
Baril

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That happened in February:
Sino-Russian Nuclear Cooperation

List of Agreements between Russia and China in the nuclear field.

- Agreement on Creation of a Joint Non-Ferrous and Rare Metals Corporation. Signed March 27, 1950.
- Aid in Developing Physics Research of the Atomic Nucleus and in Utilization of Atomic Energy for Needs of the National Economy. Signed April 27, 1955; in force April 27, 1955.
- Uranium Survey Agreement. Signed January 30, 1955.
- Aid by USSR in Construction of Industrial Enterprises. Signed April 7, 1956. Note: Included in this is construction of a 6 Megawatt reactor.
- Economic and Scientific Co-operation Agreement. Signed April 24, 1990.
- Agreement on Co-operation on the Construction and Operation of a Fast Neutron Experimental Reactor in China. Signed April 2000.
- Nuclear Co-operation Agreement. Signed July 20, 2001. Note: This includes designing a nuclear energy plant for spacecraft and the manufacture of MOX fuel.
- Fast Reactor Agreement. Signed July 2002.

China and Russia share sixty years of cooperation in the nuclear field, both military and civil.

Russia has been involved in the design and construction of research reactors in China since the late 1950s: the Heavy Water Research Reactor RFR-10 was in operation from 1958 until it was shut down in 2007.

Since 2010, both countries have agreed to expand nuclear power cooperation in several areas, including VVER technology, fast reactors, exploration of uranium mines, fuel manufacturing, nuclear isotopes, decommissioning of old plants, post-processing technology, building floating power plants and developing markets abroad.

Recently, Wang Qishan, Vice Premier of the State Council and Chinese Chairman of the China-Russia Energy Cooperation Committee (CRECC), reiterated this cooperation program with his counterpart Arkady Dvorkovich, Deputy Prime Minister of the Russian Federation.

Our editorial team will introduce briefly some of the major projects that involve Russian technology in China.

TIANWAN Nuclear Power Plant Phase 1

Tianwan Nuclear Power Plant (TNPP), a VVER-1000 (V-428) 2 x 1060 MW, was promoted by Russia as the first third-generation nuclear power plant (project "AES-91") and the largest economic entity cooperation between China and Russia.

The nuclear power plant is located in Lianyungang, Jiangsu Province.

This intergovernmental agreement was signed on December 18, 1992. The project involved the participation of more than 150 Russian companies, organizations and governmental organizations (e.g. the turbine was manufactured at the Leningrad Metal Works).

In 2004, the Russian Nuclear Regulatory Andrey Malyshev who visited the site already indicated that Russia could participate in the tender for the extension of Tianwan.

The earlier tests revealed 3,300 serious defects or non-conformance in the Russian equipment despite control from Atomstroyexport, and Rostekhnadzor, the inspection organization.

The facility started its commercial operation on May 17 and August 16, 2007.

Since beginning commercial operation, Atomstroyexport has continued its support to Jiangsu Nuclear Power Corporation (JNPC) through its subsidiaries such as Atomtechenergo (operation of the plant and provides personnel training) and Atomenergoremont (maintains and upgrades systems and components). Recently, Tianwan was provided with information on the safety improvement actions taken at Russian NPPs with regard for additional analysis performed after the Fukushima accident.

The construction of this first phase involved Chinese civil engineering companies who acquired valuable experience, such as China Construction Nuclear Industry Corporation (CNI-23). Many Chinese enterprises manufactured a number of pieces of equipment related to instrumentation and control, low-pressure pipeline, valves and fittings.

In May 2010, JNPC signed the protocols on the final acceptance of the first phase of the Tianwan nuclear power plant.

This cooperation recently led to the creation of a science and technology base, established in Lianyungang, between JNPC and Volgodonsk Nuclear Power Plant. The Council of Sino-Russian nuclear science and technology research and development of international cooperation gathers researchers from the Nuclear Power Institute of China (NPIC), China Institute of Atomic Energy (CIAE), Shanghai Nuclear Engineering Research and Design Institute (SNERDI), Institute of Nuclear and New Energy Technology Research Institute (INET) and other members from JNPC. One of the subjects of cooperation is the molten-core catcher technology, which has improved nuclear safety since September 2010.

TIANWAN Nuclear Power Plant Phase 2

In 2006, Sergei Kirienko informed President Vladimir Putin's cabinet that Rosatom would resume its expansion in Tianwan nuclear plants and intends to build six more reactors.

In November 2010, the signing of a general contract to build the Phase Two took place in St. Petersburg. The plant was designed by Gidropress.

The contract parties are JSC Atomstroyexport and JNPC.

The key responsibility of the Russian side is the nuclear island. Atomstroyexport provides 30% of the VVER units for €1.3 billion, including nuclear island equipment. The overall project is expected to cost $3.8 billion.

Atomstroyexport will not act as the principal contractor, though it insists on retaining intellectual property rights.

Iskorskiye Zavody "Izhora", part of OMZ, manufactures the reactor pressure vessels with internals and upper units. Delivery should be completed in 2014.

The delegation of the Ministry of Environment Protection of China visited the company in 2011, including representatives from the National Nuclear Security Administration (NNSA), the Northern Regional Office (NRO), the Nuclear and Radiation Security Center (NSC) and JNPC.

The Chinese experts visited the metallurgical and engineering plant production complex to become familiar with all phases of manufacture of equipment for this project.

In 2012, the representatives of "TSKBM" and OJSC "Atomenergomash" also defined a possible cooperation in the production of PARS and other gas treatment systems.

Areva (with Siemens) supplied the digital safety instrumentation & control system, and also the emergency diesel generator (with Motor and Turbine Union).

JNPC is responsible for about 70% of the project, namely, the civil work, the turbine island with equipment and related infrastructure on the site (note: Harbin Turbine Company provides the turbine design, moisture separator reheater (MSR) and other major auxiliary engine, turbine control, flexible foundation design and other key components of the manufacturing process Machines).

The civil engineering contract was awarded to China Nuclear Industry Huaxing Construction Company (HXCC), and to China Nuclear Industry 23 Construction Co for component installation.

Commercial operation is due in 2018 and 2019.

In December 2012, the Russian Deputy Prime Minister Dmitry Rogozin reported discussions with CNNC regarding phases III & IV of Tianwan (units 5-8), using VVER technology.

List of HAF 604 certification awarded to Russian Companies for Tianwan Phase 2

Corporation	Equipment	Safety Level	Range	Certification date
Izhorskiye Zavody	Pressure Vessel	Class 1, 2 & 3	Design & Manufacture	2011-3-22
	Brace			
	Pipes and pipe fittings			
	reactor internals	Class 3		
	Tank	Class 2 & 3		
	Strobe			
	Mechanic penetrating piece			
Alpha - Lawali	Heat exchanger	Class 2 & 3	Manufacture	2012-4-28
Liski	Pipes and pipe fittings			
Atommashexport	Mechanic penetrating piece	Class 2 & 3	Design & Manufacture	
	Valve			
	Brace			
	Strobe	Class 2		
	He	Class 3		
Ziomar	Heat exchanger	Class 2 & 3	Design	
	Tank			
	Pipes and pipe fittings			
	Brace			
Zio Podolsk	Heat exchanger	Class 1, 2 & 3	Manufacture	
	Tank	Class 2 & 3		
	Pipes and pipe fittings			
	Brace			
Baltiysky Zavod	Heat exchanger	Class 3		
Baltiysky Zavod	Tank			
OMZ-Special steels	Casting and Forging	Class 1, 2 & 3		
Central Design Bureau of Machine Building	Pump		Design & Manufacture	
Lebedyansky machine-building plant		Class 2 & 3		
Central Valve Design Bureau CKBA	Valve			
Gidropress	Pressure Vessel	Class 1	Design	
	Heat exchanger			
	Pipes and pipe fittings	Class 2		
	Reactor Internals			
	Control rod drive mechanism			
	Tank	Class 2 & 3	Design & Manufacture	
	Brace			
Kontur	Valve	Class 2 & 3	Manufacture	
Limited Liability Company “Atomspetsservice”	Heat exchanger	Class 3	Design & Manufacture	
	Tank	Class 2 & 3		
	Mechanic penetrating piece			
	Valve			
	Flange			
Limited Liability Company “Polesye”	Tank			
	Mechanic penetrating piece			
	Heat exchanger	Class 3		
Tyazhmash	Brace	Class 2	Manufacture	
PDTI «Atomarmproect»	Valve	Class 2 & 3	Design	
JSC «Soyuz-01» Firm			Design & Manufacture	
Enmash			Manufacture	
E4-Centroenergomontazh	Pipes and pipe fittings			
	Brace			
	Flange			
Specialized scientific research institute for instrumentation engineering	Cabinets	1E		

Major international visits to the CEFR since 2011:

October 2011: Russian Deputy Prime Minister Igor Sechin visited the China Experimental Fast Reactor (CEFR) with the Vice-Premier Wang Qishan and Wang Gang, the President of CIAE

October 2011: Alexander Bychkov, Deputy Director General of International Atomic Energy Agency (IAEA) visited the site accompanied by Ren Meizhen, Deputy Secretary General of China Atomic Energy Agency (CAEA).

April 2012: Vyacheslav Pershukov, vice manager of Rosatom, who introduced the progress achieved on basic nuclear research, isotope, fast reactor technology and fuel reprocessing.

August 2012: Nikolai Nikolaevich Ponomarev-Stepnoi from the Russian Academy of Science and project manager Valery N. Vanyukov of State Scientific Center - Research Institute of Atomic Reactors (RIIAR). Mr. Ponomorev delivered a speech on “Status and Future of Space Reactors of Russia” and expected to promote related co-operations with CIAE.

CEFR

R&D on fast neutron reactors started in 1964.

In 2003, A 65 MWt fast neutron reactor - the Chinese Experimental Fast Reactor (CEFR) - was designed and built near Beijing by the China Institute of Atomic Energy (CIAE) with the support of OKBM Afrikantov, OKB Gidropress, NIKIET and Kurchatov Institute.

This is known as the Chinese Demonstration Fast Reactor (CDFR) project 1.

The CEFR project received research assistance from the Russian Fast Breeder Reactor Association and more “detailed design” assistance from experts of the Beloyarsk Nuclear Power Station.

The main equipment including reactor safety systems, heat exchangers, reloaders and control devices was installed by OKBM.

The reactor uses highly enriched uranium (HEU) of 64.4% enrichment imported from Russia.

China intends to use mixed oxide (MOX) fuel in its industrial-scale (600 MW) China Prototype Fast Reactor envisioned for 2020.

It achieved first criticality in July 2010, and was grid connected in July 2011.

BN-800

In addition to the CDFR project 1, on October 2009, an agreement between the CIAE, CNEIC and Atomstroyexport confirmed that China would opt for the BN-800 technology as CDFR project with 70% of the equipment to be localized.

The BN-800 is the first integral type sodium reactor based on the prototype fast reactor BN-600, which has been in successful operation since 1980. It uses the closed-end nuclear fuel cycle technologies, has a thermal capacity of 2100 MW, electric power of 880 MW, installed capacity utilization factor of 80% with an efficiency of 42%, and a service life of 40 years.

OKBM Afrikantov will build the reactor at Sanmin, an inland part of Fujian province. Atomenergopoekt is in charge of the design.

Sanmin Nuclear Power Co Ltd is a joint venture company with the Fujian Investment & Development Corp and local government.

In 2012, a delegation from OJSC “Atomenergomash”, headed by the acting CEO Boris Arseev, presented the BN-800 reactor, which has been developed

First concrete pouring started at Tianwan-3
Credit: Rosatom.ru

Over 100 Russian organizations, equipment manufacturers and service suppliers, are involved in the fulfillment of the contract, including the following institutes:

- JSC Kovrov Mechanical Plant
- JSC East-European Head Design and Research Institute of Integrated Power Engineering Technology
- JSC Novosibirsk Institute VNIPIET
- JSC Tochmash
- JSC Zarubezhatomenergostroy
- JSC Atomenergoproekt
- JSC Ural Electrochemical Plant
- JSC Angarsky Electrolysis Chemical Plan

by Afrikantov at the Nuclear Industry China Exhibition (NIC) organized by the Chinese Society of Nuclear Sciences in Beijing.

The first unit is to be in operation in 2018, and the second following about a year later.

A second phase, with units 3 & 4, is due to commence building in 2015.

ENRICHMENT

In 2010 China needed 3600 tU and 2.5 million SWU of enrichment. In 2020 it expects to need 10,000 tU and 7 million SWU.

A Russian centrifuge enrichment plant at Hanzhun, SE Shaanxi province, was set up under 1992, 1993 and 1996 agreements between Minatom/ Techsnabexport (Tenex) and CNEIC, covering a total 1.5 million SWU/yr capacity in China at two sites.

The first two modules at Hanzhun came into operation between 1997 and 2000, giving 0.5 million SWU/yr as phases1 & 2 of the agreements.

The core business of Tenex is the export of conversion/uranium enrichment services (SWUs) and enriched uranium product (EUP) produced by the companies of the nuclear industry. A very prospective area of the Company's business is the implementation and realization of engineering projects related to the creation of the Nuclear Fuel Cycle production enterprises, including the construction of a gas centrifuge uranium enrichment plant in China.

In November 2007, Tenex undertook to build a fourth 0.5 million SWU/yr of capacity at Hanzhun. The agreement was signed in 2008 for 1 billion USD.

The scope of Tenex’s obligations under the contract include designing the primary manufacturing facility, supplying key technological and auxiliary equipment, providing consulting services during the installation and commissioning, providing designer supervision and training Chinese experts in Russia.

Over 70 members of the Directorate of Russian technical experts provided guidance, general supervision and design supervision during installation and commissioning on site. Chinese experts were trained at Angarsky Electrolysis Chemical Plant.

FUEL

CNNC is responsible for the fuel fabrication.

TVEL produces nuclear fuel for pressurized water reactors, uranium-graphite,

Floating Power Unit (FPU)
Credit: okbm.nnov.ru

The construction of the Akademik Lomonosov

The hull and sections of vessels for the first floating nuclear power plant are under construction at Saint Petersburg.

The reactors were designed by OKBM Afrikantov and are assembled by Nizhniy Novgorod Research and Development Institute Atomenergoproekt. The two reactors on board will be KLT- 40S units similar to those used in Russia's nuclear-powered naval and icebreaker fleets. Izhorskiye Zavody produces the reactor vessels and Kaluga Turbine Plant supplies the turbo-generators.

The nuclear power plant was designed for a life of about 36 years.

Fuels used in the construction can ensure its normal operation for 10 years, during which, its production capacity can meet the lighting and heating demand of a city with a population of 100,000.

The project and its periphery construction will require an investment of 6 billion US dollars, costs of which will be recovered within 10 years.

fast neutron reactors as well as for research and vessel-mounted reactors.

JSC Novosibirsk Chemical Concentrate Plant provided the first core and three reloads for Tianwan 1&2.

In November 2010, TVEL contracted with Jiangsu Nuclear Power Corporation (JNPC) and CNEIC to supply six fuel reloads for Tianwan 1.

November 2011, TVEL contracted for a supply for six reloads of TVS-2M nuclear fuel for unit 1.

Starting from the seventh reload, JSC TVEL will transfer its TVS-2M fuel manufacturing technology to CNNC's subsidiary China Jianzhong Nuclear Fuel (JNF) located in Yibin, Sichuan.

In addition, TVEL signed a contract for supply of Russian zirconium components needed for the China-based manufacture of UTVS fuel for the 6th reload of TNPS units 1 and 2 and TVS-2M fuel for the 7th reload of TNPS unit 2.

The total value of the contracts totals approximately $500 million.

ISOTOPE

In 1989, the predecessor of the NIIAR, the Scientific Research Institute of Atomic Reactors initiated cooperation with the CIAE in the production of a variety of radioactive sources, including californium-252.

The Department of Isotope is an important R&D base for isotope technology with top maximum technical ability and the greatest scale in China.

It also includes the following entities:

The Research Center for National Isotope Engineering Technology,

The Isotope Committee of China Nuclear Society,

The Isotope Specialty Committee of China Isotope and

The Radiation Profession Association.

The Department of Isotope has been engaging in the R&D work in the area of isotope technology including:

The development direction of isotope,

Advanced technologies to the industry and economy,

New products development,

Technology transfer and

Training and other type of education.

The NIIAR has an advanced level in high flux nuclear reactors, and can produces a variety of high specific activity radionuclides.

In 1992 CNNC and Rosatom created Beijing Shuangyuan Isotope Technology (Shuangyuan).

The company is an important supplier of medical and industrial cobalt-60 source and the exclusive californium-252 neutron source supplier.

The Russian side has provided specialized equipment for preparation of californium-252 neutron source, technical information, and technical training for Chinese experts.

Since 1996, Shuangyuan produced medical source of iridium-192, cobalt-60 medical source, medical californium -252 source and other derivatives of a cobalt-60 source. Today, the domestic production of iridium-192 is exclusively from Shuangyuan. Meanwhile, the company also provides semi-selenium -75, nondestructive testing of iridium-192 and cobalt-60 source.

Shuangyuan just celebrated its twenty year birthday in October 2012.

FLOATING NUCLEAR POWER PLANTS

During the 2010 annual meeting between Russia and China, Sergei

Kiriyenko discussed a probable partnership in floating nuclear power plants with Chen Quifa, chairman of the China Atomic Energy Authority.

China needs clean energy as its ecological environment continues to deteriorate. Compared with the traditional nuclear power plants, floating ones have better antiseismic performance and a smaller risk of a radiation leaks.

in addition to this, floating plants can support a desalination of up to 24 million tons of seawater.

Rosatom will be in charge of all the construction, operation and staff training.

In December 2012, Russia and China held their first meeting for cooperation in the development of marine nuclear energy for floating power plants and potentially for the propulsion of large ships.

Chinese interest in this kind of power source has grown steadily in recent years and has now reached the level of formal cooperation. The first meeting for this was held at the end of November in Chengdu, Sichuan province. Around the table were representatives of power plant operator Rosenergoatom, designer OKBM Afrikantov as well as CNNC and its subsidiary the Nuclear Power Institute of China (NPIC).

The Sino-Russian nuclear cooperation embraces major segments of the nuclear market. Both countries indicate their will to export the products of their cooperation, such as the VVER, and floating nuclear power plants to third countries.

At the same time, we can expect a rising competition between Rosatom subsidiaries, Rusatom Overseas and Atomstroyexport, and their Chinese counterparts CNNC, SNPTC and CGNPC in Argentina, South Africa and other countries that need nuclear power plant with a strong financing.

As for the sales of small reactors overseas, AKME-engineering which develops a lead and bismuth coolant 100 MW reactor unit (SVBR-100) and OKBM that designs the ABV-6M, KLT-40S, ATETs-80 will face INET and NPIC for their HTR and ACP100.

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