

Bolivia: The New Nuclear Research Center in El Alto

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According to the *International Atomic Energy Agency (IAEA)* and the *Acuerdo Regional de Cooperación para la Promoción de la Ciencia y la Tecnología Nucleares en América Latina y el Caribe (ARCAL)*, Latin America and the Caribbean currently have a population of about 580 million people and about 76 % of deaths annually are caused by non-communicable diseases, cardiovascular disease being the leading cause, followed by malignant neoplasms (cancer). It is estimated that by the year 2030 the number of new cases of malignant neoplasms (cancer) that will occur each year will double, causing 1 million deaths annually. This is one of the reasons why the use of research reactors in Latin America has become a priority in public health policy in the last decade, although it still finds many obstacles to social acceptance because it uses the same nuclear energy used for power generation and military. Currently in Latin America and the Caribbean, there are 7 countries with experimental nuclear reactors of different types and power (see **Table 1**).

Latin America and the Caribbean also have one of the largest land reserves in the world with an agricultural potential of 700 million hectares, which together with the high biological diversity that it has, makes it an important global reserve for food security. It is expected that by 2050 the region will meet more than 60 % of world demand for food. Currently there are only 13 irradiators in the region, with a design capacity of more than 100,000 curies of Co-60, two of which have the ability to treat foods: the *Aceletron* in Brazil and the *National Polytechnic School* in Ecuador. They each have an estimated capacity of 40 tons and 60 tons respectively. This amount represents less than 0.5 % of the total food produced in the region is irradiated. Thus, Bolivia, after Argentina, Brazil, Ecuador, Colombia, Chile, Mexico and Peru, wants to become the 8th country to implement peaceful nuclear technology. Bolivia has been a member of the *International Atomic Energy Agency (IAEA)* since 1963, a division of the United Nations. Bolivia will comply with all regulations, protocols, safeguards that accompany implementation, development and operation of the new Research Center.

From a financial point of view the project is currently in the technical feasibility study phase with the enactment of Law 614 of 13 December 2014, by which the *Plurinational State of Bolivia* included in the budget of the *Ministry of Hydrocarbons and Energy* the US-\$ 1.8 million to finance the *Bolivian Nuclear Program (PNB)*, so that the country will have as of 2019 its own nuclear technology research centre.

The estimated cost for completion of the *Center for Research and Development in Nuclear Technology (Figure 1)* is US-\$ 300 million, while the time schedule for building both civil works and equipment is estimated will last for years. During the last three years at different times Bolivia requested international technical consultants from countries that have recognized expertise in this sector, including France, Germany, Argentina and finally Russia.

Officially on 8 October, 2015 *Rosatom* and the *Ministry of Hydrocarbons and Energy* signed the Memorandum of Understanding on cooperation in the peaceful uses of atomic energy. Then the Intergovernmental Agreements were signed in furtherance of the arrangements between

Country	Reactor	Power kW	U-235 Enrichment %	h/month	Owner
Argentina	RA-0	0.001	19.8	16	Univ. Cordoba
	RA-1	40	19.8	ND	CNEA
	RA-3	10000	19.7	266	CNEA
	RA-4	0.001	19.8	16	Univ. Rosario
	RA-6	500	19.75	180	CNEA
	RA-8	0.01 to 0.1	1.8 to 4.3	0	CNEA
Brasil	Argonauta	0.5 to 5	19.9	ND	IEN-CNEN
	IEA-R1	2,000 to 5,000	19.9	256	IPEN-CNEN
	MB-01	0.1	4.3	ND	IPEN-CNEN
	IPR-R1	250	Triga 19.9	ND	CDTN-CNEN
Chile	RECH-1	5,000	19.75	96	CCHEN
	RECH-2	10,000 to 15,000	19.75	0	CCHEN
Colombia	IAN-R1	100	Triga 19.9	0	Ingeominas
Jamaica	SLOWPOKE	20	Conversion in progress	ND	ICENS
Mexico	TRIGA	1,000 to 2,000	Triga 19.9	60	ININ
Peru	RP 0	0.001	19.75	96	IPEN
	RP10	10,000	19.75	30	IPEN

Tab. 1

Sources: IAEA and ARCAL.



Fig. 1
Artist view of the Center for Research and Development in Nuclear Technology in Bolivia currently under development.

Evo Morales, President of Bolivia, and Vladimir Putin, President of the Russian Federation made within the framework of the meeting on the sidelines of the *Third Summit of the Gas Exporting Countries Forum* held in Teheran, Islamic Republic Iran, on 23 November, 2015. The Agreements include the construction of the *Nuclear Research and Technology Center* as part of multipurpose and multifunctional gamma plants, reactor plant based on the research pooled reactor with a rated capacity up to 200 kW, and also a cyclotron, engineering facilities, science and other laboratory facilities.

The Agreements form the legal basis for cooperation between the two countries in a wide range of areas of the nuclear power: Support to creation and improvement of the nuclear infrastructure in Bolivia; design and construction of nuclear research reactors; uranium exploration and mining in Bolivia; nuclear fuel cycle services, radioactive waste treatment; nuclear and radiation safety; production of radioisotopes and their application in industry, medicine and agriculture; instructing, training and retraining of specialists for the nuclear industry in Bolivia.

The Center will be the most advanced in Latin America while being unique for the global nuclear industry and will be built on 15 hectares plot located on the border of districts 8 and 10 of El Alto, in the Parcopata area between the roads to Oruro and Viacha at 4,100 meters above sea level.

At present, *Rosatom* proposes to its customer the whole range of reduced-enrichment research reactors with the capacity from a few tens of kW to 20 MW with various sets of experimental and production capabilities.

The Bolivian project marks *Rosatom's* return to the high-technology market of research reactors construction and *Nuclear Research and Technology Centers* on the basis of these reactors.

The Center will include a research reactor with the capacity of 100 to 200 kW (the safest pool type reactor). This reactor's design and operation mode are based on reference technical solutions and technologies while being best suited for a country entering the path of the nuclear technology development and application.

The project implementation will allow Bolivia to proceed to the mastering of the nuclear technologies, develop a workforce capacity for the nuclear industry, apply the capabilities of the reactor and Center to science, medicine, geology, agriculture and other areas of human life and activities where the nuclear technologies can be efficiently used for peaceful purposes.

Research reactors may be used in neutron activation analysis (NAA) to promptly determine substance concentration and element content (in geology, archeology, biology, and other applied sciences), to determine aquifer paths, to adopt the technology of isotope products required in industry.

The Center will provide for a wide use of radiation technologies in agriculture, medicine, and industry. Irradiation in food treatment will improve its quality and create conditions for the increase of Bolivian agricultural product export. The radioisotopes produced at the Center will be applied in diagnostics and treatment of cancerous diseases generally making the nuclear medicine more affordable for the population of Bolivia. The Center will also contribute to the improvement of the national education and science level providing preparation of highly qualified specialists in various fields.

The radioisotopes produced at the Center will be used in diagnostics and treatment of various cancerous diseases, endocrinology, diseases of heart and vegeto-vascular system.

After several diplomatic negotiations, accompanied by much social unrest, much of which was not properly based on valid technical arguments, on 6 March, 2016, the *Plurinational State of Bolivia* and the *Russian Federation* signed the Intergovernmental Agreement on cooperation in the peaceful use of atomic energy and the construction of the *Nuclear Research and Technology Center*.

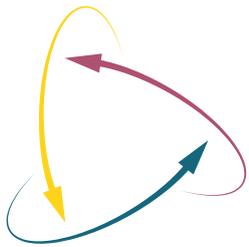


Fig. 2
Signing of the Intergovernmental Agreement on cooperation in the peaceful use of atomic energy and the construction of the Nuclear Research and Technology Center.



Fig. 3
Negotiations and signing of the Intergovernmental Agreement on cooperation in the peaceful use of atomic energy and in construction of the Nuclear Research and Technology Center. The Agreement was signed by Sergey Kirienko, Director General of Rosatom, and Luis Alberto Sanchez, Minister of Hydrocarbons and Energy in the presence of Evo Morales, President of Bolivia.

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The Agreement was signed by *Sergey Kirienko, Director General of Rosatom*, from the Russian side, and *Luis Alberto Sanchez, Minister of Hydrocarbons and Energy*, from the Bolivian side, in the presence of *Evo Morales, President of Bolivia*. (Figure 2 and Figure 3)

The *Nuclear Research and Technology Center* will allow Bolivia to proceed to mastering the nuclear technologies and its application in science, medicine, geology, agriculture and other areas of human life and activities. In particular, the Center will provide the opportunity to start production of radioisotopes in Bolivia for their wide use in diagnostics and treatment of cancerous diseases which makes the nuclear medicine more affordable for the population of Bolivia. The application of irradiation technologies for food and agricultural products treatment, pest and bacteria control will make it possible to increase the products storage period while creating conditions for the increase of national agricultural products export.

The Center will be equipped with the state of the art equipment for researchers within the framework of the national nuclear and research program of Bolivia, contributing to the improvement of the education and science level in the country.

The *Nuclear Research and Technology Center* construction project is unique for the global nuclear industry. According to *Sergey Kirienko, Director General of Rosatom*, the construction of the Center in *El Alto* will create unique conditions for development of the modern nuclear science, technologies and medicine in Bolivia. *Rosatom* proposes also the integrated approach to its customers. Besides the construction of the Center and research reactor for Bolivia will also provide training for future specialists, equip laboratories and arrange nuclear fuel supplies. This will be the most advanced Center in Latin America with the most advanced equipment.

In mid-March of 2016 the *Ministry of Hydrocarbons and Energy* implemented the *Bolivian Nuclear Energy Agency (ABEN)* which aims to develop, supply and market goods and services of nuclear technology for peaceful purposes in the country, under the *Bolivian Nuclear Program (PNB)*.

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Deutsches Atomrecht auf dem Prüfstand: Die Anforderungen aus der EURATOM-Richtlinie zur nuklearen Sicherheit

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Die Europäische Richtlinie zur Nuklearen Sicherheit vom 8. Juli 2014 [1] ist spätestens am 15. August 2017 in nationales Recht umzusetzen. Damit stellt sich zugleich die Frage, ob und inwieweit bis dahin auch das deutsche Atomrecht an die entsprechenden Vorgaben anzupassen ist.

1 Hintergrund/Historie

Eine kurze Rückschau erscheint sinnvoll, um bereits die Ausgangslage einordnen zu können. Der Paukenschlag ertönte im November 2002, als die *Europäische Kommission* ein „Gemeinschaftskonzept für die nukleare Sicherheit in der EU“ [2], kurz das sogenannte Nuclear-Package beschloss. Dieses Paket umfasste vier Elemente, nämlich Regelungen zur Entsorgung, zur Finanzierung der Entsorgung, der Zusammenarbeit mit Russland in speziellen Nuklearfragen [3] und eben von Regelungen zur nuklearen Sicherheit. Sogleich entbrannte eine intensive Diskussion zur Sinnhaftigkeit dieser Regelungen und zur Reichweite der EURATOM-Kompetenzen auf diesen Rechtsgebieten, die bereits aus Platzgründen hier nicht im Einzelnen nachgezeichnet werden kann.

Im Ergebnis kann festgehalten werden, dass es nunmehr, also ein gutes Jahrzehnt später, in allen diesen Regelungsbereichen entsprechende EURATOM-Regelungen gibt. Dies betrifft insbesondere die jüngst mit der 14. Atomgesetznovelle (Atomgesetz: AtG) vom 20. November 2015 [4] in nationales Recht umgesetzte Entsorgungsrichtlinie vom 19. Juli 2011 [5] sowie die entsprechende Empfehlung der Kommission vom 24. Oktober 2006 [6] zur Finanzierung der Entsorgung.

2 EURATOM-Richtlinie zur nuklearen Sicherheit vom 25. Juni 2009

Die EURATOM-Richtlinie zur nuklearen Sicherheit vom 25. Juni 2009 [7], die im Folgenden der Einfachheit halber Safety-Richtlinie 2009 genannt wird, wurde im Dezember 2010

fristgerecht mit der 12. AtG-Novelle [8] in das nationale Recht umgesetzt. Dies geschah im unmittelbaren zeitlichen Umfeld zur Laufzeitverlängerung, die aber gesondert in der 11. AtG-Novelle [9] geregelt wurde. Neben der Umsetzung der Safety-Richtlinie 2009 verankerte die 12. AtG-Novelle auch den § 7d AtG [10] und – zur Absicherung zukünftiger Endlager – Normen zur Enteignung im Atomgesetz.

Rechtsgrundlage der Safety-Richtlinie 2009 war und ist Art. 31 EURATOM-Vertrag [11]. Als einer sogenannten Richtlinie bedürfen deren Regelungen einer fristgerechten Umsetzung in nationales Recht, soweit diese Regelungen inhaltlich noch nicht ohnehin vollumfänglich im nationalen Recht also insbesondere dem AtG verankert sein sollten. Wer es sich einfach machen möchte, schaut hinsichtlich