JPRS L/9832

8 July 1981

Japan Report

(FOUO 39/81)

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APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000400030013-0

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CONTENTS

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RECENT TREND OF LDP ANALYZED

Tokyo SEKAI in Japanese Jun 81 pp 273-277

['Tide of Japan' Column: "Domestic Scene: Turbulent Summer" by Masashi Kiyokawa]

[Text] Aiming at 'Tomorrow'

It is rather late to be surprised now at Zenko Suzuki's remarkable ability. "It may be said that there is no one within the party who excels this man in the accuracy with which he reads the intra-party atmosphere or in the shrewdness with which he moves the political situation as he gradually builds up an outer moat."

While saying this, a close associate of the prime minister admires in particular the ability to manage the political situation which Zenka Suzuki, the most unexpected of unexpected prime ministers and presidents, is actually showing. Also, he smiles with satisfaction, saying "if it continues as is without accident, all roads lead to the road toward reelection as president."

At the outset Prime Minister Suzuki did not stand at the summit of power as a result of having accumulated a training to be prime minister from early on. In any event, regardless of whether such a top leader is right or wrong for the people, he is truly a unique prime minister in the sense that those within the party could actually feel that the seat of power was unexpectedly within reach, thinking that "if Zenko can fulfill the duties of prime minister and president, so can I." It is ironic that, as for the current within the party, this prime minister has begun to show signs of "long term political power" apart from his own plan or that of those around him. Of course, there are many "lying-in-wait" factions waiting for the opportunity to undermine and grab onto at a moment's notice the weak points and mismanagement of the Suzuki administration. The present situation is that their chance to undercut has been clearly blocked and they are at a loss. But of course, "long term political power" is not altogether firmly fixed. The famous line of the late Masajiro Kawashima, "sekai wa issun-saki wa yami" ("The political world knows not what tomorrow may bring") is poignant for no one less than the present prime minister. And then, the prime minister's tactic of prudently building up an outer moat and the contest of wits by the "small fry" commanders who aim

at "tomorrow" has to set off sparks in the depths of the political world's consciousness from summer through fall.

Prime Minister Suzuki's Determination

With Prime Minister Ohira's sudden death and decisive victories by members of both Houses in elections held the same day as the background, it is said that when he suddenly had the top seat, Prime Minister Suzuki resolved, "I will never follow in Ohira's tracks." While Ohira was alive, Prime Minister Suzuki was always "chief of staff" of the Ohira faction but was not always on the same track with Ohira's political actions. As for the track tread by Ohira, he blundered---in terms of the party, he lacked harmony with Fukuda and Miki, both of whom had been prime ministers, and his intra-party management was a series of bitter struggles, and in terms of policy, his tenacity at "rebuilding the economy must be handled by me alone" was too direct and he was badly burned wrestling head-on with the general consumption tax problem.

As for what kind of hurdles there will be in 1981 for the Suzuki administration which began its political power in any event in a situation that has to be described as groping, there are three points.

The first point is that nothing happens to Kakuei Tanaka and Takeo Fukuda, who continue to maintain as strong a control as ever over the party, not to mention their own factions, even after stepping down as prime minister, and who are the two mainstays of the Suzuki regime. The second is that the Tanaka and Fukuda factions do not crash head-on over the presidentail primary election system. And finally, that he is not driven to a large tax increase in the preparation of the JFY1982 budget.

Getting over these hurdles is nothing less than not treading the late Ohira's track. When the prime minister's handling of the political situation until now is analyzed, the fact that each political phenomenon is concerned with getting over these hurdles slowly but steadily appears as the real image.

Factional Balance

The fact that "intense good fortune" uncannily never leaves him can be cited as one more essential element supporting Prime Minister Suzuki's present position. If former Prime Minister Ohira had not died suddenly, there would not have been a Prime Minister Suzuki. One can go so far as to say that that in itself is "intense good fortune." Early in January, the report that "Former Prime Minister Tanaka collapses" instantly shocked the Nagatacho vicinity, and Prime Minister Suzuki heard this report overseas (on a tour of the five ASEAN nations). Similarly in the past, Prime Minister Eisaku Sato, on an oversease trip, quickly returned home upon receipt of the news of the sudden death of Shigeru Yoshida, his beloved mentor. But, in the dimension that these extraordinary events directly concern the political power structure, it could be said that this recent event was a far more momentous unexpected event.

It was reported that Prime Minister Suzuki could not speak for a moment at his overseas location; former Prime Minister Tanaka's condition stabilized, so the prime minister was able to go on without any problem. It goes without saying that those supporting the Suzuki regime are the three leading factions of Tanaka, Fukuda and Suzuki, but a mishap for Tanaka or Fukuda could become the trigger for mobilization of the existing factions within the party. This would have important relevance for the Suzuki regime. It may be safely said that the fact the new leaders (they have lost some of their freshness), Shintaro Abe (Fukuda faction), Noboru Takeshita (Tanaka faction), Ichiro Nakagawa (Nakayama group) cannot move at all originates in the control by these Dons. If this composition collapses either from Tanaka or Fukuda, it is possible that even those beneath the prime minister may begin to confer about escape from control of the old men in spite of a factional reorganization.

Hotline with Fukuda Reported

As for former Prime Minister Fukuda, in one sense, he wields power as the key to the birth of Suzuki's political power. It is rumored that in comparison to former Prime Minister Tanaka, a weight of "7 to 3," not "6 to 4" is attached to former Prime Minister Fukuda. There is rumored to be a Fukuda-Suzuki hotline, especially on diplomatic questions.

In the past Prime Minister Sato, setting up a two wheel "Tanaka-Fukuda" structure, built a strong long term political power; and Prime Minister Suzuki also closely resembles the Sato political power from the time when he took over the seat of political power, succeeding the previous regime's mishap. It is true that Sato built up a Tanaka-Fukuda two wheel rivalry within his own faction, and besides that erected a solid castle with the influential men called the five magistrates. In comparison, Suzuki's base is far weaker. It is all the more necessary for him to be quite sensitive about riding both wheels in his position in which Tanaka and Fukuda stand at the top and still command strong factions. Balancing the two wheels which can sometimes be jerky, whether a "6 to 4" or "7 to 3" relationship, will be Prime Minister Suzuki's unrivaled task.

It can be said that former Prime Minister Fukuda's comment on Suzuki, "Prime Minister Suzuki has no self-interest," is quite laudatory. Returning from his trip to the U.S. in late March, Fukuda immediately held talks with the prime minister; of course, there was the suggestion for a Japan-U.S. summit conference, but also a rather detailed exchange of opinions on long-standing questions of domestic politics. Concerning the cabinet reshuffle question which is one of the focuses of the post-summer political situation, in the middle of April, Fukuda displayed a viewpoint which so much as said "a November reshuffle is common sense." Certain rumors that the Meijiro area (Tanaka's residence) is in a rage about the reported Fukuda-Suzuki hotline fly about off and on in the Nagatacho area. But in reality, whether this is really his mind or not is a different story. For example, the prime minister is satisfactorily taking the "rock throwing" from the Meijiro direction with his trump card of cabinet member and party officer personnel appointments.

Kawamoto Faction Shut Out

As for the direction of the presidential primary election, he finally succeeded in making it "exist in name but disappear in reality," and solved this hurdle as extremely small. As for former Prime Minister Fukuda, he was a hardline advocate of freezing the presidential primary election because of his past bitter experience of having been defeated and having his plans upset by Ohira. Accordingly, the Suzuki regime was wary of confusion over the official election regulations. Even former Prime Minister Fukuda chose to maintain the Suzuki regime; and the Suzuki regime is now "settling down" without strife. Conversely speaking, for Kawamoto, minister of the Economic Planning Agency and one of those aiming at "tomorrow," this resulted in his one weapon---the presidential primary election---being stripped from him. This was the same as having one troublesome opponent who threatened the prime minister's "tomorrow" eliminated. Despite the fact that large numbers within the party already were inclined to having the election "exist in name but disappear in reality," the Kawamoto faction screamed "opposition" with no other alternative left. But when the fighting ring is narrowed, it is common sense to exercise immediately the next plan to gain power; the political style of Kawamoto who is limited in his ability to adapt to circumstances over and above the tragedy of the Kawamoto faction not being blessed with staff is not a troublesome enemy for Prime Minister Suzuki.

Timing of 'Administrative Reform'

As for the final hurdle, the Suzuki-style staging is now at its peak concerning the preparation of the JFY1982 budget. What surprised the political world was the excellent timing more than the intensity of the statement, "I will give political life to administrative and financial reform" which the prime minister made reference to at the Japan Chamber of Commerce and Industry meeting on March 18.

With the approved JFY1981 budget acquiring a firm footing, his technique of driving hard for a resolution of the 1982 budget to the point where most saw that "next will be the direction of important budget related bills" was extraordinary. It seemed that it was like a rocket bomb whose timing the prime minister had continuously gauged deep inside himself, so much so that even Chief Cabinet Secretary Miyazawa, his right hand man, made a dubious expression, "Hm, political life..." It is said that the prime minister's calculation of "the compilation of the 1982 budet will be a major victory or defeat with either a large tax increase or a cut in expenditures" was very quick. At the end of last year when the preparation of the 1981 budget was finished---this was the first thing the prime minister dealt with---what recurred deep inside the prime minister was "how to complete the 1982 budget." This is no trivial matter. At the beginning of January, he began secretly drawing up the scenario of "a policy of subsidy cuts in an administrative and financial reform---moving up by one month the decision on the 1982 budget ceiling (the framework of estimated requests)---in the fall, dealing with a bill on subsidy cuts in an extraordinary session of the Diet on administrative and financial reforms.

Afterwards, the prime minister casually commented, "If one asks which will be chosen, a large tax increase budget or an expenditure cut budget, isn't the (party's) answer already decided?" But the secret of his cleverness at building an outer moat is perhaps in his conception that "a full year is necessary to effect the latter (expenditure cut)."

Cabinet Reshuffle---When

Well, while getting over the three hurdles is steadily progressing, the cabinet reshuffle is raising its head. At the same time that the reshuffle is one major trump card for maintaining political power, it is also a "demon" suddenly changing to a dangerous object weakening the cabinet if one mistake is made. It can be said that surmounting this reshuffle which will definitely be carried out this year is one of the final elements of the road to reelection.

But there are many dangerous aspects. Because the reshuffle is not an easy operation, given the pressure from the Tanaka faction which increased to 102 members and the problem of how to continue to skillfully maintain a containment of Nakasone, minister of the Administrative Management Agency, and Kawamoto, minister of the Economic Planning Agency. At first, a report of a November reshuffle was launched by the Tanaka faction administration, but actually this was a "curve ball" based on the strategy of proposing an early stage reshuffle immediately after the Ottawa summit in July. As it was circulated that there are 26 candidates for cabinet minister in the Tanaka faction alone, the early assimilation of the cabinet minister's list was an issue for the Tanaka faction. It is common knowledge (?) among political circles that Nikaido, chairman of the Executive Council, is the behind-the-scenes secretary-general, but the problem of whether he will be put in the position of secretary-general in name and in reality or will enter the cabinet as he so dearly wishes has expanded, and so the Tanaka faction's countermeasures are a crucial point for the prime minister.

With the report of a "November reshuffle" coming one after another from Secretary-general Sakurauchi, former Prime Minister Fukuda and the Tanaka faction leaders, the viewpoint that "from a common sense standpoint the cabinet reshuffle is probably right" is hardening within the party. For the prime minister's camp whose tactic must certainly be "even is we're silent, the reshuffle view will burst forth within the party, especially from the direction of Meijiro. So we'll wait for that and after calmly pulling it to ourselves...," his free hand has apparently been snatched away. The way I read the prime minister's feeling is that even with such a situation, those around the prime minister would rather not abandon the early reshuffle in July. This is based on the logic that if the road to the compilation of a no tax increase 1982 budget is completely established by June, it will be alright to renovate the system with a cabinet reshuffle. There is no doubt that the prime minister will employ decisive action with a timing in which his leadership can be fully displayed to the end, not a decisive action on the reshuffle as a result of being pushed by the winds within the party.

Road to Reelection

The Nakasone and Kawamoto camps who aim for "tomorrow" have headaches on how to cope with the Suzuki regime's constant alert management of the political situation. As for the group of leaders aiming at the "tomorrow" after "tomorrow," they rely on others waiting for a "misgovernment" which can make matters worse. Nakasone is hedged in under the flag of administrative reform, just as the prime minister planned in the first cabinet formation. Can he (Nakasone) bind himself to Tanaka or Fukuda, in particular to Tanaka, or will he resort to cooperation with the Kawamoto camp. There is almost no chance of victory as long as he does not bring either Tanaka or Fukuda over to himself. If so, would it be advisable for him to get into the three faction structure and, after getting into one of the real mainstream factions, wait for his opportunity; With precisely everything going against him, he must think before taking the plunge.

Likewise, the Kawamoto faction is at a loss on how to give a telling blow, except for commiting themselves to the current of the majority within the party. "Increasing their support power within the party" continues to be a major weakpoint common to both of them. In such a situation, the possibility is far greater that they will seize the opportunity, tenaciously continuing supportive activities for the triple Tanaka-Fukuda-Suzuki factions in a battle of cooperation for the Suzuki regime rather than opposing the Suzuki regime in the form of an alliance with one of the present three mainstream factions, making a Nakasone-Kawamoto cooperation the axis.

Past administrations have corroborated that the most powerful men unexpectedly fall into a pit at the point in time when confidence becomes excessive. Will the pitfall for Suzuki be the administrative and financial reforms calling for subsidy cuts or the cabinet reshuffle? What kind of trap is waiting for him next year at the end of his present term of office? Indeed, it cannot be denied that the path to reelection is still very much in flux.

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SCIENCE AND TECHNOLOGY

THORIUM REACTOR DRAWING ATTENTION

Tokyo NIKKEI SANGYO SHIMBUN in Japanese 20 May 81 p 10

[Article: "Coupling of Accelerator and Reactor for Abundant Fuel and High Level of Safety"]

[Text] A new nuclear reactor which combines an accelerator and a molten salt breeder reactor is presently drawing considerable attention. This is a nuclear reactor which uses as fuel the element thorium which is said to be 4 times as abundant on this earth as uranium, and its development will represent a giant step forward in resolving the energy resources problem. Director Kazuma Furukawa of the High Temperature Molten Materials Laboratory of the Japan Atomic Energy Research Institute who is one of the innovators said, "By investing 5-6 billion yen over the next 15 years, I believe we will be able to realize the development of a practical reactor." Policy research groups of the Liberal Democratic party have initiated study on this subject.

Liberal Democratic Party Initiates Study

Thorium 232 is an element which is slightly lighter than natural uranium. It will absolutely not undergo nuclear fission in its natural state, but once it absorbs a neutron, it is transformed into uranium 233 which can undergo nuclear fission just as uranium 235 or plutonium 239.

This is why by the use of an accelerator to convert thorium element into uranium 233 and burning this product in a molten salt bath to generate electric power is the process envisioned in this new concept. A molten salt reactor of the type which proposes the use of thorium as fuel was researched in the past at the Oak Ridge National Laboratory in the United States, but the major feature of this new concept is the coupling together of an accelerator with a molten salt nuclear reactor.

The innovators are part of a group at the Japan Atomic Energy Research Institute headed by director Furukawa, Professor Koshidan Tsukada of the Nippon University Atomic Energy Laboratory, and principal investigators at the Japan Atomic Energy Research Institute.

The mixture of the fluorides of thorium, lithium, and beryllium is known as a molten salt, and this salt turns into a liquid melt with properties similar to

water when heated to about 500°C. This molten salt is placed within a large container made of graphite and is bombarded with protons (hydrogen atom nuclei). This irradiation converts the thorium in the melt to uranium 233 which then enters into nuclear fission with the evolution of heat which then can be used to generate electric power. This is the overall concept.

Now, when just a single accelerator-molten salt breeder reactor is involved, the electrical energy generated amounts to just about that sufficient to operate the accelerator, so the plan proposes surrounding the accelerator with about ten molten salt reactors, and the excess uranium 233 created by the accelerator is burned by these peripheral reactors to generate electric power.

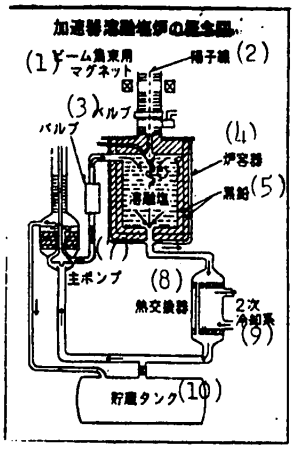
Director Furukawa has come out with a specific concept according to which the accelerating energy developed at the accelerator is of the order of one billion electron volts and 300 milliamps. The fluorides of lithium, beryllium, and thorium present in the molten salt are used. The thermal output of the reactor is of the order of 1.2-2.0 million kilowatts. Roughly 600,000 kW is expended to operate the accelerator.

This accelerator-molten salt breeder reactor is provided with the following characteristic features. 1) Since the reactor core is a molten pool, the net result is a simplified reactor core construction can be employed. 2) There is no radiation damage on materials and molten salt. 3) Chemical treatment is readily applied, and maintaining atmospheric pressure within the reactor at normal barometric pressure greatly enhances the safety factor. It is possible to scale up in order to conduct the experiment from the small scale experiments. These are some of the precautionary items which need to be promoted.

The major problem is how to develop molten salt reactors which Japan has had very little exposure thus far with regard to any possible dangers and proton accelerators. At the present time, basic research is being conducted as the successive development of the experimental reactor and test reactor increase in size, and it is anticipated that the sought for goal will be attained in about 15 years.

When director Furukawa announced this concept to the general meeting of the Nuclear Energy General Meeting, policy research groups of the Liberal Democratic party were greatly interested because of their great interest in the energy problem and initiated studies on just how to implement this concept. Research and development costs for nuclear power have ballooned during the recent years making difficult allocation of funds, but there is considerable thought being directed at just how to put into practical shape this new type nuclear reactor concept which was developed by domestic technology.

Conceptual Diagram of Accelerator-Molten Salt Reactor



KEY:

1. magnet for beam convergence
2. proton beam
3. valve
4. reactor vessel
5. graphite
6. molten salt
7. main pump
8. heat exchanger
9. secondary cooling system
10. storage tank

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SCIENCE AND TECHNOLOGY

POSSIBILITY, SIGNIFICANCE OF DEVELOPING ACCELERATOR MOLTEN SALT BREEDER REACTOR

Tokyo GENSHIRYOKU KOGYO in Japanese Vol 27, No 5, May 81 pp 28-34

[Article by Kazuo Furukawa and Yasuaki Nakahara of the Japan Atomic Energy Research Institute and Kineo Tsukada of Nippon University]

[Text] The peaceful utilization of atomic energy is in the throes of entering a new developmental period. As can be envisioned from Lilienthal's "posthumous statement," [1], one factor is that nuclear power is no longer the sole property of the leading countries. The acute demand for nuclear development on the part of the various countries including the developing countries will probably be on an ever expanding course from here on. There is also the large impact of the environmental problem caused by CO_2 which will impose limitations on the use of fossil fuel [2]. In view of this situation, one wonders whether following well-established energy pathways will necessarily be prudent.

At the present time, the stabilization of the light water reactor and the practical development of the next stage conversion reactor may be necessary, but projecting the problem that will be encountered 15 years in the future, it seems evident that there is need to hurry the introduction of a breeder reactor. At the same time, there will be need to overcome the problem of lack of fissionable material. The delays in light water reactor construction are tied in with the craving of leading countries to engage in Pu production. One of the most intriguing countermeasures to this situation which poses some very interesting basic aspects is the accelerator coupled nuclear fission material production facility which is proposed in this paper [3,4] (electric power is recovered from the heat of production but this is not a power reactor).

This facility will utilize a nuclear spallation reaction which will be discussed later by which means neutrons are generated in efficient manner which are then absorbed by parent nuclear material ^{238}U (depleted U) or natural ^{232}Th to produce fissionable ^{239}Pu or ^{233}U. Differing from the usual type conversion reactor this reactor does not have to be fueled with ^{235}U or ^{239}Pu, so it will not increase the insufficiency in these nuclear materials. It is claimed that a large amount of power will be expended just to operate an accelerator, but the concept proposed by the authors offers a possibility of recovering self-generated electric power. Because a subcritical system is involved, there are no control problems, and the process is, in principle, clearcut and simple. Let us first discuss some of the historical background.

1. History of Accelerator-Reactor Research and Development [3,4]

The worldwide administrations following World War II were developed around the axis of the sole possession of the atomic bomb by the United States, but it seems that at least to about 1947 there was no storage of even a single atomic bomb [1]. During the war, U mined in the Congo and South Africa was enriched at the Oak Ridge National Laboratory (ORNL) utilizing the vast electrical power of TVA, but the problem arose of just how to convert the large quantity of depleted U to ^{239}Pu in efficient manner.

As the result of various studies, it was established that the most promising route was the utilization of the abovementioned nuclear spallation reaction [4]. The MTA (Material Testing Accelerator) plan was developed at Berkeley from 1949, and the results of various tests indicated the feasibility of this approach. Now, in 1952 some superior U minerals were discovered in the state of Colorado, and the use of U from this source to operate Pu production reactors seemed more economical so that the MTA plan was aborted in 1954.

This technology was not published until 23 years later in 1977 [4]. Now, Lewis, et al of Canada who took a stand opposite to the breeder-power reactor line of the United States, United Kingdom, and Soviet Union held to the concept that the combination of a CANDU reactor and an accelerator breeder reactor would be an ideal energy source which they stressed from about 1954. Basic research along this line has been continued ever since [5].

During the recent years while great advances have been made in the development of accelerators, renewed interest has developed along the lines of this concept [4]. Studies were conducted at Brookhaven Laboratory in which spent fuel from light water reactor fuel assemblies were directly introduced into an accelerator-reactor without dismantling where the assemblies were to be irradiated with neutrons to form ^{239}Pu from ^{238}U [6] according to a proposal which was advanced. The proliferation of military material seems unavoidable if this type of nuclear fuel regeneration were employed. The first reactor of promise which exploited the nuclear spallation reaction was one which utilized 10 cascades of liquid Pb-Bi fuel alloy as target which were surrounded by several light water cooling pressurized tubes while a single spent fuel in the form of a light water reactor spent fuel was placed in the center for activation. There were problems such as radiation damage as well as the difficulty in maintaining uniform production of fissionable material.

The resolution of these problems to enable realization of what seems to be the most practical production reactor for fissionable material is proposed here in which molten salt technology is most effectively implemented and which will be elaborated on in detail later.

Before entering into that discussion, let us first describe the nature of the spallation reaction.

2. What is a Nuclear Spallation Reaction? Principle of the Accelerator Breeder Reactor

It is the general situation that when high speed protons collide with heavy atomic nuclei, a large number of neutrons are produced by direct cascade reactions, vaporization from compound nuclei, or nuclear fission reaction type physically complex processes. The reaction probability becomes very large starting from 0.5 GeV (500 million eV), and the formation of pi mesons becomes very active from 3 GeV and above (see Figure 1). This is why 1-1.5 GeV neutrons are considered suitable. When these neutrons are directed against U or Th atoms, one proton is expected to produce 30-50 neutrons. This complex phenomenon is illustrated in Figure 2. The neutrons generated in this manner are absorbed by ^{238}U or ^{232}Th atoms present in excess around the target area to produce ^{239}Pu or ^{233}U.

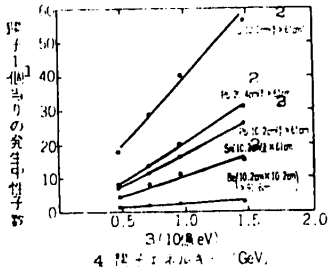

Figure 1. Relationship between Proton Energy and Number of Protons Generated Obtained with Different Target Materials

Key: 1. number of neutrons emitted per incident proton
2. -- cm diameter
3. 1 billion eV
4. proton energy (GeV)

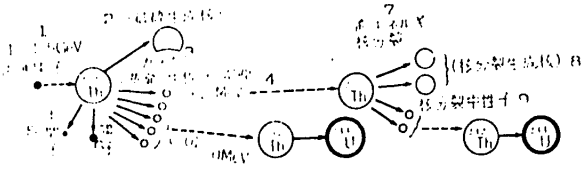

Figure 2. Spallation of Th Nuclei and Formation of ^{233}U

Key: 1. (1-1.5 GeV fast protons)
2. (spallation formed nuclei)
3. cascade
4. (vaporized) neutrons (40)
5. mesons
6. protons
7. high energy nuclear fission
8. nuclei formed from nuclear fission
9. nuclear fission neutrons

The energy distribution for the neutrons generated in this manner is illustrated in Figure 3, and it is seen that the neutron energies nearly all fall below 15 MeV with 0.1-5 MeV being the most abundant. The comparatively low energy distribution is an advantageous situation. These neutrons are utilized to produce nuclear fuel. The technological steps can be outlined in the following manner.

a) 1-1.5 GeV protons are made to collide with ^{238}U or ^{232}Th (target reaction)

b) The neutrons generated in this manner numbering several dozen per proton are absorbed by the U or Th atoms present in excess to form ^{239}Pu or ^{233}U (blanket breeding reaction)

c) The heat of formation is utilized to generate electric power to provide power for the accelerator and other working parts

d) The ^{239}Pu or ^{233}U produced in this manner is cycled to a power reactor

e) The spallation products are processed.

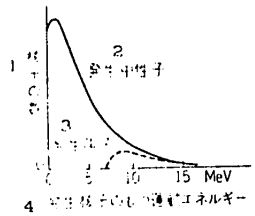

Figure 3. Kinetic Energy Distribution of Daughter Nuclide Formed by Spallation Reaction

Key: 1. number of daughter nuclides
2. neutrons generated
3. protons generated
4. kinetic energy of the generated daughter nuclides

3. Engineering Problems Related to Accelerators and Other Areas and Utilization of Molten Salt Technology

As noted above, the principle of an accelerator-reactor is surprisingly simple, and there should be very few questions concerning its operation. On the other hand, a large number of technological problems need to be resolved before this reactor can become practical. Some of the major problems are discussed below.

1) Development of the Accelerator

The generation of 1 GeV does not pose too many problems, but supplying 200-300 mA continuously presents a more formidable problem. First of all, beam leakage has to be minimized (10^{-8}-10^{-9}). Extreme radiation levels make retention difficult. This is why a linear accelerator is suited to this application, and its

length will probably be of the order of 500-1,000 meters. At the same time, the conversion efficiency of the power from the power supply has to be kept high otherwise the economic aspects suffer (countermeasures for such behavior will be discussed in Chapter 6).

2) Beam Window

There is probably no membrane material for covering the window through which the beam from the accelerator is directed toward the target which can withstand the beam. The beam can be allowed to spread a considerable degree or can be moved, but it would be great if the window can be dispensed with altogether. The BNL design [6] claims that a windowless affair is possible because of the low vapor pressure of Pb-Bi. The relatively relaxed vacuum conditions associated with a linear accelerator is a definite advantage.

3) Radiation Damage to Target, Blanket, and Coating Material

Just as was mentioned in 2), there is probably no solid material which can withstand this level of radiation. Moving the beam may be asking too much. This is why a liquid metal or molten salt bath most likely will be used.

4) Heat Removal

The reaction zone with the beam is comparatively narrow (this is about several $meter^3$ in the most severe cases). At the same time, a solid is unsuitable because of polarization.

5) Efficiency of Nuclear Fuel Production and Chemical Treatment

Protons have to be directed against Th or U atoms in efficient manner, and the neutrons thereby generated also have to be absorbed by the Th or U atoms. This is why a target which is continually being renewed is probably better (need for shuffling). At the same time, spallation products should be removed as rapidly as possible.

6) Power Regeneration

The heat removed from the target should be used to generate electric power as efficiently as possible and thereby recover as much as possible of the vast power required to operate the accelerator (600-700 MWe).

It may be evident without much further explanation that in order to resolve these various problems which were discussed above, it will become necessary to revert to the use of a liquid metal or a molten salt. The reactor engineering designs drawn up in the past which were intended for the most severe irradiation conditions probably were associated with the Na cooled fast reactor core, gas cooled fast reactor core, and the molten salt reactor core, and Mynatt of ORNL has drawn up a comparative table showing the advantages of each when used as a blanket [7]. This is shown in Table 1. As is clear from the discussion presented above, solid materials cannot be considered even as blanket material.

Table 1. Performance Comparison Table of Various Type Blankets (According to Mynatt of ORNL [7])

	Na冷却高速炉心	2 ガス冷却高速炉心	3溶融塩炉心
4 照射損傷	×	△	○
5 熱除去，その他の工学	○	△	△
6 核燃料生産	△	○	×*○
7 燃料管理	×	△	○
8 燃料処理・製作	○	×	○
9 発電効率	○	×	○

Key:
1. Na cooled fast reactor core
2. gas cooled fast reactor core
3. molten salt reactor core
4. radiation damage
5. heat removal and other engineering items
6. nuclear fuel formation
7. fuel control
8. fuel treatment, manufacture
9. power generation efficiency

Molten salt technology involving U or Th is one of the most promising methods where practicality is concerned. This may become even more decisive in the event a target is utilized.

The authors followed this line of thinking to propose a number of accelerator molten salt reactor concepts over the past 3-4 years [8]. Now, they believed that "nuclear fuel production efficiency is poor in molten salt" just as was indicated in Table 1 so that they employed not only a simple breeder reactor of the type mentioned above but also combined removal of transuranium elements to raise the value and better the efficiency of neutron generation which they considered important [8]. This was because it is not possible to raise the actinide atom concentration greater than 10 percent even in the various molten fluoride systems which have been proposed, and 90 percent has to be comprised of light element nuclide species. In order to resolve this situation, the target salt and blanket salt have to be kept separate in a 2-liquid type accelerator-molten salt reactor [8]. This reactor still offers many engineering problems, and it will probably be 10 years in the future before practical solutions will be found.

On the other hand, the ever intensifying energy situation has prompted promotion of utilizing thorium resources, and a start was made toward a single fluid type accelerator-molten salt breeder reactor AMSB (see next section). A theoretical neutronics calculation was performed whereupon the direct observation discussed above was found to be in error, and the neutron formation rate was fairly high. The x marked with a * in Table 1 then became a circle, and this is expected to resolve any major difficulties.

4. Single Fluid Type Accelerator-Molten Salt Reactor Concept [9]

The accelerator-reactor which the authors propose is really one of very simple construction as illustrated in Figure 4. Into a molten salt bath containing thorium fluoride (ThF_4) at concentration level 2-3 times that found in the usual

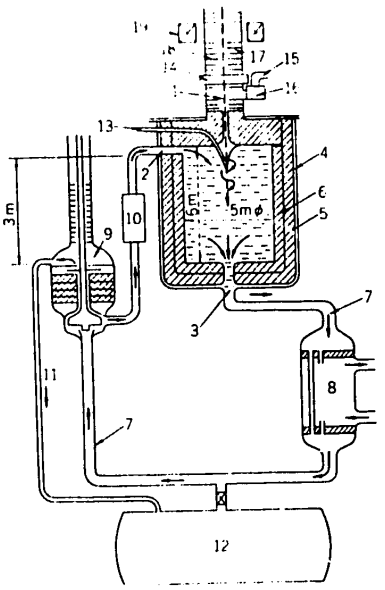

Figure 4. Conceptual Diagram of Single Liquid Type Accelerator-Molten Salt Breeder Reactor [9]

Key:
1. proton beam
2. salt inlet
3. salt outlet
4. reactor container (Hastelloy N)
5 and 6. graphite
7. primary system loop
8. heat exchanger
9. main salt pump
10. flow control valve
11. overflow distribution line
12. storage tank
13. high pressure molten salt inlet
14. gate valve
15. vacuum line
16. steam trap
17. conducting pipe
18. orifice
19. throttling magnet

type of molten salt power reactor with total volume of about 100 meter^3 will be directed a stream of protons through a windowless wall. The results of theoretical calculations indicated that 30-40 neutrons will be generated per incident proton. Consequently, at least 30 or more ^{233}U atoms will be generated per proton (see Table 2).

An eddy is created on the liquid surface near the incident port to enable the protons to penetrate as deeply as possible to generate neutrons as close as possible to the central section and thereby improve the absorption efficiency. At the same time, the accumulation of heat at a static surface with associated elevation in temperature is prevented. The rise in temperature within this reactor is roughly 100°C and the heat can be removed at a flow rate of 5 meter^3/sec.

Table 2. Estimated Properties and Neutron Yield of Molten Salts for Use as Target [9]

1成分	2組成 (モル%)	3融点 (°C)	4密度 (g·cm⁻³)	5粘性700°C (cpoise)	6中性子収率* (入射陽子1個当り)
^{7}LiF-BeF$_2$-ThF$_4$	71-9-20	540	2.97	7~9	29.6±2.1 (35.8±2.7)**
^{7}LiF-BeF$_2$-ThF$_4$	64 18 18	540	2.7	6~7	27.0±2.0
^{7}LiF-NaF-ThF$_4$	54.5 13 5 32	525	3.31		32.4±2.1
NaF-KF-ThF$_4$	11 67 22	535	2.54	8~10	25.9±3.0
^{7}LiF-BeF$_2$-UF$_4$	61 21 18	550	2.87	6~7	31.2±2.4
^{7}LiF-RbF-UF$_4$	57-10-33	470	3.57	11~13	36.0±4.0

7 * 15MeV以上の核反応に対する計算値で、低目に出ている。Beの効果も無視。
8 ** Thの1%を^{233}Uで置き換えた場合。
9 *** 融点+100°C)に対し、古川のイオン性液体構造模型により推定。

Key: 1. component
2. composition (mol%)
3. melting point (°C)
4. density (g/cm^3)
5. viscosity 700°C (cpoise)
6. neutron yield (per incident proton)
7. *This value was calculated for nuclear reactions above 15 MeV and are to the low side. The Be effect was disregarded
8. ** Case when 1 percent of Th was replaced by ^{233}U
9. *** Estimated by the Furukawa ionic liquid structure model for (melting point +100°C)

The secondary system salt and secondary system can be designed similar to the molten salt breeder reactor MSBR of ORNL. Power generation efficiency of at least 43 percent can be anticipated [11].

No structural member is necessary within the liquid pool, and the reactor container wall made of Hastelloy N (Ni-Mo-Cr alloy, can be used at temperature as high as 800°C) and is lined with graphite reflectors. Radiation damage to these members is expected to be minimal.

Initially there will be no nuclear fission products present in the molten salt. Even after a year's operation and about 1 ton of fission products have accumulated, the total concentration will be less than 0.1 mol percent with respect to $^{233}UF_4$. In a subcritical system involving no chain reaction, there is no need for control rods nor any possibility of a runaway incident. The molten salt will not react with water or air, and there is probably no reactor with such a high degree of safety.

The liquid surface is exposed to vacuum during the reactor operation, and the vapor pressure of the salt is less than 0.1 mmHg, and the vapor can probably be recovered by the pressure differential exhaust system and vapor trap placed between the accelerator and the reactor even in the absence of a window. The salt coming to the lower section of the beam duct will probably be washed and dropped while the liquid level is slightly elevated with the reactor stopped. The system is designed to provide a free liquid surface (atmospheric pressure) at the pump bowl roughly 3 meters below the liquid level so that the liquid is not drawn in by the vacuum whenever reactor operation is stopped.

Table 3. Estimated Properties of Single Liquid Type Accelerator-Molten Salt Breeder Reactor (Example) [9]

1	・陽子ビーム	21GeV 300mA連続
2	・ターゲット塩	7LiF-BeF2-ThF4
	(第2表参照)	4(64－18－18モル%)
5	・炉出入口温度	680°C→580°C
6	・塩	150m³, 405ton (Th 312ton)
		流量 5m³/秒
7	・熱出力	1,200～2,000MWth
8	・発電量	500～800MWe
9	・消費電力	～600MWe
10	・233U生産量	11300～1,000kg/年
12	・核破砕生成物	13～80kg/年

Key:
1. proton beam
2. 1 GeV 300 mA continuous
3. target salt (see Table 2)
4. (64-18-18 mol%)
5. reactor inlet-outlet temperatures
6. salt 150 m^3, 405 ton, flow rate 5 m^3/sec
7. thermal output
8. power generated
9. power expended
10. amount of ^{233}U produced
11. 300-1,000 kg/yr
12. nuclear spallation product
13. 80 kg/yr

Sputtering during irradiation is an item of concern, but forward scattering is the overwhelming process associated with high energy particles. The region of most violent nuclear reactions is about 60 cm below the incident surface, and the incidence of protons at the bottom of the eddy should enable the evective absorption of the evolved neutrons in Th in space effective manner. The principal properties estimated of this reactor are listed in Table 3. The estimation of the heat released is not too exact, and the Tunnicliffe [10] approach was adopted (see Figure 5). There should be the possibility of recovering some of the electric power expended in this situation.

The above has been a simplified explanation of the structural outline of this reactor. Research and development problems further on down the line will be discussed later, and here we will discuss the manner in which the reactor will be operated. This is because the operation will be the basis for setting up developmental guidelines.

5. Role of the Accelerator Molten Salt Breeder Reactor (AMSB)

As mentioned before, this reactor makes possible reinforcement of established lines whenever the necessity arises. For example,

(Light water reactor)--should there be a dearth of U for enrichment purpose, the remaining depleted U can be converted to and supplied as ^{239}Pu. In addition, dependence on natural U can be bypassed, and the ThO_2-$^{233}UO_2$ fuel can be produced directly.

(Na fast breeder reactor)--^{239}Pu can be produced from depleted U to assist reactor starting. The use of funds allotted to Na equipment development for AMSB is an interesting application.

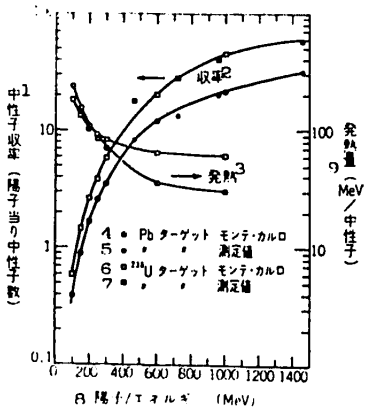

Figure 5. Neutron Yield and Heat Emitted for 20 cm Diameter Pb and ^{233}U Targets

Key: 1. neutron yield (number of neutrons per proton) 2. yield
3. heat generated 4. Pb target Monte Carlo
5. Pb target measured values 6. ^{233}U target Monte Carlo
7. ^{233}U target measured values 8. proton/energy (meV)
9. heat generated (MeV/neutron)

(High temperature gas reactor)--This system can supply ^{233}U and promote greatly superior Th fuel utilization. It is possible that the system will be combined to set up an overall breeder reactor system.

(Heavy water reactor)--This reactor has been the main stream of Canadian efforts for over 30 years [5]. This reactor also can be used together with the molten salt reactor just as was mentioned above.

(Treatment of long lived radioactive wastes)--The Th type AMSB will probably be useful in the removal of transuranium elements.

As far as the long term possibilities are concerned, production of ^{233}U with the AMSB and using this product to generate electric power in a molten salt converter reactor (MSCR) which technologically is of the same type may be the most ideal system. The reader is referred to reference paper 11 for details of the MSCR. Now, what type of research and development efforts will be required in order to develop this promising reactor type?

6. Developmental Problem Areas

An outline of the major developmental problem areas was presented in Chapter 3, and here we will discuss the three most important subjects and elaborate on them in greater detail.

1) Development of Large Output Accelerator

The Lineac (linear accelerator) is the facility which is best for direct conversion of electric power into beam current. The conversion rate is close to 50 percent, and large current beams can be obtained at lowest cost. The greatest limitations to the production of high energy and large current beams are the beam stability and irradiation of the accelerator by beam spill. The Lineac is particularly advantageous with respect to these points.

Let us now consider some technological problems and economic problems that will be encountered in the construction of a 1 GeV 300 mA Lineac. The technological problems include

i) Beam Incident System

The incident system between the ion source and the Lineac is the section where greatest beam loss occurs. Recently success was attained at the Los Alamos Laboratory in the use of a radio frequency quadrupole (RFQ) mode. This discovery has made possible to use 80 percent of a 30 mA beam current from the ion source after passage through this section to be used for acceleration [14].

ii) Large Output RF System

It is said that acceleration up to 150 MeV or thereabouts with an (Albert) type Lineac (∿150 MHz) followed by acceleration to 1 GeV with a Disk and Washer type Lineac (∿800 MHz) is suitable for this system. This necessitates the development of a klystron which can operate continuously at 1 MW output or more. The maximum output possible with klystron units at hand are of the order of 500 kW (continuous).

iii) Beam Dynamics

The space charge effect, beam blowup phenomenon (the phenomenon by which the beam is attenuated within the accelerating tube), and beam spill are research subjects for which the proper countermeasures need to be developed. These are the most troublesome problems. Studies are under way on the selection of appropriate frequencies, dimensions of the drift tube pipe higher order modes for the acceleration tube, beam converging magnet, and beam hollow scraper [phonetic].

iv) Countermeasures for Accelerator Irradiation and Continuing Maintenance

Beam spill will be minimized and provisions will be made to readily replace damaged parts by remotely controlled operations.

The economic problems are described next.

i) Improving Power-Beam Conversion Efficiency

The efficiency of the klystron and improvement in beam load efficiency are problems which need to be resolved. The former is associated with a theoretical

efficiency as high as 80 percent, but the aforementioned 500 kW output klystron (continuous) has efficiency of 60-70 percent. The beam load efficiency (beam output ratio with respect to input RF) is higher with the Disk and Washer type Lineac compared to other types with efficiency of the order of 85 percent. This type is presently undergoing development [4].

ii) Cost Calculations

The cost of the facility was estimated by the Los Alamos Laboratory (as of 1977) to be 113 M$ (million dollars) for the RF system, 54 M$ for accelerator construction, 5 M$ for the injector and control system, and other parts (includes engineering costs) for a total of 213 M$ for which a precision of a factor of two was claimed.

Keeping all these ideas in mind, a conceptual drawing of this facility is illustrated in Figure 6. The details of Lineacs presently under operation or undergoing design are listed in Table 4.

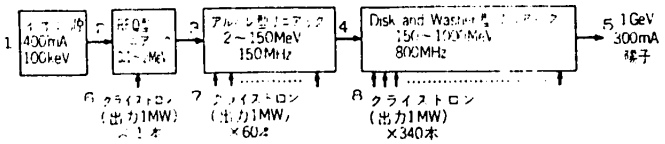

Figure 6. Block Diagram of 1 GeV, 300 mA Proton Lineac

Key:
1. ion source 400 mA 100 keV
2. RFQ type Lineac 0.1-2 MeV
3. (Albert) type Lineac (2-150 MeV, 150 MHz)
4. Disk and Washer Type Lineac 150-1,000 MeV 800 MHz
5. 1 GeV 300 mA Proton
6. klystron (1 MW output) x 1
7. klystron (1 MW output) x 60
8. klystron (1 MW output) x 340

2. Target Physics

In order to predict the economics of the situation in which an accelerator-breeder reactor is introduced into the fuel cycle and the effect of this introduction with good precision, first of all, the quantity of ^{233}U or ^{239}Pu and the self-power generationg efficiency need to be predicted in accurate manner while, secondly, the quantities of nuclear spallation products and fission products which are tied in with safety and environmental problems need to be established. This makes necessary the development of methods for the accurate calculation of the number of neutrons generated in the target, the heat liberated, and the product nuclide distribution.

When high energy protons of about 1,000 MeV are shot into the target in the case of an accelerator-reactor, the nuclear reaction processes within the target

Table 4. Examples of Large Output Lineacs

1 施設名	LAMPF Los Alamos Meson Physics Facility	FMIT Fusion Material Irradi. Test Fac. Facility	SNQ German Project on Spall. Neutron Source
2 現 状 (完成)	3 稼動中 1975	4 建設中 (1984)	5 計画(本年中に決定) (1986?)
6 場 所	7 米LASL (ロスアラモス)	8 米HEDI (ハンホード)	9 西独KFA (ユーリッヒ)
10 粒 子	11 陽 子	12 重陽子	13 陽 子
14 エネルギー	800MeV	35MeV	1,100MeV
15 平均電流	1mA 17 (現在0.5mA)	18 100mA連続	5mA
16 ピーク電流	17mA	—	100mA
19 パルス幅	500μsec	—	max. 500μsec
20 繰返し数	120Hz	—	100Hz
21 加速構造	22 アルバレ管(100MeV) + 側面結合空胴管(100~800MeV)	23 RFQ*(2MeV) + アルバレ管 (35MeV)	24 アルバレ管(105MeV) + Disk and Washer 管(105~1100MeV)
25 RF系	26 201MHz(10MW ビーム) + 805MHz(44MW ビーム)	27 FIMAC8973 (四極管0.5MW80MHz)×17本	28 108MHz1.7MW 四極管×14本 + 324MHz3.3MW 現行Klystronを改良×106本

(*RFQ: Rabio Frequency Quadrupole)

Key:

1. name of facility
2. present status (completed)
3. in operation 1975
4. under construction (1984)
5. design (to be completed this year) (1986?)
6. location
7. LASL in USA (Los Alamos)
8. HEDI in USA (Hanford)
9. West German (KFA Julich)
10. particle
11. proton
12. heavy proton
13. proton
14. energy
15. average current
16. beam current
17. (0.5 mA presently)
18. 100 mA continuous
19. pulse width
20. repeat number
21. accelerating construction
22. (Albert) type (100 MeV) + side surface coupled hollow barrel type (100-800 MeV)
23. RFQ* (2 MeV) + (Albert) type (35 MeV)
24. (Albert) type (105 MeV) + Disk and Washer Type (105-1100 MeV)
25. RF system
26. 201 MHz (10 MW beam) + 805 MHz (44 MW beam)
27. FIMAC 8973 (quadrupole tube 0.5 MW 80 MHz) x 17 units
28. 108 MHz 1.7 MW quadrupole tube x 14 + 324 MHz 3.3 MW klystron presently in use to be modified to 106 units

are much more complex than what take place in a nuclear fission reactor or a nuclear fusion reactor blanket. Not only neutrons and γ rays but protons, pi mesons, and mu mesons contribute to the nuclear reactions and heat emission. A giant computer is needed in order to calculate nuclear reactions and heat release for these particles. There is presently no data file around which can cover the energy range between 1,000 and 0 MeV, and the present practice is to use Monte Carlo calculations based on nuclear reaction theory for the high energy region in a simulation type approach.

When the characteristics of the accelerator-reactor are compared and studied, the neutron yield (average number of neutrons formed per incident proton) is used as a convenient parameter to describe nuclear properties. Measurements along this line are being conducted in the Soviet Union, United States, and Canada. The neutron yield is a valuable parameter from the standpoint of nuclear fuel breeding, but a direct measurement of the yield of ^{239}Pu or ^{233}U is to be desired. Because this measurement is not simple, only measurements of the ^{239}Pu formation rate in natural U and depleted U have been conducted and only by the Soviet Union. Experiments in the United States and Canada were directed at measuring neutron leakage from the target (see Figure 1). No experiments have as yet been conducted on Th targets.

On the other hand, Takahashi (BNL) [6] and Nakahara (JAERI) [12] who analyzed the measurement data of the Soviets showed very good agreement between measured values and calculated values. Based on this theoretical approach, calculations were performed on molten salt systems the results of which are shown in Table 2. These values are considered to be on the conservative side. In the particular case of molten salt containing Be an increase in neutron yield is seen as the result of the (n,2n) reaction, but calculations on light nuclei are extremely difficult and some actually measured values are to be desired. The heat release mechanism within the target is also very complex, and both experiment and theory are at insufficient levels. Some estimated values reported by Canadian researchers are listed in Figure 5.

Molten fluoride salt, particularly one incorporating Th (it can be a solid at first), is considered to be the most likely subject for measurement studies on neutron yield and quantity of heat generated. There is as yet no method for calculating formation rate of nuclear spallation and nuclear fission products which are the items next in line, and this is a problem for future resolution.

3) Target Chemistry and Reactor Chemistry (Spallation Chemistry)

The details of nuclear spallation and nuclear fission products are not as yet known, but referencing some predicted calculation result on Th obtained by the authors (Figure 7), the following points should be pointed out.

i) The products formed will probably be distributed over the entire periodic table of the elements. On the other hand, the generic nature is important chemically speaking, but here the nuclear fission products are spread out over the metals in the usual case and there is no real difference.

ii) According to Table 3, a year's accumulation of spallation products in the narrow sense of the term is about 40 kg while the nuclear fission products from fast neutron irradiation is also about 40 kg. Since there is no graphite in the core but a large mass of molten salt, the total concentration of fission products after a year is but 160 ppm or so. On the other hand, a year's accumulation of fission products within the MSBR is about 5,000 ppm, and the 80 ppm fission product concentration in AMSB is but 1/60 of the above. Although spallation chemistry is even more complex, there is the advantageous feature that it is only necessary to consider regions where the concentration and absolute quantity of waste products are extremely small.

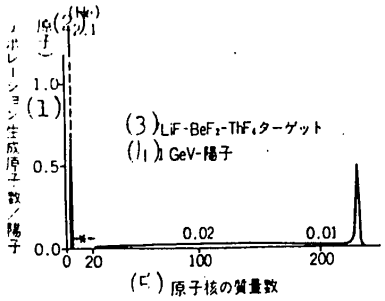

Figure 7. Mass Number Distribution of Spallation Product Atoms from Action of 1 GeV Protons on ^{7}Lif-BeF_2-ThF_4 (64-18-18 mol%) Target

(Precision of calculations in the * marked region is still inadequate)

Key: 1. number of spallation produced atoms/proton 2. atom
3. LiF-BeF_2-ThF_4 target
4. 1 GeV proton 5. mass number of atom nuclei

iii) When all the products are dispersed, they can be classified as follows:

A. Actinide elements: Pu, Np, U, Pa, Th, Ac
B. Rare gases: Ru, Xe, Kr, Ar, Ne, He
C. Hydrogen: T, D, H
D. Stable salt forming elements: Ra, Fr, At, Sr, Bi, Pb, Br, Mg, F, B, Be, Li
E. Noble metal elements: Au, W, Mo
F. Unstable salt forming elements: O, S, Se, Te, ---

Group A presents no problems from a chemical viewpoint when it is mixed in. Group B does not dissolve and can be readily discharged into a vacuum system or cover gas system (according to Figure 7, the total volume of He produced does not exceed 3.7 meter^3 under standard conditions during the course of a year). Almost all of group C is transferred to the secondary salt system and probably can be treated, and its presence is recognized [11]. Group D offers no problems as long as it is present in low quantity. Consequently, groups A-D which make up the major fraction of the products will not be too much of a problem.

Group E is either plated out or exists in the free form while group F is chemically unstable and can become the factor responsible for corrosion of materials. This group needs to be treated, but its total concentration is expected to be less than 1 ppm. The individual element concentration probably will be less than 0.1 ppm (even when the charge of fluoride initially installed has been purified, it will still contain about 10 ppm oxygen and 5 ppm sulfur). Even though their concentrations are low, they may be separable during the separation of the fission products or during the salt purification treatment process, but even when simple operations such as filtration, chemical getters, adsorption to graphite, and reduction extraction with Li, Be, or Na type reduction extractions are introduced, the small absolute quantities and concentrations will probably impose no severe economic factors.

The use of F_2 gas to form volatile UF_6 to separate ^{233}U has been demonstrated to be industrially feasible [11]. This material can be recovered by occasional batch flushing from the storage tank. It is possible that a chemical enrichment process without the need for separation may be devised.

4) Other Details

The conclusions that can be drawn from this section and Chapter 5 are that many problems need to be resolved in order to elucidate the complex phenomenon called nuclear spallation and many new subjects for development in the industrial area have evolved. On the other hand, the makeup is very simple, and it is felt that there is no other system with such good potential. It is almost as though there need be no concern for reactor control and safety. Since it is possible to initiate experiments starting off with salt containing no nuclear fission products, the experiments can be readily inaugurated. The same site can be used while accelerator power can be increased by small increments while there is an accompanying reinforcement of the molten salt engineering system. The ability to incorporate a flexible yet rational research and development plan is one of the important advantages.

The properties of AMSB will become more clearly established during the course of these studies, and the suitable operating mode will probably be developed. Should nuclear fuel production and heat generation be inadequate, the separation of fission products from the molten salt can be delayed. Both breeding and heat generation will be reinforced by nuclear fission. According to calculations performed by Nakahara, the presence of 1 percent ^{233}U in Th will increase neutron yield to 17 percent.

While this was a brief discussion, we feel fortunate if the reader acquires some insight into the accelerator-molten salt reactor concept. The reader is referred to reference articles [3], [4], and [9] as well as the review presently being drafted by Hiroshi Takahashi of BNL [13] for more detailed descriptions. It is hoped that this subject will become the topic of criticisms and discussions which will be useful when more involved research, cooperative research, and development will be initiated to advance the status of the project, and the peaceful uses of atomic energy, particularly the involvement of thorium, will be expanded to provide a new energy resource. At the same time, this program is advantageous from the standpoint of safety from nuclear proliferation and should prove very beneficial for developing countries.

BIBLIOGRAPHY

1. D. E. Lilienthal: "Atomic Energy: A New Start," (1980) Harper and Row [Translation: A Fresh Start in Nuclear Energy Which Stands at the Crossroad (1981) published by Nippon Seisansei Hombu]

2. S. Manabe and R. J. Stonffer: Nature, 282 (1979) 491; Okamoto: Genshiryoku Kogyo 25, No 2, (1979) 65.

3. Tsukada: Nippon Genshiyoku Gakkaishi, 20 (1978) 533.

4. "Proc. Inform. Meeting Accel. Breeding," CONF-770107 (1977).

5. J. Davis: Nature 270 (1977) 376, 375; G. A. Bartholomew, et al: AECL-2600 (1966).

6. M. Steinberg, et al: BNL-50592 (1976) - 26951 (1980); H. J. Kants and P. Grand (ed): BNL-50838 (1978); Nature 278 (1979) 693; Hiroshi Takahashi: Nippon Genshiryoku Gakkaishi 21, 397 (1979).

7. F. R. Mynatt: Reference (4), p 85.

8. Furukawa, et al: Trans. Annual Meeting of the Japan Atomic Energy Society (1978/3) B 54; Furukawa, Ono, Mochinaga, Igarashi: J. Nucl. Sci. Tech., 17 (1980) 562.

9. Furukawa, Tsukada, Nakahara: Proc. ICANS-IV (1980, Tsukuba) KEK; Tech. Docu Spall. Breeders, (1981) IAEA; J. Nucl. Sci. Tech., 18 (1981) 79.

10. P. R. Tunnicliffe: Reference (4) p 69.

11. M. W. Rosenthal, et al: ORNL-4812 (1972); "Molten Salt Breeder Reactor" (1977) Nippon Genshiryoku Gakkaishi. This Journal 26, No 5 (1980) 56.

12. Y. Nakahara: Proc. IANS-IV (1980, Tsukuba) KEK.

13. Hiroshi Takahashi: Nippon Genshiryoku Gakkaishi 23 (1981) in press.

14. J. E. Stovall: LA-8525-SR (1980).

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CSO: 4105/166

SCIENCE AND TECHNOLOGY

MOLTEN SALT NUCLEAR BREEDER REACTOR DEVELOPED

Claimed Safer

Tokyo DAILY YOMIURI in English 23 Apr 81 p 5

[Article by Masao Nakamura]

[Text]

A movement to build a nuclear power reactor that will use thorium, and not uranium as in conventional nuclear reactors, is gathering momentum in Japan.

Called "singe-fluid-type Accelerator Molten - Salt Breeder (AMSB), it is essentially a combination of an accelerator and a molten-salt breeder, and has been developed by a group of scientists, including Kazuo Furukawa, head of the Molten Material Laboratory of the Japan Atomic Energy Research Institute in Tokaimura, Ibaraki-ken; Yasuaki Nakahara, chief researcher of the same institute; and Professor Kineo Tsukada of the Atomic Energy Research Institute of Nihon University in Tokyo's Chiyoda-ku.

Conventional nuclear reactors employ uranium but it is estimated that deposits of thorium throughout the world are four times as large as those of uranium.

One characteristic of an atomic reactor that employs thorium is that it does not yield plutonium, which can be used in manufacturing atomic bombs.

On the other hand, thorium, when bombarded with neutrons, changes into uranium 233, whose handling is extremely difficult because of strong gamma rays, making the element useless for nuclear arms.

Accordingly, a thorium reactor is quite peaceful in nature, perfectly conforming to the nuclear nonproliferation policy of the US. The development of the reactor has been suspended, however, in the US, probably because it does not contribute to military purposes.

In Japan, the ruling Liberal-Democratic Party (LDP) March 17 inaugurated a nonpartisan body named "Dietmen's Consultative Council To Help Promote Research and Development of Natrium Energy." The council, designed to give a boost to plans to develop a thorium reactor, is headed by Susumu Nikaido, chairman of the LDP's Executive Board, while Yoshitake Sasaki and Masumi Esaki, both former international trade and industry ministers, became vice-chairmen of the organization, which is participated in by 28 members of the House of Representatives and 10 members of the House of Councilors. This move was echoed by business leaders and scientists as they also formed an organizing committee for a consultative council for research of natrium energy.

The planned reactor is unique in that it is quite simple in structure. A cylindrical reactor vessel shielded by layers of graphite is fed with lithium beryllium and thorium fluorides. and is maintained at 500 degrees centigrade. Then the contents transform into a non-oily, water-like liquid. It is bombarded with a fast proton beam (hydrogen nucleuses) at 1 billion electron volts, and thorium in the liquid changes into fissionable uranium 233 discharging heat and neutrons. These neutrons bombard the nucleuses of thorium, thus breeding uranium 233.

When this reactor is run for one year, it breeds enough uranium 233 to run another reactor of the same type. Therefore if a set of reactors is built in one area, only one accelerator will be enough to run all of these power reactors.

As a thorium reactor is run, the temperature of the liquid rises, and the liquid is led to a heat converter

to create high-temperature vapor that runs generators.

Summarized, the characteristics of the thorium reactor are:

1) The operation of a thorium reactor can be suspended easily by discontinuing the bombardment by a proton beam. Therefore there can be no runaway operation of the reactor. It requires no control rods.

2) The reactor vessel is a simply structured container which requires no additional devises.

3) There will be no fear of damaging the system from the proton beam bombardment.

4) Since the reactor requires no fuel control rods, there will be no problem of damage to control rods. There will also be no need for making control rods, which requires much labor. Operation of the reactor need not be suspended to replace control rods.

5) Radioactive waste can be removed from the metallic fluids by chemical means without suspending the operation of the reactor. The reactor also requires no spent nuclear fuel reprocessing plant.

Thus, the reactor has numerous advantages, including safety, simplicity of structure and low cost. Then why has its development been delayed? Dr Eizaburo Nishibori, an ex-director of the Japan Atomic Energy Research Institute, who is spearheading the movement to develop the reactor says: "This reactor is completely different from conventional ones because it has been developed by chemists, and not by physicists, machinists or electricians. Westinghouse and General Electric, major US nuclear reactor makers, have made tremendous investments in their projects and are apparently about to profit from the investments. Under the circumstances, they are probably reluctant to make additional investments in a project to develop a new type of a reactor."

Dr Nishibori and other people concerned say that the planned reactor is so safe that it can be built near cities. They can be shipped abroad since they will be 100 percent domestically built, without taking into account the views of the US.

"It is high time for us to build the reactor because no other country is ready to build it," they also say,

They are in high spirits as they are determined to perfect the project by all means.

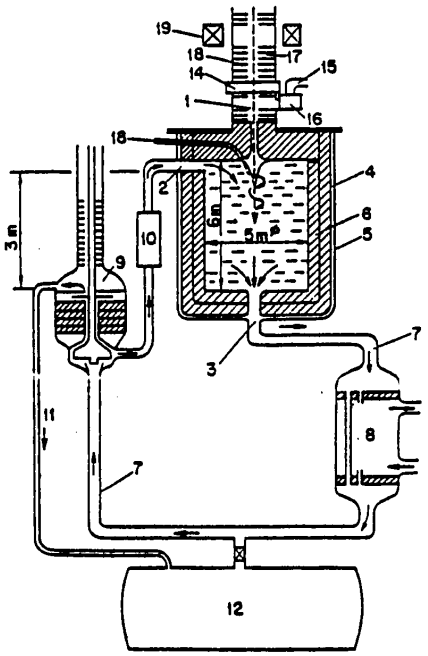


Fig. 4-1. Schematic Figure of Single-fluid-type Accelerator Molten-Salt Breeder

1 proton beam, 2 salt inlet, 3 salt outlet, 4 reactor vessel, 586 graphite, 7 primary loop, 8 heat exchanger, 9 main salt pump, 10 throttle valve, 11 overflow line, 12 storage tank, 13 high-pressure salt outlet, 14 gate valve, 15 vacuum line, 16 vapor trap, 17 duct, 18 orifice, 19 focussing magnet.

Fifteen-Year Development

Tokyo MAINICHI DAILY NEWS in English 26 May 81 p 5

[Text]

Amid mounting criticisms of light-water power reactor operations in the wake of successive serious nuclear accidents in Japan, certain businessmen, scientists, general trading houses and politicians have begun to take on active interest in introducing a new type of nuclear reactor — molten salt reactors using thorium as nuclear fuel.

These businessmen and scientists are moving to set up a foundation to utilize state funds for research and development of molten salt reactors. Meanwhile, nearly 100 Liberal-Democratic Party dietmen are expected to form a dietmen's league for thorium energy research soon.

The experimental molten salt reactor was first built in Oakridge, Tenn., by the U.S. government some 15 years ago and has been under research in Canada, India and Japan. Canada and India have plentiful reserves of thorium while the Japanese research has been theoretical.

The molten salt reactor uses thorium as fuel instead of the usual uranium, and is claimed to be "safer" than the uranium-fueled light-water and heavy-water reactors.

When the then U.S. President Jimmy Carter advocated his nuclear nonproliferation policy, the molten salt reactor came briefly into the spotlight in Japan as a possible alternative to the prevailing light-water reactors.

The new reactor, however, is still in the development stage and has considerable problems yet to be solved. On this account, and since Japan has long been committed to the light-water reactor, the molten salt reactor option was turned down.

However, the successive serious nuclear reactor accidents disclosed just recently have aggravated the people's concern over the safety of nuclear reactors here.

To counter the mounting criticism of nuclear power generation in general and light-water reactors in particular, the nuclear power advocates are increasingly turning to molten salt reactors on the yet-to-be-proven premise of "higher safety."

Eizaburo Nishibori, one-time leader of the Japanese Antarctic wintering team, director of the Japan Productivity Center and long a staunch advocate of molten salt reactors, maintains that they are not only safer but also more economical than the light-water reactors since they use the hitherto little-utilized thorium.

Thorium, in its natural state, is not a fissionable material, but can be turned into a fissionable fuel, and has therefore been considered as a latent source of nuclear power.

The nation's power companies have started studies on molten salt reactors, and Sumitomo Corp., a major trading house, is keenly supporting the rising movement for the new reactors. With the molten salt reactor, Sumitomo aims to enter the nuclear reactor business by taking advantage of its close relations with Evasco, an American firm which once engineered the molten salt reactor.

At present, the research and development of the molten salt reactor in Japan is estimated to require more than 15 years and more than 500 billion yen before commercialization.

CSO: 4120/260

SCIENCE AND TECHNOLOGY

CHEMICAL COMPANY ESTABLISHES GENE ENGINEERING LABORATORY

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 12

[Text]

Kanegafuchi Chemical Industry Co. has completed a genetic engineering laboratory at its Takasago, Hyogo Prefecture, works to start biotechnology research and development efforts.

The new facility, which cost ¥700 million to complete, is intended to completely contain wastes and contamination. The so-called "P-3" (the second highest degree of physical containment) laboratory will be run by about 10 staffers of Kanegafuchi.

The company already has 100 biochemistry specialists on its payroll. Their accomplishments prior to the genetic engineering center include yeast development for bakeries and ribonucleic acid protein. Kanegafuchi is also known for its high technical levels for fermentation, which will be combined with the gene splicing technique, for product development.

Insulin and interferon are among the target products it will try to develop by utilizing the research facilities. Drug makers, including Takeda Chemical Industries, Ltd. and Green Cross Corp., are a step advanced in interferon research. The situation prompted a company source to say: "We cannot win the race unless we develop unique products based on our own technology." Takeda and Green Cross signed pacts with foreign firms to induct their interferon know-how.

Kanegafuchi has yet to produce drugs in final form. Its penicillin line is confined to an intermediate, for example. But development of basic technology will lead to tie-ups with drug companies so that they can jointly produce end products. The research facility is also intended to develop foods, such as amino acids.

The "P-3" facility is intended to completely prevent leakage of microorganisms from the laboratory. A government guideline classifies the facilities into four levels, according to the containment capability.

CSO: 4120

SCIENCE AND TECHNOLOGY

METHODS FOR AMORPHOUS METAL RIBBON, LINES DEVELOPED

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 13

[Text]

Two Japanese industrial companies have together developed a method of mass-producing amorphous metal ribbon, while another has developed its own process of mass-manufacturing slender lines of such metal, it was recently learned.

Amorphous metals, coming in masses without any basic regular crystallized form because of their internal random atomic and molecular arrangements, in contrast to average metals with their respective regular internal structures, have long been considered a potential mainstay electric-electronic equipment material with wide applicability for their outstanding electrical characters, corrosion resistance and low prices. But their atomic and molecular irregularity had been making it difficult to ensure effective mass production.

The two new achievements could open new possibilities of applying such metals to the production of various electric and electronic appliances including TV and video tape recorder sets.

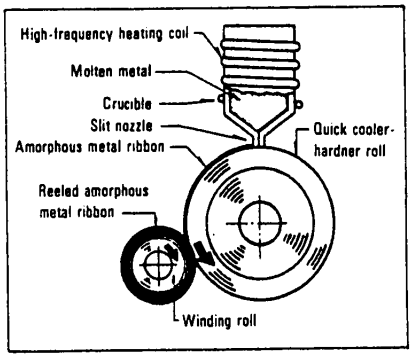
According to the two-company team, Hitachi, Ltd. and its affiliate, Hitachi Metals, Ltd., both of Tokyo, its method consists in cooling down a given molten mass of some kind of amorphous metal at a far greater speed than the conventional metal annealing process. The amorphous metal material melted down in a high frequency electric crucible is spewed out from a narrow slit to be opened at the bottom of the melting pot on a rapidly-revolving roll.

Thus, any thin filmy ribbon of such metal, about 10 cm wide and only 20 to 55 microns thick, has become producible on a continuous basis to the extent of attaining more than 300 meters in a single stretch. Because of the direct shaping character of the method, attention has been focused on the high-precision of controlling the spewing and rolling jobs to ensure uniformity of surface conditions and thickness.

According to the third developer, Sony Corp., also of Tokyo, it has succeeded in continuously producing a slender line, about 1 mm wide and 40 microns thick, of a given kind of amorphous metal by a triple rolling process, first by similar spewing out of the molten metal in the form of a thin belting in between two rapidly-turning rolls for quick refrigeration and formation, and then by passing the once-rolled strip on to another revolving roll for further cooling, narrowing, and winding.

Sony has also applied the ultimate product with success to experimental production of a coordinate-reading device for the input and output system of drawing and chart-processing computers.

Amorphous Metal Producing Equipment Jointly Developed by Two Hitachi Firms



CSO: 4120

SCIENCE AND TECHNOLOGY

MAKERS RUSH TO TURN OUT AMORPHOUS VERSIONS OF IC'S

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 13

[Text]

A new intense technological development race has started in Japan to develop large substrate type of integrated circuits and other semiconductors by making the most of amorphous substances, including amorphous silicon.

The ordinary semiconductors of crystalline materials had been limited in the producible size of their substrate surface to only 1 or 2 centimeters square. But the prospective semiconductors of amorphous materials can make 10 to scores of times larger surface substrate semiconductors.

Such amorphous semiconductors may not be fit for producing of the elements of computers and other high speed equipment because of their inferiority in essential working efficiency to the crystalline material types.

But they could be in great demand in some less sophisticated electronic manufacturing areas, such as making the image producer of liquid crystal type of flat television receiving sets, and liquid crystal-indicating watches and cameras.

In the case of trial application of some amorphous material to the production of solar cells, 10- to 30-centimeter square panels have already been produced. Besides, amorphous material substrates so far developed have come in extremely thin filmings of only 1 to 2 microns in thickness.

Development of the new semiconductors has originated in the Tokyo Institute of Technology. Its academic research has so far been focused on application to the making of transistors.

However, according to an assistant professor in charge of the research, the only problem remaining in applying the substance to the production of liquid crystal flat TV sets is how to ensure a long enough service life of the substance.

Industrially, a mounting number of Japanese enterprises is trying to develop their own substances on the basis of the academic research. Included in the enterprises are not just electronic manufacturers but timepiece, photographic equipment and glass makers.

Nippon Telegraph and Telephone Public Corp. is also making much headway apparently to sell a better read-out device for its facsimile sets. Solar cell makers, having made marked progress in developing amorphous silicon solar batteries, are also expected to contribute much to the development of the new kind of semiconductor. Commercialization of the new semiconductor thus seems possible in a year or two.

CSO: 4120

SCIENCE AND TECHNOLOGY

GOVERNMENT FOCUSES ON DEVELOPMENT OF 'TECHNOPOLISES'

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 3

[Text] Governmental action is expected shortly to initiate development in Japan of a series of technology-centered industrial communities, known as Technopolises.

A concept of building such new industrial communities was drawn up by the Technopolis Construction Concept Research Committee of the Ministry of International Trade & Industry. It was proposed in a recommendation filed with MITI in reply to the latter's inquiry and tabled before the committee soon after its creation last autumn.

According to MITI, the recommendation is to launch a regional industrial development policy venture to help develop semiconductor and other high-technology industries near major provincial cities with 200,000 or more population. The aim would be effective regional economic redevelopment. Each proposed technopolis would make the most of the labor supply and urban functions of its city, to be called the Mother Community. Each technopolis would be a sort of satellite city, less than a one day return trip from the Mother Community.

MITI, acting on the recommendation, recently chose 16 cities for its preliminary surveys for the prospective technopolises. The 16 places, screened out of a total of 38 places recommended by the authorities from Japan's 47 prefectures, include the Hakodate City area in Hokkaido, the Hamamatsu City area in Shizuoka Prefecture, the Nagaoka City area in Niigata Prefecture, the Himeji (Nishiharima) area in Hyogo Prefecture, and the Kokubu City area in Kagoshima Prefecture.

MITI believes that Japan's regional economic development has so far been based on massive raw material-consuming conventional key industries like steel, oil refining, petrochemicals and shipbuilding. But, for the future, such regional economic development pacemakers should be technology-intensive, less material consuming types, considering the growing land space limitations, mounting costs of transportation as well as environmental protection.

On top of this, MITI has recognized a recent change in such provincial community's socio-economic conditions. Previously, they suffered a semipermanent development lag from population exodus to big cities but they now enjoy a new growth pattern because of their inhabitants' disillusionment with city life and preference to settle where they now live.

CSO: 4120

SCIENCE AND TECHNOLOGY

JOINT PROJECT WITH SOVIETS ON NATURAL GAS LIQUEFACTION

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 6

[Text] Sakhalin Oil Development Cooperation Co. of Tokyo and the Soviet Union will revise their joint oil and gas master-plan in favor of liquefaction of natural gas.

One quarter of the estimated ¥800 billion requirement will be earmarked for a liquefaction plant construction starting in the fall of 1982. Representatives of the Tokyo consortium and Soviet Foreign Trade Ministry are expected to approve the new LNG-oriented project outline in their mid-June meeting.

The cooperation has so far led to sinking of 13 exploration wells on the continental shelf of Sakhalin island since the two partners signed a pact in 1975. Of the 13 wells, seven proved to be promising oil reservoirs. This year, five more wells will be drilled.

In the process of oil hunt efforts, however, the consortium obtained larger volumes of gas than had been anticipated. The island can become a source of at least 100 million tons of natural gas. In terms of calorific value, gas surpasses oil by 5:1. In addition, the Soviet Union's trade ministry wants to place a priority on gas liquefaction — a faster means of earning foreign currency than oil projects.

The June meeting will be devoted to discussion of investment sharing, LNG volumes to be supplied to Japan via SODC, delivery schedules and Specific plans for the liquefaction plant construction. It is believed that the Soviet Union will ask SODC to put up 60-70 per cent of the total ¥800 billion investment, which is twice as much as the originally estimated cost. As for the volume, the Russian unofficially proposed to supply 3 million tons a year over a 20-year period. The consortium is satisfied with this. But the Soviet Union wants to start delivery in 1985, while SODC insists on 1988.

Also to be discussed is the selection of port to ship product LNG. This question naturally will be considered as part of the LNG project, including the liquefaction plant siting and pipeline construction.

Meantime, SODC has held unofficial negotiations with electric and gas utilities. Diplomatic sources reported that virtual agreements have been reached with Tokyo and Osaka Electric Power companies that they will arrange LNG purchasing by the Japanese utility industry. For carrying LNG for these clients, SODC and the Soviet Union will build two or three 50,000-ton class tankers.

The energy project is the largest one between the two countries. It has been exempt from the economic sanctions against the Soviet since January, 1980. The U.S. Government is likely to maintain the same policy of favoring U.S. makers' exports of materials and equipment for the project.

CSO: 4120

MARKET EMERGING FOR HANDLING RADIOACTIVE WASTES

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 6

[Text]

A large market is emerging for handling radioactive waste of nuclear power plants because the electric utilities are trying to reduce radwaste volumes. Reactor makers, such as Hitachi Ltd. and Mitsubishi Heavy Industries, Ltd., thus will promote their radwaste line. Other firms are starting similar business, too, including Hitachi Plant Engineering & Construction Co.

Hitachi Plant will venture into radioactivity cleaning by chemicals and jet water streams, starting with work for the No. 1 Fukushima nuclear plant of Tokyo Electric Power Co. Kurita Water Industries, Ltd. also set up a nuclear group to improve its cleaning technical level. Technical know-how was inducted earlier this year by Ebara-Infilco Co. from Allied Nuclear of the U.S.

Radwaste transportation casks and waste evaporation equipment are being produced by shipbuilders with welding know-how, including Mitsui Engineering & Shipbuilding Co. and Hitachi Zosen Co. (Hitachi Shipbuilding & Engineering Co.) Genshiryoku Daiko Co., meantime, is specialized in nuclear plant maintenance and cleaning.

The radioactive waste from nuclear energy plants include high-level wastes, such as spent fuel, and low-level wastes, e.g., iron-exchange resins (as used in condensers), waste liquids, clothes and papers. While the Government is responsible for handling the high-level radwastes, electric utilities have to store in the stations the waste — after reducing their volumes by evaporation and burning. The wastes are contained in drums, whose numbers increased in the past 15 years to 226,700 as of December, 1980.

Industrial companies are trying to do the radwaste business partly for the market size. One atomic station is likely to invest ¥20-30 billion for the radwaste-related equipment.

CSO: 4120

SCIENCE AND TECHNOLOGY

TALKS WITH USSR CONSTRUCTION MACHINE MAKERS BEGINS

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 7

[Text]

The Soviet Lumber Export Corporation has begun approaching major Japanese traders and machinery builders to import construction machinery for use in the third Russo-Japanese forestry resources development cooperation project.

The Russians hope to import construction machines, worth some ¥230 billion, comprising 2,000 lumber-carrying machines, 500 large bulldozers, 1,000 small bulldozers, 500 to 1,000 forklifts and truck cranes.

The amount in the Soviet inquiries is equivalent to 60 per cent of Japan's total construction machinery exports in fiscal 1980 which stood at ¥388 billion on a customs clearance basis.

Under a basic accord signed recently, the Soviet corporation is due to supply Japan with a maximum of 13,240,000 cubic meters of lumber over six years from 1981 through 1986.

In return for lumber exports and machinery imports, the Russians will receive a yen loan, worth a maximum of ¥200 billion, from Japan at an annual 7.25 per cent interest rate. The Export-Bank of Japan recently signed an agreement with the Soviet Foreign Trade Bank on the credit deal.

Japanese enterprises joining the third forestry development project are Komatsu, Ltd. (machinery builder), Mitsubishi Corp. and nine other traders, and K.S. Industry Co., an affiliate of Sumitomo Forestry Co.

Proposed contracts are expected to firm up in detail by summer.

The lumber import-machinery export deals had been postponed for more than a year because of Japan's economic sanctions against the Soviet Union implemented along with Washington's request at the time of the Soviet military invasion into Afghanistan.

CSO: 4120

SCIENCE AND TECHNOLOGY

NATION LOSES INTERNATIONAL BIDS TO EUROPE

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 7

[Text] Japan's plant export industry has become unable to win orders in competition with European makers, such as those in West Germany, France and Italy, as the West German mark, French franc and other European currencies have registered a big drop against the yen rate within the period of less than a year.

The bidding prices of Japanese companies, mostly denominated in yen, have become 10 to 20 per cent higher than that of their European counterparts from foreign exchange fluctuations.

Owing to such a price gap, the Japanese have suffered four successive defeats in large-scale international plant tenders since January, this year, such as for supplying United Arab Emirates with a thermal power plant. This means that in the past half year, they have seen 15 cases of plant deals, worth about $5.5 billion, snatched out of their hands by European influences.

Prospects are that the value of Japanese certified plant exports will fall far below the level of $10 billion for two years in a row. In the past 10 months, European currencies all have marked an about 30 per cent fall against the U.S. dollar, meaning a dip of about 30 per cent also against the yen.

Since plant exports customarily are made in terms of the currency of the nation undertaking their export, the bidding price tends to rise higher when the exporting nation's exchange rate goes up. In the case of Japanese enterprises, they have striven to narrow the price margin arising from the exchange fluctuations, such as by increasing chances for bidding by forming consortiums, and other steps to bring down costs.

Even at that, "Our bidding price is about 10-20 per cent higher than that offered by European companies," says one official of a large trading firm.

Japanese plant makers saw a West German-French-Austrian consortium grab a nearly $2 billion tender for supplying Egypt with a telephone exchange system owing to their inferior export-financing terms. In other words, they have been defeated by the Europeans in five large cases, worth about $2.5 billion.

All of defeats essentially are due in part to the largeness of the price gap, a large heavy electric machinery maker says. In six cases, the Japanese lost to West Germany and to four cases to France. This includes multinational consortiums.

With the advent of this year, this trend has intensified. Up to April, this year, of the five cases of setbacks for large orders, four were lost to the Europeans owing to the price gap.

As to what they were, Italy grabbed three cases, including supplying a thermal power plant to UAE and a fertilizer plant to Indonesia. A West German-Austrian combination won the job for exporting a steel plant to Libya, worth over $1 billion. Kawasaki Steel Corp. and other Japanese firms had made a strenuous attempt to seize this order without success.

In fiscal 1979, the value of certified plant exports reached $11.8 billion. In fiscal 1980, exports were limited to $8.9 billion due to such reasons as Japan's economic sanctions against the Soviet Union, the Gulf War and intensification of plant export rivalry.

CSO: 4120

SCIENCE AND TECHNOLOGY

DOUBLE-DIGIT SALES GAIN IN SIX KEY COMPUTERS SCORED

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 9

[Text] Six leading Japanese computer builders recorded double-digit gains in computer sales in the fiscal 1980 term ended March, contrasting with the poor single-digit gains for two American-affiliated companies.

This has become known from the recent financial statements of seven of them. The business result of IBM Japan Ltd., which closed book in December, was made known late March. (Refer JEJ-Apr. 7 issue.)

Fujitsu vs IBM Japan

Fujitsu Limited last year firmed its No. 1 position in the Japanese computer market, widening the gap with second-ranked IBM Japan, a wholly-owned subsidiary of International Business Machines Corp.

The sales gap between the two largest computer makers grew to ¥43.7 billion from the merely ¥2.6 billion in fiscal 1979 when Fujitsu outranked IBM Japan for the first time.

Sales of Fujitsu's computer division gained 16.9 per cent from the preceding year to ¥382 billion. Sales of medium-scale models grew most, while large-scale and small-scale versions sold well, said Executive Director Yuichiro Koide. Sales of computer mainframes and terminals increased harmoniously, bringing about a favorable "balanced growth," Koide added.

The increase rate of IBM Japan's computer sales was limited to 4.3 per cent in fiscal 1980, with the sales value totaling ¥338.3 billion. In particular, domestic sales gained merely 0.9 per cent, though exports shot up 20.2 per cent. The company is now trying to strengthen its marketing capabilities, even discarding its "direct sales" principle and introducing "sales through agents." (Refer JEJ-May 12 issue.)

Hitachi vs NEC

Hitachi, Ltd. and Nippon Electric Co. (NEC) are strenuously vying for No. 2 position among indigenously-capitalized computer builders. Sales of Hitachi's computer division rose 15.7 per cent to ¥250 billion. NEC's sales growth was more faster at 19.8 per cent, with value reaching ¥240.3 billion. NEC narrowed the gap with Hitachi to ¥9.7 billion from fiscal 1979's ¥15.3 billion. Noteworthy is that NEC's sales figure does not include sales of PC-8000 Series personal computers (estimated at 50,000 units, worth ¥10-30 billion), which are under aegis of the electronic devices division.

Among the three biggest indigenously-capitalized computer builders, NEC had the biggest sales gain (19.8 per cent). The company saw its sales grow nearly 20 per cent for four consecutive years since fiscal 1977. Executive Vice President Akira Koike attributes the favorable fiscal 1980 performance mainly to the higher-than-expected rise in sales of ACOS 250 small-size model.

Hitachi, which is strong in the fields of very large and large-size models, witnessed a "balanced" sales of all models, said Director Katsumi Fujiki, who is in charge of the computer group.

Four followers

Office automation (OA) equipment determined last year's business performances of the four lower-ranked computer builders — Toshiba Corp., Oki Electric Industry Co., Mitsubishi Electric Corp. and Nippon Univac Kaisha Ltd. (in which Sperry Univac has a 34.7 per cent interest).

Sales of Toshiba's computer division reached ¥80.3 billion, up 59.3 per cent from

fiscal 1979. The sharp gain is responsible to the transfer of sales of terminals for financial institutions and data communications equipment to the computer division from the communications division. In actuality, the gain of Toshiba's computer sales was limited to 16 per cent.

On the strength of its "OA campaign programs," Toshiba increased sales of office computers by 40 per cent. Sales of Japanese-language word processors reached several billions of yen.

Computer sales of Mitsubishi rose 17 per cent to ¥62 billion. Its computer sales broke down almost equally into three parts — general-purpose models (including office computers), terminals and mini-computers. Among them, office computers sold best.

Oki's computer sales reached ¥78.8 billion, up 25.5 per cent. Excluding measuring and controlling equipment, which were newly included in the computer division, its sales gain was limited to 10 per cent, lowest among the six indigenously-capitalized firms. Oki lags behind Toshiba and Mitsubishi in sales of office computers. Also, it does not handle general-purpose models. Oki is trying to lessen its heavy reliance on governmental demand.

Nippon Univac's sales in fiscal 1980 gained merely 6.8 per cent to ¥78.6 billion. The joint venture between Sperry Univac and Mitsui & Co. is heavily dependent on sales of large-size models mostly for big businesses. Delay in moving into the small-size models and office automation equipment held down its sales growth, industrymen observe. Nippon Univac will strengthen its OA marketing in the coming years.

Sales of 8 Major Computer Builders

(Computer Division; In billions of yen)

	FY1976	77	78	79	80
Fujitsu	239.6	274.5	303.0	326.8	382.0
Hitachi	142.0	160.0	190.0	216.0	250.0
NEC	114.0	137.5	166.8	200.7	240.3
Toshiba	59.2	59.1	43.0	50.4	80.3
Oki Electric Industry	48.3	44.4	47.9	62.8	78.8
Mitsubishi Electric	33.0	38.0	45.0	53.0	62.0
IBM Japan	275.4	293.8	315.3	324.2	338.3
Nippon Univac	70.6	67.8	71.6	73.6	78.6

Notes: (1) The term ended December for IBM Japan. The accounting term ends in March for other companies. (2) Products included in the computer division were expanded in fiscal 1980 for NEC.

CSO: 4120

SCIENCE AND TECHNOLOGY

SEMICONDUCTOR PRODUCTION, SALES SHOW HIGH GROWTH

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 9

[Text] Production of semiconductors in fiscal 1980 (April, 1980-March, 1981) rose 35.6 per cent from the preceding year to a value of ¥916,111 million, the Electronic Industries Association of Japan announced recently.

Output of integrated circuits, in particular, shot up 44.6 per cent to ¥604,988 million, the EIAJ said.

The 587-member association has compiled these production figures from the Ministry of International Trade & Industry's production trend statistics.

The association said that exports gained 27.3 per cent to ¥245,033 million on a customs-clearance basis, while imports increased 8.6 per cent to ¥139,861 million. ICs accounted for 70-80 per cent of the semiconductor trade, with exports reaching ¥181,540 million, up 36.4 per cent, and imports totaling ¥109,950 million, up 6.1 per cent.

An analysis of the production statistics shows that digital semiconductor ICs have the biggest weight, accounting for nearly 50 per cent of the total. Among them, metal-oxide semiconductor (MOS)-type digital ICs, which are now widely used in microcomputers, calculators and watches, jumped 45.4 per cent to ¥320,835 million. Bipolar digital ICs (used mainly for computers) and linear ICs (for video tape recorders, color TVs and radios) also rose more than 45 per cent from fiscal 1979.

The weight of hybrid ICs, particularly those of the thin-layer type used mainly for communications equipment, has been gradually declining.

Production of such discrete semiconductors as diodes, transistors and rectifying devices rose 20.9 per cent mainly because of rising demand from VTR makers. However, production of these discrete semiconductors has been gradually transferred to overseas plants.

Semiconductor exports remained strong last year. In particular, cased ICs accounted for nearly four-fifths of total exports, though shipments of 16-kilobit dynamic random access memory chips to the U.S. greatly slowed.

The rise in semiconductor imports was limited to the single-digit level. The import value was 57 per cent of the export value.

Production, Exports & Imports of Semiconductors in FY1980

(In millions of yen)

(PRODUCTION)	
Total	916,111 (+35.6)
1. Discrete semiconductor elements	311,123 (+20.9)
2. Integrated circuits	604,988 (+44.6)
a. Semiconductor IC	547,957 (+45.8)
1. Linear circuits	146,898 (+45.2)
2. Digital circuits	401,059 (+46.1)
i. Bipolar	80,224 (+48.7)
ii. MOS	320,835 (+45.4)
b. Hybrid IC	57,031 (+33.6)
1. Thin-layer IC	6,926 (+11.0)
2. Thick-layer IC	50,105 (+37.5)
(EXPORTS)	
Total	245,033 (+27.3)
1. Discrete semiconductor elements	63,493 (+ 6.9)
2. Integrated circuits	181,540 (+36.4)
a. Uncased	33,451 (+43.0)
b. Cased	148,089 (+35.0)
(IMPORTS)	
Total	139,861 (+ 8.6)
1. Discrete semiconductor elements	29,911 (+18.7)
2. Integrated circuits	109,950 (+ 6.1)
a. Uncased	15,291 (+48.1)
b. Cased	94,659 (+ 1.5)

Note: Percentage change from fiscal 1979 in parentheses.

Sources: MITI for production and Finance Ministry for exports and imports.

CSO: 4120

SCIENCE AND TECHNOLOGY

BRIEFS

NUMERICAL CONTROL DEVICE--An automatic numerical control (NC) device operable by even an inexperienced worker has been developed by Yamazaki Machinery Works, Ltd. According to the company, the new NC device is a decided departure in concept from the conventional devices requiring much time and trouble, involving computer programming and operating care. The new device--Mazatrol T-1--can be operated by almost anybody because once it is put into operation, it asks for instructions in its TV-like display screen in an ordinary language according to materials, products and their shapes and forms. The operator just gives the answers. Only a few specific working instructions will be needed in special sophisticated jobs because the device remembers the majority of different modes of work. Planning to market the innovational product the world over, the company is developing many language versions of it. Already having developed a Japanese and an English language models, it will follow them up with German, French, Spanish and Russian models during this month. [Text] [Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 7] [COPYRIGHT: 1981 THE NIHON KEIZAI SHIMBUN, Inc.]

UNIQUE CERAMIC BAKING FACILITY--A unique ceramic baking facility has been completed by the Government Industrial Research Institute, Osaka, for the purpose of developing revolutionary kinds of ceramic industrial materials, including fiber-reinforced ceramic (FRC). According to the institute, it is known as an HIP--hot isostatic pressure--system, and is capable of pressurizing materials up to 2,000 atmospheres and heating them up to 2,000 degrees Centigrade. The HIP system is already well known, but even its best industrial system had been limited in capacity to much less pressure and temperature. Its FRC research envisages creation of a new super strength industrial ceramic material by implanting either silicon carbide fibers or carbon fibers in a parent material, silicon nitride. Even harder than silicon nitride, rated as the next hardest to diamond, the prospective FRC will be completely free from the vulnerability of ceramics to breakage. The principal aim is to develop extremely heat-resistant types of ceramic material for the government's new high-efficiency gas turbine under its oil energy-saving Moonlight Project. [Text] [Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 13] [COPYRIGHT: 1981 THE NIHON KEIZAI SHIMBUN, Inc.]

INTERFERON FROM 'AMNION'--Meiji Seika Kaisha, Ltd., a confectionary and drug producer, plans to commercialize know-how to produce interferon from human "amnion." Prof. Fumiaki Taguchi of Kitazato University is doing the basic

research, with collaborator Meiji planning to upgrade their development efforts to clinical tests as early as 1982. The company chose the amnion-to-interferon route, hoping that it will create a new type of interferon with different structures from alpha or beta type. Amnion is a thin, tough membranous sac that contains a watery fluid in which a human embryo is suspended. The interferon raw material can be thus obtained from a mother during or after birth of a baby. The professor told an interferon meeting in Tokyo that the interferon made from amnion should be effective when applied to human skin. Besides the well known effect of interferon against viruses, he said, the new type of interferon is effective on cells infected by viruses. Meiji intends to build facilities large enough to produce "a few billions" of units per month so that the company, with assistance from the Kitazato professor, can use the output for various tests. Initially, it will try to cultivate amnion cells. Meiji is considering eventual possibility of producing "amnion interferon" by means of genetic engineering technology. [Text] [Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 13] [COPYRIGHT: 1981 THE NIHON KEIZAI SHIMBUN, Inc.]

INDUSTRIAL ROBOT LEASING--Japan Robot Leasing Co. will lease industrial robots to foreign countries, possibly from this fall, in tie-ups with European and American companies. The company was set up in April, last year by 24 industrial robot makers, including Mitsubishi Electric Corp., through the good offices of the Ministry of International Trade & Industry. Using low interest loans from the Japan Development Bank and city banks, the company is leasing robots to minor companies at a cheap rate. During its first business year, the firm leased about 150 units, worth ¥ 1,44 million. Robots for pressing valued at about ¥20 million or so are most popular. Foreign potential demand for Japanese robots is so strong that the firm believes that its leasing contracts with overseas interests will increase at an accelerated rate. It is now under negotiations with the Export-Import Bank of Japan to secure fund for its leasing to foreign interests. [Text] [Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 958, 9 Jun 81 p 14] [COPYRIGHT: 1981 THE NIHON KEIZAI SHIMBUN, Inc.]

CSO: 4120

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