

Armenia

(Updated 2012)

1. GENERAL INFORMATION

1.1. Country Overview

1.1.1. Governmental System

The referendum for the independence of Armenia was held on September 21, 1991. Based on the results of the referendum (99% voted for independence), the parliament (The Supreme Soviet of the Armenian SSR) adopted the Declaration of Independence and announced the independence of the Republic of Armenia.

The Constitution was adopted on July 5, 1995, through a popular referendum. Amendments were adopted by referendum on 27 November, 2005.

The System of Government: The Republic of Armenia has a presidential system of government. In accordance with the Constitution, the President ensures compliance with the Constitution, the normal operation of the legislative, executive and judiciary branches, and serves as the guarantor of sovereignty, territorial integrity and security of the Republic. The President is elected by the citizens of the Republic of Armenia for a five-year term.

The Executive Power: The executive power in the Republic of Armenia belongs to the Government of the Republic. The government is composed of the Prime Minister and the Ministers.

The Legislative Power: Legislative power in the Republic of Armenia belongs to the National Assembly. The National Assembly is a 131-seat body.

The Judicial Power: In the Republic of Armenia, justice is carried out by courts in accordance with the Constitution and the Laws of the Republic of Armenia.

1.1.2. Geography and Climate

The Republic of Armenia, the smallest of the three Transcaucasian republics, is a landlocked, mountainous country, bounded on the north by the Republic of Georgia, on the east and southwest by Azerbaijan, on the south by Iran and on the west by Turkey (FIG 1). The northern border is 196 km long, the border with Azerbaijan is 913 km, the southern border has a length of 42 km and the western border 280 km. The land area of the republic is 29,743 km². The terrain is defined by the high Armenian Plateau with mountains, little forest and fast flowing rivers. The average height above sea level is about 1800 meters.

The climate is highland continental, with hot, dry summers and cold winters. Annual average temperature varies from -2.7°C to 13.8°C. The coldest month is January (from 1.2°C to -12.8°C) and the hottest months are July and August (from 25.8°C to 8.7°C). Summer temperatures may rise up to 42°C, while winter cold has maximum of 46°C below zero. Summer relative humidity is 32-45% (July-August); winter relative humidity is 80-90%. Annual rainfall varies from 220 mm to 900 mm. Maximum precipitation is usually during May-June and minimum precipitation is in winter. The annual maximum sunshine is 2,780 hours (Lake Sevan area), and minimum 1,930 hours (Ijevan). The average intensity of solar radiation on the acclinic plane on a cloudless day is 700 kcal/m². The annual average wind velocity varies from 7.7 m/sec to 1.0 m/sec.



FIGURE 1. Map of the Republic of Armenia

1.1.3. Population

The population of Armenia, according to the Country statistical data, is about 3.274 million (as of 01.01.2012), of which 64.0% live in urban areas. Armenia is a densely populated country with a density of 110 person/km². The historical population information is shown in Table 1.

TABLE 1. POPULATION INFORMATION

	1970 ^a	1979 ^a	1989 ^a	2001 ^a	2005 ^b	2007 ^b	2008 ^b	2009 ^b	2010 ^b	2011 ^a	Average annual growth rate (%)
Population (millions)	2.492	3.031	3.449	3.214	3.218	3.227	3.238	3.249	3.262	3.274	+0.17
Population density (inhabitants/km ²)	83.8	101.9	116.0	108.1	108.2	108.5	108.8	109.2	109.7	110.1	+0.17
Urban population as percent of total	59.5	65.7	68.7	64.4	64.1	64.1	64.1	64.6	64.0	64.1	-
Area (1000 km ²)											29.743

^a Formal data of the census of population. ^b Country Statistic Information.

Source: IAEA Energy and Economic Database; Data & Statistics/The World Bank; National Statistical Service of RA.

The average population growth rate from 2001 to 2012 is approximately 0.17 %. The concentration of population is not equal in different areas of the republic. The Ararat Valley is the most populous territory of the country, with a density of 245 person/km². Its area comprises close to 26.7% of the total territory, and houses almost 58.8% of the total population. Yerevan, the capital of the Republic of Armenia, lies in the Ararat Valley and is home to 1.127 million people, about one third of the total population. The highland areas are much less populated, with a density of 24 person/km².

1.1.4. Economic Data

After the disintegration of the Soviet Union, an economic crisis broke out. Armenia suffered from sharp decline in production between 1990 and 1994. The country went to great efforts to overcome it. Since then, the situation has been gradually stabilized and the republic is coming out of the crisis, following the transition to a market economy. During the period 2000-2010, the Gross Domestic Product (GDP) has increased by 447%, and the average growth rate was 18.1% per year. The historical GDP information is shown in Table 2.

TABLE 2. GROSS DOMESTIC PRODUCT (Millions US\$)

	1990	2000	2005	2006	2007	2008	2009	2010	Average annual growth rate (%) 2000 to 2010
GDP (Millions of Current US\$)	4098	1912	4900	6385	9206	11662	8648	9371	17.2
GDP (Millions of Constant 2000 US\$)	2820	1910	3400	3860	4400	4676.9	n/a	n/a	
GDP per capita (PPP* US\$/Capita)	-	2294.1	4097.8	4633.4	5261.3	5610.6	n/a	n/a	
DP per capita (Current US\$/Capita)	1145.0	515.0	1523.0	1982.0	2853.0	3606.0	2633.0	2862.0	18.7

*PPP: Purchasing Power Parity

Source: IAEA Energy and Economic Data Base; Data & Statistics/The World Bank; Country Information.

Armenia is not rich in mineral raw materials. There are only a few items of considerable industrial value: copper, bauxite, molybdenum, precious metals, perlite, diatomite and coal. This factor largely determines the economic structure of the republic. There has traditionally been very little heavy industry. The manufacturing sector has a prevailing share in GDP.

1.2. Energy Information

1.2.1. Estimated Available Energy

The main sources of energy used in Armenia, are: oil products, natural gas, nuclear energy, hydropower and coal. Hydro and a small amount of brown coal are the only domestic sources of energy, which are exploited. The republic has no oil and some gas reserves (not exploited). The geological forecast says that some quantity of uranium may be in Armenia. In July 2008, a Russian-Armenian joint venture was consequently established, for uranium geological exploring and mining.

The energy reserves are shown in Table 3. To meet its energy requirements, Armenia has to import gas, oil products and nuclear fuel.

TABLE 3. ESTIMATED ENERGY RESERVES

	Estimated available energy sources					
	Fossil Fuels			Nuclear	Renewable	
	Solid ⁽¹⁾	Liquid ⁽²⁾	Gas ⁽³⁾	Uranium ⁽⁴⁾	Hydro ⁽⁵⁾	Other Renewable ⁽⁵⁾ (Wind)
Total amount in specific units*	-	-	176.0	-	7.0	1.1
Total amount in Exajoule	-	-	0.006	-	0.025	0.004

(EJ)						
-------------	--	--	--	--	--	--

(* Sources: 20th WEC Survey of Energy Resources, 2004 and Uranium 2005: Resources, Production and Demand ("Red Book"), IAEA Energy and Economic Data Base, Country Information.

Estimated energy reserves in (Solid and Liquid in million tons, Uranium in metric tons, Gas in billion cubic m³, Hydro and Renewable in TWh per year),

(1) Coal including Lignite: proved recoverable reserves, the tonnage within the proved amount in place that can be recovered in the future under present and expected local economic conditions with existing available technology

(2) Crude oil and natural gas liquids (Oil Shale, Natural Bitumen and Extra-Heavy Oil are not included): proved recoverable reserves, the quantity within the proved amount in place that can be recovered in the future under present and expected local economic conditions with existing available technology

(3) Natural gas: proved recoverable reserves, the volume within the proved amount in place that can be recovered in the future under present and expected local economic conditions with existing available technology

(4) Reasonably Assured Resources (RAR) under < USD 130/kgU

(5) Hydropower and Renewable technically exploitable capability, the amount of the gross theoretical capability that can be exploited within the limits of current technology.

1.2.2. Energy Statistics

Primary energy sources, in ExaJoule (EJ), are summarized in Table 4. To meet its energy requirements, Armenia has to import gas, oil products and nuclear fuel.

TABLE 4. ENERGY STATISTICS (EJ)

	2000	2005	2008	2009	2010	2011	Average annual growth rate (%)
Energy consumption*							2000 to 2011
- Total	0.092	0.109	0.126	0.11	0.103	0.115	2.05
- Solid**	0.00	0.00	0.00	0.00	0.00	0.00	0.0
- Liquids	0.013	0.017	0.017	0.015	0.017	0.016	1.91
- Gases	0.052	0.056	0.075	0.061	0.048	0.069	2.6
- Nuclear	0.022	0.030	0.027	0.027	0.029	0.03	3.03
- Hydro	0.005	0.006	0.007	0.0073	0.0092	0.0089	6.5
- Other Renewable	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy production							
- Total	0.027	0.036	0.034	0.0343	0.0382	0.0389	3.38
- Solid**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Liquids	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Gases	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Nuclear	0.022	0.030	0.027	0.027	0.029	0.03	3.03
- Hydro	0.005	0.006	0.007	0.0073	0.0092	0.0089	6.5
- Other Renewable	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net import (Import-Export)							
- Total	0.064	0.073	0.092	0.076	0.065	0.016	-

* Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.

** Solid fuels include coal, lignite.

Source: IAEA Energy and Economic Database and Country Information.

1.2.3. Energy Policy

Before the disintegration of the USSR, Armenia, as a part of the Soviet Union, was under the unified All-Union energy policy. The electricity generated by Armenian Power Plants joined the Transcaucasian Energy System. After becoming an independent state, Armenia had to meet open market requirements in all branches of the industry. The energy sector and the nuclear energy sector, in particular, were deeply affected by the economic difficulties during the market transition and were in need of reorganization and de-regulation.

According to the law “On Energy” of the Republic of Armenia, the main principle of government policy in the Energy sector is the separation of functions of economic activity, state management and regulation. According to the main regulating principle, the rights of consumers and economic interests in the energy sector are to be balanced. . According to this law, the functions of regulation were given to the Commission on Public Services. The level of the average electricity tariff was 25 drams, from 1998 until April 2009. It has since increased to 30 drams.

In March 2000, the National Assembly of RA adopted the law “On Amendments and Additions to the Law On safe Use of Nuclear Energy for Peaceful Purposes”. In particular, one amendment reads: “Those objects which are of safety importance shall be constructed and decommissioned by the Law, which draft should be submitted to the Government”.

In November 2004, the National Assembly adopted the law “On Amendments and Additions to the Law On safe Use of Nuclear Energy for Peaceful Purposes”, according to which the newly constructed nuclear power facilities in Armenia can be owned by all kinds of owners. The radioactive waste and spent nuclear fuel remain state owned. The operators of nuclear facilities cannot declare bankruptcy. A similar amendment was made to the “Law on Energy”.

On 16 March, 2004, amendments were made to the “Law on Licensing”, according to which it is necessary to have a license for the following activities: design, site selection, construction, operation, decommissioning, etc., of nuclear facilities, radioactive waste storage and disposal, as well as for nuclear materials and radioactive waste processing, transportation and other activities. The rules for obtaining licenses on these activities were established with use of a number of appropriate governmental decrees.

On 8 December, 2005, the amendment was made to the “Law on Population Protection in the Emergency Situations” according to which, in the case of nuclear or radiation emergency at the nuclear power plant, the functions of all responsible organizations involved shall be determined by government decree. On 22 December, 2005, Government decree N 2338 “National Plan for the Population Protection in case of Nuclear and/or Radiation Emergency at the Armenian NPP” was issued. As a result of the exercises on nuclear or radiation emergency at the nuclear power plant, conducted in order to check the real possibilities of using that decree, a new edition of the “National Plan for the Population Protection in case of Nuclear and/or Radiation Emergency at the Armenian NPP” was produced. This was adopted by governmental decree N 194 on 17 January, 2008.

The radiation safety and protection requirements for plant workers and population (including critical groups and the population in general) are stated in governmental decrees N 1219, “Radiation Safety Norms” and N 1489 “Radiation Safety Rules”, 2006.

By governmental decree N1296 of November 2007, the Armenian Ministry of Energy Action Program was adopted according to the National Security Strategy. By this Program, it was envisaged to put into operation a new nuclear power unit(s) immediately after the shutdown of the existing one, to cover the lack of capacity. According to that document, taking into consideration the needs of country energy independence, preference is given to a 1,000 MW nuclear power unit.

The necessity of constructing a new unit was emphasised by protocol decision No. 14 “On Approval of the Concept for Ensuring Energy Security in the Republic of Armenia” of the RA Government session No. 50 (December 2011), by the importance of increasing the safety level of Unit 2 and by the importance of national energy security and independence. This decision also discussed the possibility of continuing operation of ANPP unit 2 past the year 2016.

On April 19, 2012, RA governmental decision No. 461-N “On Extension of Service Life of Unit 2 of Armenian NPP” was issued. According to this decision, the Minister of Energy and Natural Resources was assigned to organize activities on the development of the program for extension of the service life of ANPP Unit 2, and to estimate the amount of financial resources required for implementation of activities for extension of the service life of ANPP Unit 2, as well as to submit these to the RA government for discussion in September 2013.

The law of the Republic of Armenia “On Construction of a New NPP in the Republic of Armenia”, which was adopted on 27 October, 2009, will serve as a legal basis for construction of a new NPP in Armenia.

The Company “Worley Parsons” was selected in May 2009, by international tender, as a management company for the construction of the new nuclear power unit. Currently, Worley Parsons has finalized the development of a “Bankable Feasibility Study” document, which is necessary for involvement of investors.

As a result of the “Bankable Feasibility Study”, under Decree N1458 of the Government of RA, dated 3 December, 2009, for the nuclear island of a new NPP, the Russian NPP-92 (AES-92) design (capacity - 1060 MW; operation lifetime - 60 years), which has a European safety certificate, was approved. The turbine island and control system of the new nuclear unit will be selected based on tender.

The decree “On Establishment of a Closed Joint-Stock Company Aimed at Construction of a New NPP in the Republic of Armenia” was adopted by the Government of Armenia on 3 December, 2009. “Metsamorenergoatom” CJSC was established with the involvement of the RA government and “Atomstroyexport” CJSC, which was delegated by “Rosatom” Russian State Corporation. The established, “Metsamorenergoatom” CJSC is open for other investors as well. “Metsamorenergoatom” CJSC has already received the license for selection of site for the construction of the new unit.

On March 26, 2010, the “Rosatom” State Corporation and the RA Ministry of Energy and Natural Resources signed an agreement on the nuclear island equipment reservation, aimed at equipping of the new nuclear unit in the Republic of Armenia.

An agreement between the RA and RF governments was signed on August 20, 2010, to envisage the nuclear island equipment supply provisions, and is already ratified. Other nuclear unit components of the project, i.e. Turbine Island and I&C systems, are subject to negotiations with suppliers.

1.3. The Electricity System

1.3.1. Electricity Policy and Decision Making Process

Special attention was paid by the government to restructuring the electricity sector. A number of laws on energy were adopted to achieve that target. A program for improvement of metering, billing and collection of payments for electricity, heat and natural gas has been implemented, together with a conversion of the accounting system to meet international norms and standards, and annual auditing of the company's financial reports by independent auditors. A program has been implemented to organize collections through banks. Although the whole economy is facing difficulties, the government gives priority to budget payments for the electricity provided to

budget organizations, as well as compensation for the electricity consumed by irrigation, drinking water, industry and electrical transport companies.

The implementation of a stabilization policy, with the crucial role of restarting the ANPP, allowed the country to overcome the electric energy crisis of the post-Soviet period. Now, Armenia is covering its electricity demand completely, and can ensure the export of electric energy to neighbouring countries. In the near future, however, additional energy sources may be required as the economy of the republic is recovering and the living standard is increasing steadily.

For Armenia, it is critical to be involved in the regional power market that is currently in the process of formation, and foresees the establishment of a circular power system of Black Sea countries as well as creation of North-South parallel operation relations.

In future, the leading role in competition for providing services to regional power market will be given to a country which is able to produce base-load electricity from the nuclear unit, with the minimal emissions of green-house gases. We are confident that Armenia meets these requirements and is ready to undertake this role in the region.

1.3.2. Structure of Electric Power Sector

In May 2008, the Ministry of Energy of RA was re-named, and became the Ministry of Energy and Natural Resources of RA. It is responsible for the sustainable supply of electric energy to consumers, the determination of the economic potential of natural resources, and other tasks relevant to those areas. The definition of policy for development of the whole energy sector also falls under its responsibilities.

The structure of management of the energy sector in Armenia is shown in Figure 2.

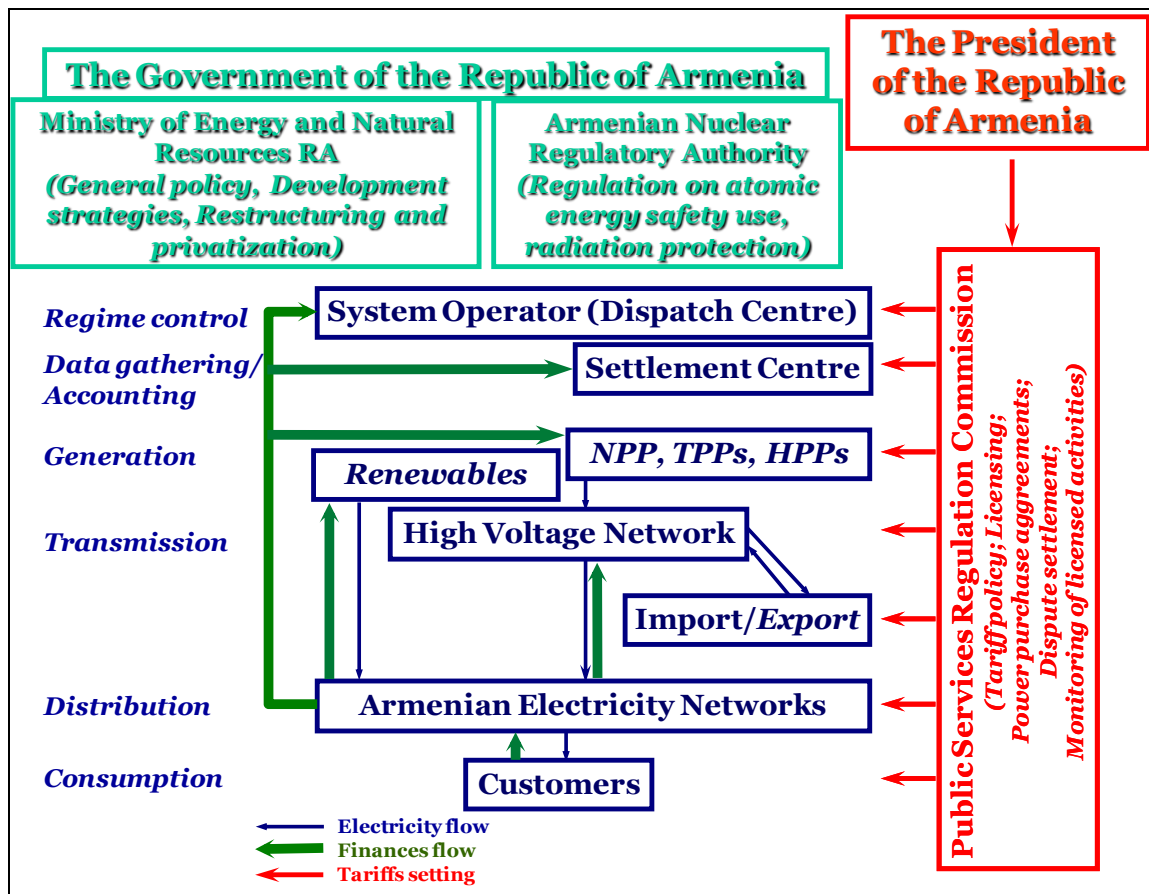


FIGURE 2. Structure of management of the Energy Sector

The duties of the Nuclear Safety Regulation State Committee, under the Government of RA, are: performing the State nuclear energy regulation and supervision over the nuclear power objects, issuing the licenses and controlling the license requirements fulfilment. Its main objective is to secure the protection of the population, the personnel involved in the nuclear industry, and the environment.

The Public Services Regulatory Commission of the RA is responsible for antimonopoly regulation. The key functions of the antimonopoly regulations are tariff regulation and licensing of entities in the energy sector.

The operator of the Electric Energy Network is responsible for the dispatching of activity, while Settlement Centre is in charge of the calculation of wholesale trade of electric energy. It also approves the balance between the participants of the trade.

ENERGY UNITS INFORMATION

Hydropower is based on the water resources of the Republic, including Lake Sevan, one of the largest highland fresh-water lakes in the world (1900 m above sea level), and the rivers: Arax, Arpa, Hrazdan, Debet and Vorotan. During the last period, beginning from 1991, 111 new small hydro power plants, with the total capacity of 157.7 MW (519.7 million kWh of electric energy annually), have been built. Hydro power plants of Sevan-Hrazdan cascade are operating at a low-level capacity as, after the intense use of the lake water during the last crisis, the Government of Armenia decided to reduce releases from Lake Sevan in order to restore its potential. The water from the lake can be used only for irrigation needs.

Two HPP cascades and small HPPs have the total installed capacity of 1113.7 MW, of which:

- Sevan-Hrazdan HPP cascade has the installed capacity of 530 MW;
- Vorotan HPP cascade has the installed capacity of 400 MW;
- Dzora HPP has the installed capacity of 26 MW;
- Small HPPs have installed capacity of 157.7 MW.

At the same time, Armenia still has unused hydraulic potential (both small and big rivers) of about 406 MW (or 1782 million kWh of electric energy), development of which is economically reasonable.

The Thermal Power Plants (TPPs) have the installed capacity of 1744 MW, of which:

- Hrazdan TPP has the installed capacity of 1100 MW. It has 4 condensation turbines, each of 200 MW. All four may be operated, but at present only two are in operation due to a lack of demand for further capacities. At present, the Gas- and Steam Turbines Unit of Hrazdan TPP, with a capacity of approximately 440 MW, has been commissioned.
- Yerevan TPP has the installed capacity of 550 MW, including 2x150 condensation turbines and 5x50 heating turbines. Only 2x50 MW turbines are currently in operation as there is no need for such a large amount of heat consumption. The Gas Turbine Combined Cycle Unit of Yerevan TPP, with the capacity about 242 MW electrical and 30 MW thermal, was put into operation in April 2010.
- Vanadzor TPP has the installed capacity of 94 MW with different capacity heating turbines. None of them are currently in operation as there is no need for heat consumption.

The results of asset revaluation show that the sector's main asset resources have already expired. Equipment is worn out and requires major overhaul, while 38% of installed capacities are already over 30 years old. It is necessary to take all due measures to renew the energy sector of Armenia.

Nuclear Power Plant (NPP) has a designed capacity of 815 MW, of which only Unit 2, with 407.5 MW, is in operation. Nuclear energy played a crucial role during the period of recovery from the economic crisis. Unit 1 is not currently operating, while Unit 2 was re-commissioned in 1995, after 6.5 years of outage. The fuel is supplied by the Russian Federation.

The high-voltage transmission network of Armenia consists of 220-110 kV lines. There are 14 substations of 220 kV and 119 substations of 110 kV. The capacity of the existing high-voltage network is considered sufficient for current and forecasted loads. The high-voltage transmission network has interconnections with all neighbouring countries: Azerbaijan: 330, 220 and 110 kV (not in operation), Georgia: 220 and 110 kV, Turkey: 220 kV (not in operation), Iran: 2x220 kV. High-voltage lines between Armenia-Iran and Armenia-Georgia (of 400 kV) are currently under construction.

Natural gas is the most important primary energy source, and is imported primarily from Russia. The designed capacity of the high-pressure gas transportation network of Armenia is 17 billion m³/year. In 1980, the maximum demand for natural gas in Armenia was above 5-6 billion m³/year. There have been five main gas pipelines built, which ensure gas delivery from three sides: Georgia, North and West Azerbaijan. Today, only the first pipeline is in operation. In 2009, the natural gas demand was 1.662 billion m³, but the projected demand by 2017 is for 5.5–6.2 billion m³/year, dependent on the ANPP status (shut down or in operation). The gas pipeline Iran-Armenia is now fully constructed and has been operating since spring 2009. It has the capacity of 2.3 billion m³. There are underground storage facilities for natural gas with a

maximal gas storage volume of 180 million m³. Nowadays, the available gas storage volume is 130 million m³. Gas distribution in Armenia is performed through high-, medium- and low-pressure distribution networks.

Oil products are imported from abroad and are mostly utilized for the transport and industry sector. During the last several years, almost no mazut was imported into the Republic.

As for renewable sources of energy (geothermal, wind, solar and waste burning), they are under study. Armenia has considerable potential for geothermal energy, but a programme has yet to be developed to explore the geothermal resources and to carry out drilling activities.

The regions most suited to the construction of wind power plants are: Vanadzor, Aragats, Lake Sevan basin and Sisian, where the wind velocity reaches 7 m/s. In December 2005, the first wind power plant was put into operation in Pushkin pass (Vanadzor region), with the installed capacity of 2.6 MW. The total capacity of the site is estimated to be 20 MW. Investigations are currently being carried out into the possible construction of wind power plants at other sites.

Armenia is a sunny country with a high level of solar radiation. Nevertheless, it is expensive to exploit solar energy and so the country, which appears to have very good solar radiation potential, cannot afford to use it.

1.3.3. Main Indicators

In January 2012, the total installed capacity of the electric energy generating plants in Armenia was 3.4 MW(e). In 2011, electricity production was 7.43 billion kWh. Table 5 shows the historical statistics of the electricity production and its distribution by plants types; Table 6, the energy related ratios. In Armenia, the electricity consumption per capita was around 2,269 kWh/capita in 2011. The energy consumption of Yerevan city is about 50% of the total electricity consumption in Armenia.

TABLE 5. ELECTRICITY PRODUCTION, CONSUMPTION AND CAPACITY

	1988	2000	2005	2009	2010	2011	Growth rate (%) 2000 to 2010
Capacity of electrical plants (GWe)							
- Total	3.51	3.05	3.05	3.06	3.30	3.42	0.96
- Thermal	1.75	1.67	1.67	1.67	1.91	1.93	1.34
- Hydro (incl. Small HPPs & Wind)	1.00	1.00	1.00	1.10	1.10	1.11	0.87
- Nuclear	0.76	0.38	0.38	0.38	0.38	0.38	0.0
Electricity production (TW·h)							
- Total ⁽¹⁾	15.28	5.96	6.21	5.67	6.49	7.43	1.85
- Thermal	8.94	2.69	1.83	1.13	1.41	2.39	-0.98
- Hydro (incl. Small HPPs & Wind)	1.52	1.26	1.66	2.05	2.59	2.49	5.84
- Nuclear	4.82	2.01	2.72	2.46	2.49	2.55	2.0
Total Electricity Consumption (TW·h)	12.39	4.77	4.89	4.83	5.21	5.64	1.41

⁽¹⁾ Electricity losses are not deducted.

Source: IAEA Energy and Economic Database; Country Information.

TABLE 6. ENERGY RELATED RATIOS

2000	2005	2008	2009	2010	2011
------	------	------	------	------	------

Energy consumption per capita (GJ/capita)	24.2	33,9	38.9	33.6	31.6	47.3
Electricity per capita (MWh/capita)	1.58	1.93	1.89	1.75	1.89	2.27
Electricity production/Energy production (%)	81	63	66	59	58	73
Nuclear/total electricity (%)	33.7	43.7	40.3	43.9	38.3	34.3
Ratio of external dependency (%) ⁽¹⁾	68	67	74	69	63	74

Source: IAEA Energy and Economic Database; Country Information.

⁽¹⁾ Net import / Total energy consumption.

2. NUCLEAR POWER SITUATION

2.1. Historical Development and current organizational structure

2.1.1. Overview

The decision to construct a nuclear power plant in Armenia was made by the former USSR Council of Ministers, and the appropriate decree was issued in September 1966. In 1968, the Armenian Branch of “Electrosetproject” Institute completed the pre-feasibility study for constructing the Armenian NPP (ANPP), under the project “The Scheme of NPP Contribution to Power Grid”. That document included a schedule to commission Unit 1 in 1973, and Unit 2 in 1974.

Technical specifications to design the ANPP were developed by “Teploelectroproject” in 1968 and approved in August 1969, under decree N 1624 R.C. of the former USSR Ministry of Energy.

More than 20 potential sites were considered for the ANPP construction before a site was finally selected in the western part of Ararat valley, 16 km from Turkish border, 10 km to the north-east of region centre, Hoktemberyan (Armavir), and 28 km west of Yerevan. Location of the ANPP is shown in Figure 3.



FIGURE 3. Map of locations of all electricity generating power plants and main high voltage interconnections with the neighbouring countries

In accordance with that specification, the capacity of the ANPP (first stage of construction), with VVER-440 type reactors, was to be 815.0 MW, each unit of 407.5 MW. The ANPP design life-time was specified to be 30 years.

Comprehensive studies and analyses showed that seismic conditions of the ANPP site were characterized by a level that corresponded to the eight-point intensity according to MSK-64 scale. This was the first nuclear power plant in the USSR intended to be constructed in a region of high seismicity.

The specific nature of the ANPP site - its seismicity - caused significant changes in VVER-440/230 design, not only in construction but also in design of reactor facility as a whole. The reactor was consequently assigned a new identification: V-270. It was based on the project of Unit 3 and 4 of the Novovoronezh NPP.

The reactor building, auxiliary building and ventilation stack, as well as the buildings and structures containing equipment and instrumentation of safety systems or safety-related on-line systems and communications connecting these structures, were assigned a category of high importance. They were considered to have one more point of seismic resistance than that of the ANPP site.

The Armenian Nuclear Power Plant was commissioned in 1976, achieving the initial criticality for Unit 1 on 22 December 1976, and for Unit 2 on 5 January 1980. The units were put into commercial operation on 6 October 1977 and on 3 May 1980, respectively.

In 1981, the technical-economic background was developed for the further expansion of the ANPP (the second stage of the plant), taking into consideration the central heating needs of Yerevan city. The technical-economic background was approved and coordinated with all the relevant organizations. In 1985, the Gorky Department of “Atomteploelectroproect” Institute prepared a project: “Armenian NPP. Its expansion is taking into consideration the Yerevan city central heating”. Excavation work was started, and the foundation pits for two new units (Unit 3, Unit 4) were dug. However, following the Chernobyl disaster of 1986, the Government of the Republic decided to refuse further expansion of the ANPP and the construction work was stopped.

After the 1988 earthquake, the Council of Ministers of the USSR decreed to shut down the ANPP as a precautionary measure, although the Armenia Nuclear Power Plant had not actually been damaged. Unit 1 was shut down on 25 February and Unit 2 on 18 March 1989. The units were not decommissioned but were kept in prolonged shut-down conditions.

Apart from the short period of regaining independence, there have been no strong antinuclear movements in Armenia. The current sentiment of the public can be explained not by a lack of awareness of the risks involved in the utilization of nuclear energy, but, in the face of the difficult economic conditions, by the considerably lower price of “nuclear electricity”, which outweighs its possible risks

In April 1993, the Government of Armenia decided to restart Unit 2 of the ANPP in order to overcome the severe economic crisis, taking into account the lack in national energy resources. After 6.5 years of outage, with the technical and financial help of the Russian Federation, Unit 2 of the ANPP was restarted in November 5, 1995. Unit 1 remained in a stand-still regime.

After the ANPP restart, 33.54 billion kWh of electric energy had been generated by January 1, 2012, in keeping with the load schedule of Armenian power system.

2.1.2. Current Organizational Chart(s)

According to the governmental decree N 98, 04.04.1996, the CJSC "Armenian NPP" was created and authorized to be the operator of nuclear power plants. For other purposes, such as liability to foreign countries, the State is assumed to be the operator.

In Armenia, the Armenian NPP is under State ownership according to the law on "Safe Use of Nuclear Energy for Peaceful Purposes".

In the past, the ANPP was in debt for the fresh nuclear fuel deliveries from its fuel supplier (the Russian Federation). To cover that debt, and in order to have the fresh nuclear fuel supply to the ANPP without delays, governmental decree N 1211 was issued "On Transfer into the Trust Management of the Rights Certified by the Shares" (September 2003). According to this decree, an agreement was signed between the Inter RAO EES and the Ministry of Energy of RA on transfer, for 5 years, of 100% of shares in the ANPP to the Inter RAO EES of Russia. In return, the latter is to fulfil the financial management of the ANPP. Inter RAO EES is obliged to deliver fresh nuclear fuel to the ANPP on time. The Russian side was responsible for the management of the plant's financial flows, while the nuclear power plant remains the property of the Republic of Armenia. On 4 December, 2008, government decree N 1411 was issued "On Transfer into the Trust Management of the Rights Certified by the Shares", according to which the financial management of the ANPP by Inter RAO EES was extended for 5 more years.

The Armenian Nuclear Regulatory Authority (the ANRA) was established in 1993. The ANRA was authorized to be the regulation body in the area of nuclear and radiation safety, to perform inspection activity and to issue the licenses for the appropriate applications (See more detailed information in Section 3.1.).

The Ministry of Energy of RA was established in 1992, by presidential order, became the Ministry of Energy and Natural Resources of RA on 18 April, 2008. During the period of preparation for the ANPP restart (1993-1996), the Armatomenergo was established under the Ministry of Energy. Armatomenergo was authorized with the functions of operator of the ANPP. On 4 April, 1996, through the governmental decree N 98, the operation of the "Armatomenergo" was ceased, and the CJSC "Armenian NPP" was given the functions of operator. At the same time, the Department of Atomic Energy was established at the Ministry of Energy of RA. The Department participates in the elaboration of Armenian energy and nuclear energy development strategy, organizes the development of a list of measures on the upgrading of ANPP safety and on the decommissioning program, and collaborates with the IAEA and other international nuclear energy organizations.

The "Armatom" Institute was established in 1973. Having been providing engineering support to the ANPP, the activities of the Institute include implementation of diagnostic systems, implementation of Safety Parameters Display System (SPDS) and development of compact and multi-functional simulators. "Armatom" is participating in the development of "Deterministic Analysis of ANPP Unit 2" and of "Probabilistic Safety Analysis of ANPP Unit 2" documents.

CJSC "Atomservice" was established in 1987. The company played an active role in the adjusting of plant systems and the implementation of testing programs during preparations for the restarting of ANPP Unit 2. It continues with the same activities today.

CJSC "Atomenergoseismoproject" was established in 1983. During the period of preparation for the restarting of ANPP Unit 2, CJSC "Atomenergoseismoproject" conducted a series of investigations into the plant's seismic conditions, for final resolution of all issues relevant to restarting the plant and to its further operation. One major finding of these investigations was that the ANPP has been erected on a whole (non-destructed) basalt block, i.e. they confirmed the absence of a tectonically active break under the ANPP site. At present, CJSC "Atomenergoseismoproject" is part of the "Scientific Research Institute of Energy" CJSC.

There are several construction, repair, mounting and other organizations also related to the operation of the ANPP.

In Armenia, the All-Armenian Atomic Power Engineers Association has been established. The founders of the Association are specialists from such organizations as the Ministry of Energy of RA, Armenian NPP, Armenian Nuclear Regulatory Authority (ANRA), State Engineering University (SEUA) and other nuclear power specialists.

The main objectives of the Association are as follows:

- to promote the development of scientific ideas in nuclear engineering
- to support the promotion and further development of nuclear energy
- to conduct testing in the field of atomic energy according to established procedures
- to organize public discussions of the problems relevant to nuclear energy
- to ensure the promotion of nuclear energy by:
 - publishing articles, magazines, books, dictionaries, reference books

- organizing scientific seminars
- creating radio-programs, documental and scientific films, video cassettes devoted to nuclear energy;
- creating computer training and demonstration programs

2.2. Nuclear Power Plants: Overview

2.2.1. Status and Performance of nuclear power plants

The ANPP consists of two nuclear power units of VVER-440-type. Both units of the ANPP with the VVER-440(V-270)-type reactors were designed and constructed by organizations of the former Soviet Union, under the supervision of the Ministry of Energy and Electrification of the USSR. The design of the first stage of the plant was developed in 1969/1970. The chief scientific supervisor was the Kurchatov Institute of Atomic Energy (Moscow), subsequently renamed RNC “Kurchatov Institute”. The organization chiefly responsible for design was Thermoelectroproect (TEP), Gorki, now called NIAEP, Nizhny Novgorod. The main organization responsible for reactor construction was OKB “Gidropress”, Podolsk. The “Izhora Factory” Leningrad Enterprise was the manufacturer of the reactors and systems. The turbines were manufactured by the Kharkov Turbine Plant (KHTP). The electric generators were supplied by the “Electrosila” plant of Leningrad. The building-construction work was performed by the “Gidroenergostroy”, Yerevan.

Since 1989, Unit 1 has remained in a stand-still regime. Since its restart in 1995, Unit 2 of the ANPP has been in operation. The installed gross capacity of Unit 2 is 407.5 MW.

All the nuclear fuel necessary for the ANPP operation has been delivered, both past and present, by the “TVEL” Concern of Russian Federation.

Table 7 shows the status and some other indicators of the nuclear power units of the ANPP.

TABLE 7. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Net Capacity (Mwe)	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
ARMENIA-2	PWR	376	ANPPJSC	Operational	FAEA	01-Jul-75	01-Jan-80	05-Jan-80	03-May-80	
ARMENIA-1	PWR	376	ANPPJSC	Permanent Shutdown	FAEA	01-Jan-73	22-Dec-76	28-Dec-76	06-Oct-79	25-Feb-89

Source: [IAEA Power Reactor Information System](#) as of 31 December 2009.

In 2005, the ANPP generated 2.72 billion kWh, which is its highest level since the ANPP restart.

The main organizations and institutions involved in nuclear energy in Armenia are: the Ministry of Energy and Natural Resources, The Nuclear Safety Regulation State Committee under the Government of RA (still referred to as “ANRA”), CJSC “ANPP”, CJSC “Armatom”, CJSC “Atomservice” and CJSC “Atomenergoseismoproject”. Some technical support has also been provided by such organizations of the Russian Federation as OKB “Gidropress”, the main reactor designer, “NIAEP Nizhnii Novgorod”, the main NPP designer, RNC “Kurchatov Institute”, scientific management, and others.

Figure 4 shows the dynamics of the significant safety events based on INES scale.

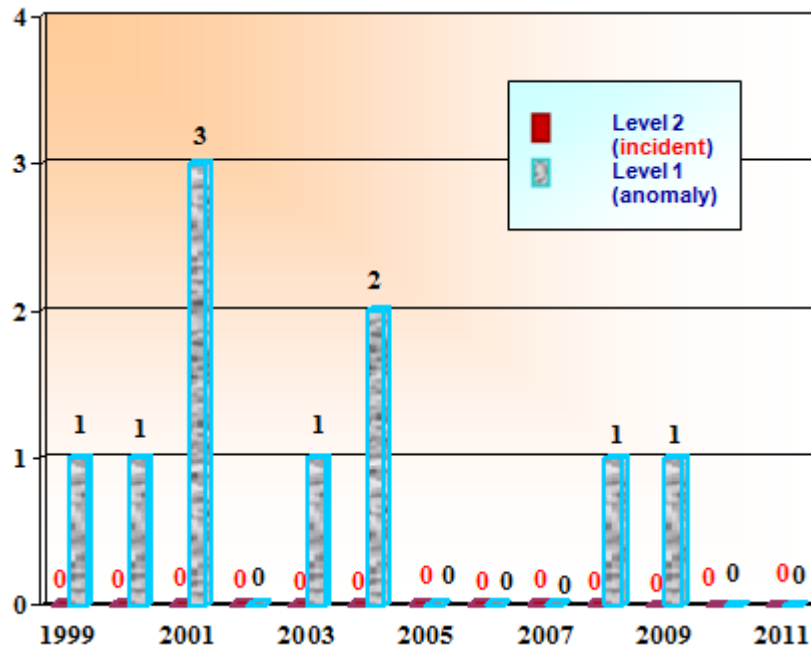


FIGURE 4. Significant safety events dynamics based on INES scale

In 1995, Unit 2 of the ANPP had five emergency events of level “0” on the International Nuclear Event Scale (INES) (below scale, deviation). In 1996, 8 emergency events occurred at the ANPP, consisting of 1 of level “1” (anomaly) and 7 of level “0” on the INES scale. In 1997, there were 5 emergency events occurred at the ANPP, 2 of level “1” and 3 of level “0” on the INES scale. In 1998, there were 7 emergency events occurred at the ANPP, with 2 of level “2”, 1 of level “1” and 4 of level “0” on the INES scale. In 1999, there was one emergency shutdown and one event of level “1”. In 2000, there were 3 events reported: one event was rated level “1”, and two were rated level “0”. In 2001, 8 emergency events occurred at the ANPP, including: 3 of level “1” and 5 of level “0” on the INES scale. In 2002, there were 8 emergency events of level “0” on the INES scale at the ANPP, and 2 emergency shut-downs. In 2003, there were 2 emergency events, 1 of level “0” and 1 of level “1” on the INES scale, with 1 emergency shutdown. In 2004, there were 2 emergency events of level “1” on the INES scale. In 2005, 2006 and 2007, no emergency event on the INES scale occurred. In 2008, during the operation of Unit 2 of the ANPP, 1 event of “1” by INES was registered, and the reactor was scrambled which was caused by an accident in the grid. In 2009, there were 5 recorded events in the plant operation, 4 of which were classified according to INES level “0” while one event was classified as a safety significant level “1” on the INES scale. In 2010, there were 7 recorded events in the plant operation, and all events were classified according to INES level “0”. In 2011, there were 4 recorded events in the plant operation, and again all events were classified according to INES level “0”.

2.2.2. Plant Upgrading, Plant Life Management and License Renewals

The issues of the ANPP safety upgrading are a first-rate priority for the Armenian Ministry of Energy and Natural Resources. The safety level of the ANPP during times of very limited financial resources was one of the main concerns of the Armenian government. After numerous consultations with experts from the USA, Western Europe countries and the Russian Federation, while also receiving assistance from IAEA experts, Armenian specialists developed a new programme for ANPP safety-upgrading, titled “List of safety upgrading activities for the period of 2009 – 2016 of Unit 2 of the Armenian NPP”. This safety upgrading process, having been permanently implemented at the ANPP, is being realized according to the provisions of that

program. Since the restart of the ANPP, there have been more than 196 completed safety upgrading activities and 1,405 completed safety improvement measures (modifications according to technical decisions, improving safety and reliability of NPP equipment and systems), as of 1 January 2012, to ensure that the plant can withstand emergency situations without suffering failures. Historical annual upgrading measures are shown in Figure 5.

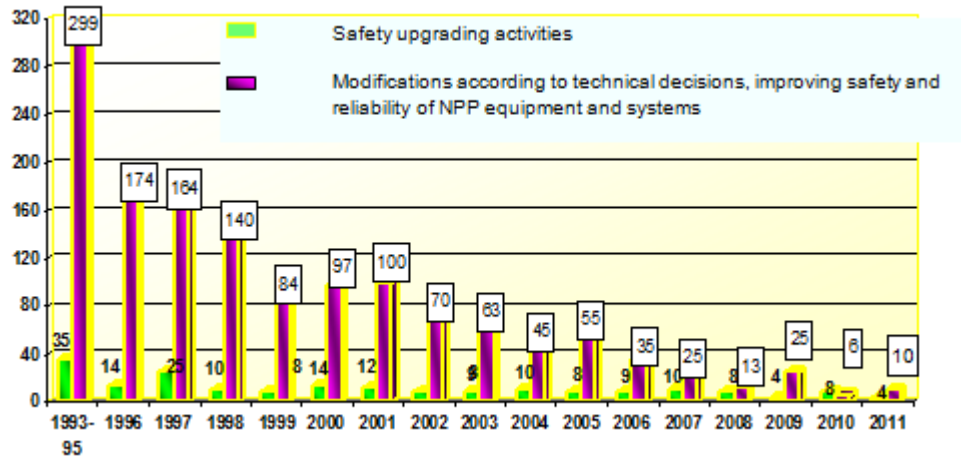


FIGURE 5. Historical annual upgrading measures

In the summer of 2005, the Director General of the IAEA, Mr. El Baradei, came to visit Armenia. During the high-level meeting, he assured the Armenian side that the IAEA will assist in coordinating activities on the upgrading of the ANPP with donor countries. On 18-19 May, 2010, the 4th IAEA working meeting was held in Yerevan, on Coordination of International assistance for the ANPP safety upgrading. The decision was made to review the existing “List of safety upgrading activities for the period of 2009 – 2016 of Unit 2 of the Armenian NPP” on the basis of the documents SAR and PSA. On 13-14 October, 2011 the 5th IAEA working meeting for co-ordination of international technical assistance to Armenian NPP was held in Vienna. The meeting was attended by representatives of Armenia, European Commission, Russia, IAEA, US DOE and Czech Republic. A number of issues were discussed to prioritize improvements and co-ordinate the activity of ANPP support organizations, aimed at maximum coordination of activities for the implementation of each specific project.

On 18-19 April, 2012, Yukiya Amano, the Director General of IAEA, met with the President of RA, the Prime Minister of RA, the Minister of Foreign Affairs and the Minister of Energy and Natural Resources of RA. During the meetings, issues concerning the cooperation between RA and the IAEA in the field of peaceful use of nuclear energy were discussed, in particular:

- issues relating to the continuation of coordinated activities to increase the safety level of ANPP 2 and technical assistance aimed at increasing its safety level and strengthening its security through physical protection. Technical assistance for decommissioning the ANPP was also discussed.
- issues concerning various implementation stages in the construction of a new nuclear power unit in RA, including the creation of appropriate infrastructure and the reviewing and proofreading of documents prepared for licensing and personnel training,
- issues relating to the strengthening of the capacity of RA State Nuclear Safety Regulatory Committee by the government and technical assistance in activities during various stages of the licensing process for a new nuclear power unit in RA.

- the long-term development projects in radiation therapy.

The IAEA delegation visited the ANPP and made a tour of its operating unit. Activities based on the program for increasing the safety and security level of ANPP 2 and further plans were presented to them.

Since 1996, the Nuclear Energy Safety Council, under the President of RA, has been acting in Armenia. Its general duty is to report annually to the President on the real situation with nuclear energy safety at the ANPP. The members of the Council thoroughly examine the relevant documents and appropriate specialist reports before reporting back to the President. The Council itself consists of internationally renowned experts. In December 2011, the 12th Council Conference took place in Yerevan.

The Ministry of Energy and Natural Resources, which defines the policy for the whole energy sector, is responsible in particular for the development of ANPP safe operation programs, in close cooperation with other responsible bodies.

At the request of the government of the Republic of Armenia, an international team of experts was assembled by the IAEA to conduct an Operational Safety Review (OSART) of the ANPP. Under the leadership of the IAEA Division of Nuclear Installation Safety, the OSART team performed an in-depth operational safety review in May 2011. The OSART team reviewed the aspects essential to the safe operation of the ANPP plant. The conclusions of this review are based on IAEA safety standards and on proven good international practices. The OSART team has made 14 recommendations and 12 suggestions, relating to areas where operational safety of the Armenian NPP could be improved. The OSART team also identified good plant practices, which will be shared with the rest of the nuclear industry for consideration.

In connection with the development of nuclear energy, after the earthquake and tsunami in Japan (Fukushima), on March 11, 2011, Armenia expressed willingness towards conducting “stress-tests” in the Armenian NPP. Currently, ANPP is completing “stress-test” activity.

2.3. Future Development of Nuclear Power

2.3.1. Nuclear Power Development Strategy

The energy policy of Armenia is focused on realization of the strategy program for providing the country with the required quantity of electric energy and gas.

In 2001-2002, within the framework of the IAEA Program on Technical Cooperation, a project was developed titled “Energy and Nuclear Power Planning study for Armenia”, which was published in July 2004 as TECDOC -1404. This document included the future energy-demand forecast for Armenia, and considered the capacities which will be needed to meet that demand. Within the study, two options for the development of the energy sector of Armenia were considered:

- with the use of thermal power plants only
- with the use of both thermal and nuclear power plants

The second option for energy sector development was preferred, taking into account the criteria of energy safety and energy independence, ecology, as well as from the social point of view. On the basis of this study, the “Least Cost Generation Plan” and “The Comprehensive National Energy Strategy and Energy Sector Improvement Action Plan” were developed, in 2006. Based

on these two documents, “The Armenian Ministry of Energy Action Program According to the National Security Strategy” was adopted by governmental decree N1296, of November 2007. With this program, it was envisaged to put the new nuclear power unit(s) into operation immediately after the shut-down of the existing one, to cover the lack of capacity. Taking into consideration the needs of country energy independence, preference was given to 1,000 MW nuclear power units.

At present, the Ministry of Energy and Natural Resources of the Republic of Armenia, assisted by the USAID Project for assistance to the energy sector of Armenia for Energy Security and Regional Integration, is reviewing the “Environmental Background Information Document” with the aim of establishing an elaborated document on “Armenia New Nuclear Unit Environmental Report”.

Public hearings on the Armenia New Nuclear Unit Environmental (Environmental Impact Assessment) Report were conducted on May 17, 2011, in Armavir town, and on May 24 in Gyumri town. Based on the comments and recommendations made during those hearings, the report was elaborated on and submitted to the Ministry of Natural Protection of the Republic of Armenia. The Ministry of Natural Protection stated that it does not yet have any comments about the Armenia New Nuclear Unit Environmental (Environmental Impact Assessment) Report, and that it will provide a final conclusion after the results of design activities are incorporated in the final report.

The law “On Construction of a New NPP in the Republic of Armenia” was adopted 27 October, 2009, and serves as the legal basis for construction of a new NPP in Armenia. According to the Armenian law “On Safe Usage of Nuclear Energy in Peaceful Purposes”, construction of a new NPP or decommissioning of the existing NPP is only possible after adoption of a relevant law.

2.3.2. Project Management

The decree “On Establishment of a Closed Joint-Stock Company Aimed at Construction of a New NPP in the Republic of Armenia” was adopted by the Government of Armenia on 3 December, 2009. “Metsamorenergoatom” CJSC was established with the involvement of RA government and “Atomstroyexport” CJSC, which was delegated by “Rosatom” Russian State Corporation. The established, “Metsamorenergoatom” CJSC is open for other investors as well.

2.3.3. Project Funding

Final funding for the project is not yet solved.

2.3.4. Electric Grid Development

Investigations into the development of a new 400 kV network in Armenia (new voltage level in the country), as well as its expansion into neighbouring power systems, have been carried out by Energy Network Design Institute of Armenia in the project “Development of the Armenian electrical grid scheme (2010, 2015, 2020)”.

Some main conclusions of this study are as follows:

- To ensure the admissible voltage level and to reduce active power losses in the electrical grid, it is desirable to construct a new 400/220 kV substation “Noravan” with input/output of double circuit “Iran-Armenia” HVL of 400 kV.
- It is necessary to install a reactance in the Hrazdan TPP 400 kV substation to ensure the allowable voltage levels and to adjust reactive power flow.
- Calculations of short circuit currents show that there is no need to replace any equipment in existing substations, or to include any extraordinary additional equipment in new 400 kV network.
- Connection of new 400 kV OHL and the increasing of electricity exports to neighbouring power systems will highly reduce the risk of unstable operation of Armenian NPP and of the power system as a whole.

2.3.5. Site Selection

A seismic hazard assessment of the Armenian NPP site has been performed with funds from the Republic of Armenia. The terms of reference for the seismic hazard assessment of the Armenian NPP site were developed and agreed upon with the IAEA. The draft report of the site seismic hazard assessment was submitted for expert review to the IAEA in August 2010. The IAEA Mission reviewing the seismic hazard assessment provided a number of comments and recommendations for the completion of the seismic hazard assessment.

The “Seismic Hazard Assessment for the Construction Site of a New Power Unit at the Armenian NPP – Final Report” was completed in February 2011, based on the latest IAEA guidance. The report also includes a “Volcanic Hazard Assessment of the Armenia Nuclear Power Plant Site”. The final report was received positively by the IAEA.

The final report by IAEA experts on the final version of the seismic and volcanic hazard assessments was provided to the Armenian party in December, 2011. The IAEA Second Mission provided comments of an editorial nature, and recommended the carrying out of additional investigations regarding the Yerevan fault.

“Metsamorenergoatom” CJSC has received the license for selection of the site for the construction of the new unit.

2.4. Organizations involved in construction of NPPs

The construction phase of the new NPP is not yet begun, and so the construction organizations involved in the project have yet to be designated.

2.5. Organizations Involved in operation of NPPs

"The Armenian Nuclear Power Plant" CJSC is the Armenian nuclear power plant's operating organization.

“Metsamorenergoatom” CJSC will be the operational organization for the Armenian New Nuclear Unit.

2.6. Organizations Involved in Decommissioning of NPPs

A number of governmental decrees have been adopted with regard to decommissioning of the Armenian NPP:

- A special fund for the decommissioning of the Armenian NPP was created under the Ministry of Finance of RA, and the Armenian NPP regularly makes allocations to that fund from the amount included in the Armenian NPP electricity tariff. The Armenian NPP Decommissioning Fund is functioning properly
- The Management Board of the fund was created, the Chairman of the Board was elected (the Vice Prime Minister of RA). The Board includes a number of Government members
- The ANPP Decommissioning Strategy was adopted by the Government of Armenia in November 2007.

Under the framework of Action Plan of EU Neighbourhood Policy, negotiations are being carried out on the matter of providing technical assistance for development of the ANPP Decommissioning Plan, as well as development of a Radioactive Waste Strategy. Further progress will mostly depend on the ANPP Decommissioning Plan.

2.7. Fuel Cycle including Waste Management

Armenia has no nuclear fuel cycle industry and uses an open nuclear fuel cycle scheme. Up until now, all nuclear fuel has been supplied by Russia. Originally, the spent nuclear fuel generated by the ANPP was managed by central Soviet Union agencies for the reprocessing and final disposal of spent nuclear fuel. The recovered uranium and plutonium was then retained by the central agencies in the Soviet Union. Since Unit 2 has been restarted, spent nuclear fuel has been retained on the ANPP site.

The ANPP is operating within a three-year fuel cycle. Before its transfer to the dry storage facility, spent nuclear fuel is kept at the wet nuclear fuel storage site in the reactor building (fuel ponds).

In 2000, construction of the first stage of spent-fuel dry-storage was completed. It was commissioned by the French firm Framatom and financed by the French government. The spent-fuel dry-storage facility has been put into operation, and all the transportation of spent fuel is performed according to the requirements of the license given by the ANRA. The first stage of the storage facility is completely filled with spent fuel.

In 2005, an agreement was signed with the French company TN International for the construction of an additional three stages of the dry storage facility. The financing was allocated from the State budget of RA. The second stage was completed and put into operation in spring, 2008. The first part of the spent nuclear fuel has been transferred into dry storage. The third stage of spent-fuel dry-storage construction is intended to start in 2012.

By protocol decision 19 of the Government of Armenia, session No. 43 of November 4, 2010, “The Concept for Safe Management of Radioactive Waste and Spent Nuclear Fuel in the Republic of Armenia” was adopted. According to the Concept, priority activities anticipated in that area are regulated and distributed between the departments of the Republic of Armenia.

Currently, the Armenian NPP is developing a program for the management of radioactive waste existing at ANPP, which will be used in the development of the document A4.01/09 “Strategy for Radioactive Waste Management in the Republic of Armenia”, provided for under the

program of the Republic of Armenia and European Commission “Nuclear Safety Activities for 2009”.

The final spent-fuel and high-level radioactive waste treatment and disposal concept will be developed and included in the ANPP Decommissioning Program.

According to the ANPP design, the annual Unit 2 radioactive waste (radwaste) generation is: 308 m³ of solid LLW, 1,5 m³ of solid MLW, 0,3 m³ of solid HLW and 108 m³ of liquid MLW. At the ANPP, there are storage facilities for both solid and liquid radwaste.

High-level waste is stored in a special room of the reactor building. The storage area consists of 380 cells, and has a storage capacity is 78.34 m³.

Medium-level radwaste is stored in the special building. Storage capacity is 1,001.22 m³. Deep evaporating facility containers are also stored temporarily on the upper unheated floor of the special building. Its effective storage volume is 655 m³ (3000 containers).

Liquid radwaste is stored in the special building. Liquid waste (evaporator residue), generated in the evaporators during drain water reprocessing, is collected in the evaporator residue tank.

The storage facility for low-level radwaste consists of two compartments, each measuring 27x36x8.9 m. The total storage volume is about 17,050 m³.

In March of 2007, the “Radioactive Waste Decontamination” CJSC was transferred under the Ministry of Energy and Natural Resources. Currently, medical and industrial ionizing sources are kept at the facility. Work is under way to modernize the “Radioactive Waste Decontamination” CJSC storage facility, so that the middle-level liquid radwaste generated by the ANPP can also be kept.

2.8. Research and Development Activities

2.8.1. R&D organizations

The main organizations and institutions involved in nuclear energy in Armenia are: CJSC “ANPP”, CJSC “Armatom”, CJSC “Atomservice”, CJSC “Nuclear and Radiation Safety Centre” and CJSC “Scientific Research Institute of Energy”.

2.8.2. Development of advanced nuclear technologies

Armenian organizations are not participating in the development of advanced nuclear technologies.

2.8.3. International Co-operation and Initiatives

In 2004, Armenia joined the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), an IAEA initiative, in order to use innovative technology to address the needs of economic, safety, non-proliferation and waste management aspects of nuclear energy and of its fuel cycle. Armenia fulfilled the Collaborative Project (CP) entitled “Implementation Issues for the Use of Nuclear Power in Smaller Countries”. The project was supported by a number of countries. The CP aimed to provide small countries with an opportunity to discover and prepare for problems that could arise from the construction of new nuclear units in their countries.

Another INPRO “SMALL” CP was recently held, and the report has been submitted to IAEA for publication.

Armenia was invited to join the Global Nuclear Energy Partnership (GNEP). On October 1, 2008, the agreement was signed and Armenia became a member of the GNEP, the participation in which would provide significant benefits to Armenia’s nuclear program. (A change of name to the International Framework for Nuclear Energy Cooperation was adopted in June 2010.)

Armenia has bilateral cooperation initiatives, mostly concerning safety of the ANPP, with such countries as Argentina, France, Italy, the Russian Federation, UK and USA. Armenia also participates in several international projects developed within the framework of cooperation under the aegis of IAEA, EC and USAID.

Very close cooperation is established with the IAEA. Armenia has been a member of the Agency since 1993. IAEA experts have participated in many assistance projects since then. When, in April of 1993, the Government of Armenia made the decision to restart Unit 2 of the ANPP, IAEA experts participated actively in pre-commissioning investigations and in evaluations of the condition of plant equipment. Moreover, they elaborated the whole concept of Unit 2 re-commissioning. Armenia is also collaborating with the IAEA in the field of nuclear safety upgrading. At present, several national programmes of ANPP Unit 2 safety upgrading are in different phases of implementation. The IAEA is constantly assisting the ANRA, providing them with the appropriate support and recommendations.

Since 1996, the US DOE, within the framework of the International Nuclear Safety Program and EC, and within the framework of TACIS Assistance Programs, started implementing projects aimed at technical assistance in upgrading a level of ANPP operation, as well as modernization of the plant technological equipment.

Over the years, several countries – France, Great Britain, Czech Republic, Italy and the Russian Federation (since 2008) – have joined these Assistance Programs.

Armenia cooperates with Argentina within the framework of the bilateral project "Creation in Armenia of a Center for training and qualification in Non-Destructive Metal Testing Techniques", with assistance from the IAEA.

There are many joint projects with the Russian Federation within the framework of the Nuclear Safety Assistance Program. In 1996, an agreement was signed between the ANPP and ROSENERGOATOM on industrial and technical-scientific cooperation. In 2000, an agreement was signed between the Governments of RA and RF on "Cooperation in the field of peaceful use of nuclear energy".

Within the framework of bilateral cooperation between Armenia and USA, and within the "Armatom" institute of RA, the International Nuclear Safety Center of Armenia was created. The joint statement on cooperation between International Nuclear Safety Centers of Armenia and USA was signed on February 7, 2001.

Since 1996, the ANPP has been a member of the World Association of Nuclear Operators (WANO). The Moscow Centre of WANO has commissioned two inspections relevant to the ANPP operational safety.

The ANRA has agreements for cooperation with nuclear regulatory authorities of the following countries: Russia, USA, Argentina and Ukraine. The ANRA is a member of the FORUM

organization, whose members are the nuclear regulatory authorities from the countries operating VVERs. The ANRA also participates in the CONCERT Group work.

In 2007, the Government of Armenia elected to join the agreement between the Governments of the Republic of Kazakhstan and the Russian Federation involving the establishment of an International Uranium Enrichment Center in Angarsk.

2.9. Human resources development

In view of energy security and energy independence, Armenia gives special attention to the development of nuclear energy in the country.

Activities towards the construction of a new Armenian nuclear unit began in 2008. A law of the Republic of Armenia, “On Construction of a New NPP in the Republic of Armenia”, was adopted on 27 October, 2009. This serves as the legal basis for the construction of a new NPP in Armenia.

The need for qualified specialists is a growing priority, with regards to the construction of new nuclear units as well as the operation, continuous safety improvement and the decommissioning of the Armenian NPP.

Armenia is the only country in the whole Caucasus region that has been operating a nuclear power plant for over 30 years. Qualified specialists are required for Armenia’s existing NPP, for the Armenian Nuclear Regulatory Authority (ANRA), for the Nuclear and Radiation Safety Centre and for ARMATOM and other research institutes in order to address issues and challenges in view of the new developments within Armenia’s nuclear program.

Armenia has two main institutions preparing nuclear experts: the State Engineering University of Armenia (SEUA-Polytechnic) and Yerevan State University. Armenian specialists from ANRA, the nuclear power plant, and from support organizations, participate in scientific visits and training in Europe, USA and other countries. This is conducted under IAEA Technical Cooperation projects and through international aid programs.

Nuclear specialists are currently trained in two departments of the Yerevan State University and the State Engineering University of Armenia. However, enhancement of the Integrated Education System for Nuclear Sector in Armenia is essential for the Republic. In order to facilitate this, a concept on human resources management has been approved by the government. Implementation of Knowledge Management for all phases, including design, construction and commissioning, operation and decommissioning both for the existing and future NPP units, is the main focus of the Concept.

An evaluation of Armenia’s human resources needs, in conjunction with an evaluation of the new NPP build, was conducted under IAEA Technical Cooperation Project ARM-005. The report from this evaluative feasibility study of nuclear energy development in Armenia, titled “Evaluation of Human Resource Needs in Conjunction with New NPP Build”, was completed in 2008 and was published as an IAEA TECDOC-1656 “Evaluation of Human Resource Needs for a New Nuclear Power Plant: Armenian Case Study” in 2011. The analysis, which covers all stages of construction of the new nuclear power unit, relates both to the sponsoring organization and to the regulatory agency dealing with nuclear power in Armenia.

Armenia is currently engaged in the following activities:

- a. Item 11 of the Protocol of GoA Session No. 26, dated 8 July, 2010, approved a program of subsidies intended to encourage attendance and academic achievements by students in the nuclear field.
- b. Under IAEA Technical Cooperation Project ARM-006, the IAEA is providing laboratory equipment and training in order to strengthen educational programs at the State Engineering University of Armenia (SEUA) and Yerevan State University (YSU). At SEUA, the IAEA has installed a VVER-1000 unit simulator for training purposes.
- c. Under the USAID Armenia project, Aid to the Energy Sector to Strengthen Energy Security and Regional Integration, a task has been completed in support of curriculum development at SEUA and YSU to restructure and improve the curricula in nuclear engineering and nuclear physics, and to increase the knowledge level of university graduates joining the nuclear workforce.
- d. A new IAEA Technical Cooperation Project is being initiated to provide IAEA assistance in reviewing relevant permission/license documents and in the creation of corresponding infrastructure for a new nuclear unit.
- e. Curricula for the Bachelor and Master levels of specialties have been developed and re-established at SEUA and YSU, in accordance with the aforementioned government decisions.

It is expected that there will be significant expansions in staffing at the Ministry of Energy and Natural Resources and at CJSC “MetsamorEnergAtom” after the selection of strategic partners and investors, in order to support new unit design and procurement. RA’s contract with Worley Parsons (as the management company for the new NPP) requires that they develop specific training plans for personnel working during the preconstruction phase and construction phase of the project, and for personnel responsible for project safety.

Enhancement of the Armenian nuclear educational system and comprehensive development and upgrading of the training system for personnel within the nuclear power sector will include the development and upgrading of the following aspects:

- Management of training system development and operation
- Organizational structure and staffing of training system
- Training Centre
- Training programmes and material using Systematic Approach to Training (SAT) for various categories of personnel
- Simulators (full-scope, compact)
- Multi-functional multimedia Computer-Based Training (CBT) systems for various jobs and activities
- Training and development of instructors
- Training and development of nuclear power sector managers

2.10. Stakeholder Communication

See Section 2.3.2.

3. NATIONAL LAWS AND REGULATIONS

3.1. Regulatory Framework

3.1.1. Regulatory Authority(s)

The state authority for supervision of nuclear and radiation safety was established by government decree N573, on November 16, 1993. It was called the State Department for Supervision on Nuclear and Radiation Safety of Utilization of Nuclear Energy at the Government of RA. By the same decree, the Department Statute was approved and the authority was charged with the function of inspections.

By the governmental decree N70, of November 19, 2000, the Department was authorized with regulating functions. The decree also paved the way for a new statute, which was approved by governmental decree N385, June 22, 2000. The Department was renamed the Armenian Nuclear Regulatory Authority (ANRA) in accordance with that decree. The ANRA was directly subordinate to the Armenian government but was independent from those organizations responsible for development and utilization of atomic energy. According to its new statute, the ANRA was to organize and perform state supervision and inspections of the utilization of nuclear energy, as well as regulating it.

On 24 May, 2001, according to the government decree N 452, the ANRA was awarded the authorization for State regulation on protection against the irradiation from ionizing radiation sources and their safety.

The status of the ANRA was changed again on 27 June, 2002, in accordance with government decree N 912. This occurred in response to the reforming principles implemented into the Armenian System of Government Management. The ANRA was attached to the Ministry of Environmental Protection of RA.

On 26 December, 2002, the new statute of the ANRA was approved by the governmental decree N 2183. The ANRA was re-named the Inspectorate for State Supervision on Nuclear and Radiation Safety of Utilization of Nuclear Energy under the Ministry of Environmental Protection of RA. According to the new statute, the ANRA was assigned the following key duty: to regulate on behalf of the State within the field of nuclear energy utilization, with the main objective of securing the protection of the population, of the personnel involved in the nuclear industry, and of environment.

In accordance with the Ordinance of the President of Armenia adopted on 20 May, 2008, the ANRA was reorganized into the State Committee on Nuclear Safety Regulation under the Government of the RA. ANRA's current role is the state regulation of atomic energy utilization (safety of nuclear facilities, the safe use of ionizing radiation sources, the safe management of radioactive waste, and the safe transport of radioactive and nuclear materials), aimed to ensure the safety of population and personnel, environmental safety and to defend safety interests of the Republic of Armenia.

Armenia has a licensing process for NPPs, and the regulatory authority for nuclear safety is the ANRA. The licensee is responsible for the safety of the NPP. The licensee is obliged by the license to:

- Guarantee the keeping of principles, criteria and requirements of nuclear and radiation safety, as well as the conditions or acts of the temporary operation permissions
- Inform ANRA of deviations from the conditions of the temporary operation permission, as well as of incidents and emergencies during NPP Unit operation.

On 25 April, 2001, in accordance with governmental decree N 342, the Science-Research Centre of Nuclear and Radiation Safety was established at the ANRA with the aim of enabling the ANRA to carry out an independent expertise activity.

On the basis of government decree N 389, of August 22, 1994, all the rules and norms applicable to nuclear power in Russia were accepted in Armenia. The ANRA is aware of the fact that some of those regulations need revision. This process is constantly underway.

According to government decree N 252, of April 7, 2007, "On Abrogation of the Government Decree N 389, 22.08.1994 and Item 2 of the Government Decree N 239, 20.04.1999", both governmental decrees No. 389, "On Nuclear Power Plant Safety Norms and Rules" (August 22, 1994), and N 239, "On the List of Normative Decisions Adopted by Council of Ministers of the Armenian Soviet Socialistic Republic and Effective Before August 23, 1990" (April 7, 2007), became ineffective. The appropriate Armenian governmental bodies are currently in the process of developing internal norms and standards for the nuclear sector.

3.1.2. Licensing Process

The licensing process of the nuclear field is regulated by the law on "Licensing" and by the relevant decisions by the Government of RA.

3.2. Main National Laws and Regulations in nuclear power

The following laws concerning activities in the field of nuclear energy use are in use in Armenia:

- Law on "Implementation of modifications and additions both in the Code of RA on administrative and criminal legal violations", entered into force on 30 November, 1996
- Law on "Energy of the Republic of Armenia", entered into force on 1 July, 1997
- The new law on "Energy of the Republic of Armenia" entered into force in March 2001, and replacing the existing one
- Law on "Safe Use of Nuclear Energy for Peaceful Purposes" entered into force on 1 March, 1999. A significant amendment to the Law on "Safe Use of Nuclear Energy for Peaceful Purposes" entered into force on 21 March, 2000, and additional amendments and additions are now in effect. Law on "Licensing" entered into force on 27 June, 2001
- The new law "On the Export Control for the Goods of Dual Purpose and Technologies and their Transit Transportation through the Territory of Armenia" entered into force in April 2010, and replaced the previous law on the same topic.

The laws, along with governmental decrees and all other legislative and regulative documents, are presented in the official websites of the National Assembly of RA (www.parliament.am), Government of RA (www.gov.am), Ministry of Energy and Natural Resources of RA (www.minenergy.am) and of ANRA (www.anra.am).

REFERENCES

- [1] "Armenian Economic Trends" issued by the European Commission, DGIA, and NIS/TACIS services.
- [2] Investment Guide of Armenian Development Agency (1998).
- [3] Specifics and Phases of the Economic Reforms in Armenia in 1991-1998, Ministry of the State Statistics.
- [4] Manual on the Climate Data for the Construction Design in Armenia.
- [5] Data & Statistics/The World Bank, www.worldbank.org/data
- [6] IAEA Energy and Economic Database (EEDB).

- [7] IAEA Power Reactor Information System (PRIS).
- [8] EC TASIC Project N Europe Aid /112/135/C/SV/Multi " Energy Consumption Forecast"
- [9] Reports 2000 -2010 National Statistical service of the RA.
- [10] Energy balances of non-OECD countries. CO₂ emissions from fuel combustion, IEA, 2005-2010.

APPENDIX 1: INTERNATIONAL, MULTILATERAL AND BILATERAL

AGREEMENTS

AGREEMENTS WITH THE AGENCY

- | | | |
|--|----------------------|-------------------------|
| • NPT related agreement INFCIRC No: 455 | Entry into
force: | 5 May 1994 |
| • Additional protocol GOV/2948 | Entry into
force: | September
2004 |
| • Improved procedures for designation of safeguards inspectors | | No reply |
| • Supplementary agreement on provision of technical assistance by the IAEA | Entry into
force: | 30
September
1999 |
| • Agreement on privileges and immunities | | Non-Party |

RELEVANT INTERNATIONAL TREATIES OR AGREEMENTS

- | | | |
|---|----------------------|-------------------------|
| • NPT | Acceded: | 15 July 1993 |
| • Convention on the physical protection of nuclear material | Entry into
force: | 23
September
1993 |
| • Convention on early notification of a nuclear accident | Entry into
force: | 24
September
1993 |
| • Convention on assistance in case of a nuclear | Entry into | 24 |

accident or radiological emergency	force:	September 1993
• Vienna convention on civil liability for nuclear damage	Entry into force:	24 November 1993
• Joint protocol		Non-Party
• Protocol to amend the Vienna convention on civil liability for nuclear damage		Not signed
• Convention on supplementary compensation for nuclear damage		Not signed
• Convention on nuclear safety	Entry into force:	20 December 1998
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management		Not signed
• ZANGGER committee		Non-Member
• Nuclear export guidelines		Not adopted
• Acceptance of NUSS codes		No reply
• Comprehensive nuclear-test-ban treaty		1 October 1996

BILATERAL AGREEMENTS

• Agreement with the Russian Federation on restarting operation of ANPP	Entry into force:	17 March 1994
• Agreement with Republic of Argentina on co-	Entry into	22 April

operation for the peaceful uses of nuclear energy	force:	1999
<ul style="list-style-type: none"> Agreement with the Government of the Russian Federation on co-operation in the field of peaceful use of nuclear energy 	Entry into force:	10 January 2001

APPENDIX 2: MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NATIONAL ATOMIC ENERGY AUTHORITIES

Ministry of Energy and Natural Resources Government House 2, Republic Square 0010 Yerevan, Republic of Armenia	Tel: +374 10 52 19 64 Fax: +374 10 52 63 65 E-mail: minenrgy@minenergy.am
---	--

Atomic Energy Department of Ministry of Energy and Natural Resources	Tel: +374 10 52 34 47 Fax: +374 10 52 34 47 E-mail: agevorgyan@minenergy.am atomen@freenet.am
--	--

State Committee under the Government of the RA on Nuclear Safety Regulation (ANRA) 4, Tigran Mets ave. 0010 Yerevan, Republic of Armenia	Tel: +374 10; 54 39 95 Fax: +374 10 58 19 62 E-mail: info@anra.am
--	---

MAIN POWER UTILITY

Armenian Nuclear Power Plant Metsamor, 377766 Armavir region 6 Republic of Armenia	Tel: +374 10 28 18 80 Fax: +374 10 28 85 80 E-mail: anpp@anpp.am
---	--

MANUFACTURERS AND SERVICES

Armatom
50, Admiral Isakov ave.,
0114 Yerevan, Republic of Armenia

Tel: +374 10 73 46 22
Fax: +374 10 74 21 30
E-mail: vpetros@@web.am

Atomservice
Metsamor, 377766
Armavir region 6
Republic of Armenia

Tel/Fax: +374 10 28 55 32
E-mail: atomservice@anpp.am

ENERGY RESEARCH INSTITUTES, UNIVERSITIES AND OTHER ORGANIZATIONS

Scientific Research Institute of Energy
5/1 Myasnikyan ave.,
0025 Yerevan, Republic of Armenia

Tel/Fax: +374 10 54 24 68
E-mail: official@energinst.am

Yerevan Physics Institute

<http://www.yerphi.am>

State Engineering University of Armenia
(Polytechnic)

<http://www.seua.am>

Yerevan State University

<http://www.yasu.am>

National Academy of Sciences of Armenia

<http://www.sci.am>

Name of report coordinator:

A. Gevorgyan

Institution:

Head of Atomic Energy Department,

Contacts:

Ministry of Energy and Natural Resources of RA, Government House-2, Republic Square,
Yerevan, Republic of Armenia, 0010

Tel/Fax: (37410) 52 34 47

Fax: (37410) 52 63 65

E-Mail: atomen@freenet.am; agevorgyan@minenergy.am