Nuclear Security of the South Caucasus

Ravan Mehdiyeva Nadir*

Nuclear security is a concern that no country can handle alone. This is what motivated the South Caucasian states to join the International Atomic Energy Agency (IAEA), to ratify relevant international conventions, and to join various IAEA documents on nuclear security. While all three South Caucasus states have had nuclear interests since the Soviet Union, today only Armenia has nuclear facilities – the Metsamor Nuclear Power Plant (NPP) – and since the Metamor NPP is technically outdated and located in a seismic zone, the focus has for some time been on nuclear security. The concern is well founded; Metsamor NPP is located in an area only 12 km from the Azerbaijani-Georgian border, 60 km from the Iranian border and 16 km from Turkey. All of these countries are at risk of radioactive contamination in the event of an accident in any category in the Metsamor NPP. This article analyzes the risk factors driving the region's concerns about Metsamor, examines the possible effects of an accident through comparison with Chernobyl (which had the same type of reactor as Metsamor), and finally evaluates the measures taken to ensure the nuclear security of the South Caucasus.

Key words: South Caucasus, Armenia, Azerbaijan, Nuclear security, Nuclear wastes

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Introduction

The South Caucasian states are members of the International Atomic Energy Agency (IAEA) and have ratified various international conventions on nuclear security.[1] Their security agendas are concerned with the nuclear threat as they are surrounded by countries possessing nuclear power plants and nuclear weapons, and are involved in producing uranium and conducting maritime and land nuclear testing. Within the region, Armenia owns and operates the Metsamor NPP despite the danger it poses to both Armenia and neighboring regional countries. Georgia has a Research Nuclear Reactor and Isotope Institute and had nuclear activities until 1990, albeit the fact that the reactor has been discontinued. Azerbaijan does not have any nuclear power plants; construction of an NPP in Nevai was started in the 1980s but was suspended after the terrible Chernobyl accident in 1986.

Chernobyl saw large amount of radionuclides thrown into the atmosphere, polluting the environment in bordering states and neighboring regions. Large volumes of radioactive gases, condensed aerosols and fuel leaked for 10 days from the 4th Block of the Chernobyl NPP. The total volume of radioactive substances was 14 EBk (14×10^{18} Bk) in the waste. 200,000 km^2 of Europe was polluted with radioactive elements. Contamination spread through heavy rain and wind. Pu and Sr polluted the 100 km area around the reactor, as they were in the form of large particles. The radionuclides have gradually broken down into the atmosphere, water and soil. Radioactive sediment on the surface of the Black Sea was identified on 1-3 May 1986.[2] The concentration of Cs^{137} in the surface waters of the Black Sea was 15-500 Bk/m^3 in June-July 1986; this fell in 1989 to 41-78 Bk/m^3 and 20-35 Bk/m^3 in 2000.[3] This contamination did not go unnoticed in the region; the

1 See: Information Circulars of International Atomic Energy Agency, https://www.iaea.org/publications/documents/infcircs?field_infcirc_number_value=INFCIRC&field_infcirc_date_value%5Bvalue%5

2 Doklad ekspertnoy gruppy «Ekologiya» Chernobyl'skogo foruma: (2008), Ekologicheskiye posledstviya avarii na Chernobyl'skoy AES i ikh preodoleniye: dvadtsatiletniy opyt, Vienna, IAEA,STI/PUB 1239, p.2-5

3 Vakulovcky S.M., et al., (1994). "Cs-137 and Sr-90 contamination of water bodies in the areas affected by releases from Chernobyl nuclear power plant accident: An overview", *J.Environ. Radiact*. 23 p.103-122. / Eremeev V.N., Ivanov L.M., Kirwan A.D., Margolina T.M. (1995), "Amount of Cs^{137} and Cs^{134} radionuclides in the Black Sea produced by the Chernobyl accident", *J. Environ. Radiact*. 27 p.49-63; International Atomic Energy Agency, (2003), *Marine Environment Assessment of the Black Sea/Final Report*, Technical Cooperation Project RER/2/003, Vienna, IAEA.

effects of the accident which happened on 26 April 1986 were already being felt in Turkey on May 1. While Russia, Belarus and Ukraine were the most affected, the whole of Northern Europe, Black Sea Region, Caucasus, and even the Middle East were hugely affected by nuclear pollution. However, the damage and threat was not confined to nuclear pollution. Uncontrolled areas and black zones make it more difficult to secure nuclear materials and nuclear facilities, to prevent illegal trafficking of nuclear materials, and to combat nuclear terrorism in the region. The weak control over nuclear materials and nuclear facilities on the eve of the USSR's collapse fueled the rise of nuclear terrorism and the illegal circulation of nuclear materials. Furthermore, the Soviet army units abandoned old, decommissioned and contaminated weapons and ammunition in the South Caucasus following the collapse of the USSR, leaving the newly independent republics to address these nuclear security deficits alone.

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Given the devastating consequences of Chernobyl disaster and the subsequent nuclear threats, what should regional countries expect from the Metsamor Nuclear Power Plant, a Soviet-built plant with outdated technology? What should they expect in terms of nuclear energy throughout the region more generally? In order to answer these questions, this article analyzes the risk matrix of the Metsamor Nuclear Power Plant, examines the possible effects of an accident in the plant via comparison with Chernobyl, and finally evaluates the measures taken to protect the nuclear security of the South Caucasus.

Georgia's Abolition of Soviet Nuclear Program

The foundations of the Nuclear Research Reactor in the Republic of Georgia were laid in 1957, and a large, six-hectare complex was built during 1960-1980 in Mchkhet. This was home to major scientific research initiatives, and Georgia became a nuclear state. The reactor that was built included cryogenic plants, which produce fluid nitrogen and helium, radiochemical laboratories with hot tubes. This complex employed more than 300 people, and became a key scientific hub for important discoveries in nuclear physics, chemistry, and biology. The Institute of Physics of the Academy of Sciences of Georgia was declared the leading

institute for radiation physics and low temperature material science, according to the USSR Council of Ministers in 1962, as, unlike other reactors, it could host research at low temperatures (-196 ÷ -293).[4]

Yet, following the beginning of the national democratization movement in Georgia in 1988, the Georgian Academy of Sciences discontinued the reactor and closed it on March 30 1990. This step was very important, as nuclear research is a highly sensitive field; not only was the reactor's condition unstable, its renovation would have been extremely expensive. The reactor had to be concreted, as dismantling it was too costly, and also, there was the need for complex constructional underground burial wells for environmentally safe isolation of highly radioactive waste that would be accumulated after the dismantling. Georgia simply could not meet these costs, and keeping the reactor open entailed a major risk, not only for the country but also for the entire region. As a result, the reactor ceased all operations under the watch of the IAEA. In accordance with international law, Georgia returned the highly-enriched uranium used in the reactor and in the Tbilisi Isotopes Institute to Russia, which produces it based on the decisions of The Hague International Nuclear Summit in 2015. Thus, there are not any highly-enriched uranium reserves in Georgia, and Tbilisi has taken an important step towards nuclear security.[5]

Azerbaijan Faces Nuclear Threats without Owning Nuclear Facilities

Azerbaijan has no nuclear energy reactors, and due to its rich oil and gas reserves, it does not need one. Nonetheless, the country has nuclear concerns and faces nuclear risks, and has taken appropriate countermeasures. There are two main factors (internal and external) that affect nuclear security (water basins, atmospheric air and soil) which raise concern about the dangers of radiation.

The country faces vast radiation pollution due to the technogenic

4 BBC NEWS, (2018) *West Condemns Russia Over Georgia*, 26 August, Available at: http://news.bbc.co.uk/2/hi/europe/7583164.stm; Youtube (2018) *Yadernyy reaktor v Gruzii - tayna goroda Mtskheta*, 7 February, Available at: https://www.youtube.com/watch?v=YKJ9wZxhk8M (Accessed May 30 2018).

5 RIA Novosti, (2015) *Gruziya Otpravila V Rossiyu Partiyu Vysokoobogashchennogo Urana*, 24 December, Available at: https://ria.ru/atomtec/20151224/1348476048.html (Accessed May 30 2018).

radionuclides in oil, oil processing, oil and gas production, mining fields, mud volcanoes, mineral and thermal water sources; radionuclides and ionizing radiation sources used in the fields of science, medicine and technology; and ionizing beams in the military field during the former Soviet Union. In addition, Azerbaijan faces increased risk of nuclear disasters as a consequence of the NPPs operating in the European part of Russia (Kaluga, Tula and Orel), the Chernobyl accident, Kazakhstan's nuclear reactors, uranium production, nuclear tests, Armenia's Metsamor NPP, and Iran's Busher NPP.

The oil and gas production processes release natural radionuclides into the environment in the form of solids, liquids and gas. These waste materials are primarily transported into the earth via oil and gas, layer water, water and reagents used in drilling technology. Oil and gas have formed in contact with various rocks underground and have changed into today's content. There are three natural ^{238}U, ^{235}U and ^{232}Th radioactive decomposition products of varying quantities in these rocks. Natural radionuclides are naturally distributed in Azerbaijan as a result of historical formations and technogenic activities like exposing to displacement. The oil and gas, mining and construction sectors are the main vectors of transportation and further distribution of natural radionuclides to the Earth's surface. Most radioactive elements are absorbed by rocks. They dissolve or are suspended in the oil or layer water. Radioactive elements released on the ground together with layer water exist in two sustainable forms. The suspended form is separated from the sediment in the initial oil refining processes and exists as solid waste, while the water-soluble radionuclides exist in liquid form in layer water and at their collection points in water basins. Solid waste can be released into the environment in absorbed and dissolved forms in reagents, gutters and other materials during drilling and maintenance processes. The decomposition product which has the highest displacement ability among the three natural radioactive elements is radon gases, which are products of the decomposition of Ra isotope. Radioactive radon gases are formed as a result of the decomposition of Ra isotopes, which are included in the content of natural gas, as well as solid and liquid waste in oil and gas production areas.[6]

6 Garibov, A.A. (2014) "Radioecological condition and problems of Azerbaijan*" (in Aze. language), Newsletters of the Azerbaijan National Academy of Sciences*, C. 1, N1, pp.87-91.

The biggest nuclear threat for Azerbaijan is the Metsamor Nuclear Reactor in Armenia. Historical experience shows us that earthquakes are the main cause of accidents in nuclear reactors. This problem is especially acute for nuclear power reactors located in seismically active regions. As such, it was repeatedly raised by the Azerbaijani government from 2001, when Azerbaijan joined the International Atomic Energy Agency (IAEA). The issue was raised by the former President of the Republic of Azerbaijan, Heydar Aliyev, during the 2002 visit by the former head of the IAEA, Mohamed ElBaradei, to Azerbaijan. Aliyev flagged the risk posed by the Armenian NPP's continued operation in a seismic zone. Unfortunately, IAEA agreed to extend the lifetime of the Armenian NPP by an additional ten years until 2026, as it did for other WWR-type reactors, with reference to institutional expertise. Ceasing the operation of the reactors that whose IAEA certification expired after the Fukushima accident is a key issue on the agenda of the Nuclear Security Summits.

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Japan's Fukushima 1 Atomic Power Station was closed in 2011 after the energy accident that was caused by a major earthquake and subsequent tsunami. The status of other nuclear reactors vulnerable to the impact of natural disasters was discussed at various international forums. The IAEA is implementing a regional project (C1-RER/1/007 9007 01) to convene an annual meeting of the European Advisory Council on the Safety of Research Reactors in Austria, Turkey, Romania, Bulgaria, Ukraine, Hungary, Kazakhstan and others. The meetings bring together the heads of the Research Reactors to assess whether or not these different reactors meet the relevant safety standards. Most European countries shut down their old reactors after the accident; 80 out of 96 reactors were suspended during 1996-2016 based on the natural disaster impact factor. It is planned that by 2030, 140 former generation reactors will be suspended, and 224 new generation reactors will be built.[7]

In line with this, the current President of Azerbaijan, Ilham Aliyev, has spoken on nuclear security at several nuclear summits, raising specific problems faced by the region, and calling upon

7 See the search result from the google.com: www.google.az/search?q=he+Nuclear+Fuel+Report &rlz=1C1VASI_enAZ512AZ512&oq= he+Nuclear+Fuel+ Report&aqs

the international community to put pressure on Armenia to close down Metsamor (built in 1976) as it poses a direct threat to the wellbeing and security of the people in the region.[8] He supports the US' work to strengthen nuclear security worldwide and attaches great importance to the prevention of possible use of Azerbaijan as a transit country for illegal trafficking of nuclear materials. In that regard he has initiated the creation of a robust national export control system.

Armenia's Irresponsible Nuclear Activities

The Metsamor NPP was constructed in the 1970s, and rendered operational in 1979. The Council of Ministers of the Armenian SSR closed the plant in 1989 after the 6.8 magnitude Spitak earthquake. The decree stated that "taking into consideration the general seismic situation related to the earthquake in the territory of the Armenian SSR, the activities of the first block of the Armenian NPP will be suspended on February 25 1989, and the second block on 18.03.1989." Both blocks were suspended in February/March 1989. Nevertheless, the second block was put back into operation on November 5 1995. So, it means that there was no conviction of seismic resistivity of the reactors that were produced during the Soviet Union at that time. For this reason, the second block was put into operation after six years of reconstruction, while the first block was permanently suspended. As the NPP's local staff left Armenia after the earthquake, the staff of the other reactors that operated in SSR was transferred to the Armenian NPP when the second block was put into operation. Management of NPP was transferred to ROSATOM in 2003. In 2006, the Armenian government announced that the NNP would cease operating in 2016. In 2011, the OSART commission under the auspices of the International Atomic Energy Agency (IAEA), comprised of experts from eight countries including US, UK, France, Hungary, and Finland, conducted inspections at Metsamor NPP, and the final opinion was that the continued operation of the NPP entailed a major risk.[9]

8 Embassy of Azerbaijan to the Netherlands, (2014) *Azerbaijan: President Aliyev participates in nuclear security summit*, Hague.mfa.gov.az, Available at: http://hague.mfa.gov.az/files/file/AZERBAIJAN_PRESIDENT_ALIYEV_PARTICIPATES_IN_NUCLEAR_SECURITY_SUMMIT.pdf (Accessed May 30 2018).

9 See the Database on Power Reactor Information System, International Atomic Energy Agency, https://www.iaea.org/pris/

The energy accident at the Fukushima-1 NPP had devastating consequences for Japan, even with its scientific and technical expertise and robust economy. The disaster followed a decision to extend the life of the first block by a period of 10 years. The levels of radioactive waste that poisoned the environment have inflicted major economic losses, Euros and large areas were rendered uninhabitable. However, despite this cautionary experience, the expiration date of the second block of Metsamor NPP was extended to 2026 on December 20 2014, according to an agreement signed between the Ministry of Energy of Armenia and the Russian Rosatom Company.

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Despite the fact that in 1995, Europe and the United States spent $1 million on improving the safety standards of the Metsamor NPP, the European Union deemed the plant old and unreliable. Metsamor NPP's failure to meet modern international safety requirements, the European Union insisted on its closure in 2004. The EU are ready to give 200 million Euros for the disassembling of the existing NPP.

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The 2014 agreement between Armenia and Russia extended the operation of the second block of Metsamor NPP, and Russia agreed to provide a $270 million loan and a $30 million grant to Armenia in 2016 to upgrade the NPP in line with international standards. As a result, the operating license of the second block of the Metsamor NPP was extended until 2026.

The international reputation of nuclear power has been tainted by three large-scale accidents. The first of these accidents took place on March 28 1979 at the Three Mile Island NPP near Pennsylvania, USA; the second on April 26 1986 in Ukraine's Chernobyl NPP; and the third on March 11 2011 in Japan's Fukushima-1 NPP. As a result of these two previous accidents, the reactor's active zone collapsed. The spread of radioactive substances was prevented by protective cover during the accident at Three Mile Island NPP, and so staff and the nearby population were not exposed to irradiation. By contrast, the accident at the Chernobyl NPP had a much wider impact; hundreds of thousands of people suffered from radiation and psychological stress. The explosion of the fourth block of the Chernobyl NPP leaked 7.4 tons of radioactive material into

the environment. The accident at Chernobyl NPP has been the biggest and most devastating disaster in the history of the use of nuclear energy for peaceful purposes. The reactor's active zone was completely destroyed, while the building of the energy block was partly destroyed, and large quantities of radioactive material poisoned the environment.

Technologies on seismic resistance have been established in Japan and appropriate technologies are used in most countries. Japan, for instance, has modern reactors with the best earthquake-proof technologies; but even those were unable to withstand the earthquake or tsunami. After the accident at the Chernobyl NPP, which is considered to be the greatest disaster of the twentieth century, most nuclear countries have carried out security assessments.

Metsamor's Implications for the Region

The peaceful use of nuclear energy is the sovereign right of any state. But according to international law, the development of one country or region cannot be achieved at the expense of the overall wellbeing of other states. Each state must create and uphold a rigorous national system for the prevention of dangerous environmental situations. Armenia is failing to uphold this duty to prevent and pre-empt any adverse consequences of its nuclear power plant.

Accordingly, 42 tons of nuclear fuel is used at Metsamor NPP each year. All the waste flows directly into the Kura-Aras Rivers, and then onwards into the Caspian Sea. This pollutes large areas of the environment, including drinking water.

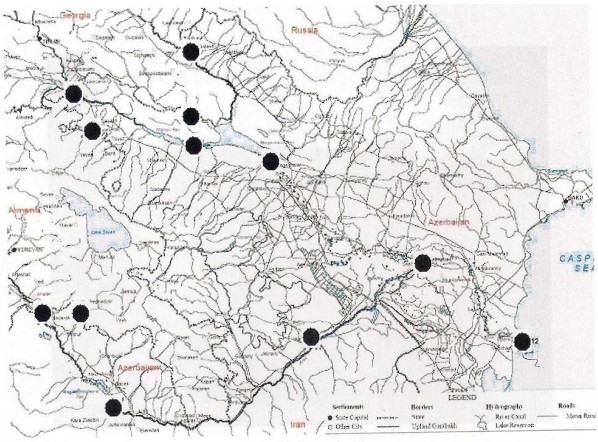
Accordingly, 42 tons of nuclear fuel is used at Metsamor NPP each year. All the waste flows directly into the Kura-Aras Rivers, and then onwards into the Caspian Sea. This pollutes large areas of the environment, including drinking water.[10] The protection and fair use of freshwater resources has become a key element of Azerbaijan's environmental safety policy. Large volumes (70%) Azerbaijan's freshwater resources - from the Kura, Aras, and Samur Rivers – flow in from the neighboring countries. The Kura River is the main source of drinking water for Azerbaijan's population. Discharge of untreated wastewater into the Kura and Aras rivers entails contamination by chemical, radioactive and other harmful substances. This damages Azerbaijan's

10 "National Security Concept of the Republic of Azerbaijan", Available at: http://www.mdi.gov.az/files/uploader/Milli_tahlukasizlik_konsepsiyasi.doc (Accessed May 30 2018).

hydro-chemical regime and water quality, creating serious and dangerous problems in regard to drinking water.[11]

In order to assess the impact of this pollution and to identify solutions in regard to detecting radioactive sources and isolating useful isotopes, vast scientific research is being conducted, by the Institute of Radiation Problems of the Azerbaijan National Academy of Sciences as well as the international community. There is specific focus on examining production areas, water resources, the radioecological state of the atmosphere, environmental impact on model systems, and the elimination of these impact factors. For instance, between 2002 and 2008, the Institute of Radiation Problems conducted a joint project with NATO's Science for Peace Fund (with contributions from the University of New Mexico in the US, Antwerp University in Belgium, and Trondheim University in Norway), entitled *SfP 977991 South Caucasus River Monitoring*. As part of the project, samples of water and sediments from the Kura-Aras Rivers and their branches were taken and examined. The project assessed the levels of radioactive isotopes such as ^{238}U, ^{234}U, ^{235}U, $^{239+240}Pu$, ^{238}Pu, ^{90}Sr, ^{241}Am, ^{137}Cs in transboundary rivers, their associated water basins, and in the sediments.

Figure 1. Kura-Aras and areas where the samples taken from their branches [12]



11 See the official website of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, http://eco.gov.az/az

12 "Radiological Survey of the Araks and Kura rives Azerbaijan", IAEA/AL/161, *IAEA Technical Cooperation project* AZB/9/004/ Seibcrsdorf, Austria, December, 2005, p.38

The research suggested that the level of ^{137}Cs in the sediment of Kura-Aras Rivers varies, in the range of 3.8 ÷ 18.8 Bk/kg. The results further showed that the activity of ^{238}U and ^{234}U isotopes on the border of the occupied Karabakh region of the Aras River and in the Kura River delta is higher than other isotopes.

There is clear negative environmental impact through the excessive contamination of water and rivers entering the Caspian Sea. The deterioration of the ecological situation in the Caspian Sea causes destruction of marine bio resources, disruption of the sea's natural and anthropogenic ecosystems, damage to the health and overall lifestyle of the population living in the area, and excessive pollution of the sea.[13] The situation echoes the 1992 finding that the basins of the Volga and Terek Rivers, flowing through Russian territory, were an "environmental disaster zone" by the relevant state agencies of the Russia. In order to prevent further pollution of the Caspian, a program to clean up the area was developed.[14] This was because the river basins were affected by the products of the nuclear, oil, and gas industries, including the nuclear materials of Russia and Kazakhstan. The initial results on artificial radionuclide content in the Caspian Sea were printed in 1998. Detailed studies on Caspian Sea water pollution with Cs^{137}, Sr^{239}, Pu^{240}, and tritium were conducted during IAEA training and research cruises in 1995-1996.[15, 16] Other expeditions to analyze the concentration of radioactive elements in the water and sediments of the Azerbaijani sector of the Caspian Sea were also conducted.

The deterioration of the ecological situation in the Caspian Sea causes destruction of marine bio resources, disruption of the sea's natural and anthropogenic ecosystems, damage to the health and overall lifestyle of the population living in the area, and excessive pollution of the sea.

Figure 2 shows the route of the expedition in the maritime area of the Iranian border from the south and the Russian border from the north, carried out by a specially equipped ship. The below expedition was conducted in 2006 on the basis of IAEA's national AZB/9/004 project, and the points show where the samples were taken.

13 Goldstein S.J., Rodrigues J.M., and Luliam N. (1997) "Measurement and Application of Uranium Isotopes for Human and Enviromental Monitoring", *Health Phys*.72(1), 1997, 10-18

14 Gosudarstvennyy doklad "O sostoyanii okruzhayushchey sredy Rossiyskoy Federatsii", 1992

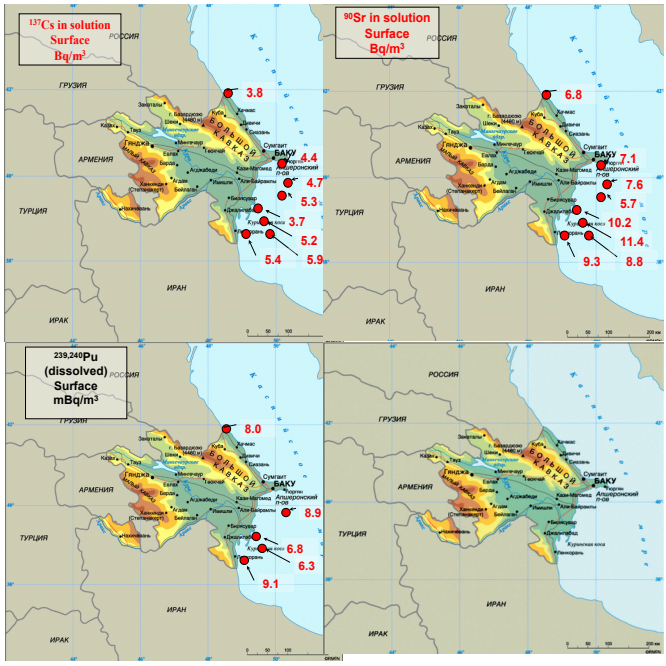
15 Vakulovsky, S.M. and Chumichev, V.B. (1998) "Radioactive contamination of the Caspian Sea, J.Radiation Protection", *Dozimetry*, Vol.75, Nos1-4, pp.61-64,

16 Froehlich, K., Rozanski, K., Povinec, P., Oregioni, B., Gastaund, J., (1999) "Isotope studies in the Caspian Sea", *The Science of Total Environment*, 237/238, 419-427

Figure 2.[17]

The activity of ^{90}Sr isotope in the surface waters of the Caspian Sea occurs due to the flow of neighboring countries with nuclear facilities, as shown in Figure 3.

Figure 3[18]



17 "Investigation of Marine Radio-activity in the Azeri region of the Caspian Sea", (2006). Rep*ort IAEA Technical Cooperation project,* AZB/9/004, Monaco, France.

18 *Ibid.*

The tables below present the results of the expeditions, including the radionuclide content of Azerbaijani waters and the distribution of nuclear pollution in the Kura-Aras Rivers and the Caspian Sea. The results demonstrate that although Azerbaijan is not a nuclear country, it suffers from nuclear contamination.[19]

Table 1. Distribution of ^{238}U, ^{234}U, $^{239+240}Pu$, ^{238}Pu, ^{90}Sr and ^{241}Am isotopes in sediments of Kura-Aras Rivers. [20]

Area, where the sample was taken	Type of samples	^{234}U	^{238}U	^{238}Pu	$^{239+240}Pu$	^{241}Am	^{90}Sr
		Bk×kg^{-1} dry weight					
Aras River sediments near Horadiz	1st layer (0-5 cm)	13,4±0,4	13,4±0,4	0,007±0,004	0,17±0,2	< 0,004	< 3,0
Aras River sediments near Horadiz	2nd layer (5-10 cm)	13,4±0,5	13,5±0,5	< 0,005	0,27±0,02	0,16±0,02	<3,0
Aras River sediments near Horadiz	3rd layer (10-18 cm)	13,2±0,6	13,6±0,6	<0,008	0,21±0,02	0,09±0,03	<3,0
the delta of the Kura near Neftchala	Sediment sample	13,1±0,4	13,2±0,4	<0,005	0,08±0,02	< 0,004	<3,0

Table 2. Results of artificial radionuclide analysis of seawater samples taken from the Azerbaijani part of the Caspian Sea in July 2006 [21]

The date of the analysis	Station code	The points that the samples were taken	^{137}Cs, Bg/m^3	^{90}Sr, Bg/m^3	$^{239,240}Pu$, mBg/m^3	^{3}H, kBg/m^3
09.07.06	I-0	Surface	(d) 3,8±0,4	(d) 6,8±1,4	(d) 8,0±2,4	(d) 1,3±0,1
06.07.06	II-1	Surface	(d) 4,4±0,4	(d) 7,1±1,4	-	-
05.07.06	II-2	Surface	(d) 4,7±0,5	(d) 7,6±1,5	(p) 6,2±1,4 (d) 8,9±2,5	(d) 1,1±0,1
	II-2	60 m	(d) 5,0±0,5	(d) 7,3±1,5	(p) 15,4±2,5 (d) 9,5±2,0	(d) 1,0±0,1
	II-2	points near the bottom (180 m)	(p) <0,04 (d) 4,9±0,5	(d) 5,1±1,0	(p) 21,7±2,9 (d) 17,5±3,4	-

19 "Radiation situation on territory of Russia and neighbouring states in 2005", (2006) *Annual book-Roshydromet*, SIRPA Typhoon, Moscow, Roshydromet Meteoagency.

20 "Radiological Survey of the Araks and Kura rives Azerbaijan", (2005) IAEA/AL/161. *IAEA Technical Cooperation project* AZB/9/004/ Seibcrsdorf, Austria, December, p.40.

21 "Investigation of Marine Radio-activity in the Azeri region of the Caspian Sea", (2006) R*eport IAEA Technical Cooperation project* AZB/9/004, Monaco, France.

05.07.06	II-3	Surface	(d) 5,3±0,5	(d) 5,7±1,2	-	-
03.07.06	III-1	Surface	(d) 3,7±0,4	(d) 10,2±2.0	(d) 6,8±3,7	-
01.07.06	III-2	Surface	(p) <0,07 (d) 5,2±0,5	(p) 0,06±0,03 (d) 11,4±2,0	(p) 6,3±1,5	(d) 1,3±0,1
	III-2	50 m	(d) 4,6±0,4	(d) 9,1±1,8	(d) 8,2±2,3	-
	III-2	Points near the bottom (180 m)	(d) 5,5±0,5	(d) 5,8±1,3	(d) 15,1±3,1	-
01.07.06	III-3	Surface	(d) 5,9±0,5	(d) 8,8±1,9	-	-
01.07.06	III-4	Surface	(p) <0,1 (d) 5,4±0,5	(p) 0,07±0,03 (d) 9,3±1,9	(d) 9,1±2,5	(d) 1,4±0,1

Note: (p) - Volume activity of suspensions obtained from taken samples (fraction of particles); (d) - the volume activities of radionuclides in sea water filtration.

Water contamination is not the only problem caused by Armenia's use of nuclear power. Disposal of radioactive waste presents another major problem for the region. According to Armenia's Gosatomnadzor (2002), polygons contain solid and liquid waste with varying activity: 4939 m^3 (low activity), 1659 m^3 (medium- activity), 27 m^3 (high-activity) solid radioactive waste, 2097 m^3 (medium activity), 350 m^3 (high-activity) liquid radioactive waste have been disposed via landfill.[22] The huge volume of waste and the overflow of the NPP landfills in Armenia prompted the construction of the second nuclear waste landfill unit. However, given that there are serious problems with the disposal of this waste, the European Commission requested the closure of the plant. Furthermore, in recent years it has emerged that Armenia's nuclear facilities use Georgian border territories as sites for the storage of radioactive waste, burial of radioactive materials, and tools and clothes used in Nagorno-Karabakh.

Water contamination is not the only problem caused by Armenia's use of nuclear power. Disposal of radioactive waste presents another major problem for the region.

In addition to the problems associated with the storage and utilization of nuclear waste, the other concern is that this waste may also be used for military purposes. It was in accordance with this concern that Article III of the Agreement between Russia and the Armenia (2000) on peaceful use of atomic energy prohibits Armenia from creating radioactive explosive devices and using them for military purposes. Nevertheless, since 2016 Armenia's officials have expressed their intention to create and use dirty

22 Unece.org (2002) "Natsional'nyy doklad» O sostoyanii okruzhayushchey sredy Armenii", Available at: http://www.Unece.org:8080/fileadmin/DAM/env/Europe/monitoring/Armenia/ru/Part5201/20_7pdf (Accessed May 30, 2018).

nuclear bombs. Ex-Prime Minister of Armenia, Grant Bagratyan stated "Armenia has this weapon since the 70s of the last century". This is a serious concern in neighboring countries. Given that Armenia has territorial claims to almost all neighboring countries (Turkey, Georgia, and Azerbaijan), these intentions appear to be aggressive and in contravention of international conventions and agreements.

The safety problems at Metsamor NPP are worrisome to a number of international agencies, official representations, and scientists. They have expressed their concerns on various platforms.

The safety problems at Metsamor NPP are worrisome to a number of international agencies, official representations, and scientists. They have expressed their concerns on various platforms. In 2004, the European Parliament declared the Metsamor NPP one of the most dangerous NPPs in the world.[23] However, the EU is not pushing Armenia hard enough. By contrast, when Lithuania joined the European Union (2009), two blocks of Ignalin NPP (which is one of the strongest reactors among WWR-type reactors with a total capacity of 1,500 MW per block) were suspended. Lithuania became an energy importing country rather than an energy exporting country. The European Union closes nuclear reactors that comply with international standards due to lack of confidence in Soviet technology, but only when the facilities are within their borders.

Concluding Remarks

Given this evaluation of Metsamor NPP, what remains troubling for the states in the region is that Metsamor NPP represents a range of serious risk factors, including its location in an earthquake-prone zone and use of old technology, not to mention the likelihood of smuggling, terrorism, and contamination. There are already vocal calls to close down the NPP, and various international experts have weighed in. For instance, Steve Thomas, Professor of Energy Policy and Director of Research at the University of Greenwich, has stated, "This plant was basically of the first design generation of the WWER reactor, the Russian equivalent of the Pressurised Water Reactor. All of the other reactors of this design have now been closed (Russia, Bulgaria, Slovak Rep) in most cases because the perceived safety shortcomings of the design, for example, the containment. It was

23 Kommersant.ru, (2018) *Bryussel' stavit blok Armyanskoy AES*, 31 January, Available at: https://www.kommersant.ru/doc/3534646 (Accessed May 30, 2018).

closed for about 5 years after the earthquake in Armenia and during some of that time, some upgrades were undertaken, but how far these meet the safety concerns and how far they improve the resistance of the plant to earthquakes, I cannot judge. Its reliability since 1995 has been relatively poor as judged by the load factor. How far this is due to grid problems and how far to the problems with the plant is impossible for me to know. I think life-extension should only take place after a comprehensive review of the design of the plant and whether it is sufficiently close to current design standards to warrant a significantly longer operating life than originally expected".[24] Similarly, experts from the British Transatlantic and Caucasian Studies Institute, Ziba Norman and William Arturs have described the Metsamor NPP as an "historical anomaly" in the earthquake zone, and an expert from Turkish Sabanci University, Cengiz Aktap, has called Metsamor the most dangerous zone, despite the fact that Armenia wanted to build the most modern reactor there.

International organizations, including the International European Atomic Energy Agency's European Nuclear Safety Regulatory Group (ENSREG) and others, cooperate with regional states, mainly Azerbaijan. This cooperation should be expanded to include the monitoring of rivers following from the territory of Armenia into Azerbaijan. In Armenia, radionuclides that are allegedly no longer active are placed in ordinary municipal landfills, and may contaminate rivers.

As the principal defender of the cause, the Azerbaijani government has proposed a systematic closure of this facility. The issue is regularly raised by the Azerbaijani delegation at the annual IAEA conference, and the President has repeatedly flagged the need to close the Metsamor NPP at the Nuclear Security Summit. Azerbaijan has also joined international conventions on the registration, use, maintenance, and circulation of nuclear and radioactive substances. The registration, storage and use of nuclear and radioactive materials in Azerbaijan are carried out in accordance with IAEA norms, rules and standards. A special agency under the Ministry of Emergency Situations has been established to regulate nuclear and radiological activity. The agency operates as a relevant infrastructure which meets international requirements. In order to prevent nuclear terrorism

24 Ayvaci, F.I. (2014) "Dancing around the atomic bomb", *J.Hazar World*, November, issue 24, p.29

and smuggling, border crossing points are equipped with modern monitoring equipment, and border and customs officials participate in regular training courses.

However, Azerbaijan cannot ensure a nuclear free and secure zone within the South Caucasus on its own. The absence of international engagement and commitment remains a barrier to closing down the world's most dangerous NPP – it would seem that the lessons from Chernobyl have been too easily forgotten.