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KEYNOTE TALK

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Your Excellencies,
Mr. Chairman,
Honoured Speakers,
Distinguished Guests,
Ladies and Gentlemen,

On behalf of the International Program Committee of this Conference and the nuclear data colleagues of Japan, it is a great honour and pleasure for me to have the opportunity of speaking at the opening session of this important International Conference.

The main purpose or motivation of the nuclear data activities, namely the systematic measurements, evaluations and compilations of nuclear data, has been and still ought to be for the peaceful uses of nuclear energy. In spite of the easing of worldwide energy supply and demand situation in recent years, we believe that research efforts towards the next generation nuclear energy development is indispensably necessary and should be reinforced.

The reasons are as follows: First of all, we believe that the nuclear energy is the best major energy source from many points of view including the global environmental viewpoint, and scientifically this situation is not changed by the happening of the Chernobyl accident. We must reduce to consume fossil fuel by burning it instead of using it as raw materials for industry. Secondly, in the medium- and long-range view, there will again and again be a high possibility of a tight supply and demand situation for oil. Thirdly, the nuclear energy is the key energy source to overcome the vulnerability of the energy supply structure in industrialized countries like Japan where virtually no fossil energy resources exist. In this situation the nuclear is a sort of quasi-domestic energy as a technology-intensive energy. Fourthly, the intensive efforts to develop the nuclear technology of the next generation will give rise to a further evolution in science and technology in the future.

Nevertheless, the opposition movements against the nuclear power generation are gaining strength remarkably after the Chernobyl accident. The leaders of opposition movements tend to instigate people by referring skillfully to many fragmental news and reports which are often false or inaccurate. There is in danger of decline of a part of support to the nuclear energy, because some people who were originally not opposite to the nuclear become thinking it too much trouble to support.

The Chernobyl accident in April 1986 happened not only because of the specific character of that type of reactor which is quite different from the others, but also reportedly by six violations of the operational regulation. Serious and broad environmental influence was inevitable by such an accident, but nevertheless, the report "the radiological impact of the Chernobyl Accident in OECD Countries" published in late 1987 by the Nuclear Energy Agency of OECD mentions in the conclusion of the executive summary that "On the whole, however, these consequences do not raise any major concern for the health of the population in OECD Member countries. In particular, individuals in those countries are not likely to have been subjected to a radiation dose, in terms of effective dose equivalent, significantly greater than that received from one year of exposure to the natural radiation background"/1/. The essential point of this encouraging report has not appeared in major newspapers in Japan in spite of a press conference by Mr. H.K. Shapar, Director General of the NEA, in the last April in Tokyo.

Since most of the opposition movements against the nuclear energy seem to have a character of those against the established social system more or less, it may be difficult to communicate them with scientific discussions, but still, we have to continue the efforts to make clearer the merits of the peaceful uses of nuclear energy, and to promote the spread of correct intelligible knowledge on the nuclear energy. The most important thing is of course to keep high nuclear safety level. There is scientific evidence with the great number of reactor years, the accumulated operation records of 4,210 power-reactor years at the end of 1986, that the peaceful uses of nuclear energy have a much higher safety level than the safety levels of other systems such as traffic and housing systems which have been accepted for a long time by the public.

It should be recognized that the present level of nuclear technology and safety is partly founded on massive accumulation of nuclear data. And, there are still many requirements for nuclear data from the needs of nuclear energy development and other applications. On the other hand, it should be emphasized that new nuclear data of good quality may have possibility to give rise to a new application or a breakthrough.

Even if insufficient accuracy of a nuclear data important to design a certain system is pointed out, it does not necessarily impede an actual designing of the system, since it may be compensated by a margin of other parameters as far as the safety and cost allow. The engineering in itself aims at furnishing users with a practical system based on the knowledge including basic data available at the time. Therefore, it is not much expected to receive a strong request for a basic data from the engineer who is designing a system at demonstration stage. A conceptual study stage and/or R & D stage for a certain system is a good source of requests for the basic data. It is not easy to appeal to the authorities for budget of a basic data activity from a viewpoint of urgency of either demonstration or conceptual stage, since the data should not be too critical for a demonstration stage or the data needs for conceptual stage allow a margin of time in a way. It is not too much to say that a field lively in the basic research including basic data activity generally has a high innovative potential. These situation may be illustrated in Fig. 1 which shows a rough qualitative relation among safety, cost (including reliability) and nuclear-data's accuracy for a

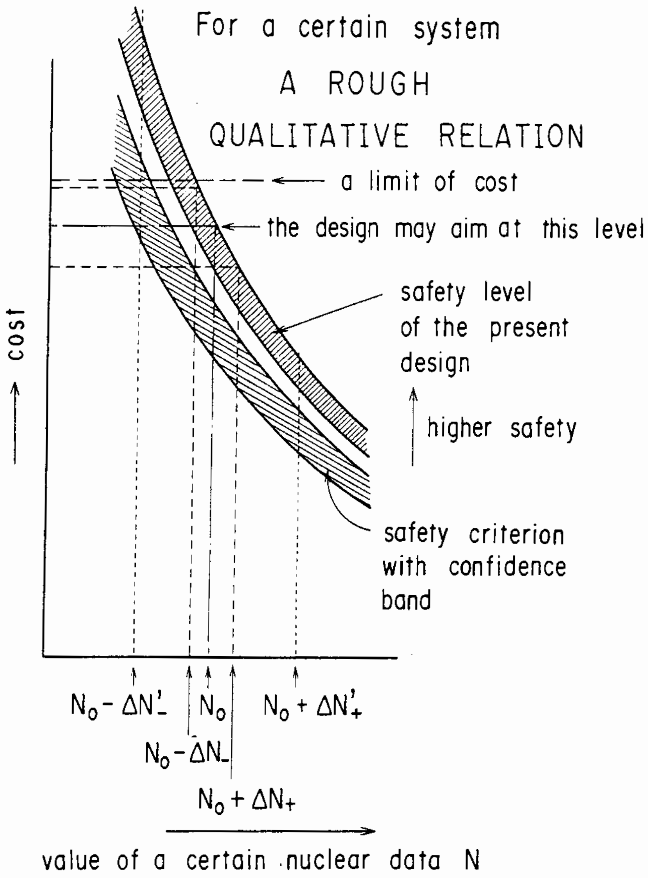

Fig. 1. Illustration of a rough qualitative relation among safety, cost (including reliability) and nuclear-data's accuracy for a certain system in designing.

certain system in designing. N_0 is the present value of a certain nuclear data N. To cite one simple example, when the question is the shielding against a certain radiation then larger absorption cross section of the shielding material for the radiation corresponds to lower cost. However, attention here is not directed to the value of nuclear data but to the accuracy of nuclear data. An estimated safety level of a certain system should be at least equal to, or higher than, a safety criterion which is estimated on the basis of the regulation. A limit of cost may be determined on the basis of the expected overall benefit of the system and a relative assessment with other systems for the same purpose. For a system at demonstration stage, the quality of the data N should be something like N_0-ΔN_-, N_0+ΔN_+ and that at conceptual study stage might be like N_0-$\Delta N'_-$, N_0+$\Delta N'_+$. In the latter case, it is not sure whether the system is realized or not, until the quality of the data N becomes the former case, or unless a condition like the former case is achieved by changing the desing. An actual quantitative assessment of this type of relation is not simple, which involves sensitivity analysis, quantitative safety assessment including probabilistic safety assessment, etc. Similar illustration can be made with other basic data than nuclear data.

In addition to the further requirements on more accurate and broad nuclear data for designing fission reactors, requirement for nuclear data has been broadening in the fields of safety analysis, fuel reprocessing, nuclear material safeguards, waste processing and disposal, environmental assessment, nuclear fusion R & D, and still more, of medical application, accelerator application, natural resources exploitation, and so forth. Those requirements for nuclear data will be discussed by the specialists in the present Conference. Specific discussions on the requirements may not be the present author's task, but it might be glanced in the following which was extracted from some recent non-systematic short discussions with the JAERI staffs in relation to the JAERI's activities.

Under the present condition that the technology of conventional light water reactors (LWRs) has been well established, utilization of plutonium in LWRs and development of new or advanced types such as high-conversion LWR, small- and medium-size LWR with inherent safety nature are aimed at for the near future. For example, a recent Specialists' Meeting on the NEACRP Burnup Benchmark Calculations for High Conversion Light Water Reactor Lattices, 19 - 22 April 1988, concluded that there were still unacceptable differences in the calculations of void coefficients, conversion ratios and burnup reactivity change, and that the reasons for the deviations lay primarily in the resonance shielding in the whole energy range and in low resolution of nuclear data for major heavy isotopes, many fission products and high actinides/2/. To aim at higher burn-up of nuclear fuel in power reactors is a worldwide tendency, and shielding against neutrons becomes more important in designing a shipping cask for higher burn-up fuel for example. The nuclear data are not sufficient to calculate accurately the contents of neutron emitting transuranic nuclides (TRU) such as ^{242}Cm, ^{244}Cm, ^{238}Pu in the spent fuel.

A high-temperature gas-cooled reactor (HTGR), featured by its components of coated particle fuel, inert helium gas coolant and graphite core structure, is able to produce gas of nearly 1,000°C at the reactor outlet, and has outstanding merits such as achievability of higher thermal efficiency (more than 40 %) of the plant, high inherent safety, high fuel burn-up, less radioactive waste and easy operation and maintenance. The HTGR will be able to improve the reactor economy and to expand the use of nuclear energy not only for electric power generation but also for direct heat supply to factories such as hydrogen production plant. The JAERI is going to construct a High Temperature Engineering Test Reactor (HTTR), whose outlet gas temperature and thermal output are 950°C and 30 MWt respectively, in order to upgrade HTGR technology and to promote R & D on basic technology on high temperature materials, fusion reactor materials, and so on. The licensing review will be started in FY '88, the construction in FY '89, and it is scheduled to be completed in the middle of 1990's. And, as for the requirement to nuclear data for HTGR, it is not explicit at present in the JAERI because of the construction stage of HTTR by the JAERI.

Although it is difficult to forecast the time when fast breeder reactors (FBRs) are commercialized, the development of FBRs will be promoted by regarding them as the mainstream of future nuclear power generation in Japan according to the Long-term Program of the Atomic Energy Commission/3/. The main purpose of the JENDL-1 and -2 was also to utilize them for the development of FBRs. The development of FBRs will be carried out by focusing mainly on the MOX fuel sodium-cooled reactor type, but, the pursuit of a breakthrough by innovation related to fuel and materials will also be promoted. The JAERI has been making research on carbide and nitride fuel, and recently, metallic fuel is becoming the center of interest again. Since hardening of the reactor neutron spectra and higher burnup of fuel are expected with the new-type fuel relative to the MOX fuel, higher accuracy of the neutron reaction data in higher energy region is required.

One of the important factors of the safety assessment for a nuclear fuel cycle facility such as reprocessing plant is the criticality safety assessment. An agreement within 0.5 % between the calculation and measurement of k_{eff} for any lump (solid or liquid) of nuclear fuel is desirable, but the calculated values of k_{eff} with different nuclear data sets not always agree with each other within 0.5 %. Discrepancy in such fundamental data as the fission cross section of ^{235}U might still have significant effect on the above difference in calculations.

Although most of the nuclear energy specialists are convinced that the radioactive wastes can be managed by the present technology with sufficient safety, there is a certain difficulty to achieve the public perception of safety for the management of long-lived radioactive nuclides such as TRU. For the R & D on TRU incineration reactor, designing of a very high performance reactor is necessary, and it is expected that for ^{238}Pu, Am and Cm the nuclear data of the same order of accuracy as that of ^{239}Pu and ^{240}Pu, and for ^{237}Np the same order of accuracy as that of ^{238}U will be required with the advancement of the designing. The present author still favors an old idea of incineration of TRU and breeding of nuclear fuel with self-sufficient energy production by an accelerator system of spallation reaction probably with proton beam of the order of 1 GeV/4/, which has also an inherent safety nature. Conditions of nuclear data for designing above system are far from satisfaction.

R & D on nuclear fusion is progressing satisfactorily with the achievement of near break-even plasma conditions by JET, JT-60 and TFTR, and the next target of the fusion R & D is to attain the self ignition condition. Improvement of nuclear data is required for plasma diagnosis, blanket design, shielding, assessments of radiation damage and induced activity, study of new concepts of fusion reactors, etc. One of the intentions of the JENDL-3 is to provide the data for fusion reactors.

International cooperation is inevitable to carry out the nuclear data activities since the range of required nuclear data is so huge that no single country can afford the self-sufficient activities, and an organization of the international cooperation for the nuclear data was established in early 1960's, which has been successfully operating with the multi-cores of the International Nuclear Data Committee of IAEA, the Nuclear Energy Agency Nuclear Data Committee, and the four international nuclear data centers in the IAEA, the OECD/NEA, the U.S.A. and the U.S.S.R.

The Japanese Nuclear Data Committee (JNDC), commonly called Sigma Committee in Japanese, was organized in February 1963 as a standing committee of the Atomic Energy Society of Japan. The JNDC is concerned primarily about the activities related to the nuclear data of interest to the development of the nuclear energy program. The committee has at present the following substructures: an executive committee, three subcommittees on "nuclear data", "reactor constants" and "nuclear structure and decay data", ten working groups under the subcommittees, and three individual groups for CINDA, WRENDA, and the compilation of the Japanese Evaluated Nuclear Data Library (JENDL). The operation of the committee meetings and the activities of the working groups are sponsored by the JAERI, however, the whole activities of JNDC are largely supported by the voluntaries of its members from industries, universities and governmental research organizations. The Nuclear Data Center of JAERI has been taking charge of the secretariat of JNDC and the window for international cooperation.

The world-wide achievement of nuclear data activities consists in a unique history of international cooperations with the voluntaries of a great many specialists and the understanding of the authorities of each country. Those cooperation systems and many methods in experiments (differential, integral and benchmark), evaluations and compilations should be instructive to the growing database activities in the all fields of science and technology. There are still many requirements for nuclear data activities as the author mentioned and as it will be seen through this Conference on the one hand, however, the nuclear data community seems to be suffering a sort of maturity. Now it is required to promote deployment of nuclear data activities with new ideas keeping up good tradition.

I would like to conclude my speech in expectation of a good many discussions during this Conference which will contribute to new development of the nuclear data activities for energy needs and other applications. Finally, I wish to express my sincere gratitude to all of you for your various contributions and supports including organizing efforts to this Conference. Thank you for your attention.

References

1) The radiological impact of the Chernobyl Accident in OECD Countries, OECD/NEA (1987).
2) Y. Ishiguro, private communication (1988).
3) Long-term Program for Development and Utilization of Nuclear Energy, Atomic Energy Commission, Japan, June 22, 1987.
4) For example: M. Steinberg, New Scientist, 7 July 1977, pp.14-16; R.F. Taschek, Proceedings of Int. Conf. on Neutron Physics and Nuclear Data for Reactors and other Applied Purposes, Harwell, 729 - 808 (1978).