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The USSR's Crude Oil Pipeline Network

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May 1983

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A Research Paper

This paper was prepared by the Office of Soviet Analysis. Comments and queries are welcome and may be addressed to the Chief, Soviet Economy Division, SOVA

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The USSR's Crude Oil Pipeline Network

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Summary

Information available as of 10 March 1983 was used in this report.

The Soviet crude oil pipeline system transports over 90 percent of the crude oil produced in the USSR. Analysis of the system's current status reveals the possibility of a temporary but costly constraint on crude oil production, depending on whether a new pipeline (now under construction) is completed in time to handle the projected increase in West Siberian oil production in 1984. In West Siberia—the one major region where oil production is expanding—rail and inland waterway transport will be operating near capacity and will offer little prospect for accommodating additional oil tonnage. With respect to the longer run, the deceleration of oil pipeline construction evident in Soviet plans suggests that Moscow foresees a leveling off in West Siberian crude oil output later in the decade.

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Most of the Soviet oil pipeline network is relatively new. Its growth has been dramatic—from 4,000 kilometers in length at the end of World War II to about 60,000 km in length in 1981—with half of the growth occurring between 1970 and 1981. During the 1970s, the Soviets began to lay 1,020-mm and 1,220-mm crude oil pipelines on a large scale. By the end of 1980 they had about 20,000 km of these large-diameter lines, nearly 80 percent of which were built during 1971-80. 25X1

The plan to construct 9,200 km of crude oil pipelines in 1981-85 is modest compared with the 22,000 km planned for 1971-75 and 15,000 km for 1976-80. The reduction undoubtedly reflects in part the priority Moscow is giving to allocation of construction funds and equipment for the gas pipeline program. Even this lower goal may not be met: in view of likely Soviet allocational decisions and perception of oil production leveling off (and taking account of chronic lags in the completion of pipelines), we believe that during 1981-85 the Soviets may construct no more than 8,000 km—1,200 km below plan. 25X1

The only new major oil transmission pipeline planned to originate in the West Siberian oil region is one being built to carry a combination of crude oil and condensate to the Volga-Urals region. Judging from the pace of construction, we estimate that the new pipeline will not become operational until late 1984 or early 1985. If that is the case, the existing West Siberian network, with a usable throughput capacity of nearly 361 million tons per year, may be unable to handle all the production planned for 1984 (385 million tons). Even temporary loss of production would not be trivial. For example, an oil production shortfall of 5 million tons could mean a loss equivalent to about $1 billion (in 1983 prices). 25X1

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Because the inland waterways are frozen for more than six months out of the year and the single-track railroad extending into the oil-producing area is already being used to capacity, there is little prospect of transporting more West Siberian crude oil by rail and water. If, however, construction activity accelerates and the new oil pipeline becomes operational early in 1984, the pipeline constraint on meeting the 1984 oil production target and the target for 1985 (399 million tons) will be removed. 25X1

Our analysis indicates that the slow pace of oil pipeline construction planned for 1981-85 is not the result of inability to obtain Western equipment. In contrast to the situation in gas pipeline construction, the Soviet Union can manufacture nearly all of the pipe and equipment it needs for crude oil pipeline construction. However, without Western pipelayers, bulldozers, surge-control valves, and insulating materials, construction takes longer, the pipelines operate less efficiently, and their economic life is shorter. 25X1

Although Soviet pipelines currently carry vast quantities of oil, the average quality of pipeline construction is below Western standards, according to Western observers and Soviet emigres. Welding and insulating procedures are often carelessly done in haste to meet deadlines. Because shoddy work of this kind facilitates corrosion, large amounts of corroded and damaged pipeline may have to be replaced in the next 10 to 15 years. In 1980, only 20 percent (12,000 km) of the USSR's oil pipeline network was 20 years old or older. In contrast, by 1995, roughly 75 percent (46,000 km) of the present network will be at least 20 years old. Replacement of some of these pipelines will not be required because they are located in regions where oil production is declining. Nevertheless, to keep the network operating satisfactorily, the Soviets will have to step up their replacement program.

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Contents

Tables

The USSR's Crude Oil Pipeline Network

25X1

Introduction

About 58,000 kilometers of the Soviet Union's 70,000 km of oil pipelines transport crude oil.[1] The remaining 12,000 km transport oil products from the refineries. In 1980, 92 percent of the country's crude oil production was transported to refineries by pipelines from gathering points near the producing areas. In contrast, only 10 percent of the output of oil products is moved from refineries by pipeline. This paper describes the existing crude oil pipeline network, how it developed, Soviet plans for its expansion, and some emerging problems.

Eight Decades of Oil Pipeline Construction

The first oil pipeline in the USSR was designed as an export line to carry kerosene from the refineries at Baku on the Caspian Sea to the export base at Batumi on the Black Sea. This pipeline, 883 km in length and 200 mm in diameter, was begun in 1896 and completed in 1906. The second and third pipelines, constructed during 1926-30, also were export lines to terminals on the Black Sea. The only other major oil pipeline completed before World War II was a 235-mm pipeline to move crude oil 709 km, from the Emba oilfields in western Kazakhstan to a refinery at Orsk.

Nearly all the oil pipelines in the Caucasus region were destroyed during World War II and later rebuilt. The only new construction during World War II was the completion of a line to carry crude from Okha on Sakhalin Island to Sofiysk on the Soviet mainland.

During the first Five-Year Plan after the war (1946-50), only 1,400 km of oil pipeline were constructed; they were limited to linking refineries with local oilfields. At the end of 1950, the Soviet network totaled more than 5,400 km. During the 1951-55 Plan, the length of the crude oil pipeline network almost doubled, to about 9,300 km. The major construction effort was the 1,149-km pipeline from Ufa to Omsk. 25X1

During 1956-65 an accelerated pace in pipeline construction followed the sharp increase in oil production in the Volga-Urals region:

- Numerous short lines were built from gathering points near producing fields to the major transfer stations at Al'met'yevsk, Kuybyshev, and Ufa.
- Major long-distance pipelines were built to transport crude oil to refineries at Gorkiy, Ryazan', Moscow, and Yaroslavl'. 25X1
- The Friendship Pipeline was laid from Kuybyshev to Uzhgorod and onward to Czechoslovakia, Hungary, Poland, and East Germany. 25X1

Largely as the result of pipeline construction from the Volga-Urals fields, the length of the crude oil pipeline network more than doubled during 1956-65, reaching 22,300 km in 1965. Moreover, according to Soviet oil industry monographs, as oilfield development and pipeline construction proceeded, the share of crude oil output transported by pipeline increased as follows (in percent):

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1950	33
1955	64
1960	78
1965	85

(U)

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The linking of the Volga-Urals oilfields with the refineries in the Moscow region by pipeline during the 1950s and 1960s was a logical development. According to Soviet statistics, operating costs for oil pipeline transport per ton-kilometer are one-third the costs for rail transport and three-fourths of the costs for water transport. Pipelines are also cheaper to build than railroads: in the late 1970s, construction of 1,220-mm

[1] The data on Soviet pipeline distances, diameters, capacities, and costs used in this paper are drawn largely from Soviet industry journals and monographs.

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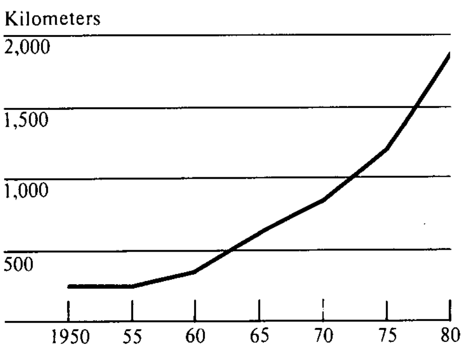
Figure 1
USSR: Pipeline Transport of Crude Oil–Average Distance



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pipeline in good terrain cost 350,000 rubles per kilometer, whereas the cost was 500,000 rubles per kilometer for railroad construction. When compared with transport on waterways, the flexibility of pipeline transport is an even more important advantage than the lower cost. Pipeline routes are not as seriously constrained as waterways by terrain and are not affected by the long winter freezes that halt traffic on the waterways in much of the Soviet Union.

During 1966-80, the network's rapid expansion continued, although the focus of activity gradually shifted to West Siberia. The first oil pipeline in West Siberia was built in 1965 and ran from Shaim to Tyumen'. The major long-distance pipelines out of West Siberia were laid in 1971-80. During these 10 years, more than 26,000 km of oil pipelines were constructed, again nearly doubling the length of the total system. By 1980 crude oil pipelines in service in the USSR totaled 57,800 km in length (see foldout map, figure 13, page 31.

With the discovery of new oilfields progressively farther east, first in the Volga-Urals area and then in West Siberia, the requirements for moving crude oil from the oilfields to the refineries or export terminals increased sharply. The average distance for transporting 1 ton of crude oil was 350 km in 1960, but by 1980 it had increased to almost 1,900 km (figure 1).

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As the pipeline network expanded during the 1970s, operating costs per ton-kilometer fell. The lower average costs resulted mainly from adding large-diameter pipelines—1,020 mm (40 inches) and 1,220 mm (48 inches) in diameter, which transport oil more efficiently than smaller lines. In 1965 only 1,300 km of 1,020-mm-diameter pipeline were operational, but by 1980 the total length of large-diameter pipeline had increased to about 20,000 km (figure 2). According to Soviet technical monographs, in 1977, for example, the price per ton-kilometer for transporting crude oil via 1,220-mm pipeline was 52 percent less than via 530-mm pipeline. The average cost for transporting a ton of crude oil the average distance of 1,875 km is shown in table 1.

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Assuming that the average ton of crude oil is transported the first half of this distance by 1,020-mm or 1,220-mm pipelines and the second half by smaller diameter lines, the average pipeline transportation cost in 1980 was about 3 rubles per ton.

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Despite a trend toward reduction in the cost per unit of oil transported, the total expenditure has increased. The average transmission distance more than tripled between 1965 and 1980, and oil production increased from 243 million tons to 603 million tons. Total outlays for crude oil shipments by pipeline are estimated to have increased from 259 million rubles in 1965 to 1.7 billion rubles in 1980.

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The Soviet Oil Pipeline System Today

West Siberia and the Volga-Urals region currently account for more than 80 percent of USSR oil production. West Siberia alone has 55 percent of the

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Figure 2
USSR: Length of Crude Oil Pipeline Network, by Diameter of Pipe

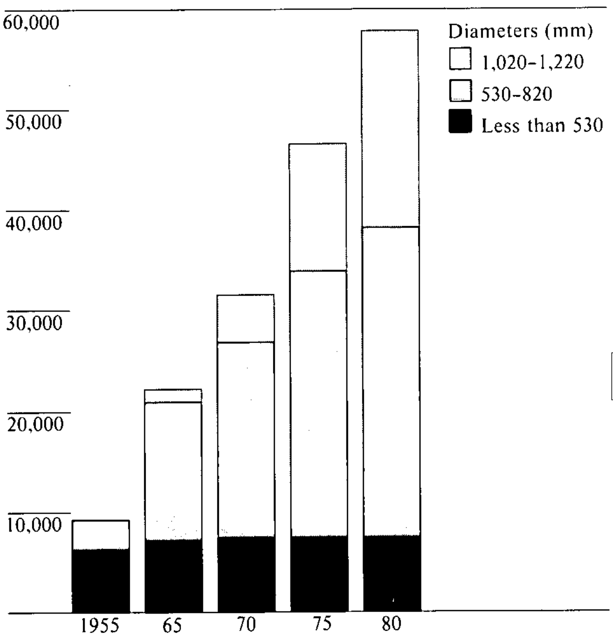

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Table 1
USSR: Crude Oil Pipeline Transportation Costs

Pipeline Diameter	Transportation Cost Per Ton *(in 1977 rubles)*
530 mm	4.3
630 mm	3.3
720 mm	2.8
1,020 mm	2.2
1,220 mm	2.1

Note: For this calculation we have used (a) the 1977 ruble prices given in Soviet sources, (b) oil pipeline distances and diameters in use in 1980, and (c) the average distance each ton of crude oil was transported in 1980—1,874 kilometers.

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total. The following sections, based largely on Soviet media and emigre reporting, discuss in detail:

- The pipeline network in individual regions.
- The directional flow of oil from producing fields to these regions.
- Some regional pipeline network problems.

In each section, the capacity of the regional pipeline networks is compared to the refinery requirements for crude oil. Individual pipelines, with data on diameter, length, capacity, and year of completion, are listed in appendix A.

West Siberia. Five large-diameter pipelines transport crude oil from the West Siberian oilfields (see figure 3). One extends eastward to Anzhero-Sudzhensk and East Siberia; a second, southward to Omsk and Central Asia; and three, westward to Kuybyshev, Al'met'yevsk, and Polotsk. From Kuybyshev and Al'met'yevsk, West Siberian crude oil can be moved through other large-diameter pipelines to the Ukraine and Eastern Europe, to the Caucasus, and to the Moscow-Leningrad region. The West Siberian pipeline network will be discussed more fully (page 11) in a section that analyzes the usable throughput of the network. 25X1 25X1

The Caucasus. The Caucasus region, at one time the center of the Soviet oil industry, today is a net importer of crude oil from other regions of the USSR (figure 4). The Soviet media have reported that the region's oil production has declined (from 55 million tons in 1970 to 37 million tons in 1980), In order to operate the refineries at Baku and Groznyy at the desired level, the region must now import crude oil from West Siberian and Volga-Urals fields. 25X1 25X1 25X1

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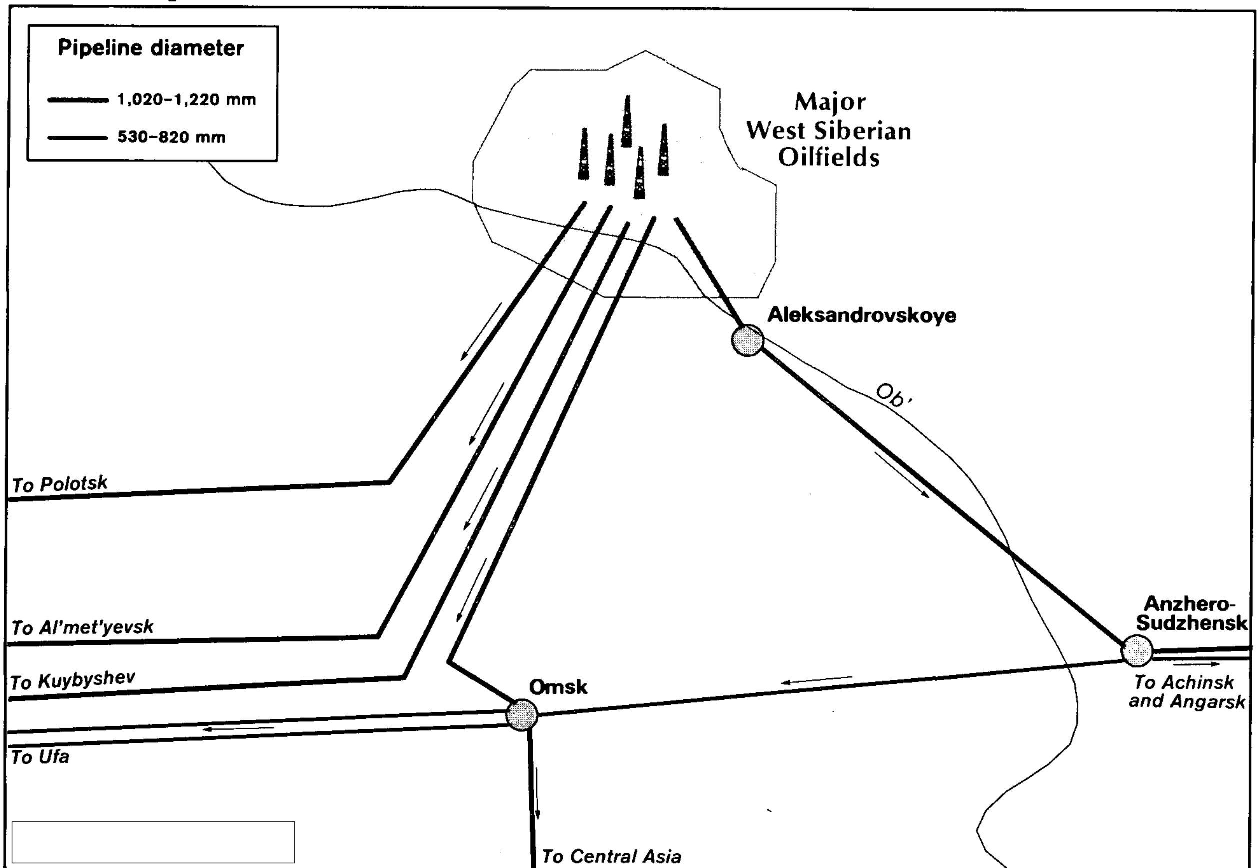
Figure 3
Crude Oil Pipelines From West Siberia



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The two major pipelines in the Caucasus are between Tikhoretsk and Groznyy, transporting West Siberian and Volga-Urals crude oil to the regional refineries. Four small-diameter pipelines transport crude to refineries and export terminals on the Black Sea.

Although the first pipeline between Tikhoretsk and Groznyy was built to move crude oil northward from Groznyy, the flow has been reversed in order to provide more crude oil for the refineries at Baku. The second Tikhoretsk-Groznyy pipeline was completed in 1980, and an extension of this new line to Baku was recently completed. According to reporting in Soviet media, Baku will be able to receive 14-18 million tons of crude oil annually through the pipeline when the extension is operating at full capacity. In addition, it will have access to 14 million tons of crude oil from local Azerbaijan production and 3 million tons from Turkmen production (via tanker), bringing the total to 31-35 million tons. Refinery capacity in Baku is about 31 million tons. If Azerbaijan production continues to decline, oil may have to be shipped by railroad from elsewhere in the Soviet Union—or the Baku refineries may operate at less than full capacity.

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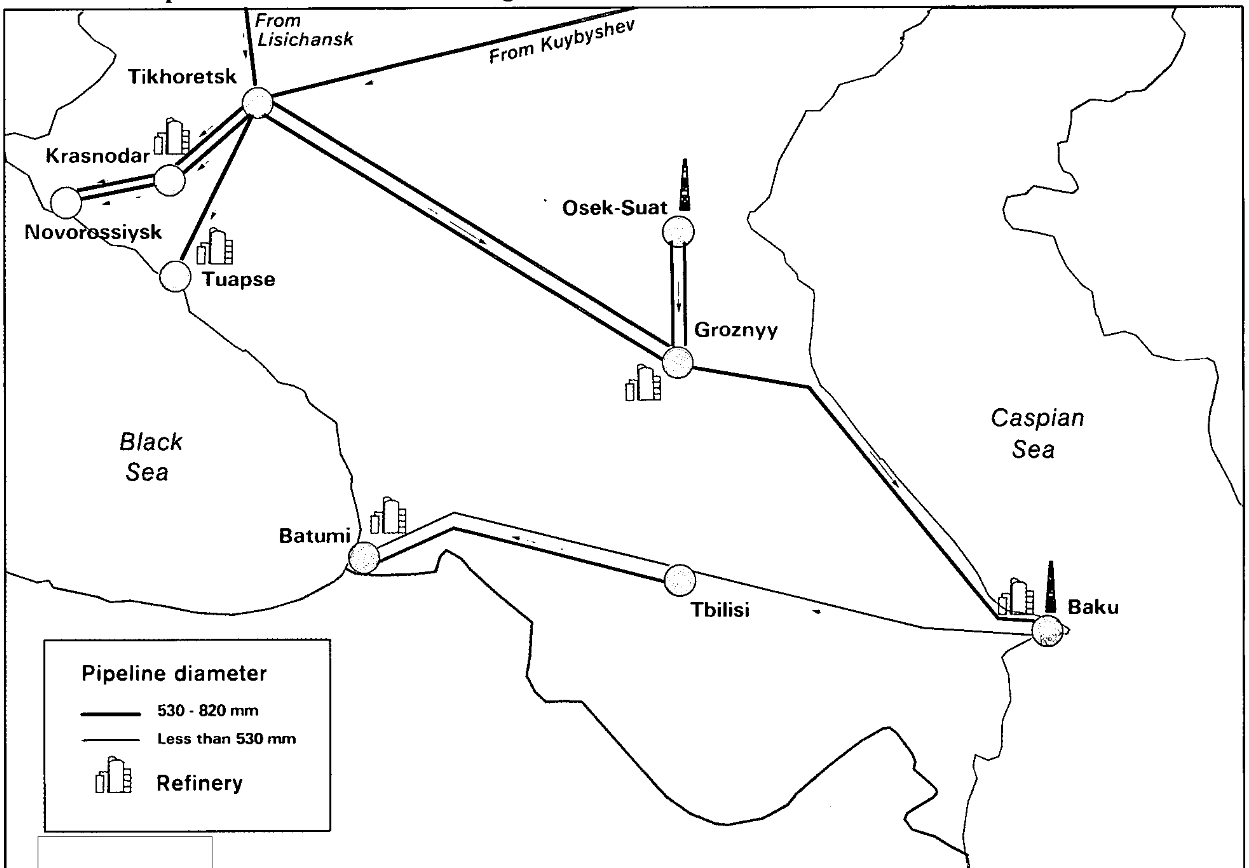
The Friendship Pipeline. The Friendship Pipeline System consists of two parallel sets of pipelines that transport crude oil from the Volga-Urals region through the Ukraine and onward to Eastern Europe (figure 5). One set was built in the early 1960s and the other in the early 1970s. New pumping stations were added in the late 1970s. On the basis of known exports to Eastern Europe and the Soviets' reporting on the capacity of their oil pipelines, we believe that

Figure 4
Crude Oil Pipelines in the Caucasus Region



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the current throughput to Eastern Europe is probably at the system's maximum capacity: 56-68 million tons per year at the USSR's western border. [redacted]

Moscow-Leningrad Region. Although the capacity of the pipeline network in the north-central region around Moscow and Leningrad (figure 6) appears adequate for providing crude oil to refineries there, some shortages have been reported. For example, [redacted] the Moscow refinery received too little crude oil to keep it operating at full capacity. Two pipelines transport crude oil to Moscow, but the Ryazan'-to-Moscow line (built during the early 1960s) may be operating at reduced throughput because of its age. [redacted]

Ukraine–South Central Region. Siberian crude oil reaches the Ukraine-South Central region via two pipelines (figure 7). Both come from Kuybyshev—one through Lisichansk and the other through Tikhoretsk—and transport oil to refineries in the Ukraine and to export terminals on the Black Sea. [redacted] 25X1

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The region may have excess crude oil pipeline capacity [redacted] large product storage tanks were built at Michurinsk in the late 1970s. This could indicate that after the completion of the Kuybyshev-to-Lisichansk pipeline in 1977, the Michurinsk-to-Kremenchug pipeline was converted from crude oil to the transport of refinery products. [redacted] 25X1

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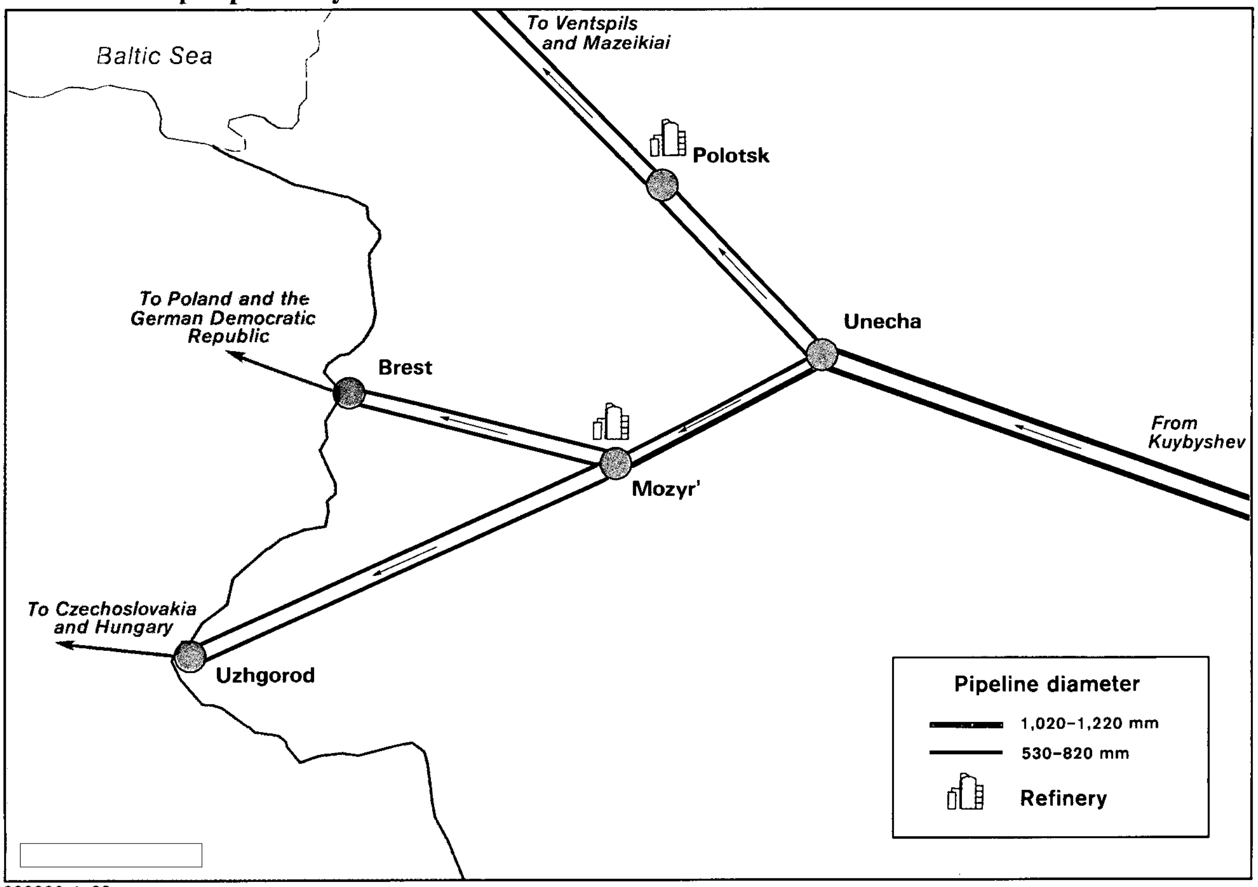
Figure 5
The Friendship Pipeline System



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East Siberia. The pipeline network in East Siberia (figure 8) is more than adequate to meet the needs of refineries in operation and under construction. [redacted] the existing refinery at Angarsk and the refinery under construction at Achinsk were to have a combined crude oil requirement of 24 million tons at the end of 1982. According to Soviet data, two crude oil pipelines from Anzhero-Sudzhensk to Irkutsk (one 720 mm and the other 1,020 mm in diameter) could together deliver 56-68 million tons annually. Because there is so much excess crude oil pipeline capacity, the 720-mm pipeline (which is about 20 years old) may be taken out of service or converted to transport refined products. [redacted]

Soviet Far East. The pipeline system in the Soviet Far East consists of two small-diameter lines that run from Okha on Sakhalin Island to Komsomol'sk on the Soviet mainland (figure 9). During the 1970s the oil production on Sakhalin Island, 2-3 million tons per year [redacted] was sufficient to meet the crude oil requirements of the refineries at Komsomol'sk and Khabarovsk. In 1981, however, a new unit began operations at Komsomol'sk, with a refining capacity of 6 million tons per year. This brought the refinery's crude oil requirement to 9 million tons, 7.5 million tons of which will have to be transported by railroad from Irkutsk. [redacted]

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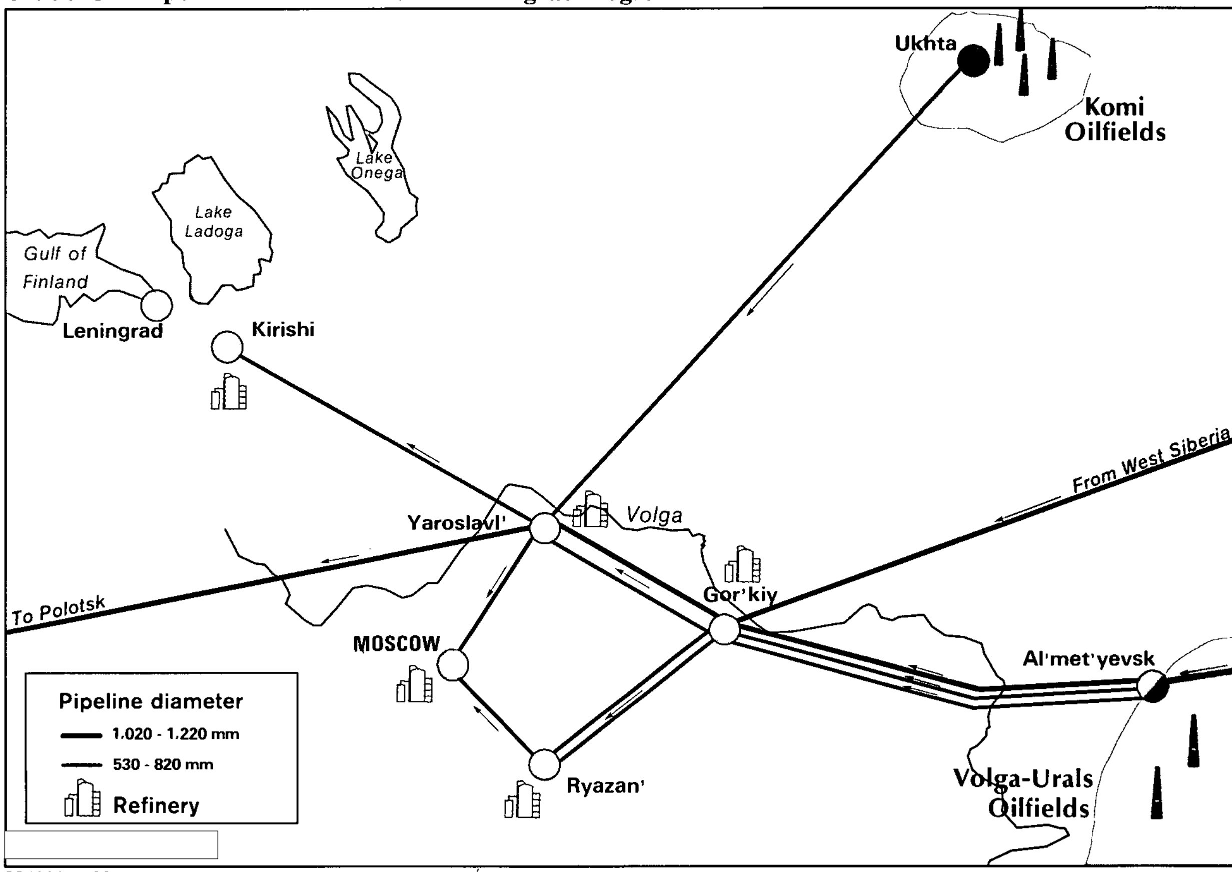
Figure 6
Crude Oil Pipelines in the Moscow-Leningrad Region



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The new unit at the Komsomol'sk refinery has been operating less than half the time [redacted] but we are uncertain whether this is due to a lack of crude oil supply or to technical problems. In the past the Soviets have talked of extending the pipeline from Irkutsk to Khabarovsk. This project has not been mentioned recently, however, and no action appears to have been taken. [redacted]

Planned Expansion Through 1985

The program for construction of crude oil pipelines during the 1981-85 Plan period is considerably smaller than that achieved in recent plan periods. This reflects to some extent the slowdown in growth and possible leveling off of crude oil production. Most of the planned pipelines are small, intraregional lines providing connection between oil-producing areas and major transmission lines. Sixteen crude oil pipelines are scheduled to be built (see table 2). [redacted] 25X1 25X1

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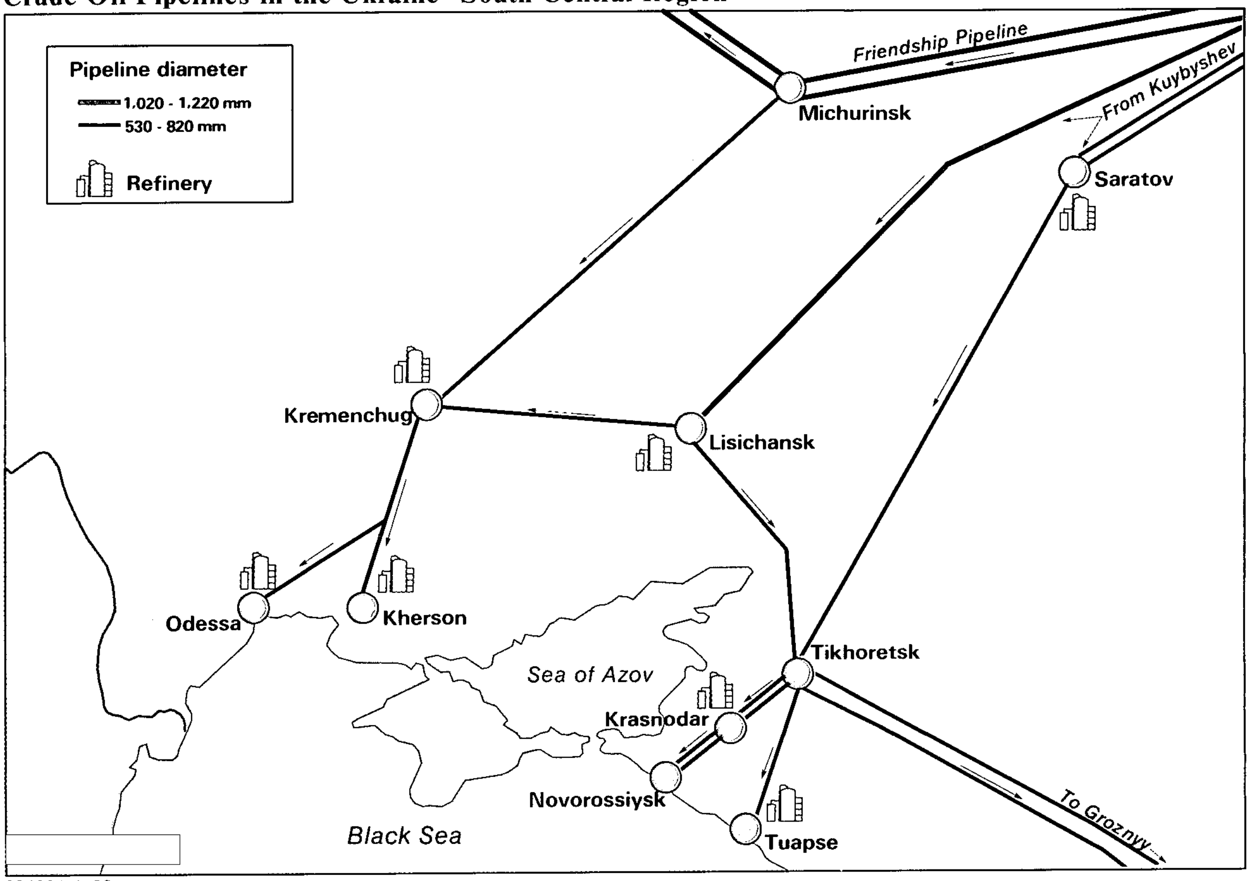
The plan for crude oil pipeline construction in 1981-85 was reported in February 1981 as 11,500 km. In August 1981 an authoritative Soviet oil-pipeline journal gave the goal as about 9,200 km, and this figure is the one adopted in this paper. (In contrast, 15,000 km were completed in 1971-75 and 11,200 km in 1976-80, as shown in figure 10.) [redacted] 25X1 25X1

Interregional Lines. Only two of the lines in the 1981-85 Plan are interregional transmission lines: these are large-diameter lines, one from Kholmogory

Figure 7
Crude Oil Pipelines in the Ukraine - South Central Region



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to Kuybyshev and one from Pavlodar to Chimkent (undergoing testing in January 1983). During 1976-80, in contrast, the Soviets laid a number of major interregional lines: Nizhnevartovsk to Kuybyshev, Krasnoyarsk to Irkutsk, Kuybyshev to Kremenchug, and Surgut to Polotsk. All of these lines were 1,020 mm or 1,220 mm.

Competing Claims on Pipeline Construction Capacity. During the 1971-75 and 1976-80 Five Year Plans the Soviets approximately fulfilled their construction targets for gas pipelines but met only about 70 percent of those for crude and oil products pipelines (table 3). The 1981-85 FYP calls for the construction of 48,000 km of gas pipelines, including some 20,000 km of 1,420-mm-diameter line. This is ambitious, and the priority accorded to it is probably responsible for some of the current lag in oil pipeline construction. Shortages of equipment and labor have been cited frequently in the Soviet media as major causes for construction delays. The USSR may simply not have enough men and equipment allocated to accommodate the enormous gas pipeline construction program and the entire oil pipeline construction program simultaneously.

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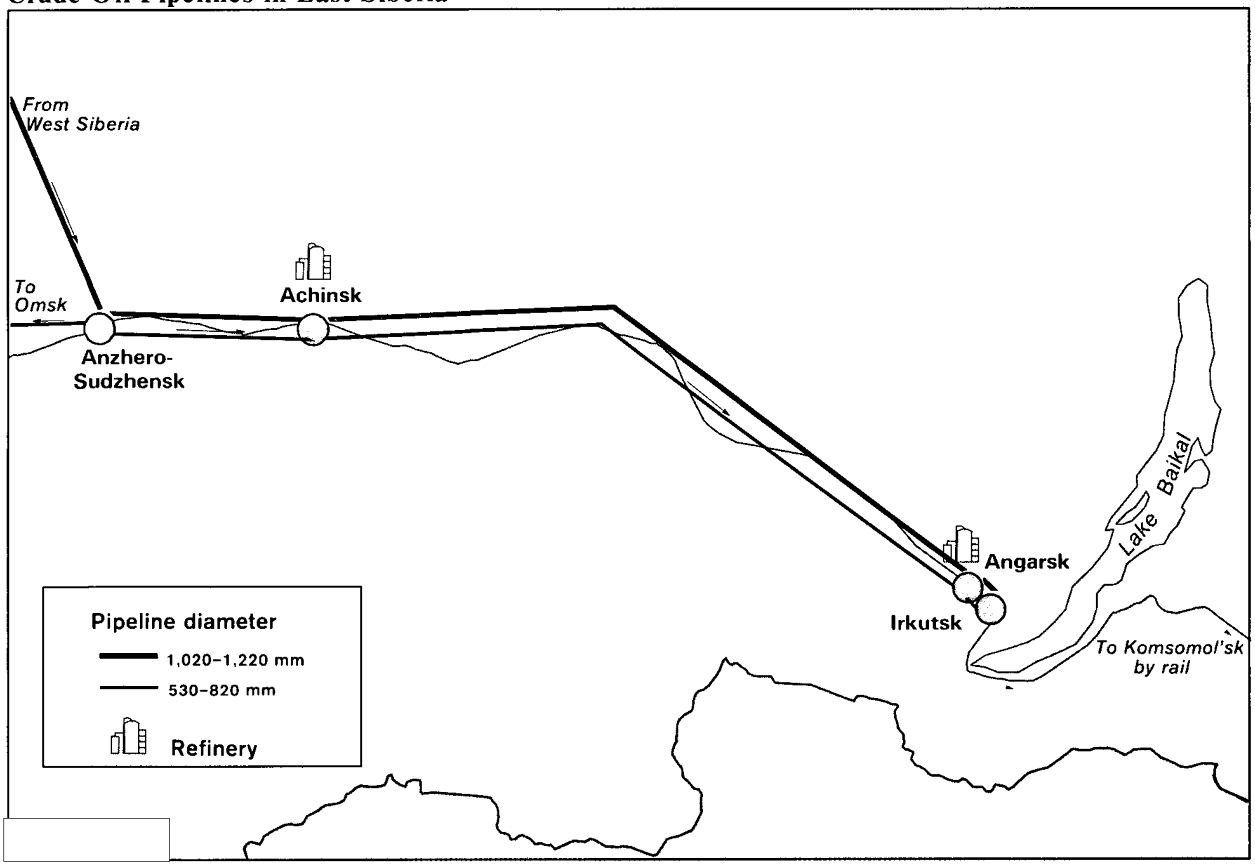
Since the early-to-mid-1970s, when major transmission pipelines were built at a rate of about 115 kilometers per month, the pace of oil pipeline construction in the Soviet Union has slowed. Examples of construction rates are:
- For the Samotlor-Al'met'yevsk pipeline, completed in 1973, about 118 km per month.
- For the Samotlor-Kuybyshev pipeline, completed in 1976, 113 km per month.

Figure 8
Crude Oil Pipelines in East Siberia



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- For the Surgut-Polotsk pipeline, completed in the spring of 1981, only 80 km per month.

The slow rate of construction on the Surgut-Polotsk line has been noted and criticized in a CPSU publication.

Oil pipeline construction schedules slipped frequently during the last half of the 10th FYP. Soviet press reports announced that the 401-km Samgori-Batumi line, construction of which began in 1977, was finally completed in 1980 after the target dates for its delivery were adjusted four times. The Krasnoyarsk-Irkutsk line, begun in 1977, was still not operational in 1981. In early 1982 the Soviet press noted the problem, praising the progress in gas pipeline construction while noting "important deficiencies" in oil pipeline construction. The Krasnoyarsk-Irkutsk, Kenkiyak-Orsk, and Perm'-Al'met'yevsk lines and a number of pumping stations and tank farms were cited in the article as examples of a "lag in the construction of important oil industry facilities."

The number of gas-pipeline compressor stations planned for the 11th FYP (360) is much greater than the number reported by the Soviet media as built during the 10th FYP (209). The labor resources of the responsible ministry (the Ministry for Constructing Oil and Gas Enterprises) appear to be inadequate to build all 360 gas pipeline compressor stations plus the 90 oil-pumping stations that are planned. For example, the Soviet pipeline construction ministry journal reported that only 59 of a planned 99 gas-compressor and oil-pumping stations were built in 1981.

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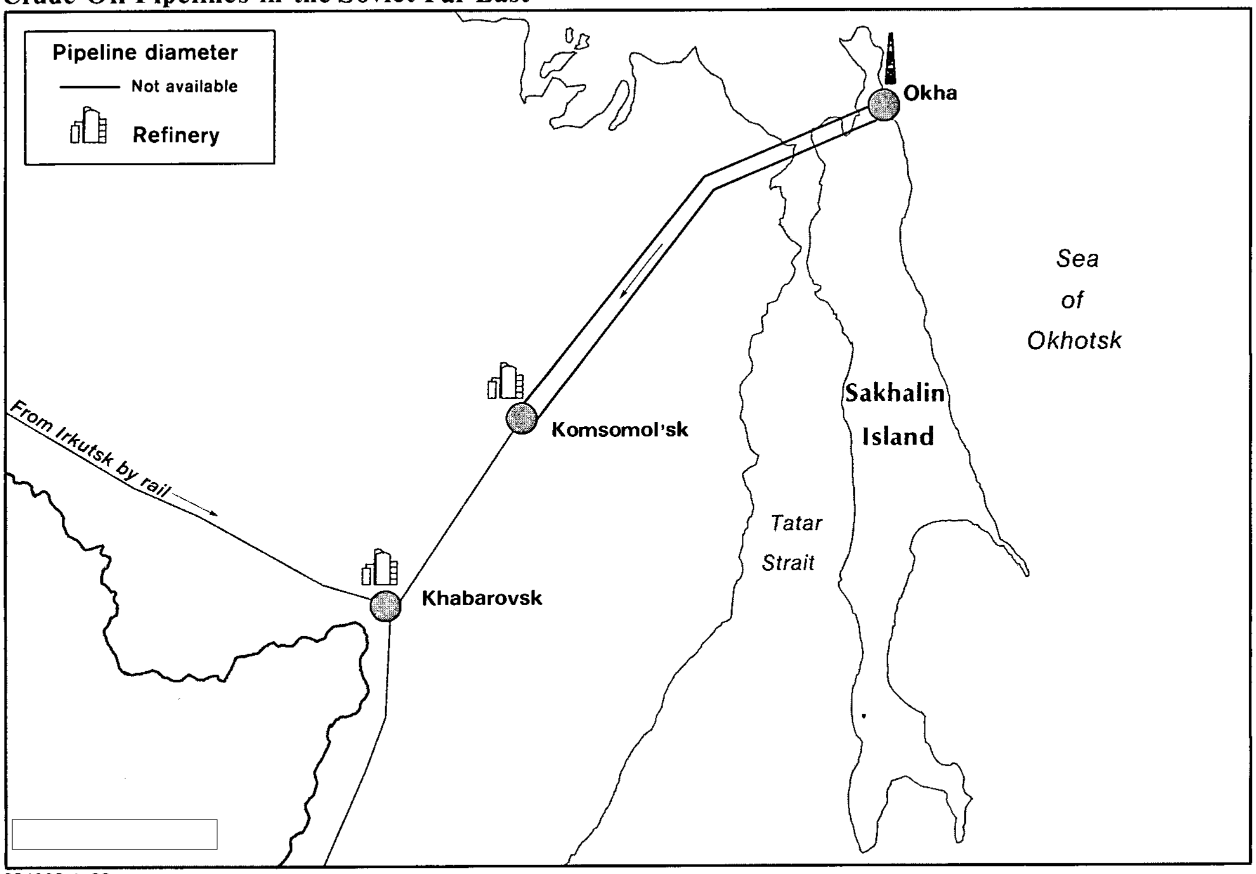
Figure 9
Crude Oil Pipelines in the Soviet Far East



[redacted] 25X1

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[redacted] to assist the ministry and alleviate its labor shortage, the Central Committee decided in a November 1981 plenum that 100 compressor stations would have to be built by other construction ministries. [redacted]

Likelihood of Success. In order to meet the 1981-85 target for crude oil pipeline construction, nearly 1,900 km will have to be completed annually. During 1981-82 the Soviets completed an average of about 1,500 km per year (see table 4). Over the past two decades, the Soviets have fallen short of oil pipeline construction targets, as follows (shortfall as percent of plan):

1966-70	55
1971-75	32
1976-80	25

The priority and resources currently being accorded to gas pipeline construction lead us to estimate that the 11th FYP target for oil pipelines will not be met. In an article in *Ekonomicheskaya gazeta* discussing plans for pipeline construction in 1983, the Soviets stated that of a total of 11,000 km planned for all types of transmission pipeline, 9,300 km were to be for gas and only 1,700 km for oil (both crude and refined). [redacted]

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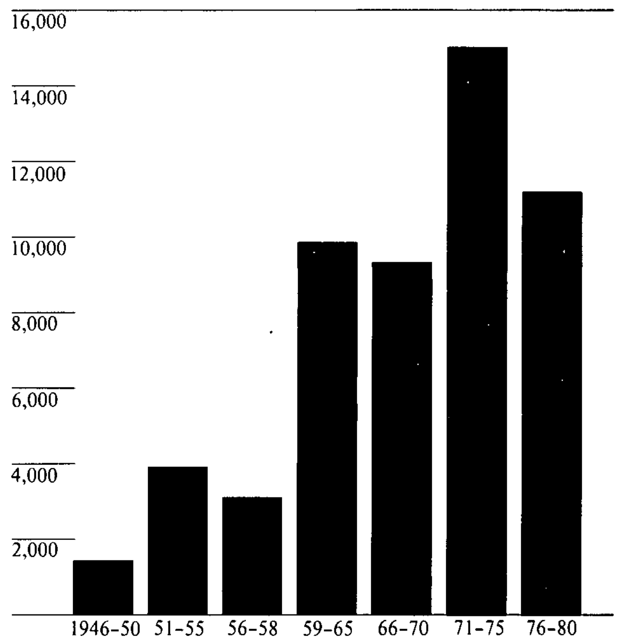
If, as is likely, the USSR misses the current 9,200-km goal by a proportion somewhat lower than in 1976-80, we can expect oil and gas-condensate pipeline construction to total about 8,000 km. [redacted] 25X1

Table 2
USSR: Crude Oil Pipelines Scheduled for Construction During 1981-85 [a]

Origin	Terminus	Length (*kilometers*)
Pavlodar	Chimkent [b]	1,642
Kholmogory	Kuybyshev [b c]	2,400
Severnyy Vozey	Usinsk	57
Yaroslavl'	Kirishi	520
Tyumen'	Yurgamysh	250
Verkhne-Tarskoye	Parabel'	180
Perm'	Al'met'yevsk	450
Chimkent	Chardzhou	700
Groznyy	Baku	620
Prorva	Gur'yev	275
Kenkiyak	Orsk	300
Krasnoleninsky Svod	Shaim	200
Usinsk	Ukhta	400
Oymasha	Zhetibay	50
Vengapur	Nizhnevartovsk [d]	250
Berezniki	Perm'	200

[a] Information is compiled from Soviet media sources.
[b] Large-diameter pipeline.
[c] This line will carry both crude oil and condensate.
[d] This line probably will carry condensate only.

Figure 10
Completion of Crude Oil Pipelines, by Plan Period



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Emerging Problems

The Soviet crude oil pipeline network has grown rapidly, but serious problems appear to be developing. The West Siberian network is operating at a high rate of utilization and, if the new Kholmogory-to-Kuybyshev pipeline is not completed expeditiously, may not have sufficient capacity to transport the oil production planned for 1984. If inadequate pipeline capacity constrains crude oil production for as much as a year pending completion of the new pipeline, a crude oil production shortfall of 5-10 million tons could result. At 1983 prices, the lost oil production would be equivalent to about $1-2 billion.

The high oil-pipeline-capacity utilization in West Siberia has further implications. In 1977, when the Surgut-to-Polotsk pipeline was begun, the West Siberian oil pipeline network had about 60 million tons of unused capacity. Construction of a new line therefore indicated that the Soviets were counting on rapid and large increases in West Siberian oil production. Now there is very little unused capacity—we estimate that more than 90 percent of the pipeline network in West Siberia is currently being used. The relatively small oil pipeline program now scheduled, taken together with the high utilization rate, lead us to conclude that the Soviets probably foresee smaller increases in West Siberian oil production. 25X1

An additional costly problem will overtake the Soviet oil industry in 10 years or so. Much of the Soviet oil pipeline network will then require substantial maintenance or replacement. A large part of the need for replacement will stem from corrosion—a problem aggravated by shoddy construction practices, the harsh climate, and soil salinity. 25X1

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Table 3
USSR: Pipeline Construction, Planned and Achieved

Kilometers

	1971-75		1976-80	
	Planned	Achieved	Planned	Achieved
Gas	30,000	31,700	35,000	30,500
Oil [a]	27,000	18,600	18,500	12,800

[a] Figures include pipelines for both crude oil and refinery products.

Table 4
USSR: Crude Oil Pipelines Constructed During 1981-82

Pipeline	Kilometers
Total	2,987
Oymasha-Zhetibay	50
Tyumen'-Yurgamysh	50
Perm'-Al'met'yevsk	500
Berezniki-Perm'	200
Severnyy Vozey–Usinsk	57
Groznyy-Baku	700
Krasnoleninsky Svod–Shaim	200
Vengapur-Nizhnevartovsk	250
Verkhne-Tarskoye–Parabel'	180
Pavoldar-Chimkent [a]	800

[a] Construction of this pipeline (1,642 km in length) began in 1978. It was originally scheduled for completion in 1980, but by that time only about 800 km had been laid, leaving approximately 800 km for construction in the 1981-82 period.

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Adequacy of West Siberian Pipelines in 1983. Our analysis indicates that at present there are four major West Siberian pipelines operating at or above design capacity. The fifth, the Aleksandrovsk–Anzhero-Sudzhensk pipeline, operates below design capacity. There is also a minor (530-mm) crude oil pipeline that runs from Shaim to Yurgamysh. These six lines are described in table 5 and figure 11.

Soviet press reports have already announced plans to increase West Siberian oil production from 354 million tons in 1982 to 372 million tons in 1983. We believe that the Soviets can move this amount of crude oil out of West Siberia if they supplement the pipelines with rail and water shipment. (Past Soviet press reporting indicates that a total of about 10 million tons can be transported by rail and water.) But the situation will be tight: there is no surplus pipeline capacity to compensate for interruptions of service. If any major pipeline were damaged and had to be taken out of service for even a month or two in 1983, production probably would be constrained.

Possible West Siberian Transport Bottleneck. For crude oil production in West Siberia to increase to a scheduled 399 million tons in 1985, output in 1984 would have to be about 385 million tons. These amounts would substantially exceed the present 361-million-ton capacity of the pipelines there.[3] The Soviets could realize some gain in capacity by constructing an additional pipeline westward from Anzhero-Sudzhensk to increase the use of the 1,220-mm pipeline from Aleksandrovsk to Anzhero-Sudzhensk, but there are no indications that they plan such a link. We estimate that up to a year of construction time would be required to build this linking pipeline. 25X1

Soviet media have reported the beginning of construction work on a large-diameter crude-oil/gas-condensate line from Kholmogory to Kuybyshev. If it becomes operational in the first half of 1984 the Soviets will have no trouble in transporting the oil planned for production in 1984 and 1985. However, the line may not be operational until late 1984 or early 1985—and it may not reach full capacity until late 1985. This could constrain West Siberian oil production. In order to reach the 1985 target of 399 million tons in West Siberia, production in 1984 would have to be about 385 million tons. At this level, West Siberian oil production will exceed the available pipeline capacity

25X1

[3] Our estimate of the usable throughput for the six pipelines currently transporting oil from the West Siberian fields is at the low end of the range (361-383 million tons per year) 25X1 25X1 If the Tobol'sk petrochemical plant becomes operational before 1985, the Soviets could begin using the condensate pipeline from Nizhnevartovsk to Tobol'sk, and pipeline capacity would increase to 369 million tons. 25X1

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Table 5
Usable Throughput of the West Siberian Pipeline Network [a]

Million tons per year

	Usable Throughput	Nameplate Throughput [b]
Surgut to Polotsk *(1,220 mm)*	83	70-78
Samotlor to Al'met'yevsk *(1,220 mm)*	83	70-78
Samotlor to Kuybyshev *(1,220 mm)*	83	70-78
Ust Balyk to Omsk *(1,020 mm)*	55	42-50
Aleksandrovsk to Anzhero-Sudzhensk [c]	48.5	70-78
Shaim to Yurgamysh *(530 mm)*	8	6-8
Total [d]	360.5	328-370

[a] Our estimate of the usable throughput for the six pipelines transporting oil from the West Siberian fields is at the low end of the 361-383-million-ton-per-year range [redacted] In discus- [redacted] their belief that three of the four 1,220-mm pipelines in the West Siberian system could possibly operate at 15 to 20 percent above design capacity (that is, at 86-90 million tons per year each). We consider that the throughput of these pipelines is constrained by pump capacity. Soviet technical monographs on pipeline construction list the maximum allowable throughput for their largest pump, the HM-10,000, at 83.3 million tons per year. This limit, which we have used in our estimate, is only 11 percent above the design capacity of a 1,220-mm pipeline. Additional considerations affecting capacity estimates are discussed in appendix B.

[b] "Nameplate" throughput represents the expected or normal range for throughput reported by the Soviets.

[c] We estimate the usable throughput capacity of this pipeline at 48.5 million tons because at Anzhero-Sudzhensk there is not enough exit pipeline capacity westward toward Omsk and refinery capacity to the east to accommodate more than 48.5 million tons per year.

If the Soviets built another pipeline between Anzhero-Sudzhensk and Omsk, they could increase the usable throughput for the Aleksandrovsk–Anzhero-Sudzhensk pipeline. To date, however, Soviet press reports and oil pipeline maps do not indicate such construction [redacted] A recent Soviet press article indicates that a pipeline for refinery products exists from Ufa as far as Novosibirsk. [redacted]

[d] In addition, a small-diameter condensate pipeline runs from Nizhnevartovsk to Surgut and then to Tobol'sk. Some press reports indicate that this pipeline is not operational because of delays in the construction of the petrochemical facility at Tobol'sk. These reports indicate that from Surgut the condensate is either mixed with the crude in the major crude oil pipelines or transported out of West Siberia by railcar. Seven million tons of condensate were produced from the Middle Ob' oilfields in 1981. The other West Siberian pipelines shown in appendix A are intraregional lines that do not transport oil out of West Siberia.

[redacted]

of nearly 361 million tons if the Kholmogory-to-Kuybyshev pipeline is not completed. Having absorbed the increment to capacity gained from building the Surgut-to-Polotsk pipeline and needing more, the Soviets would again be in a position similar to that in 1979. At that time, according to a Soviet newspaper statement by a high-ranking pipeline official, the West Siberian pipeline network was not adequate to transport increasing oil output and production was thereby constrained. [redacted] 25X1

No new pipeline construction originating from Kholmogory is evident [redacted] 25X1 25X1 [redacted] Recent Soviet media 25X1 reports indicate that some new pumping stations have been added to the existing Surgut-Polotsk pipeline between Surgut and Perm'. [redacted] 25X1

25X1

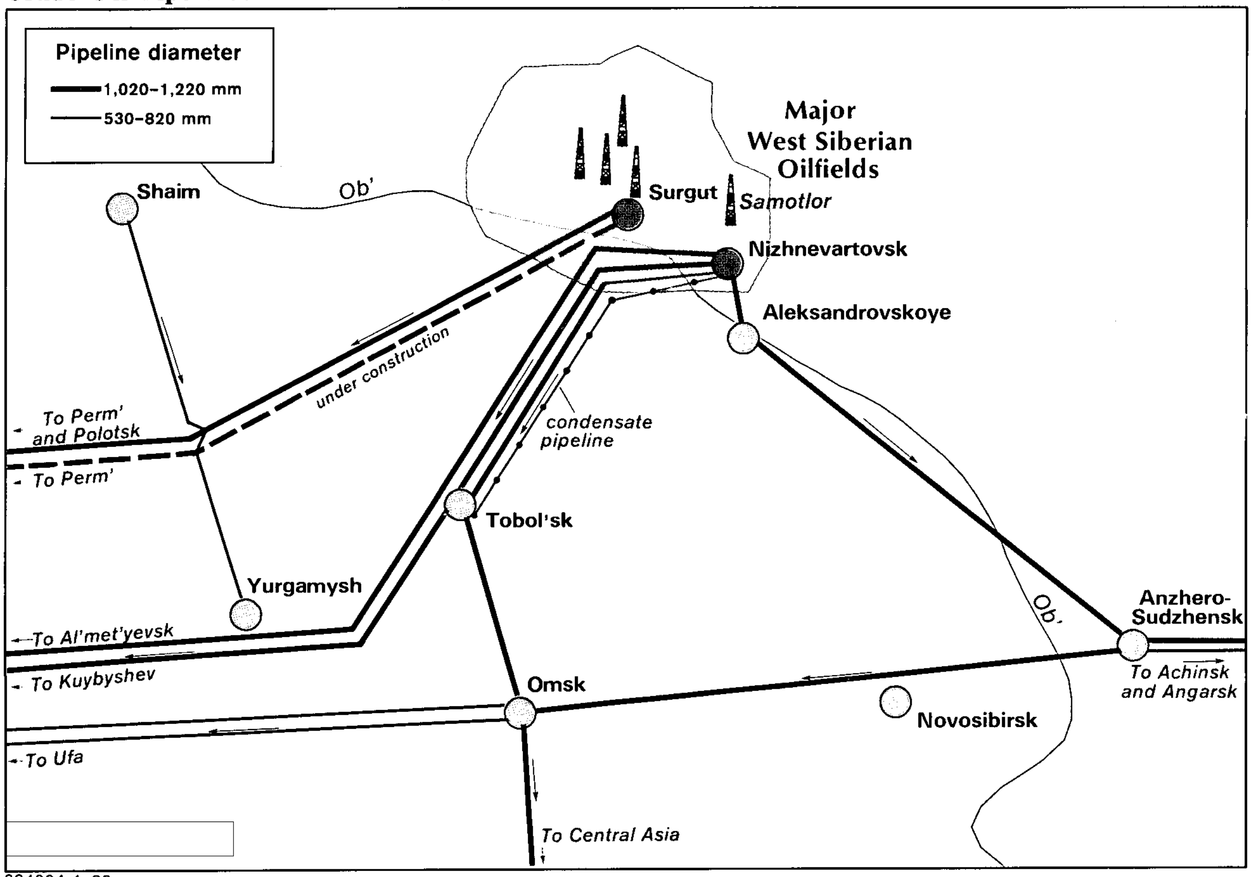
If construction began in earnest this winter and a construction rate of 80 km per month (the average for the Surgut-to-Polotsk pipeline, 1977-81) is achieved, the pipeline probably could not be operational before late 1984 or early 1985. Full throughput capacity will not be attained until all of the pumping stations are completed—probably not before the end of 1985.[4] [redacted] 25X1

[4] Soviet media reporting on the new pipeline has been inconsistent. Most of the evidence, however, indicates that it will terminate somewhere in the Volga-Urals region, either at Kuybyshev or at Kuznetsk, west of Kuybyshev along the Friendship Oil Pipeline. Some Soviet press reports indicate that the pipeline will transport crude oil; some indicate condensate. Other Soviet media reports have mentioned plans to extend the new pipeline to Urengoy. Reports in *Planovoye khozyaystvo* indicate that Urengoy condensate production could reach 40-50 million tons a year. The Minister of the Petroleum Industry has stressed the importance of using this condensate and the necessity of building a condensate pipeline. [redacted] 25X1 25X1 25X1 25X1

Soviet press reporting on construction progress has been unusually sparse. In the past, the Soviet press has highlighted the construction of major West Siberian oil pipelines as evidence of the region's rapidly increasing production possibilities. The latest Soviet media report indicated that the new pipeline was being built "slowly." All of this is in contrast with the enormous media attention that is currently being given to the gas pipeline construction program. [redacted] 25X1

25X1

Figure 11
Crude Oil Pipelines in West Siberia



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Rail and Water Shipment. West Siberian rail and water shipments probably could provide only limited help in the event of a shortfall in pipeline carrying capacity. The Soviets have already announced that the volume of crude oil to be transported by rail for the USSR as a whole will decline from 35 million tons per year in 1980 to 25-28 million tons per year in 1985. In the oil-producing areas of West Siberia there is only one rail line, which connects Surgut and Tobol'sk. It is already heavily taxed, carrying supplies to the Middle Ob' oilfields and the developing Urengoy gasfields. By 1984 the railroad probably will have little or no excess capacity for hauling oil out of West Siberia. Because the rivers are frozen over for more than half the year, water transport would provide only limited help. In 1981, for the USSR as a whole, only 12 million tons of oil were transported by river transport.

Construction Practices and Pipeline Serviceability

The quality of Soviet pipeline construction is below Western standards. Proper welding and insulating procedures are often sacrificed to simply getting the pipe laid and moving on to the next section. 25X1 25X1 25X1 Soviet performance in pipe cleaning, taping, and backfilling is unacceptable by Western standards, and the overall job would be rejected by an average pipeline company in the West. Nonetheless, Soviet pipelines carry vast amounts of oil—albeit with more frequent repair and shorter operating life than is common in the West. The increasing age of Soviet pipelines and the effects of shoddy construction may force the USSR to replace significant lengths of pipeline in the next 10 years. 25X1

A Miscalculation?

The Aleksandrovsk–Anzhero-Sudzhensk pipeline, which is 1,220 mm in diameter and has been extended to Irkutsk, serves an area with a refining capacity of 31.5 million tons per year—24 million tons for the refineries at Achinsk and Angarsk, and about 7.5 million tons (by rail transshipment) for the refinery at Komsomol'sk. Another 17 million tons are transported westward to Omsk through a 720-mm pipeline. Thus, the currently usable throughput capacity for the Aleksandovsk–Anzhero-Sudzhensk line is 48.5 million tons per year—only about 60 percent of the maximum for a 1,220-mm pipeline.

This pipeline, which went into service in 1972, probably has never operated at full capacity. by 1979 only four of a planned 10 pumping stations had been built; in 1981, six stations were operational. Additional pumping stations are still being planned for this pipeline, 10 years after it began operation.

When the Aleksandrovsk–Anzhero-Sudzhensk pipeline was completed in 1972, Soviet press reports announced plans—not subsequently implemented—to extend it to the Pacific port of Nakhodka and to build a refinery there. Long-range plans for producing 500-800 million tons of crude oil per year in West Siberia had surfaced before 1972, and the pipeline extension may have been intended to permit the export of surplus crude oil to countries in the Far East. (In 1980, India imported only 1.7 million tons of Soviet crude oil, 1.2 million tons of which were shipped from the Black Sea ports. Japan imported only 500,000 tons, probably from Sakhalin Island.)

These earlier hopes may explain why the Soviets built a large-diameter pipeline leading to an area that by 1982 had only 48.5 million tons per year of outlet capacity via pipeline.

Unlike large-diameter gas pipeline construction, for which Western pipe, ball valves, and pipelayers have been essential, oil pipeline construction in the Soviet Union does not depend on Western equipment and materials. Soviet and East European industries have been able to furnish minimum requirements for these items and have been striving to upgrade the capabilities and quality of their products. The Soviets, nevertheless, still prefer quality Western products for many uses. (See appendix C for comments on selected categories of equipment and materials.) 25X1

Despite the intrinsic quality difference between Soviet and Western products, when the Soviets use Western products the difference in effectiveness is seldom as great as might be expected. For example, if the superior Western pipe coating and wrapping materials are applied incorrectly, they will do little more to prevent corrosion than lower quality Soviet materials. 25X1 Western welding equipment may be capable of making perfect welds on pipe quickly and with minimum consumption of welding rod; but by using more 25X1 manpower and welding rod, crews can make serviceable welds with Soviet equipment. 25X1

Deficiencies in Soviet pipeline construction are widely noted by Soviet observers; many examples can be 25X1 cited. In 1978, a 30-km pipeline being tested with water in the Mangyshlak region of Central Asia burst in 39 places. A Soviet emigre, an engineer, reported that, on the average, one or two welded joints out of 10 had a leak that required rewelding. The Surgut-to-Perm' section of the Surgut-to-Polotsk pipeline was operating in July 1979 but in November still had not been accepted by the State Commission for Accepting Final Projects as completed—because of "defects in the welding operations." In the same section, river 25X1 crossings were made with one pipeline rather than the required two—the second being left "for later."

In regard to insulation, B. Shcherbina, Minister of Construction of Oil and Gas Industry Enterprises, 25X1 noted in a Soviet journal article that it "was no secret 25X1 that corrosion inflicts more losses on the national economy than any other natural consequence."

25X1

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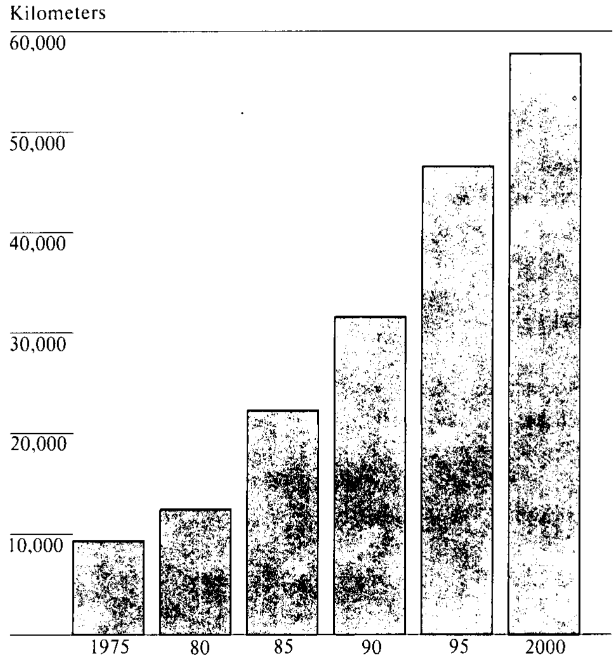
On many of the pipelines in Central Asia, where the relatively high conductance of saline soils aggravates corrosion, insulating coating and wrapping material were not applied uniformly and completely. Cathodic protection, consequently, was not very effective.[5] For example, the crude oil pipeline between Uzen', Gur'yev, and Kuybyshev (1,020 mm in diameter and 1,500 km in length) lasted less than 10 years, and a replacement line had to be built in 1977. A study made in 1977 of the durability of pipeline insulation in Central Asia showed insulation failure in 34 percent of the places examined, after only five to six years of the pipeline's operation. Of these failures, 12 percent were directly attributable to improper application of insulation. 25X1

In view of the relatively low technical quality of Soviet pipe; welding, coating, and wrapping operations; and pipelaying practices, we believe the service life of oil pipelines is shorter in the USSR than in the United States, where pipelines are built with a life expectancy of 20 years. According to a 1982 Petro-Studies report, the actual service life for steel pipe in temperate areas of the USSR is 11 years when coated with bituminous coating and 17 years when field-wrapped with tape. In the harsher climate of West Siberia and Central Asia, the service life would be less. 25X1

At the end of 1980 only about 22 percent of the USSR pipeline system (some 13,000 km) was 20 years old or older. Some of this pipe has undoubtedly been replaced. By 1995, roughly 75 percent of the present pipeline system (about 46,000 km) will be 20 years old or older (figure 12). Replacement of some of these pipelines will not be required, because they are located in regions where oil production is declining. Some pipe will require replacement, however, and the investment for reconstruction could be substantial if sufficient new oil formations are developed, necessitating continued use of these pipelines. 25X1

[5] The likelihood of corrosion is increased if there is a difference in electrical charge between the pipe and ground, because this leads to a current flow and an ion exchange. Cathodic protection, which reverses the current flow by creating a higher electric potential at various points alongside the pipeline route through induced current, can afford protection from corrosion—if the pipe is well insulated. If any surface is left exposed, however, the corrosion that would have occurred along the pipe is concentrated at one place, and failure occurs more quickly. 25X1

Figure 12
USSR: Length of Crude Oil Pipeline Network at Least 20 Years Old



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Seasonal Construction in West Siberia

The Soviet press has emphasized the necessity of year-round pipeline construction in West Siberia, but in general it is still limited to about eight months.[6] Construction in swampy areas during the summer has been achieved only on a small scale. Summer pipeline construction in West Siberia is mostly limited to construction in hard ground. According to Soviet newspaper reports, most pipelaying will continue to occur when the ground is frozen during October through May. 25X1

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Since 1972, pipeline construction during the summer constituted roughly 4 percent of the annual total in West Siberia. Expenses for summer construction are three to four times as great as for winter construction. The Soviets still use the summer season primarily for building settlements and bases, for welding linepipe into jointed lengths, and for repair and maintenance of pipelaying equipment. The construction rates achieved in the winter season depend partly on how well they performed the summer tasks. 25X1

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Appendix A

USSR: Pipeline Network

Origin	Terminus	Diameter (*millimeters*)	Length (*kilometers*)	Capacity (*million tons per year*)	Year Completed (*approximate*)
Caucasus Region					
Baku	Batumi [a]	200	883	2	1906
Khadyzhensk	Krasnodar	200	108	2	Pre-1917
Maykop	Khadyzhensk	NA	50	NA	Pre-1917
Makhachkala	Groznyy #1	200	162	2	1914
Kaluzhskaya	Afipskaya	125	25	—	Pre-1917
Patara Shiraki	Kukheti	250	64	2	Pre-1927
Mozdok	Malgobek	250	25	2	1935
Khadyzhensk	Tuapse	273	50	2	1928
Makhachkala	Groznyy #2	300	162	3	1936
Malgobek	Groznyy	250	120	2	1940
Patara Shiraki	Kachreti	200	50	2	1940
Izerbash	Makhachkala	200	63	2	1952
Keslerovo	Krymsh	NA	24	NA	1953
Goragorskiy	Groznyy	200	63	2	1940
Ostrov Peschanyy	Baku	305	7	3	1957
Ostrov Artema	Baku	305	43	3	1957
Ostrov Artema	Zyrya	375	20	3	1961
Karabulak	Groznyy #1	NA	90	NA	NA
Karabulak	Groznyy #2	NA	90	NA	NA
Ali-Bayramly	Baku	NA	134	NA	NA
Neftyanyye Kamni	Baku #1	250	100	2	1961
Neftyanyye Kamni	Baku #2	NA	100	2	1961
Neftyanyye Kamni	Ostrov Zhiloy	375	20	3	1962
Ostrov Zhiloy	Zyrya	250	20	2	1962
Ozek Suat	Groznyy #1	305	200	3	1955
Ozek Suat	Groznyy #2	530	200	6-8	1961
Tikhoretsk	Tuapse	530	240	6-8	1962
Tikhoretsk	Novorossiysk #1	530	236	6-8	1963
Kashuri	Batumi	720	234	14-18	1968
Tikhoretsk	Malgobek [b]	530	600	6-8	1969
Tikhoretsk	Novorossiysk #2	NA	236	NA	NA
Tikhoretsk	Novorossiysk #3	820	236	22-26	1974
Samgori	Batumi	NA	401	NA	1980
Tikhoretsk	Groznyy	820	600	22-26	1980
Ozek Suat	Groznyy #3	530	150	6-8	1968
Keslerovo	Krymsk	NA	40	NA	NA
Karskoye	Novorossiysk	NA	75	NA	NA
Krymsk	Novorossiysk	NA	15	NA	NA
Afipskiy	Novorossiysk	NA	80	NA	NA

[a] Pipeline was reported by Soviet press article as operating at one-third capacity.
[b] Flow was reversed in the late 1970s.

Origin	Terminus	Diameter (*millimeters*)	Length (*kilometers*)	Capacity (*million tons per year*)	Year Completed (*approximate*)
Friendship Pipeline System					
Stryy	L'vov	150	65	1	Pre-WW II
Stryy	Drogobych	150	25	1	Pre-WW II
Dolina	Drogobych	250	60	2.5	1962
Ostashkovichi	Rechitsa	325	34	3	NA
Rechitsa	Mozyr'	325	200	3	NA
Kuybyshev	Unecha #1	1,020	1,275	42-50	1964
Unecha	Mozyr' #1	820	289	22-26	1964
Mozyr'	Brest #1	630	475	10-12	1963
Mozyr'	Uzhgorod #1	630	726	10-12	1963
Unecha	Polotsk #1	720	375	14-18	1965
Polotsk	Ventspils	630	473	10-22	1967
Kuybyshev	Unecha #2	1,220	1,275	70-78	1972
Unecha	Mozyr' #2	1,020	289	42-50	1972
Mozyr'	Brest #2	820	475	22-26	1971
Mozyr'	Uzhgorod #2	720	14-18	14-18	1971
Unecha	Polotsk #2	530	450	6-8	1973
Polotsk	Mazeikiai	720	726	14-18	1978
Ukraine–South Central Region					
Astrakhan	Saratov [c]	273	655	3	1944
Glinsk	Kremenchug	NA	125	NA	NA
Kuybyshev	Saratov	530	443	6-8	1955
Zhirnovsk	Volgograd	300	300	3	1957
Kuybyshev	Tikhoretsk	820	1,280	22-26	1974
Kremenchug	Khersen	NA	355	NA	1972
Michurinsk	Kremenchug	530	753	6-8	1974
Lisichansk	Tikhoretsk	630	472	10-12	1974
Kuybyshev	Lisichansk	1,020	1,089	42-50	1977
Lisichansk	Kremenchug	NA	400	NA	1977
Snigirevka	Odessa	NA	227	NA	1977
Moscow-Leningrad Region					
Al'met'yevsk	Gorkiy #1	530	577	6-8	1961
Al'met'yevsk	Gorkiy #2	720	577	14-18	1961
Gorkiy	Ryazan' #1	720	394	14-18	1961
Ryazan'	Moscow	530	198	6-8	1961
Gorkiy	Yaroslavl' #1	720	358	22-26	1962
Yaroslavl'	Kirishi	720	524	14-18	1969
Usinsk	Ukhta	720	410	14-18	1972
Verkhne Gluboshchorskoye	Usinsk	NA	165	NA	NA
Dzer field	Ukhta	NA	NA	NA	1976
Gorkiy	Ryazan' #2	NA	394	NA	1970
Al'met'yevsk	Gorkiy #3	1,020	577	22-26	1970
Ukhta	Yaroslavl'	820	1,130	22-26	1973
Yaroslavl'	Moscow	720	245	14-18	1975
Perm'	Gorkiy	1,220	820	70-78	1981

[c] Pipeline reported in Soviet press article as out of service.

Origin	Terminus	Diameter (*millimeters*)	Length (*kilometers*)	Capacity (*million tons per year*)	Year Completed (*approximate*)
Gorkiy	Yaroslavl' #2	1,020	358	42-50	1980
Yaroslavl'	Polotsk	1,020	800	42-50	1981
Volga-Urals					
Naryshevo	Buguruslan (RR)	NA	NA	NA	1949
Romashkino	Kuybyshev	530	241	6-8	1954
Karabash	Romashkino #1	250	20	2	NA
Karabash	Romashkino #2	350	20	3	NA
Al'met'yevsk	Klyavlino (RR)	250	98	2	1963
Al'met'yevsk	Klyavlino #2 (RR)	350	98	3	1956
Minibayevo	Al'met'yevsk	350	25	3	NA
Minibayevo	Al'met'yevsk #2	500	25	6-8	NA
Minibayevo	Karabash	350	20	3	NA
Krotovka	Kuybyshev	530	86	6-8	1953
Pilyugino	Buguruslan	NA	30	NA	1953
Karabash	Bavly #1	350	58	3	1953
Bavly	Kuybyshev #1	530	314	6-8	1953
Bulgul'ma	Subkhankulovo	NA	65	NA	1954
Subkhankulovo	Ufa #1	350	156	3	1947
Subkhankulovo	Ufa #2	350	156	3	1953
Subkhankulovo	Ufa #3	529	156	6-8	1954
Zol'noye	Kuybyshev	NA	43	NA	1947
Yablonovo	Kuybyshev	NA	35	NA	1949
Al'met'yevsk	Aznakayevo #1	530	45	6-8	1956
Al'met'yevsk	Aznakayevo #2	720	45	14-18	1960
Aznakayevo	Subkhankulovo #1	530	50	14-18	1956
Naryshevo	Subkhankulovo	NA	NA	NA	1953
Naryshevo	Bavly	NA	NA	NA	1953
Bavly	Kuybyshev #2	300	314	1	1950
Subkhankulovo	Ufa #4	530	156	6-8	1954
Aznakayevo	Subkhankulovo #2	500	50	6-8	1960
Perm'	Al'met'yevsk	377	500	4	1955
Lobanovo	Perm'	NA	22	NA	NA
Alkeyevo	Sulezevo	NA	12	NA	1957
Suleyevo	Al'met'yevsk	NA	16	NA	1957
Chubovka	Krasny Yar	NA	25	NA	1957
Krasny Yar	Zolnoye	NA	52	NA	1957
Alakayevka	Chubovka	NA	12	NA	1956
Sosnovka	Pokhvistnevo	NA	40	NA	1957
Bavly	Subkhankulovo #1	350	40	4	1957
Karabash	Bavly #2	530	58	6-8	1957
Naryshevo	Urussu	NA	15	NA	1954
Subkhankulovo	Ufa #5	720	156	14-18	1957
Subkhankulovo	Shkapovo	530	96	6-8	1956
Shkapovo	Salavat	530	146	6-8	1955
Tanypskoye	Chernuska	NA	30	NA	1958

Origin	Terminus	Diameter (*millimeters*)	Length (*kilometers*)	Capacity (*million tons per year*)	Year Completed (*approximate*)
Bavly	Subkhankulovo #2	820	40	22-26	1957
Bavly	Kuybyshev #3	300	314	3	1965
Pokrovka	Kuybyshev	NA	75	NA	1962
Pokrovka	Syzran' #1	350	100	3	1962
Kaleshobka	Kuybyshev	529	100	6-8	1963
Mukhanovo	Kuybyshev #1	NA	115	NA	1963
Mukhanovo	Kuybyshev #2	NA	115	NA	1963
Chernushka	Osa	NA	100	NA	1963
Ishimbay	Orsk	530	333	6-8	1960
Kaltasy	Salavat	700	324	14-18	1961
Kaltasy	Ufa	300	280	3	1958
Naberezhnyy Chelny	Al'met'yevsk #1	350	100	4	1963
Naberezhnyy Chelny	Al'met'yevsk #2	530	108	6-8	NA
Chekmagush	Aznakayevo	NA	134	NA	1968
Chernushka	Kaltasy	NA	75	NA	1967
Osa	Perm'	530	108	6-8	1968
Severokamsk	Perm'	NA	60	NA	1963
Subkhankulovo	Ufa #6	800	156	14-18	1962
Krasnokamsk	Perm'	NA	42	NA	1963
Yarino	Perm'	NA	66	NA	1963
Kamenyy Log	Perm' #1	NA	70	NA	1963
Buguruslan	Kuybyshev	530	200	6-8	1968
Subkhankulovo	Kuybyshev	820	350	22-26	1974
Pokrovka	Syzran' #2	350	100	4	1974
Kaltasy	Ufa	NA	110	NA	1976
Naberezhnyy Chelny	Al'met'yevsk #3	NA	100	NA	1971
Kaltasy	Al'met'yevsk #1	NA	240	NA	1971
Kaltasy	Al'met'yevsk #2	NA	240	NA	1975
Kiyengop	Naberezhnyy Chelny	NA	NA	NA	1978
Kamenyy Log	Perm' #2	NA	70	NA	1971
Ishevsk	Gremikhino	NA	60	NA	1980
West Siberia					
Omsk	Ufa #1	530	1,149	6-8	1955
Omsk	Ufa #2	720	1,149	14-18	1960
Shaim	Tyumen'	530	410	6-8	1965
Ust'-Balyk	Omsk	1,020	1,026	42-50	1967
Nizhnevartovsk	Surgut	720	252	14-18	1969
Aleksandrovsk	Anzhero-Sudzhensk	1,220	850	70-78	1972
Nizhnevartovsk	Aleksandrovsk #1	NA	40	NA	NA
Nizhnevartovsk	Al'met'yevsk	1,220	2,119	70-78	1973
Nizhnevartovsk	Aleksandrovsk #2	NA	40	NA	1974

Origin	Terminus	Diameter (*millimeters*)	Length (*kilometers*)	Capacity (*million tons per year*)	Year Completed (*approximate*)
Var-yegan	Nizhnevartovsk	NA	150	NA	NA
Vat-yegan	Lokosov	NA	100	NA	NA
Vakh	Nizhnevartovsk	NA	98	NA	1975
Agan	Vatinsk #1	NA	50	NA	1975
Agan	Vatinsk #2	NA	50	NA	NA
Belozerskoye	Nizhnevartovsk	NA	65	NA	1976
Kholmogory	Surgut	NA	250	NA	1976
Nizhnevartovsk	Kuybyshev	1,220	2,263	70-78	1976
Sovetskoye	Nizhnevartovsk	NA	61	NA	NA
Vasyugan	Raskino	NA	150	NA	1978
Surgut	Perm'	1,220	1,250	70-78	1979
Ur'yevskiye	Yuzhnyy Balyk	NA	180	NA	1980
Lyantor	Ust'-Balyk	NA	150	NA	NA
Tyumen'	Yurgamysh	530	250	6-8	1981
East Siberia					
Omsk	Irkutsk	720	2,295	14-18	1964
Anzhero-Sudzhensk	Irkutsk	1,020	1,478	42-50	1980
Soviet Far East					
Okha	Moskalvo	300	29	2	1942
Okha	Zaliv Urkt	250	20	2	1937
Ekhabi	Okha	150	15	1	1937
Okha	Sofiysk	325	300	3	1947
Sofiysk	Komsomol'sk	325	324	3	1955
Sabo	Okha	NA	52	NA	1962
Ekhabi	Zaliv Urkt	150	14	1	1937
Mongi	Pogobi	NA	NA	NA	1978
Okha	Komsomol'sk	NA	630	NA	1978
Central Asia					
Koschagyl	Makat #1	250	120	2	1934
Kulsary	Koschagyl	200	20	2	1935
Makat	Orsk	235	709	2	1936
Koschagyl	Makat #2	NA	120	NA	1957
Prorva	Koschagyl	305	125	3	NA
Munaly	Koschagyl	NA	60	NA	1962
Barsa Gelmes	Vyshka	305	25	3	NA
Kum Dag	Vyshka	305	25	3	NA
Vyshka	Belek #1	305	100	3	NA
Okarem	Okarem Sea Terminal	305	20	3	NA
Kotur-Tepe	Cheleken	305	100	3	NA
Kotur-Tepe	Belek #1	305	100	3	NA
Kotur-Tepe	Belek #2	305	100	3	NA
Belek	Krasnovodsk #1	305	100	3	NA
Belek	Krasnovodsk #2	305	100	3	NA

Origin	Terminus	Diameter (*millimeters*)	Length (*kilometers*)	Capacity (*million tons per year*)	Year Completed (*approximate*)
Belek	Krasnovodsk #3	305	100	3	NA
Uzen'	Shevchenko	530	142	6-8	1966
Kenkiyak	Bayganin	NA	20	NA	1967
Uzen'	Kuybyshev #1 [d]	1,020	1,506	60	1970
Uzen'	Kuybyshev #2	1,020	1,506	50	1978
Vyshka	Belek #2	NA	100	NA	1976
Omsk	Pavlodar	1,020	456	42-50	1977
Tauchik	Shevchenko	NA	80	NA	1979

[d] This pipeline is now out of service or it is being used to transport water.

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Appendix B

Throughput for Two Siberian Oil Pipelines

We estimate that the maximum throughput for the 1,220-mm pipelines from Samotlor to Al'met'yevsk and from Samotlor to Kuybyshev is about 86 million tons per year.[7] This is based on 70-km spacing between pumping stations (the average observed over the first 900 km of their routes) and a maximum allowable operating pressure (MAOP) for the pipe of about 54 atmospheres (atm).

The 54-atmosphere estimate is based on:

- Soviet monographs on oil pipeline transport, which list the operating pressure for 1,220-mm oil pipelines as between 42.5 and 51 atm.

- An article in a Soviet oil pipeline journal, which stated that the steel (17G1S) used for these pipelines would permit an operating pressure of 48 atm.

- A US estimate that such steel could operate at 63 atm with good welding and at 50 atm with poor welding. With about average welding, the MAOP would be about 56 atm.

- Comparison of the test pressure for 17G1S steel with that for Sumitomo pipe, which is designed to operate at 75 atm but is tested at 100 atm. If the Sumitomo ratio (.75) between operating pressure and test pressure is applied to the cited 17G1S test pressure of 67 atm, the safe operating pressure is approximately 50 atm.

- The fact that one pipeline is already 10 years old and the other seven.

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[7] The estimate of 86 million tons per year does not take into account the constraint imposed by Soviet pumps—11,450 cubic meters per hour, or 83 million tons per year.

[8] Yield strength is that force per unit area at which plastic deformation begins; tensile strength is that at which failure or rupture occurs.

Appendix C

The Role of Western Equipment in Soviet Oil Pipeline Construction

For the construction of crude oil pipelines, there is no single piece of imported equipment that the USSR absolutely needs. But without Western pipelayers, bulldozers, surge-control valves, and insulating materials, the pipelines' construction would take longer (especially in West Siberia), their operation would be less efficient, and their economic life would be shorter. [redacted]

Pipelayers

Emigres have said that Western pipelayers are one of the items most necessary in Soviet pipeline construction. A pipelayer is usually a crawler tractor with a side-boom for lifting pipe. Under Soviet operating conditions, attrition rates for pipelayers and bulldozers are higher than in the West. Poor operating and maintenance practices, and the use of less skilled personnel as operators, generally shorten their operating life. Difficult climate and terrain also take a severe toll, especially in the northern areas. Soviet pipelayers have had a limited load-handling capacity, which has limited their effectiveness for handling large-diameter pipe (a Soviet official once commented that it took three Soviet pipelayers to do the job of one US machine). However, a new Soviet pipelayer, which is said to have load-handling capability comparable to that of Western machines, has recently been placed in service. We have no information on its efficiency and durability. [redacted]

To meet the needs of the past decade's massive oil and gas pipeline programs, Moscow has purchased large numbers of pipelayers from the West since 1972. Caterpillar has shipped nearly 2,300 pipelayers and tractors to the Soviet Union, and International Harvester and Fiat Allis together have sold perhaps half that number. The Japanese Komatsu firm has sold more than 2,300 tractors and pipelayers, of which nearly 1,400 were for 1981-82 delivery. [redacted]

With pipes of 1,020-mm and 1,220-mm diameter, older Soviet pipelayers supposedly have sufficient lift capacity, but they have not been able to maintain the required chassis stability. To remedy this situation, the Soviets are producing a more powerful and stable pipelayer at the Sterlitamak assembly plant in the Bashkir ASSR. The new unit (TG-502) is designed for laying 1,220-mm- and 1,420-mm-diameter pipe. Series production began in 1980, and by 1982 more than 450 units were to have been produced. By the end of 1985, the Soviets plan to have produced about 1,700 of the TG-502s. [redacted] 25X1

The Soviets have reported that the TG-502 has a nominal lift capacity of 50 tons, which is greater than that of the Caterpillar 594 but considerably less than that of the Fiat-Allis FP-120. For greater stability, they have increased the chassis width and the width of the caterpillar tracks to dimensions comparable to those of the FP-120. The TG-502's height (measured from the ground to the top of the cabin) is less than the height of either the Caterpillar 594 or the Komatsu D-355. With its low center of gravity and wider frame, the TG-502 should have both the lift capacity and the stability to handle 1,220-mm- and 1,420-mm-diameter pipe. [redacted] 25X1

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Soviet pipelayers have broken down much more frequently than Western pipelayers when used in West Siberia, primarily because:

- The metallurgy for critical engine parts (pistons, cylinders, bearings) is inadequate and leads to high engine wear. High wear shortens engine life and causes undependable performance. 25X1

- [redacted] the Soviets do not produce adequate quantities of "Arctic lubricants" with pour points low enough to flow in extreme cold. To compensate, they thin some of their oils with kerosene. This procedure is somewhat effective until the kerosene evaporates and the oil begins to congeal, resulting in poor lubrication and accelerated wear. [redacted] 25X1

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Excavators

For digging the pipeline trench, the Soviets use both rotary excavators and backhoes. Their excavating and bucket capacities are comparable to those of Western equipment. [redacted] the Soviets produce well-designed excavators that work well in non-Arctic conditions. In Siberia, however, these excavators have the same basic problem as Soviet pipelayers: engine failure due to poor-quality metallurgy and lubricants. To compensate, the Soviets usually assign 14 excavators to each large-diameter pipelaying brigade—about twice the number assigned to a Western pipelaying crew. [redacted]

The Soviets have developed two excavators for large-diameter pipe: the ETR-231 for 1,220-mm pipe and the ETR-253 for 1,420-mm pipe. They say that the ETR-253 is capable of excavating rocky and permafrost soils. The Soviet press has recently announced the development and production of a new rotary excavator, the ETR-254, which is supposedly even more capable than the ETR-253. [redacted]

For excavation in swampy areas, the Soviets use single-bucket backhoes. The Soviet backhoes have bucket capacities almost comparable to those of the Caterpillar Model 235 and Komatsu PC-300 (1.25 and 1.54 m^3, respectively). [redacted]

Where the ground is frozen to such a depth that it cannot be broken by a ripper moving ahead of the excavator, the Soviets plan to use an excavator, the ETTs-208D, that cuts slits into the ground for explosive charges. Serial production of this excavator has begun, and the Soviets plan to be producing about 100 of these excavators per year by 1984. [redacted]

Insulating Materials

Soviet insulating materials for pipelines and the technology used for applying the materials do not satisfactorily protect the pipe from corrosion. This deficiency does not delay construction or affect initial operation of pipelines, but it will increase the cost of maintenance and the requirements for pipeline repair and replacement in the future. [redacted]

When insulating pipe at the factory, the Soviets use a polyethylene coating mixed with an epoxy resin. [redacted]

When insulating pipe in the field, the Soviets primarily use a polymer tape. They are unable, however, to produce a tape with the adhesive tension characteristics necessary to withstand extreme heat and cold. The Soviets have used Japanese-manufactured tape but were dissatisfied. They would prefer to use US-produced tape, which adheres well under tension, and have taken steps to acquire it. [redacted]

Pipe Requirements

The total large-diameter pipe requirements for the Pavlodar-to-Chimkent and Kholmogory-to-Kuybyshev pipelines (the only large-diameter oil pipelines planned for 1981-85) would be about 1.5 million tons. This requirement is relatively small—because pipe used for oil transmission does not need to be as high in quality as pipe used for gas transmission—and the USSR should have no problem producing enough. [redacted]

Pumping Stations

The Soviet Union appears to have few problems in constructing pumping stations for its crude oil pipelines and keeping them supplied. A minor problem may exist in the construction of surge-control valve systems. [redacted] 25X1

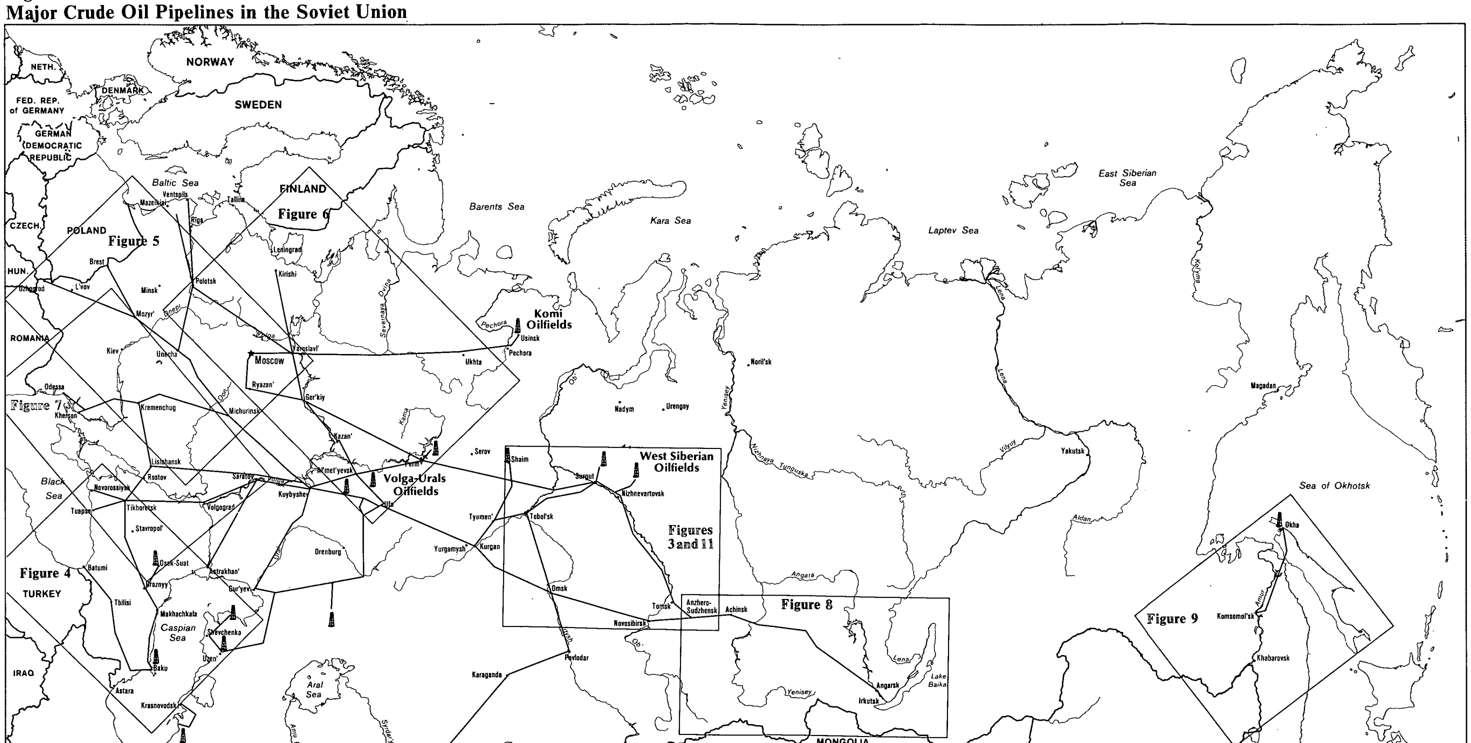
To build the pumping stations more quickly, the Soviets have begun using prefabricated modular units. Reductions in construction time from three years to six months have been reported. These are isolated examples, however. Soviet oil industry monographs list the norm for construction of a head pumping station with a yearly throughput capacity of 28 million tons of crude oil as 24 months; for an intermediate pumping station with a yearly throughput capacity of 13 million tons, it is 14 months. [redacted] 25X1

Analysis of Soviet technical journals shows that the Soviets use centrifugal pumps with electric motor drives. They manufacture a series of pumps with throughputs ranging from 125 m^3 per hour (the HM-125) to 10,000 m^3 per hour (the HM-10,000). The HM-10,000 is large enough to propel the maximum throughput of a 1,220-mm-diameter pipeline, 83 million tons per year. [redacted] 25X1

Attempts are being made to develop pumps with an even greater throughput capacity. In 1981 the Sumy Pump Plant manufactured, on a trial basis, four pumps with throughput capacities of 12,500 m^3 per hour. Serial production of these pumps could enable the Soviets to increase the operating capacity of their 1,220-mm pipeline. The pipeline at the discharge side of the pump, however, would require greater strength in order to cope with the greater internal pressures. [redacted] 25X1

In 1979 the Soviets purchased 40 surge-control valve systems from a US manufacturer, and in 1980 they were seeking to purchase seven more. These devices are usually located at the output side of pumping stations or at low elevations where the internal line pressures increase. [redacted] 25X1

Figure 13
Major Crude Oil Pipelines in the Soviet Union



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