International Nuclear Societies Council's

Committee Report

A VISION FOR THE SECOND FIFTY YEARS OF NUCLEAR ENERGY

Vision and Strategies

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FOREWORD OF THE REPORT

By INSC Chairman, Prof.Mishima Yoshitsugu

This report, "A Vision for the Second Fifty Years of Nuclear Energy", summarizes a study by the International Nuclear Societies Council (INSC) that took 2 years to complete. It looks at nuclear science and technology in the next half century from the perspective of the achievements in the first 50 years since the initial controlled fission reaction in the Fermi reactor.

The report presents a professional, global, and unrestricted view of the development and utilization of nuclear power and related research around the world:

- professional, because it was written by technical people whobelong to nuclear societies that are part of INSC;
- global, because it gathers the opinion of some 50000 people from around the world who are represented at INSC through their nuclear societies;
- unrestricted, because it reflects no political or commercial bounds.

Although many nuclear programs are governmental, the contributors to the report, acting as individuals belonging to a non governmental organization like the INSC, are mindful of the concerns about whether very large amounts of energy from nuclear fission, inferred from the supply and demand projections of this study, could be actually feasible. It is their judgment, from their expert sense of conscience and responsibility, that you will find in this report.

In this study, the forecast made by the World Energy Council was extrapolated to estimate worldwide requirements of energy supply and demand in the first half of the next century. The report considers the decrease in the use of energy sources that have an adverse environmental impact; the economy of the use of fossil fuels, which may be depleted within the time scale of the study; and an estimation of renewable energies under the hopeful perspective that their development might produce more than expected. Only the balance of energy needs was allocated to nuclear power, or more specifically to nuclear fission.

In order to achieve the expected share of nuclear power to satisfy these needs, about 100 units of the thousand-megawatt-electric class might have to be constructed every year around the world by the middle of the next century. Could these amounts be achieved if, indeed, they are necessary? Moreover, most of them will be needed in developing countries. Do adequate sites exist? If the 1000 MW(electric) class were to be too large, and even if smaller units would be acceptable, places that meet adequate site conditions are still difficult to find.In addition, investments of the order of more than half the current Japanese

national budget must come out in some way to finance these units. Could any power plant be built with a good economic outlook by using loans to be repaid through the utilities' income after a construction period of about 10 years?

If the utilization of thermal reactors should continue as at present, a shortage of uranium might be experienced by the middle of the next century. The idea of economically extracting uranium from sea water has some scientific support, but it is generally accepted that only land-based uranium ore is a dependable resource. As nuclear fuel cycles with fast breeder reactors increase the efficiency of uranium use by a factor of the order of 60 to 70, commercial operation of fast breeder reactors around the year 2030 may become indispensable; otherwise, uranium resources might be fully depleted before the end of the next century.

The use of plutonium for fast breeder reactors will require the conclusion of international agreements, as a protocol to the Treaty on the Non-Proliferation of Nuclear Weapons, to safeguard plutonium use exclusively for peaceful purposes.

There are no insuperable technical difficulties in designing and constructing a nuclear plant. The practical difficulties are related to public concerns regarding safety, waste disposal, and nuclear proliferation. Without public acceptance, no nuclear power or nuclear radiation utilization program can be effectively built up. Finding the way out of such difficulties is one of the major challenges the energy supply sector will encounter.

You may think that this report is not too different from similar reports that come out from time to time. Please do not jump to such a conclusion, and take the time to read the report. You may find some unexpected assessments and challenging answers.

Mishima Yoshitsugu
Chairman, International Nuclear Societies Council

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1. INTRODUCTION

A joint meeting of the American Nuclear Society, the European Nuclear Society, and the U.S. Council on Energy Awareness was held in Chicago, Illinois, in November 1992 on the 50th anniversary of the first man-made, controlled nuclear chain reaction. This occasion provided an opportunity to take stock of the development of nuclear energy and to contemplate the prospects for the next 50 years. The International Nuclear Societies Council (INSC), considering the needs of the world in the coming decades, anticipated that an even more important contribution will be demanded of nuclear technology, and in June 1993, it set up a committee to prepare "A Vision for the Second Fifty Years of Nuclear Energy," based on the views of its member nuclear societies from all over the world.

The members of the nuclear societies, some 50 000 professionals working in the nuclear field, come from schools, colleges, and universities; from government departments and regulatory bodies; from research and development laboratories; from hospitals and cancer treatment facilities; from utility and reactor operating staffs; from consulting and architect-engineers; and from equipment and services suppliers and industrial users of radiation. Taking into account the geographical expanse and the professional diversity of its membership, it was natural for INSC to produce a politically and commercially independent report.

Objective

The objective of this report is to provide a reliable proposal for global policy making:

- to identify the future role of nuclear science and technology in improving the global quality of life

and
- to identify actions to enable nuclear science and technology to fulfill that role, i.e., to resolve the anomaly that despite the attributes and the contributions of nuclear science and technology, it is currently being used in only a few countries.

Relevant factors that contribute to the global quality of life are (a) matching energy supply to needs on a regional basis, (b) making energy available at an acceptable cost, (c) minimizing adverse effects on the environment, and (d) reducing the risks of energy production to acceptable levels.

The experience of the last 50 years is used to indicate the directions and issues to be faced in the next 50 years, taking into account the best available estimates of the future and the scientific and technological knowledge on hand and reasonably foreseeable.

The emphasis of the report is on the utilization of nuclear energy technologies and radiation applications on a worldwide scale, based on practical considerations rather than on the exploration of lines of research and development.

Methodology

The vision report was prepared by the Fifty-Year Vision Committee, made up of members appointed by the nuclear societies of the INSC. Contributors who specialize in the study areas were invited by the committee to produce the chapters of the report, which were analyzed by a team of reviewers, also appointed by the committee, to unify ideas and verify consistency.

Scope

Looking over the coming half century until the middle of the twenty-first century, such global problems as population growth in developing countries, increase of energy consumption, and the resulting increases of carbon dioxide content in the atmosphere as well as other environmental problems make it important to secure energy resources with low environmental impact, high economic competitiveness, and long sustainable supply to satisfy worldwide energy demand. We analyze the issues and direction of long-term global utilization of nuclear science and technology in the upcoming half century on the basis of the achievements and experiences of nuclear development and utilization over the past half century.

The report makes a distinction between the use of nuclear science and technology for the production of large quantities of energy - nuclear power - and other applications of nuclear energy that now encompass a wide range of applications, including medicine, industry, and general consumables. The latter use is expected to further increase as more applications of radiation are developed and the trend toward wide-ranging utilization continues.

The scope of the study covers the following aspects:

1. wealth, energy, and the quality of life
2. energy availability
3. status of nuclear power utilization
4. electricity and nuclear power in the future
5. reactor and fuel cycle strategies for the future
6. public perception of nuclear power
7. institutional, social, and international strategies
8. other applications of nuclear science and technology
9. future use of radiation and radioactive sources

To clearly separate the issues involved, this document has been divided into two parts:

- a ***vision*** of the next 50 years of nuclear science and technology,

- ***strategies*** that could be followed to achieve.

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