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CENTRAL INTELLIGENCE AGENCY

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MEMORANDUM FOR: Jeffrey R. Cooper
Assistant to the Secretary
Department of Energy

SUBJECT : Update of the 1972 Task Force Report on Petroleum and Petrochemcials

Attached is the update of part of the 1972 task force report on petroleum and petrochemicals which you requested. No attempt was made to recast the piece, only to make it correct and current while maintaining as much of the original language as possible. If you have any additional questions, feel free to contact [ ].

Office of Economic Research

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Update of the 1972 Task Force Report on
Petroleum and Petrochemicals

7 September 1978

USSR Crude Oil Position

The USSR is the world's largest producer of crude oil with an output of 546 million tons in 1977. (See Table 1.) Plans call for crude oil production to reach 620-640 million tons in 1980. West Siberia is to provide 315 million tons in 1980. Production in the West Siberian region is, and will continue to be plagued with problems and high costs because of the permafrost, extremes of climate, difficult terrain, shortages of equipment and labor, and poor transport and supply facilities. Chronic shortages of suitable drilling rigs, automation equipment, all-terrain vehicles, earthmoving equipment, and building materials exist. There is inadequate planning for construction of roads, railroads, pipeline, or electric power facilities before the fields are developed.

Even if the USSR imports equipment and technology from the West, the 1980 production goal probably cannot be attained. Production is likely to peak around 1980, probably at less than 600 million tons. Thereafter, a sharp decline to between 400 and 500 million tons is likely by 1985. This supply of oil would be inadequate to meet all domestic needs, provide the necessary oil required by the East European countries, and still leave substantial quantities for export to the Free World and to other Communist countries. By 1985 although Soviet oil production and consumption may be roughly in balance, continued Soviet oil exports to the other Communist countries would have to be covered by imports from the West.

Soviet exports of oil to the Free World have been the largest single source of hard currency earnings in recent years and have been used to acquire machinery and equipment from the West. (See Table 2 for Soviet trade in oil in 1976.) Moscow's hard currency oil earnings, which totaled $4.5 billion in 1976, were up more than 20 percent in 1977 to $5.6 billion.

In the Soviet Union and in Eastern Europe there has been some belt tightening in anticipation of possible future shortages of oil. Moscow has doubled the internal price of gasoline and has stepped up a campaign for the conservation of energy resources, especially hydrocarbons. The USSR has approached Iran

Table 1

Production of Crude Oil in the[1/] USSR and Eastern Europe

(Million metric tons)

Country	1975	1976	1977[2/]	1980 Plan
USSR	490.8	519.7	546.0	620-640
Romania	14.6	14.7	14.7	15.5
Hungary	2.0	2.2	2.2	2.0
Poland	0.6	0.5	0.5	N.A.
Bulgaria	0.1	0.1	0.1	N.A.
Czechoslovakia	0.2	0.1	0.1	N.A.
East Germany	0.1	0.1	0.1	N.A.
TOTAL	508.4	537.4	563.7	N.A.

1. Including gas condensate.
2. Data for Eastern Europe are estimated.

Table 2

Soviet Trade in Crude Oil and Petroleum Products, 1976

(Million metric tons)

	Total
Exports to:	
Free World	64.5
Communist Countries	84.0
Eastern Europe	68.5
Far East	2.0
Other	13.5
TOTAL	148.5
Imports from:	
Iraq	5.8
Egypt	0.1
Other	0.5
TOTAL	6.4

and possibly other OPEC countries to discuss possible crude purchases and has advised its East European CEMA partners to begin to look for alternative sources of crude oil supplies.

Substitution of natural gas cannot be expected to relieve the pressure on the Soviet oil industry. Despite the publicity given to large Soviet reserves of gas and to recent Soviet sales of gas to Western Europe, the problems of the gas industry are large. It is unlikely that gas production will reach the upper limit of the 1980 plan (435 billion cubic meters). Output is more likely to be in the 415-420 bcm range in 1980. Production growth throughout the 1980s probably will be constrained by West Siberian bottlenecks and by declining extraction rates at aging fields elsewhere in the USSR. Gas output in 1985 is now projected to be about 560-600 bcm.

It is, of course, quite feasible that under conditions of extended conventional war a combination of damaged oil fields and transportation and with increased demand for petroleum products arising from rapidly increasing military and military-related needs, a serious shortage of crude oil would occur in the USSR. Although some relief might be obtained from cutting back drastically on non-essential civilian consumption, this cushion is believed to be relatively small. Some further relief, of course, could be obtained from eliminating exports of crude oil and petroleum products to the Free World, but elimination of exports to other Eastern European countries (if they remained in the Soviet orbit) could be self-defeating, at least in part.

It has been estimated that military consumption in peacetime tends to take 3-4 percent of domestic consumption. Under conditions of extended conventional warfare, military use alone generally rises five- or sixfold. Applying these rough measures to the Soviet 1975 apparent consumption of oil products of about 320 million metric tons would give about 10 to 13 million tons consumption for peacetime military use. Multiplying these figures by the lower multiple (5) for wartime would give a range of 50 to 65 million tons for 25-40 percent of the 1975 total consumption for only military use. When the higher multiple (6) is used, the range jumps to 60 to 78 million tons or about 30-50 percent for only military use. Whether

as an added demand against the current resources, or more importantly against any of the several possibilities of reduced petroleum availability (except that of radically reduced refinery facilities), such demand represents a substantial component in the supply/demand picture that could be offset by about 50 percent by elimination of exports to the Free World. These calculations do, of course, exclude that important sector of wartime demand which would undoubtedly increase substantially over its peacetime level -- the military-related needs of industry. It is reiterated that the preceding analysis represents only the roughest of estimates which could vary significantly.

Oil and gas exploration, a vital oil industry activity, depends largely on the seismic process to provide the basic data from which the shapes, attitudes, and structural relations of subsurface rock strata are determined.

Because of damage already done to the older oil fields in the USSR by improper management, poor extractive techniques (such as extensive use of water flooding, overproduction, etc.) as well as other poor management and logistics aspects, the Soviets must look to finding new reserves by deep horizon drilling of old fields or by exploiting the West Siberian and Central Asian fields. A majority of the more obvious oil structures have already been located and new fields are likely to call for deep horizon seismic exploration and further exploration of the permafrost and the offshore areas.

Deep horizon seismic exploration can take place on land or sea. Therefore, a digital seismic acquisition system is constructed to operate in any environment whether jungle, marine, arctic or desert climates. Its use varies from one operation to the other. It is ruggedly constructed to withstand vibrations as well as physical shock when transported or operated in aircraft, marine vessels or terrain vehicles.

The area of seismic data processing and interpretation may be divided as follows: (a) the hardware, which generally constitutes Office Playback Systems, i.e., computers, plotters, and other peripheral equipment and (b) the software which involves the computer programming essential for the processing and interpretation of the data obtained during field exploration activities.

a. Hardware: The U.S. has a recognized lead in digital computer technology and its applications to seismic data processing. This claim is substantiated by the fact that US companies supply more than 75% of the seismic equipment used in the Free World. The Soviets do not at this time have an adequate inventory of modern digital seismic survey equipment. The digital method provides the ability to delineate deep geologic sub-surface features such as stratigraphic traps much more accurately than is possible with the previously conventional analog methods. The effectiveness of U.S. unilateral control of digital computer technology and hardware for data processing is open to question because French, West German, and UK firms can supply comparable equipment.

b. Software: Effective U.S. unilateral control does exist, however, in the area of advanced software for processing and interpretation of seismic data. In recent years, there has been a growing interest in the subject of digital processing of seismic data. Unfortunately, the accent has been on the "digital" part of the subject, whereas, the real value of the new system lies in the "processing" part, and what it can do with the seismic data.

Software is the key ingredient in converting field recorded seismic data into meaningful geologic data by its efficient processing through a digital computer. It is essentially the mathematical processing of data by means of a digital computer. Software, as hardware, undergoes several generations of updating. Each new generation software package is an order of magnitude better in sophistication than the previous, and each package is specifically designed for a given environment, i.e., arctic and permafrost, offshore/marine, or land.

In the field of land gravity meters and certain proton magnetometers, the U.S. possesses effective control. The former are particularly important for deep horizon exploration of the salt dome oil deposits in the Caspian embayment. The latter are useful in exploration of vast areas by means of airborne techniques. They also have significant usefulness in marine exploration activities. But such equipment is already under control to Soviet bloc areas for military significance rather than for seismic exploration reasons.

Various other specialized electronic systems are also valuable, particularly for relevant marine exploration purposes, but this equipment and technology are also already under effective U.S. unilateral control for purposes other than petroleum exploration. Included among such equipment are:

- Satellite and Doppler Sonar navigation and positioning systems
- Stablized platform marine guidance and navigation systems
- Certain high precision gyro compasses
- Certain buoys and hydrophones, and
- Certain Radar equipment.

Thus, looking at the problem as a whole, it appears that the USSR exploration problem, in terms of envisaged conventional warfare needs, might be solvable over a reasonable time period by the deep horizon seismic technology available to the USSR from non-U.S. sources, particularly France, although such equipment and technology would not be equal to best U.S. equipment. This would be particularly advantageous because the further exploitation of established fields near the refinery and usage centers could be achieved. However, this other availability would help to solve the USSR curde oil problem only if the USSR satisfactorily resolved its deep well drilling and production problems. Otherwise, principal reliance would have to be placed on even further increases in production in West Siberia and Central Asia and possible Arctic sources. All of these latter alternatives represent difficult exploration, drilling and transportation problems.

The above technical comments and judgments are equally applicable to exploration for natural gas.

Drilling

Drilling for oil or gas is important both in exploration and exploitation of crude fields. The USSR has emphasized turbo-drilling rather than rotary drilling which is used by most of the rest of the world. Turbo-drilling (employing high speed of the drilling bit) functions by having the drilling fluids drive a down-hole motor (turbine) and bit, while the drill pipe remains relatively stationary. Turbo-drilling has been found to be particularly good for shallow and hard formations, such as those in the Urals-Volga region. In geological structures requiring drilling deeper than 2000 meters, turbo-drilling has proved to be less satisfactory. In soft formations turbo-

drilling below such depth is very inefficient. Turbo drills are used in the U.S. primarily for directional drilling. Although deeper drilling is becoming necessary in both the older producing fields and the new areas being developed, the USSR still uses turbo-drilling in about 80% of its drilling operations. Soviet data reveal that typically 12 months or more are needed to drill a well to a depth of 3000 meters, compared to U.S. practice of one month. It is also known to require four years in the USSR to drill a 7000 meter well, while a similar well in the United States takes only about six months.

In the Free World about 99% of the drilling is done by rotary drilling. In rotary drilling the entire drill column and the bit are rotated from the surface by motors. Slower rotational speeds, increased torque and reduced axial loads, and wear on bits represent the chief economic advantages of the rotary method. Of equal importance, the rotary drilling technique has proved to be excellent for soft rock formations or for drilling more deeply than 2000 meters.

USSR experts have advocated that the USSR move toward a combination of turbo-drilling (to 1500 meters) and rotary drilling beyond that depth.

USSR total drilling for exploration and development of oil and gas fields rose from 11.9 million meters in 1970 to 15.2 million in 1975. During 1976-80, the oil ministry alone must drill 15 million meters a year and it is highly unlikely that this objective will be reached. The principal obstacle to effective rotary drilling and real exploitation of deep horizon oil and gas reserves is the USSR lack of the following equipment and related technology:

- Rotary drill rigs (including automated rigs) designed for a total continuous input of 300 horsepower or over, and lift capacity of 150 tons and over, and associated equipment.
- High quality drill pipe
- Certain drill collars and joints (e.g., safety and telescoping type)
- Rock drill bits, reamers, and hole openers 6-3/4" in diameter and larger
- Blowout preventers and chokes with rated capacities in excess of 3000 psi
- Mud pumps, 3,000 psi and 400 GMP discharge and 700 Hp and over (e.g., triplex, quad-ruplex and quintuplex slush pumps)

- Downhole surveying and testing equipment (e.g., well-logging and recording units, drift indicators containing gyros and cameras, formation testers, etc.)
- Downhole flow and drilling control equipment (e.g., jars, packers, fluid accelerators, subs, cutters, overshots, baskets and other fishing tools and specialized downhole equipment)
- Specialized equipment and techniques for Arctic drilling (e.g. insulated casing)
- Offshore drilling rigs (monopod, jack-up, tow barge, submersible, semi-submersible, or drillship types) for deep water (250 ft. and deeper), and associated equipment (e.g., subsea control systems, motion compensators, riser systems, dynamic positioning systems, etc.)

With the exception of high-quality drill pipe, the above equipment and technology are basically under effective unilateral U.S. control.

In the case of high-quality drill pipe, the U.S. drill pipe has always dominated the field. Currently the U.S. produces about 75% of Free World output. Three West European firms produce less than 30,000 tons a year. The quality of the pipe produced in Western Europe is inferior to U.S. pipe in terms of durability. U.S. drill pipe has a four-year life.

Some qualification on deep water offshore drilling rigs is also necessary.

Offshore technology in the USSR is far behind that developed in the United States, and in use throughout most of the waters of the Free World. Petroleum deposits located offshore in the Caspian Sea in water depths exceeding 40 meters have been inaccessible, except by directional drilling from either onshore locations or by drilling from man-made offshore islands which are connected to the mainland by trestle-supported roadways. The Soviets have no experience with floating type, and very limited experience with jack-up type, drilling rigs. Until 1967, the Soviets' had only two offshore jack-up platforms, which were limited to

the drilling of shallow wells no more than 2000 meters deep in up to 20 meter water depths. In 1967, the Soviets completed construction on their first modern jack-up, "the Baku", and the following year imported a second modern jack-up, the "Khazar", at a cost of $10 million from the Netherlands. Both the Khazar and Baku are able to drill 6000-meter wells in water depths of 60 meters. However, maintenance of the Khazar equipment has proven difficult and prevented optimal performance. In 1977, a second modern Soviet-built jack-up (the "60th Anniversary of October") was completed and this year a modern semi-submersible (imported from the U.S.) is being fitted out. By 1980 the Soviets expect to have five modern jack-ups and three "semis" working in the Caspian. The import of additional rigs from Western suppliers will be required to reach this goal. The U.S. industry possesses offshore drilling rigs (jack-up, drillship, submersible, and semi-submersible types) which operate throughout the world and hold most operating records. The key element in U.S. jack-up rigs lies in the jack-up devices and techniques. Critical U.S. components in the floating rigs include the mooring system, the riser, the sub-sea control system, the drilling controls, and the vessel itself. In the more important other platforms (i.e., non-jack-up types) key elements are the stabilization systems.

The lack of much of this equipment and technology, which provide a high drilling safety factor, undoubtedly causes severe losses of drilling equipment and entire wells in the USSR in addition to the other economic and time costs involved. As wells go deeper, such losses are expected to increase. Even in the Free World, where this equipment and these techniques are well known and widely applied, such losses are still significant.

The general USSR deficiency in the rotary drilling area will limit its ability to drill faster, more deeply and more efficiently and will, in time, limit the amount of oil and gas reserves that can be explored and exploited in the USSR without disproportionate increases in investment.

In sum, the U.S. dominates the world market for petroleum industry equipment and technology, especially in the drilling area. Without high quality drill pipe and special Arctic drilling equipment and technology, the growth and effectiveness of USSR oil and gas drilling in deep horizon, deep water offshore and Arctic oil and gas exploration and development is severely constrained. Over time, the USSR could conceivably increase investment in an attempt to overcome this technological backwardness in this area, but it would be very costly for them to do so and their level of success would not be certain.

Production

Production operations in oil and gas fields in the USSR would benefit most from the acquisition of automated producing equipment such as Lease Automated Custody Transfer Systems, multi-zone reducing equipment, high temperature centrifugal downhole pumps, certain associated gas processing plants and low temperature separation equipment, certain pumps and compressors, certain Christmas tree and wellhead equipment (including all valves in excess of 10,000 psi), oilfield desalting and dewatering equipment for field processing of crude oil and hermetically-sealed storage tanks. In offshore operations the USSR lacks certain underwater wellhead equipment as well. In the future, for its West Siberian and Arctic permafrost operations, the USSR will be needing the automated and sophisticated producing equipment essential for such production. Of particular significance here, will be the special wellheads, pumps and valves, gathering systems and tank batteries. In most of these items and technology the U.S. has supplier control. The important exceptions are:

- Automated surface control equipment
- Shallow depth gas lift equipment
- Certain wireline equipment
- Low pressure non-retrievable, retrievable, and safety valves.

Although not directly related to the petroleum equipment issue, it should be noted that production in the West Siberian region is, and will continue to be, plagued with problems and high cost because of the permafrost, extremes of climate, difficulty of terrain, shortages of equipment and labor, and poor transport and supply facilities. The lack of produc-

tion equipment suitable for use in Siberian conditions is a major bottleneck. In addition to the petroleum equipment already noted, there are chronic shortages of all-terrain vehicles, earth-moving equipment, and building materials. Most of the Soviet oil tool manufacturing industry is located far from Siberian activity and has been slow to meet the needs of this region. There is inadequate planning for the construction of roads, railroads, pipelines and electric power facilities before the fields are developed. In many instances, equipment must be delivered by helicopter.

Transportation

As noted under the earlier discussion of natural gas, the principal oil and gas transportation problem in the USSR lies in its huge demand for pipeline and related equipment, primarily for the large-diameter gaslines. During 1971-75, oil pipeline construction was planned to increase more than 2.5 times over what was accomplished during 1966-70 but actual construction only doubled. Construction plans for 1976-80 call for an additional 18,500 kilometers of crude and product lines to be laid. Construction is behind schedule so far this year. The oil pipeline program must compete with gas line construction for funds, labor, and pipe supply, which is inadequate for the total program. The USSR technology for large diameter pipe and related equipment (primarily modern compressors) lags substantially behind that in the West, but the U.S. does not have an effective supplier control in this area. It should be recalled that a multilateral control over large diameter pipes was dropped several years ago. Most of the USSR's pipeline requirments can be met from non-U.S. sources.

Under conditions of extended conventional war, it is realized that pipelines and pumping stations (particularly unburied ones) are subject to severe damage and disruption. Moreover, other forms of oil transport, e.g., railroads, barges, etc., may also be severely damaged.