USSR:
Prospects for Reduced Imports of Large-Diameter Pipe

A Research Paper

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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 [redacted] SOVA

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Key Judgments

Information available as of 1 September 1983 was used in this report.

Since the early 1960s imported large-diameter (1,020- to 1,420-mm) pipe has played a key role in Soviet construction of oil and gas pipelines. Many projects now under way, including the Siberia–to–Western Europe gas-export pipeline, rely almost exclusively on imported 1,420-mm pipe.

During 1981-85 we project that the Soviets will import about 2.2 million tons of 1,420-mm pipe annually. In addition, domestic 1,420-mm pipe production (about 400,000 tons per year) will depend on imports of high-strength, low-alloy (HSLA) steel plate. Thus, at least through 1985, the USSR will be almost totally dependent on the West for an annual average of 2.6 million tons of 1,420-mm pipe and steel plate suitable for use in 1,420-mm gas pipelines.

Some time after 1985, however, and probably no later than 1990, the USSR will be able to cut back on its imports of 1,420-mm pipe. It will need less foreign pipe because of a likely slowdown in the pace of construction of domestic oil and gas pipelines during 1986-90 and an increase in domestic capacity for manufacturing 1,420-mm pipe using a process that does not require high-quality steel plate.

Our analysis indicates that, barring unexpected additions to the gas pipeline construction program, annual Soviet requirements for 1,420-mm pipe for gas pipeline construction will drop from 2.6 million tons during 1981-85 to about 1.8 million tons during 1986-90. At the same time, we believe that Soviet production of 1,420-mm pipe suitable for use in gas pipelines may rise by roughly 900,000 tons to 1.3 million tons annually during 1986-90. The startup and expansion of output at a new pipe mill at Vyksa (near Moscow) should add some 500,000 tons to Soviet capacity for production of 1,420-mm pipe. In addition, capacity available for 1,420-mm pipe production at Khartsyzsk (in the Ukraine) will increase from 400,000 tons in 1982 to as much as 800,000 tons by the end of the decade.

At Vyksa the Soviets already have started production of 1,420-mm multilayered pipe. This pipe does not require HSLA steel plate and is capable of operating at 75 atmospheres (about 1,102 pounds per square inch) of pressure. Soviet production technology is far behind state-of-the-art single-walled pipe—the technique used exclusively in the West. The increased metal, energy, and welding requirements of Soviet technology would make the process prohibitively expensive in the West. Nevertheless,

US metallurgical experts are convinced that the Soviet pipe will work as planned. We believe that the Soviet commitment to manufacture 1,420-mm pipe despite the high costs involved reflects Moscow's ongoing concern about possible vulnerability to Western sanctions and a desire to conserve hard currency.

Pipe production at the Khartsyzsk mill, however, will require HSLA plate. Although the Soviets are currently building a rolling mill—which may be operational in 1985 or 1986—to provide HSLA steel plate for the pipe plant, the Soviet track record indicates that the Soviets will, at best, slowly develop a capability to produce HSLA steel plate for civilian consumers during 1986-90.

Thus, with Moscow's requirements for 1,420-mm pipe projected at 1.8 million tons annually during 1986-90 and domestic production increasing to as much as 1.3 million tons during this period, imports of 1,420-mm pipe could decline by 1.7 million tons while imports of less expensive steel plate increase by 400,000 tons. We estimate that annual Soviet expenditures for 1,420-mm pipe and HSLA plate for manufacture of pipe could fall during 1986-90 to as little as $500 million compared with $1.3 billion during 1981-85. In a best-case scenario from the Soviet viewpoint, if development of HSLA steel plate proceeds smoothly to support 1,420-mm pipe production at the Khartsyzsk mill, imports of steel plate could decline to negligible levels.

A substantial drop in Soviet imports of 1,420-mm pipe would most affect Japan and West Germany—the USSR's largest suppliers. Increased Soviet output of 1,420-mm pipe, however, will be phased in over a period of several years, giving Western suppliers some breathing room. The Soviets also would want to avoid the political consequences that would result from any sharp, unexpected cuts in orders placed in countries with which the USSR is trying to improve political ties.

Contents

USSR: Prospects for Reduced Imports of Large-Diameter Pipe

Introduction

The bulk of the Soviet Union's petroleum resources are located in remote areas of Western Siberia. To transport oil and gas from these areas to the western industrial regions of the country, the Soviets laid more than 90,000 km of large-diameter oil and gas transmission pipelines by the end of 1982.[1] Large-diameter pipelines transport oil and gas much more efficiently than smaller diameter pipelines and have played an important role in the exploitation of West Siberian and Central Asian oil and gas fields.

This paper discusses the development of the Soviet large-diameter pipe industry since 1960 and the role of imported pipe in Soviet construction of oil and gas pipelines. It then examines Soviet plans to increase production of large-diameter pipe and estimates pipe requirements for Soviet oil and gas pipeline programs and the likely level of supply during 1986-90. The report assesses the USSR's potential to reduce large-diameter pipe imports after 1985 and the effect this reduction would have on overall Soviet hard currency balances. The paper closes with a discussion of some of the political factors that could affect the Soviet decision to reduce dependence on Western suppliers.

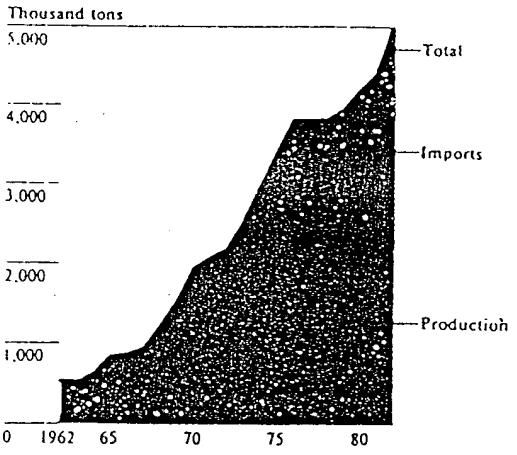
Appendix A discusses the CIA methodology for estimating Soviet large-diameter pipe requirements during 1986-90. Appendix B provides the results of a [redacted] of the major Soviet large-diameter pipe plants and a description of the processing technology at each Soviet plant.

Background

Trends in Production

In 1962 Soviet production of large-diameter pipe was about 50,000 tons—an amount sufficient to support construction of less than 200 kilometers (km) of 1,020-mm pipeline. Since then Soviet production has increased steadily to about 2.2 million tons in 1982 (see figure 1 and table 1). Although technically still behind the West, the Soviets have made steady gains both in increasing the diameter of the pipe and in raising the operating pressure these pipes can withstand (see the discussion below on the relationship between pipe diameter, operating pressures, and annual capacity).

Figure 1
Soviet Union: Large-Diameter Pipe Production and Imports, 1962-82



In 1962 NATO embargoed exports of large-diameter pipe to the USSR in an effort to delay construction of an oil pipeline to Eastern Europe on the grounds that

[1] "Large-diameter pipe" as defined in this paper has an outside diameter of 1,020 mm or more. The most common sizes are 1,020 mm, 1,220 mm, and 1,420 mm—40, 48, and 56 inches, respectively.

Table 1
Soviet Pipe Production:
Chronology of Major Events

1961	Novomoskovsk Pipe Plant began production of 1,020-mm pipe.
1962	NATO embargo imposed on large-diameter pipe; Soviet production of 1,020-mm pipe was 50,000 tons.
1963	Two shops at Khartsyzsk Pipe Plant began 1,020-mm pipe production.
	Shop at Chelyabinsk Pipe Plant began 1,020-mm pipe production.
1964	Three shops at Zhdanov Pipe Plant began 1,020-mm pipe production.
1965	Production of 1,020-mm pipe was 685,000 tons.
1968	Shops at Chelyabinsk Pipe Plant modified to produce 1,220-mm pipe.
	Shops at Zhdanov Pipe Plant reconstructed to produce 1,220-mm pipe.
1970	USSR production of 1,020- and 1,220-mm pipe was about 1 million tons.
1971	Volzhskiy Pipe Plant began production. Technology and equipment provided by Czechoslovakia.
1972	Chelyabinsk Pipe Plant reconstructed to produce pipes with thicker walls.
1974	Soviets complete construction of a 1,020- to 1,420-mm pipe mill at Khartsyzsk.
1979	Shop at Khartsyzsk Pipe Plant began limited production of 1,420-mm pipe.
1982	First production of multilayer pipe at Vyksa Pipe Plant.
	Experimental two-layer 1,420-mm spiral seam successfully produced at Novomoskovsk Pipe Plant.
1983	Soviets announce that production of 1,420-mm pipe will reach 250,000 tons at Vyksa in 1983.

it enhanced Soviet military capabilities. The embargo probably delayed completion of the "Friendship" oil pipeline by about one year.[1] More importantly, the embargo also accelerated the modification of existing pipe mills and provided impetus to the construction of new, large-diameter pipe mills. By 1965 the USSR was producing about three times as much 1,020-mm pipe as the amount that would have been supplied under the Western contracts canceled by the embargo. By 1966 the Novomoskovsk, Zhdanov, Chelyabinsk, and Khartsyzsk mills were producing 1,020-mm pipe. Combined output of these plants amounted to about 735,000 tons annually, almost 15 times as large as output in 1962.

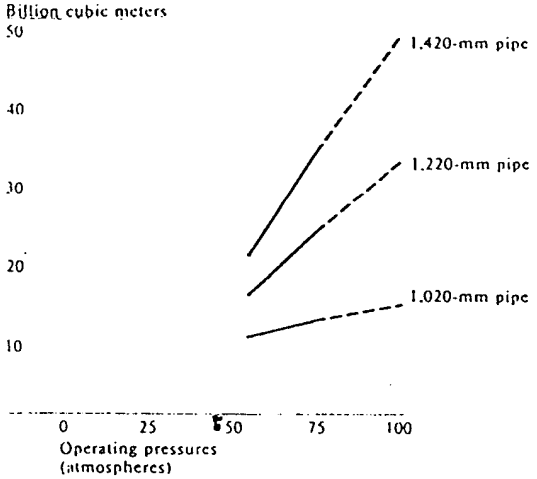
With memories of the NATO embargo still fresh, Soviet leaders continued their efforts to create domestic capacity for the production of 1,220-mm pipe. During 1966-70 the Soviets started to produce 1,220-mm pipe at a new mill at Chelyabinsk. In 1970 Soviet output of 1,020- and 1,220-mm pipe reached about 1 million tons.

The Soviets completed mills capable of producing 1,020- to 1,420-mm pipe at Volzhskiy in 1971 and Khartsyzsk in 1974. They could not, however, produce sufficient amounts of steel plate strong enough to operate at 75 atmospheres (atm) of pressure. By increasing the diameter and operating pressures of the pipe, the Soviets can greatly increase the amount of gas flowing through each pipeline and thereby reduce the number of pipelines needed to deliver a given amount of gas. The improvement in pipeline efficiency is also mirrored in reduced investment and operating costs (see figure 2 and table 2). For example, a 1,020-mm line operating at 75 atm can handle about 12 billion cubic meters of gas per year, whereas a 1,420-mm line operating at the same pressure can handle 33 billion cubic meters per year. In other words the Soviets would have to build about three 1,020-mm lines running at 75 atm to match the capacity of one 1,420-mm line. In terms of steel requirements, one 1,420-mm line (4,000 km in length) would require about 2.6 million tons of steel pipe. Three 1,020-mm lines of the same length would require about 3.6 million tons of steel pipe. The strength and quality of the pipe also play an important role. For example, a 1,420-mm line at 75 atm can handle about 60 percent more gas than a 1,420-mm line at 55 atm, but it requires stronger, higher quality steel.

Soviet production of large-diameter pipe increased steadily during the 1970s, reaching about 2 million tons per annum by the end of the decade. Most of the

[1] See

Figure 2
Large-Diameter Gas Pipeline: Relationship Between Pipe Diameter, Operating Pressures, and Annual Capacity



Note: The dashed line represents theoretical values. Currently 75 atmospheres is the highest operating pressure of LD gas pipelines.

Table 2
USSR: Investment and Operating Costs for Large-Diameter Gas Pipelines, in the Central Regions [a]

	Capital Investment [b] (*rubles/m³/km*)	Operating Expense [c] (*rubles*)	Throughput [d] (*billion m³/year*)
1,020 mm	17.5	2.46	12
1,220 mm	16.8	2.29	23
1,420 mm	12.4	2.25	33

[a] Information is extracted from Soviet energy transport monograph, *Ekonomika transporta topliva i energii*, Moscow, 1980.
[b] Capital investment for 1 kilometer of pipeline in thousand rubles divided by the expected annual gas throughput (in billion cubic meters). For pipeline construction in the northern regions, capital investment nearly doubles.
[c] Cost in rubles to transport 1 billion cubic meters of gas 1 kilometer.
[d] At 75 atm.

output consisted of 1,020- and 1,220-mm pipe. The information that is available suggests that nearly all of the pipe currently produced in the Soviet Union for high-pressure 1,420-mm gaslines uses steel plate imported from the West

The Role of Imports

Despite impressive gains in the quantity and quality of their pipe, the Soviets have been highly dependent on the West for large-diameter pipe for the last 25 years. During the 1960s the Soviets imported about 2.8 million tons of pipe, almost all 1,020 to 1,220 mm in diameter. Imports accounted for about 40 percent of total Soviet pipe supply during this period

During the 1970s the Soviets began to lay transcontinental 1,420-mm gaslines. As noted, the Soviets were unable to produce high-quality plate for high-pressure gaslines and were totally dependent on the West, primarily Japan and West Germany, for 1,420-mm pipe as well as steel plate for domestic 1,420-mm pipe production (see figure 3). During 1971-80, total Soviet pipe imports amounted to an estimated 15 million tons, of which about 10 million tons were 1,420 mm. According to [redacted] the Western pipe and steel plate enabled the USSR to build an integrated pipeline network connecting all major gasfields with important centers of industry and population.

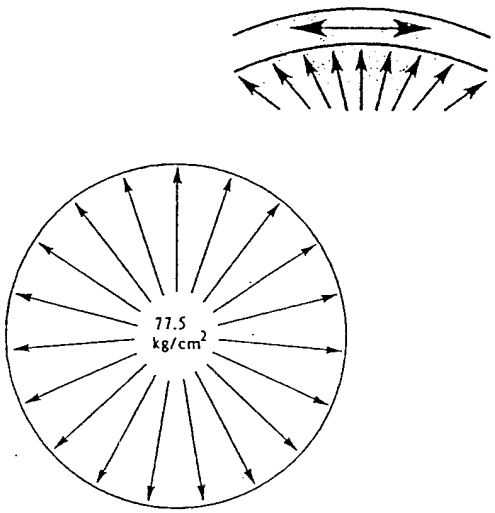
Requirements Versus Production Capacity

Pipe Requirements During 1981-85

On the basis of Soviet media reports, we estimate that the Soviets will lay about 36,000 km of large-diameter oil and gas pipelines during 1981-85. Of this total, 20,000 km will be 1,420 mm in diameter and about 16,000 km will be 1,020 and 1,220 mm. To meet these goals the USSR will need about 13 million tons of 1,420-mm pipe and about 6-7 million tons of 1,020- and 1,220-mm pipe.[1]

[1] Calculated on the basis that 1 km of 1,420-mm pipe weighs 650 tons, and 1 km of 1,020- and 1,220-mm pipe weighs 300 and 450 tons, respectively

Figure 3
Stresses Created by 75-Atmosphere Line Pressure



Although an internal line pressure of 75 atmospheres exerts a stress of 77.5 kg per cm^2 (1,140 psi) perpendicular to the pipe wall, much larger stresses are created in the tangential direction. This may be visualized by focusing on the area of the pipe enclosed by the blue box. As illustrated in the inset, the internal forces perpendicular to the pipe wall are cumulatively trying to pull apart or "open" the pipe as indicated by the arrows.

As the pipe's diameter is increased, maintaining the same operating pressure creates additional stress, and the strength of the steel must be increased. In other words, higher grade steel is required to sustain 75 atmospheres in 1,420-mm pipe than in 1,220-mm pipe.

For this reason, linepipe designed for operating at 77.5 kg per cm^2 (1,140 psi) is required to have a minimum yield strength of nearly 5,000 kg per cm^2. (Yield strength is defined as that maximum force per unit area at which the material returns to its original physical dimensions after the load is removed.)

In addition to being unable to make 1,420-mm linepipe for high-pressure operation, the Soviets, until recently, were unable to produce pipe that could be used in arctic conditions. Arctic-grade steels must be resistant to embrittlement caused by the extremely low temperatures, and to fracture propagation, which is enhanced by low temperature.

We anticipate that, to support their 1,420-mm pipeline program, the Soviets will import about 11 million tons of 1,420-mm pipe and about 2 million tons of steel plate during 1981-85. The import bill for 1,420-mm pipe and steel plate probably will amount to roughly $7 billion (1982 prices) during the current five-year plan. Preliminary information suggests that Soviet imports of 1,420-mm pipe could reach 2.6 million tons in 1983, compared with average annual purchases of 2.2 million tons in 1981-82.

Imports of 1,020- and 1,220-mm pipe probably will remain at about 200,000 to 400,000 tons per annum. The combination of imports and domestic production should be more than adequate to cover Soviet requirements for pipe of these sizes. The associated hard currency outlays will be comparatively minor, about $60-75 million per year at 1982 prices.

Pipe Requirements During 1986-90

We estimate that annual Soviet requirements for large-diameter pipe will fall during 1986-90, the result of a slowdown in the construction of gas pipelines and a halt in construction of new oil pipelines (see table 3). We believe that annual Soviet requirements for 1,420-mm pipe will drop to about 1.8 million tons per annum during 1986-90, compared with about 2.6 million tons per annum during 1981-85. Similarly, annual requirements for 1,020- and 1,220-mm pipe probably will fall to about 1 million tons per year during 1986-90, compared with about 1.3 million tons per annum during the current five-year plan. (Appendix A discusses the basis for the estimates of requirements for pipe for new lines and for replacing pipe in old lines.)

Our estimate for annual Soviet requirements of 1,420-mm pipe during 1986-90 assumes no additional gas-export pipeline construction during this period. If the Soviets were to build a second gas-export pipeline in the late 1980s, similar to the Siberia-to-Europe line now nearing completion, an additional 3 million tons of pipe would be required—most of which probably would be imported.

Table 3
USSR: Installation of Large-Diameter Pipeline

Kilometers

	1961-65	1966-70	1971-75	1976-80	Plan 1981-85	Estimate 1986-90
Oil (1,020-1,220 mm)	1,300	3,400	8,000	6,900	3,200	NEGL
Gas (1,020-1,220 mm)	6,635	14,082	16,103	12,474	13,200	14,000 •
Gas (1,420 mm)	0	0	3,708	11,000	20,000	14,000
Total	**7,935**	**17,482**	**27,811**	**30,374**	**36,400**	**28,000**

• Includes replacement requirement.

Oil Pipelines. On the basis of previous analysis, we believe that the USSR will construct no large-diameter oil pipelines during 1986-90.[4] Oil production is increasing at less than 1 percent per year and probably will peak and begin to fall later in the 1980s.[5] If this estimate is correct, major additions to the pipeline network will not be required. (In any event, because the pipe used for main oil pipelines weighs less than linepipe for gas transmission and the operating pressures are not as great, the Soviets can construct long-distance, main transmission oil pipelines entirely with domestic technology.)

The pace of construction of large-diameter crude oil pipelines has already slowed from a high of 8,000 km during 1971-75 and 6,900 km during 1976-80 to an estimated 3,200 km during 1981-85; in large part this reflects the slowdown in the growth of oil production. West Siberia currently accounts for more than 50 percent of Soviet crude oil production. Five large-diameter lines currently transport crude oil out of this region, and construction of a sixth line is under way. If this pipeline is placed in service during 1986-90, we estimate that the usable throughput of the West Siberian oil pipeline network will be 8.2 to 8.9 million barrels per day (b/d). This capacity should be more than enough to transport the 7 to 8 million b/d that CIA estimates will be produced in this region in 1990.

Although East Siberia and offshore basins in the Kara Sea and Barents Sea may contain abundant oil resources, we believe that technological constraints, the absence of economic infrastructure, and the remoteness of these areas will prevent significant oilfield development until at least 1990 and probably later. Thus, we believe that no oil transmission pipelines will be required from these areas during 1986-90.

About 75 percent of the existing large-diameter oil pipelines were built during 1970-80 and probably will remain fundamentally sound until at least 1990. Thus, we believe that the amount of large-diameter pipe needed for replacement of oil pipelines in 1986-90 will be very small, mainly limited to the replacement of short segments

Gas Pipelines. In contrast to oil pipeline construction, Soviet gas pipeline construction has averaged about 30,000 km per five-year period since 1965. The plan for 1981-85 is 48,000 km, including 20,000 km of 1,420-mm pipeline. (We estimate, on the basis of actual construction in 1981 and 1982, that the Soviets will lay about 42,000 km of gaslines during 1981-85.) The growth in the total length of the gas pipeline network was needed to support the steep rise in gas production—from 128 billion cubic meters in 1965 to 501 billion cubic meters in 1982. We estimate that gas production will continue to increase, to about

595 billion cubic meters in 1985 and to roughly 710 billion cubic meters in 1990. Thus, the need for new gas pipelines will remain great through 1990.

The level of gas production in the late 1980s will depend heavily on Soviet success in substituting gas for other fuels in industrial processes, electric power generation, and space heating. How far substitution proceeds will in turn depend on the rate of expansion of the distribution grid carrying gas from the main pipelines to industrial enterprises and to power and heating plants. Underlying this estimate are assumptions about the absorptive capacity of the market. We think that the ability to market the gas rather than the availability of gas reserves will govern the rate of increase in gas output.

The share of large-diameter pipelines in total Soviet gas pipeline construction climbed sharply in the past two decades—from about 30 percent during 1961-65 to 75 percent during 1976-80. For 1,420-mm gas pipelines, the share has increased from nearly 12 percent during 1971-75 to a planned 40 percent in the 1981-85 period. We believe that the trend toward the use of 1,420-mm pipe will continue.

We estimate that the Soviets will need to lay roughly 25,000 km of new, large-diameter gas pipelines during 1986-90, of which 14,000 km will be 1,420 mm in diameter. We also estimate that the Soviets will lay about 3,000 km of replacement gaslines.

Our estimate of planned 1,420-mm gas pipeline construction during 1986-90, some 14,000 km, is about 30 percent less than planned construction for the first half of the decade. Some Soviet economists have already commented that the growth of gas production in West Siberia may slow because:

- The cost of pipeline construction in Western Siberia is so great. According to the Soviet pipeline construction minister, the total cost of the gas-export pipeline will amount to about 15 billion rubles (about $20 billion).
- The Soviets face limits on the amount of gas that can be absorbed in the domestic economy. Construction of storage and distribution systems is lagging, slowing the substitution of gas for other energy sources

Moreover, the Soviets cannot step up sales of gas to other Communist countries and Western Europe at will. In Eastern Europe, the high proportion of oil used in agriculture and transportation limits possibilities for substitution of gas for oil.* According to [redacted] Soviet gas imports may increase from 32 billion cubic meters in 1983 to 41-45 billion cubic meters in 1990. Future West European energy import demands may be affected increasingly by energy security considerations

Nonetheless, even if Soviet construction of 1,420-mm pipelines slows as we expect, the pace of construction will still be rapid. During 1986-90 the Soviets may build four or five pipelines, each about 3,000 km in length, compared with six such lines during 1981-85—a pace of pipeline construction unmatched elsewhere in the world.

Soviet Production Capacity During 1986-90

At the same time that Soviet requirements for large-diameter pipe will be falling, domestic production capacity will be increasing. We believe that Soviet production of 1,420-mm pipe suitable for use in gas pipelines may rise by as much as 900,000 tons, to 1.3 million tons per annum some time during 1986-90. The startup and expansion of output at a new pipe mill at Vyksa should add some 500,000 tons to Soviet capacity for production of 1,420-mm pipe. In addition, the capacity available for 1,420-mm pipe production at Khartsyzsk will increase from 400,000 tons to as much as 800,000 tons. Production at Khartsyzsk, however, may continue to depend on imports of steel plate from the West.

Multilayered Pipe at Vyksa. The new mill being built at Vyksa (near Moscow) to produce 1,420-mm pipe will produce a multilayered 1,420-mm pipe, in contrast to the single-walled pipe imported from the West. The multilayered pipe will be produced from ordinary low-carbon steel sheet—which the Soviets can manufacture—in contrast to the high-strength, low-alloy (HSLA) steel plate used in single-walled

* Fo

pipe for high-pressure gasline service. The multilayer technology is far behind the Western state of the art. Because of increased metal, energy, and welding requirements (the pipe is about 50 percent heavier than Western pipe), this kind of pipe would be prohibitively expensive to manufacture in the West.[1] Nevertheless, US metallurgical experts are certain that the Soviet pipe will work as planned.[2] (See appendix B for details.) Moreover, it has the important advantage of not requiring high-quality HSLA steel plate.

Construction at Vyksa has proceeded rapidly and should be completed by 1985. The Soviets have announced that the plant will produce 250,000 tons of pipe in 1983 and 500,000 tons in 1985. We estimate that the plant could be operating at full capacity as early as 1986

Production of 1,420-mm Pipe at Khartsyzsk. We estimate that the Soviets will have a requirement for 1.4 million tons per year of 1,020- and 1,220-mm pipe during 1986-90, 1 million tons for 1,020- and 1,220-mm gas pipeline construction, and a residual requirement of 400,000 tons for irrigation systems and water mains. Combined output of this pipe in the Chelyabinsk, Zhdanov, Novomoskovsk, and Volzhskiy pipe plants is projected at 1.45 million tons per year (see figure 4)

Until recently, the Khartsyzsk plant produced mostly 1,020- and 1,220-mm pipe because the demand for pipe of this size was so great. The Soviets laid about 24,000 km of 1,020- and 1,220-mm oil and gas lines during 1971-75 and 19,500 km during 1976-80. (See appendix A for more details.) We foresee that, with a decline in demand for 1,020- and 1,220-mm pipe, Khartsyzsk may be able to devote some, if not most, of its capacity (about 800,000 tons) to production of 1,420-mm pipe. The Khartsyzsk plant has the fabrication equipment to produce 1,420-mm pipe. It only needs the steel plate with the requisite strength and ductility

[1] Because multilayered pipe is heavier than conventional pipe, we have expressed annual production at Vyksa in terms of an equivalent weight corresponding to the amount of pipeline that could be laid if conventional, single-layered Western pipe were used. (U)
[2] The Soviets claim that the pipe produced at Vyksa will be capable of operating at 120 atm of pressure. Although we cannot rule out this claim entirely, most of the evidence suggests that this pipe will operate at 75 atm.

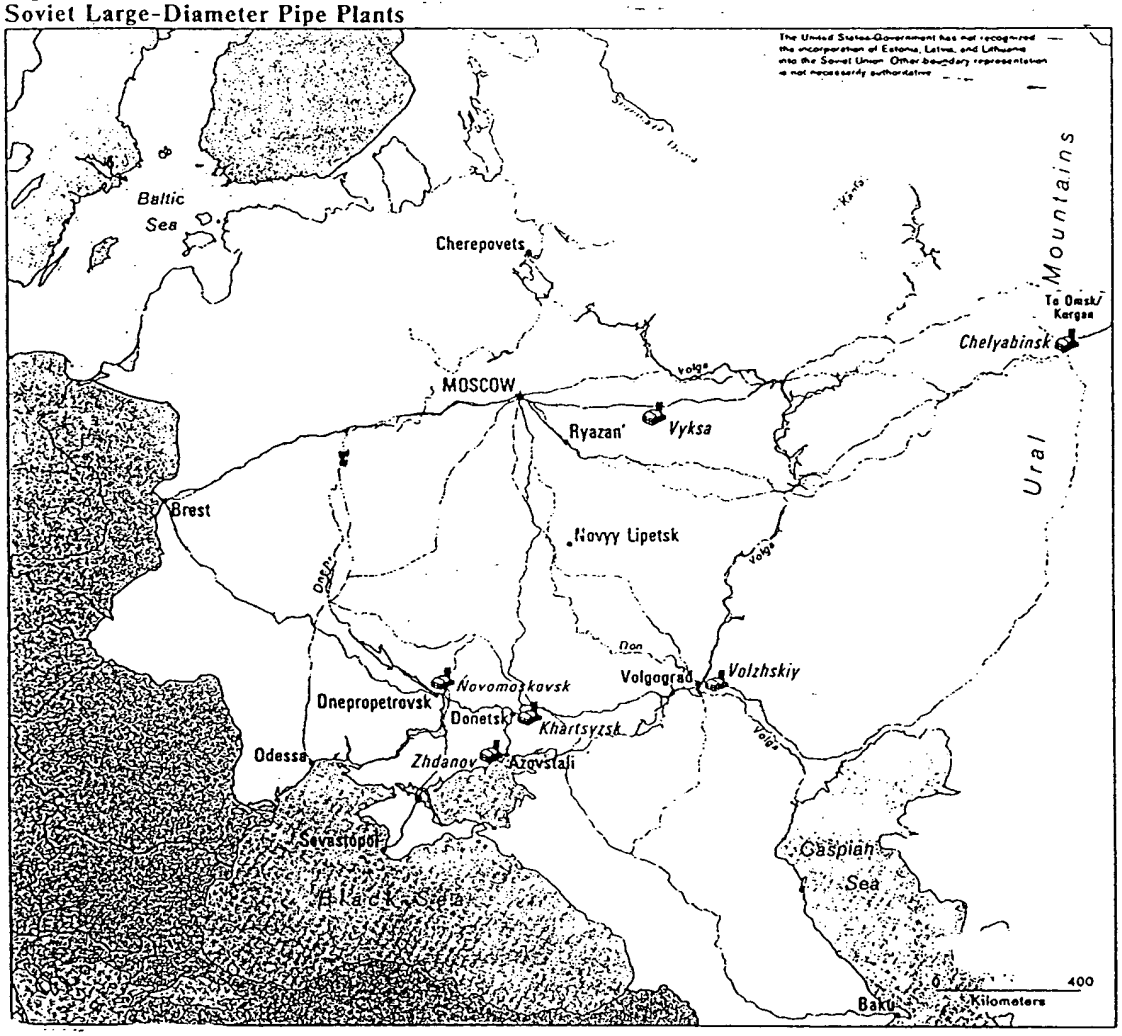
According to media reports, the Soviets intend to expand production of 1,420-mm pipe at Khartsyzsk using domestically produced steel plate and strip during 1986-90. The Soviets are adding new steelmaking capacity to supply the large amounts of steel sheet and plate the pipe mills will require. According to [redacted] most of the sheet and plate will be supplied by new facilities at Novyy Lipetsk, Cherepovets, Zhdanov, and by existing facilities at Azovstali. The pace of construction observed in [redacted] suggests that the rolling mill at Zhdanov should be operational in 1985 or 1986. These plants are also equipped with continuous casting equipment which, according to our earlier analysis, is another indication of the Soviet Union's potential to produce steel plate of uniformly high quality.

Nonetheless, the Soviet track record indicates that the Soviets will, at best, develop the capability to produce HSLA plate for civilian consumers slowly over the 1986-90 period (see inset). Analysis of open-source Soviet technical journals indicates that limited production of high-strength, low-alloy plate for use in pipelines began in 1978 at the Azovstal' Steel Works. The Soviets, however, are still importing steel plate for pipe production, suggesting that they have not worked out all the problems in large-scale production of HSLA steel plate

According to a Soviet pipeline construction journal, the Khartsyzsk plant is currently producing about 400,000 tons per year of 1,420-mm pipe. We believe that most of the pipe is produced using plate imported from the West. During 1986-90 about 800,000 tons of capacity will be available at Khartsyzsk for 1,420-mm pipe production. If unable to produce adequate amounts of high-quality HSLA steel plate during 1986-90, the Soviets will have to increase steel plate imports substantially from the current level of 400,000 tons per year to meet the requirements for 1,420-mm pipe production at Khartsyzsk

[1] For

Figure 4
Soviet Large-Diameter Pipe Plants



To summarize, we estimate annual Soviet production of 1,420-mm pipe during 1986-90 at 1.3 million tons (500,000 from Vyksa and 800,000 at Khartsyzsk). The steel requirement for manufacture of multilayer pipe at Vyksa can be met readily from Soviet-produced steel sheet. The pipe production at Khartsyzsk, however, may depend to a substantial degree on imported Western plate if the Soviets are unable to produce adequate amounts of HSLA steel plate themselves (see figure 5).

Implications

As noted above, Moscow's requirements for 1,420-mm pipe are likely to amount to about 1.8 million tons annually during 1986-90. Soviet production will probably increase from 400,000 tons to about 1.3 million tons per annum during this period, suggesting an import requirement of 500,000 tons of pipe and up to

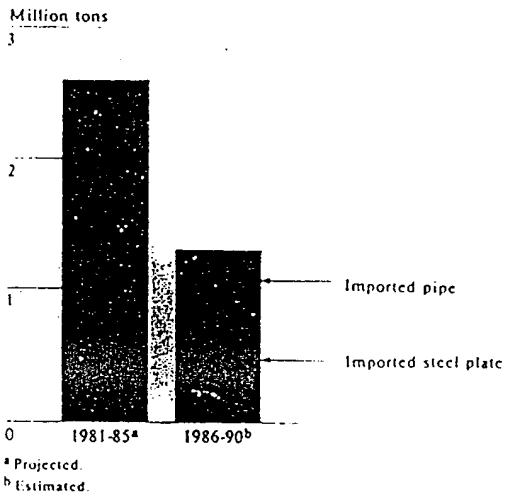
Steel Plate for Large-Diameter High-Pressure Pipe

According to analysis of Soviet technical journals

the Soviet Union was not producing high-strength, low-alloy (HSLA) steel plate strong enough to be used for pipe in gasline service at an operating pressure of 75 atm until the late 1970s (for pipe production). The Soviet military probably preempted the vast majority of the HSLA steel plate that was produced

During the late 1970s, the Soviets developed a limited capability for the Khartsyzsk plant. The Soviets had to develop a steel with a composition that was strong enough to permit operation at 75 atm and ductile enough to be used in Arctic conditions without additions of molybdenum. (Molybdenum, the primary additive used by Western pipe manufacturers to limit brittleness, is in short supply in the Soviet Union.) We believe that West German involvement in construction of the new pipe-coating mill at Khartsyzsk indicates the increased importance of this plant

Figure 5
Soviet Union: Projected Annual Imports of Steel Plate and 1,420-mm Pipe



800,000 tons of steel plate. This estimated requirement for steel plate imports is based on our assessment that the Soviet steel industry still faces many hurdles before it can achieve large-scale production of HSLA steel plate of consistently high quality. In a best case scenario from the Soviet viewpoint, if development of HSLA steel plate proceeds smoothly to support 1,420-mm pipe production at the Khartsyzsk mill, imports of steel plate could decline to negligible levels. This could reduce the annual import requirement to as little as 500,000 tons of 1,420-mm pipe and little if any plate by 1990, compared with 2.2 million tons of pipe and 400,000 tons of plate per annum during 1981-85

Hard Currency Impact

A cutback in imports of large-diameter pipe and steel plate would clearly help Moscow meet other priority import requirements.[10] We estimate that annual Soviet expenditures for 500,000 tons of 1,420-mm pipe and 800,000 tons of steel plate for manufacture of 1,420-mm pipe during 1986-90 could drop to as little as $500 million compared with $1.3 billion during 1981-85. The substitution of purchases of steel plate for imports of pipe is attractive because the price of steel plate per ton is only about half the price per ton of 1,420-mm pipe. Since our estimates indicate that the USSR will be able to increase hard currency imports little, if at all, in the second half of the decade without a sizable increase in its debt service ratio, a cut in its steel imports would help Moscow significantly

Impact on Western Suppliers

A substantial drop in Soviet imports of 1,420-mm pipe would most affect Japan and West Germany—the USSR's largest suppliers. Presently, about half of Japanese and virtually all of West German production

[10] For

of 1,420-mm pipe is earmarked for the Soviet market.

The Soviets are unlikely to make sudden and sharp cuts in pipe purchases. We expect that increased Soviet output of 1,420-mm pipe will be phased in over a period of several years, giving Western suppliers some breathing room. Moreover, Western companies are aware of Soviet efforts to produce 1,420-mm pipe and thus are unlikely to be caught by surprise when the Soviets begin to reduce pipe purchases. The Soviets also would want to avoid political consequences resulting from any sharp unexpected cuts in orders placed in countries with which the USSR is trying to improve political ties.

Political Versus Economic Trade-Offs

US experts who have studied the multilayer technology employed at Vyksa have commented that, if this process were used in a Western plant, costs might be at least double current Western levels because of increased metal and energy requirements. Moreover, each weld in the field will take longer to perform and more pipelayers will be required to handle the heavier pipe sections.

We believe that the Soviet commitment to manufacture 1,420-mm pipe on a large scale, even at substantial economic costs, reflects Moscow's ongoing concern about possible vulnerability of its energy program to Western economic sanctions. Analysis of public statements reveals mounting Soviet skepticism over the benefits of expanded East-West trade and technology transfer from 1977 onward. The recent embargoes probably rekindled earlier Soviet concerns of the vulnerability of Moscow's energy program to Western pressure. Such factors probably reinforced the decision to develop 1,420-mm pipe production capacity despite the high economic costs involved.

Appendix A

Methodology for Estimating Requirements for Soviet Gas Pipeline Construction, 1986-90

The Soviets have not yet published the target for gas pipeline construction during 1986-90. We have estimated the requirement by using the past relationship between gas production and the length of the large-diameter gas pipeline network and our estimate of future gas production.

The almost complete integration of the gas pipeline network through pipeline interconnections between the gas-producing fields and industrial areas in the Soviet Union tends to minimize the need for new transmission pipelines. Additional capacity in the trunkline system will be concentrated along the corridors from West Siberia to regional distribution centers where the new transmission pipelines will tie into the existing network. By 1985 most industrial areas will have access to West Siberian gas via the new transmission pipelines presently operational or under construction and the existing regional pipeline network.

Table 4
USSR: Relationship Between Gas Production and Length of Gas Pipeline Network

Year	Gas Production (*billion m*) (a)	Length of Network (*1,000 km*) (b)	Ratio (a)÷(b)
1965	127.7	41.8	3.05
1970	197.9	67.5	2.93
1975	289.3	99.2	2.90
1980	435	129.7	3.35
1985	595 [a]	172.2 [b]	3.45

[a] CIA estimate.
[b] On the basis of the amount of gas pipeline laid during 1981 and 1982, 17,000 km, we estimate that pipeline construction during 1981-85 will be 42,500 km. This would bring the total length of the gas pipeline network to 172,200 km in 1985.

If, for example, Central Asia should become a net importer of gas from other regions in the USSR, a new transmission pipeline probably would not have to be built into Central Asia. The reversal of flow in the Central Asia–Urals gas pipeline system would allow Urengoy gas to reach Central Asia (see figure 6). If production from the Orenburg gasfields decreases and is no longer adequate to supply the needed volume of gas to the "Soyuz" gas pipeline (the major pipeline for supply of gas to Eastern Europe), then the recently completed Urengoy-to-Novopskov pipeline could provide gas to the "Soyuz" system, which passes through Novopskov. Alternatively, Urengoy or Central Asian gas could feed the Soyuz gasline via a 1,220-mm gasline, which connects Dombarovskiy on the Central Asian–Urals system with the Orenburg gasfields. According to Soviet media reports, this gasline was built explicitly to link the Orenburg and Central Asian gasfields.

The implementation of large programs to substitute gas for other forms of energy will require additional construction of lateral pipelines for intraregional distribution. For this reason, we believe that the Soviet large-diameter pipe requirements will not involve exclusively 1,420-mm pipe and that a substantial requirement for 1,020- and 1,220-mm pipe will exist during 1986-90. During 1971-75 and 1976-80, about 16,000 and 12,500 km of pipeline 1,020 and 1,220 mm in diameter, respectively, were laid

The ratio between annual gas production and the cumulative length of the gas pipeline network in 1980 is now somewhat higher than during 1965-75, and in 1985 it will probably be about 3.45 (see table 4). Using an estimate of 710 billion cubic meters for gas production in 1990, combined with the 1985 ratio of 3.45 billion cubic meters for each 1,000 km of gas pipeline, we estimate that 33,600 km of new gas pipeline may be needed during 1986-90.

Figure 6
Major Gas Pipeline Corridors in the Soviet Union

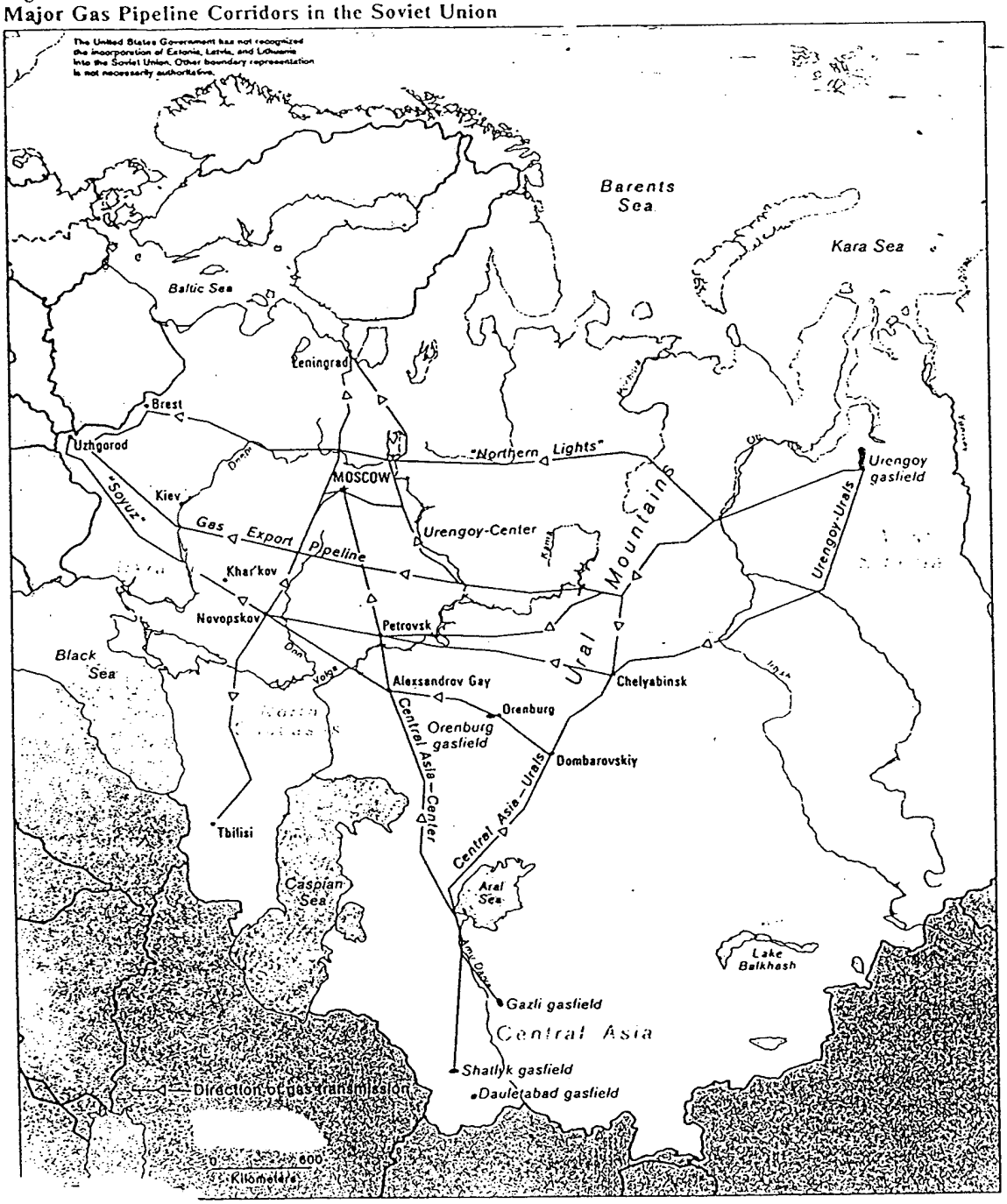


Table 5
USSR: Share of Large-Diameter Gas Pipelines in New Gas Pipeline Construction

Percent

	1961-65	1966-70	1971-75	1976-80	1981-85
1,020-1,220 mm	31.9	54.9	50.8	40.9	NA
1,420 mm	0	0	11.7	35.0	42 •
Total	**31.9**	**54.9**	**62.5**	**75.9**	NA

• Based on plan data.

Large-Diameter Gas Pipelines

Since 1961-65 the proportion of large-diameter pipelines added to the network has more than doubled (see table 5). We believe that the percentage attained during 1976-80, about 75 percent, will probably be maintained throughout the 1980s. Further, during 1981-85 about 40 percent, or 20,000 km, of the planned new pipelines are to be 1,420 mm in diameter, and we believe that this percentage will remain as high during 1986-90.

In estimating the 1986-90 gas pipeline requirements, we have used the 1981-85 ratio because we believe that the regional patterns of gas production and pipeline construction will be similar during the two periods:

- West Siberia will provide nearly all of the increase in Soviet gas production. New transmission pipelines will have to be built from the developing Urengoy gasfield. The Soviet media already have reported that at least three new pipelines will be needed to transport increases in West Siberian gas production during 1986-90 and that another gas-export pipeline may be laid.

- Central Asian gas production as a whole will remain relatively constant. New production from the Dauletabad fields will supplement declining production from the Gazli and Shatlyk fields. However, the construction of another major transmission pipeline from this area probably will not be required. The Central Asian system includes six transmission pipelines (two to the Urals region and four to the European USSR).

- Although gas production in the older gasfields of the Ukraine and the Caucasus will continue to decline, new transmission pipelines from Urengoy will offset the effects of those regional production decreases. During 1981-85, according to Soviet media, two gaslines will be built to the Ukraine, one to Kharkov and the other to Kiev. These reports also indicate that one of the lines is already under construction. Because of the large industrial base in the Ukraine, some large-diameter lateral transmission gaslines (1,020 and 1,220 mm) probably will be required for this area.

Therefore, 75 percent of the estimated 1986-90 requirement of 33,600 km yields some 25,000 km of new large-diameter gas pipeline of which 14,000 km (40 percent of 33,600 km) will be 1,420 mm in diameter. The estimated 14,000 km of 1,420-mm gasline would enable the Soviets to build four or five gaslines from the Urengoy gasfields to the European USSR with an average length of about 3,000 km. This estimate is generally consistent with the fragmentary Soviet media reports on gasline construction planned for 1986-90.

Replacement Requirements.

Most pipelines built in the United States have a planned life expectancy of 20 years, although they usually last longer than this. In contrast, the replacement-free life for steel pipe in temperate areas of the USSR is 11 years when bituminous coated and 17 years when wrapped with tape, according to a 1982 Petrostudies estimate. Some gaslines in the harsh climate of West Siberia and in the acidic soil of Central Asia have required replacement of lengthy segments after only 10 years of operation. Accordingly, we estimate that the replacement-free life for most Soviet gas pipelines is about 15 years (compared with 20 years for oil pipelines), and that subsequent replacement of pipeline segments is required at the rate of about 1 percent a year.

We believe that, at least until 1985, Soviet replacement requirements for gas pipelines will be small. About 80 percent of the Soviet Union's 1,420-mm gas pipelines were laid after 1975 and probably are, with

Table 6
Soviet Large-Diameter Pipe Production Plants

	Method	Millimeters	Production, 1985 (tons)
Chelyabinsk	Longitudinal (two seam)	1,020 1,220	700,000
Khartsyzsk	Longitudinal (two seam)	1,020 1,220 1,420	820,000
Novomoskovsk	Spiral	1,020	180,000 [a]
Volzhskiy	Longitudinal (two seam) Spiral	1,020 1,220 1,420	450,000
Vyksa	Multilayer	1,420	500,000 [b]
Zhdanov	Spiral	1,020	60,000
Total			2,710,000

[a] Large-diameter pipe production includes 30,000 tons expected to come on line by 1985.
[b] Because the multilayered pipe at Vyksa is about 50 percent heavier than conventional pipe, we have equated estimated annual production at Vyksa to an equivalent weight corresponding to the amount of pipeline that could be laid if conventional single-layer Western pipe were used.

the exception of some individual small segments, still in good order. The Soviets, however, laid some 16,000 km of 1,020- and 1,220-mm gas pipelines during 1971-75. Of these, we believe that at least 5 percent, or 800 km, will require replacement during 1986-90. We also estimate that 10 percent, or about 2,000 km, of the pipeline built during 1961-70 will also require replacement—indeed, some segments probably have already been replaced. Therefore, we estimate a total requirement of large-diameter pipe for 1986-90 of about 28,000 km, of which 25,000 km will be for new construction and some 2,800 km for replacement of older lines.

Appendix B

Soviet Pipe Plants and Production Methods

Six Soviet plants manufacture large-diameter pipe. They are the Khartsyzsk, Volzhskiy, Vyksa, Chelyabinsk, Zhdanov, and Novomoskovsk Pipe Plants. All of these plants are rail and road served and, except for Chelyabinsk, are located west of the Ural mountains. All the plants are located at or near iron and steel plants for easy access to steel plate and coil.

From 1975 to early 1983 the Soviet Union increased large-diameter pipe production [redacted] During this same period, auxiliary facilities, such as coating mills and foundries, colocated with pipe production expanded [redacted]

In 1984 and 1985 pipe fabrication [redacted] will increase [redacted] We project that expansion of facilities not directly associated with pipe production will increase [redacted] (see tables 6 and 7).

Soviet methods for producing 1,420-mm pipe are vastly different from the method normally used in the West. In the West, steel plate that is as long as the intended length of the pipe section and as wide as the intended circumference is formed across its width into a cylinder by means of "U-ing and O-ing" presses (see figure 7). A single seam, welded both internally and externally, extends the length of the pipe.

Our analysis indicates that the Soviets cannot use this method for 1,420-mm pipe because they are unable to produce HSLA steel plate that is wide enough to permit a single weld. With the single-seam, longitudinal-weld method described above, the plate must be about 4,500 mm (nearly 15 feet) wide. The maximum width for Soviet HSLA plate currently is about 3,200 mm. With plate of this width, the Soviets can produce 1,020-mm single-seam, longitudinally welded pipe but are unable to produce single-seam 1,220-mm and 1,420-mm pipe.

Table 7
USSR: Large-Diameter Pipe Production and Imports, 1962-82

Thousand tons

	Imports of Large-Diameter Pipe [a]	Estimated Production
1962	523	50 [b]
1963	263	300
1964	166	500
1965	195	685 [c]
1966	175	735
1967	205	777
1968	436	834
1969	635	938
1970	925	1,050
1971	1,032	1,070 [d]
1972	994	1,210
1973	1,275	1,280
1974	1,332	1,650
1975 [e]	1,692	1,720
1976	NA	1,885 [f]
1977	NA	1,885
1978	NA	1,885
1979	NA	2,010
1980	2,200 [g]	2,010
1981	2,400 [g]	2,010
1982	2,800 [g]	2,200

[a] Until 1975 Soviet trade journals listed the amount of imports of "welded pipe of large diameter." We believe that these imports consisted almost exclusively of pipe 1,020 mm and larger in diameter.

[b] Estimates for 1962-64 were taken from the study cited in footnote 2.

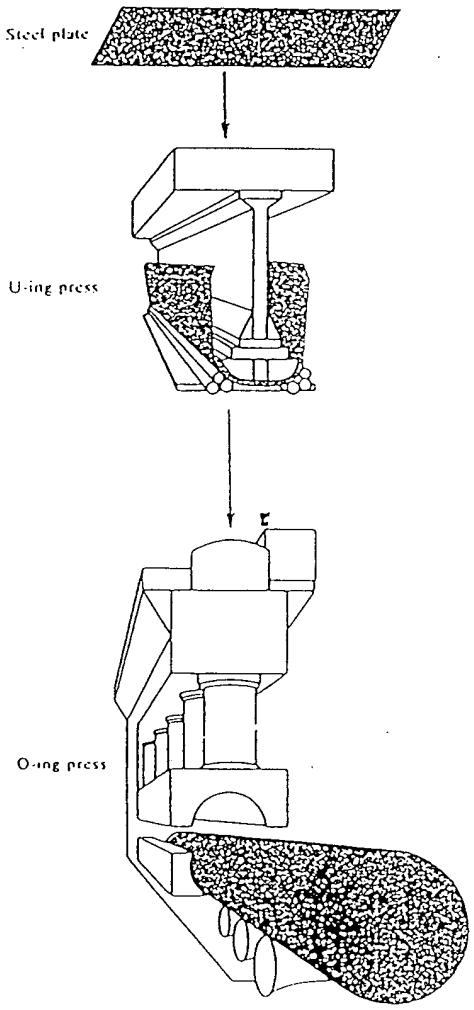
[redacted]

[e] Through 1975 the cumulative total of imports and estimated Soviet production was about 22.9 million metric tons. On the basis of Soviet media reporting of actual large-diameter pipeline construction, we estimate that 20.8 million metric tons of large-diameter pipe were needed during 1961-75.

[f] Estimates for 1976-81 are on the basis of analysis of [redacted] in conjunction with collateral reporting.

[g] Estimates are based on a variety of sources on Soviet imports of large-diameter pipe. About 90 percent of this pipe was 1,420 mm in diameter.

Figure 7
"U-ing" and "O-ing" Presses



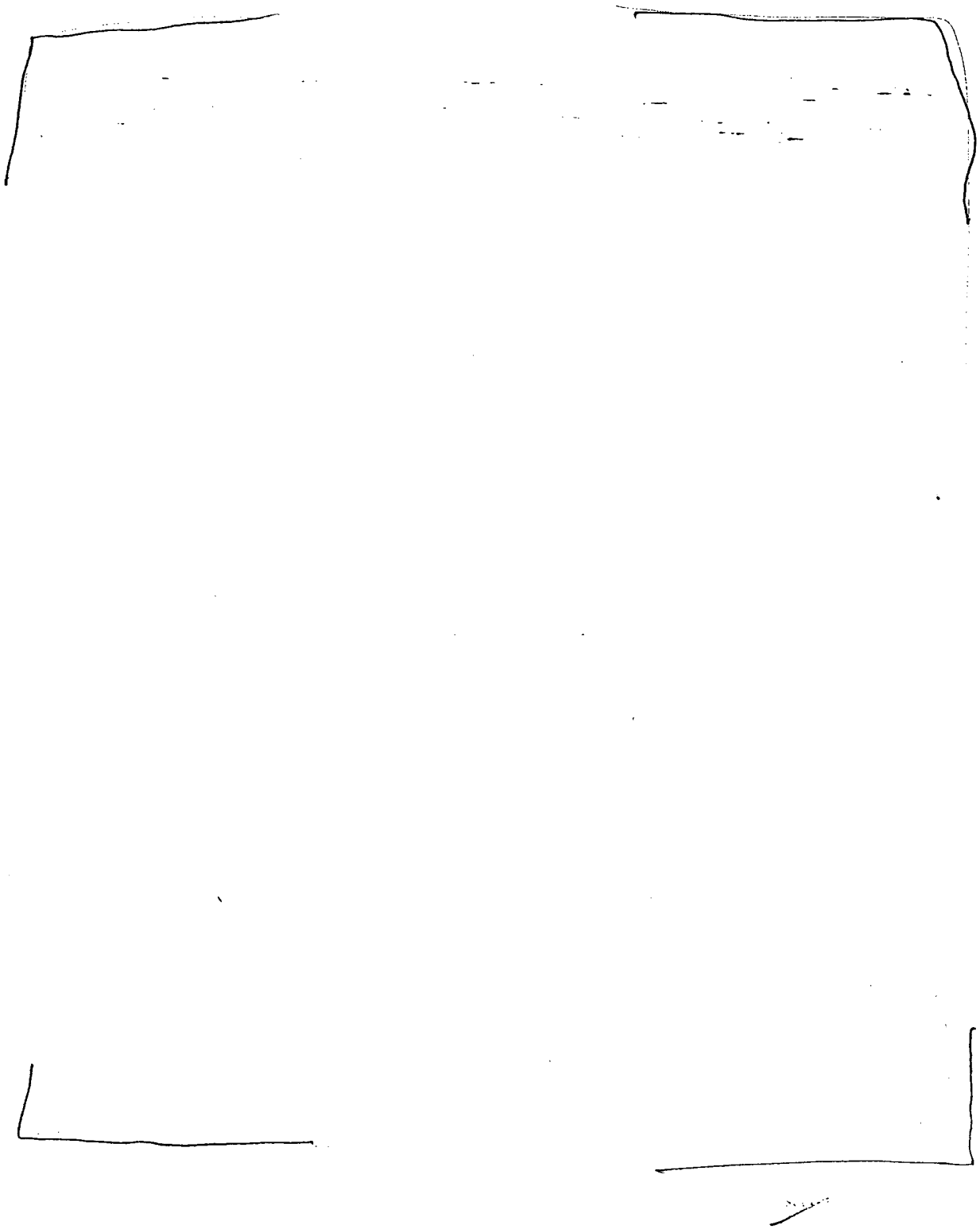
The remaining sections of this appendix will discuss in more detail each Soviet plant where large-diameter pipe is manufactured. In the case of 1,420-mm pipe production, a description of the production process is provided. The production estimates in table 7 were derived from [ ] Soviet media reporting, [ ] and reporting [ ] with knowledge of the Soviet large-diameter pipe manufacturing industry. The 1983 estimates are based on a systematic study of the large-diameter plants using [ ] from 1975 through 1983 in conjunction with collateral reporting.

Khartsyzsk Pipe Plant

The Khartsyzsk Pipe Plant is located east of the city of Donetsk, about 900 kilometers south of Moscow. A spur from the Brest to Volgograd rail line serves the plant (see figure 8)

[ ] We estimate that the Khartsyzsk Pipe Plant is capable of producing 820,000 tons of large-diameter pipe annually [ ] According to a combination of seven internal and five external welders can produce 30 large-diameter pipe sections per hour, each 11 meters in length. On the basis of the layout of welding machines given in unclassified Soviet reporting, the Khartsyzsk Pipe Plant, which contains 14 internal and 10 external welders, has a maximum production capacity of 60 pipe sections per hour. According to a Soviet technical journal, the tack welders (the first temporary weld) can weld an 11-meter pipe section in approximately one minute.

From 1975 to 1983 there was no expansion of large-diameter pipe production facilities at Khartsyzsk, although area for expansion is available south of the pipe mill. Construction on what a Soviet trade journal and press release indicate is a pipe-coating mill and



fabrication building was started in early 1975. By 1980 the fabrication building was complete, and by late 1982 the pipe-coating mill was near completion. According to the Soviet press, the pipe-coating mill will be able to coat about 760,000 tons of pipe annually.

Information from Soviet publications indicates that the 1,420-mm pipe produced at the Khartsyzsk Pipe Plant is welded longitudinally along two seams. The Soviets take two sheets of steel plate 2,350 mm in width, bend each sheet into a semicylinder, and then longitudinally weld the two semicylinders together

The Soviets have been producing 1,220-mm pipe using the semicylinder concept since 1968 at the Chelyabinsk Pipe Plant. Pressforming is used to shape the semicylinder at this plant. The pipe-forming and welding equipment at Khartsyzsk, however, was redesigned to use a continuous roll-forming process.[11] According to Soviet metallurgical journals, assembling of the fabrication equipment was completed in 1974. We believe, however, that production at Khartsyzsk of 1,420-mm pipe for high-pressure gaslines did not start until the late 1970s. Analysis of Soviet open sources indicates that the Soviets did not begin controlled rolling of the specially alloyed plate needed for 75-atm pipe at the Khartsyzsk Pipe Plant until 1978 or 1979.[12] [redacted] also reported that the Khartsyzsk Pipe Plant began limited production of 1,420-mm pipe in 1979.

Volzhskiy Pipe Plant

The Volzhskiy Pipe Plant is located near Volgograd and about 1,000 km south-southeast of Moscow (see figure 9). A spur from the Brest to Volgograd rail line serves the plant. Facilities for large-diameter pipe production increased during 1975-83[redacted] (Expansion of the existing pipe mill and construction of a second large-diameter pipe mill were completed in the late 1970s.) Expansion of other plant facilities increased [redacted] Construction included a foundry, machine shop, and a pipe-coating mill. Construction of the machine shop was completed in the late 1970s. Construction of the coating mill and foundry was begun in 1975 and was in a late stage of construction by early 1983.

According to early and mid-1970 [redacted] estimates, the Volzhskiy Pipe Plant could produce about 300,000 tons per year of large-diameter pipe in 1974 [redacted] We estimate that the Volzhskiy Pipe Plant can currently produce about 450,000 tons per year of large-diameter 1,020- and 1,420-mm pipe.

The Soviets can produce 1,020- to 1,420-mm spiral-welded pipe at the Volzhskiy Pipe Plant. In spiral welding, steel plate that has a width of 1,600 to 1,900 mm is run at an angle into a series of rollers positioned to form a circle; as the steel passes through the rollers, the edges are welded together and helically wound pipe is produced (see figure 10).[13]

In the manufacture of spiral-welded pipe, the maximum thickness of the steel plate is usually 12 to 14 mm. Steel plate thicker than 14 mm cannot be formed into a circle by the spiral roll-forming equipment.

Soviet technical journals state that the pipe is quenched and tempered to increase mechanical properties. Although this process greatly improves the strength, toughness, and weldability of the pipe [redacted] claim that it is twice as expensive as controlled rolling. Analysis of open sources indicates that production at the Volzhskiy Pipe Plant

[11] Rollforming shapes the steel plate by passing the plate through a series of rollers that have been preset to bend the metal progressively into the desired shape. Pressforming uses enormous pressure applied to the whole length of the steel plate simultaneously to form the desired shape.

[12] In controlled rolling, steel ingots are heated and then rolled to successively smaller thicknesses while the temperature is periodically reduced. Controlled rolling results in a grain refinement and produces steel plate that has both high strength and high resistance to the propagation of fractures, an important requirement for high-pressure gaslines

[13] One major disadvantage in the use of spiral-welded pipe is that the weld is longer than with straight-seam pipes, and the likelihood of failure because of an improper weld naturally increases. On the other hand, 20 to 30 percent less load is applied to spiral welds than to longitudinal welds in straight-seam pipes. Thus, if the weld is performed properly, the spiral welds can be more resistant to failure

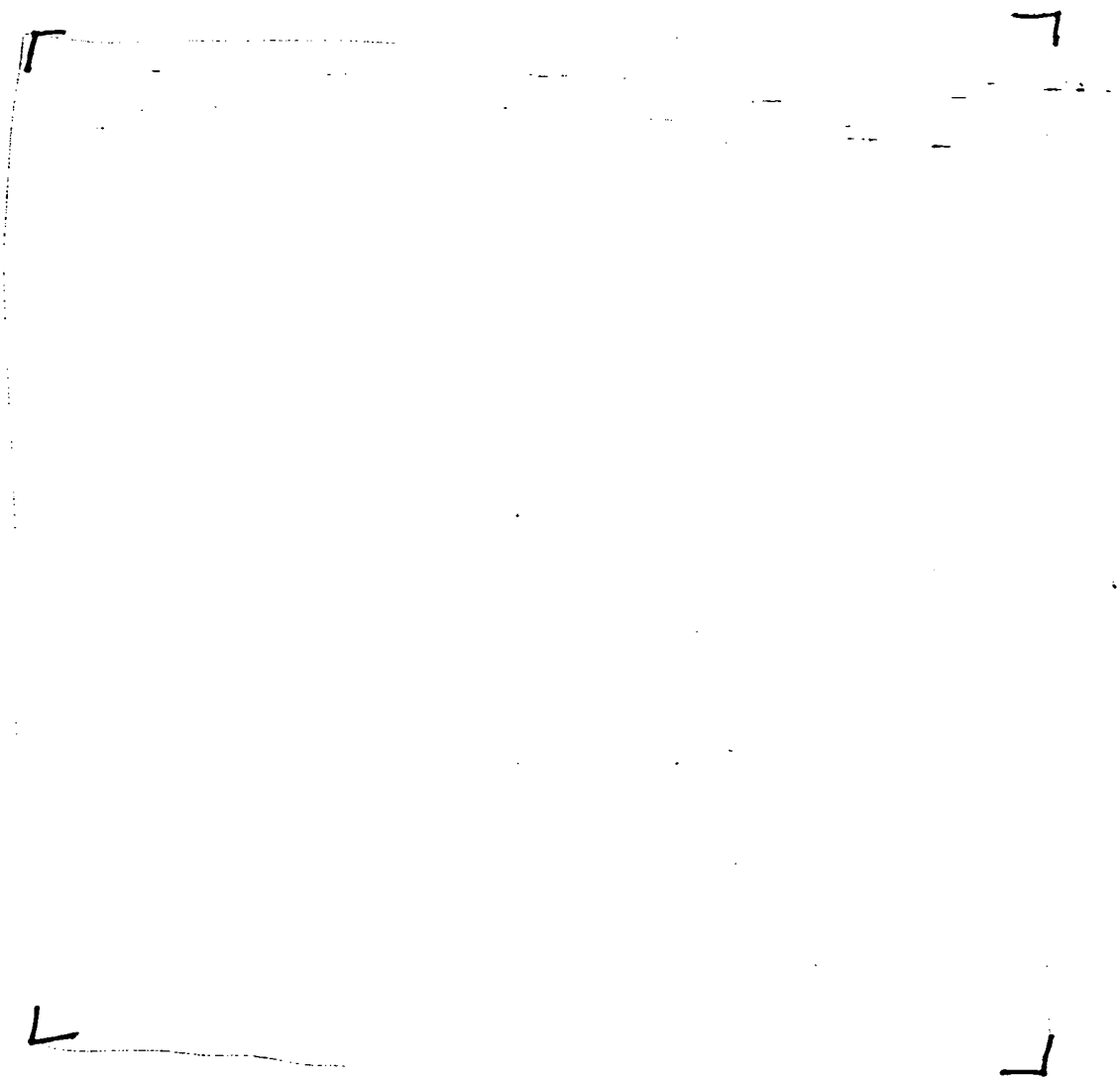
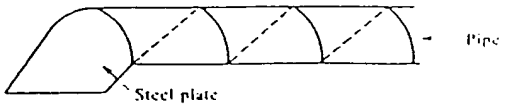
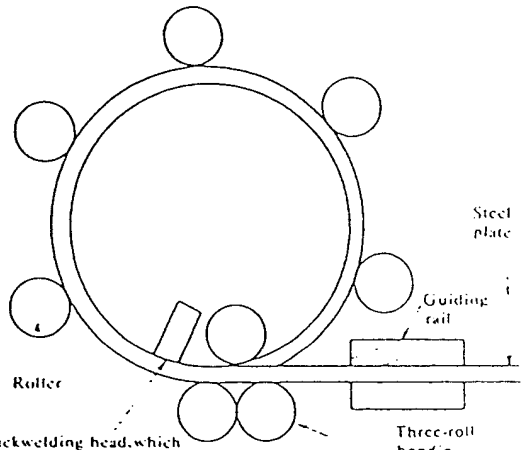


Figure 10
Roll-Forming System for Spiral-Welded Pipe

Schematic of Pipe Production



Roll-Forming System for Spiral-Welded Pipe



of high-strength 1,420-mm pipe for use on high-pressure gaslines did not begin until late 1981 or 1982. At a 1979 ferrous metals symposium, a Soviet metallurgist conceded that, although production of 1,220-mm pipe for gaslines had begun at the Volzhskiy Pipe Plant in 1976, the composition of 14-mm steel plate strong enough to withstand 75-atm operating pressure had not been established until 1979. Soviet media reported that the first trial batch (16,000 tons) of 1,420-mm pipe with mechanical properties suitable to permit operation at 75 atm was produced in early 1980.

Vyksa Iron and Steel Plant

The Vyksa plant is located about 300 km east of Moscow (see figure 11). A spur from the Moscow to Kurgan rail line serves the plant. Construction on the new pipe mill began in early 1978. In early 1983 the mill was about 50 percent complete and partially operating. [redacted]

[redacted]

According to the Soviet press, the Vyksa plant, when complete, will be the most modern and largest producer of large-diameter pipe in the Soviet Union, and it will produce 500,000 tons of 1,420-mm multilayer pipe annually by 1985. [redacted] Pipe production schedules provided to [redacted] firm that was asked to submit a bid for building a pipe-coating facility also indicate a final capacity of about 500,000 tons per year (conventional pipe equivalent).

According to [redacted] the large-diameter pipe produced at Vyksa is manufactured from multilayer cylinders, 1,620 to 1,650 mm (about 5 feet) long, which are then joined together by circumferential arc welds to form an 8- to 10-meter pipe length.[14] The individual cylinders are produced by overlapping steel strip 4 to 5 mm in thickness repeatedly to form a five- to six-layered segment. Overlapping inner and outer welds are performed at the beginning and end of the wrapping process (see figure 12). To reduce the number and size of gaps and spaces between the layers, the pipe segment is then hydraulically expanded.

Soviet technical journals state that multilayer pipe must be designed to deal with pressure leakage through the first, or inner, layer because of corrosion,

[14] Soviet media report describe the production process as the assembling [redacted] each of which consists of several layers of sheet steel.

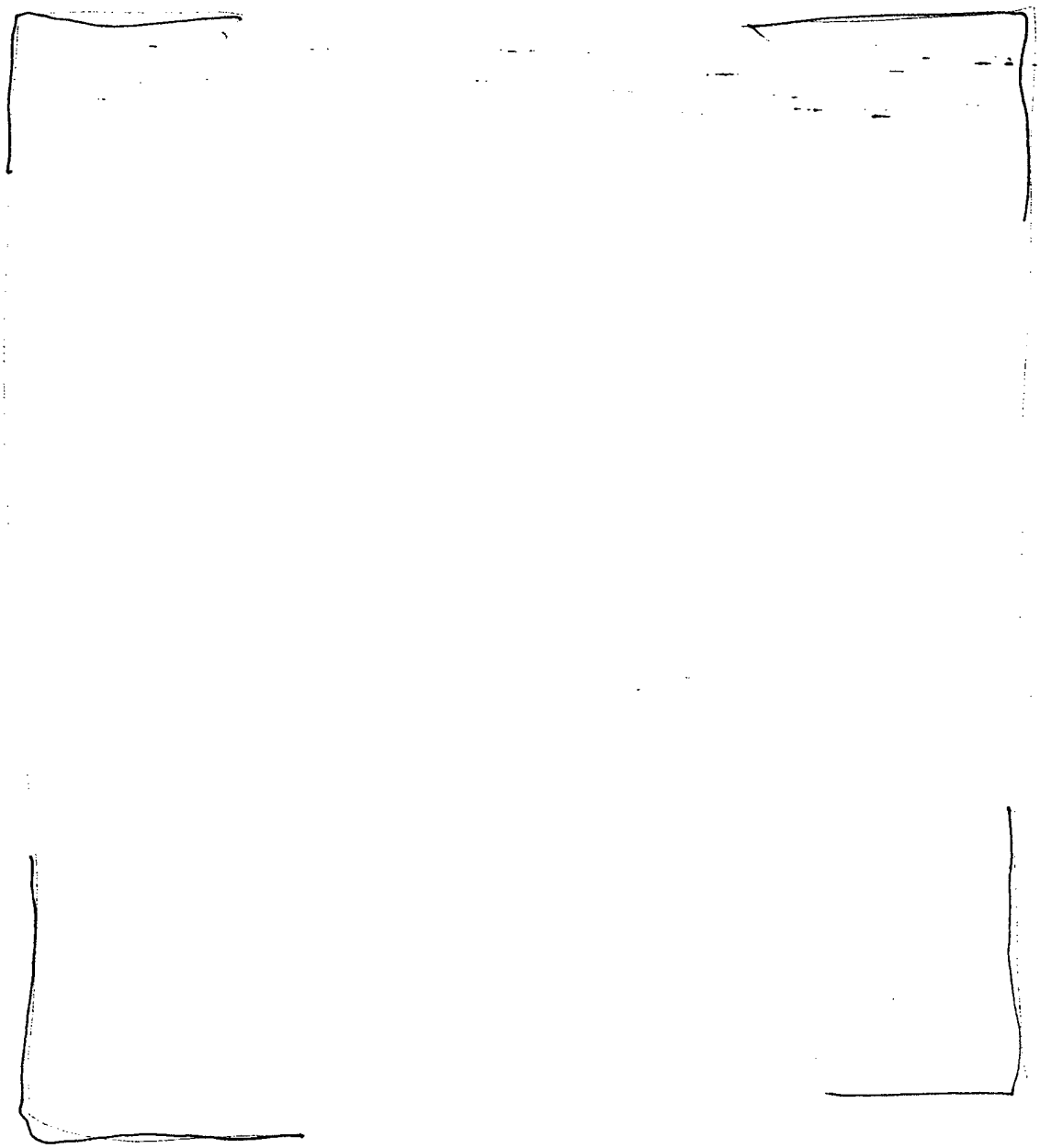
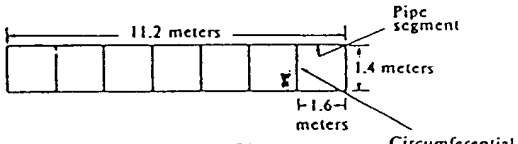
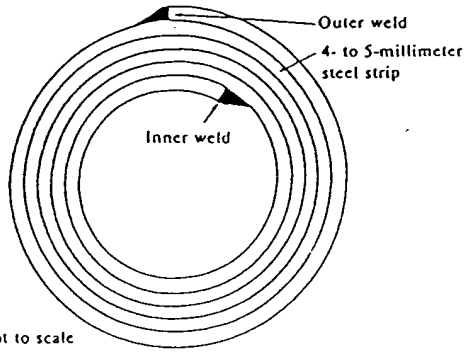


Figure 12
Soviet Multilayer Pipe

Completed Pipe Length Composed of Seven Smaller Segments



Cross section of Multilayer Pipe



Not to scale

improper welding, or metal defects. Leakage could permit the passage of gas through the spaces between the layers, build up pressure, and eventually cause the pipe to burst. To forestall this, the Soviets are reportedly deliberately making the last, or outer, weld discontinuous to allow the gas a means of escape and thus relieve internal pressures.

According to [redacted] and Soviet media reports, the production technology for the multilayered pipe was tested in an experimental shop at the Khartsyzsk Pipe Plant in 1979.

Chelyabinsk Pipe Plant

The Chelyabinsk Pipe Plant is located near the Ural Mountains about 1,500 km east-southeast of Moscow. A spur from the Ryazan' to Omsk rail line serves the facility. There was no expansion of pipe production facilities at Chelyabinsk from 1975 to mid-1983.

According to a Soviet engineering journal, the Chelyabinsk plant is one of the country's largest producers of large-diameter pipe, producing about 730,000 tons of longitudinally welded 1,020- and 1,220-mm pipe annually [redacted]

According to [redacted] the Chelyabinsk Pipe Plant could produce 47 pieces of double-seamed longitudinally welded pipe per hour. We estimate that, at this production rate (working two shifts per day, 260 days per year, and with an 80-percent efficiency), the Chelyabinsk Pipe Plant produces about 700,000 tons per year of 1,020- and 1,220-mm pipe. This estimate is generally consistent with other reporting.

Zhdanov Pipe Plant

The Zhdanov plant is located about 1,000 km south of Moscow. A spur from the Moscow to Zhdanov rail line serves the plant. According to earlier [redacted] estimates, the plant can produce about 60,000 tons of 1,020-mm spiral-welded pipe per year. From 1975 to early 1983, no expansion of pipe production facilities occurred. The plant appears to be in a rundown state, and we have no reason to believe that pipe production is increasing.

Novomoskovsk Pipe Plant

The Novomoskovsk plant is located near Dneprpetrovsk. A spur from the Brest to Volgograd rail line serves the plant. [redacted] Construction of an addition to a large-diameter pipe mill was started and completed during 1975-79. According to earlier

[redacted] estimates, the Novomoskovsk plant has a capacity to produce about 180,000 tons of pipe per annum.

Soviet media have reported that an experimental shop at the Novomoskovsk Pipe Plant produced two-layer, spiral-welded 1,420-mm high-pressure pipeline in August 1982. These reports announced that a mill with 1,420-mm pipe capacity would be built at Novomoskovsk some time in the future. Analysis [redacted]

[redacted]

Some media reports referred to two layers of steel being fed simultaneously into a spiral-welding forming machine. We believe, however, that Novomoskovsk will not begin large-scale production until the 1990s and, thus, will not be a factor during 1986-90.