The latest figures on uranium

by R. Vance*

According to the latest figures on uranium, soon to be published by the NEA, uranium resources, production and demand are all on the rise. Exploration efforts have increased recently in line with the expected expansion of nuclear energy in the coming years. Total identified resources have grown and are now sufficient to cover 100 years of supply at 2008 rates of consumption. Costs of production have, however, also increased.

This article is based on the latest edition of the "Red Book", *Uranium 2009: Resources, Production and Demand,* which presents the results of the most recent biennial review of world uranium market fundamentals and a statistical profile of the world uranium industry as of 1 January 2009. It contains official data provided by OECD Nuclear Energy Agency (NEA) and International Atomic Energy Agency (IAEA) member countries on uranium exploration, resources, production and reactor-related requirements. Projections of nuclear generating capacity and reactor-related uranium requirements through 2035 are also provided as well as a discussion of long-term uranium supply and demand issues.

Exploration

Worldwide exploration and mine development expenditures have more than doubled compared to figures reported in the 2007 edition of the Red Book, despite declining uranium market prices since mid-2007. Most major producing countries reported increasing expenditures, as efforts to identify new resources and to bring new production centers online moved forward. The majority of global exploration activities remain concentrated in areas with potential for hosting unconformity-related and ISL (*in situ* leach) amenable sandstone deposits, primarily in close proximity to known resources and existing production facilities. However, since uranium prices remain higher than those that prevailed during the last two decades of the 20th century, even with the price decline since mid-2007, "grass roots" exploration has been stimulated, as well as increased exploration in regions known to have good potential based on past work. Based on preliminary data, domestic exploration and development expenditures are expected to decline somewhat, but to have remained strong throughout 2009.

CEA

Kasolite crystals containing uranium.

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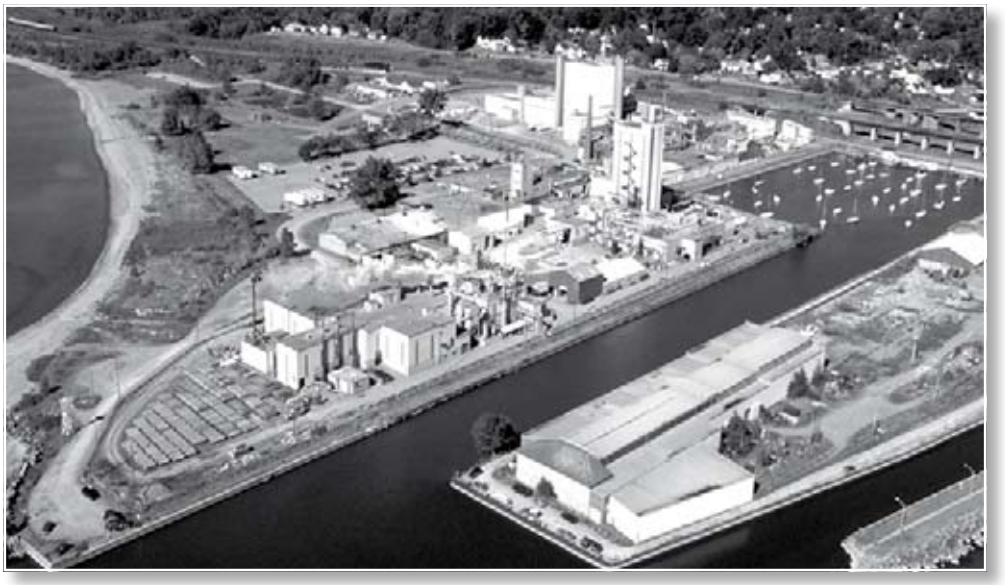

Cameco

The Port Hope uranium production centre in Canada.

Resources

Total identified resources as of 1 January 2009 increased by about 15% compared to 1 January 2007. A high-cost category of <USD 260/kgU was used in this edition in response to both the generally increased market prices for uranium since 2002 and increased mining costs. Although total identified resources have increased overall, there has been a significant reduction in lower-cost resources owing to increased mining costs. Though a portion of the overall increases relate to new discoveries, the majority result from re-evaluations of previously identified resources. At 2008 rates of consumption, identified resources are sufficient for over 100 years of supply.

Total undiscovered resources, estimated at 10.4 million tonnes of uranium (tU), declined slightly from the 10.5 million tU reported in the 2007 edition of the Red Book. It is important to note however that some countries, including major producers with large identified resource inventories, do not report resources in this category.

Resource figures are dynamic and related to commodity prices. The overall increase in identified resources from 2007 to 2009, equivalent to about 15 years of supply of 2008 uranium requirements, demonstrate that uranium prices continue to impact resource totals and that with market incentives, new resources are readily identified. The uranium resource figures presented in this volume are a "snapshot" of the situation as of 1 January 2009. Favourable market conditions will stimulate exploration and, as in the past, increased exploration efforts will lead to the identification of additional resources through intensified investigation of existing deposits and the discovery of new deposits of economic interest. For example, recent efforts in Australia have led to the discovery of new deposits and continued efforts in Canada have led to discoveries of high-grade deposits in the Athabasca Basin.

Production

Uranium production in 2008 (the most recent year with full production figures) totalled 43 880 tU, a 6% increase from the 41 244 tU produced in 2007 and an 11% increase from the 39 617 tU produced in 2006. As in 2006, a total of 20 countries reported output in 2008. Global production increases between 2006 (data from the 2007 edition of the Red Book) and 2008 were driven principally by significant increases in Kazakhstan (76%). More modest increases were recorded in Australia, Brazil, Namibia and the Russian Federation. Reduced production was recorded in a number of countries between 2006 and 2008 (including Canada, Niger and the United States) owing to a combination of lower ore grades and technical difficulties. *In situ* leach (ISL, sometimes referred to as *in situ* recovery, or ISR) production is rising rapidly in global importance, principally because of capacity increases in Kazakhstan. Global uranium production in 2009 is expected to grow by about 15% compared to 2008, with Kazakhstan continuing to ramp up production and production beginning in Malawi.

Environmental aspects of uranium production

Environmental aspects of the uranium production cycle can generally be divided into two areas. The first encompasses ongoing efforts to remediate the consequences of uranium mining practices, no longer licensed today, that resulted in a number of legacy uranium mining sites in several countries. Included in the 2009 edition of the Red Book are updates of some of these activities. These experiences are an important reminder of the consequences of outdated mining practices that must continue to be avoided in coming years as uranium mining is poised to expand to new producing countries.

The second area encompasses efforts to ensure that ongoing operations are conducted in a fashion that protects people and the environment and avoids the creation of new uranium mining legacies. Information presented in a number of national reports include accounts of crucial aspects of modern uranium mine development, such as environmental assessment processes prior to mine openings or expansions, monitoring programmes at mines currently in production, efforts to reduce water consumption and the establishment of new, more stringent environmental radiological protection regimes. Uranium mining can bring benefits to local populations and the use of funds raised through resource taxes on uranium mining operations, as well as efforts by the mining companies themselves, to improve living conditions of people in the vicinity of mining operations are outlined. Uranium mining companies also continue to obtain the internationally recognised ISO 14001 for sustainable management and environmental protection.

Uranium demand

At the end of 2008, a total of 438 commercial nuclear reactors were connected to the grid with a net generating capacity of about 373 GWe. Uranium acquisitions have declined in recent years as generally higher uranium prices have motivated utilities to specify lower tails assays at enrichment facilities in order to reduce uranium consumption. By the year 2035, world nuclear capacity is projected to grow to between 500 and 785 GWe net. Accordingly, world reactor-related uranium requirements are also projected to rise.

Significant regional variation exists within these projections. Nuclear energy capacity and resultant uranium requirements are expected to grow significantly in the East Asia region and in non-European Union countries in Europe and western Asia. Nuclear capacity and requirements display a wide variation in North America and in the European Union. 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.

Supply and demand relationship

At the end of 2008, world uranium production provided over two-thirds of world reactor requirements, with the remainder being met by supplies of uranium already mined (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 increased prices and rising demand. As currently projected, uranium mine production could satisfy projected high-case world uranium requirements until the late 2020s. Should demand increase as projected growth in nuclear power is realised, uranium prices would strengthen allowing mine production capacity to be increased even further. However, sufficiently high market prices will be required to fund such mine development activities, especially in light of rising costs of production. Secondary sources will continue to be required, complemented to the extent possible by uranium savings achieved by specifying lower tails assays at enrichment facilities and possible technical developments in fuel cycle technology.

Although information on secondary sources is incomplete, they are generally expected to decline in importance through the next decade. However, there remains a potentially significant amount of previously mined material (including for military requirements), and the possibility that at least some of this material could make its way to the market in a controlled fashion cannot be discounted. Nonetheless, a sustained strong market for uranium will be needed to stimulate the timely development of production capability and to increase the identified resource base should growth in nuclear generating capacity follow currently projected trends. However, 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), the relatively sparse global network of uranium mine facilities and geopolitical uncertainties in some important producing countries, uranium supply shortfalls could potentially develop.

Conclusions

Despite recent declines stemming from the global financial crisis, world demand for electricity is expected to continue to grow significantly over the next several decades to meet the needs of an increasing population and economic growth. The recognition by an increasing number of governments that nuclear power can produce competitively priced, baseload electricity that is essentially free of greenhouse gas emissions, coupled with the role that nuclear can play in enhancing security of energy supply, increases the prospects for growth in nuclear generating capacity, although the magnitude of that growth remains to be determined.

Regardless of the role that nuclear energy ultimately plays in meeting rising electricity demand, the uranium resource base is more than adequate to meet projected requirements. Meeting even high-case requirements to 2035 would consume less than half of the identified resources described in this edition. Nonetheless, the challenge remains to develop mines in a timely and environmentally sustainable fashion as uranium demand increases. A strong market will be required for these resources to be developed within the time frame required to meet future uranium demand.