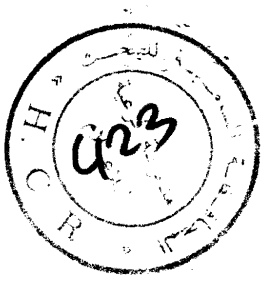
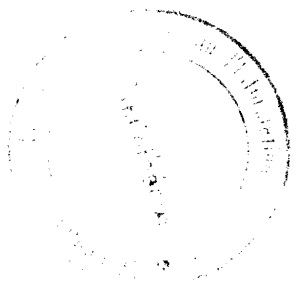
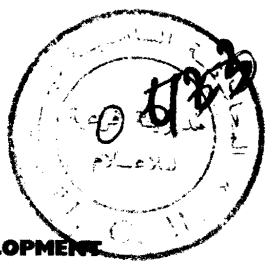


URANTUM

RESOURCES PRODUCTION AND DEMAND



A JOINT REPORT BY THE
OECD NUCLEAR ENERGY AGENCY
AND THE
INTERNATIONAL ATOMIC ENERGY AGENCY



ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The Organisation for Economic Co-operation and Development (OECD), which was set up under a Convention signed in Paris on 14th December, 1960, provides that the OECD shall promote policies designed:

- *to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;*
- *to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development;*
- *to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.*

The Members of OECD are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

The OECD Nuclear Energy Agency (NEA) was established on 20th April 1972, replacing OECD's European Nuclear Energy Agency (ENEA) on the adhesion of Japan as a full Member. NEA thus groups eighteen European Member countries of OECD and Japan, with Canada and the United States as Associated countries. The Commission of the European Communities takes part in the work of the Agency.

The objectives of NEA remain substantially those of ENEA, namely the orderly development of the uses of nuclear energy for peaceful purposes. This is achieved by:

- *assessing the future role of nuclear energy as a contributor to economic progress, and encouraging co-operation between governments towards its optimum development;*
- *encouraging harmonisation of governments' regulatory policies and practices in the nuclear field, with particular reference to health and safety, radioactive waste management and nuclear third party liability and insurance;*
- *forecasts of uranium resources, production and demand;*
- *operation of common services and encouragement of co-operation in the field of nuclear energy information;*
- *sponsorship of research and development undertakings jointly organised and operated by OECD countries.*

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

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Part I

GENERAL

1. FOREWORD

In August 1965, a report entitled "World Uranium and Thorium Resources" was published by the European Nuclear Energy Agency, on the basis of an examination carried out by the ENEA Study Group on the Long-Term Role of Nuclear Energy in Western Europe.

It was foreseen at the time of publication that the results of this examination would need to be updated at intervals, and in December 1967 a second report, "Uranium Resources, Revised Estimates" was published. In order to enlarge the geographical coverage of the study, and to receive the advice of experts from uranium-producing countries outside the OECD area, this revision was made jointly with the International Atomic Energy Agency, Vienna.

During 1968 a joint ENEA/IAEA Working Party prepared a first report on "Uranium Production and Short Term Demand", in an attempt to relate information on uranium production supplied by the members of the Working Party, with a prediction of the probable demand over the next ten years. The report was published in January 1969.

In September 1970 a report on "Uranium Resources, Production and Demand" was published jointly by ENEA and the IAEA. This report contained an updating of the uranium resources position since 1967 which was again carried out by the joint ENEA/IAEA Working Party on Uranium Resources. In addition, the Secretariat had prepared estimates of uranium and separative work requirements which were annexed to the report.

The present report is essentially similar to the previous one, in that it contains updated information on uranium resources, production and demand. Part II on Uranium Resources and Production was

prepared in the framework of the joint NEA*/IAEA Working Party on Uranium Resources, as was the case in the three foregoing reports. The estimates of requirements for natural and enriched uranium, contained in Part III of the Report, have been prepared by a "Working Party on Uranium Demand", with an international membership set up for this purpose in spring 1972 by the NEA Study Group on the Long-Term Role of Nuclear Energy. As a result of this approach the estimates for uranium and separative work demand are based on corporately agreed input data, and the scope of the demand calculations has been extended considerably through access to relevant computer programs in several participating countries.

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* NEA, the Nuclear Energy Agency of OECD, replaced ENEA as the Agency's official name following the adhesion of Japan as a full member in April 1972.

2. SUMMARY AND CONCLUSIONS

The present report is essentially similar in content to that published in September 1970. However, subsequent changes in the parity of the US dollar (the basis for classifying resources), and different assumptions for the demand calculations, render comparison with the earlier figures more complex.

Reasonably assured world uranium resources under \$10/lb U_3O_8 now amount to 866,000 tonnes uranium (1,126,000 short tons U_3O_8), an increase of about one-third over the past three years.

Annual production of U_3O_8 has remained fairly stable during this period, attaining a modest increase of about 10 per cent to a 1972 total of something over 19,000 tonnes uranium (25,000 short tons U_3O_8). Annual production capacity is planned to reach about 30,000 tonnes uranium (40,000 short tons U_3O_8) by 1975 and could attain about 50,000 tonnes uranium (65,000 short tons U_3O_8) by 1978.

Estimates of future demand have been based upon individual national forecasts of varying tendencies. As a result, it has been considered more appropriate to suggest a range of figures, rather than attempt a single authoritative forecast. The ranges have been so chosen (see Fig. 3) as to allow more latitude for a shortfall in capacity than an excess. The possibility that an accelerated nuclear programme might be instituted in many countries to overcome an energy shortage was not considered in this report.

Annual demand for uranium is expected to establish itself in the region of 60,000 tonnes uranium (about 80,000 short tons U_3O_8) by 1980 and almost double this figure by 1985. No shortages of uranium supply are to be expected in the 1970s. However, the rapid growth in demand in the coming decade cannot be satisfied on the basis of existing uranium exploration levels. Given the necessity of a lead time of about eight years between discovery and actual production,

it is therefore essential that steps be taken to increase the rate of exploration for uranium so that an adequate forward reserve may be maintained.

The assumed predominance of light water reactors in the growth of nuclear power over the next ten to fifteen years imposes an annual demand for separative work of the order of 30,000 to 40,000 tonnes SWU* by the early 1980s. Existing and currently planned separative work capacity is therefore almost certainly bound to be saturated within the next ten years. In theory, the lead time for construction of additional capacity is within that required for the nuclear power stations it will feed, but hesitations over the extension of separative work capacity could introduce significant delays. If new separative work capacity is not provided in a timely manner, operators may be led to favour plutonium or to the choice of reactor types which minimise separative work requirements.

Notwithstanding the uncertainties with regard to future availability of natural and enriched uranium supplies, it is clear from the work of the Study Group that the most significant variations in demand arise not from one or another strategy involving mainly enriched uranium reactors, but from variations in the growth of nuclear power as a whole. This finding underlines the continuing necessity of improving the quality of nuclear power forecasts in the light of past experience, and of updating these forecasts at frequent intervals, taking into account the latest developments in energy policy.

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* Separative Work Units.

3. DEFINITIONS

The present report is principally concerned with uranium resources considered to be exploitable in the near future. Deposits from which, for various reasons, uranium is not readily recoverable, or which are unlikely to be exploited in the foreseeable future, are not included in the summary tables. As in the previous report, there is therefore no mention of resources in the price classification of \$15 to \$30/lb U_3O_8, because it is unlikely that such material will be worked in the short term. For the same reason, by-product uranium is not in general included in the totals of available resources (an exception is uranium from gold production in South Africa).

The following price ranges have been applied to the different resource categories reported on:

- up to \$10/lb U_3O_8 ($\leq$ \$26/kg U) [Abbreviated <\$10 uranium]
- \$10 to \$15/lb U_3O_8 (\$26 to \$39/kg U) [Abbreviated \$10-15 uranium]

In this context it should be mentioned that current uranium prices are of the order of \$6/lb U_3O_8. However, taking into account that actual prices may often be lower than full cost prices, reflecting an unfavourable market position, and that the general trend of uranium costs is likely to increase, the price limit of \$10/lb U_3O_8 has been maintained in this report. Due to parity changes of the US\$, the absolute value of this price limit (as of March 1973) is about 17 per cent lower than in the previous report. It should be noted, however, that the symbol \$ is employed throughout this report to represent the US dollar (at March 1973 values) whereas in the last report it represented the EMA u/a*. The March 1973 US dollar now

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* EMA u/a: European Monetary Agreement units of account.

corresponds to 0.82895 EMA u/a (as against 1.00 EMA u/a in the last report). It would therefore be unwise strictly to compare the detail of the resource figures quoted in the two price ranges with corresponding figures in previous years, although in practice the overall impression given by such a comparison is probably reasonable.

In this report, as previously, uranium in each price range has been subdivided into two categories:

The term Reasonably Assured Resources as employed in the previous report, has been retained for the first category, and refers to uranium which occurs in known ore deposits of such grade, quantity and configuration that it can, within the given price range, be profitably recovered with currently proven mining and processing technology. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of ore-body habit. Reasonably assured resources in the price category below $10/lb are equivalent to Reserves in the mining sense.

The term Estimated Additional Resources refers to uranium surmised to occur in unexplored extensions of known deposits or in undiscovered deposits in known uranium districts, and which is expected to be discoverable and economically exploitable in the given price range. The tonnage and grade of estimated additional resources are based primarily on knowledge of the characteristics of deposits within the same districts.

Consequently the Estimated Additional Resources usually do not represent material which is definitely known to be available and recoverable, but as defined above, may include, for example, postulated deposits in known uranium districts. These qualifications are given in the individual country reports. It should also be noted that a significant proportion of resources in the $10-$15 category is in the same deposits as the lower cost material. As mining continues at a cut-off grade appropriate for the lower costs, much of the higher cost material will be lost entirely or become even more costly for later recovery. On the other hand, the estimate of resources in the higher priced category is, overall, a very conservative one in that prospecting and exploration have been directed primarily toward the identification of lower-cost resources; thus reliability is higher for the price range below $10 per pound and lower for the high-cost deposits.

Finally, information from the USSR, Eastern Europe and China could not be included in the report because data have not been made available. Therefore, where the word "world" is used in this report, these countries are not included.

Important note

All resources are expressed in metric tons of uranium metal (tonnes U), and for convenience are also given in short tons U_3O_8 (1 short ton U_3O_8 = 0.7693 tonnes U). The latter value is given in brackets, e.g. 1,000 tonnes U (1,300).

A conversion table is given below:

Tonnes U	Short tons U_3O_8	Tonnes U	Short tons U_3O_8
1	1.3	6	7.8
2	2.6	7	9.1
3	3.9	8	10.4
4	5.2	9	11.7
5	6.5	10	13.0