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The Global Nuclear Fuel Market, Supply and Demand 2003-2025

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Introduction

The World Nuclear Association (formerly The Uranium Institute) has published reports on uranium supply and demand at roughly two yearly intervals since its foundation in 1975. This report is the eleventh in the series. It builds on the previous report, issued in September 2001 but lengthens the forecasting period from 2020 up to 2025. It includes scenarios covering wide range of possibilities, reflecting possible outcomes for nuclear power. Forecasts of the period beyond 2025 are beyond the scope of this report and could require different approaches, but the key issues examined here are likely to have continued relevance.

In common with its predecessors, this report concentrates on the "front end" of the nuclear fuel cycles, i.e. from uranium mining to electricity generation, without detailed consideration of the "back end". Spent fuel management and plant decommissioning are important issues within the nuclear industry but only the impact of recycling spent nuclear fuel is closely examined here.

Methodology

This report follows previous practice by making extensive use of information from the WNA's members in its compilation. They represent all aspects of the nuclear fuel cycle on a worldwide basis. Some contributions have been made formally via working groups made up of member representatives.

The cut-off date for information is 30 June 2003. Developments up to that point are included in the analysis, but those subsequent to this are excluded.

Questionnaires to both member and non-member organisations active in the fuel cycle were used to extend the knowledge base and to help produce the forecasts included in this report. Confidentiality of the responses was secured by having answers compiled by a firm of accountants, with only regionally aggregated data being provided to the WNA. This allowed access to information otherwise very difficult to acquire. The questionnaires were supplemented, where necessary, by judgements applied by the WNA, based on published material and other information deemed accurate. Sources of information include regular reports produced by industry participants, conference papers, and the publications of public bodies such as the Energy Information Administration (EIA) in the United States and the Euratom Supply Agency (ESA) in the European Union (EU).

The forecasts of fuel requirements were assisted by a computer model developed at the WNA over many years, which incorporates the key operating characteristics of reactors.

Summary of the report

The following is a summary of the report, which covers the main highlights. The full report is quite lengthy but will merit detailed study by the interested reader.

Rapid growth in world demand for electricity has provided a strong market for the development of nuclear power over the past 30 years, and it now contributes nearly 17% of world electricity supply. Today, electricity demand growth is relatively low in most of the countries where nuclear power is well-established, but remains rapid in many developing countries. In both established and potential markets, nuclear power faces a competitive challenge from other modes of generation, while continuing to face regulatory and political hurdles (Chapter 1).

The forecasts of nuclear generating capacity in individual countries and areas have been fully revised. It is expected that the fortunes of nuclear power in a relatively small number of countries, notably the United States, China, India and Russia, will be particularly crucial in determining nuclear power's overall contribution to world electricity supplies (Chapter 2).

The outlook for nuclear power around the world has generally brightened since the previous Market Report was issued in 2001. This is despite the continuation of unhelpful political interference in some countries. The operating performance of existing reactors continues to improve, ensuring their economic competitiveness in liberalised electricity markets. The prospects for new reactor build have improved in the United States and some other countries (Chapter 2).

Three scenarios for world nuclear generating capacity up to 2025 have been prepared, referred to as the reference, upper and lower scenarios. These range from a substantial revival of nuclear power to a slow decline over the forecast period. At the end of 2002, world nuclear capacity was 357 GWe. In the reference scenario this is expected to be 367 GWe by 2005, and then to grow to 396 GWe by 2010 and to 438 GWe by 2025. The annual average rate of growth over the whole period is 0.9%. Given expected world electricity demand growth substantially in excess of this, the nuclear share of total generation is likely to decrease. In the upper scenario, the equivalent figures are 374 GWe in 2005, 426 GWe in 2010, and 549 GWe in 2025. The lower case has 362 GWe in 2005, 373 GWe in 2010, and 308 GWe by 2025 (Chapter 2).

Generating capacity is directly related to reactor requirements which are the key demand indicator for nuclear fuel. The reactor requirements model has been updated, with a reassessment of the various factors which affect nuclear fuel demand, such as enrichment levels, cycle lengths and fuel burnups. Questionnaires sent to nuclear utilities throughout the world provided useful information to both inform and supplement the model (Chapter 3).

The three scenarios for nuclear generating capacity were used to produce reference, upper and lower scenarios for reactor uranium requirements. World

reactor requirements in 2002 are estimated at 65 300 tU equivalent. In the reference scenario, these are expected to be 68 400 tU in 2005, rising to 74 800 tU in 2010 and 81 900 tU by 2025. The annual rate of growth 2002-2025 is 1%, slightly ahead of the equivalent growth in generating capacity. This can mainly be explained by higher reactor load factors being achieved. Requirements are 69 500 tU in 2005, 79 800 tU in 2010, and 102 500 tU in 2025 in the upper scenario. The lower case figures are 67 000 tU in 2005, 70 200 tU in 2010, and 57 700 tU in 2025 (Chapter 3).

World known reserves of uranium are more than adequate to satisfy reactor requirements to well beyond 2025. World uranium production fell slightly in 2002 to 36 097 tU, after rising in both 2000 and 2001. Two trends continue to be dominant. Firstly, production is becoming increasingly concentrated in a small number of large mines in a limited number of countries, particularly Canada and Australia. Secondly, ownership of the major mines is becoming concentrated in a smaller number of companies, and thus the share of production attributable to these companies is rising (Chapter 4).

Two scenarios for uranium production have been developed by applying a standard 80% capacity utilisation rate to anticipated mine production capacity. On the assumption that new mines come into operation as currently planned, production should rise towards 40 000 tU per annum in the period to 2010 in both cases. Thereafter, further increases are dependent on some of the prospective production capacity coming into operation. If all mines currently envisaged come into operation, production could exceed 55 000 tU by 2020 (Chapter 4).

Imports from Russia and the Newly Independent States (NIS) continue to be a major supply source for the Western world. It is now judged that over 150 000 tU (including primary production and secondary sources) has been exported from the NIS to the West since 1989. There remain uncertainties about the magnitude and character of Russian inventories and stockpiles, and it is still unclear where they will be consumed and how long these will last. However, it is known that spare Russian enrichment capacity is being used to re-enrich depleted uranium from the West, and that this has become an important source of secondary supply to both Eastern and Western markets. Ex-military high enriched uranium (HEU) from both Russia and, potentially, the United States will be an important element in the market in the period to 2015 (and possibly thereafter), but ex-military plutonium will have only a minor impact (Chapter 4).

There are discrete markets for conversion, enrichment and fuel fabrication services. Demand for each service is clearly linked to that for uranium and for the other services, but each market has to be considered individually. Most of the secondary sources which will have an impact on the uranium market will also affect the conversion and enrichment markets. The fuel fabrication market differs from the others in that it supplies a highly differentiated product, rather than a bulk commodity-type service (Chapters 3, 4 and 5).

Combining all primary and secondary uranium supply sources suggests that the nuclear fuel market will be adequately supplied in the period to 2010, but the period beyond is clouded with some uncertainty. The ending of the HEU deal between Russia and the United States in 2013 may prove to be a major watershed,

and it is clear that primary production must rise substantially to make up the loss of this source of supply. There have always been significant risks for the nuclear power industry in over-reliance on supplies from secondary sources, as additional primary supplies can only be brought on line with some delay. Much consolidation has already occurred in the uranium mining industry, and new uranium projects face many challenges in entering production (Chapter 5).