• Russian Federation •

URANIUM EXPLORATION

Historical review

Since the beginning of uranium exploration in 1944, more than 100 uranium deposits have been discovered within 14 districts in the Russian Federation. These deposits can be classified into three major groups: the Streltsovstk district, which includes 19 volcanic caldera-related deposits where the mining of some deposits is ongoing, the Transural and Vitim districts where sandstone basal-channel type deposits are developed for uranium production by ISL mining and other uranium bearing districts containing numerous deposits of vein, volcanic and metasomatite types higher cost uranium resources that are planned to be mined.

Recent and ongoing uranium exploration activities

Uranium exploration and prospecting is financed from the state budget by the Federal Subsoil Resources Management Agency (Rosnedra). In 2005, financing for geological exploration increased 2.3 times as compared to 2004. In 2006, the financing increased by yet another 60% to RUB 773.6 million. The executing organisations were the territorial subsidiaries of the Federal State Enterprise Urangeologorazvedka, as well as by Sosnovgeo, Koltsovgeologia and Chitageologorazvedka.

Uranium exploration was performed in accordance to the "Long-Term State Program of Subsoil Exploration and Mineral Resources Replenishment" adopted on 8 June 2005 by the Ministry of the Natural Resources of the Russian Federation. Recent operations have focused on three types of exploration targets:

- sandstone basal channel type deposits amenable for ISL mining in the Transural (Kurgan Region) and Vitim (Buryat Republic) uranium ore district.
- unconformity-type deposits in Eastern Siberia (Yenisei ridge, Eastern Sayan, Nichat-Torgoy, Bulbukhta and Akitkan district), as well as the north-western (Baltic shield) and central (Voronezh massif) regions of the western Russia.
- vein-stockwork and volcanic-type deposits in the southern Priargun district (Chita Region).

Exploration yielded positive results in areas favorable for sandstone-type deposits. In Eastern Siberia a number of promising new areas and anomalies for unconformity and vein-stockwork mineralisation were also identified.

The exploration in 2006 resulted in increases in Prognosticated Uranium Resources by 15 000 tU and Speculative Resources by 25 000 tU.

The budget for uranium exploration in 2007 is again increased, amounting to RUB 1 097.4 million. The bulk of the funds will be used to explore the areas located nearby the existing uranium producing centres and in prospective areas of Chukotka, Eastern Siberian, Kalmykya, etc. For 2007, the targeted increase of the Prognosticated and Speculative Resources is 29 500 tU and 178 000 tU, respectively.

In addition to the geological exploration activities in new areas financed by Rosnedra from the state budget, the uranium producing enterprises of Rosatom perform detailed exploration of known deposits to re-evaluate resources and transfer them to higher confidence categories.

In 2007, JSC Atomredmetzoloto, a Russian company authorised for uranium exploration and mining, signed an Agreement with Cameco Corporation to establish jointly owned project companies to explore for uranium in Russia and Canada.

Recent mine development activities

Development of deposits included pilot test works and pre-feasibility studies.

Pilot test works at the Khiagda deposit (Vitimsky Region of the Buryat Republic) have been conducted by JSC Khiagda since 2000. In 2006, 26.5 tU were produced and in 2007-2008 the pilot field is to be expanded to produce 120 tU. Exploration of the adjacent Vershinnoye and Namaru deposits will start in 2008.

The feasibility study of the JSC Khiagda producing enterprise with a 1 000 tU/year capacity has been developed and is currently being reviewed by state authorities.

In 2006-2007, pre-feasibility studies were conducted on the development of stand-by uranium deposits in the Elkon uranium region (Republic Sakha-Yakutia) and in the Eastern Transbaikalia.

The pre-feasibility study of the Elkon uranium region included the layout and development of major production facilities, an assessment of the ore mining and processing technologies, environmental monitoring plans and preparations for public hearings. The development of a feasibility study of the Yuzhnaya zone, where the main resources are located, is ongoing. The Lunnoye Company was established in 2006 to develop one of the gold-uranium deposits in the area.

With respect to the Eastern Transbaikalia deposits, a preliminary technical and economic assessment for Olovskoye, Gornoye and Berezovoye deposits has been prepared.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

In the last two years, uranium resources in Russia have been substantially increased. In 2006, comprehensive technical and economic evaluation of numerous stand-by uranium deposits discovered and explored in the past 50 years was conducted. Earlier, such resources were classified as so-called "non-balance-sheet" resources and were not accounted in the State Committee for National Resources Inventory. Re-evaluation of these non-balance sheet resources led to a re-classification of those which can be reasonably developed in an economic fashion.

Thus, as of 1 January 2007, recoverable Identified Resources (RAR and Inferred) amount to 545 634 tU, a 373 232 tU increase (46%) over the 2005 Red Book total, of which 83 599 tU (22%) are recoverable at a cost of <USD 40/kgU. Without considering production and processing losses, Identified *in situ* resources amount to 662 946 tU in the Russian Federation.

All Identified Resources recoverable at a cost below USD 40/kgU are situated near existing and committed production centres where volcanic deposits are mined using conventional underground mining methods, and sandstone-type deposits where ISL methods are used to extract uranium.

The reclassification of uranium deposits in the Elkon uranium ore district (Republic of Sakha Yakutia) accounts for the bulk of these increases (289 000 tU). These metasomatic type deposits are to be mined using the conventional underground mining method.

Small and medium-size vein-stockwork deposits in the Chita and Khabarovsk regions (24 000 tU in total), to be mined underground, and sandstone-type deposits in the Buryat Republic (57 000 tU) that are to be extracted using ISL technology, account for the remaining increase in resources.

Reasonably Assured Resources (RAR) recoverable at <USD 80/kgU amount to 172 365 tU. The bulk of these resources are to be mined by conventional mining methods. RAR recoverable at a cost of <USD 40/kgU (47 543 tU) are attributed to the existing and committed mining centres. These resources have been reduced over the last two years due to mining depletion.

Inferred Resources amount to 373 269 tU in total, of which 323 007 tU are recoverable at a cost of <USD 80/kgU. Most of these deposits belong to metasomatic type uranium deposits of Elkon district.

Undiscovered Resources (Prognosticated & SR)

Re-evaluation of resources of the stand-by uranium deposits also resulted in an increase of the Undiscovered Resources. Compared to the 2005 Red Book, Prognosticated Resources increased by 172 000 tU to a total of 276 500 tU and Speculative Resources increased by 169 000 tU to amount to 714 000 tU, as of 1 January 2007.

The majority of Prognosticated Resources are located in the Chita Region (Streltsovsk and East-Transbaikal uranium ore districts), the Republic of Buryatia (Vitim District), and the Republic of Sakha Yakutia (Elkon uranium ore district).

URANIUM PRODUCTION

Historical review

The first organisation responsible for uranium production was the Lermontov Complex, presently referred to as the Lermontov State Enterprise “Almaz”. Almaz is located 1.5 km from the town of Lermontov, in the Stavropol region or district. This district included the Bestau and Byk vein deposits, which have been mined out. Their original resources totalled 5 300 tU, at an average grade of 0.1% U. These resources were extracted by two underground mines starting in 1950. Mine 1 (Beshtau) was closed in 1975 and Mine 2 (Byk) in 1990. The ore was processed at the local processing plant using sulphuric acid leaching starting in 1954. From 1965 to 1989, stope or block leaching were also used. From the 1980s until 1991 uranium ore transported from Ukraine and Kazakhstan was also processed at Almaz. Production from local deposits totalled 5 685 tU, with 3 930 tU extracted by underground mining and 1 755 tU by a combination of different leaching technologies.

Between 1968 and 1980, 440 tU were produced by ISL from the Sanarskoye deposit in the Transural district. The Malyshevsk Mining Enterprise operated the project.

The joint Stock Company "Priargunsky Mining-Chemical Production Association" (PPGHO) has been the only active uranium production centre in Russia in the last decade. The Priargunsky production centre is located in the Chita region, 10-20 km from the town of Krasnokamensk, which has a population of about 60 000 people. The production is based on 19 volcanic deposits of the Streltsovsk uranium district (an area of 150 km^2) which has an overall average uranium grade of about 0.2% U. Mining has been conducted since 1968 by two open pits (both are depleted) and three underground mines (mines 1, 2 and 4 are still active). Milling and processing has been carried out since 1974 at the local hydrometallurgical plant using sulphuric acid leaching with subsequent recovery by a combination of ion exchange and solvent-extraction. Since the 1990s low-grade ore has been processed by heap and stope/block leaching.

More than 100 000 tU has been produced from the Stresovsk deposits at Priargunsky, making it one of the most productive uranium districts in the world. Cumulative production through 2004 in the Russia Federation totalled 119 963 tU, which makes it the fifth largest uranium producer in the world based on historical production.

Status of production capability

Uranium production in the Russian Federation is managed by the Federal Agency for Nuclear Energy (Rosatom). Until 2007, three Russian uranium producing companies (Priargunsky, Dalur and Khiagda) were the daughter companies of TVEL Corporation, whose core business is nuclear fuel fabrication. The Russian exporter of low enriched uranium, Techsnabexport (TENEX), had a 49% share in Russian-Kyrgyz-Kazakhstan JV Zarechnoye in Kazakhstan. Since 2006, TENEX has also been involved in new uranium mining and exploration projects in the Russian Federation and abroad.

In 2007, as part of the Russian nuclear industry restructuring programme, a state company Atomenergoprom was established to consolidate all entities of Rosatom which operate in the civil nuclear sector, from uranium production to power generation. Atomredmetzoloto, nominated as the principal uranium producing company, is responsible for all uranium mining activities and uranium supply. It will manage uranium mining assets previously owned by TVEL and TENEX. Atomredmetzolotos became a part of Atomenergoprom as a result of this re-organisation.

Annual uranium production in Russia continues to remain at the level of about 3 000 tU. In 2006 production amounted to 3 190 tU, of which 2 711 tU were produced by traditional underground mining methods, 186 tU by heap leaching and 289 tU by ISL. The aggregated historical uranium production in Russia after USSR disintegration (since 1992) amounts to 41 901 tU. Total production, including production from 1950 to 1992 at all Russian centres, amounts to 132 801 tU.

Priargunsky Mining and Chemical Production Association (PPGHO) remains the key uranium production centre in Russia. It produces uranium from the volcanic deposits of Streltsovsk uranium ore district from a resource base of 144 026 tU (*in situ*). Uranium production in 2006 amounted to 2 901 tU. Uranium ore is mined in three active underground mines. The bulk of the ore is processed at the local hydrometallurgical plant using conventional sulphuric acid leaching technology and ion-exchange resin sorption. A small amount of uranium (190 tU/year) is produced by heap and in-place leaching methods. In 2006, a new radiometric ore sorting plant was commissioned and in 2008, an expansion of heap leaching processing and completion of a new sulfuric acid plant is planned.

In order to increase uranium production, PPGHO is preparing a feasibility study of a new mine (No. 6). The planned mine will extract uranium from three deposits with a total of about 43 900 tU (*in situ)*, including the Argunskoye deposit (37 400 tU). The feasibility study considers the construction of a mine complex, heap leaching unit, upgrading the mill, and construction of a new autoclave carbonate leaching circuit. To increase the uranium resources, PPGHO is conducting geological exploration at the flanks and deep levels of the Streltsovsk ore field and in the southern Priargun province.

Since 2004, a commercial ISL operation is being developed by the Dalur company, in the Kurgan Region, beginning with the Dalmatovskoye deposit. In 2006, the new processing plant with an annual capacity of 1 000 tU came into operation and uranium production is planned to increase gradually to 700 tU in 2010. The processing unit constructed on the central site will be the base for development of the other deposits situated nearby. It will process production solutions from the Dalmatovskoye deposit and pregnant alluates from the local sorption units of Dalmatovskoye and Khokhlovskoye deposits. In 2006, the Dalur company produced 262 tU and in 2007 is expected to produce 350 tU. It has also started pilot, design and engineering works to prepare the Khokhlovskoye deposit for pilot development.

Employment in the uranium industry

In 2006, the total number of staff in uranium producing companies in the Russian Federation was 12 575, of which 12 271 worked for PPGHO and 304 for Dalur. Of the PPGHO employees, 4 804 were directly involved in uranium production and processing, while the rest worked in auxiliary units (coal production, TPP, vitriol works, machinery and other services).

Future production centres

To satisfy the uranium requirements of the Russian nuclear industry a "Medium Term Plan of Joint Activities of the Ministry of Natural Resources of Russia, Rosnedra and Rosatom" was approved in 2006. Implementation of this plan should allow Russia to increase uranium production to 18 000 tU by 2020.

The main source of uranium supply to 2010 will come from the development of uranium production at the existing Russian mining sites. As a result of a major upgrade of the existing facilities and commissioning of new mine No. 6, the annual production of PPGHO is expected to increase by 2015 to 5 000 tU. By 2011, Dalur is expected to reach an annual capacity of 1 000 tU, and by 2015 Khiagda should reach a capacity of 2 000 tU/year. Thus, the total annual uranium production by the three companies should reach 8 000 tU in 2015.

Production of uranium in new mines exploiting formerly stand-by deposits should start in 2010 and will reach the level of 7 000 tU by 2020. The largest uranium producing centre in the Elkon uranium district will reach a capacity of 5 000 tU/year by 2020. The Elkonskaya mining company was established in 2007 to perform the entire complex of work related to uranium ore mining, milling, sorting, processing and production of uranium oxide. The company will conduct underground development of the Elkon, Elkon Plateau, Kurung, Neprokhodimoye and Druzhnoye deposits. Pilot production work is scheduled to commence in 2010. Currently a feasibility study of this development is in progress.

Russian Federation

Two mines in Transbaikalia are expected to reach total capacity of up to 1 200 tU/year by 2016. One, with a capacity of 600 tU/year, will exploit the Gornoye and Beryozovoye deposits in Transbaikalia (Chita Region), using conventional underground mining techniques and heap leaching. Another production centre, with a capacity of 600 tU/year, will exploit the Olovskoe deposit (Chita Region), using an open-pit and underground mine with heap leaching. In 2007-2008, a pre-feasibility study of these projects will be developed, including a site survey and a baseline environmental study. Feasibility studies will begin in 2008 and construction is expected to begin in 2010. Two mining companies (Gornoe and Olovskoe) were established in 2007.

The remaining 800 tU/yr needed to meet the targeted production increase will come from the development of the other deposits in the Russian Federation.

In addition to expanded uranium production in the Russian Federation, production increases through joint venture partnerships abroad (mainly in Kazakhstan) are also underway. Uranium import from CIS countries is expected to total 2 700 tU by 2010, and will increase to 8 000 tU by 2020.

Uranium production centre technical details
(as of 1 January 2007)

	Centre #1	Centre #2	Centre #3
Name of production centre	Priargunsky Mining and Chemical Production Association (PPGHO)	Dalur	Khiagda
Production centre classification	existing	existing	committed
Start-up date	1968	2002	2008
Source of ore:			
• Deposit name (s)	Antei, Streltsovskoe, Oktyabrskoe, etc.	Dalmatovskoe Khokhlovskoe, etc.	Khiagda, Vershinnoe, etc.
• Deposit type (s)	volcanic, in caldera	sandstone basal channel	sandstone basal channel
• Resources (tU)	126 743	15 732	30 932
• Grade (% U)	0.18	0.04	0.05
Mining operation:			
• Type (OP/UG/ISL)	UG, HL, IPL	ISL	ISL
• Size (t ore/day)	6 700	NA	NA
• Average mining recovery (%)	95	75	75
Processing plant (acid/alkaline):	acid	acid	acid
• Type (IX/SX/AL)	IX	IX	IX
• Size (t ore/day) for ISL (L/day or L/hour)	4 700	no data	no data
• Average process recovery (%)	95	98	98
Nominal production capacity (tU/year)	3 500	800	1 000
Plans for expansion	5 000 t/y to 2017	1 000 t/y to 2012	2 000 t/y to 2015

NA Not available.

* HL – heap leaching, IPL – In-place leaching.

Uranium production centre technical details (contd.)
(as of 1 January 2007)

	Centre #4	Centre #5	Centre #6
Name of production centre	Elkon	Gornoe	Olov
Production centre classification	planned	planned	planned
Start-up date	2010	2010	2011
Source of ore:			
• Deposit name (s)	Yuzhnoe, Severnoe, etc.	Gornoe, Beryozovoe	Olovskoe
• Deposit type (s)	metasomatic	vein	vein
• Resources (tU)	271 672	6 408	9 200
• Grade (% U)	0.15	0.2	0.082
Mining operation:			
• Type (OP/UG/ISL)	UG	UG, HL, IPL	UG, HL, IPL
• Size (t ore/day)	5 500	1 900	3 000
• Average mining recovery (%)	85	70	70
Processing plant (acid/alkaline):	acid	acid	acid
• Type (IX/SX/AL)	IX	IX	IX
• Size (t ore/day) for ISL (L/day or L/hour)	no data	no data	no data
• Average process recovery (%)	95	95	95
Nominal production capacity (tU/year)	5 000	600	600
Plans for expansion	Exploration of the Elkon district deposits.	no	no

* HL – heap leaching, IPL – In-place leaching.

URANIUM REQUIREMENTS

As of 1 January 2007, ten nuclear power plants with 31 units (total installed capacity of 23.2 GW) were in operation in the Russian Federation. This fleet is composed of 15 water-cooled power reactors (9 VVER-1000 and 6 VVER-440), 15 uranium-graphite channel-type reactors (11 RMBK-1000 and 4 EPG-6) and one fast breeder reactor (BN-600). In 2006, nuclear power generation reached an all-time high of 156.4 TWh, an increase of 4.8% compared to 2005. The nuclear share of total electrical generation in the Russian Federation grew from 16% to 17% in 2006.

Current uranium requirements for NPPs in the Russian federation amount to approximately 4 100 tU. The total annual requirements of the Russian nuclear industry, including export of nuclear fuel and low enriched uranium, amount to approximately 19 000 tU. These requirements are supplied by uranium mined by the Russian mining companies (3 200 tU), stockpiles, secondary sources, and the import of uranium and uranium-bearing materials.

Pursuant to the approved state programme "Development of Nuclear Power Generation Complex in 2007-2010 and up to 2015", the capacity of the Russian nuclear plants will increase annually by 1 GW starting in 2009 and by 2 GW starting in 2012. The objective of the nuclear industry is to commission by 2020 new nuclear reactors with the total capacity of 32 GW and increase the NPPs share of power generation from 17% to 25-30%. The annual requirements of the Russian NPPs will increase correspondently from the current 4 100 tU to 9 700 tU in 2020.

NATIONAL POLICIES RELATING TO URANIUM

The Russian Federation reported no information on national policies relating to uranium, uranium stocks or uranium prices.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million RUB	2004	2005	2006	2007 (expected)
Industry exploration expenditures	51.2	19.1	12.8	41.4
Government exploration expenditures	211.5	482.1	773.6	1 097.4
Industry development expenditures	44.6	197.3	118	520.6
Government development expenditures	0	0	0	0
Total expenditures	307.3	698.5	904.4	1 659.4
Industry exploration drilling (metres)	25 753	16 352	15 500	7 520
Number of industry exploration holes drilled	131	NA	NA	NA
Government exploration drilling (metres)	77 196	107 414	86 641	112 409
Number of government exploration holes drilled	369	549	490	593
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	NA	NA	NA	NA
Number of development exploration holes drilled	NA	NA	NA	NA
Subtotal exploration drilling (metres)	102 949	123 766	102 141	119 929
Subtotal exploration holes	500	549	490	593
Subtotal development drilling (metres)	NA	NA	NA	NA
Subtotal development holes	NA	NA	NA	NA
Total drilling (metres)	102 949	123 766	102 141	119 929
Total number of holes	527	549	490	593

Reasonably Assured Resources
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	36 935	144 111	144 111	95
Open-pit mining	0	0	0	80
In situ leaching	10 608	10 608	10 608	75
Heap leaching	0	7 769	7 769	70
In-place leaching (stope/block leaching)	0	8 329	8 329	85
Co-product and by-product	0	0	0	
Unspecified	0	1 548	1548	75
Total	47 543	172 365	172 365	

Reasonably Assured Resources by deposit type
(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	10 608	10 608	10 608
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	9 877	9 877
Intrusive	0	0	0
Volcanic and caldera-related	36 935	97 670	97 670
Metasomatite	0	54 210	54 210
Other	0	0	0
Total	47 543	172 365	172 365

Inferred Resources
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	244 222	244 222	95
Open-pit mining	0	0	0	80
In situ leaching	36 056	36 056	36 056	75
Heap leaching	0	4 978	4 978	70
In-place leaching (stope/block leaching)	0	23 321	23 321	85
Co-product and by-product	0	0	0	
Unspecified	0	14 430	64 692	75
Total	36 056	323 007	373 269	

Resources are reported as recoverable.

Inferred Resources by deposit type
(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	36 056	55 208	69 280
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	8 230	8 230
Intrusive		0	0
Volcanic and caldera-related	0	42 107	49 576
Metasomatite	0	217 462	234 558
Other	0	0	11 625
Total	36 056	323 007	373 269

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
276 500	276 500

Speculative Resources
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
714 000	0

Historical uranium production
(tonnes U in concentrate)

Production method	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Open-pit mining[1]	38 655	0	0	0	38 655	0
Underground mining[1]	79 504	2 880	2 863	2 711	87 958	2 800
In situ leaching	3 538	210	221	289	4 258	381
Heap leaching	1 123	189	191	186	1 689	200
In-place leaching*	216	11	10	4	241	0
Co-product/by-product	0	0	0	0	0	0
U recovered from phosphates	0	0	0	0	0	0
Other methods**	0	0	0	0	0	0
Total	123 036	3 290	3 285	3 190	132 801	3 381

(1) Pre-2004 totals may include uranium recovered by heap and in-place leaching.
* Also known as stope leaching or block leaching.
** Includes mine water treatment and environmental restoration.

Ownership of uranium production in 2006

Domestic				Foreign				Totals	
Government		Private		Government		Private			
[tU]	[%]	[tU]	[%]	[tU]	[%]	[tU]	[%]	[tU]	[%]
3 190	100	0	0	0	0	0	0	3 190	100

Uranium industry employment at existing production centres
(person-years)

	2004	2005	2006	2007 (expected)
Total employment related to existing production centres	12 670	12 551	12 575	12 751
Employment directly related to uranium production	4 746	4 778	4 804	4 851

Short-term production capability
(tonnes U/year)

2007				2010				2015			
A-I	B-I	A-II	B-II	A-I	B-I	A-II	B-II	A-I	B-I	A-II	B-II
2 000	2 000	3 400	3 400	3 200	3 200	4 700	5 000	5 200	5 400	7 400	12 000

2020				2025				2030			
A-I	B-I	A-II	B-II	A-I	B-I	A-II	B-II	A-I	B-I	A-II	B-II
5 500	7 500	8 000	18 000	5 500	7 500	8 000	18 000	5 500	7 500	8 000	18 500

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	149.4	156.4

Installed nuclear generating capacity to 2030
(MWe net)

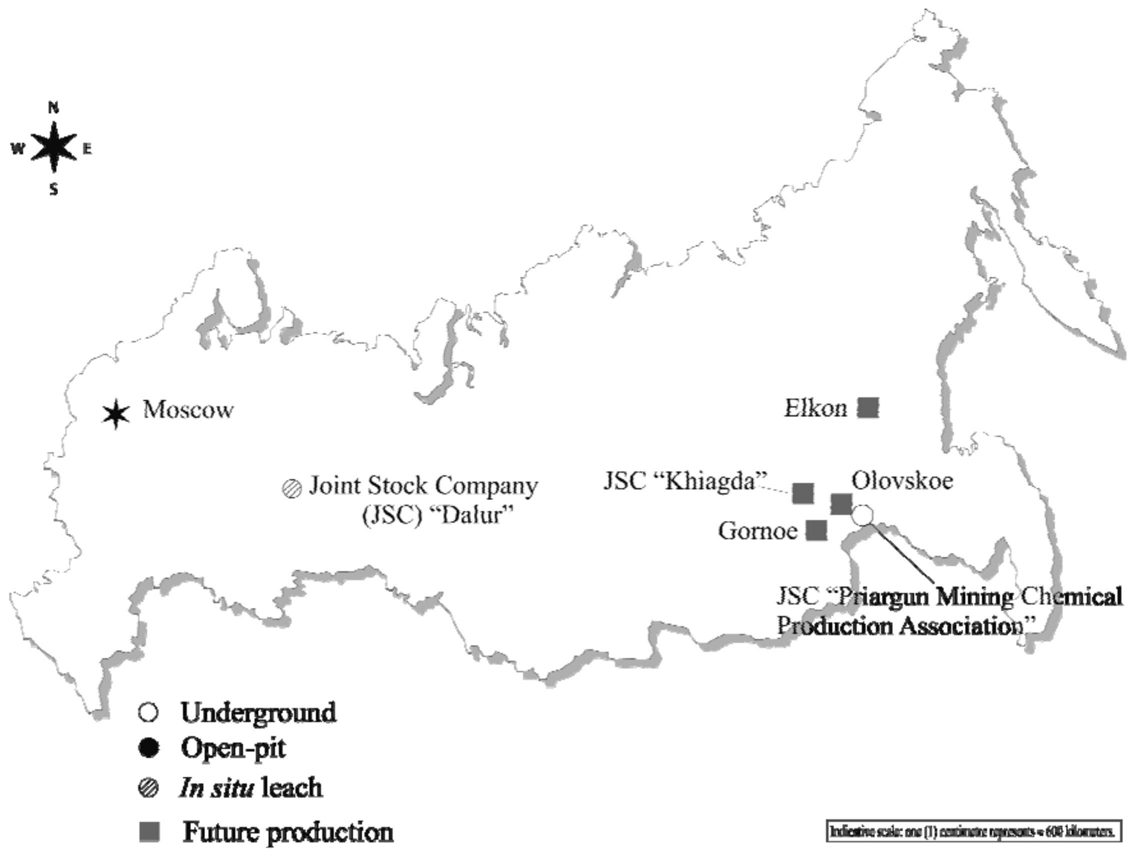
2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
23 000	23 200	24 000	25 000	30 000	32 000

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
37 000	44 000	40 000	50 000	42 000	60 000

Annual reactor-related uranium requirements to 2030 (excluding MOX)
(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
4 000	4 100	5 400	5 400	7 200	7 700

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
8 200	9 700	8 800	11 000	9 200	13 000



• Slovak Republic •

URANIUM EXPLORATION AND RESOURCES

Historical review

Uranium exploration was performed within the Slovak Republic since 1950s in different regions. Based on the results of the evaluation, it was concluded at that time that the Slovak Republic had no uranium resources of economic interest. No uranium exploration occurred between 1990 and 2005.

Recent and ongoing uranium exploration and mine development activities

In 2005, the private Canadian company Tournigan Gold Corporation acquired an exploration license covering 32 km^2 around the uranium mineralisation discovered near Jahodna in Eastern Slovakia. In March 2006, an independent NI 43-101 technical report was issued that contained a mineral resource estimate of 7 000 tU, grading at 0.56% U. Tournigan is continuing exploration at this and other less advanced properties (Novoveska Huta and Spisska Teplica) in Eastern Slovakia.

Appendix 4

GLOSSARY OF DEFINITIONS AND TERMINOLOGY

UNITS

Metric units are used in all tabulations and statements. Resources and production quantities are expressed in terms of tonnes (t) contained uranium (U) rather than uranium oxide (U_3O_8).

1 short ton U_3O_8	= 0.769 tU
1 percent U_3O_8	= 0.848 percent U
1 USD/lb U_3O_8	= USD 2.6/kg U
1 tonne	= 1 metric ton

RESOURCE TERMINOLOGY

Resource estimates are divided into separate categories reflecting different levels of confidence in the quantities reported. The resources are further separated into categories based on the cost of production.

a) Definitions of resource categories

Uranium resources are broadly classified as either conventional or unconventional. Conventional resources are those that have an established history of production where uranium is a primary product, co-product or an important by-product (e.g., from the mining of copper and gold). Very low-grade resources or those from which uranium is only recoverable as a minor by-product are considered unconventional resources.

Conventional resources are further divided, according to different confidence levels of occurrence, into four categories. The correlation between these resource categories and those used in selected national resource classification systems is shown in Figure A.

Reasonably Assured Resources (RAR) refers to uranium that occurs in known mineral deposits of delineated size, grade and configuration such that the quantities which could be recovered within the given production cost ranges with currently proven mining and processing technology, can be specified. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics. Reasonably Assured Resources have a high assurance of existence. Unless otherwise noted, RAR are expressed in terms of quantities of uranium recoverable from mineable ore (see Recoverable Resources).

Inferred Resources refers to uranium, in addition to RAR, that is inferred to occur based on direct geological evidence, in extensions of well-explored deposits, or in deposits in which geological continuity has been established but where specific data, including measurements of the deposits, and knowledge of the deposit's characteristics, are considered to be inadequate to classify the resource as RAR. Estimates of tonnage, grade and cost of further delineation and recovery are based on such sampling as is available and on knowledge of the deposit characteristics as determined in the best known parts of the deposit or in similar deposits. Less reliance can be placed on the estimates in this category than on those for RAR. Unless otherwise noted, Inferred Resources are expressed in terms of quantities of uranium recoverable from mineable ore (see Recoverable Resources).

Figure A. **Approximate Correlation of Terms used in Major Resources Classification Systems**

<table>
<tr><td></td><td colspan="3">IDENTIFIED Resources</td><td colspan="3">Undiscovered Resources</td></tr>
<tr><td>NEA/IAEA</td><td colspan="2">Reasonably Assured</td><td>Inferred</td><td>Prognosticated</td><td colspan="2">Speculative</td></tr>
<tr><td rowspan="2">Australia</td><td colspan="2">Demonstrated</td><td rowspan="2">Inferred</td><td colspan="3" rowspan="2">Undiscovered</td></tr>
<tr><td>Measured</td><td>Indicated</td></tr>
<tr><td>Canada (NRCan)</td><td>Measured</td><td>Indicated</td><td>Inferred</td><td>Prognosticated</td><td colspan="2">Speculative</td></tr>
<tr><td>United States (DOE)</td><td colspan="2">Reasonably Assured</td><td colspan="2">Estimated Additional</td><td colspan="2">Speculative</td></tr>
<tr><td>Russian Federation, Kazakhstan, Ukraine, Uzbekistan</td><td>A + B</td><td>C 1</td><td>C 2</td><td>P1</td><td>P2</td><td>P3</td></tr>
<tr><td>UNFC*</td><td colspan="2">G1 + G2</td><td>G3</td><td>G4</td><td colspan="2">G4</td></tr>
</table>

* United Nations Framework Classification correlation with NEA/IAEA and national classification systems is still under consideration.

The terms illustrated are not strictly comparable as the criteria used in the various systems are not identical. "Grey zones" in correlation are therefore unavoidable, particularly as the resources become less assured. Nonetheless, the chart presents a reasonable approximation of the comparability of terms.

Prognosticated Resources refers to uranium, in addition to Inferred Resources, that is expected to occur in deposits for which the evidence is mainly indirect and which are believed to exist in well-defined geological trends or areas of mineralisation with known deposits. Estimates of tonnage, grade and cost of discovery, delineation and recovery are based primarily on knowledge of deposit characteristics in known deposits within the respective trends or areas and on such sampling, geological, geophysical or geochemical evidence as may be available. Less reliance can be placed on the estimates in this category than on those for Inferred Resources. Prognosticated Resources are normally expressed in terms of uranium contained in mineable ore, i.e., *in situ* quantities.

Speculative Resources (SR) refers to uranium, in addition to Prognosticated Resources, that is thought to exist, mostly on the basis of indirect evidence and geological extrapolations, in deposits discoverable with existing exploration techniques. The location of deposits envisaged in this category could generally be specified only as being somewhere within a given region or geological trend. As the term implies, the existence and size of such resources are speculative. SR are normally expressed in terms of uranium contained in mineable ore, i.e., *in situ* quantities.

b) Cost categories

The cost categories, in United States dollars (USD), used in this report are defined as: <USD 40/kgU, <USD 80/kgU, and <USD 130/kgU. All resource categories are defined in terms of costs of uranium recovered at the ore processing plant

NOTE: It is not intended that the cost categories should follow fluctuations in market conditions.

Conversion of costs from other currencies into USD is done using an average exchange rate for the month of June in that year except for the projected costs for the year of the report, which uses the exchange rate of 1 January 2007 (Appendix 8).

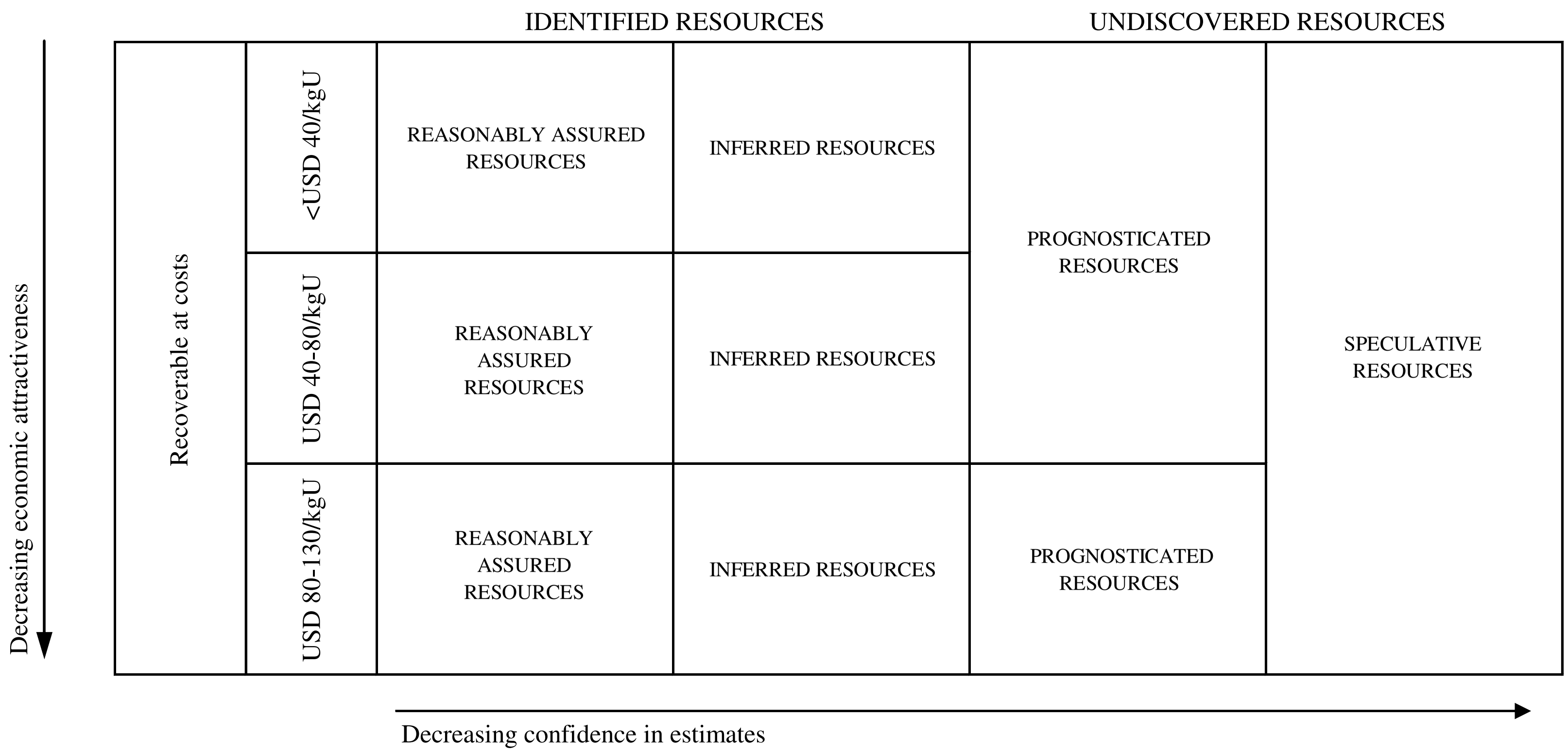
When estimating the cost of production for assigning resources within these cost categories, account has been taken of the following costs:

- The direct costs of mining, transporting and processing the uranium ore.
- The costs of associated environmental and waste management during and after mining.
- The costs of maintaining non-operating production units where applicable.
- In the case of ongoing projects, those capital costs that remain non-amortised.
- The capital cost of providing new production units where applicable, including the cost of financing.
- Indirect costs such as office overheads, taxes and royalties where applicable.
- Future exploration and development costs wherever required for further ore delineation to the stage where it is ready to be mined.
- Sunk costs are not normally taken into consideration.

c) Relationship between resource categories

Figure B illustrates the inter-relationship between the different resource categories. The horizontal axis expresses the level of assurance about the actual existence of a given tonnage based on varying degrees of geologic knowledge while the vertical axis expresses the economic feasibility of exploitation by the division into cost categories.

Figure B. **NEA/IAEA Classification Scheme for Uranium Resources**



d) Recoverable resources

RAR and Inferred Resource estimates are expressed in terms of recoverable tonnes of uranium, i.e. quantities of uranium recoverable from mineable ore, as opposed to quantities contained in mineable ore, or quantities *in situ*, i.e., not taking into account mining and milling losses. Therefore both expected mining and ore processing losses have been deducted in most cases. If a country reports its resources as *in situ* and the country does not provide a recovery factor, the Secretariat assigns a recovery factor to those resources based on geology and projected mining and processing methods to determine recoverable resources. The recovery factors that have been applied are:

Mining and milling method	Overall recovery factor (%)
Open-pit mining with conventional milling	80
Underground mining with conventional milling	80
ISL (acid)	75
ISL (alkaline)	70
Heap leaching	70
Block and stope leaching	75
Co-product or by-product	70
Unspecified method	75

SECONDARY SOURCES OF URANIUM TERMINOLOGY

a) Mixed-oxide fuel (MOX): MOX is the abbreviation for a fuel for nuclear power plants that consists of a mixture of uranium oxide and plutonium oxide. Current practice is to use a mixture of depleted uranium oxide and plutonium oxide.

b) Depleted uranium: Uranium where the ^{235}U assay is below the naturally occurring 0.7110%. (Natural uranium is a mixture of three isotopes, ^{238}U – accounting for 99.2836%, ^{235}U – 0.7110%, and ^{234}U – 0.0054%). Depleted uranium is a by-product of the enrichment process, where enriched uranium is produced from initial natural uranium feed material.

PRODUCTION TERMINOLOGY[1]

a) Production centres: A production centre, as referred to in this report, is a production unit consisting of one or more ore processing plants, one or more associated mines and uranium resources that are tributary to these facilities. For the purpose of describing production centres, they have been divided into four classes, as follows:

1. IAEA (1984), *Manual on the Projection of Uranium Production Capability,* General Guidelines, Technical Report Series No. 238, Vienna, Austria.

i) **Existing** production centres are those that currently exist in operational condition and include those plants which are closed down but which could be readily brought back into operation.

ii) **Committed** production centres are those that are either under construction or are firmly committed for construction.

iii) **Planned** production centres are those for which feasibility studies are either completed or under way, but for which construction commitments have not yet been made. This class also includes those plants that are closed which would require substantial expenditures to bring them back into operation.

iv) **Prospective** production centres are those that could be supported by tributary RAR and Inferred, i.e., "Identified Resources", but for which construction plans have not yet been made.

b) Production capacity and capability

Production capacity: Denotes the nominal level of output, based on the design of the plant and facilities over an extended period, under normal commercial operating practices.

Production capability: Refers to an estimate of the level of production that could be practically and realistically achieved under favourable circumstances from the plant and facilities at any of the types of production centres described above, given the nature of the resources tributary to them. Projections of production capability are supported only by RAR and/or EAR-I. The projection is presented based on those resources recoverable at costs <USD 80/kgU.

Production: Denotes the amount of uranium output, in tonnes U contained in concentrate, from an ore processing plant or production centre (with milling losses deducted).

c) Mining and milling

***In situ* leaching (ISL)**: The extraction of uranium from sandstone using chemical solutions and the recovery of uranium at the surface. ISL extraction is conducted by injecting a suitable uranium-dissolving leach solution (acid or alkaline) into the ore zone below the water table thereby oxidising, complexing, and mobilising the uranium; then recovering the pregnant solutions through production wells, and finally pumping the uranium bearing solution to the surface for further processing.

Heap leaching (HL): Heaps of ore are formed over a collecting system underlain by an impervious membrane. Dilute sulphuric acid solutions are distributed over the top surface of the ore. As the solutions seep down through the heap, they dissolve a significant (50-75%) amount of the uranium in the ore. The uranium is recovered from the heap leach product liquor by ion exchange or solvent extraction.

In place leaching (IPL): involves leaching of broken ore without removing it from an underground mine. This is also sometimes referred to as stope leaching or block leaching.

Co-product: Uranium is a co-product when it is one of two commodities that must be produced to make a mine economic. Both commodities influence output, for example, uranium and copper are co-produced at Olympic Dam in Australia. Co-product uranium is produced using either the open-pit or underground mining methods.

By-product: Uranium is considered a by-product when it is a secondary or additional product. By-product uranium can be produced in association with a main product or with co-products, e.g., uranium recovered from the Palabora copper mining operations in South Africa. By-product uranium is produced using either the open-pit or underground mining methods.

Uranium from phosphates: Uranium has been recovered as a by-product of phosphoric acid production. Uranium is separated from phosphoric acid by a solvent extraction process. The most frequently used reagent is a synergetic mixture of Tri-m-Octyl Phosphine Oxide (TOPO) and Di 2-Ethylhexyl Phosphoric Acid (DEPA).

Ion exchange (IX): Reversible exchange of ions contained in a host material for different ions in solution without destruction of the host material or disturbance of electrical neutrality. The process is accomplished by diffusion and occurs typically in crystals possessing – one or two – dimensional channels where ions are weakly bonded. It also occurs in resins consisting of three-dimensional hydrocarbon networks to which are attached many ionisable groups. Ion exchange is used for recovering uranium from leaching solutions.

Solvent extraction (SX): A method of separation in which a generally aqueous solution is mixed with an immiscible solvent to transfer one or more components into the solvent. This method is used to recover uranium from leaching solutions.

DEMAND TERMINOLOGY

a) **Reactor-related requirements:** Refers to natural uranium acquisitions *not* necessarily consumption during a calendar year.

ENVIRONMENTAL TERMINOLOGY[2]

a) **Close-out:** In the context of uranium mill tailings impoundment, the operational, regulatory and administrative actions required to place a tailings impoundment into long-term conditions such that little or no future surveillance and maintenance are required.

b) **Decommissioning:** Actions taken at the end of the operating life of a uranium mill or other uranium facility in retiring it from service with adequate regard for the health and safety of workers and members of the public and protection of the environment. The time period to achieve decommissioning may range from a few to several hundred years.

c) **Decontamination:** The removal or reduction of radioactive or toxic chemical contamination using physical, chemical, or biological processes.

d) **Dismantling:** The disassembly and removal of any structure, system or component during decommissioning. Dismantling may be performed immediately after permanent retirement of a mine or mill facility or may be deferred.

---

2. Definitions based on those published in OECD (2002), *Environmental Remediation of Uranium Production Facilities*, Paris.

e) Environmental restoration: Cleanup and restoration, according to predefined criteria, of sites contaminated with radioactive and/or hazardous substances during past uranium production activities.

f) Environmental impact statement: A set of documents recording the results of an evaluation of the physical, ecological, cultural and socio-economic effects of a planned installation, facility, or technology.

g) Groundwater restoration: The process of returning affected groundwater to acceptable quality and quantity levels for future use.

h) Reclamation: The process of restoring a site to predefined conditions, which allows new uses.

i) Restricted release (or use): A designation, by the regulatory body of a country, that restricts the release or use of equipment, buildings, materials or the site because of its potential radiological or other hazards.

j) Tailings: The remaining portion of a metal-bearing ore consisting of finely ground rock and process liquids after some or all of the metal, such as uranium, has been extracted.

k) Tailings impoundment: A structure in which the tailings are deposited to prevent their release into the environment.

l) Unrestricted release (or use): A designation, by the regulatory body of a country, that enables the release or use of equipment, buildings, materials or the site without any restriction.

GEOLOGICAL TERMINOLOGY

a) Uranium occurrence: A naturally occurring, anomalous concentration of uranium.

b) Uranium deposit: A mass of naturally occurring mineral from which uranium could be exploited at present or in the future.

c) Geologic types of uranium deposits[3]

Uranium resources can be assigned on the basis of their geological setting to the following categories of uranium ore deposit types (arranged according to their approximate economic significance):

1. Unconformity-related deposits.
2. Sandstone deposits.
3. Hematite breccia complex deposits.
4. Quartz-pebble conglomerate deposits.
5. Vein deposits.
6. Intrusive deposits.
7. Volcanic and caldera-related deposits.
8. Metasomatite deposits.
9. Surficial deposits.
10. Collapse breccia pipe deposits.
11. Phosphorite deposits.
12. Other types of deposits.
13. Rock types with elevated uranium content.

3. This classification of the geological types of uranium deposits was developed by the IAEA in 1988-89 and updated for use in the Red Book.

1. **Unconformity-related deposits**: Unconformity-related deposits are associated with and occur immediately below and above an unconformable contact that separates a crystalline basement intensively altered from overlying clastic sediments of either Proterozoic or Phanerozoic age.

   The unconformity-related deposits include the following sub-types:

   - *Unconformity contact*
     i. Fracture bound deposits occur in metasediments immediately below the unconformity. Mineralisation is monometallic and of medium grade. Examples include Rabbit Lake and Dominique Peter in the Athabasca Basin, Canada.
     ii. Clay-bound deposits occur associated with clay at the base of the sedimentary cover directly above the unconformity. Mineralisation is commonly polymetallic and of high to very high grade. An example is Cigar Lake in the Athabasca Basin, Canada

   - *Sub-unconformity-post-metamorphic deposits*
     Deposits are strata-structure bound in metasediments below the unconformity on which clastic sediments rest. These deposits can have large resources, at low to medium grade. Examples are Jabiluka and Ranger in Australia.

2. **Sandstone deposits:** Sandstone uranium deposits occur in medium to coarse-grained sandstones deposited in a continental fluvial or marginal marine sedimentary environment. Uranium is precipitated under reducing conditions caused by a variety of reducing agents within the sandstone, for example, carbonaceous material, sulphides (pyrite), hydrocarbons and ferro-magnesium minerals (chlorite), etc. Sandstone uranium deposits can be divided into four main sub-types:

   - *Roll-front deposits*: The mineralised zones are convex down the hydrologic gradient. They display diffuse boundaries with reduced sandstone on the down-gradient side and sharp contacts with oxidised sandstone on the up-gradient side. The mineralised zones are elongate and sinuous approximately parallel to the strike, and perpendicular to the direction of deposition and groundwater flow. Resources can range from a few hundred tonnes to several thousands of tonnes of uranium, at grades averaging 0.05-0.25%. Examples are Moynkum, Inkay and Mynkuduk (Kazakhstan); Crow Butte and Smith Ranch (United States) and Bukinay, Sugraly and Uchkuduk (Uzbekistan).

   - *Tabular deposits* consist of uranium matrix impregnations that form irregularly shaped lenticular masses within reduced sediments. The mineralised zones are largely oriented parallel to the depositional trend. Individual deposits can contain several hundreds of tonnes up to 150 000 tonnes of uranium, at average grades ranging from 0.05-0.5%, occasionally up to 1%. Examples of deposits include Westmoreland (Australia), Nuhetting (China), Hamr-Stráz (Czech Republic), Akouta, Arlit, Imouraren (Niger) and Colorado Plateau (United States).

   - *Basal channel deposits*: Paleodrainage systems consist of several hundred metres wide channels filled with thick permeable alluvial-fluvial sediments. Here, the uranium is predominantly associated with detrital plant debris in ore bodies that display, in a plan-view, an elongated lens or ribbon-like configuration and, in a section-view, a lenticular or, more rarely, a roll shape. Individual deposits can range from several hundreds to 20 000 tonnes uranium, at grades ranging from 0.01-3%. Examples are the deposits of Dalmatovskoye (Transural Region), Malinovskoye (West Siberia), Khiagdinskoye (Vitim district) in Russia and Beverley in Australia.

- *Tectonic/lithologic deposits* occur in sandstone related to a permeable zone. Uranium is precipitated in open zones related to tectonic extension. Individual deposits contain a few hundred tonnes up to 5 000 tonnes of uranium at average grades ranging from 0.1-0.5%. Examples include the deposits of Mas Laveyre (France) and Mikouloungou (Gabon).

3. **Hematite breccia complex deposits:** Deposits of this group occur in hematite-rich breccias and contain uranium in association with copper, gold, silver and rare earths. The main representative of this type of deposit is the Olympic Dam deposit in South Australia. Significant deposits and prospects of this type occur in the same region, including Prominent Hill, Wirrda Well, Acropolis and Oak Dam as well as some younger breccia-hosted deposits in the Mount Painter area.

4. **Quartz-pebble conglomerate deposits:** Detrital uranium oxide ores are found in quartz-pebble conglomerates deposited as basal units in fluvial to lacustrine braided stream systems older than 2.3-2.4 Ga. The conglomerate matrix is pyritiferous, and gold, as well as other oxide and sulphide detrital minerals are often present in minor amounts. Examples include deposits found in the Witwatersrand Basin where uranium is mined as a by-product of gold. Uranium deposits of this type were mined in the Blind River/Elliot Lake area of Canada.

5. **Vein deposits:** In vein deposits, the major part of the mineralisation fills fractures with highly variable thickness, but generally important extension along strike. The veins consist mainly of gangue material (e.g. carbonates, quartz) and ore material, mainly pitchblende. Typical examples range from the thick and massive pitchblende veins of Pribram (Czech Republic), Schlema-Alberoda (Germany) and Shinkolobwe (Democratic Republic of Congo), to the stockworks and episyenite columns of Bernardan (France) and Gunnar (Canada), to the narrow cracks in granite or metamorphic rocks, also filled with pitchblende of Mina Fe (Spain) and Singhbhum (India).

6. **Intrusive deposits:** Deposits included in this type are those associated with intrusive or anatectic rocks of different chemical composition (alaskite, granite, monzonite, peralkaline syenite, carbonatite and pegmatite). Examples include the Rossing and Trekkopje deposits (Namibia), the uranium occurrences in the porphyry copper deposits such as Bingham Canyon and Twin Butte (United States), the Ilimaussaq deposit (Greenland), Palabora (South Africa), as well as the deposits in the Bancroft area (Canada).

7. **Volcanic and caldera-related deposits**: Uranium deposits of this type are located within and nearby volcanic caldera filled by mafic to felsic volcanic complexes and intercalated clastic sediments. Mineralisation is largely controlled by structures (minor stratabound), occurs at several stratigraphic levels of the volcanic and sedimentary units and extends into the basement where it is found in fractured granite and in metamorphites. Uranium minerals are commonly associated with molybdenum, other sulphides, violet fluorine and quartz. Most significant commercial deposits are located within Streltsovsk caldera in the Russian Federation. Examples are known in China, Mongolia (Dornot deposit), Canada (Michelin deposit) and Mexico (Nopal deposit).

8. **Metasomatite deposits**: Deposits of this type are confined to the areas of tectono-magmatic activity of the Precambrian shields and are related to near-fault alkali metasomatites, developed upon different basement rocks: granites, migmatites, gneisses and ferruginous quartzites with production of albitites, aegirinites, alkali-amphibolic and carbonaceous-ferruginous rocks. Ore lenses and stocks are a few metres to tens of metres thick and a few hundred metres long. Vertical extent of ore mineralisation can be up to 1.5 km. Ores are uraninite-brannerite by composition and belong to ordinary grade. The reserves are usually medium scale or large. Examples include Michurinskoye, Vatutinskoye, Severinskoye, Zheltorechenskoye and Pervomayskoye deposits (Ukraine), Lagoa Real, Itataia and Espinharas (Brazil), the Valhalla deposit (Australia) and deposits of the Arjeplog region in the north of Sweden.

9. **Surficial deposits:** Surficial uranium deposits are broadly defined as young (Tertiary to Recent) near-surface uranium concentrations in sediments and soils. The largest of the surficial uranium deposits are in calcrete (calcium and magnesium carbonates), and they have been found in Australia (Yeelirrie deposit), Namibia (Langer Heinrich deposit) and Somalia. These calcrete-hosted deposits are associated with deeply weathered uranium-rich granites. They also can occur in valley-fill sediments along Tertiary drainage channels and in playa lake sediments (e.g., Lake Maitland, Australia). Surficial deposits also can occur in peat bogs and soils.

10. **Collapse breccia pipe deposits:** Deposits in this group occur in circular, vertical pipes filled with down-dropped fragments. The uranium is concentrated as primary uranium ore, generally uraninite, in the permeable breccia matrix, and in the arcuate, ring-fracture zone surrounding the pipe. Type examples are the deposits in the Arizona Strip north of the Grand Canyon and those immediately south of the Grand Canyon in the United States.

11. **Phosphorite deposits**: Phosphorite deposits consist of marine phosphorite of continental-shelf origin containing syn-sedimentary stratiform, disseminated uranium in fine-grained apatite. Phosphorite deposits constitute large uranium resources, but at a very low grade. Uranium can be recovered as a by-product of phosphate production. Examples include New Wales Florida (pebble phosphate) and Uncle Sam (United States), Gantour (Morocco) and Al-Abiad (Jordan). Other type of phosphorite deposits consists of organic phosphate, including argillaceous marine sediments enriched in fish remains that are uraniferous (Melovoe deposit, Kazakhstan).

12. **Other deposits**

Metamorphic deposits: In metamorphic uranium deposits, the uranium concentration directly results from metamorphic processes. The temperature and pressure conditions, and age of the uranium deposition have to be similar to those of the metamorphism of the enclosing rocks. Examples include the Forstau deposit (Austria) and Mary Kathleen (Australia).

Limestone deposits: This includes uranium mineralisation in the Jurassic Todilto Limestone in the Grants district (United States). Uraninite occurs in intra-formational folds and fractures as introduced mineralisation.

Uranium coal deposits: Elevated uranium contents occur in lignite/coal, and in clay and sandstone immediately adjacent to lignite. Examples are uranium in the Serres Basin (Greece), in North and South Dakota (United States), Koldjat and Nizhne Iliyskoe (Kazakhstan) and Freital (Germany). Uranium grades are very low and average less than 50 ppm U.

13. **Rock types with elevated uranium contents:** Elevated uranium contents have been observed in different rock types such as pegmatite, granites and black shale. In the past no economic deposits have been mined commercially in these types of rocks. Their grades are very low, and it is unlikely that they will be economic in the foreseeable future.

    Rare metal pegmatites: These pegmatites contain Sn, Ta, Nb and Li mineralisation. They have variable U, Th and rare earth elements contents. Examples include Greenbushes and Wodgina pegmatites (Western Australia). The Greenbushes pegmatites commonly have 6-20 ppm U and 3-25 ppm Th.

    Granites: A small proportion of un-mineralised granitic rocks have elevated uranium contents. These "high heat producing" granites are potassium feldspar-rich. Roughly 1% of the total number of granitic rocks analysed in Australia have uranium-contents above 50 ppm.

    Black Shale: Black shale-related uranium mineralisation consists of marine organic-rich shale or coal-rich pyritic shale, containing syn-sedimentary disseminated uranium adsorbed onto organic material. Examples include the uraniferous alum shale in Sweden and Estonia, the Chatanooga shale (United States), the Chanziping deposit (China), and the Gera-Ronneburg deposit (Germany).

Appendix 5

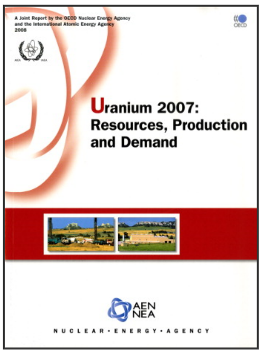
ACRONYM LIST

AGR	Advanced gas-cooled reactor
AL	Acid leaching
ALKAL	Alkaline atmospheric leaching
BWR	Boiling water reactor
CANDU	***Can***adian ***d***euterium ***u***ranium
CWG	Crush-wet grind
DOE	Department of Energy (United States)
EC	European Commission
EIA	U.S. Energy Information Administration
EU	European Union
EUP	Enriched uranium product
FLOT	Flotation
Ga	Giga-years
GDR	German Democratic Republic
GIF	Generation IV International Forum
GNSS	Global Nuclear Services and Supply
GWe	Gigawatt electric
HEU	Highly enriched uranium
HL	Heap leaching
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
INPRO	International project on innovative nuclear reactors and fuel cycles
IPL	In-place leaching
ISL	*In situ* leaching
IX	Ion exchange
kg	Kilograms
km	Kilometre
LEU	Low enriched uranium
LWR	Light water reactor
MAGNOX	Magnesium oxide
MOX	Mixed oxide fuel
MWe	Megawatt electric

NEA	Nuclear Energy Agency
OECD	Organisation for Economic Co-operation and Development
OP	Open-pit
ppm	Part per million
Pu	Plutonium
PHWR	Pressurised heavy-water reactor
PWR	Pressurised water reactor
RAR	Reasonably assured resources
RBMK	Water-cooled, graphite-moderated reactor (Russian acronym)
SWU	Separative work unit
SX	Solvent extraction
t	Tonnes (metric tons)
Th	Thorium
tHM	Tonnes heavy metal
TOE	Tonnes oil equivalent
tU	Tonnes uranium
TVA	Tennessee Valley Administration
TWh	Terrawatt-hour
U	Uranium
UG	Underground mining
USSR	Union of Soviet Socialist Republics
VVER	Water-cooled, water-moderated reactor (Russian acronym)

TABLE OF CONTENTS

APPENDICES



From:
Uranium 2007
Resources, Production and Demand

Access the complete publication at:
https://doi.org/10.1787/uranium-2007-en

Please cite this chapter as:

OECD/International Atomic Energy Agency (2008), "Russian Federation", in *Uranium 2007: Resources, Production and Demand*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/uranium-2007-34-en

OECD