II and Brody) and 24 intermediate stations. It should be noted that the tank farms of the terminal stations consist of large capacity cylindrical tanks (10,000 cu.m and 30,000 cu.m) constructed of prefabricated prestressed reinforced concrete elements(1). These reservoirs are buried.

3. Pump stations

- the distance between pump stations is from 80 to 110 kilometres. On all stations the pumps are linked according to the series diagram in order to reduce the unit power of the electrical motors and achieve greater operational flexibility.

(1) The 30,000 cu.m tanks have a diameter of 66 m and are 10 m high

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When completed, Druzhba will consist of a total of 173 pumping units, including 128 for stations located in the USSR.

- The stations are equipped with special centrifugal pumps. Working pressures at pump outlets are from 50 to 60 atmospheres (depending on the diameter of the pipes).
- Pump capacities are shown in the table below:

Diameter of pipe (m/m)	Engine power (kw)	Pump capacity (cu.m/hour)
529	1,600	1,100
630	1,600	1,600
720	1,600	2,200
820	2,500	4,000
1,020	4,400	7,000

LENGTH OF PIPELINE AND DIAMETER OF PIPE

Section		Length	Diameter of pipe
From	to		
Al'met'yevsk	Kujbysev	273 km	1,020 mm
Kujbychev	Penza	400 km	1,020 mm
Penza	Micurinsk	336 km	1,020 mm
Micurinsk	Unecha	539 km	1,020 mm
Unecha	Novopolock	450 km	720 mm
Novopolock	Ventspils	500 km	630 mm
Unecha	Mozyr' Michalki	289 km	820 mm
Mozyr' Michalki	Brest	441 km	630 mm
Brest	Plock	248 km	630 mm
Plock	Bielinek	427 km	529 mm
Bielinek	Schwedt	27 km	529 mm
Schwedt	Leuna Lutzkendorf	300 km	426 mm
Mozyr' Michalki	Brody	401 km	529 mm
Brody	Uzgorod	Approximately 340 km	529 mm
Uzgorod	Sahy	Approximately 260 km	529 mm
Sahy	Szazhalombatta	133 km	426 mm
Sahy	Bratislava	145 km	529 mm
Sahy	Most	Approximately 500 to 540 km	426 mm

CROSSING OF MAJOR OBSTACLES

Obstacle	Nature of obstacle	Crossing point	Method of crossing
(1)	(2)	(3)	(4)
I. <u>USSR</u>			
VOLGA	River	Between Novokuzhbysev and Syzran to approx. 20 km south of Syzran	Under river bed
SURA	"	Immediately west of Penza	"
VORONEZ	"	Approximately 40 km west of Nikol'skoe	"
DON	"	Approximately 90 km west of Nikol'skoe and 45 km east of Stranovazha	"
OKA	"	A few kilometres east of Stal'nov'kon which is located approx. 20 km north of Orel	"
DESNA	"	Approximately 30 km west-south-west of Briansk	"
DNIEPR'	"	(2 crossing points) 1. to the north, between Mogilev and Senno, approximately 20 km north-west of Mogilev. 2. to the south, between Gomel and Mozyr', approximately 30 km west-south-west of Gomel	"

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(1)	(2)	(3)	(4)
PRIPZHAT'	River	At Mozyr' or in its immediate vicinity	Under the river bed
Area of WHITE RUSSIA	Marsh	Area between Gomel and Brest	Not overhead
DNIESTR	River	Between Kozovo and Dolina approximately 15 km south of Kozovo	
CARPATHIANS	Mountain range	Between Dolina and Uzhgorod	Partially overhead
BUG	River	(2 crossing points including one in Poland). In USSR immediately west of Brest	Unknown
<u>II. POLAND</u>			
BUG	River	Approximately 40 km west of Tokary	Special bridge
NAREW	"	Approximately 12 km west of Jablonna	Probably under river bed
VISTULA	"	Immediate vicinity of Plock (1,500 m above steel bridge)	Special bridge
ODER	"	Roughly half-way between Belinek and Lunow.	Unknown
<u>III. CZECHOSLOVAKIA</u>			
ELBE	River	Roughly half-way between Kolin and Moshov	Unknown
<u>IV. HUNGARY</u>			
DANUBE	River	At Sunahaeaszti	Under the river

CHARACTERISTICS OF BRIDGES USED FOR
THE DRUZHBA FOR THE FIRST PIPE

Obstacle	Characteristic	Length (m)	Observation
VISTULA	Suspension bridge with 3 spans of 140, 350 and 140 m	630	Supports two pipes of 529 and 630 m/m
BUG	Steel trussed arch bridge resting on two supports	335	The supports were used for the railway bridge before 1939 and were re-built for Druzhba

CROSSING OF ROADS, RAILWAYS AND RIVERS

- the crossing of roads and railways is achieved by steel sheaths. The difference in diameter between the sheath and the pipeline varies from between 100 and 200 m/m depending on the diameter of the pipe;
- the crossing of rivers by submersion occurs at varying depths with a minimum of 2 m in the case of a large water barrier. All river crossings are by multiple pipes (2 or 3 crossings per major river and per pipeline)(1). It should be noted that there also exist overhead river crossings.

(1) If necessary, two parallel pipes of different diameters crossing one and the same river can be interconnected

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REFINERIES LOCATED ALONG THE DRUZHBA

(Trends in capacity from 1965 to 1975)

Refinery	Capacity (in millions of tons)			Observation
	1965	1973	Forecast 1975	
(1)	(2)	(3)	(4)	(5)
A. <u>Known refineries whose oil is at present supplied by Druzhba</u>				
1. <u>USSR</u>				
SYZRAN	2.6	7.6	10	Connected to Druzhba on 22.1.65
NOVOPOLOCK	2.6	6.0	9	Under construction. Must be the largest in Europe. Supplied by the Unecha branch.
L'VOV	less than 1	ditto	ditto	Insignificant
Total USSR	6	14	19	
2. <u>POLAND</u>				
PLOCK	2	8	12	Partially operational since 21.12.64
3. <u>GDR</u>				
SCHWEDT	2.5	7	10	6.5 million tons end 1972. Partially operational
LEUNA	0	1.5	1.5	
BOHLEN	2	2	2	
Total GDR	4.5	10	13	

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(1)	(2)	(3)	(4)	(5)
4. <u>CZECHOSLOVAKIA</u>				
BRATISLAVA	2.5	7	9	
PARDUBICE	0.6	0.6	0.5	
KOLIN	0.6	0.6	0.5	
MOST	0.7	2.0	6.5	
Total Czechoslovakia	4.4	10.2	16-17	
5. <u>HUNGARY</u>				
SZAZHALOMBATTA	0	4.7	7	Under construction. Came into operation in March 1965
B. <u>Refinery whose activities will probably be linked to the Druzhba</u>				
1. <u>USSR</u>				
KUJBYSEV and NOVO KUJBYSEV	10			Their connection to the Druzhba is very problematic. They are apparently supplied by the pipe from Oktyabrskii and by local oil carried by rail tankers and Volga tankers
BRJANSK	10			
				Although planned several years ago it has not yet been constructed

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(1)	(2)	(3)	(4)	(5)
MOZYR'			6	Under construction since 1966.
KREMENCUG	6			Its connection to Druzhba is linked with the construction of the Nikol'skoe branch at Odessa, still at the planning stage
DOLINA	Very small			Could be supplied by the Druzhba

PERCENTAGE INCREASE IN CAPACITY FROM 1965 TO 1975

	1965	1973	1975	% 65 to 73	65 to 75
- Soviet sector of Druzhba	6	14	19	230	300
- Poland	2	8	12	400	600
- GDR	4.5	10.5	13.5	200	300
- Czechoslovakia	4.4	10.2	16-17	220	400
- Hungary	0	4.7	7	470	700
Total satellites	10.9	33.4	50	300	500

The refining capacity of the four satellite countries therefore trebled from 1965 to 1973 and increased fivefold from 1965 to 1975.

The initial advance from 1965 to 1973 (300%) resulting from the setting-up of the refinery infrastructure can be expected to slow down from 1973 to 1975 (50%). In 1975 capacity will have reached the normal level for countries of a comparable size.

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CRUDE OIL DEPOTS AT REFINERIES AND PUMPING STATIONS
LOCATED ALONG DRUZHBA I

Location	Type of depot	Capacity (in T)	Observations
(1)	(2)	(3)	(4)
<u>USSR</u>			
AL'MET'YEVSK	Station	100,000	
OKTYABRSKII	"	170,000	
KUIBYSHEV	Refinery	?	
LOPATINO	Station	85,000	15 tanks
SYZRAN	"	80,000	
"	Refinery	Approx. 400,000	
KUZNETS	Station	80,000	
PENZA	"	"	
SOSEDKA	"	"	
MALINOVKA	"	"	
MITCHURINSK/ NIKOL'SKOE	"	170,000	8 large and 4 small tanks
SUKHAIA	"	80,000	
BRIANSK	"	"	
UNETSHA/VYSOKOE	"	380,000	
POLOTSK	Refinery	Approx. 300,000	
BOBOVITSHI	Station	70,000	
VOZYR	"	80,000	
TUROV	"	"	
KOBRIN	"	"	
MIKHALKY	"	"	
OVRUTSH	"	50,000	

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(1)	(2)	(3)	(4)
ROVNO	Station	50,000	
BRODY	"	"	
STRII	"	"	
UZHGOROD	"	?	
<u>POLAND</u>			
TOKARY	"	50,000	
PLOCK	Refinery	Approx. 300,000	
<u>GDR</u>			
SCHWEDT	"	Approx. 350,000	
LEUNA	"	Approx. 100,000	
<u>CZECHOSLOVAKIA</u>			
BUDOVCE	Station	50,000	
MOLDAVA	"	"	
SAHY	"	"	
KLOBUKY	"	"	
VELKA BITES	"	"	
HRABRY	"	"	
BRATISLAVA	Refinery	Approx. 350,000	
MOST	"	Approx. 100,000	

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