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# PETROLEUM REVIEW

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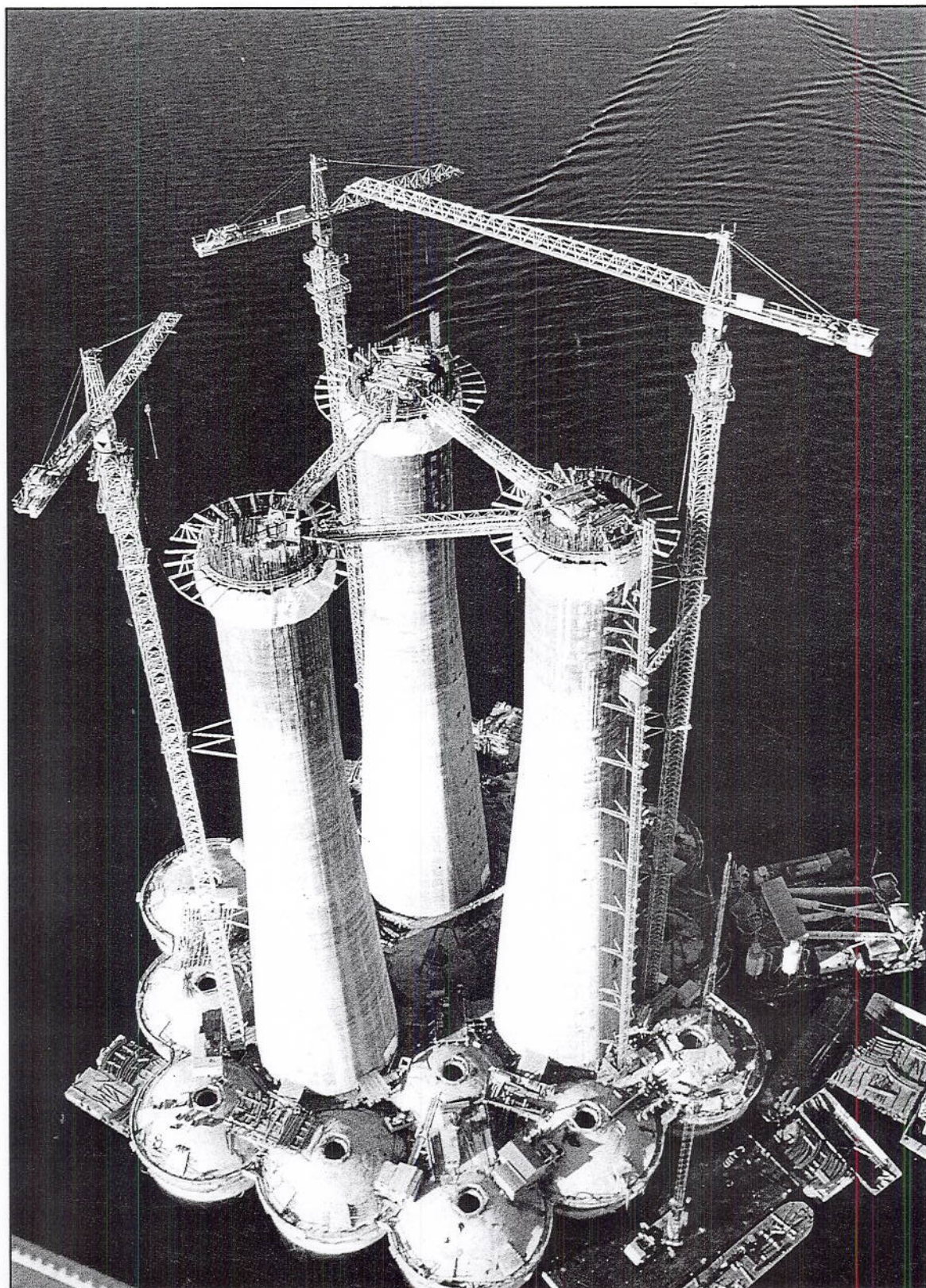
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future development. But nobody should forget that the period from the starting of prospecting drilling up to full exploitation of the deposit on the Arctic shelf will take on average not less than 10 years (American expert forecast in the case of the Beaufort Sea is 14 years). Simulations show that real results out of Arctic Sea oil

projects are expected to be obtained only in the first quarter of the next century.

In conclusion it is necessary to underline two more points. Firstly, the development of Arctic Sea oil is connected with technological risk — that is the necessity to use stationary bases which can resist ice drift, but there is no experience here or

abroad of how to exploit them for a long period of time. Secondly, there is the 'ecological' risk — that is possible oil leakage; in this case, decomposition of oil is much harder by a factor of 20–50 times less than in southern latitudes and the ice sheet makes it much more difficult to eliminate oil leakage.

## Future possible role of the Arctic and other severe seas in the USSR offshore petroleum development

By Dr Andrey Konoplyanik, Institute of World Economy and International Relations (IMEMO), World Energy Analysis and Forecasting Group (GAPMER), USSR

The USSR possesses the biggest continental shelf in the world. It is equal to some 22 percent of the world's ocean shelves and contains about one-fifth of the country's oil and gas initial potential resources. The largest part of the Soviet continental shelf lies under Arctic and Far Eastern regularly frozen seas with heavy-ice situation, severe environment and undeveloped or poorly developed onshore infrastructure. Those seas contain about 80 percent of the initial potential oil and gas resources of the USSR continental shelf. So, below the Arctic and Far Eastern seas lies one-sixth of Soviet resources.

During more than 40 years of Soviet continental shelf exploitation, the only offshore fields developed are those in the unfrozen part of the Caspian Sea at water depths of less than 130 metres. Up to now, less than 2 percent of the country's continental shelf prospective area has been covered by wildcat drilling. In 1987 offshore oil and NGL production, at 10.5 million tonnes was 1.7 percent of the total USSR petroleum production. Natural gas production reached 15 bcm or 2.1 percent of Soviet gross production. To compare: in the mid 80s, world offshore petroleum production outside centrally planned economies exceeded 750 million tonnes or 36 percent of the total. World offshore gas production exceeded 375 bcm or about 28 percent of the total. In comparison the role of Soviet offshore production is so far very small.

The geological structure of the Soviet continental shelf has been explored highly unevenly. About a half of the shelf's prospective area is almost totally unexplored in terms of geophysics. The offshore areas mostly explored by geophysics are the southern seas, Sakhalin Island's shelf, and southern parts of the Baltic, Barents and Kara Seas. In the

1980s geological exploration was concentrated in the southern part of the Caspian Sea. Less explored by geophysical prospecting are the eastern part of offshore

Arctic basins and the Far Eastern seas.

According to some approximate calculations for an offshore petroleum field in the Arctic region to be exploitable, it must contain not less than 7.5–10 million tonnes of recoverable reserves per platform and must have a capacity of more than 100 tonnes/day per well. This is for a hypothetical field in the Pechora Sea region (the district with the most serious heavy-ice situation throughout the year). If a hypothetical field is located in the deepest waters of the unfrozen western part of the Barents Sea, it must contain not less than 20 million tonnes per platform with a capacity of more than 175–200 tonnes/per day per well (1,250–1,500 barrels per day).

	1990	1995	2000	2005
<i>Oil and NGL million tonnes</i>				
Caspian Sea	11.4	16.3	19.2	20.3
Sakhalin's Shelf	—	2.2	5.0	6.9
Arctic Seas	—	—	—	3.0
Total Offshore	11.4	18.6	24.2	30.3
<i>Percent</i>				
Caspian Sea	100	88	79	67
Sakhalin's Shelf	—	12	21	23
Arctic Seas	—	—	—	10
<i>Natural Gas, bcm</i>				
Caspian Sea	7.4	7.0	6.8	6.5
Sakhalin's Shelf	—	3.5	7.7	9.2
Arctic Seas	—	—	—	8.3
Total Offshore	8.7	11.9	15.9	25.5
<i>Percent</i>				
Caspian Sea	85	59	43	25
Sakhalin's Shelf	—	29	48	36
Arctic Seas	—	—	—	33

**Table 1: The Possible Levels of the USSR Offshore Oil and Gas Production and its Forecast Geographical Distribution**

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It is estimated that more than 80 percent of offshore oil and gas resources could be contained below the Caspian, Okhosk, Barents and Kara Seas. In all except the Baltic Sea, gas resources are expected to predominate.

Future levels of offshore exploration activities are expected to increase. During the next 15 years the level of offshore geophysical prospecting may increase by some 30 percent, and seismic activities by more than one-third, with oil and NGL reserves additions increasing by more than 40 percent and natural gas resources additions by some three times. It is expected also that the geographical distribution of offshore geological prospecting may change greatly. The role of the Caspian Sea will probably decrease. The share of the Far Eastern Seas may stay near today's level. And we can expect a sharp increase of the Arctic Seas share in offshore geological prospecting.

During the next 15 years the yearly volume of offshore development drilling may be about 270-300,000 metres for oil and some 40-60,000 metres for gas. The rate of development drilling may reach 70-90 oil wells and 20-30 gas wells per annum. In this period the overall volume of development drilling for oil and gas on the continental shelf may decrease by some 7 percent and oil and gas well completions by about 20 percent. In contrast, the role of the Far Eastern and Arctic Seas will be steadily increasing.

All the offshore petroleum production in our country is located today at the Caspian, Black and Azov Seas. In perspective the Caspian Sea may provide up to one half of the oil plus NGL additional national offshore production. The other half may be provided by the shelf of Sakhalin Island and the Arctic Seas. These two regions may provide also the whole additional offshore gas production of the country because it is considered that gas production levels in the Caspian Sea will be steadily decreasing (Table 1).

In the next 15 year period all the Caspian Sea production would be probably located in the areas with water depths less than 350 metres, though right now there is no national technology for offshore petroleum development at 200-350 metres water depths range. The alternative scenario for Caspian Sea exploitation suggests development of its northern part with the shallower but periodically frozen waters. This would bring the problem of creating some largely new and ecologically clean technologies.

New technologies must be also created for offshore resources development in water depths in the range 350-500 metres. That means that these technologies if created may be several times more expensive than existing ones. Up to now this

Location, water depths	Total oil production per platform M ton/year	Discounted development costs, rouble/ton	Availability of national technology
<i>Caspian Sea</i>			
less than 200 m	6	up to 60	yes
200-350 m	6-8	80-100	no
350-500 m	..	100-150	no
<i>Sakhalin's Shelf</i>			
less than 50 m	8-10	up to 80	no
50-100 m	..	more than 150	no

**Table 2: The Possible Range of Future Development Costs in the Soviet Continental Shelf**

water depth range has been considered uneconomic (not commercially exploitable): discounted costs may reach 100-150 roubles per tonne (Table 2). For comparison oil wholesale prices at the end of the century are supposed to be some 70 roubles per tonne and replacement costs about 125-150 roubles per tonne. So we can suppose that in the next 15 years this range of water depths will probably not be developed.

The priority regions for offshore petroleum development on the Sakhalin Island's shelf would be areas with water depths less than 50 metres. For these water areas special technologies must also be created, ice-breaking platforms being one of the principal items.

Special technologies for water depths of 50-100 metres in this region can be several times more complicated and expensive than for depths of less than 50 metres. We believe that we must solve our technical problems for shallower waters at first and only then work out the problem of deeper water depths' development.

Table 1 shows levels of possible production including some new offshore oil fields development such as Pieltun-Astokchskoye, Lunskeye, etc. Future gas production possible increase is based on supposed Lunskeye field development in the early 1990s.

In the Arctic Seas, resources evaluation and appraisal work would be continued to ensure future stable production in the Barents Sea, Tazov and Ob Gubas (Bays) and Yamal Peninsula's shelf.

For economic evaluation of the work held in the region it is considered that petroleum fields could possibly be discovered here with potential annual production of 3 million tonnes at the beginning of the next century (Table 1).

Arctic gas production would be probably located in two places. The first is in unfrozen parts of the Barents Sea. The gas field discovered at Murmanskoye may achieve some 3.3 billion cu metres p.a. production level at the beginning of the next century. The second is an offshore part of the gas field Semakovskoye-Antipoyutinskoye located at Tazov Guba. Gas production there may achieve some 5 billion cu metres p.a. at the beginning of the next century (Table 1).

Because of relatively effective exploration methods, the unit costs of reserves additions in this country are on average substantially lower on the shelf than on the land. It is supposed that these unit costs would on the whole be decreasing in the future (see Table 3). During the same period the units costs of gas reserves additions may decrease more sharply.

To realize such a programme of offshore petroleum development the coun-

	1991-95	1996-00	2001-05
Oil, total (1991-95 = 100)	100	95	90
Caspian Sea	105	100	95
Far Eastern Seas	120	140	145
Arctic Seas	80	70	65
Gas, total (1991-95 = 100)	100	50	40
Caspian Sea	160	150	140
Far Eastern Seas	70	80	90
Arctic Seas	90	40	40

**Table 3: Indexes of Probable Unit Investments for Oil and Gas Future Reserves Additions on the Soviet Continental Shelf**

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	(Percent Shares)		
	1991-95	1996-00	2001-05
<i>Geographical</i>			
Caspian Sea	44	38	31
Far Eastern Seas	33	34	37
Arctic Seas	18	27	31
<i>Functional</i>			
Exploration Drilling	18	19	19
Development Drilling	9	8	7
Equipment Purchases	22	20	13
Construction	51	53	61

**Table 4: Geographical and Functional Distribution of Possible Investments in Soviet Offshore Petroleum Development, %**

try's total investments in that sphere must increase by some 10 percent every five years. The Caspian Sea's share in this total investment may decrease with corresponding increases in the shares of the Far Eastern and Arctic Seas (Table 4). To achieve this, considerable additional financing may be needed.

Table 4 also shows a changing pattern of expenditure for such development:

- exploration costs would be increasing and their share in total investments would stabilize,
- development drilling costs would stabilize in volume and their share in total investments would fall,
- the costs of equipment purchasing would be falling in volume and in share as the offshore areas become equipped,
- development costs other than drilling would also sharply increase (Table 4).

Technical reconstruction of the offshore petroleum industry and equipping it with new-type machinery (using where possible advanced Western achievements in this sphere) make it possible to develop offshore resources in unfrozen seas at depths of up to 200 metres and to explore periodically-frozen seas during their interfrozen periods.

But the volumes of new-type machinery production and their supplies to the petroleum industry are less than required. This equipment suffers too often from great shortcomings in technical level and in quality. It often lags behind corresponding Western equipment in its weight and size characteristics, energy intensities, levels of automation and mechanisation of main technological processes, etc.

As mentioned above, further offshore petroleum resources, development will inevitably be moved to water areas deeper than 200 metres and to the Far Eastern and Arctic Seas with conditions of severe climate, heavy ice, and maybe seismic activity.

For the development of these new

regions principally new-type equipment must be created. As for existing machinery — its technical level and quality needs to be greatly increased.

From my point of view, to solve these problems in the most effective way, our country must develop strong economic relations with Western countries including scientific and technological co-operation with them.

The economic reform which is being carried out in the USSR creates favourable possibilities for expanding the sphere of East-West relations into the area of offshore petroleum development in severe environments where joint venturing is of special importance.

Possible co-operation with Western economies could be along the following lines:

- Organisation of mutually beneficial economic co-operation with leading Western petroleum companies for exploration of the USSR offshore petroleum resources on the basis of joint ventures. I consider that they can be an effective form of frontier petroleum development in the USSR, provided that they are based on production-sharing or risk-service contracts.
- Organisation of joint ventures with Western petroleum companies in order to extend exploration and exploitation activities on the shelves of socialist, developing and maybe developed countries.
- Rise of current technical level of national machinery and equipment for offshore petroleum development, using broadly advanced Western experience in this sphere through the programmes of scientific and technological co-operation.
- Purchases of licences, technologies and specimens of advanced Western machinery and equipment for organisation of their production at Soviet enterprises.

- Import of Western machinery and equipment which is unprofitable to develop at Soviet enterprises.

Among these directions I consider joint venture creation for the country's offshore petroleum development to be the priority. As for the economic problems to be solved through joint ventures, I should mention two points.

Firstly, the creation of joint ventures is impossible without preliminary unification among the partners of the methods of evaluating their economic activities. So the question arises whether there is compatibility between Soviet and Western methods of profitability analysis of economic activities in general and of frontier petroleum development in particular and in what parameters they may differ.

The rules which are currently used in the USSR are based on the principle of cash flow discounting. However the particularities of its use and quantitative parameters which are applied to profitability analysis of petroleum development in this country, may differ substantially from Western practice. I refer to discount rates, energy prices, costs of production, risk assessment, inflation rates, rates of interest, etc. This is especially the case for frontier petroleum development where the parameters of economic assessments should be correspondingly modified.

Secondly, in worldwide practice, a system of petroleum agreements between multinational corporations and host countries does exist. These agreements provide an economic order and legal rules for joint ventures in the industry. The history of petroleum agreements in Western countries covers some 90 years. In our country the modern history of joint ventures began in 1987 (if we exclude all the pre-revolutionary period and the post-revolutionary period of Lenin's 'new economic policy' in the 1920s). Thus institutional and financial principles of joint venture activities in this country are only now being formulated. So the question arises whether or not these principles affecting joint venture activities in Western practice and in the USSR are compatible, both in the economy as a whole, and in the petroleum industry.

I consider that both these problems are underestimated in current Soviet economics and in energy economics in particular. In my opinion they are not less significant than the technical problems of the country's continental shelf development. To escape future serious problems, we must pay attention not only to technical or economic internal questions but also to these methodological, institutional and financial issues in the international sphere.