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An Outlook for Indian «Peaceful Atom»: Prospects of Indian-Armenian Cooperation in the Field of Nuclear Energy

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ABSTRACT:

The article considers the geopolitical cross-section of the development of India's nuclear power industry. The main milestones in the history of the development of the energy industry of India, as well as the state of electrification and the problems of energy shortages are presented. It is demonstrated that the removal of the restrictions of the Nuclear Suppliers Group (NSG) in 2008 caused the acceleration of the nuclear power development in India. Thus, the Indian nuclear power market has become an arena of competition for such geopolitical players as Russia, France and the United States. At the same time, Indian-Armenian cooperation in the nuclear field is considered in the context of India's capability to become one of the major exporters of nuclear technologies, facilities and expertise in the world. The rich history of nuclear energy development in India and Armenia will ensure positive effects for both sides. The study also presents the geopolitical dimension of Indian-Armenian collaboration. The conclusions presented in the article are of an applied nature and can be used by official institutions responsible for the development of interstate relations between Armenia and India.

Key words: nuclear power, NPP, NSG, geopolitics, India, Armenia

INTRODUCTION:

According to the National Electricity Plan of India, the share of non-fossil energy sources (Nuclear + Hydro + Renewable Sources) will increase to 49.3 % by the end of 2021-22 and will further increase to 57.4% by the end of 2026-27 [1]. The Plan demonstrates the will of Indian authorities for the maximum diversification of the energy system which is the basis of the energy security of any state. Thus, India stimulates the development of its energy market, reduces the risks of energy crises and thereby increases the level of its investment attractiveness. The development of power sector facilitates economic growth in various sectors of the economy, such as manufacturing, agriculture, commercial enterprises, and railways.

Along with this, it is noteworthy that the country has a leading position in the world in terms of total energy consumption, after the USA, China and Russia. At the same time about 15,47% of the Indian population does not have access to electricity, and the Indian authorities intend to solve this problem completely by 2030 [2]. India makes unprecedented progress towards the electricity access, as there is a strong push from the government that has resulted in almost 100 million people gaining access to electricity in 2018 [3]. In general, today the Indian economy is mainly based on agriculture, mining and manufacturing, providing 7% growth per year.

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Traditionally, coal and oil have dominating position in the energy balance of India, about 60%. This fact doesn't quite fit into the economic development strategy of India, developed by the Indian authorities for the long term. The current decade has been declared to solve the problem of energy diversification in India. According to the program of innovative development of India, initiated by ex-P.M. Manmohan Singh (2004-2014), the task was set to create an innovative model of economic growth in India, including through the implementation of policies in the field of scientific engineering and experimental design. As a result of the consistent implementation of the program, a number of key players in the global technology market (for example, IBM, Microsoft, Cisco, Nokia, Xerox, etc.) today consider India as a platform for launching new products. In this background the raw material component of the Indian economy should eventually give way.

It is difficult to determine whether the Indian authorities will succeed the Third Plan, according to which the share of energy from non-fossil fuel sources will increase to 57% by the end of 2026-2027 [1]. The share of renewable energy (primarily the sun, water resources and biomass) is planned to be 24.2% of the total energy production in 2026-27 respectively. But there are a number of factors that make us look at the new model of the Indian energy market from a different angle. First of all, the energy future of India must be considered in the context of regional geopolitical architecture. In this regard, when considering the prospects for the development of Indian energy, it is important not to forget TAPI pipeline construction project (Turkmenistan-Afghanistan-Pakistan-India), Myanmar-Bangladesh-India and "Peace" pipeline construction projects (Iran-Pakistan-India) which form some skepticism regarding the fossil fuel free energy future of India. At the same time, India continues to increase oil production, which is accompanied by the construction of a number of oil refineries and their products are stably exported to foreign markets, including China and the U.A.E. The share of export of fuel products from India in last few years has been about 12-16% of the total export structure [4].

The diversification of Indian energy involves the strengthening of the nuclear complex as the guarantor of India's energy security, which is also indicated in the Third Plan. In this regard, it is important to take into account the prospects for Russian-Indian cooperation, that has already yielded tangible results in the form of launching two reactors at the Kudankulam NPP with a current installed capacity of 2000 MW. Thus, the approach of parallel development of the traditional and renewable sectors is, in fact, the basis for India's new energy strategy and testifies its "energy pragmatism". Obviously India plans to boost electricity exports to Asian countries. India has the capability to export nuclear power and non-nuclear facilities and to provide high-qualified expertise for developing energy infrastructure in developing countries.

The study of the Indian experience of the effective development of energy infrastructures and its nuclear component, in particular, can be useful for developing countries. To reveal the phenomenon of Indian "energy pragmatism", it is necessary to study the main features of functioning of the Indian energy system and its nuclear component on a deeper level.

THE HISTORY OF ELECTRIFICATION IN INDIA

The influence of India is getting bigger and

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bigger in the world and in the Asian region, in particular. In this regard, it is important to analyse the modernization experience of the country and its energy complex. Today, India is among the top ten countries in the production of electricity per capita, in consumption and production of electricity. However, energy shortages in India are still common.

The process of electrification in India has passed some stages. It started at the end of the 19th century, when Calcutta, Bombay and Delhi were electrified. The energy industry was mainly controlled by the Indian affiliates of British and American companies. In 1910 the first legislation to regulate the energy sector was created [5]. According to the law of 1919, regulation of the electric power industry passed into the jurisdiction of Indian states which eliminated a single policy in the energy sector [6]. After gaining independence in 1948 Electricity supply act was adopted aiming to develop electric networks at the local level. In 1954 the Department of Atomic Energy was established to develop nuclear power technologies and to promote research of radiation technologies. In the late 1950s the country began developing uranium deposits. The first nuclear power plant was built in Tarapur, Maharashtra consisting of two reactors with the total capacity of 300 MW of electricity with the participation of the American General Electric (commissioned in 1969). In subsequent years, new nuclear power plants were launched in Rajasthan, Madras and elsewhere. It is noteworthy that in 1960-1970s 18 thermal power stations and 1 hydroelectric power station were built in India with total capacity of 5200 MW with the assistance of the Soviet Union [7]. In 1987 Nuclear Power Corporation of India (NPCIL) was established which is responsible for the nuclear power production. Starting from the eighth five-year plan (1992-1997), the Government of India started paying more attention to rural electrification. Central Electricity Regulatory Commission (CERC) was formed for maintaining unified planning and policy in all the states of India to overcome the problem of electrification.

In 2015, on the Independence Day the current P.M. of India Narendra Modi in his speech set a 1000-days deadline for the completion of the electrification of all rural areas. According to official statistics, 100% of towns and 98,1% of villages in India were electrified in 2015-2016 [8]. It is noteworthy to mention that in India about 42% of electricity is consumed by the industry, 24% - by domestic consumers, 17% - by agriculture. However, this statistics doesn't fully describe the current state of electrification of Indian population. According to World Bank data, by 2017 only 99,2% of urban population and 89,3% of rural population have access to electricity [9]. The ambiguity of official claims on the complete electrification of Indian rural areas origins from the general principle of accounting electrification data: a village is considered to be electrified if 10% of its homes and all public buildings are connected to the grid [10]. Despite the ambivalence of national statistics, there can be found a positive tendency in providing access to electricity in India since the famous speech of the current Indian P.M.

Another important issue in the power industry of India is the large degree of losses in the transmission of electricity from producer to consumer which ranges from 22-34% [11]. At the same time, by 2020, about 62,8% of the electricity produced in India is generated by thermal power plants, 12.4% - by hydro power stations, 1.9% - by nuclear power plants and 23,5% - by renewable energy sources [12]. Most TPPs generate electricity using low-quality coal

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with high CO_2 emissions. It is remarkable that India has signed and ratified the Paris Global Climate Agreement in 2016, according to which the country intends to significantly reduce greenhouse gas emissions.

THE MAIN STAGES OF DEVELOPMENT OF NUCLEAR ENERGY IN INDIA

India is one of the first countries in Asia to consider developing nuclear energy. Initially, India's nuclear program developed as part of the Colombo Plan, designed to strengthen the position of the already agonizing British Empire. According to the plan, the UK and its dominions pledged to provide technical assistance to India, Pakistan, Ceylon (now Sri Lanka) for promotion of their economic and social development. The start of the foundation of the nuclear field in India can be regarded the foundation of the Tata Institute of Fundamental Research in Mumbai, in 1945. From that moment, a scientific and production base has been formed in the country, allowing it to create almost all types of nuclear products, both for peaceful and military aims. In the 1950s, the famous Indian physicist Homi J. Bhabha developed a three-stage program for the development of nuclear energy, according to which uranium dependence in the future should decrease due to the transition to thorium, reserves of which are 13% of the global reserves in India. The program proceeded from the fact that uranium reserves in India are insignificant and of low quality, which determines the high cost of Indian uranium (4-5 times more expensive than imported uranium). It makes the country dependent on external fuel supplies.

Currently, there are 22 nuclear reactors with a total capacity of 6.780 MW in India. It is envisaged that in the next 25 years there will be a fourfold increased demand for electricity, associated with population growth, industrial development and urbanization. Realizing this, India has developed a promising nuclear energy development program, according to which by 2032 nuclear power capacity will be 63,000 MW [13]. In general, according to the plans, 25% of electricity will be produced by nuclear power plants by 2050. At the same time, by 2050 India plans to meet 30% of its energy demands via thorium reactors. It is notable that in the next two decades, it is planned to build 12 nuclear power units in India according to the Russian project. NPPs of 7,000 megawatt (MW) capacity are currently under various phases of construction, including 3 units of Kudankulam power station project with total capacity of 3,000 MW.

India does not hide its ambition to become one of the main suppliers on the foreign nuclear energy market. To enter the foreign markets, it is necessary to solve the problem of its dependence on imports of raw materials and resource shortages. At the same time, the country managed to achieve significant progress in the development of original technologies in the field of nuclear energy. According to experts of DAE, the dependence of India on foreign equipment and materials in the nuclear industry doesn't exceed 10-15%. Experts estimate that India may become a supplier of heavy water reactors to foreign markets in the foreseeable future.

India also produces competitive products in areas related to nuclear energy: medicine, agriculture, desalination and water treatment. Technologies in the field of nuclear medicine are used to diagnose and treat cancer, sterilize medical equipment, and develop lasers used in surgical treatment. In agriculture, nuclear technology is used to increase yields by changing the properties of seeds at the genetic

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level. Nuclear desalination and water treatment technologies are widely used in the dry regions of India.

SOME GEOPOLITICAL ASPECTS OF THE DEVELOPMENT OF "PEACEFUL ATOM" IN INDIA

Today in India, the problem of "peaceful atom" is especially relevant, since the development of nuclear energy inevitably affects non-proliferation issues. These issues are regulated by various agreements, such as the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the Convention on the Physical Protection of Nuclear Materials, nuclear-weapon-free zone treaties, etc., as well as other international organizations, such as International Atomic Energy Agency (IAEA), UN Security Council, the Nuclear Suppliers Group (NSG) and other institutions.

India hasn't signed the Nuclear Non-Proliferation Treaty in connection with its nuclear weapons program. For this reason, NSG, which was established in 1975, after India's testing of nuclear weapon in 1974, placed restrictions on the supply of equipment and technologies in India for 34 years which constrained the development of nuclear energy. In 2008, exceptions were made for India by removing the NSG restrictions. As a result, India gained wider opportunities for developing nuclear energy and overcoming energy shortages. The decision to remove restrictions was the result of the United States' efforts in order to achieve a geopolitical advantage in the Asian region as a counterweight to the influence of China.

Nuclear power in India today is developing to a greater extent due to competition among large foreign suppliers. India maintains cooperation with major global suppliers of technology equipment for Nuclear Fuel Cycle (NFC) - Russia, France and the United States. The cooperation with Russia is progressing most effectively. Russia has already managed to launch two power units of the Kudankulam NPP in Tamil Nadu. Compared to other nuclear partners, Russia retains its leadership in the Indian nuclear industry. According to the DAE, the estimated cost of produced electricity is around Rs 6,5-12 per unit for the American and French companies' based NPPs, while for the Kudankulam two units the cost is only Rs 3,5-4 per unit [14]. It is noteworthy that India's accession to the NPT may lead to a situation that Russia may lose its monopoly status in India's nuclear energy.

In this background the United States and France are advancing less successfully. Initially, two lands were allocated for the Americans - Kovvadav in Andhra Pradesh and Mithi Virdi in Gujarat, but due to unfavorable legislation the construction of the nuclear power plant was suspended. France plans to build the Jaitapur NPP, but the construction deadline is being extended. In November, 2015 an agreement on civil nuclear cooperation was concluded with the United Kingdom, and in November, 2016 similar agreement was concluded with Japan.

It should be noted that deployment of NPPs often leads to conflicts with local residents in Indian settlements. The reasons for mass protests are the lack of information and distrust of local residents towards the modernization of the country, especially after significant disasters at the Bhopal chemical plant (1984), the Chernobyl NPP (1986), and the Fukushima NPP (2011). The most active and lengthy protests were held against the construction of the Kudankulam NPP, that allows to assume that

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the protests might be organized by French and American companies with the aim of causing damage to Russian positions. It is important to note that in September, 2019 the NPCIL confirmed that there was a cyber attack on the Kudankulam NPP. U.S. State Department officials and American media sources accused North Korea to launch the attack [15]. However, in few days the NPCIL excluded the possibility of cyber attack on Kudankulam NPP, as its network is not connected to internet.

Despite the criticism and protests based on environmental concerns, it is clear that India, along with other Asian countries (China, Japan and South Korea), is actively involved in the global industry of nuclear power. Along with solving domestic problems of electrification, India has the capability to become one of the main exporters of peaceful nuclear technologies and nuclear power reactors like Russia, France, the U.S., Japan and South Korea. India can offer its expertise in the sphere of nuclear energy development and non-nuclear applications as well. India and Russia are already collaborating in the project of building Rooppur NPP with two units in Bangladesh. The cooperation of the countries in the nuclear sector seems to be continuous as they discuss mutual projects in the third countries including construction of NPPs in African region and in the Middle East [16]. Probably, it is only the beginning of the emergence of India as a nuclear exporter, and India will find new avenues of collaboration in other regions as well. It will inevitably lead to the growth of India's geopolitical influence in the Asia-Pacific region and beyond it.

POTENTIALS OF INDIAN-ARMENIAN COOPERATION IN THE FIELD OF NUCLEAR ENERGY

We consider the probable scenario of Indian-Armenian cooperation in the field of nuclear energy reciprocally advantageous for both sides. South Caucasus region and Armenia, in particular, may interest India in the context of implementation of the Great Silk Road project by China. The membership of Republic of Armenia in Eurasian Economic Union (EEU) gives new prospects for development of energy markets in the Eurasian region. India as a potential key partner of the EEU, may provide its rich experience of strategic development of energy system for the formation of common energy market in the region. The rich history of nuclear energy development in India and Armenia will ensure the high effectiveness of the possible collaboration.

Indian-Armenian relations have a long history, despite the geographic distance of the countries. Diplomatic relations between Armenia and India were established in 1992, after Armenia got independence in 1991. Since then, an effective political, economic and cultural dialogue has been established between the countries. However, the current state of economic relations doesn't fully reflect the potential of the bilateral cooperation and still needs rethinking. Prerequisite for deepening the cooperation is the fast economic growth of India and its geopolitical rearrangement, on the one hand, and the integration of Armenia in the EEU, on the other hand. Moreover, Armenia and India have intergovernmental agreements on trade and economic, scientific and technical cooperation, on the promotion and protection of investments and so on.

South Caucasus region and Armenia, in particular, may interest India as a transit corridor, especially in the context of implementation of the Great Silk Road project by

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China. The collaboration in the nuclear energy sphere will be gainful for both sides in political and economic sense, by providing opportunities for technical and scientific progress and innovations.

Armenia has a well balanced electric energy system. Armenian energy system fully covers the electricity demand in the internal market and has significant potential to export the electricity. "Under the Soviet regime, the RA energy system was designed as an energy surplus, covering part of the region's needs, as a result of which Armenia today is able to ensure uninterrupted export of electricity to neighboring countries. Obviously, if there is a power deficit in countries such as Georgia, Azerbaijan, Turkey, Iran and Iraq, the Republic of Armenia has every chance to declare itself as a key player in the regional electric power market" [17]. Armenia has a protectionist nuclear policy in the field of "peaceful atom", developing nuclear energy as one of the main sources of national energy supply (about 40% of the total electricity production). According to the Law on Energy of RA (Chapter 2, Article 6), "nuclear power is a state monopoly. The state bodies authorized by the Government of the Republic of Armenia control the activities of forming the organizational, legal and technical systems of nuclear and radiation safety. The issues of nuclear energy, its impact on the environment and security are regulated in accordance with international treaties and the legislation of the Republic of Armenia" [18].

Armenia has joined the NPT in 1991, and in 2006 has ratified the CTBT. Since 1993, Armenia has been a member of the IAEA and has been actively cooperating with the agency as a country that uses nuclear energy for peaceful purposes. Since Armenia is not a manufacturer of nuclear materials, equipment and technologies, it does not participate in organizations exercising export control regime – the NSG and the Zangger Committee (Nuclear Exporters Committee). Republic of Armenia gives big importance to international treaties in the nuclear energy field that has strategic importance in the process of maintaining international security.

The Armenian NPP is considered as one of the leading factors of economic and geopolitical competitiveness of Armenia in the region. The presence of peaceful nuclear energy in Armenia maintains the political-economic equilibrium and regional security in South Caucasus. It is noteworthy that Azerbaijan plans to step in the nuclear market, despite its demands on the closure of the Armenian NPP because of its «regional environmental risk» (as stated by Azerbaijani officials).

At absence of own natural power resources, the Armenian NPP is guarantor of Armenia's energy independence and energy security. The only Armenian NPP is situated in Metsamor and consists of two units, with installed capacity of 408 MW per unit. The first unit was exploited in 1976 and the second one – in 1980. The Armenian NPP was closed down in 1989 after 1988 Spitak earthquake, after continuous public protests. The second unit was put into operation in 1995 but long-term shutdown was imposed on the first one. The exploitation of Unit 2 was realized with the assistance of Russian organizations, and the systematic assessment and improvement of the security of this block were carried out with the assistance of IAEA, European Union and USA and Russian organizations [19].

The Decommissioning Plan of the Armenian

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NPP was adopted by the Government of RA in 2007. New nuclear power unit(s) needs to be constructed to replace Unit 2. It was envisaged that new unit(s) should be put into operation immediately after the shutdown of the current one to cover the lack of capacity. For ensuring energy independence of the country preference is given to the nuclear plant with up to 600 MW capacity, according to the Government Session No.54 Protocol Decision. Armenia and Russia have adopted intergovernmental agreement of cooperation on construction new nuclear unit(s) on the territory of Armenia. The Russian Federation's portion of investment will be equal to the cost of the nuclear island. Other costs are expected to be covered by Republic of Armenia or other investors [20].

In this regard, India has a successful collaboration experience with the Russian Federation in building Rooppur NPP in Bangladesh, so it can be considered as a potential partner of Republic of Armenia and the Russian Federation in the construction of new unit(s) in Armenia. The Indian-Armenian cooperation in the field of nuclear energy will lead to certain outcomes:

1. Armenia can be a platform for the implementation of Indian nuclear technologies and facilities, as well as, for scientific innovations in the nuclear energy production by considering the many years of successful experience of nuclear energy development in both countries. Armenia has more than 40 years experience in this field. It has developed an educational system for the preparation of professional workers in the field of nuclear energy and is rich with high-skilled nuclear specialists.
2. Indian-Armenian cooperation can lead to the scientific achievements in other spheres of peaceful use of the nuclear energy (agriculture, health care and medicine).
3. Educational exchanges will reflect positively on the preparation of high-quality specialists with innovative ideas in the nuclear energy field.

It is important to state that the EEU has planned the formation of general electricity market of the Union by 2025, so India can be the key partner of the EEU in this process. The general electricity market will create opportunities for effective regulation of electricity trade and its transit through the countries of the Union and beyond it.

CONCLUSIONS

1. The removal of restrictions in India by the NSG has allowed achieving certain successes in the field of nuclear energy. India has strategically important task, namely: to achieve 100% electrification of the country through the development of nuclear energy, which will let to pull out some part of the country's population from the state of poverty.
2. Considering India's rich experience in the development of nuclear energy, we can assume that the nuclear component will dominate in the Indian energy balance in the framework of the new philosophy of energy development. The international practice shows that renewable energy in this situation will perform no less important, but still auxiliary function. This approach, involving the parallel development of the traditional and renewable sectors, is the basis for India's new energy strategy and testifies to its "energy pragmatism".

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3. To enter the foreign markets, India needs to solve the problem of dependence on imports and the problem of shortage of raw materials. At the same time, the country managed to achieve significant progress in the development of original technologies in the field of nuclear energy. India's dependence on foreign equipment and materials in the nuclear industry doesn't exceed 10-15%.
4. As a result of the lifting of restrictions on the supply of nuclear technology, India gained greater opportunities for developing nuclear energy and overcoming energy shortages, which was largely the result of efforts by the United States to achieve a geopolitical advantage in the Asian region as opposed to the influence of China.
5. India has the capability to become one of the main exporters of peaceful nuclear technologies and facilities like Russia, France, the U.S., Japan and South Korea. India can offer its expertise in the sphere of nuclear energy development. The current Russian-Indian collaboration in the project of building Rooppur NPP in Bangladesh testifies it.
6. Armenia might interest India in the context of implementation the Chinese Great Silk Road project and its membership the Eurasian Economic Union. The latter gives new prospects for development of energy markets in the Eurasian region.
7. Nuclear energy is one of the main sources of national energy supply in Armenia (about 40% of the total electricity production), assuring energy security and independence of the country. Indian-Armenian cooperation in the field of nuclear energy will lead to positive effects for both countries. Armenia can be a platform for the implementation of Indian nuclear technologies and for providing scientific researches in the nuclear energy production by considering the many years of successful experience of nuclear energy development in both countries.

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