A Joint Report by the OECD Nuclear Energy Agency
and the International Atomic Energy Agency
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Uranium 2007: Resources, Production and Demand

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NEA No. 6345

NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full member. NEA membership today consists of 28 OECD member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

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PREFACE

Since the mid-1960s, with the co-operation of their member countries and states, the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) have jointly prepared periodic updates (currently every two years) on world uranium resources, production and demand. These updates have been published by the OECD/NEA in what is commonly known as the "Red Book". This 22nd edition of the Red Book replaces the 2005 edition and reflects information current as of 1st January 2007.

The Red Book features a comprehensive assessment of current uranium supply and demand and projections to the year 2030. The basis of this assessment is a comparison of uranium resource estimates (according to categories of geological certainty and production cost) and mine production capability with anticipated uranium requirements arising from projections of installed nuclear capacity. In cases where longer-term projections of installed nuclear capacity were not provided by national authorities, projected demand figures were developed with input from expert authorities. Current data on resources, exploration, production and uranium stocks are also presented, along with historical summaries of exploration and production and plans for future mine production. In addition, individual country reports provide detailed information on recent developments in uranium exploration and production, updates on environmental activities and information on relevant national uranium policies. The Red Book also includes a compilation and evaluation of previously published data on unconventional uranium resources. Available information on secondary sources of uranium is compiled and the potential market impact of this material is assessed.

This publication has been prepared on the basis of data obtained through questionnaires sent by the NEA to OECD member countries (19 countries responded) and by the IAEA for those states that are not OECD member countries (21 countries responded and one country report was prepared by the IAEA Secretariat). The opinions expressed in Parts I and II do not necessarily reflect the position of the member countries or international organisations concerned. This report is published on the responsibility of the OECD Secretary-General.

Acknowledgement

The OECD Nuclear Energy Agency (NEA), Paris, and the International Atomic Energy Agency (IAEA), Vienna, would like to acknowledge the co-operation of those organisations (see Appendix 2) which replied to the questionnaire.

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APPENDICES

EXECUTIVE SUMMARY

Uranium 2007 – Resources, Production and Demand presents, in addition to updated resource figures, the results of the most recent review of world uranium market fundamentals and provides a statistical profile of the world uranium industry as of 1 January 2007. First published in 1965, this is the 22nd edition of what has become known as the "Red Book." It contains official data provided by 40 countries (and one Country Report prepared by the IAEA Secretariat) on uranium exploration, resources, production and reactor-related requirements. Projections of nuclear generating capacity and reactor-related uranium requirements through 2030 are provided as well as a discussion of long-term uranium supply and demand issues.

Exploration

Worldwide exploration and mine development expenditures in 2006 totalled about USD 774 million, an increase of 254% compared to updated 2004 figures, as the market strengthened considerably. Most major producing countries reported significantly increased expenditures, perhaps best exemplified by Australia, where exploration and development expenditures in 2002 amounted to a little over USD 3 million, increased to almost USD 10 million by 2004, over USD 30 million in 2005 and in 2006 exceeded USD 60 million. The majority of global exploration activities remain concentrated in areas with potential for hosting unconformity-related and *in situ* leaching (ISL) amenable sandstone deposits, primarily in close proximity to known resources and existing production facilities. However, high prices for uranium over the last several years have stimulated "grass roots" exploration, as well as increased exploration in regions known to have good potential based on past work. About 75% of the exploration and development expenditures in 2006 were devoted to domestic activities. Non-domestic exploration and development expenditures, although reported by only Australia, Canada, France and Switzerland, rose to over USD 214 million in 2006, a more than 200% increase from the non-domestic expenditures reported in 2004. Exploration and development expenditures are expected to remain strong in 2007, amounting to about USD 718 million.

Resources[1]

Total Identified Resources (Reasonably Assured & Inferred) in 2007 increased to about 4 456 000 tonnes of uranium metal (tU) in the <USD 80/kgU category and to about 5 469 000 tU in the <USD 130/kgU category (increases of 17% and 15%, respectively compared to their 2005 levels).

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[1] Uranium Resources are classified by a scheme (based on geological certainty and costs of production) developed to combine resource estimates from a number of different countries into harmonised global figures. "**Identified Resources**" (*RAR* and *Inferred*) refer to uranium deposits delineated by sufficient direct measurement to conduct pre-feasibility and sometimes feasibility studies. For Reasonably Assured Resources (*RAR)*, high confidence in estimates of grade and tonnage are generally compatible with mining decision making standards. *Inferred Resources* are not defined with such a high a degree of confidence and generally require further direct measurement prior to making a decision to mine. "**Undiscovered Resources**" (*Prognosticated* and *Speculative*) refer to resources that are expected to occur based on geological knowledge of previously discovered deposits and regional geological mapping. *Prognosticated Resources* refer to those expected to occur in known uranium provinces, generally supported by some direct evidence. *Speculative Resources* refer to those expected to occur in geological provinces that may host uranium deposits. Both *Prognosticated* and *Speculative Resources* require significant amounts of exploration before their existence can be confirmed and grades and tonnages can be defined. For a more detailed description see Appendix 4.

Though a portion of these increases relate to new discoveries, the majority result from re-evaluations of previously Identified Resources in light of the effects of higher uranium prices on cut-off grades. At current (2006) rates of consumption, Identified Resources are sufficient for about 100 years of supply.

Total Undiscovered Resources (Prognosticated Resources & Speculative Resources) in 2007 amounted to more than 10 500 000 tU, increasing by 485 000 tU from the total reported in 2005, even though some countries, including major producers, do not report resources in this category.

Resource figures are dynamic and related to commodity prices. The increased resource totals from 2005 to 2007, equivalent to 11 years of 2006 uranium requirements, demonstrate the impact that increased uranium prices have on resource totals. The uranium resource figures presented here are a "snapshot" of the available information on resources of economic interest as of 1 January 2007 and are not an inventory of total amount of mineable uranium contained in the earth's crust. Should favourable market conditions continue to stimulate exploration additional discoveries can be expected, as was the case during past periods of heightened exploration activity. For example, Australia's Reasonable Assured Resources in the <USD 80/kgU category were increased by over 200 000 tU and Inferred Resources in the same price category increased by 75 000 tU through mid-2007 as a result of deposit extensions and new discoveries.

Production

Uranium production in 2006 totalled 39 603 tU, a 6% decrease from the 41 943 tU produced in 2005 and 1.5% less that the 40 188 tU produced in 2004. A total of 20 countries reported output in 2006, compared to 19 in 2004, as the Islamic Republic of Iran began production in 2006. While production declined overall between 2004 and 2006, significant increases were recorded in Kazakhstan (42%) and the United States, where production almost doubled (albeit starting from a relatively low figure of <1 000 tU in the case of the United States). More modest increases (about 8%) were recorded in Niger and Uzbekistan. Reduced production was recorded in a number of countries between 2004 and 2006 (including Australia, Canada, the Russian Federation and South Africa) owing to a combination of lower than expected ore grades, extreme weather events and technical difficulties. Underground mining accounted for 40% of global production in 2006; open-pit mining, 24%; ISL mining, 25%; while co-product and by-product recovery from copper and gold operations and other unconventional methods accounting for most of the remaining 11%. Uranium production in 2007 is expected to increase to 43 328 tU, with the largest increases (>37%) anticipated to occur once again in Kazakhstan.

Environmental aspects of uranium production

Although the focus of the Red Book remains uranium resources, production and demand, environmental aspects of the uranium production cycle are once again included in this volume. Information presented in a number of National Reports include descriptions of monitoring programmes at mines currently in production (India, Kazakhstan and Ukraine), updates on decommissioning and remediation efforts at closed mines (Brazil, Bulgaria, Czech Republic, Germany, Hungary, Poland, Slovenia, Spain and the United States) and environmental assessments of proposed production increases (Canada and Niger). Additional information on the environmental aspects of uranium production may be found in a joint NEA/IAEA Uranium Group publication titled *Environmental Remediation of Uranium Production Facilities*, Paris, OECD, 2002.

Past uranium mining practices, no longer licensed today, resulted in a number of legacy uranium mining sites in several countries (e.g., Canada, Czech Republic, Germany and the United States). Shared experiences in efforts to remediate these sites have been compiled by the Uranium Mine Remediation Exchange Group (UMREG). These experiences are an important reminder of the consequences of outdated mining practices and, in an effort to ensure that all jurisdictions involved in uranium mining benefit from the lessons learned, in particular those without recent experience in uranium mining, a summary description of UMREG is included in Appendix 3.

Uranium demand

At the end of 2006, a total of 435 commercial nuclear reactors were operating with a net generating capacity of about 370 GWe requiring about 66 500 tU. By the year 2030, world nuclear capacity is projected to grow to between about 509 GWe net in the low demand case and 663 GWe net in the high demand case. Accordingly, world reactor-related uranium requirements are projected to rise to between 93 775 tU and 121 955 tU by 2030.

Significant regional variation exists within these projections. Nuclear energy capacity and resultant uranium requirements are expected to grow significantly the East Asia region (between 91% to over 124% in the low and high cases, respectively) and in the Central, Eastern and South East Europe region (between 84% and 159%). Nuclear capacity and requirements are expected to increase slightly in North America (between 9% and 32%), but to decline in Western Europe (a reduction of between 10% and 29%) as plans to phase-out nuclear energy are implemented. However, there are uncertainties in these projections as there is ongoing debate on the role that nuclear energy will play in meeting future energy requirements. Key factors that will influence future nuclear energy capacity include projected base load electricity demand, non-proliferation concerns, public acceptance of nuclear energy and proposed waste management strategies, as well as the economic competitiveness of nuclear power plants and their fuel compared to other energy sources. Concerns about longer-term security of supply of fossil fuels and the extent to which nuclear energy is seen to be beneficial in meeting greenhouse gas reduction targets could contribute to even greater projected growth in uranium demand.

Supply and demand relationship

At the end of 2006, world uranium production (39 603 tU) provided about 60% of world reactor requirements (66 500 tU), with the remainder being met by supplies of already mined uranium (so-called secondary sources) including excess government and commercial inventories, the delivery of low enriched uranium (LEU) arising from the down-blending of highly enriched uranium (HEU) derived from the dismantling of nuclear warheads, re-enrichment of depleted uranium tails and spent fuel reprocessing.

Uranium mine development has responded to the market signal of high prices and rising demand. As currently projected, primary uranium production capabilities including Existing, Committed, Planned and Prospective production centres supported by Identified Resources (RAR and Inferred) could satisfy projected high case world uranium requirements through 2028. However, actual production has declined in recent years, and in order for production to meet future demand mine expansions and openings must proceed as planned and production will have to be maintained at full capability. This is unlikely, as illustrated by mine development setbacks and production difficulties experienced in recent years. Therefore, to ensure demand is met, secondary sources will continue to be necessary, complemented to the extent possible by uranium savings achieved by specifying low tails assays at enrichment facilities.

Although information on secondary sources is incomplete, they are widely expected to decline in importance, particularly after 2013. As secondary supplies are reduced, reactor requirements will have to be increasingly met by mine production. The introduction of alternate fuel cycles, if successfully developed and implemented, will impact the market balance, but it is too early to say with certainty how effective and widely implemented these proposed fuel cycles will be. What is clear is that a sustained strong demand for uranium will be needed to stimulate the timely development of production capability and to increase Identified Resources. Because of the long lead-times required to identify new resources and to bring them into production (typically on the order of ten years or more), there exists the potential for the development of uranium supply shortfalls and continued upward pressure on uranium prices.

Conclusion

World demand for electricity is expected to continue to grow rapidly over the next several decades to meet the needs of an increasing population and economic growth. The recognition by many governments that nuclear power can produce competitively-priced base-load electricity that is essentially free of greenhouse gas emissions, combined with the role that nuclear can play in enhancing security of energy supplies, has increased the prospects for growth in nuclear generating capacity, although the magnitude of that growth remains uncertain.

Regardless of the role that nuclear energy ultimately plays in meeting rising electricity demand, the uranium resource base described in this document is adequate to meet projected future requirements. The challenge is to develop mines and increase production in a timely fashion to bring these resources to the market. A continued strong market and sustained high prices will be necessary for resources to be developed within the timeframe required to meet future uranium demand.

I. URANIUM SUPPLY

This chapter summarises the current status of worldwide uranium resources, exploration and production. In addition, production capabilities in reporting countries for the period ending in the year 2030 are presented and discussed.

A. URANIUM RESOURCES

Identified Resources (previously "Known Conventional Resources")

Identified Resources consist of ***Reasonably Assured Resources*** (RAR) and ***Inferred Resources*** (previously EAR-I), recoverable at a cost of less than USD 130/kgU (<USD 130/kgU).[1] Relative changes in different resource and cost categories of Identified Resources between this edition and the 2005 edition of the Red Book are summarised in Table 1. As shown in Table 1, Identified Resources <USD 130/kgU increased significantly between 2005 and 2007. This increase is mainly the result of reported increases by Australia, the Russian Federation, South Africa and Ukraine. The overall increase in Identified Resources recoverable at <USD 130/kgU between 2005 and 2007 (about 726 000 tU) is equivalent to about 11 years of 2006 uranium requirements. The most significant change occurred in the Inferred Resources <USD 40/kgU, which saw an increase of about 405 000 tU. Though some of these reported increases are due to new discoveries resulting from increased exploration, it is important to note that the bulk of the increases are due to re-evaluations reflecting the effects of higher uranium prices on cut-off grades. Current estimates of Identified Resources, RAR and Inferred Resources, on a country-by-country basis, are presented in Tables 2, 3 and 4, respectively.[2]

Distribution of Identified Resources by categories and cost ranges

The most significant changes between 2005 and 2007 in Identified Resources (Table 1) occurred in Australia, Kazakhstan, the Russian Federation, South Africa and Ukraine, and to a lesser extent in Bulgaria, Canada, China, Jordan and Niger. The distribution of Identified Resources, RAR and Inferred Resources, among countries with major resources, is shown in Figures 1, 2 and 3, respectively.

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[1] All Identified Resources are reported as recoverable uranium. In cases where resources were reported by countries as *in situ*, resource figures were adjusted to estimate recoverable resources either by using recovery factors provided by the country or applying Secretariat estimates according to expected production method (see ***Recoverable Resources*** in Appendix 4).

[2] It should be noted that the United States does not report resources in the Inferred Resource category.

Table 1. **Changes in Identified Resources 2005-2007**
(1 000 tU)

Resource category	2005	2007	Changes*
Identified (Total)			
<USD 130/kgU	4 743	5 469	+ 726
<USD 80/kgU	3 804	> 4 456	+ 652
<USD 40/kgU**	> 2 746	2 970	+ 224
RAR			
<USD 130/kgU	3 297	> 3 338	+ 41
<USD 80/kgU	2 643	2 598	– 45
<USD 40/kgU**	> 1 947	> 1 766	– 181
Inferred Resources			
<USD 130/kgU	1 446	> 2 130	+ 684
<USD 80/kgU	1 161	> 1 858	+ 697
<USD 40/kgU**	> 799	1 204	+ 405

* Changes might not equal differences between 2007 and 2005 because of independent rounding.

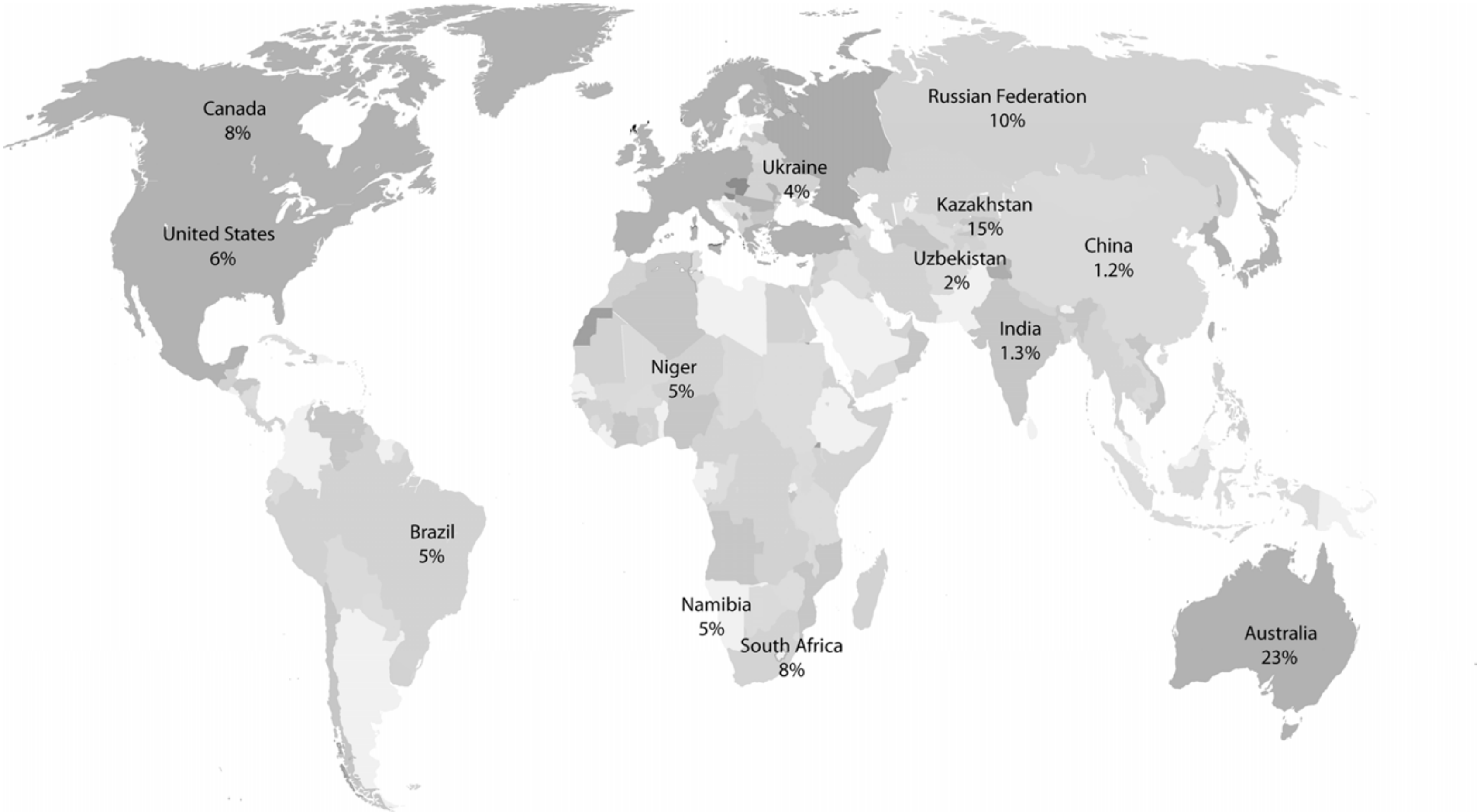
** Resources in the cost categories of <USD 40/kgU are likely higher than reported, because several countries have indicated that either detailed estimates are not available, or the data are confidential.

RAR recoverable at costs <USD 40/kgU, the most economically attractive category, decreased significantly by 181 000 tU since 2005 (about 9%). RAR at <USD 130/kgU increased by about 41 000 tU compared to 2005 (about 1%). Although most of these changes were the result of re-evaluation of known deposits and their transfer to and from other resource categories, additions to resource totals from deposits that had not been previously reported were also important (e.g. the Russian Federation and Ukraine; Table 5). Of particular note are changes reported by Kazakhstan and Niger. In Kazakhstan, RAR available at <USD 130/kgU decreased by almost 136 000 tU and in Niger, total resources available at <USD 130/kgU increased overall by more than 60 000 tU but lower cost resources decreased considerably (over 150 000 tU at <USD 40/kgU and over 135 000 tU at <USD 80/kgU).

Inferred Resources recoverable at <USD 130/kgU increased by about 684 000 tU, compared to 2005 (about 47%). Inferred Resource increases were greatest in Australia, Kazakhstan, the Russian Federation, South Africa and Ukraine. These changes (Table 5) are mainly related to additional resources defined during exploration and development activities (Australia, Niger).

Together, the changes in Identified Resources (i.e. RAR plus Inferred Resources), recoverable at a cost of <USD 40/kgU, significantly increased by about 224 000 tU (about 8% from 2005) and at costs <USD 130/kgU increased by even more (726 000 tU, some 15% greater than in 2005). These changes are mainly the result of increased resources reported in Australia, the Russian Federation and South Africa.

Figure 1. **Global distribution of Identified Resources** (<USD 130/kgU)



The global distribution of Identified Resources amongst 13 countries that are either major uranium producers or have significant plans for growth of nuclear generating capacity illustrates the widespread distribution of these resources. Together, these 13 countries are endowed with about *93%* of the identified global resource base in this cost category (the remaining *7%* are distributed among another 30 countries). The widespread distribution of uranium resources is an important geographic aspect of nuclear energy in light of security of energy supply.

Table 2. **Identified Resources (RAR + Inferred)**
(recoverable resources as of 1 January 2007, tonnes U, rounded to nearest 100 tonnes)

COUNTRY	Cost ranges		
	< USD 40/kgU	< USD 80/kgU	< USD 130/kgU
Algeria (b, c)	NA	19 500	19 500
Argentina	7 100	11 000	12 000
Australia	1 196 000	1 216 000	1 243 000
Brazil (e)	139 600	231 000	278 400
Canada	352 400	423 200	423 200
Central African Republic (a, b, c)	NA	6 000	12 000
Chile (c)	NA	NA	1 500
China (c)	39 300	61 900	67 900
Congo, Dem. Rep. of (a, b, c)	NA	2 700	2 700
Czech Republic	0	700	700
Denmark (a, b, c)	0	0	32 300
Finland (b, c)	0	0	1 100
France (a)	0	0	11 700
Gabon (a, b)	0	0	5 800
Germany (b)	0	0	7 000
Greece (a, b)	1 000	7 000	7 000
India (c, d)	NA	NA	72 900
Indonesia (a, b, c)	0	300	5 800
Iran, Islamic Republic of (c)	0	0	1 600
Italy (a, b)	NA	4 800	6 100
Japan (b)	0	0	6 600
Jordan (c)	111 800	111 800	111 800
Kazakhstan (c)	517 300	751 600	817 300
Malawi (a, b, c)	NA	9 600	11 600
Mexico (a, b, c)	0	0	1 800
Mongolia (a, b, c)	16 300	62 000	62 000
Namibia * (e)	116 400	230 300	275 000
Niger	34 200	75 200	274 000
Peru (c)	0	2 900	2 900
Portugal	0	5 700	7 200
Romania (a)	0	0	6 700
Russian Federation	83 600	495 400	545 600
Slovenia (b, c)	0	3 300	5 500
Somalia (a, b, c)	0	0	7 600
South Africa (b, f)	234 700	343 200	435 100
Spain (b)	0	2 500	11 300
Sweden (a, b)	0	0	10 000
Turkey (b, c)	0	7 300	7 300
Ukraine (c)	34 100	184 100	199 500
United States (b)	NA	99 000	339 000
Uzbekistan * (a, c)	86 200	86 200	111 000
Vietnam (c)	NA	800	6 400
Zimbabwe (a, b, c)	NA	1 400	1 400
Total (g)	**2 970 000**	**4 456 400**	**5 468 800**

NA Data not available. * Secretariat estimate.
(a) Not reported in 2007 responses, data from previous Red Book.
(b) Assessment not made within the last five years.
(c) *In situ* resources were adjusted by the Secretariat to estimate recoverable resources using recovery factors provided by countries or estimated by the Secretariat according to the expected production method.
(d) Cost data not provided, therefore resources are reported in the < USD 130/kgU category.
(e) Data from previous Red Book, reduced by past production.
(f) Resource estimates do not account for production.
(g) Totals related to cost ranges <USD 40/kgU and <USD 80/kgU are higher than reported in the tables because certain countries do not report resource estimates, mainly for reasons of confidentiality.

Table 3. **Reasonably Assured Resources (RAR)**

(recoverable resources as of 1 January 2007, tonnes U, rounded to nearest 100 tonnes)

COUNTRY	**Cost ranges**		
	< USD 40/kgU	< USD 80/kgU	< USD 130/kgU
Algeria (b, c)	NA	19 500	19 500
Argentina	5 100	9 000	9 000
Australia	709 000	714 000	725 000
Brazil (e)	139 600	157 400	157 400
Canada	270 100	329 200	329 200
Central African Republic (a, b, c)	NA	6 000	12 000
Chile (c)	NA	NA	800
China (c)	31 800	44 300	48 800
Congo, Dem. Rep. of (a, b, c)	NA	1 400	1 400
Czech Republic	0	600	600
Denmark (a, b, c)	0	0	20 300
Finland (b, c)	0	0	1 100
Gabon (a, b)	0	0	4 800
Germany (b)	0	0	3 000
Greece (a, b)	1 000	1 000	1 000
India (c, d)	NA	NA	48 900
Indonesia (a, b, c)	0	300	4 600
Iran, Islamic Republic of (c)	0	0	500
Italy (a, b)	NA	4 800	4 800
Japan (b)	0	0	6 600
Jordan (c)	44 000	44 000	44 000
Kazakhstan (c)	235 500	344 200	378 100
Malawi (a, b, c)	NA	9 600	11 600
Mexico (a, b, c)	0	0	1 300
Mongolia (a, b, c)	8 000	46 200	46 200
Namibia * (e)	56 000	145 100	176 400
Niger	21 300	44 300	243 100
Peru (c)	0	1 400	1 400
Portugal (a)	0	4 500	6 000
Romania (a)	0	0	3 100
Russian Federation	47 500	172 400	172 400
Slovenia (b, c)	0	1 000	1 000
Somalia (a, b, c)	0	0	5 000
South Africa (b, f)	114 900	205 900	284 400
Spain (b)	0	2 500	4 900
Sweden (a, b)	0	0	4 000
Turkey (b, c)	0	7 300	7 300
Ukraine (c)	27 400	126 500	135 000
United States (b)	NA	99 000	339 000
Uzbekistan * (a, c, e)	55 200	55 200	72 400
Vietnam (c)	NA	NA	1 000
Zimbabwe (a, b, c)	NA	1 400	1 400
Total (g)	**1 766 400**	**2 598 000**	**3 338 300**

NA Data not available. * Secretariat estimate.

(a) Not reported in 2007 responses, data from previous Red Book.

(b) Assessment not made within the last five years.

(c) *In situ* resources were adjusted by the Secretariat to estimate recoverable resources using recovery factors provided by countries or estimated by the Secretariat according to the expected production method.

(d) Cost data not provided, therefore resources are reported in the < USD 130/kgU category.

(e) Data from previous Red Book, reduced by past production.

(f) Resource estimates do not account for production.

(g) Totals related to cost ranges <USD 40/kgU and <USD 80/kgU are higher than reported in the tables because certain countries do not report resource estimates, mainly for reasons of confidentiality.

Table 4. **Inferred Resources**
(recoverable resources as of 1 January 2007, tonnes U, rounded to nearest 100 tonnes)

COUNTRY	**Cost ranges**		
	< USD 40/kgU	< USD 80/kgU	< USD 130/kgU
Argentina	2 000	2 000	3 000
Australia	487 000	502 000	518 000
Brazil (b)	0	73 600	121 000
Canada	82 300	94 000	94 000
Chile (c)	NA	NA	700
China (c)	7 500	17 600	19 100
Congo, Dem. Rep. of (a, b, c)	NA	1 300	1 300
Czech Republic	0	100	100
Denmark (a, b, c)	0	0	12 000
France (a)	0	0	11 700
Gabon (a, b)	0	0	1 000
Germany (b)	0	0	4 000
Greece (a, b)	NA	6 000	6 000
India (c, d)	NA	NA	24 000
Indonesia (a, b, c)	0	0	1 200
Iran, Islamic Republic of (c)	0	0	1 100
Italy (a, b)	0	0	1 300
Jordan (c)	67 800	67 800	67 800
Kazakhstan (c)	281 800	407 400	439 200
Mexico (a, b, c)	0	0	500
Mongolia (a, b, c)	8 300	15 800	15 800
Namibia (a, c)	60 400	85 200	98 600
Niger	12 900	30 900	30 900
Peru (c)	NA	1 500	1 500
Portugal	0	1 200	1 200
Romania (a, b, c)	0	0	3 600
Russian Federation	36 100	323 000	373 300
Slovenia (b, c)	0	2 300	4 500
Somalia (a, b, c)	0	0	2 600
South Africa (b)	119 800	137 300	150 700
Spain (b)	0	0	6 400
Sweden (a, b)	0	0	6 000
Ukraine (c)	6 700	57 600	64 500
Uzbekistan (a, c)	31 000	31 000	38 600
Vietnam (c)	NA	800	5 400
Total (e)	**1 203 600**	**1 858 400**	**2 130 600**

NA Data not available.

(a) Not reported in 2007 responses, data from previous Red Book using Inferred or EAR-I data.

(b) Assessment not made within the last five years.

(c) *In situ* resources were adjusted to estimate recoverable resources, using recovery factors provided by the countries or estimated by the Secretariat according to the expected production method.

(d) Cost data not provided, therefore resources are reported in the < USD 130/kgU category.

(e) Total related to cost range < USD 40/kgU is higher than reported in the tables because certain countries do not report resource estimates, mainly for reasons of confidentiality.

Distribution of resources by production method

In 2007, countries reported Identified Resources by cost categories and by the expected production method, i.e., ***open-pit*** or ***underground*** mining, ***in situ leaching***, ***heap leaching or in-place leaching***, ***co-product/by-product*** or as unspecified.

Of the low-cost RAR (<USD 40/kgU) reported by mining method, recovery as a co-product/by-product is the most important (mainly in Australia and South Africa), followed closely by underground mining (Table 6). Significant portions of these low-cost resources are also expected to be recovered by *in situ* leaching (ISL), underlining the importance of this method in future production. With respect to RAR recoverable at costs <USD 130/kgU, most are expected to be produced by underground mining (almost 1/3 of the reported resources), followed by open-pit mining then by co-product/by-product and ISL.

Similar observations may be made for the Inferred Resources (Table 7). In the <USD 40/kgU category, uranium that would be recovered as a co-product/by-product represents the most important proposed production method, followed closely by ISL. In the <USD 130/kgU category, underground mining is expected to be the most important production method (about 1/3 of the reported resources with a specified production method), followed by recovery as co-product/by-product, ISL and open-pit mining.

Distribution of resources by deposit type

In 2007, countries reported Identified Resources by cost categories and by geological types of deposits, i.e., unconformity related, sandstone, hematite breccia complex, quartz-pebble conglomerate, vein intrusive, volcanic and caldera-related, metasomatite or as other. Definition of the deposit types can be found in the glossary of definitions in Appendix 4.

In the low cost (<USD 40/kgU) category, almost all (about 72%) the RAR reported by deposit type belong to the hematite breccia complex (in Australia), unconformity related (in Canada and Australia) and sandstone (in Kazakhstan) categories (Table 8). In the <USD 130/kgU category, sandstone related resources (in the United States, Kazakhstan and Niger) is the most important category, followed by hematite breccia complex and unconformity related deposit types.

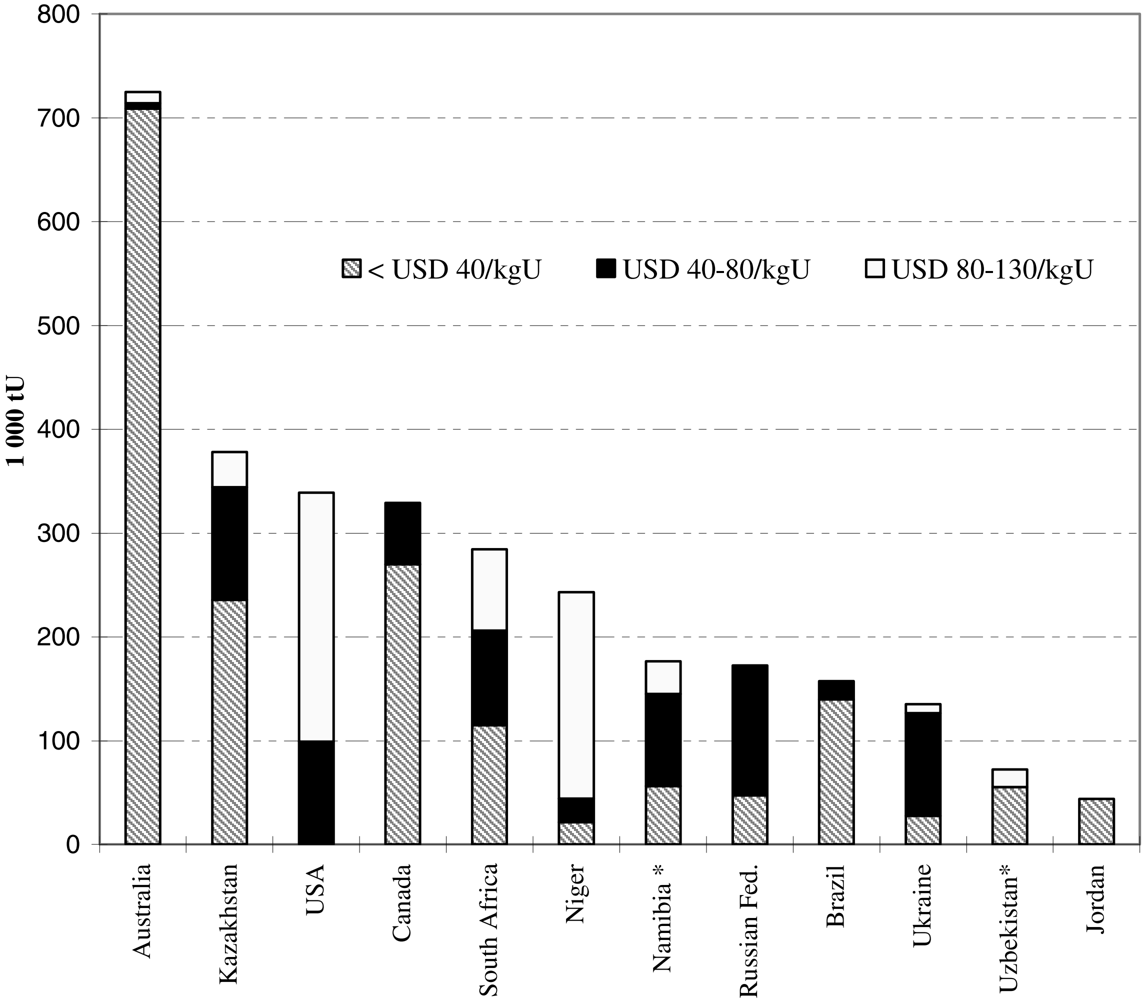
Similar observations can be made for the Inferred Resources (Table 9). In the <USD 40/kgU category, resources related to hematite breccia complex (in Australia) are the most important, closely followed by resources related to sandstone deposits (in Kazakhstan). In the <USD 130/kgU category, resources related to sandstone deposits (in Kazakhstan and Russia) are the most important, followed by resources related to hematite breccia complex and metasomatite (in Russia and Ukraine) deposits. Also worthy of mention is the relative importance of resources related to vein-type deposits (mainly in Kazakhstan) in this cost category.

Table 5. **Major Identified Resource changes by country**

(recoverable resources in 1 000 tonnes U)

Country	Resource category	2005	2007	Changes	Reasons
Australia	RAR				Additional resources defined at Olympic Dam, Ranger, Mt Fitch, Mt Gee, Westmoreland and Valhalla deposits.
	<USD 130/kgU	747	725	-22	
	Inferred				
	<USD 40/kgU	343	487	+144	
	<USD 80/kgU	360	502	+142	
	<USD 130/kgU	396	518	+122	
Bulgaria	RAR				Previously estimated resources considered non-economic after re-evaluation.
	<USD 80/kgU	6	0	-6	
	Inferred				
	<USD 80/kgU	6	0	-6	
Canada	RAR				Depletion of resources by past production.
	<USD 40/kgU	287	270	-17	
China	RAR				Increase of known resources in the Zaohuohao (Erdos basin) and Wukueqi (Yili basin) ISL deposits.
	<USD 40/kgU	26	32	+6	
	<USD 130/kgU	38	49	+11	
Jordan	RAR				Re-evaluation of the Central Jordan deposits.
	<USD 40/kgU	30	44	+14	
	Inferred				
	<USD 40/kgU	49	68	+19	
Kazakhstan	RAR				Re-evaluation.
	<USD 40/kgU	279	236	-43	
	<USD 80/kgU	378	344	-34	
	<USD 130/kgU	514	378	-136	
	Inferred				
	<USD 40/kgU	129	282	+153	
	<USD 80/kgU	228	407	+179	
	<USD 130/kgU	302	439	+137	
Niger	RAR				Re-evaluation following development drilling and feasibility studies.
	<USD 40/kgU	173	21	-152	
	<USD 80/kgU	180	44	-136	
	<USD 130/kgU	180	243	+63	
	Inferred				
	<USD 40/kgU	0	13	+ 13	
	<USD 80/kgU	45	31	-14	
	<USD 130/kgU	45	31	-14	
Russia	RAR				Re-evaluation; depletion by mining.
	<USD 40/kgU	58	48	-10	
	<USD 80/kgU	132	172	+40	
	Inferred				
	<USD 40/kgU	22	36	+14	
	<USD 80/kgU	41	323	+282	
	<USD 130/kgU	41	373	+332	
South Africa	RAR				Increase of resources with the re-opening of two gold mines, resulting in their uranium resources becoming potentially exploitable again, and to the results of exploration and development activities.
	<USD 40/kgU	89	115	+26	
	<USD 80/kgU	177	206	+29	
	<USD 130/kgU	256	284	+28	
	Inferred				
	<USD 40/kgU	55	120	+65	
	<USD 80/kgU	72	137	+65	
	<USD 130/kgU	85	151	+65	
Ukraine	RAR				Re-evaluation of resources and addition of Central, Novokonstantinovskoye and Podgaytsevskoye deposits.
	<USD 80/kgU	58	126	+68	
	Inferred				
	<USD 80/kgU	17	58	+41	

Figure 2. **Distribution of Reasonably Assured Resources (RAR) among countries with major resources**



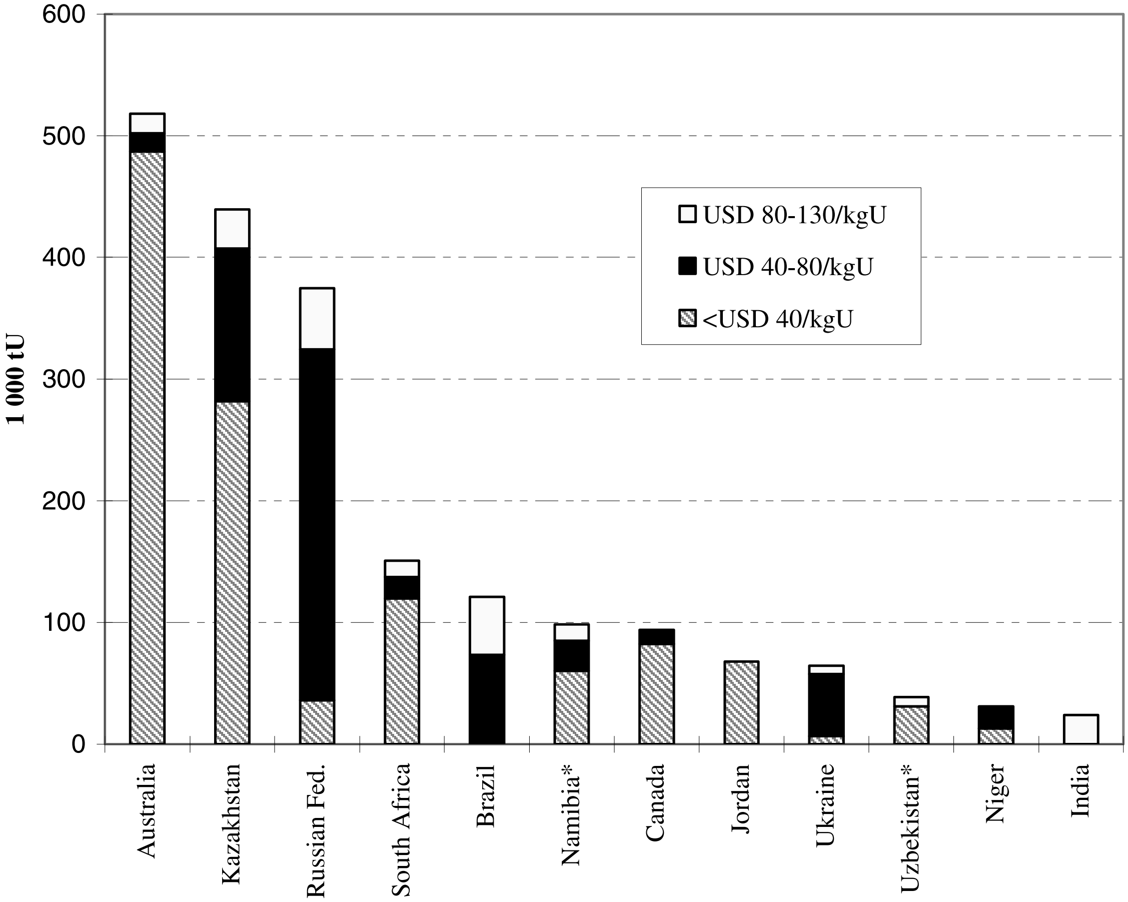
* Secretariat estimate.

Table 6. **Reasonably Assured Resources (RAR) by production method**
(tonnes U)

	<USD 40/kgU	**<USD 80/kgU**	**<USD 130/kgU**
Open-pit mining	300 700	456 700	797 100
Underground mining	541 000	944 200	1 225 500
In situ leaching	312 200	362 500	419 700
Heap leaching*	36 800	52 500	53 600
In-place leaching	300	8 600	8 600
Co-product / by-product	547 100	606 500	606 500
Unspecified mining method	28 300	167 000	227 300
Total	**1 766 400**	**2 598 000**	**3 338 300**

* Secretariat estimate.

Figure 3. **Distribution of Inferred Resources among countries with major resources**



* Secretariat estimate.

Table 7. **Inferred Resources by proposed production method**
(tonnes U)

	<USD 40/kgU	**<USD 80/kgU**	**<USD 130/kgU**
Open-pit mining	202 100	199 300	251 900
Underground mining	265 700	692 400	767 000
In situ leaching	344 400	378 200	389 700
Heap leaching*	12 700	22 300	23 900
In-place leaching	1 500	24 800	24 800
Co-product / by-product	367 000	445 800	493 200
Unspecified mining method	10 200	95 600	180 100
Total	**1 203 600**	**1 858 400**	**2 130 600**

* Secretariat estimate.

Table 8. **Reasonably Assured Resources (RAR) by deposit type**
(tonnes U)

	<USD 40/kgU	**<USD 80/kgU**	**<USD 130/kgU**
Unconformity-related	424 100	485 200	491 600
Sandstone	347 800	537 300	999 500
Hematite breccia complex	492 300	492 300	499 400
Quartz-pebble conglomerate	88 100	126 400	163 600
Vein	0	89 600	156 800
Intrusive	47 400	131 400	183 700
Volcanic and caldera-related	50 400	155 700	157 800
Metasomatite	121 200	291 300	304 900
Other *	162 300	221 000	284 300
Unspecified	32 800	67 800	96 700
Total	**1 766 400**	**2 598 000**	**3 338 300**

* Includes Surficial, Collapse breccia pipe, Phosphorite and other types of deposits, as well as rock types with elevated uranium content. Pegmatite and black shale are not included.

Table 9. **Inferred Resources by deposit type**
(tonnes U)

	<USD 40/kgU	**<USD 80/kgU**	**<USD 130/kgU**
Unconformity-related	148 300	152 300	158 100
Sandstone	374 800	468 100	524 400
Hematite breccia complex	393 900	399 900	401 500
Quartz-pebble conglomerate	113 700	132 000	138 300
Vein	0	108 500	167 700
Intrusive	61 600	78 800	104 200
Volcanic and caldera-related	1 000	44 600	53 500
Metasomatite	14 800	289 200	368 800
Other *	77 800	133 900	154 400
Unspecified	17 700	51 100	59 700
Total	**1 203 600**	**1 858 400**	**2 130 600**

* Includes Surficial, Collapse breccia pipe, Phosphorite and other types of deposits, as well as rock types with elevated uranium content. Pegmatite and black shale are not included.

Proximity of resources to production centres

A total of eight countries provided estimates of the availability of resources for near-term production by reporting the percentage of Identified Resources (RAR and Inferred Resources) recoverable at costs <USD 40/kgU and <USD 80/kgU that are tributary to existing and committed production centres (Table 10). Resources tributary to existing and committed production centres in 11 countries listed below total 2 337 745 tU at <USD 40/kgU, about 9% above 2005, and 2 757 590 tU at <USD 80/kgU, about a 17% increase compared to 2003. These tributary resources represent about 79% of reported total Identified Resources at <USD 40/kgU and about 62% at <USD 80/kgU.

Table 10. **Identified Resources proximate to existing or committed production centres***

Country	**RAR + Inferred recoverable at <USD 40/kgU in Existing or Committed Production Centres**			**RAR + Inferred recoverable at <USD 80/kgU in Existing or Committed Production Centres**		
	Total resources	%	Proximate resources	Total resources	%	Proximate resources
Australia	1 196 000	77	920 920	1 216 000	75	912 000
Brazil	139 600	87	121 452	231 000	66	152 460
Canada	352 400	100	352 400	423 200	84	355 488
China	39 300	NA	NA	61 900	100	61 900
Kazakhstan	517 300	95	491 435	751 600	68	511 088
Namibia**	116 400	90	104 760	230 300	90	207 270
Niger**	34 200	100	34 200	75 200	100	75 200
Russian Fed.	83 600	100	83 600	495 400	37	183 298
South Africa	234 700	61	143 167	343 200	42	144 144
Ukraine	34 100	57	19 437	184 100	48	88 368
Uzbekistan**	86 200	77	66 374	86 200	77	66 374
Total	**2 833 800**		**2 337 745**	**4 098 100**		**2 757 590**

NA Data not available.
* Identified Resources only in countries that reported proximity to production centres; not world total.
** Secretariat estimate.

Undiscovered Resources

Undiscovered Resources (***Prognosticated*** and ***Speculative)*** refer to resources that are expected to occur based on geological knowledge of previously discovered deposits and regional geological mapping. ***Prognosticated Resources*** refer to those expected to occur in known uranium provinces, generally supported by some direct evidence. ***Speculative Resources*** refer to those expected to occur in geological provinces that may host uranium deposits. Both Prognosticated and Speculative Resources require significant amounts of exploration before their existence can be confirmed and grades and tonnages can be defined. Almost all Prognosticated Resources and Speculative Resources are reported as *in situ* resources (Table 11).

Worldwide, reporting of SR is incomplete, as only 26 countries have historically reported resources in this category. Only 16 countries reported SR for this edition, compared to the 25 that reported RAR. A number of countries did not report Undiscovered Resources for the 2007 Red Book, while others indicated that they do not regularly update evaluations of this type of resource. Nonetheless, some of these countries, such as Australia, Gabon and Namibia, are considered to have significant resource potential in as yet sparsely explored areas.

Prognosticated Resources are estimated to total about 2.8 million tU recoverable at <USD 130/kgU (2.5 million tU in 2005), including about 1.9 million tU at <USD 80/kgU (1.7 million tU in 2005). Major changes in Prognosticated Resources between 2005 and 2007 occurred in India (increase from 12 100 tU to 50 900 tU in the <USD 80/kgU cost category), Jordan (increase from 37 500 tU to 84 800 tU in the <USD 130/kgU cost category) and the Russian Federation (increase from 56 300 tU to 276 500 tU in the <USD 40/kgU category). The total for countries reporting Speculative Resources (SR) recoverable at <USD 130/kgU is about 4.8 million tU, an increase of over 240 000 tU compared to the 2005 total. About 3 million tU of additional SR are reported without an estimate of production cost, almost the same amount as in 2005. The most significant change in SR is reported in the Russian Federation (increase from 545 000 tU to 714 000 tU in the <USD 130/kgU cost category). Total reported SR are estimated to amount to a little over 7.7 million tU, up slightly compared to the 2005 total of 7.5 million tU.

Table 11. **Undiscovered Resources***
(in 1 000 tonnes U, as of 1 January 2007)

COUNTRY	**Prognosticated Resources**		**Speculative Resources**		
	Cost ranges		Cost ranges		
	< USD 80/kgU	< USD 130/kgU	< USD 130/kgU	Cost range unassigned	Total
Argentina	1.4	1.4	NA	NA	NA
Brazil	300.0	300.0	NA	500.0	500.0
Bulgaria	0.0	0.2	NA	NA	NA
Canada	50.0	150.0	700.0	0.0	700.0
Chile	NA	1.5	NA	3.2	3.2
China	3.6	3.6	4.1	0.0	4.1
Colombia (a)	NA	11.0	217.0	0.0	217.0
Czech Republic	0.2	0.2	0.0	179.0	179.0
Denmark (a)	0.0	0.0	50.0	10.0	60.0
Germany	0.0	0.0	0.0	74.0	74.0
Greece (a)	6.0	6.0	0.0	0.0	0.0
Hungary	0.0	18.4	NA	NA	NA
India	NA	50.9	NA	17.0	17.0
Indonesia (a)	NA	NA	0.0	12.5	12.5
Iran, Islamic Republic of	0.0	4.1	12.2	NA	12.2
Italy (a)	NA	NA	NA	10.0	10.0
Jordan	67.8	84.8	84.8	NA	84.8
Kazakhstan	280.0	300.0	500.0	NA	500.0
Mexico (a)	NA	3.0	NA	10.0	10.0
Mongolia (a)	0.0	0.0	1 390.0	NA	1 390.0
Niger (a)	14.5	24.6	NA	NA	NA
Peru	6.6	6.6	19.7	0.0	19.7
Portugal	1.0	1.5	NA	0.0	NA
Romania (a)	NA	3.0	3.0	0.0	3.0
Russian Federation	276.5	276.5	714.0	0.0	714.0
Slovenia	0.0	1.1	NA	NA	NA
South Africa	34.9	110.3	NA	1 112.9	1 112.9
Ukraine	8.4	22.5	120.0	135.0	255.0
United States (b)	839.0	1 273.0	858.0	482.0	1 340.0
Uzbekistan (a)	56.3	85.0	0.0	134.7	134.7
Venezuela (a)	NA	NA	0.0	163.0	163.0
Vietnam	0.0	7.9	100.0	130.0	230.0
Zambia (a)	0.0	22.0	NA	NA	NA
Zimbabwe (a)	0.0	0.0	25.0	0.0	25.0
Total (reported by countries)**	**1 946.2**	**2 769.0**	**4 797.8**	**2 973.3**	**7 771.1**

* Undiscovered Resources are reported as *in situ* resources.

** Totals may not equal sum of components due to independent rounding.

NA Data not available.

(a) Not reported in 2007 responses, data from previous Red Book.

(b) The USA does not report Inferred or Prognosticated Resources all EAR is classified as Prognosticated.

Other resources and materials

Conventional resources are defined as resources from which uranium is recoverable as a primary product, a co-product or an important by-product, while unconventional resources are resources from which uranium is only recoverable as a minor by-product, such as uranium associated with phosphate rocks, non-ferrous ores, carbonatite, black schists, and lignite. Most of the unconventional uranium resources reported to date are associated with ***uranium in phosphate rocks***, but other potential sources exist (e.g., seawater and black shale). Since few countries reported updated information a comprehensive compilation of unconventional uranium resources and other potential nuclear fuel materials (e.g., thorium) is not possible. Instead, a summary of information documented in 2007 and data reported in past editions is provided below.

Historically phosphate deposits [1] are the only unconventional resources from which a significant amount of uranium has been recovered. Processing of Moroccan phosphate rock in Belgium produced 690 tU between 1975 and 1999 and about 17 150 tU were recovered in the United States from Florida phosphate rocks between 1954 and 1962. As much as 40 000 tU was also recovered from processing marine organic deposits (essentially concentrations of ancient fish bones) in Kazakhstan. Estimated production costs for a 50 tU/year project, including capital and investment, ranged between USD 40/kgU and USD 115/kgU in the United States in the1980s [2].

Unconventional uranium resources were reported by countries in Red Books between 1965 and 1993. Today, only very few countries (Chile, Egypt, Finland, Jordan, Peru and Vietnam) mention or report these resources (Table 12). However, with uranium prices above USD 260-310/kgU, by-product recovery of uranium from unconventional resources, and in particular from phosphate processing facilities, may become economically viable and could again become an important, competitive source of uranium.

Table 12. **Unconventional Resources reported in 2007**
(tonnes U)

Country	Tonnes U	Types of deposit
Chile	5 458	Phosphorite, copper deposits
Egypt	NR	Phosphorite, and black shale deposits
Finland	5 500	Black shale and carbonatite deposits
Jordan	59 360	Phosphorite deposits
Peru	25 600	Phosphorite and polymetallic (Cu, Pb, Zn, Ag, W, Ni) deposits
Vietnam	NR	Phosphorite and coal deposits

NR = not reported.

Table 13 summarises ranges of unconventional resources reported in Red Books between 1965 and 1993 [3]. These figures are incomplete. They do not include all worldwide unconventional resources since large uranium resources associated with the Chattanooga (United States) and Ronneburg (Germany) black shales, which combined total 4.2 million tU, are not listed. Neither are large uranium resources associated with monazite-bearing coastal sands in Brazil, India, Egypt, Malaysia, Sri Lanka and the United States. With the exception of Kazakhstan, unconventional resources are also not reported in former USSR countries.

Table 13. **Unconventional uranium resources** (1 000 tU) **reported in 1965-1993 Red Books**

Country	Phosphate rocks	Non-ferrous ores	Carbonatite	Black schist, lignite
Brazil*	28.0 – 70.0	2.0	13.0	
Chile	0.6 – 2.8	4.5 – 5.2		
Columbia	20.0 – 60.0			
Egypt**	35.0 – 100.0			
Finland			2.5	3.0 – 9.0
Greece	0.5			
India	1.7 – 2.5	6.6 – 22.9		4.0
Jordan	100 – 123.4			
Kazakhstan	58			
Mexico	100 – 151	1.0		
Morocco	6 526			
Peru	20	0.14 – 1.41		
Sweden				300.0
Syria	60.0 – 80.0			
Thailand	0.5 – 1.5			
United States	14.0 – 33.0	1.8		
Venezuela	42.0			
Vietnam				0.5

* Considered a conventional resource in Brazil and is thus included in conventional resource figures for Brazil.
** Includes an unknown quantity of uranium contained in monazite.

The total uranium reported in previous Red Books as unconventional resources, dominated by phosphorite deposits in Morocco (>85%), amounts to about 7.3 – 7.6 million tU. As noted above, this total does not include significant deposits in other countries and is therefore a conservative estimate of the existing unconventional uranium resource base.

Other estimates of uranium resources associated with marine and organic phosphorite deposits point to the existence of almost 9 million tU in four countries alone: Jordan, Mexico, Morocco and the United States [4]. Others estimate the global total to amount to 22 million tU, an estimate cited in the 2005 Red Book [5]. The variation in these estimates shows that these figures should be considered as part of a general mineral inventory rather than conforming to standard categories used in reporting resources. The development of more rigorous estimates of uranium in phosphate rocks is required given that recent uranium spot market prices may justify the economic exploitation of these deposits.

Seawater may also be regarded as a possible source of uranium, due to the large volume of uranium contained (about 4 billion tU) and its almost inexhaustible nature. However, because of the low concentration of uranium in seawater (3-4 ppb), it is estimated that it would require the processing of about 350 000 tonnes of water to produce a single kg of uranium. Nonetheless, with the exception of its high recovery cost, there is no intrinsic reason why at least some of these significant resources could not be extracted from various coast lines at a total rate of a few hundred of tonnes annually.

Research was carried out on uranium recovery from seawater in Germany, Italy, Japan, United Kingdom and United States in the 1970s/80s, but is now known to be continuing only in Japan. Between 2001 and 2003, Japanese researchers tested a braid type recovery system directly moored to the ocean floor, recovering about 1.5 gU over a 30 day test period [6]. The annual recovery factor of such a system is estimated to be about 1 200 tU/year at a recovery cost of over USD 700/kgU. Research is continuing in Japan to improve the recovery factor and cost.

Thorium

Thorium, abundant and widely dispersed, could also be used as a nuclear fuel resource. Most of the largest identifed thorium resources were discovered during the exploration of carbonatites and alkaline igneous bodies for uranium, rare earth elements, niobium, phosphate, and titanium. Today, thorium is recovered mainly from the mineral monazite as a by-product of processing heavy-mineral sand deposits for titanium-, zirconium-, or tin-bearing minerals. Information on thorium resources [1,3] was published in Red Books between 1965 and 1981, typically using the same terminology used for uranium resources at that time (e.g. Reasonably Assured Resources and Estimated Additional Resources I and II, which are now termed Inferred and Prognosticated Resources, respectively). Worldwide thorium resources, which are listed by major deposit types in Table 14, are estimated to total about 6.08 million t Th, including undiscovered resources.

Table 14. **Major thorium deposit types and resources** [3]

Deposit type	**Resources** (1 000 t Th)
Carbonatite	1 900
Placer	1 500
Vein-type	1 300
Alkaline rocks	1 120
Other	258
Total	**6 078**

Table 15 lists these thorium resources on a country by country basis, classified in categories similar to those used for uranium resources.

Table 15. **World thorium resources** (1 000 t Th) [3]

Country	**RAR** < USD 80/kgTh	**EAR I (Inferred)** <USD 80/kgTh	**Identified Resources** <USD 80/kgTh	**Prognosticated**
Australia*	46	406	452	NA
Brazil*	172	130	302	330
Canada	NA	44	44	128
Egypt	NA	100	100	280
Greenland	54	NA	54	32
India	319	NA	319	NA
Norway	NA	132	132	132
Russian Fed.	75	NA	75	NA
South Africa	18	NA	18	130
Turkey	344	NA	344	400 – 500
USA	122	278	400	274
Venezuela	NA	300	300	NA
Others	23	10	33	81
Total	**1 173**	**1 400**	**2 573**	**1 787 – 1 887**

NA Data not available. * Based on updated assessments.

World total thorium resources estimated in the categories RAR, EAR-I (Identified Resources) and Prognosticated Resources listed in Table 15 total 4.4 million t Th, or about 72% of the world thorium resources listed in Table 14. Differences in these estimates are the result of the differing approaches used (e.g. different costs and degrees of geological assurance).

So-called secondary sources of uranium, though small compared with the resources described above, play a significant role in supplying current nuclear fuel requirements and are expected to continue to do so for several years. These resources are discussed in detail in the Uranium Demand section of this volume.

B. URANIUM EXPLORATION

A very significant increase in exploration and development activities occurred in 2005 and 2006, driven by increases in the uranium spot price. These activities were conducted in countries which explored and developed uranium deposits in the past and also in many countries where exploration for uranium had not been conducted for many decades. Since most of these countries did not report exploration and development expenditures, total worldwide uranium exploration and development expenditures are likely higher than what is reported here.

Worldwide uranium exploration continues to be unevenly distributed geographically, with the majority of exploration expenditures being concentrated in areas considered to have the best likelihood for the discovery of economically attractive deposits, mainly ***unconformity-related***, ***sandstone-type*** and ***hematite breccia complex*** deposits.

In 2006, only Australia, Canada, France and Switzerland reported non-domestic exploration and development expenditures amounting to a total USD 214.1 million (Table 16). In 2007, these same four countries are expected to increase non-domestic expenditures to over USD 259.4 million, more than 13 times the 2003 total. Trends in domestic and non-domestic exploration expenditures are depicted in Figure 3.

Domestic exploration and development expenditures generally decreased from 1998 to 2001, then began to slightly increase in 2002 where a total of 18 countries reported domestic expenditures of about USD 95.1 million (Table 17). In 2003 and 2004, 20 and 21 countries, respectively, reported exploration and development activities amounting to about USD 123.8 million and USD 218.8 million, respectively.

In 2005, 19 countries reported domestic exploration and development expenditures totalling about USD 364 million, an increase of about 66% compared to 2004. In 2006, 17 countries reported domestic expenditures totalling about USD 773.8 million, an increase of about 113% compared to 2005 (these figures include conservative Secretariat estimates for Namibia, Niger, United States and Uzbekistan). The bulk of 2006 expenditures were reported in only seven countries: Australia, Canada, China, India, the Russian Federation, South Africa and the United States. These countries together accounted for about 97% of reported domestic exploration and development expenditures. Of reported domestic expenditures, 76% were made in only two countries, Canada and the United States. Overall, domestic exploration and development expenditures are expected to remain strong but decrease slightly to about USD 718 million in 2007 (if conservative Secretariat estimates for Namibia, Niger, United States and Uzbekistan are included), with the most significant increases anticipated in Canada, Kazakhstan and the Russian Federation. Figure 4 portrays these trends, showing the recent, rapid divergence between domestic and non-domestic expenditures.

Table 16. **Non-domestic uranium exploration and development expenditures**
(USD in year of expenditures)

COUNTRY	**Pre-2000**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007** (expected)
Australia	NA	NA	NA	NA	NA	1 571	8 855	4 580	4 724
Belgium	4 500	0	0	0	0	0	0	0	0
Canada	16 556	3 667	2 597	2 549	2 547	9 559	53 968 p	124 546 p	139 655 p
China	0	0	0	0	0	0	NA	NA	NA
France	707 603	7 330	7 690	14 370	16 701	59 701	127 500	85 000	115 000
Germany	403 158	0	0	0	0	0	0	0	0
Japan	418 331	NA	NA	NA	NA	NA	NA	NA	NA
Korea, Republic of	24 049	NA	NA	NA	NA	NA	NA	NA	NA
Spain	20 400	0	0	0	0	0	0	0	0
Switzerland	29 657	0	0	0	0	3	0	3	16
United Kingdom	61 263	0	0	0	0	0	0	0	0
United States	260 598	NA	NA	NA	NA	NA	NA	NA	NA
Total	**1 946 115**	**10 997**	**10 287**	**16 919**	**19 248**	**70 834**	**190 323**	**214 129**	**259 395**

Note: Domestic exploration and development expenditures represent the total expenditure from domestic and foreign sources within each country. Expenditures abroad are thus a subset of domestic expenditures.

* Secretariat estimate.

p Provisional data.

NA Data not available.

Table 17. **Industry and government uranium exploration and development expenditures – domestic**

(USD thousands in year of expenditure)

COUNTRY	Pre-2000	2000	2001	2002	2003	2004	2005	2006	2007 (expected)
Argentina	49 454	791	777	265	627	701	966	650	656
Australia	494 953	4 390	2 470	3 020	4 116	9 971	31 366	61 603	70 866
Bangladesh	453	NA	NA	NA	NA	NA	NA	NA	NA
Belgium	2 487	0	0	0	0	0	0	0	0
Bolivia	9 343	NA	NA	NA	NA	NA	NA	NA	NA
Botswana	825	NA	NA	NA	NA	NA	NA	NA	NA
Brazil	186 128	0	NA	NA	NA	449	0	0	463
Cameroon	1 282	0	0	0	0	0	0	0	0
Canada	1 197 013	30 667	16 234	22 876	21 687	78 676	184 921	432 727	458 621
Central African Rep.	21 800	NA	NA	NA	NA	NA	NA	NA	NA
Chile	6 287	214	126	154	115	133	84	100	113
China (a)	0	4 200	6 000	7 200	7 600	9 500	13 500	25 500	33 600
Colombia	19 946	NA	NA	NA	NA	0	0	0	6 000
Costa Rica	364	NA	NA	NA	NA	NA	NA	NA	NA
Cuba	972	NA	NA	NA	NA	NA	NA	NA	NA
Czech Rep. (b)	313 903	44	48	25	56	23	53	132	152
Denmark	4 140	0	0	0	0	0	0	0	0
Ecuador	1 945	NA	NA	NA	NA	NA	NA	NA	NA
Egypt	76 087	10 499	9 404	7 186	5 631	2 589	1 730	1 736	1 751
Finland	13 984	0	0	0	0	210	803	1 798	3 529
France	907 240	0	0	0	0	0	0	0	0
Gabon	102 433	0	0	0	0	0	0	0	0
Germany (c)	2 002 789	0	0	0	0	0	0	0	0
Ghana	90	NA	NA	NA	NA	NA	NA	NA	NA
Greece	17 547	NA	NA	NA	NA	NA	NA	NA	NA
Guatemala	610	NA	NA	NA	NA	NA	NA	NA	NA
Hungary	3 700	0	0	0	0	0	0	0	0
India	262 706	14 368	12 060	11 922	14 172	14 333	16 588	16 422	22 743
Indonesia	15 731	61	23	30	33	31	NA	NA	NA
Iran, Islamic Rep. of	1 857	1 700	1 004	1 389	3 781	3 751	3 723	4 958	8 775
Ireland	6 200	NA	NA	NA	NA	NA	NA	NA	NA
Italy	75 060	NA	NA	NA	NA	NA	NA	NA	NA
Jamaica	30	NA	NA	NA	NA	NA	NA	NA	NA
Japan	19 697	0	0	0	0	0	0	0	0
Jordan	920	0	0	0	0	0	0	0	0
Kazakhstan	6 830	11 035	13 175	11 836	4 372	723	1 169	8 500	26 309
Korea, Rep. of	17 886	0	0	0	0	0	0	0	0
Lesotho	21	NA	NA	NA	NA	NA	NA	NA	NA
Madagascar	5 293	NA	NA	NA	NA	NA	NA	NA	NA

Table 17. **Industry and government uranium exploration and development expenditures – domestic** (contd.)
(USD thousands in year of expenditure)

COUNTRY	Pre-2000	2000	2001	2002	2003	2004	2005	2006	2007 (expected)
Malaysia	10 412	66	NA	NA	NA	NA	NA	NA	NA
Mali	58 693	NA	NA	NA	NA	NA	NA	NA	NA
Mexico	30 306	0	NA	NA	NA	NA	NA	NA	NA
Mongolia	8 153	NA	NA	NA	NA	NA	NA	NA	NA
Morocco	2 752	NA	NA	NA	NA	NA	NA	NA	NA
Namibia	25 631	0	0	0	110	1 747	2 000 *	2 000 *	2 000 *
Niger	206 729	633	1 088	3 126	4 545	4 222	6 400 *	6 400 *	6 400 *
Nigeria	6 950	NA	NA	NA	NA	NA	NA	NA	NA
Norway	3 180	0	0	0	0	0	0	0	0
Paraguay	26 360	NA	NA	NA	NA	NA	NA	NA	NA
Peru	4 776	0	0	0	0	0	0	0	0
Philippines	3 447	5	4	4	2	NA	NA	NA	NA
Portugal	17 618	19	0	0	0	0	0	0	0
Romania	9 903	157	NA	NA	NA	NA	NA	NA	NA
Russian Fed.	52 169	13 300	11 470	10 420	7 241	10 597	24 946	33 496	63 095
Rwanda	1 505	0	0	0	0	0	0	0	0
Slovenia (d)	1 581	NA	NA	NA	NA	NA	NA	NA	NA
Somalia	10 000	NA	NA	NA	NA	NA	NA	NA	NA
South Africa	140 846	0	0	0	73	886	1 593	24 698	15 143
Spain	140 455	0	0	0	0	0	NA	NA	NA
Sri Lanka	43	NA	NA	NA	NA	NA	NA	NA	NA
Sudan	200	0	0	0	0	0	0	0	0
Sweden	47 900	0	0	0	0	0	0	0	0
Switzerland	3 359	0	0	0	0	0	0	0	0
Syria	1 151	NA	NA	NA	NA	NA	NA	NA	NA
Thailand	11 299	NA	NA	NA	NA	NA	NA	NA	NA
Turkey	21 981	0	NA	NA	7	7	23	56	50
Ukraine	6 533	2 107	1 701	1 898	3 415	4 259	4 801	6 168	6 220
United Kingdom	3 815	0	0	0	0	0	0	0	0
United States (e)	2 495 240	6 694	4 827	352	31 300	59 000	77 800	155 300	155 000 *
Uruguay	231	NA	NA	NA	NA	NA	NA	NA	NA
USSR	3 692 350								
Uzbekistan	89 734	14 152	8 516	13 255	13 923	16 995	21 230 *	21 230 *	21 230 *
Vietnam	2 364	104	104	132	980	45	NA	NA	NA
Zambia	25	NA	NA	NA	NA	NA	NA	NA	NA
Zimbabwe	6 902	NA	NA	NA	NA	NA	NA	NA	NA
Total	**12 992 599 (c)**	**115 206**	**89 031**	**95 090**	**123 786**	**218 848**	**364 066**	**773 844**	**718 086**

Note: Domestic exploration and development expenditures represent the total expenditure from domestic and foreign sources within each country. Expenditures abroad are thus a subset of domestic expenditures.

NA Data not available. * Secretariat estimate.

(a) Development expenditures not included.

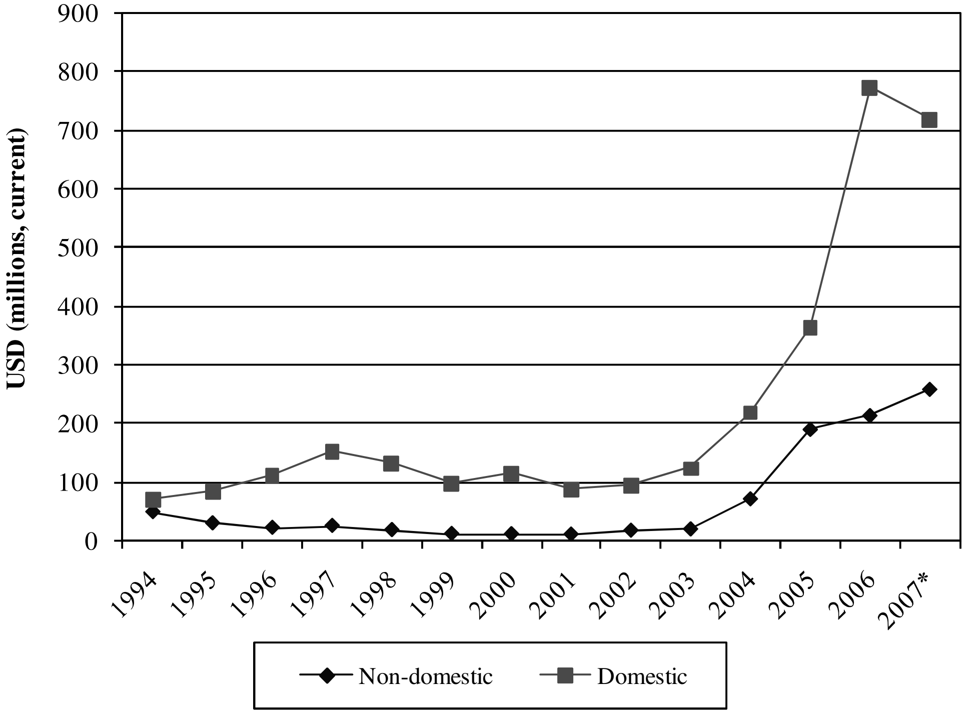
(b) Includes USD 312 560 expended in Czechoslovakia (pre-1996).

(c) Includes USD 1 905 920 spent in GDR between 1946 and 1990.

(d) Includes expenditures in other parts of former Yugoslavia.

(e) Includes reclamation and restoration expenditures in 2004, 2005 and 2006. In 2006, reclamation and restoration expenditures amounted to USD 50.9 million.

Figure 4. **Trends in exploration and development expenditures**



* 2007 values are estimates.

Current activities and recent developments

North America. In **Canada,** after a steady decrease in domestic exploration and mine development expenditures from 1998 (USD 41.1 million) to 2003 (USD 21.7 million), spending began to grow again, reaching USD 78.7 million in 2004 and over USD 432 million in 2006. In 2007, expenditures are expected to increase by about 6% to USD 458.6 million.

As in previous years, uranium exploration remained focused on areas favourable for the occurrence of deposits associated with Proterozoic unconformities in the Athabasca Basin of Saskatchewan, and to a lesser extent, similar geologic settings in the Thelon and Hornby Bay basins of Nunavut and the Northwest Territories. Significant exploration activities were also conducted in other areas of the country, such as Quebec, Newfoundland and Labrador, Alberta, Yukon, Ontario, Manitoba and British Columbia.

Uranium exploration and surface development drilling amounted to some 547.5 km in 2005, compared to 266.1 km in 2004. More than half of the overall exploration and development expenditures in 2006 can be attributed to advanced underground exploration, deposit appraisal activities, and care and maintenance expenditures associated with projects awaiting production approvals. Basic “grass roots” uranium exploration exceeded USD 200 million (USD 112 million in Saskatchewan alone) in 2006, more than doubling 2005 expenditures of USD 79 million. Over 55% of the combined exploration and surface development drilling in 2005 and 2006 took place in Saskatchewan. Non-domestic exploration expenditures in 2006 amounted to USD 125 million, with activities mainly carried out in Australia and Kazakhstan. In 2007, non-domestic expenditures are expected to increase slightly to about USD 140 million.

In 2006, the **United States** recorded a significant increase in domestic exploration and mine development spending with expenditures that year totalling about USD 155.3 million (although a portion of these expenditures relate to decommissioning and reclamation activities), surging from a mere USD 0.352 million in 2002 and USD 77.8 million in 2005. Expected expenditures for 2007 are not available.

Central and South America. Argentina reported exploration expenditures totalling about USD 1.0 million in 2005, up slightly from about USD 0.7 million in the previous year. Activities included a programme to complete the final feasibility study of the Cerro Solo deposit and evaluation of the surrounding areas. In addition more exploration programmes (vein type deposit at Las Thermas and sandstone type deposits favourable for *in situ* leach mining) are planned in the near future.

No exploration work was carried out in **Brazil** in 2005 and 2006. In 2007, a drilling programme is planned to confirm the continuity of the Cachoeira and Engenho deposits at Lagoa Real (Caetité site).

In 2005-2006, archived information on the uranium potential of **Colombia** was reviewed. Exploration titles for approximately 2 000 km^2 were requested. Exploration expenditures are expected to amount to USD 6 million in 2007, and could increase to about USD 20 million in the following years.

Exploration activities were also conducted in Bolivia, Guyana, Paraguay, Peru, although details were not reported.

Western Europe. Only **Finland** reported domestic exploration expenditures in 2005 (USD 0.8 million) and 2006 (USD 1.8 million). International companies have been reserving claims and acquiring claim areas, but to date only reconnaissance type field studies (ground radiometrics, geological mapping, radon surveys) have been conducted. One company involved carried out first phase trenching and drilling on a discovery site in northern Finland in 2005.

France reported an increase in non-domestic uranium exploration and development expenditures from about USD 60 million in 2004 to over USD 127 million in 2005, before declining to USD 85 million in 2006. Expenditures of over USD 115 million are expected in 2007. French exploration and development activities were reported in Australia, Canada, Finland, Kazakhstan, Mongolia, Niger and Russia.

In 2005 and 2006, several foreign companies applied for exploration and mining titles in **Portugal,** with the Nisa area being the main target. International uranium exploration companies applied for exploration permits in historic mining regions in **Spain** and **Sweden.**

Central, Eastern and South-eastern Europe. The Euratom Supply Agency reported that exploration activities were ongoing in **Hungary.** No fieldwork was conducted in the **Czech Republic** and exploration activities were focused on archiving and processing previously obtained data.

In the **Russian Federation,** exploration activities were concentrated on sandstone deposits amenable to ISL, unconformity-related deposits in Eastern Siberia, the Baltic Shield and the central Voronezh massif regions and for vein-stockwork and volcanic deposits in the Chita region (southern Priargun). Exploration activities, including drilling programmes, continued in the Transural, Vitim and Irkutsk districts, as well as in the north-western region of the country. Work is these areas is planned to continue in 2007. Total exploration and development expenditures in 2006 amounted to USD 33.5 million and are expected to increase to USD 63.1 million in 2007.

In 2005-2006, some exploration activities were performed in the eastern regions of **Slovakia** by a Canadian exploration company.

In **Turkey**, granitic and aciditic intrusive rocks, and sedimentary rocks were explored for radioactive raw material in the Sulakyurt-Kaman region. Similar activity is expected to be conducted in 2007-2008 in the Kirsehir-Nevsehir-Aksaray-Ankara regions.

Ukraine continued exploration for ***vein-type*** and unconformity-related deposits in the Ukrainian shield area. Unconformity type deposits (Verbovskaya, Khotynskaya, Drukhovskaya) were discovered on the western slopes of the Ukrainian shield on the Riphean unconformity. Efforts to estimate thorium resources in the Ukrainian Shield continued. Exploration expenditures totalled about USD 4.8 million in 2005, rose in 2006 to USD 6.2 million and are expected to remain at USD 6.2 million in 2007.

Africa. In **Egypt,** activities were concentrated on exploring for conventional uranium resources in the Eastern Desert granites and sedimentary formations in the Sinai. Unconventional resources, including phosphorite deposits and black shales, are also under investigation. Total expenditures in Egypt have steadily decreased from the high of USD 10.5 million in 2000 to USD 1.7 million in 2005 and 2006. Expenditures are expected to remain at about the same level (USD 1.8 million) in 2007.

In **Niger**, activities focused on resource development in and around the existing mine sites in an effort to expand the resource base in the western Arlit area where several deposits are under development (Ebba, Tamgak and Tabele). New exploration and development projects, with intensive drilling campaigns, were initiated in 2006 on the Imouraren and Azelik deposits and will continue in 2007. Although exploration and development expenditures were not reported by the Government of Niger, annual drilling programmes amounting to 59.9 km in 2005 and 134.6 km in 2006 were reported. In 2007, exploration and development drilling is expected to amount to 160 km.

In **Namibia**, major drilling programmes were conducted to develop the Langer Heinrich (in preparation for mining in 2006), Valencia and Trekkopje deposits during 2005 and 2006.

In **South Africa**, the upsurge in the price of uranium from 2005 onwards prompted a closer look at the Witwatersrand gold reefs where uranium may now comprise a more substantial income contributor than gold. Strong gold prices stimulated renewed interest in exploration for this metal at several locations along the limb of the Witwatersrand Basin, while high uranium prices encouraged some gold mining groups to routinely record uranium concentrations. Some mining companies have also drilled and assayed tailings piles (“slimes”) to determine uranium and gold content for possible future exploitation. Renewed interest in uranium occurrences in the Karoo Basin has also been seen in recent years. Total expenditures in South Africa increased from USD 0.9 million in 2004 to USD 1.6 million in 2005 and USD 24.7 million in 2006. In 2007, exploration expenditures are expected to amount to USD 15.1 million.

Exploration activities are also known to have been conducted in Botswana, Cameroon, the Central African Republic, the Democratic Republic of Congo, Gabon, Guinea, Madagascar, Malawi, Morocco, Mozambique, Senegal, Tanzania and Zambia, although details and associated costs were not reported by the governments of these countries.

Middle East, Central and Southern Asia. In **India**, active programmes are being conducted in several provinces, focusing on Proterozoic basins, Cretaceous sandstones, and other promising geological settings. Annual drilling decreased from 46.4 km in 2004 to 35.5 km and 40.1 km in 2005 and 2006, respectively, but is expected to increase to 133.7 km in 2007. Exploration expenditures amounted to about USD 16.6 million and USD 16.4 million in 2005 and 2006, respectively, and are expected to increase to USD 22.7 million in 2007.

In **Iran**, activities included exploration and evaluation of uranium resources associated with Precambrian magmatic and metasomatic complexes in the Bafgh-Robateh-el-Badam province, which includes Khoshumi, Narigan, Chahjuleh, Zarigan and Saghand uranium mines, and also in the Azarbaijan regions. Uranium occurrences in southern Iran are also being investigated, including the Gachin salt plug which has proved to be a surficial uranium deposit. Total expenditures amounted to about USD 3.7 million and USD 4.9 million in 2005 and 2006, respectively, and are expected to increase to about USD 8.8 million in 2007, including funding for a 14 km drilling programme.

In **Kazakhstan**, exploration was conducted in 2005 and 2006 at Moinkum, Inkai, Mynkuduk and Budyonovskoye deposits in the Chu-Sarysu uranium province and the Northern Kharasan deposit in the Syr-Darya uranium province, where several ISL test sites were completed and mining tests were initiated. Geologic and economic re-estimation of the North Kazakhstan province deposits was also initiated in order to define the uranium reserves and potential resources related to the vein-stockwork and unconformity related deposits suitable for underground and open-pit mining. In the coming years, uranium exploration is expected to be restarted in the Chu-Sarysu and Syr-Darya uranium provinces. Total exploration and development expenditures increased from USD 0.7 million in 2004 to USD 1.2 million in 2005, and USD 8.5 million in 2006, and are expected to rise sharply to USD 26.3 million in 2007 as a significant drilling programme (1 438 holes, 661 km) is to be initiated.

Exploration continues in **Uzbekistan** in order to increase uranium production, although details were not reported by the government. During 2006-2007, the State Committee on Geology and Mineral Resources established joint ventures with companies from Japan (Itochu Corporation, JOGMEC) and the Republic of Korea (Korea Resources Corporation) to explore black shale deposits and with the Russian company TENEX to explore sandstone deposits.

South-eastern Asia. No exploration activities were reported in South-eastern Asia, although **Indonesia**, the **Philippines** and **Vietnam** are known to have maintained low level activities aimed at evaluating previously discovered mineralisation.

East Asia. China reported increasing exploration and development expenditures of USD 13.5 million and USD 25.5 million in 2005 and 2006, respectively. China continues to focus exploration efforts on sandstone-type deposits amenable to ISL in the Yili basin of the Xinjiang region and the Erdos basin in Inner Mongolian Autonomous Region. In addition, work was restarted on hydrothermal type deposits in southern China in 2006, after more than ten years of inactivity, resulting in the discovery of vein-type deposits. In 2007, exploration expenditures are expected to amount to USD 33.6 million, featuring an important drilling programme (1 410 holes, 450 km). Non-domestic exploration and development activities were carried out mainly in Kazakhstan and in Niger, although details were not reported.

Exploration continues in **Mongolia**, although details were not reported by the government. Exploration was performed principally by Canadian companies Khan Resources Inc., Western Prospector Group Ltd. and Denison Mines. Activities included development of the Dornot deposit, the Gurvanbulak, Nemer and Mardaingol deposits of the Saddle Hills and the Kharat and Khairkhan deposits of the eastern Gobi region.

Pacific. Exploration continued vigorously in several regions of **Australia**, with annual exploration and development expenditures amounting to about USD 31.4 million in 2005 and about USD 61.6 million in 2006 reported. Exploration was focused on the Frome Embayment (South Australia) for sandstone type deposits, the Gawler Craton- Stuart Shelf region (South Australia) for hematite breccia complex deposits and Arnhem Land (Northern Territory) for unconformity-related deposits. Significant discoveries in 2005 and 2006 included the Four Mile deposit in South Australia (12 720 tU of Inferred Resources), major extensions of the Olympic Dam deposit and extensions of the Valhalla and Skal deposits (Queensland). In 2007, exploration expenditures are expected to increase again to about USD 70.9 million. Australia's non-domestic exploration expenditures amounted to USD 8.9 million in 2005, and USD 4.6 million in 2006, principally funding a major drilling programme to outline additional resources at the Langer Heinrich deposit in Namibia. Non-domestic expenditures are expected to hold steady in 2007 at USD 4.7 million.

C. URANIUM PRODUCTION

In 2006, uranium was produced in 20 different countries; one more than in 2004 as the Islamic Republic of Iran started production in 2006. However, three of these 20 countries (France, Germany and Hungary) only produced uranium as a consequence of mine remediation efforts. Two countries, Canada and Australia, accounted for 44% of world production in 2006 and just eight countries, Canada (25%), Australia (19%), Kazakhstan (13%), Niger (9%), the Russian Federation (8%), Namibia (8%), Uzbekistan (6%) and the United States (5%), accounted for about 93% of world production in 2006 (Figure 5).

Overall, world uranium production increased from 40 188 tU in 2004 to 41 943 tU in 2005 before declining by about 6% to 39 603 tU in 2006. In 2007, uranium production is expected to increase by a little less than 10% to 43 328 tU.

Within OECD countries, production decreased slightly from 22 019 tU recorded in 2004 and 22 821 tU in 2005 to 19 705 tU in 2006. Production in 2007 is expected to increase marginally to 19 809 tU. Table 18 summarises the significant changes that occurred in production in selected countries between 2004 and 2006. Historical uranium production on a country-by-country basis is provided in Table 19 and Figure 6.[3]

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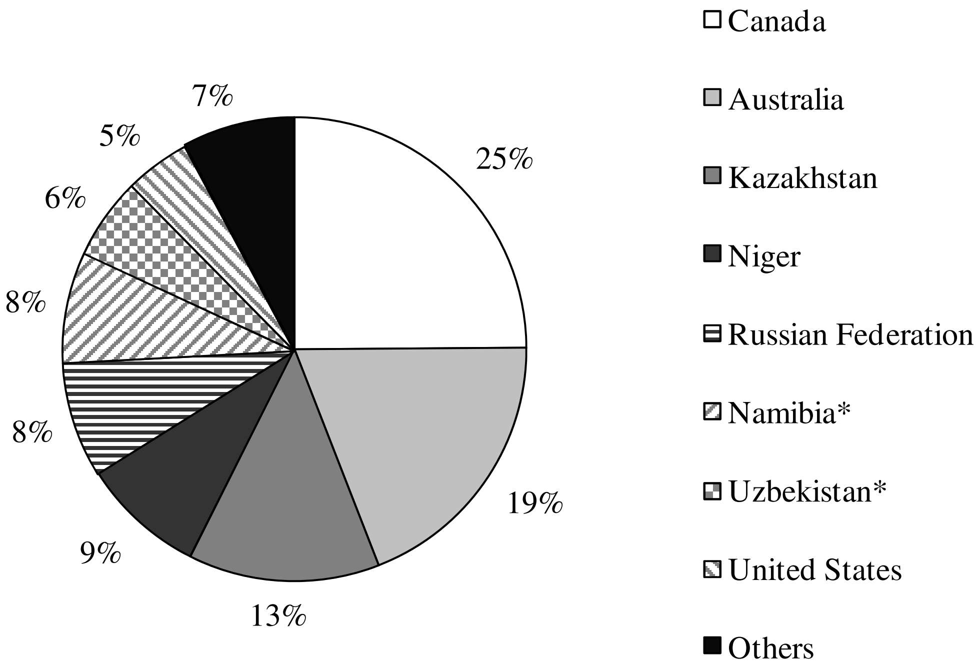
[3] Some historical production figures have changed since the last edition of the Red Book as a result of new data made available by member countries.

Figure 5. **Uranium production in 2006: 39 603 tU**



* Secretariat estimate.

Table 18. **Production in selected countries and reasons for major changes** (tonnes U)

Country	Production 2004	Production 2006	Change 2004-2006	Reasons for changes in production since 2002
Australia	8 982	7 593	-1 389	Production decreased at all three mines: at Olympic Dam due to processing difficulties, at Ranger due to high rainfall restricting access to high grade ore, and at Beverley due to technical difficulties.
Canada	11 597	9 862	-1 735	Low grade ore milled at McClean Lake and Rabbit Lake reduced output.
Kazakhstan	3 719	5 281	+1 562	Increased production at existing mines and new mines.
Niger	3 185	3 443	+258	Increased production at Arlit (+342 tU) greater than decreased production at Akouta (-84 tU).
South Africa	747	534	-213	Operational problems at Vaal River operations and maintenance problems at the Nufcor plant.
United States	943	1 805	+862	Production increased at existing mines and mine re-openings.

Table 19. **Historical uranium production**
(tonnes U)

COUNTRY	Pre-2004	2004	2005	2006	Total to 2006	2007 (expected)
Argentina	2 512	1	0	0	2 513	0
Australia	113 305	8 982	9 512	7 593	139 392	7 600
Belgium	686	0	0	0	686	0
Brazil	1 599	159	110	200	2 068	340
Bulgaria	16 357	0	0	0	16 357	0
Canada	375 107	11 597	11 628	9 862	408 194	9 850
China	27 689 *	730 *	750 *	750 *	29 919	750 *
Congo, Democratic Rep. of	25 600 *	0	0	0	25 600	0
Czech Republic (a)	108 649	412	409	375	109 845	309
Finland	30	0	0	0	30	0
France	75 965	6 *(c)	4 *(c)	3 *(c)	75 978	2 *(c)
Gabon	25 403	0	0	0	25 403	0
Germany (b)	219 240	77 (c)	94 (c)	65 (c)	219 476	45 (c)
Hungary	21 043	2 (c)	3 (c)	2 (c)	21 050	3
India	7 963 *	230 *	230 *	230 *	8 653 *	270 *
Iran, Islamic Rep of	0	0	0	5 *	5	20 *
Japan	84	0	0	0	84	0
Kazakhstan (d)	98 409	3 719	4 346	5 281	111 755	7 245
Madagascar	785 *	0	0	0	785	0
Mexico	49	0	0	0	49	0
Mongolia	535	0	0	0	535	0
Namibia	78 736	3 038	3 146	3 067	87 987	3 800
Niger	94 137	3 185	3 322	3 443	104 087	3 633
Pakistan	961 *	38 *	40 *	40 *	1 079 *	40 *
Poland	650	0	0	0	650	0
Portugal	3 717	0	0	0	3 717	0
Romania	17 989	90	90 *	90 *	18 259 *	90 *
Russian Federation	123 036	3 290	3 285	3 190	132 801	3 381
South Africa	153 253	747	673	534	155 207	750
Spain	5 028	0	0	0	5 028	0
Sweden	200	0	0	0	200	0
Ukraine (d)	9 900 *	855	830	808	12 393 *	900
United States	356 482	943	1 171	1 805	360 401	2 000 *
USSR (e)	123 086	0	0	0	123 086	0
Uzbekistan (d)	23 682	2 087	2 300 *	2 260 *	30 329	2 300 *
Yugoslavia	380	0	0	0	380	0
Zambia	102	0	0	0	102	0
OECD	1 280 235	22 019	22 821	19 705	1 344 780	19 809
Total	**2 112 349**	**40 188**	**41 943**	**39 603**	**2 234 083**	**43 328**

* Secretariat estimate.

(a) Includes 102 241 tU produced in the former Czechoslovakia and CSFR from 1946 through the end of 1992.

(b) Production includes 213 380 tonnes U produced in the former GDR from 1946 through the end of 1989.

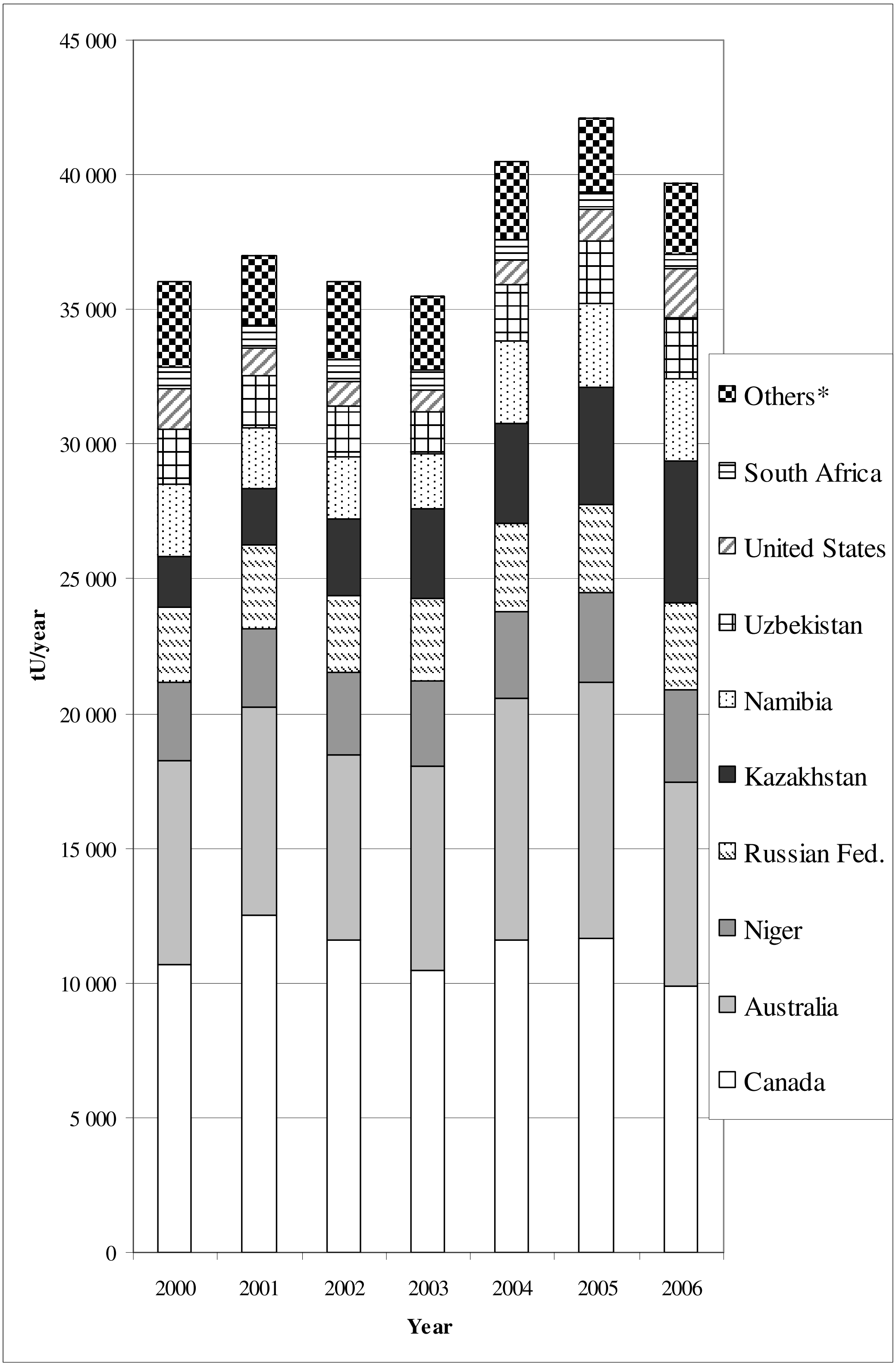
(c) Production comes from mine rehabilitation efforts only.

(d) Production since 1992 only.

(e) Includes production in former Soviet Socialist Republics of Estonia, Kyrgystan, Russian Federation, Turkmenistan, Ukraine and Uzbekistan from 1945 through the end of 1991.

Note: In some cases, alternate historical production figures are provided in the Red Book Retrospective [3].

Figure 6. **Recent world uranium production**



* "Others" includes the remaining producers (Table 19).
Values for China, France, India, Iran, Pakistan, Romania and Uzbekistan are estimates.

Present status of uranium production

North America production, about 30% of the world total in 2006, decreased slightly from 2004 (12 540 tU) to 2006 (11 667 tU). **Canada** remained the world's leading producer, despite the fact that current uranium production remains below full capacity. In 2006, production amounted to 9 862 tU, 15% below 2005 production due to the lower grade ore being milled at McClean Lake and lower than expected ore grades processed at Rabbit Lake. In 2007, production is expected to remain steady at approximately 9 850 tU. A proposal to increase production at McArthur River and Key Lake by some 18% annually (from 7 200 tU/year to 8 500 tU/year) remains under regulatory review. Construction of the Cigar Lake mine was expected to be completed in 2007 but owing to a rock fall that resulted in the mine being completely flooded, production is now not expected until 2011. Production in the **United States** increased to 1 805 tU in 2006, (54% above 2005 production) and is expected to increase to 2 000 tU in 2007. Three ISL operations, in Nebraska, Texas and Wyoming, and underground operations in the Colorado Plateau contributed to the increased production.

Brazil was the only producing country in **South America** in 2005 and 2006. Production decreased from 159 tU in 2004 to 110 tU in 2005, then rose to 200 tU in 2006, as regulatory requirements led to temporary interruptions in the operation of the Lagoa Real production centre. Expansion of this facility to a nominal capacity to 670 tU/year remains on course, however. In **Argentina**, the Sierra Pintada mine of the San Rafael complex, placed on standby in 1999, is expected to restart production in the near future.

Output from **Western Europe and Scandinavia** remained very low in 2006, representing less than 1% of total world production. In **Germany**, 65 tU were recovered from mine rehabilitation activities in 2006 and it is expected that about 45 tU will be recovered in 2007.

Production in **Central**, **Eastern** and **South-eastern Europe** decreased slightly from 4 794 tU in 2004 to 4 375 tU in 2006, or about 11% of world production. In 2007, production is expected to increase slightly to 4 583 tU. Production in the **Czech Republic** amounted to 375 tU in 2006 and it is expected to be reduced slightly to 309 tU in 2007. Production at the Rozna mine was to be terminated in 2008, but in light of higher uranium prices it has since been decided to continue mining as long as it remains profitable. **Hungary** effectively ceased mine production in 1997 and today only small amounts are produced through mine remediation efforts. Production in the **Russian Federation** decreased from 3 290 tU in 2004 to 3 190 tU in 2006. Although the majority came from the Priargunsky mine, 289 tU were produced in 2006 at the Dalur ISL facility (the Dalmatovskoe deposit) in the Transural district. Production is expected to rise slightly to 3 381 tU in 2007. Production in **Ukraine** decreased from 855 tU in 2004 to 808 tU in 2006. Production from the underground mines of Michurinskoye and Vatutinskoye is expected to amount to 890 tU in 2007.

Three countries in **Africa**, Namibia, Niger and South Africa, contributed about 18% to world production in 2006. Overall, production in Africa decreased from 7 167 tU in 2004 to 7 044 tU in 2006. Production in **Namibia** increased slightly from 3 038 tU in 2004 to 3 067 tU in 2006 and is expected to increase further in 2007 as open-pit mining of the Langer Heinrich deposit was initiated at the end of 2006. **Niger**'s output also increased from 3 185 tU in 2004 to 3 443 tU in 2006 and is expected to increase further to 3 633 tU in 2007. In contrast, production in **South Africa** decreased from 747 tU in 2004 to 534 tU in 2006, but is expected to increase to 750 tU in 2007. The decrease in the South African production was due to operational difficulties at the Vaal River operations, which resulted in lower volumes of ore and in turn lower production at the Nufcor plant. Due to commercial considerations, maintenance at this plant had been neglected in previous years, which led to further difficulties that eventually curtailed production. Uranium production in South Africa is primarily determined by the gold content of the ore, since uranium is produced as a by-product or co-product of gold mining.

Production in the **Middle East, Central** and **Southern Asia** increased steadily between 2004 and 2006, totalling 7 811 tU (about 20% of the world total) in 2006, compared to 6 074 tU in 2004. This increase is largely driven by developments in **Kazakhstan**, where production rose from 3 719 tU in 2004 to 5 281 tU in 2006 (a 42% increase). In 2007, production is expected to increase by 37% to 7 245 tU. Production in **Uzbekistan,** estimated to have reached 2 260 tU in 2006, is expected to increase to 2 300 tU in 2007. Iran reported the start of production by open-pit mining of the Gachin deposit and processing at the Bandar Abbas uranium production plant. Production is estimated to have amounted to 5 tU in 2006, but could increase to 20 tU in 2007. **India** and **Pakistan** do not report production data but output is estimated to have remained steady from 2004 to 2006 at 230 tU and 40 tU, respectively.

China, the only producing country in **East Asia**, does not report official production figures. Annual production is estimated to have been 750 tU from 2004 through 2006. Production is expected to increase in 2007 however, since the Qinlong underground mine was recently opened and the Yining ISL mine has been expanded. These developments are expected to add 200 tU/year nominal capacity, when full scale production is achieved.

Australia, the only producing country in the **Pacific** region, reported a significant decrease from 8 982 tU in 2004 to 7 593 tU in 2006 (a 20% decline from 2005 production of 9 512 tU). Production decreases at all three mines were recorded in 2006, at Olympic Dam due to processing difficulties, at Ranger due to higher than average rainfall restricting access to high grade ore and at the Beverley ISL facility due to operational difficulties. Production in Australia is expected to remain at about 7 600 tU in 2007.

Ownership

Table 20 shows the ownership of uranium production in 2006 in the 20 producing countries. Domestic mining companies controlled about 71.3% of 2006 production, compared to about 69.3% in 2004. Non-domestic mining companies controlled about 28.7% of 2006 production with approximately 10.2% controlled by government-owned companies and 18.5% by privately-owned companies.

Table 20. **Ownership of uranium production based on 2006 output**

COUNTRY	Domestic mining companies				Non-domestic mining companies				TOTAL
	Government-owned		Privately-owned		Government-owned		Privately-owned		
	tU	%	tU	%	tU	%	tU	%	
Australia	0	0.0	1 983	26.1	0	0.0	5 610	73.9	7 593
Brazil	200	100.0	0	0.0	0	0.0	0	0.0	200
Canada	0	0.0	7 193	72.9	2 617	26.5	52	0.5	9 862
China*	750	100.0	0	0.0	0	0.0	0	0.0	750
Czech Republic	375	100.0	0	0.0	0	0.0	0	0.0	375
France*	2	87.7	1	12.3	0	0.0	0	0.0	3
Germany	65	100.0	0	0.0	0	0.0	0	0.0	65
Hungary	2	100.0	0	0.0	0	0.0	0	0.0	2
India*	230	100.0	0	0.0	0	0.0	0	0.0	230
Iran, Islamic Rep of*	5	100.0	0	0.0	0	0.0	0	0.0	5
Kazakhstan	3 759	71.2	712	13.5	0	0.0	810	15.3	5 281
Namibia*	107	3.5	2 960	96.5	0	0.0	0	0.0	3 067
Niger	1 157	33.6	0	0.0	1 440	41.8	846	24.6	3 443
Pakistan*	40	100.0	0	0.0	0	0.0	0	0.0	40
Romania*	90	100.0	0	0.0	0	0.0	0	0.0	90
Russian Federation	3 190	100.0	0	0.0	0	0.0	0	0.0	3 190
South Africa	0	0.0	534	100.0	0	0.0	0	0.0	534
Ukraine *	808	100.0	0	0.0	0	0.0	0	0.0	808
United States*	0	0.0	1 805	100.0	0	0.0	0	0.0	1 805
Uzbekistan*	2 260	100.0	0	0.0	0	0.0	0	0.0	2 260
Total	**13 040**	**32.9**	**15 188**	**38.4**	**4 057**	**10.2**	**7 318**	**18.5**	**39 603**

* Secretariat estimate.

Employment

Although the data are incomplete, Table 21 shows that employment levels at existing uranium production centres increased slightly from 2004 to 2006, and are expected to continue to do so in 2007, mainly due to the development of new projects in Kazakhstan. Table 22 provides, in selected countries, employment directly related to uranium production (excluding head office, R&D, pre-development activities, etc).

Table 21. **Employment in existing production centres of countries listed**
(in person-years)

COUNTRY	2000	2001	2002	2003	2004	2005	2006	2007 (expected)
Argentina	70	62	60	60	60	60	60	80
Australia (a)	527	550	502	655	743	889	959	1 054
Brazil (b)	48	128	128	140	140	140	140	140
Canada (c)	1 026	973	972	965	985	1 067	1 152	1 300
China	8 500	8 200	8 000	7 700	7 500	7 000	7 300	7 400
Czech Republic	2 887	2 641	2 507	2 426	2 409	2 312	2 251	2 263
Germany (d)	3 115	3 004	2 691	2 444	2 230	2 101	1 835	1 757
India	4 000	4 200	4 200	4 200	4 200	4 200	4 300	4 300
Iran, Islamic Rep of	0	0	0	0	0	0	200	200 *
Kazakhstan	4 100	4 000	3 770	3 870	5 120	6 522	6 941	7 845
Namibia	902	785	782	NA	NA	NA	NA	NA
Niger	1 680	1 607	1 558	1 606	1 598	1 657	1 741	1 930
Portugal	47	30	11	0	0	0	0	0
Romania	2 150	2 000 *	2 000 *	2 000 *	2 000 *	2 000 *	2 000 *	2 000 *
Russian Federation	12 500	12 325	12 800	12 785	12 670	12 551	12 575	12 751
Slovenia (d)	79	69	48	45	40	28	20	12
South Africa	160	150	150	150	150	150	150	150
Spain	134	58	56 (d)	56 (d)	56 (d)	56 (d)	58 (d)	58 (d)
Ukraine	NA	NA	NA	NA	4 380	4 350	4 310	4 310 *
United States	401	245	277	204	299	524	600	600 *
Uzbekistan	7 331	7 300	8 370	8 460	8 560	8 620 *	8 700 *	8 700 *
Total	**49 657**	**48 327**	**48 882**	**47 766**	**53 140**	**54 227**	**55 292**	**56 850**

NA Not available. * Secretariat estimate.

(a) Olympic Dam does not differentiate between copper, uranium, silver and gold production. Employment has been estimated for uranium-related activities.

(b) Employment directly related to uranium production.

(c) Employment at mine sites only.

(d) Employment related to decommissioning and rehabilitation.

Table 22. **Employment directly related to uranium production and productivity**

COUNTRY	2004		2005		2006	
	Production employment (person-years)	Production (tU)	Production employment (person-years)	Production (tU)	Production employment (person-years)	Production (tU)
Australia	743	8 982	889	9 512	959	7 593
Brazil	140	159	140	110	140	200
Canada	985	11 597	1 067	11 628	1 152	9 862
China	6 750	730*	6 300	750*	6 700	750*
Kazakhstan	3 732	3 719	4 873	4 346	4 460	5 281
Namibia	NA	3 038*	NA	3 146*	NA	3 067*
Niger	1 388	3 185	1 591	3 322	1 678	3 443
Russian Fed.	4 746	3 290	4 778	3 285	4 804	3 190
South Africa	60	747	60	673	65	534
Ukraine	1 790	855	1 760	830	1 720	808
United States	173	943	445	1 171	878	1 805
Uzbekistan	7 050	2 087	7 130*	2 300*	7 200*	2 260*

NA Data not available.
* Secretariat estimate.

Production methods

Uranium is mainly produced using open-pit and underground mining techniques processed by conventional uranium milling. Other mining methods include *in situ* leaching (ISL); co-product or by-product recovery from copper, gold and phosphate operations; heap leaching and in-place leaching (also called stope or block leaching). Stope/block leaching involves the extraction of uranium from broken ore without removing it from an underground mine, whereas heap leaching involves the use of a leaching facility on the surface once the ore has been mined. Small amounts of uranium are also recovered from mine water treatment and environmental restoration activities.

Historically, uranium production has principally involved open-pit and underground mining. However, over the past two decades, ISL mining, which uses either acid or alkaline solutions to extract the uranium directly from the deposit, has become increasingly important. The uranium dissolving solutions are injected into, and recovered from, the ore-bearing zone using a system of wells. ISL technology is currently being used to extract uranium from sandstone deposits only and in recent years has become an increasingly important method of uranium production. In 2006, production by ISL exceeded production by open-pit mining and in 2007 this trend is expected to continue.

The distribution of production by type of mining or "material sources" for 2003 through 2007 is shown in Table 23. The category "Other methods" includes recovery of uranium through treatment of mine waters as part of reclamation and decommissioning.

As shown in Table 23, open-pit and underground mining with conventional milling continue to be the dominant uranium production technologies, accounting for 67.5% of total production in 2005 and 64.1% in 2006. The increase in ISL since 2002 resulted from increased production in Australia, China, Kazakhstan (increasing by 35% from 2004 to 2006), the Russian Federation, the United States and Uzbekistan. The contribution from co-product/by-product recovery, which declined from 11% in 2004 to 8.6% in 2006, mainly resulted from reduced production at the Olympic Dam mine in Australia.

In 2007, open-pit and underground mining are expected to continue to account for a majority of the world's uranium production (61.4% of total production), although both open-pit and underground shares are expected to decrease slightly. Production using ISL technology is expected to increase its relative share due to increasing production expected in Kazakhstan (a 37% increase from 2006 to 2007). In the near future, ISL could increase in significance further if planned projects in Kazakhstan, the Russian Federation, the United States and Uzbekistan are brought into production. On the other hand, implementation of a major increase in capacity at Olympic Dam, currently the subject of a feasibility study, would ensure a continued important role for the co-product/by-product category.

Table 23. **Percentage distribution of world production by production method**

Production method	**2003**	**2004**	**2005**	**2006**	**2007** (expected)
Open-pit	29.8	27.5	28.1	24.2	23.7
Underground	41.6	39.1	39.4	39.9	37.7
In situ leaching	18.4	20.0	20.0	24.9	27.7
In place leaching*	<0.1	<0.1	<0.1	<0.1	<0.1
Co-product/by-product	9.7	11.0	10.3	8.6	8.4
Heap leaching**	1.9	2.2	1.9	2.2	2.4
Other methods***	0.5	0.2	0.3	0.2	0.1

* Also known as stope leaching or block leaching.

** A subset of open-pit mining, since it is used in conjunction with open-pit mining.

*** Includes mine water treatment and environmental restoration.

Projected production capabilities

To assist in developing projections of future uranium availability, member countries were asked to provide projections of ***production capability*** through 2030. Table 24 shows the projections for ***existing and committed production centres*** (A-II columns) and for existing, committed, ***planned and prospective production centres*** (B-II columns) in the <USD 80/kgU category through 2030 for all countries that either are currently producing uranium or have the potential to do so in the future. Note that both the A-II and B-II scenarios are supported by local RAR and Inferred Resources in the <USD 80/kgU category.

Several current or potential uranium producing countries, including China, India, Malawi, Mongolia, Namibia, Pakistan, Romania, United States and Uzbekistan, did not report projected production capabilities. Projections of future production capability for Pakistan and Romania in Table 24 are based on reports that these countries intend to meet their future domestic reactor requirements with domestic production.

The reported production capability of existing and committed production centres in 2007 is about 54 370 tU. Expected 2007 production of 43 328 tU thus represents 80% of the stated production capability. For comparison, 2005 uranium production was 41 943 tU, about 84% of the 2005 production capability. Total production capability for 2007, including planned and prospective centres, is about 56 855 tU, 5 290 tU more than the 2005 total capability of 51 565 tU, with significant increases in Kazakhstan (2 800 tU), Namibia (1 000 tU) and South Africa (730 tU). Clearly, an expansion in production capability driven by recent uranium price increases is underway.

According to the information compiled for this volume, the uranium production industry is projected to undergo a significant expansion during the next five to ten years as existing production centres are expanded (Australia, Canada, Kazakhstan, Niger and the Russian Federation) and new production centres are brought online (Canada, Jordan, Kazakhstan, Malawi, Namibia, Niger, the Russian Federation, South Africa, the Ukraine, and United States). Later, closure of existing mines due to resource depletion is expected to be offset by the opening of new mines and plants. As currently projected, production capability of existing and committed production centres would reach over 95 630 tU/year in 2015. Total potential production capability (including planned and prospective production centres) is currently projected to rapidly climb to over 117 000 tU/year in 2015.

Changes in production facilities

Production capability at existing and committed production centres has increased only slightly between 2001 (45 310 tU), when uranium prices began to increase, 2003 (47 170 tU) and 2005 (49 720 tU). Driven by recent uranium spot price increases, production capability at existing and committed production centres is projected to increase to 54 370 tU in 2007. Significant new production capability is planned for the near-term both through the expansion of existing production centres and the opening of new mines. Some of the significant changes that are expected in the next few years include:

Planned mine re-openings or expansion of existing facilities

2007	China (Expansion of Fuzhou to 200 tU).
2007	India (Production at Banduhurang mine in sandstone).
	India (Production centre at Bagjata mine in vein).
2008	Australia (Ranger: Construction of a laterite treatment plant to produce 340 tU/year, over seven years).
2009	Niger (Expansion of Somair plant production capability, and construction of a heap leaching unit – 700 tU/year).
2010	Canada (McArthur River and Key Lake expansion to produce 8 800 tU/year).
2010	Kazakhstan (Southern Zarechnoye, 1 000 tU/year).
	Brazil (Caetité expansion to 340 tU/year)
2013	Australia (Proposed Olympic Dam expansion, to produce 12 720 tU/year).

Table 24. **World uranium production capability to 2030**

(in tonnes U/year, from RAR and Inferred Resources recoverable at costs up to USD 80/kgU, except as noted)

COUNTRY	2007		2010		2015		2020		2025		2030	
	A-II	B-II	A-II	B-II	A-II	B-II	A-II	B-II	A-II	B-II	A-II	B-II
Argentina	120	120	500	500	500	500	500 *	500 *	500 *	500 *	500	500 *
Australia	9 400	9 400	10 200	10 200	10 200	19 000	10 200	22 400	5 500	17 700	5 500	17 700
Brazil	340	340	420	420	1 100	1 100	1 100 *	1 100 *	1 100	1 100	1 100 *	1 100 *
Canada	14 990	14 990	17 730	19 270	17 730	19 270	17 730	19 270	17 730	19 270	17 730	19 270
China*	940	1 040	940	1 040	1 200	1 200	1 200	1 200	1 200	1 200	1 200	1 200
Czech Republic	500	500	200	200	50	50	50	50	40	40	30	30
India*	295	980	980	980	980	1 200	1 000	1 600	1 000	2 000	1 000	2 000
Iran, Islamic Rep. of	20	20	70	70	100 *	100 *	100 *	100 *	100 *	100 *	100 *	100 *
Jordan	0	0	2 000	2 000	2 000	2 000	2 000 *	2 000 *	2 000 *	2 000 *	2 000 *	2 000 *
Kazakhstan	7 000	7 000	18 000	18 000	21 000	22 000	20 000	23 000	20 000 *	23 000 *	20 000 *	23 000 *
Malawi*	0	0	1 270	1 270	1 270	1 270	0	0	0	0	0	0
Mongolia*	0	0	150	500	150	500	150	500	150	500	150	500
Namibia*	5 000	5 000	6 000	7 000	8 000	9 000	6 000	8 000	5 000	7 000	5 000	7 000
Niger	4 000	4 000	4 500	4 500	10 000 *	10 000 *	5 700 *	5 700 *	5 700 *	5 700 *	5 000 *	5 000 *
Pakistan (a)	65	65	65	110	90	110	235	380	360	530	360 *	530 *
Romania (a)	100	100	200	200	200	200	300	300	300	300	300	300
Russian Federation	3 400	3 400	4 700	5 000	7 400	12 000	8 000	18 000	8 000	18 000	8 000	18 500
South Africa (b)	2 000 *	2 000 *	4 860	4 860	4 860	6 320	4 860	6 320	4 860	6 320	4 860	6 320
Ukraine	1 000	1 000 *	1 500 *	1 500	2 000 *	2 000	2 700 *	2 700	3 700 *	3 700	3 700 *	3 700
United States (c)	2 900	4 600	3 400	6 100	3 800	6 600	3 700	6 500	3 100	5 600	3 100 *	5 600 *
Uzbekistan (c)	2 300	2 300	3 000	3 000	3 000	3 000	3 000	3 000	3 500	3 500	3 500 *	3 500 *
TOTAL	54 370	56 855	80 685	86 720	95 630	117 420	88 525	122 620	83 840	118 060	83 130	117 850

A-II Production Capability of Existing and Committed Centres supported by RAR and Inferred Resources recoverable at <USD 80/kgU.

B-II Production Capability of Existing, Committed, Planned and Prospective Centres supported by RAR and Inferred Resources recoverable at <USD 80/kgU.

* Secretariat estimate.

NA Data not available or not reported.

(a) Projections are based on reported plans to meet domestic requirements.

(b) From resources recoverable at costs of <USD 40/kgU.

(c) Data from previous Red Book.

Recent mine openings

2005		
	Kazakhstan	(Kendala JSC- Central Mynkuduk, 2 000 tU/year in 2010)
2006		
	Iran	(Bandar Abbas, 21 tU/year)
	Namibia	(Langer Heinrich, 1 000 tU/year)

New mines planned (date indicates estimated start of production)

2007		
	China	(Qinlong, 100 tU/year)
	Kazakhstan	(Appak LLP-West Mynkuduk, 1 000 tU/year in 2010)
	Kazakhstan	(Karatau LLP- Budenovskoye, 1 000 tU/year in 2009)
	South Africa	(Uranium One – Dominium & Rietkuil, 1 460 tU/year in 2010)
2008		
	Australia	(Honeymoon, 340 tU/year)
	Kazakhstan	(Semizbai-U LLP – Semizbai, 500 tU/year)
	Kazakhstan	(Kyzylkum LLP – Kharasan-1, 3 000 tU/year in 2010)
	Kazakhstan	(Southern Inkai, 1 000 tU/year)
	Kazakhstan	(Irkol, 750 tU/year)
	Kazakhstan	(Baiken-U LLP– Kharasan, 2 000 tU/year in 2014)
	Kazakhstan	(Akbastau JV JSC – Budenovskoye, 3 000 tU/year)
	Namibia	(Trekkopje, 1 600 tU/year)
	Russia	(Khiagda, 1 000 tU/year, 2 000 tU in 2015)
2009		
	Iran	(Saghand, 50 tU/year)
	Malawi	(Kayelekera, 1 270 tU/year)
	Namibia	(Valencia, 1 000 tU/year)
2010		
	Canada	(Midwest, 2 300 tU/year)
	India	(Tummalapalle, 220 tU/year)
	Russia	(Gornoe, 600 tU/year)
2011		
	Brazil	(Itataia, 680 tU/year)
	Canada	(Cigar Lake, 6 900 tU/year)
	India	(Mohuldih, 30 tU/year)
	Niger	(Imouraren, 5 000 tU/year)
	Niger	(Azelik, 700 tU/year)
	Russia	(Olov, 600 tU/year)
2012		
	India	(Lambapur-Peddagattu, 130 tU/year)
	India	(Killeng-Pyndengsohiong, 340 tU/year)
	Russia	(Elkon, 5 000 tU/year)
2015		
	Ukraine	(Severinskoye, 1 200 tU/year)
2010-2030		
	Kazakhstan	(Central Moinkum, 1 000 tU/year)
	Kazakhstan	(Zhalpak, 1 000 tU/year)

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II. URANIUM DEMAND

This chapter summarises the current status and projected growth in world nuclear electricity generating capacity and commercial ***reactor-related uranium requirements***. Relationships between uranium supply and demand are analysed and important developments related to the world uranium market are described. The data for 2007 and beyond are estimates and actual figures could differ.

A. CURRENT COMMERCIAL NUCLEAR GENERATING CAPACITY AND REACTOR-RELATED URANIUM REQUIREMENTS

World (370.23 GWe net as of 1 January 2007)

On 1 January 2007, a total of 435 commercial nuclear reactors were operating in 30 countries and 27 reactors were under construction (about 21.4 GWe net).[4] During 2005 and 2006, seven reactors were connected to the grid (about 5.3 GWe net) and ten reactors were permanently shut down (about 3.2 GWe net). Seven of these shutdowns occurred on 31 December 2006. Table 25 and Figures 7 and 8 summarise the status of the world's nuclear power plants as of 1 January 2007. The global nuclear power plant fleet generated about 2 630 TWh of electricity in 2005 and about 2 675 TWh in 2006 (Table 26).

World annual uranium requirements amounted to 66 500 tU in 2006 and are estimated to increase to about 69 110 tU in 2007.

OECD (308.60 GWe net as of 1 January 2007)

As of 1 January 2007, the 343 reactors in operation in 17 OECD countries constituted about 83% of the world's nuclear electricity generating capacity. A total of three reactors were under construction with a net capacity of about 4.5 GWe. During 2005 and 2006, four reactors were connected to the grid (about 3.3 GWe net) and eight reactors were shut down (about 2.4 GWe net).

Within the OECD there are significant differences in nuclear energy policy. Japan and South Korea remain committed to continued growth in nuclear energy, whereas several member countries in Western Europe have made commitments to phase out nuclear energy, notably Belgium, Germany, Spain and Sweden, although some are reconsidering such commitments. At the same time, other countries in Western Europe, such as Finland and France, remain committed to the use of nuclear energy. In North America there are indications that construction of new capacity in Canada and the United States will take place, in the case of the United States stimulated by incentives provided in the 2005 *Energy Policy Act*.

The OECD reactor-related uranium requirements were 56 625 tU for 2006 and are expected to increase to 57 690 tU in 2007.

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[4] Figures include the reactors operating and under construction in Chinese Taipei.

Table 25. **Nuclear data summary**
(as of 1 January 2007)

COUNTRY	**Operating reactors**	**Generating capacity** (GWe net)	**2006 Uranium requirements** (tU)	**Reactors under construction**	**Reactors started up during 2005 and 2006**	**Reactors shut down during 2005 and 2006**	**Reactors using MOX**
Argentina	2	0.94	120	1	0	0	0
Armenia	1	0.38	90	0	0	0	0
Belgium	7	5.83	880	0	0	0	1
Brazil	2	1.80	450	0	0	0	0
Bulgaria	2	1.91	505	2	0	2	0
Canada	18	12.50	1 800	0	0 (a)	0	0
China (b)	10	7.57	1 200	3	1	0	0
Czech Republic	6	3.49	665	0	0	0	0
Finland	4	2.68	465	1 (c)	0	0	0
France	59	63.26	7 185 +(d)	0	0	0	20
Germany	17	20.34	3 710 (d)	0	0	1	7
Hungary	4	1.78	380	0	0	0	0
India	16	3.78	445	6	2	0	1
Iran, Islamic Rep. of	0	0.00	0	1	0	0	0
Japan	55	47.10 +	7 940 (d)	1	3	0	1
Korea, Republic of	20	17.45	3 200 +	1	1	0	0
Lithuania	1	1.19	60	0	0	0	0
Mexico	2	1.37	200 +	0	0	0	0
Netherlands	1	0.48	65	0	0	0	0
Pakistan	2	0.43	65 *	1	0	0	0
Romania	1	0.65	100 *	1	0	0	0
Russian Federation	31	21.74	4 000	5	0	0	NA
Slovak Republic	5	2.03	490	0	0	1	0
Slovenia	1	0.70	250	0	0	0	0
South Africa	2	1.84	280	0	0	0	0
Spain	8	7.45	1 725	0	0	1	0
Sweden	10	9.03	1 600	0	0	1	0
Switzerland	5	3.22	265	0	0	0	3
Ukraine	15	13.80	2 480	2	0	0	0
United Kingdom	19	10.50	2 165	0	0	4	0
United States	103	100.10	22 890	0	0	0	0
OECD	343	308.60	56 625	3	4	8	32
TOTAL	**435**	**370.23**	**66 500**	**27**	**7**	**10**	**33**

Sources: IAEA Power Reactor Information System (www.iaea.org/programmes/a2/) except for *Generating capacity* and *2006 Uranium requirements*, which use Government-supplied responses to a questionnaire, unless otherwise noted and rounded to the nearest five tonnes. MOX not included in U requirement figures.

NA Data not available.

* Secretariat estimate.

\+ Data from NEA *Nuclear Energy Data*, OECD, Paris, 2007.

(a) During 2005, one reactor at the Pickering site, shut down in 1997 for safety concerns, was restarted.

(b) The following data for Chinese Taipei are included in the world total but not in the total for China: six nuclear power plants in operation, 4.9 GWe net; 830 tU; two reactors under construction; none started up or shut down during 2005 and 2006.

(c) Construction of Okiluoto-3 (1.6 GWe net EPR) officially began in December 2005.

(d) Excluding MOX fuel.

Figure 7. **World installed nuclear capacity: 370.23 GWe net**
(as of 1 January 2007)

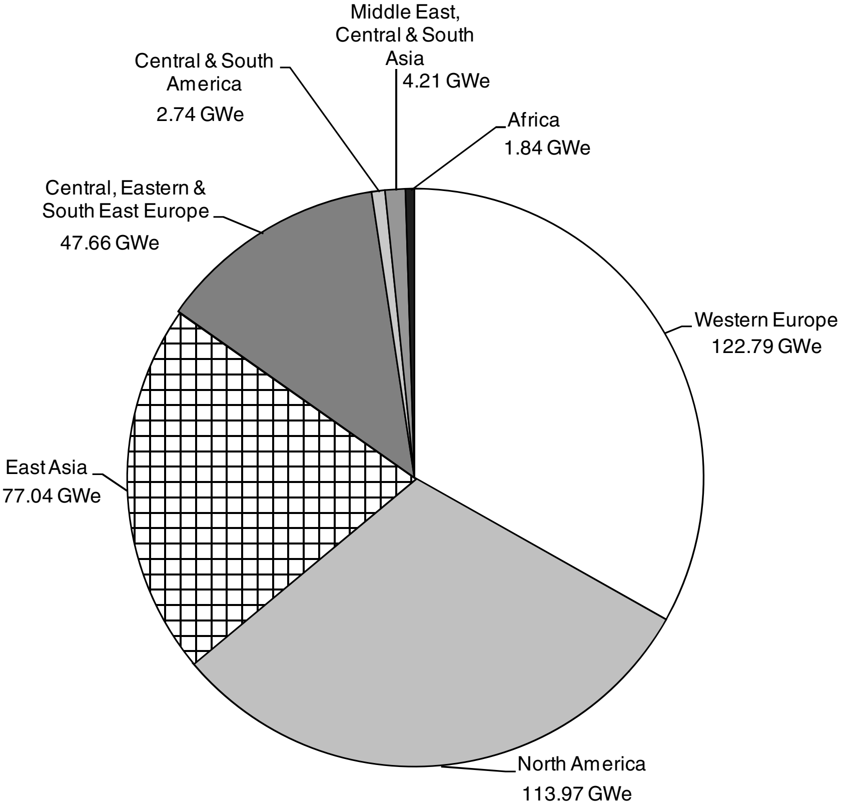

Figure 8. **2006 world uranium requirements: 66 500 tU**

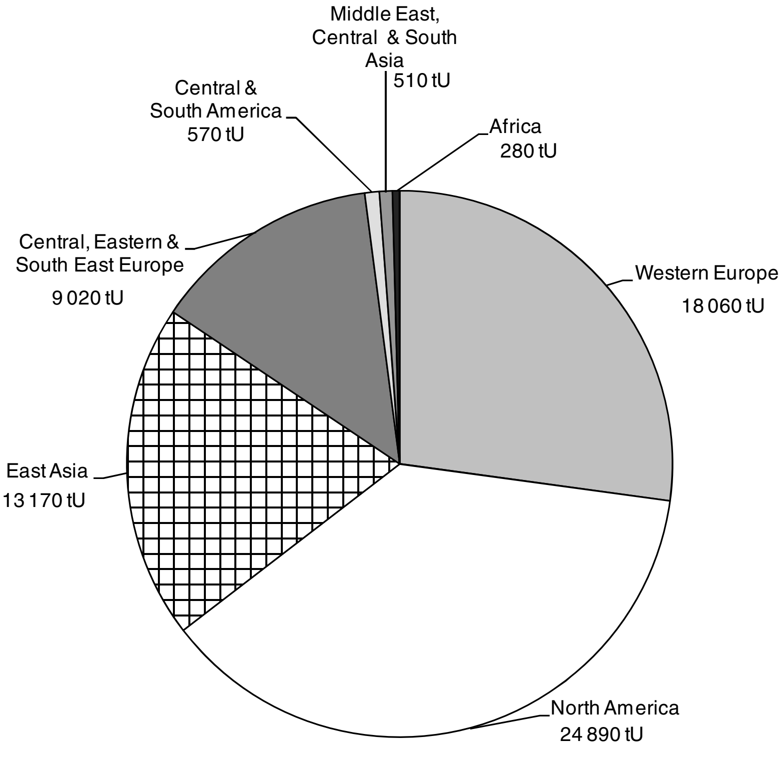

Table 26. **Electricity generated using nuclear power plants**

(TWh net)

COUNTRY	**2003**	**2004**	**2005**	**2006**
Argentina	8.40	8.50	6.40 *	7.15 *
Armenia	1.82	2.21	2.50 *	2.42 *
Belgium	44.90	44.90 (b)	45.30	44.31
Brazil	13.34	11.55	9.85	13.77
Bulgaria	16.09 *	15.60 *	17.30 (d)	18.13 (d)
Canada	70.70	84.20	86.70	94.00
China (c)	41.50	47.50	50.30	51.80
Czech Republic	24.40 (a)	24.80 (a)	23.30	24.50
Finland	21.70	21.70	22.40	22.30
France	419.80	426.80 (a)	430.00 (a)	428.70 (b)
Germany	156.20	155.70	154.60	158.70
Hungary	11.00 +	11.90 +	13.00	12.66
India	16.64	15.04	15.70 (d)	15.59 (d)
Japan	230.00	282.00	280.70 (d)	291.50 (d)
Korea (d)	123.50 (a)	123.97 (a)	139.50 (a) +	141.18 (a) +
Lithuania	15.50	15.10	9.50	8.70
Mexico	10.00 +	8.70 +	10.80 +	10.90 (a) +
Netherlands	3.60 +	3.60 +	3.30	3.60
Pakistan	1.81 *	1.93 *	2.40 *	2.55 *
Romania	5.10 *	5.10 *	5.10 *	5.18 *
Russian Federation	138.40	143.00	149.40	156.40
Slovak Republic	16.40	15.70	16.30	16.60
Slovenia	4.96	5.21	5.61	5.29
South Africa	12.67 *	14.28 *	12.20 *	10.07 *
Spain	59.20	60.90	55.40 +	57.80 +
Sweden	65.70 +	75.00 +	69.50 (b)	65.05
Switzerland	26.00 (a)	25.30	22.64	26.63 (a)
Ukraine	81.40	87.40	75.20	84.90 *
United Kingdom	81.90	73.70	75.20 +	69.40 (d)
United States	764.00	789.00 (a)	782.00 +	787.00 +
OECD	2 129.00	2 227.87	2 230.64	2 254.83
TOTAL	**2 524.03**	**2 638.29**	**2 630.50**	**2 675.08**

* Secretariat estimate.

\+ *Nuclear Energy Data*, OECD, Paris, 2007.

(a) Generation record.

(b) Provisional data.

(c) The following data for Chinese Taipei are included in the World Total but not in the total for China: 37.4 TWh in 2003, 38.0 TWh in 2004, 38.4 TWh in 2005, 38.3 TWh in 2006.

(d) Gross capacity converted to net by Secretariat.

Western Europe (122.789 GWe net as of 1 January 2007)

As of 1 January 2007, 130 nuclear reactors were operating in Western Europe. No reactors were connected to the grid in 2005 or 2006 but one European Pressurised-water Reactor (EPR) was under construction in Finland and a second EPR was committed to construction in France. These advanced design plants are expected to commence operations in 2011 and 2012, respectively. One reactor each in Germany (about 0.3 GWe net), Sweden (about 0.6 GWe net) and Spain (about 0.1 GWe net) and four reactors in the United Kingdom (about 0.9 GWe net combined) were shut down in 2005 and 2006. Nuclear phase out policies have been implemented in Belgium, Germany, Spain and Sweden. However, in early 2007, the European Union proposed a common European energy policy that would see, among other things, a rapid increase in nuclear energy beginning in 2020 and accelerating after 2030.

In **Belgium**, the government's policy to phase out nuclear energy by limiting the operational lives of its seven reactors to 40 years and permitting no new construction continues, but the policy can be overridden if Belgian's security of supply is threatened. A report analyzing the country's current energy policy, commissioned by the Minister for Energy in 2006, will be submitted to the new government (a Christian Democrat – Liberal coalition that is expected to be formed as a result of the June 2007 election) following extensive review. The recommendations in this report, prepared by an expert group, are to be taken into consideration as the new government's energy policy is prepared.

In **Finland**, construction of the Olkiluoto 3 EPR (about 1.6 GWe net) nuclear power plant continues, but has been delayed by about a year due to issues associated with licensing validation of components and the quality of the concrete used in construction. It is now expected to be in operation in 2011. In 2007, Teollisuuden Voima Oy (TVO) began an Environmental Impact Assessment (EIA) on the possibility of building a fourth reactor at the Olkiluoto site and Fortum launched an EIA on the possibility of building a third reactor at the Loviisa site, with decisions on investment to follow. In late June 2007, a consortium of Finnish industrial and energy companies (Fennovoima) announced its intention to construct a new nuclear power plant (1.0 to 1.80 GWe) at an as yet undetermined site to begin operation in the 2016-2018 time frame.

In **France**, the industrial group AREVA announced its 100th reactor order, a 1.6 GWe net EPR destined to be built in Flamanville, Normandy. Construction was to begin in late 2007, with the unit scheduled to begin operating in 2012. One of the priorities laid out by the central government in the *Energy Planning Act* of 2005 is to keep the nuclear option open until 2020 by having an operational new reactor in service by 2015 so as to be able to replace the current generation of reactors.

In **Germany**, the April 2002 *Atomic Energy Act* (AEA) that governs the long-term phase out nuclear energy for commercial power generation has thus far resulted in the shutdown of two reactors (Stade in 2003 and Obrigheim in 2005). The AEA grants each plant operating as of 1 January 2000 a residual operating life that has been calculated based on a standard operating life of 32 calendar years from the commencement of commercial operation. This would lead to the elimination of nuclear power generation in Germany around 2023. The law also bans the reprocessing of spent fuel after 1 July 2005. In early 2007, an application by a utility to transfer capacity from a decommissioned reactor to the currently operating Biblis nuclear facility in order to extend its life from 2008 to 2011 was turned down by the Minister of Environment.

In the **Netherlands**, the planned 2005 shutdown of the Borssele nuclear power plant was changed and the plant is now expected to operate through a 20 year life extension to 2033. In December 2006 the plant's power was increased by 0.35 GWe by improvements to the blade design of the turbine. In 2006, the Dutch government set conditions required for new nuclear construction that include a decision on high level waste disposal before 2016.

In **Norway**, the state-owned energy company Stakraft announced in 2007 that it was to evaluate the possibility of building a nuclear power plant fuelled by thorium. Some of the world's largest deposits of thorium are found in Norway.

In **Spain**, the government's plan to phase out nuclear energy in an orderly and progressive way, without compromising security of electricity supply, continues. In April 2006, the Jose Cabrera nuclear power plant (about 140 MWe net) was permanently shut down after 38 years of operation as a result of this policy.

Sweden remains committed to the phase out of nuclear energy over the next 30-40 years and closure of the second plant under this policy, the Barseback-2 reactor (about 0.6 GWe net), took place in May 2005. However, power uprates to the remaining reactors in the Swedish fleet are expected to make up for the 1.2 GWe in net capacity lost with the shutdown of Barseback-1 and -2.

In **Switzerland**, two popular initiatives, "Moratorium Plus" and "Electricity Without Nuclear" – the first to extend the moratorium on the licensing of new nuclear power plants that lapsed in 2000 and the second to phase out nuclear altogether – were rejected in a national vote in 2003 by majorities of 58.4% and 66.3%, respectively. After two years of parliamentary debate, a new *Nuclear Energy Law* (NEL) was adopted in March 2003 and entered into force in February 2005. The NEL keeps the nuclear energy option open, addresses key issues related to radioactive waste management (including a ten-year moratorium on reprocessing spent fuel as of 1 July 2006) and empowers the Federal Government (Federal Council) to authorise the construction, operation and decommissioning of NPPs.

In the **United Kingdom**, the four oldest reactors (Sizewell A 1&2 and Dungeness A 1&2) were permanently shut down on 31 December 2006 after 40 and 41 years of operation, respectively. A review of energy policy earlier in 2006 signalled the government's desire to replace the country's nuclear power stations, principally due to energy security concerns and commitments to reduce carbon emissions. Any new nuclear power plants are to be financed and built entirely by the private sector (with internalised waste and decommissioning costs). In May 2007, the government published a white paper outlining how approval of major new infrastructure projects, like nuclear plants, would be streamlined. Westinghouse, EDF, General Electric and Atomic Energy Canada Limited (AECL) indicated shortly thereafter their intention to submit designs for Generic Design Acceptance (pre-licensing). Later in 2007, the government launched a round of public consultation on the nuclear option.

The reactor-related uranium requirements for Western Europe in 2006 were about 18 060 tU and are expected to increase to 19 180 tU in 2007.

North America (113.965 GWe net as of 1 January 2007)

At the beginning of 2007, there were 103 reactors operating in the United States, 18 in Canada and two in Mexico. No new reactors were under construction or shut down in 2005 and 2006, though one reactor in long-term shutdown was restarted in Canada and one reactor in long-term shutdown in the United States (Brown's Ferry-1) was in the process of being returned to service.

In **Canada**, the Government of Ontario confirmed in 2006 that nuclear power will be an important part of its plan to address looming energy shortages and both Ontario Power Generation and Bruce Power applied for licenses to prepare sites for the construction of as many as eight new reactors. A feasibility study on the refurbishment of the Pickering B nuclear power station was initiated and refurbishment of the Darlington nuclear power plant is under consideration. In January 2007, the regulatory authority accepted Bruce Power's application for new build and an environmental assessment process was initiated. A programme to restart Bruce A Units 1 and 2 and refurbish Units 3 and 4 was initiated in 2005, with the first unit expected to be restarted in 2009. In Alberta, Energy Alberta Corporation proposed building two Advanced CANDU (ACR) reactors to produce the electricity required for extraction of oil from the tar sands and AECL is conducting a USD 2.4 million feasibility study of building a second reactor in the province of New Brunswick, in this case a 1.2 GWe ACR Reactor. In July 2005, New Brunswick Power contracted AECL for the USD 1.4 billion refurbishment of the Point Lepreau reactor.

In **Mexico**, a feasibility study of building additional nuclear power plants at Laguna Verde and other sites on the coast of the Gulf of Mexico has been completed and a decision by the government of Mexico is pending. In 2007, a USD 600 million refurbishment programme of the two units at Laguna Verde was initiated. The refurbishment, expected to be completed in 2010, is designed to increase the power of the two units by about 20%.

In the **United States**, momentum continues to build toward the construction of new nuclear power plants stimulated, in part, by the enactment of the *Energy Policy Act* of 2005 that offers several incentives for new power plant construction. In September 2007, NRG Energy submitted an application for a full combined construction and operation licence to regulatory authorities, the first utility in the United States in over 30 years to do so. Extensions to the operating lives and uprates of existing power plants continue to increase installed capacity and projected uranium requirements. United States regulatory authorities granted approvals of license extensions and power uprates through May 2007 that cover a total of 113 reactors, comprising about 4.9 GWe of capacity. Ten applications (1.02 GWe) are pending. Additional capacity was added in May 2007 when the Browns Ferry-1 plant (shut down since 1985) was returned to service after a USD 1.8 billion restart programme. In August 2007, the plant's owner, the Tennessee Valley Authority, announced that it would embark on a five year, USD 2.49 billion construction project to complete construction of the second unit at the Watts Bar nuclear plant (1.18 GWe). This plant was about 60% complete when construction was halted in 1988.

Annual uranium requirements for North America were about 24 890 tU in 2006 and are expected to increase to 24 925 tU in 2007.

East Asia (77.041 GWe net as of 1 January 2007)

As of 1 January 2007, 85 reactors[5] were in operation in East Asia. In this region, which is undergoing the strongest growth in nuclear capacity in the world, five power plants were connected to the grid (about 4.3 GWe net) during 2005 and 2006 while none were shut down. Six reactors were under construction that will add about 5.5 GWe net to the grid.

In **China**, there were ten reactors in operation (about 7.57 GWe net) and three under construction (about 3.2 GWe net) as of 1 January 2007. Construction of the Lingao 3 reactor (about 1.0 GWe net) was initiated in 2005 and construction of the Qinshan II-3 (about 0.61 GWe net) and Lingao 4 (about 1.0 GWe net) reactors began in 2006. In late 2006, following a bidding process, the Chinese government selected Westinghouse to construct four AP 1000 reactors. In July 2007, it was agreed these units (1.1 GWe each) would be built in pairs at the Sanmen and Hayang sites beginning in 2009, with operation expected in 2013. The Tianwan-1 Russian designed pressurised water reactor (about 1.0 GWe net) was connected to the grid in May 2006 and began commercial operation in May 2007.

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[5] There were also six nuclear power plants in operation in Chinese Taipei (about 4.9 GWe net) and two plants under construction (about 2.7 GWe net).

That same month the Tianwan-2 unit was connected to the grid and began commercial operation in August 2007. Construction was initiated in August 2007 at the Hongyanhe nuclear power station, where four (1.0 GWe each) reactors of Chinese design are to be built, the first expected to commence operation in 2012. The government of China continues to implement a plan to increase installed nuclear capacity to 40 GWe by 2020 (about 4% of electrical supply) and has expressed the desire to further increase it to between 120 GWe and 160 GWe, including a gradual development and phase-in of a closed fuel cycle with fast breeder reactors. To reach the near-term goal, 30 additional reactors of at least 1.0 GWe net each will need to be constructed by 2020.

In **Japan**, both the Hamaoka 5 boiling water reactor (1.38 GWe gross) and the Higashidori 1 boiling water reactor (1.10 GWe gross) were connected to the grid in 2005 and the Shika 2 advanced boiling water reactor (1.36 GWe gross) was connected to the grid in 2006. Construction of the Tomari 3 pressurised water reactor (0.912 GWe gross)**,** which is expected to begin operation in late 2009, continues. In early 2007 the Government of Japan approved the basic energy plan to enhance security of supply by placing greater importance on developing nuclear power, a nuclear fuel recycling system and fast breeder reactors.

In the **Republic of Korea**, the Ulchin 6 reactor (about 0.96 GWe net) was connected to the grid in 2005 and in addition to Shin Kori 1, which began construction in 2006, construction of three additional Korean standard nuclear power plants (OPR 1000; about 0.96 GWe net each) was initiated in 2007; Shin Kori 2, which along with Shin Kori 1 is scheduled to be completed in late 2010 or 2011, and Shin Wolsong 1 and 2, which are due to be completed by 2012 and 2013. Construction of the first pair of third-generation APR-1400 reactors (Shin Kori-3 and Shin Kori-4) has been authorised, with construction to be initiated in 2008 and operation expected by 2013 and 2014. Current plans also include the construction of two more APR-1400 units (Shin-Ulchin 1 and 2), which are expected to be completed in 2015 and 2016. As a result, there are expected to be 28 nuclear reactors operational by 2016 as compared to the 20 power plants in operation on 1 January 2007.

The 2006 reactor-related uranium requirements for the East Asia region were 13 170 tU and for 2007 are expected to increase to 14 320 tU.

Central, Eastern and South-eastern Europe (47.665 GWe net as of 1 January 2007)

As of 1 January 2007, 67 reactors were operating in 10 countries. This region is also undergoing strong growth with ten reactors under construction that will add about 9.05 GWe net when completed. During 2005 and 2006, no new plants were connected to the grid but three reactors were shut down (a total of about 1.25 GWe net). Entry into the European Union has been a driving factor in the recent shutdown of these older model reactors in Bulgaria and the Slovak Republic, as well as the reactor shutdown in Lithuania in 2004. These shutdowns may eventually be offset by new nuclear capacity as these governments and private industry are considering the construction of new nuclear power plants to meet growing energy demand while reducing carbon dioxide emissions. In August 2007, the Cernavoda 2 CANDU 6 reactor (about 0.65 GWe) was connected to the grid in Romania.

In **Bulgaria**, two of the four reactors at Kozloduy (about 0.41 GWe net each) were permanently shut down by the end of 2006 as part of Bulgaria's agreement for entry into the European Union. This leaves only the two larger units (about 0.95 GWe net each) in operation at the site that once had six operating reactors. To compensate for the loss of generating capacity, construction of two VVER reactors (about 0.95 GWe net each) is underway at the Belene site, with the first expected to begin operating in the 2013-2014 time frame. In mid-2007 the Government of Bulgaria was seeking partners for a 49% share in the Belene Power Company that will operate these units.

In the **Czech Republic**, six reactors were in operation on 1 January 2007 with an installed capacity of about 3.5 GWe net. Ongoing modernisation of the Dukovany nuclear power plant units (4 VVERs with a capacity of 0.41 GWe net each), including the already completed reconstruction of low pressure flow parts and the introduction of advanced fuel, is expected to increase generation capacity by about 14% in 2012. In 2007, replacement parts were installed to the turbines of both units at the Temelin nuclear power plant, resulting in a capacity increase of about 0.3 GWe and an extended turbine life span. At present, there are no plans to build additional nuclear power plants before 2030.

In **Hungary**, four VVER reactors were in operation at the Paks nuclear power plant on 1 January 2007 with a combined installed capacity of about 1.8 GWe net. In 2005, the Government of Hungary endorsed a plan to extend operating lives of all four units by 20 years. In 2006, a USD 26 million uprate programme was initiated that will see the combined capacity of Paks plant increased to a total of 2.0 GWe net by 2009.

In **Lithuania**, the only remaining operating reactor, Ignalina-2 (about 1.2 GWe net), is scheduled to be shut down at the end of 2009 in accordance with agreements made for entry into the European Union. Ignalina-1 was shut down on 31 December 2004 under the same agreement. In 2007, the three Baltic states (Lithuania, Latvia and Estonia) and Poland agreed in principle to build new nuclear generating capacity at Ignalina, initially adding two units with a combined generating capacity of 3.2 GWe. At least one unit is expected to be in operation by 2015. As of August 2007, representatives from each country in the project were negotiating partnership share arrangements.

In **Romania**, one reactor with an installed capacity of about 0.65 GWe net was in operation and one reactor was under construction on 1 January 2007. This unit, the second at the Cernavoda site, a CANDU 6 PHWR (about 0.65 GWe net), was connected to the grid in October 2007. That same month, the Romanian government launched a new tender for the USD 3 billion construction of Cernavoda units 3 and 4 (each with a capacity of 0.72 GWe) that are expected to start-up in the 2014-2015 time frame.

In the **Russian Federation,** 31 reactors (about 21.7 GWe net) were in operation as of 1 January 2007. Five reactors were under construction (about 4.5 GWe net combined), including the Beloyarsk 4 fast breeder reactor (about 0.75 GWe net) that was initiated in July 2006. In April 2007, construction of two reactors on the world's first floating nuclear power plant [Severodvinsk – Akademik Lomonosov 1&2 (2x30 MWe)] officially began. The government plans are to add 2-3 GWe/year of capacity each year from 2009 to 2030, and by 2050 to have inherently safe nuclear plants in operation using fast reactors with a closed fuel cycle and MOX fuel. Plans are also in place to upgrade existing power plants by using better fuels more efficiently and to extend operating lives.

In the **Slovak Republic**, five reactors at two sites with a combined capacity of about 2.03 GWe net were in operation as of 1 January 2007. Bohunice-1 (about 0.41 GWe net) was shut down on 31 December 2006 and Bohunice-2 is scheduled to be shut down at the end of 2008 in accordance with agreements made for entry into the European Union, despite a recently completed major refurbishment programme. In early 2007, the Slovak utility Slovenske Elektrarne announced that it would finalise construction of Mochovce-3 and 4 units (about 0.4 GWe net each) and upgrade the Bohunice-3 and Bohunice-4 units in an effort to extend operating lives to 40 years (until 2025). Construction of the Mochovce-3 and 4 reactors originally began in 1987 but was halted in 1992 due to lack of funding. Completion of the two reactors under the new programme is expected to begin in 2008 and be finalised by 2012 and 2013.

Slovenia has a single nuclear reactor in operation (Krsko, 696 MWe) that is jointly owned by Croatia. Owned and operated by a joint Slovene-Croat company (NEK), Krsko entered commercial operation in 1983 and has an operational life designed for 40 years. Steam generators were replaced and the plant was uprated in 2001. The unit supplied 40% of the Slovenia's electricity in 2006.

In **Ukraine**, 15 reactors with a combined installed capacity of about 13.1 GWe net were in operation on 1 January 2007. The current Ukrainian government strategy calls for the nuclear share to be retained through 2030 at the current level of 45-50% of the total national electricity generation. This is expected to require the construction of twelve new reactors, ten of which with a capacity of about 1.5 GWe net.

Although other countries in the region do not currently have nuclear power plants, several governments, including **Armenia**, **Belarus**, **Georgia** and **Turkey**, are considering the possibility of building nuclear capacity to meet rising energy demand and to reduce greenhouse gas emissions.

Reactor-related uranium requirements in 2006 for the Central, Eastern and South-eastern European region were about 9 020 tU and are expected to increase to 9 310 tU in 2007.

Middle East, Central and Southern Asia (4.205 GWe net as of 1 January 2007)

As of 1 January 2007, 18 reactors were in operation and 8 were under construction (about 4.1 GWe net). During 2005 and 2006, two reactors were connected to the grid (about 1.0 GWe net) and no reactors were shut down.

In **India**, 16 reactors (about 3.58 GWe net) were operational on 1 January 2007 and seven reactors (four PHWRs, two light water reactors of Russian design and a prototype fast breeder reactor), with a total capacity of about 3.1 GWe net, were under construction. In April 2007, construction of one PHWR was completed and the Kaiga-3 reactor (about 0.2 GWe net) was connected to the grid. The total nuclear power generating capacity is expected to grow by about 6.7 GWe net by 2011 as units under construction are completed. Government plans call for the increase of the country's nuclear generation capacity to 20 GWe by 2020. The ongoing construction of a prototype fast breeder reactor (about 0.5 GWe) represents a major step forward in India's plans to introduce a thorium-based nuclear fuel cycle. Similarly, a prototype Advanced Heavy Water Reactor that would use thorium and uranium as fuel and generate more uranium than it consumes while producing electricity and desalinating water was undergoing pre-licensing review in 2007. In July 2007, India and the United States signed a civil nuclear co-operation agreement. If the agreement is approved by both governments and the Nuclear Suppliers Group, and India successfully negotiates an inspection regime with the IAEA for its civil nuclear facilities, India could access foreign nuclear fuel and equipment for the first time in three decades. At present, the scope of India's nuclear growth and the capacity of its currently operating reactors are periodically limited by indigenous uranium supply.

In **Iran**, the expected start-up of the Bushehr-1 reactor (about 0.9 GWe net) has been delayed until late 2008. Atomstroyexport, the Russian supplier of the reactor, has pushed back the start-up date of the reactor a number of times owing to technical difficulties. The Government of Iran has announced its intention to have 20 GWe net of installed capacity by 2026.

In **Pakistan**, two reactors (about 0.43 GWe net) were operational on 1 January 2007. In 2005, construction of a third reactor, Chasnupp-2 (about 0.3 GWe net), began under an agreement with the China National Nuclear Corporation. Completion is expected in 2011. In 2005, in order to meet rising demand for electricity, the Government of Pakistan approved a plan to increase nuclear generating capacity to 8.8 GWe by the year 2030, corresponding to a share of 5% in the total installed electricity generating capacity of the country at that time. The plan envisions gradually increasing local content to reduce the capital cost of nuclear power plants, as well as increasing unit capacity from 0.3 GWe to 0.6 GWe before eventually standardising it at 1.0 GWe.

In July 2006, the Government of **Kazakhstan** signed a USD 10 billion agreement with the Russian Federation for new reactors, uranium production and enrichment. To date, plans detailing the timing of the construction of new reactors have not been announced.

In May 2007, the Gulf Cooperation Council (**Saudi Arabia**, **Kuwait**, **United Arab Emirates**, **Qatar**, **Bahrain** and **Oman**) announced its intention to consider the construction of nuclear power plants for generating electricity and desalinisation in the 2020 to 2025 time frame. In August 2007, that Minister of National Infrastructures of **Israel** announced that he would submit a plan to the government to build a nuclear reactor. That same month, the government of **Yemen** also expressed interest in building nuclear capacity to meet the growing shortfall of electricity supply.

Reactor-related uranium requirements for the Middle East, Central and Southern Asia region were about 510 tU in 2006 and are expected to remain the same in 2007.

Central and South America (2.735 GWe net as of 1 January 2007)

At the beginning of 2007, there were four reactors operating in two countries in this region.

In **Brazil**, two reactors (Angra-1 and -2, about 0.6 GWe net and 1.2 GWe net, respectively each) were in operation on 1 January 2007. In May 2007, the President of Brazil approved the resumption of construction of the Angra-3 reactor (about 1.2 GWe net), which is expected to be completed in 2014. The government of Brazil is considering the possibility of building an additional four to eight units by 2030 in order to meet rising energy demand in the country.

In **Argentina**, two reactors (in total about 0.9 GWe net) were in operation on 1 January 2007. In May 2006, AECL signed an agreement with the state nuclear electrical utility to assist in completing the construction of the country's third reactor (Atucha-2), refurbish the Embalse PHWR and develop a feasibility study of building another PHWR for operation by 2015. Construction of the Atucha-2 reactor was suspended in 1984 because of a lack of funds when the reactor was about 80% complete.

The uranium requirements for Central and South America were about 570 tU in 2006 and are expected to remain the same in 2007.

Africa (1.84 GWe net as of 1 January 2007)

Nuclear capacity remained constant in Africa with the region's only two reactors located in **South Africa**. In order to meet rising demand for electricity, South Africa's state-owned utility Eskom approved the construction of a second nuclear power station in 2007 and issued an EIA of the construction of a new 4.0 GWe nuclear station. Should the project proceed as planned, it is estimated that construction could begin in 2009 or 2010 and the first unit of the station could be commissioned in 2016. This is the first step in Eskom's evaluation of adding 20.0 GWe of nuclear generating capacity by 2025. South Africa is also continuing to develop the Pebble Bed Modular Reactor, a high-temperature, helium-cooled reactor (about 0.1 GWe net). A demonstration plant is to be built in 2009 with operation expected to begin in 2013.

In July 2007, **Libya** signed a memorandum of understanding with France to build a nuclear powered desalinisation plant. The government of **Nigeria** expects to have its first nuclear power plant built and in operation by 2017, in order to meet rising demand for electricity. Other countries, including **Egypt**, **Ghana**, **Namibia** and **Uganda**, have also expressed interest in constructing nuclear power plants in order to meet rising electricity demand and for desalinisation.

Annual reactor-related uranium requirements for Africa were about 280 tU in 2006 and are expected to increase slightly to 290 tU in 2007.

South-eastern Asia (0 GWe net as of 1 January 2007)

This region has no current commercial nuclear power capacity. However, **Indonesia** and **Vietnam** are planning the construction of nuclear reactors to satisfy rising demand for electricity. Indonesia has announced its intention to start construction of a commercial nuclear power plant by 2010 with operation expected by 2016. Vietnam has established a nuclear power programme and approved a national energy plan that aims to construct two units (total capacity of 2.0 GWe) to be operational by 2020. The governments of the **Philippines** and **Thailand** are also considering the use of nuclear power to meet growing electricity demand.

Pacific (0 GWe net as of 1 January 2007)

This region currently has no commercial nuclear power capacity. Although current policy prohibits the development of commercial nuclear energy, the Government of **Australia** released in late 2006 a report on opportunities for Australia in uranium mining and nuclear energy. The results of this report have initiated a debate on the role nuclear power generation should play in Australia's future. Construction of the Open Pool Australian Light-water (OPAL) research reactor was completed and the first fuel loaded in August 2006. The government of **New Zealand** has a policy prohibiting the development of nuclear power but has recently discussed the possibility of building nuclear power plants for future electricity supply in light of greenhouse gas reduction targets and declining supply of natural gas.

B. PROJECTED NUCLEAR POWER CAPACITY AND RELATED URANIUM REQUIREMENTS TO 2030

Factors affecting capacity and uranium requirements

Reactor-related requirements for uranium, over the short-term, are fundamentally determined by installed nuclear capacity, or more specifically by the number of kilowatt-hours of electricity generated in operating nuclear power plants. As noted, the majority of the anticipated near-term capacity is already in operation, thus short-term requirements may be predicted with relative certainty.

Uranium demand is also directly influenced by changes in the performance of installed nuclear power plants and fuel cycle facilities, even if the installed base capacity remains the same. Over the past decade there has been a worldwide trend toward higher nuclear plant energy availability and capacity factors. In 2006, the average world nuclear energy availability factor (as defined by the IAEA) was 82.7%, compared to 71.0% [1] in 1990. Longer operating lifetimes and increased availability tend to increase uranium requirements. Other factors that affect uranium requirements include plant retirements, fuel-cycle length and discharge burn-up and the strategies employed to optimise the relationship between the price of natural uranium and enrichment services.[6] Recent high uranium prices have provided the incentive for utilities to reduce uranium requirements by specifying lower tails assays at enrichment facilities, to the extent possible in current contracts and the ability of the enrichment facilities to provide the increased services. As noted in the 2006 Annual Report of the Euratom Supply Agency, the trend toward lower tails assays has continued in the European Union (EU), with some utilities now specifying tails assays as low as 0.20% [2].

The strong performance and economic competitiveness of existing plants, chiefly because of low operating, maintenance and fuel costs, has made retention and improvement of these plants desirable in many countries. This has resulted in the trend to keep existing plants operating as long as can be achieved safely as well as upgrading their generating capacity, when possible. This strategy is especially pronounced in the United States but other countries (e.g. Canada, France, Hungary, Netherlands, the Russian Federation, Sweden and Switzerland) have or are planning to extend the lives of existing power plants and/or upgrade their generating capacities.

Installation of new nuclear capacity will increase uranium requirements, providing that new build capacity outweighs retirements. Many factors influencing decisions on building new nuclear generating capacity must be considered before any new significant building programmes will take place. These factors include projected electricity demand, security and cost of fuel supplies, the cost competitiveness of nuclear compared to other generation technologies and environmental considerations, in particular greenhouse gas emissions. With respect to nuclear, additional critical issues in need of resolution include public attitudes and acceptance of the safety of nuclear energy and proposed waste management strategies, as well as non-proliferation concerns stemming from the relationship between the civil and military nuclear fuel cycles.

Recent events indicate that many nations have decided that, on balance, objective analysis of these factors supports the construction of new nuclear power plants. Significant building programmes are underway in China, India, Korea, Japan and the Russian Federation and are planned in South Africa. Smaller programmes are also underway or planned in Canada, Finland and France and momentum is continuing to build in the United States, where the construction of 15 plants or more is currently under consideration. In September 2007, NRG Energy became the first nuclear utility in the United States in over 30 years to submit a full combined construction and operating license application to regulators.

Increased nuclear growth has also received support from key international organisations and political leaders. The 2006 World Energy Outlook, after noting that current energy development is underinvested, vulnerable and dirty, included an alternative policy scenario that, among other things, would result in a 10% increase in nuclear power generating capacity to address security of supply issues and reduce greenhouse gas emissions. In April 2007, G7 Finance Ministers endorsed nuclear energy as an increasingly attractive source of electricity as governments confront the issues of global climate change and an over-dependence on fossil fuels. They also recommended diversification of energy sources for both developed and developing countries, noting that such a strategy can include advanced energy technologies such as renewable, nuclear and clean coal. In May 2007, the Intergovernmental Panel on Climate Change acknowledged the role that nuclear energy could play in

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[6] A reduction of the enrichment tails assay from 0.3 to 0.25% ^{235}U would, all other factors being equal, reduce uranium demand by about 9.5% and increase enrichment demand by about 11%. The tails assay selected by the enrichment provider is dependent on many factors including the ratio between natural uranium and enrichment prices.

reducing greenhouse gas emissions, although it noted that safety, proliferation and waste remain constraints to nuclear development. In June 2007, G8 leaders issued a statement noting that some of the group believed that the continued development of nuclear energy would contribute to global energy security, reduce harmful air pollution and address the climate change challenge.

On the other hand, nuclear phase-out programmes currently in place in several European nations will tend to reduce installed capacity over time in that region. However, construction programmes, particularly in east and central Asia, along with capacity upgrades and life extensions, are projected to outweigh reactor shutdowns and world installed nuclear capacity is expected to continue to increase through 2030, thereby increasing projected uranium requirements.

Projections to 2030[7]

Forecasts of installed capacity and uranium requirements, although uncertain due to the above-mentioned factors, point to future growth. Installed nuclear capacity is projected to grow from about 370 GWe net at the beginning of 2007 to about 509 GWe net (low case) or 663 GWe net (high case) by the year 2030. The low case represents growth of 38% from current capacity, while the high case represents a net increase of about 80% (Table 27 and Figure 9).

Nuclear capacity projections vary considerably from region to region. The East Asia region is projected to experience the largest increase that, by the year 2030, could result in the incorporation of 69-94 GWe of new capacity, representing 91% to over 124% increases over current capacity, respectively. Nuclear capacity in Central, Eastern and South-eastern Europe is also expected to increase considerably, with 40-74 GWe of new capacity projected by 2030 (increases of about 84-159%). Other regions projected to experience growth include the Middle East and Southern Asia; Central and South America; Africa and South-eastern Asia. For North America, the increase of projected nuclear capacity for 2030 varies from about 9% to 32%. Only in Western Europe is nuclear capacity expected to decrease significantly, despite new reactors being built or planned in Finland and France, as announced plans to phase out nuclear energy in Belgium, Germany, Spain and Sweden are implemented. Decreases in capacity of about 10-29% are projected for 2030 in Western Europe.

World reactor-related uranium requirements by the year 2030 (assuming a tails assay of 0.3%) are projected to increase to between 93 775 tU/year in the low case and 121 955 tU/year in the high case, representing about 41% and 83% increases respectively, compared to 2006 (Table 28 and Figure 10). As in the case of nuclear capacity, uranium requirements are expected to vary considerably from region to region. Uranium requirement increases are projected to be largest in the East Asia region, where expected increases in nuclear capacity would more than double the 2006 uranium needs by the year 2030. In contrast to steadily increasing uranium requirements in the rest of the world, requirements in North America are projected to remain fairly constant or increase by about 20% in the high case, whereas in the Western Europe region uranium requirements are expected to decline between 4% and 34% through the year 2030.

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[7] Projections of nuclear capacity and reactor-related uranium requirements are based on official responses from member countries to questionnaires circulated by the Secretariat. For countries that did not provide this information, Secretariat projections are based on data from the IAEA *Energy, Electricity and Nuclear Power Estimates for the Period up to 2030*. Because of the uncertainty in nuclear programmes in the years 2015, 2020, 2025 and 2030, high and low values are provided.

Table 27. **Installed nuclear generating capacity to 2030**
(MWe net, as of 1 January 2007)

COUNTRY	2006	2007	2010		2015		2020		2025		2030	
			Low	High	Low	High	Low	High	Low	High	Low	High
Argentina	940	940	940	1 625*	1 625*	2 320*	2 320*	2 320*	1 985*	3 700*	1 985*	4 060*
Armenia*	375	375	375	375	375	375	0	700	0	700	0	1 400
Belarus*	0	0	0	0	0	0	0	1 000	1 000	1 000	1 000	1 000
Belgium	5 825	5 825	5 825	5 825	5 825	5 825	4 035	5 825	2 025	5 825	0	5 825
Brazil	1 795[b]	1 795[b]	1 795[b]	1 795[b]	1 795[b]	3 905[b]	3905*	3 905	4 095*	5 095*	4 095*	8 095*
Bulgaria	2 720[b]	1 905[b]	1 905[b]	1 905[b]	2 905*	3 905[b]	3 905[b]	3 905*	3 905*	3 905[b]	3 905*	3 905[b]
Canada	12 500	12 500	14 000+	14 000+	14 000	14 000+	14 000	14 000+	15 000*	17 000*	17 000*	20 000*
China[a]	6 570[b]	7 570[b]	13 000	20 000	25 000	35 000	30 000	40 000	40 000	50 000	50 000	60 000
Czech Republic	3 490	3 490	3 500	3 550	3 540	3 600	3 550	3 750	3 600	3 750	3 600	3 750
Egypt*	0	0	0	0	0	0	0	600	0	1200	0	1800
Finland	2 680	2 680	2 680	2 680	4 280	4 280	4 280	4 280	4 280	4 280	4 280	4 280
France	63 260	63 260	63 130	63 130	63 130	64 700	63 130	64 700	64 700	64 700	64 700	64 700
Germany	20 336	20 339	12 500	16 700	8 000	12 000	1 300	4 000	0	0	0	0
Hungary	1 780	1 780[b]	1 920	1 920	1 920	1 920	1 920	1 920	1 920	1 920	1 920	1 920
India	3 575	3 780	6 220	6 690	9 180	13 130	13 725*	19 435	19 435*	27 665*	19 435*	35 425*
Indonesia*	0	0	0	0	0	0	0	900	900	1 800	900	3 600
Iran, Islamic Rep. of	0	0	915*	915*	915	915	6 000	6 000	11 000	11 000	16 000	20 000
Japan	47 100[b]	47 100[b]	48 545[b]	48 545[b]	49 830*	55 030*	56 355*	62 780*	62 780*	69 280*	62 980*	72 080*
Kazakhstan	0	0	0	0	0	600	0	600*	0	600*	0	600*
Korea, Republic of[b]	17 454	17 454	17 450	18 150	24 155	25 530	25 530	26 910	25 530	26 910	25 530	26 910
Lithuania	1 190[b]	1 190[b]	0	0*	0	1 500*	1 500*	1 500*	1 500*	3 000*	1 500*	3 000*
Malaysia*	0	0	0	0	0	0	0	0	0	0	0	900
Mexico	1 365+	1 365+	1 365+	1 570+	1 510*	1 580+	1 510*	1 580+	1 510*	1 580+	1 510*	1 580+

Table 27. **Installed nuclear generating capacity to 2030** (continued)
(MWe net, as of 1 January 2007)

COUNTRY	**2006**	**2007**	**2010**		**2015**		**2020**		**2025**		**2030**	
			Low	High	Low	High	Low	High	Low	High	Low	High
Netherlands	450	480	480	480	480	480	480	480	480	480	480	480
Pakistan*	425	425	725	725	600	725	900	1 975	1 850	3 750	1 850	6 000
Poland	0	0	0	0	0	0	0	0	1500	1500*	4500	4500*
Romania*	650	650	1 300	1 300	1 300	1 950	1 950	1 950	1 950	2 950	1 950	2 950
Russian Fed.	21 740[b]	21 740[b]	24 000	25 000	30 000	32 000	37 000	44 000	40 000	50 000	42 000	60 000
Slovak Republic	2 440	2 030	1 740	1 740	1 740	2 610	1 740	2 610	1 740	2 610	870	2 740
Slovenia	675	695	695	695	695	695	695	2 200	695	2 200	695	2 200
South Africa	1 800	1 840	1 840	1 840	2 005	8 420	10 500	15 340	16 000	25 000	20 000	25 000
Spain	7 450	7 450	7 450	7 450	7 450	7 450	7 450	7 450	7 300*	9 250*	7 300*	10 750*
Sweden	8 990	9 035	9 480+	9 480*	10 080+	10 080*	10 080+	10 080*	10 080+	10 080*	10 080+	10 080*
Switzerland	3 220	3 220	3 220	3 220	2 865	3 220	2 865	3 220	2 135	3 220	0	3 220
Turkey	0	0	0	0	1 500	4 500	4 500	4 500	4 500*	4 500*	4 500*	5 000*
Ukraine	11 800	13 800	13 800	13 800	15 800	17 900	16 600	20 200	18 800	26 200	20 000	26 200
United Kingdom	11 900	10 500	10 500	10 600+	6 000	6 000*	3 700	11 070*	1 200	11 660*	1 200	12 700*
USA	100 100	100 100	100 500	100 500	103 400	103 400	108 500	111 700	108 500	118 300	105 900	128 700
Vietnam*	0	0	0	0	0	0	0	1 000	1 000	2 000	1 000	3 000
OECD TOTAL	310 340	308 608	304 240	309 540	309 705	326 205	314 925	340 855	317 280	355 345	311 850	374 715
WORLD TOTAL	369 515	370 233	376 670	392 480	409 520	456 355	450 735	516 495	490 515	587 530	509 080	663 050

* Secretariat estimate based on *Energy, Electricity and Nuclear Power Estimates for the Period up to 2030*, IAEA (Vienna), July 2007.

\+ Data from *Nuclear Energy Data*, NEA (Paris), 2007.

(a) The following data for Chinese Taipei are included in the World Total but not in the totals for China: 4 920 MWe net in 2006 and 2007, 4 920 and 6 270 MWe net for the low and high cases of 2010, 7 620 MWe net for the low and high cases of 2015, 7 620 and 8 920 MWe net for the low and high cases of 2020 and 2025, and 6 415 and 11 500 MWe net for 2030 low and high cases, respectively.

(b) MWe gross converted to net by the Secretariat.

Table 28. **Annual reactor-related uranium requirements to 2030**
(tonnes U, rounded to nearest five tonnes)

COUNTRY	2006	2007	2010		2015		2020		2025		2030	
			Low	High	Low	High	Low	High	Low	High	Low	High
Argentina	120	120	95*	250*	250*	475*	475*	475*	400*	750*	400*	825*
Armenia*	90	90	90	90	90	90	0	180	0	180	0	300
Belarus*	0	0	0	0	0	0	0	180	0	180	0	180
Belgium	880	1 065	1 075	1 075	750	1 075	750	1 075	375	1 075	0	1 075
Brazil	450	450	450	810	450	810	810*	810*	1000*	1200*	1 000*	2 000*
Bulgaria	505	505	1 320	1 320*	1 050	1 050*	1 050	1 050*	1 050	1 050*	1 050	1 050*
Canada	1 800	1 900	1 900	2 000	1 900	2 000	2 000	2 300	2 400*	2 600*	2 600*	2 900*
China[a]	1 200	1 500	2 340	3 600	4 500	6 300	5 400	7 200	7 200	9 000	9 000	10 800
Czech Republic	665	740	695	770	650	710	650	710	650	710	650	710
Egypt*	0	0	0	0	0	0	0	110	0	220	0	380
Finland	465	470	440	470	640	700	640	700	640	700	640	700
France+	7 185	9 000	8 500	9 500	8 000	9 000	8 000	9 000	8 000	9 000	8 000*	9 000*
Germany	3 710	3 490	1 800	2 000	1 100	1 500	200	350	0	0	0	0
Hungary	380	380	380	380	380	380	380	380	380	380	380	380
India*	445	445	880	880	1 140	1 400	2 825	2 825	2 825	4 060	2 825	5 200
Indonesia*	0	0	0	0	0	0	0	160	160	325	160	650
Iran, Islamic Rep. of	0	5	160	160	160	160	255	255	995	995	2 475	2 475
Japan	7 940	8 790	8 875	8 875*	11 340*	11 340	12 500*	13 940*	13 940*	15 380*	13 980*	16 000*
Kazakhstan	0	0	0	0	0	60	0	90*	0	90*	0	90*
Korea, Rep. of	3 200	3 200	3 200	3 600	4 400	5 000	4 800	5 300	4 800	5 300	4 800	5 300
Lithuania	60	90	0*	0*	0*	270*	270*	270*	270*	540*	270	540*
Malaysia*	0	0	0	0	0	0	0	0	0	0	0	160*
Mexico	200+	200+	210+	410+	210+	410*	215*	425+	215+	425*	215+	425*

Table 28. **Annual reactor-related uranium requirements to 2030** (continued)
(tonnes U, rounded to nearest five tonnes)

COUNTRY	**2006**	**2007**	**2010**		**2015**		**2020**		**2025**		**2030**	
			Low	High	Low	High	Low	High	Low	High	Low	High
Netherlands	65	70	70	70	70	70	70	70	70	70	70	70
Pakistan*	65	65	155	155	90	110	135	155	330	670	330	1180
Poland*	0	0	0	0	0	0	0	0	270	270	660	660
Romania*	100	200	200	200	200	300	300	300	300	455	300	455
Russian Federation	4 000	4 100	5 400	5 400	7 200	7 700	8 200	9 700	8 800	11 000	9 200	13 000
Slovak Republic	490	475	385	385	400	595	385	585	400	595	195	395
Slovenia	250	250	250	250	250	250	250	750	250	750	250	750
South Africa	280	290	290	290	295	1 310	1 570	2 145	2 100	3 235	3 175	3 235
Spain	1 725	1 310	1 830	1 830	1 010	1 010	1 400	1 400	1 400	1 755*	1 400	2 040*
Sweden+	1 600	1 600*	1 400	1 800	1 400	1 800	1 500	1 800	1 500	1 800	1 500	1 800
Switzerland	265	275	370	385	320	385	500	565	380	565	0	445
Turkey*	0	0	0	0	200*	650*	650*	650*	650*	650*	650*	700*
Ukraine	2 480	2 480	2 480	2 480	2 480	3 230	3 020	3 660	3 390	4 800	3 600	4 800
United Kingdom	2 165	1 900*	1 700	1 900	800	1 100	400	1 900*	300	2 000*	300	2 200*
United States	22 890	22 825*	22 625	22 625	23 860	23 865	24 510	25 245	23 855	25 865	22 265	26 615
Vietnam*	0	0	0	0	0	0	0	180	180	360	180	540
OECD TOTAL	55 625	57 690	55 455	58 075	57 435	61 590	59 550	66 395	59 955	68 870	57 645	70 755
WORLD TOTAL	66 500	69 110	70 395	75 020	76 870	86 385	85 390	98 600	90 935	110 510	93 775	121 955

* Secretariat estimate based on *Energy, Electricity and Nuclear Power Estimates for the Period up to 2030*, IAEA (Vienna), July 2007.

\+ Data from *Nuclear Energy Data*, NEA (Paris), 2007.

(a) The following data for Chinese Taipei are included in the World Total but not in the totals for China: 830 tU/year in 2006 and 2007; 830 tU/year and 1 280 tU/year in the low and high cases in 2010, respectively, 1 280 tU/year in the low and high cases in 2015, 1 280 tU/year and 1 510 tU/year in the low and high cases in 2020 and 2025, respectively, and 1 075 tU/year and 1 930 tU/year in the low and high cases in 2030, respectively.

(b) Preliminary data.

Figure 9. **Projected installed nuclear capacity to 2030**
(low and high projections)

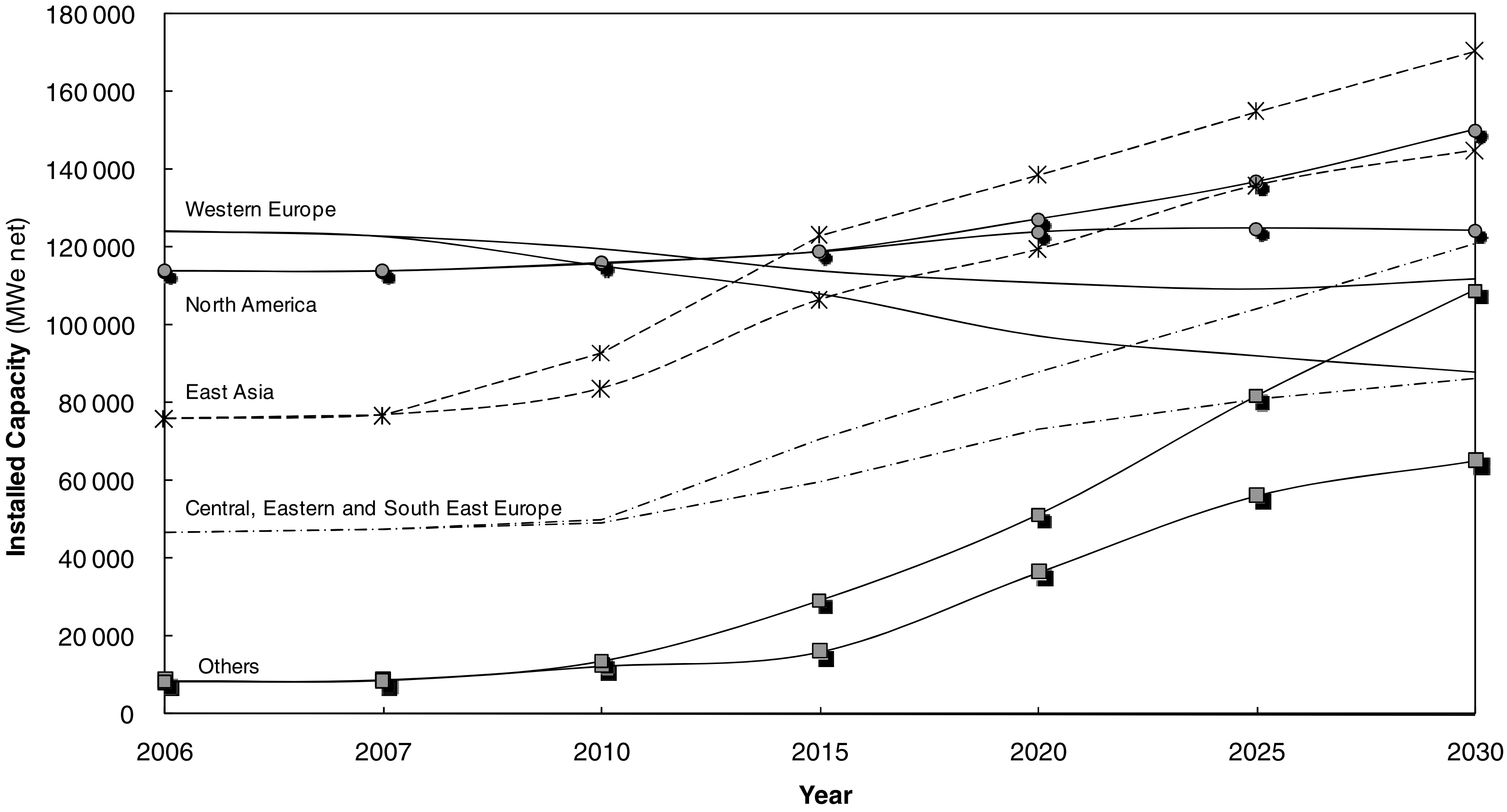
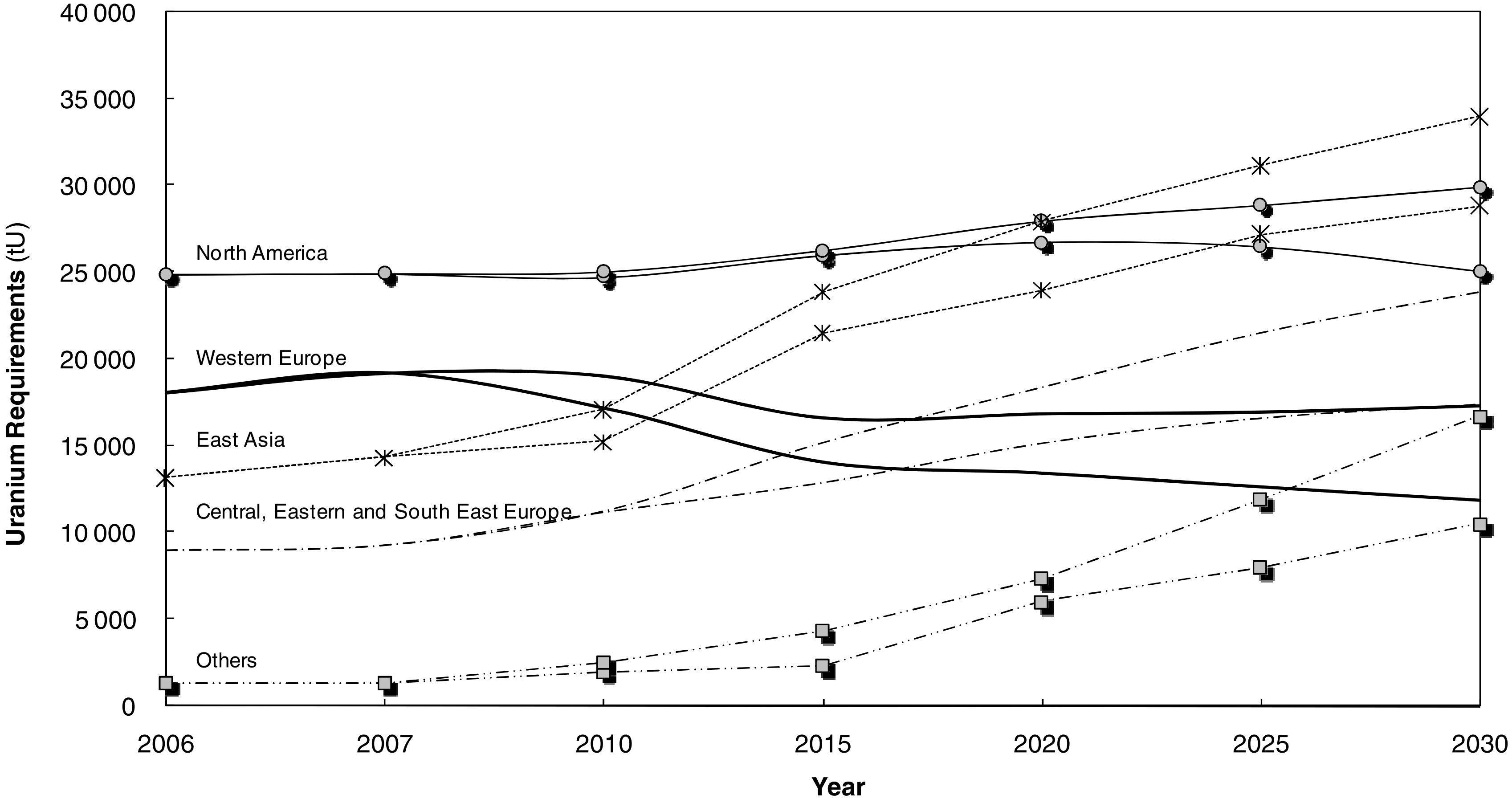


Figure 10. **Annual reactor uranium requirements to 2030**
(low and high projections)



C. URANIUM SUPPLY AND DEMAND RELATIONSHIPS

Uranium supply and demand remains in balance and there have been no supply shortages since the last report. However, a number of different sources of supply are required to meet demand. The largest is the primary production of uranium that, over the last several years, has satisfied some 50-60% of world requirements. The remainder has been provided or derived from secondary sources including stockpiles of natural and enriched uranium, the reprocessing of spent fuel and the re-enrichment of depleted uranium tails.

Primary sources of uranium supply

Uranium was produced in 20 countries in 2006, one more than in 2005, as the Islamic Republic of Iran started small-scale production in 2006. However, three of the 20 countries (France, Germany and Hungary) only produce uranium as a consequence of mine remediation efforts. Two countries, Australia and Canada, accounted for 44% of world production in 2006, and just eight countries, Canada (25%), Australia (19%), Kazakhstan (13%), Niger (9%), the Russian Federation (8%), Namibia (8%), Uzbekistan (6%) and the US (5%), accounted for 93% of the world's uranium mine output.

In comparison, 31 countries currently consume uranium in commercial nuclear power plants creating an uneven distribution between producing and consuming countries (Figure 11). In 2006, only Canada and South Africa produced sufficient uranium to meet domestic requirements. All others must use secondary sources or import uranium and, as a result, the international trade of uranium is a necessary and established aspect of the uranium market. Given the uneven geographical distribution between producers and consumers, the safe and secure shipment of nuclear fuel will need to continue without unnecessary delays and impediments. Difficulties that some producing countries, in particular Australia, have encountered with respect to international shipping requirements and transfers to international ports have therefore become a matter of some concern. However, efforts to better inform port authorities of the risks involved and the longstanding record of successful shipments of these materials have resulted in some improvements in the situation.

Primary uranium production alone is insufficient to meet world uranium requirements. In 2006, world uranium production (39 603 tU) provided about 60% of world reactor requirements (66 500 tU). In OECD countries, 2006 production of 19 705 tU provided only about 35% of demand of 55 625 tU (Figure 12). Remaining requirements were met by imports and secondary sources.

Secondary sources of uranium supply

Uranium is unique among energy fuel resources in that a significant portion of demand is supplied by secondary sources rather than direct mine output. These secondary sources include:

- Stocks and inventories of natural and enriched uranium, both civilian and military in origin.
- Nuclear fuel produced by reprocessing spent reactor fuels and from surplus military plutonium.
- Uranium produced by re-enrichment of ***depleted uranium*** tails.

Figure 11. **Estimated 2007 uranium production and reactor-related requirements for major producing and consuming countries**

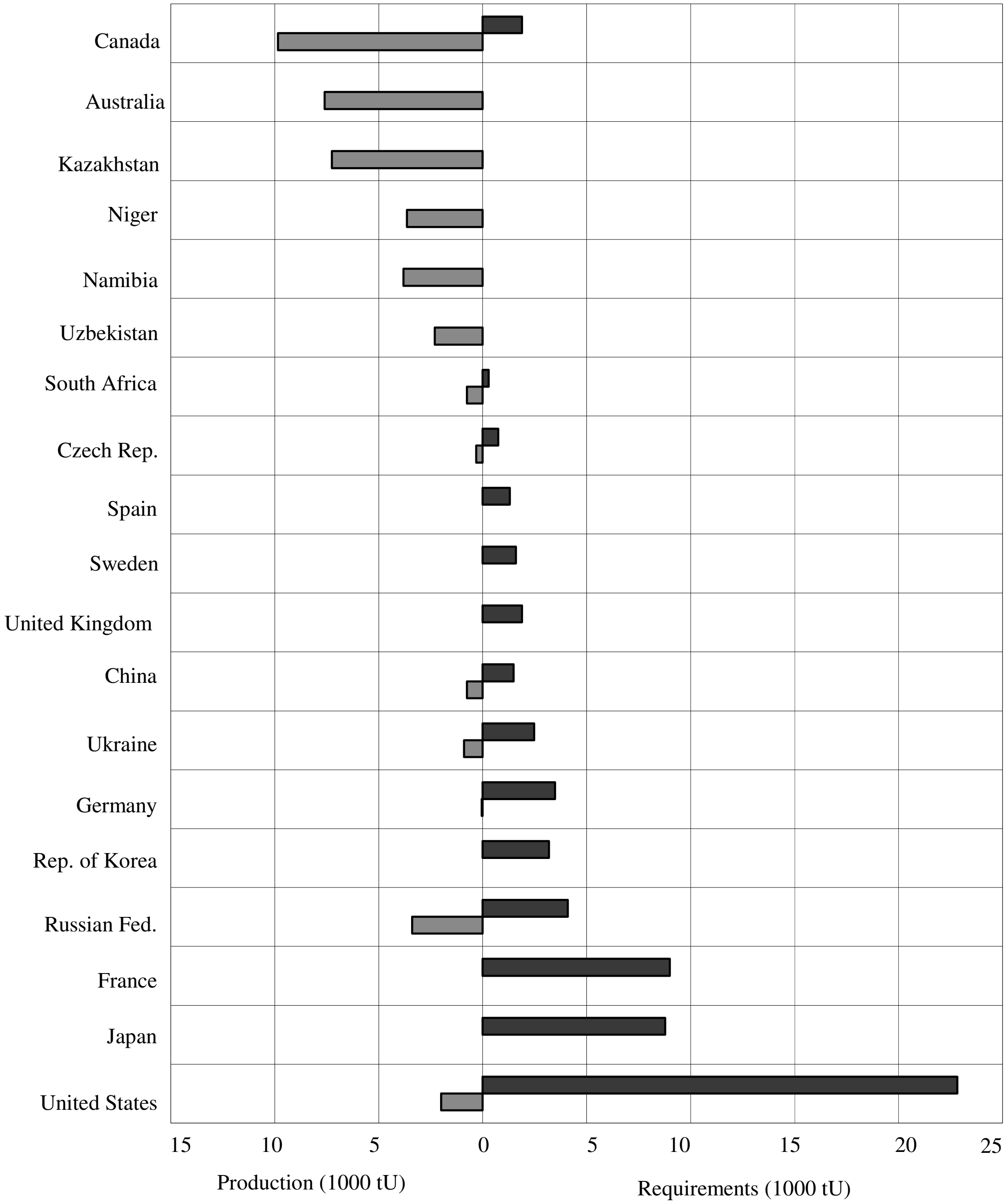
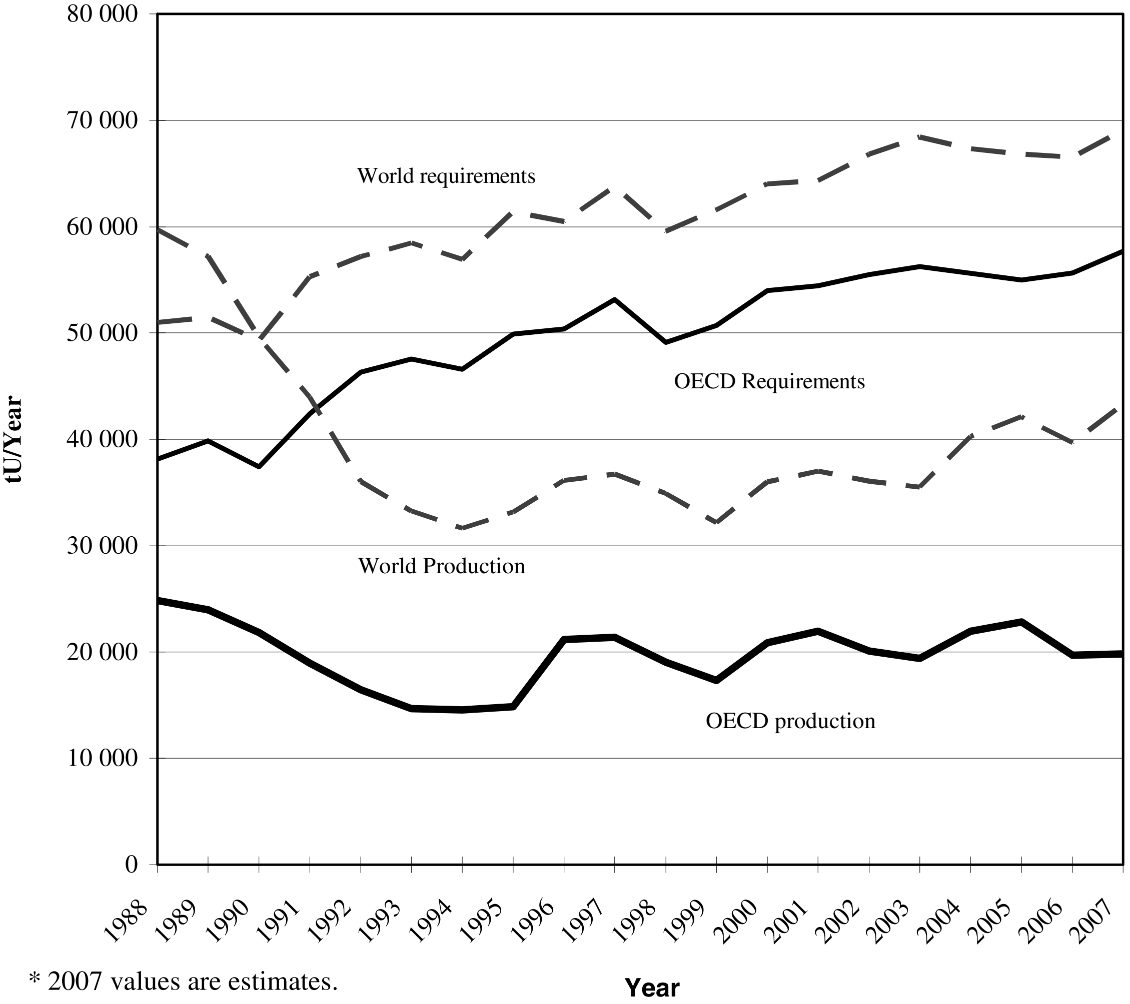


Figure 12. **OECD and world uranium production and requirements***
(1988-2007)

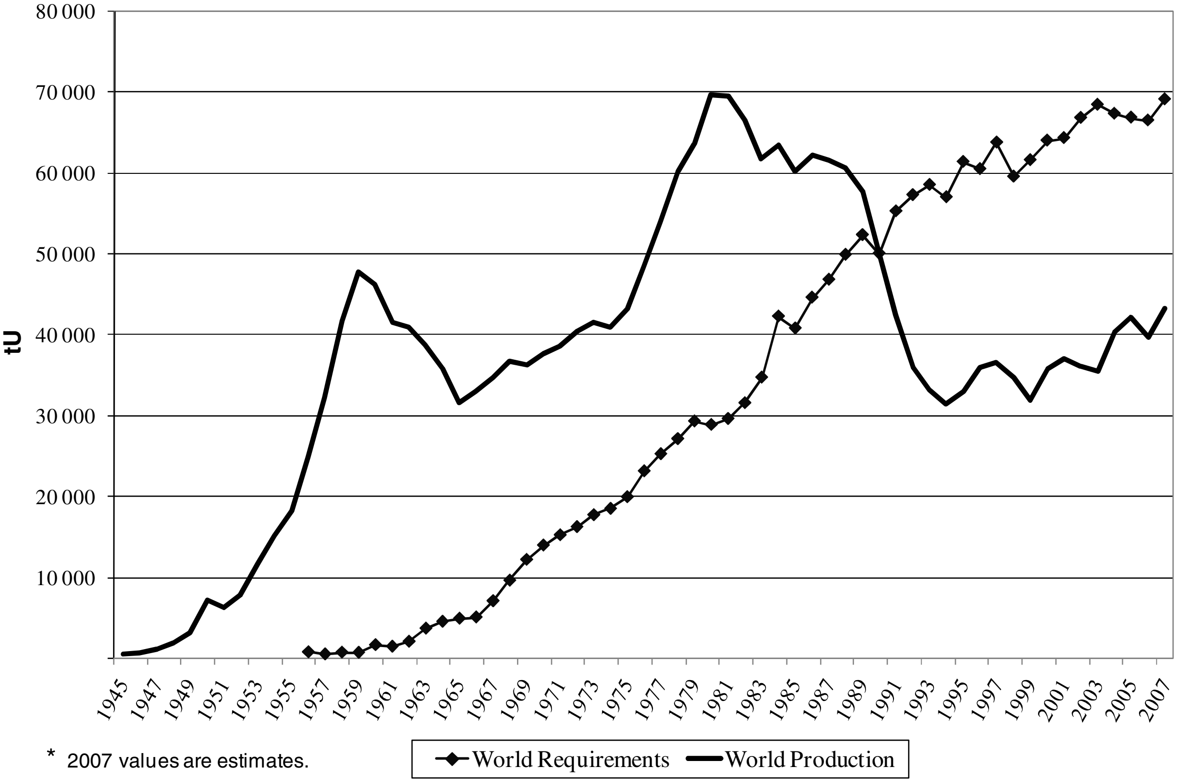


* 2007 values are estimates.

1. Natural and enriched uranium stocks and inventories

From the beginning of commercial exploitation of nuclear power in the late-1950s through to about 1990, uranium production consistently exceeded commercial requirements (Figure 13). This was mainly the consequence of a lower than expected nuclear electricity generation growth rate and high levels of production for military purposes. This over production created a stockpile of uranium potentially available for use in commercial power plants.

Figure 13. **Annual uranium production and requirements***
(1945-2007)

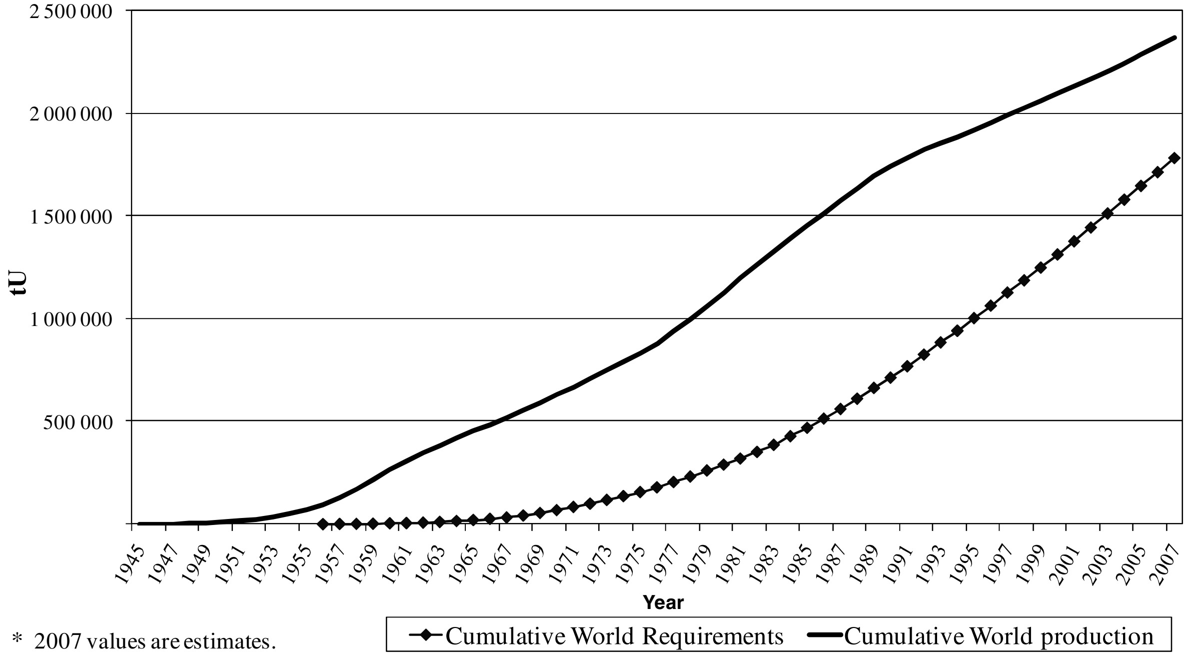


* 2007 values are estimates.

Following the political and economic reorganisation in Eastern Europe and the former Soviet Union in the early-1990s, major steps have been taken to develop an integrated commercial world uranium market. More uranium is now available from the former Soviet Union, in particular Kazakhstan, the Russian Federation and Uzbekistan, as is more information on the production and use of uranium in the former Soviet Union. Despite these developments and the increased availability of information regarding the amount of uranium held in inventory by utilities, producers and governments, uncertainty remains regarding the magnitude of these inventories as well as the availability of uranium from other sources. This, combined with uncertainty about the desired levels of inventories, continues to have significant influence on the uranium market.

However, data from past editions of this publication, along with information recently provided by member states, gives an indication of the possible upper bound of potentially commercially-available inventories. Cumulative production through 2006 is estimated to have amounted to about 2 325 000 tU, whereas cumulative reactor requirements through 2006 amounted to about 1 700 000 tU. This leaves an estimated remaining stock of about 625 000 tU, the upper limit of what could potentially become available to the commercial sector (Figure 14). This base of already mined uranium has essentially been distributed into two segments with the majority used and/or reserved for the military sector and the remainder used or stockpiled by the civilian sector. Since the end of the Cold War, increasing amounts of uranium, previously reserved for military purposes, have been released to the commercial sector. However, a significant portion of this will likely always remain reserved for military uses.

Figure 14. **Cumulative uranium production and requirements***
(1945-2007)



* 2007 values are estimates.

Civilian inventories include strategic stocks, pipeline inventory and excess stocks available to the market. Utilities are believed to hold the majority of commercial stocks because many have policies that require carrying the equivalent of one to two years of natural uranium requirements. Despite the importance of this secondary source of uranium, relatively little is known about the size of these stocks because few countries are able or willing to provide detailed information on stockpiles held by producers, consumers or governments due to confidentiality concerns (Table 29).

There is, however, evidence that some utilities have recently been building inventory. In the United States, 2006 year-end commercial uranium stocks (natural and enriched uranium equivalent) totalled 41 279 tU. This represents an increase of about 13% compared to the 2005 and 2004 levels of 36 068 tU and 36 622 tU, respectively. Utility stocks drove this upward trend, increasing by 12.4% between year end 2004 and 2005, and by 20.8% between 2005 and 2006, resulting in a total holding of 30 081 tU at year end 2006. In contrast, government stocks of natural uranium declined 11% from 19 326 tU at the end of 2004 to 17 179 tU at the end of 2006 in the United States.

The Euratom Supply Agency noted in its 2006 Annual Report [2] that uranium deliveries to the EU were slightly higher than the amount of uranium loaded into reactors, suggesting that uranium inventories were also being built in the EU, similar to the situation noted above in the case of utilities in the United States.

Available information suggests that no significant excess inventories are held in Eastern Europe and Central Asia, with the exception of the Russian Federation. The inventory of enriched uranium product and natural uranium held by the Russian Federation, though never officially reported, is believed to be substantial. However, these inventories have been drawn down for several years.

Large stocks of uranium, previously dedicated to military applications in both the United States and the Russian Federation, have become available for commercial applications introducing a significant source of uranium into the market. Highly enriched uranium (HEU) and natural uranium held in various forms by the military sector could total several years supply of natural uranium equivalent for commercial applications.

Table 29. **Uranium stocks in countries that have reported data**
(tonnes natural U equivalent as of 1 January 2007)

COUNTRY	Natural uranium	Enriched uranium
Argentina (a)	110	0
Australia (b)	NA	0
Belgium	NA	NA
Bulgaria	0	81
Canada (b)	NA	0
China	NA	NA
Czech Republic	< 200	NA
Egypt	0	0
Finland (c)	0	0
France (d)	NA	NA
Germany(e)	2 600	100
Hungary	1	0
India	NA	NA
Korea, Republic of (f)	NA	NA
Lithuania (g)	0	47
Mexico (h)	NA	NA
Netherlands	NA	NA
Niger	0	0
Poland	NA	NA
Portugal	168	0
Slovak Republic (i)	0	NA
South Africa (b)	NA	NA
Spain (j)	NA	611
Switzerland	1 609	1 422
Turkey	< 2	0
Ukraine	0	0
United Kingdom	NA	NA
United States (k)	39 154	8 722
Vietnam	0	0
TOTAL	> 43 844	> 10 983

NA Not available or not disclosed.
(a) Government data only. Commercial data are not available.
(b) Government stocks are zero in all categories. Commercial data are not available.
(c) The nuclear power utilities maintain reserves of fuel assemblies sufficient for 7-12 months use.
(d) A minimum of three years forward fuel requirements is maintained by EDF.
(e) Holdings also include 3 500 t (U equivalent) of depleted U.
(f) A strategic inventory is maintained along with about one year's forward consumption in pipeline inventory.
(g) A three month's stock of enriched fuel is generally maintained at the Ignalina NPP.
(h) Maintain one to two reloads of natural uranium at an enrichment facility.
(i) The government maintains a small stock of enriched uranium in the form of fuel assemblies.
(j) Regulations require a strategic inventory of at least 611 tU be maintained jointly by nuclear utilities.
(k) Government and utility stocks only; producer stocks amounted to an additional 11 197 tU but a breakdown into amounts of natural and enriched uranium is not available.

Highly enriched uranium from the Russian Federation

An Agreement between the Government of the US and the Government of the Russian Federation Concerning the Disposition of Highly Enriched Uranium Extracted from Nuclear Weapons (HEU Purchase Agreement) was signed on 16 October 1992 by the US and the Russian Federation providing for the blending down of 500 tons of HEU to low enriched uranium (LEU) over 20 years. USEC, Inc., the US Government's sole executive agent for implementing the HEU Purchase Agreement, receives deliveries of LEU from the Russian Federation for sale to commercial nuclear power plants. USEC purchases and sells only the enrichment component of this LEU under existing commercial contracts with purchasers of enrichment services. An agreement for the maintenance of a domestic uranium enrichment industry that was signed on 17 June 2002 by the Department of Energy and USEC, Inc. contained conditions for USEC, Inc. to continue as the US Government's sole executive agent for the HEU Purchase Agreement. In June 2006, the Russian Federation indicated that the HEU agreement will not be renewed when the initial agreement expires in 2013.

Under a separate agreement under the HEU programme, the natural uranium feed component is sold under a commercial arrangement between three western corporations (Cameco, AREVA, and Nukem) and Techsnabexport of the Russian Federation. Outside of the natural uranium feed component of HEU-derived LEU, imports of uranium from the Russian Federation have been limited by the *Agreement Suspending the Antidumping Duty Investigation on Uranium from the Russian Federation* (Suspension Agreement) signed between the US Department of Commerce (DOC) and the Ministry of Atomic Energy of the Russian Federation in 1992. As a result of the Suspension Agreement, DOC suspended antidumping investigations and the Russian Federation agreed to sell uranium to the United States under a quota system whereby Russian imports would have to be matched by an equivalent quantity of newly produced US uranium. A 1994 amendment to the suspension agreement contained language specifying an expected termination date of 31 March 2004. However, Russia did not request the DOC to undertake a termination review, a requirement for termination, and the DOC took the position that the Suspension Agreement had not expired. A second sunset review agreement was subsequently signed on 1 July 2005, maintaining the Suspension Agreement terms during the review.

In September 2005, the governments of the United States and Russian Federation issued a joint statement acknowledging that the implementation of the HEU Purchase Agreement had achieved its halfway point with 250 tonnes of HEU having been down-blended to low enriched uranium out of the total 500 metric tons of HEU covered in the agreement. As of 30 June 2007, 306 tonnes of HEU had been down-blended and 8 930 tonnes of low enriched uranium fuel have been delivered to the United States for use in commercial reactors. Deliveries as of 30 June 2007 represent the dismantlement of 12 231 nuclear warheads.

United States highly enriched uranium

The United States has committed to the disposition of 174.3 tonnes of surplus HEU with about 151 tonnes planned to be eventually blended down for use as LEU fuel in research and commercial reactors and 23 tonnes slated for disposal as waste. Through 2006, 94 tonnes of HEU were down-blended yielding 1 051 tonnes of LEU fuel.

The Department of Energy (DOE) and Tennessee Valley Authority (TVA) entered an Interagency Agreement in April 2001, whereby TVA will utilise LEU derived from blending down about 33 tonnes of US surplus HEU. In 2004 this agreement was modified to increase the total to 39 tonnes of HEU. This LEU is considered "off-spec" because it contains ^{236}U in excess of the specifications established for commercial nuclear fuel. Different portions of this material are being down-blended at DOEs Savannah River site (SRS) and at a TVA contractor. Down-blending began at SRS in 2003 and at the contractor facility in 2004. This down-blending programme will continue through 2007 and use of the resultant blended low enriched uranium (BLEU) fuel at TVA reactors is expected to continue until 2016.

About 10 tonnes of surplus HEU will be blended down to make low enriched research reactor fuel through approximately 2016. In addition, 17.4 tonnes of HEU will be down-blended to low enriched uranium fuel as part of the Reliable Fuel Supply initiative announced by DOE in September 2005. Under the Reliable Fuel Supply initiative, the United States will keep a reserve of low enriched uranium that, in the event of a market disruption, can be sold to countries that forgo enrichment and reprocessing. On 29 June 2007, the DOE's National Nuclear Security Administration (NNSA) awarded a contract to Wesdyne International, LLC (a subsidiary of Westinghouse Electric Company, LLC) and Nuclear Fuel Services, Inc. to down-blend the 17.4 tonnes of HEU between 2007 and 2010, producing about 290 tonnes of low enriched uranium fuel. The fuel will be available for use in civilian reactors by nations that are not pursuing uranium enrichment and reprocessing technologies. Qualifying countries will have access to the fuel at the current market price only in the event of an emergency that disrupts the normal flow of fuel supply.

In November 2005, the DOE announced that an additional 200 tonnes of HEU beyond the initially declared 174.3 tonnes of HEU would be permanently removed from further use by the United States in nuclear weapons. Of the additional 200 tonnes HEU, 160 tonnes will be provided for use in naval propulsion, 20 tonnes is to be blended down to low enriched uranium fuel for use in power or research reactors, and 20 tonnes reserved for space and research reactors that currently use HEU, pending development of fuels that would enable the conversion to low enriched uranium fuel cores. For power reactors, the LEU would become available gradually over a 25-year period.

2. Nuclear fuel produced by reprocessing spent reactor fuels and surplus weapons-related plutonium

The constituents of spent fuel from power plants are a potentially substantial source of fissile material that could displace primary production of uranium. When spent fuel is discharged from a commercial reactor it is potentially recyclable, since about 96% of the original fissionable material remains along with the plutonium created during the fission process. The recycled plutonium can be reused in reactors licensed to use mixed-oxide fuel (MOX). The uranium recovered through reprocessing of spent fuel, known as reprocessed uranium (RepU), is not routinely recycled; rather, it is stored for future reuse.

The use of MOX has not yet significantly altered world uranium demand because only a relatively small number of reactors are using this type of fuel. Additionally, the number of recycles possible using current reprocessing and reactor technology is limited by the build-up of plutonium isotopes that are not fissionable by the thermal neutron spectrum found in light-water reactors and by the build-up of undesirable elements, especially curium.

In January 2007 there were over 33 reactors, about 8% of the world's operating fleet,[8] licensed to use MOX fuel, including reactors in Belgium, France, Germany, India and Switzerland (Table 30).

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[8] In December 2002, Sweden authorised the limited use of MOX fuel at the Oskarshamn nuclear power plant. This decision allows the use of 900 kg of plutonium separated from spent fuel removed from Swedish reactors prior to 1982. Since 1982, Swedish used nuclear fuel has been placed in storage pending final disposal.

Additional reactors could be licensed to use MOX in China and the Russian Federation. The United States has licensed a reactor to use MOX as part of its weapons material disposition programme and initial tests of MOX fuel were loaded in 2005. In addition, the United States has proposed a new programme, the Global Nuclear Energy Partnership, which is intended to work with international partners to demonstrate the capability to safely recycle used nuclear fuel using more proliferation-resistant processes.

MOX reprocessing and fuel fabrication facilities exist or are under construction in China, France, India, Japan, the Russian Federation and the United Kingdom. Japan Nuclear Fuel Ltd. has been performing test separation of plutonium at the Rokkasho reprocessing plant since March 2006 and Japanese utilities are aiming to use MOX fuel in 16 to 18 reactors by 2010, following consultations and licensing processes. Initially, MOX fuel manufactured overseas will be used, followed by the use of MOX fuel produced at Rokkasho.

In September 2004, Cogema (now AREVA) filed an application with the French authorities to increase production at its Marcoule site from 145 tHM to 195 tHM. In July 2006, the MOX fuel plant in Belgium (Belgonucléaire) was shut down.

The Euratom Supply Agency (ESA) reported that the use of MOX fuel in the EU-15[9] reduced natural uranium requirements by an estimated 1 010 tU in 2005 and 1 225 tU in 2006. Since 1996, the ESA estimates that EU-15 reactors have displaced 11 515 tU through the use of 95.8 tonnes of plutonium in MOX fuel [2]. Since the great majority of world MOX use occurs in Western Europe, this figure provides a reasonable estimate of the impact of MOX use worldwide during that period.

Responses to the questionnaire provided some data on the production and use of MOX (Table 30).

Table 30. **MOX production and use**
(tonnes of equivalent natural U)

COUNTRY	**Pre-2004**	**2004**	**2005**	**2006**	**Total to 2006**	**2007** (expected)
MOX production						
Belgium	437	86	0	0	523	0
France	8 600	1 110	1 160	1 160	12 030	1 160
Japan	583	15	0	0	598	9
United Kingdom	NA	0	11	22	NA	11
MOX use						
Belgium	437	29	28	26	520	0
France	NA	800*	NA	NA	NA	NA
Germany	4 560	480	480	320	5840	240
Japan	331	2	4	8	345	3
Switzerland	1 022	12	108	159	1 301	26
United States	0	0	0.1		0.1	0

NA Not available or not disclosed.

* Data from 2005 Red Book.

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[9] Data are for the fifteen EU countries prior to enlargement in May 2004. No MOX fuel is used in new member states.

Uranium recovery through reprocessing of spent fuel, known as RepU, has been conducted in the past in several countries, including Belgium and Japan. It is now routinely done only in France and the Russian Federation, principally because recycling of RepU is a relatively costly endeavour, in part due to the requirement for dedicated conversion, enrichment and fabrication facilities. Changing market conditions and non-proliferation concerns are, however, leading to renewed consideration of this recycling option. Very limited information is available concerning how much reprocessed uranium is used though available data indicate that it represents less than 1% of projected world requirements annually (Table 31).

Table 31. **Re-processed uranium production and rse**
(tonnes of equivalent natural U)

COUNTRY	**Pre-2003**	**2004**	**2005**	**2006**	**Total to 2006**	**2007** (expected)
Production						
France	NA	1 100	1 100	1 100	NA	1 100
Japan (a)	595	50	0	0	645	0
Russian Federation*	NA	1 300	1 300	1 300	NA	1 300
United Kingdom	~50 000	NA	1 270	NA	~51 270	NA
Use						
Belgium	508(b)	0	0	0	508	0
France*	NA	275	275	275	NA	275
Japan (a)	64	28	46	27	165	54
Switzerland	1 009	254	281	244	1 788	289
United Kingdom	~15 000	NA	NA	NA	~15 000	NA

NA Data not available.
* Secretariat estimate.
(a) For fiscal year.
(b) From 1993 to 2002.

Mixed-oxide fuel produced from surplus weapons-related plutonium

In September 2000, the United States and the Russian Federation signed an agreement for the disposition of surplus plutonium. Under the agreement, both the United States and the Russian Federation will each dispose of 34 tonnes of surplus weapon-grade plutonium at a rate of at least two tonnes per year in each country once facilities are in place. Both countries agreed to dispose of surplus plutonium by fabricating it into MOX fuel for irradiation in nuclear reactors and the development of MOX fuel fabrication facilities is underway in both countries. This approach will convert the surplus plutonium to a form that cannot be readily used to make a nuclear weapon.

On 3 March 2005, the NRC announced that it had issued a license amendment that authorises Duke Power to use four mixed-oxide (MOX) fuel lead assemblies fabricated in France at its Catawba nuclear power plant near Rock Hill, S.C. On 1 August 2007, DOE’s NNSA initiated construction of a MOX fuel fabrication facility at the US Department of Energy’s Savannah River site near Aiken, South Carolina. It is expected to begin producing MOX fuel in 2016 for use in four specially licensed commercial reactors.

The 68 tonnes of weapons-grade plutonium would displace about 14 000 to 16 000 tonnes of natural uranium over the life of the programme. This represents about 1% of world annual uranium requirements over the period of the programme.

3. *Uranium produced by re-enrichment of depleted uranium tails*[10]

Depleted uranium stocks represent a significant reserve of uranium that could displace primary uranium production. However, the re-enrichment of depleted uranium has been limited as a secondary source of uranium since it is only economic in centrifuge enrichment plants that have spare capacity and low operating costs.

At the end of 2005 the inventory of depleted uranium is estimated at about 1 600 000 tU and to be increasing by about 60 000 tU annually based on uranium requirements of 66 000 tU per annum [3]. If this entire inventory was re-enriched to levels suitable for nuclear fuel it would yield an estimated 450 000 tU of equivalent natural uranium, which would be sufficient for about seven years of operation of the world's nuclear reactors at the 2006 uranium requirement levels.[11] However, this would require significant spare enrichment capacity that is not currently available.

Deliveries of re-enriched tails from the Russian Federation are a significant source of uranium for the EU, representing 3-8% of the total natural uranium delivered annually to EU reactors between 2001 and 2006 (Table 32). However, in 2006, the Russian Federation indicated that it will stop the re-enrichment of depleted uranium tails once the existing contracts come to an end.

Table 32. **Russian Federation supply of re-enriched tails to European Union end users**

Year	**Re-enriched tail deliveries** (tU)	**Percentage of total natural uranium deliveries**
2001	1 050	7.6
2002	1 000	6.0
2003	1 200	7.3
2004	900	6.2
2005	500	2.8
2006	700	3.3

Sources: Euratom Supply Agency (2007), *Annual Report 2006*, Luxembourg.

In the United States, the DOE and the Bonneville Power Administration have initiated a pilot project to re-enrich 8 500 tU of the DOE tails inventory. The pilot project is anticipated to produce, over a two-year period, a maximum of 1 900 tonnes of natural uranium equivalent for use by the Columbia Generating Station between 2009 and 2017.

Additional information on the production and use of re-enriched tails is not readily available. The information provided, however, indicates that its use is relatively limited (See Table 33).

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[10] Depleted uranium is the by-product of the enrichment process having less ^{235}U than natural uranium. Normally, depleted uranium tails will contain between 0.25 and 0.35% ^{235}U compared with the 0.711% found in nature.

[11] OECD Nuclear Energy Agency, (2007) *Management of Recyclable Fissile and Fertile Materials*, Paris, France. This total assumes 1.6 million tU at 0.3% assay is re-enriched to produce 420 000 tU of equivalent natural uranium, leaving 1 080 000 tU of secondary tails with an assay of 0.14%.

Table 33. **Re-enriched tails use**
(tonnes of equivalent natural U)

COUNTRY	Pre-2003	2004	2005	2006	Total to 2006	2007 (expected)
Belgium	345	0	0	0	345	0
Finland	287	140	60	108	595	140
France (a)	NA	0	0	0	NA	0

NA Data not available.

(a) A small amount of tails are re-enriched in the Russian Federation and recycled within the Georges Besse enrichment plant.

Uranium market developments

Uranium price developments

Some national and international authorities, i.e., Australia, United States and the Euratom Supply Agency, make available price indicators to illustrate uranium price trends. Additionally, spot price indicators for immediate or near-term delivery (typically less than 15% of all uranium transactions) are regularly provided by industry sources such as the TradeTech, Ux Consulting Company LLC (UxC) and others. Figure 15 shows a comparison of annual average delivered prices reported by various government sources.

The over-production of uranium, which lasted through 1990 (Figure 13), combined with the availability of secondary sources, resulted in uranium prices trending downward from the early-1980s until 1994 when they reached their lowest level in 20 years. Between 1990 and 1994 there were significant reductions in many sectors of the world uranium industry including exploration, production and production capability. This decreasing supply situation combined with growing demand for uranium and the bankruptcy of an important uranium trading company resulted in a modest recovery in uranium prices from October 1994 through mid-1996. This trend, however, reversed as increasingly better information about inventories and supplies maintained downward pressure on uranium prices until 2001.

Beginning in 2001, the price of uranium began to rebound from historic lows to levels not seen since the 1980s and continued to rise through 2006. Price information from a limited number of government sources all display this trend (Figure 15). Depending on the nature of the purchases (long term contracts versus spot market), the limited information available on uranium purchases in 2006 indicate that purchase prices ranged between USD 45/kgU and USD 75/kgU (USD 17/lbU_3O_8 and USD 29/lbU_3O_8).

While the trend of increasing prices has also been characteristic of information available on purchases made on the spot market since 2001, and in particular after 2003, the price has been much more volatile. In June 2007, the spot market price reached as high as USD 136/lb U_3O_8 (USD 354/kgU) before declining to USD 85/lb U_3O_8 (USD 221/kgU) in October 2007 (Figure 16).[12] Note that Figure 15 reflects mostly long-term contracts and thus the dynamic changes of the past two years are not as evident as the changes shown in Figure 16.

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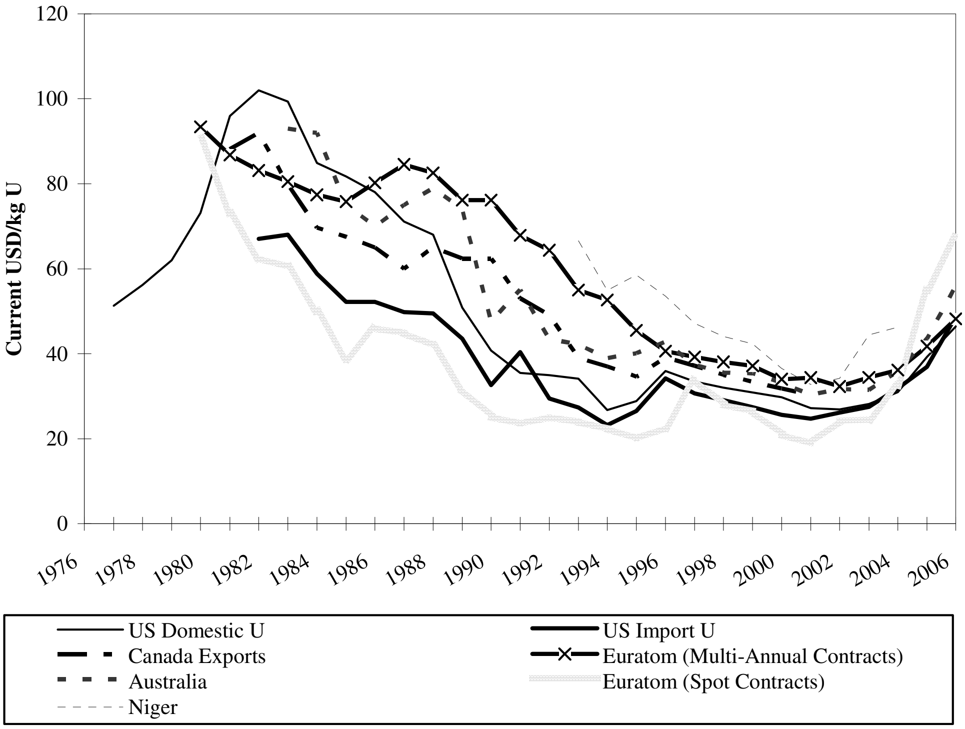
[12] Spot price data courtesy of TradeTech (www.uranium.info).

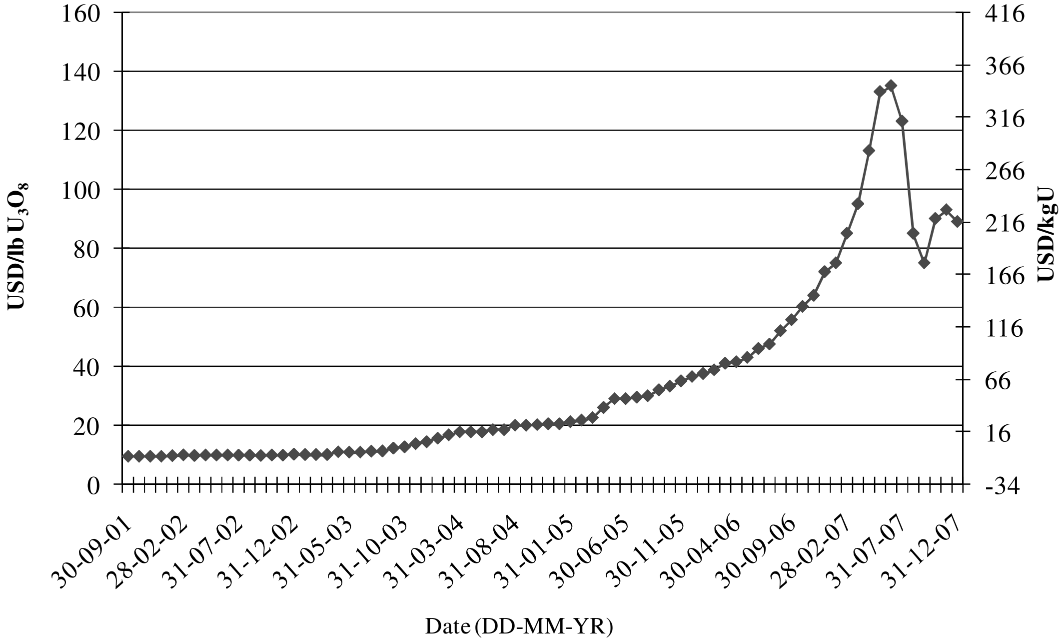
Figure 15. **Uranium prices: 1976-2006**



Notes: 1. Euratom prices refer to deliveries during that year under multi-annual contracts.
2. Beginning in 2002, Natural Resources Canada (NRCan) suspended publication of export price for 3-5 years pending a policy review.

Sources: Australia, Canada, Euratom Supply Agency, Niger, United States.

Figure 16. **NUEXCO exchange value trend** (30 September 2001 – 31 December 2007)



A variety of reasons have been put forward to account for the price changes experienced in the last few years, including problems experienced in nuclear fuel cycle production centres in 2003 and weakness of the United States dollar, the currency used in many uranium transactions, which began a significant decline against the major world currencies in 2002. While these events likely did not, in themselves, cause the price increase, all combined to create uncertainty about the robustness of the supply chain. An increasing sense of the finite nature of inventories, the expansion of nuclear power generation in countries such as China and Russia, the recognition by many governments that nuclear power can produce competitively priced base load electricity that is essentially free of greenhouse gas emissions and the role nuclear can play in enhancing security of energy supply have all likely contributed to the strengthening market. The appearance of speculators in the market has also impacted uranium prices by introducing demand from sources outside the electricity generation industry. In fact, purchases by speculators may have been an important factor in the rapid upward ascendancy of price since early 2007. The downturn in price since June 2007 has alternately been attributed to a market correction or a seasonal slow-down in activity. Regardless of the cause, the uranium spot market price has gone through more rapid and significant changes in 2007 than it has in decades, creating great interest in the commodity and injecting much needed investment into the industry.

Other market developments

On 13 February 2002, the Department of Commerce (DOC) issued determinations in antidumping and countervailing duty investigations involving LEU from France, Germany, the Netherlands, and the United Kingdom. The DOC placed an antidumping duty order on LEU imports from France while all four countries were issued countervailing duty orders. The decision resulted in countervailing duties being assessed against France, but not against Germany, the Netherlands, and the United Kingdom. The DOC determinations were challenged at the US Court of International Trade (CIT). The US Court of Appeals for the Federal Circuit (CAFC) affirmed in March 2005 a ruling by the US Court of International Trade (CIT) that contracts for the purchase of enrichment services, quantified by separative work units, were contracts for the sale of services, not goods. US antidumping law applies only to the sale or purchase of goods, not services. The CAFC further affirmed that CIT was correct in ruling that the Department of Commerce’s approach to defining the word “producer” was in accordance with law. This provides USEC the ability to trigger the antidumping and countervailing subsidy investigations. This ruling, if confirmed, could impact the imposition of duties on LEU imported from the European Union, as well as, the Russian Suspension Agreement on Uranium, which is based on US antidumping law and covers uranium enriched in Russia. Pending a final resolution that may involve further appeals and re-hearings, the import duties now imposed will continue to be collected.

Policy measures in the European Union

Since its establishment in 1960 under the Euratom Treaty, the Euratom Supply Agency (ESA) has pursued a policy of diversification of sources of nuclear fuel supply in order to avoid over-dependence on any single source. Within the European Union, all uranium purchase contracts by EU end-users (i.e. nuclear utilities) have to be approved by the ESA. In approving such contracts, the ESA is seeking to maintain a sufficient diversity of supply sources, with the aim of enhancing security of supply. The main effect of this policy in recent years has been to generally reduce the market share of supplies from the Russian Federation (even though the enlargement of the EU added some Russian designed nuclear power plants to the EU and supplies from the Russian Federation correspondingly increased in 2006, compared to 2005). The results of the application of the supply diversification policy are set out in the ESA Annual Reports, which showed that in 2006 the total supply of natural uranium and feed contained in EUP from the Russian Federation comprised about 26% of the EU market (including a proportion of the material derived from ex-military HEU).

In November 2003, the European Commission received negotiating directives from the European Council to start negotiations with the Russian Federation for a nuclear trade agreement. The agreement will have to take into account the new market conditions in the enlarged EU and the special relations between the new member states and the Russian Federation in this field. The agreement will also take into consideration the interests of European consumers and the need to maintain the viability of EU industries at the front end of the fuel cycle. A draft agreement was presented to the Russian Federation in 2004. As of 2006, however, negotiations with the Russian Federation on the draft agreement have not progressed.

The Euratom Supply Agency continues to stress the importance for utilities to maintain an adequate level of strategic inventory and to use market opportunities to increase their inventories, consistent with their circumstances. Furthermore, it recommends that utilities cover most of their needs under long-term contracts with diversified supply sources.

Supply and Demand to 2030

Market conditions are the primary driver of decisions to develop new or expand existing primary production centres. As market prices have increased significantly, plans for increasing production capability have developed rapidly. A number of countries, notably Australia, Canada, Kazakhstan and South Africa, have reported plans for significant additions to planned future capability. Moreover, in some African countries production centres not anticipated in the 2005 Red Book have been developed that are either in production or are expected to be producing in the near future. These developments are indeed timely as demand is rising and secondary sources are declining in availability.

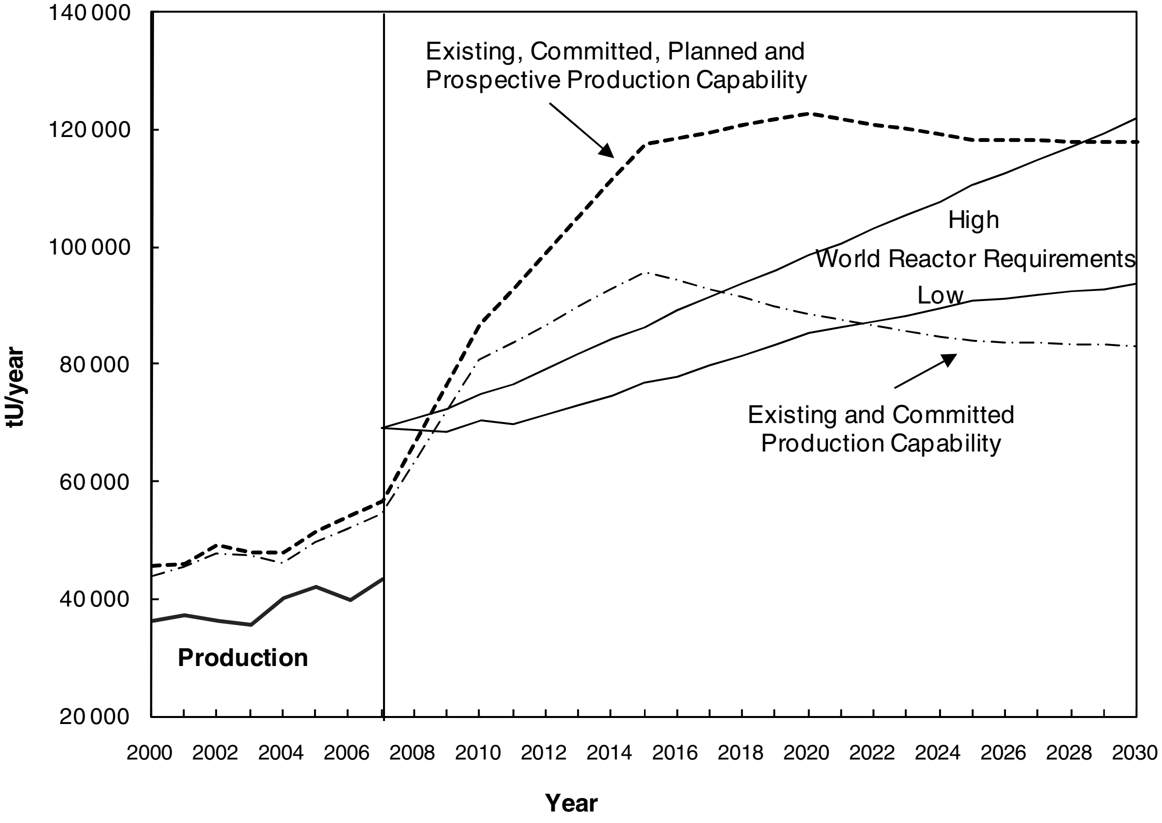
The supply and demand picture is evolving rapidly as strong market conditions are stimulating heightened activity. Not only is demand to 2030 projected to rise, but a dynamic expansion of production capability has significantly altered the supply – demand relationship of the recent past, such that even requirements stemming from the high case demand scenario could be met through 2028 if all Existing, Committed, Planned and Prospective production centres are developed on time and full production capability is achieved (Figure 17). In contrast, planned capability from all reported Existing and Committed production centres, although potentially exceeding high case demand requirements between 2010 and 2017, is projected to satisfy about 89% of the low case requirements but only about 68% of the high case requirements in 2030. With Planned and Prospective production centres, primary production capability would be adequate to satisfy low case requirements to 2030, but in the high case primary production capability would fall short (97% of high case requirements in 2030).

Although it may be tempting to interpret projections of production capability portrayed in Figure 17 as indicating an oversupplied market, past experience shows that this is not likely to be the case. Production capability is not production. To the left of the vertical line demarcating 2007 (Figure 17), world production (including expected production in 2007) has been plotted to illustrate the difference existing today between production and production capability. The challenge will be closing the gap between world production and high and low reactor requirements in the coming years.

World production has never exceeded 89% of reported production capability [4] and since 2003 has varied between 75% and 84% of production capability. Given the recent record of mine development, delays in the establishment of new production centres can reasonably be expected, reducing and/or delaying anticipated production from Planned and Prospective centres. Hence, even though the industry has responded vigorously to the market signal of high prices, additional primary production and secondary supply will be required, supplemented by uranium savings achieved by specifying low enrichment tails assays, to the extent possible. After 2013, secondary sources of uranium are expected to decline in availability and reactor requirements will have to be increasingly met by primary production [5]. Therefore, despite the significant additions to production capability reported here, there remains pressure to bring facilities into production in a timely fashion. To do so, strong market conditions will be required to bring the necessary investment to the industry.

A key element in the uranium market continues to be the availability of secondary sources, particularly the level of stocks available and the length of time remaining until those stocks are exhausted. As Table 29 shows, accurate information on secondary sources of uranium, especially inventory levels, is not readily available. This hampers effective decision making on new production capability. However, it is clear that the strong market of late has spurred increased exploration and the development of production capability.

Figure 17. **Projected annual world uranium production capability through 2030 compared with projected world reactor requirements***



Sources: Tables 17 and 21.

* Includes all Existing, Committed, Planned and Prospective production centres supported by RAR and Inferred Resources recoverable at a cost of <USD 80/kgU.

D. THE LONG-TERM PERSPECTIVE

Uranium demand is fundamentally driven by the number of operating nuclear reactors, which ultimately is driven by the demand for electricity. World demand for electricity is expected to double from 2002 through 2030 to meet the needs of an increasing population and sustained economic growth. The International Energy Agency reference scenario projection indicates that 5 087 GW of new capacity will be needed by 2030 to meet the projected increase in electricity demand and to replace ageing infrastructure [6]. Growth is expected to be strongest in nations seeking to improve their standard of living, led by India and China. The significance of the role that nuclear energy will play in future electrical generation will depend on how effectively a number of factors discussed earlier are addressed (economics, safety, non-proliferation concerns, security of supply, waste disposal, environmental considerations, etc.) and how public acceptance of nuclear energy evolves.

The extent to which nuclear energy is seen as beneficial in meeting greenhouse gas reduction targets could potentially increase the role of nuclear energy in future electrical generation. As noted by the Intergovernmental Panel on Climate Change (IPCC), electricity generated from fossil fuels has been by far the biggest culprit in terms of emissions growth since 1970, exceeding by two times the next largest energy contributor and growing at a much faster rate [7]. Highlighting the role that this environmental issue could play in future development, the IEA alternative policy scenario envisions slightly lower growth in electricity generation overall, but an increasing share of nuclear generating capacity in order to reduce greenhouse gas emissions. Recent sustained increases in fossil fuel prices have also increased interest in nuclear energy because of the significant role that fuel costs play in fossil energy generation costs compared to nuclear energy, thereby improving the relative economic competitiveness of nuclear energy [8]. Dependence on imported fossil fuels in some countries has also raised concerns about the security of energy supplies. However, in countries where public concerns about safety, security, non-proliferation and waste disposal are not convincingly addressed, the contribution that nuclear energy makes to the future energy mix could be limited. Yet, if only 10% of this projected increase in capacity is met by nuclear energy this would more than double the current installed capacity with a corresponding impact on uranium requirements.

Several alternative uses of nuclear energy have the potential to heighten its role worldwide, such as the desalination of seawater, heat production for industrial or residential purposes and ultimately, the production of hydrogen. While heat production will likely remain a niche use, the potential exists for desalination and hydrogen production to become significant roles for nuclear energy. The increasing need for fresh water has led to plans being announced for the use of nuclear desalination plants in several countries, such as China, India, Korea, Morocco, Pakistan and the Russian Federation. If these plans come to fruition they could significantly increase uranium requirements.

Energy use for transportation, which is projected to continue to grow rapidly over the coming decades, is also a major source of greenhouse gas emissions. Hydrogen is seen as a potential replacement for fossil fuels, as a means of reducing emissions. Nuclear energy offers the potential of producing hydrogen that could make this alternate energy carrier available with significantly less greenhouse gas emissions compared to current methods of hydrogen production. Any electricity-producing reactor can produce hydrogen through the process of electrolysis. As the market for hydrogen continues to develop more commercial reactors may install electrolysis equipment to permit them to produce hydrogen during off-peak hours, thus permitting optimal usage of the baseload generating capability of the reactor and maximising revenue. The overall efficiency of production of hydrogen in this way, however, is relatively low. Some existing reactors and high-temperature reactors under development hold the promise to generate hydrogen at much higher efficiencies using high-temperature steam electrolysis or thermo-chemical processes.

Recently launched multilateral fuel cycle initiatives also have the potential to alter uranium demand. Driven by rising energy needs, non-proliferation and waste concerns, governments and the IAEA have made a number of proposals that could accelerate the development of a closed fuel cycle and lead to the establishment of multilateral enrichment and fuel supply centres. As of December 2007, 19 nations (Australia, Bulgaria, Canada, China, France, Ghana, Hungary, Italy, Japan, Jordan, Kazakhstan, Lithuania, Poland, the Republic of Korea, Romania, the Russian Federation, Slovenia, Ukraine and the United States) further promoted development of the Global Nuclear Energy Partnership (GNEP) by signing a "Statement of Principles". The GNEP programme promises to aid the expansion of the peaceful use of nuclear energy through enhanced safeguards, international fuel service frameworks, and advanced technologies, including reprocessing and the development of fast breeder reactors. The Uranium Enrichment Centre created by the Russian Federation and Kazakhstan is an alternative approach to address non-proliferation concerns by allowing international partners access to enriched nuclear fuel without having to deploy the technology locally.

Technological advancements also promise to be a factor in defining the long-term future of nuclear energy and uranium demand. Advancements in reactor and fuel cycle technology not only promise to address economic, safety, security, non-proliferation and waste concerns, but also to radically increase the efficiency with which uranium resources are utilised. The introduction and use of advanced reactor designs would also permit the use of other materials as nuclear fuel, such as uranium-238 and thorium, thereby expanding the available resource base. Moreover, breeder reactors could produce more fuel than they consume, since spent fuel could be recovered, reprocessed and reused to produce additional energy.

Many national and several major international programmes are working to develop advanced technologies, for example, the Generation IV International Forum (GIF) and the IAEA International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). The objective of INPRO is to help to ensure that nuclear energy is available to contribute, in a sustainable manner, to the energy needs in the 21st century. As of July 2007, 27 countries (Argentina, Armenia, Belarus, Belgium, Brazil, Bulgaria, Canada, Chile, China, Czech Republic, France, Germany, India, Indonesia, Japan, Republic of Korea, Morocco, Netherlands, Pakistan, the Russian Federation, Slovakia, the Republic of South Africa, Spain, Switzerland, Turkey, Ukraine, and the United States) and the European Commission were working together in the INPRO Project.

Argentina, Brazil, Canada, France, Japan, the Republic of Korea, the Republic of South Africa, Switzerland, the United Kingdom, the United States and Euratom are members of GIF. In 2002, the GIF selected six nuclear energy system concepts to be the focus of continued collaborative research and development. The reactor concepts are a sodium-cooled fast reactor, a very high-temperature reactor, a supercritical water reactor, a lead-cooled fast reactor, a gas-cooled fast reactor and a molten-salt reactor. All but the very high-temperature reactor involves recycling fuel and several may be suitable for hydrogen production.

As documented in this volume, sufficient resources exist to support significant growth in nuclear capacity for electricity generation in the long-term. Identified Resources[13] are sufficient for over 80 years, considering 2006 uranium requirements of 66 500 tU. If estimates of current

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[13] Identified resources include all cost categories of RAR and Inferred Resources for a total of about 5 468 800 tU (Table 2).

(2006) rates of uranium consumption in power reactors[14] are used (a more realistic approach, since uranium requirements are government expectations of annual national uranium purchases; not the uranium consumed in nuclear fuel), the Identified Resource base would be sufficient for about 100 years of reactor supply, without considering uranium savings achieved by for example, specifying lower tails assays or using MOX fuel. Exploitation of the entire Conventional Resource[15] base would increase this about 300 years, though significant exploration and development would be required to move these resources into more definitive categories. Given the limited maturity and geographical coverage of uranium exploration worldwide, there is considerable potential for discovery of new resources of economic interest.

As noted in the Uranium Supply chapter, there are also considerable Unconventional Resources, including uranium contained in phosphate rocks, that could be utilised to significantly lengthen the time that nuclear energy could supply energy demand using current technologies. However, considerable effort and investment would need to be devoted to better defining the extent of this potentially significant source of uranium.

Deployment of advanced reactor and fuel cycle technologies could also significantly add to world energy supply in the long-term. Moving to advanced technology reactors and recycling fuel could increase the long-term availability of nuclear energy from hundreds to thousands of years. In addition, thorium, which is more abundant than uranium in the earth's crust, is also a potential source of nuclear fuel, if alternative fuel cycles are developed and successfully introduced. Thorium-fuelled reactors have already been demonstrated and operated commercially in the past.

Thus, sufficient nuclear fuel resources exist to meet energy demands at current and increased demand well into the future. However, to reach their full potential considerable exploration, research and investment is required, both to develop new mining projects in a timely manner and to facilitate the deployment of promising technologies.

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[14] Uranium usage per TWh is taken from OECD/NEA (2001), *Trends in the Nuclear Fuel Cycle*, Paris [9]. These were used to define how much electricity could be generated for the given levels of uranium resources. Years of generation were then developed by factoring in the 2006 generation rate (2 675 TWh net, Table 26) and rounding to the nearest five years.

[15] Total conventional resources includes all cost categories of RAR, Inferred, Prognosticated and Speculative Resources for a total of about 16 008 900 tU (Tables 2 and 11). This total does not include secondary sources or unconventional resources, e.g. uranium from phosphate rocks.

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[6] IEA (2006), *World Energy Outlook: 2006*, OECD, Paris, France.

[7] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2007), Working Group II Report, "Impacts, Adaptation and Vulnerability", http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf.

[8] NEA (2005), *Projected Costs of Generating Electricity – 2005 Update*, OECD, Paris, France.

[9] NEA (2001), *Trends in the Nuclear Fuel Cycle*, OECD, Paris, France.

III. NATIONAL REPORTS ON URANIUM EXPLORATION, RESOURCES, PRODUCTION, DEMAND AND THE ENVIRONMENT

INTRODUCTION

Part III of the report presents the national submissions on uranium exploration, resources and production. These reports have been provided by official government organisations (Appendix 2) responsible for the control of nuclear raw materials in their respective countries and the details are the responsibility of the individual organisations concerned. In countries where commercial companies are engaged in exploration, mining and production of uranium, the information is first submitted by these companies to the government of the host country and may then be transmitted to the NEA or the IAEA at the discretion of the government concerned. In certain cases, where an official national report was not submitted and where deemed helpful to the reader, the Secretariat has provided additional comments or estimates to complete the Red Book. Where utilised, the Secretariat estimates are clearly indicated.

The Agencies are aware that exploration activities may be currently proceeding in a number of other countries which are not included in this report. They are also aware that in some of these countries uranium resources have been identified. However, it is believed that the total of these resources would not significantly affect the overall conclusions of this report. Nevertheless, both Agencies encourage the governments of these countries to submit an official response to the questionnaire for the next Red Book exercise.

Finally, it should be noted that the national boundaries depicted on the maps that accompany the country reports are for illustrative purposes and do not necessarily represent the official boundaries recognised by the member countries of the OECD or the Member states of the IAEA.

Additional information on the world's uranium deposits is available in the IAEA publications: "World Distribution of Uranium Deposits" (STI/PUB/997), together with the "Guidebook to accompany the IAEA Map: World Distribution of Uranium Deposits" (STI/PUB/1021). The location of 582 uranium deposits is given on a geologic base map at the scale 1:30 000 000. The guidebook (which is available at no cost with purchase of the map) and map provide information on the deposit: type, tectonic setting, age, total resources, average uranium grade, production status and mining method. They may be ordered from:

INTERNATIONAL ATOMIC ENERGY AGENCY
Sales & Promotion Unit, Division of Publications
P.O. Box 100, Wagramerstrasse 5, A-1400 Vienna, Austria

Telephone: (43) 1-2600-22529
Facsimile: (43) 1-26007-29302
Electronic Mail: sales.publications@iaea.org

Forty member countries submitted a response to the questionnaire and the Secretariat drafted one country report. As a result, there are a total of 41 national reports in the following section. This edition uses the revised format introduced in 2005, where the data tables are provided at the end of each country's report.

• Algeria •

URANIUM EXPLORATION

Historical review

Uranium exploration began in Algeria in 1969. The Precambrian shield of the Hoggar and its Tassilian sedimentary cover were considered to provide a geological environment favourable for uranium mineralisation. Initial exploration, carried out by means of ground radiometric surveys, found several radioactive anomalies (Timgaouine, Abankor and Tinef). In 1971, an aerial radiometric survey was performed over the entire country, an area of 2 380 000 km^2. After evaluation of the data from that survey, several prospecting teams were involved in ground follow-up and in verifying anomalies. This led to the discovery of a large number of promising areas for further uranium exploration: Eglab, Ougarta, and southern Tassili (Tin-Seririne basin) where the Tahaggart deposit was discovered. Follow up of the aerial radiometric survey also led to identification of the Tamart-N-Iblis and Timouzeline sectors as areas for future uranium exploration. At the same time, the search for uranium entered a phase (1973-1981), which focused primarily on evaluation of the deposits already discovered. A second phase (1984-1987) was characterised by a marked slowdown in the search effort; however, investigations of the flanks of the known deposits and in neighbouring regions revealed other potential mineralised areas (e.g. Tesnou zone in the northwest and north Timgaouine). In Tin-Seririne basin (Tassili south of the Hoggar), geological mapping has resulted in characterisation of the distribution of uranium mineral deposits in the Paleozoic sedimentary sequences.

Recent and ongoing uranium exploration and mine development activities

From 1998 to 2006 no exploration or prospecting activity was carried out in the field.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Algeria’s Reasonably Assured Resources are comprised of two geological types: Upper Proterozoic unconformity-related deposits and vein deposits. The first category includes deposits associated with weathering profiles (regolith) and deposits associated with the basal conglomerate and sandstone of the sedimentary cover, which are located primarily in the Tin-Séririne basin in the southern Hoggar. Deposits of the second (vein) type are located in veins in primary fractures associated with faults across granite batholiths. This type of deposit includes the Timgaouine and Abankor in the south-western Hoggar and the El-Bema and Aït-Oklan deposits in the northern Hoggar.

Undiscovered Resources (Prognosticated & SR)

Algeria does not report any resources in any category other than RAR.

URANIUM PRODUCTION

Historical review

Algeria does not produce any uranium.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Environmental protection issues arising from mining activities are addressed in:

- Act No. 01-10 of 3 July 2001 implementing the Mining Act.
- Act No. 03-10 of 19 July 2003 on Environmental Protection for Sustainable Development.
- Environmental issues specific to uranium mining activities will be regulated by the new Nuclear Act which is in the course of preparation.

NATIONAL POLICIES RELATING TO URANIUM

Act No. 01-10 of 3 July 2001 implementing the Mining Act does not give any special status to uranium. The Order of 30 December 2002 listing mineral substances, and in particular Section 3 of the Order, classifies uranium as a non-ferrous metallic mineral without any particular strategic character.

In accordance with the rules in force, any public, private, national or foreign operator may be authorised to prospect for, and mine, uranium.

By Presidential Decree No. 06-183 of 31 May 2006 amending Presidential Decree No. 96-436 of 1 December 1996, the Atomic Energy Commission was attached to the Ministry for Energy and Mines.

An Algerian Nuclear Act is in the course of preparation by the Ministry for Energy and Mines.

In order to meet the country’s major challenges, namely electricity production, the development of the agricultural sector, exploitation of water resources and improvement in health services, there needs to be a comprehensive acquisition of scientific knowledge. There is no doubt that nuclear technologies, in compliance with the Non-Proliferation Treaty to which Algeria is a party, can make an important contribution towards achieving these objectives.

As an oil and gas producer, Algeria is aware of the non-renewable nature of these energy resources which have a limited lifespan. This makes it absolutely necessary for us to diversify our energy sources by exploring sustainable and economically viable options. With this in mind, the Algerian Government has introduced programmes to stimulate research into alternative sources, such as solar, wind and biomass energy, having regard to economic cost and environmental considerations.

At the present time, these programmes need fresh impetus by making use of the most advanced technological developments while considering the place to be given to nuclear energy as a safe, non-polluting and economically attractive alternative, as emphasised by the Paris Conference on the contribution of nuclear energy to the 21st century.

Thus the development of programmes to promote nuclear power and the enhancement of national capacities for energy planning take on a particular interest.

Algeria did not report any information on uranium production, uranium requirements, uranium stocks or uranium prices.

Reasonably Assured Resources*
(tonnes U)

Production method	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**	**Recovery factor** (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	NA	26 000	26 000	
Total	NA	26 000	26 000	

* *In situ* resources.

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
26 000	26 000

• Argentina •

URANIUM EXPLORATION

Historical review

Uranium exploration activities in Argentina began in 1951-1952. The Huemul sandstone deposit was found in 1954, while exploring for red bed copper mineralisation. The Tonco district with the sandstone deposits Don Otto and Los Berthos was discovered by an airborne geophysical survey conducted in 1958. During the late 1950s and the early 1960s, airborne surveys also led to the discovery of the Los Adobes sandstone deposit in Patagonia.

During the 1960s, the Schlagintweit and La Estela vein deposits were found by exploration in granitic terrain. The resources hosted in these deposits were subsequently mined in the production centres of Los Giagantes and La Estela, respectively. In 1968, an airborne survey led to the discovery of the Dr. Baulies deposit, which occurs in volcanoclastic sediments, in Sierra Pintada district in Mendoza province.

During the 1970s, follow-up exploration in the vicinity of the previously discovered uranium occurrences in Patagonia, led to the discovery of two new sandstone deposits: Cerro Condor and Cerro Solo. An airborne survey carried out in 1978 in Patagonia contributed to the discovery of the small Laguna Colorada deposit located in a volcanic environment.

During the 1980s, an airborne survey conducted over granitic terrain identified a number of strong anomalies. Subsequently in 1986, ground exploration identified the vein Las Termas mineralisation. At the end of the 1980s, a nation-wide exploration programme was started to evaluate those geological units that were believed to have uranium potential.

Recent and ongoing uranium exploration and mine development activities

In 1990, exploration was initiated in the vicinity of the Cerro Solo deposit in Patagonia. Since 1998, more than 56 000 m have been drilled to test the potential of favourable portions of the paleochannel structure. The results included the localisation and partial evaluation of specific mineralised bodies containing resources of several thousand tonnes. These results allowed completion of the prefeasibility study for this U-Mo deposit. The National Atomic Energy Commission (CNEA) has developed a programme to complete the feasibility study of the Cerro Solo deposit including the exploration and evaluation of the surrounding areas. This last programme is going to be carried out in 2007 with four or five drill holes surrounding the sector C and 3 000 m in the B sector.

The uranium exploration project of Las Thermas (vein type) has been studied, analysing the samples obtained before. At the present time, a new drill holes programme is presented and is going to be evaluated in the next future.

Some other areas were selected to develop geological studies. This includes the potential for exploitation by the *in situ* leaching technology of some favourable occurrence (sandstone type), favourability studies in granitic environments (vein and episyenite types).

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

There are no significant changes with the information in the 2003 Red Book.

Undiscovered Resources (Prognosticated & SR)

There are no significant changes with the information in 2003 Red Book.

URANIUM PRODUCTION

Historical review

Argentina has been producing uranium since the mid-1950s. A total of seven commercial scale production centres were in operation at different times through 2000. In addition, a pilot plant operated from 1953-1970.

Between the mid-1950s and 1999, the cumulative production totalled 2 509 tU. Since 1996, all the production has come from the San Rafael centre. Production data are given in the relevant table.

Los Colorados mine and mill complex, located in La Rioja province started production in 1993, and was shut down at the end of 1995. Los Colorados was owned and operated by Uranco S.A., a private company. Ore was mined from a small sandstone deposit and treated in the attached IX recovery plant that was relocated to Los Colorados from La Estela project. The closure of the Los Colorados operation resulted in a change in the ownership structure of uranium production in Argentina. Since 1996, the uranium mining industry has been wholly owned by the government agency CNEA.

Status of production capability

The production projects

For about 20 years the nuclear power plants were fed with fuel obtained from national sources. At the end of the nineties, it was decided that due to the gaping disparity between costs of the national concentrates and those produced abroad, uranium had to be imported.

At present CNEA proposes to restart local production. There are better conditions to obtain competitive costs and the government has set up a policy to encourage the growth of nuclear electricity.

Once the decision of completing the Atucha II plant construction and starting operation was taken, Argentina's nuclear power plants fuel requirements might increase in the mid-term from 120 tU/year to 220 tU/year.

The San Rafael Mining-Milling Complex Remediation and Reactivation Project

In June 2004 CNEA presented a proposal to reactivate the San Rafael Mining-Milling Complex to the Mendoza Province and national (Nuclear Regulatory Authority) licensing authorities. The main step of the licensing process is the Environmental Impact Assessment, which includes both the engineering for remediation of wastes generated by the former production stage, and the assessment of environmental management of future production activities. The EIA was carried out by the National Technological University, with the collaboration of the DBE TEC consultant company from Germany and some local institutions.

The EIA was elaborated after two years of intensive work. In the first part, it included wide base studies about the environmental components and the activity risks. It also aimed at solving some concerns the community had with regards to the wastes that are under transitory management and the reactivation project.

The studies carried out concluded that the former operations had neither affected the quality of the underground and surface water of the area nor any other component of the environment in the region.

The remediation can be prior to or simultaneous with the restart of the production operations, which include substantial improvements coherent with the new methodologies to put in practice. These methodologies incorporate additional safety measurements, oriented to improve the environment protection compared to the previous operational stage.

The feasibility of the project is based on re-evaluation studies of the main ore deposit areas, and on the changes of the methodology in mineral treatment which allow an important reduction of cost production. In the period 2003-2004 new pilot tests were performed for confirm the results of the previous ones, aimed at producing important changes in the methodology.

The Cerro Solo Project

At the prefeasibility stage, the Cerro Solo Project, in the Province of Chubut, is at the same time under consideration to reinitiate in the short term the feasibility studies and development-production stage.

With the present conditions in the market, the estimated cost of production of the project has become competitive and the resources could be sufficient to supply the long term needs of nuclear power plants in Argentina.

Cerro Solo is a sandstone uranium-molybdenum ore deposit type, 0.3% U grade, lying between 50 and 120 m deep. The estimated resources are 5 000 tU (RAR and Inferred Resources), and there are high possibilities of increasing these resources in the surrounding area.

Ownership structure of the uranium industry

At present, all of Argentina's uranium industry is government owned.

Employment in the uranium industry

Employment in uranium supply in Argentina amounts to 60 persons.

Secondary sources of uranium

Argentina reported no information on mixed-oxide fuels and re-enriched tails production and use.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

On behalf of the INCO-DC project of the European Union named "Innovative Strategies for the Preservation of Water Quality in Mining Areas of Latin America", hydro-geochemical studies were performed in order to define baseline previous to any mining work in the Cerro Solo U-Mo deposit area. The tasks included were as follows: water and stream sediment surveys, chemical and isotopic studies, geochemical interpretation, ground radiometric mapping and environmental impact evaluation.

Sierra Pintada's ongoing project for updating the feasibility study emphasises good environmental practices. Improvement of surface and underground water monitoring and studies of mining waste and mill tailings management are short-term objectives. The World Bank is now working to supply a grant to remediate all closed uranium mines and production plants.

URANIUM REQUIREMENTS

Supply and procurement strategy

The National Atomic Energy Commission's ongoing projects for restarting uranium production in Argentina in the mid-term, described in different sections of this report, reflect a policy aimed at finding equilibrium between market opportunities and reduction of supply and price uncertainties.

NATIONAL POLICIES RELATING TO URANIUM

There are no restrictions that preclude local and foreign private companies from participating in uranium exploration and production, but local requirements must be met before sales to other countries are possible. The legal framework issued in the 1994-95 period regulates these activities to ensure environmental practices that conform to international standards.

URANIUM STOCKS

As of 1 January 2007, total uranium stocks held by the CNEA amounted to 100 tU.

URANIUM PRICES

There is no uranium market in Argentina.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in ARS	2004	2005	2006	2007 (expected)
Industry exploration expenditures	60 000	600 000	1 020	1 030
Government exploration expenditures	1 800 000	2 100 000	2 000 000	2 000 000
Industry development expenditures	200 000	100 000	NA	NA
Government development expenditures	0	0	NA	NA
Total expenditures	2 060 000	2 800 000	2 001 020	2 001 030
Industry exploration drilling (metres)	0	5 000	NA	NA
Number of industry exploration holes drilled	0	25	NA	NA
Government exploration drilling (metres)	0	1 500	0	3 900
Number of government exploration holes drilled	0	5	0	28
Industry development drilling (metres)	0	NA	NA	NA
Number of development exploration holes drilled	0	NA	NA	NA
Government development drilling (metres)	0	NA	NA	NA
Number of development exploration holes drilled	0	NA	NA	NA
Subtotal exploration drilling (metres)	0	6 500	NA	3 900
Subtotal exploration holes	0	30	NA	28
Subtotal development drilling (metres)	0	NA	NA	NA
Subtotal development holes	0	NA	NA	NA
Total drilling (metres)	0	6 500	NA	3 900
Total number of holes	0	30	NA	28

Uranium exploration and development expenditures – non-domestic

Expenses in ARS	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	0	NA	NA
Government exploration expenditures	0	0	0	0
Industry development expenditures	0	0	NA	NA
Government development expenditures	0	0	0	0
Total expenditures	0	0	NA	NA

Reasonably Assured Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	90
Open-pit mining	5 140	9 040	9 040	90
In situ leaching	NA	NA	NA	
Heap leaching	5 140	9 040	9 040	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	5 140	9 040	9 040	

Argentina

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	2 640	6 400	6 400
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	2 500	2 640	2 640
Metasomatite	0	0	0
Other	0	0	0
Total	5 140	9 040	9 040

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	90
Open-pit mining	2 030	2 030	3 000	90
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	2 030	2 030	3 000	

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	2 030	2 030	3 000
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	2 030	2 030	3 000

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
1 440	1 440

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]	1 807	0	0	0	1 807	0
Underground mining[1]	0	0	0	0	0	0
In situ leaching	0	0	0	0	0	0
Heap leaching	705	1	0	0	706	0
In-place leaching*	0	0	0	0	0	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	2 512	1	0	0	2 513	0

(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.

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

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	60	60	60	80
Employment directly related to uranium production	60	60	60	80

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
120	120	120	120	300	300	500	500	500	500	500	500

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
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Argentina

Total uranium stocks
(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	110	0	0	0	110
Producer	0	0	0	0	0
Utility	NA	0	0	0	NA
Total	NA	0	0	0	NA

• Australia •

URANIUM EXPLORATION

Historical review

A brief historical review of uranium exploration and mine development in Australia is provided in the 2001 edition of the Red Book. For a comprehensive review of the history of uranium exploration and mine development in Australia please refer to *Australia's Uranium Resources, Geology and Development of Deposits*, which can be viewed at:
http://www.ga.gov.au/about/corporate/ga_authors/uranium_resources.jsp

Recent and ongoing uranium exploration and mine development activities

Uranium exploration expenditure in Australia increased from AUD 13.96 million in 2004, to AUD 41.09 million in 2005, and AUD 80.7 million in 2006. In 2006, more than 200 companies professed to have an interest in uranium, compared with approximately 34 companies in the previous year.

The main areas where uranium exploration was carried out during 2005 and 2006 were:

- Frome Embayment [South Australia (SA)] – exploration for sandstone uranium deposits.
- Gawler Craton/Stuart Shelf region (SA) – exploration for hematite breccia complex deposits.
- Arnhem Land [Northern Territory (NT)] – exploration for unconformity-related deposits in Palaeoproterozoic metasediments below a thick cover of Kombolgie Sandstone.

Significant discoveries during 2005 and 2006 included: Four Mile deposit (8 km northwest of the Beverley mine, SA); major extensions of the Olympic Dam deposit (SA); and extensions of Valhalla and Skal deposits [Mt. Isa region, Queensland (Qld)].

At Four Mile deposit in the Frome Embayment, drilling has outlined a broad area of mineralisation covering 5 km^2 in Palaeogene (Tertiary) sands along the flanks of Proterozoic basement rocks of the North Flinders Ranges. There are two deposits within this broad area: Four Mile West and Four Mile East. Four Mile West (covering 1 km^2) has been defined by close-spaced drilling and has Inferred Resources of 3.9 million tonnes averaging 0.37% U_3O_8 (15 000 tonnes of contained U_3O_8) (12 720 tU). The average thickness of the mineralisation within the resource outline is 2.2 m and is hosted by fluviatile sands at 140-170 m depth. Recent drilling at Four Mile East has intersected high grade mineralisation and this has become the focus of an intensive exploration drilling programme with four rigs currently operating at the prospect. Best intersections to date include: 1.5 m @ 2.58% pU_3O_8; and 2.0 m @ 1.37% pU_3O_8 (Note: pU_3O_8 are radiometric grades in drillhole intersections as measured by downhole Prompt Fission Neutron probe).

Exploration drilling in the south-eastern portion of the Olympic Dam deposit has outlined significant additional resources.

Uranium exploration and development expenditures – non-domestic

During 2005 and 2006, Paladin Resources Ltd (an Australian exploration company) completed the development of an open cut mining operation at the Langer Heinrich project in Namibia. Mine production commenced in early 2006. A major exploration drilling programme outlined areas of additional resources adjacent to the deposit. Paladin also continued exploration at the Kayelekera deposit in Malawi.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

At 1 January 2007, Australia's Identified Resources recoverable at costs of less than USD 40/kgU amounted to 1 196 000 tU, compared to 1 044 000 tU at 1 January 2005 – a 15% increase. Australia's Identified Resources recoverable at costs of less than USD 80/kgU amounted to 1 216 000 tU, compared to 1 074 000 tU at 1 January 2005 – a 13% increase. These increases were due to additional resources being defined at Olympic Dam (SA), Ranger (NT), Mt Fitch (Rum Jungle area, NT), Mt Gee (SA), Westmoreland (Qld), and Valhalla deposits (Qld).

Since the compilation of Australia's resource estimates for 1 January 2007, additional reserves/resources have been announced for the Olympic Dam and Ranger 3 deposits, and first estimates released of resources for the Four Mile deposit. Geoscience Australia's estimates of Australia's uranium resources at August 2007 are:

	(tU)		
	<USD 80/kgU	**USD 80-130/kgU**	**<USD 130/kgU**
Reasonably Assured Resources	953 000	11 000	964 000
Inferred Resources	577 000	16 000	593 000

Approximately 93% of Australia's Identified Resources recoverable at less than USD 80/kgU are within the following six deposits:

- Olympic Dam, which is the world's largest uranium deposit;
- Ranger, Jabiluka, Koongarra in the Alligator Rivers region (NT);
- Kintyre and Yeelirrie (Western Australia).

Olympic Dam is the world's largest uranium deposit. Based on Ore Reserves and Mineral Resources reported by BHP Billiton as at June 2006, Geoscience Australia estimated that the deposit contains 476 000 tU in RAR recoverable at <USD 80/kgU. This represents almost 18% of the world's total resources in this category. The total Identified Resources at <USD 80/kgU for Olympic Dam were estimated to be 843 000 tU as at December 2006.

As at June 2007, Geoscience Australia estimated that the Olympic Dam deposit contains at least 716 000 tU in RAR recoverable at <USD80/kgU based on Ore Reserves and Mineral Resources reported by BHP Billiton. The total resources (RAR and Inferred) for Olympic Dam were estimated to be at least 1 149 000 tU as at June 2007, an increase of 170 000 tU.

At Olympic Dam, uranium is a co-product of copper mining. Gold and silver are also recovered.

Seventy-seven percent of Australia's Identified Resources recoverable at costs of <USD 40/kgU; and 75% of Identified Resources recoverable at <USD 80/kgU are tributary to existing and committed production centres.

Undiscovered Resources (Prognosticated & SR)

Estimates are not made of Australia's Undiscovered Resources.

Unconventional Resources and other materials

Estimates are not made of Australia's uranium resources in the categories of Unconventional Resources and other materials.

URANIUM PRODUCTION

Historical review

A comprehensive review of the history of uranium production in Australia is given in *Australia's Uranium Resources, Geology and Development of Deposits*, Aden McKay and Yanis Miezitis, AGSO-Geoscience Australia, Resource Report No. 1:

http://www.ga.gov.au/about/corporate/ga_authors/uranium_resources.jsp

Status of production capability

Australia has three operating uranium mines: Olympic Dam (underground), Ranger (open pit) and Beverley (*in situ* leaching). In 2006, Australia's uranium production was 7 593 tU, 20% less than for the previous year. Production decreased at all three mines during the year.

Olympic Dam

In 2006, production from Olympic Dam was 2 868 tU, some 22% lower than the previous year. The decrease in production was due to processing difficulties. BHP Billiton is undertaking a two year prefeasibility study into the expansion of Olympic Dam. The expansion would more than treble annual production from the current capacity of 3 731 tU per annum to approximately 12 720 tU (15 000 t U_3O_8) per annum. An Environmental Impact Statement is being prepared for the Australian and South Australian Governments. The Olympic Dam expansion project is scheduled to take seven years, with the first ore produced from the open pit in 2013-2014. This expansion is based on a large open pit to mine the south-eastern portion of the deposit.

Ranger

In 2006, Ranger mine produced 4 029 tU, which was approximately 20% lower than the previous year. This was due to higher than average rainfall restricting access to high grade ore and operational difficulties within the acid plant.

The 2006 exploration drilling identified extensions of the Ranger No. 3 ore body at depth. The company has undertaken a feasibility study for expansion of the pit and announced that the mining operation will extend to 2014. Milling from stockpiled ore will continue until 2020.

Energy Resources of Australia (ERA) announced the approval of a AUD 27.6 million laterite treatment plant, the first laterite ore is scheduled to be processed in early 2008 with production expected to extend over 7 years. The plant will add approximately 288 tU (340 t U_3O_8) per annum. In addition, the company will be constructing a AUD 13 million radiometric ore sorter, which will allow an additional 930 tU to be produced by the end of 2013.

Beverley

In 2006, the Beverley operation produced 696 tU, approximately 16% lower than the previous year. Heathgate Resources has identified new zones of uranium mineralisation extending to the east of the Mining Lease (Beverley East) and also additional mineralisation in an area to the south known as Deep South.

Ownership structure of the uranium industry

The Ranger uranium mine is owned by Rio Tinto (68.39%) with the remaining 31.61% owned by the public.

The Olympic Dam mine is wholly-owned by BHP Billiton.

The Beverley mine is 100% owned by Heathgate Resources Pty Ltd, which is a wholly-owned subsidiary of General Atomics (USA).

Employment in the uranium industry

Total employment at Australia’s three uranium mines increased from 743 employees in 2004 to 959 in 2006. It is anticipated that employment will increase further to more than 1 050 in 2007.

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

	Centre # 1	Centre # 2	Centre # 3	Centre # 4
Name of production centre	Ranger	Olympic Dam	Beverley	Honeymoon
Production centre classification	existing	Existing	existing	committed
Start-up date	1981	1988	2000	2008
Source of ore:				
• Deposit name	Ranger No.3	Olympic Dam	Beverley	Honeymoon & East Kalkaroo
• Deposit type	unconformity-related	hem. breccia complex	sandstone	sandstone
• Reserves (tU)	43 137	222 000	5 560	3 230
• Grade (% U)	0.13	0.06	0.15	0.17
Mining operation:				
• Type (OP/UG/ISL)	OP	UG	ISL	ISL
• Size (t ore/year)	4.5 Mt (a)	9 Mt	NA	NA
• Average mining recovery (%)	100	85	65 (d)	65 (d)
Processing plant (acid/alkaline):	acid	Acid	acid	acid
• Type (IX/SX/AL)	CWG, AL, SX	CWG, FLOT, SX, AL	IX, AL	SX, AL
• Size (t ore/year); for ISL (L/d or L/h)	2.5 Mt/year	9 Mt/year	1.62 ML/h	Not reported
• Average process recovery (%)	88	72	(d)	(d)
Nominal production capacity (tU/year)	4 660	3 930	848	340
Plans for expansion	(b)	(c)	(e)	NA
Other remarks	NA	NA	NA	NA

(a) Capacity to mine a total of 4.5 million tonnes per year of ore and waste rock.

(b) ERA recently announced the approval of a laterite treatment plant, the first laterite ore is scheduled to be processed in early 2008 with production expected to extend over seven years. The plant will add approximately 340 tU (400 t U_3O_8) per annum. In addition, the company will be constructing a AUD 13 million radiometric ore sorter, which will allow an additional 930 tU (1 100 t U_3O_8) to be produced by the end of 2013.

(c) BHP Billiton is investigating the feasibility of expanding capacity of Olympic Dam operations to produce 12 720 tU (15 000 t U_3O_8) per year. It is proposed to mine the southern portion of the deposit by a large open pit in conjunction with underground mining (sub-level open stoping) in the northern portion of the deposit.

(d) Recovery includes combined losses due to ISL mining and hydro-metallurgical processing.

(e) Approval has been granted to extend the capacity of the Beverley *in situ* leaching operations to produce 1 270 tU (1 500 t U_3O_8) per year when the company decides it is commercially viable to do so. In addition, Heathgate are going through environmental approvals for the Beverley mine extension.

Future production centres

Honeymoon

Production (*in situ* leaching) at Uranium One's Honeymoon deposit (SA), Australia's fourth uranium mine, is planned to commence in 2008 at 400 t U_3O_8 per annum.

Oban

Curnamona Energy Ltd will undertake a field leach trail at the Oban deposit (65 km north of Honeymoon mine). The deposit is hosted by Paleogene sands of the Frome Embayment (SA).

Jabiluka

Mining was approved by the Commonwealth and Northern Territory Governments in 1999 subject to over 90 environmental conditions. As with Ranger, Jabiluka is surrounded by, but is not part of, Kakadu National Park.

ERA has announced that there would be no further development at Jabiluka without the formal support of Aboriginal people, and subject to feasibility studies and market conditions.

In February 2005, the Mirarr Gundjeihmi Aboriginal people, ERA Ltd and the Northern Land Council signed an agreement on the long-term management of the Jabiluka lease. This agreement obliges ERA Ltd (and its successors) to secure Mirrar consent prior to any future mining development of uranium deposits at Jabiluka.

Secondary sources of uranium

Australia has no production or use of mixed-oxide fuels, re-enrichment of tailings or reprocessed uranium.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Comprehensive reviews of environmental activities and socio-cultural issues for Ranger, Jabiluka, Olympic Dam, Beverley and Honeymoon operations were provided in the 2001, 2003 and 2005 editions of the Red Book.

URANIUM REQUIREMENTS

Australia has no commercial nuclear power plants and thus has no uranium requirements. The Australian Government opposes the development of nuclear power in Australia, but realises that nuclear energy is a part of the energy mix in some nations which may not have access to the diversity of domestic energy resources that Australia enjoys.

NATIONAL POLICIES RELATING TO URANIUM

The Australian Government's policy is to approve new uranium mines and uranium exports provided they comply with very strict environmental, health, safety and nuclear safeguards requirements. Where Indigenous interests are involved, the government is committed to ensuring full consultation with the affected Aboriginal communities.

Exports of uranium are only allowed under Australia's policy which is to supply only to countries with which Australia has a bilateral safeguards agreement, are members of the Nuclear Non-proliferation Treaty, and in the case of Non-weapon States, adhere to the Additional Protocol. The control over exports reflects both national interest considerations and international obligations.

The Australian Government is working to remove impediments to the development of the uranium industry, primarily through the Uranium Industry Framework. More information on the Framework can be found at http://www.ret,gov.au/uif .

State Governments are responsible for approving uranium exploration and mining in Australia. In 2007 only two States, South Australia and the Northern Territory, allow uranium exploration and mining. The State Governments of Queensland and Western Australia have policies prohibiting uranium mining. The States of New South Wales and Victoria have legislation prohibiting uranium exploration and mining.

URANIUM STOCKS

For reasons of confidentiality, information on producer stocks is not available.

URANIUM PRICES

Average annual export prices for Australian uranium have been:

	Average annual export price (AUD/kgU)
1994	53.06
1995	55.74
1996	53.96
1997	48.93
1998	57.28
1999	54.32
2000	57.37
2001	59.07
2002	56.10
2003	48.83
2004	50.25
2005	54.67
2006	72.04

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million AUD	2004	2005	2006	2007 (expected)
Industry exploration expenditures	13.96	41.09	80.70	90.00
Government exploration expenditures	0	0	0	0
Industry development expenditures	NA	NA	NA	NA
Government development expenditures	0	0	0	0
Total expenditures	NA	NA	NA	NA
Industry exploration drilling (metres)	109 244	456 178	NA	NA
Number of industry exploration holes drilled	NA	NA	NA	NA
Government exploration drilling (metres)	0	0	0	0
Number of government exploration holes drilled	0	0	0	0
Industry development drilling (metres)	NA	NA	NA	NA
Number of development exploration holes drilled	NA	NA	NA	NA
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	109 244	456 178	NA	NA
Subtotal exploration holes	NA	NA	NA	NA
Subtotal development drilling (metres)	NA	NA	NA	NA
Subtotal development holes	NA	NA	NA	NA
Total drilling (metres)	109 244	456 178	NA	NA
Total number of holes	NA	NA	NA	NA

Uranium exploration and development expenditures – non-domestic

Expenses in million AUD	2004	2005	2006	2007 (expected)
Industry exploration expenditures	2.2[a]	11.6[a]	6.0[a]	>6.0
Government exploration expenditures	0	0	0	0
Industry development expenditures	NA	NA	NA	NA
Government development expenditures	0	0	0	0
Total expenditures	2.2	11.6	6.0	>6.0

a) Total expenditure by Australian exploration companies in Namibia and Malawi.

Reasonably Assured Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	78 000	78 000	78 000	80
Open-pit mining	141 000	146 000	153 000	89
In situ leaching	14 000	14 000	18 000	65
Heap leaching	0	0	0	NA
In-place leaching (stope/block leaching)	0	0	0	NA
Co-product and by-product	476 000	476 000	476 000	71 for reserves, 60 for resources
Unspecified	0	0	0	NA
Total	709 000	714 000	725 000	

Reasonably Assured Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	154 000	156 000	158 000
Sandstone	20 000	22 000	26 000
Hematite breccia complex	478 000	478 000	479 000
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	2 000	2 000
Volcanic and caldera-related	3000	3 000	5 000
Metasomatite	13 000	12 000	12 000
Other	41 000	41 000	43 000
Total	709 000	714 000	725 000

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	60 000	60 000	60 000	80
Open-pit mining	56 000	62 000	74 000	89
In situ leaching	4 000	7 000	11 000	65
Heap leaching	0	0	0	NA
In-place leaching (stope/block leaching)	0	0	0	NA
Co-product and by-product	367 000	373 000	373 000	60 for resources
Unspecified	0	0	0	NA
Total	487 000	502 000	518 000	

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	66 000	70 000	71 000
Sandstone	14 000	18 000	31 000
Hematite breccia complex	383 000	389 000	389 000
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	4 000	5 000	5 000
Volcanic and caldera-related	1 000	1 000	1 000
Metasomatite	9 000	9 000	9 000
Other	10 000	10 000	12 000
Total	487 000	502 000	518 000

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]	83 294	4 357	5 008	4 029	96 688	4 000
Underground mining[1]	838	0	0	0	838	0
In situ leaching	1 679	919	828	696	4 122	700
Heap leaching	0	NA	NA	NA	NA	NA
In-place leaching*	0	NA	NA	NA	NA	NA
Co-product/by-product	27 494	3 706	3 676	2 868	37 744	2 900
U recovered from phosphates	0	NA	NA	NA	NA	NA
Other methods**	0	NA	NA	NA	NA	NA
Total	113 305	8 982	9 512	7 593	139 392	7 600

(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]	[%]
0	0	1 983	26.1	0	0	5 610	73.9	7 593	100

Uranium industry employment at existing production centres

(person-years)

	2004	2005	2006	2007 (expected)
Total employment related to existing production centres	743	889	959	1 054
Employment directly related to uranium production	NA	NA	NA	NA

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
9 400	9 400	9 400	9 400	10 200	10 200	10 200	10 200	10 200	19 000	10 200	19 000

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
10 200	22 400	10 200	22 400	5 500	17 700	5 500	17 700	5 500	17 700	5 500	17 700

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	0
Producer	NA	0	0	0	NA
Utility	0	0	0	0	0
Total	0	0	0	0	0

• Belgium •

URANIUM EXPLORATION

Historical review

Until 1977, only a few uranium occurrences were known in Belgium. These were mainly connected with black shales of the Upper Visean-Namurian, in the Dinant Basin, and of the Revinian, in the Stavelot Mountains, and also with breccia, in the Visean and Frasnian chalk, in the Visé Mountains.

From 1977 to 1979, there was renewed interest in uranium exploration, leading to a study of the uranium occurrences in the Visé Mountains and a study on the uranium content of the phosphates in Cretaceous formations, in the Mons Basin.

From 1979 to 1981, the European Communities and the Ministry of Economic Affairs financed a general reconnaissance survey for uranium in the areas of Paleozoic formations in Belgium. The Geological Service co-ordinated three types of exploration, covering an area of approximately 11 000 km^2: car-borne radiometric survey, geochemical survey on alluvial deposits and hydrochemical survey. The Belgian universities of Mons, Louvain (UCL), and Brussels (ULB), respectively, were entrusted with the work. The general report was published in 1983.

From 1981 to 1985, this research was conducted chiefly at the Mons Laboratory, with the aim of studying the geological environment of the main anomalies discovered in the course of general exploration (Visean-Namurian and Lower Devonian).

From 1985 to 1988, an exploration programme financed by the Underground Resources Service (Walloon Region) led to the discovery of anomalies and deposits (over 1% uranium equivalent at certain points) in schistose sandstone formations of the Lower Devonian and surface formations in Upper Ardenne.

Strategic and tactical uranium exploration was pursued in the lower Devonian, in the Belgian Ardenne and on the basis of isolated anomalies discovered during the preliminary car-borne prospecting. This project was jointly financed by the EEC and the Geological Service of Belgium, during 1979-1982. Different geochemical and geophysical methods were used (radon in spring water, ground radon survey, gamma spectrometry) for indications discovered during the second phase, as well as trenching and shallow drilling (about 10 m). Deeper core sampling and drill hole-logging surveys were conducted on a regional basis by the Geological Service.

Currently, it is estimated that none of the areas investigated are of economic interest. Although the occurrences are numerous and varied, the uranium content of each indication showing more than 100 ppm amounts to less than one tonne.

The uranium content of phosphates in the Mons Basin has also been evaluated, and a new estimate of the P_2O_5 resources in the basin has put unconventional uranium resources at approximately 40 000 tU. This includes approximately 2 000 tU of resources in areas suitable for phosphate mining although the contents are below 10% P_2O_5 and 100 ppm uranium equivalent.

Recent and ongoing uranium exploration and mine development activities

None.

URANIUM RESOURCES

Belgium has no known Identified Resources (RAR and Inferred). No Undiscovered Resources (Prognosticated and SR) have been identified.

URANIUM PRODUCTION

Historical review

In 1998, Prayon-Rupel Technologies decided to stop recovering uranium from imported phosphates. Subsequently the facility has been decontaminated and dismantled.

Status of production capability

There is no production centre in Belgium and none is foreseen in the 2005-2025 period.

Secondary sources of uranium

MOX Production in Belgium

Belgonucléaire at the Dessel nuclear site, in the Mol region, manufactured plutonium/uranium mixed-oxide (MOX) pellets and fuel rods at the PO plant. After a long period of industrial operation since 1986, the MOX fuel plant was shut down in July 2006. During its operation, the Belgonucléaire plant produced about 650 tonnes of MOX fuel for nuclear power plants in France, Belgium, Switzerland, Germany and Japan. The company still possesses an extremely valuable knowledge of MOX fuel fabrication, which it values in the framework of the disposition of military plutonium.

URANIUM REQUIREMENTS

Uranium requirements

No change in uranium requirements, although the increase in uranium prices relative to enrichment price is anticipated to reduce overall uranium requirements.

Supply and procurement strategy

No change of the supply and procurement strategy.

NATIONAL POLICIES RELATING TO URANIUM

None reported. Information on uranium stocks and on uranium prices is not available for reasons of confidentiality.

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]	0	0	0	0	0	0
Underground mining[1]	0	0	0	0	0	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	0	0	0	0	0	0
Co-product/by-product	0	0	0	0	0	0
U recovered from phosphates	686	0	0	0	686	0
Other methods**	0	0	0	0	0	0
Total	686	0	0	0	686	0

(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.

Mixed-oxide fuel production and use

(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	437.5	85.8	0	0	523.4	0
Use	437.5	28.6	28.1	26.1	520.3	0
Number of commercial reactors using MOX		1	1	1		0

Re-enriched tails production and use

(tonnes of natural U equivalent)

Re-enriched tails	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	0	0	0	0	0	0
Use*	345*	0	0	0	345*	0

* Purchased for future re-enrichment.

Reprocessed uranium use

(tonnes of natural U equivalent)

Reprocessed uranium	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	0	0	0	0	0	0
Use	508*	0	0	0	508*	0

* From 1993 to 2002.

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	45.3	44.3

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
5 825	5 825	5 825	5 825	5 825	5 825

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
4 037	5 825	2 023	5 825	0	5 825*

* By law, the nuclear power plants have to be retired from service after 40 years of operation, except in case of *force majeure* called by the Belgian authorities.

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
880	1 060	1 075	1 075	750	1 075

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
750	1 075	375	1 075	0	1 075

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	0
Producer	0	0	0	0	0
Utility	NA	NA	NA	NA	NA
Total	NA	NA	NA	NA	NA

• Brazil •

URANIUM EXPLORATION

Historical review

Systematic prospecting for radioactive minerals began in 1952 by the Brazilian National Research Council. These efforts led to the discovery of the first uranium occurrences at Poços de Caldas (State of Minas Gerais) and Jacobina (State of Bahia). In 1955, a technical co-operation agreement was signed with the United States Government to assess the Brazilian uranium potential. After the creation of the National Nuclear Energy Commission (CNEN) a mineral exploration department was organised with the support of the French CEA in 1962.

In the 1970s, CNEN exploration for radioactive minerals increased due to the availability of more financial resources. Additional incentive for exploration was provided in 1974, when the government opened NUCLEBRAS, an organisation with the exclusive purpose of uranium exploration and production. One of the early achievements of the government organisations was the discovery and development of the Osamu Utsumi deposit in the Poços de Caldas plateau.

In late 1975, Brazil and Germany signed a co-operation agreement for the peaceful use of nuclear energy. It was the beginning of an ambitious nuclear development programme that required an increase of NUCLEBRAS exploration activities. This led to the discovery of eight areas hosting uranium resources including the Poços de Caldas plateau, Figueira, the Quadrilátero Ferrífero, Amorinópolis, Rio Preto/Campos Belos, Itataia, Lagoa Real and Espinharas (discovered and evaluated by NUCLAM, a Brazilian-German joint-venture).

In 1991, INB uranium exploration activities came to a halt according to the Brazilian nuclear development programme reorganisation of 1988.

Recent and ongoing uranium exploration and mine development activities

In August 2004, INB carried out a drilling programme in ore bodies located at Lagoa Real Uranium Province, in Bahia State. Because of the distance between old bore holes, the purpose was to better define the thickness and obtain more information about the grade in some mineralised levels at Cachoeira and Engenho uranium deposits. The results confirmed the continuity of the mineralised bodies as well as the grades, previously interpreted. About 8 000 m of drilling was carried out, and approximately USD 500 000 expended.

No exploration work was carried out in the period 2005-2006.

For the end of 2007, drillings are planned to confirm the continuity of ore bodies of the Cachoeira and Engenho deposits at Lagoa Real Uranium Province (Caetité site).

URANIUM RESOURCES

Brazil's conventional known and undiscovered uranium resources are hosted in the following deposits:

- Poços de Caldas (Osamu Utsumi Mine) with the orebodies A, B, E and Agostinho (collapse breccia pipe-type).
- Figueira and Amorinópolis (sandstone).
- Itataia, including the adjoining deposits of Alcantil and Serrotes Baixos (metasomatic).
- Lagoa Real, Espinharas and Campos Belos (metasomatic-albititic).
- Others including the Quadrilátero Ferrifero with the Gandarela and Serra des Gaivotas deposits (quartz pebble conglomerate).

Identified Resources (RAR & Inferred)

According to (1) Process Performance achieved during these last four years and taking into account (2) Geological Model, (3) Exploration Methodology and, (4) Estimation Methodology carried out, INB decided to change Lagoa Real Uranium Province cost category. Therefore, all resources estimated since then, will change to Identified Resources (RAR), as <USD 40/kgU cost category.

With the same purpose after optimisation of the mining project and chemical process, the cost category of Itataia Project was also changed according to presented on RAR Table.

Respecting Brazilian regulation, some private companies in Brazil can produce uranium as by-product. The Pitinga deposit located at Amazonas State, produces tantalite-columbite concentrates. The uranium mineralisation is associated, and it is possible to recover uranium as concentrate product. The quantities related to the different stages of the processing plant, were distributed in three categories according to the production cost (<USD 40, <USD 80 and <USD 130/kgU), and were included in Reasonably Assured Resources Table.

No additional data was produced in the period 2005-2006.

Undiscovered Resources (Prognosticated & SR)

Considering the exploration activities developed on the promising area called Rio Cristalino (south of Pará State) and additional resources at Pitinga site, it is possible to prognosticate approximately 300 000 tU as *in situ* resources.

URANIUM PRODUCTION

The Poços de Caldas uranium facility was closed in 1997. A remediation/restoration study is being carried out. This industrial facility was used to produce rare earth compounds from monazite treatment until 2006. This operation is now closed for market reasons.

The Caetité Unit (Lagoa Real) started production in 2000, with 340 tU/year nominal capacity.

Status of production capability

The expansion of Lagoa Real is on course, aiming at increase the nominal capacity to 670 tU/year. INB is now considering changing the heap leaching process for conventional agitated leaching. The overall expansion investment is estimated in USD 10 million. Regulatory requirements caused operations to be stopped periodically and as a result production levels were low in 2005 and 2006.

After 2005, INB worked on the development of Itataia site a phosphate/uranium deposit. First scheduled to start in 2006, the now called Sta. Quitéria Project has been delayed to 2008 due to problems arising from a partnership agreement needed to carry out phosphate exploration and commercialisation. The planned capacity is 680 tU/year with a portion destined for external market.

Ownership structure of the uranium industry

The Brazilian uranium industry is 100% government-owned through the state-owned company *Indústrias Nucleares do Brasil* – INB.

Employment in the uranium industry

See Table – Uranium Industry Employment at Existing Production Centres.

Future production centres

See Table – Short-Term Production Capability.

Secondary sources of uranium

None reported.

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

	Centre #1	Centre #2
Name of production centre	Caetité	Itataia
Production centre classification	Existing	planned
Start-up date	1999	2007
Source of ore:		
• Deposit name	Cachoeira	Santa Quitéria
• Deposit type	Metasomatite	metamorphic/phosphorite
• Reserves (tU)	12 700	76 100
• Grade (% U)	0.3	0.08
Mining operation:		
• Type (OP/UG/ISL)	OP	OP
• Size (t ore/day)	1 000	4 000
• Average mining recovery (%)	90	90
Processing plant (acid/alkaline):		
• Type (IX/SX/AL)	HL/SX	AL/SX
• Size (t ore/day); for ISL (L/day or L/h)		
• Average process recovery (%)	80	75
Nominal production capacity (tU/year)	340	680
Plans for expansion	2010	NA
Other remarks	Start-up OP Engenho deposit (2010). Transition to underground in 2010.	Co-product with phosphoric acid.

NA Not available.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Government policies and regulations

Government policies and regulations are established by *Comissão Nacional de Energia Nuclear* – CNEN (Brazilian Nuclear Energy Commission), and include a standard *Diretrizes Básicas de Radioproteção* (Radioprotection Basic Directives) – NE-3.01, and two specific standards on licensing of mines and mills of uranium and thorium ores, named NE-1.13 – *Licenciamento de Minas e Usinas de Beneficiamento de Minérios de Uranio ou Tório*, and on tailings ponds decommissioning: *Segurança de Sistema de Barragem de Rejeito Contendo Radionuclídeos* (Safety of Radionuclide Bearing Tailing Pond Systems) – NE-1.10, and a standard for conventional mining and milling industry with U and Th associated (NORM and TENORM), *Requisitos de Segurança e Proteção Radiológica para Instalações Mínero-Industriais* – NN-4.01. In the absence of specific norm, ICRP and IAEA recommendations are used.

The closure of Poços de Caldas Unit in 1997 brought to an end the exploitation of a low-grade ore deposit, which produced vast amounts of waste rock. The closure, remediation and restoration actions are still under development. Several studies are being carried out to characterise geochemical and hydrochemical aspects of the effects that waste rock and tailings dam may have had on the environment and to establish mitigation measures if necessary. The overall decommissioning plan for the installation should mainly consider the acid drainage aspects.

URANIUM REQUIREMENTS

Uranium requirements

Brazil's present uranium requirements for the Angra I nuclear power plant, a 630 MWe PWR, are about 140 tU/year. The Angra II nuclear power plant, a 1 245 MWe PWR, requires 300 tU/year. In addition, start-up of Angra III (similar to the Angra II nuclear power plant) operation is expected around 2014.

NATIONAL POLICIES RELATING TO URANIUM

INB is planning to increase its uranium production in order to supply internal uranium requirements. After the implementation of the Caetité/Lagoa Real centre, INB focus is turning to the Itataia deposit in Ceará State. Although uranium extraction is considered to be in the low-cost category, project viability is dependent on the production of phosphoric acid. These activities are thus dependent on setting-up partneship with a private enterprise interested in this product. The start-up date is planned to 2008.

URANIUM STOCKS

None reported.

URANIUM PRICES

None reported.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in BRL	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	1 400 000	0	0	1 000 000
Industry development expenditures	0	0	0	0
Government development expenditures	NA	NA	NA	NA
Total expenditures				
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	8 000	0	0	5 000
Number of government exploration holes drilled	40	0	0	100
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	8 000	0	0	5 000
Subtotal exploration holes	40	0	0	100
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	8 000	0	0	5 000
Total number of holes	40	0	0	100

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	58 300	58 300	58 300	80
Open-pit mining	10 500	10 500	10 500	80
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	71 100	88 900	88 900	70
Unspecified	0	0	0	
Total	139 900	157 700	157 700	

* Mine depletion not considered.

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	86 300	104 100	104 100
Other	53 600	53 600	53 600
Total	139 900	157 700	157 700

* Mine depletion not considered.

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	2 400	2 400	70
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	31 200	78 600	70
Unspecified	0	40 000	40 000	70
Total	0	73 600	121 000	

Inferred Resources by deposit type
(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	7 600	7 600
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	8 900	8 900
Vein	0	600	600
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	6 000	53 400
Other	0	50 500	50 500
Total	0	73 600	121 000

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
300 000	300 000

Speculative Resources
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
NA	500 000

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]	1 097	0	0	0	1 097	0
Underground mining[1]	0	0	0	0	0	0
In situ leaching	0	0	0	0	0	0
Heap leaching	502	159	110	200	971	340
In-place leaching*	0	0	0	0	0	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	1 599	159	110	200	2 068	340

(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]	[%]
200	100	0	0	0	0	0	0	200	100

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

	2004	2005	2006	2007 (expected)
Total employment related to existing production centres	NA	NA	NA	NA
Employment directly related to uranium production	140	140	140	140

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
340	340	340	340	420	420	420	420	1 100	1 100	1 100	1 100

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
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	9 852	13 770

Installed nuclear generating capacity to 2030
(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
1 875	1 875	1 875	1 875	1 875	3 120

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

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

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
450	450	450	810	450	810

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

• Bulgaria •

URANIUM EXPLORATION

Historical review

Manifestations of uranium mineralisation in Bulgaria, in the Buhovo ore deposit (25 km from Sofia) have been known since 1920 and the first exploration activities were conducted in 1935. More serious exploration activities based on technological research and economical calculations took place between 1938 and 1939, with the co-operation of German specialists. The first 300 tonnes of uranium ore were mined in 1939.

In the period 1946-1947, Soviet geologists performed intensive geological investigations of the Buhovo ore deposit. In the spring of 1946, a joint Soviet-Bulgarian enterprise was established but its activity is ceased in 1956. A Rare Metals Bureau with the Council of Ministers was subsequently established and it maintained its independence despite numerous administrative re-organisations until 1992, when the government made a decision to cease uranium production activities.

A large number of exploration methods have been used in Bulgaria, including geological, geophysical, technological and combined techniques. Aero-gamma-ray-spectrometry, hydro-radio-geochemical and water-helium photographies were also used for the exploration purposes.

A total of 39 ore deposits were found within the territory of Bulgaria, tens of mines were constructed almost all over the country and two facilities for processing uranium ores and U_3O_8 production were operated in Buhovo and Eleshnitsa.

Industrial type uranium deposits are small to medium size (up to 10 000 tU) and low-grade (0.1% U). They have complex morphology and irregular mineralisation. Deposits exploited via classical mining methods have complex geological structure and are situated mainly in mountain regions (Stara Planina, Rhodope massif, East Sredna Gora). The mean area of the ore beds is between 250 m^2 to 20 000 m^2 at a depth of about 500 m. Difficult mining conditions and challenging geological parameters mean production costs are high and recovery is low.

The main ore deposits for underground mining are: Buhovo near Sofia; Eleshnitsa, Senokos and Simitli in South-western Bulgaria; Vinishte and Smolyanovtsi in North-western Bulgaria; Sliven in Central Bulgaria; Smolyan, Dospat and Selishte in the Rhodopa Moutains.

ISL mining has been used in favourable conditions since 1969. Heap leaching has also been used in underground mines.

Deposits suited for ISL mining are located in regions of the Upper Thracian, the Struma and the Dospat River valleys, where ore deposits occur at a depth of 30 to 250 m below surface and thicknesses vary between 10-12 m to 60-80 m. Uranium mineralisation is also situated in Pliocene sandstone where thicknesses vary from 0.4 m to 7-8 m. Ore grades are variable, but the mean value is about 0.03% U.

In the case of rock deposits, the dimensions of ore beds are situated between 50-70 m and 500-600 m below the surface and are 2-4 m to 80-100 m thick. Uranium concentration is between 0.03% U to 0.2-0.3% U.

Recent and ongoing uranium exploration activities

Uranium exploration activities were terminated in 1990.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Identified Resources by 1 January 1991 amounted to 20 565 tU. It should be mentioned that they were categorised at that time as economically and ecologically unprofitable. New exploration activities are forthcoming and reassessment according to actual international market prices will be done.

According to re-calculations done by the National Geo Fund, identified uranium resources in Bulgaria amount to about 19 809 tU (*in situ*) as of 1 January 2007. An amount of 11 908 tU of these resources could be mined by underground mining method, and the remaining 7 901 tU are amenable to the ISL mining. However, since the costs of mining these resources have not yet been determined, they are not officially reported in the 2007 Red Book. These quantities are the combined total of 67 separate, small deposits. For this reason they are currently considered economically and technologically unprofitable.

During the production period, the mean recovery factor averaged about 65% for all 16 deposits that were mined. An official estimate of the production cost has not been made.

Undiscovered Resources (Prognosticated & SR)

Prognosticated Resources are estimated to amount about 25 000 tU.

Unconventional Resources and other materials

No Unconventional Resources have been identified.

URANIUM PRODUCTION

Historical review

Up to 1990, 60 000 tonnes of uranium deposits were discovered and about 16 500 tU was produced. The production followed an ascending rate from 150-200 tU/year in the 1950s to 430 tU/year in 1975. The adoption of ISL mining of the Upper Thracian deposits raised the production to 660 tU in 1989, when 70% of the uranium was produced by ISL. Ores were processed in two hydro-metallurgical plants. Uranium extraction and processing of pregnant ISL resins was done at the Zvezda plant near Eleshnitsa, where U_3O_8 (80-82% concentration) was produced.

Production activities were state owned.

Production of uranium ores and uranium in Bulgaria for the period 1946-1990

Year	**Ore** (tU)	**U** (%)	**Uranium** (kg)				
			Classic production	**Combination method ***	***In situ***	**U from water**	**Total**
1946	12 800	0.227	29 100				29 100
1947	36 000	0.081	29 100				29 100
1948	21 600	0.119	25 600				25 600
1949	28 300	0.122	34 400				34 400
1950	36 900	0.213	78 600				78 600
1951	66 400	0.193	128 100				128 100
1952	105 800	0.159	168 100				168 100
1953	119 500	0.141	167 900				167 900
1954	158 000	0.099	157 200				157 200
1955	180 900	0.116	209 200				209 200
1956	236 600	0.124	294 290				294 290
1957	271 900	0.118	321 450				321 450
1958	245 200	0.107	263 150				263 150
1959	259 900	0.110	285 860				285 860
1960	308 800	0.105	324 620				324 620
1961	378 900	0.101	382 220				382 220
1962	437 200	0.098	430 620				430 620
1963	463 800	0.094	435 220				435 220
1964	527 800	0.088	464 180				464 180
1965	541 200	0.074	402 830				402 830
1966	541 700	0.067	363 910				363 910
1967	578 000	0.066	380 140				380 140

Production of uranium ores and uranium in Bulgaria for the period 1946-1990 (contd.)

Year	**Ore** (tU)	**U** (%)	**Uranium** (kg)				
			Classic production	**Combination method ***	***In situ***	**U from water**	**Total**
1968	557 900	0.064	356 480				356 480
1969	550 400	0.063	349 460		7 650		357 110
1970	485 400	0.060	291 450	880	17 460		309 790
1971	438 700	0.055	240 290	10 170	63 850		314 310
1972	387 500	0.061	234 770	18 960	87 080		340 810
1973	460 800	0.059	272 620	21 210	87 130		380 960
1974	521 000	0.057	296 870	21 440	88 810		407 120
1975	549 100	0.056	307 440	19 330	106 580		433 350
1976	566 300	0.053	300 920	19 070	118 900		438 890
1977	600 000	0.050	297 790	18 580	140 770		457 140
1978	623 152	0.047	295 746	18 380	167 350	1 760	483 236
1979	621 450	0.047	295 040	18 070	180 260	2 420	495 790
1980	614 400	0.050	308 000	19 060	194 970	2 450	524 480
1981	575 500	0.049	284 260	30 560	201 910		516 730
1982	532 000	0.049	260 140	32 270	221 010	1 110	514 530
1983	582 600	0.043	250 090	35 440	243 430	1 360	530 320
1984	590 000	0.043	252 580	28 690	261 760	770	543 800
1985	584 300	0.040	235 630	34 710	274 370	60	544 770
1986	578 200	0.039	224 140	49 340	312 390		585 870
1987	645 900	0.039	249 850	38 710	360 280		648 840
1988	601 100	0.037	224 000	47 220	396 430		667 650
1989	470 600	0.041	192 400	36 920	415 610		644 930
1990	342 100	0.038	130 380	29 850	323 770		484 000
Total	18 035 602	0.064	11 526 136	548 860	4 271 770	9 930	16 356 696

* In place or heap leaching.

Status of production capability

At present no uranium production centres exist. If plans on renewal of the uranium production are re-considered, all processes and facilities will have to be built by private operators.

On the territory of the former uranium ore processing plant, Zvezda, an installation for ion-exchange resins is operational, where it is used to purify uranium contaminated mining waters. It is a small capacity installation that can process about 742 m^3 of resins per year.

Since 1992, only activities concerning dismantling facilities, closing mining works, re-cultivation of contaminated areas, purification of uranium contaminated mining waters and environmental monitoring have been conducted.

ENVIRONMENTAL ACTIVITIES AND SOCIAL CULTURAL ISSUES

Uranium production and processing in the Republic of Bulgaria was ceased by government decree No. 163 of 20 August 1992.

Remediation activities of uranium production and processing facilities include: technical liquidation, technical and biological re-cultivation, purification of uranium contaminated mining waters and environmental monitoring of areas affected by mining.

Related technical documentation has been prepared concerning hydroecological and radiological assessments and prognoses, pre-project investigations, work projects for technical liquidation, technical and biological re-cultivation and water purification and monitoring.

Remediation of underground and open-pit uranium and geo-technological production centres have been completed. Mine openings have been sealed, vertical shafts were filled in and openings were covered by armored concrete slabs. A total of seven uranium open-pit mines were remediated.

ISL production facilities have been dismantled and associated soils were re-cultivated, with the exception of 26.5 ha of concrete foundations of the former buildings.

At this time, technical remediation of all sites mentioned in the governmental decree has been completed, with the exception of the Gabra shaft near Novi Han, close to Sofia.

A total of 54 sites have been remediated. Nineteen of the existing 21 vertical shafts owned by the former state enterprise Rare Metals were filled in and sealed, and over 600 horizontal mine galleries were closed (including galleries totalling over 600 km in the Buhovo deposit).

A total of 37 re-cultivation projects were completed and 1 172.7 ha of agricultural lands were biologically re-cultivated and returned to their owners after remediation was approved by the appropriate land property commissions.

Risk assessment and categorisation was completed for 37 facilities.

The larger of the two hydro-metallurgical plants (Metalurg, in Buhovo, owned by the enterprise Rare Metals), was sold. The tailings facility at the Metalurg plant is under pre-project investigation for implementation of technical re-cultivation. The second hydro-metallurgical plant, Zvezda, in Eleshnitsa, is almost totally dismantled and all buildings have been destroyed. The tailings facilities have been sealed and re-cultivated. The capacity of the purification facility has been reduced to cover water purification needs.

Technical and biological re-cultivation activities on the waste banks near the uranium mining sites are ongoing. Simultaneously monitoring, mainly of waters, is ongoing and at some sites, where contaminated mining waters are percolating to the surface, water purification is ongoing.

The total financial resources spent on the implementation of the government decrees No. 163 of 20 August 1992, No. 56 of 29 March 1994, No. 213 of 9 September 1995 and No. 74 of 27 March 1998 on ending uranium production and processing, according to the Ministry of Financial Affairs amounted to BGN 26 578 618 as shown below:

Year	Bulgarian levs (BGN)
1992	317 324
1993	408 398
1994	497 175
1995	442 300
1996	400 745
1997	1 702 465
1998	1 888 558
1999	3 765 522
2000	4 365 059
2001	3 479 790
2002	1 800 090
2003	1 733 632
2004	3 676 429
2005	2 101 131
Total	26 578 618

At this time, the majority of the environment remediation of uranium mining impacts is considered complete. A project on sealing and re-cultivation of the tailings facilities and adjoining areas in Buhovo is forthcoming. Similar projects at other sites where geological exploration activities were conducted and small quantities of uranium were produced are also forthcoming. The total price of these remaining projects is expected to amount to BGN 3 million.

URANIUM REQUIREMENTS

Nuclear power in Bulgaria contributes significantly to meeting the required electricity energy of the country, and surrounding regions. For the last ten years, Kozloduy nuclear power plant (KNPP) has been providing 40-47% of the average annual electricity production in the Republic of Bulgaria.

The energy strategy of Bulgaria adopted in 2002 envisages maintaining the share of nuclear electricity at this level. This strategy will be implemented through lifetime extension of the nuclear units in operation and construction of new nuclear power plants. Nuclear energy is – and will continue to be – part of the solution to meet Bulgaria's energy needs while reducing greenhouse gas emissions.

On 31 December 2006, Bulgaria shut down Units 3 and 4 of KNPP as part of Bulgaria's EU Accession Treaty.

The country plans to launch the construction of new reactors. The public opinion in Bulgaria is favourable, with more than 70% of the population supporting further development of nuclear energy. Planning analysis concludes that an additional 1 000 to 2 000 MWe of base load electrical generation will be required to meet projected demand between 2010 and 2015.

In April 2004, Bulgarian Government approved in principle the continuation of the construction activities at the Belene site, based on the conclusion that nuclear energy is the main and most efficient way to meet Bulgaria's future electricity needs. Nuclear power also provides high reliability and economic electricity generation, security of supply and implementation of international agreements on environmental protection.

On 21 December 2004, the Nuclear Regulatory Agency (NRA) Chairman signed a permit to the NEC for selection of a site for construction of a new NPP.

In April 2005, the Council of Ministers by Decision No. 260 approved the construction of a new NPP at Belene site.

On 30 October 2006, following a decision of the Board of Directors of NEK EAD, Atomstroyexport JSC was selected as a winning participant in the tender for the construction of two 1 000 MW units B 466 type, with a total price up to EUR 3 997 260 billion and term of construction of six and a half years for Unit 1 and seven and a half years for Unit 2.

On 29 November 2006, Atomstroyexport JSC and NEC EAD, signed an Agreement for construction of Belene NPP. Construction works are expected to start by the end of 2007. Expected commissioning of the first unit is in 2013-2014. On 21 December 2006 the NRA Chairman approved the Belene site for construction of a new NPP.

Since the end of 2004, when Units 1 and 2 of Kozloduy NPP were shut down, Bulgaria's uranium requirements diminished by about 250 tU. This trend continues after the shutdown of Units 3 and 4 of KNPP on 31 December 2006. For the year 2006, Bulgaria's uranium requirements amounted to 506 tU. From 2007 to 2010, the country's uranium requirements are expected to remain unchanged, related only to fuel supply for Units 5 and 6 of KNPP. For the commissioning of Unit 1 of Belene NPP in 2013-2014, uranium requirements in 2010-2011 will rise to about 814 tU for the first core load. After the commissioning of the second 1 000 MW unit, uranium requirements will double compared to 2006-2007.

Supply and procurement strategy

Bulgaria imports the nuclear fuel needed for the operation of KNPP. The Kozloduy NPP fuel cycle includes all stages (uranium purchase, conversion, enrichment, fabrication, interim storage, spent fuel transportation, reprocessing and used fuel disposal) based on the agreement between the Republic of Bulgaria and the Russian Federation according to long term commercial contracts for fuel supply and spent fuel reprocessing.

The contract was concluded after a tender procedure in 2002 with the Russian company TVEL as the supplier. The quantities and terms of delivery are contracted on annual basis.

Bulgarian nuclear power plant Kozloduy has signed an Annex in 2006 to its existing long-term contract from 2002 for supply of nuclear fuel for Units 5 and 6 with TVEL until 2020, assuming security of final supply.

NATIONAL POLICIES RELATING TO URANIUM

No changes of the legal basis related to uranium.

At this time, Bulgaria does not intend to renew uranium mining activities but, considering the construction of the Belene NPP project, this policy may be altered.

URANIUM STOCKS

No changes in the uranium stock levels.

URANIUM PRICES

Following the Annex to the contract for fuel supply signed in 2006, from 2008 the prices of the spent fuel will be negotiated in three-year intervals.

Prognosticated Resources (tonnes U)

Cost Ranges	
<USD 80/kgU	<USD 130/kgU
0	25 000

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]		0	0	0	0	0
Underground mining[1]	11 526	0	0	0	11 526	0
In situ leaching	4 272	0	0	0	4 272	0
Heap leaching		0	0	0	0	0
In-place leaching*	549	0	0	0	549	0
Co-product/by-product		0	0	0	0	0
U recovered from phosphates		0	0	0	0	0
Other methods**	10	0	0	0	10	0
Total	16 357	0	0	0	16 357	0

(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.

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	18.653	19.493

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
2 880	2 000	2 000	NA	NA	4 000

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
4 000	NA	NA	4 000	NA	4 000

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
506	506	1 320	NA	1 048	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
1 048	NA	1 048	NA	1 048	NA

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	0
Producer	0	0	0	0	0
Utility	0	80.7	0	0	80.7
Total	0	80.7	0	0	80.7

• Canada •

URANIUM EXPLORATION

Historical review

Uranium exploration in Canada began in 1942, with the focus of activity first at Great Bear Lake, Northwest Territories where pitchblende ore had been mined since the 1930s. In the post war period, exploration in the Athabasca Basin of northern Saskatchewan and in the Elliot Lake region of Ontario led to the development of additional mines. In the late 1960s exploration returned to the Athabasca Basin where large high-grade deposits were discovered and later developed. The last of the Elliot Lake mines closed in the 1990s and Saskatchewan is now the sole producer of uranium.

Recent and ongoing uranium exploration and mine development activities

As in previous years, uranium exploration remained focused on areas favourable for the occurrence of deposits associated with Proterozoic unconformities in the Athabasca Basin of Saskatchewan, and to a lesser extent, similar geologic settings in the Thelon and Hornby Bay Basins of Nunavut and the Northwest Territories. However, significant uranium spot price increases over the past four years have created a surge in exploration activity in other areas of the country, such as Quebec, Newfoundland and Labrador, Alberta, Yukon, Ontario, Manitoba and British Columbia. Surface drilling, as well as geophysical and geochemical surveys of extensions of mineralised zones and other promising areas in the Athabasca Basin continue to be the principal exploration activities.

In 2006, overall Canadian uranium exploration and development expenditures amounted to CAD 476 million, while uranium exploration and surface development drilling were 558 700 m, compared to the 2005 total of 275 600 m. More than half of the overall exploration and development expenditures in 2006 can be attributed to advanced underground exploration, deposit appraisal activities, and care and maintenance expenditures associated with projects awaiting production approvals. Basic "grass roots" uranium exploration reached CAD 221 million (101 million in Saskatchewan alone) in 2006, more than doubling expenditures of CAD 99 million in 2005.

Over 55% of the combined exploration and surface development drilling in 2005 and 2006 took place in Saskatchewan. The top five operators, accounting for two-thirds of the CAD 325 million expended in 2006 were Cameco Corp., AREVA Resources Canada Inc., UEX Corp., Denison Mines Corp. and Aurora Energy Resources Inc.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

As of 1 January 2007, Canada's total identified uranium resources (i.e. recoverable at a cost of <USD 80/kgU) amounted to about 423 200 tU, compared to 431 000 tU as of 1 January 2006. This downward adjustment of some 2% from the 2006 total is primarily the result of mining depletion. As of 1 January 2007, uranium resources recoverable at a cost of <USD 40/kgU were estimated to be 352 400 tU, down from the 2006 value of 356 000 tU.

The bulk of Canada's identified uranium resources occur in Proterozoic unconformity-related deposits of the Athabasca Basin of Saskatchewan and the Thelon Basin of Nunavut. These deposits host their mineralisation near the unconformity boundary in either monometallic or polymetallic mineral assemblages. Pitchblende prevails in the monometallic deposits, whereas uranium-nickel-cobalt assemblages prevail in the polymetallic assemblages. The average grade varies from 1% U to over 15% U. None of the uranium resources referred to or quantified herein are a co-product or by-product output of any other mineral of economic importance. Mining loses (~20%) and ore processing losses (~3%) were used to calculate known conventional resources.

Of the Reasonably Assured Resources and Inferred Resources recoverable at <USD 40/kgU, 100% are in existing or committed production centres, and 84% of RAR and Inferred Resources recoverable at <USD 80/kgU are in existing or committed production centres.

Undiscovered Resources (Prognosticated & SR)

Prognosticated and Speculated Resources have not been a part of recent resource assessments; hence there are no changes to report in these categories since 1 January 2001.

URANIUM PRODUCTION

Historical review

Canada's uranium industry began in the Northern Territories with the 1930 discovery of the Port radium pitchblende deposit. Exploited from 1933 to 1940, the deposit was re-opened in 1942 in response to demand for uranium for British and United States defence programmes. A ban on private exploration and development was lifted in 1947, and by the late 1950s some twenty uranium production centres had started up in five producing districts. Production peaked in 1959 at 12 200 tU. No further defence contracts were signed after 1959 and production began to decline. Despite government stockpiling programmes, output fell rapidly to less than 3 000 tU in 1966, by which time only four producers remained. While the first commercial sales to electric utilities were signed in 1966, it was not until the mid-1970s that prices and demand had increased sufficiently to promote expansions in exploration and development activity. By the late 1970s, with the industry firmly re-established, several new facilities were under development. Annual output grew steadily throughout the 1980s, as Canada's focus of uranium production shifted increasingly from east to west. The last remaining Ontario uranium centre closed in mid-1996.

Status of production capability

Overview

Since the last Elliot Lake production facility closed in 1996, all active uranium production centres are located in northern Saskatchewan. Current Canadian uranium production remains below full production capability. In 2006, production was 9 862 tU, 15% below 2005 production due to the lower grade ore milled at McClean Lake and Rabbit Lake. In 2007, production is expected to be approximately 10 000 tU.

Saskatchewan

Cameco Corporation is the operator of the McArthur River mine, a Cameco (70%), AREVA (30%) joint venture. Production at this, the world's largest uranium mine, reached 6 963 tU and 7 004 tU in 2005 and 2006, respectively. After raise bore mining of the high-grade ore behind a freeze curtain created to control groundwater inflow, a high-grade ore slurry is produced with underground crushing, grinding and mixing circuits. The slurry is then pumped to automated stations on the surface that load specially-designed containers that are trucked 80 km to Key Lake, where all McArthur River ore is milled.

The Key Lake mill is a Cameco (83%) and AREVA (17%) joint venture operated by Cameco. Although mining at Key Lake was completed in 1997, the mill maintained its standing as the world's largest uranium production centre by producing 7 200 tU and 7 200 tU in 2005 and 2006, respectively. These totals represent a combination of high-grade McArthur River ore slurry and stockpiled, mineralised Key Lake special waste rock that is blended to produce a mill feed grade of about 3.4% U. A proposal to increase production at McArthur River and Key Lake by some 18% annually (from 7 200 tU/year to 8 500 tU/year) is currently being reviewed by the federal nuclear regulator, the Canadian Nuclear Safety Commission (CNSC).

The McClean Lake production centre, operated by AREVA, is a joint venture between AREVA (70%), Denison Mines Ltd. (22.5%), and OURD (Canada) Co. Ltd., a subsidiary of Overseas Uranium Resources Development Corporation of Japan (7.5%). Production in 2005 and 2006 amounted to 2 111 tU and 690 tU, respectively. The decrease in 2006 production is a result of the low grade ore that is currently being milled. Modifications are being made to the mill to process ore from the Cigar Lake mine which should result in increased production by 2011.

The Rabbit Lake production centre, wholly-owned and operated by Cameco, produced 2 316 tU and 1 972 tU in 2005 and 2006, respectively. The decline in 2006 production is the result of lower than expected ore grades. Over 69 km of underground drilling was completed in the Eagle Point underground mine in 2006. This resulted in the delineation of 3 000 tU of additional assured resources, extending the life of the mine beyond 2009. Cameco has indicated that it intends to continue the drilling programme in 2007.

Cigar Lake, with about 90 000 tU at an average grade of approximately 16% U, is the world's second-largest high-grade uranium deposit. The mine is a Cameco (50.025%), AREVA (37.1%), Idemitsu (7.875%) and TEPCO (5%) joint venture operated by Cameco. When completed, the mine is expected to have a full annual production capacity of 6 900 tU. It is expected that about half of the first phase of Cigar Lake ore will be partially processed at the Rabbit Lake mill, pending receipt of regulatory approvals. A proposal to produce and ship a uranium-rich solution produced from Cigar Lake ore at McClean Lake for final processing at the Rabbit Lake mill is currently the subject of an environmental assessment.

Construction of the Cigar Lake mine began on 1 January 2005, and completion was expected by 2007. However, in October 2006, a rock fall resulted in a major inflow of groundwater into the mine that could not be controlled and it completely flooded the mine. Cameco has begun the first phase of the remediation plan which involves drilling holes down to the inflow and pumping concrete and grout to seal off the breach. Subsequent phases include dewatering the mine, ground freezing in the area of the inflow, restoring underground areas, and resumption of mine development, with completion now expected by 2010.

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

	Centre # 1	Centre # 2	Centre # 3	Centre # 4	Centre # 5
Name of production centre	McArthur/ Key Lake	McClean Lake	Rabbit Lake	Cigar Lake	Midwest
Production centre classification	existing	existing	Existing	committed	planned
Start-up date	1999/1983	1999	1975	2010	2010
Source of ore:					
• Deposit name	P2N *et al.*	Sue A-C, Jeb, McClean	Eagle Point	Cigar Lake	Midwest
• Deposit type	unconformity	unconformity	unconformity	unconformity	unconformity
• Reserves (tU)	168 000	12 655	6 925	89 000	13 460
• Grade (% U)	21.2	1.4	1.0	17.8	3.7
Mining operation:					
• Type (OP/UG/ISL)	UG	OP-UG	UG	UG	UG/OP
• Size (t ore/day)	NA	NA	NA	NA	NA
• Average mining recovery (%)	NA	NA	NA	NA	NA
Processing plant (acid/alkaline):					
• Type (IX/SX/AL)	AL/SX	AL/SX	AL/SX	McClean and Rabbit Lake	NA
• Size (t ore/day) for ISL (L/day or L/hour)	750	300	2 300		NA
• Average process recovery (%)	98	97	97		NA
Nominal production capacity (tU/year)	7 200	3 077	4 615	6 924	2 300 (est)
Plans for expansion		relates to Cigar Lake	relates to Cigar Lake		
Other remarks					

Ownership structure of the uranium industry

On 6 June 2006, the legal name of the Canadian mining arm of the AREVA group of companies, Cogema Resources Inc (CRI), was changed to AREVA Resources Canada Inc. This was a result of a decision by AREVA to standardise its global brand in the nuclear industry and was not due to any change in ownership of CRI.

Employment in the uranium industry

Direct employment in Canada's uranium industry totalled 1 067 in 2005 and 1 152 in 2006 (1 665 in 2006 including head office and contract employees).

Future production centres

The remaining uranium mining projects in Saskatchewan that have cleared or are undergoing the environmental review process are either poised to enter into production or are in the final stages of development leading to production and will extend the lives of existing production centres. Cigar Lake ore will provide feed for the McClean Lake and Rabbit Lake mills beginning in 2010 and Midwest will provide additional feed for the McClean Lake mill, once regulatory approvals have been obtained. AREVA is currently considering development of the Kiggavik deposit in Nunavut and has been active in seeking local support for the project.

Secondary sources of uranium

Canada reported that there was no production or use of mixed-oxide fuels nor any production or use of re-enriched tailings.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Environmental assessments

On 2 March 2006, the environmental assessment for the Midwest project began. The Midwest project is a joint venture between AREVA (69.16%), Denison Mines Ltd (25.17%) and OURD [Canada] Co Ltd (5.67%). The proposal is to mine the Midwest deposit (16 000 tU averaging 4.6%) by open pit and to transport the ore to McClean Lake for milling (where a further expansion of the JEB mill would be required). On 1 December 2006, the Governments of Canada and the province of Saskatchewan released the Draft Project-Specific Guidelines and Scoping Document for the Proposed Midwest Uranium Mine Development Project. If the project receives regulatory approval, it would take two years to develop the mine and a further two years to mine the ore. Milling of the Midwest ore is expected to take from five to seven years depending on the milling rate, which will be determined by the owners and approved by regulators.

A screening level EA of a proposal to send uranium-rich solution produced from Cigar Lake ore from McClean Lake to Rabbit Lake for further processing was initiated on 8 February 2005. The proposal includes minor modifications to the McClean Lake JEB mill required to load the uranium-rich solution for transport and modifications to the Rabbit Lake mill in order to receive the solution. The proposed project will also require a modification to the Rabbit Lake Tailings Management Facility to provide sufficient capacity to effectively manage the processing-related waste associated with this proposal. The proposal includes the construction of a dedicated "restricted access" haul road between McClean Lake and Rabbit Lake to transport the solution in specially designed containers.

A proposal to increase production at McArthur River and Key Lake by some 18% annually (from 7 200 tU/year to 8 500 tU/year) is the subject of a screening level EA that was initiated on 7 January 2003. Increased production at McArthur River requires changes to manage additional waste rock, mineralised waste and mine water flow. At Key Lake, the means to address the increased rate of tailings and treated effluent resulting from this proposal will be considered in this assessment.

A proposal by Cameco to construct and operate blending facilities to produce slightly enriched uranium (SEU) at the Port Hope conversion plant had been undergoing environmental assessment since May 2003. The proposal was withdrawn on 23 September 2005 and Cameco now plans to import the SEU which will be used in a new type of CANDU fuel which contains 1% ^{235}U. A proposal to assemble the fuel was submitted to the CNSC by Zircatec Precision Industries Inc. on 15 September 2006 and is currently undergoing a screening level environmental assessment.

On 4 July 2005, Cameco applied for amendment to an existing licence to authorise an increase in the production capacity of the Blind River Refinery from 18 000 to 24 000 tU as uranium trioxide. The proposal is currently undergoing a screening level environmental assessment.

Regulatory activities

In 2006, the CNSC completed the "Eldorado Nuclear Epidemiology Study Update – Eldorado Uranium Miners' Cohort". This report presents the results of the statistical analysis of a cohort of 17 660 individuals known to have worked for Eldorado Nuclear Limited in a period between 1930 and 1999. Exposure to radioactive radon decay products is one of the best-studied carcinogenic phenomena in epidemiology. The results obtained from these studies, primarily of underground miners, are very consistent in showing increases in lung cancer risk from such exposure, but no increase in any other disease.

Environmental management

Water treatment and minor engineering works continued to be the main activities at the closed Elliot Lake area uranium mine and mill sites in 2006. Denison Mines Inc. submitted a report to the Canadian Nuclear Safety Commission (CNSC) which recommended the installation of a pump station for the Dam G area at the former Stanrock mine to improve overall water quality.

Decommissioning

On 2 April 2007, the Government of Canada and the Government of Saskatchewan announced the first phase of the cleanup of closed uranium mines in northern Saskatchewan (principally Gunnar and Lorado). The total cost, which the Governments of Canada and Saskatchewan will share, will be CAD 24.6 million. Although these mines were operated by the private sector from the 1950s until the early 1960s, the companies no longer exist. When the sites were closed, there was no regulatory framework in place to appropriately contain and treat the waste, which has led to environmental impacts on local soils and lakes.

In Elliot Lake, Ontario, the major uranium mining centre in Canada for over 40 years, uranium mining companies have committed well over CAD 75 million to decommission all mines, mills and waste management areas. These companies continue to commit some CAD 2 million each year for treatment and monitoring activities.

URANIUM REQUIREMENTS

Canada has 22 CANDU reactors operated by public utilities and private companies in Ontario (20), Quebec (1) and New Brunswick (1). Of these 22 reactors, 18 are currently in full commercial operation, generating on average of about 15% of total electricity production in Canada. Of the 20 reactors in Ontario, two at the Pickering "A" station and two at the Bruce "A" station are currently out of service.

The two nuclear operators in Ontario, Ontario Power Generation (OPG) and Bruce Power, are pursuing options to increase capacity. Of the eight units that had been laid-up at Bruce and Pickering, three units were brought back to service in 2004 and Pickering A, Unit 1 was returned to service in November 2005 adding a total of 2 530 MWe of generating capacity to Ontario's grid.

OPG announced in August 2005 that it has decided not to proceed with the refurbishment of Pickering A, Units 2 and 3. The physical condition of Units 2 and 3 did not make them as good candidates for refurbishment as Units 1 and 4. OPG also noted that studying the case to extend the life of the Pickering B and ultimately Darlington reactors were key elements of their future plans.

Meanwhile, in October 2005, Bruce Power and the Ontario Power Authority (OPA) announced that they had entered into an agreement to refurbish Bruce A Units 1 and 2. Atomic Energy of Canada Limited (AECL) has been awarded the retubing contract by Bruce Power as part of the refurbishment of the Bruce A units. As well, Bruce Power will extend the operating life of Unit 3 by replacing the steam generators and fuel channels when required. They will also replace the steam generators in Unit 4. The capital programme for the refurbishment and restart of these units is expected to cost CAD 4.25 billion.

In December 2005, the OPA tabled with the government its report on key findings and recommendations in setting Ontario's future electricity supply mix. The report recommended substantial new nuclear power capacity for Ontario and refurbishment of existing CANDU nuclear power stations, aiming to keep nuclear share of electricity generation at about 50%. The report highlighted a critical need to increase baseload supply and identified a need for between 9 400 to 12 400 MW of nuclear power to be added by 2025 in Ontario.

On 13 June 2006, the Government of Ontario announced an energy policy which included the building of new nuclear power stations and the refurbishing of exiting nuclear power stations. In response to this policy, OPG filed a site preparation license application with the CNSC for a new nuclear facility with up to four reactors at Darlington. Similarly, Bruce Power has also begun a federal approvals process for the possible refurbishment or replacement of units at the Bruce site, again with up to four new reactors. The CNSC has recommended that the environmental assessment for this proposal be referred to a review panel.

In July 2005, New Brunswick Power signed a contract with AECL as the general contractor for the refurbishment of its nuclear power plant, Point Lepreau. The refurbishment is expected to take place in 2008-2009 with an estimated cost for the project, including replacement electricity, of CAD 1.4 billion. The New Brunswick Government has recently announced that it is considering building an additional nuclear power plant.

Hydro-Québec is currently considering the refurbishment of its nuclear power plant (Gentilly 2) as it is approaching the point where a decision needs to be taken on whether to refurbish or prepare for decommissioning. A decision on refurbishment is expected in 2008. If approved, the refurbishment of Gentilly 2 is expected to take place in 2010-2012.

Supply and procurement strategy

Ontario Power Generation fills its uranium requirements through long-term contracts with a variety of suppliers, as well as periodic spot market purchases. Cameco provides all uranium and uranium conversion services, and contracts all required fuel fabrication services, in managing all of Bruce Power's fuel procurement needs since becoming a partner in Bruce Power in 2001.

NATIONAL POLICIES RELATING TO URANIUM

The *Nuclear Fuel Waste (NFW) Act* came into force on 15 November 2002 requiring nuclear energy corporations to establish a Nuclear Waste Management Organization (NWMO) to manage nuclear fuel waste over the long-term.

Under the *NFW Act*, the NWMO is required to submit a study of the options for the long-term management of nuclear fuel waste. On 3 November 2005, the NWMO submitted its report to the government for review and consideration. In its report, the NWMO presented the following options:

- Deep geological disposal with possible retrieval; ongoing storage at the reactor sites.
- Above- or below-ground ongoing storage at the central site.
- The adaptive phased management approach (APM).

The NWMO recommended the APM as its preferred approach. This approach allows sequential and collaborative decision-making, providing the flexibility to adapt to experience and technical change. It will provide a viable, safe and secure long-term storage capability, with the potential to retrieve used fuel until and if a decision is made in the future to seal the facility.

The *NFW Act* requires the government to select one of the options from among those set out in the NWMO study. On 14 June 2007, the federal government announced its acceptance of the recommendation of the NWMO and selected APM as the preferred approach.

The *Nuclear Liability Act (NLA)* sets out a comprehensive scheme of liability for third-party injury and damage arising from nuclear accidents, and a compensation system for victims. It embodies the principles of absolute and exclusive liability of the operator, mandatory insurance, and limitations on the operator's liability in both time and amount. Under the *NLA*, operators of nuclear installations are absolutely liable for third-party liabilities to a limit of CAD 75 million. All other contractors or suppliers are thereby indemnified. A bill to amend the *NLA* has recently been tabled in Parliament. If passed, these amendments will overhaul the current legislation to better address public interests and reflect international standards. Key among the proposed amendments will be to increase the operator liability limit.

URANIUM STOCKS

The Canadian Government does not maintain any stocks of natural uranium and data for producers and utilities are not available. Since Canada has no enrichment or reprocessing facilities, there are no stocks of enriched or reprocessed material in Canada. Although Canadian reactors use natural uranium fuel, small amounts of enriched uranium are used for experimental purposes and in booster rods in certain CANDU reactors.

URANIUM PRICES

In 2002, Natural Resources Canada suspended the publication of the Average Price of Deliveries under Export Contracts for uranium.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million CAD	2004	2005	2006	2007 (expected)
Industry exploration expenditures	44	99	221	320
Government exploration expenditures	0	0	0	0
Industry development expenditures	63	134	255	212
Government development expenditures	0	0	0	0
Total expenditures	107	233	476	532
Industry exploration drilling (metres)	117 800	266 100	547 500	600 000
Number of industry exploration holes drilled	NA	NA	NA	NA
Government exploration drilling (metres)	0	0	0	0
Number of government exploration holes drilled	0	0	0	0
Industry development drilling (metres)	1 200	9 500	11 200	12 000
Number of development exploration holes drilled	NA	NA	NA	NA
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	NA	NA	NA	NA
Subtotal exploration drilling (metres)	117 800	266 100	547 500	600 000
Subtotal exploration holes	NA	NA	NA	NA
Subtotal development drilling (metres)	1 200	9 500	11 200	12 000
Subtotal development holes	NA	NA	NA	NA
Total drilling (metres)	119 000	275 600	558 700	612 000
Total number of holes	NA	NA	NA	NA

Uranium exploration and development expenditures – non-domestic

Expenses in million CAD	2004	2005	2006	2007 (expected)
Industry exploration expenditures	13	50[P]	100[P]	100
Government exploration expenditures	0	0	0	0
Industry development expenditures	0	18	37	62
Government development expenditures	0	0	0	0
Total expenditures	13	68	137	162

P Provisional data.

Reasonably Assured Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	243 600	243 600	243 600	
Open-pit mining	26 500	42 100	42 100	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	43 500	43 500	
Total	270 100	329 200	329 200	

Reasonably Assured Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	270 100	329 300	329 300
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	270 100	329 300	329 300

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	82 300	82 300	82 300	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	11 700	11 700	
Total	82 300	94 000	94 000	

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	82 300	94 000	94 000
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	82 300	94 000	94 000

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
50 000	150 000

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
700 000	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]	108 646	2 475	2 348	886	114 355	800
Underground mining[1]	265 461	9 122	9 280	8 976	292 839	9 200
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	1 000	0	0	0	1 000	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	375 107	11 597	11 628	9 862	408 194	10 000

(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]	[%]
0	0	7 193	73	2 617	26.5	52	0.5	9 862	100

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

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	1 754	1 560	1 665	1 700
Employment directly related to uranium production	985	1 067	1 152	1 300

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
14 990	14 990	14 990	14 990	17 730	19 270	17 730	19 270	17 730	19 270	17 730	19 270

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
17 730	19 270	17 730	19 270	17 730	19 270	17 730	19 270	17 730	19 270	17 730	19 270

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	86.7	94

Installed nuclear generating capacity to 2030
(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
12 500	12 500	13 300	14 000	14 000	15 000

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
14 000	17 000	NA	NA	NA	NA

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
1 800	1 900	1 900	2 000	1 900	2 000

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
2 000	2 300	NA	NA	NA	NA

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	0
Producer	NA	0	0	0	NA
Utility	NA	0	0	0	NA
Total	NA	0	0	0	NA

• Chile •

URANIUM EXPLORATION

Historical review

The key phases of uranium exploration in Chile are:

- 1950-1960: USAEC (USA)-Chile review of mining districts with Cu, Co, Mo and Ag mineralisation.
- 1970-1974: Nuclear Energy Board (JEN) Spain-Chile: survey of the Tambillos mining district, 4th region.
- 1976-1990: IAEA-UNDP: regional prospecting of 150 000 km^2 using geochemical drainage surveys, aerial radiometry, geology and ground radiometry. This resulted in the detection of 1 800 aerial anomalies, 2 000 geochemical and radiometric anomalies, the designation of 120 sectors of interest, the surveying of 84 areas of interest, the discovery of 80 occurrences of uranium, the study of 12 uranium sites, the preliminary exploration of two sites and the evaluation of uranium resources as a by-product of copper and phosphate mining.
- 1980-1984: Pudahuel Mining Company – Chilean Nuclear Energy Commission (CCHEN) carried out exploration using boreholes of the Sagasca Cu-U deposit, Tarapaca, 1st region. Technical and economic evaluation of the Huinquintipa copper deposit, 1st region.
- 1986-1987: Production Promotion Corporation (CORFO) and CCHEN carried out exploration and technical and economic evaluation of the Bahia Inglesa phophorite deposit, Atacama, 3rd region.
- 1990-1996: CCHEN carried out a geological and uranium metallogenic survey, principally in the north of the country.
- 1996-1999: CCHEN and the National Mining Company (ENAMI) carried out a survey of rare earth elements (REE) associated with radioactive minerals in the region of Atacama and Coquimbo. Dozens of primary sources were studied, with priority given to the Diego de Almagro anomaly no. 2. Study of these 180 km^2 identified disseminated deposits and veins of davidite, ilmenite, magnetite, sphene, rutile and anatase, with 3.5-4 kg/t of rare earth oxides (REO), 0.3-0.4 kgU/t and 20-80 kgTi/t, resulted in a geological resource estimate of 12 000 000 tU. The metallurgical recovery of the REOs from these minerals was also investigated. The aim of this project was to investigate mineral resources with medium-term economic potential.

- 1998-1999: CCHEN established the National Uranium Potential Evaluation project. This project combines metallogenic research with establishment of a geological data base to develop a portfolio of research projects whose implementation would improve the assessment of the national uranium potential.
- 2000-2002: A preliminary geological study of U-REE (rare earth elements) at the Cerro Carmen site, located in Atacama III Region, was carried out under the Specific Co-operation Agreement between CCHEN and ENAMI. Geophysical surveys were carried out (magnetometrics, resistivity and chargeability), which can be used to define a target of metallic sulphurs, with uranium and associated rare earths.
- 2001: A portfolio of projects was submitted, including updates of the metallogeny of Chile and the geological areas likely to contain uranium, 166 research project proposals, ranging from regional to detailed scientific activities, to be carried out sequentially in accordance with CCHENs capabilities.

  In the extractive metallurgy sector, work has been carried out since 1996 under the co-operation agreement between CCHEN and ENAMI on developing process for the production of commercial concentrates of rare earth elements. High-grade concentrates of light rare earths and yttrium have been obtained.
- 2003: Regional exploration for uranium and rare earths was carried out in the 1st region and subsequently the co-operation agreement between ENAMI and CCHEN was terminated.
- 2004: Work on populating the database continued and paid services were provided to the mining industry.

Recent and ongoing uranium exploration and mine development activities

2005-2006: Paid services were provided to the mining industry.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Chile reports known conventional resources totalling 1 930 tU, including 1 034 tU RAR and 896 tU Inferred (no costs are assigned to either category). The 1 January 2007, estimate includes 68 tU mainly in the low grade (0.02% U) surficial type occurrences Salar Grande and Quillagua, 1 763 tU in Upper Cretaceous metasomatic occurrences including mainly the Estacion Romero and Prospecto Cerro Carmen (REE) occurrences whose grades range between 0.03 and 0.20% U, and 100 tU in the Cenozoic volcanogenic deposit of El Laco, which grade ranges between 0.01 and 0.18% U.

Undiscovered Resources (Prognosticated & SR)

Undiscovered conventional resources (Prognosticated and SR) are estimated to total 4 688 tU with no assigned cost category. The bulk of this resource (4 060 tU) is expected to occur in the Upper Cretaceous metasomatic type occurrences. Within this group the majority of the resource, totalling 2 900 tU, is assigned to the Diego de Almagro occurrence.

Unconventional or by-product resources

Chile reported unconventional or by-product resources totalling 5 458 tU. The majority of these resources are associated with the Chuquicamata copper deposit and with the Bahia Inglesa and Mejillones uraniferous phosphate deposits. Uranium could potentially be recovered as a by-product from both types of deposits. However, because of the very low uranium content (0.008 to 0.01% U), production costs are projected to exceed USD 80/kgU.

URANIUM PRODUCTION

None reported.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

The Chilean Nuclear Energy Commission has an ongoing programme for the dissemination of the peaceful use of nuclear energy, which comes under the Public Relations and Outreach Office.

URANIUM REQUIREMENTS

Chile has made significant technological progress in the fabrication of MTR fuel elements based on U_3Si_2 (uranium silicide). In March 1998, the fabrication of 47 fuel elements began at the CCHEN fuel element plant and was completed in 2004. Sixty kg of uranium metal enriched to 19.75% in ^{235}U was bought from the Russian Federation for this work, and this material covers the uranium requirements up to date. To date, 47 fuel elements have been fabricated of which 16 are being used in the RECH-1 reactor. One of these fuel elements was sent to Petten Research centre in the Netherlands for assessment under irradiation in the high flux reactor (HFR). This was completed in November 2004.

Supply and procurement strategy

In view of the possible fabrication of other fuel element loads, the procurement of enriched uranium is being considered.

Installed nuclear generation capacity

Chile does not have any nuclear power plants. The National Energy Commission's (CNE) medium-term projections (10 years) do not envisage adding a nuclear power plant into the national electricity grid during this period.

NATIONAL POLICIES RELATING TO URANIUM

Under Law 16.319, the Chilean Nuclear Energy Commission (CCHEN), a state agency, is responsible for advising the Chilean Government on all issues relating to the peaceful use of nuclear energy and for developing, proposing and implementing national plans for all aspects of nuclear power research, development, use and control, especially concerning the legal and regulatory provisions governing ownership of deposits of uranium and thorium ores.

Under Law 18.248 of 14 October 1983, the Mining Code allows free claims to uranium, as an incentive to private sector prospecting and exploration for natural radioactive minerals. The law also gives the CCHEN the first option to buy. However, in view of the market conditions prevailing from 1980 to 2004, there was no private sector participation in this activity. In the past two years, both national and foreign companies have shown an interest in developing uranium exploration and production businesses in the country. Consequently, for the purposes of fulfilling its mandate under the law the CCHEN, as a state agency, develops basic geological information on potential national resources of radioactive minerals in place of the private sector.

Supreme Decree no. 302 of 21 December 1994 approved the National Nuclear Development Plan, including objectives concerning the prospecting and exploration of materials of nuclear interest. This mandate has been implemented by means of geological surveys.

URANIUM STOCKS

None.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million CLP	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	83 778	48 500	52 475	59 713
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	83 778	48 500	52 475	59 713
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	NA	NA	NA	NA
Number of government exploration holes drilled	NA	NA	NA	NA
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)	NA	NA	NA	NA
Subtotal exploration holes	NA	NA	NA	NA
Subtotal development drilling (metres)	NA	NA	NA	NA
Subtotal development holes	NA	NA	NA	NA
Total drilling (metres)	NA	NA	NA	NA
Total number of holes	NA	NA	NA	NA

Reasonably Assured Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	NA	NA	1 034	
Total	NA	NA	1 034	

* *In situ* resources.

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	NA	NA	68
Metasomatite	NA	NA	966
Other	0	0	0
Total	NA	NA	1 034

* *In situ* resources.

Inferred Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	NA	NA	896	
Total	NA	NA	896	

* *In situ* resources.

Inferred Resources by deposit type*

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	NA	NA	100
Metasomatite	NA	NA	796
Other	0	0	0
Total	NA	NA	896

* *In situ* resources.

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
NA	1 528

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
NA	3 160

• China •

URANIUM EXPLORATION

Historical review

Before the 1990s, China's uranium resource exploration activities were mainly carried out on hydrothermal related granite type and volcanic type uranium deposits in Jiangxi, Hunan, Guangdong Provinces and Guangxi Autonomous Region in southern China. With decades of exploration, the Bureau of Geology (BOG), China National Nuclear Corporation (CNNC) has been successful in discovering some significant uranium deposits such as the Xiangshan, Xiazhuang ore-fields and Chengxian deposit in the southern China fold belt. These deposits mainly occur in intermediate to acid magmatic rocks such as granitoid and volcanic rocks. As a number of these deposits are of relatively small size, low to middle grade, and their transportation and power supply are not easily accessible, the mining costs turned out to be much higher than those acceptable to the commercial nuclear reactor operators. At the beginning of the 1990s, when China initiated its nuclear energy programme, the demand for uranium from China's nuclear power plants was not so urgent. Additionally in the mid-1990s China experienced relatively high currency inflation, which resulted in the decrease of uranium exploration activities in China from the mid-1990s to the end of the decade.

Facing financial difficulties, as well as the challenge of meeting demand for economic uranium resources for the country's mid-term and long-term nuclear energy development plan, the BOG made the decision to change its prospecting direction from the "hard rock" type to *in situ* leaching type, in the northern and northwest regions. From the mid-1990s, China began to speed up the construction of nuclear power plants in coastal areas, and accordingly the demand for uranium started to steadily increase. As the low cost known uranium resources decreased through mining depletion, the BOG initiated some regional geological reconnaissance projects and drilling survey projects in Yili, Turpan-Hami, Junggar, Er'lian and Songliao Basins in northern and northwest China with limited funding from the beginning of the 1990s. During the 1990s, due to an insufficient budget from the government, the average annual drilling distance was maintained at about 40 000 m. In 1999, the government conducted a significant structural reform in China's mineral exploration sector, which resulted in a large part of the personnel, who had been involved in geological exploration, being transferred to local governments. After the transfer of most of the geological organisations, the staff of BOG was reduced from more than 45 000 to only about 5 500. At the end of the 1990s, the government gradually became aware of the importance of increasing the economic uranium resources to guarantee the supply of uranium for the domestic nuclear power industry. Investment in uranium exploration steadily increased from 2000, and drilling distance experienced a rebound from 40 000 m to 70 000 m in 2000 gradually increasing to 130 000 m in 2003 and 140 000 m in 2004. All these drillings were focused on prospecting for *in situ* leaching amenable sandstone type uranium deposits in northern China, the important target areas including Yili, Erdos, Turpan-Hami, Er'lian, Junggar, and Songliao Basins.

Recent and ongoing uranium exploration activities

During the years 2005 and 2006 uranium prospecting and exploration in China accelerated markedly, focusing on areas with known uranium deposits but also extending to grassroots areas that had not been systematically explored. The total drilling distance dramatically increased to 600 000 m in the last two years due to the increased input of financial resources from the government. As a result, significant discoveries of uranium resources in the northern China added more than 15 000 tU of Identified Resources (RAR and Inferred Resources), mainly from deposits in northern China amenable to ISL extraction. These new discoveries are concentrated in the Zaohuohao deposit located in the Dongsheng area of Erdos Basin, Inner Mongolia, and the Wukuerqi deposit located in the Yili basin, Xinjiang Autonomous region. In addition to exploration in the sandstone basins of northern China, the prospecting and exploration of hard rocks in the southern part of China was restarted, and new discoveries of vein-type uranium mineralisation were made in several uranium districts, such as Xiangshan, Jiangxi, Miaoeshan, Guangxi and Daqiaowu.

In the year of 2005, prospecting and exploration was focused on Meso-Cenozoic sedimentary basins in northern, north-western and north-eastern China, targeting ISL amenable sandstone type uranium deposits. A total 200 000 m of drilling was completed in the northern and northwest parts of the area, including the Erdos, Yili, Turpan, Erlian, Junggar and Songliao basins.

In 2006, the approach to exploration began to change. In addition to the continuation of prospecting and exploration in the sandstone basins, exploration of hydrothermal type uranium deposits in the southern part of China were restarted after more than ten years of inactivity. The focus here was given to the known uranium deposit areas such as Xianshan, Jiangxi, Xiazhuang-Zhuguang, Guangdong, Miaoeshan, Guangxi and Daqiaowu, Zhejiang, etc.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Uranium resources in China total 100 000 tU, as listed in the following table. The increase of 15 000 tU compared to the 2005 Red Book is due to the increase in known ISL mining resources in the Erdos Basin, Inner Mongolia Autonomous Region and the Yili Basin of the Xinjiang Autonomous Region.

The main uranium deposits or ore fields, and known uranium resources in China, are listed in the following table:

	tU
Xiangshan uranium field in Jiangxi Province	26 000
Xiazhuang uranium field in Guangdong Province	12 000
Qinglong uranium field in Liaoning Province	8 000
Chanziping uranium deposit in Guangxi Autonomous Region	5 000
Chengxian uranium deposit in Hunan Province	5 000
Tengchong uranium deposit in Yunnan Province	6 000
Lantian uranium deposit in Shanxi Province	2 000
Yili uranium deposit in Xinjiang Autonomous Region Wukueqi deposit in Yili basin	16 000
Shihongtan uranium deposit inrpan-Hami Basin in Xinjiang Autonomous Region	3 000
Zaohuohao uranium deposit in Erdos Basin in Inner Mongolia Autonomous Region	17 000
Total	100 000

The increased uranium resources are provided by the Zaohuohao deposit in the Erdos basin of the Inner Mongolia Autonomous Region and the Wukueqi deposit in the Yili Basin. The large Zaohuohao deposit, located at the northeast of Erdos Basin, occurs in Middle Jurassic Zhiluo Formation sandstone. The host rocks here are middle-coarse grained arkoses, with ore formation controlled by redox front. The ore zone is about 40 km in length, 5 km in width and 3.68 m thick. The average ore grade is 0.46% U. ISL tests have successfully produced yellowcake. Work at the Wukueqi deposit, located in Yili basin of the Xinjiang Autonomous Region, resulted in the addition of another 3 000 tU to the resource base.

Undiscovered Resources (Prognosticated and Speculative Resources)

China has great potential for uranium occurrences. Accordingly to statistical analyses conducted by several institutes in China, on the order of 1.2 to 1.7 million tU of Undiscovered Resources are predicted. Favourable areas in the Er’lian Basin, the Erdos basin, and the Inner Mongolia Autonomous Region have been identified in the last two years. Other areas, such as the Tarim Basin, the Junggar Basin in Xinjiang Autonomous Region, and the Songliao Basin in northeast China are also considered favourable potential target areas. More uranium resources may be added to the known uranium deposits in southern China as prospecting and exploration work continues.

Unconventional Resources and other materials

No systematic appraisal of these potential sources of uranium has been conducted to date.

URANIUM PRODUCTION

Historical review

The nearly 50 year history of China’s uranium industry has experienced both a boom in activity during the first two decades followed by a decline in late 1980s and 1990s. In the early years of the new century it a resurgence has taken place, driven principally by the ambitious new nuclear power plant construction programme announced by Chinese Government and the surging uranium spot price. As a result, uranium production has once again been a focus of attention in China. Several production centres are under construction, such as Fuzhou and Chongyi uranium mines, with the new Chongyi production centre situated in a different location, subject to the results of ongoing pilot tests. In addition, the former Qinglong uranium mine has been rebuilt and brought back into operation recently. Feasibility studies are also being carried out on other select uranium deposits.

Status of production capability

Construction of two new production centres has been finished recently and production is expected to begin once final approvals from the relative authorities have been received. One, the Qinglong uranium mine, is a conventional underground mine associated with the Benxi uranium mine. The other is an expansion of the Yining ISL mine. Combined, these facilities will add an additional 200 tU/year nominal capacity when they are put into full operation. The status of other production centres in China remains the same. No productions centres have been shut down in the last two years.

Ownership structure of the uranium industry

The uranium industry in China is 100% owned by a state company.

Employment in the uranium industry

With the new production centres coming into operation, new employees are needed. At the same time, a programme in old production centres is gradually being finalised and the number of employees has been decreased order to increase efficiency and lower costs. As a result, employment in this industry will be on balance slightly increased.

Future production centres

New production centres at the Fuzhou uranium mine and the Chongyi uranium mine remain under construction. The Chongyi production centre will use the in-stope leaching method for the first time in China, resulting in a significant reduction of ore transportation to the surface, lowering both the production cost and the amount of land required to store the tailings.

ISL pilot tests at the Shihongtan deposit are ongoing. The pilot test in Dongsheng uranium deposit is also ongoing but only in the western portion of the field owing to low permeability in the eastern part of the deposit making it unsuitable for ISL extraction.

Feasibility studies are being conducted on several other deposits, such as Liaohe sandstone type uranium deposit and the Guyuan granite uranium deposit.

With the current high uranium spot market price, some uranium mines currently on stand-by are expected to be put into operation again.

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

	Centre # 1	Centre # 2	Centre # 3	Centre # 4	Centre # 5	
Name of production centre	Fuzhou	Chongyi	Yining	Lantian	Benxi	Benxi
Production centre classification	existing committed	existing	existing	existing	existing	existing
Start-up date	1966	1979	1993	1993	1996	2007
Source of ore:						
• Deposit name			Dep 512	Lantian	Benxi	Qinglong
• Deposit type	volcanic	granite	sandstone	granite	granite	volcanic
• Resources (tU)						
• Grade (% U)						
Mining operation:						
• Type (OP/UG/ISL)	UG	UG	ISL	UG	UG	UG
• Size (t ore/day)	700	350	NA	200	100	200
• Average mining recovery (%)	92	90	NA	80	85	85
Processing plant (acid/alkaline):	conventional	heap leach		heap leach	heap leach	heap leach
• Type (IX/SX/AL)	IX, AL	IX, AL	IX, AL	IX, AL	SX, AL	IX
• Size (t ore/day) for ISL (L/day or L/h)	700	350	NA	NA	NA	NA
• Average process recovery (%)	90	84	NA	90	90	96
Nominal production capacity (tU/year)	300 200 (committed)	120	300	100	120	100
Plans for expansion	NA	Expansion to 270 t/a		NA	NA	NA
Other remarks						

Secondary sources of uranium

China reports no production or use of mixed-oxide fuels or re-enriched tailings.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Owing to the new environmental regulations put in place recently, new technologies are widely used in uranium mines in China. Mine liquids are collected, treated and recycled for use underground. Only very small amounts of waste water are discharged after treatment to meet the relative discharging regulations. In the last two years, new regulations require that treated water that is not discharged directly, but instead is withheld in a storage pond for a period of time before being checked again to verify that it meets discharge standards.

There are a total of three closed mines that have been rehabilitated. One has been approved by the responsible government authority and approvals for the other two are expected in 2007.

URANIUM REQUIREMENTS

As of 1 January 2007, the total installed nuclear capacity in China of 6 700 MWe, required about 1 200 tU annually. Once the final test operations have been successfully completed, two units (1 000 MWe each) at Tianwan nuclear power plants are expected to be put into commercial operation in 2007.

According to the government's plan for nuclear power development, total nuclear generating capacity will reach 40 GWe by the end of 2020. New nuclear power plants were under construction at Ling'ao (phase II; 2×1 000 MWe) and Qinshan (phase II; 2×600 MWe). Early stage feasibility studies are ongoing at Sanmen in the Zhejiang province, Haiyang in the Shandong province and Yangjiang in the Guangdong province (2×1000 MWe each). Other potential NPP sites are still waiting for government approval, such as sites in the Liaoning , Hunan and Fujian provinces.

As a result, it is expected that in five years annual reactor related uranium requirements will increase significantly.

Supply and procurement strategy

In order to meet the demand of China's expanding nuclear power plant capacity, additional production capability is needed. In the past two years, new production centres are being brought into operation, old production centres are being expanded and some older facilities currently on stand-by may be re-started. As noted above, construction of two new production centres finished recently will add another 200 tU/year capability. Feasibility studies in different stages are underway at other uranium deposits. Though domestic production is capable of meeting short term uranium requirements, demand is increasing and there is pressure to develop additional production capability as nuclear power expands in China. Accordingly, investment in domestic uranium exploration has greatly increased in the last two years. Because of increasing uranium demand in the future, many companies are also involved in developing foreign uranium resources. For example, in July 2006 the Chinese National Nuclear Corporation (CNNC) signed an agreement with the Government of Niger to develop the uranium resources. It is envisioned that production from both witin and outside China will be the principle means of meeting the rising demand in China, supplemented by uranium purchases, as required.

NATIONAL POLICIES RELATING TO URANIUM

In order to meet the demand of nuclear power plants in China, domestic production must increase greatly. The Chinese Government encourages exploration for economic uranium resources and the expansion of domestic production capabilities. Besides building new production centres, raising production capability is also pursued by technological advancement, such as using bacterial leaching to shorten the leaching cycle.

The development of uranium production capability with partners outside China is also encouraged. In July, 2006, the CNNC and the Government of Niger signed an agreement to co-develop uranium deposits in Niger. In addition, Sinosteel Corporation (Sinosteel) and PepinNini Minerals Limited signed a Memorandum of Understanding(MOU) to enter into a strategic alliance for joint participation and co-operation in the development of uranium deposits in South Australia.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million USD (USD 1 = CNY 7.74)	**2004**	**2005**	**2006**	**2007** (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	9.5	13.5	25.5	33.6
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	9.5	13.5	25.5	33.6
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	140 000	200 000	400 000	450 000
Number of government exploration holes drilled	552	730	1 230	1 410
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	140 000	200 000	400 000	450 000
Subtotal exploration holes	552	730	1 230	1 410
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	140 000	200 000	400 000	450 000
Total number of holes	552	730	1 230	1 410

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	10 050	12 050	12 050	
Open-pit mining	0	0	0	
In situ leaching	8 000	12 000	18 000	
Heap leaching	24 950	36 250	36 250	
In-place leaching (stope/block leaching)	400	400	400	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	43 400	60 700	66 700	

* *In situ* resources.

Inferred Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	3 400	7 400	7 400	
Open-pit mining	0	0	0	
In situ leaching	2 000	5 000	7 000	
Heap leaching	2 600	9 200	9 200	
In-place leaching (stope/block leaching)	2 000	2 000	2 000	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	10 000	23 600	25 600	

* *In situ* resources.

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
3 600	3 600

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
4 100	NA

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]	NA	0	0	0	NA	0
Underground mining[1]	NA	NA	NA	NA	NA	NA
In situ leaching	NA	200	200	250	NA	300
Heap leaching	NA	NA	NA	NA	NA	NA
In-place leaching*	NA	NA	NA	NA	NA	NA
Co-product/by-product	NA	NA	NA	NA	NA	NA
U recovered from phosphates	NA	NA	NA	NA	NA	NA
Other methods**	NA	NA	NA	NA	NA	NA
Total	NA	NA	NA	NA	NA	NA

(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]	[%]
NA	100	0	0	0	0	0	0	NA	100

Uranium industry employment at existing production centres

(person-years)

	2004	2005	2006	2007 (expected)
Total employment related to existing production centres	7 500	7 000	7 300	7 400
Employment directly related to uranium production	6 750	6 300	6 700	6 720

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	50.3	51.8

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
6 700	8 700	13 000	20 000	25 000	35 000

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
30 000	40 000	40 000	50 000	50 000	60 000

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
1 200	1 500	2 340	3 600	4 500	6 300

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
5 400	7 200	7 200	9 000	9 000	10 800

• Colombia •

URANIUM EXPLORATION

Historical review

Until 1962 there had never been any exploration specifically for uranium in Colombia; only some isolated data from some very preliminary studies. After that date the former Institute for Nuclear Affairs (Instituto de Asuntos Nucleares, IAN) began to take an interest and carried out field studies. Companies and agencies, such as Agip, Enusa, Total, Minatome, Cogema, IAEA and Coluranio surveyed part of the Andes and some sectors of the Guyana shield. The result of this phase was that some anomalies were discovered in sites such as Santa Elena (Norte de Santander Department), Berlín (Caldas Department), Zapatota, California, San Celestino and Contratación (Santander Department).

In 1981, the IAN presented a Regional Programme for Evaluating Uranium-bearing Areas, which reported 450 anomalies. However, no concrete Evaluation Plan was designed to identify deposits. Ten uranium-bearing geological formations, covering approximately 90% (1 024 312 km^2) of the national territory were described in this report.

Recent and ongoing uranium exploration and mine development activities

It was only as of 2005 that INGEOMINAS (the Colombian Institute of Geology and Mining) began reporting applications, a total of 26 at the time, covering approximately 55 000 hectares. Nine mining concessions have been signed and exploration companies holding these will have to report activities within the next year.

In the field of science, the IAN-R1 nuclear reactor, a research reactor using TRIGA type ^{235}U operating at 30 kW is capable of attaining a neutron flux of 6.4~1011 $n/cm^2/s$. This reactor, responsibility of INGEOMINAS, is used by a multidisciplinary group of professionals in order to develop applications for studies using neutron activation analysis techniques for geological and geochemical purposes (rock, sediment, ores and oil); fission track dating; the production of some radiotracers (isotopes used in hydrology).

As of March 2007, the Colombian mining registry listed nine mining concessions in the name of two holders. On the other hand, in the past two years (2005 and 2006), there has been a large influx of mining applications; currently there are more than 30 such applications which, together with existing mining concessions, cover approximately 200 000 hectares.

The areas covered include areas in which earlier studies had found favourable geological formations for uranium. In other words, over the past few years concession applicants have been concentrating on reviewing and verifying the information in studies which had been conducted by firms and by the State in the past.

Department	Towns
Santander	Betulia, San Vicente de Chucury, Zapatota
Norte de Santander	Ocaña, Abrego, La Esperanza
Cesar	Río de Oro, San Martín, San Alberto

The main uranium exploration company in Colombia is the Canadian company, Lerida Bay Ltd. (Canadian); other mining applicants are also springing up around registered companies or are filing on behalf of the latter company.

Private sector investment is expected to be of the order of USD 6 million for 2007 and around USD 20 million over the next few years. These investments will be allocated to programmes for geophysical and geochemical exploration, drilling, and evaluating reserves.

Currently INGEOMINAS is organising geochemical data generated by studies carried out in the past; the review process has shown some anomalous values in the Orinoco and Amazon regions.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

None.

Undiscovered Resources (Prognosticated & SR)

It is estimated that there are *in situ* resources of 11 000 tU Prognosticated and 217 000 tU Speculative.

Unconventional Resources and other materials

None.

URANIUM PRODUCTION

None.

URANIUM REQUIREMENTS

None.

NATIONAL POLICIES RELATING TO URANIUM

The handling of radioactive materials is governed by Law 728 of 27 December 2001, which approves the "Convention on the Physical Protection of Nuclear Material", signed in Vienna and New York on 3 March 1980. Among other objectives, it was to set up a National Working Group on Nuclear Affairs under the Energy Directorate. The functions of the Nuclear Affairs Group are to:

- Design national policy on nuclear energy and the management of radioactive materials.
- Draft documents which will be used to set licensing and inspection service tariffs for the management of radioactive materials in the country.
- Promote compliance with international treaties, agreements and conventions on nuclear safety and radiation protection.

As regards mining activities, Law 685 of 2001 (the Mines Code) applies no restrictions, therefore any individual, national or foreign, may apply for a mining concession.

Uranium exploration and development expenditures and drilling effort – domestic
Currency reported: USD (30 March 2007)

Expenses in USD	**2004**	**2005**	**2006**	**2007** (expected)
Industry exploration expenditures	0	0	0	6 000 000
Government exploration expenditures	0	0	0	0
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	0	0	0	6 000 000
Industry exploration drilling (metres)	NA	NA	NA	NA
Number of industry exploration holes drilled	NA	NA	NA	NA
Government exploration drilling (metres)	0	0	0	0
Number of government exploration holes drilled	0	0	0	0
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	NA	NA	NA	NA
Subtotal exploration holes	NA	NA	NA	NA
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	NA	NA	NA	NA
Total number of holes	NA	NA	NA	NA

Prognosticated Resources*
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
0	11 000

* As reported in previous Red Books.

Speculative Resources*
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
217 000	0

* As reported in previous Red Books.

• Czech Republic •

URANIUM EXPLORATION

Historical review

Following its start in 1946, uranium exploration in Czechoslovakia grew rapidly and developed into a large-scale programme in support of the country's uranium mining industry. A systematic exploration programme including geological, geophysical and geochemical surveys and related research was carried out to assess the uranium potential of the entire country. Areas with identified potential were explored in detail using drilling and underground methods.

Exploration continued in a systematic manner until 1989 with annual exploration expenditures in the range of USD 10-20 million and an annual drilling effort in the range of 70-120 km. Exploration was traditionally centred around vein deposits located in metamorphic complexes of the Bohemian massif and around the sandstone-hosted deposits in northern and north-western Bohemia.

In 1989, the decision was made to reduce all uranium related activities. No field exploration has been carried out since the beginning of 1994.

Recent and ongoing uranium exploration and mine development activities

No field exploration has been carried out since the beginning of 1994.

Exploration activities have been focused on the conservation and processing of previously collected exploration data. Processing the exploration data and building the exploration database will continue in 2007.

URANIUM RESOURCES

Historically, most of the known uranium resources of the Czech Republic occurred in 23 deposits, of which 20 have been mined out or closed. Of the three remaining deposits, one is being mined (Rozná), and two, including Osecná-Kotel and Brzkov have resources that are not recoverable because of environment protection. Undiscovered uranium resources are believed to occur in the Rozná and Brzkov vein deposits in the metamorphic complex of western Moravia, as well as in the sandstone deposits of the Stráz block, Tlustec block and Hermánky region in the Northern Bohemian Cretaceous basin.

Identified Resources (RAR & Inferred)

Identified Resources as of 1 January 2007 increased by 110 tU, compared to the previous estimate.

In detail, the Reasonably Assured Resources recoverable at cost below USD 80/kgU increased by 50 tU, and the RAR above USD 80/kgU are no longer registered. The increase in RAR was the result of the re-evaluation and specification of the resources at the Rozná deposit during the depletion.

Inferred Resources at below USD 80/kgU increased by 60 tU from the same reason as RAR, i.e. as a result of the re-evaluation and specification of the resources at the Rozná production centre. Inferred Resources above USD 80/kgU are no longer reported. All the Identified Resources recoverable at cost below USD 80/kgU are tributary to the existing Rozná and Stráz production facilities. Mining losses of 5% have been accounted for in estimating RAR and Inferred Resources.

Undiscovered Resources (Prognosticated & SR)

No new areas favourable for the discovery of resources have been identified in the last two years.

The Undiscovered Resources (PR and SR) did not change over the last two years (see details in the 2001 Red Book).

URANIUM PRODUCTION

Historical review

The industrial development production in Czechoslovakia began in 1946. Between 1946 and the dissolution of the Soviet Union, all uranium produced in Czechoslovakia was exported to the Soviet Union. The first production came from Jachymov and Horni Slavkov mines, which completed operations in the mid-1960s. Pribram, the main vein deposit, operated in the period 1950-1991. The Hamr and Stráz production centres, supported by sandstone deposits, started operation in 1967. The peak production of about 3 000 tU was reached in about 1960 and production remained between 2 500 and 3 000 tU/year from 1960 through 1990, when it began to decline. A cumulative total of 109 845 tU was produced in the Czech Republic during the period 1946-2006. About 86% of that total was produced by underground and open-pit mining methods while the remainder was recovered using *in situ* leaching.

Status of production capability

Two production facilities remain in the Czech Republic. These are the conventional deep mine Rozná (stoping c. 1 100 m under ground) in Dolni Rozinka uranium production centre and the chemical mining centre currently under remediation in Stráz pod Ralskem (*in situ* leaching c. 180 m under ground). Both Dolni Rozinka and Stráz pod Ralskem production facilities are capable of producing the uranium. On the basis of the global rise in uranium prices and persisting good uranium resources at the Rozná deposit, the government recently decided (Decree in May 2007) to continue in mining activities as long as they are profitable. Production amounted to 262 tU in 2007 and this level is expected to be maintained in future years, although expansion is possible.

Uranium from the ISL facility in Stráz pod Ralskem is produced as a part of environmental remediation. Production capability is decreasing due to low uranium concentration in solutions. Expected production is 28 tU in 2007, and it is expected to decrease continuously thereafter.

Uranium obtained from mine water treatment is also not insignificant. Total expected production is 19 tU in 2007, i.e. increased by 16 tU in comparison to 2005. The increase in uranium production due to a new water treatment plant that was put into operation at the Pribram mined out deposit after flooding of underground in 2006.

Ownership structure of the uranium industry

In ownership of the uranium producing operations are no changes. All uranium related activities, including exploration and production have been carried out by the government-owned enterprise, DIAMO, s.p., based in Stráz pod Ralskem.

Employment in the uranium industry

With respect to recent and ongoing uranium and related environmental activities, employment in the Czech uranium production centres has settled on 2 251 workers, as of the end 2006. This employment is engaged in uranium production, decommissioning and restoration activities in Dolní Rozínka and Stráz pod Ralskem centres.

Future production centres

No other production centres are committed or planned in the near future.

Production and/or use of mixed-oxide fuels

CEZ, a.s., the operator of all six country power reactors does not consider usage of MOX fuels. Alike, it has not been scheduling utilisation of RepU or re-enriched tails in fuels yet.

Production and/or use of re-enriched tails

None.

Production and/or use of reprocessed uranium

None.

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

	Centre #1	Centre #2
Name of production centre	Dolní Rozínka	Stráz pod Ralskem
Production centre classification	Existing	existing
Start-up date	1957	1967
Source of ore:		
• Deposit name	Rozná	Stráz
• Deposit type	Vein	sandstone
• Resources (tU)	680	1 320
• Grade (% U)	0.378	0.030
Mining operation:		
• Type (OP/UG/ISL)	UG	ISL
• Size (t ore/day)	550	–
• Average mining recovery (%)	95	50 (estimated)
Processing plant:		
• Type (IX/SX/AL)	IX/ALKAL/CWG	ISL/AL/IX
• Size (t ore/day); for ISL (L/day or L/h)	530	20 000 kl/day
• Average process recovery (%)	92.5	–
Nominal production capacity (tU/year)	400	100
Plans for expansion	None	none
Other remarks	–	Extraction under remediation process

ENVIRONMENTAL ACTIVITIES AND SOCIAL CULTURAL ISSUES

Both environmental activities and solution of social issues are main parts of the contraction programme of the Czech uranium industry, which started in 1989. The environmental remediation activities include planning, administration, environmental impact assessment, decommissioning, waste rock management, remediation of tailings impoundments, site rehabilitation, water treatment and long-term monitoring. These activities are completely provided at the existing production centres as well as at the sites of former uranium facilities.

The fundamental uranium environmental projects are as follows:

- Remediation of the after-effects of the *in situ* leaching in Stráz pod Ralskem (affected in sum 266 million m^3 groundwater, enclosure 600 ha surface area).
- Rehabilitation of the tailings impoundments in Mydlovary, Pribram, Stráz pod Ralskem, Rozná (in sum 19 ponds, total area 576 ha).
- Rehabilitation of the waste rock dumps in Pribram, Hamr, Krizany, Licomerice, Rozná, Olsi and others (in sum 406 dumps, capacity 46 million m^3).
- Mine water treatment from uranium facilities in Pribram, Stráz, Horni Slavkov, Licomerice, Olsi, and others (approximately 11 million m^3 per year, gained 17 tU).

The major part of environmental projects (more than 90%) is being funded by the state budget. The projects will continue until approximately 2040 and should cost more than CZK 60 million.

The contraction programme of the uranium industry consists in gradual decreasing of the employment related to uranium production and developing of alternative projects for elimination the social issues. The social part of the contraction programme (compensations, damages, rents, etc.) is financed by the state budget. The Czech uranium industry is carried out by the state-owned enterprise DIAMO, as an environmental engineering company.

Expenditures related to environmental activities and social issues(CZK millions)

	Total through end of 2004	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Uranium environmental remediation	19 929	1 193	1 300	22 422	1 415
Social programme and social security	5 446	490	488	6 424	521
Total	25 375	1 683	1 788	28 846	1 936

URANIUM REQUIREMENTS

The Czech Republic has six VVER power reactors (4 x 440 and 2 x 1 000 MW, gross) operated by the Czech power utility CEZ, a.s. The share of nuclear energy amounted to 30.8% of the total domestic gross electric generation in the year of 2006. The Dukovany NPP generated a record amount of 14.03 TWh and the Temelin NPP 12.02 TWh of electricity (gross). The total net generating capacity was 3.472 TW in 2006. Ongoing modernisation of the Dukovany NPP (such as already finished reconstruction of low-pressure flow parts of the unit 3 and 4 turbogenerators which has increased the gross capacity of units by 3.5% from 440 to 455 MWe) along with scheduled deployment of progressed fuel shall gradually increase gross generation capacity to 500 MW each, until 2012. There are no new nuclear units considered to be put in operation until 2030, for the present. Uranium requirements after 2025 only reflect considerations about additional extension of operation of the Dukovany reactors; i.e., beyond their 40 year lifespan. Accordingly, there will be no substantial change in long-term uranium requirements, except those related to optimisation of tails assays. However, some fluctuation and temporary increase in the total uranium needs in the range from 650 to 800 tonnes will be in the period of 2009-2013 according to a carried out alternative and pace of transition to a new fuel fabricator for the Temelin NPP.

Supply and procurement strategy

In 2005-2006, domestic uranium production covered about one third of CEZ’s total needs. A remaining portion was procured from foreign sources on the basis of long-term contracts.

NATIONAL POLICIES RELATING TO URANIUM

The extensive contraction programme of the Czech uranium industry has been decided and started at the end of the 1980s. However according to government decree the remaining uncovered deposits Rozná and Stráz will be mined out (without financial share of the government). Next uranium mining depends on technical and economic conditions at the deposits and uranium price development.

The Government of the Czech Republic has positive nuclear policy in the field of the power industry for the future.

URANIUM STOCKS

There is no national legislation or policies which would demand utilities to maintain obligatory stocks of fuel or uranium. The power utility CEZ, a.s. holds strategic reserves of uranium in different degrees of processing (including fabricated fuel) to cover minimally its annual needs. Besides that CEZ, a.s. maintains a reasonable level of pipeline uranium inventories.

URANIUM PRICES

Uranium prices are not available as they are commercially confidential. However, such prices generally reflect price indicators of the long-term uranium market at the time of signature of those supply contracts, escalated to a date of delivery.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million CZK	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0.1	0.1	0.1	0.1
Government exploration expenditures	0.5	1.1	2.8	3.1
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	0.6	1.2	2.9	3.2
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	0	0	0	0
Number of government exploration holes drilled	0	0	0	0
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	0	0	0	0
Subtotal exploration holes	0	0	0	0
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	0	0	0	0
Total number of holes	0	0	0	0

Reasonably Assured Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	560	560	90
Open-pit mining	0	0	0	0
In situ leaching	0	0	0	0
Heap leaching	0	0	0	0
In-place leaching (stope/block leaching)	0	0	0	0
Co-product and by-product	0	0	0	0
Unspecified	0	0	0	0
Total	0	560	560	90

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	560	560
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	560	560

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	120	120	90
Open-pit mining	0	0	0	0
In situ leaching	0	0	0	0
Heap leaching	0	0	0	0
In-place leaching (stope/block leaching)	0	0	0	0
Co-product and by-product	0	0	0	0
Unspecified	0	0	0	0
Total	0	120	120	90

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	120	120
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	120	120

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
180	180

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
0	179 000

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]	0	0	0	0	0	0
Underground mining[1]	90 810	339	356	310	91 815	262
In situ leaching	17 218	71	50	48	17 387	28
Heap leaching	125	0	0	0	125	0
In-place leaching*	3	0	0	0	3	0
Co-product/by-product	0	0	0	0	0	0
U recovered from phosphates	0	0	0	0	0	0
Other methods**	493	2	3	17	515	19
Total	108 649	412	409	375	109 845	309

(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]	[%]
375	100	0	0	0	0	0	0	375	100

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

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	2 409	2 312	2 251	2 263
Employment directly related to uranium production*	1 291	1 192	1 213	1 283

* Employment in Stráz centre engaged in both uranium production and remediation programme is undifferentiated.

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
0	0	500	500	0	0	200	200	0	0	50	50

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
0	0	50	50	0	0	40	40	0	0	30	30

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	23.3	24.5

Installed nuclear generating capacity to 2030
(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
3 490	3 490	3 500	3 550	3 540	3 600

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
3 550	3 750	3 600	3 750	3 600	3 750

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
664	740	695	770*	650	710*

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
650	710*	650	710*	650	710*

* High case projections assume enrichment using tails of 0.3% U.

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	0
Producer	<200	0	0	0	<200
Utility	NA	NA	0	0	NA
Total	<200	NA	0	0	<200

• Egypt •

URANIUM EXPLORATION

Historical review

In the framework of the peaceful uses of nuclear energy, the Government of Egypt had plans, beginning in the 1980s, to implement a nuclear power plant for electric power generation. Other R&D plans also considered the use of nuclear energy for water desalination. All of these plans implied the implementation of uranium exploration programmes. These programmes were undertaken by the Egyptian Nuclear Materials Authority (NMA), which is the government body responsible for nuclear raw materials in the country. In the early phases, these programmes included training NMA teams in exploration and associated relevant tasks. A number of Technical Co-operation (TC) projects and expert missions were executed in collaboration with the IAEA for this purpose. Since then, the NMA activities can be divided into three main phases:

- Before the 1990s, NMA exploration works resulted in the discovery of seven U-potential prospects. The development of these prospects included mainly geophysical and geochemical exploration, supported by a limited amount of exploration drilling and experimental mining. However, these works did not succeed in evaluating ore reserves and grades of any of these prospects. Most of the results of these development works were reported in the previous Red Book editions and IAEA TC reports.
- For several reasons, the Egyptian Government delayed its NPP plans, following the prevailing world concern about the safety of operating NPPs after the Chernobyl accident, the lack of experience to operate such complicated systems and the difficulties in providing the financial support for such projects. The delay of this programme affected NMA activities, which were significantly decreased during the 1990s. For instance, only one additional uranium potential prospect was added, but the evaluation of the reserves remained in the early phases. However, some bench-scale trials to process samples were undertaken to assess the potential of Unconventional Resources (e.g. phosphorite deposits and black sands). These results were also reported in the Red Book editions and TC reports during this period.
- In the framework of reduction in the governmental expenditure in Egypt at the beginning of 2001, NMA witnessed substantial budget cuts during the period 2001-2005. This led to a reorganisation of all exploration, drilling and training activities in the absence of a national nuclear programme. Under such circumstances, a two-fold plan was considered:
  - Concerning uranium exploration activities, the plan involved concentration on continuation of the exploration and evaluation activities in the most promising prospects only. This also required the implementation of TC programmes with the IAEA to reach conclusions about the potential of the prospects under investigation.
  - The plan also involved (for the first time) the employment of the exploration experience and facilities gained by past uranium activities in other exploration programmes in the country. These studies have dealt mainly with mineral, oil and groundwater exploration on a contract basis. These contracts have been employed to contribute to the national development plan and also support the NMA budget.

Recent and ongoing uranium exploration and mine development activities

In the absence of a governmental nuclear programme and according to the received budget, the facilities and experience of most NMA activities have been directed towards minerals, groundwater and oil exploration. Such contracted activities now represent most of the NMA activities. The Nuclear Materials Authority is currently concentrating its activities in the following areas:

- Exploration for conventional uranium resources in the Eastern Desert. These activities concentrate on the younger granites of Pan-African type and the associated inter-mountain basins (TC project EGY/03/014).
- Evaluation of uranium resources in some uranium occurrences in the Eastern Desert. NMA is now preparing for drilling programmes in El Sella and Kab Amiri areas of the Eastern Desert. This programme is currently conducted in collaboration with the IAEA (TC project EGY/03/015).

  NMA and the IAEA have recently agreed on receiving additional technical assistance through the EGY/03/015 project to evaluate uranium prospects throughout the country and to investigate the promising occurrences. This task will certainly help NMA to make considerable progress in the assessment of uranium resources in the country, if the required budget is available in the future.
- Black sand resources (a potential unconventional uranium resource) are currently considered titanium and zirconium resources. The role of NMA is restricted to the assessment of environmental radiation hazards and mitigation of their environmental impact with a goal to economic mining of these deposits for their Ti and Zr minerals as non-contaminated products. The relevant studies are currently conducted through the TC EGY/9/037 IAEA project.
- Purification of phosphoric acid employing a semi-pilot plant has been completely converted to produce phosphoric acid for agricultural, food grade and other domestic purposes. The previously planned uranium extraction has been completely suspended due to the difficulties discovered during tests of this unit since 1997. The difficulties included the low U-content in phosphoric acid and the serious failures in the extraction cycle in the unit.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Some inferred conventional resources have been identified in the Eastern Desert (granitic rocks), Sinai (sedimentary rocks). These resources are currently under exploration.

Egypt does not report any known uranium resources according to the standard IAEA/NEA classification system.

Undiscovered Resources (Prognosticated & SR)

No speculative resources have been identified in Egypt.

Undiscovered Resources (Prognosticated & SR)

No speculative resources have been identified in Egypt.

URANIUM PRODUCTION

Egypt has no uranium production centres, no exploitation mines and no mills.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Egypt has no uranium production centres, no exploitation mines and no mills. All experimental mining, trenching, drilling tasks and laboratory units are under environmental control and radiation safety regulations according to the international roles considered by the International Atomic Energy Agency.

NMA is responsible for studies to assess and manage the radioactive wastes that are expected to arise during the black sand exploitation and mineral separation. This task will be performed in collaboration with the IAEA (TC project EGY/9/037).

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million EGP	**2005**	**2006**	**2007**	**2008** (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	10	10	10	10
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	10	10	10	10
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	NA	NA	NA	NA
Number of government exploration holes drilled	NA	NA	NA	NA
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	NA	NA	NA	NA
Subtotal exploration holes	NA	NA	NA	NA
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	NA	NA	NA	NA
Total number of holes	NA	NA	NA	NA

• Finland •

URANIUM EXPLORATION

Historical review

Uranium exploration was carried out in Finland from 1955 to 1989, first by several organisations but from the late-1970s mainly by the Geological Survey. Since their beginning in the early-1970s, the regional aero-geophysical and geochemical mapping programmes have played an important role in uranium exploration.

The distribution of uranium provinces and the geological settings of uranium deposits can be summarised as follows; the grades (% U) and tonnages of (*in situ*) uranium of the deposits are given in brackets:

- The Kolari-Kittilä province in western Lapland, including the Kesänkitunturi sandstone deposit (0.06% U; 950 tU) and the Pahtavuoma-U vein deposit (0.19% U; 500 tU) in Paleoproterozoic quartzite and greenstone-associated graphitic schists, respectively.
- The Kuusamo province in north-eastern Finland, with metasomatite uranium occurrences associated with mineralisations of gold and cobalt (e.g. Juomasuo deposit) in a sequence of Paleoproterozoic quartzites and mafic volcanics.
- The historical Koli province in eastern Finland, with several small sandstone (Ipatti, Martinmonttu and Ruunaniemi: 0.08-0.14% U; 250 tU) and epigenetic uranium deposits (the former Paukkajanvaara mine) and occurrences of uranium and thorium-bearing quartz-pebble-conglomerate in Paleoproterozoic quartzites, with an additional prospect of unconformity-related deposits in a Paleoproterozoic regolith.
- The Uusimaa province of intrusive uranium occurrences in Paleoproterozoic granitic migmatites of southern Finland, represented by the Palmottu deposit (0.1% U; 1 000 tU) and the Askola area.

The geological settings further include:

- Uraniferous phosphorites associated with sedimentary carbonates of the Paleo-proterozoic sequences, e.g., the Vihanti-U (Lampinsaari) deposit (0.03% U; 700 tU) and the Nuottijärvi deposit (0.04% U; 1 000 tU).
- Uranium mineralisation and uraniferous carbonate veins in Paleoproterozoic albitite and albite diabase dykes, mostly in northern Finland.
- Uranium- and thorium-bearing dykes and veins of Paleoproterozoic pegmatite granites.
- Surficial concentrations of young uranium in recent peat.

Finland has previously reported 2 900 tU of reasonably assured resources in the cost range USD 130 or more/kgU, included in several deposits. Because this cost category is no longer used in the Red Book, these resources have to be excluded for the present. In addition, for environmental and technical reasons many of these deposits will not be mineable anymore.

Possible by-product uranium has previously been reported in the low-grade Ni-Cu-Zn deposit of Talvivaara (0.001-0.004% U), hosted by Paleoproterozoic black shales, in central Finland, and in pyrochlore of the Paleozoic Sokli carbonatite (0.01% U) in eastern Lapland.

Recent and ongoing uranium exploration activities

The progress in the new uranium exploration by international companies was on a low level during the years 2005 and 2006. Companies have mainly been acquiring claim reservation and claim areas, with only reconnaissance type field studies (ground radiometrics, geological mapping, radon surveys) at the targets. One of the companies carried out first phase trenching and drilling on a discovery site in northern Finland in 2005. During 2005 and 2006, almost all of the uranium occurrences shown in the deposits database of the Geological Survey of Finland were registered by the companies as claim reservations. Claim applications have been filed in the Ministry of Trade and Industry (MTI) in six areas in southern, eastern and northern Finland. By the end of 2006, one claim was granted and two claim applications were rejected by the MTI. The accepted claim (exploration license) is not yet in force because of appeals to the Supreme Administrative Court. The companies active in uranium exploration in Finland are Agricola Resources, Apofas, AREVA NC/Cogema (with a subsidiary AREVA Resources Finland since July, 2006), Karelian Resource Services, Mawson Resources, Namura Finland/Cooper Minerals and Uranium Star Corp.

In January 2007 the MTI rejected an additional four claim applications because the applications did not meet the requirements set in legislation. MTI granted another claim with conditions. Five applications were filed by three companies in March, and, as claim reservations are expiring, still more are likely to be filed during 2007.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Finland reports 1 500 tU of Reasonably Assured Resources in the cost range USD 80-130/kgU, included in the deposits of Palmottu and Pahtavuoma-U. No Inferred Resources are reported.

Undiscovered Resources (Prognosticated & SR)

None reported.

Unconventional Resources and other materials

Since the 1981 IUREP report, Finland has noted that between 3 000 and 9 000 tU could be recovered from the Talvivaara black shales, and another 2 500 tU from the Sokli carbonatite as by-product resources. The 340 Mt of low-grade polymetallic sulphide ores in the Talvivaara black shales are currently under mining development because of their nickel, zinc, copper and cobalt resources. With bioheapleaching as the method, the mine is expected to start in 2008. The uranium content of the metalliferous black shales is so low, however (IUREP: 0.001-0.004% U), that the mining plan does not include uranium recovery.

URANIUM PRODUCTION

Historical review

Uranium production in Finland has been confined only to the now restored Paukkajanvaara mine that operated as a pilot plant between 1958 and 1961. A total of 40 000 tonnes of ore was hoisted, and the concentrates produced amounted to about 30 tU. As listed in the Red Book Retrospective, the total historical production calculated from the MTI Mining Register statistics is no more than 41 tU from 1958 to 1961. Currently, Finland has no production capability and no plans to develop any.

Secondary sources of uranium

Finland does not produce or use mixed-oxide fuels. Since 2000, Teollisuuden Voima Oy (TVO) has used re-enriched tails for fuel, totalling 595 tU (natural equivalent) by the end of 2006.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

The Paukkajanvaara uranium mine area was restored in the 1990s. After the final field measurements in 1999, the Finnish Centre for Radiation and Nuclear Safety gave the certificate of accomplished environmental restoration to the landowner in 2001.

According to legislation in Finland, export or import of spent nuclear fuel is not permitted. Since the beginning of the 1980s, investigations have been made to solve the problem of final disposal. Posiva Oy was established by Teollisuuden Voima Oy (TVO) and Fortum Power and Heat Oy, the power companies responsible for nuclear waste management, in 1996.

In 1999, Posiva filed an application for a decision-in-principle (DIP) on building of a final disposal facility. In December 2000, the government made a positive DIP and in May 2001 the Finnish Parliament ratified it. The final disposal facility will be built in Olkiluoto, at Eurajoki municipality. The DIP applies to the spent fuel from Finland´s present four nuclear power plant units. In May 2002, in parallel with the DIP ratification of the Olkiluoto 3 nuclear unit, the Parliament also ratified a DIP on the final disposal of the spent nuclear fuel from this unit.

Posiva Oy started the construction of the underground laboratory named Onkalo for final disposal of spent fuel in summer of 2004. Construction of the repository is expected to commence in 2013 and the disposal operations are planned to start in 2020.

URANIUM REQUIREMENTS

At the beginning of 2007, four reactors were in operation: Olkiluoto 1 and Olkiluoto 2 owned by the Finnish private utility TVO (Teollisuuden Voima Oy) and Loviisa 1 and Loviisa 2 owned by Fortum Power and Heat Oy (the former IVO). The installed capacity was about 2.7 Gwe net. Uranium requirements are approximately 520-550 tU/year for the four reactors.

In October 2003 TVO selected Olkiluoto as the location of the new unit and the consortium Framatome ANP – Siemens, now AREVA, was selected as the main supplier. The construction license application for Olkiluoto 3 pressurised water reactor (type EPR, European Pressurised Water Reactor) was submitted to the Council of State in 2004. The reactor’s thermal output is 4 300 MW and electric output about 1 600 MW. The granting of the construction licence took place in 17 February 2005. The construction of the plant unit will probably take approximately six years. The new unit is planned to start commercial operation in 2011. The uranium requirements for this new unit will range from 200 to 300 tU/year.

Supply and procurement strategy

TVO procures natural uranium, enrichment services and fuel fabrication from several countries. Fortum Power and Heat Oy purchases fuel assemblies from Russia and Spain, but until now all the uranium has been from Russia. Starting from 2008 all fuel assemblies will be purchased from Russia.

NATIONAL POLICIES RELATING TO URANIUM

Licenses for mining, enrichment, possession, fabrication, production, transfer, handling, use and transport of nuclear materials and nuclear wastes may be granted only to natural persons, corporations or authorities under the jurisdiction of a Member State of the European Union. However, under special circumstances, foreign organisations or authorities may be granted a license to transport nuclear material or nuclear waste within Finland. No significant changes to Finnish uranium policy are reported.

Since September 2006, environmental impact assessment procedure will be applied to all uranium mining projects, without any limitations on the annual amount of the extracted resource or on the area of an opencast mine. In addition to the licensing based on the Mining Act and on the environmental and radiation legislation, production of uranium or thorium also needs a license from the government according to the Nuclear Energy Act.

URANIUM STOCKS

The nuclear power utilities maintain reserves of fuel assemblies from seven months to one year's use, although the legislation demands only five months use.

URANIUM PRICES

Due to commercial confidentiality price data are not available.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in EUR	2004	2005	2006	2007 (expected)
Industry exploration expenditures	155 000	640 000	1 399 000	2 682 000
Government exploration expenditures	0	0	0	0
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	155 000	640 000	1 399 000	2 682 000
Industry exploration drilling (metres)	0	252	0	3 500
Number of industry exploration holes drilled	0	5	0	35
Government exploration drilling (metres)	0	0	0	0
Number of government exploration holes drilled	0	0	0	0
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	0	252	0	3 500
Subtotal exploration holes	0	5	0	35
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	0	252	0	3 500
Total number of holes	0	5	0	35

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	1 500	
Total	0	0	1 500	

* *In situ* resources.

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	500
Intrusive	0	0	1 000
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other*	0	0	0
Total	0	0	1 500

* *In situ* resources.

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]	15	0	0	0	15	0
Underground mining[1]	15	0	0	0	15	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	0	0	0	0	0	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	30	0	0	0	30	0

(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.

Re-enriched tails production and use

(tonnes of natural U equivalent)

Re-enriched tails	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	0	0	0	0	0	0
Use	287	140	60	108	595	140

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	22.4	22.3

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
2 680	2 680	2 680	2 680	4 280	4 280

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
4 280	4 280	4 280	4 280	4 280	4 280

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
467	470	440	470	640	700

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
640	700	640	700	640	700

• France •

URANIUM EXPLORATION

Uranium exploration in France began in 1946, focusing on already known uranium ore deposits and the few mineralisation occurrences discovered during radium exploration. In 1948, exploration work led to the discovery of the La Crouzille deposit, formerly of major importance. By 1955, deposits had been identified in the granite areas of Limousin, Forez, Vendée and Morvan.

Prospecting activities were subsequently extended to sedimentary formations in small intragranitic basins and terrigeneous formations, arising from eroded granite mountains and mainly located north and south of the Massif Central.

Recent and ongoing uranium exploration and mine development activities

No domestic activities have been carried out in France since 1999.

Abroad, AREVA NC has been focusing on targets aimed at the discovery of exploitable resources in Australia, Canada, Finland, Kazakhstan, Niger and Mongolia. AREVA NC is also directly or indirectly involved in uranium exploration or development activities through subsidiaries. In Canada, Niger and Kazakhstan, it is involved in uranium mining operations and projects. In addition, without being an operator, it holds shares in several mining operations and research projects in different countries.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Following the closure of the last uranium mine in 2001, there are no longer Reasonably Assured Resources in France. The amount of Inferred Resources remains unchanged from the last edition of the Red Book (11 740 tU).

Undiscovered Resources (Prognosticated & SR)

No systematic appraisal is made of undiscovered resources.

URANIUM PRODUCTION

Historical review

As a result of the mine closures French uranium production has declined since 1990. With the closure of the Lodève mining site in 1997 and of Le Bernardan in 2001, there remain no active uranium operations in France.

Status of production capability

Following the closure of all uranium mines in 2001, all the ore processing plants were shut down, dismantled and the sites reclaimed.

Only one or two tonnes of uranium per year are still recovered on resins during water cleaning process of the outflow from the former Lodève mine, in South of France. The resins are eluted at the Malvesi refinery, and the uranium is recovered.

Future production centres

There are no plans to develop new production centres in the near future.

Secondary sources of uranium

Production and/or use of mixed-oxide fuels

The annual production of MOX fuel in France is about 145 tHM, roughly corresponding to 1 160 tU equivalent using Red Book recommended conversion factor. This corresponds to the total amount of MOX fuel contained in fuel elements produced in France. Production over 100 tonnes of MOX is sent abroad.

The Cadarache MOX fuel factory ceased its commercial production in 2003. The production of a few fuel elements from United States excess military plutonium was achieved in 2004-2005 and these lead-test assemblies returned to Duke Power Catawba power station where they are currently burnt.

In 2007, the Melox plant in Marcoule has been awarded a licence upgrade to produce up to 195 tonnes of MOX/year (from previously 145 tonnes).

Production and/or use of re-enriched tails

A fraction of the depleted UF_6 flow generated through the enrichment activities is currently sent to the Russian Federation for re-enrichment. This fraction is limited to materials with mining origin allowing their transfer (according to international and bilateral agreements dealing with the exchange of nuclear materials). The return flow is exclusively used to over-feed the enrichment plant in France (Georges Besse gaseous diffusion plant run by EURODIF, an AREVA subsidiary).

Production and/or use of reprocessed uranium

Production of reprocessed uranium in France results from the activity of the la Hague reprocessing plant. The annual production was slightly above 1 000 tU in 2006.

In France between 150 tonnes to 400 tU are recycled every year in one or two reactors (EDF reactors of Cruas power plant).

ENVIRONMENTAL ACTIVITIES AND SOCIAL CULTURAL ISSUES

None reported.

URANIUM REQUIREMENTS

The total number of nuclear power reactors should not change much with the addition of one EPR 1 600 MWe to be put into service at Flamanville between 2010 and 2015. After this addition, the total capacity of the nuclear power plants and uranium requirements should not change significantly since no reactor is expected to be shut down in the near future.

Supply and procurement strategy

Since France is a net importer of uranium, its policy towards procurement is one of supply diversification. French mining operators participate in uranium exploration and exploitation outside France within the regulatory framework of the host countries. They also purchase uranium, under short or long-term contracts, either from mines in which they have shareholdings or from mines operated by third parties.

URANIUM STOCKS

Électricité de France (EDF) possesses strategic uranium inventories, the minimum level of which has been fixed at the equivalent of three years' forward consumption to offset possible supply interruptions.

URANIUM PRICES

Information on uranium prices is not available.

Uranium exploration and development expenditures – non-domestic

Expenses in million USD	2004	2005	2006	2007 (expected)
Industry exploration expenditures	13	NA	40	60
Government exploration expenditures	NA	NA	NA	NA
Industry development expenditures	31	NA	45	55
Government development expenditures	NA	NA	NA	NA
Total expenditures	44	127.5	85	115

Inferred Resources
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	11 740	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	0	11 740	

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]	0	0	0	0	0	0
Underground mining[1]	0	0	0	0	0	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	0	0	0	0	0	0
Co-product/by-product	0	0	0	0	0	0
U recovered from phosphates	0	0	0	0	0	0
Other methods**	0	6	4	3	0	2
Total	75 965	6	4	3	75 978	2

(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.

Mixed-oxide fuel production and use

(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	8 600	1 110	1 160	1 160	12 030	1 160
Use	NA	NA	NA	NA	NA	NA
Number of commercial reactors using MOX	NA	NA	NA	NA	NA	NA

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	430.0	428.7

Installed nuclear generating capacity to 2030

(MWe net)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
63 260	63 260	63 130	63 130	63 130	64 700

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
63 130	64 700	64 700	64 700	64 700	64 700

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

(tonnes U)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
NA	9 000	8 500	9 500	8 000	9 000

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
8 000	9 000	8 000	9 000	8 000	9 000

• Germany •

URANIUM EXPLORATION

Historical review

After World War II, exploration for uranium in Germany occurred in the two separate countries prior to reunification in 1990. A summary of the activities is provided below.

Former German Democratic Republic before 1990

Uranium exploration and mining was undertaken from 1946 to 1953 by the Soviet stock company, SAG Wismut. These activities were centred around old mining locations of silver, cobalt, nickel and other metals in the Erzgebirge (Ore Mountains) and in Vogtland, Saxony, where uranium had first been discovered in 1789. The mining of uranium first began at the cobalt and bismuth mines near Schneeberg and Oberschlema (a former famous radium spa). During this early period more than 100 000 people were engaged in exploration and mining activities. The rich uraninite and pitchblende ore from the vein deposits was hand-picked and shipped to the USSR for further processing. Lower grade ore was treated locally in small processing plants. In 1950, the central mill at Crossen near Zwickau, Saxony was brought into operation.

In 1954, a new joint Soviet-German stock company was created, *Sowjetisch-Deutsche Aktiengesellschaft Wismut* (SDAG Wismut). The joint company was held equally by both governments. The entire uranium production either hand-picked concentrate, gravity concentrate, or chemical concentrate was shipped to the USSR for further treatment. The price for the final product was simply agreed to between the two partners. Profits were used for further exploration.

At the end of the 1950s, uranium mining was concentrated in the region of Eastern Thuringia. Uranium exploration had started in 1950 in the vicinity of the radium spa at Ronneburg. From the beginning of the 1970s, the mines in Eastern Thuringia provided about two-thirds of SDAG Wismut's annual production.

Between the mid-1960s and the mid-1980s, about 45 000 people were employed by SDAG Wismut. In the mid-1980s, Wismut's employment decreased to about 30 000. In 1990, only 18 000 people worked in uranium mining and milling.

Uranium exploration using a variety of ground-based and aerial techniques occurred in the southern part of the former GDR that covered an extensive area of about 55 000 km^2. About 36 000 holes were drilled in an area covering approximately 26 000 km^2. Total expenditures for uranium exploration over the life of the GDR programme were on the order of GDR Mark 5.6 billion.

Federal Republic of Germany before 1990

Starting in 1956, exploration was carried out in several areas of geological interest: the Hercynian Massifs of the Black Forest, Odenwald, Frankenwald, Fichtelgebirge, Oberpfalz, Bayerischer Wald, Harz, the Paleozoic sediments of the Rheinisches Schiefergebirge, the Permian volcanics and continental sediments of the Saar-Nahe region and other areas with favourable sedimentary formations.

The initial phase included hydro-geochemical surveys, car borne surveys, field surveys, and, to a lesser extent, airborne prospecting. Follow-up geochemical stream sediment surveys, radon surveys, and detailed radiometric work, followed by drilling and trenching, were carried out in promising areas.

During the reconnaissance and detailed exploration phases both the federal and state geological surveys were involved, whereas the actual work was carried out mainly by industrial companies.

Three deposits of economic interest were found: the partly high-grade hydrothermal deposit near Menzenschwand in the southern Black Forest, the sedimentary Müllenbach deposit in the northern Black Forest, and in the Grossschloppen deposit in north-eastern Bavaria. Uranium exploration ceased in Western Germany in 1988. Through 1988, about 24 800 holes were drilled, totalling about 354 500 m. Total expenditures were on the order of USD 111 million.

There have been no exploration activities in Germany since the end of 1990. Several German mining companies did perform exploration abroad mainly in Canada up through 1997.

Recent and ongoing uranium exploration and mine development activities

There are no actual exploration activities in Germany. In recent times, there have been several inquiries for the Großschloppen deposit by national and international consultants and junior mining companies. No reports or plans exist so far for exploration or drilling. Renewed exploration activities in the uraniferous Pöhla mine, Erzgebirge, focus on the commodities tungsten and tin.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Known conventional resources were last assessed in 1993. The known conventional resources occur mainly in the closed mines, which are in the process of being decommissioned. Their future availability remains uncertain.

Undiscovered Resources (Prognosticated & SR)

All undiscovered conventional resources are reported as Speculative Resources in the cost category above USD 130/kgU.

URANIUM PRODUCTION

Historical review

Federal Republic of Germany before 1990

A uranium processing centre at Ellweiler, in the state of Baden-Württemberg was operated by Gewerkschaft Brunhilde beginning in 1960. Serving as a test mill for several types of ore its capacity was only 125 tU per year. It was closed on 31 May 1989 after producing around 700 tU.

Former German Democratic Republic before 1990

Two processing plants were operated by SDAG Wismut in the territories of the former GDR. A plant at Crossen, near Zwickau in Saxony, started processing ore in 1950. The ore was transported by road and rail from numerous mines in the Erzgebirge. The composition of the ore from the hydrothermal deposits required carbonate pressure leaching. The plant had a maximum capacity of 2.5 million tonnes of ore per year. Crossen was permanently closed on 31 December 1989.

The second plant at Seelingstadt, near Gera, Thuringia, started ore processing operations in 1960 using the nearby black shale deposits. The maximum capacity of this plant was 4.6 million tonnes of ore per year. Silicate ore was treated by acid leaching until the end of 1989. Carbonate-rich ores were treated using the carbonate pressure leaching technique. After 1989, Seelingstadt's operations were limited to the treatment of slurry produced at the Königstein mine using the carbonate method.

Since 1992, all uranium production in Germany has been derived from the clean-up operations at the Königstein mine.

Status of production capability

There is no commercial production of uranium in Germany. Since 1991 uranium is recovered from clean-up activities in previous mines. Between 1991 and 2006, the recovery from mine water treatment and environmental restoration totalled 2 390 tU.

Ownership structure of the uranium industry

In August 1998, Cameco completed its acquisition of Uranerz Exploration and Mining Ltd. (UEM), Canada, and Uranerz USA Inc. (UUS), from their German parent company Uranerzbergbau GmbH (Preussag and Rheinbraun, 50% each). As a result, no commercial uranium industry remains. The German Federal Government through Wismut GMBH retains ownership of all uranium recovered in clean up operations.

Employment in the uranium industry

All employment is engaged in decommissioning and rehabilitation of former production facilities.

Future production centres

None reported.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

With the reunification of Germany in 1990, commercial uranium production was terminated. The German Government took responsibility for the decommissioning and rehabilitation of former production sites and has allocated a total of EUR 6.6 billion in its Federal budget. Up to the end of 2006 about EUR 4.76 billion have been spent. Thanks to the efforts jointly invested in the Wismut project by all participants, significant progress has been achieved leading to a significant abatement of adverse environmental impacts. Expenditures related to environmental activities are tabulated below.

Expenditures for environmental activities
(EUR million)

	1991-2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007** (expected)
Monitoring	110.8	18.9	18.7	16.1	13.3	14.7	12.8
Rehabilitation of tailings	169.4	31.9	29.1	31.4	26.9	25.6	30.4
Site rehabilitation	180.1	17.4	21.9	24.1	16.8	9.9	16.1
Water treatment	250.1	43.4	46.3	40.0	42.0	37.6	38.7
Waste rock management	480.4	71.2	68.0	63.5	66.9	70.7	41.0
Total	1 190.8	182.8	184.0	175.1	165.9	158.5	139.0

NATIONAL POLICIES RELATING TO URANIUM

According to the agreement between the Federal Government of Germany and the utility companies dated 14 June 2000, the future utilisation of nuclear power plants shall be restricted. For each plant the residual operating life remaining after 1 January 2000 shall be calculated on the basis of a standard operating life of 32 calendar years from the commencement of commercial power operation. Accordingly the future uranium requirements will decrease; however, details of the annual requirements for the period to 2020 cannot be given.

URANIUM STOCKS

Germany reported no information on national policies relating to uranium, uranium stocks, or uranium prices.

Reasonably Assured Resources
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	3 000	
Total	0	0	3 000	

* *In situ* resources.

Inferred Resources
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	4 000	
Total	0	0	4 000	

* *In situ* resources.

Speculative Resources
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
0	74 000

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]	NA	0	0	0	NA	0
Underground mining[1]	NA	0	0	0	NA	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	0	0	0	0	0	0
Co-product/by-product	0	0	0	0	0	0
U recovered from phosphates	0	0	0	0	0	0
Other methods**	2 154	77	94	65	2 390	45
Total	219 240	77	94	65	219 476	45

(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)	(%)
65	100	0	0	0	0	0	0	65	100

Uranium industry employment at existing production centres

(person-years)

	2004	2005	2006	2007 (expected)
Total employment related to existing production centres	2 230	2 101	1 835	1 757
Employment directly related to uranium production	NA	NA	NA	NA

Mixed-oxide fuel production and use

(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	0	0	0	0	0	0
Use	4 560	480	480	320	5 840	240
Number of commercial reactors using MOX	10	9	8	7	11	7

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	154.6	158.7

Installed nuclear generating capacity to 2030
(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
20 336	20 339	12 500	16 700	8 000	12 000

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
1 329	4 034	0	0	0	0

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

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
3 708	3 486	1 800	2 000	1 100	1 500

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
200	350	0	0	0	0

• Hungary •

URANIUM EXPLORATION

Historical review

The first reconnaissance for uranium started in 1952 when, with Soviet participation, material from Hungarian coal deposits was checked for its radioactivity. The results of this work led in 1953 to a geophysical exploration programme (airborne and surface radiometry) over the western part of the Mecsek Mountains. The discovery of the Mecsek deposit was made in 1954 and further work was aimed at the evaluation of the deposit and its development. The first shafts were placed in 1955 and 1956 for the mining plants I and II. In 1956, the Soviet-Hungarian uranium joint venture was dissolved and the project became the sole responsibility of the Hungarian State. In the same year, uranium production began.

URANIUM RESOURCES

Hungary's reported uranium resources are limited to those of the Mecsek deposit.

The ore deposit occurs in Upper Permian sandstones that may be as thick as 600 m. The sandstones were folded into the Permian-Triassic anticline of the Mecsek Mountains. The ore-bearing sandstone occurs in the upper 200 m of the unit. It is underlain by a very thick Permian siltstone and covered by Lower Triassic sandstone. The thickness of the green-grey ore-bearing sandstone, locally referred to as the productive complex, varies from 15 to 90 m. The ore minerals include uranium oxides and silicates associated with pyrite and marcasite.

Identified Resources (RAR & Inferred)

None reported.

Undiscovered Resources (Prognosticated & SR)

Speculative Resources are not estimated. Known uranium resources classified as prognosticated are recoverable at costs <USD 130/kgU. These resources are tributary to the Mecsek production centre.

URANIUM PRODUCTION

Historical review

The Mecsek mine and the underground facility, was the only uranium producer in Hungary. Prior to 1 April 1992, it was operated as the state-owned Mecsek Ore Mining Company (MÉV). The complex began operation in 1956 and was producing ore from a depth of 100-800 m until 1997, when it was finally shut down. During operation, it produced about 500 000-600 000 tonnes ore/year at an average mining recovery of 50-60%. The ore processing plant had a capacity of 1 300 to 2 000 tonnes ore/day and employed radiometric sorting, agitation acid leach (and alkaline heap leaching) with ion exchange recovery. The nominal production capacity of the plant was about 700 t/year.

The Mecsek mine consisted of five sections with the following history:

Section I:	operating from 1956 to 1971.
Section II:	operating from 1956 to 1988.
Section III:	operating from 1961 to 1993.
Section IV:	operating from 1971 to 1997.
Section V:	operating from 1988 to 1997.

The ore processing plant became operational in 1963. Until that time, raw ore was exported to the USSR. A total of 1.2 million tonnes ore was shipped to the Sillimae metallurgy plant in Estonia. After 1963, uranium concentrates were shipped to the Soviet Union.

The mining and milling operations were closed down at the end of 1997 because of changes in market conditions. Until this date the total production from the Mecsek site, including heap leaching, was about 21 000 tU.

Status of production capability

In 1998 and 1999 the only uranium production was 7 and 4 tU/year as a by-product of water treatment activities. Since 2000 this has been 2-3 tU/year.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

In 1998, after the closure of the mines, began the stabilisation and remediation work on the base of the conceptual plan, which was made by the staff and accepted by the competent authorities of Hungary. The government accepted the financial requirement and appointed the time of completion to be the end of 2002. This deadline was modified several times because of financial problems. The new deadline is the end of 2008. The projects include:

- Closing down underground mines.
- Remediating waste rock piles, heap-leaching sites, tailings ponds and contaminated water flows.
- Decommissioning the milling plant and open-pit sites.
- Operating a monitoring system.
- Treating contaminated water.

The most important activities were the covering of the tailing ponds and the vertical drainage as well as the conditioning and placing of the precipitation-waste for water treatment.

The legal successor of the former Mecsek mine is also responsible for paying compensation including damages for occupational disease, income and pension supplements, reimbursements of certified costs and dependent expenses to people formerly engaged in uranium mining.

Costs of environmental management
(HUF thousands)

	PRE 1998	1998 to 1999	2000	2001	2002	2003	2004	2005	2006
Closing of underground spaces	NA	2 107 897	281 992	0	0	0	0	0	0
Reclamation of surficial establishments and areas	NA	459 447	589 728	651 766	320 519	67 895	31 610	6 190	23 232
Reclamation of waste rock piles and their environment	NA	222 943	141 253	286 930	82 543	37 209	0	1 868	0
Reclamation of heap-leaching piles and their environment	NA	900 941	608 231	115 936	18 938	0	0	0	0
Reclamation of tailings ponds and their environment	NA	538 203	741 195	1 304 629	1 869 523	941 816	274 807	995 821	312 749
Water treatment	NA	626 649	383 436	243 941	241 686	496 783	447 249	398 192	452 287
Reconstruction of electric network	NA	0	98 361	20 790	0	0	0	0	0
Reconstruction of water and sewage system	NA	1 000	0	0	0	0	0	0	0
Other infrastructural service	NA	342 000	93 193	42 651	47 329	0	0	0	0
Other activities including monitoring, staff, etc.	NA	581 197	431 678	461 512	367 677	101 229	38 045	139 865	157 424
SUBTOTAL	5 406 468	5 780 277	3 369 067	3 128 155	2 948 275	1 644 932	791 711	1 541 936	945 692
Reserves for the amount of 1998-2000		139 120	0	0	0	0	0	0	0
TOTAL	5 406 408	5 919 397	3 369 067	3 128 155	2 948 275	1 644 932	791 711	1 541 936	945 692

NA: Not available.

URANIUM REQUIREMENTS

Hungary operates the Paks nuclear plant which consists of four VVER-440-213 type reactor units with a total net nuclear generating capacity of about 1 800 MWe net. In order to enhance the economic and operational effectiveness and to improve market position, the Paks Nuclear Power Plant started an Economical Effectiveness Enhancement Programme in 2005, the principal elements of which being power uprating, maintenance optimisation and operating lifetime extension. This programme includes short-, medium- and long-term measures and tasks some of which have already begun and/or are planned for enhanced effectiveness.

In 2006, a power uprate of 8% on Unit 4 was realised and the technical preparation of the operating lifetime extension programme continued. As part of the environmental licensing process, on the basis of impact assessment documentation of the operating lifetime extension, consultations and public hearings were held with the participation of professional and civil organisations of the countries requesting them. The process in accordance with the Espoo Convention was successfully completed with Austria, Croatia and Romania and the relevant Hungarian authority issued the environmental licence for the operating lifetime extension on 25 October 2006. At present, there are no firm plans for construction of additional units.

The annual uranium requirements for the Paks NPP are about 380 tU. Until 1997, the requirements could be met by uranium mined domestically. Since that time, uranium requirements are solely satisfied by imports from Russia.

NATIONAL POLICIES RELATING TO URANIUM

Since the shutdown of the Hungarian uranium mining industry in 1997, there are no uranium related policies.

URANIUM STOCKS

The by-product of the water treatment activities (UO_4 $2H_2O$) – until the exportation – is stored in the mine water treatment facility. At the end of 2006 the inventory was 1 007 kg.

URANIUM PRICES

Uranium prices are not available as they are commercially confidential.

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
0	18 399

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]	0	0	0	0	0	0
Underground mining[1]	20 475	0	0	0	20 475	0
In situ leaching	0	0	0	0	0	0
Heap leaching	525	0	0	0	525	0
In-place leaching*	0	0	0	0	0	0
Co-product/by-product	0	0	0	0	0	0
U recovered from phosphates	0	0	0	0	0	0
Other methods**	43	2	3	2	50	3
Total	21 043	2	3	2	21 050	3

(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]	[%]
2	100	0	0	0	0	0	0	2	100

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	13.01	12.66

Installed nuclear generating capacity to 2030

(MWe net)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
1 780	1 920	1 920	1 920	1 920	1 920

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
1 920	1 920	1 920	1 920	1 920	1 920

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

(tonnes U)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
379	379	380	380	380	380

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
380	380	380	380	380	380

Total uranium stocks

(tonnes natural U-equivalent)

Holder	**Natural uranium stocks in concentrates**	**Enriched uranium stocks**	**Depleted uranium stocks**	**Reprocessed uranium stocks**	**Total**
Government	0	0	0	0	0
Producer	1	0	0	0	1
Utility	0	0	0	0	0
Total	1	0	0	0	1

• India •

URANIUM EXPLORATION

Historical review

The history of uranium exploration in India dates from 1949. Until the mid-1970s, uranium exploration was mainly confined to known uranium provinces in the Singhbhum, Jharkhand and Umra-Udaisagar belt in Rajasthan where vein-type mineralisation was already known. One deposit at Jaduguda in Singhbhum, Jharkhand has been exploited since 1967 and many other deposits in nearby areas were earmarked for future exploitation. Subsequently, investigations were expanded to other geologically favourable areas, based on conceptual models and an integrated exploration approach. This resulted in the discovery of two main types of deposits:

- A relatively high-grade, medium-tonnage deposit in the Cretaceous sandstones of Meghalaya in north-eastern India.
- A low-grade, large tonnage, stratabound deposit in the Middle Proterozoic dolostones of Cuddapah Basin in Andhra Pradesh.

Other small, moderately low-grade deposits discovered during this phase of exploration include:

- Lower Proterozoic amphibolites at Bodal, Chhattisgarh.
- Lower Proterozoic sheared migmatites of Chhotanagpur gneiss complex at Jajawal, Chhattisgarh.
- Basal quartz pebble conglomerates at Walkunji, Western Karnataka and Singhbhum, Jharkhand.

During the early-1990s, a near surface deposit was discovered adjacent to the unconformity contact between basement granites with overlying Proterozoic Srisailam Quartzite at Lambapur in Nalgonda district, Andhra Pradesh. These and others showings were further followed up, and by 1996 the following areas had been identified on the basis of favourable geological criteria and promising exploration results. They were consequently selected for intensive investigations: Cuddapah Basin, Andhra Pradesh; Cretaceous sandstones of Meghalaya; Son Valley, Madhya Pradesh and Uttar Pradesh; Singhbhum Shear Zone, Jharkhand and Orissa; and Aravallis, Rajasthan.

Exploration drilling in the Lambapur Peddagattu area has confirmed the potential of the northwest part of the Cuddapah Basin. Cretaceous sandstones in Meghalaya have been identified as a potential horizon for uranium concentration. Surveys and prospection in the areas around the Domiasiat uranium deposit have revealed further promising areas.

Recent and ongoing uranium exploration and mine development activities

Uranium exploration activities in India have been concentrated in the following areas:

- Proterozoic Aravalli-Delhi basins, Rajasthan.
- Meso-Neoproterozoic Cuddapah basin, Andhra Pradesh.
- Neoproterozoic Bhima basin, Karnataka.
- Cretaceous sedimentary basin, Meghalaya.

Proterozoic Dehli-Aravalli basins, Rajasthan

The zone of albitisation, with varying dimensions over 320 km in length, also referred to as "albitite line", occurs along the contact of the Mesoproterozoic Dehli Supergroup and Archean Banded Gneissic Complex (BGC), between Raghunathpura in Haryana and Ladera and Tal in Rajasthan. A number of uranium and uranium-thorium anomalies were reported along this zone.

At Ghateshwar-Rohil, uranium mineralisation is associated with albitites in association with carbonaceous phyllite and mica schist of Delhi Supergroup. At Rohil, a relatively small deposit has been established. Currently the area is under exploration for augmentation of resources.

Sub-surface exploration is in progress in Karela ka Ghura area, for possible unconformity type mineralisation in carbon phyllites of Aravalli Supergroup.

Cuddapah basin, Andhra Pradesh

The Meso-Neoproterozoic Cuddapah basin is spread over an area of 44 000 km^2 and encompassing Papaghni, Nallamalai, Srisailam, Kurnool and Palnad sub-basins. The basement Archean gneisses/Dharwar metasedimentaries are thrusted over Cuddapah Supergroup rocks on the eastern margin of the basin. Three types of uranium mineralisation/deposits have been identified in the Cuddapah basin. These include stratabound and unconformity related deposits and fracture controlled mineralisation.

Unconformity-related deposits

Reconnaitory/exploratory drilling in a small portion of the Chitrial outlier in the north-western periphery of the Cuddapah basin has resulted in establishing a medium tonnage low grade deposit associated with the unconformity between Basement Granitoids and Srisailam Formation.

Evaluation and exploratory drilling of the mineralised unconformity surface between the basement granites and the overlying Srisailam Formation has further enlarged the resource position of Peddagattu deposit located in the north part of the basin.

A small size, low grade deposit has been established at the unconformity between basement granite and overlying quartzite of Banganapalle Formation at Koppunuru in Kurnool sub-basin, where exploration is being actively pursued.

Surveys carried out in the northern part of the Palnad sub-basin, have indicated the presence of uranium anomalies in basement granite, basic dykes and overlying quartzite of Banganapalle Formation over an area of 7 km^2 between Rallavagu Tanda and Damarchela, Nalgonda district.

Sub-surface exploration in Proddatur-Chappadu and Nagayapalle sectors in the southern part of Cuddapah basin, is being carried out for possible unconformity related mineralisation.

Fracture controlled uranium mineralisation

The Gulcheru quartzite exposed in the southern part of the basin is fractured, faulted and intruded by basic dykes. Uranium mineralisation is associated with the quartz-chlorite breccia and is intermittently spread over an area of 35 km^2 along Madyalabodu-Gandi-Rachakuntapalle-Kannampalle tract and at Idupulapaya in Cuddapah district, Andhra Pradesh.

Neoproterozoic Bhima basin, Karnataka

The Bhima basin consists of arenaceous, calcareous and argillaceous sediments of Bhima Group and is affected by a number of E-W and NW-SE trending major faults. The exploration carried out so far in this area has established a small size, medium grade deposit associated with limestone and basement granite at Gogi. Some drill-holes have intercepted mineralisation with grades over 1% U, with appreciable thickness. The Ore (limestone as well as granite) is amenable to conventional leaching by alkaline route.

Two cross faults across the south-eastern margin of Bhima basin, viz., Ukinal-Kurlagere and Wadi fault zones are being investigated by exploratory drilling for possible unconformity/vein type uranium mineralisation. Geologically, these two fault zones are analogous to the Gogi area in which a small deposit has already been established.

Cretaceous sedimentary basin, Meghalaya

Evaluation and exploratory drilling of the mineralised Mahadek sandstone has further strengthened the resource position of Wahkyn deposit located about 10 km SW of Domisiat in West Khasi Hills district.

A low grade -low tonnage deposit at Lostoin has been established west of the Wahkyn deposit in the same geological environment.

Reconnaissance radiometric surveys have brought to light significant new uranium anomalies in the Cretaceous Mahadek sandstones around Umthongkut in West Khasi Hills district and Khonglah-Mawngap area in Jaintia Hills district, Meghalaya.

Other potential areas

Uranium exploration for locating unconformity related deposits has been taken up in the Mesoproterozoic Gwalior Basin, Madhya Pradesh, and Chhattisgarh basin, Chhattisgarh.

Some of the earlier located uranium occurrences associated with quartz pebble conglomerates (QPC) in the Sundargarh and Jajpur districts of Orissa are now being re-assessed to establish their potential.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

India's known conventional uranium resources (RAR and Inferred) are estimated to contain 91 100 tU and are hosted by the following type of deposits:

Vein type	55.96%
Sandstone type	16.94%
Unconformity type	12.58%
QPC	0.39%
Metasomatite	0.73%
Others	13.40%

As of 1 January 2007, the known conventional *in situ* resources include 61 100 tU under Reasonably Assured Resources (RAR) and 30 000 tU under Inferred Resources (IR) categories. Substantial increase in the RAR is mainly due to the reassessment of some of the deposits, which were earlier kept under inferred category. There is only a marginal increase compared to the 2005 figure in respect of IR due to additional data accrued for some of the deposits, reported in past years in the EAR-II category (now named Prognosticated Resources), which ultimately firmed up.

Undiscovered Resources (Prognosticated & SR)

In part of Rajasthan, Madhya Pradesh, Karnataka, Meghalaya and Andhra Pradesh, uranium resources were firmed up with enhanced degree of confidence and some of the resources, reported in previous editions in the EAR-II category, were reassigned to the IR category. Due to the reassessment and identification of many new areas in Srisailam sub-basin, Andhra Pradesh, Mahadek basin, Meghalaya and North Delhi Fold Belt of Haryana and Rajasthan, substantial increase is shown under Prognosticated Resource category (PR). There was no change under the Speculative Resource category (SR). As of 1 January 2007, the Undiscovered Resources include 50 900 tU under the PR category and 17 000 tU under the SR category as *in situ* resources.

URANIUM PRODUCTION

Historical review

The Uranium Corporation of India Limited (UCIL) was formed in October 1967 under the administrative control of the Department of Atomic Energy, Government of India. UCIL is now operating four underground mines at Jaduguda, Bhatin, Narwapahar and Turamdih in the district of Singhbhum East, Jharkhand State. The ore produced from these mines are processed in a common processing plant located at Jaduguda. All these units fall within a multi metal mineralised sector – called Singhbhum Shear Zone in the eastern part of India.

Status of production capability

The total installed capacity of Jaduguda plant is about 2 100 t dry ore/day.

Jaduguda Mine: Jaduguda uranium deposit lies within meta-sediments of Singhbhum Shear Zone. The host rocks are of Proterozoic age. There are two prominent parallel ore lenses – Footwall lode (FWL) and Hangwall lode (HWL). These lodes are separated by a barren zone of 100 m thickness. The FWL extends over a strike length of about 600 m in the southeast-northwest direction. The strike length of HWL is about 250 m and is confined to the eastern part of the deposit. Both the lodes have an average dip of 40 degrees towards the northeast. Of the two lodes, the FWL is better mineralised. Jaduguda deposit has been explored up to a depth of 800 m.

Jaduguda Mine was commissioned in October 1967. The entry into the mine is through a 640 m deep vertical shaft. An underground auxiliary vertical shaft, sunk from 555 m to 905 m provides access to deeper levels. Cut-and-fill stopping method is practiced in this mine, which gives about 80% of ore recovery. De-slimed mill tailings are used as backfill material. Broken ore is hoisted by the skip through shaft to surface and sent to Jaduguda mill by a conveyor for further processing.

Bhatin Mine: Bhatin uranium deposit is located 4 km northwest of Jaduguda. A major strike-slip fault lies between these two deposits (Jaduguda and Bhatin). Bhatin Mine came into production in 1986. The ore lenses in this mine have a thickness of 2 to 10 m with an average dip of 35 degrees. The geological settings of Bhatin are similar to that of Jaduguda deposit. The entry into the mine is through an adit and deeper levels are accessed by inclines. Cut and fill method of stoping is followed at Bhatin using deslimed mill tailings of Jaduguda mill.

Narwapahar Mine: Narwapahar deposit, located about 12 km west of Jaduguda is in operation since 1995. In this deposit, discrete uraninite grains occur within ch1orite-quartz schist with associated magnetite. There are several ore lenses in this deposit extending over a strike length of about 2 100 m. The ore shoots are lenticular in shape, with an average north-easterly dip of 30 to 40 degrees. The thickness of individual ore shoots varies from 2.5 to 20 m. The deposit is accessed by a 355 m deep vertical shaft and a 7 degree decline from the surface. Cut-and-fill stoping method is also practiced in this mine using deslimed mill tailings of Jaduguda plant as back fill material. Ore of Narwapahar mine is sent to Jaduguda plant by truck for processing.

Turamdih Mine: Turamdih deposit is located about 12 km west of Narwapahar. This mine was commissioned in 2003. Discrete uraninite grains within feldspathic-chlorite schist fonn a number of ore lenses with very erratic configuration. Two levels at 70 m and 100 m depth have been opened accessed by a 8 degree decline from surface. A vertical shaft is being sunk to provide access to deeper levels.

Jaduguda Mill: Uranium ore produced from Jaduguda, Bhatin, Narwapahar and Turamdih Mines are being processed in the mill located at Jaduguda. It has an installed capacity to treat about 2 100 t/day dry ore. The mill was commissioned in 1968.

Following the crushing and grinding to 60% passing 200 mesh, ore is leached in pachuca tanks using sulphuric acid under controlled pH and temperature. After the filtration of the pulp, ion exchange resin is used to recover uranium. After elution, the product is precipitated using magnesia to produce magnesium di-uranate containing 70% U_30_8. The treatment of mines water and reclaiming of tailings water has resulted in reduction of fresh water requirements, as well as increasing purity of the final effluent.

A magnetite recovery plant is also in operation at Jaduguda producing very fine grained magnetite as by-product.

Ownership of the uranium industry

The uranium industry is wholly owned by the department of Atomic Energy, Government of India. The Atomic Minerals Directorate for Exploration and Research under the Department of Atomic Energy is responsible for uranium exploration programmes in India. Following the discovery and deposit delineation, the economic viability is worked out. The evaluation stage may also include exploratory mining. Once a deposit of sufficient tonnage and grade in proved, UCIL initiates activities for commercial mining and production of uranium concentrates.

Employment in the uranium industry

About 4 300 people are engaged in uranium mining and milling activities.

Future production centres

The uranium deposits located at Banduhurang, Bagjata and Mohuldih in Singbbhum Shear Zone, Jharkhand are being taken up for commercial mining and these are in different stages of construction.

The deposit located at Banduhurang has been developed as an opencast mine and it will be commissioned soon. The orebody at Banduhurang is the western extension of ore lenses at Turamdih.

The deposit at Bagjata, about 26 km east of Jaduguda is being developed as an underground mine with a 7 degree decline as entry and vertical shaft to access deeper levels.

The uranium deposit located at Mohuldih, about 2.5 km west of Banduhurang has been planned for underground mining and various pre-project activities have been taken up.

A new ore processing plant at Turamdih is under construction to treat the ore of Turamdih and Banduhurang mines. This will commissioned soon. Expansion of this plant has also been taken up to treat the ore of Mohuldih mine.

The uranium deposits located at Lambapur-Peddagattu in Nalgonda district, Andhra Pradesh are also planned for development. One open-pit mine and three underground mines are proposed at this site. The uranium ore processing plant is being proposed to be constructed at Seripally, 50 km away from the mine site. Pre-project activities are in advanced stage of completion.

Another uranium deposit in carbonate hosted rock at Tummalapalle in Cuddapah district of Andhra Pradesh is also being taken up for development. An underground mine is being planned and the ore will be treated in an Alkali leaching (under pressure) plant to be constructed near the mine.

A sandstone hosted uranium deposit at Kylleng-Pyndengsohiong, Mawthabah (former name Domiasiat) in West Khasi Hills District, Meghalaya State in north-eastern part of the country, is being taken up for open-pit mining with a processing plant near the site.

Uranium production centre technical details

(as of 1 January 2007)

	Centre # 1	Centre # 2	Centre # 3	Centre # 4
Name of production centre	Jaduguda	Bhatin	Narwapahar	Bagjata
Production centre classification	existing	Existing	existing	committed
Start-up date	1967	1986	1995	2007
Source of ore:				
• Deposit name	Jaduguda	Bhatin	Narwapahar	Bagjata
• Deposit type	vein	Vein	vein	vein
• Resources (tU)				
• Grade (% U)				
Mining operation:				
• Type (OP/UG/ISL)	UG	UG	UG	UG
• Size (t ore/day)	650	150	1 000	500
• Average mining recovery (%)	80	75	80	80
Processing plant (acid/alkaline):	Jaduguda			
• Type (IX/SX/AL)	IX/AL			
• Size (t ore/day)	2 100			
• Average process recovery (%)	80			
Nominal production capacity (tU/year)	175			
Plans for expansion	Undergoing expansion to treat 2 500 tonnes ore/day.			
Other remarks	Ore being processed in Jaduguda plant.			Ore to be processed in Jaduguda plant.

	Centre # 5	Centre # 6	Centre # 7
Name of production centre	Turamdih	Banduhurang	Mohuldih
Production centre classification	Existing	committed	planned
Start-up date	2003	2007	2011
Source of ore:			
• Deposit name	Turamdih	Banduhurang	Mohuldih
• Deposit type	vein	vein	vein
• Resources (tU)			
• Grade (% U)			
Mining operation:			
• Type (OP/UG/ISL)	UG	OP	UG
• Size (t ore/day)	550	2 400	500
• Average mining recovery (%)	75	65	80
Processing plant (acid/alkaline):	Turamdih		
• Type (IX/SX/AL)	IX/AL		
• Size (t ore/day)	3 000		
• Average process recovery (%)	80		
Nominal production capacity (tU/year)	190		
Plans for expansion	Turamdih mine (1 000 TPD), Banduhurang mine (3 500 TPD) and Turamdih plant (4 500 TPD) are under expansion.		
Other remarks	Presently, ore being processed in Jaduguda plant. Subsequently, will be treated in Turamdih plant.	Ore to be processed in Turamdih plant.	Ore to be processed after the expansion of Turamdih plant.

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

	Centre # 8	Centre # 9	Centre # 10
Name of production centre	Lambapur-Peddagattu	Tummalapalle	Kylleng-Pyndengsohiong, Mawthabah
Production centre classification	planned	planned	planned
Start-up date	2012	2010	2012
Source of ore:			
• Deposit name	Lambapur-Peddagattu	Tummalapalle	KPM
• Deposit type	unconformity	strata bound	sandstone
• Resources (tU)			
• Grade (% U)			
Mining operation:			
• Type (OP/UG/ISL)	UG/OP	UG	OP
• Size (t ore/day)	1 250	3 000	2 000 (250 days/y working)
• Average mining recovery (%)	75	60	90
Processing plant (acid/alkaline):	Seripally	Tummalapalle	KPM
• Type (IX/SX/AL)	IX/AL	ALKPL	IX/AL
• Size (t ore/day)	1 250	3 000	2 000 (275 days/y working)
• Average process recovery (%)	77	70	87
Nominal production capacity (tU/year)	130	217	340
Plans for expansion			
Other remarks	Ore to be processed in the plant at Seripally.		

Secondary sources of uranium

See relevant table for India's production and use of mixed-oxide fuels. India reported no information on the production and use of re-enriched tails or reprocessed uranium.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Environmental impact assessment and monitoring

A well-equipped Environmental Survey laboratory is set-up at Jaduguda by Bhaba Atomic Research Center under Department of Atomic Energy. This unit regularly monitors the status of the environment around the operating units. Different environmental matrices are taken into account over an area of 20 km radius. Samples of effluents from mine, mill, and tailings pond are regularly collected and analysed. The water from different streams and local river system, sediments from river-beds are also analysed in different seasons. Samples of soil, grass, vegetables, food stuff and aquatic organisms like algae, fish etc are collected and analysed. The samples of ground water from wells and hand pumps are periodically collected and analysed for evaluation of radioactive and chemical pollutants. Measurement of gamma radiation, environmental radon concentration, and natural background radiation are carried out using sophisticated instruments and techniques. These surveillances in the area have not shown any significant rise of any harmful elements in the atmosphere in the entire history of UCIL's operations.

Tailings impoundment facility

The tailings impoundment facility – called Tailings Pond – created at Jaduguda has high natural hills as barriers on three sides. The embankment has been designed in one side to accommodate the entire tailings for a very long period. The decantation wells in the pond are planned to allow the flow of excess water only preventing any discharge of solid particles. Encroachment into the tailings pond area is prohibited by laying of permanent fences all around. Security personnel are also posted at site to guard any unwarranted entry. The pond is located at a safe distance from the population to avoid any direct contamination. Large part of the pond is covered with vegetation to prohibit re-suspension of dust into the atmosphere.

Waste rock management

There are minimal waste rocks generated from mining. They are mainly disposed in underground works for filling the void. A quantity is also used within premises for filling low-lying areas.

Effluent management

Mine water is treated for use in ore processing plant after clarification. The decanted effluent from the tailings pond is treated further at effluent treatment plant, and is brought to normal conditions before being used in the process. Remaining water, if any, is discharged into the environment after strict monitoring.

Site rehabilitation

People displaced by the construction of mines and plants are suitably re-housed as per the government rules.

Regulatory activities

There are many independent Central and State regulatory bodies, which regulate the operation of each unit. The Atomic Energy Regulatory Board is the apex organisation under DAE to regulate all safety related activities in nuclear units.

Social and cultural issues

Creation of employment, providing education and health care, undertaking infrastructure development, promoting sports, conducting cultural programmes, are some of the areas in which UCIL has contributed towards the society around its operating units. Demographic surveys are carried out from time to time in and around the operating units of UCIL. The reports have substantially proved that there is no adverse effect of radiation on health of residents around the area.

URANIUM REQUIREMENTS

India's uranium requirement is for its nuclear power programme. The installed capacity as of 1 January 2007 was 3 900 MWe (gross) – 3 577 MWe (net) which comprised 2 boiling water reactors (BWRs) and 15 pressurised heavy water reactors (PHWRs). Construction of 3 PHWRs (Kaiga-4 – 1×220 MWe and RAPP 5&6 – 2×220 MWe), 2 light water reactors (LWRs; KKNPP 1&2 – 2×1 000 MWe) and one prototype fast breeder reactor (PFBR; 500 MWe) is in progress. The total nuclear power generating capacity is expected to grow to about 7 280 MWe (gross) – 6 689 MWe (net) by 2011, with progressive completion of projects under construction. More projects are envisaged to be taken up. However, the programme beyond 2020 is yet to be finalised.

Uranium requirement for PHWRs is met from indigenous sources. Two operating BWRs and two under construction LWRs (VVER type) require enriched uranium and are fuelled by imported uranium. Future LWRs would also be fuelled by imported uranium.

Supply and procurement strategy

In India, exploration for uranium is carried out by the Atomic Minerals Directorate for Exploration and Research, a wholly owned government organisation. Neither private nor any foreign companies are involved in exploration, production and/or marketing of uranium. The UCIL, a public sector undertaking under the Department of Atomic Energy, is responsible for the production of yellow cake. The rest of the fuel cycle, up to the manufacture of fuel assemblies, is the responsibility of the Nuclear Fuel Complex, a wholly-owned government organisation.

Investment in uranium production in India is directly related to the country's nuclear power programme. For planning purposes the lead time from uranium exploration and development to production is assumed to be seven years.

NATIONAL POLICIES RELATING TO URANIUM

Uranium exploration, mining, production, fuel fabrication and nuclear power reactors are controlled by the Government of India. National policies relating to uranium are governed by the Atomic Energy Act 1962 and the provisions made there under.

Imported LWRs which would be inducted in future would be based on assurance of fuel supply for the lifetime of the reactor.

India reported no information on stocks of uranium or uranium prices.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million INR	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	645.7	712.6	742.1	1 013.2
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	645.7	712.6	742.1	1 013.2
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	46 417	35 455	40 148	133 700
Number of government exploration holes drilled	NA	NA	NA	NA
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	46 417	35 455	40 148	133 700
Subtotal exploration holes	NA	NA	NA	NA
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	46 417	35 455	40 148	133 700
Total number of holes	NA	NA	NA	NA

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	NA	NA	48 500	
Open-pit mining	NA	NA	12 600	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	NA	NA	61 100	

* *In situ* resources.

Reasonably Assured Resources by deposit type*

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	NA	NA	5 500
Sandstone	NA	NA	12 600
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	NA	NA	30 800
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	NA	NA	12 200
Total	NA	NA	61 100

Inferred Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	NA	NA	28 000	
Open-pit mining	NA	NA	2 000	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	NA	NA	0	
Unspecified	0	0	0	
Total	NA	NA	30 000**	

* *In situ* resources.

** These include 1 500 tonnes in small deposits (i.e. less than 500 tU each).

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	NA	NA	6 000
Sandstone	NA	NA	2 800
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	400
Vein	NA	NA	20 100
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	700
Other	NA	NA	0
Total	NA	NA	30 000*

* These include 1 500 tonnes in small deposits (i.e. less than 500 tU each).

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
NA	50 900

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
NA	17 000

Ownership of uranium production in 2006

Domestic				Foreign				Totals	
Government		Private		Government		Private			
[tU]	[%]	[tU]	[%]	[tU]	[%]	[tU]	[%]	[tU]	[%]
NA	100	0	0	0	0	0	0	NA	100

Uranium industry employment at existing production centres

(person-years)

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	4 200	4 200	4 300	4 300
Employment directly related to uranium production	NA	NA	NA	NA

Mixed-oxide fuel production and use

(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	NA	NA	NA	NA	NA	NA
Usage	NA	NA	NA	NA	NA	NA
Number of commercial reactors using MOX		3	1	1		1

Net nuclear electricity generation

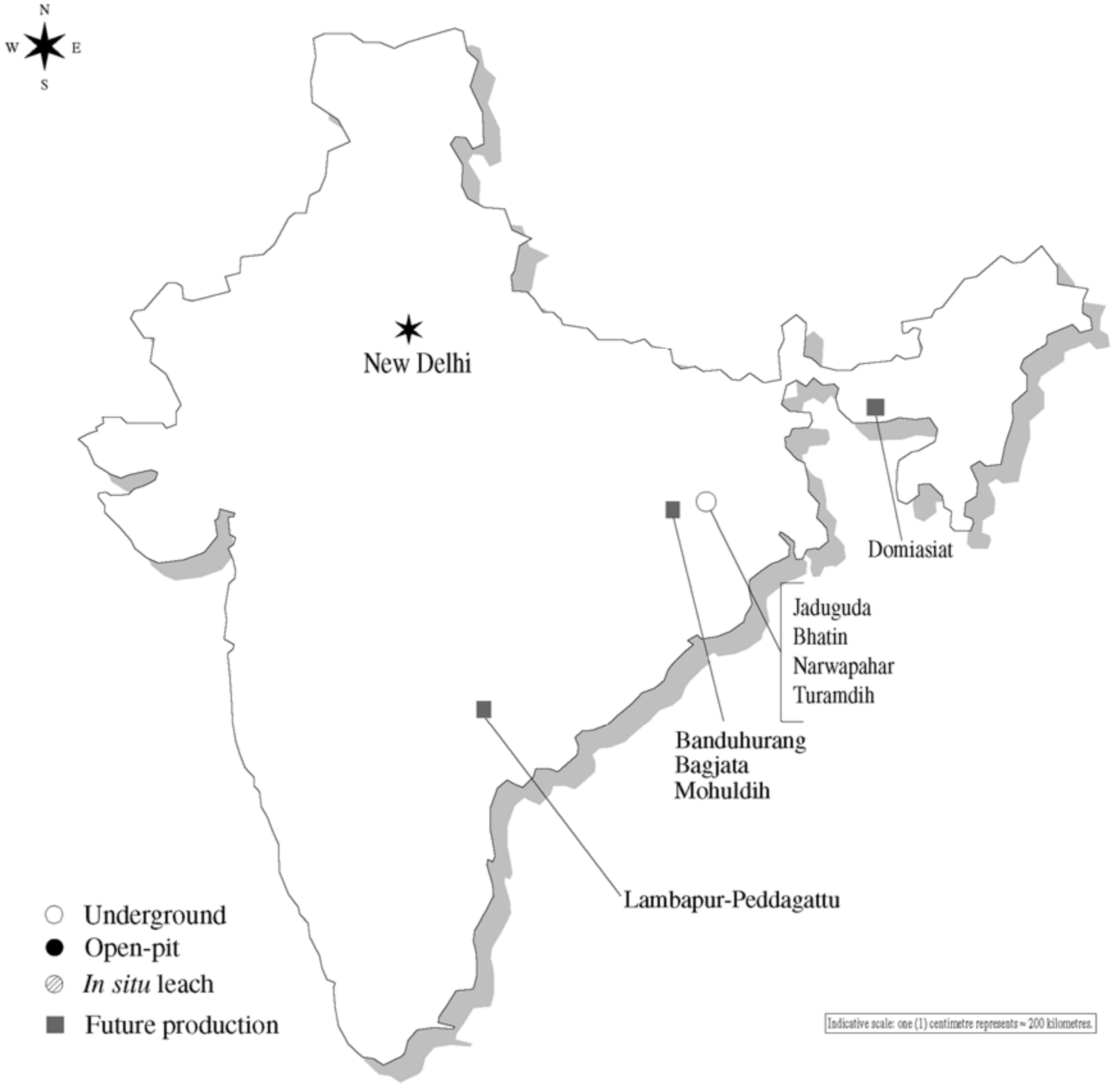
	2005	**2006**
Nuclear electricity generated (TWh net)	17 830	17 794

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
3 577	3 779	6 219	6 689	9 182	13 132

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
19 433		NA	NA	NA	NA



• Islamic Republic of Iran •

URANIUM EXPLORATION AND MINE DEVELOPMENT

Historical review

In 1935, the first occurrence of radioactive minerals was detected in the Anarak mining region. In 1959 and 1960, through co-operation between the Geologic Survey of Iran (GSI) and a French company, preliminary studies were carried out in Anarak and Khorassan of central Iran and Azarbaijan regions in order to evaluate the uranium mineralisation potential of these areas.

Systematic uranium exploration in Iran began in the early 1970s in order to provide uranium ore for processing facilities programmed to be established in the future. Between 1977 and the end of 1978, one-third of Iran (650 000 km²) was covered by terrain clearance airborne geophysical surveys. Many surficial uranium anomalies were identified and follow-up field surveys have continued to date. The airborne coverage is mainly over the central, south-eastern, east and north-western parts of Iran. The favourable regions studied by this procedure are Bafq-Robateh Posht e Badam region (Saghand, Narigan, Khoshumi, etc.), Maksan and Hudian in south-eastern Iran, and Dechan, Mianeh and Guvarchin in Azarbaijan. Outside of the airborne geophysics coverage area, uranium mineralisation at Talmesi, Meskani, Kelardasht and the Salt Plugs of south Iran are also worthy of mention.

Recent and ongoing activities

Major exploration areas are located in the Bafgh-Robateh Posht e Badam, a uranium mineralisation belt of central Iran, which includes Khoshumi, Narigan, Chahjuleh, Zarigan, Saghand uranium mine, and also in the Azarbaijan region.

The deposits identified by airborne surveys are mainly metasomatite or granites with elevated uranium content. Detailed exploration studies are to be carried out through borehole drilling, trenching, geological mapping, etc.

In addition to the mineral occurrences identified during airborne geophysical surveys, some probable suitable sedimentary structures have also been identified by field surveys in different parts of Iran, including prospective sandstone uranium deposits. Some cases of uranium occurrences in southern Iran are also considered of interest, in particular the Gachin uraniferous calcerite salt plug which has proved to be a surficial uranium deposit.

Based on the processing and interpretation of comprehensive airborne geophysical data (650 000 km²), more than 1 000 radioactive anomalies and exploration targets have been identified, and the Atomic Energy Organization of Iran (AEOI) has decided to follow-up on the ground with primary exploration throughout the entire country, focusing on central Iran. Exploration in and around the 67 salt plugs of south Iran near the Gachin uranium mine is another on-going activity. In addition, uranium exploration of sedimentary formations has been planned in related regions.

Mine Development activities in Saghand

Up to now, 76% of activities related to shaft sinking (two cylindrical shafts, each having 4 m in diameter and extending 350 m in depth) and tunnelling (about 620 m in total) have been carried out in the frame of five projects and the rest will be implemented during the second half of 2009. Ninety percent of exploitation is going to be accomplished through room and pillar, cut and fill and sub-level stopping methods.

Mine development activities in the Gachin salt plug (Bandar-Abbas)

The mining activities by open-pit are being carried out mainly in four blocks.

URANIUM PRODUCTION

Historical review

Uranium from the Gachin Salt Plug is mined by open-pit method and processed in the Bandar-Abbas Uranium Production Plant (BUP) located in south Iran. BUP is owned by the Government and is the only uranium producing centre in the country so far. Planned capacity of BUP is 21 tU per year.

Status of production capability

Iran's only operating uranium production centre, BUP, began operating in 2006. BUP, which is capable of treating 48 tonnes of uranium ore per day and has a production capacity of 21 tU per year, has been started at lower production levels from Gachin ore. A second production facility near the town of Ardakan, with a production capacity of 50 tU per year, is under construction and is expected to begin production in 2009. It will be supplied by ore from the Saghand uranium mine.

Ownership structure of the uranium industry

The owner of the uranium industry is the Government of the Islamic Republic of Iran and the operator is the AEOI.

Employment in the uranium industry

Two hundred and eighty employees are involved in uranium mining, milling and related activities at BUP, the only existing uranium production centre in the country.

Future production centres

There is one existing production centre in Bandar-Abbas and another is planned in Ardakan. Production costs at these sites will be above USD 80/kgU.

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

	Centre # 1	Centre # 2
Name of production centre	Bandar Abbas	Ardakan
Production centre classification	Existing	planned
Start-up date	2006	2009
Source of ore:		
• Deposit name	Gachin	Saghand
• Deposit type	Surficial	metasomatite
• Resources (tU)	100	900
• Grade (% U)	0.200	0.0553
Mining operation:		
• Type (OP/UG/ISL)	OP	10% OP, 90% UG
• Size (t ore/day)	55	500
• Average mining recovery (%)	85-90	85-90
Processing plant (acid/alkaline):		
• Type (IX/SX/AL)	AL	AL
• Size (t ore/day); for ISL (L/day or L/h)	48	400
• Average process recovery (%)	>70	>75
Nominal production capacity (tU/year)	21	50
Plans for expansion		
Other remarks		

ENVIRONMENTAL ACTIVITIES AND SOCIAL CULTURAL ISSUES

Because many exploration prospects are located in national protected wildlife habitat environmental areas, all exploration activities are carried out with care so as not to pollute these sensitive areas. For this purpose, giving instructions to the experts and workers about environmental pollutants and the necessity of garbage collecting from all the exploration sites and camps are continuous policies during all AEOI exploration and mining activities.

Central Iran is one of the major regions for uranium exploration and has been an active mining region for hundreds of years. In desert towns like Anarak, almost all the people have been involved in mine exploration and exploitation through generations for centuries. The dependence of the local residents for employment in the accessible regions is sufficient reason to prevent emigration of these work forces. Movement to remote areas and evacuation of historical towns, each of which preserves a unique heritage, could be a significant cultural loss. The local exploration and mining activities not only provides technical employment for these societies but also renders training and experience which could lead to opportunities for the newer generations that may later be employed in other mineral fields rather than uranium in the region.

URANIUM REQUIREMENTS

Preliminary feasibility studies for 16 000 MWe of nuclear power capacity have been accomplished and the final results are summarised in the tables below. It is important to note that the Parliament of the Islamic Republic of Iran approved an Act which obligates the government to install and commission 20 000 MWe of nuclear power plant capacity over the next 20 years.

Uranium exploration and development expenditures and drilling effort – domestic

(as of 1 January 2007)

Expenses in million IRR	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	9 344	12 400	21 015	35 000
Industry development expenditures	0	0	0	0
Government development expenditures	22 800	20 898	24 376	46 000
Total expenditures	32 144	33 298	45 391	81 000
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration hole drilled	0	0	0	0
Government exploration drilling (metres)	9 030	12 200	10 800	14 000
Number of government exploration holes drilled	134	176	130	160
Industry development drillings (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	NA	NA
Number of development exploration holes drilled	0	0	NA	NA
Subtotal exploration drilling (metres)	9 030	12 200	10 800	14 000
Subtotal exploration holes	134	176	130	160
Subtotal development drilling (metres)	0	0	NA	NA
Subtotal development holes	0	0	NA	NA
Total drilling (metres)	9 030	12 200	10 800	14 000
Total number of holes	134	146	130	169

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	491	85-90
Open-pit mining	0	0	100	85-90
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	0	591	

* *In situ* resources.

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	491
Other	0	0	100
Total	0	0	591

Inferred Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	876	NA
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	480	NA
Total	0	0	1 356	

* *In situ* resources.

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	180
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	1 176
Other	0	0	0
Total	0	0	1 356

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
0	4 150

Speculative Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
	12 200

Installed nuclear generating capacity to 2026
(MWe net)

2007	2016	2021	2026
1 000	6 000	11 000	16 000

Annual reactor-related uranium requirements to 2026 (excluding MOX)
(tonnes U)

2007	2016	2021	2026
6.4	254	995	2 474

• Japan •

URANIUM EXPLORATION

Historical review

Domestic uranium exploration has been carried out by the Power Reactor and Nuclear Fuel Development Corporation (PNC) and its predecessor since 1956. About 6 600 tU of uranium resources have been detected in Japan. Domestic uranium exploration activities in Japan were terminated in 1988. Overseas uranium exploration began in 1966. Exploration activities were carried out mainly in Canada and Australia, and in other countries such as the United States, Niger, China and Zimbabwe.

In October 1998, PNC was reorganised into the Japan Nuclear Cycle Development Institute (JNC). Based on the decision by the Atomic Energy Commission in February 1998, uranium exploration activities, which were carried out by PNC, were terminated in 2000, and mining interests and technologies which remained in JNC were transferred to the private sector. In October 2005, the Japan Atomic Energy Agency (JAEA) was established by integrating the Japan Atomic Energy Research Institute and JNC.

Recent and ongoing uranium exploration and mine development activities

Japan-Canada Uranium Co. Ltd., which took over JNC's mining interests in Canada, is carrying out exploration activities in Canada. Japanese private companies hold shares in developing and mining operations in Canada, Niger, Kazakhstan and elsewhere.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

About 6 600 tU of Reasonably Assured Resources have been identified and classified as recoverable at <USD 130/kgU.

URANIUM PRODUCTION

Historical review

A test pilot plant with a capacity of 50 tonnes ore per day was established at the Ningyo-toge mine in 1969 by PNC. The operation ceased in 1982 with a total production of 84 tU. In 1978, the vat leaching test of the Ningyo-toge ore began on a small scale with a maximum capacity of 12 000 tonnes ore per year, consisting of three 500-tonne ore vats. The vat leaching test was terminated at the end of 1987.

Production facilities

The plutonium fuel plant of JAEA consists of three facilities, the Plutonium Fuel Development Facility (PFDF), the Plutonium Fuel Fabrication Facility (PFFF) and the Plutonium Fuel Production Facility (PFPF).

- The PFDF was constructed for basic research and fabrication of test fuels and started operation in 1966. As of December 2006, approximately two tonnes of MOX fuels have been fabricated in PFDF.
- In the PFFF there are two MOX fuel fabrication lines, one for the experimental Fast Breeder Reactor Joyo (FBR line) with one-tonne MOX/year of fabrication capability and the other for the prototype Advanced Thermal Reactor Fugen (ATR line) with a 10 tonnes MOX/year fabrication capability. The FBR line started its operation in 1973 with Joyo initial load fuel fabrication. The fuel fabrication for the Joyo in the FBR line was finished in 1988, and the role of the fuel fabrication for Joyo was switched to PFPF. The ATR line started its operation in 1972 with MOX fuel fabrication for the Deuterium Critical Assembly (DCA) in O-arai Research and Development Centre of JAEA. The fuel fabrication for ATR Fugen was started in 1975 and was finished in 2001. The total amount of MOX fuel fabricated by both lines was approximately 155 tonnes.

- PFPF FBR line was constructed to supply MOX fuels to the prototype FBR Monju and the experimental FBR Joyo with five tonnes MOX/year of fabrication capability. The PFPF FBR line started its operation in 1988 with Joyo reload fuel fabrication and fuel fabrication for the FBR Monju was started in 1989. As of December 2006, approximately 13 tonnes of MOX fuels had been fabricated in the PFPF.

Use of mixed-oxide fuels

- Prototype Fast Breeder Reactor Monju

  Monju successfully achieved its first criticality in April 1994, and supplied electricity to the grid initially in August 1995. However, the pre-operational test of the plant was abruptly interrupted by a sodium leak accident in the secondary heat transport system in December 1995 during a 40% power operation test. After carrying out the cause investigation and the comprehensive safety review for two years and the necessary licensing procedure, the permit for plant modification (countermeasure against potential sodium leak etc.) was issued in December 2002 by the Ministry of Economy, Trade and Industry (METI). JAEA have started preparatory work for modification, after being given prior approval by the local governor of Fukui in February 2005, and the main modification work is in progress since September 2005, which has achieved approximately 89% completion by the end of December 2006. Also the function test for modified systems has been in progress since December 2006. Sequentially the comprehensive system function test, considering the long period of plant shutdown, is scheduled in the near future.

- Experimental Fast Reactor JOYO

  The experimental fast reactor JOYO attained its initial criticality in April 1977 with the MK-I breeder core. As an irradiation test bed, the JOYO MK-II core achieved the maximum design output of 100 MWt in March 1983. Thirty-five duty cycle operations and thirteen special tests with the MK-II core were completed by June 2000. The MK-III high performance irradiation core, of which maximum design output increases to 140 MWt achieved its initial criticality in July 2003. Five duty cycle operations and three special tests with MK-III core have been completed by December 2006. The JOYO net operation time reached around 70 000 hours and 585 fuel subassemblies were irradiated during the MK-I, MK-II and MK-III core operations.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

None reported.

URANIUM REQUIREMENTS

As of 1 January 2006, Japan had 55 operating commercial nuclear power reactors. Total gross electric generating capacity was 49 580 MWe, providing approximately one third of the electricity generated in Japan. Two additional commercial nuclear power reactors (Tomari-3, Shimane-3) and one prototype fast breeder reactor MONJU are under construction.

Supply and procurement strategy

Japan has relatively scarce domestic uranium resources and, therefore, must depend to a great extent on overseas supply of uranium. A stable supply of uranium resources is to be ensured through long-term purchase contracts with overseas uranium suppliers, direct participation in mining development and diversification of suppliers and countries.

NATIONAL POLICIES RELATING TO URANIUM

There is no special legislation for uranium exploration and exploitation under the Japanese Mining Laws and Regulations. Uranium exploration and exploitation is open to private companies incorporated in Japan. However, no private company has pursued uranium exploitation in Japan.

URANIUM PRICES

Uranium import prices are contracted by private companies. Government information is not available for these data.

Uranium exploration and development expenditures – non-domestic

Expenses in JPY	**2004**	**2005**	**2006**	**2007** (expected)
Industry exploration expenditures	NA	NA	NA	NA
Government exploration expenditures	0	0	0	0
Industry development expenditures				
Government development expenditures				
Total expenditures	NA	NA	NA	NA

Reasonably Assured Resources

(tonnes U)

Production method	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**	**Recovery factor** (%)
Underground mining	0	0	6 600	85
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	0	6 600	85

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	0	0	6 600
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	0	6 600

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]	0	0	0	0	0	0
Underground mining[1]	45	0	0	0	45	0
In situ leaching	0	0	0	0	0	0
Heap leaching	39	0	0	0	39	0
In-place leaching*	0	0	0	0	0	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	84	0	0	0	84	0

(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.

Mixed-oxide fuel production and use

(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	583	15	0	0	598	9
Use	331	2	4	8	345	3
Number of commercial reactors using MOX		1	1	1		1

Reprocessed uranium use

(tonnes of natural U equivalent)

Reprocessed uranium	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	595	50	0	0	645	0
Use	64	28	46	27	165	54

Net nuclear electricity generation*

	2005	2006
Nuclear electricity generated (TWh gross)	304.8	333.9

* For fiscal year.

Installed nuclear generating capacity to 2030*

(MWe gross)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
49 580	49 580	51 100	51 100	NA	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

* For fiscal year.

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
7 941	8 792	8 877	8 877	11 340	11 340

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

* For fiscal year.

• Jordan •

URANIUM EXPLORATION

Historical review

In 1980 an airborne spectrometric survey covering the entire country was completed. By 1988 ground based radiometric surveys of anomalies identified in the airborne survey were completed. During the 1988-1990 period, the Precambrian basement and Ordovician sandstone target areas were evaluated using geological, geochemical and radiometric mapping and/or surveys.

During the period 1990-1992 a regional geochemical sampling programme, involving stream sediments and some rock samples, was completed over the basement complex area. Geological and radiometric follow-up was carried out at locations within the basement complex and Precambrian sandstone areas.

The re-evaluation of airborne gamma anomalies and ground radiation studies and/or surveys [gamma scintillometry and spectrometry, radon emanometry and radon (track-etch) measurements] led to the identification of five (5) non-phosphatic uranium deposits and several radioactive phosphatic areas.

A systematic study and evaluation of the uranium concentration in Jordan’s phosphate deposits was conducted to assess the environmental effects of the uranium. This study was completed in September 1997.

Recent and ongoing exploration and mine development activities

All uranium exploration activities in Jordan are conducted by the Natural Resources Authority (NRA) funded by the government. The main findings from exploration activities are described below:

- Radiometric measurements (gamma and radon) and chemical analyses defined several surficial uranium occurrences in central, southern, south-western and south-eastern Jordan.
- Uranium deposits in south-western Jordan (Wadi Araba – Wadi Dana area) are associated with apatite minerals (vein) in Cambrian sandstone.
- In central Jordan, the occurrences are associated with Pleistocene sediments and closely related to varicoloured marble. They occupy an area of about 350 km^2.

Uranium deposits in central Jordan occur as minute mineral grains disseminated within fine calcareous Pleistocene sediments and as yellowish films of carnotite and other uranium minerals coating fractures of fragmented chalk or marl of Mastrichtian-Paleocene age. In the southern and south-eastern area uranium occurs only as yellowish stains associated with chalk or marl.

- The Chalk Marl sequence in the investigated area is the major constituent of the uranium bearing rocks. The calcite and clay content are low.
- Preliminary leach tests using the alkaline method indicate leachability of more than 90% in 24 hours.
- Results of channel sampling in three areas in central Jordan indicate uranium contents ranging from 140 to 2 200 ppm over an average thickness of about 1.3 m. The average thickness of the overburden is about 0.5 m.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Given the world uranium market status in the year 1998, uranium concentration cut-off grades between 120 and 510 part per million (ppm) were considered for estimating uranium resources in central Jordan and 31 800 metric tonnes of uranium resources were estimated in a total area of 38 km² with 585 ppm uranium concentration average.

Uranium resources have been recently re-evaluated according to the uranium ore classification systems utilised by IAEA and US-DOE, the deposit type (sedimentary surficial deposits), the distribution of uranium concentrations and the recent world uranium market status, especially demand and prices.

The recent resource re-estimation in central Jordan shows that the total extent of the uranium ore area is 60 km^2 containing 55 000 tU using a 170 ppm cut-off grade.

However, uranium resources in central Jordan are likely more than the calculated amount (55 000 tU) because almost 20% of the explored area has not yet been covered with detailed studies including resource estimation.

Undiscovered Resources (Prognosticated & SR)

See relevant table.

Unconventional or by-product Resources

A total of approximately 59 360 tU are associated with phosphate rocks belonging to the by-product category. The average uranium concentration of the Eshidia deposits, which constitute most of the phosphate resources, ranges between 20 and 40 ppm. The smaller Al-Hassa and Al-Abiad deposits have an average uranium concentration in the range of 50 to 70 ppm.

URANIUM PRODUCTION

Historical review

Jordan does not currently produce uranium. In 1982, a feasibility study for uranium extraction from phosphoric acid was presented by the engineering company LURGI A.G., Frankfurt, Germany, on behalf of the Jordan Fertiliser Industry Company. This company was later purchased by the Jordan Phosphate Mines Company (JPMC). One of the extraction processes evaluated was originally found to be economically feasible, but as uranium prices dropped down in the 1990s, the process became in that time uneconomic and extraction plant construction was deferred.

Feasibility studies in 1989 were based on experience operating a micro pilot plant. These tests, which were terminated in 1990, served as the basis for preparation of a project document for a uranium extraction pilot plant from phosphoric acid.

Status of production capability

Jordan does not currently produce uranium.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

None reported.

URANIUM REQUIREMENTS

According to the Jordanian plan of refreshing uranium exploration and developing peaceful atomic energy programmes, Jordan needs to be helped in uranium resource estimation and to send national staff to uranium exploration and production training courses.

NATIONAL POLICIES RELATED TO URANIUM

Recently, Jordan has intended to develop peaceful atomic energy programmes for generating electricity and water desalination; therefore, Jordanian natural resources authority (NRA) has recently refreshed the uranium exploration project.

The government will study the feasibility of building civilian programmes with nuclear reactors.

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	55 000	55 000	55 000	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0		
Unspecified	0	0	0	
Total	55 000	55 000	55 000	

* *In situ* resources.

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	55 000	55 000	55 000
Total	55 000	55 000	55 000

* *In situ* resources.

Inferred Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	84 800	84 800	84 800	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	84 800	84 800	84 800	

* *In situ* resources.

Inferred Resources by deposit type*

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	84 800	84 800	84 800
Total	84 800	84 800	84 800

* *In situ* resources.

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
67 800	84 800

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
84 800	NR

NR Not reported.

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
0	0	0	0	NA	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

NA Not available.

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
0	0	0	NA	2 000	0	0	0	2 000	0	0	0

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
NA	0	0	0	NA	0	0	0	NA	0	0	0

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

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
0	0	0	0	NA	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

NA Not available.

• Kazakhstan •

URANIUM EXPLORATION

Historical review

Uranium exploration in Kazakhstan started in 1948 at the Kurdai deposit situated south of Kazakhstan, when the now independent Republic was part of the USSR. Subsequent exploration activities can be divided into distinct stages, based on target areas and exploration concepts applied.

During the first stage, which last through 1957, those portions of the Republic which were not overlain by young unconsolidated sediments were covered by regional ground and airborne radiometric surveys. Investigations carried out in this period resulted in the discovery of several uranium deposits in what later became the uranium districts of Pribalkhash (vein-stockwork deposits in volcanics), Kokchetau (vein-stockwork deposits in folded sedimentary formations) and Pricaspain (phosphoritic fish bone detritus). These districts are respectively, near Lake Balkhash (in south-eastern Kazakhstan), in northern Kazakhstan and near the Caspian Sea.

After 1957, conceptual models developed during regional assessment of Kazakhstan's sedimentary basins led to the discovery of sandstone deposits in which the uranium is associated with oxidation-reduction interfaces in the Chu-Sarysu basin, located in central Kazakhstan.

In addition, uranium mineralisation was discovered in the Koldjat deposit in the Ily basin in eastern Kazakhstan. The uranium, which grades up to 0.1% U, is associated with coal and did not receive further attention due to economic reasons.

During 1970 and 1971, *in situ* leaching mining tests were successfully conducted at the Uvanas deposit in the Chu-Sarysu basin. Since that time, exploration has been concentrated on Mesozoic and Cenozoic sedimentary basins having the potential for ISL amenable deposits. The Stepnoye and Central Mining Companies are currently operating ISL mines in the Chu-Sarysu district. No. 6 Mining Company conducts ISL operations in the Syr-Darya district.

The main results of exploration for the last 30 years are discoveries of large uranium deposits associated with Cretaceous and Paleocene sediments of the Chu-Sarysu and Syr-Darya basins, which have significantly increased the resource base of Kazakhstan. Discovery and development of the ISL amenable resources have placed Kazakhstan in a position to compete with other low-cost uranium producers in the world. Because of the very large resource base, reconnaissance exploration has been suspended.

Prospecting works were however continued on the sandstone deposits in the Shu-Saryssuiskaia and Syr-Daryinskaia uranium ore provinces in order to add to the uranium resource base. Prospecting was followed by experimental-industrial works on ISL uranium mining that is a part of a geological survey.

Governmental financing of exploration was stopped in 1992. In 1993-2004, prospecting works were funded by joint stock companies, such as KATEP, NAC Kazatomprom, Katco (joint venture between Kazakhstan and AREVA) and Inkai (joint venture between Kazakhstan and Cameco).

Recent and ongoing uranium exploration and mine development activities

In 2005-2006, exploration was performed at Moinkum, Inkai, Mynkuduk and Budyonovskoye deposits in the Shu-Sarysu Uranium Province and at the Northern Kharasan deposit in the Syrdaria Uranium Province.

Katco performs uranium exploration at site no. 3 (Central) of the Moinkum deposit. Currently Katco is completing the exploration at site no. 2 (Tortkuduk) of the Moinkum deposit. Inkai continues exploration and pilot-mining ISL operations at sites no. 2 and no. 1 of the Inkai deposit.

In 2005, Appak LLP commenced exploratory works on the western site of the Mynkuduk deposit, Betpak Dala LLP at site no. 4 of the Inkai deposit and Karatau LLP at site no. 2 of the Budyonovskoye deposit. In 2006, Kyzylkum LLP commenced exploratory works at site no. 1 of the northern Kharasan deposit. As a result of this exploration, the inferred uranium resources have increased by 9 805 tU at site no. 4 of the Inkai deposit. Pilot-mining ISL uranium operations will start at these sites in 2007.

In 2006, JSC NAC Kazatomprom commenced work on geology-economical re-estimation of the north Kazakhstan uranium province deposits in order to define the uranium resources and to develop forecasts of resources related to the ores of the vein-stockwork and unconformity-related deposits suitable for underground and open-pit mining methods.

In the near-term, JSC Volkovgeology is planning to renew the uranium prospect-exploratory works in sandstone deposits (suitable for ISL) in perspective areas of the Shu-Sarysu and Syrdaria uranium provinces.

No new deposits were discovered during the reported period.

No uranium exploration was performed beyond the limits of the Republic of Kazakhstan.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

As of 1 January 2007, the identified *in situ* uranium resources amounted to 943 377 tU (recoverable at <USD$130kgU).

In 2005-2006, 9 627 tU were mined. Considering the losses during mining (997 tU or 10.4%), 10 624 tU of reserves were depleted. Whereas 8 709 tU (90.5%) were produced by ISL method, 918 tU (0.5%) were produced by underground mining at the Vostok and Zvezdnoye deposits (1 010 tU of reserves were depleted).

Inferred Resources at site no. 4 of the Inkai deposit (Betpak Dala LLP) were increased by 9 805 tU (transfer from Prognosticated Resources) as a result of geological exploration. Mineralisation is localised in Palaeogene-age sands. The average content of uranium is 0.043%.

Undiscovered Resources (Prognosticated & SR)

During the reporting period, no significant new Prognosticated or Speculative Resources in Kazakhstan have been defined. Out of 300 000 tU of Prognosticated Resources, 280 000 tU are related to sandstone deposits, 10 000 tU to inconformity-related deposits and 10 000 tU to vein deposits. Out of 500 000 tU of Speculative Resources, 80% are related to sandstone deposits, 10% to inconformity-related deposits and 10% to vein deposits.

URANIUM PRODUCTION

Historical review

Uranium mining in Kazakhstan started in 1957 at the Kurdai deposit in the southern part of the country using the open pit method. Until 1978, four companies belonging to the USSR Ministry of Middle Machine Construction (Kyrgyzski Mining Combine, Leninabadski Mining and Chemical Combine in the south, Tselinny Mining and Chemical in the north and Prikaspiiski Mining and Chemical Combine in the west) mined uranium by underground and open pit methods. About 15 deposits, with an approximate cumulative output of 5 000 tU, were mined.

Deposits mined-out during these years were mainly of the vein-stockwork mineralisation type located in the Kokshetauskaia and the Pribalkhashskaia uranium provinces. Two syngenetic genesis deposits, where mineralisation was connected with phosphatised bone detritus of fossil fish, were also mined. ISL uranium mining of sandstone deposits started in 1978. Mineralisation is represented by roll ore bodies 10 km in length. All deposits of the Shu-Saryssuiskaia and Syr-Daryinskaia uranium provinces are sandstone type.

Production capability

In 2005-2006, uranium was mined at the following deposits: Uvanas, Mynkuduk, Kanzhugan, Moinkum, Akdala, north and south Karamurun, Vostok, Zvezdnoye and Inkai (pilot production). All deposits except Vostok and Zvezdnoye are being mined by ISL. Vostok and Zvezdnoye deposits are mined underground.

Uvanas, Mynkuduk (eastern site), Kanzhugan, Moinkum (southern part of site no. 1), north and south Karamurun are operated by the Mining Company LLP and the Akdala deposit is operated by the joint venture Betpak Dala LLP. Katco LLP takes part in the operation of the Moinkum deposit (northern part of site no. 1), whereas the Vostok and Zvezdnoye deposits are operated by the Stepnogorskiy Mining and Chemical Complex LLP by underground mining method. The Inkai deposit (sites no. 1 and 2) is being operated by Inkai LLP.

In 2005-2007, five new ISL production centres were established. Ken Dala.kz JSC began development of the central site of the Mynkuduk deposit in the Shu-Sarysu uranium province with plans to achieve a design capacity of 2 000 tU per year by 2010. In 2007, Appak LLP started uranium pilot production at the western site of the Mynkuduk deposit with plans to achieve a mine design capacity of 1 000 tU per year by 2010. Also in 2007, Karatau LLP began uranium pilot production at the Budyonovskoye deposit (site no. 2), with plans to reach a mine design capacity of 1 000 tU per year in 2009. In the Syrdaria uranium province, Kyzylkum LLP plans to start pilot production of uranium in 2008 at the northern Kharasan deposit (Kharasan-1 site), working toward commercial production of 1 000 tU per year in 2010 and further expansion to 3 000 tU. Baiken-U LLP plans to start uranium exploration in 2007 at the northern Kharasan deposit (Kharassan-2 site and southern-eastern flank), working toward commercial production in 2008-2010 and a design capacity of 2 000 tU per year in 2014.

In 2005-2006, 9 627 tU were mined in Kazakhstan. The underground mining method accounts for 918 tU of general production, including 181 tU produced by means of heap leaching method. Production by ISL accounts for 8 709 tU (90.5% of total production).

As of 1 January 2007, the total capacity of uranium production centres in Kazakhstan is 5 600 tU per year. It is planned to expand production capacity to 27 000 tU per year by 2015.

Uranium production at ISL mines is carried out using sulphuric-acid method to produce pregnant uraniferous solutions. Further processing of pregnant uraniferous solutions is based on ion-exchange sorption-elution technologies with uranil salts precipitation and/or further extraction refining with production of natural uranium concentrate.

During production of natural uranium concentrate from the Vostok and Zvezdnoye deposits, the technique of autoclave soda leaching is also used at the hydrometallurgical plant.

Ownership structure of the uranium industry

In 2006, the State share of uranium production in Kazakhstan was 71%, including 12% from NAC Kazatomprom owing to its partnership in joint-ventures and 59% from the Mining Company LLP, which belongs to NAC Kazatomprom, a 100% state-owned company.

The Mining Company LLP includes the following entities: Taukent Mining and Chemical Complex LLP, Stepnoye Mining Group LLP and the Mining Group-6. All develop uranium deposits using the ISL method.

LLC Karatau and LLC Semizbai-U are 100% owned by JSC NAC Kazatomprom. Deposits at these sites are also mined with the ISL method. As of 1 January 2007, JSC NAC Kazatomprom also held shares in eight joint ventures (LLC JV Betpak Dala, LLC JV Inkai, LLC JV Katco, LLC Appak, JSC JV Zarechnoye, JSC JV Akbastau, LLC Kyzylkum, and LLC Baiken-U) with private companies of Kazakhstan, Canada, France, Japan, Russia, Kyrgyzstan, and the Netherlands.

The LLC Stepnogorsk Mining-Chemical Complex (LLC SMCC) is under trust management of JSC NAC Kazatomprom. LLC SMCC mines deposits by the underground method. LLC SMCC also wholly-owns LLC Ken Dala.kz, where mining is conducted using the ISL method.

In 2006, the production share of private foreign companies from Canada, France, Japan, Russia, Netherlands, Great Britain and Kyrgyzstan in Kazakhstan amounted to 14% of total production, whereas the share holding of these same private companies amounted to 15%.

Employment in the uranium industry

In 2005-2006, the establishment of new uranium production centres led to a shortage of qualified personnel in Kazakhstan. As a result, two training centres were established in the local communities in Kyzylorda (the Shieli settlement) and south Kazakhstan (the Taukent settlement) near areas where production facilities are located. In addition, NAC Kazatomprom established the Kazakhstan Nuclear University and the Geotechnology Regional Training Center. For the new uranium production centres, the students of higher and secondary education technical institutions of Kazakhstan will be engaged as well.

According to subsoil use contracts annual obligatory training expenses comprised about 1% of uranium production cost.

Due to the restructuring of the Mining Company LLP and the transfer of some specialists into amalgamated service centres, the number of personnel in the uranium production sector was slightly reduced in 2006.

Future production centres

At the end of 2006, two new ISL production centres were established by Semizbai-U LLP (the Semizbai sandstone deposit) located in north Kazakhstan uranium province and by Akbastau Kazakhstan-Russian Joint-venture (the Budyonovskoye sandstone deposit, sites no. 1, 3 and 4) located in the Shu-Sarysu uranium province.

By 2012, it is planned to complete geologic and economic re-evaluation of the deposits in north Kazakhstan uranium province, which would allow the creation of new production centres for underground and open-pit mining, initially at the Kamyshevoye and Grachevskoye deposits (where operations have been suspended) and the nearby Kossachinoye deposit.

The Kamyshevoye deposit (hydrothermal genesis with ores of vein-stockwork and unconformity-related types) is partly developed. More than 20 000 tonnes of RAR and Inferred Resources, with 0.134% U average grade, remain to be mined. Open-pit and underground mining is possible.

The Grachevskoye deposit of hydrothermal genesis is also developed. The remaining 11 000 tonnes RAR and Inferred Resources have an average grade of 0.178% U. It is possible that this site will be developed for underground mining.

The Kossachinoye deposit is also of hydrothermal genesis with ores of vein-stockwork type. RAR and Inferred Resources total 100 000 tonnes with an average grade of 0.1% U. Open-pit and underground mining is possible.

After exploration of promising areas of Shu-Sarysu and Syrdaria uranium provinces is completed, new ISL production centres may be established.

Uranium production centre technical details

(as of 1 January 2007)

	Centre #1	Centre #2	Centre #3	Centre #4	Centre #5	Centre #6	Centre #7
Name of production centre	Taukentskiy Mining Chemical Complex LLP	Stepnoye Mining Group LLP	Mining Group-6 LLP	Betpak-Dala JV LLP	KATKO JV LLP	Inkai JV LLP	Stepnogorskiy Mining Chemical Complex LLP Mining Group-1
Production centre classification	existing (mining)	existing (mining)	existing (mining)	existing (mining)	existing (mining, exploration)	existing (exploration)	existing (mining)
Start-up date	1982	1978	1985	2004	1996	1996	1958
Source of ore:							
• Deposit name	Kanzhugan, Moinkum (site 1)	Mynkuduk (eastern site), Uvanas	North and South Karamurun, Irkol	Akdala, Inkai (site 4)	Moinkum (sites 1, 2, 3)	Inkai (sites 1,2)	Vostok, Zvezdnoye
• Deposit type	Sandstone	sandstone	sandstone	Sandstone	sandstone	sandstone	vein-stockwork
• Resources (tU)	28 192	27 102	60 140	38 811	66 776	150 307	10 559
• Grade (% U)	0.057	0.032	0.062	0.048	0.074	0.060	0.120
Mining operation:							
• Type (OP/UG/ISL)	ISL	ISL	ISL	ISL	ISL	ISL	UG
• Size (t ore/day) for ISL (L/day)							1 000
• Average mining recovery (%)	87	90	91	90	85	80	90
• Processing plant (acid/alkaline):	Acid	acid	acid	Acid	acid	acid	acid
• Type (IX/SX/AL)	IX, SX	IX	IX	IX	IX	IX	SX,AL
• Size (t ore/day) for ISL (L/day)	50 000	45 000	40 000	20 000	15 000	6 000	1 000
• Average process recovery (%)	97	97	97	97.5	97	96	92.5
Nominal production capacity (tU/year)	1 000	1 200	1 000	1 000	500	400	500
Plans for expansion	1 200	1 300	1 750	3 000	1 500	4 000	no

Uranium production centre technical details (contd.)

(as of 1 January 2007)

	Centre #8	Centre #9	Centre #10	Centre #11	Centre #12	Centre #13	Centre #14	Centre #15
Name of production centre	Zarechnoye JV JSC	Karatau LLP	KenDala.kz JSC	Appak LLP	Kyzylkum LLP	Baiken-U LLP	Akbastau JV JSC	Semizbai-U LLP
Production centre classification	existing (development)	existing (exploration)	existing (development)	existing (exploration)	existing (exploration)	existing (exploration)	committed	committed
Start-up date	2001	2006	2005	2005	2005	2006	2006	2006
Source of ore:								
• Deposit name	Zarechnoye	Budyonovskoye (site 2)	Mynkuduk (central site)	Mynkuduk (western site)	Northern Kharasan (site 1)	Northern Kharasan (site 2)	Budyonovskoye (sites 1,3,4)	Semizbai
• Deposit type	sandstone	sandstone	sandstone	sandstone	sandstone	sandstone	sandstone	sandstone
• Resources (tU)	18 997	6 900	50 400	26 000	34 352	24 824	25 100	17 108
• Grade (% U)	0.056	0.094	0.032	0.032	0.108	0.108	0.094	0.059
Mining operation:								
• Type (OP/UG/ISL)	ISL	ISL	ISL	ISL	ISL	ISL	ISL	ISL
• Size (t ore/day) for ISL (L/day)								
• Average mining recovery (%)	94	85	90	90	90	90	85	75
• *Processing plant (acid/alkaline):*	*acid*	*acid*	*acid*	*acid*	*acid*	*acid*	*NA*	*acid*
• Type (IX/SX/AL)	IX	IX	IX	IX	IX	IX	NA	IX
• Size (t ore/day) for ISL (L/day)	0	0	0	0	0	0	0	0
• Average process recovery (%)	96	96	96	96	96	96	NA	96
Nominal production capacity (tU/year)	0	0	0	0	0	0	0	0
Plans for expansion	2 000	1 000	2 000	1 000	3 000	2 000	3 000	500

Secondary sources of uranium

Production and/or use of mixed-oxide (MOX) fuels

Mixed-oxide (MOX) fuel is not produced or used in Kazakhstan.

Production and/or use of re-enriched tails

Uranium obtained through re-enrichment of depleted uranium tails is not produced or used in Kazakhstan.

ENVIRONMENTAL ACTIVITIES AND SOCIAL CULTURAL ISSUES

Environment activities

Kazakhstan has significant environmental concerns about the wastes associated with its previous and currently operating uranium production facilities. It is also concerned about the environmental aspects of its large volume of sandstone hosted uranium resources that are amenable to ISL extraction.

In 2003-2004, about 99% of the uranium was mined by the ISL method. The ISL method produces fewer environmental impacts in comparison with open and underground mining, as it does not result in significant surface deformation, accumulation of waste rocks and non-commercial ores, or tailing pits.

Monitoring

Because sulphuric acid is used in the ISL process, monitoring wells are constructed in and around all developed and operational ISL sites. The number of wells and well patterns are determined by the projects, and confirmed by respective state bodies. At least once every three months, samples are taken from wells above and below the ore horizons, and from the ore bodies themselves. Contents of uranium, thorium, radium, sulphate-ion, nitrate-ion, sulphuric acid, pH, Eh, and solid residual are determined in these samples.

On developed sites, well monitoring has been conducted for more than ten years. Results show that industrial sulphuric acid solutions spread no more than tens of metres from the ore bodies.

Tailings impoundment

When conventional mining and processing methods to recover uranium are used, the ore is crushed and milled. As a result, mine tailings are produced. These wastes are forwarded by hydro-transport to a tailing dump in liquid form. Tailing dumps are equipped with an anti-filtration screen and a two-level drainage system.

Around tailing dumps, monitoring wells have also been constructed, where operations are being performed following the scheme described above.

Waste rock management

Low-level radioactive wastes, generated in small quantities during mining and processing, are disposed of at specially prepared areas, which have been agreed upon with regional state sanitary-epidemiological organisations.

Effluent management

Storm and ice waters within the areas of industrial construction are diverted by means of self-flow for blind areas of buildings and then along a specially designed surface to natural soils.

Site rehabilitation

Rehabilitation is being done at the developed sites according to specially prepared plans, which are co-ordinated with the respective state bodies.

Social and/or cultural issues

All contracts for uranium exploration and mining provided by the Government require financial deductions for development of local social cultural improvements. All subsoil users are obliged to finance the establishment, development, maintenance and support of the regional social sphere, including health care facilities for employees and local citizens, education, sport, recreation and other activities in accordance with the Strategy of JSC NAC Kazatomprom and by an agreement with local authorities. Contributions from each operator amount to:

- USD 30 000-50 000 per year (during period of exploration).
- Up to 15% of annual operational expenses or USD 50 000-120 000 per year (during period of mining).

At the end of 2004, Demeu-Kazatomprom LLP was established. It is responsible for social and cultural issues related to uranium production in Kazakhstan.

Expenses related to environmental protection activity and social cultural issues in 2005-2006

	Expenses in million KZT
Environmental impact assessments	81.5
Monitoring	122.8
Tailings impoundment	37.0
Waste rock management	16.9
Effluent management	7.5
Site rehabilitation	19.3
Regulatory activities	41.4
Social and/or cultural issues	2 765.8

URANIUM REQUIREMENTS

Internal demand for natural and enriched uranium is not expected to appear in Kazakhstan until 2015.

Construction of a NPP (VBER-300 reactor) is under consideration in Kazakhstan. The NPP could be constructed in the Mangistau region, where the fast-breeder reactor BN-350 had been operated since 1973. At present this reactor is decommissioned, and its fuel is utilised.

Supply and procurement strategy

At present the entire volume of uranium produced in Kazakhstan is exported to the world market.

NATIONAL POLICIES RELATING TO URANIUM

The Decree of the Government of the Republic of Kazakhstan, dated 23 January 2004, approved the Programme for Development of the Uranium Industry in the Republic of Kazakhstan from 2004 to 2015.

The programme's objective is priority development of the uranium industry as one of the high-tech industries in the country, export diversification and entry in world high-tech product markets, and to increase the country's export potential to the world markets.

Based on the existing uranium resources, the major strategic task of the programme is to achieve an annual production capacity of 15 000 tU by 2030.

The programme's tasks are also aimed strengthening Kazakhstan's position as the main manufacturer of fuel pellets for nuclear reactors of the CIS countries and to gain access to the world nuclear fuel market; maintaining and expanding world market positions for uranium products along with the services for uranium materials reprocessing; increasing uranium reprocessing capacity and entry in the world market of uranium-containing products of high technological availability produced from Kazakhstan's raw materials; and the implementation of an action plan for environmental safety of nuclear-fuel cycle facilities.

NAC Kazatomprom was assigned as the national operator for export/import of uranium and its compounds, nuclear fuel for nuclear power plants, special equipment and technologies, as well as dual-use materials.

The diversification of power sources requires development of the nuclear power industry in order to provide resources for sustainable development to all territories of the country. A feasibility study for the construction of a nuclear power station in Kazakhstan is currently being developed.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million KZT	2004	2005	2006	2007 (expected)
Industry exploration expenditures	68	123	957	3 241
Government exploration expenditures	0	0	0	0
Industry development expenditures	30	30	80	116
Government development expenditures	0	0	0	0
Total expenditures	98	153	1 037	3 357
Industry exploration drilling (metres)	0	10 720	174 802	603 650
Number of industry exploration holes drilled	0	16	382	1 090
Government exploration drilling (metres)	0	0	0	0
Number of government exploration holes drilled	0	0	0	0
Industry development drilling (metres)	40 235	30 544	48 827	57 341
Number of development exploration holes drilled	119	144	225	348
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	0	10 720	174 802	603 650
Subtotal exploration holes	0	16	382	1 090
Subtotal development drilling (metres)	40 235	30 544	48 827	57 341
Subtotal development holes	119	144	225	348
Total drilling (metres)	40 235	41 264	223 629	660 991
Total number of holes	119	160	607	1 438

Note: number of drilled technological holes and related expenditures are not given.

Reasonably Assured Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	84 102	125 476	82
Open-pit mining	0	30 100	30 100	91
In situ leaching	266 103	280 006	280 006	88.5
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0		0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	266 103	394 208	435 582	

* *In situ* resources.

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	266 103	280 006	280 006
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	84 102	125 476
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other**	0	30 100	30 100
Total	266 103	394 208	435 582

* *In situ* resources.

** Phosphorite and uranium-coal deposit type.

Inferred Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	118 400	157 170	82
Open-pit mining	0	0	0	
In situ leaching	318 420	350 625	350 625	88.5
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	318 420	469 025	507 795	

* *In situ* resources.

Inferred Resources by deposit type*

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	318 420	350 625	350 625
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	118 400	157 170
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	318 420	469 025	507 795

* *In situ* resources.

Prognosticated Resources*
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
280 000	300 000

* *In situ* resources.

Speculative Resources*
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
500 000	NA

* *In situ* resources.

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]	21 618	0	0	0	21 618	0
Underground mining[1]	39 251	116	423	314	40 104	376
In situ leaching	37 540	3 603	3 838	4 871	49 852	6775
Heap leaching	0	0	85	96	181	94
In-place leaching*	0	0	0	0	0	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	98 409	3 719	4 346	5 281	111 755	7 245

(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]	[%]
3 759	71	712	14	0	0	810	15	5 281	100

Uranium industry employment at existing production centres

(person-years)

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	5 120	6 522	6 941	7 845
Employment directly related to uranium production	3 732	4 873	4 460	4 706

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
6 600	6 600	7 000	7 000	17 000	17 000	18 000	18 000	20 000	20 000	21 000	22 000

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
19 000	20 000	20 000	23 000	NA	NA	NA	NA	NA	NA	NA	NA

Installed nuclear generating capacity to 2030

(MWe net)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
0	0	0	0	0	600

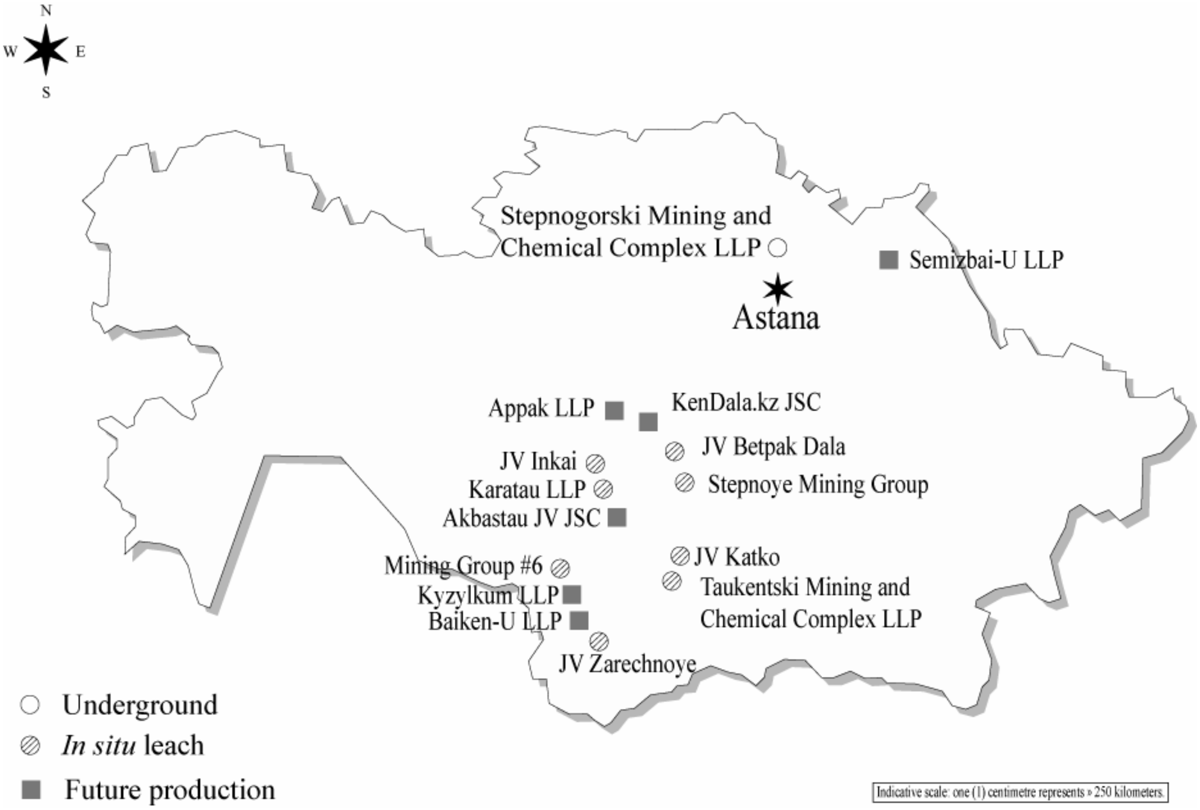
2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

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

(tonnes U)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
0	0	0	0	0	60

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA



• Republic of Korea •

URANIUM EXPLORATION

Recent and ongoing uranium exploration and mine development activities

The Korea Electric Power Corporation (KEPCO), as part of its exploration programme, participated in a number of projects abroad, such as, the Crow Butte project in Nebraska, USA and the Cigar Lake and Dawn Lake projects in Saskatchewan, Canada. KEPCO, however, suspended its participation in these projects and sold its shares in 1999. The Dae Woo Corporation has participated in the Baker Lake project in Canada since 1983.

URANIUM RESOURCES

Korea has no known uranium resources.

URANIUM PRODUCTION

Korea has no domestic uranium production capability.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

None reported.

URANIUM REQUIREMENTS

The nuclear capacity as of December 2006 in Korea was 17 716 MWe at 20 units, representing 27% of Korea's total installed capacity. Nuclear power generation last year reached 149 billion kWh, or 39% of the country's total electricity generation.

Currently, four Korean Standard Nuclear Power Plants (OPR1000) are under construction. Shin-Kori Units 1 and 2 are due to be completed in December 2010 and 2011, respectively. Shin-Wolsong Units 1 and 2 will be connected to the grid on March 2012 (unit 1) and 2013 (unit 2).

Also, Shin-Kori Units 3 and 4 which are the first units constructed by the design of Advanced Power Reactor (APR-1400) are being prepared at Shin-Kori sites and will start commercial operation in 2013 and 2014, respectively.

In addition, Korea has a construction plan for two more APR-1400 units (Shin-Ulchin Units 1 and 2), which are due to be completed in 2015 and 2016.

Along with the increase of nuclear capacity, the requirements of uranium concentrates and fuel cycle services are increasing continuously.

Supply and procurement strategy

In order to secure stable and economical uranium supply, KHNP maintains diversification policy and relies on long-term contracts.

NATIONAL POLICIES RELATING TO URANIUM

KHNP has pursued a policy to secure stable and economical uranium supply and KHNP maintains optimal strategic inventory as part of a government policy.

URANIUM STOCKS

KHNP maintains strategic inventory along with around one-year pipe-line inventory.

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	147	147

Installed nuclear generating capacity to 2030

(MWe gross)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
17 716	17 716	17 716	18 716	24 516	25 916

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
25 916	27 316	25 916	27 316	25 916	27 316

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
3 200	3 200	3 200	3 600	4 400	5 000

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
4 800	5 300	4 800	5 300	4 800	5 300

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	0
Producer	0	0	0	0	0
Utility	NA	NA	0	0	NA
Total	NA	NA	0	0	NA

• Lithuania •

URANIUM EXPLORATION, RESOURCES, AND PRODUCTION

Past exploration programmes have been unsuccessful in discovering uranium in Lithuania. Therefore, Lithuania has neither uranium resources nor production and is not currently undertaking any uranium exploration.

Secondary sources of uranium

Lithuania reported mixed-oxide and re-enriched tails production and use at zero.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

None reported.

URANIUM REQUIREMENTS

Transportation of fuel from Unit 1 to Unit 2 for loading it in the reactor core has started in 2006. Therefore the requirement for fresh fuel has decreased in 2006 and following years.

Supply and procurement strategy

From 1 May 2004 Lithuania became a member of the European Union. The Euratom Supply Agency has the exclusive right in the EU to conclude supply contracts. The long-term nuclear fuel supply contract concluded in 1998 by Ignalina NPP and Russian supplier was submitted to the Agency for approval and remains in force. A complementary agreement to the contract is concluded each year based on planned electricity production.

NATIONAL POLICIES RELATING TO URANIUM

The new government programme for 2004-2008 states that Lithuania should strive to remain a country with the nuclear energy programme. Policies relating uranium are not specifically addressed.

URANIUM STOCKS

There is no stockpile of natural uranium material in Lithuania. A three-month stock of enriched fuel (60 tU equivalent for one unit) is generally maintained by the Ignalina nuclear power plant. No information concerning uranium prices was reported.

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	9.5	8.7

Installed nuclear generating capacity to 2030

(MWe gross)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
1 380	1 380	0	NA	0	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
0	NA	0	NA	0	NA

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
60	93	0	NA	0	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
0	NA	0	NA	0	NA

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	0
Producer	0	0	0	0	0
Utility	0	47	0	0	47
Total	0	47	0	0	47

• Malawi* •

The Kayelekera uranium project

The Kayelekera uranium project is located in the Karonga district of the northern region of Malawi, about 600 km by road from the capital city of Lilongwe. Uranium production, by open-pit mining, with an annual production of 1 270 tU, is expected to start in 2009 and continue for some seven to nine years.

Previous exploration and development work

In the early 1980s, Central Electricity Generating Board of Great Britain (CEGB) discovered mineralisation in the sandstones of Kayelekera. Extensive drilling from 1982 to 1988 defined an initial Inferred Resource of 9 800 tU at an average grade of 0.13% U. From 1989 to 1992, geotechnical, metallurgical, hydrological and environmental works were conducted, and a feasibility study to assess the viability of a conventional open pit mining operation. This work was completed in 1991 at a total cost of USD 9 million. The CEGB study indicated that the project was uneconomic using the mining model adopted and the low uranium prices of that time and the project was abandoned in 1992.

In 1998, Paladin Resources Ltd acquired an interest in the Kayelekera project through a joint venture with Balmain Resources Ltd which then held exploration rights over the project area. Engineering and financial evaluation work indicated a positive outcome for the project. In 2004, additional drilling was completed to improve confidence in resource estimates, and the pre-feasibility study was updated. Resource drilling and bulk sample drilling for metallurgical test-works were completed in 2005, followed by a bankable feasibility study.

The feasibility study and the environmental impact study were finalised in early 2007, and a mining licence was obtained in April 2007. Construction of the project started in 2007, and first production is expected in early 2009.

Paladin Resources Ltd, an Australian listed public company, holds an 85% interest in the Kayelekera project, with the remaining 15% being held by the Republic of Malawi.

Geology

The Kayelekera uranium deposit is a sandstone-hosted uranium deposit, located close to the north tip of the North Rukuru Basin. This basin contains a thick (at least 1 500 m) sequence of Permian Karoo sandstones preserved in a semi-graben about 35 km to the west of and broadly parallel to the Lake Malawi section of the East African Rift system.

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* Report prepared by Secretariat, and based on information from the *Environmental Impact Study* (Knight Piesold, 2007).

The Kayelekera mineralisation lies within the uppermost 150 m of the Muswanga Member, which is the upper part of the Karoo formation. The Muswanga Member consists of a total of eight separate arkose units with intervening silty mudstones in an approximate 1:1 ratio. Such a succession is indicative of cyclic sedimentation within a broad, shallow, intermittently subsiding basin.

The arkose units contain most of the uranium mineralisation. They are on average about 8 m thick, are generally coarse grained and poorly sorted, and contain a high percentage of fresh, pink feldspar clasts. The basal layer of arkose units is usually a quartz-feldspar pebble conglomerate.

Coffinite has been identified as the principal uranium bearing species and it occurs together with minor uraninite. Near surface weathering of primary ore has produced a zone of oxide ore characterised by yellow and green secondary uranium minerals (meta-autunite and boltwoodite). Approximately 40% of the total ore is reduced arkose, 30% oxydised arkose, 10% mixed arkose and 20% of the mudstone type.

Historical studies indicate that economically recoverable resources of uranium and coal only occur within the Kayelekera area. Coal is present in the project tenement area in two deposits: the Nkhachira deposit (850 000 tonnes, recoverable by open-pit and underground mining) and in the Kayelekera deposit itself. Coal in the Kayelekera deposit is contained within the uranium resources and is therefore unavailable for commercial extraction. Moreover, this coal is of very low quality.

Resources

(Tonnes U)

Measured	Indicated	Inferred
2 315* 2 085**	9 230* 6 980**	1 730* 940**

* Assuming a cut-off grade of 250 ppm U.

** Assuming a cut-off grade of 500 ppm U.

The above resources are associated with arkose (83%) and mudstone (17%). Estimated resources, using a 340 ppm U cut off for arkose ore and a 500 ppm U cut off for mudstone ore are:

Type	**Proven** (tU)	**Probable** (tU)	**Total** (tU)
Arkose	1 920	6 480	8 400
Mudstone	235	1 015	1 250
Total	2 155	7 495	9 650

Additional material, in marginal low-grade resources, expected to be processed at the end of the mine life, has also been evaluated:

Type	tU
Arkose	1 650
Mudstone	425
Total	1 975

The project

The Keyelekera uranium deposit is to be mined by open pit. Operations are programmed for an approximate seven-year life, with an annual production of 1 270 tU, but could be extended to nine years with the treatment of marginal ore (bringing the process plant life to a total of eleven years). The final open pit dimensions are expected to be in the order of 300 m wide, by 600 m long and 130 m deep. The stripping ratio (waste to ore) is expected to be on average 2.4:1.

Uranium will be recovered using a solvent extraction process, with sulphuric acid as lixiviant and sulphur dioxide/air mixture as oxidant. Expected uranium mill recovery is 90%. Total uranium production is expected to amount 10 700 tU.

• Namibia •

URANIUM EXPLORATION AND MINE DEVELOPMENT

Historical review

In 1928, Captain G. Peter Louw discovered uranium mineralisation in the vicinity of the Rossing Mountains in the Namib Desert. Over many years he tried to promote the prospect, but it was not until the late 1950s that Anglo-American Corporation of South Africa prospected the area by drilling and by some underground exploration. Due to erratic uranium values and poor economic prospects for uranium, the Anglo-American Corporation abandoned the search.

As a result of an upswing in the uranium market demand and prices, extensive uranium exploration started in Namibia in the late 1960s. Several airborne radiometric surveys were conducted by the geological survey during this period and numerous uranium anomalies were identified. One of these developed into the Rossing deposit, where Rio Tinto had obtained exploration rights in 1966. This deposit was developed into a large scale open-pit mine, which started production in 1976.

The development of Rossing, combined with a sharp trend in uranium prices, stimulated extensive exploration activity, mainly in the Namib Desert. Two major types of deposits were identified including the intrusive type, associated with Alaskite at Rossing, and the surficial, calcrete type.

Of the intrusive deposits other than Rossing, the Trekkopje deposit has significant resources, whereas the most promising deposit of the surficial calcrete-type is the Langer Heinrich deposit. Feasibility studies were carried out on several of these low-grade deposits but low prices led to the cessation of any further work.

The combined effect of political uncertainty and the decline of uranium prices caused the rapid curtailment of exploration and development work in the early 1980s. This was indeed unfortunate as the refinement of exploration techniques, which had proved to be so successful in the Namib Desert, were poised to potentially locate a number of new deposits.

Since that time, the continued weakness of the uranium market discouraged further exploration activities, except in the immediate vicinity of the Rossing mine. However, the recent upturn in demand for uranium has stimulated exploration and made possible the development of the Langer Heinrich deposit.

Langer Heinrich

The Langer Heinrich Uranium Project is located in the west of central Namibia, Southern Africa. It lies 80 km east of the major deepwater seaport at Walvis Bay and the coastal town of Swakopmund.

General Mining and Finance Corporation Limited (Gencor), now a part of BHP-Billiton, carried out extensive evaluation work of the Langer Heinrich project over an eight-year period following the discovery of calcrete hosted uranium mineralisation in the early 1970s. Gencor spent approximately USD 8.5 million and completed a full project evaluation study based upon conventional open-pit mining and alkaline extraction of uranium in 1980. Gencor's evaluation included detailed resource definition work and thorough mining, metallurgical and processing studies. Approximately 25 000 m of percussion drilling, 2 000 m of diamond drilling and excavation of 32 rectangular 2 m x 1 m exploratory shafts (up to 22 m depth) were carried out to establish the necessary confidence in the deposit's ore reserve status. The Gencor studies included excavation of about 300 000 tonnes of mineralised rock, the construction of a 300 000 tpa dry screening plant and completion of intensive high quality metallurgical work utilizing a purpose built pilot plant from 1977 to the end of 1979.

While the study indicated that the Project had good potential for development, it was subsequently placed on care and maintenance due to depressed uranium prices. In 1998, the Project was sold to the Australian listed public company Acclaim Uranium NL (Acclaim).

Acclaim completed a Pre-Feasibility Study at a cost of USD 1.26 million that included 2 800 m of reverse circulation drilling (107 holes), geochemistry, geostatistics, ore resource re-evaluation, metallurgical, engineering and baseline environmental studies. Although the results of the study were favourable, depressed uranium markets and prices again curtailed further development.

Geology

Langer Heinrich is a calcrete related uranium deposit associated with valley-fill sediments occurring within an extensive Tertiary palaeodrainage system. The calcretes are chemical precipitates that developed under arid to semi-arid climate conditions. At Langer Heinrich, calcretisation has affected a complex sequence of conglomerates, grits, sandstone, silts and clay in a braided stream depositional environment.

The uranium mineralisation takes the form of carnotite that is a secondary oxidized mineral containing both uranium and vanadium. The deposit occurs over a 15 km length with seven higher grade pods occurring within a lower grade mineralised envelope. The carnotite occurs as thin films lining cavities and fracture planes and as grain coatings and disseminations in the calcretised sediments. Mineralisation is 1 m to 30 m thick and is 50 m to 1 100 m wide, depending on the width of the palaeo-valley.

After the uranium mineralisation event, the calcreted sediments were eroded as a result of uplift that rejuvenated river flows. These drainages have dissected and modified both the calcrete and associated mineralisation. The deposit is blanketed by up to 8 m of river sands and scree associated with the prevailing ephemeral drainage system.

Recent and ongoing uranium exploration and mine development activities

Recently, an extraordinary growth in uranium exploration has occurred in the west-central Namibia area of Erongo, focusing mainly on previously-known deposits with considerable historic data.

Rossing

In order to extend Rossing's mine life beyond 2020, exploration was resumed on uranium occurrences within the mining license area that had been known since the late 1970s, but which were not economic in the past years due to unfavourable market conditions. The present plan calls for drilling a total of 70 000 m during the 2006-2008 period.

An exercise to determine the level of information available on the various anomalies was carried out during 2005 and culminated in a target list, which was then scheduled for follow up work by the Geology section. The main targets were identified as the SH and SK areas as P1, while the Z19, Z8 and Z10 were identified as potential P2 targets.

The follow up by Geology included the setting up of a drilling project to drill the SH and SK anomalies to JORC inferred resource level in order that a decision be made on future work in these areas. This would involve 14 000 m of drilling. The programme was re-evaluated and the total amount of drilling required for the work revised upwards to 74 000 m with an expected outcome of a JORC indicated resource.

As of October 2007, 18 000 m (comprising 13 000 m of diamond drilling and 5 000 m of reverse circulation) have been drilled. This has resulted in a preliminary evaluation of the SH as 100 Mt deposit with a grade of 140 ppm using a cut-off grade of 0 ppm. A preliminary pit with an extraction ratio of 1:0 has also been designed. Current work is on ensuring that the identified plant process is optimised and capital cost evaluated on the basis of a desktop design.

The SK area is not yet at evaluation stage, as information is currently being gathered. However, a feasibility study is in progress on the SK4 section of the SK area to evaluate the potential for developing an SK "starter" pit targeting the SK4, 5, 10 and 19 anomalies, which have drilling information gathered in a 1977-1978 drilling programme.

Langer Heinrich

In 2005, a reverse circulation drilling programme was carried out in order to increase confidence in resource modelling and to delineate extensions to known uranium mineralisation in the palaeo-channel. The drilling programme included 11 534 m and was confined to selected target areas. All drill holes were geologically and radiometrically logged.

In 2006, reverse circulation drilling was carried out in order to establish indicated and measured mineral resources and to increase inferred mineral resources in the eastern portion of the Langer Heinrich ore body. A total of 6 355 m were drilled and all were geologically and radiometrically logged.

Since the potential for increasing the resource base even further within ML140 is regarded as high, a further resource definition campaign, comprising some 11 000 m of reverse circulation drilling, was started in 2007 with the aim of delimiting all the mineralisation within the Langer Heinrich mining lease. At the same time a Reverse Circulation resource infill drilling programme of approximately 10 000 m will be conducted to upgrade Inferred Resources with the intention of more than replacing those resources depleted by mining during the next two years.

The Ministry of Mines and Energy granted an Exclusive Exploration Licence (EPL) to Langer Heinrich Uranium (Pty) Ltd in October 2006. The EPL covers 30 km^2 to the west of and adjoining the Langer Heinrich Mining Licence (ML140). The EPL was applied for to secure the interpreted westward extension of the Langer Heinrich palaeo-channel and offers approximately 5 km of exploration target containing potential for increasing the mineral resource base of the Langer Heinrich ore body. Exploration in 2007/2008, include 3 000 m of reverse circulation drilling, will concentrate on delineation of the additional 5 km palaeo-channel extension on the new tenement and identifying uranium mineralisation trends within this channel.

Trekkopje (calcrete deposit) and Valencia (alaskite hosted deposit) are in feasibility and pre-feasibility stages, respectively.

Other exploration projects include Husab (alaskite), Goanikontes (alaskite) and Marenica (alaskite), where drilling is underway. Less advanced exploration projects include Gawib West (calcrete), Oryx/Tubas/Tumas (calcrete), Aus/Cape (alaskite), Cross/Engo (calcrete) and Valley/Warmbad (siltstone/sandstone).

URANIUM RESOURCES

The uranium resources of Namibia, including both identified and undiscovered, occur in a number of geological environments and consequently are hosted in several deposit types. The Identified Resources are mainly associated with intrusive and surficial deposits.

In addition to the Identified Resources in the Rossing and Valencia alaskite type deposits located in the Precambrian Damara Orogenic Belt, and those associated with surficial calcretes (Langer Heinrich and Trekkopje), there is large undiscovered uranium potential.

Although not quantitatively assessed, the uranium potential is considered greatest in the following geological environments:

- The 5 000 km^2 granitic terrain of the Damara Belt. This area is largely overlain by surficial deposits and/or wind-blown semi-consolidated sand. Past investigations were principally focused on airborne radiometric anomalies. Substantial additional resources, potentially the size of the Rossing deposit, are suspected to occur under the post-mineral cover.
- Tertiary to recent surficial sedimentary terrains in semi-arid areas, where further potential for calcrete deposits is thought to exist. Eleven of 38 identified regional airborne anomalies were investigated by extensive drilling, adding Identified Resources to Namibia's resource inventory. In most cases the drilling encountered low-grade mineralisation associated with calcrete-filled paleo-river channels.
- Another potentially favorable geological environment is the sandstone basins that include the Permo-Triassic Karoo sediments, which were extensively investigated in South Africa in the early 1970s. These basins have been explored in Namibia as well. The Karoo sediments are extensively dissected by river systems in the north-western part of Namibia and airborne radiometric expressions are consequently very pronounced. Ground follow-up, including substantial drilling, delineated nearly 6 million tonnes of low-grade uranium mineralisation. However, this was not included to the Identified Resources due to high recovery costs.

Langer Heinrich

Following completion of the 2005 and 2006 drilling programmes, JORC-compliant ore resource estimates were updated and revised. The mineral resource estimates presented in the table below are based on derivation of U_3O_8 grades using down-hole gamma logging results and applying standard practice radiometric determination methods for U_3O_8 determination (eU_3O_8).

Category	**Tonnes** [Mt]	**Grade U** [%]	**Tonnes U**
Measured	22.7	0.05	12 393
Indicated	14.4	0.04	6 728
Inferred	43.4	0.05	21 461
Total	80.5	0.05	40 582

Trekkopje *(calcrete deposit)*

Using a 0.0085% U cut off grade, measured and indicated resources amount to 42 328 tU at 0.013% U. An Inferred Resource of 3 100 tU at 0.011% U was also estimated.

Valencia *(alaskite hosted deposit)*

Using a 0.0085% U cut off grade, measured and indicated resources amount to 13 483 tU at 0.012% U. An Inferred Resource of 5 765 tU at 0.010% U was also estimated.

URANIUM PRODUCTION

Historical review

In August 1966, Rio Tinto Zinc (RTZ) acquired the exploration rights for the Rossing deposit and conducted an extensive exploration programme that lasted until March 1973. After a feasibility study that included surveying, mapping, drilling, bulk sampling and metallurgical testing in a 100 t/day pilot plant, a production centre was established.

Rossing Uranium Limited was formed in 1970 to develop the deposit. TTZ was the leading shareholder with 51.3% of the equity (at the time of the formation of the company).

Mine development commenced in 1974 and commissioning of the processing plant and initial production took place in July 1976. In 1977, a full design capacity of 5 000 short tons of U_3O_8/year (3 845 tU/year) was established, but due to the highly abrasive nature of the ore, an aspect not identified during the pilot plant testing stage, the production target was not reached until 1979 following major plant design changes.

Rossing

Based on a sharp increase of the uranium market price and a detailed feasibility study, the mine life was recently extended to 2016. In order to prepare the extension of the open pit to access the ore, waste has been removed from the southeast and northwest sides of the open pit (7.5 Mt and 16.8 Mt during 2005 and 2006, respectively).

The objective is to increase the annual production of uranium to 3 400 tU in 2007, then to 3 800 tU in 2008 and beyond.

Langer Heinrich

In August 2002, Paladin acquired 100% of Langer Heinrich Uranium (Pty) Ltd, the Namibian registered company holding the Project rights. Subsequently, a pre-feasibility study was completed, followed by a bankable feasibility study. The year-long study was completed in April 2005 by GRD Minproc (Pty) Ltd.

The feasibilty study confirmed that a large body of uranium mineralisation exists at Langer Heinrich that could be mined by open pit. The study showed Indicated and Measured Resources supported a minimum mine life of 11 years and a process plant life of 15 years.

Based on the mill throughput design of 1.5 Mtpa of ore, the feasibility study showed 1 000 tU/year could be produced for the first 11 years at a head feed grade of 0.074% U and 340 tU over the last four years, using the accumulated low-grade (0.027% U) stockpile.

Full scale development of the mining operation proceeded after receipt of a 25 year Mining License granted by the Ministry of Mine and Energy on 15 September 2005.

A revision of the resource model in November 2005 combined with an increase in the base uranium price used for mining studies to USD 30/lb U_3O_8 allowed the estimation of new resources. These new resource figures are summarised below:

210 ppm cut-off	**Tonnes** [Mt]	**Grade U** [%]	**Tonnes U**
Proven reserves	16.7	0.06	9 830
Probable reserves	8.6	0.06	4 620
Total	25.4	0.06	14 450

Production at Langer Heinrich started in late 2006.

Future production centres

The Trekkopje mine, located 20 km north of Rossing, is expected to start production by the end of 2008. Although the ore is low-grade (averaging 0.013% U), most of it is located at shallow depth, and the deposit should therefore be relatively inexpensive to mine. Production is targeted at 1 600 tU/year initially, scaling up to 3 200 tU/year in 2011. Small quantities of vanadium by-product will also be produced. Heap leaching processing is expected to be used over the eight year operating life of the facility.

Valencia, located 35 km east of Rossing, is another project with near-term production potential, although no mine development schedule has as yet been announced. Nonetheless, commissioning could take place in early 2009 with initial production amounting to as much as 1 000 tU/year.

Employment in existing production centres

Rossing employment in 2006 was 939 employees (plus 660 contractors) and is expected to increase to 1 089 employees in 2007.

Uranium production centre technical details

(as of 1 January 2007)

	Centre #1	Centre #2
Name of production centre	Rossing	Langer Heinrich
Production centre classification	Operating	operating
Start-up date	1976	2006
Source of ore:		
• Deposit name	Rossing ore body	Langer Heinrich
• Deposit type	Intrusive	calcrete
• Resources (tU)	NA	14 450
• Grade (% U)	0.03	0.06
Mining operation:		
• Type (OP/UG/ISL)	OP	OP
• Size (t ore/day)	40 000	4 500
• Average mining recovery (%)	85	90
Processing plant (acid/alkaline):	Acid	alkaline
• Type (IX/SX/AL)	AL/IX/SX	IX/SX
• Size (t ore/day); for ISL (L/day or L/h)	30 000	4 000
• Average process recovery (%)	86	90
Nominal production capacity (tU/year)	3 817	1 000
Plans for expansion	Yes	
Other remarks		

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Rossing

No environmental impact assessments were carried out during 2005 and 2006. An assessment of the proposed extension of Rössing's mine life to 2016 was completed in 2004.

Monitoring at the Rössing mine includes: radiation protection; sealed sources and control thereof; medical surveillance; air quality, including greenhouse gas emissions; water utilisation and seepage management; waste (for hazardous and non-hazardous, mineral and non-mineral wastes), dust; biodiversity; and occupational hazards related to all operations.

A stability assessment of the tailings impoundment carried out in 2006 confirmed the stability of the facility. There were no changes to the waste rock footprint in terms of land area during the review period. However, the heights of the waste dumps were increased. The life of mine plan includes changes that will occur to the waste dump footprint in the years 2008 through 2016 and is being thoroughly evaluated as part of the environment management plan that is maintained with the department of environment.

Effluent management principally consists of water recycling. Fresh water is added to the processing plant where it is used to produce uranium. The waste water together with a much larger volume of recycled water is then used to pump the tailings to the tailings dam. Some water is lost from the tailings dam due to evaporation and storage within the tailings material. However, over 60% of the waste water pumped to the dam is recovered and returned to the processing plant. The volume of fresh water added is determined by the water losses due to evaporation and adsorption. Any additional fresh water is stored in the tailings dam for later use. No waste water is discharged into the environment. Annually, between 60% and 70% of fresh water used is recycled.

No site rehabilitation activities were carried out at Rössing during 2005 and 2006. However, the mine closure plan was updated during 2005 consistent with the new mine plan extending mine life to 2016.

Established in 1976, the mining town of Arandis was handed over to the Government of Namibia some two years after Independence, and became a town with an elected Town Council to manage its affairs. In 2000, with the closure of the mine envisaged a few years ahead, and with the town and its inhabitants still greatly dependent on the mine's economic benefits, Rössing Uranium decided to open a Rössing Foundation office in Arandis and it came into operation in Arandis and the Erongo Region in 2002. In November 2003, it started to broaden its development functions, while the actual programme implementation started in earnest from January 2004. Along with the community's input, the Foundation initially identified six work areas in the Arandis programme, focusing on improving schools, tourism opportunities, business development, local government and infrastructure, and the promotion of recreational cultural and agricultural activities. The Rössing Foundation's activities were reviewed during April 2006. Following this review, a new reporting structure and areas of focus were introduced and became operational in December 2006. Education became the primary focus area, while work with the Arandis Town council was regarded as crucial to the sustainability of Arandis. Following this, a decision was taken that Rössing would assist the Arandis Town Council in selected infrastructure development projects while the Rössing Foundation would focus on capacity-building. Health and safety became additional operational areas, focusing specifically on HIV/AIDS.

URANIUM REQUIREMENTS

Namibia has no reactor-related requirements since it has no reactors and no plans to develop nuclear generating capacity.

NATIONAL POLICIES RELATING TO URANIUM

Uranium is regulated in terms of the Minerals (Mining and Prospecting) Act 1991. Uranium is defined as a controlled mineral and section 102 deals with the exports, processing, possession and enrichment of uranium. There is no particular policy that deals with the mining and milling of uranium. Namibia is in the process collaborating with countries that have national policies related to uranium in order to develop such policy. A project concept in this respect was submitted to the IAEA technical co-operation programme.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in NAD	**2004**	**2005**	**2006**	**2007** (expected)
Industry exploration expenditures	11 500 000	NA	NA	NA
Government exploration expenditures	0	NA	NA	NA
Industry development expenditures	NA	NA	NA	NA
Government development expenditures	0	NA	NA	NA
Total expenditures	11 500 000	NA	NA	NA
Industry exploration drilling (metres)	6 720	NA	NA	NA
Number of industry exploration holes drilled	166	NA	NA	NA
Government exploration drilling (metres)	0	NA	NA	NA
Number of government exploration holes drilled	0	NA	NA	NA
Industry development drilling (metres)	NA	NA	NA	NA
Number of development exploration holes drilled	NA	NA	NA	NA
Government development drilling (metres)	0	NA	NA	NA
Number of development exploration holes drilled	0	NA	NA	NA
Subtotal exploration drilling (metres)	6 720	NA	NA	NA
Subtotal exploration holes	166	NA	NA	NA
Subtotal development drilling (metres)	0	NA	NA	NA
Subtotal development holes	0	NA	NA	NA
Total drilling (metres)	6 720	NA	NA	NA
Total number of holes	166	NA	NA	NA

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	67 260	156 400	187 630	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	67 260	156 400	187 630	

* *In situ* resources as of 1 January 2005.

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	10 000	17 100	17 100
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	57 260	139 300	170 530
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	67 260	156 300	187 630

* *In situ* resources as of 1 January 2005.

Inferred Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	75 545	106 515	123 215	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	75 545	106 515	123 215	

* *In situ* resources as of 1 January 2005.

Inferred Resources by deposit type*

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	5 000	15 700	15 700
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	70 545	90 815	107 515
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	75 545	106 515	123 215

* *In situ* resources as of 1 January 2005.

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]	78 736	3 038	3 146	3 067	87 987	3 800
Underground mining[1]	0	0	0	0	0	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	0	0	0	0	0	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	78 736	3 038	3 146	3 067	87 987	3 800

(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]	[%]
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Uranium industry employment at existing production centres

(person-years)

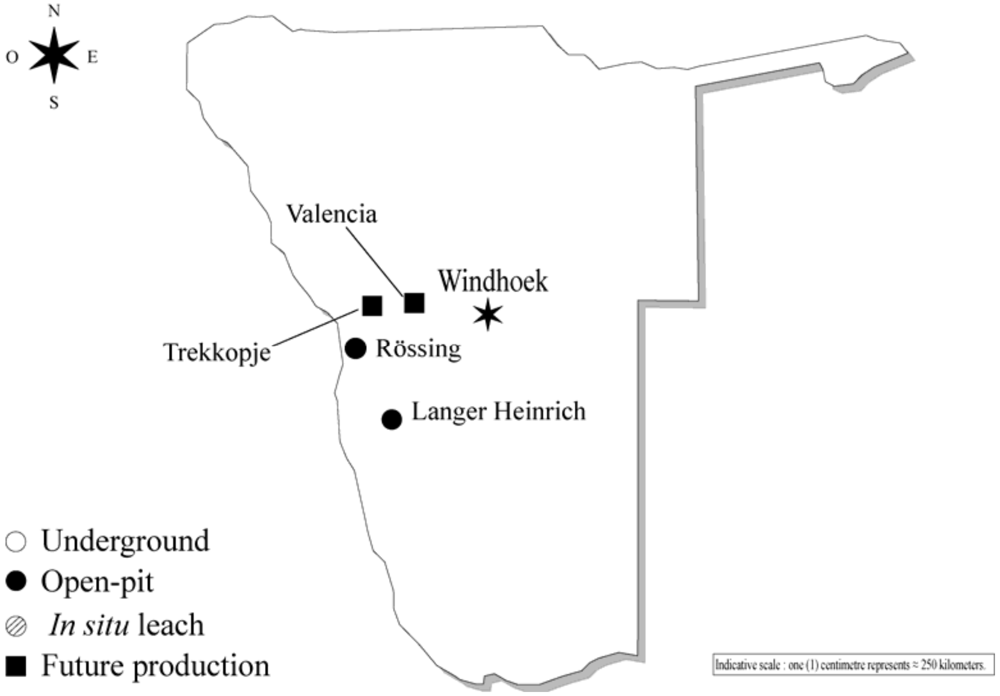
	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	833	860	NA	NA
Employment directly related to uranium production	365	404	NA	NA

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
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA



• Niger •

URANIUM EXPLORATION

Historical review

Uranium exploration in the Arlit area began in 1956 and was conducted by the *Commissariat à l'énergie atomique* (CEA), later followed by COGEMA. Discovery of mineralised areas eventually led to the mining of the Arlette, Artois and Ariege deposits by the *Société des Mines de l'Air* (Somaïr), and the Akouta and Akola deposits by the *Société des Mines d'Akouta* (Cominak). Exploration along the northwest extension of the Arlette flexure fault resulted in the discovery of the Taza deposit. The *Société Minière de Tassa N'Taghalgue* (STT) was organised to own the deposit but assigned part of its mining rights to Somaïr in 1986.

In subsequent years, both Somaïr and Cominak were involved in exploration solely for the purpose of better evaluating known deposits. Somaïr delineated the Taza Nord deposit, while Cominak evaluated a mineralised area located southeast of the Akola deposit.

Since 1993, both Somaïr and Cominak have carried out significant drilling programmes. Part of the drilling results led to reassessment of the resource estimates of the Takriza and Tamou deposits by Somaïr and further evaluation of the South Akouta and Akola deposits by Cominak. The remainder of SMTT's rights were assigned to Somaïr in 1996 and SMTT was subsequently dissolved.

Recent and ongoing uranium exploration and mine development activities

The year 2006 has seen a revitalisation of uranium exploration in Niger, with a total of six new exploration permits granted in the year. Among these, the most advanced are the Imouraren exploration permit granted to AREVA NC Niger, and the Teguidda permit to the China National Uranium Corporation (CNUC), where the Imouraren and Azelik deposits, respectively, have already been delineated.

Somaïr

Drilling campaigns were conducted in 2005 and 2006 in order to define the north and south extensions of the Tabele deposit. Mine development of the Tamgak deposit started in 2006 and will continue in 2007.

Cominak

Further delineation of the southern part of the Ebba deposit continues. This deposit is located south of the previously mined Akouta and Akola deposits, in an area covered by a mining permit granted by the Government of Niger in 2006.

AREVA NC Niger

Intensive drilling campaigns were conducted in 2006 on the Imouraren deposits, and will continue in 2007.

China National Uranium Corporation

Exploration of the Azelik deposits started in 2006, and will continue in 2007, in order to confirm the existing resources.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Somaïr

Following development drilling on the Tabele deposit, RAR were increased from 488 tU to 1 986 tU.

A feasibility study completed in 2006 confirmed the economic value of ore stockpiles that could be processed by heap leaching. The treatment of the stockpiles was stopped in the past due to the low price of uranium. Processing is now possible owing to a new heap leaching method and improved uranium prices.

Cominak

RAR amount to 28 716 tU at a cost under USD 80/kgU.

AREVA NC Niger

Proven and probable resources amount to 180 000 tU.

China National Uranium Corporation

Proven and probable resources amount to 12 763 tU.

Undiscovered Resources (Prognosticated & SR)

Prognosticated Resources as reported in the 2005 edition of the Red Book amounted to 24 608 tU at a cost of <USD 130/kgU.

URANIUM PRODUCTION

Historical review

In Niger, uranium is produced by two companies, Somaïr and Cominak, which have been operating mines in sandstone deposits since 1970 and 1978 respectively. A third company, the *Société Minière de Tassa N'Taghalgue* (SMTT) assigned its mining rights to Somaïr in 1996 and was subsequently dissolved.

Status of production capability

The second treatment line, currently in the process of being re-vamped, will when completed increase Somaïr's production capability to 2 200 tU per year.

The total production capability of the two production centres in Niger is in the process of being increased from 3 800 tU in 2006 to 4 500 tU in 2009.

Ownership structure of the uranium industry

The ownership structure of Niger's two production companies is defined below:

Somaïr	Cominak
36.6% SOPAMIN (Niger) 37.5% AREVA NC (France) 25.9% CFMM (France)	31% SOPAMIN (Niger 34% AREVA NC (France) 25% OURD (Japan) 10% Enusa (Spain

Employment in the uranium industry

Employment in the uranium industry, at the end of 2006, was 1 741. An important programme of hiring new employees is currently under way in order to address the problems of retiring staff combined with the increasing of activity at the existing production centres.

Future production centres

Somaïr

- Efforts are underway to increase production capability of the plant from 550 000 t ore to 660 000 t ore in 2009.
- Construction of a heap leaching unit, able to process 1 400 000 t ore per year is currently underway and commissioning is expected in 2009.

SOMINA (Société des Mines d'Azelik)

A new company (*Société des Mines d'Azelik*) was created on 3 June 2007, in order to mine the Azelik uranium deposits. First production is planned in 2011, with a production capability of 700 tU/year. The ownership structure of the company is:

	%
SOPAMIN (Government of Niger)	33.0
SINO-U (China)	37.2
ZX Joy Invest (China)	24.8
Trenfield Holdings SA (Niger private)	5.0

AREVA NC

AREVA NC is presently conducting intensive development work on the Imouraren uranium deposits, which is to be followed by a feasibility study. A production capability of 5 000 tU/year is expected, with production starting in 2011.

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

	Centre #1	Centre #2	Centre #3
Name of production centre	Arlit (Somaïr)	Arlit (Somaïr)	Akouta (Cominak)
Production centre classification	Operating	planned	operating
Start-up date	1970	2009	1978
Source of ore:			
• Deposit name	Tamou/Artois Tamgak	Low grade stockpiles	Akouta/Akola Ebba
• Deposit type	Sandstone	sandstone	sandstone
• Resources (tU)	29 200	5 000	36 935
• Grade (% U)	0.28	0.07	0.40
Mining operation:			
• Type (OP/UG/ISL)	OP		UG
• Size (t ore/day)	1 900	3 800	1 800
• Average mining recovery (%)	100	100	100
Processing plant (acid/alkaline):			
• Type (IX/SX/AL)	AL/SX	AL/SX	AL/SX
• Size (t ore/day); for ISL (L/day or L/h)	1 900	3 800	1 900
• Average process recovery (%)	95	65	95
Nominal production capacity (tU/year)	1 500	700	2 300
Plans for expansion	Yes		
Other remarks			

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Three environmental impact assessment studies were completed in 2005-2006 in order to obtain administrative authorisation to mine the Ebba (Cominak), Artois and Tamgak (Somaïr) uranium deposits.

Expenditures related to environmental activities and socio-cultural issues are provided in the table below:

Expenses in million CFA Francs	**2005**	**2006**	**2007** (expected)
Environmental Impact Assessment	16	0	0
Site rehabilitation	104	199	110
Socio-cultural	209	288	426
Other	112	56	58
Total	441	543	594

URANIUM REQUIREMENTS

Niger has no existing facilities and no plans to develop nuclear generating capacity and consequently has no reactor-related uranium requirements.

NATIONAL POLICIES RELATING TO URANIUM

One of the main objectives of Niger's national uranium policy is to achieve a higher degree of international competitiveness in its uranium industry.

URANIUM STOCKS

None reported.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million CFA Francs	2004	2005	2006	2007 (expected)
Industry exploration expenditures	NA	NA	NA	NA
Government exploration expenditures	NA	NA	NA	NA
Industry development expenditures	NA	NA	NA	NA
Government development expenditures	NA	NA	NA	NA
Total expenditures	NA	NA	NA	NA
Industry exploration drilling (metres)	NA	NA	NA	NA
Number of industry exploration holes drilled	NA	NA	NA	NA
Government exploration drilling (metres)	NA	NA	NA	NA
Number of government exploration holes drilled	NA	NA	NA	NA
Industry development drilling (metres)	NA	NA	NA	NA
Number of development exploration holes drilled	NA	NA	NA	NA
Government development drilling (metres)	NA	NA	NA	NA
Number of development exploration holes drilled	NA	NA	NA	NA
Subtotal exploration drilling (metres)	NA	NA	NA	NA
Subtotal exploration holes	NA	NA	NA	NA
Subtotal development drilling (metres)	NA	NA	NA	NA
Subtotal development holes	NA	NA	NA	NA
Total drilling (metres)	79 340	59 890	134 567	160 000
Total number of holes	612	403	1 038	1 200

Reasonably Assured Resources

(tonnes U)

Production method	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**	**Recovery factor** (%)
Underground mining	0	22 973	38 250	90
Open-pit mining	16 300	16 300	199 800	95
In situ leaching	5 000	5 000	5 000	
Heap leaching	0	0	0	65
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	21 300	44 273	243 050	

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	21 300	44 273	243 050
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	21 300	44 273	243 050

Inferred Resources

(tonnes U)

Production method	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**	**Recovery factor** (%)
Underground mining	0	17 994	17 994	
Open-pit mining	12 900	12 900	12 900	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	12 900	30 894	30 894	

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	12 900	30 894	30 894
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	12 900	30 894	30 894

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
14 500	24 600

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]	34 580	1 260	1 345	1 602	38 787	1 710
Underground mining[1]	53 772	1 925	1 977	1 841	59 515	1 923
In situ leaching	0	0	0	0	0	0
Heap leaching	5 785	0	0	0	5 785	0
In-place leaching*	0	0	0	0	0	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	94 137	3 185	3 322	3 443	104 087	3 633

(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]	[%]
1 157	33.6	0	0	1 440	41.8	846	24.6	3 443	100

Uranium industry employment at existing production centres

(person-years)

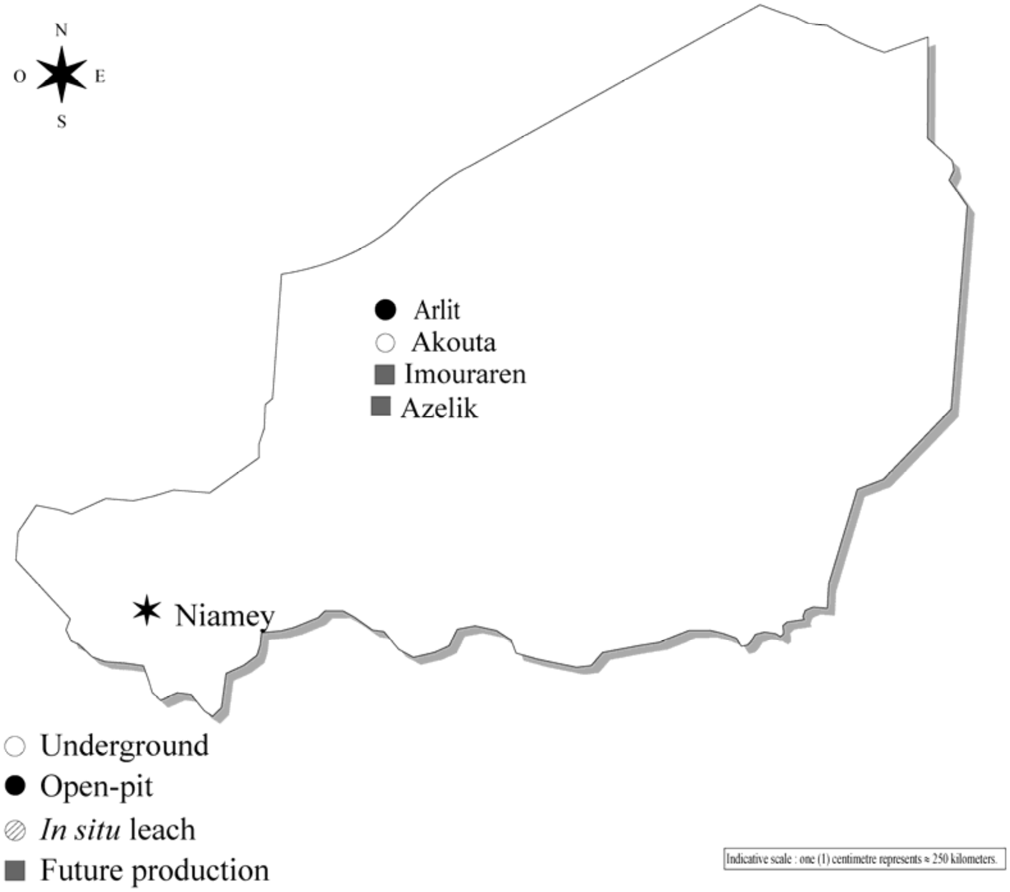
	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	1 598	1 657	1 741	1 930
Employment directly related to uranium production	1 388	1 591	1 678	1 863

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
4 000	4 000	4 000	4 000	4 500	4 500	4 500	4 500	4 500	4 500	4 500	4 500

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
4 500	4 500	4 500	4 500	NA	NA	NA	NA	NA	NA	NA	NA



• Peru •

URANIUM EXPLORATION

Historical review

The Macusani uraniferous district (Puno Department) is located in southeastern Peru. The uraniferous mineralisation is found in acid volcanic rock from the Mio-Pliocene era, which fills the Macusani tectonic depression that overlies Palaeozoic era rocks.

Radiometric prospecting revealed over 40 uraniferous areas, the most important being Chapi, Chilcuno-VI, Pinocho, Cerro Concharrumio and Cerro Calvario.

The uranium mineralisation consists of pitchblende, gummite, autunite and meta-autunite, that fill sub-vertical to sub-horizontal fractures with impregnation on both sides of the fracture. The host rock is the lapilli tuffs of the volcanic Quenamari Formation.

Of all the areas discovered, Chapi is the most important, and detailed radiometry, emanometry, trench and gallery work, as well as diamond drilling, has been performed there. The mineralisation is in sub-vertical fractures distributed in structural lineaments about 15-150 m wide and 20-30 m thick. The grades vary between 0.03% U and 0.75% U, with an average of 0.1% U. Based on the exploration results to date and both the geological and emanometry information, a minimum potential of 10 000 tU has been assigned to the Chapi site and 30 000 tU to the whole Macusani uraniferous district.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

The identified uranium resources of Peru are primarily located in the Macusani area, Department of Puno. See the relevant table for details.

Undiscovered Resources (Prognosticated & SR)

Undiscovered Conventional Resources are estimated to total 26 350 tU. Of this total, 6 610 tU are classified as Prognosticated Resources and 19 740 tU are classified as Speculative Resources in the Chapi deposit area, based on the distribution of the volcanic host rock in the Macusani uraniferous district (1 000 km^2).

Undiscovered Non-conventional Resources

The uranium contained in phosphate rocks (with an average content of 90 ppm U) and in polymetallic deposits (Cu-Pb-Zn-Ag-W-Ni) is estimated to amount to 25 600 tU:

Bayovar phosphates	20 000 tU
Other locations (39)	5 600 tU
Total	25 600 tU

Peru has never produced uranium and reported no plans to do so. Additionally, Peru has no uranium requirements nor reported any plans to develop a nuclear generation capacity.

NATIONAL POLICIES RELATING TO URANIUM

Mining activities that are the responsibility of the State, under the Law for the Promotion of Investment in the Mining Sector, have been subject to a privatisation process as part of a programme for the stability and security of long-term investments, including uranium. In the past few years, interest in uranium exploration has revived enabling various foreign private companies to resume exploration in the zone in which the Peruvian Nuclear Energy Institute (IPEN) carried out its prospecting and exploration work; the IPEN thus has the technical information.

Peru reported no information on uranium stocks or prices.

Reasonably Assured Resources*
(tonnes U)

Production method	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**	**Recovery factor** (%)
Underground mining	0	0	0	
Open-pit mining	0	1 790	1 790	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	1 790	1 790	

* *In situ* resources.

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	1 790	1 790
Metasomatite	0	0	0
Other	0	0	0
Total	0	1 790	1 790

Inferred Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	1 860	1 860	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	1 860	1 860	

* *In situ* resources.

Inferred Resources by deposit type (tonnes U)

Deposit Type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	1 860	1 860
Metasomatite	0	0	0
Other	0	0	0
Total	0	1 860	1 860

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
6 610	6 610

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
19 740	NA

• Poland •

URANIUM EXPLORATION

Historical review

Prospecting for uranium accumulations in Poland began in 1948. Then the Industrial Plant in Kowary (Lower-Silesian Voivodeship) was established, which was involved in exploitation and processing of uranium deposits.

Research from 1956 by the Polish Geological Institute concerned Carboniferous formations of the Upper Silesian Coal Basin, phosphorite formations and research in boreholes in the Polish Lowlands. As a result of this research, signs of uranium mineralisation were discovered in lower Ordovician formations of the Podlasie Depression (Rajsk deposit) and in Triassic formations of the Perybaltic Syneclize and the Sudetes (Okrzeszyn, Grzmiąca, Wambierzyce). Approximately 20 tU were extracted from the Kopaliny-Kletno deposit.

In the Ladek and Snieznik Klodzki metamorphics small occurrences of uranium mineralisation and the Kopaliny-Kletno deposit were discovered.

Recent and ongoing uranium exploration and mine development activities

There are no current (up-to-date) uranium deposits in Poland and no concessions for uranium granted. There are some perspective indications of uranium resources, and currently no prospects for the discovery of uranium that could be economically exploited.

Uranium exploration and development expenditures – non-domestic

Expenses in PLN	2004	2005	2006	2007 (expected)
Industry exploration expenditures	NA	NA	NA	NA
Government exploration expenditures	0	0	0	0
Industry development expenditures	NA	NA	NA	NA
Government development expenditures	0	0	0	0
Total expenditures	NA	NA	NA	NA

URANIUM RESOURCES

In situ uranium resources amounting to 7 270 tU have been identified in the following regions of Poland. Since recovery costs have not been developed, these figures are not included in the global resource base.

Region	***In situ*** (tU)	**Uranium content** (% U)
Rajsk deposit (Podlasie Depression)	5 320	0.025
Perybaltic Syneclise	–	
Okrzeszyn (Sudetes)	940	0.05-0.11
Grzmiaca (Sudetes)	790	0.05
Wambierzyce (Sudetes)	220	0.0236

Prognosticated Resources are estimated to amount to over 100 000 tU in the following regions. No costs of recovery have been developed for these resources.

Region	**Prognosticated** (tU)*
Rajsk deposit (Podlasie Depression)	88 850
Perybaltic Syneclise	10 000
Wambierzyce (Sudetes)	2 000

* Only assigned for a depth of up to 1 000 m.

Unconventional Resources and other materials

None reported.

URANIUM PRODUCTION

Historical review

In 1948, a government operated industrial plant was established in Kowary (Lower-Silesian Voivodeship) to process ore mined from local uranium deposits.

Exploitation of vein deposits in the Karkonosko-izerski Block and metamorphic deposits in the Ladek and Snieznik Klodzki continued until 1967. Data concerning production from these uranium deposits is presented below.

Deposit name	**Resources** (tU)	**Exploited** (tU)
Wolnosc	94	94
Miedzianka	14.7	14.7
Podgorze	280	199
Rubezal	0.5	0.5
Mniszkow	4.5	4.5
Wiktoria	0.28	0.28
Majewo	0.96	0
Wolowa Gora	2.5	2.5
Radoniow	345	214
Wojcieszyce	14.4	12.3

Exploitation of vein deposits in the Karkonosko-izerski Block (Wolnosc, Miedzianka, Podgorze, Rubezal, Mniszkow, Wiktoria, Majewo, Wolowa Gora, Radoniow, Wojcieszyce) and of metamorphic deposits of Ladek and Snieznik Klodzki (where small uranium mineralisations and the Kopaliny-Kletno deposit were discovered) took place up to 1967, when deposits were almost completely depleted. During this time, all uranium production was exported to USSR.

It is estimated that between 1948 and 1967 there were approximately 650 tU was mined in the Sudetes of Poland.

Chemical treatment of low-grade ores started in Kowary in 1969 at the only uranium processing plant in Poland. The processing of low-grade ore continued until 1972. In produced a significant volume of waste, which was disposed of in a tailings pond.

According to estimations, in years 1948-1967 there were approximately 650 tonnes of metallic uranium exploited in Sudetes.

Status of production capability

Currently in Poland no concessions for uranium granted.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

All activities associated with uranium mining and processing in Poland were performed in years 1948-1976. The companies associated with this activity no longer exist. However, there is still a need to remediate the environment in the area around the sites where the mines operated. The Geological and Mining Law stipulates that the State Treasury is accountable for liabilities from all past uranium production activities in Poland. Therefore, the government is responsible for funding remediation, either from the national or the district Environmental Protection Fund.

The regional authority of the Voivodship and its special inspectorates or officers are responsible for different aspects of remediation. The local authority has to approve the remediation plans and supervise their execution and effects. The inspectorates of the Environmental Protection of Voivodship are responsible in general for environmental monitoring. The radiological monitoring is considered as part of this monitoring and is performed under responsibility of the President of the National Atomic Energy Agency.

Since 1996, Poland has taken part in the PHARE Multicountry Environmental Sector Programme on “Remediation Concepts for the Uranium Mining Operation in CEEC” (Central and Eastern European Countries). In the framework of the Programme, the inventory and a common database for the CEEC have been executed. According to this inventory, the situation in Poland is characterised by a large number of small-scale liabilities from uranium exploration, localised over several places in the country and generally causing minor impacts on the environment.

Only a limited number of issues related to mining and milling are considered to be causing serious impacts. The most important is the tailings pound in Kowary. The 1.3 ha tailing pond is a hydrological construction closed on three sides by a dam that has been modified a number of times over the past years. The dam is 300 m long (the sum of three sides) with a maximum height of 12 m. As a result of the uranium processing activities, the tailings pond has been filled with about 250 000 tonnes of fine-grained gneisses and schists with average uranium content of 30 ppm. In the early 1970s, the Wroclaw University of Technology (WUT) received, by governmental decision, the ownership of both the area and facilities of the former uranium mining company. Subsequently, a company owned by WUT has continued to use the existing chemical plant for various experimental processes on rare metals, chemical production and galvanic processes. As a result, about 300 tonnes of remnants of rare metals processing and 5 000 m^3 of post-galvanic fluids, with up to 30 tonnes of solids with high content of aluminum, nickel, zinc and sodium sulphates, have been disposed of in the pond. The specific objectives of the remediation programme are related to the construction of the drainage systems, the design and construction of the tailings pond cover and the final site reclamation. The remediation programme of the tailings pond was prepared in 1997 by the WUT and successfully carried out under PHARE programme until 2003.

NATIONAL POLICIES RELATING TO URANIUM

Demand for nuclear fuel (type and amount) in Poland in the future (to 2030) depends on category and size of the reactor that is to be built.

According to the last accepted document concerning energy policy in Poland, first nuclear power station should be in operation from about 2021-2022.

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]	NA	0	0	0	0	0
Underground mining[1]	650	0	0	0	NA	0
In situ leaching	NA	0	0	0	0	0
Heap leaching	NA	0	0	0	0	0
In-place leaching*	NA	0	0	0	0	0
Co-product/by-product	NA	0	0	0	0	0
U recovered from phosphates	NA	0	0	0	0	0
Other methods**	NA	0	0	0	0	0
Total	NA	0	0	0	NA	0

(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.

Installed nuclear generating capacity to 2030
(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
0	0	NA	NA	NA	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	1 500*	NA	4 500	NA

* According to estimations made by the Energy Market Agency (Agencja Rynku Energii SA) document "Określenie optymalnego zakresu i tempa rozwoju energetyki atomowej w Polsce", 2006.

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

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
0	0	NA	NA	NA	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	*	*	*	*

* It cannot be estimated at this time.

• Portugal •

URANIUM EXPLORATION

Historical review

The first uranium-radium deposits in Portugal were found in 1907 and the first mining concession (Rosmaneira) was granted in 1909, although it was Urgeiriça that became the first producing mine in 1913. Radium at Urgeiriça was mined until 1944 (it is estimated that the production of 50 g of radium resulted in a loss of 500 tU) and uranium was mined between 1944 and 1951. Between 1945 and 1962 a foreign privately owned enterprise, *Companhia Portuguesa de Radium* (CPR) extracted and processed ores from Urgeiriça and other mines in the Beira Alta (Central Portugal) region. CPR also carried out radiometric surveys, detailed geological mapping, trenching and extensive core drilling with gamma ray logging. All the targets were located in the Beiras granitic formations of Hercynian age.

In 1954, the Portuguese government created the *Junta de Energia Nuclear* (JEN) under supervision of the Prime Minister and in 1955 started an extensive and systematic exploration programme of the territory based on geological mapping, car-borne and ground radiometric surveys, geophysics (resistivity), trenching and core and percussion drilling. This programme successfully increased the resource inventory significantly. Metasediments surrounding granitic formations also proved to be a very good target to host uranium mineralisation of economic interest. By the end of the exploration programme in 1959, JEN had discovered about 100 deposits of medium and small size in Hercynian granitic and perigranitic formations in Beiras and Alto Alentejo. The Beiras deposits together with Urgeiriça ore mill treatment plant were managed as an integrated uranium production centre. Although the Alto Alentejo deposits, which include the largest national ore body (Nisa, with roughly 3 500 tU) could support another production centre, it has remained untouched. The last attempt to start production in this area was abandoned in 1999 after a positive environmental assessment but a negative economic appraisal. However, the present level of uranium prices has raised the interest of several foreign companies in mining the deposit.

Since 1976 until the mid-1990s exploration in crystalline regions continued with relative success with new discoveries, roughly keeping pace with depletion by mining. Exploration in sedimentary formations between 1971 and 1982, based on geological mapping, geochemistry, emanometry and drilling surveys in the western Meso-Cenozoic fringe of the Lusitanian Basin, were not successful in identifying additional resources of economic interest.

Recent and ongoing uranium exploration and mine development activities

During 2005 and 2006, no uranium exploration or exploitation activities were conducted in Portugal or by companies based in Portugal or abroad. Several environmental studies were conducted by *Companhia de Indústria e Serviços Mineiros e Ambientais* (EXMIN), the organisation responsible for the rehabilitation of mine sites, including uranium old mines. In 2005, rehabilitation field work started on the Urgeiriça, with confinement of the tailings dam the main project.

During 2005 and 2006, several foreign companies applied for mining and exploration rights in Portugal. Nisa is the main target of this intended activity. The Government of Portugal decided to launch a bidding process open to those that had applied for mineral and exploration rights.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Portugal reports a revised RAR figure of 4 500 tU recoverable at a cost of <USD 80/kgU and 1 000 tU of IR recoverable at a cost of <USD 130/kgU. Revised processing plus mining losses of ~25% are used in both categories of resource estimates.

Undiscovered Resources (Prognosticated & SR)

A new estimate of Undiscovered Conventional Resources include 1 500 tU of Prognosticated Resources. Speculative Resources recoverable at costs <USD 130/kgU are not reported, because the only available appraisal is out of date.

URANIUM PRODUCTION

Historical review

In 1950-1951, a uranium mill facility processing 50 000 t/year was commissioned at Urgeiriça and underground extraction at the mine continued until 1973. In place leaching techniques were used from 1970 to 1991. The mine reached a depth of 500 m with 1 600 m in extensions. In 1951, a natural leaching process (made possible by the high sulphur content of the ore) was used for the first time in Portugal. Five different heap leaching facilities operated in the period 1953-1959, producing a total of 40 tU.

Between 1951 and 1962, CPR produced a total of 1 123 tU from 22 concessions, of which 1 058 tU were milled at the Urgeiriça plant and 65 tU were produced at other mines by heap leaching. A low-grade concentrate was obtained by precipitation using magnesium oxide. During the period 1962 to 1977, JEN took over the mining and milling activities from CPR, introducing organic solvent extraction in 1967 to produce a rich ammonium uranate concentrate and expanding ore treatment capacity to 100 000 t/year. In July 1985, a new capacity expansion to 200 000 t/year was implemented. A total of 825 tU were produced from at the Urgeiriça plant and the pilot plant at Senhora das Fontes under JEN management. Between 1977 and 2001, ENU produced 1 772 tU. Production ceased in March 2001. Of the total historical concentrate production, 25% came out from Urgeiriça.

Ore processing was stopped at the Urgeiriça mill in 1999 and the facility was decommissioned in March 2001. Between 1999 and 2001, only exchange ions resins charged at heap and in place leaching plants located in Bica e Quinta do Bispo mines were processed at the mill. In total, 57 ore bodies have been mined, 29 by underground methods, 24 by open pit and four by mixed underground-open pit methods. In 18 of these mines local ore treatment was used, but only at Urgeiriça were uranium concentrates produced on an industrial scale. Two pilot treatment plants (Forte Velho and Sr^{a} das Fontes) produced limited amounts of concentrates (sodium uranate).

Ownership of Urgeiriça mill evolved and after CPR concluded the agreement with the Portuguese Government in 1962, JEN took over until 1977 when a publicly-owned enterprise *Empresa Nacional de Urânio*, SA (ENU) acquired exclusive rights for uranium concentrate production and sale. In 1978, the exploration teams of JEN joined the *Direcção-Geral de Geologia e Minas* (DGGM). In 1992, ENU was integrated into the Portuguese State mining holding, *Empresa de Desenvolvimento Mineiro* (EDM). In March 2001, EDM decided to liquidate ENU by the end 2004.

Status of production capability

No processing facilities have operated since 2001. Demolition/reclamation of the Urgeiriça mill as well as other mine sites, are in an advanced phase. A EUR 5 million reclamation project of the tailings dam started in 2005 after an environmental impact assessment. Neutralisation of acid mine water from Urgeiriça, Bica, Cunha Baixa and Quinta do Bispo is ongoing.

Ownership structure of the uranium industry

The Portuguese uranium mining and processing company ENU was extinguished on 31 December 2004. Presently no company holds the necessary exploration or mining rights over uranium resources to make them eligible to obtain mineral rights to produce uranium.

Employment in the uranium industry

None.

Future production centres

Although no future production centres are planned, the Nisa mine may start in a near future if the appropriate government authorities grant mineral rights to one of the several companies interested in obtaining these rights.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Under the Decree 198-A/2001 the Portuguese State institutionalised the rehabilitation of all orphan mine sites in the country, including uranium mine sites, given the role played by the State in their development. Resolution 93/2001 of the Council of Ministers created the state subsidiary EXMIN, within the mining sector EDM. As of September 2006, EXMIN was incorporated by EDM.

The on-going programme under the Decree 198-A/2001 is designed to rehabilitate mine sites, address public health, potential economic development, as well as cultural and heritage issues.

A monitoring programme of old mines has been conducted by EDM, which has assumed all the responsibilities previously held by EXMIN.

In 2005, an EIA of the rehabilitation project on the old tailings dams was approved.

URANIUM REQUIREMENTS

Portugal has no uranium requirements.

NATIONAL POLICIES RELATING TO URANIUM

The national authorities responsible for national policies concerning uranium are the Ministry of Economy and Innovation (as of March/2005) and the Directorate General for Geology and Energy (DGGE). During 2005 and 2006, several foreign companies applied for mining and exploration rights. Nisa is the main target of this intended activity. The Government decided to launch a bidding process among all the appliers in order to grant mineral rights and will no longer accept applications.

In 2006, a private company proposed to build a nuclear plant (one EPR reactor, 1 600 MWe) in Portugal but the government refused it on the basis that its strategic plan for energy provides no consideration of nuclear power. The initiative did however launch a debate in the Portuguese society about advantages and drawbacks of nuclear energy, which the President of the Republic welcomed.

URANIUM PRICES

None reported.

Reasonably Assured Resources
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	500	
Open-pit mining	0	4 500	5 500	75
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	4 500	6 000	

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	4 500	6 000
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	4 500	6 000

Inferred Resources
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	1 000	1 200	75
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	1 000	1 000	

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	1 000	1 000
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	1 000	1 000

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
1 000	1 500

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
NA	0

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	168	0	0	0	168
Producer	0	0	0	0	0
Utility	0	0	0	0	0
Total	168	0	0	0	168

• 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.

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

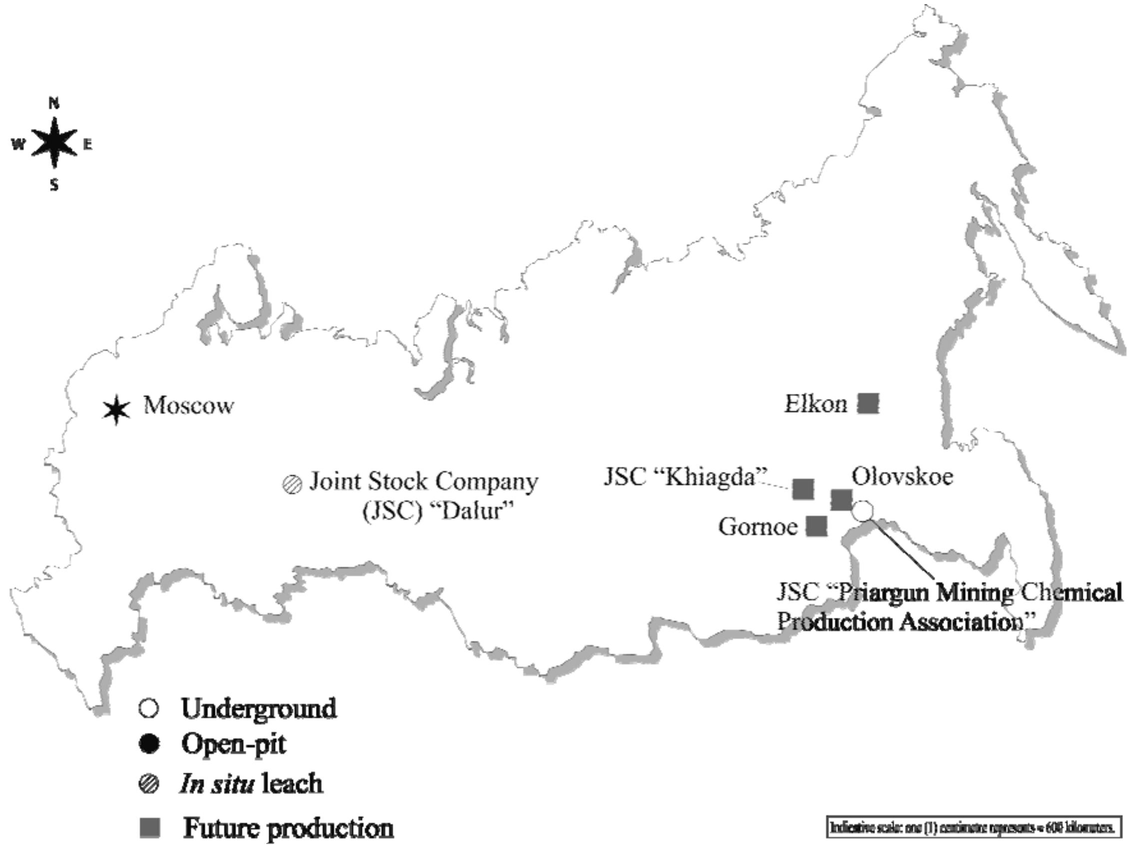
2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
37 000	44 000	40 000	50 000	42 000	60 000

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.

URANIUM PRODUCTION

Historical review

In 1960s and 1970s some small quantities of uranium ore were mined in Eastern Slovakia. Production was stopped due to inefficiency and the low-grade of the ore.

Status of production capability

The Slovak Republic has no uranium mining industry or production capability.

Secondary sources of uranium

The Slovak Republic does not produce or use mixed-oxide fuels, re-enriched tails and reprocessed uranium.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

None reported.

URANIUM REQUIREMENTS

The Slovak Republic has two nuclear power plants located at Bohunice and Mochovce. The NPP Bohunice had four units of the VVER-440 type in operation, with installed capacity of 2 x 406 MWe net and 2 x 407 MWe net. Following the Slovak Government commitment to the European Union, Slovakia shut down the first reactor (Unit 1) of the Bohunice NPP on 31 December 2006. A second Bohunice reactor should be stopped at the end of 2008. The two VVER-440 type reactors at Mochovce remain in operation.

In 2006 Slovenské elektrárne commenced use of new nuclear fuel with burnable Gd absorber in NPP Bohunice Units 3 and 4 and NPP Mochovce Units 1 and 2.

Under preparation and development are uprates of NPP Bohunice Units 3 and 4 and NPP Mochovce Units 1 and 2 uprating as well as consideration of constructing new reactors (Units 3 and 4) at NPP Mochovce.

NATIONAL POLICIES RELATING TO URANIUM

The Slovak Republic utility purchases complete fuel assemblies for all operating units from Russian manufacturers. Therefore, there are no special contracts on uranium, conversion and enrichment services.

URANIUM STOCKS AND PRICES

The Slovak Republic does not maintain an inventory of uranium. The Slovak government keeps small stock of enriched uranium in form of complete fuel assemblies. Based on above-mentioned information, the Slovak Republic utility has not any special uranium contracts; therefore it cannot publish prices for uranium.

Uranium exploration and development expenditures and drilling effort – domestic

	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	NA	NA	NA
Government exploration expenditures	0	0	0	0
Industry development expenditures	0	NA	NA	NA
Government development expenditures	0	0	0	0
Total expenditures	0	NA	NA	NA
Industry exploration drilling (metres)	0	NA	NA	NA
Number of industry exploration holes drilled	0	NA	NA	NA
Government exploration drilling (metres)	0	0	0	0
Number of government exploration holes drilled	0	0	0	0
Industry development drilling (metres)	0	NA	NA	NA
Number of development exploration holes drilled	0	NA	NA	NA
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	0	NA	NA	NA
Subtotal exploration holes	0	NA	NA	NA
Subtotal development drilling (metres)	0	NA	NA	NA
Subtotal development holes	0	NA	NA	NA
Total drilling (metres)	0	NA	NA	NA
Total number of holes	0	NA	NA	NA

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	16.3	16.6

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
2 438	2 032	1 740	1 740	1 740	2 611

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
1 740	2 611	1 740	2 611	871	2 742

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

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
491	476	387	387	399	596

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
387	583	399	596	197	393

Total uranium stocks
(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	NA	0	0	NA
Producer	0	0	0	0	0
Utility	0	0	0	0	0
Total	0	NA	0	0	NA

• Slovenia •

URANIUM EXPLORATION

Historical review

Exploration of the Zirovski Vrh area began in 1961. In 1968, the P-10 tunnel was developed giving access to the ore body. Mining began at Zirovski Vrh in 1982 and uranium concentrate production (as yellow cake) began in 1985.

Recent and ongoing uranium exploration and mine development activities

Expenditures for exploration ended in 1990. There are no recent or ongoing uranium exploration activities in Slovenia.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Resource assessment of the Zirovski deposit was carried out in 1994. RAR are estimated to amount to 2 200 tU in ore with an average grade of 0.14% U in the <USD 80/kgU category. Inferred resources total 5 000 tU in the <USD 80/kgU category and 10 000 tU in the <USD 130/kgU category at an average grade of 0.13% U. This deposit occurs in the grey sandstone of the Permian Groeden formation, where the ore bodies occur as linear arrays of elongated lenses within folded sandstone.

Undiscovered Resources (Prognosticated & SR)

See relevant table.

URANIUM PRODUCTION

Historical review

The Zirovski Vrh uranium mine located 20 km southwest of Škofja Loka was the only uranium producer in Slovenia. Ore production at this mine started in 1982 and the associated ore processing plant (annual production capability of 102 tU) began operations in 1984, initially treating previously stockpiled ore. The ore (which occurs in numerous small bodies in the mineralised coarse-grained sandstone) was mined selectively using a conventional underground operation with a haulage tunnel and ventilation shaft with room and pillar, and cut and fill methods. In 1990, operations were terminated. Cumulative production from the Zirovski Vrh mine-mill complex totalled 382 tU (620 000 t ore at an average grade of 0.072% U).

Status of production capability

In 1992, a decision for final closure and subsequent decommissioning of the Zirovski Vrh mine and mill was made and there has been no production from the Zirovski facility since. In 1994, the plan for decommissioning the facility was accepted by Slovenian government authorities.

Ownership structure of the uranium industry

No changes in ownership have occurred since 1988. The Zirovski Vrh production centre is owned by the Republic of Slovenia.

Employment in the uranium industry

See relevant table. All employment is related only to decommissioning and rehabilitation of the mine.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

The government owned Zirovski Vrh Mine Company manages all activities connected with the rehabilitation of the former uranium production site. It obtains all remediation permits required, monitors the environmental impact of the mine effluents (air and water), and maintains the area to prevent damage to the environment.

Annual effective dose contribution from all mine objects has been decreased due to remediation activities from between 0.2 and 0.4 mSv/a, compared to 0.5 mSv/a during operation. Background annual effective levels are 5 mSv/a in the area surrounding the mine.

Associated with the facility are 620 000 tonnes of tailings (70 g U/t) and 80 000 tonnes of mine waste, located on the slope of a hill between 530 and 560 m a.s.l., over an area of 4.5 ha. The critical factor is the stability of the site. The mine waste pile containing 1 650 000 tonnes of mine waste and mill debris, over an area of 5 ha, is located in a former ravine. The mine effluents are monitored on a regular monthly basis, due to uranium, radium and other chemical contaminants.

Remediation of the Žirovski Vrh mine site is expected to be completed by 2010. There is a plan to turn over the mine's remediated property to the community to develop an industrial centre.

Environmental impact assessments

Rudnik Zirovski Vrh has three long-term targets for remediation: the underground mine, the mine waste pile (Jazbec) and the mill tailings (Borst). All other mine liabilities and production areas will be decontaminated and returned to society for future use. An extensive safety report has been prepared for the mine waste pile Jazbec remediation. A safety report for the mill tailings Borst will be prepared as well.

Monitoring

The mine's air and water effluents have been monitored on regular base since the start of the ore production in 1982. The programme, modified when production stopped in 1990, is ongoing. Emissions to surface waters and air are monitored and doses to the critical group of inhabitants have been calculated since 1980. There are plans for long-term monitoring and stewardship of the location.

Tailings impoundment

There is one 4.5 ha specially designed long-term tailings site called Borst, with a capacity of 700 000 tonnes. The wastes have been stored in dry shape due to filtration of the leached liquor. Borst will be covered with a 2 m thick engineered multi-layer soil cover with a clay base to prevent leaching of contaminants.

Waste rock management

All waste piles will be relocated to the central mine waste pile Jazbec. All other sites will be decontaminated to a greenfield condition. The 5 ha Jazbec facility will contain 1.8 million tonnes of mine waste and debris, and it too will be covered with an engineered multi-layer soil cover 2 m thick.

Effluent management

Treatment of the mine's effluents is not planned due to low concentrations of the radioactive contaminants.

Site rehabilitation

Mine staff manage the mine site remediation. The mine is practically remediated and the areas of the temporary waste piles have been cleaned. Work on the mine waste pile Jazbec remediation is in progress and the remediation of the mill tailings Boršt are planned to start in 2007. All works should be finished in 2010.

Regulatory activities

The company manages acquirements of all required consensuses and permits for site remediation. The main acts regulating these actions are the Act on Safety against Radioactive Radiation and the Act on Nuclear Safety and the Mining Act.

Social and/or cultural issues

The problems were twofold: the loss of jobs and the loss of local economical power when the mine ceased production in 1990. The problems were solved with pensions, compensation, and agreements with companies in the vicinity, etc. The state is helping to develop and support the economic growth of the former mining community.

URANIUM REQUIREMENTS

The sole nuclear power plant in Slovenia is based at Krško. It started commercial operation in January 1983 and was modernised in 2000 with replacement steam generators, that increased net capacity to 676 MWe. Net capacity was again increased in 2006 to 696 MWe with low-pressure turbine replacement. The power plant is owned 50% each by Slovenia and Croatia.

In October 2006, the Government of Slovenia adopted a package of 35 new long-term projects important for further development of Slovenia. A new nuclear power plant at the Krško site (Krško 2) is one of those projects. This new NPP is expected to have installed capacity between 1 000 and 1 600 MWe and it is expected to be in operation before 2020.

Supply and procurement strategy

There are no uranium stocks maintained in Slovenia. The company that owns and operates the Krško plant imports uranium based on meeting requirements on a "just-in-time" basis.

Reasonably Assured Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	2 200	2 200	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	2 200	2 200	

* *In situ* resources.

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	0	2 200	2 200
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	2 200	2 200

* *In situ* resources.

Inferred Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	5 000	10 000	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	5 000	10 000	

* *In situ* resources.

Inferred Resources by deposit type* (tonnes U)

Deposit Type	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**
Unconformity-related	0	0	0
Sandstone	0	5 000	10 000
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	5 000	10 000

* *In situ* resources.

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
0	1 060

Speculative Resources
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
NA	NA

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]	0	0	0	0	0	0
Underground mining[1]	382	0	0	0	382	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	0	0	0	0	0	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	382	0	0	0	382	0

(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.

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

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	42	39	28	20
Employment directly related to uranium production	0	0	0	0

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	5.61*	5.29*

* Only ½ of this electricity belongs to Slovenia; the other 50% belongs to a Croatian owner.

Installed nuclear generating capacity to 2030
(MWe net)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
676	696	696	696	696	696

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
696	2 200	696	2 200	696	2 200

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

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
250	NA	250	250	250	250

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
250	750	250	750	250	750

• South Africa •

URANIUM EXPLORATION

Historical review

The world-wide search for uranium resources in the early 1940s resulted in the commencement of uranium exploration in South Africa during 1944. Attention at the time was focused on the occurrence of uranium in the gold bearing quartz-pebble conglomerates of the Witwatersrand Supergroup. Exploration for uranium in the Witwatersrand Basin was always a consequence of gold exploration until the oil crisis emerged in 1973. With the price of uranium increasing more than five times in a short space of time, uranium exploration activities intensified leading to the establishment of South Africa's first primary uranium producer at Beisa Mine in 1981.

However, the crash in the uranium market shortly thereafter not only resulted in the closure of the Beisa's uranium production facility in 1985, but also had a detrimental effect on uranium exploration in general. Incidental discoveries of new uranium resources were nevertheless made during the exploration for gold due to the ubiquity of uranium in the quartz-pebble conglomerates. The static gold price in the 1990s furthermore led to a substantial curtailment of gold exploration activities within the Witwatersrand Basin.

The discovery of uranium in the Karoo Basin whilst drilling for oil in the early 1970s, resulted in a diversification of uranium exploration activities in South Africa. Although initially at a modest level, exploration activities increased until the incident at Three Mile Island in 1979, which sent the overheated uranium market plummeting. Exploration activities in the Karoo Basin declined rapidly thereafter and finally ceased in the mid 1980s.

Exploration for uranium outside of these two geological basins resulted in the discovery of uranium deposits associated with coal seams, carbonatites, granites, marine phosphates as well as surface deposits. Such exploration has always been undertaken on a low-key basis and rendered very limited success in terms of additional uranium resources.

Recent and ongoing uranium exploration and mine development activities

Exploration for uranium as a primary commodity was last experienced in 1988 during exploration activities on the Springbok Flats in the Limpopo Province. The upsurge in the price of uranium from 2005 onwards prompted a closer look at the Witwatersrand gold reefs where uranium comprises a more substantial income contributor with gold a useful windfall. This led to the establishment of a new Canadian registered mining group, Uranium One, which will become the only primary South African uranium producer.

An increase in the gold price from below USD 400 towards the end of 2003 to more than USD600/troy ounce at the end of 2006 stimulated a renewed interest in exploration for this precious metal at several locations along the limb of the Witwatersrand Basin, while the much higher uranium price encouraged some gold mining groups to revert to a routine of recording the uranium concentrations within the reefs during their ore outlining, development and mining activities. Some mining companies have also drilled and assayed slimes dams to determine their uranium and gold content for possible future exploitation. Renewed interest in uranium occurrences in the Karoo Basin has also been experienced in recent years.

Although no new discoveries of uranium in South Africa have been reported lately, significant additional resources of uranium have been delineated by Uranium One at its new mine NW of Klerksdorp in the North West Province.

No exploration for uranium by South African based companies outside of South Africa has been undertaken.

The statutory responsibility for uranium exploration and development has been transferred from the Atomic Energy Corporation of South Africa Limited to the South African Nuclear Energy Corporation Limited and National Nuclear Regulator in 1999, whilst the responsibility for updating the Red Book information had since taken place under the guidance of the Council for Geoscience.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

By far the largest portion (about 67%) of South Africa's Identified Resources comprises low-grade concentrations within the gold-bearing Witwatersrand quartz-pebble conglomerates. Where uranium is recovered as a by-product of gold operations, it generally accounts for less than 10% of the total revenue from the ore mined.

The low level of exploration for gold experienced in recent years made way for increased exploration activities fuelled by an increase in the gold price to above USD 600/troy ounce in 2006 and fast diminishing known ore reserves. Two of the three operating gold mines which closed down during 2005 have been reopened resulting in their uranium resources potentially becoming exploitable again.

The exploration for uranium as a primary commodity as reflected in an almost exponential increase in the exploration and development expenditure in 2006, resulted in a substantial increase in the resources figure for RAR recoverable at a cost of <USD40/kgU.

As uranium is presently only produced as a by-product of gold mining, the gold and uranium prices, rand/USD exchange rate, as well as the mining and processing costs have a significant effect on South Africa's uranium resource figures and cost category allocations.

The majority (about 73%) of South Africa's identified *in situ* uranium resources recoverable at less than USD 80/kgU is likewise associated with gold resources within the Witwatersrand Supergroup. However, since only one mine, Vaal River Operations, has a uranium recovery plant in operation, large amounts of uranium are presently being discarded in tailing dams. Recovery of uranium from this source will depend to a large extent on the degree of dilution by non-uraniferous tailings and the possible use of such tailings as backfill in mined-out areas.

Less than ten percent (9%) of the total South African identified uranium resources recoverable at less than USD 40/kgU and 13% of the Identified Resources recoverable at less than USD 80/kgU are associated with South Africa's only uranium recovery facility.

Undiscovered Resources (Prognosticated & SR)

Little exploration for uranium deposits outside of the Witwatersrand Basin is presently undertaken. More than thirty applications for uranium prospecting permits associated with previously discovered deposits within the Karoo Basin have, however, been issued during 2006.

Limited efforts to identify Witwatersrand-type basins outside of the currently known limits of the main basin have rendered discouraging results. The lack of funding for speculative type of exploration has further precluded the chances of any meaningful outcome.

Uranium resources in the Prognosticated Resources category which can be produced at a cost of less than USD 80/kg U, as well as the estimate for Speculative Resources with no cost range assigned, remained unchanged from previous estimates.

Unconventional Resources and other materials

No Unconventional Resources have been identified.

Availability of Identified (RAR & Inferred) Resources

Sixty-one percent of South Africa's RAR plus Inferred Resources recoverable at USD 40/kgU or less are in existing and committed production centres.

Forty-two percent of South Africa's RAR plus Inferred Resources recoverable at USD 80/kgU or less are in existing and committed production centres.

URANIUM PRODUCTION

Historical review

Uranium production in South Africa commenced in 1952 with the commissioning of a plant at the West Rand Consolidated Mine to extract uranium from quartz-pebble conglomerates of the Witwatersrand Basin.

During 1953 a further four plants came into production at various centres. Total uranium production peaked in 1959 when 4 957 tU was produced from 17 plants being fed from 26 mines within the Witwatersrand Basin. Production thereafter declined to 2 263 tU in 1965.

The world oil crisis which emerged in 1973 stimulated the demand for uranium as an alternative source of energy. The large uranium containing tailings stockpiles which accumulated over many decades at the time became a readily available source of uranium. These stockpiles were reprocessed at Welkom (Joint Metallurgical Scheme – 1977), on the East Rand (ERGO – 1978) and at Klerksdorp (Chemwes – 1979) which culminated in a record uranium production of 6 028 tU in 1980.

In 1967 there were seven producers (2 585 tU); this number increased to 14 in 1983 (5 880 tU). Since 1983 there was a steady decline in the number of producers with only three remaining in 1994 (1 550 tU). The Phalabora Mining Company which commenced uranium production in 1994 outside of the Witwatersrand Basin as a by-product of copper mining, ceased production in 2002, leaving the Vaal River Operations as the sole producer of uranium in South Africa at present.

Status of production capability

Uranium is mined at Vaal River Operations near Klerksdorp as a by-product of gold. Uranium rich slurries are collected from two mines and transported to Nufcor for processing into a uranium oxide concentrate.

Nufcor presently has two processing plants capable of producing ca. 4 000 t U_30_8 (3 392 tU). A heightened interest in uranium production is being experienced in the industry since 2006 mainly due to a significant rise in the uranium price. Several mining companies are now investigating the possibility of producing uranium rich slurries in the future. Nufcor may decide to treat such material on a toll-treatment basis.

Ownership structure of the uranium industry

In 1998 Nufcor became a wholly owned subsidiary of AngloGold Ashanti Limited, a public company listed, amongst others, on the New York and London Stock Exchanges and the Johannesburg Securities Exchange.

The South African Government is not associated with any uranium production activities.

Employment in the uranium industry

Vaal River Operations employs a total of 100 persons (apportioned on a full time basis) associated with its uranium operation. An additional 55 workers are employed at Nufcor.

Future production centres

Since the uranium resources in South Africa occur mainly as a by-product of gold, it is difficult to predict whether any prospective operator, other than the existing and committed production centres, could be supported by existing Identified Resources in the Reasonably Assured and Inferred Resources categories recoverable at a cost of <USD 80/kgU. The cost of producing uranium is to a large degree determined by the gold content of the ore, the gold price, working costs as well as the SA rand/USD exchange rate.

Given favourable conditions in respect of these variables and the current uranium price in excess of 100 USD per pound U_3O_8, it is not inconceivable for South Africa to achieve uranium production levels of more than 6 000 tU per annum (last experienced in 1980) within the next decade. South Africa further has significant quantities of uranium contained in mine tailings, which could be extracted given stable and predictable long-term sales contracts.

Exploration for uranium as a primary commodity which was undertaken since 2003 and gained momentum during 2006 yielded good results. Uranium One's committed processing plant with a design capacity of 1 460 tU per annum is expected to operate at full capacity by 2010.

Employment in existing production centres

Vaal River Operations employs a total of 100 persons at the slurry collection operation with an additional 55 individuals employed at Nufcor.

Uranium production centre technical details

(as of 1 January 2007)

	Centre #1	Centre #2
Name of production centre	Vaal River Operations	Uranium One
Production centre classification	Existing	committed
Start-up date	1977	2007
Source of ore:		
• Deposit name	Vaal Reef	Dominium & Rietkuil
• Deposit type	quartz-pebble conglomerate	quartz-pebble conglomerate
• Resources (tU)		
• Grade (% U)	NA	NA
Mining operation:		
• Type (OP/UG/ISL)	UG	UG
• Size (t ore/day)		NA
• Average mining recovery (%)	Variable	NA
Processing plant (acid/alkaline):		
• Type (IX/SX/AL)	AL/SX	SX
• Size (t ore/day) for ISL (L/day or L/h)		NA
• Average process recovery (%)	Variable	NA
Nominal production capacity (tU/year)	3 400	1 460
Plans for expansion	under surveillance	feasibility study
Other remarks	None	none

NA Not available.

Secondary sources of uranium

Production and use of mixed-oxide fuel

South Africa has never produced or utilised mixed-oxide fuels and has no plans to do so in future.

Production and use of re-enriched tails

South Africa decommissioned and dismantled its uranium enrichment plant at Pelindaba in the period 1997-1998 and does not undertake enrichment activities at present.

Production and use of reprocessed uranium

No reprocessed uranium is produced or utilised in South Africa.

ENVIRONMENTAL ACTIVITIES AND SOCIAL CULTURAL ISSUES

Within South Africa mine related land exists which has been contaminated by radioactivity, particularly where existing and previous uranium plants are or were located. If development takes place on former mine land, the area is radiometrically surveyed and, where necessary, decontaminated. The National Nuclear Regulator is the body responsible for the implementation of nuclear legislation related to these activities, and the standards conform to international norms. Large areas around gold/uranium mines are covered with slimes dams and rock dumps. South Africa has strict environmental legislation, which ensures that such areas are suitably rehabilitated after closure.

Environmental issues relating to gold/uranium mining within Witwatersrand Basin are dust pollution, surface and ground water contamination and residual radioactivity. Scrap materials from decommissioned plants may only be sold after these have been decontaminated to internationally acceptable standards.

The by-product status of uranium production in South Africa makes it impossible to establish what portion of the total expenditure on environmental related activities specifically pertain to uranium. The South African mining industry, however, allocates considerable resources for environmental rehabilitation from the exploration stage, through to mining and finally mill closure.

URANIUM REQUIREMENTS

South Africa has only one nuclear power plant, Koeberg, which has two reactors. Koeberg I was commissioned in 1984 and Koeberg II in 1985. They have a combined installed capacity of 1 840 MW electricity and collectively consume *ca.* 292 tU per annum.

Eskom, South Africa's national electricity generating utility, intends to have *ca.* 20 000 MW nuclear electricity generating capacity by 2025. Due to practical considerations the first additional nuclear generating capacity is unlikely to come on stream before 2015. Eskom's ambitious expansion plans will result in an almost ten times increase in uranium fuel requirements by 2025.

Nuclear fuel will also be required for the commission of a Pebble Bed Modular Reactor (PBMR) demonstration plant to be constructed at Koeberg. The demonstration PBMR is designed to produce 165 MWe consuming *ca.* 2 tU per annum. The Environmental Impact Assessment process is at present still ongoing, a prerequisite for the issuing of a licence by the National Nuclear Regulator. It is believed that construction of the demonstration plant should start in 2009. Commercial PBMR reactors will likewise produce electricity each, and to maximise the sharing of support systems it is believed that it will be most economical to build it in a 4-pack configuration. The intention is to have a local installed capacity from PBMR of between 4 000 and 5 000 MW electricity by 2025. As many as 80 reactors could also be exported from South Africa between 2020 and 2030 once the technology has been demonstrated successfully.

Supply and procurement strategy

Fuel for the Koeberg nuclear power plant used to be manufactured at Pelindaba near Pretoria prior to 1997. Subsequently Eskom sources its uranium from the international market, including from secondary sources, provided that the country of origin is a signatory to the IAEA NPT treaty and that the supply is in accordance with applicable legislation, safeguard treaties and policies. The anticipated expansion of South Africa's nuclear programme and changes in the world uranium market of late would most likely necessitate an adjustment of the utility's uranium procurement strategy to a more long-term relationship focused strategy. Fuel for the demonstration PBMR plant will be manufactured at Pelindaba from radioactive material to be imported. The issuing of a licence by the National Nuclear Regulator for this facility is awaited.

NATIONAL POLICIES RELATING TO URANIUM

The Nuclear Energy Act No. 131 of 1993, as amended, provided expression to South Africa's national policies relating the prospecting for and mining of uranium, foreign participation in such activities, the State's role in this regard, as well as the export of uranium and the disposal of spent nuclear fuel.

This Act has been replaced by the Nuclear Energy Act No. 46 of 1999 and the National Nuclear Regulator Act No. 47 of 1999. The former act provides for the establishment of the South African Nuclear Energy Corporation Limited (NECSA) to replace Atomic Energy Corporation of South Africa Limited, a public company wholly owned by the State to, *inter alia*, regulate the acquisition and possession of nuclear fuel, the import and export of such fuel and to prescribe measures regarding the discarding of radioactive waste and the storage of irradiated nuclear material. The latter Act provides for the establishment of a National Nuclear Regulator to regulate nuclear activities, to provide for safety standards and regulatory practices for protection of persons, property and the environment against nuclear damage.

URANIUM STOCKS

Uranium fuel stock levels are dependent on market and contractual conditions and it is conceivable that Eskom might increase its strategic stock levels to mitigate the current supply/demand imbalance.

URANIUM PRICES

Confidential information**.**

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million ZAR	**2004**	**2005**	**2006**	**2007** (expected)
Industry exploration expenditures	1 472	9 000	158 750	7 000
Government exploration expenditures	0	0	0	NA
Industry development expenditures	4 360	1 559	2 772	99 000
Government development expenditures	0	0	0	NA
Total expenditures	5 832	10 559	161 522	106 000
Industry exploration drilling (metres)	NA	10 300	91 621	21 269
Number of industry exploration holes drilled	9	52	164	855
Government exploration drilling (metres)	0	0	0	NA
Number of government exploration holes drilled	0	0	0	NA
Industry development drilling (metres)	NA	5 624	NA	95 346
Number of development exploration holes drilled	50	70	56	243
Government development drilling (metres)	0	0	0	NA
Number of development exploration holes drilled	0	0	0	NA
Subtotal exploration drilling (metres)	1 472	9 000	158 750	7 000
Subtotal exploration holes	9	52	164	855
Subtotal development drilling (metres)	4 360	1 559	2 772	99 000
Subtotal development holes	50	70	56	243
Total drilling (metres)	NA	15 924	91 621	116 615
Total number of holes	59	122	220	1 098

NA Not available.

Reasonably Assured Resources*

(tonnes U)

Production method	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**	**Recovery factor** (%)
Underground mining	93 977	136 117	193 665	NA
Open-pit mining	1 643	22 543	24 938	NA
In situ leaching	0	0	0	0
Heap leaching	0	0	0	0
In-place leaching (stope/block leaching)	0	0	0	0
Co-product and by-product	0	0	0	0
Unspecified	19 248	47 272	65 775	NA
Total	114 868	205 932	284 378	NA

* Recoverable resources, but depletion is not considered.

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	1 643	22 543	24 938
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	88 135	126 380	163 632
Vein	0	0	0
Intrusive	1 351	1 351	1 351
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	23 739	55 658	94 457
Total	114 868	205 932	284 378

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	114 877	124 260	130 322	NA
Open-pit mining	2 974	7 376	7 894	NA
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	1 906	5 676	12 495	NA
Total	119 757	137 312	150 711	NA

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	2 974	7 376	7 894
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	113 702	123 085	129 147
Vein	0	0	0
Intrusive	1 175	1 175	1 175
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	1 906	5 676	12 495
Total	119 757	137 312	150 711

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
34 901	110 310

Speculative Resources
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
–	1 112 900

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]	0	0	0	0	0	0
Underground mining[1]	0	0	0	0	0	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	153 253	747	673	534	155 207	750
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	153 253	747	673	534	155 207	750

(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]	[%]
0	0	534	100	0	0	0	0	534	100

Uranium industry employment at existing production centres

(person-years)

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	150	150	150	150
Employment directly related to uranium production	60	60	65	65

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
4 860	4 860	0	0	4 860	4 860	0	0	4 860	6 320	0	0

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
4 860	6 320	0	0	4 860	6 320	0	0	4 860	6 320	0	0

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	1 800	1 800

Installed nuclear generating capacity to 2030

(MWe net)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
1 800	1 840	1 840	1 840	2 005	8 420

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
10 500	15 340	16 000	25 000	20 000	25 000

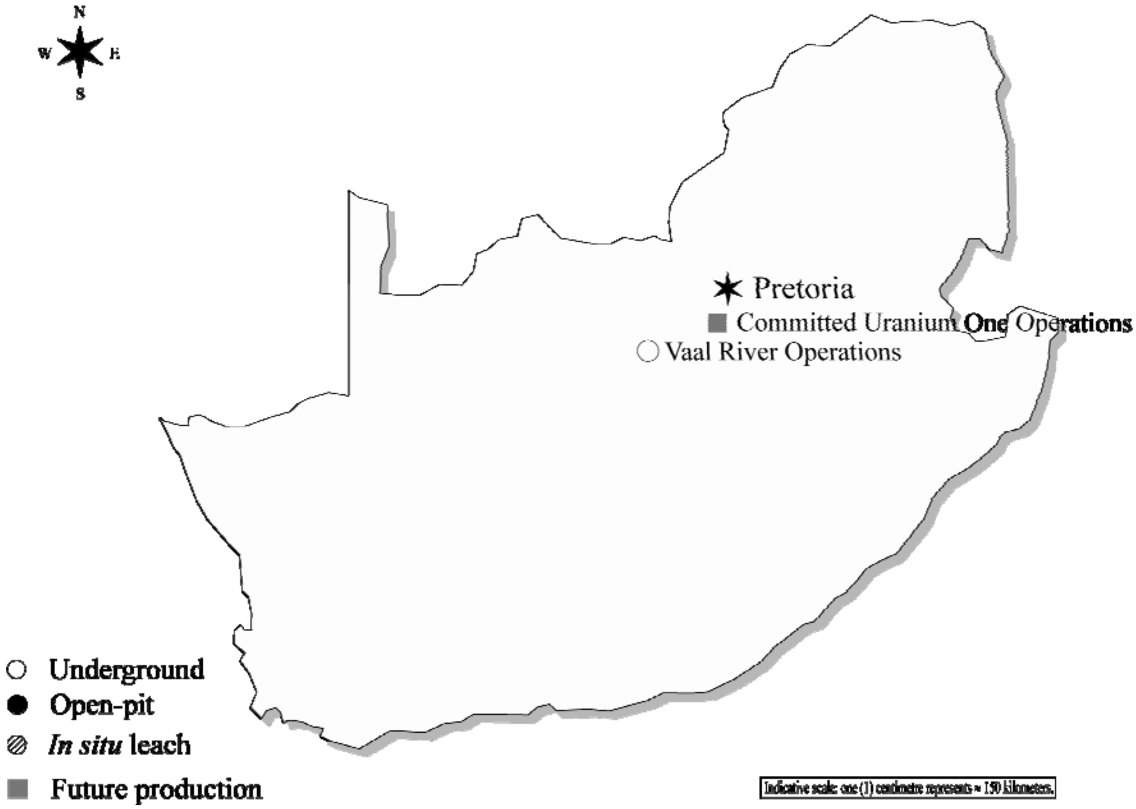
Annual reactor-related uranium requirements to 2030 (excluding MOX)
(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
282	292	292	292	294	1 312

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
1 569	2 144	2 099	3 235	3 175	3 235

Total uranium stocks
(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	0	0	0	0	NA
Producer	Unknown	0	0	0	NA
Utility	0	0	Unknown	0	NA
Total	NA	0	NA	0	NA



• Spain •

URANIUM EXPLORATION

Historical review

Uranium exploration started in 1951 and was carried out by the *Junta de Energía Nuclear* (JEN). Initial targets were the Hercynian granites of western Spain. In 1957 and 1958, the first occurrences in Precambrian-Cambrian schists were discovered, including the Fe deposit, located in the province of Salamanca. In 1965, exploration in sedimentary rocks started and the Mazarete deposit in Guadalajara province was discovered. Exploration activities by the *Empresa Nacional del Uranio*, S.A. (ENUSA) ended in 1992. Joint venture exploration between ENUSA and other companies continued until the end of 1994. During this period, most of the Spanish territory had been surveyed using a variety of exploration methods, adapted to different stages. An ample coverage of airborne and ground radiometrics of the most interesting areas has been achieved.

Recent and ongoing uranium exploration and mine development activities

In the last two years some international Junior Uranium Companies have applied for exploration permits in different historic uranium mining regions in Spain.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Both of the RAR and Inferred resources remain unchanged from the 2003 Red Book, and are reported as recoverable by open-pit mining.

Undiscovered Resources (Prognosticated & SR)

No resources for these categories were reported.

URANIUM PRODUCTION

Historical review

Production started in 1959 at the Andujar plant, Jaen province, and continued until 1981. The Don Benito plant, Badajoz province remained in operation from 1983 to 1990. Production at the Fe Mine (Salamanca Province) started in 1975 with heap leaching (Elefante plant). A new dynamic leaching plant (Quercus) started in 1993 and was shut down in December 2000. The license for a definitive shutdown of the production was submitted to Regulatory authorities in December 2002 and was approved in July 2003.

Status of production capability

Mining activities were terminated in December 2000. The processing plant finished the production of uranium concentrates in November 2002. A plan for its decommissioning has been presented to the Regulatory Authorities in 2005.

Ownership structure of the uranium industry

The only production facility in Spain belongs to the company ENUSA Industrias Avanzadas, S. A., owned (60%) by Sociedad de Participaciones Industriales (SEPI) and Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT), with 40%.

Employment in the uranium industry

Employment at the Fe Mine was 58 at the end of the year 2006.

Future production centres

No new production centres are being considered.

Secondary sources of uranium

Spain reported mixed-oxide fuel and re-enriched tails production and use as zero.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

The present conditions of uranium production facilities in Spain are as follows:

- Fabrica de Uranio de Andujar (Jaén Province): Mill and tailings pile are closed and remediated, with a ten-year surveillance and control programme (groundwater quality, erosion control, infiltration and radon control). This programme has been extended two additional years.

- Mine and plant "LOBO-G" (Badajoz Province): Open pit and mill tailings dump are closed and remediated, with a surveillance and control programme (groundwater quality, erosion control, infiltration and radon control) until 2004. In this year the long term stewardship and monitoring programme began after the declaration of closure.

- Old Mines (Andalucía and Extremadura Regions): Underground and open pit mines are restored, with work being completed in 2000.

- Elefante plant (Salamanca Province): Decommissioning Plan has been approved by Regulatory Authorities (heap leaching plant) in January 2001. The plant was dismantled in 2001. Ore stockpiles (used for heap leaching) were re-graded, then completely covered with a protection layer in 2004, and a five year surveillance and control programme was initiated.

- Open pit mine in Saelices el Chico (Salamanca Province): In 2004 the remediation plan of the open pit mine in Saelices el Chico (Salamanca Province) was approved by the Regulatory Authorities. This remediation plan is scheduled to be finished in 2008.

- Quercus plant (Salamanca Province): Mining activities ended in December 2000 and the processing plant finished the production of uranium concentrates in November 2002. A plan for decommissioning was submitted to the Regulatory Authorities in 2005.

URANIUM REQUIREMENTS

The net capacity of Spain's nuclear plants is about 7.45 GWe with eight operating reactors. No new reactors are expected to be built in the near future.

On 14 October 2002 the Ministry of Economy awarded the renewal of the Operating Permit to the José Cabrera NPP (150 MWe), allowing the plant to continue operation until 30 April 2006, the date on which the country's oldest reactor was permanently shut down, after 38 years of operation.

Supply and procurement strategy

All uranium procurement activities are carried out by ENUSA representing the companies that own the eight operating nuclear power plants in Spain.

NATIONAL POLICIES RELATING TO URANIUM

Spain's uranium import policy provides for diversification of supply. The Spanish legislation leaves uranium exploration and production open to national and foreign companies.

URANIUM STOCKS

Present Spanish regulation provides that a strategic uranium inventory of enriched uranium should be held jointly by the utilities that own nuclear power plants. The previous stock of at least 369 tU (435 t U_3O_8) was increased by a Ministerial Order of 7 September 2005 to 611 tU (721 t U_3O_8). Additional inventories could be maintained depending on uranium market conditions. No information on uranium prices was reported.

Reasonably Assured Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	2 460	4 925	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	2 460	4 925	

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	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	2 460	4 925
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	2 460	4 925

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	6 380	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	0	6 380	

Inferred Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	0	0	0
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	6 380
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	0	6 380

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]	4 961	0	0	0	4 961	0
Underground mining[1]	0	0	0	0	0	0
In situ leaching	0	0	0	0	0	0
Heap leaching	0	0	0	0	0	0
In-place leaching*	0	0	0	0	0	0
Co-product/by-product	0	0	0	0	0	0
U recovered from phosphates	0	0	0	0	0	0
Other methods**	67	0	0	0	67	0
Total	5 028	0	0	0	5 028	0

(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.

Uranium industry employment at existing production centres

(person-years)

	2004	2005	2006	2007 (expected)
Total employment related to existing production centres	56	56	58	58
Employment directly related to uranium production	0	0	0	0

Net nuclear electricity generation*

	2005	2006
Nuclear electricity generated (TWh net)	55.4	57.8

* *Nuclear Energy Data*, OECD, Paris, 2007.

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
7 450	7 450	7 450	7 450	7 450	7 450

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
7 450	7 450	NA	NA	NA	NA

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
1 726	1 308	1 830	1 830	1 010	1 010

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
1 400	1 400	1 400	1 400	1 400	1 400

Total uranium stocks

(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	NA	NA	NA	NA	NA
Producer	NA	NA	NA	NA	NA
Utility	NA	611	NA	NA	NA
Total	NA	NA	NA	NA	NA

• Sweden •

URANIUM EXPLORATION

Historical review

Uranium exploration was carried out during the period 1950-1985. However, at the end of 1985, exploration activities were stopped due to availability of uranium at low prices on the world market.

There are four main uranium provinces in Sweden:

The first is in the Upper Cambrian and Lower Ordovician sediments in southern Sweden and along the border of the Caledonian mountain range in central Sweden. The uranium occurrences are stratiform, in black (alumn) shales. Billigen (Vastergotland), where the Ranstad deposits is located, covers an area of more than 500 km^2.

The second uranium province Arjeplog-Arvidsjaur-Sorsele, is immediately south of the Arctic Circle. It comprises of one deposit, Pleutajokk, and a group of more than 20 occurrences. The individual occurrences are discordant, of a vein or impregnation-type, associated with sode-metasomatism.

A third province is located north of Ostersund in central Sweden. Several discordant mineralised zones have been discovered in, or adjacent to, a window of Precambrian basement within the metamorphic Caledonites.

A fourth province is located near Asele in northern Sweden.

Recent and ongoing exploration and mine development activities

Since 2005, a number of exploration companies have requested and received permits to explore for uranium in Sweden. In some cases, these permits were challenged by some members of local communities. Nonetheless, exploration companies are working toward the production of NI 43-101 compliant resource estimates. Since the Swedish government does not report exploration expenditures by these companies, details on these activities are not available.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

There are small resources in granite rocks (vein deposits) in Sweden.

Undiscovered Resources (Prognosticated & SR)

There are no Prognosticated or Speculative Resources reported in Sweden.

Unconventional Resources

There are potentially large resources of uranium in alum shale; however, these deposits are very low grade and the cost of recovery is above USD 130/kgU.

URANIUM PRODUCTION

Historical review

In the 1960s, a total of 200 tU were produced from the alum shale deposit in Ranstad and represents all of Sweden's historical production. This mine is now being restored to protect the environment.

Status of production capability

There is no uranium production in Sweden and there are no plans for production.

Secondary sources of uranium

Sweden reported mixed-oxide fuel and re-enriched tails production and use as zero.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

The Ranstad mine was rehabilitated in the 1990s. The open-pit was transformed into a lake and the tailings area was covered with a multilayer top to prevent the formation of acid from sulphur in the shale tailings. An environmental monitoring programme is now being carried out.

The total cost of restoration of the Ranstad mine was SEK 150 million. The current monitoring programme represents only minor costs.

URANIUM REQUIREMENTS

By the end of 2005, two of Sweden's 12 nuclear power reactors, Barsebäck 1 (1999) and Barsebäck 2 (2005), were retired from service as a result of a political decision.

Supply and procurement strategy

The utilities are free to negotiate their own purchases.

NATIONAL POLICIES RELATING TO URANIUM

Sweden has joined the Euratom Treaty and adjusted its policy accordingly.

URANIUM STOCKS

The Swedish parliament decided in 1998 to replace the previous obligation that utilities had to keep a stockpile of enriched uranium corresponding to the production of 35 TWh with a reporting mechanism. Sweden reported no information on uranium stocks.

URANIUM PRICES

As Sweden is now part of the deregulated Nordic electricity market, costs of nuclear fuel are no longer reported.

Reasonably Assured Resources
(tonnes U)

Production method	**<USD 40/kgU**	**<USD 80/kgU**	**<USD 130/kgU**	**Recovery factor** (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	4 000	
Total	0	0	4 000	

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	6 000	
Total	0	0	6 000	

Net nuclear electricity generation*

	2005	2006
Nuclear electricity generated (TWh net)	69.5	65.0

* *Nuclear Energy Data*, OECD, Paris, 2007.

Installed nuclear generating capacity to 2030*

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
8 990	NA	9 480	NA	10 080	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
10 080	NA	10 080	NA	10 080	NA

* *Nuclear Energy Data*, OECD, Paris, 2007.

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
1 600	NA	1 400	1 800	1 400	1 800

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
1 500	1 800	1 500	1 800	1 500	1 800

* *Nuclear Energy Data*, OECD, Paris, 2007.

• Switzerland •

URANIUM EXPLORATION

Historical review

In June 1979, the federal government decided to encourage uranium exploration by awarding a grant of CHF 1.5 million for the period 1980-1984. During 1980 and 1981 about 1 000 m of galleries were excavated for prospecting by a private company in the Hercynian Massif of Aiguilles Rouges and the surrounding gneisses. The limited work so far has not allowed a clear picture of the factors controlling the mineralisation, which is of low grade and disseminated in an area which is geologically very complex.

In 1982, the federal government supported surface prospecting to the south of Iserables and drilling at Naters (Valais). Between 1982 and 1984, in the framework of the five-year programme financed by the federal government, uranium exploration was carried out in the rugged region of the Penninic Berhard nappe, in the western Valais. The radiometric and geochemical investigations concentrated mainly on the detrital deposits of the Permo-Carboniferous and schists of older age (series of Nendaz and the underlying series of Siviez). Owing to strong alpine tectonism, the uranium is generally irregularly disseminated in the rock. Radioactive anomalies seem to be bound to the carbonatic and chloritic facies of the Nendaz series, but their practical value could not be confirmed.

Private industry was engaged in uranium exploration, mining and milling in the western United States from 1983 to 1995. Since 1985 all domestic exploration activities have been stopped.

Recent and ongoing uranium exploration and mine development activities

None.

URANIUM RESOURCES

No uranium resources have been reported for Switzerland.

URANIUM PRODUCTION

Switzerland does not produce uranium and no future production centres in Switzerland are envisaged at this time.

Secondary sources of uranium

Production and/or use of reprocessed uranium

Due to Swiss law there is, starting on 1 July 2006, a 10-year moratorium on the export of burned fuel assemblies for reprocessing.

URANIUM REQUIREMENTS

Switzerland has five operating nuclear power stations located at Beznau (Units 1 and 2), Muehleberg, Goesgen and Leibstadt. In 2006, total installed nuclear capacity was about 3 200 MWe net.

Supply and procurement strategy

Uranium is procured from a combination of long-term and spot market contracts.

NATIONAL POLICIES RELATING TO URANIUM

Switzerland does not produce uranium and does not export uranium. There is no official import policy as private companies handle their own procurement.

URANIUM STOCKS

It is the policy of nuclear plant operating companies to maintain a stockpile of fresh fuel assemblies at the reactor site. In Switzerland, uranium stocks, if they exist, are held only by the utilities. No detailed information is available on utility uranium stocks.

Uranium stocks are held as U_3O_8, UF_6 (natural) and UF_6 (enriched).

URANIUM PRICES

None reported.

Mixed-oxide fuel production and use
(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	0	0	0	0	0	0
Use	1021.5	12.5	108.5	158.6	1 301.1	25.6
Number of commercial reactors using MOX	3	3	3	3		3

Switzerland

Reprocessed uranium use

(tonnes of natural U equivalent)

Reprocessed uranium	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	0	0	0	0	0	0
Use	1 009	254	281	244	1 788	289

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	22.637	26.627

Installed nuclear generating capacity to 2030

(MWe net)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
3 220	3 220	3 220	3 220	2 865	3 220

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
2 865	3 220	2 135	3 220	0	3 220

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

(tonnes U)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
267	275	371	387	318	387

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
498	567	378	567	0	447

Total uranium stocks

(tonnes natural U-equivalent)

Holder	**Natural uranium stocks in concentrates**	**Enriched uranium stocks**	**Depleted uranium stocks**	**Reprocessed uranium stocks**	**Total**
Government	0	0	0	0	0
Producer	0	0	0	0	0
Utility	0	0	0	0	0
Total	1 609	1 422	0	0	3 031

• Turkey •

URANIUM EXPLORATION

Historical review

Uranium exploration in Turkey began in 1956-1957 and was directed towards the discovery of vein type deposits in crystalline terrain, such as acidic igneous and metamorphic rocks. As a result of these activities, some pitchblend mineralisations were found but they did not form economic deposits. Since 1960, studies have been conducted in sedimentary rocks which surround the crystalline rock and some small ore bodies containing autunite and torbernite mineralisation have been found in different parts of the country. In the mid-1970s the first uranium deposit with black ore, below the water table, was found in the Köprübaşı area. As a result of recent exploration activities, uranium mineralisation has also been found in Neogene sediments in the Yozgat-Sorgun region of Central Anatolia.

Recent and ongoing uranium exploration and mine development activities

In 2005 and 2006, granite and acidic intrusive rocks and sedimentary rocks were explored for radioactivity over a 7 000 km^2 area.

In 2007 and 2008, granite and acidic intrusive rocks and sedimentary rocks will be explored for radioactivity, over a 10 000 km^2 area.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

- Salihli-Köprübaşi: a total of 2 852 tU in 10 ore bodies at grades of 0.03% U to 0.04% U in fluvial Neogene sediments;
- Fakılı: 490 tU at 0.04% U in Neogene lacustrine sediments;
- Koçarlı (Küçükçavdar): 208 tU at 0.04% U in Neogene sediments;
- Demirtepe: 1 729 tU at 0.07% U in gneiss fracture zones;
- Yozgat-Sorgun: 3 850 tU at 0.08% U in Eocene deltaic lagoon sediments.

Undiscovered Resources (Prognosticated & SR)

None reported.

Unconventional Resources and other materials

None reported.

URANIUM PRODUCTION

Turkey has no uranium production.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

None reported.

URANIUM REQUIREMENTS

Turkey has no operating nuclear power plants.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in USD	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	7 000	23 000	56 000	50 000
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	7 000	23 000	56 000	50 000

Reasonably Assured Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	9 129	9 129	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	0	9 129	9 129	

* *In situ* resources.

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	0	7 400	7 400
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	1 729	1 729
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	0	0	0
Other	0	0	0
Total	0	9 129	9 129

Installed nuclear generating capacity to 2030

(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
NA	NA	NA	NA	1 500	4 500

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
4 500	4 500	NA	NA	NA	NA

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

(tonnes U)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
NA	NA	NA	NA	NA	NA

Total uranium stocks
(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	1.9	0	0	0	1.9
Producer	0	0	0	0	0
Utility	0	0	0	0	0
Total	1.9	0	0	0	1.9

• Ukraine •

URANIUM EXPLORATION

Historical review

On 3 November 2007, there will have been 60 years since the foundation of *Kirovgeology* – an organisation which now conducts all surveys and exploration for uranium in Ukraine. But prospecting for uranium in Ukraine began in 1944 as a revision of works performed by wells drilled before and mine workings produced in the North Krivoy Rog ore area. The Pervomayskoye and Zheltorechenskoye uranium deposits, which were discovered as a result of these works, were mined out in 1967 and 1989 respectively.

The first sandstone type deposit Devladovskoye was discovered in 1955.

In the mid-60s the main geological explorations were concentrated in the Kirovograd ore region for discovery of uranium metasomatite type deposits. As a result of this work, the Michurinskoye, Vatutinskoye and Severinskoye deposits were discovered.

At present, metasomatite type deposits comprise the major proportion of raw material resources of Ukraine. Uranium content in ores is 0.1-0.2%. They are suitable for mining. The second type of economic deposits is the ores of sandstone type, but they comprise a small part of total resources. Uranium content is 0.02-0.06%. They are applicable for extraction by *in situ* leaching from the wells.

Recent and ongoing uranium exploration and mine development activities

Using exploration criteria and indications on the base of international and national practice, specialists of *Kirovgeology* compiled a new prediction map of Ukraine for uranium at a scale 1:500 000 where ore areas and potential ore regions and nodes have been distinguished as prospective regions of finding deposits of unconformity-related vein type and hematite breccias, and of volcanic type.

The ore grades of these deposits are expected to surpass the metasomatite type deposits.

In 2005-2006, prospecting studies for discovery of deposits of different geological economic types were conducted.

Unconformity type deposits were discovered within the areas of the western slope of the Ukrainian Shield in zones of the Riphean unconformity. The works within Verbovskaya and Khotynskaya areas have been completed (the report is being compiled) and the works within the Drukhovskaya area (450 km^2) have begun.

Within zones of Vendian unconformity the works were conducted in the South Podolian area (840 km^2) of southwestern slope of the Ukrainian Shield.

Prognostication works were conducted for the vein type deposits in Zelenovskaya and Mikhaylovskaya areas of the West Inguletskaya zone of the Ukrainian Shield (field works have been completed, the report is being compiled).

Because of limited uranium exploration activity in 2005-2006, no results of economic interest were obtained.

In 2006, estimation of Dibrovskoye rare earth-thorium-uranium mineralisation within the Pryazov block the Ukrainian Shield started with assessment the Prognosticated Resources of uranium and thorium.

In the context of rising prices for uranium, exploration is being planned for deposits of metasomatite type, first of all within the areas of operating mines.

The works on estimation thorium presence of the Ukrainian Shield continued in 2005-2006 based on compiling a registration map of thorium occurrences at a scale 1:500 000. Government and private companies in Ukraine do not conduct any exploration activities for uranium in other countries. Neither foreign governments nor private companies conduct exploration activities for uranium in Ukraine.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

As of 1 January 2007, RAR and IR resources at mining cost less than 80 USD/kgU totalled 230 580 tU, compared to 98 700 tU as of 1 January 2005. This large increase is a result of taking into account the resources of the Novokonstantinovskoye and Central deposits, which were not taken into account earlier. The resources of the Podgaytsevskoye deposit were however aggregated with the Severinskoye deposit. For the Michurinskoye and Vatutinskoye deposits, residual resources are given even though the bulk of the deposit has been mined out.

As of 1 January 2007 uranium resources, recovered at mining cost less than 40 USD/kgU, are estimated as 43 140 tU, compared to 45 040 as of 1 January 2005. This decrease took place as a result of mining the Vatutinskoye and Michurinskoye deposits.

The main economic resources of uranium are concentrated in Ukraine within deposits of two types:

- Metasomatite type deposits located within the Kirovograd block of the Ukrainian Shield. The deposits are monometallic. Uranium content of the ore is 0.1-0.2%. These deposits are suitable for underground mining.
- Sandstone type deposits located within the Dnieper-Bug metallogenic area (17.3 thousand km2). In addition to uranium, molybdenum, selenium and rare earths of the lanthanide group occur in these ores. Uranium content of the ore is 0.01-0.06%. These deposits are suitable for mining by ISL.

Uranium resource assessments were conducted during the last five years period for deposits of metasomatite type (Vatutinskoye, Michurinskoye and Severinskoye), but not for the sandstone type deposits. Depletion of resources is taken into account. In 2005 and 2006 resources of the Michurinskoye and Vatutinskoye deposits has been reduced by 1 900 tU.

Undiscovered Resources (Prognosticated & SR)

The total amount of resources in these categories following reassessment amounts to 270 300 tU.

Prognosticated Resources (PR) are mainly confined to the flanks of the Severinskoye deposit and are equal to 15 300 tU.

Speculative Resources (SR) have been assessed according to the results of prediction-prospecting works in the Central-Ukrainian metallogenic area and uranium prognostication map compiled by *Kirovgeology* at a scale 1:500 000. They amount to 255 000 tU and are subdivided according to geological-production types as follows:

- speculative deposits of metasomatite type (133 500 tU);
- deposits of sandstone type in sedimentary cover of the Ukrainian Shield (20 000 tU) and deposits of sandstone type outside the shield (in bitumen) (16 500 tU);
- deposits of “unconformity” type (40 000 tU);
- vein type deposits (30 000 tU) ;
- “intrusive” deposits in potassium metasomatites (15 000 tU).

URANIUM PRODUCTION

In 1951 the Government of Ukraine created the Vostochnyi mining-processing combinat (VostGOK) in the city of Zheltye Vody in the Dnepropetrovsk region for mining and processing uranium ores from Pervomayskoye and Zheltorechenskoye deposits. The Pervomayskoye deposit was completely worked out in 1967 and the Zheltorechenskoye deposit in 1989.

Today, VostGOK is operating uranium production from the deposits of the Central Ukrainian ore province (the Michurinskoye deposit, 3 km south of Kirovograd, and the Vatutinskoye deposit near the town Smolino) and is committed to mining the Severinskoye deposit, 4 km north of Kirovograd.

The Michurinskoye deposit was discovered in 1964 and construction of the Ingulsky mine began in 1967. Uranium content of ore bodies in the deposit is about 0.1%. Radiometric sorting of mine cars, conducted in the mine, optimises uranium content (up to 0.1-0.2%). Two shafts, 7 m in diameter, have been sunk. Ore hoisted along the northern shaft supplies two trucks with a loading capacity of 11 tonnes. The southern shaft is used for transporting the workers, provisioning and other technical aims. A ventilation shaft supplies 480 m^3 of fresh air per second. Mining is conducted in blocks 60-70 m high at the horizons -90, -150, -350 m.

The Vatutinskoye deposit was discovered in 1965 and construction of the Smolinsky mine began in 1973. The industrial area of facilities mining the Vatutinskoye deposit is situated near the town Smolino, 80 km west of Kirovograd. Transport of mined rocks to the surface is conducted along the "Main" and "Helping" shafts sunk down to the depth of 460 m. The lower part of a deposit (a depth of 640 m) was stripped by two blind stems ("Blind-1" and "Blind-2"). Stationary compressor terminals were installed on the surface of each shaft to produce compressed air used for the drill and fire system, loading and unloading mine-cars, facilities for radioactive ore-dressing, and servicing the shaft top. Electro-hydraulic perforators, diesel transportation of ore and rock, autonomous production of compressed air are being introduced now to increase production capacity and decrease costs of production.

The ore is mined with standard drill and fire operations followed by backfilling. The mines are operated by three shifts totalling 850 workers. Within each cleaned block, after drill and fire operations, the ore is moved to loading pocket, transferred to electric powered trams and transported to the main stem, where it is crushed before being hoisted to the surface. Radiometric ore-dressing, storage, loading to railway carriages and shipping for further processing occurs on the surface. Mined out space is backfilled by hydro-packing.

In situ leaching has been practiced in Ukraine since 1961. From 1966 to 1983 three deposits (Devladovskoye, Bratskoye and Safonovskoye) were mined by sulphuric acid ISL at a depth of about 100 m. These sandstone deposits are located within the sedimentary cover of the Ukrainian Shield at the depth of less than 100 m. However, ISL mining was stopped mainly due to environmental reasons. At present, monitoring of conditions of mined out deposits is ongoing. Development of two deposits for ISL mining with alternate leaching reagents is being planned.

Hydrometallurgical processing plant

The hydrometallurgical processing plant of the VostGOK is situated in the c. Zheltye Vody region. The annual capacity of the plant is 1.5 Mt ore by 30-35 persons per shift at the plant. Ore is transported to the plant by specially equipped trains from two mines, Ingulskiy and Smolinskiy, situated 100 km and 150 km west, respectively. After crushing and radiometric sorting, the ore is leached in autoclaves using sulphuric acid at a temperature of 150-200°C and 20 atmospheres pressure for four hours. Acid expenditure is 80 kg/t ore. For uranium extraction, an ion-exchange resin is applied. After washing with a mixture of sulphuric and nitric acids, the uranium-bearing solution is subjected to further concentration and purification through extraction with solvents, and ammonium gas for precipitation. The dewatered precipitate is calcined at 800°C until a dark colour product is obtained.

Innovation techniques in uranium production

In metasomatite type deposits in Ukraine the uranium content of the ore is about 0.1%. Mineralisation is disseminated throughout the volume of ore (uraninite, brannerite, coffinite, nasturane). The ore bodies are steeply-falling. The mines are situated about 100 and 150 km from the hydrometallurgical plant. This makes mining, transportation and processing of the ore difficult.

Quarrying is conducted by underground mining, processing is conducted by crushing the ore and technology of recovery by sulfuric acid in autoclaves. Poor uranium ore grades combined with the most expensive technologies of mining and processing makes uranium production non profitable under existing market conditions.

In order to decrease prime costs of production from low-grade uranium ores, innovative production technologies have been introduced lately at mines, such as deep radiometric sorting (separation), in-place leaching and heap leaching, and reprocessing (reclamation) of dumps at operating mines.

The so-called multistage radiometric separators, designed by State Enterprise VostGOK for different size lumps, are used for both mined ore and the rock mass in mine dumps. In the case of mined ore, the uranium content in concentrate treated this way may reach 0.03-0.3%U. In contrast, uranium content in "tailings" is less than 0.006%.

If rocks in dumps have average specific activity at the level of 1 500-1 600 Bk/kg, then the "tailings" obtained after radiometric separation have only 350-650 Bk/kg and can be used as construction material of the second class with specific activity within the limits 370-740 Bk/kg.

Separators may be installed both on the surface and underground in the mine. Output of a system of two separators (for different machine classes) is 150 000 tons of ore per year. Three products are obtained during radiometric separation of dump rocks:

- 30% – uranium concentrate (0.05-0.06% U);
- 55% – pure "tailings" with specific activity less than 740 Bk/kg for use as construction material of the second class;
- 15% – inert material for use as hydro-backfill of mined-out space in mine conditions.

Subsequently, uranium is detached from the crushed concentrate by heap leaching (HL). The prime cost of 1 kg of ready product from HL is 62% less than the cost of processing this concentrate at a hydrometallurgical plant.

Poor ore bodies with uranium content 0.04-0.06% are mined applying in-place leaching (IPL) method. The optimal technique of detonation has been employed to crush the ore in blocks. Uranium concentration in pregnant solutions changes from 1 000 mg/l at the beginning to 50 mg/l at the end of IPL. Recovery of uranium during HL is about 70-75% per one year of leaching. The cost is 58% of that for conventional technology of ore mining and processing. Three blocks have been prepared now for mining applying IPL method.

Ores of metasomatite deposits of Ukraine are applicable for HL. Only one parameter of twelve (finely disseminated uranium mineralisation) is inapplicable for HL. Therefore the degree of crushing is the most important parameter. It determines the degree of uranium recovery possible and the permeability of the material during HL. The maximum size of uranium minerals nodes is usually between 1 and 5 mm. The optimum size of a lump of ore material is 10 mm, which typically yields 80-90% uranium recovery during two-three months.

The heaps are either formed of ore with uranium content 0.050-0.080% or of concentrate, obtained as a result of dump sorting with uranium content 0.50-0.60%. The volume of a heap is 40 000 tons of ore, its height is up to 6.0-8.0 m. At the Vatutinskoye deposit the site for heap leaching is being built and at the Michurinskoye deposit it is committed. The site for HL consists of four heaps with total volume of processing 160 000 tonnes of ore per year.

Efforts to improve the technology of radiometric ore-dressing at the radiometric processing plants (RPP) available at each uranium pit are ongoing. Only two years ago at the Smolinskaya RPP specific activity in “tailings” was 1900 Bk/kg, now it is no more than 1 100 Bk/kg. Applying a new generation of separators will reduce the specific activity of “tailings” to between 500 and 600 Bk, which corresponds to specific activity of construction materials of the second class. In this case “tailings” may be used as construction materials for highways and industries, and this reduces wastes produced in mining.

Ownership of uranium industry

All the enterprises of uranium industry connected with mining, ore-dressing of uranium and further obtaining nuclear fuel in Ukraine belong to the state and are subordinate to the Department of atomic-industrial complex of the Ministry of Fuel and Energy of Ukraine.

Vostochnyi mining-processing combinat is in charge of mining and processing of uranium ores in Ukraine and is subordinate to the Department of atomic-industrial complex. In addition to subdivisions of mining and processing uranium ore, VostGOK runs a plant for production of sulfuric acid, a mechanical-repair plant, a scientific-production complex called “Automatics and machinery construction”, and a transportation sub-unit.

State Enterprise *Kirovgeology* is responsible for mineral raw material reserves of uranium in Ukraine (search, assessment and exploration of uranium deposits) and is subordinate to State Geological Survey of the Ministry of Environmental Protection.

In December 2006, the Government of Ukraine founded State Concern *Ukratomprom* in the sphere of Directorate of Ministry of Fuel and Energy. Management of current activity and presentation of its interests in external economic and investment relations is the responsibility of the State Enterprise National Atomic Energy-Generating Company *Energoatom.*

Uranium production centre technical details

(as of 1 January 2007)

	Centre #1	Centre #2
Name of production centre	Hydrometallurgical plant (HMP) c. Zheltye Vody	Hydrometallurgical plant
Production centre classification	Operating	committed
Start-up date	1958	2015
Source of ore:		
• Deposit name	Michurinskoye Vatutinskoye	Severinskoye
• Deposit type	Metasomatite	metasomatite
• Resources (tU)		
• Grade (% U)	0.1%	
Mining operation:		
• Type (OP/UG/ISL)	UG	UG
• Size (t ore/day)	NA	
• Average mining recovery (%)	Michurinskoye – 78% Vatutinskoye – 79%	80%
Processing plant (acid/alkaline):	sulphuric acid	sulphuric acid
• Type (IX/SX/AL)	ion-exchange (IX)	ion-exchange (IX)
• Size (t ore/day) for ISL (L/day or L/h)	NA	NA
• Average process recovery (%)	92	NA
Nominal production capacity (tU/year)	1 500	1 200
Plans for expansion		
Other remarks		

NA Not available.

Secondary sources of uranium

Mixed-oxide fuel (MOX) has never been produced and has never been used in power plant reactors in Ukraine.

Re-enrichment of uranium tails has never been conducted. There are no storage facilities for such uranium in Ukraine and nuclear fuel produced from re-enriched uranium tails has never been used.

Reprocessing (regeneration) of uranium from spent nuclear fuel is not conducted in Ukraine and reactor fuel produced from reprocessed (regenerated) uranium (Rep U) has never been used.

ENVIRONMENTAL ACTIVITIES AND SOCIAL CULTURAL ISSUES

The main environmental impacts of uranium production (mines Inguletskaya and Smolinskaya) are produced at ore sheds, tailings dumps, waste rock dumps, and transport.

The main factors of environmental impact of uranium production (hydrometallurgical plants, heap-leaching sites) are:

- harmful chemical and ore dust emissions (for the sites of hydrometallurgical plants and heap leaching);
- wind transportation of aerosols and groundwater contamination from tailings impoundments.

To assure environmental impacts are minimised, permanent monitoring is being conducted.

At the mined out Devladovskoye and Bratskoye deposits, observations of ground water conditions have been conducted since 1988. Results show that the halo of residual leaching reagents does not cross the contours of mined out ore bodies, but is diluted and reduced in volume.

Treatment at the hydrometallurgical plant (c. Zheltye Vody) results in the removal and storage of processing wastes (tailings), clearing of the liquid part and using recycled water in the technological process. Two tailings impoundments, one situated at 9 km from the hydrometallurgical plant consisting of two sections (135 and 163 hectares), and the second at 0.5 km from the plant (55 hectares), receive tailings. The second tailings impoundment is filled to capacity and reclamation is ongoing.

There are problems connected with decommissioning of uranium mining and uranium processing enterprises.

The Prydnieprovsky chemical plant in c. Dnieprodzerzhynsk produced uranium concentrate from 1949 to 1991. On the territory of the plant and outside its limits, nine tailings impoundments were used during uranium production (total area of 268 hectares containing 42 Mt of wastes) with total activity of 75 000 Ku. The area of radioactive pollution of the territory of production site of the plant with exposed dose of gamma radiation over 100 MkR/hour is 250 000 m^2. Some buildings and other facilities are polluted by radioactivity. The Cabinet of Ministers of Ukraine issued the "State programme for putting unsafe objects of the Pridnieprovskiy chemical plant in an environmentally safe condition and providing protection of the population from the harmful impacts of ionising radiation". This programme has been funded since 2005 at the expense of State Budget to a sum of UAH 22.3 million.

This State programme was approved in 1995 to improve radiation protection at all enterprises of the atomic industry and all contaminated areas resulting from mining and processing of uranium.

The cost of works foreseen by the programme is assessed as USD 360 million. The programme will include decontamination of polluted soils, environmental monitoring, installation of monitoring systems where necessary, improvement of technology of management with water flows, radioactive rocks in dumps, polluted equipment and land areas.

URANIUM REQUIREMENTS

Natural uranium production in Ukraine is at the level of 30% of the country's nuclear energy requirements.

Since the beginning of electricity production in nuclear power plants in Ukraine, requirements of NPPs in nuclear fuel have been provided at the expense of 100% import of fuel elements from the Russian Federation (provider TVEL).

To supply four operating NPPs with 15 units (13-VVER-100 and 2-VVER-440), 15 loading sets of fuel elements are provided from Russia annually. The total cost of delivery is about USD 300 million.

In 2005, operational testing of six fuel units sets produced by "Westinghouse" for reactors VVER-1000 at the South Ukraine NPP began. After testing, in three years, it will become possible to conduct a tender to determine alternative providers of nuclear fuel.

At present, the cost of nuclear fuel from "Westinghouse" is 40% higher than the cost of Russian fuel. Therefore for the nearest future the Company "Westinghouse" is not expected to become the provider of nuclear fuel for Ukraine.

It is expected that, by 2010-2012, 100% of requirements of NPPs will be supplied by natural uranium production within Ukraine.

Natural uranium requirements in 2005-2006 were met by mining and purchases from the companies TVEL (Russia), URANGESELLSCHAFT (Germany) and RWE NUKEM GmbH (Germany).

Installed nuclear generating capacity by 2030

At present 15 energy units are operating at four nuclear power plants: at the Zaporozhskaya NPP, six VVER-1000 units; at the South Ukraine NPP, three VVER-1000 units; at the Rovenskaya NPP, four units (2 VVER 440 and 2 VVER-1000); at the Khmelnitskaya NPP, two VVER-1000 units.

According to the programme of development of nuclear energy production, it is foreseen to preserve by 2030 a share of electric energy production at NPPs of not less than 45-50% of the total production. This means that nuclear energy production will increase about two times from 75.2 to 150 billion KWe/h annually.

The following will be required to realise this programme:

- Life extension of the operating NPP units.
- Putting into operation twelve new NPPs, including ten new units with a capacity of 1 500 MWe each.
- Decommissioning of twelve NPPs due to ageing, even after life extension.

NATIONAL POLICIES RELATING TO URANIUM

On 29 December 2006 the Cabinet of Ministers of Ukraine passed a Resolution No. 1854 "On improvement of administration of atomic-industrial complex". This Resolution founded the State Concern "Ukratomprom", which comprised all enterprises and scientific research institutes, connected with nuclear fuel cycle. This Resolution is aimed at improving investment conditions.

The Ukrainian Government Policy is aimed at increasing uranium production and attracting foreign investment for the development of uranium mining projects within the territory of Ukraine.

According to the Government's strategy of nuclear energy production development to 2030, it is foreseen to retain the share of electric energy production by NPP at the level of 45-50% of total electricity production. As a result, NPP production will have to be doubled by 2030 (from 87 to 150 G KWe/h annually). To do so twelve, among them ten new, energy units of NPP with capacity of 1 500 MWe each will have to be put into production.

It is also foreseen by this policy that the country will increase its domestic uranium mining capacity in order to meet NPP requirements.

The Cabinet of Ministers of Ukraine approved Resolution No. 634/8 on 6 June 2001 establishing the Complex Programme for the Nuclear Fuel Cycle. However, uranium enrichment is foreseen to be conducted outside the limits of Ukraine.

URANIUM STOCKS

There are no uranium stocks for future supply of NPP reactors in Ukraine, and no stocks of enriched uranium and nuclear fuel.

URANIUM PRICES

The data on costs of natural uranium production in Ukraine are not available.

To produce reactor fuel for Ukrainian NPPs, the prices of natural U, conversion and ore-dressing, taking into account recent increases, are guaranteed by the Russian Federation Government. Guaranteed profitable price conditions for providing nuclear fuel by the concern "TVEL" at the conditions of international tender until 2010 have also been provided.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million UAH	2004	2005	2006	2007 (expected)
Industry exploration expenditures	0	0	0	0
Government exploration expenditures	22.7	24.1	30.3	30.4
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0.6	0.7
Total expenditures	22.7	24.1	30.9	31.1
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	40 938	32 297	37 720	37 850
Number of government exploration holes drilled	261	206	241	242
Industry development drilling (metres)	NA	NA	NA	NA
Number of development exploration holes drilled	NA	NA	NA	NA
Government development drilling (metres)	NA	NA	4 494	5 250
Number of development exploration holes drilled	NA	NA	74	79
Subtotal exploration drilling (metres)	40 938	32 397	37 720	37 850
Subtotal exploration holes	261	206	241	242
Subtotal development drilling (metres)	0	0	4 494	5 250
Subtotal development holes	0	0	74	79
Total drilling (metres)	40 938	32 397	42 214	43 100
Total number of holes	261	206	315	321

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	27 750	151 640	162 300	
Open-pit mining	0	0	0	
In situ leaching	6 900	6 900	6 900	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	34 650	158 540	169 200	

* *In situ* resources, given without taking into account mining and processing losses.

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	6 900	6 900	6 900
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	27 750	151 640	162 300
Other	0	0	0
Total	34 650	158 540	169 200

Inferred Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	7 290	70 840	79 560	
Open-pit mining	0	0	0	
In situ leaching	1 200	1 200	1 200	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	0	0	0	
Total	8 490	72 040	80 760	

* *In situ* resources, given without taking into account mining and processing losses.

Inferred Resources by deposit type
(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	0	0	0
Sandstone	1 200	1 200	1 200
Hematite breccia complex	0	0	0
Quartz-pebble conglomerate	0	0	0
Vein	0	0	0
Intrusive	0	0	0
Volcanic and caldera-related	0	0	0
Metasomatite	7 290	70 840	79 560
Other	0	0	0
Total	8 490	72 040	80 760

Prognosticated Resources

(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
8 350	22 540

Speculative Resources

(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
120 000	135 000

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]	NA	NA	NA	NA	NA	
Underground mining[1]	NA	855	830	808	NA	890
In situ leaching	NA	NA	NA	NA	NA	
Heap leaching	NA	NA	NA	NA	NA	
In-place leaching*	NA	NA	NA	NA	NA	10
Co-product/by-product	NA	NA	NA	NA	NA	
U recovered from phosphates	NA	NA	NA	NA	NA	
Other methods**	NA	NA	NA	NA	NA	
Total	NA	855	830	808	NA	900

(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]	[%]
808	100	0	0	0	0	0	0	808	100

Uranium industry employment at existing production centres

(person-years)

	2004	**2005**	**2006**	**2007** (expected)
Total employment related to existing production centres	4 380	4 350	4 310	NA
Employment directly related to uranium production	1 790	1 760	1 720	1 690

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
1 000	NA	NA	NA	NA	NA	NA	1 500	NA	NA	NA	2 000

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
Na	NA	NA	2 700	NA	NA	NA	3 700	NA	NA	NA	3 700

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	75.2	NA

Installed nuclear generating capacity to 2030

(MWe gross)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
11.8	13.8	13.8	13.8	15.8	17.9

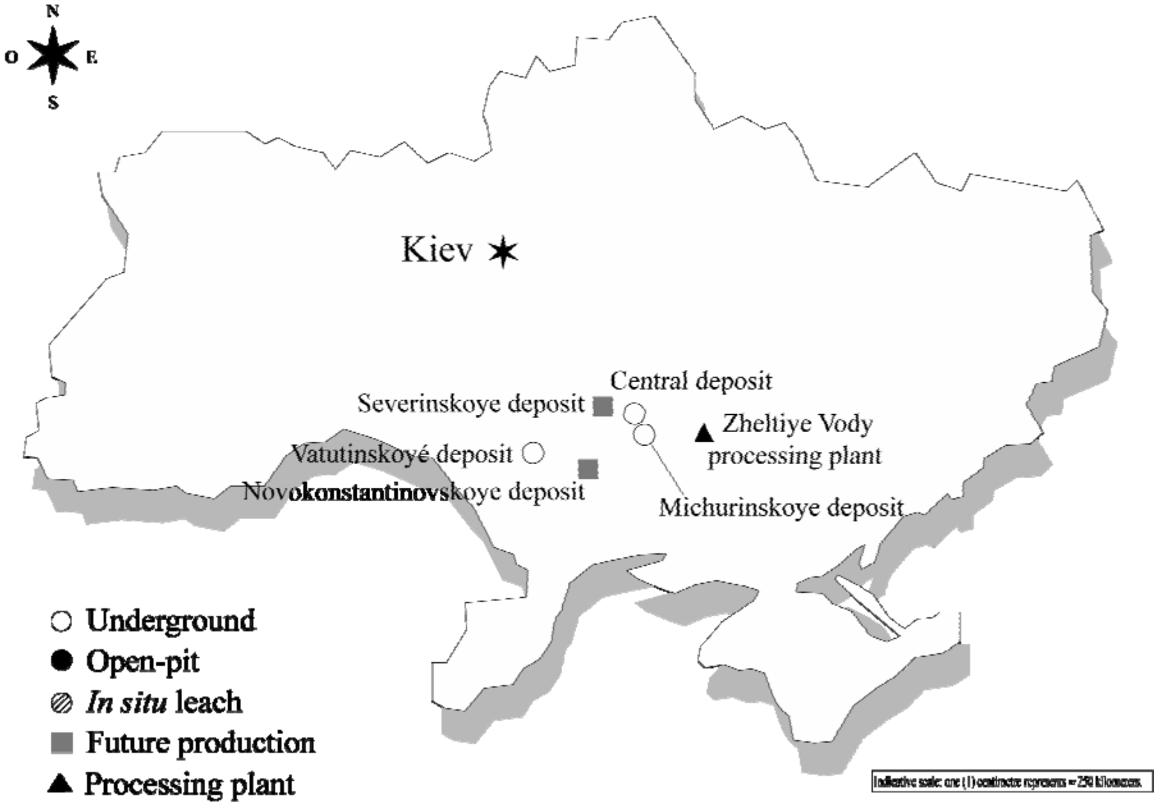
2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
16.6	20.2	18.8	26.2	20.0	26.2

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

(tonnes U)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
2 480	2 480	2 480	2 480	2 480	3 230

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
3 020	3 660	3 390	4 800	3 600	4 800



• United Kingdom •

URANIUM EXPLORATION

Historical review

Some uranium mining occurred in Cornwall, as a sideline to other mineral mining, especially tin, in the late 1800s. Systematic exploration occurred in the periods 1945-1951, 1957-1960, and 1968-1982, but no significant uranium reserves were located.

Recent and ongoing uranium exploration and mine development activities

Exploration in overseas countries is carried out by private companies operating through autonomous subsidiary or affiliate organisations established in the country concerned (e.g., members of the Rio Tinto group of companies).

There were no industry expenditures reported for domestic exploration from 1988 to the end of 2006, nor were there any government expenditures reported for exploration either domestic or abroad. Since 1983, all domestic exploration activities have been halted.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

The Reasonably Assured Resources (RAR) and Inferred Resources are essentially zero. There has been no geological appraisal of the UK uranium resources since 1980.

Undiscovered Resources (Prognosticated & SR)

There are small quantities of *in situ* Undiscovered Resources as well as Speculative Resources. Two districts are believed to contain uranium resources:

- Metalliferous mining region of southwest England (Cornwall and Devon). Uranium occurs in veins and stockworks, often in association with tin and other metals, emplaced in Devonian metasediments and volcanic and related to the margins of uraniferous Hercynians granites. Mineralisation is locally of moderate (0.2-1% U) but of sporadic distribution. Resource tonnages of individual prospects may be up to several hundred tU.
- North Scotland including Orkneys. The Precambrian metamorphic rocks or north Scotland, with intruded Caledonian granites, are overlain by a post-orogenic series of fluviatile and lacustrine Devonian sediments. Uranium occurs in phosphatic and carbonaceous sediments disseminated in arkosic sandstone (Ousdale) and in faults both within the sediments (Stromness) and in underlaying granite (Helmsdale). Resources of a few thousand tonnes of uranium are indicated with an average grade less than 0.1% U.

URANIUM PRODUCTION

Status of production capability

The United Kingdom is not a uranium producer.

Secondary sources of uranium

MOX fuel has been utilised in fast reactor and, on a trial basis, gas-cooled reactor programmes in the United Kingdom in the past. None of the reactors in the United Kingdom currently use MOX fuel and this is not expected to change in the near future. In October 2001, the government announced the approval for MOX fuel manufacture in the United Kingdom. In December 2001 BNFL started the first stage of plutonium commissioning of the Sellafield MOX Plant (SMP), following the granting of licence consent by the UK Health and Safety Executive's Nuclear Installations Inspectorate. The plant manufactures MOX fuel from plutonium oxide separated from the reprocessing of spent fuel and tails of depleted uranium oxide. SMP has a potential annual throughput of up to 40 tHM of MOX fuel manufacture. Detailed programmes for the SMP are commercially confidential.

Production and/or use of re-enriched tails

Urenco has a long-term contractual agreement to upgrade tails material, but considers this to be commercially confidential.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

There is no uranium mining in the United Kingdom.

URANIUM REQUIREMENTS

A consultation on the future of nuclear power was published in May 2007 along with a white paper "Meeting the Energy Challenge". The United Kingdom believes that there needs to be as wide a choice of low carbon options as possible so it does not become over reliant on any one form of electricity generation. The consultation ran until October 2007.

Nuclear is an important part of the UK's energy mix supplying 18% of the UK's electricity in 2007. The Government has stated in the Consultation that a decision needs to be taken before the end of 2007 on whether to continue to obtain some electricity from nuclear. It will be for the private sector to undertake, fund, construct and operate new nuclear plants and cover the cost of decommissioning and their full share of long-term waste management costs.

Following the closure of Dungeness A and Sizewell A at the end of 2006 only two Magnox power stations remain operational. The remaining sites, at Oldbury and Wylfa, shall close in 2008 and 2010 respectively. The Advanced Gas Cooled Reactors (AGRs) operated by British Energy at Hinkley Point B and Hunterston B are planned to close in 2011, followed by Hartlepool and Heysham 1 in 2014, Dungeness B in 2018, and Heysham 2 and Torness in 2023. The Pressurised Water Reactor at Sizewell B is expected to remain operational until 2035.

In the near future the uranium requirements of the United Kingdom shall decline but it is difficult to predict what the long term uranium requirements of the UK shall be.

Supply and procurement strategy

In the US anti-dumping (selling at less than fair value) and countervailing (subsidy) action initiated by USEC at the end of 2000 against imports of low enriched uranium from The Netherlands, Germany and the United Kingdom, Urenco was found not to have been dumping but to have been receiving subsidies. This resulted in a small duty rate of *ca.* 1.5% being levied for the period 2001/2002. The duty rate is now zero, as the deemed benefit of the subsidies ended in 2002 and no further subsidies have been received. Various appeals were filed against the original decisions by the US Department of Commerce and these are still being progressed through the Court of International Trade.

The Nuclear Decommissioning Authority was set up as an executive Non departmental Public Body (NDPB) under the Energy Act 2004. The NDA assumed its full set of powers on 1 April 2005, including responsibilities for nuclear sites, facilities and installations formerly owned and operated by British Nuclear Group, Westinghouse-Toshiba and the United Kingdom Atomic Energy Authority.

The latest version of the NDA's Lifetime Plans – which detail the commercial operations, decommissioning and clean up programmes of the NDA's 20 sites – now shows an undiscounted total cost of GBR 64.8 billion for cleaning up the UK civil public sector nuclear liabilities.

Additionally the NDA is carrying out a strategic review of options for the management of its nuclear materials stock which will report in the summer of 2007.

NATIONAL POLICIES RELATING TO URANIUM

No changes to uranium policy have taken place in the United Kingdom. As regards the current policy on participation of private and foreign companies, the UK Atomic Energy Act 1946 gives the Secretary of State for Trade and Industry wide-ranging powers in relation to uranium resources in the United Kingdom, in particular to obtain information (section 4), to acquire rights to work minerals without compensation (section 7), to acquire uranium mined in the United Kingdom on payment of compensation (section 8), and to introduce a licensing procedure to control or condition the working of uranium (section 12A).

There are no specific policies relating to restrictions on foreign and private participation in uranium exploration, production, marketing and procurement in the United Kingdom, nor exploration activities in foreign countries. There is no national stockpile policy in the United Kingdom. Stocks of Uranium Hexaflouride Tails are stored as a zero value asset. Utilities are free to develop their own policy. Current policy is to either recycle them if economically sensible to do so or to de-convert the material to a more stable form starting no later than 2020. Stocks of depleted Uranium derived from reprocessing of Magnox reactors are stored as a zero value asset. Current policy is to recycle this material when it becomes economically sensible to do so.

Exports of uranium are subjects to the Export of Goods (Control) Order 1970 (SI No. 1 288), as amended, made under the Import, Export and Customs Powers (Defence) Act 1939.

URANIUM STOCKS

The UK uranium stockpile practices are the responsibility of the individual bodies concerned. Actual stock levels are commercially confidential.

URANIUM PRICES

Uranium prices are commercially confidential in the United Kingdom.

Mixed-oxide fuel production and use
(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	NA	NA	11	22	NA	11
Use	0	0	0	0	0	0
Number of commercial reactors using MOX	NA	0	0	0	NA	0

Reprocessed uranium use
(tonnes of natural U equivalent)

Reprocessed uranium	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	~ 50 000	NA	1 270	NA	~ 51 270	NA
Use	~ 15 000	NA	NA	NA	~ 15 000	NA

Re-enriched tails production and use
(tonnes of natural U equivalent)

Re-enriched tails	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	NA	NA	NA	NA	NA	NA
Use*	NA	NA	NA	NA	NA	NA

Net nuclear electricity generation

	2005	2006
Nuclear electricity generated (TWh net)	82	82

Installed nuclear generating capacity to 2030
(MWe net)

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
11 900	10 500	10 500	NA	6 000	NA

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
3 700	NA	1 200	NA	1 200	NA

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

2006	2007	2010		2015	
		Low	*High*	*Low*	*High*
2 165	NA	1 700	1 900	800	1 100

2020		2025		2030	
Low	*High*	*Low*	*High*	*Low*	*High*
400	500	300	400	300	400

Total uranium stocks
(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	NA	NA	NA	NA	NA
Producer	NA	NA	NA	NA	NA
Utility	NA	NA	NA	NA	NA
Total	NA	NA	NA	NA	NA

• United States of America •

URANIUM EXPLORATION

Historical review

From 1947 through 1970, the United States (US) Government fostered a domestic private-sector uranium exploration and production industry to procure uranium for military uses and to promote research and development into peaceful atomic energy applications. By late 1957, the number of new deposits being brought into production by private industry and production capability had increased sufficiently to meet projected requirements, and Federal exploration programmes were ended. The government has continued to monitor private-industry exploration and development activities to meet Federal informational needs.

Exploration by the US uranium industry increased throughout the 1970s in response to rising prices and the projected large demand for uranium to fuel an increasing number of nuclear reactors being built or planned for civilian electric power stations. The peak total in annual surface drilling (exploration and development) was reached in 1978, when 14 700 km of borehole drilling were completed. From 1966 through 1982, US surface drilling totalled 116 400 km in search for new uranium deposits. The US uranium industry completed an additional 12 050 km of surface drilling from 1983 through 1999. Surface drilling is the primary method of delineating uranium deposits in the US, and the annual total for drilling has proved to be a reliable indicator of overall US exploration activity.

In the US, exploration has primarily been for sandstone-type uranium deposits in districts such as the Grants Mineral Belt and Uravan Mineral Belt of the Colorado Plateau region and in the Wyoming basins and Texas Gulf Coastal Plain regions. Vein and other structure-controlled deposits were developed in the Front Range of Colorado, near Marysvale in Utah, and in northeastern Washington State. Since 1990, large sandstone-hosted deposits have been mined in northwestern Nebraska. Several relatively high-grade deposits associated with breccia-pipe structures were mined in northern Arizona, but those mines have not been active since the mid-1990s. A large uranium deposit discovered in Virginia in the early 1980s has been pre-empted from exploitation by a state-imposed moratorium on uranium mining in that state.

Recent and ongoing uranium exploration and mine development activities

In the United States, the expenditures for uranium surface drilling (exploration and development) during 2005 increased to USD 18.1 million from the USD 10.6 million reported in 2004 and to USD 40.1 million in 2006. These increases were a continuation of a significant turnaround for the industry from the steady decline in drilling expenditures experienced between 1997 and 2003. The number of holes drilled was 3 143 in 2005 and 4 903 in 2006, with a total of 508 537 metres drilled in 2005 and 827 134 metres drilled in 2006. These totals were greater than any year since 1998. Higher uranium prices contributed to this change.

Total reported private industry expenditures for uranium exploration and mine development activities in the United States in 2005 and 2006 were USD 77.8 million and USD 155.3 million, respectively, representing an increase of 32% and 163% over 2004 expenditures of USD 59 million. In 2005 and 2006, there were no exploration expenditures for uranium in the US or abroad by the US Government. Data on industry exploration expenses abroad are not available.

Although the US Government no longer reserves land for uranium production, the US Department of Energy (DOE), under its Uranium Lease Management Program, still administers 13 active lease tracts (as of year-end 2006). Leaseholders can conduct ongoing uranium production on these tracts. As leases become inactive and are returned to the DOE, they are not leased again under the current programme. Some of the active leases were scheduled to expire by the end of 2007. The DOE is responsible for ensuring that any abandoned uranium production sites on these tracts comply with environmental laws and regulations. After reclamation, the land associated with the DOE lease tracts is eligible for return to the public domain under the administrative jurisdiction of the Bureau of Land Management, US Department of the Interior.

The DOE is reviewing its lease programme. DOE is preparing 25 inactive lease tracts in the Uravan Mineral Belt of western Colorado for new leasing by private companies, and has issued a draft environmental assessment as part of its leasing process. These leases have been held by the DOE and its predecessor agencies since 1948. Based on the historical production total of 3 000 tU, the DOE Office of Legacy Management estimates that 770 tU could be generated annually from the combination of the 25 re-activated tracts and 13 active tracts under the new programme.[1] Production from these properties will rely on either open-pit or underground mining with conventional milling.

Rising uranium (and vanadium) prices since 2004 have renewed interest in leasing activity for historical uranium reserve properties in several western States. This interest led to the purchase of uranium mineral rights on these tracts and the formation of new joint ventures to explore and develop prospective new deposits. Encompassed in this activity are thousands of acres located principally in the following States: Arizona, California, Colorado, Nevada, New Mexico, Oregon, South Dakota, Utah, Wyoming, and Texas.

Titles to most of the uranium properties and claim blocks with reserves and resources identified by drilling during the 1970s and early 1980s have been acquired through three options: restaking, acquisition from previous owners, and mergers. Areas surrounding many properties are being considered for further evaluation. Most of the companies involved are following up acquisitions with in-house evaluations of old drillholes and geochemical data acquired with the property, new drilling to verify reserves, and external expert technical reports to meet financial reporting standards for mining properties. In addition, the uranium industry is assessing the potential of areas bordering many mined-out properties.

The western Colorado Plateau ores can be exploited only by conventional mining and milling methods as the ores are often above the water table or are not readily soluble using current US ISL technology which is designed to limit ground-water contamination. Breccia-pipe uranium mineralisation in northwestern Arizona has attracted much attention as these deposits are among the highest grade in the US (average of 0.65% in past production). Drilling projects are ongoing at several pipes north of the Grand Canyon in northwestern Arizona. Ore from the breccia-pipe deposits in Arizona and U-V (uranium-vanadium) sandstone deposits in eastern Utah and western Colorado will most likely be shipped to the White Mesa and Shootaring Canyon mills in southeastern Utah. Uranium mining in these areas will be limited by milling capacity and by the transportation costs. The White Mesa Mill presently processes "alternate feed material" (uranium-contaminated soils and other materials). The Shootaring Canyon Mill now has a reclamation license. Converting this license to an operating license is a lengthy process that might take years.

Nearly 40% of the total US uranium reserves are in the San Juan Basin of northwestern New Mexico. Some ores are amenable to ISL, but future development could be influenced by Native American concerns. In 2005, the Navajo Nation banned uranium exploration, mining, and processing in "Indian Country." The Navajos are seeking to broaden the definition of "Indian Country" to include tribal lands and adjacent areas with potential impact on those lands and Native American communities. For example, in a recent court decision on an action filed by Native American and other groups, the US Environmental Protection Agency was granted regulatory control over injection of lixiviant into ground water for recovery of uranium at the proposed Church Rock ISL mine. The State of New Mexico has already issued a permit for this activity, but the permit is being challenged.

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[1] *Draft: Programmatic Environmental Assessment,* page 21, Department of Energy, Office of Legacy Management, Contract No. DE-AC01-02GJ79491, July 2006, Washington, DC.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

For the US, the estimate of RAR for the <USD 80/kgU category at year-end 2003 was 102 000 metric tons U. Similarly, the estimate for RAR for the <USD 130/kgU category at the end of 2003 was 342 000 metric tons U. The 2003 RAR estimates as reported have been adjusted to account for mining dilution and processing losses.

The US does not report resources for the Inferred category separately.

Undiscovered Resources (Prognosticated & SR)

For the US, the estimates of resources for the Prognosticated (EAR) and Speculative categories are unchanged from the prior-reported estimates as of 1994.

URANIUM PRODUCTION

Historical review

Under the Atomic Energy Act of 1946, designed to meet the US Government's uranium needs, the Atomic Energy Commission (AEC) from 1947 to 1970 fostered a domestic uranium industry, chiefly in the western states, through incentive programmes for exploration, development, and production. To assure that the supply of uranium ore would be sufficient to meet future needs, the AEC, in April 1948, implemented a domestic uranium ore procurement programme designed to stimulate a civilian-based domestic mining industry. The AEC also negotiated uranium concentrate procurements contracts, pursuant to the Atomic Energy Act of 1946 and 1954, with guaranteed prices for source materials delivered within specified times. Contracts were structures to allow milling companies that built and operated mills the opportunity to amortise plant costs during their procurement-contract periods. By 1961, a total of 27 privately owned mills were in operation. Eventually, 32 conventional mills and several pilot plants, concentrators, up graders, heap-leach, and solution-mining facilities were operated at various times. The AEC, as the sole government purchasing agent, provided the only US market for uranium. Many of the mills were closed soon after completing deliveries scheduled under their uranium contracts, although several mills continued to produce concentrate for the commercial market after fulfilling their AEC commitments. The Atomic Energy Act of 1954 made lawful the private ownership of nuclear reactors for commercial electricity generation. By late 1957, domestic ore reserves and milling capacity were sufficient to meet the government's projected requirements. In 1958, the AECs procurement programmes were reduced in scope, and, in order to foster utilisation of atomic energy for peaceful purposes, domestic producers of ore and concentrate were allowed to sell uranium to private domestic foreign buyers. The first US commercial-market contract was finalised in 1966. The AEC announced in 1962 that its procurement programme would enter a "stretch-out" phase, wherein the government would be committed to take domestic uranium industry production while it converted to a private market place. The government's uranium procurement programme was ended at year end 1970, and the industry became a private sector, commercial enterprise with no additional government purchases.

Uranium concentrate production in the US has supported the commercial market since 1970. The peak year for US production was 1980 (16 810 tU); subsequently the US industry experienced a generally declining annual production in the period 1981-2003. Beginning in 2004, however, US production began increasing once again in response to higher uranium prices. Production from all sources in 2004 was 943 tU and in 2005 was 1 171 tU. In 2006, production amounted to 1 805 tU. Since 1991, production from ISL and other non-conventional production methods has dominated US annual production. In 2004, 2005 and 2006, concentrate production was obtained from facilities in the States of Colorado, Nebraska, Texas, and Wyoming.

Status of production capability

At year-end 2004, one uranium mill with a capacity of 400 short tons per day (STPD) was operating, two uranium mills with a combined capacity of 5 000 STPD were being maintained on standby status, one mill (1 000 STPD) was in reclamation status, and one mill that was shut down provided no capacity data. Of the eleven ISL production facilities with a combined capacity of 3 385 tU, three (totalling 1 462 tU) were operating, two (totalling 769 tU) were closed indefinitely or on standby, one (385 tU) was pending license award, and three were undergoing restoration or were depleted. Two (totalling 769 tU) were licensed but not in operating status.

At year-end 2005, two mills (2 400 STPD) were operating, one (3 000 STPD) was maintained in standby, one mill (1 000 STPD) was in reclamation and one mill was being demolished. Of the eleven ISL production facilities with a combined capacity of 5 039 tU, four (3 193 tU) were operating, three (1 077 tU) were on standby, and two were undergoing restoration. Two (769 tU) were licensed but not in operating status.

At year-end 2006, one mill (2 000 STPD) was operating, two (totalling 3 400 STPD) were maintained in standby, one mill (1 000 STPD) applied to amend its license to full operation but is currently on standby, and one mill was being demolished. Of the twelve ISL production facilities with a combined capacity of 5 500 tU, five (totalling 3 577 tU) were operating, one (385 tU) was under development, two were undergoing restoration, and two (totalling 769 tU) were on standby. Two partially licensed and permitted facilities (totalling 769 tU) were not in operating status.

Several uranium companies are in pre-licensing negotiations with State and Federal regulatory agencies for both conventional and ISL uranium mining in Wyoming, Colorado, Utah, New Mexico, and Texas. Existing and new ISL properties are most likely to be the largest contributors to expanded US production in the near term. New ISL mining operations have relatively short lead times due to simpler regulatory requirements, lower capital costs, and shorter construction schedules, compared to new conventional mills. Two companies have announced plans to build uranium mills, one each in western Colorado and northwestern New Mexico.

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

	Centre # 1	Centre # 2	Centre # 3	Centre # 4
Name of production centre	Canon City	Crow Butte	Kingsville Dome	Smith Ranch Highland
Production centre classification	existing	existing	existing	existing
Start-up date	1979	1991	1988	1988
Source of ore:				
• Deposit name (s)	Various	Crow Butte	Kingsville Dome	Smith Ranch Highland
• Deposit type (s)	sandstone	sandstone	sandstone	sandstone
• Resources (tU)	W	W	W	W
• Grade (% U)	W	W	W	W
Mining operation:				
• Type (OP/UG/ISL)	UG	ISL	ISL	ISL
• Size (t ore/year)	NA	NA	NA	NA
• Average mining recovery (%)	NA	NA	NA	NA
Processing plant (acid/alkaline):	acid & alkaline	—	—	—
• Type (IX/SX/AL)	SX	IX	IX	IX
• Size (t ore/year); for ISL (L/day or L/hour)	360 TPD	NA	NA	NA
• Average process recovery (%)	NA	NA	NA	NA
Nominal production capacity (tU/year)	210	385	385	2 116
Plans for expansion	unknown	unknown	unknown	unknown
Other remarks	standby	operating	operating	operating

	Centre # 5	Centre # 6	Centre # 7	Centre # 8
Name of production centre	Sweetwater	White Mesa	Vasquez	Hobson
Production centre classification	existing	existing	existing	existing
Start-up date	1981	1980	2004	1979
Source of ore:				
• Deposit name (s)	various	various	Vasquez	various
• Deposit type (s)	sandstone	sandstone	sandstone	sandstone
• Resources (tU)	W	W	W	W
• Grade (% U)	W	W	W	W
Mining operation:				
• Type (OP/UG/ISL)	OP	UG	ISL	ISL
• Size (t ore/year)	NA	NA	NA	NA
• Average mining recovery (%)	NA	NA	NA	NA
Processing plant (acid/alkaline):	acid	Acid	—	—
• Type (IX/SX/AL)	SX	SX	IX	IX
• Size (t ore/year); for ISL (L/day or L/hour)	2 720 TPD	1 820 TPD	NA	NA
• Average process recovery (%)	NA	NA	NA	NA
Nominal production capacity (tU/year)	350	1 200	308	385
Plans for expansion	unknown	unknown	unknown	unknown
Other remarks	standby	Processes alternative feed stocks	operating	standby

W = withheld NA = not available

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

	Centre # 9	Centre # 10	Centre # 11
Name of production centre	Rosita	Alta Mesa	La Palangana
Production centre classification	Existing	existing	development
Start-up date	1990	2005	2007e
Source of ore:			
• Deposit name (s)	Rosita (Rogers)		Various
• Deposit type (s)	Sandstone	sandstone	sandstone
• Resources (tU)	W	W	W
• Grade (% U)			W
Mining operation:			
• Type (OP/UG/ISL)	ISL	ISL	ISL
• Size (t ore/year)	NA	NA	NA
• Average mining recovery (%)	NA	NA	NA
Processing plant (acid/alkaline):			
• Type (IX/SX/AL)	IX	IX	IX
• Size (t ore/year); for ISL (L/day or L/hour)	NA	NA	NA
• Average process recovery (%)	NA	NA	NA
Nominal production capacity (tU/year)	385	385	385
Plans for expansion	Unknown	unknown	development
Other remarks	Standby	operating	development

Ownership structure of the uranium industry

Publicly owned firms own the six uranium facilities that produced uranium concentrate in 2006. Foreign firms control five and one is domestically owned. Foreign interests thus controlled the major part of US uranium concentrate production in 2006.

Employment in the uranium industry

Employment in the raw materials sector (exploration, mining, milling, and processing) of the US uranium industry has generally declined each year during the period 1998-2003, but has been increasing since 2004. The employment level at year-end 2004 was reported as 299 person years expended; it increased to 524 person years in 2005 and to 600 (estimated) person years in 2006. This change represents an increase of about 75% during 2005 and about 15% in 2006. During 2005, employment in the exploration sector increased from the 2004 level of 18 person years to 79 person years, and in the mining sector from 108 person years to 149 person years. During 2006, employment in the exploration sector increased to 188 person years, while in the mining sector, employment decreased to 121 person years. Changes in the employment levels for the component areas for the milling and processing sectors and specific information on the mining sector cannot be released due to the company proprietary nature of those data.

Future production centres

Two new non-conventional production facilities were in the process of permitting and licensing during 2005 and 2006. Two companies have announced plans to build uranium mills, one each in western Colorado and northwestern New Mexico.

Secondary sources of uranium

Secondary supplies of uranium continue to enter the US market from utility inventories and downblending of US and Russian highly enriched uranium. The Uranium Producers of America (a 13-company industry consortium) is encouraging DOE to hold its uranium inventory as a strategic reserve for shortages that could develop in the future and to control its impact on the current market.

Production and/or use of mixed-oxide fuels

Mixed-oxide fuel production was zero. The use of mixed-oxide fuels was 0.1 tonnes of natural U equivalent in 2005.

Production and/or use of re-enriched tails

The DOE and the Bonneville Power Administration initiated a pilot project to re-enrich 8 500 tonnes of the DOE's enrichment tails inventory in 2005. The pilot project is anticipated to produce a maximum of 1 900 tonnes of uranium equivalent over a two-year period for use by the Columbia Generating Station between 2009 and 2017.

Production and/or use of reprocessed uranium

Reprocessed uranium production and use is zero.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Overview

For a complete description of environmental and socio-cultural issues in the US, see the 2005 edition of the Red Book.

In 2006, the US Nuclear Regulatory Commission (NRC) deferred active regulation on ground-water restoration at ISL sites in Nebraska and Wyoming, pending development of agreements with the two States. The main issue of contention is whether the NRC's primary goal of ground-water restoration to pre-operational (baseline) water quality conditions is achievable or whether secondary standards, allowable under other Federal laws, should apply. The differences in concentration between the two standards are significant; for example, the primary restoration standard at the Crow Butte property in northwestern Nebraska is 0.092 mg/L U compared to a secondary restoration standard of 5 mg/L U. Groundwater restoration constitutes about 40% of the decommissioning costs for US ISL mines, based on 1994 data for 14 reclaimed properties.

In January 2006, the US Environmental Protection Agency (EPA) released a review document entitled *Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Volume 1: Mining and Reclamation Background.* This volume documents the uranium mining component of a larger effort to evaluate hazards associated with technologically enhanced, naturally occurring radioactive materials (TENORM) in several industries such as oil and gas production, phosphate mining, water treatment, and rare earth mining. Volume 2 of this report will evaluate the radiation hazards associated with uranium mine wastes. The main focus of both volumes is uranium mine wastes from underground or open-pit mining, but wastes from ISL mining operations are also included. Of particular concern is the radioactive wastes generated by the above-ground parts of the ISL operations, specifically the radioactivity of waters in the evaporation ponds. The NRC has primary authority over these wastes as "by-product materials" under US regulations, but the EPA controls the injection of ISL lixiviant fluids under its Underground Injection Control programme. In August 2006, the EPA released a "uranium location" database for the US compiled from 19 other databases which includes names and location data for about 14 800 properties where uranium has been identified as present. Over 4 000 of these locations are mines with past uranium production.

Mine reclamation

US Federal and State land management agencies continue conventional uranium mine reclamation activities at multiple sites in California (Juniper Mine), Colorado (Graysill Mine), New Mexico (St. Anthony Mine, JJ No. 1/L-Bar Mine, Section 27 Mine), Oregon, (White King and Lucky Lass Mines), Washington (Midnite Mine), Utah (22 properties in the Labyrinth Canyon area of Emery and Grand Counties), South Dakota and in the Navajo Nation.[2] In the Navajo Nation, almost all uranium mine sites with significant hazards to human health, including all large surface pits on Navajo lands, have been reclaimed. Several small, remote uranium mine sites in steep topography remain to be reclaimed. The State of Wyoming and responsible companies continue to reclaim uranium properties in the Gas Hills area and elsewhere at a cost of USD several million per year. In June 2004, the US Bureau of Land Management (BLM), along with the State of Utah, the Forest Service and Tribal governments, completed a five-year, multi-agency watershed partnership cleanup effort in Cottonwood Wash in southeastern Utah. This watershed had been heavily impacted by uranium and vanadium mining which lead to its listing as an impaired watershed. By reclaiming 199 openings, plugging 282 open drill holes, reclaiming 265 mine waste dumps and 15.2 miles of mine access roads BLM and its partners were able to reduce the effects of uranium in this drainage.

Restoration of several depleted ISL mines in south Texas and Wyoming was completed prior to 2005 with release of the land for unrestricted use; however, relaxation of ground water standards was required for many releases to occur. A few ISL properties were in various stages of restoration in 2005 and 2006.

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2. The Navajo Nation encompasses 16 million acres of land, occupying all of northeastern Arizona and extending into Utah and New Mexico. It is the largest land area assigned primarily to a Native American jurisdiction within the United States.

The NRC continues to evaluate how best to determine ground water restoration costs at depleted ISL mines and the associated bond requirements. A USGS study completed in December 2006 (after revisions based on public comment) presented and demonstrated examples of relevant geochemical modeling simulations for groundwater restoration at ISL mining sites as they relate to estimating costs and determining financial assurance requirements.

URANIUM REQUIREMENTS

Preliminary annual uranium requirements for the US in 2006 are 22 890 tU. Requirements for the period 2007 through 2030 are projected to increase to 26 617 tU (high case) in 2030. In the low case the requirements are projected to peak in 2020 at 24 508 tU and then to begin to decline to about 22 265 tU in 2030.

Supply and procurement strategy

The United States allows supply and procurement of uranium production to be driven by market forces with resultant sales and purchases conducted solely in the private sector by firms involved in the uranium mining and nuclear power industries.

NATIONAL POLICIES RELATING TO URANIUM

An *Agreement between the Government of the US and the Government of the Russian Federation Concerning the Disposition of Highly Enriched Uranium Extracted from Nuclear Weapons* (HEU Purchase Agreement) was signed on 16 October 1992 by the US and the Russian Federation providing for the blending down of 500 tons of HEU to low enriched uranium (LEU) over 20 years. USEC, Inc., the US Government's sole executive agent for implementing the HEU Purchase Agreement, receives deliveries of LEU from the Russian Federation for sale to commercial nuclear power plants. USEC purchases and sells only the enrichment component of this LEU under existing commercial contracts with purchasers of enrichment services. An agreement for the maintenance of a domestic uranium enrichment industry that was signed on 17 June 2002 by the Department of Energy and USEC, Inc. contained conditions for USEC, Inc. to continue as the US Government's sole executive agent for the HEU Purchase Agreement. In June 2006, Russia indicated that the HEU agreement will not be renewed when the initial agreement expires in 2013.

Under a separate agreement under the HEU programme, the natural uranium feed component is sold under a commercial arrangement between three western corporations (Cameco, COGEMA, and Nukem) and Techsnabexport of the Russian Federation. Outside of the natural uranium feed component of HEU-derived LEU, imports of uranium from the Russian Federation have been limited by the *Agreement Suspending the Antidumping Duty Investigation on Uranium from the Russian Federation* (Suspension Agreement) signed between the Department of Commerce (DOC) and the Ministry of Atomic Energy of the Russian Federation in 1992. As a result of the Suspension

Agreement, DOC suspended antidumping investigations and the Russian Federation agreed to sell uranium to the US under a quota system whereby Russian imports would have to be matched by an equivalent quantity of newly produced US uranium. A 1994 amendment to the suspension agreement contained language specifying an expected termination date of 31 March 2004. However, Russia did not request the DOC to undertake a termination review, a requirement for termination. The DOC took the position that the Suspension Agreement had not expired. A second sunset review agreement was subsequently signed on 1 July 2005, maintaining the Suspension Agreement terms during the review.

On 13 February 2002, the DOC issued determinations in antidumping and countervailing duty investigations involving LEU from France, Germany, the Netherlands, and the United Kingdom. The DOC placed an antidumping duty order on LEU imports from France while all four countries were issued countervailing duty orders. The decision resulted in countervailing duties being assessed against France, but not against Germany, the Netherlands, and the United Kingdom. The DOC determinations were challenged at the US Court of International Trade (CIT) The US Court of Appeals for the Federal Circuit (CAFC) affirmed in March 2005 a ruling by the US Court of International Trade (CIT) that contracts for the purchase of enrichment services, quantified by separative work units, were contracts for the sale of services, not goods. US antidumping law applies only to the sale or purchase of goods, not services. The CAFC further affirmed that CIT was correct in ruling that the Department of Commerce's approach to defining the word "producer" was in accordance with law. This provides USEC the ability to trigger the antidumping and countervailing subsidy investigations. This ruling, if confirmed, could impact the imposition of duties on LEU imported from the European Union, as well as, the Russian Suspension Agreement on Uranium, which is based on US antidumping law and covers uranium enriched in Russia. Pending a final resolution that may involve further appeals and re-hearings, the import duties now imposed will continue to be collected.

URANIUM STOCKS

At the end of 2005, total commercial stocks of uranium (natural and enriched uranium equivalent) were 36 068 tU, which represented a decrease of 1.5% when compared to the 36 622 tU level at the end of 2004.

Utility stocks held at year-end 2005, 24 897 tU, were 12.4% more than the 22 181 tU held at year-end 2004. The inventories of natural uranium increased to 17 439 tU from 10 731 tU in the prior year; however, enriched uranium stocks decreased to 7 458 tU from 11 449 tU. These totals include utility-owned stocks reported as inventories at enrichment supplier facilities.

At the end of 2006, total commercial stocks of uranium (natural and enriched uranium equivalent) were 41 279 tU, which represented an increase of 14.5% when compared to the 36 077 tU level at the end of 2005.

Utility stocks held at year-end 2006, a total of 30 081 tU, were 20.8% more than the 24 897 tU held at year-end 2005. The 2006 estimated utility inventories of natural uranium increased to 21 358 tU from 17 439 tU in 2005, and enriched uranium stocks increased to 8 722 tU in 2006 from 7 458 tU in 2005. These totals include utility-owned stocks reported as inventories at enrichment supplier facilities.

Suppliers' total stocks at year-end 2004, 2005, and 2006 were 14 441 tU, 11 181 tU, and 11 197 tU, respectively.

Government stocks at year-end 2006 total 17 796 tU, all of which is identified as natural uranium stocks in concentrates.

URANIUM PRICES

Owners and operators of US civilian nuclear power reactors purchase uranium under spot contracts and long-term contracts. A spot contract is defined as a one-time delivery of the entire contract to occur within one year of contract execution. A long-term contract is defined as one or more deliveries to occur after a year following contract execution.

In 2006, purchases under spot contracts amounted to 2 423 tU, a decrease of 8.7% from 2 654 tU in 2005. However, the weighted-average spot price increased from USD 52.10 per kilogram U equivalent in 2005 to USD 102.64 per kilogram U equivalent. Uranium purchased under long term contracts in 2006 amounted to 22 848 tU, an increase of 1.1% from 22 600 tU in 2005. The weighted-average price increased from USD 35.62 per kilogram U equivalent in 2005 to USD 42.59 per kilogram U equivalent in 2006.

Average US uranium prices, 2000-2006
(USD per kilogram U equivalent)

Year	Spot Contracts	Long-term Contracts
2006	102.64	42.59
2005	52.10	35.62
2004	38.40	31.82
2003	26.26	28.44
2002	24.15	27.51
2001	20.59	28.49
2000	22.20	30.42

Note: Prices shown are quantity-weighted averages (nominal US dollars) for all primary transactions (domestic- and foreign origin uranium) for which prices were reported. The transactions can include US-origin as well as foreign-origin uranium.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million USD	**2004**	**2005**	**2006**	**2007** (expected)
Industry exploration expenditures	NA	NA	23.3	NA
Government exploration expenditures	0	0	0	NA
Industry development expenditures	W	W	132.0	NA
Government development expenditures	0	0	0	NA
Total expenditures	59.0c	77.8C	155.3C	NA
Industry exploration drilling (metres)	W	W	250 305	NA
Number of industry exploration holes drilled	W	W	1 473	NA
Government exploration drilling (metres)	0	0	0	NA
Number of government exploration holes drilled	0	0	0	NA
Industry development drilling (metres)	W	W	576 829	NA
Number of development exploration holes drilled	W	W	3 430	NA
Government development drilling (metres)	0	0	0	NA
Number of development exploration holes drilled	0	0	0	NA
Subtotal exploration drilling (metres)	W	W	250 305	NA
Subtotal exploration holes	W	W	1 473	NA
Subtotal development drilling (metres)	W	W	576 829	NA
Subtotal development holes	W	W	3 430	NA
Total drilling (metres)	380 793	508 537	827 134	NA
Total number of holes	2 185	3 143	4 903	NA

W = Withheld to avoid disclosure of sensitive information.

C = Total expenditures in 2004, 2005 and 2006 include expenditures for reclamation and restoration work that could not be separated from expenditures for drilling, land acquisition, and other exploration and development work during 2004 and 2005. The 2006 numbers include USD 50.9 million in reclamation and restoration work.

NA = Not available.

Uranium exploration and development expenditures – non-domestic

Expenses in million USD	**2004**	**2005**	**2006**	**2007** (expected)
Industry exploration expenditures	NA	NA	NA	NA
Government exploration expenditures	0	0	0	NA
Industry development expenditures	NA	NA	NA	NA
Government development expenditures	0	0	0	NA
Total expenditures	NA	NA	NA	NA

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	NA	53 000	178 000	NA
Open-pit mining	NA	11 000	99 000	NA
In situ leaching	NA	38 000	64 000	NA
Heap leaching	NA	0	0	NA
In-place leaching (stope/block leaching)	NA	0	0	NA
Co-product and by-product	NA	0	0	NA
Unspecified	NA	0	1 000	NA
Total	NA	102 000	342 000	NA

* *In situ* resources.

Reasonably Assured Resources by deposit type

(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	NA	0	0
Sandstone	NA	99 000	327 0000
Hematite breccia complex	NA	0	0
Quartz-pebble conglomerate	NA	0	0
Vein	NA	0	0
Intrusive	NA	0	0
Volcanic and caldera-related	NA	W	W
Metasomatite	NA	0	0
Other	NA	W	W
Total	NA	102 000	342 000

* Includes Surficial, Collapse breccia pipe, Phosphorite and other types of deposits, as well as rocks with elevated uranium content. Pegmatite, granites and black shale are not included.

W = Withheld.

NA Not Available.

Inferred Resources

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	NA	NA	NA	NA
Open-pit mining	NA	NA	NA	NA
In situ leaching	NA	NA	NA	NA
Heap leaching	NA	NA	NA	NA
In-place leaching (stope/block leaching)	NA	NA	NA	NA
Co-product and by-product	NA	NA	NA	NA
Unspecified	NA	NA	NA	NA
Total	NA	NA	NA	NA

Inferred Resources by deposit type
(tonnes U)

Deposit type	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU
Unconformity-related	NA	NA	NA
Sandstone	NA	NA	NA
Hematite breccia complex	NA	NA	NA
Quartz-pebble conglomerate	NA	NA	NA
Vein	NA	NA	NA
Intrusive	NA	NA	NA
Volcanic and caldera-related	NA	NA	NA
Metasomatite	NA	NA	NA
Other*	NA	NA	NA
Total	NA	NA	NA

* Includes Surficial, Collapse breccia pipe, Phosphorite and other types of deposits, as well as rocks with elevated uranium content. Pegmatite, granites and black shale are not included.

NA= Not Available.

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
839 000	1 273 000

Speculative Resources
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
858 000	482 000

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]	NA	0	0	NA	NA	NA
Underground mining[1]	NA	W	W	NA	NA	NA
In situ leaching	NA	W	NA	NA	NA	NA
Heap leaching	NA	W	W	NA	NA	NA
In-place leaching*	NA	W	W	NA	NA	NA
Co-product/by-product	NA	W	W	NA	NA	NA
U recovered from phosphates	NA	0	0	NA	NA	NA
Other methods**	NA	W	W	NA	NA	NA
Total	356 482	943	1 171	1 805	360 401	NA

(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]	[%]
0	0	1 805	100	0	0	0	0	1 805	100

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

	2004	2005	2006	2007 (expected)
Total employment related to existing production centres	299	524	600	NA
Employment directly related to uranium production	W	445	412	NA

W = Withheld.
NA = Not Available.

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
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Mixed-oxide fuel production and use
(tonnes of natural U equivalent)

Mixed-oxide (MOX) fuels	Total through end of 2003	2004	2005	2006	Total through end of 2006	2007 (expected)
Production	0	0	0	0	0	NA
Use			0.1	0	0.1	NA
Number of commercial reactors using MOX			1			NA

Reprocessed uranium use
(tonnes of natural U equivalent)

Reprocessed uranium	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	0	0	0	0	0	NA
Use	0	0	0	0	0	NA

Re-enriched tails production and use
(tonnes of natural U equivalent)

Re-enriched tails	**Total through end of 2003**	**2004**	**2005**	**2006**	**Total through end of 2006**	**2007** (expected)
Production	0	0	1 015.3	924.5	1 939.8	NA
Use	0	0	0	0	0	NA

Net nuclear electricity generation

	2005	**2006**
Nuclear electricity generated (TWh net)	782	787

Installed nuclear generating capacity to 2030
(MWe net)

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
100.1	100.1p	100.5	100.5	103.4	103.4

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
108.5	111.7	108.5	118.3	105.9	128.7

p = Preliminary.

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

2006	**2007**	**2010**		**2015**	
		Low	*High*	*Low*	*High*
22 890p	NA	22 623	22 623	23 858	23 863

2020		**2025**		**2030**	
Low	*High*	*Low*	*High*	*Low*	*High*
24 508	25 245	23 856	25 867	22 265	26 617

Total uranium stocks
(tonnes natural U-equivalent)

Holder	Natural uranium stocks in concentrates	Enriched uranium stocks	Depleted uranium stocks	Reprocessed uranium stocks	Total
Government	17 796	NA	NA	NA	17 796
Producer*	NA	NA	NA	NA	11 197
Utility	NA	NA	NA	NA	30 081
Total	NA	NA	NA	NA	59 074

Data are preliminary for 2006.
NA = Not Available
* Producer stocks include all U.S. supplier inventories.

• Vietnam •

URANIUM EXPLORATION

Historical review

Uranium exploration in selected areas of Vietnam began in 1955. Since 1978, a systematic regional exploration programme has been underway throughout the entire country.

About 330 000 km^2, equivalent to almost 100% of the country, have been surveyed at the 1:200 000 scale using surface radiometric methods combined with geological observations. About 103 000 km^2 (31% of the country) have been explored at the 1:50 000 scale. Nearly 80 000 km^2, or 24% of the country, has been covered by an airborne radiometric/magnetic survey at the 1:25 000 and 1:50 000 scales. Selected occurrences and anomalies have been investigated in more detail by 75 800 m of drilling and by underground exploration workings.

Recent and ongoing uranium exploration and mine development activities

Uranium exploration is conducted by the Geological Division for Radioactive and Rare Elements and the Geophysical Division of the Department of Geology and Minerals of the Ministry of Industry. From 1997 through 2002, exploration was concentrated on evaluation of the uranium potential of the Nong Son basin, Quang Nam province. Exploration activities were concentrated on three projects: (1) evaluation of the An Diem deposit hosted in sandstone; (2) exploration of the Pa Rong area and (3) exploration of the Dong Nam Ben Giang area in the southeast Ben Giang-Nong Son basin.

The relevant Table lists exploration expenditures and drilling statistics.

URANIUM RESOURCES

Identified Resources (RAR & Inferred)

Vietnam reports RAR recoverable at <USD 130/kgU of 1 337 tU, as *in situ* resources. Inferred resources of 6 744 tU are reported in the Khe Hoa-Khe Cao deposit, and of 500 tU at an average grade of 0.034% U in the An Diem deposit, Nong Son basin. A total of 7 244 tU of Inferred resources, recoverable at a cost of <USD 130/kgU, is reported, including 1 091 tU recoverable at a cost of <USD 80/kgU. No mining method is specified. An overall recovery of 75% of the uranium is expected.

Undiscovered Resources (Prognosticated & SR)

Prognosticated Resources have increased by 1 000 tU (An Diem area) in the <USD 130/kgU category compared to the 2001 Red Book. Prognosticated Resources recoverable at costs <USD 130/kgU are located mainly in the Tabhing occurrence of the Nong Son basin. Speculative Resources are the same as reported in the 2001 Red Book.

Unconventional and by-product resources

Unconventional Resources are reported occurring in coal deposits of the Nong Son basin, rare earth deposits, the sedimentary Binh Duong phosphate deposit and the Tien An graphite deposit.

URANIUM PRODUCTION

Vietnam is not a uranium producing country.

ENVIRONMENTAL ACTIVITIES AND SOCIO-CULTURAL ISSUES

Environmental monitoring is carried out to assess the environmental impacts resulting from exploration activities.

URANIUM REQUIREMENTS

The government is planning to construct a nuclear power plant by 2020.

NATIONAL POLICIES RELATING TO URANIUM

Vietnam is a country with few fossil fuels. Therefore, in its energy policy for the 21st century, the government includes nuclear power as one of the alternatives. However, no long-term plans for developing a domestic uranium supply have been established. Vietnam has no uranium stocks and reported no information on uranium prices.

Uranium exploration and development expenditures and drilling effort – domestic

Expenses in million VND	2002	2003	2004	2005 (expected)
Industry exploration expenditures	0	0	NA	NA
Government exploration expenditures	2 000	15 000	700	NA
Industry development expenditures	0	0	0	0
Government development expenditures	0	0	0	0
Total expenditures	2 000	15 000	700	NA
Industry exploration drilling (metres)	0	0	0	0
Number of industry exploration holes drilled	0	0	0	0
Government exploration drilling (metres)	900	1 500	600	NA
Number of government exploration holes drilled	11	20	8	NA
Industry development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Government development drilling (metres)	0	0	0	0
Number of development exploration holes drilled	0	0	0	0
Subtotal exploration drilling (metres)	900	1 500	600	NA
Subtotal exploration holes	11	20	8	NA
Subtotal development drilling (metres)	0	0	0	0
Subtotal development holes	0	0	0	0
Total drilling (metres)	900	1 500	600	NA
Total number of holes	11	20	8	NA

Reasonably Assured Resources*

(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	NA	NA	1 337	
Total	NA	NA	1 337	

* *In situ* resources.

Inferred Resources*
(tonnes U)

Production method	<USD 40/kgU	<USD 80/kgU	<USD 130/kgU	Recovery factor (%)
Underground mining	0	0	0	
Open-pit mining	0	0	0	
In situ leaching	0	0	0	
Heap leaching	0	0	0	
In-place leaching (stope/block leaching)	0	0	0	
Co-product and by-product	0	0	0	
Unspecified	NA	1 091	7 244	
Total	NA	1 091	7 244	

* *In situ* resources.

Prognosticated Resources
(tonnes U)

Cost ranges	
<USD 80/kgU	<USD 130/kgU
0	7 860

Speculative Resources
(tonnes U)

Cost ranges	
<USD 130/kgU	Unassigned
100 000	130 000

Appendix 1

MEMBERS OF THE JOINT NEA-IAEA URANIUM GROUP

Algeria	Mr. M.T. BOUARROUDJ	Commissariat à l’énergie atomique (COMENA), Alger
Argentina	Mr. A. CASTILLO **(Vice-Chair)**	Comisión Nacional de Energía Atómica Unidad de Proyectos Especiales de Suministros Nucleares, Buenos Aires
Australia	Mr. I. LAMBERT **(Vice-Chair)** Mr. A. McKAY Ms. L. CARSON	Geoscience Australia, Canberra
Belgium	Ms. F. RENNEBOOG	Fuel Supply Department, Synatom, Brussels
Brazil	Mr. L. F. da SILVA	Indústrias Nucleares do Brasil INB-S/A, Rio de Janeiro
Bulgaria	Ms. K. KOSTADINOVA	Nuclear Energy and Safety Unit, Ministry of Economy and Energy, Sofia
	Mr. P. PETROV	Ministry of Economy and Energy, Sofia
Canada	Mr. T. CALVERT	Uranium and Radioactive Waste Division, Natural Resources Canada, Ottawa
China	Mr. X. PENG	Bureau of Geology, China National Nuclear Corporation (CNNC), Beijing
	Mr. B. XIU	Division of Nuclear Fuel, China Atomic Energy Authority, Beijing
Czech Republic	Mr. P. VOSTAREK	DIAMO s.p. Stráz pod Ralskem
Egypt	Mr. H.S.E.N.S. ABOU KHOZAYEM Mr. E.M.I. ELKATTAN Mr. A.E.M. ELSIRAFY	Nuclear Materials Authority (NMA) El-Maadi, Cairo
Finland	Mr. O. ÄIKÄS	Department of Economic Geology Geological Survey of Finland, Espoo
France	Mr. G. CAPUS **(Chair)**	AREVA NC, Vélizy
	Mr. F.-L. LINET	Commissariat à l’énergie atomique Direction de l'énergie nucléaire, Gif-sur-Yvette
Germany	Mr. U. SCHWARZ-SCHAMPERA	Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover

Hungary	Mr. G. Németh	Paks Nuclear Power Plant, Paks
India	Mr. A. CHAKI Mr. S.A. PANDIT	Atomic Minerals Directorate for Exploration and Research (AMD), Dept. of Atomic Energy, Hyderabad
Iran, Islamic Republic of	Mr. F. YEGANI Mr. A. REZA	Atomic Energy Organisation of Iran, Tehran
Japan	Mr. T. KOBAYASHI	Office of Strategy Research, Japan Atomic Energy Agency (JAEA), Tokai-mura
	Mr. H. MIYADA	Japan Atomic Energy Agency (JAEA), Toki-shi
	Mr. K. SAWADA	Japan Oil, Gas and Metals National Corporation, Kawasaki
Jordan	Mr. A.M. SAYMEH	Geophysics Division, Natural Resources Authority, Amman
Kazakhstan	Mr. A. KUTZHAN	National Atomic Company "KAZATOMPROM", Almaty
Pakistan	Mr. Kahlid BIN SATTAR	Pakistan Atomic Energy Commission, Atomic Energy Minerals Centre, Lahore
Romania	Mr. D.-A. STIOPOL	Commission for Nuclear Activities Control, Bucharest
Russian Federation	Mr. A.V. BOITSOV **(Vice-Chair)**	TENEX, Moscow
	Mr. A.V. TARKHANOV Mr. O. KNJAZEV	All-Russian Institute of Chemical Technology, Ministry of Atomic Energy, Moscow
Slovak Republic	Mr. M. LASCEK	Slovenské elecktrárne, a.s., Bratislava
South Africa	Mr. S. PHETO	National Nuclear Regulator (NNR), Centurion
Spain	Mr. F. T. GARCIA	Enusa Industrias Avanzadas, S.A.
Switzerland	Mr. G. KLAIBER	Nordostschweizerische (NOK) Kraftwerke AG, Baden
Ukraine	Mr. A. BAKARZHIYEV Mr. Y. BAKARZHIYEV	The State Geological Enterprise "Kirovgeology", Kiev
United Kingdom	Mr. K. WELHAM	Rio Tinto plc, London
	Mr. Craig JONES	UK Delegation to the OECD
United States	Mr. S. SITZER **(Vice-Chair)**	Energy Information Administration US Department of Energy, Washington
	Mr. J. OTTON	US Geological Survey, Denver

Uzbekistan	Mr. H. HALMURZAEV	State Geological Enterprise “Kyzyltepageologia”, Tashkent
Venezuela	Mr. T. TOSIANI	Ministerio del Poder Popular para la Energía y Petróleo, Caracas
Vietnam	Mr. Le BA THUAN	Vietnam Atomic Energy Commission (VAEC), Hanoi
European Commission	Mr. Z. PATAKI	Euratom Supply Agency, Luxembourg
IAEA	Mr. J. SLEZÁK **(Scientific Secretary)**	Division of Nuclear Fuel Cycle and Waste Technology, Vienna
OECD/NEA	Mr. R. VANCE **(Scientific Secretary)**	Nuclear Development Division, Paris

Appendix 2

LIST OF REPORTING ORGANISATIONS AND CONTACT PERSONS

Algeria	Commissariat à l’énergie atomique (COMENA), 02, Boulevard Franz Fanon, BP 399, Alger-Gare, 16000, Alger Contact person: Mr. Allaoua Khaldi
Argentina	Comisión Nacional de Energía Atómica, Unidad de Proyectos Especiales de Suministros Nucleares, Avenida del Libertador 8250, 1429 Buenos Aires Contact person: Mr. Alberto Castillo
Australia	Geoscience Australia, GPO Box 378, Canberra, ACT 2601 Contact person: Mr. Aden D McKay
Belgium	Ministère des Affaires économiques, Administration de l'énergie, Division des applications nucléaires, 16 Boulevard du Roi Albert II, B-1000 Bruxelles Contact person: Ms. Françoise Renneboog (SYNATOM)
Brazil	Indústrias Nucleares do Brasil S/A, INB, Rua Mena Barreto, 161, 4º andar, Botafogo, CEP 22271-100, Rio de Janeiro – RJ, Brasil Contact person: Mr. Luiz Filipe da Silva
Bulgaria	Ministry of Economy and Energy, 8 Slavianska Str., Sofia Contact person: Ms. Katerina Kostadinova
Canada	Natural Resources Canada, Uranium and Radioactive Waste Division, 580 Booth Street, Ottawa, Ontario K1A OE4 Contact person: Mr. Tom Calvert
Chile	Comisión Chilena de Energía Nuclear, Departamento de Materiales Nucleares, Unidad de Geologia Y Mineria, Centro Nuclear Lo Aguirre, Ruta 68, km 28 Region Metropolitana Contact person: Mr. Loreto Villanueva Zamora
China	China Atomic Energy Authority, Division of Nuclear Affairs and International Organisations, A8, Fuchenglu, Haidian District, Beijing 100037 Contact person: Mr. Xiu Binglin
Colombia	Ingeominas, Dirección Servicio Geológico, Diagonal 53 Nº 34-53, Bogota, D.C. Contact person: Ms. Silvia Alvarez Quintero
Czech Republic	DIAMO s.p., Máchova 201, 471 27 Stráz pod Ralskem. CĚZ, a.s., Nuclear Fuel Cycle Section Duhová 2/1911, 14053 Praha 4 Contact person: Pavel Vostarek
Denmark	Danish Energy Authority, Ministry of Transport and Energy, Energy Efficiency and Economics, Amaliegade 44, DK-1256 Copenhagen K Contact person: Mr. Ali Zarnaghi
Egypt	Nuclear Materials Authority, Maadi-Kattamya Road, P.O. Box 530, Elmaadi, Cairo Contact person: Mr. El Sayed M. Elkattan

Finland
Ministry of Trade and Industry, Energy Department, P.O. Box 32,
FIN-00023 Helsinki
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Appendix 3

THE URANIUM MINING REMEDIATION EXCHANGE GROUP (UMREG)

> *"The time is ripe to launch an international initiative*
> *for consolidation of a good remediation practice*
> *for the old uranium mining sites and to*
> *limit the environmental impact of the*
> *new uranium mines worldwide."*

Origins

In 1993 and 1994, the first bilateral US/German meetings were held on remediation of uranium mining and milling legacy sites (that is, sites at which mining practices of the past, no longer licensed today, led to environmental impacts that were left to governments to remediate). These meetings facilitated a useful exchange of ideas on remedial strategies and resulted in the introduction of cost-efficient solutions and pragmatic administrative procedures based on sound scientific principles and proven technology.

The first multilateral meeting (with the participation of Canada and South Africa) followed in 1995. Later meetings in 1995, 1997, 1998, 2000 and 2001 included participation by representatives from Australia and France. In more recent meetings (2002, 2003, 2005 and 2007), participation progressively increased to include representatives from uranium producing countries in Africa, Latin America, Central and Eastern Europe and Central Asia. Proceedings were published after each UMREG Meeting.

With the aim of promoting "economically and environmentally balanced uranium mining and remediation practices," UMREG provides a non-commercial exchange platform for all members. Shared experiences in UMREG clearly demonstrate that low-impact mining practices both minimise environmental impacts and enhance life-cycle economics of projects.

The present revival of the uranium mining

According to many sources, world energy demand is expected to increase significantly by 2030 and beyond. The majority of base-load electricity is presently generated by power plants using fossil fuels or uranium. The use of uranium as a fuel is a plausible solution to the dilemma of a simultaneously increasing energy demand and reducing greenhouse gas emissions. Hence, uranium demand and prices for the commodity are increasing, as are global exploration and mine development activities.

The need to achieve stakeholder support for uranium mining was underestimated in the past and this, combined with practices that led to environmental impacts in the past, have undermined the credibility of today's uranium miners. Past experience shows that societal concerns must be on the "critical path" of any new uranium mine development project. The revival of the uranium market today also presents an opportunity to governments to remediate uranium mining legacy sites not yet dealt with. Although needs differ between countries, the commitment to remediation is universally seen as an environmentally responsible approach to mining.

Increasing uranium production today typically requires a lengthy review and approval process. While the time required from discovery to the opening of a mine took approximately 3-5 years in the 1950 and 1960s, it had increased to as much as twenty years in the 1990s. This represents a serious hindrance to the economic development of the industry. Accordingly, challenges for governments, industry and regulatory authorities today include:

- Improving credibility with stakeholders;
- Establishing global mine development practices that minimise environmental impacts;
- Continuing to repair environmental damages resulting from past practices no longer licensed today.

Mission of UMREG

To overcome these challenges, UMREG advocates adoption of policies that will minimise environmental impacts from efficient mining operations and promote remediation of the remaining legacy sites. These policies should be developed with full stakeholder consultations to achieve broad consensus and should include:

- Consideration of the utilisation of mining sites following remediation, driven by stakeholder interest;
- Promotion of efficient, environmentally sound mining, production and full life cycle use of uranium, a non-renewable resource;
- Distribution of information on past experiences to relevant parties in countries where these approaches have not yet been adopted.

UMREG helps implement these general policy goals by providing an international forum for the exchange of experience on low environmental impact uranium mining and value added remediation, harmonisation of "good environmental practices" and positive involvement of stakeholders in the remediation of uranium mines. UMREG promotes education and implementation of desired policies by linking with institutions, companies and projects involved in the transfer of technology and know-how and by maintaining a worldwide network of experts and a data and information management system that makes the cumulative experience available to the co-operating parties.

Conclusion

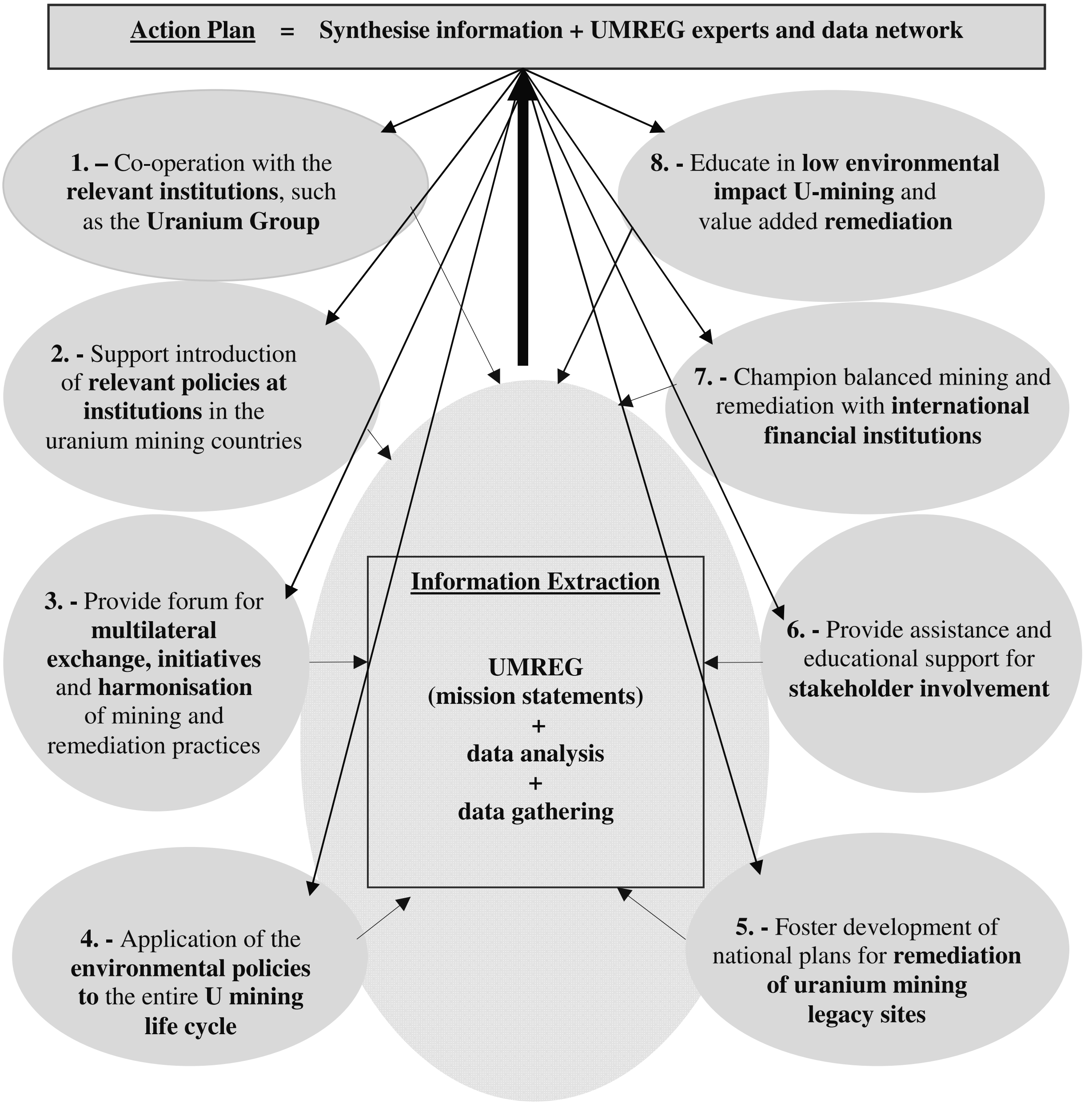
The remediation of the remaining uranium mining legacy sites is an important step toward enhancing future stakeholder support of the industry and hence the stability of future uranium mining projects. The present revival of the uranium mining industry is an ideal setting for governments to advance the cause of remediation of the remaining legacy sites.

New uranium mine developments should follow a complete life-cycle approach to environmental and waste management to keep environmental impacts as low as reasonably achievable to improve stakeholder confidence and minimise the risk of inflated remediation costs.

Beyond compliance with the health, safety and environmental standards, the remediation of the remaining legacy sites should be considered as an investment in the creation of conditions needed for value-added economic development of these regions.

"The true goal of mine remediation has been achieved if the health and environmental hazards have been contained <u>*and*</u> *conditions created that facilitate future utilisation of the site, thus triggering economic development and revitalisation in the post-mining region."*

IMPLEMENTATION OF THE POLICIES RECOMMENDED BY UMREG AND CONSIDERATION OF PROJECT FEEDBACK



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).

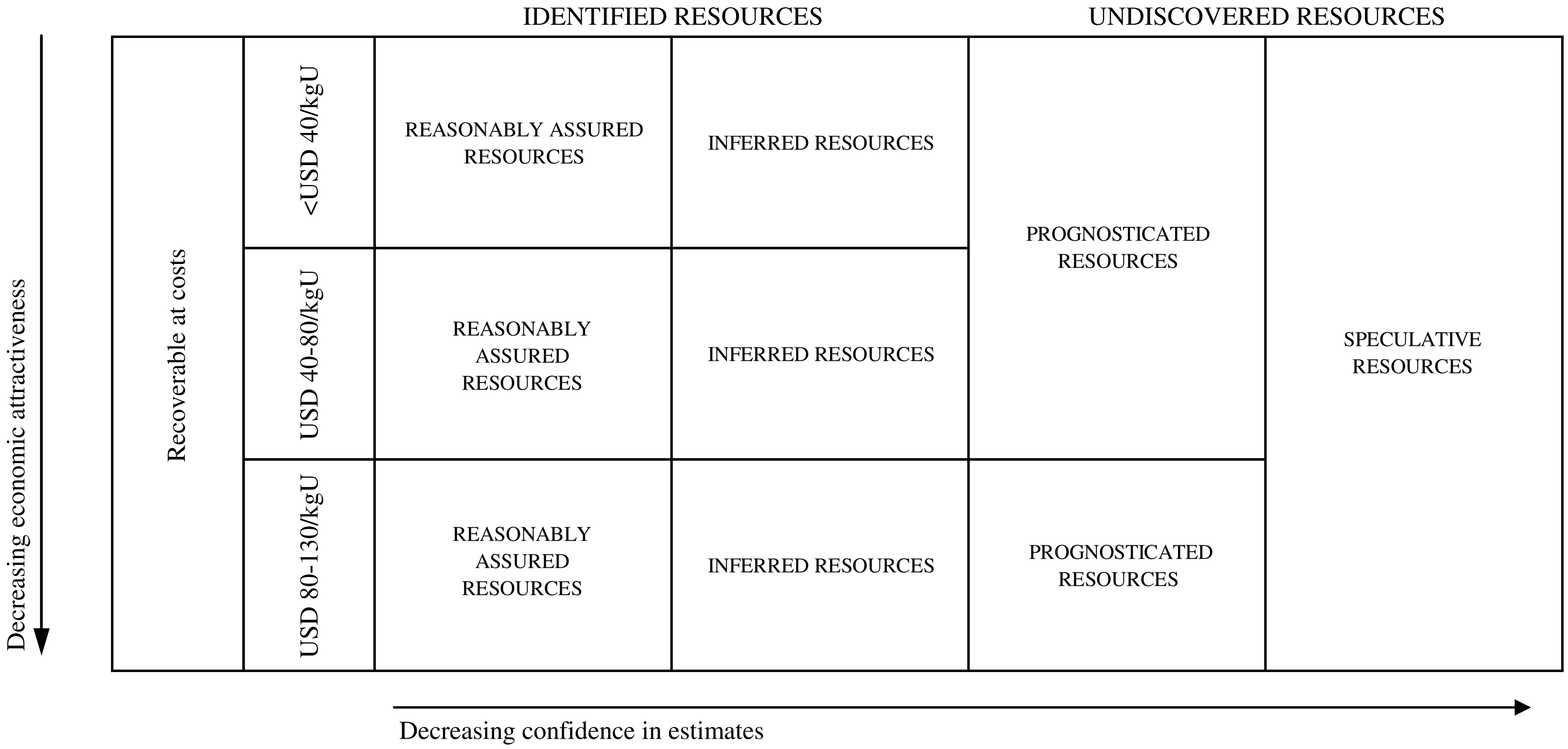
When estimating the cost of production for assigning resources within these cost categories, account has been taken of the following costs:

- 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**



		IDENTIFIED RESOURCES		UNDISCOVERED RESOURCES	
Recoverable at costs	<USD 40/kgU	REASONABLY ASSURED RESOURCES	INFERRED RESOURCES	PROGNOSTICATED RESOURCES	SPECULATIVE RESOURCES
	USD 40-80/kgU	REASONABLY ASSURED RESOURCES	INFERRED RESOURCES		
	USD 80-130/kgU	REASONABLY ASSURED RESOURCES	INFERRED RESOURCES	PROGNOSTICATED 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:

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[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.

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[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.

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[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*
     1. 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.
     2. 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)

Appendix 6

ENERGY CONVERSION FACTORS

The need to establish a set of factors to convert quantities of uranium into common units of energy appeared during recent years with the increasing frequency of requests for such factors applying to the various reactor types.

ENERGY VALUES FOR URANIUM USED IN VARIOUS RECTOR TYPES[1]

Country	**Canada**	**France**	**Germany**		**Japan**		**Russian Federation**		**Sweden**		**United Kingdom**		**United States**	
Reactor type	CANDU	N4 PWR	BWR	PWR	BWR	PWR	VVER-1000	RBMK -1000	BWR	PWR	MAGNOX	AGR	BWR	PWR
Burn-up [Mw/day/tU]														
a) Natural uranium or natural uranium equivalent	7 770	5 848	5 665	5 230	5 532	4 694	4 855	4 707	6 250	5 780	5 900	NA	4 996	4 888
b) Enriched uranium	–	42 500	40 000	42 000	33 000	43 400	42 000	22 000	40 000	42 000	–	24 000	33 000	40 000
Uranium enrichment [%^{235}U]	–	3.60	3.2	3.60	3.00	4.10	4.23	2.40	3.20	3.60	–	2.90	3.02	3.66
Tails assay [%^{235}U]	–	0.25	0.30	0.30	0.25	0.30	0.25	0.25	0.25	0.25	–	0.30	0.30	0.30
Efficiency of converting thermal energy into electricity	30%	34.60%	33.50%	34.20%	33%	34%	33.30%	31.20%	34.00%	34.50%	26%	40%	32%	32%
Thermal energy equivalent of 1 t natural uranium [in 10^{15} joules][2]	0.671	0.505	0.490	0.452	0.478	0.406	0.419	0.406	0.540	0.500	0.512	0.360	0.432	0.422
Electrical energy equivalent of 1 t natural uranium [in 10^{15} joules][2]	0.201	0.175	0.164	0.155	0.158	0.140	0.139	0.127	0.184	0.173	0.133	0.144	0.138	0.135

1. Does not include Pu and U recycled. Does not take into account the requirement of an initial core load, which would reduce the equivalence by about 6%, if based on a plant life of about 30 years with a 70% capacity factor.
2. Does not take into account the energy consumed for ^{235}U enrichment in LWR and AGR fuel. The factor to be applied to the energy equivalent under the condition of 3% ^{235}U enrichment and 0.2% tails assay should be multiplied by 0.957.

NA Not available.

Conversion Factors and Energy Equivalence for Fossil Fuel for Comparison

1 cal = 4.1868 J

1 J = 0.239 cal

1 tonne of oil equivalent (TOE) (net, LHV) = 42 GJ* = 1 TOE

1 tonne of coal equivalent (TCE) (standard, LHV) = 29.3 GJ* = 1 TCE

1 000 m^3 of natural gas (standard, LHV) = 36 GJ

1 tonne of crude oil = approx. 7.3 barrels

1 tonne of liquid natural gas (LNG) = 45 GJ

1 000 kWh (primary energy) = 9.36 MJ

1 TOE = 10 034 Mcal

1 TCE = 7 000 Mcal

1 000 m^3 natural gas = 8 600 Mcal

1 tonne LNG = 11 000 Mcal

1 000 kWh (primary energy) = 2 236 Mcal**

1 TCE = 0.698 TOE

1 000 m^3 natural gas = 0.857 TOE

1 tonne LNG = 1.096 TOE

1 000 kWh (primary energy) = 0.223 TOE

1 tonne of fuelwood = 0.3215 TOE

1 tonne of uranium: light water reactors = 10 000-16 000 TOE
open cycle = 14 000-23 000 TCE

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* World Energy Council standard conversion factors (from WEC, 1998 Survey of Energy Resources, 18th Edition).

** With 1 000kWh (final consumption) = 860 Mcal as WEC conversion factor.

Appendix 7

LISTING OF ALL RED BOOK EDITIONS (1965-2008) AND NATIONAL REPORTS

Listing of Red Book editions (1965-2008)

1.	OECD/ENEA	World Uranium and Thorium Resources, Paris, 1965
2.	OECD/ENEA	Uranium Resources, Revised Estimates, Paris, 1967
3.	OECD/ENEA-IAEA	Uranium Production and Short-Term Demand, Paris, 1969
4.	OECD/ENEA-IAEA	Uranium Resources, Production and Demand, Paris, 1970
5.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1973
6.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1975
7.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1977
8.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1979
9.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1982
10.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1983
11.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1986
12.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1988
13.	OECD/NEA-IAEA	Uranium Resources, Production and Demand, Paris, 1990
14.	OECD/NEA-IAEA	Uranium 1991: Resources, Production and Demand, Paris, 1992
15.	OECD/NEA-IAEA	Uranium 1993: Resources, Production and Demand, Paris, 1994
16.	OECD/NEA-IAEA	Uranium 1995: Resources, Production and Demand, Paris, 1996
17.	OECD/NEA-IAEA	Uranium 1997: Resources, Production and Demand, Paris, 1998
18.	OECD/NEA-IAEA	Uranium 1999: Resources, Production and Demand, Paris, 2000
19.	OECD/NEA-IAEA	Uranium 2001: Resources, Production and Demand, Paris, 2002
20.	OECD/NEA-IAEA	Uranium 2003: Resources, Production and Demand, Paris, 2004
21.	OECD/NEA-IAEA	Uranium 2005: Resources, Production and Demand, Paris, 2006
22.	OECD/NEA-IAEA	Uranium 2007: Resources, Production and Demand, Paris, 2008

INDEX OF NATIONAL REPORTS

	1965	**1967**	**1969**	**1970**	**1973**	**1975**	**1977**	**1979**	**1982**	**1983**	**1986**
Algeria						1975	1977	1979	1982		
Argentina		1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Armenia											
Australia		1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Austria							1977				
Bangladesh											1986
Belgium									1982	1983	1986
Benin											
Bolivia							1977	1979	1982	1983	1986
Botswana								1979		1983	1986
Brazil				1970	1973	1975	1977	1979	1982	1983	1986
Bulgaria											
Cameroon							1977		1982	1983	
Canada	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Central African Rep.				1970	1973		1977	1979			1986
Chile							1977	1979	1982	1983	1986
China											
Colombia							1977	1979	1982	1983	1986
Costa Rica									1982	1983	1986
Côte d’Ivoire									1982		
Cuba											
Czech Rep.											
Czech and Slovak Rep.											
Denmark (Greenland)	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Dominican Republic									1982		
Ecuador							1977		1982	1983	1986
Egypt							1977	1979			1986
El Salvador										1983	1986
Estonia											
Ethiopia								1979		1983	1986
Finland					1973	1975	1977	1979	1982	1983	1986
France	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Gabon		1967		1970	1973				1982	1983	1986
Germany				1970		1975	1977	1979	1982	1983	1986
Ghana							1977			1983	
Greece							1977	1979	1982	1983	1986
Guatemala											1986
Guyana								1979	1982	1983	1986

INDEX OF NATIONAL REPORTS (contd.)

1988	**1990**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**	**2004**	**2006**	**2008**	
							2002	2004	2006	2008	Algeria
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Argentina
						2000	2002	2004	2006		Armenia
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Australia
											Austria
1988											Bangladesh
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Belgium
	1990										Benin
											Bolivia
1988											Botswana
		1992	1994	1996	1998	2000	2002	2004	2006	2008	Brazil
	1990	1992	1994	1996	1998					2008	Bulgaria
											Cameroon
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Canada
											Central African Rep.
1988		1992	1994	1996	1998	2000	2002	2004	2006	2008	Chile
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	China
1988	1990			1996	1998					2008	Colombia
1988	1990										Costa Rica
											Côte d'Ivoire
1988		1992		1996	1998						Cuba
			1994	1996	1998	2000	2002	2004	2006	2008	Czech Rep.
	1990										Czech and Slovak Rep.
	1990	1992		1996	1998			2004			Denmark (Greenland)
											Dominican Republic
1988											Ecuador
1988	1990	1992	1994	1996	1998	2000		2004	2006	2008	Egypt
											El Salvador
					1998			2004			Estonia
											Ethiopia
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Finland
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	France
				1996	1998	2000	2002	2004	2006		Gabon
1988	1990	1992	1994	1996	1998	2000	2002		2006	2008	Germany
											Ghana
1988	1990	1992	1994	1996	1998						Greece
1988											Guatemala
											Guyana

INDEX OF NATIONAL REPORTS (contd.)

	1965	**1967**	**1969**	**1970**	**1973**	**1975**	**1977**	**1979**	**1982**	**1983**	**1986**
Hungary											
India	1965	1967		1970	1973	1975	1977	1979	1982	1983	1986
Indonesia							1977				1986
Iran, Islamic Rep. of							1977				
Ireland								1979	1982	1983	1986
Italy		1967		1970	1973	1975	1977	1979	1982	1983	1986
Jamaica									1982	1983	
Japan	1965	1967		1970	1973	1975	1977	1979	1982	1983	1986
Jordan							1977				1986
Kazakhstan											
Korea, Rep. of						1975	1977	1979	1982	1983	1986
Kyrgyzstan											
Lesotho											
Liberia							1977			1983	
Libyan Arab Jamahirya										1983	
Lithuania											
Madagascar						1975	1977	1979	1982	1983	1986
Malawi											
Malaysia										1983	1986
Mali											1986
Mauritania											
Mexico				1970	1973	1975	1977	1979	1982		1986
Mongolia											
Morocco	1965	1967				1975	1977	1979	1982	1983	1986
Namibia								1979	1982	1983	1986
Netherlands									1982	1983	1986
New Zealand		1967					1977	1979			
Niger		1967		1970	1973		1977				1986
Nigeria								1979			
Norway								1979	1982	1983	
Pakistan		1967									
Panama										1983	
Paraguay										1983	1986
Peru							1977	1979		1983	1986
Philippines							1977		1982	1983	1986

INDEX OF NATIONAL REPORTS (contd.)

1988	**1990**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**	**2004**	**2006**	**2008**	
		1992	1994	1996	1998	2000	2002	2004	2006	2008	Hungary
	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	India
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006		Indonesia
					1998	2000	2002	2004	2006	2008	Iran, Islamic Rep. of
		1992			1998						Ireland
1988		1992	1994	1996	1998	2000					Italy
											Jamaica
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Japan
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Jordan
			1994	1996	1998	2000	2002	2004	2006	2008	Kazakhstan
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Korea, Rep. of
				1996			2002				Kyrgyzstan
1988											Lesotho
											Liberia
											Libyan Arab Jamahirya
			1994	1996	1998	2000	2002	2004	2006	2008	Lithuania
1988											Madagascar
						2000				2008	Malawi
1988	1990	1992	1994	1996	1998	2000	2002				Malaysia
1988											Mali
	1990										Mauritania
	1990	1992	1994	1996	1998	2000					Mexico
			1994	1996	1998						Mongolia
1988	1990				1998						Morocco
1988	1990			1996	1998	2000	2002	2004	2006	2008	Namibia
	1990	1992	1994	1996	1998	2000	2002				Netherlands
											New Zealand
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Niger
											Nigeria
		1992		1996	1998						Norway
					1998	2000	2002				Pakistan
1988											Panama
											Paraguay
1988	1990	1992	1994	1996	1998	2000		2004	2006	2008	Peru
	1990		1994	1996	1998	2000	2002	2004	2006		Philippines

INDEX OF NATIONAL REPORTS (contd.)

	1965	**1967**	**1969**	**1970**	**1973**	**1975**	**1977**	**1979**	**1982**	**1983**	**1986**
Poland											
Portugal	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Romania											
Russian Fed.											
Rwanda											1986
Senegal									1982		
Slovak Rep.											
Slovenia											
Somalia							1977	1979			
South Africa	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Spain	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Sri Lanka							1977		1982	1983	1986
Sudan							1977				
Surinam									1982	1983	
Sweden	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Switzerland						1975	1977	1979	1982	1983	1986
Syrian Arab Rep.									1982	1983	1986
Tajikistan											
Tanzania											
Thailand							1977	1979	1982	1983	1986
Togo								1979			
Turkey					1973	1975	1977	1979	1982	1983	1986
Turkmenistan											
Ukraine											
United Kingdom						1975	1977	1979	1982	1983	1986
United States	1965	1967	1969	1970	1973	1975	1977	1979	1982	1983	1986
Uruguay							1977		1982	1983	1986
USSR											
Uzbekistan											
Venezuela											1986
Vietnam											
Yugoslavia											
Zaire		1967			1973		1977				
Zambia											1986
Zimbabwe									1982		

INDEX OF NATIONAL REPORTS (contd.)

1988	**1990**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**	**2004**	**2006**	**2008**	
						2000	2002			2008	Poland
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Portugal
		1992	1994	1996	1998	2000	2002				Romania
			1994		1998	2000	2002	2004	2006	2008	Russian Fed.
											Rwanda
											Senegal
			1994	1996	1998	2000	2002	2004	2006	2008	Slovak Rep.
			1994	1996	1998		2002	2004	2006	2008	Slovenia
											Somalia
		1992	1994	1996	1998	2000	2002	2004	2006	2008	South Africa
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Spain
1988											Sri Lanka
											Sudan
											Surinam
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Sweden
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Switzerland
1988	1990		1994								Syrian Arab Rep.
							2002				Tajikistan
	1990										Tanzania
1988	1990	1992	1994	1996	1998	2000	2002		2006		Thailand
											Togo
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	Turkey
								2004			Turkmenistan
			1994	1996	1998	2000	2002	2004	2006	2008	Ukraine
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	United Kingdom
1988	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	United States
1988	1990										Uruguay
		1992									USSR
			1994	1996	1998	2000	2002	2004	2006		Uzbekistan
1988											Venezuela
		1992	1994	1996	1998	2000	2002	2004	2006	2008	Vietnam
		1992									Yugoslavia
1988											Zaire
1988	1990	1992	1994	1996	1998						Zambia
1988		1992	1994	1996	1998						Zimbabwe

Appendix 8

CURRENCY EXCHANGE RATES*

(in national currency units per USD)

COUNTRY (currency abbreviation)	**June 2004**	**June 2005**	**June 2006**	**January 2007**
Afghanistan (AFA)	49.37	49.68	49.57	49.76
Algeria (DZD)	70.450	72.51	70.32	69
Argentina (ARS)	2.940	2.9	3.08	3.05
Armenia (AMD)	557.000	436	440	362
Australia (AUD)	1.400	1.31	1.31	1.27
Austria (EURO)	0.816	0.797	0.778	0.76
Belgium (EURO)	0.816	0.797	0.778	0.76
Brazil (BRL)	3.120	2.43	2.19	2.16
Bulgaria (BGN)	1.610	1.54	1.51	1.48
Canada (CAD)	1.360	1.26	1.1	1.16
Chile (CLP)	630.000	580	524	530
China (CNY)	8.266	8.266	8	7.82
Colombia (COP)	2 700.000	2 335	2 438	2 226
Cuba (CUP)	1.000	1	1	1
Czech Republic (CZK)	26.200	24.3	22	21
Denmark (DKK)	6.070	5.93	5.82	5.67
Egypt (EGP)	6.180	5.78	5.76	5.71
Finland (EURO)	0.816	0.797	0.778	0.76
France (EURO)	0.816	0.797	0.778	0.76
Gabon (XOF) [CFA Franc BEAC]	535.261	522.798	510.335	498.527
Germany (EURO)	0.816	0.797	0.778	0.76
Greece (EURO)	0.816	0.797	0.778	0.76
Hungary (HUF)	205.000	201	204	192
India (INR)	45.050	42.96	45.19	44.55
Indonesia (IDR)	8 800.000	9 400	9 200	9 015
Iran, Islamic Republic of	8 570	8 945	9 155	9 231
Italy (EURO)	0.816	0.797	0.778	0.76
Japan (JPY)	111.000	108	112	118
Jordan (JOD)	0.708	0.708	0.708	0.708
Kazakhstan (KZT)	135.500	130.9	122	127.6
Korea, Republic of (KRW)	1 166.000	990	933	927.55

COUNTRY (currency abbreviation)	**June 2004**	**June 2005**	**June 2006**	**January 2007**
Kyrgyzstan (KGS)	43.470	40.6	40.47	38.2
Lithuania (LTL)	2.817	2.752	2.686	2.624
Malawi (MWK)	106.060	114.84	140.18	137.31
Malaysia (MYR)	3.770	3.77	3.62	3.55
Mauritania (MRO)	264.230	264.5	276	270.61
Mexico (MXN)	11.400	10.94	11.29	10.84
Mongolia (MNT)	1 159.000	1 188	1 175	1 163
Morocco (MAD)	9.120	8.75	8.67	8.38
Namibia (NAD)	6.580	6.63	6.54	7
Netherlands (EURO)	0.816	0.797	0.778	0.76
Niger (XOF) [CFA Franc BCEAO]	535.261	522.798	510.335	498.527
Norway (NOK)	6.700	6.36	6.11	6.27
Peru (PEN)	3.480	3.25	3.27	3.2
Philippines (PHP)	55.670	54.4	52.92	49.28
Poland (PLN)	3.800	3.24	3.01	2.9
Portugal (EURO)	0.816	0.797	0.778	0.76
Romania (RON)	----	----	2.75	2.56
Russian Federation (RUB)	29.000	28	27	26.3
Serbia & Montenegro (CSD)	59.150	65.06	68.65	
Slovak Republic (SKK)	33.120	30.6	29.44	26.11
Slovenia (SIT, EUR)	SIT 195.000	SIT 190	SIT 186	EUR 182
South Africa (ZAR)	6.580	6.63	6.54	7
Spain (EURO)	0.816	0.797	0.778	0.76
Sweden (SEK)	7.420	7.32	7.21	6.87
Switzerland (CHF)	1.250	1.23	1.21	1.22
Syria (SYP)	51.720	53.15	52.2	52.21
Tajikistan (TJS)	3.010	3.1	3.25	3.47
Thailand (THB)	40.710	39.92	38.12	35.52
Turkey (TRY)	----	1.34	1.53	1.43
Ukraine (UAH)	5.330	5.02	5.01	5
United Kingdom (GBP)	0.545	0.548	0.533	0.511
United States (USD)	1.000	1.000	1.000	1.000
Uruguay (UYU)	29.700	24.4	23.9	24.25
Uzbekistan (UZS)	1 010.720	1 099.73	1 221.39	1 239
Viet Nam (VND)	15 680.000	15 765.000	15 935.000	16 061.000
Zambia (ZMK)	4 700.000	192	196.4	198.4
Zimbabwe (ZWD)	5 350.000	4 590	3 370	4 050

* *Source*: The Department of Finance of the United Nations Development Programme, New York.

Appendix 9

GROUPING OF COUNTRIES AND AREAS WITH URANIUM-RELATED ACTIVITIES

The countries and geographical areas referenced in this report are listed below. Countries followed by "*" are members of OECD.

1. North America

Canada*
Mexico*
United States of America*

2. Central and South America

Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Ecuador
El Salvador
Guatemala
Jamaica
Paraguay
Peru
Uruguay
Venezuela

3. Western Europe

Austria*
Belgium*
Denmark*
Finland*
France*
Germany*
Ireland*
Italy*
Netherlands*
Norway*
Portugal*
Spain*
Sweden*
Switzerland*
United Kingdom*

4. Central, Eastern and South-eastern Europe

Armenia
Bulgaria
Croatia
Czech Republic*
Estonia
Greece*
Hungary*
Lithuania
Poland*
Romania
Russian Federation
Slovak Republic*
Slovenia
Turkey*
Ukraine

5. Africa

Algeria
Botswana
Central African Republic
Congo, Democratic Republic
Egypt
Gabon
Ghana
Lesotho
Libya
Madagascar
Malawi
Mali
Morocco
Namibia
Niger
Nigeria
Somalia
South Africa
Zambia
Zimbabwe

6. Middle East, Central and Southern Asia

Bangladesh
India
Iran, Islamic Republic of
Israel
Jordan
Kazakhstan
Kyrgyzstan
Pakistan
Sri Lanka
Syria
Tajikistan
Turkmenistan
Uzbekistan

7. South-eastern Asia

Indonesia
Malaysia
Philippines
Thailand
Vietnam

8. Pacific

- Australia*
- New Zealand*

9. East Asia[1]

- China
- Korea, Republic of*
- Korea, Democratic People's Republic of
- Japan*
- Mongolia

The countries associated with other groupings of nations used in this report are listed below.

Commonwealth of Independent States (CIS) or Newly Independent States (NIS)

- Armenia
- Azerbaijan
- Belarus
- Georgia
- Kazakhstan
- Kyrgyzstan
- Moldavia
- Russian Federation
- Tajikistan
- Turkmenistan
- Ukraine
- Uzbekistan

European Union

- Austria
- Belgium
- Bulgaria
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxemburg
- Malta
- Netherlands
- Poland
- Portugal
- Romania
- Slovak Republic
- Slovenia
- Spain
- Sweden
- United Kingdom

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[1] Includes Chinese Taipei.

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