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Japan Speeds Organization of Nuclear Program

By CLARK GOODMAN

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**The Japanese
Atomic Energy
Commission**



Hideki Yukawa



Hiromi Arisawa



Matsutaro Shoriki (chmn)



Ichiro Ishikawa



Yoshio Fujioka

JAPAN

Speeds Organization of Nuclear Program

By CLARK GOODMAN
U. S. Atomic Energy Commission
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THIS IS A REPORT on the rapid development of nuclear affairs in Japan since last year's Geneva conference. One of the author's major observations is that the Japanese government is taking the lead in research while Japanese industry is taking the lead in power developments. This turn of events is in the tradition of strong industrial leadership in Japan. The Japanese Atomic Industrial Forum provides the focal point for industry.

However, the main activity is in the individual large companies, particularly the leading utilities such as Tokyo Electric Power and Showa Electric in Tokyo, Kansai Electric Power in Osaka, and Kyushu Electric in Fukuoka. Each of these companies has an active study group whose objective is to determine as quickly as possible which nuclear power system is best suited to the environment and economy of Japan.

- Japan is more prosperous now than in 1954 or 1955.
- Nuclear energy has become an accepted reality to the Japanese people.
- Nuclear energy has become a major means of international cooperation and negotiation between Japan and other countries.
- Nuclear energy is being used both individually and collectively as a powerful political propellant in Japanese academic, industrial, and government circles.
- Since the atomic energy law of Japan went into effect (Jan. 1, 1956), her atomic activities are being rapidly and effectively organized.
- As part of this effort a broad base is being established in nuclear science and engineering.
- The major leadership in nuclear research is being taken by the government.
- The major leadership in nuclear power development is being taken by private industry.
- The present delicate political balance in Japan, more than any other single factor, will probably delay somewhat the development of industrial nuclear power.

THE FUTURE INDUSTRIALIZATION of Japan, as in the past, will be directly proportional to the additional power capability that can be built and operated economically. The present power generation operates at an unusually high load factor. In some cases operation is certainly beyond the optimum economic level since there is no time for systematic repair and replacement.

It is true that the 8-9-million kw of developed hydropower represents only about 40% of the national potential. However, the cost of construction and operation will increase markedly as the more marginal watersheds are utilized. Somewhere, at some as yet undeterminable point along this rising cost curve, nuclear power will become competitive with hydroelectric power.

Japan's 5-6-million kw of chemically-fueled electric power are supplied largely by her domestic coal production, which totals 40-50-million tons per year. Modernization of mining methods has offset to some extent the increase in cost of coal production. Japanese nuclear power at first will face stiff competition from Japanese coal even though it is high in ash content. However, in the long run industrial nuclear power will exceed chemical power because of the limited coal reserves.

The annual production of about 2.2-million barrels of petroleum only provides less than 10% of Japan's domestic needs. Hence, more than 90% of her crude oil is imported so as to keep the ever-increasing number of

internal combustion engines supplied with gasoline and diesel oil. The U. S. produces as much petroleum in one day as Japan does in three years. Yet the population of Japan is more than half that of the U. S.

To plan and execute the bringing of nuclear power to Japan, a complete organization has been evolved.

Japanese Atomic Organization

The atomic energy law of Japan, which became effective in January this year, establishes the following five organizations:

1. **Atomic Energy Committee** (reports to the prime minister through the chairman, Matsutarō Shōriki, who is a state minister in the Cabinet).

Members (two full-time, two part-time, appointed by prime minister with consent of both houses of Diet):

Ichiro Ishikawa (also chairman of board of directors of the Atomic Research Institute), full-time.

Yoshio Fujioka (formerly professor of physics at Tokyo University), full-time.

Hideki Yukawa (Nobel Laureate in physics and professor at Kyoto University) part-time.

Hiromi Arisawa (professor of economics at Tokyo University) part-time.

2. **Atomic Energy Bureau** (administrative agency to carry out general administrative functions of JAEC), Toshitake Sasaki, director. Divided into three sections: general affairs, isotope, and administration.

3. **Atomic Energy Research Institute** (supported primarily by the government and in part by industry).

Ichiro Ishikawa, chairman of board of directors.

Sakuji Komagata, vice chairman (an electrical engineer, formerly director of electrotechnical laboratory of the Ministry of International Trade and Industry—MITI).

4. **Joint Diet Committee on Atomic Energy.**

Yasuhiro Nakasone, chairman (member of House of Representatives, Liberal Democratic Party).

5. **Nuclear Fuel Corporation** (responsible for the prospecting, mining, refining and controlling of nuclear raw materials and nuclear fuel materials). Just being formed—chairman not yet named.

In addition, the following are im-

The author, who had spent a year in Japan in 1954-55, visited Japan again this year sponsored by the International Educational Exchange Service, Department of State. About half his time was spent in traveling and giving lectures on the general status of industrial nuclear power in the United States. The other half was used in detailed discussions with Japanese scientists, engineers, industrialists and government officials regarding the present status of nuclear energy developments in Japan. This report summarizes the observations made during this trip.

portant segments of the atomic organization.

6. Japan Atomic Industrial Forum (established March 1, 1956, as a private organization of about 300 companies having interest in atomic energy development; information-exchange and money-raising are primary functions). Executive members:

President—Reinosuke Suga, chairman, board of directors of the Tokyo Electric Power Company.

Vice presidents—Kineo Uemura, vice-chairman, Federation of Economic Organizations; Atsushi Oya, chairman, fuel committee, Federation of Economic Organizations; Michisuke Sugi, chairman, Osaka Chamber of Commerce and Industry.

Managing directors—Naritaro Okamoto, director, Japan Chamber of Commerce and Industry; Teizo Horikoshi, secretary, Federation of Economic Organizations; Soichi Matsune, director, Federation of Electric Power Companies; Seinosuke Hashimoto, director, Institute for Electric Power Economy.

Secretary General—Seinosuke Hashimoto, director, Institute for Electric Power Economy.

7. Nuclear Research Institute (an essentially independent unit of Tokyo University).

Seishi Kikuchi, director.

Since the national universities derive their primary research support from the Japanese government, the Nuclear Research Institute is financed almost entirely from government appropriations. After some initial difficulties in getting started because of local inhabitants' fear of stray radiation, this well-equipped laboratory for basic physical research has been established at Tanashi, about 25 miles from the center of Tokyo. A 60-in. cyclotron (alternatively a synchro- or fixed-frequency cyclotron) is being built. Plans are well advanced for a 600-Mev electron synchrotron. Some consideration is being given to a 2-Bev proton synchrotron, but this is well in the future. This laboratory is undoubtedly the best equipped and most effectively organized of any scientific laboratory in Japan. The equipment is all new and of the latest type. Budgeting is no longer a difficulty. Housing of the staff remains the only pressing problem since Tanashi is only a small village.

8. Nuclear Laboratory at Osaka University. While at Osaka Uni-

versity, Kikuchi, now director of the Nuclear Research Institute, built up a strong experimental physics group that is continuing actively under Tetsuo Wakatsuki. A 15-Mev cyclotron is operating with a good outside beam. A 3-Mev pressurized Van de Graaff is being used effectively by Kenzo Sugimoto for angular correlation studies during electric excitation of nuclei by protons. A 20-Mev betatron is being used to produce X-rays for radiography. This work is part of the general program of applied physics being carried out under the direction of Tsunejiro Asada. Other important basic physics researches in progress at Osaka University are high-resolution beta-ray spectroscopy, high-resolution low-intensity mass spectrometry and X-ray crystallography (under Prof. Watanabe).

K. Fushimi has for the past two years been active in promoting nuclear engineering in Japan. His efforts have resulted in the translation of several books into Japanese—notably Glasstone and Edlund's "Elementary Reactor Theory." He has also built up one of the more knowledgeable groups of young men are located at other institutions.

9. Kyoto Laboratory of Nuclear Science. Under the direction of Prof. Kimura, a 16-Mev fixed-frequency cyclotron has been completed recently.

This machine will be used for physics experiments and for production of radioisotopes. Concurrent with the recent work on the cyclotron, some staff members carried out detailed studies of fallout and radioactive fish. These

researches have been reported in detail in a publication that has received wide distribution in the U. S.*

A small plant (\$28,000) for producing D₂O by an evaporation method went into operation earlier this year. The estimated cost of D₂O is \$50/lb, i.e., about twice the U. S. sales price.

Several of the younger staff members, notably Sakae Shimizu and Dr. Okada, have begun actively promoting a research reactor of the swimming-pool type. The University of Michigan has generously provided a set of blueprints of their Phoenix Project reactor and buildings. These plans are much more elaborate than Kyoto expects to be able to build to, but they form an excellent starting point for their study.

10. Research Institute for Fundamental Physics. This Institute, known as Yukawa Hall, is the apex of science in Japan, being headed by Hideki Yukawa, Nobel Laureate in physics. Despite his membership on the Japanese Atomic Energy Commission, it is doubtful that any appreciable amount of the theoretical research at this Institute will be devoted to applied atomic energy. However, a symposium was held on nuclear fusion in May, 1956.

11. Tokyo University. The nuclear laboratory has a 3-Mev Van de Graaff and a 4-Mev cyclotron. In addition, much basic and applied nuclear physics is done. In fact, Tokyo University is the most outstanding educational institution in Japan. It is only because of my lack of detailed knowledge about this University that much more is not

* Reviewed in NUCLEONICS, April '55, p. 86.



MORE THAN 350,000 persons saw U. S. Information Agency's Atoms-for-Peace show in Tokyo before it went on tour of Osaka, Hiroshima, Fukuoka, Sapporo, and Sendai. Show had spectacular success in Japan; said one review, "It replaced the vague and menacing picture of the 'atomic mushroom' with a shining vision of a happier, healthier, more prosperous mankind . . ."



SEISHI KIKUCHI in new Nuclear Research Institute lab at Tanashi near Tokyo

included here regarding its place among the atomic organizations in Japan.

12. Radiochemistry Laboratory. This well-equipped and ultramodern laboratory is part of the school of chemistry at Shizuoka University. It is headed by Takanobu Shiobawa, a recognized authority on the separation and study of radioactive ash. In particular he has studied in detail the materials from the *Fukuryu Maru*—the fishing boat "Fortunate Dragon" that was caught in fallout from a U. S. bomb test. His well-equipped laboratory is also active in radioactivity monitoring.

13. Meteorological Research Institute. This institution has extensive monitoring equipment for rain, seawater, air, and dust. Under the direction of Yasuo Miyake, detailed studies of low-activity fallout are carried out on a continuous basis. Detailed studies of the Russian tests have been made and indications of the test sites have been obtained and published.

14. Other nuclear research facilities are: (a) Tokyo Education University: a 3-5-Mev betatron; a larger betatron is planned. (b) Tokyo Technological University; a 40-Mev synchrotron. (c) The Science Research Institute (Tokyo); a 4-Mev cyclotron and cosmic-ray research facility.

Japan-U. S. Bilateral Agreement

The research bilateral agreement between Japan and the U. S. was made on June 21, 1955, and signed in Washington on Nov. 14, 1955. On March 12, 1956, a contract was made between the Atomic Energy Research Institute

(AERI), under authorization of the Japanese government, and North American Aviation, Inc. (Atomics International Div.) for the purchase of a 50-kw water-boiler (type L-8) research reactor (containing about 1.5 kg U^{235}). Thus Japan became one of the first four countries to sign a contract for a research reactor pursuant to a U. S. bilateral research agreement. I think this step epitomizes the present active interest of the Japanese in this field.

The second research reactor to be located at the AERI site will be of the CP-5 type. It was originally planned that this would be 100 kw (heat). The latest plans call for raising this to 5,000 kw so as to attain a maximum neutron flux of 10^{14} and to be able to use the reactor for radiation testing (i.e., as a small-scale MTR). This reactor will contain enriched uranium and will be purchased from a U. S. company. The AERI hopes to have this reactor installed in 1957.

Atomic Energy Budget

The total amount budgeted for fiscal 1954 and 1955 for the Japanese atomic energy program was about \$1.7-million. The amount budgeted for fiscal 1956 is about \$10-million—mostly to the AERI and for training of nuclear scientists and engineers. Further, AERI expects to receive about \$0.5-\$0.6-million in contributions from industry—largely through their Forum.

In addition, most of the major electric companies have their own nuclear research groups, as do a number of the large industrial companies. No budget figures for these were available.

Applications of radioisotopes in medical and agricultural fields have been carried out in Japan for many years. Applications in industrial fields have been expanding rapidly in the last few years. At present the imports of radioisotopes (largely from the USAEC) aggregate \$100,000/yr.

The Kyoto cyclotron will begin to supplement these pile-produced isotopes soon. However, in the future, the research reactors being installed will take over most of the radioisotope production in Japan. Because of foreign currency restrictions, domestic radioisotopes will probably be used in preference to imported ones even though the latter may be somewhat less expensive dollarwise.

Future Power Demands

The power requirement in Japan has increased about 9%/yr during the last several years. According to their 5-year economic program, it is estimated that power requirements will average an increase of 6.3% until 1960. Beyond 1960 the forecast, while less certain, seems to decrease down to 5 to 4% increase in requirement per year. Thus, it is estimated that Japan's power requirements will be doubled in 15 years and multiply 2.5 times in 20 years. To meet such future requirements it is necessary to continue to develop about a million kw of electrical capacity annually, while the exploitation of Japan's hydro and coal resources is reaching the limit.

The total potential hydropower resources officially estimated is 22-million kw. Major economical sites will be mostly developed in 15 to 20 years if the development continues at the present rate. Coal-fired power is considered to reach its limits, physically as well as economically, in 10 years.

Hence, it is considered necessary in Japan that power demonstration reactors be built within a few years so as to realize economical nuclear power as early as possible. In this way the Japanese hope to be supplying part of their power requirements by means of large nuclear plants by 1966.

The Japanese AEC is even now considering a British proposal that allegedly would give them economic nuclear power in five years (NU, July '56, p. R5, Aug. p. R6), and is sending study teams to both the U. S. and U. K. this fall.

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