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THE MAIN DIRECTIONS OF ENSURING ENVIRONMENTAL SAFETY IN THE CONDITIONS OF USING THE ECONOMIC POTENTIAL OF THE CASPIAN SEA

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Abstract

The article analyzes the problems of determining the main directions of ensuring environmental safety, the basin in terms of using the economic potential of the Caspian Sea.

First and foremost, the main factors that determine the use of the economic potential of the basin, increasing its prospective position in hydrocarbon production are identified, the need to protect the marine ecosystem is highlighted.

Key words: environmental safety, economic potential, sustainable development, environmental risks, carcinogens, anaerobic condition, self-cleaning coefficient of the basin.

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Introduction

After the collapse of the Soviet Union, a group of independent countries was formed in the Caspian region, and the region, having received the status of a privileged prospective zone in its economic potential, became the center of attention of the leading countries of the world. The region covers about 3.5 million km2, representing more than 10% of the world's indoor in door pools. The basin, in the central part of which the Caspian Sea is located, stretches for 2500 km from north to south, and for 1000 km from west to east. On the territory of the region there are 9 independent states, among which 5 are the countries of the Caspian basin, which have direct access to the sea. The potential of the economic and geographical location of the territory is characterized by its location at the intersection point of the Eurasian continent, sea coast with a length of 6,700 km and operating all year round with numerous commercial ports, with historically formed infrastructure potential. At present (01/01/2016), the population of the region is 378, 4 million people, which corresponds to 5.2% of the world population. (2)

More than 200 large urban agglomerations and more than 220 industrial complexes with a strong influence on the ecological condition of coastal waters function on the territory of the Caspian coast alone. Its main distinctive regional features are in a large economic potential, a leading position in the global supply of hydrocarbon fuels, and most importantly, in the central hub of the trade corridor west-east and north-south. In such conditions, the ever-increasing use of the economic potential of the

region, first of all, brings to the forefront the provision of the environmental safety of the Caspian Sea and defines it as the main strategic objective of the sustainable development of coastal states. (10)

Research methods

The theoretical and methodological basis of the research were the scientific works of world scientists devoted to the problem of increasing the environmental safety of the Caspian Sea.

This study was carried out using the methods of traditional analysis of data evaluation, showing the degree of consistency of expert opinions and modern geographic information technologies.

The aim of the study is to compare the traditional methods of analysis and build an analysis of environmental safety based on the economic and mathematical methods of evaluation of statistical data and modern geographic information technologies, quantitative indicators that allow for a more accurate input of data arrays of multidirectional data and visualization of the results of analysis, which contributes to a more effective environmental decisions making. The proposed methods of statistical analysis is universal and allows for its integrated analysis of parameters required to manage environmental issues for each specific situation.

Results of research

What are the main economic factors that determine the status of the Caspian region as an "economic space" of global interest? First of all, this is the transformation of the Caspian Sea into a major supplier of hydrocarbon fuels to Europe on the eve of the 21st century, the introduction of numerous oil and gas fields found on the sea shelf, an increase in hydrocarbon production and its centralized transit to the world market.

Thus, according to the estimates of British Petroleum (based on the final report of 2014), only in 5 countries of the Caspian basin, the approved reserves of oil and gas amount to 40.8 billion tons and 86.8 trillion. cc m, respectively, which is equal to 17.0% of oil reserves and 46.4% of gas reserves of approved global reserves (Table 1).

Analysis of the materials in the table shows that for the next 20-30 years, the Caspian region will be able to maintain its leading position in meeting global demand for hydrocarbon fuel and will become a promising economic zone with the status of a major strategic geopolitical territory. Promising opportunities are, first of all, the growing demand for natural gas and crude oil in the industrial complexes of the leading European countries and the availability of convenient transport infrastructure, a transport corridor characterized by the possibility of continuous activity throughout the year and, in particular, its location in the center of the Silk Road branching .

Table 1

Approved oil and natural reserves gas in the Caspian states (*according to the results of the projected report for 2014 the company "BP").*

Caspian states	Oil reserves (billion)	By world oil reserves in% - x	Natural gas reserves (trillion m3)	By world reserves of natural gas in% - x
1	2	3	4	5

The Republic of Azerbaijan	**1,0**	**0,4**	**1,2**	**0,6**
Iranian Islamic Republic	**21,7**	**9,3**	**34,0**	**18,2**
Kazakhstan republic	**3,9**	**1,8**	**1,5**	**0,8**
Russian Federation	**14,1**	**6,1**	**32,6**	**17,4**
Turkmenistan Republic	**0,1**	**0,04**	**17,5**	**9,3**
Total:	**40,8**	**17,6**	**86,8**	**46,3**

Note: The table is based on the 2014 Statistical Review of World Energy statistical review.

In addition, considering the potential reserves, it can be seen that the region is currently concentrating in itself also, one can say, the bulk of the world's natural gas reserves, which is happening against the background of the depletion of the North Sea reserves.

Along with hydrocarbon reserves, the Caspian region is also considered to be the main source of autochthon-endemic bio resources.

As a result of research conducted by biologists, 1809 species of fauna were found in the Caspian Sea, including 101 species of fish, 415 vertebrate mammals and 728 species of flora. (14)

In general, the biological resources of the Caspian Sea are estimated at 2.9 million tons. 90% of world sturgeon fish are concentrated in the basin, which makes up the bulk of food and export caviar. (17)

In this regard, there is a need for the effective use of resources of fauna and flora, and this factor becomes the main incentive for constructive cooperation between coastal states.

All coastal states have adopted as the main strategic goal and included in the range of their activities the protection of bio resource diversity, prevention of its depletion, rational use and addition, and, in general, ensuring sustainability in this area.

One of the factors contributing to the growth of the economic potential of the Caspian region is the fact that the region has an extensive transport network with subsea land pipelines playing a leading role in economic progress and the gradual transformation into a strategically important transport and communication corridor of Eurasia. Located at the crossroads of the Middle and Middle East, Central Asia, the Caucasus, including the southern part of the Russian Federation, the Caspian region forms the foreign economic relations of different countries and represents a sphere of economic interest of the leading world powers.

According to calculations of international experts, over the next 5-10 years, an increase in foreign trade turnover is expected to be more than 1.5-2 times between Europe and Asia, and the Caspian region is the most convenient transport corridor for the transport of these goods.

The attractiveness of this corridor also lies in the short delivery time for goods to consumers for 10-12 days and 20% cheaper compared to traditional directions of transportation. (16)

The beginning of the implementation of certain projects in this direction. Thus, in 2000, the North-South Corridor Agreement was signed between the three states of the Eurasian continent: the Russian Federation, Iran and India, and, according to this agreement, the goods were shipped from the port of Mumbai to the Indian Ocean - the Persian Gulf - the port of Bender Abbas - the port Bender Amirabad - the port of Anzali - the Caspian Sea - the port of Olya - St. Petersburg. It was decided to form a transport corridor in the opposite direction.

It can be seen that in this transport corridor, which allows connecting the Indian Ocean to the Caspian Sea, the Black Sea, the Baltic Sea basin, as well as the Atlantic and North Arctic oceans, the leading position belongs to the seaports of the Caspian Sea.

As a result, the prospects and economic efficiency of the transport corridor led to the connection of Belarus, Azerbaijan, Tajikistan, Kazakhstan and the Omani Sultanate. The intersection of the "TRACECA" transport corridor with this transport corridor makes it possible in the future to attract more countries here and gradually increases its economic transit value. The Caspian basin has a powerful port infrastructure. Thus, in the Caspian region there are 9 main seaports (Russia-3, Iran-2, Azerbaijan-2, Turkmenistan-1, Kazakhstan-1) with 98% of the freight traffic in the region. According to approximate calculations, at present, in the Caspian Sea, cargo transportation employs more than 800 vessels of various sizes and purposes, belonging to different states. It is planned that foreign trade and cargo turnover only along the North-South corridor will be more than 30 million tons from 2015 to 2020. It should also be noted that at the present time, 36% of the vessels participating in cargo transportation belong to the Russian Federation, 35% to the Republic of Azerbaijan, only 5% to Turkmenistan and 2% to Kazakhstan; the remaining 22% belong to different countries. The Republic of Turkmenistan and Kazakhstan are gradually strengthening the fleet. One of the potential indicators necessary to assess ecologically in foreign trade turnover is the prospect of continuous oil production in the Caspian basin and the use of transport potential when exporting it to the world market. Currently, oil transportation in the Caspian region is carried out using tankers, ferries, railways. Experts offer several directions for the export of hydrocarbon fuel from the Caspian Sea to the world market: Iranian, Russian, Black Sea and from the Mediterranean Sea. Promising is the transportation of hydrocarbon fuels in the direction of the Black Sea - Mediterranean Sea - on a mixed transit: Aktau-Caspian Sea-Baku-oil pipeline Batumi-Black Sea-Europe. This direction provides transportation of oil delivered to Baku and to the Novorossiysk port, as an additional option, and to the Mediterranean Sea via the Baku-Tbilisi-Ceyhan pipeline. In this direction, Turkmenistan, using the port of Turkmenbashi, is trying to ensure the export of hydrocarbon fuel to the Mediterranean Sea via the Baku-Tbilisi-Ceyhan pipeline.
Basin tankers with a deadweight of 12-14 thousand tons, operating in the direction of Aktau-Baku, allow to transport 1 million tons of crude oil per year.

A variety of areas, work to increase the number and carrying capacity of tankers at the same time, accompanied by an increase in production. According to OPEC data for 2014, oil and natural gas production in the countries of the Caspian region has changed from 837.9 million tons to 969.3 billion cubic meters, which is 19.9% of world oil production and 27.2% of production natural gas. It is also necessary to pay attention to the interesting fact that 75% of the oil produced in the countries of the region and 67% of natural gas falls on the 160-kilometer shelf zone of the Caspian Sea (table 2). The intensity of production and a balanced comparison of the amount of oil and gas used by the countries of the region show that in statistical reports for 2014, this ratio varies, respectively, as follows: 19%: 6.3% and 27.2%: 20.2%.

Table 2 [1]

Oil and natural gas production in the Caspian states (according to these indicators the final report "OPEC" for 2014)

Caspian states	Oil production (million tons)	World oil production at%	Natural gas production (billion m3)	Worldwide natural gas production at%
1	2	3	4	5
The Republic of Azerbaijan	42,0	1,0	18,6	% 0,5
Iranian Islamic республика	169,2	4,0	212,8	6.0
Kazakh republic	80,8	1,9	20,8	0,6
Russian Federation	534,1	17,7	642,9	18,3

Turkmen республика	**11,8**	**0,3**	**74,2**	**2,1**
Total:	**837,9**	**24,9**	**969,3**	**27,5**

Note: The table is based on the OPEC Statistical Review of World Energy 2014 source.

Excess use of the volume of oil and gas produced can be said to be a characteristic indicator of the states of the Caspian region. It is not by chance that, at the moment, in the international geographical division of labor, such states of the region as Azerbaijan, Kazakhstan, Iran are characterized as world exporters of oil, and the Russian Federation and Turkmenistan as world exporters of gas. This indicates that in the near future, the states of the region will strive to strengthen their economies and generate national income through the growth of hydrocarbon fuel exports.

An analysis of the economic potential of the Caspian region shows that the marine basin is gradually turning into a center for hydrocarbon fuel production, a transport corridor for transit traffic and infrastructure services, and a territory with a strong habitat. Under such conditions, the adoption of a strategy to ensure the environmental safety of an environmentally sensitive sea is considered one of the main issues as the main leading factor in overall development. The preference of the principle of an integrated approach is one of the main issues in determining the directions for solving environmental problems of the marine basin. Therefore, in order to optimally solve the problem, we have divided the main sources of pollution of the marine basin into 4 separately considered groups:

• extraction of oil and gas on the continental shelf of the sea and the polluting effect of the process of their transportation;

• Impact on the aquatic environment flowing into the river basin and pollutants flowing from them;

• polluting effects of livelihoods of cities located on coastal areas

• contaminating effects on the basin of areas prone to flooding due to fluctuations in sea level.

Oil and gas production on the sea continental shelf at all stages is different polluting effects. This is especially evident during exploration, drilling exploration and production wells, oil and gas production, preparation of oil for transportation, storage and transportation. One of the main tasks is to ensure environmental safety in these processes and to assess risks at each stage.

Table 3[1]

Frequency of oil and gas spills in the mining process and the trend changes in the magnitude of spills

The main types of implemented works and operations	**Number of spill cases detected (pcs..)**	**Total spill (t)**	**The amount of oil for each spill (t)**
1	**2**	**3**	**4**
Drilling and production:	**4**	**762**	**191**
Oil storage and loading processes	**12**	**30952**	**2579**

Filling oil in pipelines and transportation	**63**	**49660**	**788**
Tanker transportation	**23**	**78000**	**3391**
Total:	**102**	**159374**	**6949**

Note: Calculations are made on the basis of indicators Table IOSD (International Organization for Sustainable Development) in 1999.

Various accidents in the sea basin, the complexity of the movement of oil spilled in the water basin, which is important for the environment, led to the development of state plans to eliminate oil spills. In this situation, this type of activity has acquired the character of a specialized industrial sector. The environmental results of spills from accidents show that it is important to develop an interstate strategy to deal with oil spills, to adopt special regulatory loss standards for the Caspian basin, as a closed water basin where large-scale oil projects are implemented. Currently, depending on the types of activity of the Russian Federation, the standards for oil losses are defined as follows:
a) For every 1 million of oil — 420 tons for rail transportation, b) 171 tons for 1 million tons of oil during filling, c) 1,400 tons for 1 million when filling tankers 9. In addition to the standards for losses, depending on the volume oil production, to ensure the environmental safety of the basin, it is also important that a certain part of the income from the oil produced is proportionally spent on ensuring the preservation of environmental stability. Even if the Russian Federation accepts at the same time, as a possible option, 1% of the volume of oil production, then in this situation these costs will not be enough to reduce the tendency to pollution. Acceptance of 1.5-2.0% as a regulatory option, important for the Caspian littoral states, is determined by our mathematical calculations as the end result of sustainability.

To this end, we first used and included the mathematical dependence of the Ec-coefficient of environmental sensitivity, allows us to determine the indicator of ensuring the sustainability of natural water basins and self-purification from pollution or providing the function of self-healing water basins

$$Ec = \frac{S1}{S\ 2}$$

Based on this mathematical dependence, from our side, on the basis of our calculations, the following indicator was obtained for the Caspian Sea:

$$Ec == \frac{392{,}6\,m\ln km}{3{,}5\,\mathrm{mln\,km}} = 0{,}1$$

The coefficient of sensitivity of the Caspian Sea basin obtained as a result of the study to pollution, as well as weak self-healing processes and all other operations carried out by the research, once again proves the need for comparison with this coefficient. For information it should be noted that for the world ocean, Ec = 0.3, for other water basins it varies within the limits of Et = 0.9-2.8.

As a result of our analysis of pollution materials, once again confirm the validity of this option. Thus, with the growth of the economic potential, oil pollution of the Caspian Sea is a problem that requires great attention. It is necessary to take into account that the oil and gas reserves of the Caspian Sea belong to exhaustible and non-renewable resources, while its susceptible bio resources belong to the group of exhausted, but recoverable, and have the ability to be used effectively and for a long time.

Therefore, efforts should be made so that the status of a territory that has become unusable after the exploitation of oil and gas resources does not belong to the Caspian Sea basin, but remains inexhaustible wealth for future generations.

However, analysis of the dynamics of the ecological status of the Caspian Sea shows that the amount of pollutants flowing into the basin continues to grow from year to year, and the ability of the sea to absorb pollutants, that is, the self-cleaning function falls from year to year. As a result of diagnostic monitoring studies of the Caspian Environment Program, it turned out that during the year only 138.4 tons of oil, 104 tons of phosphorus compounds and 886.1 tons of nitrogen compounds entered the Caspian Sea from coastal states only (8). Caspian Sea. State of the Environment Report of the interim Secretariat of the Framework Convention for the Protection of the Marine Environment of the Caspian Sea and the project management and coordination project (8).

In the near future, taking into account the current economic situation, it is expected that the total annual volume of pollutants from coastal states will increase in the marine basin by a factor of 1.5-2.0 (table 4).

If we add to this the transit transportation and pollution coming in the process of drilling and production, then only for oil products this figure reaches 132 thousand tons, which, according to V. Ivanov, is 123 thousand tons (9 thousand tons / year) or 14.7 times the self-cleaning ability of the Caspian Sea. At present, the level of oil pollution in the Caspian Sea water area as a whole varies from 0.03 mg / l to 570 mg / l, which exceeds the allowable density limit hundreds of times (19).

Table 4

Projected total annual volume pollution levels from industrial effluents complexes, municipal farms and transit rivers of coastal states Caspian Sea Basin for 2016-2020 (tons / year)

Coastal States	Oil products	Phosphorus compounds	Nitrogen compounds
1	2	3	4
Russian Federation	171,6	178,0	1620,6
Iranian Islamic Republic	41.4	17,4	57,2
Kazakh republic	17.2	2,4	27,2
The Republic of Azerbaijan	36,0	6,9	49,7
Turkmen Republic	11,0	6,1	1,5
Total....	277,2	210,8	1756,2

Note: The indicators are predicted based on the current level of development of coastal states, the equipment of cities with sewage treatment plants, industrial technology.

It should also be noted that the sea basin has the ability to self-clean at a contamination level of 35 mg / l in the summer months and only 10 mg / l in the winter months. The high intensity of pollution is primarily due to the fact that the technology of oil and gas production does not meet modern environmental requirements, the coastal areas are poorly equipped with sewage treatment plants, the fixed assets of port facilities are physically outdated, the lack of necessary automatic systems, and the implementation of environmental measures. factors, evaluating them as secondary. According to experts, the role of oil and oil products among the pollutants of the basin is very large. A hundred years

of research has shown that, due to the high degree of pollution in the basin, its phyto and zoobenthos have practically lost their function in the area of oil production, and anaerobic conditions have been formed in the sediments of the bottom. At the same time, the product of primary photosynthesis of phytoplankton decreased by almost 50 times. (17)

One of the factors affecting the pollution of the sea basin and having a promising polluting potential is the Caspian-European "oil and gas corridor". As already noted, the potential offshore oil and gas reserves of the marine strip are becoming the largest hydrocarbon suppliers in Europe. In terms of its hydrocarbon potential, the Caspian basin is already compared with the North Sea and the Persian Gulf, and its share is continuously growing on the European market. Currently, only 25 oil and gas fields have been discovered on the shelf of Azerbaijan. At 17 of them produce mining, at 2 it is completed, the remaining 6 are not yet exploited. Aliyev I.G. Caspian oil of Azerbaijan. M .: Izvestia. 2003. - 712 s. Tengiz Karachanag, Uzen and Kashagan deposits located in western Kazakhstan are in the process of intensive development. More than 50 fields have been discovered in Turkmenistan and many of them are already exploited. (19).

More than 20 prospective structures have been opened on the Russian shelf. Intensive exploration is underway on the Iranian shelf. Despite the fact that the potential for entering the European market remains problematic, certain projects have been implemented in this direction, some projects are under development. Thus, the Baku-Novorossiysk, Baku-Tbilisi-Supsa, Baku-Tbilisi-Ceyhan and Baku-Tbilisi- Arzurum pipelines function as part of Azerbaijan, and the Tengiz-Novorossiysk pipelines and tanker shipments of the Russian Federation through the Black Sea through Kazakhstan. However, Kazakhstan and Turkmenistan continue to work on new projects to enter Europe through the territory of Azerbaijan, and among them the Trans-Caspian oil and Trans-Caspian gas projects attract attention. The laying of one part of the Trans-Anatolian and Trans-Adriatic pipelines originating from the Shah Deniz gas condensate field has already been completed. At the other end of the segment, work continues. The Trans-Caspian oil pipeline project provides for the transportation of Kazakh and Turkmen oil to Europe through pipelines laid on the seabed at the same distance of 388 km along the Aktau-Baku route, according to another variant of Aktau-Turkmenbashi-Baku, while the Trans-Caspian gas pipeline along the seabed along the route Shatlik-Turkmenbashi-Baku-Tbilisi-Turkey. Their implementation is gradually becoming a reality. In such a situation, coming to the fore, ensuring environmental safety is becoming the main factor requiring planning for ongoing projects. (15) Thus, the annual growth in transit traffic has led to the migration of alien species to the Caspian Sea, which has led to a real threat of biodiversity loss in the basin. Detection of jellyfish in the basin (aurella aurita, mneniopsis leudyi), mass death of keelfish and seals is considered one of the facts of a dangerous environmental situation. Its main reason is explained not only by oil pollution, but also by ballast water during transportation, the problem of which is not solved in the basin. The adoption of measures to eliminate the intensity of migration to the basin of alien living organisms with ballast water remains the main environmental problem in coastal states. One of the issues of forecasting the potential of pollution in the Caspian Sea is the fluctuation of the sea level and its role in pollution. The current level fluctuation is accompanied by transgression and regression processes, covering a period of more than 30 years (1978-2015). In the period of transgression, observed in 1978-1995, the sea level rose by 2.5 m, followed by a stabilization cycle, and now the rise is again observed. It should be noted that this process is characterized by a dynamic cycle and is always characterized by certain environmental consequences. The results of oscillations are aggravated by "surges" processes occurring in the sea. Depending on wind speed, especially in a raging sea, rising sea levels lead to flooding of the coastline, causing sea pollution from the coastal strip. The greatest limit of the surge process on the shores of the Caspian Sea occurs on its

very shallow northern and north-western shores during strong southeastern and eastern winds. On the northwestern shores of the sea, during very strong and persistent eastern and southeastern levels, the water level rises by 2.5-3.0 m. A wide strip of low shores is flooded, a large number of oil wells become a source of pollution. This is also evidenced by the oil spill in 1988 on the eastern shores of the sea during the surge process, when a large amount of oil spilled on the Teren-Uzek, Tengiz and Breakthrough oil fields from 800 oil wells in the sea 11. In the future, a 25 m deviation of sea level become a predicted reality that can cause serious damage to the marine ecosystem, increasing the risk of flooding most of the existing oil wells in the coastal zone. Therefore, one of the necessary measures to eliminate the threat of sea pollution is to develop a unified long-term ecological program of the basin in order to avoid the transformation of industrial objects of the coastal zone, subject to fluctuations of sea level, into pollution sources.

Conclusion

Along with using the economic potential of the Caspian Sea, the protection of its ecosystem is one of the key issues that are at the center of attention not only of coastal states, but also foreign operating companies and international organizations operating in the region, in particular the International Maritime Organization (IMO) (12). Recently, a number of important steps have been taken in this direction. The Tehran Framework Convention, in force since August 12, 2006, was signed, which is the main legal document. Later, in 2011 and 2012, protocols were signed on a joint plan to deal with oil spills and marine pollution from coastal sources. In 2013, an agreement was signed in Astrakhan to apply a moratorium on sturgeon fishing. In Ashgabat, in 2014, a special protocol on the protection of marine biodiversity was signed at the national and regional levels. Based on this protocol, the implementation of oil and gas production according to the requirements of the Tehran Framework Convention was imputed as an environmental obligation to foreign companies operating in the Caspian Sea.
However, analyzes show that, despite all efforts, a balanced mechanism has not yet been created between the use of the economic potential of the sea and respect for its environmental protection, and the trend of ecosystem exposure to pollution continues (3), (Babayev). The expansion of tourism in coastal beach areas, sea cruises in the Caspian Sea, including inland waterways, especially puts the solution of environmental issues in seaports and en route. Opportunities to expand tourism have already opened, in addition to the coastal zone of Azerbaijan, but also through the organization of sea cruises in the Caspian Sea. On this occasion, preparatory activities are already underway in the tourism organizations of the country, a memorandum of cooperation has already been signed.
Tourists from the Caspian countries along the route Moscow - Baku will also be able to travel on this sea cruise; Astrakhan - Makhachkala - Baku; Baku - Enzeli - Noushehr - Turkmenbashi - Aktau - Astrakhn and others.

Attracting holidaymakers from the Republic of Turkey to the Caspian Sea cruise with its large port of Istanbul and other coastal zones will significantly increase their flow.
A sea cruise on the Caspian and Black Seas will lead to the revitalization of the city and the pier in tourist routes.

Given the real environmental threat, the main focus in addressing the problem of environmental safety should be the fulfillment of the requirements of the Tehran Framework Convention and the protocols adopted to it in the form of annexes. It is also necessary to take measures such as assessing the environmental impact of the sea in a trans boundary context, creating a balanced mechanism between intensive hydrocarbon production, their transportation in the sea basin from coastal states and the protection of its unique ecosystem.

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